REPUBLIC OF INDIA
GOVERNMENT OF MAHARASHTARA

STUDY ON WATER SUPPLY SYSTEMS OF MAHARASHTRA GOLDEN QUADRILATERAL CITIES IN DELHI-MUMBAI INDUSTRIAL CORRIDOR OF THE REPUBLIC OF INDIA

FINAL REPORT

FEBRUARY 2012

JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO ENGINEERING CONSULTANTS Co., Ltd.
YOKOHAMA WATER CORPORATION

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JICA, December 2011

SUMMARY

1. OBJECTIVES OF THE STUDY

The Study targets the DMIC region (National Capital Territory of Delhi, Haryana, Gujarat, Rajasthan, Madhya Pradesh, Maharashutra) where is expected to have economic growth and demand on development of urban infrastructure, and select either one of these states or multiple states across the DMIC region.

The main objectives of the Study are:

a) Collect information on Japanese technology which can be applied to India to contribute to the improvement of water supply and sewerage infrastructure

b) Propose the detail of candidate projects which Japanse technology can apply to

2. STUDY IMPLEMENTATION SCHEDULE

JICA assigned this study to the Study Team consisted of Tokyo Engineering Consultants(TEC) and Yokohama Water Corporation (YWC). The first field survey was carried out during the beginning of November and the middle of December, 2011.

The first site study was conducted from the beginning of November, 2011 to middle of December. As a result, this Interim Report was prepared to present findings of the Study for the Indian parties concerned as well as JICA for possible technical and/or financial cooperation towards projects. The report covers the followings:

a) An assessment of current situation,
b) Identification of critical issues and improvement needs,
c) Proposal of improvement measures, and
d) Assessment of potential for Japanese assistance.

3. STUDY AREA

Four cities (Mumbai, Pune, Nashik and Aurangabad) located in the “Maharashtra Golden Quadrilateral” in Maharashtra state in DMIC region are selected for this Study.

1) DMIC

Delhi-Mumbai Industrial Corridor is a mega infra-structure project of USD 90 billion with the financial & technical aids from Japan, covering an overall length of 1483 km between the political capital and the business capital of India, i.e. Delhi and Mumbai.

Delhi-Mumbai Industrial Corridor is to be conceived as a Model Industrial Corridor of international standards with emphasis on expanding the manufacturing and services base and develop DMIC as the 'Global Manufacturing and Trading Hub'. The Government is considering this ambitious project to establish, promote and facilitate Delhi-Mumbai industrial corridor to augment and create social and physical infrastructure on the route which is world class and will help spurring economic growth of the region.

2) DMIC in Maharashtra and Maharashtra Golden Quadrilateral Cities

The 4-development cities in DMIC region is called as “Mumbai – Pune – Nashik -Aurangabad Golden Quadrilateral” in Maharashtra. The industrial policy of the state government is aims to develop Maharastra as Asia’s most competitive manufacturing hub. Maharastra state promotes the Golden Quadrilateral as the “priority industrial development areas” in their industrial policy. There are 72 special economic zones (SEZs), approximately 80 percent of which are located in the Golden Quadrilateral. They account for 80 percent of Maharashtra’s gross domestic products (GDP) and focus on manufacturing and services industries.

4. Condition of Water Supply and Sewerage in Maharashtra

Maharashtra is the second largest state in India both in terms of population and geographical area (3.08 lakh sq. km.). The State is highly urbanized with 42 % people residing in urban areas.

Wide disparities exist in the water supply in the urban and rural areas of Maharashtra. As of 2000, more than 96 % of urban and about 70 % of rural population has been provided with public drinking water supply (State of Environment in Maharashtra, 2010). As far as the urban population is concerned, more than 245 urban centers have piped water supply schemes for drinking, though the supply of water is not adequate as per the standards laid down by the GoI. It can be seen that in the state, as of 2000, more than 53 % of the households have water supply within their premises and about 64 % of the households get their water supply through taps.

Over the years, per capita water supply has changed considerably. The disparities in the amount of water supply in various urban centers as well as within different areas of a city are very striking. For example, though Mumbai has a maximum average water supply of 200 Lpcd, on an average, the supply in different areas of the city is very much skewed. While slum areas of Mumbai are not getting even 90 LPCD, the well off areas receive as high as 300-350 LPCD.

5. Potential for Application of Japanese Technologies to India

(1) Required Technical Background

Operation and maintenance of water facilities in india, especially in the upstream such as water treatment plant, reservoires etc. tend to be relatively well-organized. However, water facilities at downstream such as transmission and distribution pipeline, service pipeline, water meter etc. are not sufficiently operated and maintained. In addition, although customer lists for tariff collection are existed, the revenue water volume is at very low level due to illegal connection, un-metered installation, non-functioning meters, no timely meter reading and so on.

Moreover, the pace of new water resource development is not meeting the pace of water demand in India, and very often there is a lack of enough water resources. It could be more effective to reduce non-revenue water in the distribution system and cover the lack of water volume, rather than to develop the new resources. Thus the rationalization and NRW reduction technologies for distribution water have a large potential.

The four cities in the scope of the Study have a strong demand on this field. In Pune city, an Italian consulting firm has started a study on this issue from January 2012. In Aurangabad city, PPP project covering all areas of water supply system from intake to supply such as facilities construction, operation and maintenance, revenue collection has just started in mid 2011. Mumbai and Nashik cities do not have any solid plan in this field as yet, however both cities strongly desire to receive technical cooperation from the Japanese side due to a lack of know-how on the rationalization of distribution system.

(2) Application Method of Japanese Technologies

During the Study, technologies of rationalization of water distribution have been recognized in 4 cities as important fields. Japanes private sectors do not have these technologies while Japanes water agencies do have. So, joint ventures of both are only solutions for Japanese private sectors go into an Indian market. As a mid-term measure, Japanese private sectors need to be given chances of water supply system operation; starting from partial PPP and finally full PPP inclusive of operation and maintenance.

Demonstration of the technologies to decision-makers of the Indian central government, and local governments should be initiated first. Identification of cities requiring the above technologies should be done secondly. For the identified cities, as a prerequisite, master plan should be formulated, through which reliance on the Japanese technologies will be strengthened.

Proposed lot system should not be traditional facility type lot but operation-type lot; i.e., an operation area complete from treatment plant to distribution pipe with SCADA, GIS, NRW reduction, metering and revenue collection. By this lot system, competition of equipment or products can be avoided. Instead, only water majors and consortiums (cosnsisting of construction, equipment and operation and maintenance company or entity) can participate in the project.

Japanese water agencies should be a member of JV to strengthen Japanese JV. If technical cooperation between cities in India and Japan are concluded and Japanese water enterprises can be a member of Japanese JV, such expenses can be financed under JICA technical cooperation program. It will enhance Japanes JV competitiveness and reliance.

6. SCOPE OF CANDIDATE CO-OPERATION PROJECTS

The potential for Japanese cooperation can be summarized in Table. The evaluation rank (A - C) of the candidate cooperation projects is also given to each option of the Table, based on the Study team evaluation.

Summary of Potential for Japanese Cooperation

City / Sector	Greater Mumbai	Pune
Water Supply	**1. ODA-Loan（1,200 crore Rs./ 17.9 bil. JPY） rank: B** Water Resource Development Project • *Funding to Gargai dam construction* [Observation 1] • F/S is expected to be completed in May 2012. C/P hasindicated preference to the soft-loan **2. T/C for Development Planning (MP, F/S) rank: A** [Observation 2] • After the project, it will be effective to start 3. Technical Cooperation project. **3. T/C Project rank: A** Capacity Development on Distribution Network Management and NRW Reduction through the Establishment of GIS Database and DMA zoning [Observation 3] • High need for rationalization of distribution system and NRW reduction with a strong request from C/P • Precondition to the above work is to have a study on basic information on supply demand, population in each zone etc beforehand. • Delivered Application Form for T/C Project	**5. ODA-loan (640 crore Rs./ 9.6 bil. JPY) rank:A** Water Supply System Improvement Project • *Funding to the construction of transmission pipeline and WTP* [Observation 5-a] • Desirable priority order of the works is: 1) Construction of a new WTP at Parvati , 2) Replacement of aged Cantonment WTP, 3) Construction of Vadgaon WTP. • *Funding to the distribution network management and O&M works* [Observation 5-b] • "*Distribution network management and O&M works*" is commissioned to an Italian consulting firm, started in January 2012. • DPR for the above work is being prepared. PPP model will be considered.
Sewerage	**4. ODA-loan (20,000-25,000 crore Rs./ 299-374 bil. JPY) rank: B** Sewerage System Development Project • *The funding is assumed to cover a part of Phase III-V works due to the long plan for15 years with 3 phases* • *Phase III-V works include development of STP, PS and sewer network, and sulm sanitation. STP construction in 3 zones in Phase III-V has been launched.* • *Phase I-II works are mostly being implemented* [Observation 4] • A Consulant is already in place for the detailed design/ supervision of overall work. If the loan is realized, a management consultant will need to be employed. • Focus on the divided works by zone or by facility is better for increasing efficiency and effectiveness. • In the above case, the divided work by facility (STPs for 4 zones, PSs, etc) is better for increasing efficiency and effectiveness.	**6. ODA-loan (215 crore Rs./ 3.2 bil. JPY) rank: B** Sewerage System Development Project • *70% of the project cost (500 crore Rs.) will be funded by NRCP, State Gov.'s share of 20% is uncertain.* • *PMC is looking for the State Gov.'s share as above plus its portion (10%) funding possibility from JICA.*
Drainage (Storm Water)	No potential • *The augmentation project is on-going.*	**7. T/C for Development Planning (MP, F/S) rank: C** Improvement of Storm Water Drainage System

Summary of Potential for Japanese Cooperation (Contd..)

Sector \ City	Nashik	Aurangabad
Water Supply	**8. T/C Project rank: A** Capacity Development on Distribution Network Management and NRW Reduction through the DMA zoning [Observation 8] • A study on NRW reduction is under implementation by GIZ, it will be completed in Feb. 2012. This work most likely be not continued according to NMC information. • High need for rationalization of distribution system. • Strong request from C/P • Delivered Application Form **9. ODA-loan (1,693 crore Rs./ 25.3 bil. JPY) rank: C** Water Supply System Development Project • *Funding for replacement/ augumentation of WTPs and construction of transmission pipeline targeting for the year 2026.* • *NMC has looked for the funding for Phase I work of Package II in the project.* • *Interested in the funding from JICA.* [Observation 9] • The population growth rate is high at 64% during a recent decade, the potential to become a large city exists.	No potential • *The project is already launched under PPP scheme.*
Sewerage	Low potential • *Most of construction works for facilities to meet the demand of the year 2026 is already on-going* .	**10. ODA-loan (203 crore Rs./ 3.0 bil. JPY) rank: A** Sewerage System Development Project • *Funding to the work of new construction/ expansion of STP and development of sewers targeting the year 2026* • *50% of the project cost (203 crore Rs.) will be funded by the State Gov., but the remaining 50% fund is not determined.* [Observation 10] • The treatment capacity of the limited number of STPs is still small, therefore a high development need exists.
Drainage (Storm Water)	No potential • *All storm water drainage works are under implementation by the JNNURM resource.*	Less potential • *Storm water management may have less priority*

[Note]: Exchange rate: 1 Indian Rupees = 1.494 JPY (JICA, December 2011)

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ABBREVIATIONS

24×7, 24/7 - 24 hours a day, 7 days a week
AMC - Additional Municipal Commissioner
AMC - Aurangabad Municipal Corporation
BMC – Brihanmumbai Municipal Corporation (Municipal Corporation of Greater Mumbai)
BRIMSTOWAD - Brihanmumbai Storm Water Drainage
CAGR - Compound Average Growth Rate
CE - Chief Engineer
CDP - City Development Plan
CIDCO - City & Industrial Development Corporation (of Maharashtra)
crore - Ten Million (10,000,000; 10^7)
DFC - Dedicated Freight Corridor
DPR - Detailed Project Report
DIPP - Department of Industrial Policy & Promotion
DMC - Deputy Municipal Commissioner
DMIC - Delhi-Mumbai Industrial Corridor
Dy.Ch.E. - Deputy Chief Engineer
ESR - Elevated Service Reservoirs
EPS - Effluent Pumping Station
GIZ - German Agency for International Cooperation
GoI - Government of India
GoM - Government of Maharashtra
GSDA - Groundwater and Survey Development Agency
Ha – Hectare (10,000 m^2)
HPEC - High Powered Expert Committee
IHSDP- Integrated Housing and Slum Development Programme
IA - Industrial Area
IR - Investment Region
IPS - Influent Pumping Station
JE – Junior Engineer
JNNURM - Jawaharlal Nehru National Urban Renewal Mission
lakh - One hundred thousand (100,000; 10^5)
LPCD (or lpcd) - Litres Per Capita per Day
MCGM - Municipal Corporation of Greater Mumbai (synonymous with BMC)
METI - Ministry of Economy, Trade and Industry
MJP - Maharashtra Jeevan Pradhikaran
ML - Million Liters

MLD - Million Liters per Day
MoUD - Ministry of Urban Development
MPCB - Maharashtra Pollution Control Board
MSDP - Mumbai Sewage Disposal Project
NCR - National Capital Region
NEERI - National Environmental Engineering Research Institute
NIJNNURM - New Improved JNNURM
NMC - Nashik Municipal Corporation
NRCP - National River Conservation Programme
NRDWP - National Rural Drinking Water Programme
NRW - Non-revenue Water
O&M - Operation & Maintenance
PMC - Pune Municipal Corporation
PPP - Public–Private Partnership
SE – Superintending Engineer
SEZ - Special Economic Zone
SP - Sewerage Project
SSP - Slum Sanitation Programme
STP – Sewage Treatment Plant
SW - Storm Water
SWD - Storm Water Drains
UFW – Unaccounted For Water
UIDSSMT - Urban Infrastructure Development Scheme for Small and Medium Towns
ULB - Urban Local Body
UIG - Urban Infrastructure and Governance
WSP - Water Supply Project
WSSD - Water Supply and Sanitation Department
WTP - Water Treatment Plant
WWTF - Waste Water Treatment Facility

1. INTRODUCTION AND BACKGROUND

1.1 Background of the Study

India, the second most populous country in the world, is developing and urbanizing rapidly. Sustaining the pace of development requires similar advancement in basic infrastructures, water supply sector being one of them. The provision of adequate, safe, and reliable water supplies on a continuous (24 hrs × 7 days) basis in the context of an increasing population and rapid urban development in India is a major challenge to the Government of India and its development partners.

Water supply systems in most Indian urban centers are struggling to meet performance targets set by the Ministry of Urban Development (MoUD) which include 24×7 water supply and non-revenue water below 20%. In most cases major transformations of the water systems will be required in order to meet these targets.

Ageing infrastructures, high non-revenue water, lack of adequate fund, and outdated management practices are among the most pressing issues in many Indian urban water systems. As a result, water is mostly supplied intermittently with supply duration of only a few hours. Improvement of water supply systems is being planned and implemented in some urban centers but covering all cities and towns is a huge task which will require persistence, time and money.

On the other hand, Japan has made a remarkable progress in this sector and has been able to manage its water supply systems with a very high efficiency. For example, non-revenue water in Tokyo is less than 4 %, a rare feat in itself. In the course, Japan has accumulated a wealth of experience and technology which can be beneficially applied to water systems of Indian urban centers. In this context, there is a good potential for India-Japan cooperation in the water sector as well as the sewerage sector and this Study is the very first step in this direction with a special focus in the State of Maharashtra.

1.1.1 Objectives of the Study

The Study targets the DMIC region (National Capital Territory of Delhi, Haryana, Gujarat, Rajasthan, Madhya Pradesh, Maharashutra) where is expected to have economic growth and demand on development of urban infrastructure, and select either one of these states or multiple states across the DMIC region.

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1.1.2 Study Implementation Schedule

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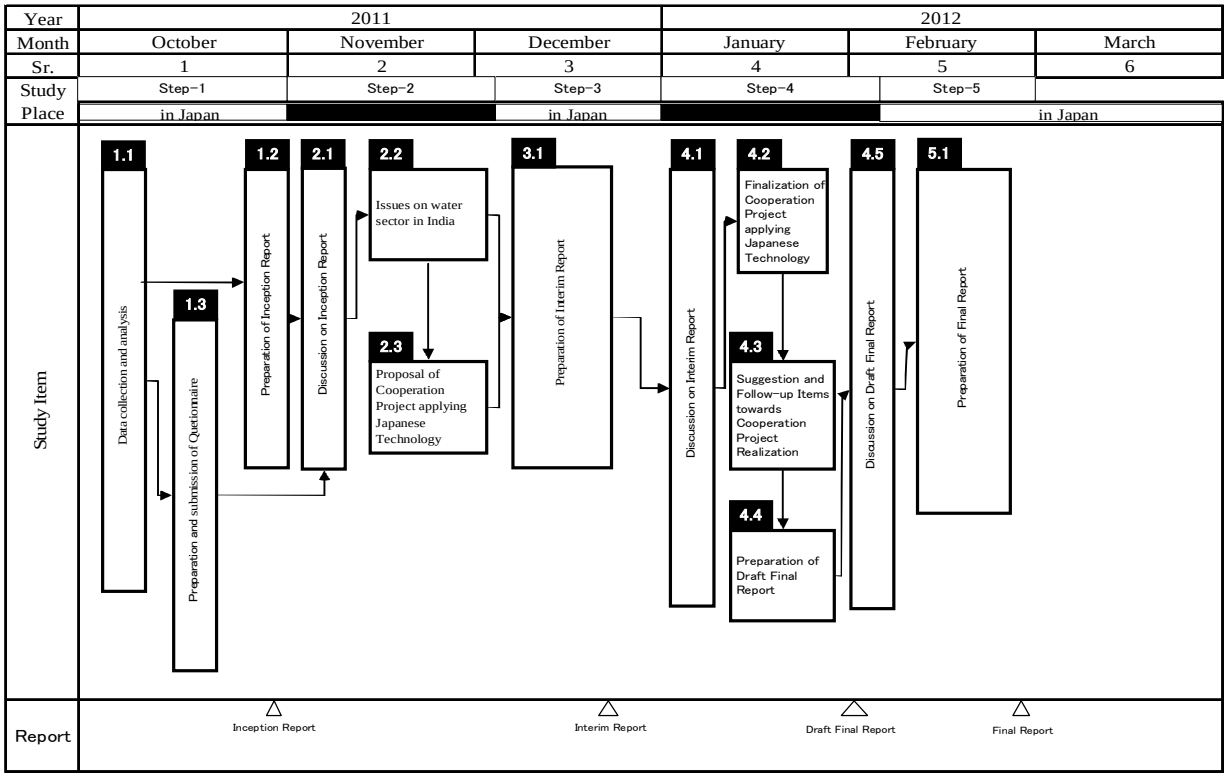


Figure 1.1: Study Flow Chart

1.1.3 Staffing and Assignment Schedule

The JICA Study Team is composed of the members shown in the following Table.

Assignment	Name	Affiliation	Financial Year 2011					
			October	November	December	January	February	March
Team Leader	Momose Kazufumi	TEC						
O&M Management	Nakanosono Kenji	YW						
Planning & Design (Water Supply Facility)	Ikei Minoru	TEC						
Planning & Design (NRW/GIS)	Thapa Phatta	TEC						
Finance/Administration Management	Ohno Atsuo	TEC						
			Step-1	Step-2	Step-3	Step-4	Step-5	

Legend: Work in India; Work in Japan
TEC: Tokyo Engineering Consultants
YW: Yokohama Water Corporation

Figure 1.2: Staff Assignment Schedule

1.2 Study Area

Four cities (Mumbai, Pune, Nashik and Aurangabad) located in the "Maharashtra Golden Quadrilateral" in Maharashtra state in DMIC region are selected for this Study.

The reasons for selection are described as below.

- Maharashtra state is the state which has experienced the most rapid economic growth in India. The economic activity as represented by Mumbai city which is the center of economic, commercial and financial city is very dynamic.
- Maharashtra state is one of the most industrialized and urbanized state, so-called "the engine for industial development in India".
- Maharashtra state is neighbored Andhra Pradesh state and Karnataka state, which have industrializing cities such as Bangalore and Hyderabad respectively, in the DMIC area.
- Maharashtra state is the most attractive city for foreign direct investment in India, which have received the largest accumulated investment in India.
- Maharashtra state has have the largest PPP projects in India, so large potential for the implementation of PPP infrastructure projects is existed.
- Rapid economic growth in future is anticipated in Maharastra state, because Maharashtra state has five on-going/or planned "Early Bird Projects" as the larget number in India including two large-scale industrial complexes development projects. The importance of water supply development in Maharashtra state is also growing along with the economic development.

1.2.1 Delhi-Mumbai Industrial Development Corridor

Delhi-Mumbai Industrial Corridor is a mega infra-structure project of USD 90 billion with the financial & technical aids from Japan, covering an overall length of 1483 km between the political capital and the business capital of India, i.e. Delhi and Mumbai.

A MOU was signed in December 2006 between Vice Minister, Ministry of Economy, Trade and Industry (METI) of Government of Japan and Secretary, Department of Industrial Policy & Promotion (DIPP). A Final Project Concept was presented to both the Prime Ministers during Premier Abe's visit to India in August 2007.

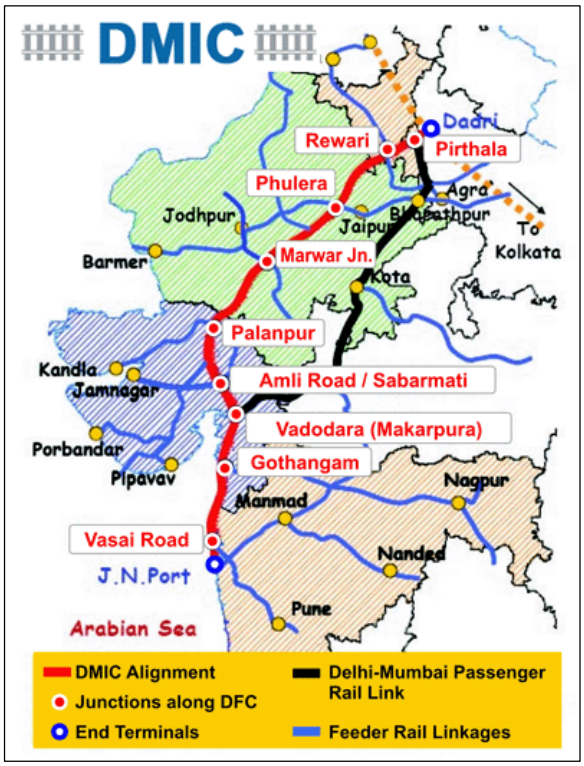


Figure 1.1: Location Map of DMIC

Finally Government of India has announced establishing of the Multi-modal High Axle Load Dedicated Freight Corridor (DFC) between Delhi and Mumbai, covering an overall length of 1483 km and passing through the six States - U.P, NCR of Delhi, Haryana, Rajasthan, Gujarat and Maharashtra, with end terminals at Dadri in the National Capital Region of Delhi and Jawaharlal Nehru Port near Mumbai. The Delhi - Mumbai leg of the Golden Quadrilateral[1] National Highway also runs almost parallel to the Freight Corridor. Along this corridor, real estates, integrated townships, industrial parks/SEZs, agro-processing zones will be developed. To support the towns, this corridor will be equipped with an array of infrastructure facilities such as power facilities, water supply facilities, knowledge parks, logistics, and rail and road connectivity to airports and seaports en route etc. Approximately 180 million people, 14 % of the population, will be affected by the corridor's development.

[1] "Golden Golden Quadrilateral" mentioned in this sentence is the one across the whole India, which is the quadrilateral area of the four major cities (Delhi, Calcutta, Chennai, Mumbai). It is aimed to enhance infrastructure development connecting to these cities, ultimately it may contribute to reduce the gap between urban and rural, to increase social flexibility, and enahcne economic growth.

This project incorporates 9 Mega Industrial zones of about 200-250 sq. km., high speed freight line, three ports, and six air ports; a six-lane intersection-free expressway connecting the country's political and financial capitals and a 4000 MW power plant. Several industrial estates and clusters, industrial hubs, with top-of-the-line infrastructure would be developed along this corridor to attract more foreign investment. Funds for the projects would come from the Indian government, Japanese loans, and investment by Japanese firms and through Japan depository receipts issued by the Indian companies.

This high-speed connectivity between Delhi and Mumbai offers immense opportunities for development of an Industrial corridor along the alignment of the connecting infrastructure. A band of 150 km (Influence region) has been chosen on both sides of the Freight corridor to be developed as the Delhi-Mumbai Industrial Corridor.

The vision for DMIC is to create strong economic base in this band with globally competitive environment and state-of-the-art infrastructure to activate local commerce, enhance foreign investments, real-estate investments and attain sustainable development. In addition to the influence region, DMIC would also include development of requisite feeder rail/ road connectivity to hinterland/markets and select ports along the western coast. It is also envisaged that the alignment of the proposed corridor will have nine junction stations for exchange of traffic between the existing railway system and the DFC.

Delhi-Mumbai Industrial Corridor is to be conceived as a Model Industrial Corridor of international standards with emphasis on expanding the manufacturing and services base and develop DMIC as the 'Global Manufacturing and Trading Hub'. The Government is considering this ambitious project to establish, promote and facilitate Delhi-Mumbai industrial corridor to augment and create social and physical infrastructure on the route which is world class and will help spurring economic growth of the region.

Integrated Corridor Development Approach for DMIC

High impact/ market driven nodes - integrated Investment Regions (IRs) and Industrial Areas (IAs) have been identified within the corridor to provide transparent and investment friendly facility regimes. These regions are proposed to be self-sustained industrial townships with world-class infrastructure, road and rail connectivity for freight movement to and from ports and logistics hubs, served by domestic/ international air connectivity, reliable power, quality social infrastructure, and provide a globally competitive environment conducive for setting up businesses. An IR would be a specifically delineated industrial region with a minimum area of

over 200 square kilometers (20,000 hectares), while an IA would be developed with a minimum area of over 100 square kilometers (10,000 hectares). 24 such nodes - 9 IRs and 15 IAs spanning across six states have been identified. It is proposed that 6 IRs and 6 IAs would be taken up for implementation in the First Phase during 2008-2012 and rest of the development would be phased out in the next 4 years. An estimated $90 to $100 billion would be required to create the infrastructure in the first phase of the project. Japanese companies are expected to invest over $10 billion in the proposed corridor during the First Phase. One node each from 6 states has been identified as IRs for First Phase and one node each from 5 states except Gujarat has been identified as IAs for First Phase.

DMIC Project Goals

The developmental planning for DMIC aims to achieve certain end results with implementation that would ensure realization of envisaged vision for the project and lead to economic development. Accordingly the project goals for DMIC are:

- Double employment potential in five years (14.87% CAGR)
- Triple industrial output in five years (24.57% CAGR)
- Quadruple exports from the region in five years (31.95% CAGR)

1.2.2 DMIC in Maharashtra and Maharashtra Golden Quadrilateral Cities

In Maharashtra, the alignment of DFC terminates at the Jawaharlal Nehru Port in Navi Mumbai, with about 18% of area of the state within the influence area of DMIC.

Early Birds Projects

Within the framework of the DMIC, “Early Birds Projects” (priority projects) were selected. Both India and Japan defined these projects which were taken the lead in implemention. As of June 2010, 27 projects in total, 6 projects from the Japanese side and 21 projects from the indian side, hase been determined (Table 1.2).

Out of the identified twenty-seven early projects of DMIC, the following five projects are in Maharashtra state:

- Shendra - Bidkin Industrial Park, Aurangabad
- Supa – Newasa - Dhavlapuri Industrial Park, Pune
- Multi Modal Logistic Parks and ICD at Talegaon, Pune
- Transportation and Tele-communication network in adjoining region with reference to Pune - Nashik and Pune- Aurangabad highways.
- Convention cum Exhibition center at Navi Mumbai or Aurangabad

The above development node in DMIC region is called as "Mumbai – Pune – Nashik - Aurangabad Golden Quadrilateral" in Maharashtra.

The industrial policy of the state government is aims to develop Maharastra as Asia's most competitive manufacturing hub. Maharastra state promotes the Golden Quadrilateral as the "priority industrial development areas" in their industrial policy. There are 72 special economic zones (SEZs), approximately 80 percent of which are located in the Golden Quadrilateral. They account for 80 percent of Maharashtra's gross domestic products (GDP) and focus on manufacturing and services industries[2].

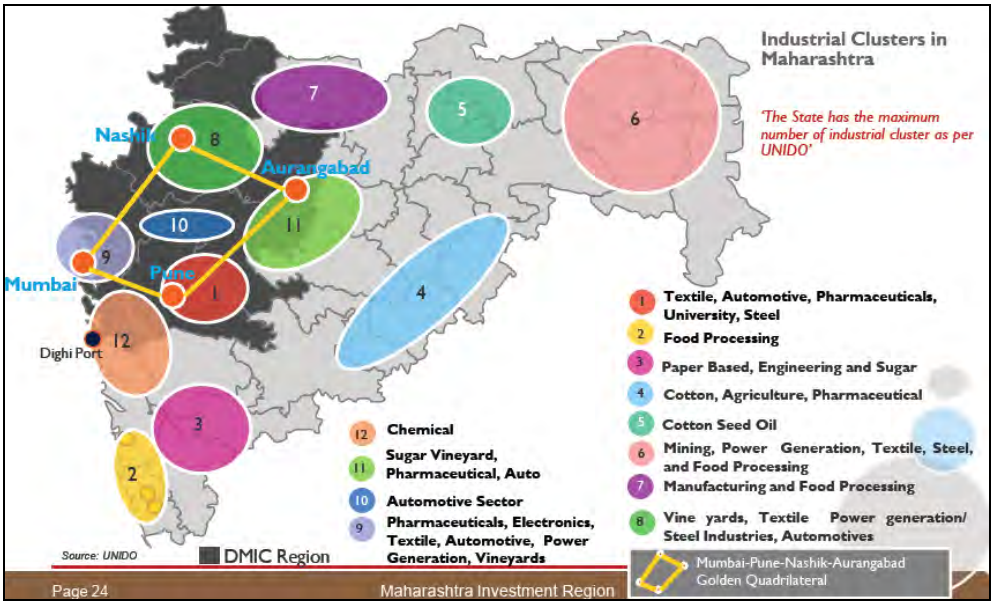


Figure 1.2: Location Map of Maharashtra Golden Quadrilateral Cities

Table 1.1: Early Bird Project Lists

	Japanese side（6 Projects）	Indian side（21 projects）
Maharashtra	• DMIC Human Resources Training Project	• Industrial Mega parks (Shendra-Bidkin) • Industrial Mega parks • Integrated Multimodal Logistics Hub (Talegaon) • Logistics andtelecommunication network (Pune - Nashik, Pune - Aurangabad highway） • Convention center（Navi-mumbai）
Gjyarat	• Waste Textile & Mobile Phone Recycle Project	• Industrial Mega parks in DSIR • International Air port to serve Ahmedabad-Dholera SIR • Central Spine for Dholera SIR - Ahmedabad-Vataman-Pipli-Dholera-Bhavnagar six lane Road • International Air port to serve Ahmedabad-Dholera SIR

[2] Frontline, http://webcache.googleusercontent.com/search?q=cache:efyHDCHAIsgJ:www.frontlineonnet.com/fl2820/stories/20111007282012200.htm+Golden+Quadrilateral,+maharashtra+state,+pune,+nashik&cd=4&hl=ja&ct=clnk&gl=jp

	Japanese side（6 Projects）	Indian side（21 projects）
Rajasthan	• Captive Power Plant at Neemrana Japan Investment Park • Neemrana Jet Stream Logistics Project	• Road development between Neemrana-Bhiwadi • Airport city development surrounding Jaipur • Knowledge city
Haryana	• FTWZ (Free Trade Warehousing Zone) Project	• Multi Modal Logistic hub at Rewari • Convention center
Uttar Pradesh	• FTWZ (Free Trade Warehousing Zone) Project	• Development of Boraki railway station • Integrated Multimodal Logistics Hub (Greater Noida) • International airport development（Greater Noida）
Madhya Pradesh		• Knowledge city in Ujjain District • Continuous water supply and waste water management for PithampurIndustrial Area Development of integrated water grid and waste water treatment system • Integrated Multimodal Logistics Hub (Pithampur) • Development of economic corridor along the link road connecting Indore • Airport & Pithampur SEZ

(June, 2010)

1.2.3 Presence of Japanese Private Enterprises in Maharashtra

Japanese investments to India have gradually progressed although those to China and Southeast Asian countries are significant. Number of Japanese firms was 725 in October 2010 and increased by 12% to 812 in October 2011 (press release by Embassy of Japan in India). Tamil Nadu (286 in 2011), Haryana (236), Maharashtra (218) and Karnataka (182) are their favorite locations (Some Japanese firms have more than two offices or factories so that their total numbers are exceeding firms' number). Offices and factories of the Japanese firms in Maharashtra were 198 in 2010 and 218 in 2011. Mumbai had 154, followed by Pune (56), Thane (4), Aurangabad (2), Nagpur (1) and Raigad (1) in 2011.

2. PRESENT CONDITION OF WATER SUPPLY AND SEWERAGE SECTOR IN INDIA AND MAHARASHTRA

National Water Mission

The objectives of the India's National Water Mission are 'conservation of water, minimizing wastage and ensuring its more equitable distribution both across and within States through integrated water resources management'. The goals of the Mission are a comprehensive water data base in the public domain, assessment of the impact of climate change on water resources, promotion of citizen and State actions for water conservation, augmentation and preservation, focused attention to overexploited areas, increasing water use efficiency by 20 %, and promotion of basin-level integrated water resources management. (Source: Economic Survey of India, 2011)

2.1 Condition of Water Supply and Sewerage in India

2.1.1 Water Supply

Supply Situation. The overall water supply situation, when looked at the city level, is reasonably adequate in most cities and towns, the problem in many cases lies in the poor distribution infrastructure. The water crisis is often related to the poor distribution of water than the lack of water at source (e.g. Delhi). However, there are urban centers where water source itself is depleting and is unable to cater to the water requirements of the urban centers (e.g. towns of Tamil Nadu, Andhra Pradesh). Almost all urban water supply systems supply water intermittently with low pressure, and their quality of services are not up to the standard.

In most cities there are more households than water supply connections, indicating that either there are many shared connections or households depend upon public stand posts. Many households have their own sources of water supply while others complement own sources of supply with that of the public agency.

Non-revenue Water. NRW is generally an estimate worked out by the technical staff based on their perception of the situation. Most cities do not have bulk meters or meters at all the user's end. This makes the task of calculating NRW very difficult. Therefore, the reported figures of NRW should be taken as the best estimates that could be made by the technical staff of the water-supplying agency. Smaller size towns that supply water from nearby sources or use ground water source have smaller NRW compared to the larger cities.

Metering and Billing. A very small percentage of urban centers have all connections metered (e.g. Bangalore, Pune). About one-third of the urban centers do not have any metered connections. In many urban centers a large percentage of domestic connections are unmetered

while in a little above one-fourth urban centers all non-domestic connections are also unmetered. With no monitoring system in place and no incentive to reduce inefficiencies, the urban water scenario in India is one of poor service delivery, poor maintenance of physical systems, poor recovery of costs, and poor generation of revenues. Water utilities in India are typically able to recover only 30-35 % of the operations and maintenance (O&M) cost (Ref: Report of High Powered Expert Committee for Estimating the Investment Requirement for Urban Infrastructure Services, 2011).

Uniform volumetric charges and fixed charges (ferrule based etc.) are the most common methods of charging. Incremental block tariff is mostly used in the larger cities, with a few exceptions. In many cities, non-domestic connections are metered while the domestic connections are unmetered. Since meters often do not work, many cities charge fixed tariff for water supply based on the calculated consumption patterns.

Water Source and Treatment. Many large Indian cities have to source water from long distances ranging from 50 to 200 km due to exhaustion or pollution of nearby sources. This increases the cost of raw water and enhances the possibility of leakage during transmission. Most large cities depend upon surface sources for water supply, supplementing it with ground water sources to meet the demand. However, the share of ground water increases with a decrease in city size, with smaller size class of urban centers showing greater dependence on ground water for water supply. The large investments required to supply water from surface sources could be one reason for this pattern. This also reflects in the existence of water treatment plants. While all metro cities using surface source have water treatment plants, there is a small percentage of urban centers in other size classes that use surface water but do not have water treatment plants.

The brunt of the burden of poor quality of water delivery is borne by the poor. Lower-income households without access to public networks typically have to rely on market sources to access water at a higher price. Intermittent water supplies force the poor to forgo work on days when water arrives, as they have to stand in line on those days to collect the same.

Low pressure in the system encourages those consumers who can afford the cost to install booster pumps, thereby increasing energy consumption. Others make provision for storage of water by investing in storage tanks, which is difficult for low income households for want of money and space. The poor quality of water means that consumers either spend large amounts on purifying water at home or on treatment of water-borne diseases, further adding to their financial burden.

India has one of the lowest standards of continuity of water supply. The recent results of the Government of India's sanitation rating, where water quality samples of only 39 out of 441 cities qualified on three basic water quality parameters, highlight the urgency of moving to a continuous water supply system. Data from a few pilot projects across the country suggest that for the current population, 24×7 water supply can be designed with the current levels of per capita supplies of source water.

Institutional Arrangement and Funding. There are many different types of institutional arrangements for water supply in the urban areas of the country. The most common arrangement is that the capital works are done by a state level agency and the local government does the O&M. However, there are wide variations to this arrangement. These variations range from the state level agency managing the entire water supply system in the entire state (Rajasthan) to the urban local body performing all the tasks related to water supply (Mumbai).

Privatisation or public-private partnerships are still not very common in water supply with less than one-tenth of the urban centers using private participation in this service. Cost recovery is a major concern in water supply. While it is possible to achieve cost-recovery in water supply, the fact is that almost four-fifths of the urban centers are unable to recover even the O&M cost in this service. This indicates that while theoretically water can be treated as an economic good, there are practical difficulties in implementing decisions on raising water tariff. Water continues to be treated, as a social good and even recovering O&M cost in most cities would require political consensus.

The additional capital investment requirements for covering the entire population with water supply in the years to come is enormous, running into thousands of crores of rupees (This has been summarized later in this section). While it may be difficult to find resources to finance such large investments, private sector participation could be encouraged. Public-private partnerships could reduce the financial burden of public agencies to some extent and bring in some financial discipline into this sector. While efforts have to be made to improve efficiency of water supply to reduce operating costs, maintenance of existing assets would help in reducing new investment requirements in the near future.

There are however, excellent trends being shown in some cities regarding water supply system management. Some cities in Karnataka and Maharashtra have achieved remarkable improvement in water supply service level as well as revenue generation by means of a number of governance reforms, tariff increases and employing the principle of partnership with private sectors.

National and state wise details of household's access to safe drinking water up to year 2001 are shown in the following Table 2.1. Updated data is still not available (even to the Economic Survey of India Team), and that is probably the reason for National Water Mission's emphasis on creating a comprehensive water database in public domain.

Table 2.1: Household's Access to Safe Drinking Water

(in per cent)

Sl No.	States/ Union Territorries	Tap/Handpump/Tubewell								
		1981			1991			2001		
		Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban
1	Jammu & Kashmir	40.3	28.0	86.7	na	na	na	65.2	54.9	95.7
2	Himachal Pradesh	44.5	39.6	89.6	77.3	75.5	91.9	88.6	87.5	97.0
3	Punjab	84.6	81.8	91.1	92.7	92.1	94.2	97.6	96.9	98.9
4	Chandigarh	99.1	94.4	99.4	97.7	98.1	97.7	99.8	99.9	99.8
5	Uttarakhand	[a]	[a]	[a]	[a]	[a]	[a]	86.7	83.0	97.8
6	Haryana	55.1	42.9	90.7	74.3	67.1	93.2	86.1	81.1	97.3
7	Delhi	93.0	62.3	94.9	95.8	91.0	96.2	97.2	90.1	97.7
8	Rajasthan	27.1	13.0	78.7	59.0	50.6	86.5	68.2	60.4	93.5
9	Uttar Pradesh	33.8	25.3	73.2	62.2	56.6	85.8	87.8	85.5	97.2
10	Bihar	37.6	33.8	65.4	58.8	56.5	73.4	86.6	86.1	91.2
11	Sikkim	30.3	21.7	71.9	73.1	70.8	92.8	70.7	67.0	97.1
12	Arunachal Pradesh	43.9	40.2	87.9	70.0	66.9	88.2	77.5	73.7	90.7
13	Nagaland	45.6	43.4	57.2	53.4	55.6	45.5	46.5	47.5	42.3
14	Manipur	19.5	12.9	38.7	38.7	33.7	52.1	37.0	29.3	59.4
15	Mizoram	4.9	3.6	8.8	16.2	12.9	19.9	36.0	23.8	47.8
16	Tripura	27.3	22.2	67.9	37.2	30.6	71.1	52.5	45.0	85.8
17	Meghalaya	25.1	14.3	74.4	36.2	26.8	75.4	39.0	29.5	73.5
18	Assam	na	na	na	45.9	43.3	64.1	58.8	56.8	70.4
19	West Bengal	69.7	65.8	79.8	82.0	80.3	86.2	88.5	87.0	92.3
20	Jharkhand	[a]	[a]	[a]	[a]	[a]	[a]	42.6	35.5	68.2
21	Orissa	14.6	9.5	51.3	39.1	35.3	62.8	64.2	62.9	72.3
22	Chhattisgarh	[a]	[a]	[a]	[a]	[a]	[a]	70.5	66.2	88.8
23	Madhya Pradesh	20.2	8.1	66.7	53.4	45.6	79.4	68.4	61.5	88.6
24	Gujarat	52.4	36.2	86.8	69.8	60.0	87.2	84.1	76.9	95.4
25	Daman & Diu	54.5	46.4	67.0	71.4	56.9	86.8	96.3	94.9	98.9
26	Dadra & Nagar Haveli	19.4	16.8	54.3	45.6	41.2	91.0	77.0	70.5	96.1
27	Maharashtra	42.3	18.3	85.6	68.5	54.0	90.5	79.8	68.4	95.4
28	Andhra Pradesh	25.9	15.1	63.3	55.1	49.0	73.8	80.1	76.9	90.2
29	Karnataka	33.9	17.6	74.4	71.7	67.3	81.4	84.6	80.5	92.1
30	Goa	22.5	8.6	52.3	43.4	30.5	61.7	70.1	58.3	82.1
31	Lakshadweep	2.2	1.0	3.7	11.9	3.4	18.8	4.6	4.6	4.6
32	Kerala	12.2	6.3	39.7	18.9	12.2	38.7	23.4	16.9	42.8
33	Tamil Nadu	43.1	31.0	69.4	67.4	64.3	74.2	85.6	85.3	85.9
34	Puducherry	80.6	76.9	84.2	88.8	92.9	86.1	95.9	96.6	95.5
35	Andaman & Nicobar Islands	51.6	36.3	92.0	67.9	59.4	90.9	76.7	66.8	97.8
	ALL INDIA	**38.2**	**26.5**	**75.1**	**62.3**	**55.5**	**81.4**	**77.9**	**73.2**	**90.0**

Source: Office of the Registrar General, India. Ministry of Home Affairs

na : Not available as no census was carried out in Assam during 1981 and in Jammu & Kashmir during 1991.

[a] Created in 2001. Uttarakhand, Jharkhand and Chattisgarh for 1981 and 1991 are included under Uttar Pradesh, Bihar and Madhya Pradesh respectively.

(Source: Economic Survey of India, 2010-11)

Estimates for investment in water supply in the cities and towns of India for the 20-year period, (2012-2031) as well as the associated operations and maintenance (O&M) expenditure for existing and new assets are presented in the following Table 2.2.

Table 2.2: Aggregate Cost for Water Supply

	Rs. Crore
Capital Expenditure	
Investment for Unmet Demand	147,699
Investment for Additional Demand	118,757
Investment required for Replacement	25,844
Total Capital Investment for Domestic Requirements	292,301
Capital Investment for Industrial and Commercial Requirements	28,607
Total Residential, Industrial, and Commercial Capital Investment	**320,908**
Operation & Maintenance Cost	**546,095**
Aggregate Cost	**867,003**

(Source: HPEC for Estimating the Investment Requirement for Urban Infrastructure Services, 2011)

2.1.2 Sanitation

The challenge of sanitation in Indian cities is acute. With very poor sewerage networks, a large number of the urban poor still depend on public toilets. Many public toilets have no water supply while the outlets of many others with water supply are not connected to the city's sewerage system. Over 50 million people in urban India defecate in the open every day. The cost in terms of Disability Adjusted Life Years (DALY) of diarrheal disease for children from poor sanitation is estimated at Rs. 500 crore. The cost per day per person due to poor sanitation is estimated at Rs. 5400 and due to poor hygiene practices at Rs. 900 (MoUD 2009). The problem of sanitation is much worse in urban areas than in rural due to increasing congestion and density in cities.

Wastewater collection in most urban centers with sewerage system usually does not exceed about two-thirds of that generated. However, the wastewater treatment situation is quite alarming. While the smaller sized urban centers with sewerage system treat less than one-fourth of the wastewater generated, even the metropolitan cities treat only about two-fifths of the wastewater generated. Wastewater disposal is done both on land and in water body by most urban centers. Recycling/ reuse of wastewater is practiced in very few urban centers and wherever it is done, it is mostly used for agriculture or horticultural purposes.

There is no fixed mechanism for charging for wastewater collection and disposal. The charging may be through property tax, a charge on water closet or an additional charge on water supplied. Wastewater is not charged for in all urban centers, therefore, the cost recovery

is generally very low from this service with even the metro cities showing a very small recovery rate. The situation is even worse in urban centers of smaller size. In most cities where the recovery rate has been very good, the reasons have been either due to provision of new connections (connection charges) or due to levying of sewerage/ drainage tax.

In a City Sanitation Study conducted by the Ministry of Urban Development in 2010, none of the 423 cities was found to be 'healthy' and 'clean'. The Municipal Corporations of Chandigarh, Mysore, and Surat and the New Delhi Municipal Council were the only four ULBs that fared relatively better. Close to 190 cities in the study were rated to be in a state of emergency with respect to public health and the environment. The situation of urban sanitation is summarized below (Source: HPC Report, 2011).

- 4861 out of the 5161 cities/towns in India do not have even a partial sewerage network
- Almost 50 % of households in cities like Bangalore and Hyderabad do not have sewerage connections
- About 18 % of urban households do not have access to any form of latrine facility and defecate in the open
- Only 21 % of the waste water generated is treated
- Of the 79 sewage treatment plants under state ownership reviewed in 2007, 46 were operating under very poor conditions

It is estimated that the lack of wastewater treatment leads to over $15 billion spent in treating water-borne diseases in India. Often, polluted water is allowed to leach untreated into surface and ground water bodies. In the Ganges Basin alone, there are 223 towns and cities that generate 8250 million litres of sewage each day, of which about 2500 million litres is disposed directly into the Ganges without treatment and 4250 million litres into its tributaries (ibid).

Like in water supply sector, recently there have been a few exemplary projects in city sewerage. The cases of Navi Mumbai's city-wide sanitation initiative where the O&M of the STPs has been outsourced to private companies through a performance-linked contract, and Alandur's sewerage project with distinctive feature of residents' involvement can be taken as a silver lining to the colossal problem of urban sanitation in India.

To address the problem of urban sanitation MoUD formulated a National Urban Sanitation Policy in 2008. This policy, whose salient features as shown in the following chart, has laid down the framework for addressing the challenge of city sanitation. The Policy emphasizes the need for spreading awareness about sanitation through an integrated city-wide approach,

assigning institutional responsibilities and with due regard for demand and supply considerations, with special focus on the urban poor. As one of the outcomes of this policy City Sanitation Plans are now being prepared in 210 cities adopting integrated approach of sanitation.

Table 2.3: Salient Features of National Urban Sanitation Policy

Government of India to assist with
- Generating awareness
- Dividing institutional responsibilities
- Providing assistance for funding projects as part of City Sanitation Plans
- National-level monitoring and evaluation
- Mainstreaming sanitation into national investment in urban infrastructure and housing

State governments to assist with
- Assigning institutional responsibilities, resources, and capacities
- Setting standards at state level within the overall framework of the national standards
- Resolving issues of tenure and space in providing sanitation facilities for the poor
- Monitoring and evaluating cities' performance
- Capacity building and training

Role of ULBs
- Preparing City Sanitation Plans
- Planning and financing schemes
- Creating assets and managing systems to meet service norms
- Fixing tariff and revenue collection for O&M
- Engaging stakeholders in ensuring 100 per cent sanitation

Source: MoUD, Government of India (2008a).

Estimates for investment in sewerage for the 20-year period (2012-2031) for all classes of cities, as well as the associated O&M expenditure for existing and new assets are shown in the following Table 2.4.

Table 2.4: Aggregate Cost for the Sewerage

	Rs. Crore
Capital Expenditure	
Investment for Unmet Demand	108,443
Investment for Additional Demand	99,364
Investment required for Replacement	34,881
Total Capital Investment for Domestic Requirements	**242,688**
Operation & Maintenance Cost	**236,964**
Aggregate Cost	**479,652**

(Source: HPEC for Estimating the Investment Requirement for Urban Infrastructure Services, 2011)

2.2 Condition of Water Supply and Sewerage in Maharashtra

Maharashtra is the second largest state in India both in terms of population and geographical area (3.08 lakh sq. km.). The State is highly urbanized with 42 % people residing in urban

areas. The State has 35 districts which are divided into six revenue divisions, namely, Konkan, Pune, Nashik, Aurangabad, Amravati and Nagpur for administrative purposes. For local self-governance in rural areas, there are 33 Zilla (District) Parishads, 355 Panchayat Samitis and 27,993 Gram (Village) Panchayats. The urban areas are governed through 23 Municipal Corporations, 222 Municipal Councils, 4 Nagar Panchayats and 7 Cantonment Boards.

2.2.1 Organizational Setup for Water and Sanitation in Maharashtra

In Maharashtra, the Ministry of Water Supply and Sanitation along with the Department of Water Supply and Sanitation was created in 1996 to exclusively concentrate on the poor coverage and access to these essential services in both urban and rural areas. The Ministry is headed by the Minister of Water Supply and Sanitation and is supported by the State Minister for Water Supply and Sanitation. The Secretary heads the Water Supply and Sanitation Department (WSSD). The WSSD is supported by two technical wings, namely, Maharashtra Jeevan Pradhikaran (MJP) and Groundwater and Survey Development Agency (GSDA). Organization chart of MJP is shown below Figure 2.1.

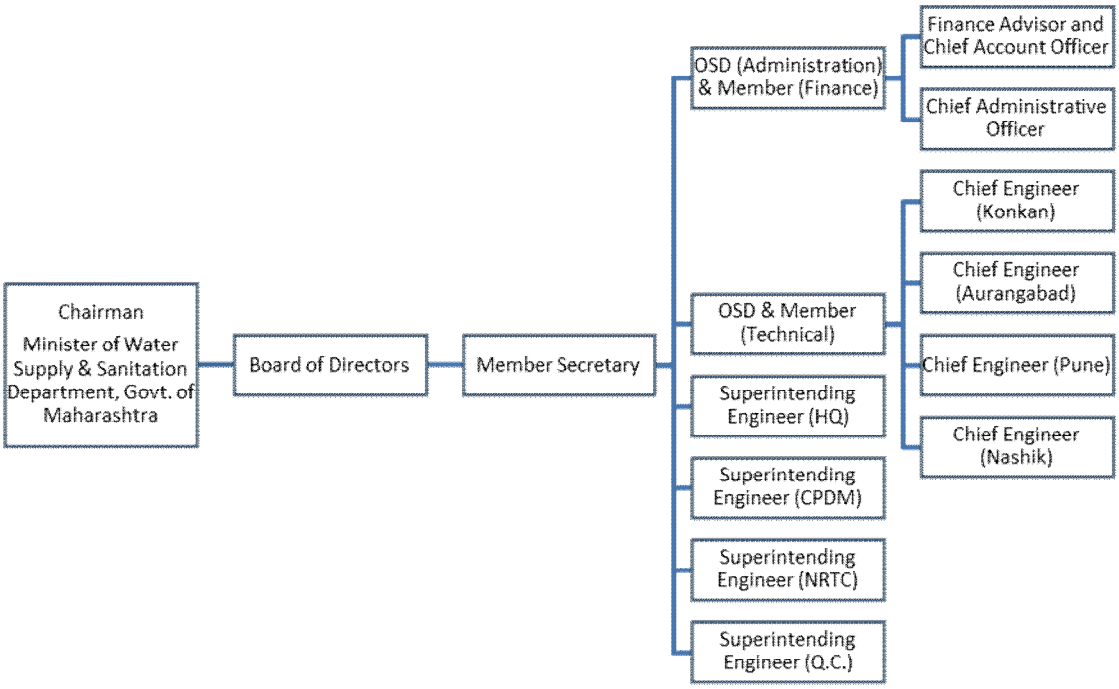


Figure 2.1: Organizational Structure of Maharashtra Jeevan Pradhikaran

2.2.2 Water Supply and Sanitation Policy

(a) <u>Rural Water Supply</u>

Government of Maharashtra has taken the following decisions in the light of White Paper published for drinking water supply program and revised guideline of Central Government:

(1) To implement the drinking water supply program effectively and to coordinate with the various agencies a separate department viz. "Water Supply and Sanitation" has been created at the Ministry.
(2) At District level in each Zilla Parishad for implementation of Water Supply Scheme "Water Supply Division & Sub-divisions" have been created.
(3) 40 Lpcd norms prescribed for preparing Rural Drinking Water Supply Schemes.
(4) Rural Water Supply Schemes should be prepared considering future need of 15 years.
(5) The beneficiaries have to pay 10% capital cost of the scheme as "Popular Contribution". Also they have to bear 100% expenditure towards operation & maintenance of the scheme.

(b) Rural Sanitation Program

Under this scheme grant-in-aid is paid to Zilla Parishads for construction of surface drainage in villages. Each Zilla Parishad is given grant-in-aid equal to 60 % of the gross cost of the project and balance 40 % is required to be borne by the local bodies from their own resources. The maintenance of such works is the responsibility of the concerned Zilla Parishad/Panchayat Samiti.

(c) Urban Water Supply and Sanitation

It is the responsibility of Municipal body to provide protected drinking water to the citizens and also to provide waste water disposal system for the towns. As the funds required for piped water supply schemes and sewerage schemes are generally very large, the Municipal Authorities are not in a position to take up such schemes entirely from their own funds. The Municipal Councils/Corporations are, therefore, given grant-in-aid by State Government. Loans from Life Insurance Corporation, India and financial institutions are also made available with Government Guarantee Schemes are executed by Maharashtra Jeevan Pradhikaran and after completion are handed over to the concerned Municipal Body.

In the places of fairs and pilgrimage centers, important hill stations, places of natural and strategic importance, etc., the policy is to undertake water supply schemes with l00 % Government finances, as far as possible.

A study group appointed by the Government to study and recommend ways & means for implementation of water supply and sanitation schemes during the Tenth Five Year Plan has made the following recommendations:

(1) The Urban Water Supply program should be implemented on the basis of demand.
(2) The decision regarding Water & Energy audit taken by Government should be made applicable to all the urban bodies.

(3) As recommended by the Sukthankar Committee a separate Regulatory Body should be established for levying water tax, its periodic increase and its recovery.

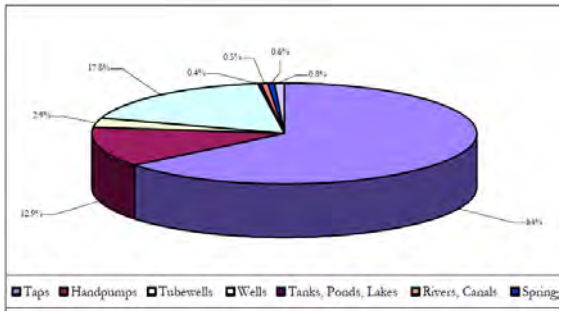
(4) The Urban local bodies must raise loan on its own, instead of on Government guarantee. Also they should make separate budgetary provision and maintain a separate account for repayment of loan.

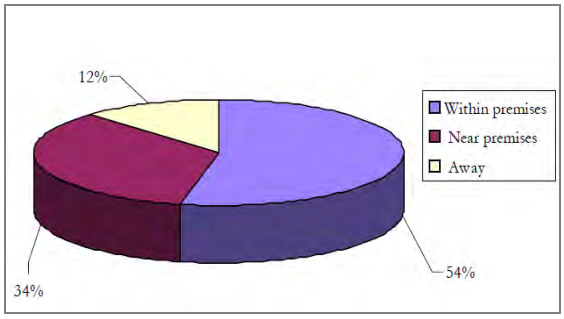
(Source: Government of Maharashtra's Tenth Five Year Plan, Chapter 29: Water Supply and Sanitation)

2.2.3 Existing Situation of Water Supply in Maharashtra

Wide disparities exist in the water supply in the urban and rural areas of Maharashtra. As of 2000, more than 96 % of urban and about 70 % of rural population has been provided with public drinking water supply (State of Environment in Maharashtra, 2010). As far as the urban population is concerned, more than 245 urban centers have piped water supply schemes for drinking, though the supply of water is not adequate as per the standards laid down by the GoI. The distribution of households by source of drinking water and its location is given Figure 2.2. It can be seen that in the state, as of 2000, more than 53 % of the households have water supply within their premises and about 64 % of the households get their water supply through taps.

Over the years, per capita water supply has changed considerably. The disparities in the amount of water supply in various urban centers as well as within different areas of a city are very striking. For example, though Mumbai has a maximum average water supply of 200 Lpcd, on an average, the supply in different areas of the city is very much skewed. While slum areas of Mumbai are not getting even 90 LPCD, the well off areas receive as high as 300-350 LPCD.





(a) (b)

Figure 2.2: Distribution of Households in Maharashtra by (a) Sources & (b) Location of Drinking Water

(Source: 2001 census)

Over use and misuse of water can be observed in various activities. Due to intermittent/irregular water supply, it is the normal practice of every household to store more water than needed. When fresh water is to be stored for the next day, the old stock is just thrown away to empty the containers. Unnecessary wastage of water by keeping the water taps running, while bathing, shaving and so on is also a common feature.

2.2.4 Existing Situation of Sanitation

Situation of sanitation as of 2000 is shown in Table 2.5.

Table 2.5: Distribution of Households in Maharashtra
(by Availability of Water and Drainage Facilities)

	Rural	Percent	Urban	Percent	Total	Percent
Total number of households	10,993,623		8,069,526		19,063,149	
Number of households having bathroom facilities within the house	5,066,823	46.1	6,584,731	81.6	11,651,554	61.1
Type of Latrine within the house						
Pit latrine	1,124,458	10.2	571,036	7.1	1,695,494	8.9
Water closet	585,470	5.3	3,580,166	44.4	4,165,636	21.9
Other latrine	292,008	2.7	535,330	6.6	827,338	4.3
No latrine	8,991,687	81.8	3,382,994	41.9	12,374,681	64.9
Type of Drainage Connectivity for Waste Water Outlet						
Closed drainage	565,776	5.1	3,637,125	45.1	4,202,901	22.0
Open drainage	3,957,015	36.0	3,430,112	42.5	7,387,127	38.8
No drainage	6,470,832	58.9	1,002,239	12.4	7,473,121	39.2

Source: Census 2001.

2.2.5 On-going Water Supply & Sanitation Schemes

Currently several types of schemes are being implemented in the state, the most important ones are listed below.

(a) National Rural Drinking Water Programme (NRDWP)

This program is implemented under Bharat Nirman, a program launched by the Government of India in 2005 for building infrastructure and basic amenities in rural areas. The funding pattern for this scheme is 50:50.

(b) Comprehensive Action Plan and Scarcity Programme

Comprehensive Action Plan is being implemented under Bharat Nirman since 2005. The main objective of this plan is to provide water to those villages/wadis which received less than 40 litres of drinking water per person. In the State, 9,745 villages/wadis were identified as facing problem of drinking water as per comprehensive action plan for the year 2010-11 and 5,181 villages/wadis were tackled with an expenditure of Rs. 555.62 crore upto the end of November, 2010.

(c) Maharashtra Sujal and Nirmal Abhiyan

On account of the golden jubilee year of the State, the Government has initiated exclusive and qualitative service of water supply and sanitation under profitable service charges and is aiming at an objective of providing technical, economical and administrative improvement under this scheme. The primary objective of this scheme is to overcome the water scarcity and growing demand by providing potable water and good sanitation facilities to all citizens.

(d) Nagri Dalit Vasti Water Supply and Sanitation Scheme

In the golden jubilee year of the State, this scheme is being implemented under Maharashtra Sujal and Nirmal Abhiyan to provide individual water connections and toilets to the Scheduled Cast families and Nav Boudhha families.

(e) Shivkalin Pani Sathvan Yojana

This scheme is being implemented in the State with an objective of conservation of water by conventional and non-conventional measures for strengthening drinking water source, harvesting roof top rainwater, construction of tanks in hilly areas for storage of rainwater and similar other measures for sustained availability of drinking water.

(f) Jalswarajya Yojana

The State Government is implementing Jalswarajya Yojana since October, 2003 with an objective to improve the quality of rural water supply and environmental sanitation service. At present, the implementation of the project is being carried out in 3,008 Grampanchayats.

(g) Rural Water Supply 'Aaple Pani' Project

With the financial assistance from the German Government Development Bank, Rural Water Supply Project 'Aaple Pani' is being implemented in three districts, namely, Pune, Aurangabad

and Ahmednagar. The main objective of the project is to improve health and sanitation standards through sustainable water supply, development of watershed areas, exhaustive planning of ground water, etc. It also involves strengthening of the local bodies for their active involvement in the project.

(h) Total Sanitation Campaign

Government of India launched'Total Sanitation Campaign' in the rural areas in 2002 to eradicate the practice of open defecation by construction of latrines and thereby promote health and sanitation.

(i) Maharashtra Suvarna Jayanti Nagarutthan Mahabhiyan

Government of Maharashtra launched this programme for the development and augmentation of the urban infrastructure of Urban Local Bodies (ULB) of the Maharashtra State.

2.2.6 Financial Situation of Maharashtra

(a) Budget 2010-11

In the budget 2010-11, the Government continued the tax exemption on essential items upto March 2011 in view of achievement of tax recovery of VAT. In spite of this tax exemption, tax revenue is expected to increase by 16.8 % over the previous year. Expected total receipts and total expenditure for 2010-11 are Rs. 1,29,359 crore and Rs. 1,29,500 crore respectively, resulting in fiscal deficit of Rs. 24,294 crore, 21.4 % less than the previous year. Details are given in Table 2.6.

Table 2.6: Income and Expenditure of Maharashtra

(₹ crore)

	Item	2004-05 (Actual)	2005-06 (Actual)	2006-07 (Actual)	2007-08 (Actual)	2008-09 (Actual)	2009-10 (R.E.)	2010-11 (B.E.)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1.	**Revenue Receipts (a + b)**	**41,013**	**48,438**	**62,195**	**79,583**	**81,271**	**88,498**	**97,044**
	a) Tax Revenue	34,201	38,522	46,122	55,126	60,049	63,959	74,722
	b) Non-Tax Revenue	6,812	9,916	16,073	24,457	21,222	24,539	22,322
2.	**Revenue Expenditure**	**51,047**	**52,280**	**61,385**	**64,780**	**75,694**	**1,01,229**	**1,04,698**
	of which							
	a) Interest Payments	10,258	10,523	11,983	12,932	13,027	14,647	16,469
	b) Administrative Services	3,776	4,207	4,824	5,504	6,560	8,670	10,936
	c) Pensions & Misc. gen. Services	3,514	4,104	4,364	4,215	5,199	6,483	7,871
3.	**Revenue Deficit (2 - 1)**	**10,034**	**3,842**	**(-) 810**	**(-) 14,803**	**(-) 5,577**	**12,731**	**7,654**
4.	**Capital Receipts**	**35,316**	**24,176**	**16,298**	**1,718**	**19,065**	**35,440**	**32,315**
	of which							
	a) Recovery of loans	2,041	551	51	733	560	338	354
	b) Other capital receipts	0	0	0	0	18	0	0
	c) Borrowings & Other Liabilities	18,743	17,883	11,540	(-) 3,717	14,363	30,209	24,153
5.	**Capital Expenditure**	**25,159**	**20,082**	**17,121**	**17,414**	**24,278**	**23,404**	**24,802**
6.	**Total Receipts (1 + 4)**	**76,329**	**72,614**	**78,493**	**81,301**	**1,00,336**	**1,23,938**	**1,29,359**
7.	**Total Expenditure (2 + 5)**	**76,206**	**72,362**	**78,506**	**82,194**	**99,972**	**1,24,633**	**1,29,500**
8.	**Budgetary Deficit (7 - 6)**	**(-) 123**	**(-) 252**	**13**	**893**	**(-) 364**	**695**	**141**
9.	**Fiscal Deficit (8 + 4 C)**	**18,620**	**17,631**	**11,553**	**(-) 2,824**	**13,999**	**30,904**	**24,294**

(Source: Economic Survey of Maharashtra, 2010-11)

(b) Debt Position

The accumulation of unpaid loan and other liabilities on the government forms the Debt stock. There are three types of debt, (i) Public Debts, (ii) Borrowings from the Small Savings & Provident Funds and (iii) Other interest bearing obligations such as, reserve funds and deposits bearing interest. The overall fiscal liability of the State has increased at compound growth rate of 13.9 % during 2006-07 to 2010-11. The loans raised from Central Government during 2009-10 were Rs. 1,291 crore. Considering the repayment or redemption of loans and deposits of Rs. 8,665 crore, the net debt of the Government amounted to Rs. 23,153 crore. The debt stock at the end of 2009-10 increased to Rs. 1,83,825 crore out of which OMB is Rs. 61,573 crore (33.5 %).

During 2010-11, the net debt of the State Government is likely to be Rs. 25,822 crore out of which Rs. 21,847 crore will be the net internal debt including open market borrowings. The debt stock of the Government is expected to increase to Rs. 2,09,648 crore.

(c) Government Guarantees

The outstanding guarantees given by the State Government at the end of 2008-09 amounted to Rs. 21,301 crore. The major guarantees given by the Government were to the Co-operation, Marketing & Textile Department (Rs. 4,918 crore), Industry, Energy & Labour Department

(Rs. 4,177 crore), Public Works Department (Rs. 3,535), Water Resources Department (Rs. 3,123 crore) and Water supply and Sanitation Department (Rs.2,812 crore).

2.3 JICA'S Assistance Program

JICA uses an array of development assistance schemes to meet the diverse needs of developing countries around the world.
(Refer to http://www.jica.go.jp/english/operations/schemes/index.html).

2.3.1 Official Development Assistance (ODA) and ODA Loans

ODA is broadly divided into bilateral aid, in which assistance is given directly to developing countries, and multilateral aid, which is provided through international organizations. Bilateral aid consists of concessional loans (ODA loans, etc.) and grants (grant aid and technical cooperation). Of these, JICA provides concessional loans as ODA loans.

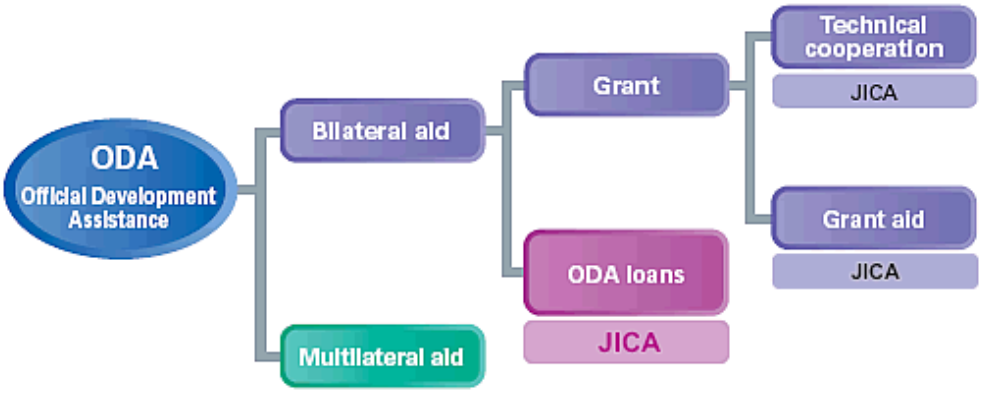


Figure 2.3: Types of ODA

- **ODA Loans**

ODA loans support developing countries by providing low-interest, long-term and concessional funds to finance their development efforts. Terms and conditions for India are shown in Table 2.7.

Table 2.7: Terms and Conditions of Japanese ODA Loans (Effective from April 1, 2011)

		Interest Rate (%)	Repayment Period (Year)	Grace Period (Year)	Conditions for Procurement
General Terms	Standard	1.40	30	10	Untied
	Option 1	0.80	20	6	
	Option 2	0.70	15	5	
Preferential Terms *	Standard	0.65	40	10	Untied
	Option 1	0.55	30	10	
	Option 2	0.50	20	6	
	Option 3	0.40	15	5	

* If water supply contributes to the prevention of infectious disease and poverty reduction, these terms are applied.

- **Project Cycle of ODA Loans**

ODA loans follow six steps. As lessons learned from the ex-post evaluation at the final stage will be fed back to preparations of new projects, this flow of steps is called the project cycle (Figure 2.4).

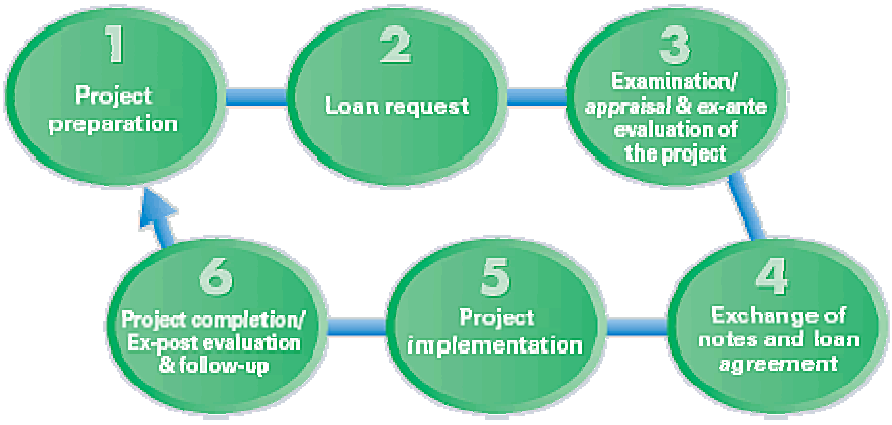


Figure 2.4: Project Cycle of ODA Loans

- **Special Assistance Facility (SAF)**

JICA carries out SAF in order to strengthen JICA systems that assist recipient countries from project formation through completion and on-going operation, and to carry out projects effectively responding to developing countries' diverse needs. SAF is a study carried out by consultants employed by JICA. The funds necessary for SAF are provided by JICA. Special Assistance for Project Formation (SAPROF) is one of the 4 types of facility.

The preparation and formation of development projects involves multifaceted studies which require expertise in a broad range of fields. However, even in the case of high-priority projects, developing countries are often unable to undertake detailed project planning because of financial and technical limitations. In such cases, when a country requests or indicates the intention to request JICA's financial assistance, JICA can carry out the SAPROF study, additional assistance for the developing country to plan the effective project. SAPROF assignments are carried out by consultants and experts hired by JICA.

2.3.2 Technical Cooperation Projects

Technical cooperation as a grant is an all-embracing term used to describe JICA's practical assistance to developing countries. Depending on the specific project, technical assistance can include the dispatch of JICA experts, the training of local officials for ‘capacity development’, the supply of equipment or financial assistance.

- **Dispatch of Experts**

Japanese experts are dispatched to developing countries to disseminate necessary technologies and knowledge to partner country government officials and engineers (counterparts). At the

same time, they cooperate with these counterparts in developing and spreading technologies and institutions suited to the conditions in those countries as well as conducting awareness-raising activities. Giving consideration to a partner country's regional characteristics, historical background and language, when appropriate, JICA dispatches experts from third countries (countries other than Japan or the partner country) rather than experts from Japan in order to deliver services more efficiently.

- **Acceptance of Training Participants**

JICA invites competent personnel in developing countries, who have significant responsibility in social and economic development, to Japan as training participants. They participate in training programs in Japan and obtain knowledge and technologies needed in their home countries. JICA also organizes training programs in partner countries or in third countries.

- **Provision of Equipment**

Equipment needed by experts for implementing effective cooperation is provided to partner countries.

- **Technical Cooperation Projects**

Technical Cooperation projects, which optimally combine the "Dispatch of Experts," "Acceptance of Training Participants" and/or "Provision of Equipment" are the core operations of JICA's Technical Cooperation. Even more reliable project outcomes can be obtained through systematic and comprehensive project operation and implementation from planning to implementation and evaluation.

- **Technical Cooperation for Development Planning**

While supporting developing countries' policymaking and public works plans, JICA transfers technologies, including survey/analysis methods and planning methods to counterparts in the partner country. The following four features are the main contents of cooperation.

  - Master plans (M/P) and policy support studies (fiscal reforms, establishment of legal systems, etc.) to support policymaking and the planning of public projects
  - Emergency support studies (rehabilitation and reconstruction of basic infrastructure that has been damaged by natural disasters, conflicts or other factors)
  - Feasibility studies (F/S) for projects which will be realized by the developing country governments or other donor
  - Other studies (topographic mapping, groundwater surveys, etc.)

Following the completion of this cooperation, based on the results of Technical Cooperation for development planning, developing countries will 1) formulate plans for sector/regional development or rehabilitation/reconstruction by utilizing recommendations; 2) implement

plans (project) by raising funds from international organizations and others; and/or 3) carry out the recommended organizational/institutional reforms.

2.3.3 Yen Loan Projects for Water Supply and Sewerage in India

Table 2.8 lists Yen loan projects for water supply and sewerage in India.

Table 2.8: Major Yen Loan Projects for Water Supply and Sewerage in India

Project Name	Date of Approval	Amount of Approval (millions JPY)	Executing Agency	Study Assistance by JICA
Delhi Water Supply Improvement Project	?	?	Delhi Jal Board	Master Plan and Feasibility Study
Yamuna Action Plan Project 3	2011/2/17	32,571	Delhi Jal Board	
Guwahati Water Supply Project	2009/3/31	29,453	Guwahati Metropolitan Development Authority	SAPROF
Hogenakkal Water Supply and Fluorosis Mitigation Project	2008/3/10	22,387	Tamil Nadu Water Supply and Drainage Board	SAPROF
Tamil Nadu Urban Infrastructure Project	2008/3/10	8,551	Tamil Nadu Urban Development Fund	
Goa Water Supply Project	2007/9/14	22,806	Public Works Department, State of Goa	Master Plan and Feasibility Study
Agra Water Supply Project	2007/3/30	24,822	Uttar Pradesh Jal Nigam	
Amritsar Sewerage Project	2007/3/30	6,961	Public Water Supply and Sewerage Board	SAPROF
Kerala Water Supply Project (II)	2007/3/30	32,777	Kerala Water Authority	
Orissa Integrated Sanitation Improvement Project	2007/3/30	19,061	Orissa Water Supply and Sewerage Board	SAPROF
Bangalore Water Supply and Sewerage Project (II-2)	2006/3/31	28,358	Bangalore Water Supply and Sewerage Board	
Hussain Sagar Lake and Catchment Area Improvement Project	2006/3/31	7,729	Hyderabad Urban Development Authority	
Bangalore Water Supply and Sewerage Project (II-1)	2005/3/31	41,997	Bangalore Water Supply and Sewerage Board	
Ganga Action Plan Project (Varanasi)	2005/3/31	11,184	National River Conservation Directorate of Ministry of Environment and Forests	Master Plan and Feasibility Study
Bisalpur Jaipur Water Supply Project(Transfer System)	2004/3/31	8,881	Public Health Engineering Department,State Government of Rajasthan	
Yamuna Action Plan Project	2003/3/31	13,333	National River	SAPROF

Project Name	Date of Approval	Amount of Approval (millions JPY)	Executing Agency	Study Assistance by JICA
(II)			Conservation Directorate of Ministry of Environment and Forests	
Kerala Water Supply Project	1997/2/25	11,997	Kerala Water Authority	

2.4 Expectation of India Concerning Private Enterprises Entry and the Present Comparison

2.4.1 National Water Policy – 2002 and Private Sector Participation

The first National Water Policy was adopted by National Water Resources Council in 1987. This was revised and updated in April 2002. A new national water policy is in the drafting stage and is expected by March 2012. The highlights of the 2002 policy related to drinking water/water supply are reproduced below.

Institutional Mechanism. "As maintenance of water resource schemes is under non-plan budget, it is generally being neglected. The institutional arrangements should be such that this vital aspect is given importance equal or even more than that of new constructions."

Drinking Water. "Adequate safe drinking water facilities should be provided to the entire population both in urban and in rural areas. Irrigation and multipurpose projects should invariably include a drinking water component, wherever there is no alternative source of drinking water. Drinking water needs of human beings and animals should be the first charge on any available water."

Financial and Physical Sustainability. "Besides creating additional water resources facilities for various uses, adequate emphasis need to be given to the physical and financial sustainability of existing facilities. There is, therefore, a need to ensure that the water charges for various uses should be fixed in such a way that they cover at least the operation and maintenance charges of providing the service initially and a part of the capital costs subsequently. These rates should be linked directly to the quality of service provided. The subsidy on water rates to the disadvantaged and poorer sections of the society should be well targeted and transparent.

Private Sector Participation. "Private sector participation should be encouraged in planning, development and management of water resources projects for diverse uses, wherever feasible.

Private sector participation may help in introducing innovative ideas, generating financial resources and introducing corporate management and improving service efficiency and accountability to users. Depending upon the specific situations, various combinations of private sector participation, in building, owning, operating, leasing and transferring of water resources facilities, may be considered."

The policy emphasizes the private sector participation in water and there have been considerable attempts to implement this policy. PPP efforts in the country have met with varying success. The JNNURM has had limited success in promoting PPP in urban infrastructure projects (The HPEC Report, 2011). As per this report, very little is being executed through PPP, and even that is largely in the form of outsourcing of services to the private sector. Financing from private partners has not come forth, mainly because ULBs have not been able to undertake reforms in a convincing manner. Perhaps revenue models which underpin access to external finance are not yet tested for India, and it was unrealistic to expect cities to have the track record and credibility to mobilise private counterpart funding.

Despite the limitation of JNNURM in promoting PPP, there have been there have been instances of successful implementation. Figure 2.5 shows the evolution of PPP in the water sector in India and the Figure 2.6 shows the scope of some PPP projects implemented in India.

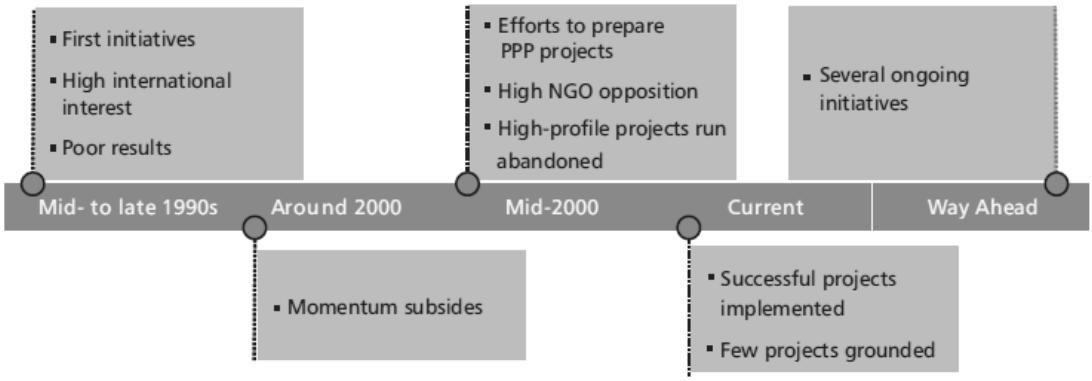


Figure 2.5: PPP Timelines in Water and Sanitation Sector in India
(Source: Tool kit for PPP in water supply for the state of Maharashtra in India, ADB, 2011)

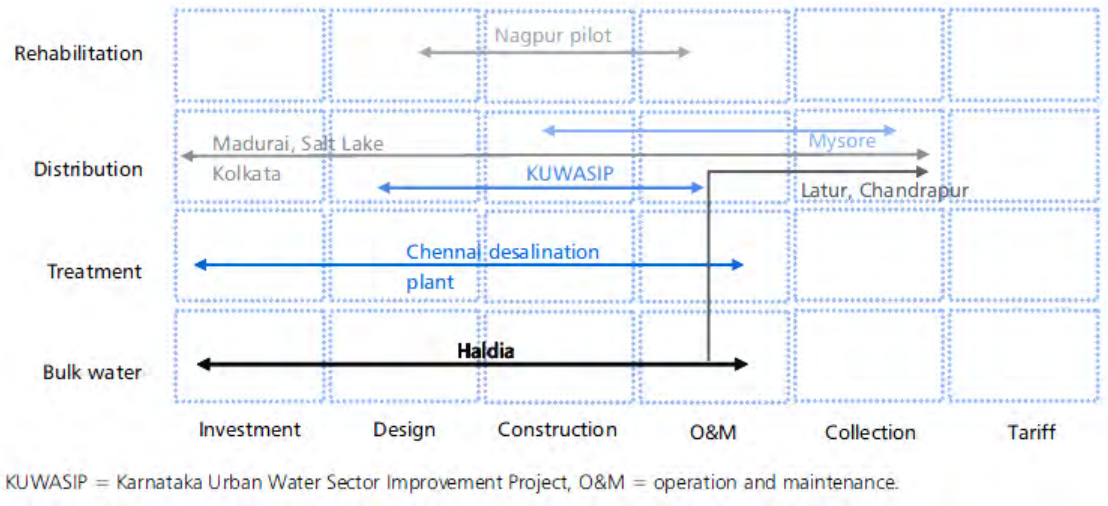


Figure 2.6: Scope of Some PPP Projects Implemented in India
(Source: Tool kit for PPP in water supply for the state of Maharashtra in India, ADB, 2011)

In the above light and GOI's ongoing thrust on PPP, ever increasing role of private sector in urban water and sanitation sectors can be expected.

PPP in Pune Water Supply

The Pune Municipal Corporation has recently (starting January 2012) employed an International Consultant in order to help it improve its distribution system, reduce non-revenue water, and implement continuous water supply. The Consultant's work is split into three phases; first six months for the preparation of detailed project report, next five years for implementation of activities, and the last five years for operation & maintenance. The Consultant's scope of work includes preparation of PPP model for the funding of the project and liaisoning with the state government/JNNURM or any other funding agency. The project is expected to be funded largely through GOI's JNNURM and associated grants as well as gap funding through various financial institutions like the World Bank, Asian Development Bank, JICA and so on.

The modality of PPP is not yet clear since the Consultant has just started the first phase of work.

PPP in Aurangabad Water Supply

Aurangabad Municipal Corporation has initiated a comprehensive project aimed at improving the water supply system of the Aurangabad City on PPP basis. In April 8, 2011, the SPML Infra Limited and VA-Tech Wabag and National Water and Sewerage Corporation (Consortium), were selected as preferred Bidder Concessionaire and established as a special purpose corporation (SPC). Then, Concession Agreement was made with AMC on 22nd

September 2011. The SPC will undertake various activities to increase coverage, reduce NRW, and supply water continuously. The SPC will then operate and maintain the entire system for a specific duration and at the end return the assets to the AMC. With a design period of 30 years, the total project cost is Rs. 638.38 crores of which the Concessionaire is to contribute Rs. 198.45 crores.

2.5 Potential for Application of Japanese Technologies to India

2.5.1 Japanese Technologies on Water Supply and Sewerage and Current Condition of Water Business

(1) System of Japanese Technologies on Water Supply and Sewerage

Japanese waterworks and sewerage works have supplied water safely and stably, responding to various changes of natural and social environment. Thus Japan has accumulated a wealth of experience and technology which can be beneficially applied to water systems in both hard and soft components.

Japan has advanced water technologies including water treatment technologies, water supply control systems and measures against water loss, sludge utilization converting to energy, sewerage operation and maintenance as shown Figure 2.8. Japanese water and sewerage entities are working to improve water service efficiency and enhance added value by combining these diverse individual technologies.

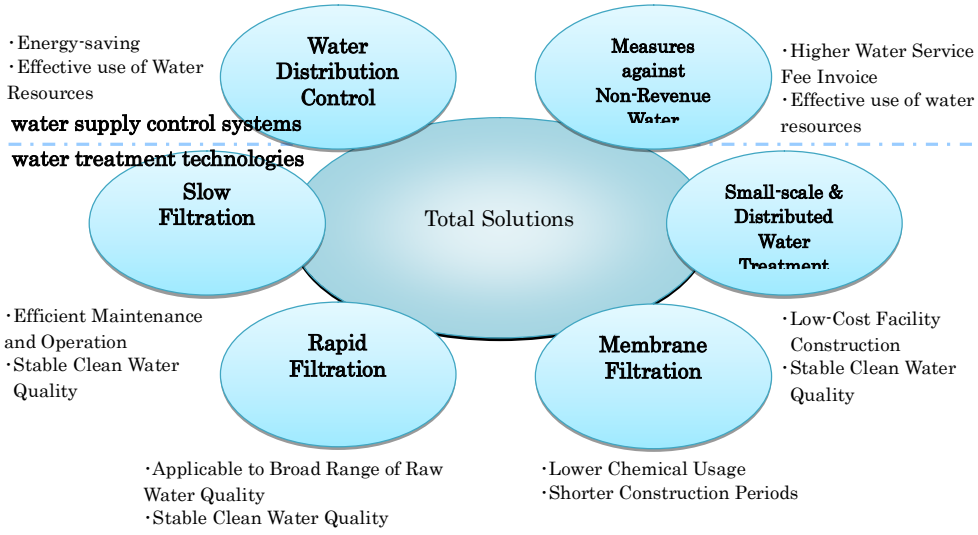


Figure 2.7: A System of Water Supply Technologies owned by Japan

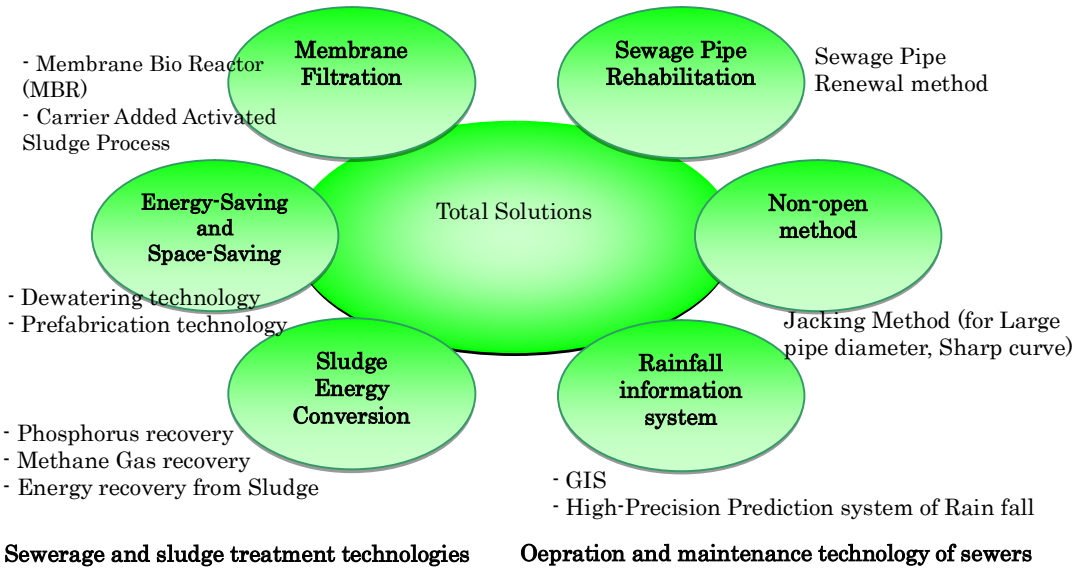


Figure 2.8: A System of Sewerage Technologies owned by Japan

(2) Outline of Water Supply Technologies

Water supply technologies owned by Japan are mainly divided into two; water treatment technologies, and water supply control systems and measures against water loss.

The representative example of water treatment technologies (Figure 2.7 down side) is a filtration technology for turbidity control, which is countermeasures against the quality fluctuation of raw water and against removal of cryptosporidium, developed by the social high demand on water quality. In addition, another advanced technology is high purification technology responding to trihalomethane, odor, chromaticity etc. Also, membrane filtration technology responding to small-scale water supply system and the automation, desalination technology, recycle technology of general service water and so on.

Rationalization technology for distribution of water (Figure 2.7 upper side) is a combined technology of distribution control by small blocks, data collection system for monitoring control (SCAD ; Supervisory Control And Data Acquisition), leakage detection technology, and asset management system technology. These technologies are indicated in Annex 3.

(3) Outline of Sewerage Technologies

Sewerage technologies owned by Japan are mainly divided into two; sewerage and sludge treatment technology and operation andn maintenance technology for sewers.

Sewerage and sludge treatment technologies (Figure 2.8, left) are membrane bio reactor (MBR) and Carrier Added Activated Sludge Process. Energy-saving and space-saving

technologies have, for instance, a various type of dewatering technology and prefabrication technology. Technology on sludge energy conversion are phosphorus recovery, methane gas recovery and technology for energy recovery from sludge.

Oepration and maintenance technology of sewers (Figure 2.8, righr) has, for instance, Sewage Pipe Renewal method, which is one of the rehabilitation technologies. Non-open method has jacking method (for large pipe diameter, sharp curve) and so on. Rainfall information system have two types; GIS-based and a high-precision prediction system of rain fall.

(4) Current Condition of Japanese Firm for Water Business and Challenges

＜Water Business in World Market＞

Water demand has been increasing more rapidly than the forecast of population growth, the market scale is predicted to expand from 36.2 trillion yen in 2007 to 72.5 trillion yen in 2020 (Source : Economic White Paper 2011, refer to Table 2.9). Of this, 62.7 trillion yen out of 72.5 trillion yen, is a market for 'conventional technologies (volume zone)', not for advanced technologies which Japan has a competitive advantage such as high water treatment technologies.

Meanwhile, the market scale of 'advanced technologies (growth zone)' which Japanese firms have a competitive advantage such as desalination of sea water, industrial water and recycle water, is relatively small at 9.8 trillion yen. However the growth rate is more than three times of that in 2007, it is considered as a promising area and is expected to be expanded more.

Table 2.9: Water Business in World Market (2020)

Business type

(Rs. Trillion)

Sector type

	Consulting for provision of materials and parts, Construction, Design	Management service	Total
Water Supply	23.3	25.7	49.0
Desalination of Sea Water	1.3	4.0	5.3
Industrial Water and Sewerage	6.6	0.4	7.0
Recycle Water	2.2	-	2.2
Sewerage (Treatment)	25.8	18.8	44.6
Total	59.2	48.9	108.1

--- Growth zone (Gwoth rate is more than 3 times to 2007)

Current situation on water business and main challenges for Japanese firms are shown as below.

＜Current Situation＞

- Japanese firms have a conpetitive adbvantage on instrument technology, however it is specialized and divided, in contrast to foreign water major firms.
- Japanese firms are limited to the participation by delivering membranes for water treatment and water-saving technical equipment to water major firms in EU and USA as prime contractors and by investing to local enterprise firms.
- Japanese private firms have limited experiences and know-how on operation and maintenance, and waterworks management with a lack of proven performance, since these works have been the responsibility of local municipal governments.

＜Challenges＞

- It should be said that the competitiveness of Japanese equipment manufacturers themselves is weak, since there are many local manufacturers producing water treatment equipment, pump equipment, electric equipment, SCADA equipment and so on.
- Japanese private firms do not have overall know-how and proven performance on operation and maintenance of facilities, and waterworks management.
- Because of a lack of the proven performance on waterworks management, the current situation is that Japanese firms are not able to compete with water major firms in EU and USA which have sufficient experiences and actual achievement.

2.5.2 Application of Japanese Technologies to India

(1) Water Purification Technology

1) Required Technical Background

Water purification technology on water quality in India is relatively low at present, in comparison to Japan, thus conventional technologies can be applied to India.

2) Conventional Technology

Water facilities and equipment with low specification including water treatment technology by using conventional technologies can be procured within India. Therefore, Japanese water treatment technologies could be over specification for applying to waterworks in India from the view point of water quality requirement and cost, and be low competitive from the price aspect.

3) Advanced Technology

High demand on membrane filtration and desalination of sea water and general service water can be seen in middle eastern countries, however the application to developing countries such as India is limited to some of facilities due to the high cost.

(2) Application of Rationalization of Distribution System

1) Required Technical Background

Operation and maintenance of water facilities in india, especially in the upstream such as water treatment plant, reservoires etc. tend to be relatively well-organized. However, water facilities at downstream such as transmission and distribution pipeline, service pipeline, water meter etc. are not sufficiently operated and maintained. In addition, although customer lists for tariff collection are existed, the revenue water volume is at very low level due to illegal connection, un-metered installation, non-functioning meters, no timely meter reading and so on.

Meanwhile, various studies by international institutions and facilities development by the Indian side have been implemented, the current situation is that the facilities development is mainly focussed on water sources, water treatment plant, reservoirs, transmission pipeline etc, thus restructuring of distribution and water supply system is lagging behind.

Moreover, the pace of new water resource development is not meeting the pace of water demand in India, and very often there is a lack of enough water resources. It could be more effective to reduce non-revenue water in the distribution system and cover the lack of water volume, rather than to develop the new resources. Thus the rationalization and NRW reduction technologies for distribution water have a large potential.

The four cities in the scope of the Study have a strong demand on this field. In Pune city, an Italian consulting firm has started a study on this issue from January 2012. In Aurangabad city, PPP project covering all areas of water supply system from intake to supply such as facilities construction, operation and maintenance, revenue collection has just started in mid 2011. Mumbai and Nashik cities do not have any solid plan in this field as yet, however both cities strongly desire to receive technical cooperation from the Japanese side due to a lack of know-how on the rationalization of distribution system.

2) Current Technical Level of Indian Firms

In recent years, the Indian central government has put a strong emphasis on rationalization of distribution system and reducing NRW to make realize continuous water supply. Under this policy, many local firms have joined in the market of this field (JUSCO as a business afilliation of TaTa group, L&T as the largest construction firm, SPML company, a foreign

affiliated VEOLIA, WABAG, etc.). However, the know-how in this technology of these local firms is poor, thus there is a large opportunity that Japanese know-how can be applied to.

Meanwhile, although the pre-qualification is held in the bidding process, the pre-qualification conditions are not necessarily set up properly because of a lack of know-how in the contractee side. So, it is possible that local firms with insufficient technical capability may possibly pass through the pre-qualification hurdle. Since the firm proposing the lowest price succeeds to get the project after the pre-qualification, it is assumed that it is difficult for the Japanese firms to win.

3) Application Method of Japanese Technologies

In many cases, local firms are aware of the lack of know-how on the rationalization of distribution system and reducing NRW, these firms are eager to learn these know-how. Thus, a possible break through of Japanese firms is to colaborate with these local firms as joint venture. The rationalization technology for distribution system and NRW control cosists of advanced technologies such as SCADA and conventional technologies such as a development of GIS and leakage detection.

Except for leakage detection, the Indian side has already obtained these individual technologies and are being gradually applied by waterworks entities. However, it could be pointed out that these individual technologies overlook a holistic approach to achieve an upper objective of rationalization of distribution water and reduction of NRW in many cases. Therefore, the first step for the application is to enhance for the Indian side's understanding that 'rationalization technology for distribution water and NRW reduction' is only a way for achiving equitable and continuous (24 hours) water supply.

2.5.3 Application of the Japanese Technology to India

As explained in the preceeding section, technologies of rationalization of distribution system can be accepted by the Indian side.

(1) Measures to promote technologies of rationalization of distribution system

1) Promotion to Decison-makers of the central government, local governments and water supply/sewerage agencies

・Demonstartion to the official of the central government should be at most 1 week because of their tight schedules in their offices. Preferebly water experts of JICA with rich knowledge of water and fluent English, should hold a seminar on the above subject. Water experts of JICA should also accompany with them to appropriate water supply agencies in Japan. For selction of appropriate agencies, cooperation with the Ministry of Health, Labour and Welfare and Japan Waterworks Association is needed.

- As is encouraged by the Central Government in India, high ranked officials in the local governments and water supply agencies have recognized the importance of shifting towards 24x7 and equitable water supply and have intention to implement it. The above intention was observed through interviews of each municipal commissioner. Similar demonstrations should be programed for officials of the local governments and water supply agencies.

2) Identification of the local governments who will show interest in technologies of rationalization of water distribution.

Demonstration should start with officials of the central government followed by local governments and water supply agencies. This demonstration should be implemented before any programe starts. In order for demonstartion to be effective, we should identify in which local governments and water supply agencies, necessities exist and they have intention to accept the technology. Consultants can be utilised to identify them. JICA will instruct the consultants which cities are possible to provide technical assistance. Out of the possible cities, consultants will study and identify cities.

3) Combination of Master Plan Formulation, Technical Assistance and Soft Loan Provision

Prior to applying the technology of rationalization of water distribution, existing distribution system, areal water demand etc, should be known. This has been learned from the JICA-assisted master plan for Delhi and from this study on complex nature of distribution network in Mumbai. The above will be known by formulating master plan. As a result the Indian side will aceralate reliance on and confidence towards Japanese technologies.

Rationlization of water distribution will be formulated as one of the master plan issues. During implementation several lots of tendering packages should be made. Traditionally, facility-type lot is made; such as treatment plant, pumps, pipes etc. Instead of this lot system, area-wise lot system should be made ; e.g. every facilities of treatment plant, pumps, pipes etc. in one specific area should be under one lot system. Further, not only these facilities but also other works should be under one lot system such as non-revenue water reduction measures, SCADA systen development, GIS mapping system construction and meter reading/invoicing and collection. This kind of lot system was proposed in Delhi water master plan. By this lot system, water majors or consortiums can participate in the project.

The followings should be considered for Japanese manufacturers and operators to obtain the above type of lot;

- Joint Venture with prominent local partners (construction, treatment process, operation of plants etc.)
- Provision of Japanese soft loan
- Specification writing by Japanese consultants. Specification should encourage experiences and performance records of successful operation of water distribution including NRW ratio.

(2) Measures to Promote Matching for Joint Venture in Public-Private Sector between Japan and India

1) Technical Cooperation Using Twin or Sister Cities between Japan and India

If Japanese manufactueres and operators want to enter into an Indian market in the water sector, they must get joint venture with local partners. In doing so each side supplements other side's weakness and JV will become a strong entity. This might work in Indian market. Technical cooperation between local governments of Japan and India may strengthen the above JV's position. Reliance of the Indian side on Japanese technologies is strong. If any local government of Japan is or will be a member of JV, and if JICA finances its portion under technical cooperation, JV's financial power can compete with other non-Japaness JVs or water majors and simultaneously JV's credibility will become strong.

2) Joint ventures of India Corporations and Japanese Corporations

In operation of "Rationalization of Distribution System" works, operational issues such as suspension of water supply during construction, traffic jam from construction in roads and pipe works in slums etc, cannot be avoided. Moreover, Japanese enterprises are weaker in price competitiveness of pipe laying work than Indian enterprises. Because "Rationalization of Distribution System" works which mostly consist of pipe works are the conventional technology and can also be constructed only by Indian enterprises. In order for Japanese companies to conquer the weak point of price competition/business practice/tax system/administrative procedure and to move in to Indian market, the joint venture with the leading Indian enterprises in construction/manufacturing/O&M fields is indispensable. The roles of Japanese companies will be mainly management of enterprise enforcement, construction supervision, supply/support of advanced technology, supply of materials and equipment and sending of SV's in O&M period etc.

The following activities will be required in order for Japanese enterprises promoting the joint venture with Indian enterprises,

(a) Opening of a matching seminar of Japanese enterprises and Indian enterprises,

- It is recommended 1) to explain an formulation method of a master plan proposed for Delhi city, and 2) to promote to have a matching seminar participated primarily by Japanese local waterworks bureaus who have a wealthy knowledge and experiences on the operation and maintenance of distribution network and on NRW reduction, in order to respond the need of rationalization of distribution network and NRW reduction in waterworks of Mumbai, Pune and Nashik cities.
- In the matching seminar, particularly in the case Mumbai city, it is desirable that local waterworks bureaus like Yokohama city with more than 1 million population at least should participate in, because some difficulties such as water stoppage during the works, traffic jam, improvement of complicated pipeline in the slum areas will be assumed during the work in Mumbai city. Moreover, Japanese private companies have technology on installation works for the network improvement without stopping water supply, thus the participation of these experienced companies is expected.
- In the sewerage project in Mumbai city, there is a possibility to apply the technology on sewerage and sludge treatment or membrain treatment including recycle use of water, which are already applieded by local governments and private companies in Japan, because sewerage water is still discharged into the surrounding sea. Since Indian companies are assumed not to sufficiently have such advanced treatment and membrain technology, the joint venture business in this field could be effective.

(a) Joining Japanese enterprises in seminars and exhibitions of India

- Japan Waterworks Association (JWWA) co-organized a half-day seminar in the anual meeting of Indian Waterworks Association (IWWA) in collaboration with IWWA in January 2012. In the seminar, Japanese local waterworks bureaus and a private meter manufacturing company made presentations for their promotion. In addition, during the annual meeting program, an exhibition was held at the same venue, some companies from not only India but also Malasia and Singapole participated in the exhibition with the boothes for their promotion. The similar annual meeting will be held in Pune in 2013, thus it is recommend that the Japanese entities including waterworks bureau and private companies actively graps the opportunity.

(b) Inviting Indian organizations/enterprises to water sector exhibitions in Japan.

- JETRO has already carried out the seminar and exhibition to Japanese enterprises, and a cosponsorship/support for these activities will be possible for JICA.

As introduced in the above (a) – (c), it could be an effective measure for enhancement of joint venture between Japan andIndia that these activities are planed and implemented as a part of training in a technical cooperation project organized by JICA in the initial stage.

3) Progress of the Japanese enterprises to the water sector of India

In the first step, Japanese enterprises will mainly undertake a yen-loan works, and will gain experience/achievement in India. In the next step, it is expected that they will gain directly to the water works share of an overseas organization and/or local government.

The following will be assumed as support of JICA in that stage.

- Support for information service about affiliated company establishment of Japanese enterprises

  In order to reduce risksrelated to a tax system/administrative procedure in India, many Japanese enterprises are expected to establish local branches with Indian staff.

- Understanding promotion of the international transaction and management buildup to local government and body leaders

  In order that a local government and bodies mainly undertake "Rationalization of Distribution System" works, reduction of the dispute risk during enterprise operation will be desired.

Finally growth of the Japanese enterprises to the water major enterprises which can be comprehensively entrusted with water service enterprise management will be desired through the above-mentioned activities.

2.5.4 Strategy of Japanese Enterprises for Working in India

(1) Cooperation at an Early Stage or Planning Stage

Out of the Japanese Enterprises who regard India as a prosperous market, about 60% of them do not have any concrete plan and further 90% of them do not have any offices in India. Namely, they are merely wishing to go into an Indian maeket without any concrete plan (see Figure below).

Relatively small number of corporate plans exist for India due presumably to cultural differences and lack of infrastructures. Japanese entrprises should involve in, at an early and planning stage, formulation of development plan of infrastructuers in India. If it can be done,

needs of infrastructures can be identified properly and technologies of Japan can be built in the development plan.

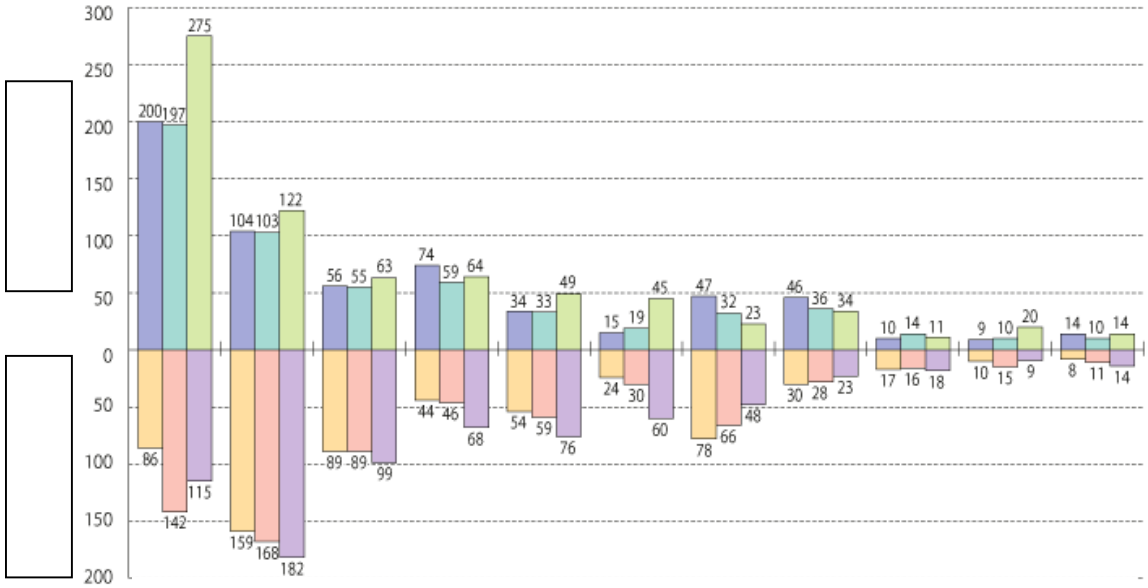


Figure 2.9: Existence of Corporate Plan for Countries and Regions whom Japanese Enterprises regard promising (within 3 years)

(2) Standardization of Japanese Technologies

As a marketing strategy, European countries and USA have long utilized international standardization of technologiesof their origins. Recently, China and Korea have followed. As a result, manufactureres of European countries and USA have advantage of winning projects over Japanes one.

Governments and manufactureres of Japan have noticed its importance and are doing their best of their original technologies to adopt tothe International standards. Japanese consultants should involve in planning and designing stage of the works so that there will be big chances of Japanese technologies to be employed in specifications.

(3) Long Records/ Experiences of Water Supply Operation

Entering into Indian market of the Japanese enterprises needs long record/ experiences of Japanese water agencies who have long operated and maintained water supply systems. As a transitional measures, the both[thapa1] should form joint venture. However, as a long term measure, Japanese enterprises should be given chances of acquiring know-how and records of water operation.

(4) PFI／PPP

Recently, works have been entrusted to private sectors as PFI/PPP in Japan. However, scope of works does not cover wide ranges but limits to part of works like treatment process, sludge treatment etc. Namely, real PPP has not been practiced in Japan. Therefore, operational know-how of managing water supply system as a whole has not been transfered to private sectors.

Japanese JVs are only possible means to enter into an Indian market for the time being. PPP practices in India are explained in section 2.4.

(5) Strengthening of Advanced Technoligies

Japanese enterprises have technical advantages on such advanced technologies as membrane filtration, desalination, water recycling though their costs are not competitive. To accelerate their chances of entering into an Indian market, construction and demenstration of pilot plants in India is a possible means and it can be financed/ subsidized by the Japanese government. Further, during such period, localization process should be sough to combat weak cost competitiveness.

In Maharashtra, we could not find the market of the above advanced technologies because of relatively abundant water resources amount. However, they might be applied to areas with water scarcity such as Rajasthan, Gujarat etc.

(6) Conclusion

During the Study, technologies of rationalization of water distribution have been recognized in 4 cities as important fields. Japanes private sectors do not have these technologies while Japanes water agencies do have. So, joint ventures of both are only solutions for Japanese private sectors go into an Indian market. As a mid-term measure, Japanese private sectors need to be given chances of water supply system operation; starting from partial PPP and finally full PPP inclusive of operation and maintenance.

Demonstration of the technologies to decision-makers of the Indian central government, and local governments should be initiated first. Identification of cities requiring the above technologies should be done secondly. For the identified cities, as a prerequisite, master plan should be formulated, through which reliance on the Japanese technologies will be strengthened.

Proposed lot system should not be traditional facility type lot but operation-type lot; i.e., an operation area complete from treatment plant to distribution pipe with SCADA, GIS, NRW reduction, metering and revenue collection. By this lot system, competition of equipment or products can be avoided. Instead, only water majors and consortiums (cosnsisting of construction, equipment and operation and maintenance company or entity) can participate in the project.

Japanese water agencies should be a member of JV to strengthen Japanese JV. If technical cooperation between cities in India and Japan are concluded and Japanese water enterprises can be a member of Japanese JV, such expenses can be financed under JICA technical cooperation program. It will enhance Japanes JV competitiveness and reliance.

3. MUNICIPAL CORPORATION OF GREATER MUMBAI (MCGM)

3.1 City Development Plan

City development plan has been formulated in 2005 which was a mandatory to access government sponsored grant-aid programs under JNNURM. On the other hand, the spatial growth and sprawl of the city is guided and managed by the Development Plan and the Development Control Regulations therein. In the current development Plan (1991 to 2013), guided poly-nucleated type of development fostering decongestion and distribution of the activities wherein the population was expected to stabilize with projected population of 9.87 million by the year 2001. According to 2001 census, its population was 11.99 million over the expected population. However, the population growth during 1981 to 2001 slowed down at 1.8 to 1.9% per annum, much lower than the preceding decades. (According to 2011 provisional census, its population growth has become stabilized and its population was only 12.5 million.)

Table 3.1: Population in Mumbai

Year	Population (thousand)	Decadal Population Growth rate
1971	5,971	-
1981	8,243	38.1 %
1991	9,926	20.4 %
2001	11,914	20.0 %
2011	12,478	4.7 %

In the city development plan, the population is projected to grow to 14.69 million (low estimate) to 16.31 million (high estimate) by the year 2031. Its share to Metropolitan Mumbai Region is 67% in 2001 and is projected to decrease to 45 to 48% (depending on high to low estimate). Needs to various infrastructure developments including water supply, sewerage and storm water are presented in the city development plan.

Water supply master plan for 2021 was formulated in 1999 based on which strategic actions are presented. They are source augmentation and modifications/ strengthening of its existing distribution network through replacement and rehabilitation. The works up to 2011 have been in progress. Namely Bhatsa (IIIA) has already yielded 455 MLD and Middle Vaitarna (IV) will yield 455 MLD by 2012. Feasibility study on another two dams was completed. Network improvement is also being implemented; strengthening of transmission network, replacement of pipes, universal metering etc.

Sewerage sector has also a master plan called as MSDP II for 2005 to 2025. Implementation of the MSDP II thus forms the action plan for sewerage sector. MSDP II addresses the following 4 concerns.

- Extending sewerage network to unserved areas (i.e. slum areas)
- Comply with disposal standards through outfall provision
- Enhancement of system capacity to cater to additional flows
- Rehabilitating existing sewers

Project implementation is in progress in the above objectives. In addition, current projects include secondary treatment construction in all 7 plants to comply with marine water quality standard.

After the deluge of 26th July 2005, stormwater drainage sector has become the priority sector. The works are on-going based on the recommendations of the master plan (BRIMSTOWAD report) in 1993.

The priority projects for the 3 sectors identified in the city development plan are shown in the Table 3.2.

Table 3.2: The Priority Projects for the Three Sectors

No.	Project Name	Implementing Agency	Estimated Cost (Rs.crore)	Indicative Timeframe
1	Storm Water Drainage Project BRIMSTOWAD Project	MCGM	1,800	2007 – 2009
2	Middle Vaitarna Water Supply	MCGM	1,600	2007 – 2012
3	Mumbai Sewage Disposal Project including Slum Sanitation – MSDP-II	MCGM	6,684	2006 – 2025
4	Strengthening of Distribution System for water supply	MCGM	500	2006 – 2010
5	Meethi River Development Project (part of drainage project)	MCGM/ MMRDA	1,200	2006 - 2011

3.2 Water Supply System

3.2.1 Broad Features

Water supply in Mumbai has kept rising with newer schemes to meet the increase in demand for the growing population and the city is, comparatively, better off. However, the reasons for water shortages are distribution losses, pilferage, wasteful use etc., causing about 40%-60% loss of water. The following is the salient features of Mumbai water;

1) Mumbai's Current Population : 12.48 million
2) Mumbai's water supply : 3,228 MLD (3,683 MLD in 2012)
3) Per capita water availability : 260 Lpcd (300 Lpcd in 2012)
4) Avg. Hours of Supply : 2 to 4 hours

Thus Mumbai has enough water to switch over from the present intermittent pattern to continuous pattern of water supply provided;

1) Non- revenue water is reduced.
2) Customer demand is managed (including wastage).
3) Supply is augmented as per rising demand.

The future water sources, conveyance, treatment plants, reservoirs and distribution network is designed for 240Lpcd for the projected population to take care of transit losses, evaporation losses, higher standard of living in future and increase in allied services with the growth of the city.

3.2.2 Water Sources and Conveyance Pipe/Tunnel

Before Independence, Tansa was the major source and these water pipelines run along Bombay-Agra road (National Highway 3). After independence, (Lower) Vaitarna-cum-Tansa project envisaged a tunnel between Vaitarna and Tansa. The Upper Vaitarna Scheme, in 1973, provided 544MLD. Then came the Bhatsa Scheme which also envisaged construction of pumping, treatment and conveyance at Pise, Panjrapur and Bhandup. Bhatsa water is pumped into Vaitarna mains and brought through tunnels to Bhandup's water treatment-cum-pumping-cum-reservoir complex.

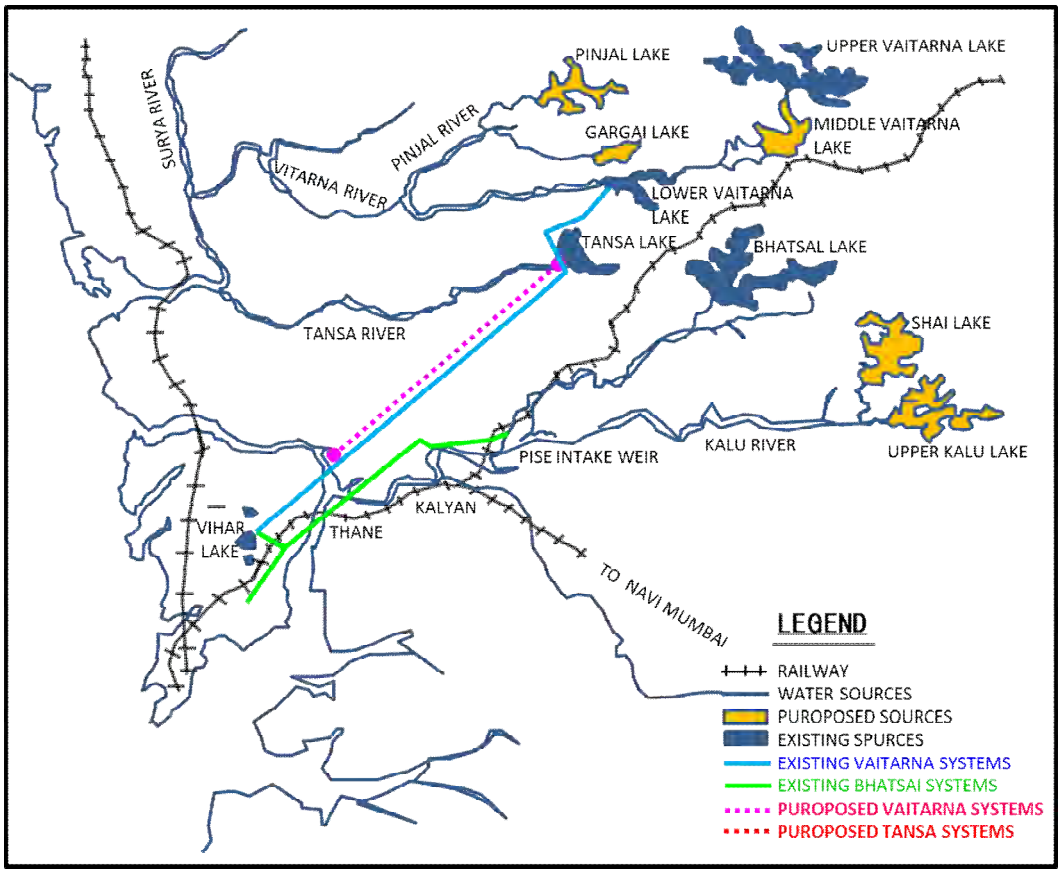


Figure 3.1: Sources of Mumbai's Water Supply

(Source: Hydraulic Engineer's Development Planning and Research)

Table 3.3: Existing Water Supply Sources

No.	Name of the Source	Year of completion	Quantity of water (MLD)	Total Quantity of water (MLD) (cumulative)
1	Vihar lake	1860	68	68
2	Tulsi lake	1879	18	86
3	Tansa lake	(4 stages) 1892 to 1948	408	494
4	Lower Vaitarna (Modak Sagar)	1957	490	984
5	Upper Vaitarna	1973	544	1528
6	Bhatsa (World Bank Assisted)			
	I Mumbai	1981	455	1983
	II Mumbai	1989	455	2438
	III Mumbai	1996	455	2893
	IIIA Mumbai	2006	455	3348

*Out of 3,348 MLD, 120 MLD is used en route, and the remaining 3,228 MLD is used for Mumbai

Master plan for 2021 proposed to build five dams for future water demand increase. In 2007 MCGM has started the Middle Vaitarna project, consisting Middle Vaitarna dam, conveyance system (3000 mm dia. pipe) and augmentation of Bhandup water treatment plants/ transmission system. It will be completed by May 2012. Feasibility studyis in progress for two other dams, the Gargai and Pinjal projects. The study is expected to be completed by April

or May this year. Approximate cost of these two projects is estimated at 12,000 crores. Other dams in Ulhas River basin are also in consideration. In total, an additional water source will amount to 3,432 ML. So, when all these water sources are added, available water source will be some 6,660 MLD. It will accommodate for some 25 million population, double of the current 12.5 million population.

Table 3.4: Sources Identified for Future Projects

Water Scheme	Quantity of Water (MLD)	Note
Vaitarna River Basin		
- Middle Vaitarna	455	will be completed by May 2012
- Gargai	455	Commenced by 2014 and completed by 2018?
- Pinjal	865	Commenced by 2014 and completed by 2019?
Ulhas River Basin		
- Kalu	590	
- Shai	1067	
Total	3,432	

The Gargai water will be conveyed to Modak Sagar (Lower Vaitarna) Dam through proposed 2.5 km. long tunnel and then conveyed to Bhandup WTP. The Pinjal water will be conveyed up to Pogaon by 55 km. Long tunnel and then conveyed Gundovali village through 8 km. long proposed pipeline and eventually to Bhandup WTP. The planned Gargai and Pinjal and constructing Middle Vaitarna are all gravity sources, whereas the planned Ulhas river basin sources (Shai and Upper Kalu) will need pumping water.

In addition, diversion of planned Dananganga river is being considered as one of the national river linkage project. 1,586 MLD water from the Dananganga river flowing through the Gujarat state will be firstly diverted through tunnel of 5,250 mm dia. to the planned Pinjal dam. Then, 2,450 MLD water combining water from the Pinjal dam of 865 MLD, will be conveyed through tunnel of 5,500 mm dia. and 77 km length to Bhandup complex via Gundawali village.

There are 4 existing transmission pipes (2750 mm of upper Vaitarna main, 2500 mm of lower Vaitarna main and two 1800 mm of Tansa east and west) originating at Tansa dam. The 45 km old twin 1800 mm pipelines of Tansa east and west will be replaced by installing a new 2,750 mm pipeline.

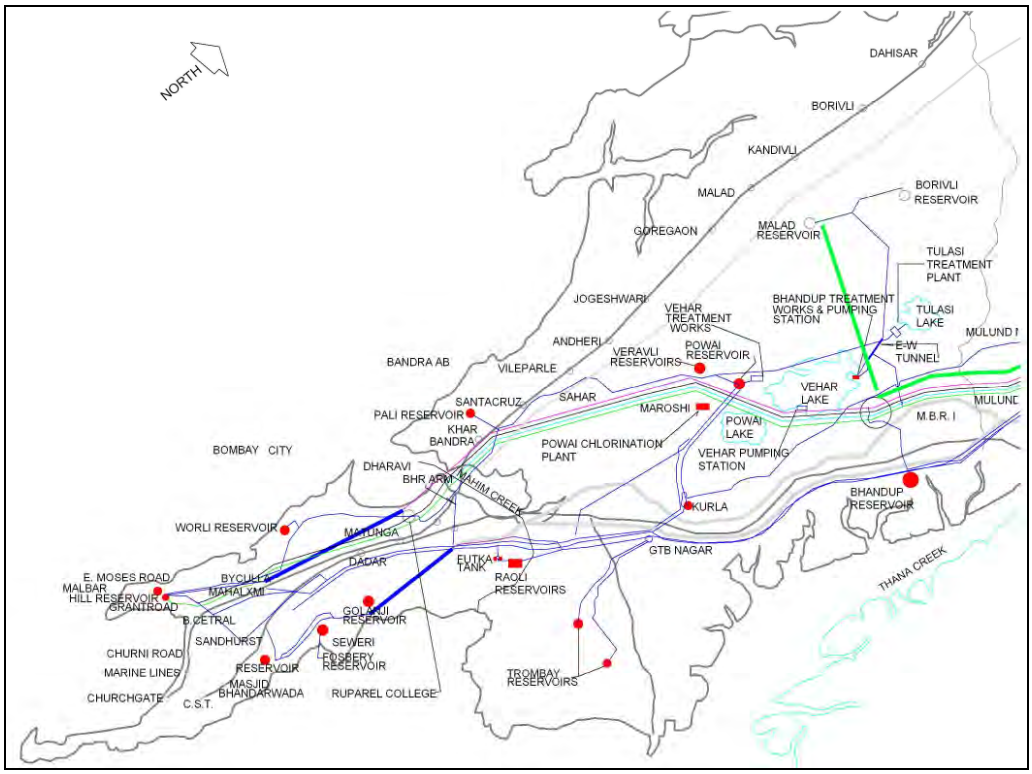


Figure 3.2: Distribution System of Greater Mumbai
(Note: Red marks show Service reservoirs)

The 17-km-long tunnel is being built to replace the existing pipelines between Bhandup WTP complex and Gundawali village where all conveyance pipes merge. The existing two Tansa mains, (Lower) Vaitarna mains, Upper Vaitarna mains will be connected through this tunnel to the Bhandup WTP complex. The tunnel will cater for Middle Vaitarna and Pinjal as well.

3.2.3 Water Treatment Plant

There are two large and two small water treatment plants. Vihar and Tulsi are the small and old WTPs. They are receiving water from Vihar and Tulsi lakes, respectively. Panjarapur WTP with a capacity of 1,355 MLD is taking water at weir at the downstream of the Bhatsa river. The largest Bhandup WTP are receiving water from other dams, namely lower Vaitarna, upper Vaitarna and Tansa dams. Its treatment capacity is 1,910 MLD but working capacity is 2,100 MLD with 10 % overloading.

Table 3.5: WTP Capacity

WTP	Capacity MLD	Note
Bhandup	2,100	rated capacity is 1,910
Panjrapur	1,355	
Vihar	90	
Tulsi	18	
Sub-total	3,563	

WTP capacity at Bhandup is being augmented by 900 MLD to cater for water source from the middle Vaitarna and compensating its overloading. It will be completed by 2012.

3.2.4 Works for Strengthening Water Distribution (under IIIA and IV Mumbai Project)

Initial water master plan was developed in 1971 for 1981 to 2001. It was intended to distribute water through service reservoirs which was fed from two Master Balancing reservoirs at two large WTPs. However, during the course of time, Mumbai has experienced population explosion. Its population was 6.0 million in 1971 and reached 11.9 million in 2001. Its population density exceeds 20,000 persons per sq. km. It has also invited many migrants and has developed many slum areas. Over half of population resides in slum areas. As a result of non-availability of lands for additional service reservoirs and routes of inlet and outlet pipes, "through service reservoirs" water distribution became difficult.

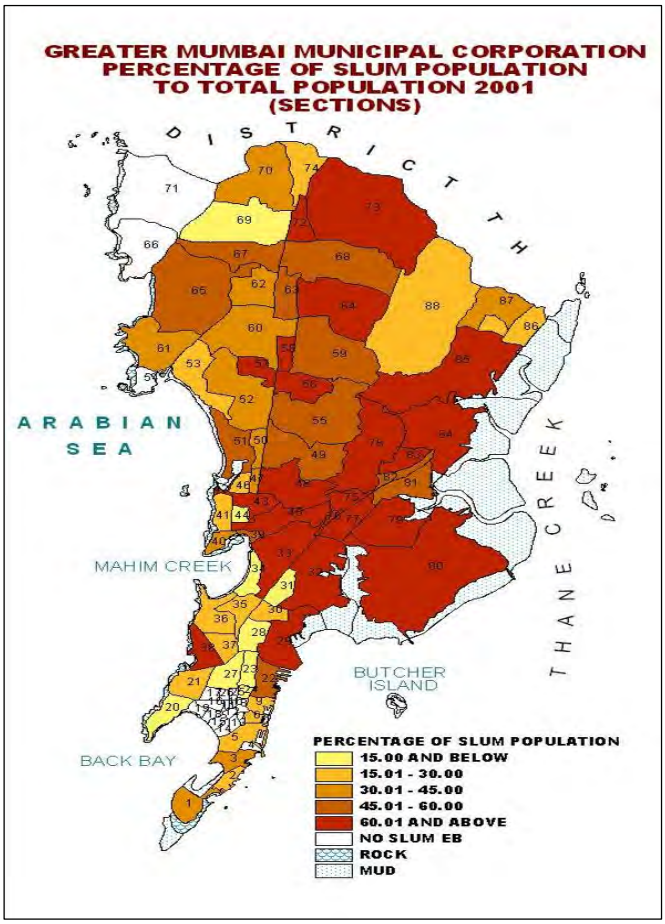


Figure 3.3: Percentage of Slum Population in Mumbai (2001 census)

Master plan for 2001 to 2021 was prepared in 1999. The plan was to build five dams as mentioned before. The works are also proposed for transmission main pipes or tunnels in the city, connecting WTP with intended service areas under 'asset replacement' program to meet the growing demand of water and overcome the problem of its inequitable distribution. Some of them are as follows:

- Bhandup WTP - Charkop tunnel (12-km long for western suburbs)
- Maroshi - Ruparel colledge tunnel, (dia. 3.00 meter, 12.4 km long) replacing the existing (lower) Vaitarana, Tansa (East) and Tansa (West) main surface pipelines.)
- Verawali Hill reservoir - Yari Road tunnel (dia. 2.2 meters, 6.1km long)
- Malbar Hill reservoir - Cross Maidan tunnel. (dia. 2.25 meter, 3.6km long)

- Powai - Veravali tunnel (dia. 2.20 meter, 2.2km, long) strengthening the inlet system of Veravali (I & II) reservoirs
- Powai - Ghatkopar tunnel (dia. 2.2 meter, 4.2km. long) strengthening the inlet system of Ghatkopar (H.L. & L.L.) reservoirs.

3.2.5 Water Distribution Improvement Project

A World Bank-funded study on "water distribution improvement project (WDIP)" was conducted in 2007 for the K-east ward of western suburbs with 0.8 million population, half living in slums. There are 65 major industries, 6 five-star hotels, 1 international airport in K-east ward. The study identified 4 main problems with the water utility:

a) Intermittent water supply
b) Contamination
c) Inequitable water distribution
d) Inefficient customer complaints redressal system

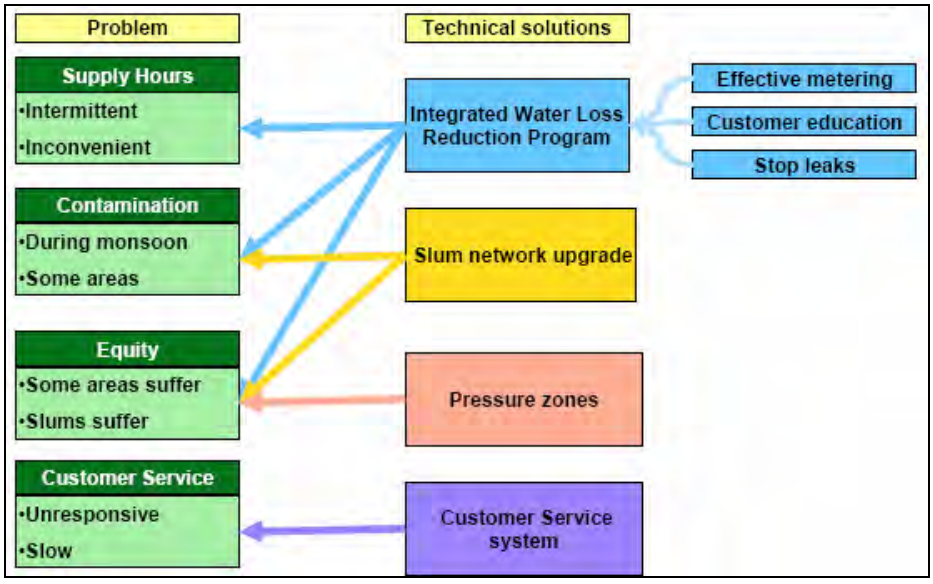


Figure 3.4: Problems and Solutions Identified in K-east Ward

The study proposed a model so as to eventually curb water leakage, pilferage and contamination and ensure an efficient 24x7 water supply through outsourcing the services to a multinational private operator. However, it was not implemented. Instead, the MCGM launched the 'Sujal Mumbai Abhiyan' which was based to a certain extent on the above study. Its objective is a 24x7 supply. This scheme plans on adopting an integrated approach to water management. Some of its important features are explained below:

a) Private Contractors

Distribution network has been contracted to the 6 contractors each responsible one of the 6 zones. These private contractors look after work related to water distribution, elimination of leakages, replacement and rehabilitation of water mains, laying of new water pipelines, supplying and installing meters, conducting meter readings, etc. The MCGM will retain the distribution system, customer interface, billing and collection of water charges.

b) Pre-paid water meters

In order to resolve illegal connections, water thefts and unauthorized water vendors, the MCGM decided to introduce pre-paid water meters for slum dwellers.

c) Telescopic Water Rate

MCGM has intended to introduce telescopic rates for consumption of water setting 150 liters of consumption per person per day (150LPCD) as the norm. Those who consume more than this quantity will pay more.

d) DMA

The city will be divided into District Metering Areas (DMAs) of 1000 connections each.

The Sujal Mumbai Abhiyan scheme has also introduced various technical solutions such as the use of superior quality AMR meters (Automatic Meter Recording System), replacement of bunches of connections by stub mains, replacement of old valves, diversion of water mains from open gutters as well as leak detection surveys.

3.2.6 Vision 2041

MCGM is in process of extending the master plan to year 2041. This was discussed in 2008 for "Vision 2041".

3.2.7 Distribution System

From Bhandup's Master Balancing Reservoir I (MBR I, 240 ML) and MBR II (130 ML) at Yewai Hills, water is supplied to the city and suburbs through 27 service reservoirs and 650 km transmission mains, 4,000 km of distribution mains and 3,200 km of service pipes. From service reservoirs water supply is redistributed in 110 water supply zones at convenient consumer timing with 800 valves operation daily.

Mumbai is a few meters above mean sea water level mostly so that distribution is mostly via a gravity system except at major source pumping stations at Pise weir in the Bhatsa river, Panjarapur WTP, and Bhandup WTP.

Table 3.6: Salient Feature of the Distribution System

Reservoir name	Capacity
Yawal	127 ML
Bhandup	246 ML
Service reservoirs	27 Reservoir
Length of water mains	4,000 km
Distribution Zones	110 Zones
Leakage-detection Zones	615 Zones
Daily operation valves	800 Valves

MCGM has a water control system. Master control center exists at Bhandup WTP complex. In addition, it has 3 zonal control centers, in city (at Malbar Hill), eastern suburbs (at Ghatkopar) and western suburbs (at Vile Parle).

The following particulars are monitored:

- Flows
- Pressures
- Levels
- Pump Status at Plants
- Residual Chlorine
- Turbidity

Replacement and rehabilitation of old distribution pipelines are conducted. About 170 km pipes were replaced in each year 2006 and 2007. It is equivalent to 4 % of the total length.

Table 3.7: A major program costing Rs. 356 Crore under the JNNURM

Year pipelines	2006-07 length	2007-08 length
Replacement	221 km	103 km
Rehabilitation	196 km	94 km
Total	417 km	197 km
Expenditure (Rs. Crore)	150	206

On an average there are 250 major pipe-bursts every year. That’s a pipe-burst every 36 hours. Often, the number of water pipes run in bunches through narrow passages and side gutters in slums. Even though MCGM has pipe maps (water and sewer) in an AutoCAD format, they show pipes locations only along the roads but do not show exact locations on the roads. Under these circumstances, it is extremely difficult to locate the fault or leakage and fix problems. So, replacement/rehabilitation work should start identifying exact locations by digging sections of the roads. The tertiary network is also being replaced / rehabilitated wherever necessary, in order to repair pipe burst and reduce leakage. For smooth and effective works, city is divided into 6 zones where zonal contractors are being appointed.

MCGM has recognized the importance of reducing leaking water. As early as 1970s, leak detection unit was established. However, due to congested roads, development of slum areas and lack of enthusiasm among the staff, its activity is not up to the initial expectations. Attempts are being made to install water meters to make sure users pay as much as they consume.

3.2.8 GIS Map

Water pipes — many laid up to 100 years ago — need to be mapped. Projects are often delayed as workers dig blindly trying to find pipes. Indiscriminate digging also mars roads and snarls traffic. MCGM has a GIS map for storm water drainage system. It has 0.2 meter interval contour lines. However, it cannot be utilized to water and sewerage sectors due to its copyright.

Figure 3.5: Example of Mumbai's Distribution Pipe in AutoCAD Format

3.2.9 Tariff and Financial Situation

Households consume 92% of total water supplied. Water Tariff structure consists of water charge and sewerage charges. Telescopic rates were not employed yet. The daily water bill for a family of five consuming about 1,000 litres of water is Rs. 3.50 only. Water supply to slum is subsidized. The domestic consumption of water is highly subsidized by commercial and

industrial users. 50% of total revenue is generated from 8% Non-Domestic consumers. Production cost is Rs. 7.31 per 1,000 litres.

Table 3.8: Water Tariff Structure

No.	Category	Rs. Per m^3
1	Domestic - Stand post	2.25
2	Domestic – Buildings and Chawls	3.50
3	Halls, Hospitals, Playgrounds Swimming Pools etc.	10.50
4	Industries, Dhobi-ghats, Government Premises etc.	18.00
5	Refineries, Airports, Public Sector Undertakings, etc.	25.00
6	Race Courses & Star Hotels	38.00
Sewerage charges are at 60% of water charges		

Revenues and expenditure of water supply (and sewerage) sectors are under category "G" budget in MCGM budget. Its revenue will be Rs. 2898.6 crores and its expenditure will be Rs. 2037.1 crores in 2010/2011 budget so its operating surplus is expected as Rs. 726.5 Crores.

Table 3.9: Revenue (Income) & Expenditure (Operation) for Water Supply and Sewerage

(Rs. in Lakhs)

No.	Item	2008 - 2009	2009 – 2010	2010 - 2011
	Revenue (Income)			
1	Water charges (from metered connections)	48837.00	50013.13	50158.02
2	Water Tax (from unmetered connections)	9734.00	9734.00	9734.00
3	Water Benefit Tax (from all)	42968.00	47264.80	51992.00
4	Other Water Revenue	11525.00	11525.00	11525.00
	Sub-Total			**123409.02**
5	Sewerage Charge	24163.00	25486.70	26232.87
6	Sewerage Tax	16587.98	16588.00	16588.00
7	Sewerage Benefit Tax	25633.97	28198.00	31018.00
8	Other Sewerage Revenue	2500.00	2500.00	2500.00
	Sub-Total			**76338.87**
9	General Revenue	49484.00	76724.00	90113.00
	Total (Revenue)	**231431.97**	**268033.63**	**289860.89**
	Expenditure			
1	Establishment Expenses	34390.52	54674.48	68074.98
2	Administrative Expenses	10501.05	11027.95	17588.04
3	Operation & Maintenance	48098.25	62189.73	60430.79
4	Interest and Financing Charges	10360.98	9462.71	8765.94
5	Programmed Expenses	70.88	-	-
6	Revenue Grants, Contributions & Subsidies	14507.42	30647.23	32571.61
7	Provisions & Write Off	14401.00	15432.00	15671.00
8	Prior Period Items	-	6050.74	607.63
	Total Expenses	**132330.10**	**189484.84**	**203709.99**
	Provisions/ Contributions	10000.00	22500.00	13500.00

No.	Item	2008 - 2009	2009 – 2010	2010 - 2011
	Surplus to transferred to meet Capital Expenditure	89101.87	52278.95	72650.90

Capital expenditure will be Rs. 3446.5 crores, Rs. 2721.5 for water supply and Rs. 641.2 crores for sewerage sectors in the 2010/2011 budget. This expenditure will be financed by internal loans and internal/ external grants.

Table 3.10: Capital Expenditure for Water Supply and Sewerage Sectors

(Rupees in Lakhs)

No.	Group	Department	2008 - 2009	2009 – 2010	2010 - 2011
1	General		484.40	568.00	879.35
2	Water Supply	Water Operation	81405.60	102931.99	128009.65
		Water Supply Project	138231.35	132305.12	144137.81
3	Sewerage	Sewerage Operation	23702.01	19319.37	18195.30
		Sewerage Project	23743.55	24174.41	20683.43
		MSDP*	27115.39	21305.40	25246.79
	Total Capital Expenditure		294682.30	300604.29	337152.33
	Add: Repayment of Loan		6904.96	7352.01	7500.00
	Total Capital Expenditure		301587.26	307956.30	344652.33

* Mumbai Sewerage Disposal Project

Table 3.11: Source for Meeting Capital Expenditure & Repayment of Loan

(Rupees in Lakhs)

No.	Particulars	2008 - 2009	2009 - 2010	2010 - 2011
1	Revenue Surplus after meeting Operational Expenditure and Provisions	89101.87	52278.95	72650.90
2	Internal Loans			
	IV Middle Vaitarna Project - Depreciation Fund	36703.00	23557.00	32631.00
	Mumbai Sewerage Disposal Project Stage II Project - Depreciation Fund	23198.00	15237.00	17231.00
	Sub-Total	59901.00	31313.00	49862.00
3	External Loans	0.00	0.00	0.00
4	Contribution/ Grant			
	Middle Vaitarna, JNNURM	36703.00	13083.00	21135.00
	MSDP Stage II, JNNURM	23197.00	7756.00	9750.00
	Tunnels & Tansa Main, JNNURM	13356.00	4861.00	4861.00
	Contribution from Asset Repla & Rehabi Fund (Tunnel)	31162.00	4861.00	4861.00
	Contribution from Asset Repla & Rehabi Fund Additional (Tunnel)	0.00	10078.00	12278.00
	Contribution from Asset Repla & Rehabi Fund Additional (Tansa Main)	0.00	20000.00	20000.00
	Contribution from Development Charges	4450.00	2200.00	5000.00
	Contribution from Asset Repla & Rehabi Fund	0.00	15410.00	10762.00
	Sub-Total	108868.00	58249.00	88647.00
5	Transfer from Accumulated Surplus	43804.60	137600.00	133600.00

No.	Particulars	2008 - 2009	2009 - 2010	2010 - 2011
	Total (1 to 5)	301675.47	279440.95	344759.90
	Less: Capital Expenditure inclusive of Repayment of loan	301587.26	279347.94	344652.33
	Total Surplus	88.21	93.01	107.57

Capital expenditure of water supply sector will be used for augmentation of water sources (Stage IV, middle Vaitarna project), replacement/ rehabilitation of old pipelines and universal metering.

Table 3.12: Main Capital Expenditure of Water Supply in 2010 – 2011 Budget

Thrust Areas	Activities	Amount (Rs. crore)
Augmentation of Water Sources	Mumbai IIIA Water Supply Project	48.25
	Mumbai IV Middle Vaitarna Water Supply Project	549.55
	Mumbai IV Middle Vaitarna Water Supply Project (Tunnel)	415.00
	Sub-total	**1012.80**
Expansion and Strengthening of Water Delivery System	Expansion of Distribution Network	130.00
	Reconstruction of Reservoir	30.00
	Rehabilitation of Old Water Mains	380.00
	Replacement & Rehabilitation of Old Pipelines	107.62
	Sub-total	**647.62**
Reduction non-revenue Water	Sujal Mumbai Abhiyan, WDIP	132.21
Effective Demand Management Measures	Universal Meters & Flow Metering	**430.00**
Rain Water Harvesting		66.00
Strengthening of Leak Detection Section		10.50
Cleanliness of Existing Wells and Providing Tube Wells		72.00

Table 3.13: Capital Expenditure of Sewerage in 2010 – 2011 Budget

Thrust Areas	Activities	Amount (Rs. crore)
Expansion of sewerage network	Under the Component-I of the MSDP (Stage-II, Priority Works), approved under the JNNURM	88.00
	Consultancy Services for M.S.D.P. Stage-II Works MSDP	95.00
Rehabilitation and Replacement of old sewer lines and pumping stations	Replacement and Rehabilitation of sewer lines	51.00
Upgradation of sewage pumping stations for qualitative and quantitative improvements	Mechanical & Electrical Works at Sewage Pumping Stations (Dy Ch.E (M&E) S.P.)	0.96
Efficient use of energy with a view to reducing operating costs and responding to the threat of global warming	Energy Audit	0.69
Construction/repair and rehabilitation of public toilets and sanitary system in slum settlements	Slum Sanitation Program & Retrofitting of Existing Slum Toilets	25.00

Thrust Areas	Activities	Amount (Rs. crore)
Contributing to enhancement of the aesthetic appeal of Mumbai		29.00
Welfare measures for the staff involved in sewage operations		0.50

3.2.10 Organizational Structure

The mayor's role is symbolic and the mayor is assigned by mutual election of a member of a city council. MCGM headed by Municipal Commissioner is carrying out city activities. The Municipal Commissioner is supported by 4-Additional Municipal Commissioners, 19-Deputy Municipal Commissioners and 28-Assistant Commissioners. The Municipal Commissioner and Additional Municipal Commissioners are appointed by Government of Maharashtra. Deputy Municipal Commissioners are appointed by Corporation with the approval of Government of Maharashtra. Assistant Commissioners are administrative heads of wards and appointed by Corporation on recommendation of Maharashtra Public Services. MCGM has 44 Head of Departments.

The administrative structure of MCGM along with the assigned responsibility of key personnel is shown in Figure 3.6.

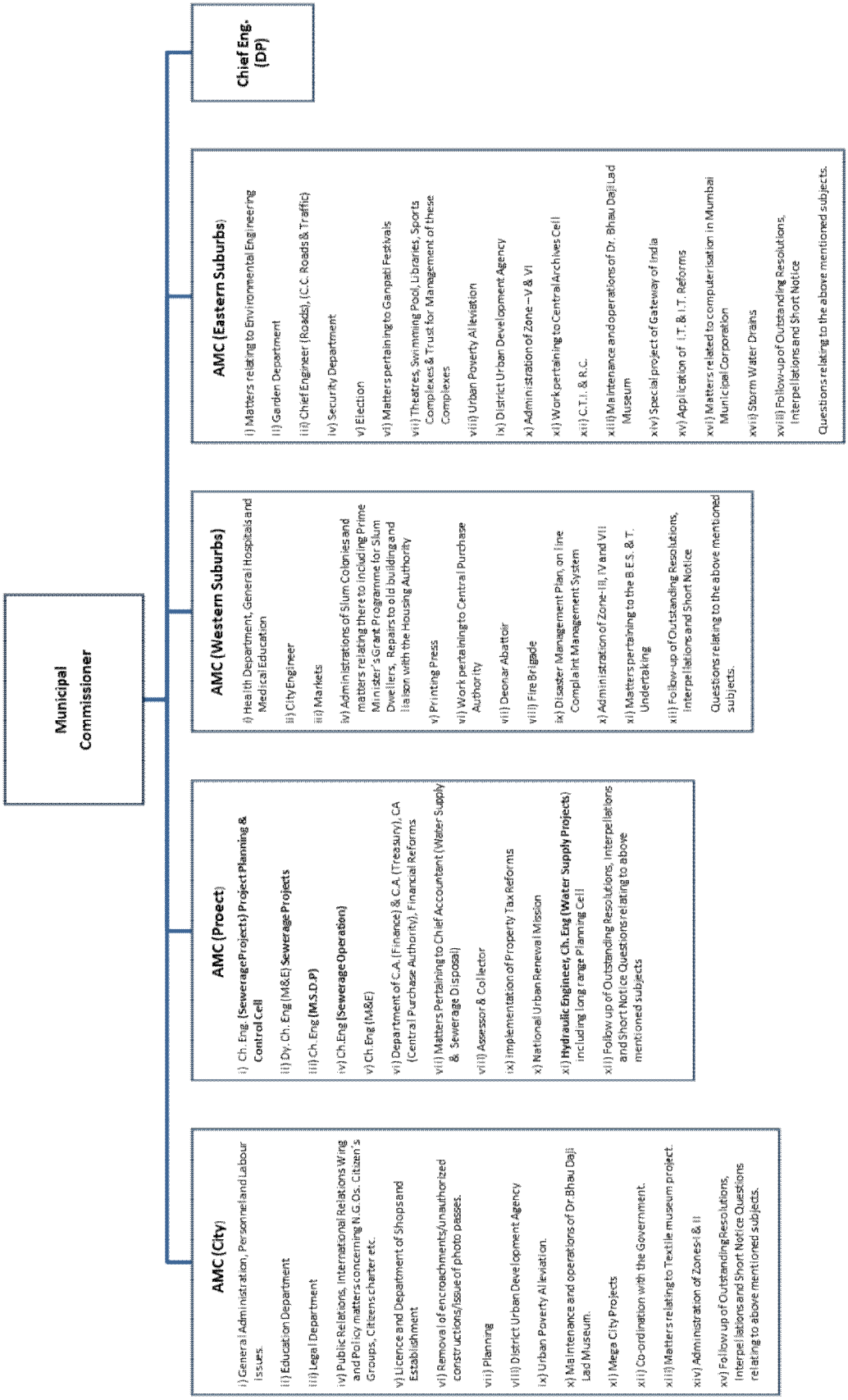


Figure 3.6: Administrative Structure and Responsibility of Key Personnel in BMC

Water Supply and Sewerage Departments

There are five departments dealing with water and sewerage services as shown below. These departments are grouped together under a budget heading 'Budget G' and have a separate accounting section headed by a Chief Accountant.

1. Water Supply (Projects)
2. Water Supply (Hydraulic Engineering)
3. Sewerage (Operation)
4. Sewerage (Project), and
5. Sewerage (Mumbai Sewage Disposal Project)

Responsibility of these departments is shown below.

Water Supply (Projects Department)

- To conceptualize, plan, design, estimate & implement projects for augmentation of water supply in Mumbai.
- To implement projects with a view to improve water distribution system and phse out old watre mains of Mumbai such as construction of underground tunnels.

Water Supply (Hydraulic Engineering Department)

- Distribution of potable water to Mumbai City for population of 1,26,90,000, and
- Operation and maintenance of dams, pumping stations, treatment plants, service reservoirs and distribution network.

The number of staff in these departments is given in Table 3.14 and their organizational structures for Projects and Hydraulic Engineering Departments are shown in Figure 3.7 and Figure 3.8, respectively. The staff strength and organizational structure for sewerage is given in the next section of this report dealing with sewerage.

Table 3.14: Staff Strengths of Water Supply Departments

Post	Water Supply (Projects Dept.)	Water Supply (Hydraulic Engineering Dept.)
Chief Engineer	01	-
Hydraulic Engineer	-	1
Dy. Chief Engineers	09	-
Dy. Hydraulic Engineers	-	11
Executive Engineers	18	31
Assistant Engineers	43	129
Sub Engineers	71	426
Junior Engineers	21	432
Administrative and Labour Staff	130	11,037

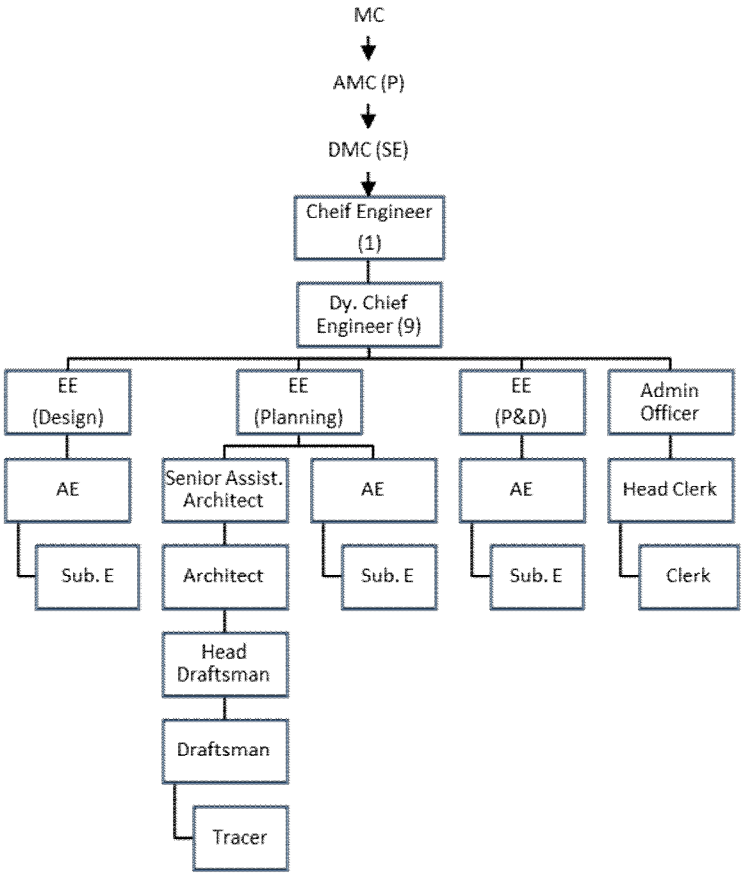


Figure 3.7: Organizational Chart of Water Supply (Project Department)

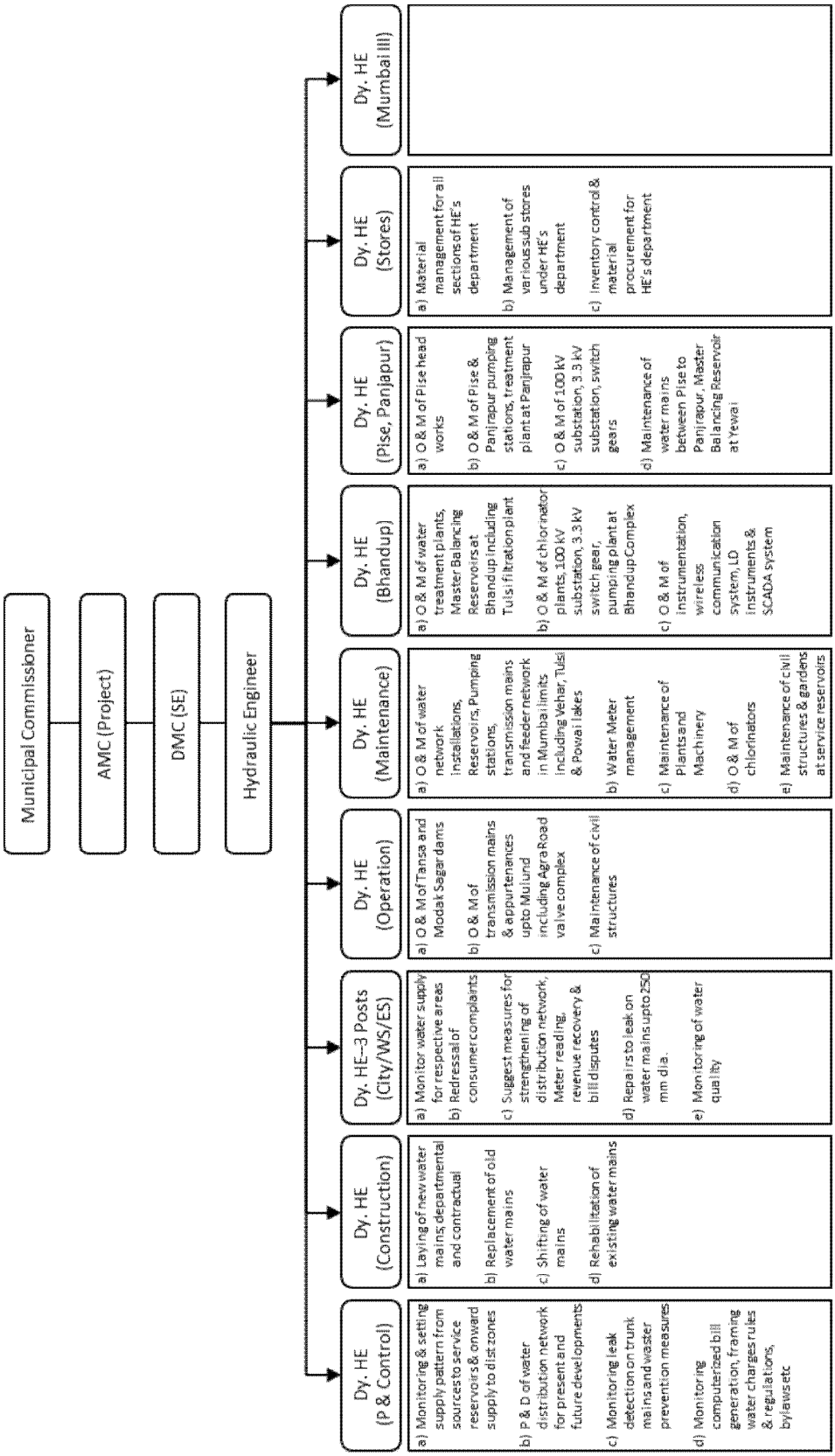


Figure 3.8: Organizational Chart of Water Supply (Hydraulic Engineering Department)

3.2.11 Scope for Challenge

On contrary to upstream facilities from water source to WTP, downstream facilities need to improve. The followings Water Distribution Management & NRW/ Reduction are the main fields to be improved:

- Digital mapping of the utility on GIS compatible base maps.
- Hydraulic modeling of the entire network.
- Hydraulic model of DMA, each comprising about 1000 connections.
- 100% Consumer metering, Bulk metering and District Metering set-up.
- Water balance and estimation of NRW/ UFW.
- Leakage detection, Repairs/ Rehabilitation/ Replacement plan.
- Water balance, if NRW within limits, implement 24×7 supply.
- Introduce pressure regulating devices for equitable distribution.
- Introduce/ upgrade Distribution management tool SCADA.
- Revision of Master Plan

3.3 Sewerage System

3.3.1 Current Sewerage Situation

Mumbai has a two-tier sewerage system. One is the underground sewerage system that discharges about 3.5 km into the sea. The other is the surface system which is present in the suburbs and which discharges directly into the sea right at the sea shore. All non-slum population is provided with basic sanitation facilities and 80 % of them are provided with underground sewerage network whereas only 65 % of the slum population is provided with basic sanitation facilities of toilet blocks and septic tanks.

Though sewerage lines are laid in above zones, due to rapid expansion, development, dense population and non-accessibility etc sewage in some of the parts particularly in extended suburbs and slums is connected to stormwater drains.

The underground drainage pipes of the sewerage system in Mumbai are more than 100 years old. In congested parts, the sewerage lines and water pipelines run together increasing the chance of contamination of drinking water. The problem of sewer lines of small diameters getting choked due to solid waste and silt entering them is rampant. The result is that instead of getting drained, sewage often overflows on to the surface.

3.3.2 Sewage Collection, Conveyance and Treatment System

For proper implementation and management purpose, the area of Greater Mumbai limit is divided into seven sewerage zones as summarized in the following Table and Figure. Each zone operates independently, and each zone consists of a sewerage collection, conveyance

system, pumping stations, rising mains, treatment facilities and disposal facilities. Sewage is collected in sewer lines through gravity and conveyed to satellite pumping stations. From here it is pumped to the main sewage pumping station (SPS). The SPS sends untreated sewage to the sewage treatment plant of a zone for treatment and final disposal. The population served by the network has grown eleven-fold in the past 100 years and has tripled since 1961.

Table 3.15: Sewerage Zones in Greater Mumbai and Population Served

No.	Zone	Population (million)	Area (ha)	Sewer (km)	Pump Station (no.)
1	Colaba	0.2	574	32	6
2	Worli	2.0	3,891	339	16
3	Bandra	3.4	7,730	326	16
4	Versova	0.95	2,140	146	2
5	Malad	2.85	11,500	300	6
6	Bhandup	1.2	4,274	105	3
7	Ghatkopar	2.0	7,730	136	3
	Total	12.6	37,839	1,384	52

Note: Area does not cover the reserved area etc.

Figure 3.9: Sewerage Zones in MCGM

Zone 1 – Colaba covers an area of 574 hectares, contains six pumping stations and about 32 km of sewers leading to preliminary treatment and the short pipe outfall to Colaba Harbor.

Zone 2 – Worli covers an area of 3891 ha., contains sixteen pumping stations and about 339 km of sewers leading to preliminary treatment and the new, three-kilometer long sea outfall at Worli, discharging to the Arabian Sea.

Zone 3 – Bandra covers an area of about 7730 ha., has sixteen pumping stations and about 326 km of sewers. Flow from the IPS passes to Bandra preliminary treatment works prior to discharge via the EPS and a 3.5 kilometer long sea outfall to the Arabian Sea.

Zone 4 – Versova covers an area of about 2140 ha. There are only two stations, a final pumping station and one small pumping station at Versova village. The 146 km. of sewers lead to preliminary and three stage aerated lagoon treatment discharging to Malad Creek.

Zone 5 – Malad covers an area of over 11500 ha. There are six pumping stations and about 300 km. of sewers. A final pumping station delivers flows from the interceptor to preliminary treatment, which discharges to Malad Creek.

Zone 6 – Bhandup covers an area of 4274 ha. There are three pumping stations and about 105 km of sewer leading to preliminary and single stage aerated lagoon treatment discharging to Thane Creek.

Zone 7 – Ghatkopar serves an area of about 7730 ha. There are 3 pumping stations and 136 km of sewers leading to preliminary and single stage aerated lagoons treatments discharging to Thane Creek.

Table 3.16: Summary of Sewerage Network

No.	Particulars	Quantity
1	Area of the city	437 sq.km
2	Population of the city	12,000,000
3	Sewered area of the city	60%
4	Unsewered area	40%
5	Percentage of population living in slum	60%
6	Percentage of population served with sewerage facility	40%

(Source: Fact Finding Committee's Report on Mumbai Floor, March 2006)

Table 3.17: Summary of Sewerage System

No.	Particulars	Quantity
1	Length of Sewer Lines	1400 km.
2	No. of Sewage Pumping Station	51 Nos.
3	No. of Wastewater Treatment Facilities	7 Nos.
4	No. of Outfall	3 Nos.
5	No. of Lagoons	3 Nos.
6	No. of Street Connections	2,65,000
7	No. of Manholes	53,000
8	Size of Smallest Sewers	6" dia.
9	Size of Maximum Sewers	6' dia. Circular & 6' × 9'ovoid shape
10	Total sewage handled	1700 MLD

Table 3.18: Current Sewage Generation and Treatment Facilities

No.	Zone	Average Dry Weather Flow (MLD)	Peak Flow (MLD)	Treatment Facility
1	Colaba	37	101	Aerated Grit Chamber and Marine Outfall.
2	Worli	493	981	- do -
3	Bandra	303	591	- do -
4	Versova	325	750	Aerated Grit Chamber and Lagoons
5	Malad	847	1726	To be decided in Phase – II
6	Bhandup	323	693	Aerated Grit Chamber and Lagoons
7	Ghatkopar	506	1048	Aerated Grit Chamber and Lagoons
	Dharavi	425	752	Sewage is collected and diverted to Bandra
	Total	3,259	6,642	

(Source: MCGM)

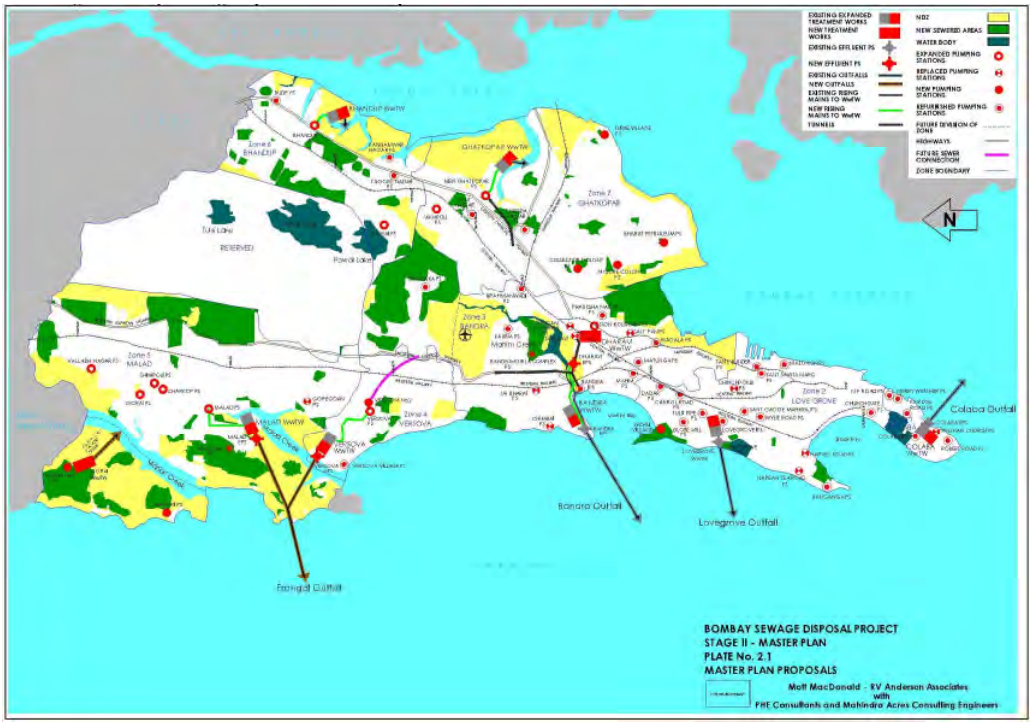


Figure 3.10: MCGM Sewerage Zones and Treatment Facilities

(Source: Mumbai Floods Fact Finding Committee Report, 2006)

3.3.3 Sewerage System Development Plans and Programs

History of Sewerage System Development in Mumbai

In 1960, primary treatment plants were constructed at Khar (currently in zone 3), Versova (zone 4) & Ghatkopar (zone 6). In the year 1962 a High Level Committee was appointed to study the Water Supply Resources and Sewerage. However, a very little progress was achieved mainly due to paucity of funds. In the year 1969, World Bank was approached to finance development of Water Supply & Sewerage System of the City. As a result an integrated project for Water supply and Sewerage was formulated. This was planned and

executed in three phases now known as Mumbai – I, II & III Projects. MCGM implemented Mumbai I, Mumbai II, and Mumbai III during 1975 to 1996. In these projects 123 kms sewer lines were laid, 23 pumping stations, 6 STPs, 1 pipe outfall & 1 aerated lagoon were constructed. These projects were implemented with the help of World Bank. Details of Mumbai I, II and III are described in subsequent paras.

Prior to start of Mumbai-I Project M/s. Binnie & Partners were appointed as Consultants, some time in the year 1970, to prepare feasible Development Plan for the sewerage system. The Consultants submitted their report in 1971 and suggested a complete sewerage system plan consisting of conveyance system, construction of Pumping Stations and Sewage Treatment in the form of secondary treatment at 3 locations. However, since higher priority was given to Water Supply Works it was decided to restrict the sewerage works to laying of some sewers and construction of few pumping stations.

M/s. Metcalf & Eddy Consultants were appointed in the year 1976 to review the proposed sewerage system with special reference to oceanographic surveys, proposed land use and feasibility of reuse of sewage. This was as per World Bank advice. The consultants carried out extensive studies and came out with a revised development plans by 1979, consisting of provision of marine outfalls at Colaba, Love Grove (for zone 2) and Bandra and aerated lagoons at Versova, Malad, Bhandup and Ghatkopar for sewage disposal apart from conveyance system.

Sewerage Master Plan - 1979

In 1979 Consultants Metcalf & Eddy submitted the first Sewerage Master Plan which had the following features.

- Feasibility studies
- Design for the year 2005
- Estimated population 94 lakhs
- Estimated wastewater 2600 MLD including industrial flow of 240 MLD
- Total 437.71 sq.km. Mumbai area divided into seven zones
- For 3 city zones preliminary treatment with marine outfall proposed due to non-availability of land
- For remaining 4 suburban zones preliminary and secondary treatments proposed due to adequate availability of mud flats land at cheap rates.

As stated above, these recommendations were accepted & implemented under Mumbai – I, II, III & MSDP - I with the assistance of World Bank.

MUMBAI – I

First integrated water supply & sewage project was implemented in the 1973-81 at a cost of Rs. 2162 Millions. B & P Partners were consultants for WSP and Metcalf & Eddy Inc. (USA) with EEC (India) for Sewerage Project. In this project, additional 455 MLD water from Bhatsa were brought in the City and six sewage pumping Stations were constructed.

MUMBAI – II

Second integrated water supply & sewage project was implemented in the year 1979-88 at a cost of Rs. 7400 millions. B & P Partners were Consultants for WSP and ES-AIC-PHE for SP for detailed Engineering & design. Additional 455 MLD water from Bhatsa was brought in the City & seven IPS & STPs, 14 satellite pumping stations, 7 km length of collector tunnel & EPS, one marine outfall and 89 km of sewer were constructed.

MUMBAI - III

Third integrated water supply & sewage project was implemented in the year 1987-96 at a cost of Rs. 6130 million. M/s. TCE were consultants for WSP & B&P for SP for detailed design & construction supervision. Additional 455 MLD water was brought from Bhatsa in the City and 3 satellite pumping stations and 54 km of sewer was constructed. Uncompleted and remaining works of Mumbai – II were funded by M.M.R.D.A. (Mumbai Metropolitan Region Development Authority) with the financial support of Rs. 162 crores.

Mumbai Sewage Disposal Project

In August 1990 MCGM reviewed the progress of Mumbai – II & Mumbai – III Sewerage Project works and observed that supplemental financing would be desirable to complete the ongoing works. Therefore, MCGM approached to the World Bank, who indicated that following works could be considered for the further funding under as **Mumbai Sewage Disposal Project.**

- Outfalls at Worli & Bandra
- Aerated Lagoons at Ghatkopar & Bhandup
- Remedial works for the existing pumping stations and conveyance system
- Operation and maintenance, topo-survey, condition assessment survey and consultancy for the same
- Bandra – Ghatkopar Tunnel
- Slum Sanitation Project
- Master Plan for MSDP-II
- Rehabilitation of sewer lines.

As a pre-requisite to the Pre-appraisal Mission & funding agency, it was necessary to undertake a detailed Environmental Impact Assessment Study. The Study was carried out by Environmental Engineering Research Institute (NEERI). The study indicated that MCGM has to come out and prepare for further projects to bring the pollution levels in and around Mumbai to the acceptable limits of Government of India/International Standards.

Mumbai Sewage Disposal Project – I

The MCGM had approached to the World Bank for completing incomplete works of Mumbai II & III and some additional works after EMS Study and finalization of report. The World Bank had sanctioned loan, credit, aid amounting to U.S. $295 Millions in July, 1995. The project was executed during the period of July 1995 to December 2003. All major works of MSDP-I were satisfactorily completed except construction of certain community toilet blocks in slum area of Mumbai. The major works completed under MSDP-I are as listed below.

- Worli Outfall
- Bandra Collector Tunnel
- Bandra Outfall
- Bandra Pumping Station
- Bhandup lagoon
- Ghatkopar High Level Tunnel
- Ghatkopar lagoons
- Missing links reestablished by micro-tunneling method & some Conveyance System
- Rehabilitation of old sewer lines – 22.5 km
- More than 300 toilet blocks constructed
- Master Plan for 2nd stage studies prepared
- Consultancy services for Condition Assessment
- O& M study
- Topo survey.

The MSDP Stage-I works increased the capacity of the existing infrastructure and provided a much improved means of the safe disposal of sewage by means of the long sea outfalls at Worli and Bandra and the aerated lagoons at Ghatkopar and Bhandup.

3.3.4 Mumbai Sewage Disposal Project Stage-II

The need of Stage-II Master Plan for Sewerage was anticipated to further improve environment in and around Mumbai and to cater to the needs of ever growing population. Accordingly, Stage-II Feasibility Studies for the Sewerage System of Mumbai was carried out and Master Plan for MSDP Stage-II (target year 2025) was prepared for improvement in

sewerage system. MCGM appointed M/s Mott MacDonald / R.V. Andersons Associates Ltd. (Mott/RVA) to carry out MSDP Sewerage Stage-II Feasibility Studies in September 1999.

The master plan included the development of demographic forecasts and the construction of a hydraulic model for each of the seven zones. A range of options for collection, transfer, treatment and discharge wastewater flows was developed to allow the optimum solution to be selected. Treatment processes were optimised for local conditions, including climate, land take and environmental impact.

The plan also involved preparation of preliminary designs for the major elements of the project, including 58 km of new sewers, 106 km of upsized sewers, replacement or refurbishment of over 60 pumping stations, seven new or extended sewage treatment works with a total capacity of 2,600 MLD dry weather flow, and a 3.6 m diameter outfall. An extensive slum sanitation program formed an important part of the master plan proposals. The project included the screening of options using an initial environmental examination and the preparation of a preliminary environmental impact assessment for the preferred options.

The overall capital program was divided into 5 five-year phases, with a total construction cost of Rs. 5,570.4 crores. In addition to advising on operations and maintenance requirements, the master plan also included a financial model to ensure affordability and advice on the options for private sector participation.

Implementation of this Master Plan is expected to increase the coverage of the sewer system to include all parts of the city, provide a new outfall to serve the western suburbs and upgrade all seven wastewater treatment facilities to the highest standards. Structure and components of the MSDP Stage-II Master Plan is shown in the following Figure 3.11.

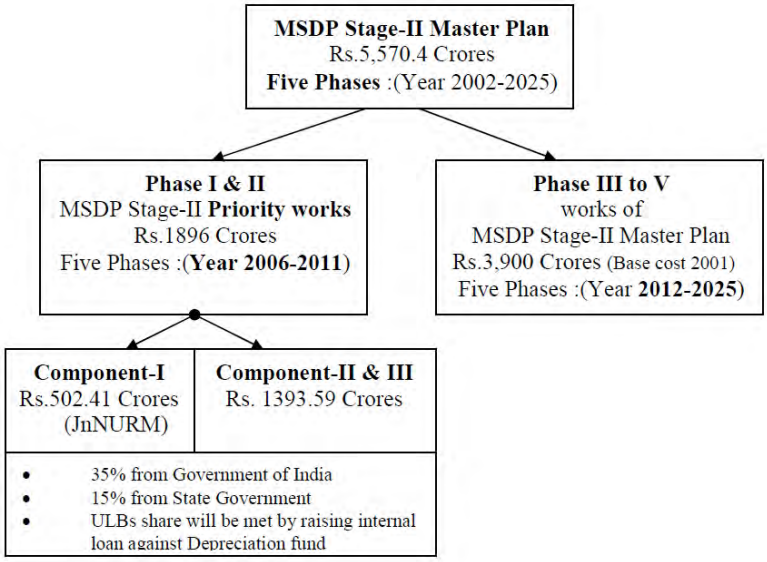


Figure 3.11: Structure and Components of MSDP Stage-II Master Plan

Components and original cost of the MSDP Stage-II are given in Table 3.19.

Table 3.19: Main Components and Cost of MSDP Stage – II

No.	Components	Quantum of Work	Cost (in Rs. crore)
1	Slum sanitation	3241ha	1,625.2
2	New Trunk Sewers	58 km	60.0
3	Upsized Trunk Sewers	106 km	382.4
4	Sewer Rehabilitation	363 km	1,167.4
5	Illegal Connections		7.3
6	Area Sewers	3628 ha	476.4
7	Pumping Stations	51 No	547.6
8	Transfer Schemes	4 No	246.5
9	Treatment Works	9 No	815.3
10	Outfall	1 No	242.3
	Total		5,570.4

Summary of phasewise breakdown of the components and cost of MSDP Stage-II works are given in Table 3.20. Further details of works and phasing are given in Appendix 4.

Table 3.20: Phasewise Components and Cost of MSDP Stage - II

(Cost in Rs. Millions)

Item	Phase 1 2002-05	Phase 2 2006-10	Phase 3 2011-15	Phase 4 2016-20	Phase 5 2021-25	Total
Slum sanitation	18.6	4058.5	4058.5	4058.5	4058.5	16252.5
Upsizing of sewers	564.0	1436.7	1144.1	668.9	9.8	3823.6
New sewers	98.8	97.0	150.2	101.3	152.9	600.2
Rehab of sewers						
Survey	252.9	286.4	0.0	0.0	0.0	539.3

Item	Phase 1 2002-05	Phase 2 2006-10	Phase 3 2011-15	Phase 4 2016-20	Phase 5 2021-25	Total
Sewers	0.0	1798.2	3100.4	3100.4	3100.4	11099.3
Manholes	17.6	17.6	0.0	0.0	0.0	35.3
Area sewers	1664.1	760.7	591.2	1147.3	600.5	4763.9
Pumping stations	487.2	740.8	1493.5	661.3	1532.4	4915.3
Pumping mains	160.5	114.5	243.4	16.7	25.4	560.5
Illegal connections	22.2	36.6	14.4	0.0	0.0	73.1
Outfall	121.2	2302.2	0.0	0.0	0.0	2423.3
Transfer	0.0	152.2	0.0	1307.7	1005.3	2465.2
Sewage treatment plant	0.0	311.4	5741.7	144.3	1955.1	8152.5
Total	3407.1	12112.7	16537.4	11206.5	12440.4	55704.0
Total (In Rs. crores)	340.71	1211.27	1653.74	1120.65	1244.04	5570.4

(Source: 2006 Mumbai Flood Fact Finding Committee Report)

MSDP Stage –II Priority Works

The works identified under Phase - I and II are priority works (Table 3.21). The priority works aimed at providing disposal facility in each zone. They also planned to provide extra capacity in collection, conveyance, pumping and treatment. The cost of these works is Rs. 23,760 millions, out of which Rs. 18,960.00 millions is for sewerage and Rs. 4,800 millions is for SSP. These works were originally scheduled for completion in 2011. The proposed works are carrying out for Malad and Versova.

Table 3.21: Components of Stage – II Priority Works

No.	Proposed Works	Quantum	Cost (Rs. in Million)
1	New sewers	25 km.	195.8
2	Upsizing sewers	60 km.	2,000.7
3	Sewer rehabilitation	75 km.	2,372.7
4	Area sewers	1344 Ha.	2,424.8
5	Pumping Station	17 Nos.	2,122.3
6	Outfall	3.4 km.	2,423.4
7	Treatment works		374.6
8	Others		519.5
9	Contingencies		6,530.00
10	Slum Sanitation Program		4,800.00
		Total	23,760.00

Figure 3.12 shows new sewer lines required in Malad (Zone 5).

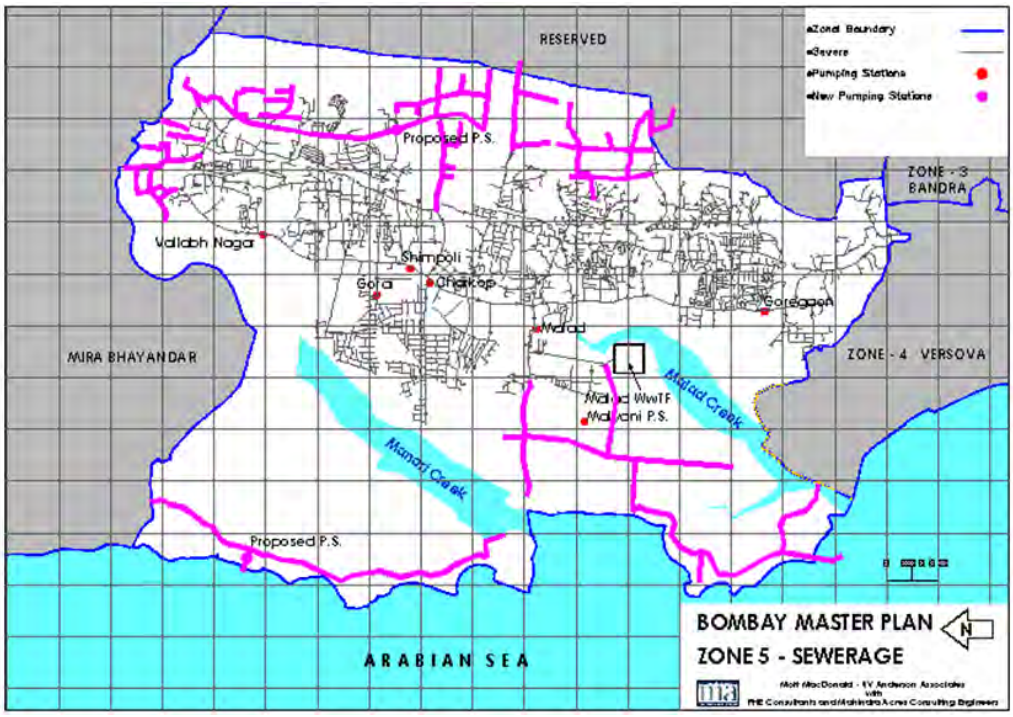


Figure 3.12: Stage-II New Sewers in Zone 5 (Malad)

Similarly the sewer lines requiring upsizing in this zone are shown in Figure 3.13.

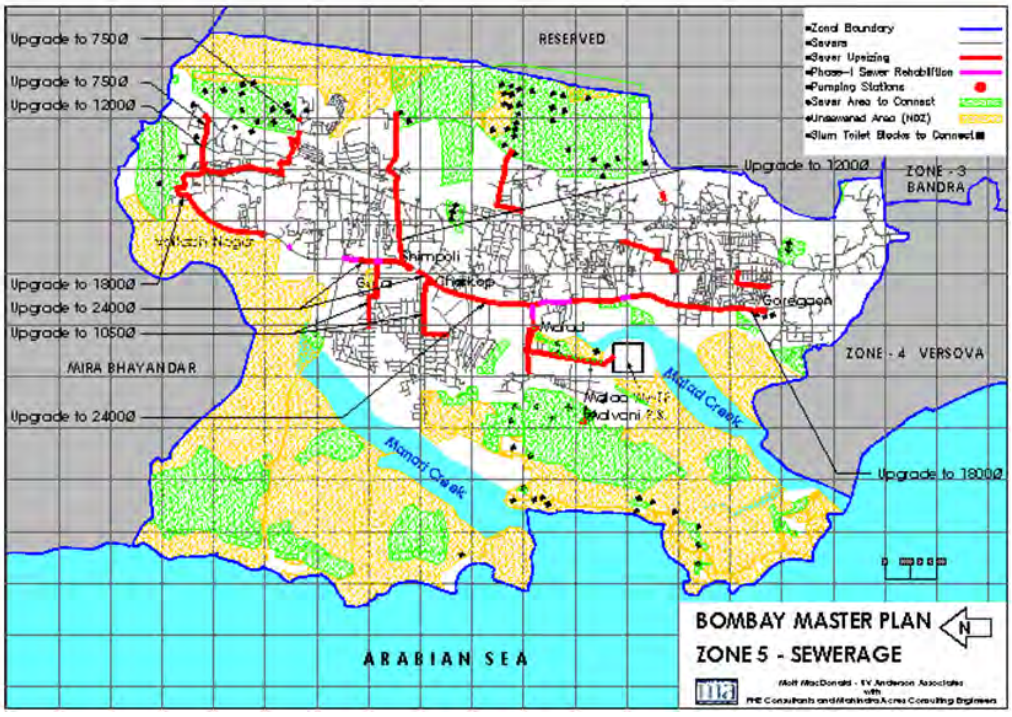


Figure 3.13: Stage-II Sewer Upsizing works in Zone 5 (Malad)

An integral part of the MSDP-I/ MSDP-II works is the Slum Sanitation Program (SSP). There are 6.9 Million slum dwellers in Mumbai constituting more than half of City's population.

Prior to the implementation of SSP the slums had near absence of sewerage system, were not connected to sewers and the sewage from the slums used to flow to stormwater drainage system.

The SSP has the following features:

- Sanitation facility explicitly for poorer segment
- Based on the principles of community Driven demand
- Treats slum dwellers as initiators, collaborators & resources to build on
- Demand-driven and participatory approach
- Sustainable investments by community members
- Survey of sanitation facilities in slums of Mumbai.

3.3.5 Funding and Implementation Status

MCGM prepared and posed the Component -I DPR amounting to Rs. 502.41 crores for JNNURM funding. After the technical approval by CPHEEO, the Central Sanctioning & Monitoring Committee approved the same on September 2006 for the cost of Rs. 364.47 crores. The works under this component are scheduled to be completed by March 2012.

MCGM has appointed Consultants for the Detailed Engineering Designs & Project Management of the Component II and III works. These works are ongoing and scheduled to be completed by Dec. 2015, although they were originally scheduled for completion in 2011.

MCGM is adopting 'area by area' approach in implementing Phase III to V works. The area-wise priority is as follows: 1) Colaba, 2) Bhandup and Ghatkopar, 3) Versova, 4) Malad, and 5) Worli. MCGM is also considering dividing works in Bhandup and Ghatkopar in two steps, implementing 2/3rd in the beginning and the rest at a later step.

MCGM has started implementation of Phase III works. The original cost which was based on 2001 price is being revised for Phase III to V. In the meantime, the cost revision was also required due to MCGM's plan to accommodate water supply upto year 2031. In addition, the STPs need to conform to the new MPCB guideline. The revised cost is not final but is estimated at about 20,000 to 25,000 crores. MCGM intends to complete all these projects by 2017.

Progress of Sewage Treatment Plants

As of end of January 2012 pre-qualification of contractors for the Cobala plant under BOT scheme has been completed. RFP will soon follow. For other two STPs; Ghatkopar and Bhandup, call for PQ has been published.

3.3.6 Organization Set-up for Sewerage System

AMC (Projects) is In-charge of Sewerage. As explained earlier in MCGM's Water Supply section of this report, the sewerage has three departments with defined responsibilities as shown in Figure 3.14.

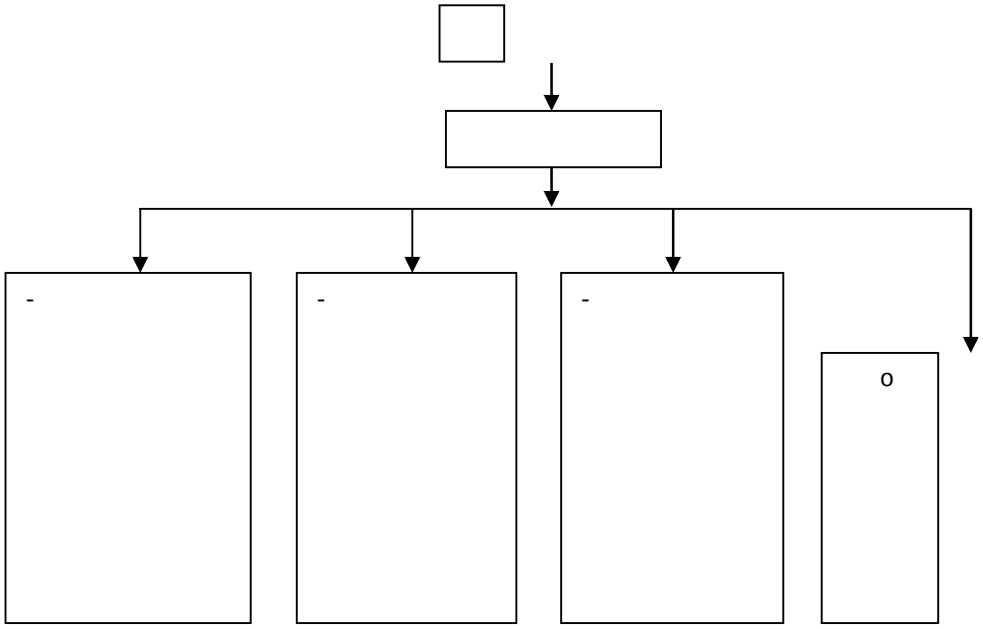


Figure 3.14: Organization and Responsibility Area of Different Sewerage Departments

Staff strengths of these three departments are shown in Table 3.22.

Table 3.22: Staff Strength of Sewerage Departments

Post	Sewerage (Projects Dept.)	Sewerage (Operation Dept.)	Sewerage (MSDP Dept.)*
Chief Engineer	1	1	1
Dy. Chief Engineers	2	5	3
Executive Engineers	5	17	12
Assistant Engineers	18	42	20
Sub engineers	62	98	38
Junior Engineers	-	62	2
Administrative Staff	9	NA**	48
Total	97		124

Note:
* Compiled from the organization chart obtained on 27th January 2012 from BMC
** Exact figure could not be obtained, approximate number is about 150

The Sewerage (Project) is further divided into P&D (planning and design) and Construction.

The section headed by the Deputy Chief Engineer (M&E) S.P. has the staff strength as shown

below.

Dy. Ch. Eng. (M&E) SP:	1 No.
Executive Engineers:	3 Nos.
Assistant Engineers:	6 Nos.
Sub Engineers:	2 Nos.
Administrative Staff:	17 Nos.

The accounting section for Water Supply and Sewerage (Budget G) has a total strength of 625 staff and is headed by the Chief Accountant (Water Supply and Sewerage).

Organization structures of these departments are presented in the following figures.

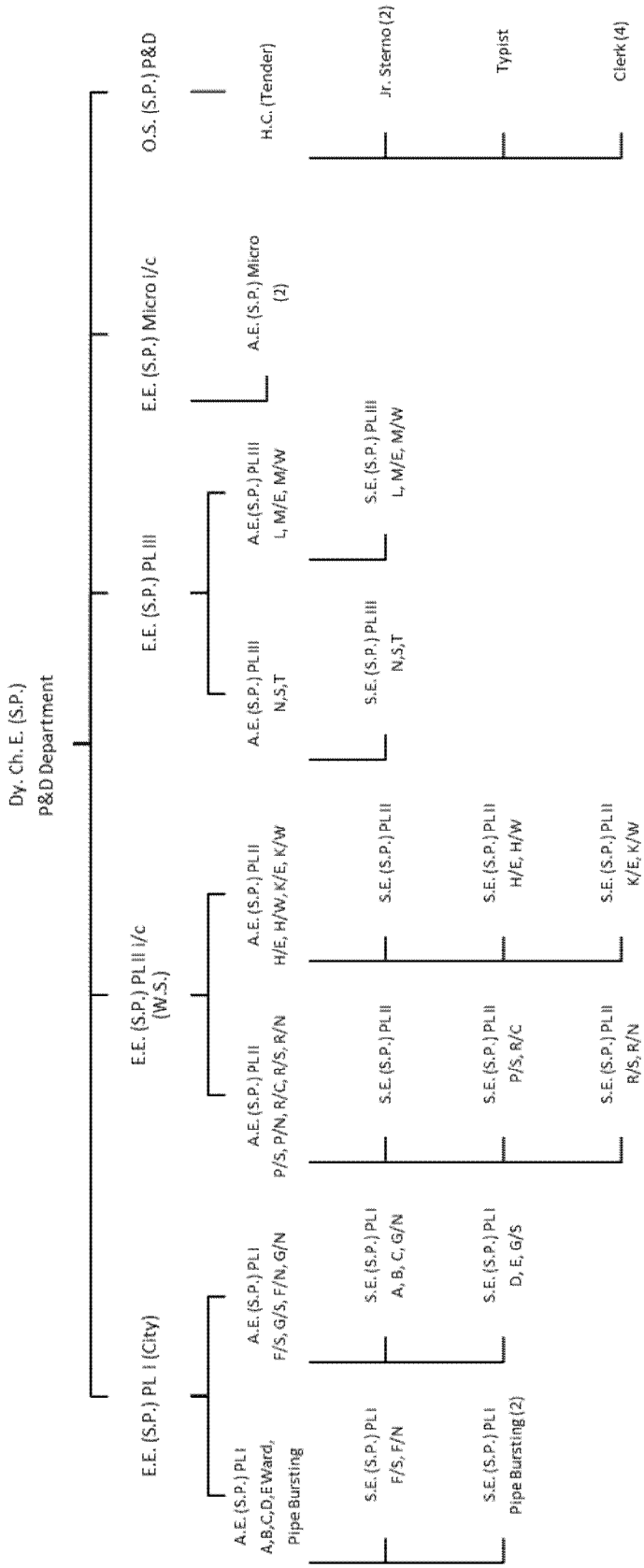


Figure 3.15: Organizational Structure of the Sewerage (Project) (P&D)

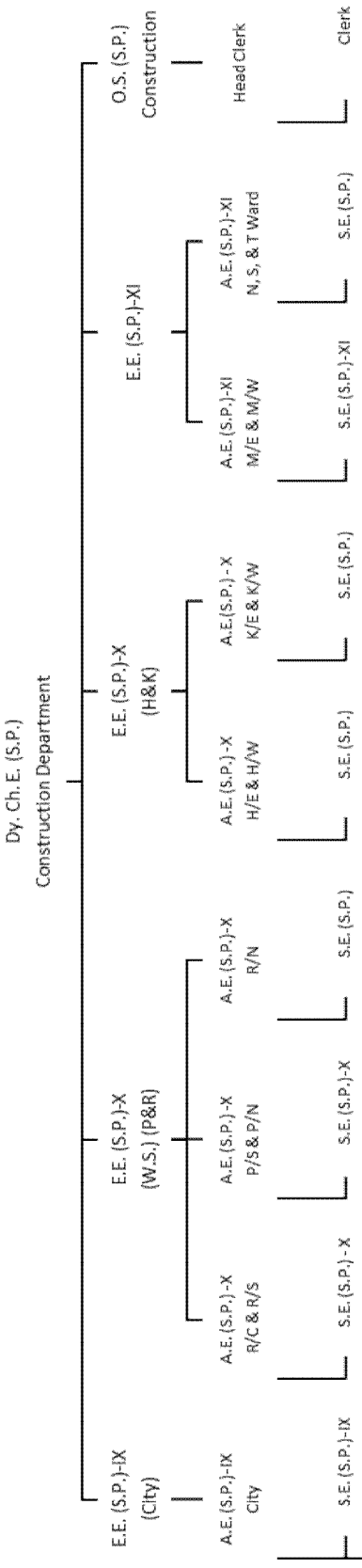


Figure 3.16: Organizational Structure of the Sewerage (Project) (Construction)

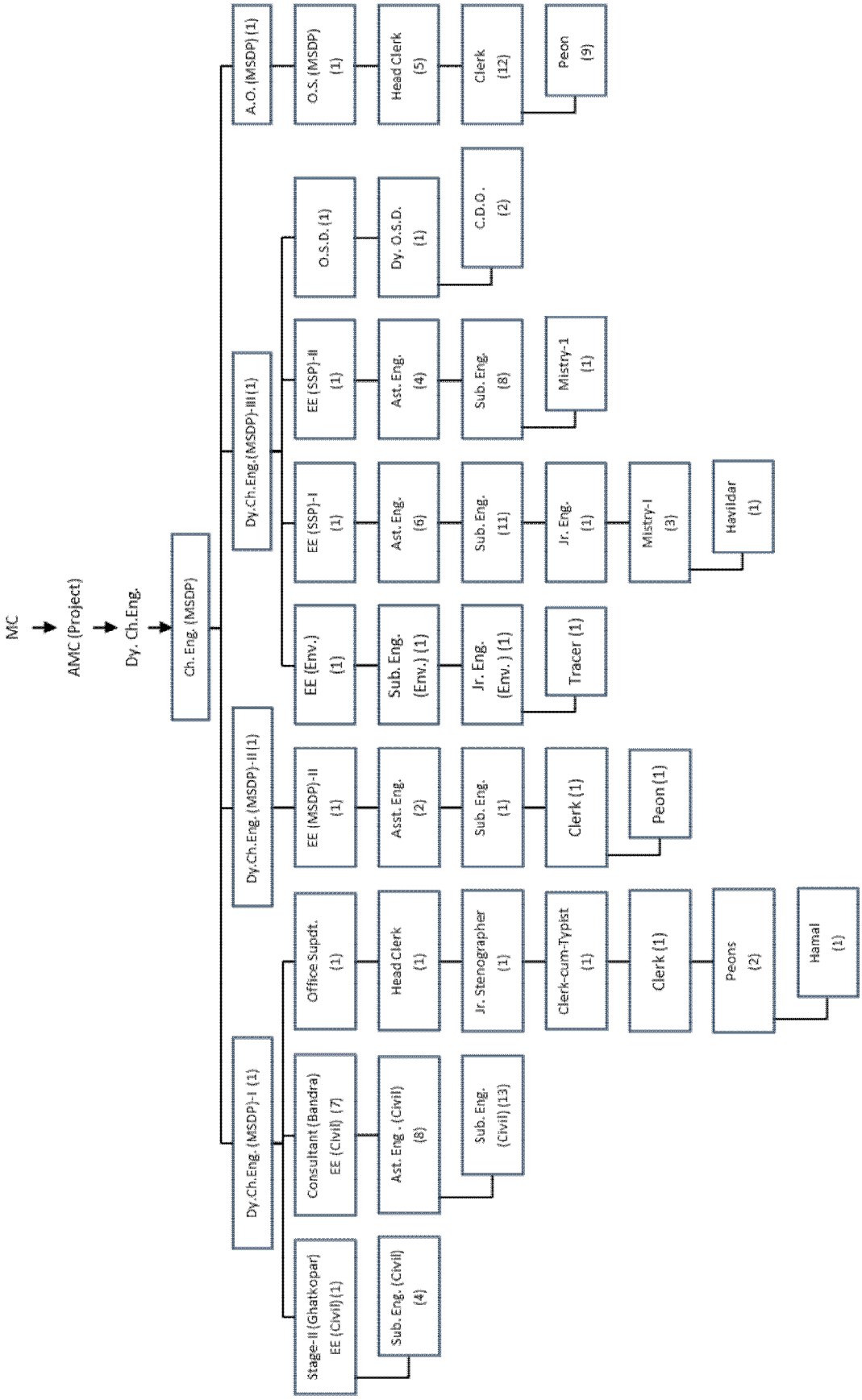


Figure 3.17: Organizational Structure of MSDP Department

Restructuring of Water and Sewerage Departments

A recent newspaper article (The Times of India, January 30, 2012) mentions that the Chief Minister of the State (Maharashtra) has decided to take out the departments related to water supply and sewerage from the BMC and form an entity like Delhi Jal Board which will come directly under the Chief Minister. Citing the BMC sources, the paper also mentions that to execute the plan, a consultant (London based consultant Deloitte) has been recently appointed by the BMC. Its interim report is expected within two months and the full report in the next six months.

3.3.7 Scope of JICA's Assistance

As discussed in above sections, master plan and DPR have already been prepared and consultants are already in place. As such, MCGM won't need any technical assistance from JICA. Regarding funding MCGM intends to implement most of the components as BOT and will be requiring substantial funding. MCGM expects to get a part of this fund from the Government of India, some from the state government and provide some from its own internal resources. However, considering the huge amount it will require, MCGM has shown interest to JICA's ODA loan for implementation of Phase III to V works.

3.4 Stormwater Drainage System

3.4.1 Present System

Mumbai receives average annual rainfall of 2400 mm, with 35-40% of the annual rainfall occurring just in 2-3 events (Report from SWD, Mumbai). Its drainage system has been divided into 121 catchment areas. The storm water is drained through open Nallas, road side drains, and closed pipe drains consisting of about 1245 km. Of this closed pipe drainage is 528 km. The drain water is discharged in to Arabian sea (136 outfalls), Mahim Creek (36 outfalls), and Thane Creek (14 outfalls). Of these outfalls, 45 numbers are below mean sea level, 135 numbers above M.S.L. but below High Tide Level (H.T.L.). Only the remaining 6 numbers are above H.T.L.

Flooding occurs when heavy rainfall coincides with high tide because the gates are closed then to prevent ingress of sea water. Average flood depth ranges from 0.5 to 1.5 m in low lying areas. There are 67 major flooding areas identified and mapped on a basemap. The main reasons for flooding are as follows:

City	Suburbs
• Low ground levels • Outfalls below low tide levels • Absence of holding ponds • Increase in Run off coefficient (From 0.5 to 1.0 due to concretisation) • Dilapidated drains • Siltation of drains/ Nallas • Obstructions by utilities	• Low ground levels • Encroachment along Nallas/outfalls • Garbage dumping in S.W. drains. • Siltation of drains/ Nallas and no access for desilting • Obstructions by utilities

The prepared GIS base map contains the following features:

- Road network,
- Land marks,
- Parks & gardens,
- Water bodies, Nallas including retaining wall and river systems,
- Attribute information of the land feature, and
- Contour lines at interval of 0.2 m.

Due to contractual/copyright issues this base map seems to be not available for use to other sections of the MCGM.

3.4.2 Master Plan

A master plan for augmentation of the SWD system, popularly known as the BRIMSTOWAD Report was prepared in 1993 to minimise the problem of flooding. The Report had identified 58 priority works and recommended preparation of a GIS base map. The priority works identified included:

- Rehabilitation and augmentation of underground drains
- Construction of new drains
- Training of Nallahs
- Widening and deepening of Nallahs, and
- Construction of storm water pumping stations.

3.4.3 On-going Projects

Works

In 26 July 2005, coincidence of very heavy rainfall (of up to 136 mm/hr) and high tide level (of up to 4.48 m) resulted into massive flooding of Mumbai. In accordance with the recommendations of the Fact Finding Committee (under the Chairmanship of Shri Madhavrao Chitale) appointed by the Government of Maharashtra after this flood, and the BRIMSTOWAD Report, the following measures are being taken by the MCGM:

- 146 low lying areas identified and 186 dewatering pumps installed during monsoon,
- Augmentation of capacity of drains to cater to 50 mm/hr of rainfall with a runoff coefficient of 1.0 in place of 25mm /hr with a runoff coefficient of 0.5, i.e. the system is being augmented four times,
- Since 2006, the SWD system is being cleaned/desilted to the bottom-most level,
- Thirty-five automated rain gauges have been installed at 28 locations,
- Widening, deepening and training of major Nallahs,
- Widening and deepening of Mithi and other rivers,
- Rehabilitation of old arch/box drains, particularly in the Island City, and
- Construction of 8 major storm water pumping stations. Two stations already completed eliminating 9 flooding spots, 2 planned for completion in May 2012 and 4 stations planned for completion in May 2013. After completion of the latter 6 stations 33 more flooding spots will be eliminated.

For implementation, the 58 priority works identified by the BRIMSTOWAD report were divided into two phases. Implementation status of these works is shown in Table 3.23.

Table 3.23: On-going Project of the 58 priority works

Details	Phase I	Phase II
No. of Works	20	38
Works completed	12	2
Works in progress	8	26
Works to be reviewed after preparation of Master Plan	0	1
Tenders under process for invitation	0	9
Total	20	38

Total No. of Works = 58 Nos.

Estimated cost of these works is shown in Table 3.24.

Table 3.24: On-going Project of Estimated cost

No.	Name of the work	Cost as appraised and approved as per DPR	Additional Cost	Estimated cost at Completion (Rs. in Crores)
1	City Phase I	247.76	452.32	700.08
2	City Phase II	290.19	507.57	797.76
3	West Suburb Phase I	61.24	171.16	232.40
4	West Suburb Phase II	284.07	641.29	925.36
5	East Suburb Phase I	47.55	107.74	155.29
6	East Suburb Phase II	256.38	920.4	1176.78
	Total	**1187.19**	**2800.48**	**3987.67**
		Say 1200.00	**2800.00**	**Say 4000.00**

Budget in 2011 - 2012

Budget for stormwater in 2011 – 2012 is Rs. 1328.78 crores, consisting of capital budget of 1059.82 and revenue budget of 268.96. Capital expenditure is shown in Table 3.25.

Table 3.25: Capital Expenditure for Stormwater in 2011 -2012 Budget

(Rs. Crores)

Thrust Areas	Activities	Provisions
Upgrading the SWD in Mumbai with a view to minimize water logging and ensure quick dispersal of storm water in the city and suburbs	(i) Construction/reconstruction/improvement/ remodeling /training /widening of Storm Water Drains. - **BRIMSTOWAD Project Works** - Works other than BRIMSTOWAD Project Works.	 **452.90** 507.40
	(ii) Repairs of collapsed walls on nallas and collapsed portions of culverts	2.23
	(iii) Converting pipe culverts into box culverts, remodelling of existing culverts.	5.13
Creating pumping capacity to pump out excess storm water	Setting up of storm water pumping stations (**BRIMSTOWAD Project Works**)	**99.52**
Widening/Desilting and removal of obstructions from major/minor nallas/drains	(i) General civil repairs - S.W.D.	48.00
	(ii) Desilting of arch drains, box drains, dhapa drains, nallas in the City and the Suburbs including payment to Railways and NGOs.	61.00
	(iii) Widening, training and desilting of Mithi river within the jurisdiction of the M.C.G.M. and other rivers/nalla systems in Brihanmumbai as per the recommendations of the **Brimstowad Report**, the Fact Finding Committee, appointed by the State Govt. and the C.W.P. & R.S.	**51.00**
	(iv) Rehabilitation of structures along Nalla/ S.W. Drains	34.96

3.4.4 Scope of Japanese Cooperation

The work for 50 mm rainfall and runoff coefficient of 1.0 is being in progress with an internal source. Therefore, there is no scope for Japanese cooperation.

4. PUNE MUNICIPAL CORPORATION (PMC)

4.1 Introduction

Pune is the second largest city in the state of Maharashtra. It is situated at a height of 560 m above the mean sea level, near the confluence of Mula and Mutha rivers. These rivers originate along the eastern flank of Western Ghats of Maharashtra. Pune Municipal Corporation (PMC) covers an area of 243.84 sq.km and had 3.115 million population in 2001. Boundary of PMC has kept changing due to inclusion/exclusion of adjoining areas several times. The latest such change was due to inclusion of 23 adjoining villages in 1997. Figure 4.1 shows the PMC boundary before and after the expansion. There were 564 slums (214,193 households) with a population of 11.85 lakhs in 2001. Collective population of Pune urban conglomeration (consisting of Pimpri-chnchwad Municipal Corporation and the two cantonments of Khadki and Pune) is over 5 million in 2011.

Table 4.1: Population Growth in Pune City

Year	No of wards	Area of town (sq.km)	Population	Decadal Population Growth rate	Density of population (no/ sq. km)
1971	-	139.79	8,56,015	41.10	6128
1981	-	147.66	12,03,363	40.60	8150
1991	147	166.11	16,91,430	40.60	10183
2001	162	243.96	25,38,473	50.10	10405
2011	-	243.96	3,115,431 (provisional)		

For the last four decades up to 2001, the decadal growth rate in population has been in excess of 40%. It is projected (City Development Plan, 2006) that the population will reach 56.57 lakhs by 2031. The population density will be over 23,000 per square kilometers by 2031. This population is a base for water supply system, but for sewerage plan it is relatively higher; 9,149 thousand in 2041 (6,747 thousand in 2029).

Rapid population growth is being witnessed in the fringe areas of the city and just outside the PMC limits, especially in the southwest direction. Several villages adjoining the PMC boundary like Undiri, Manjiri, Fursungi, Urli, Vavdhan, Mhalunge, Vadgaon-khurd, Balewadi, Baner, Lohgaon, Dhanori, Wagholi, and Pisoli are growing rapidly and they are potential candidates for inclusion in PMC if PMC expands in future. Their total population in 2001 exceeded 110,000.

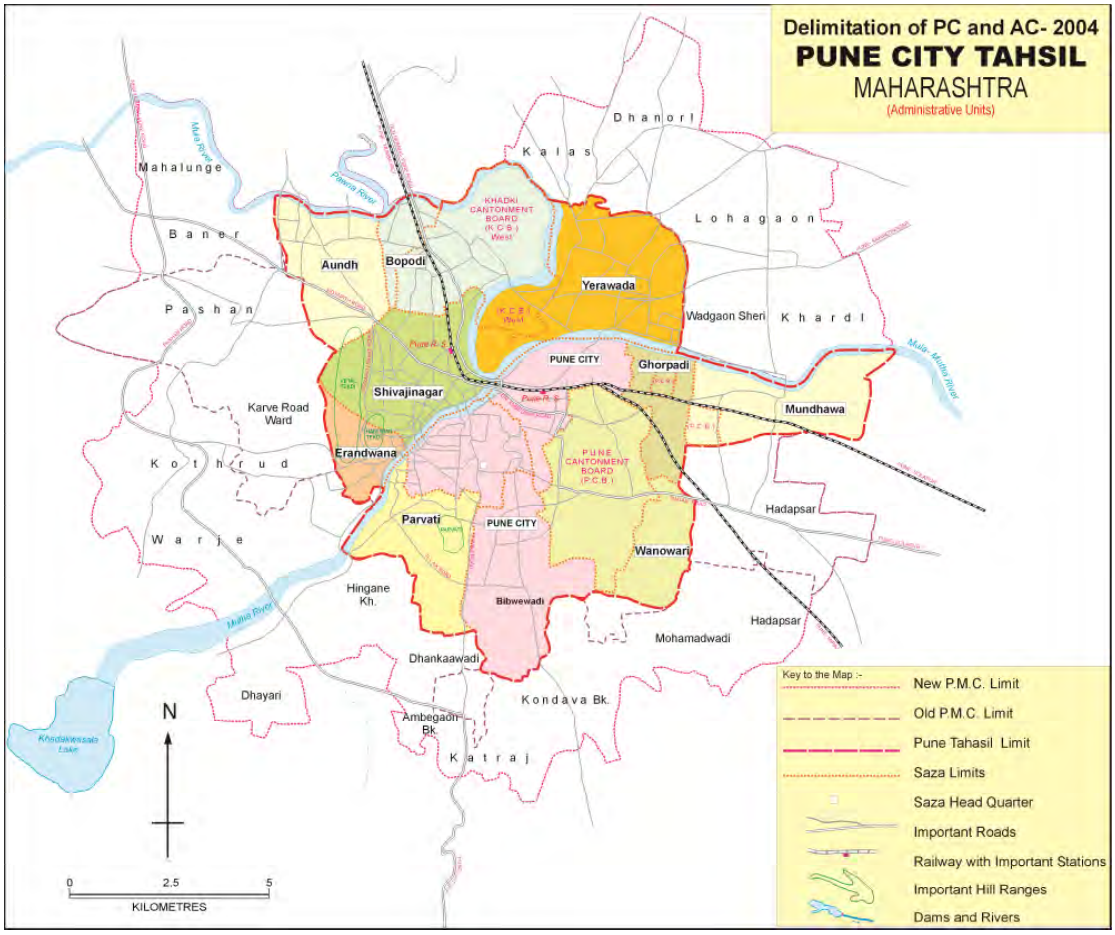


Figure 4.1: Outline Map of Pune Municipal Corporation

4.2 Water Supply System

PMC supplies water to municipal corporation area as well as Pune and Khadaki Cantonment areas. Parameters related to distribution system are summarized in Table 4.2.

Table 4.2: Features of Water Supply System in the Pune City

Particulars	Quantity
No. of distribution zones	47
Total length of pipelines	2400 Km
No. of water treatment plants	7
No. of pumping stations	20
No. of chlorinators	24
No. of (Ground Storage Reservoir) GSR, (Elevated Service Reservoir) ESR	47

(Source: City Sanitation Plan)

4.2.1 Service Levels

The service levels with regard to water supply are shown in Table 4.3.

Table 4.3: Water Service Level Indicators

Performance Indicator	Benchmark	PMC Status
Coverage	100%	94.19%
Per capita supply of water (LPCD)	135	194
Extent of metering	100%	29.71%
Extent of non-revenue water	20%	30.00%
Continuity of water supply	24×7	4 to 6 hrs/day
Quality of water supplied	100%	100%
Efficiency in redressal of customer complaints	80%	98.36%
Cost recovery	100%	70.67%
Efficiency in collection of water charges	90%	90.93%
Staff per 1000 connections		1.94 (Source: WB)

(Source: Adopted from Presentation by PMC in September 2010)

Even though the average daily water supply in the city is 195 LPCD (assuming population of 39 laks inclusive of floating population, water supply of 1,120 mld and 30% loss at distribution and treatment plants), central areas receive water at an average of over 300 LPCD while the fringe and suburban areas get only 50 LPCD.

Water supply is intermittent; typically, twice a day. The duration is on average from 4 to 6 hours a day. But there are many areas in the city which receive 24 hours of water supply. Except for high level areas in the city and in fringe areas, pressures are reasonably high. With regard to water quality, raw water and treated water are tested regularly at the laboratory installed in Parvati Water Works. Samples are collected from the consumer taps. The record shows that while raw water has presence of coliform and E-coli organism of more than 1800 per 100 mL, these are not present in treated water; residual chlorine of 0.4 mg/L to 1 mg/L is seen in all samples.

Coverage

Coverage of water supply is summarized in Table 4.4.

Table 4.4: Water Supply Coverage

Description	Numbers	Percentage
Households served through water connections	937,938	94.19
Total Households without connection	57,793	5.81
Households served through tankers	6,900	0.69
Households in undeclared slums without water connections	24,153	2.43
Households in declared slums without water connections	26,740	2.68

(Source: City Sanitation Plan)

Metering Status

The Table 4.5 summarizes the metering status of the connections.

Table 4.5: Metering Status

Descriptions	Number of Connections	Percentage
Total number of direct service connections and stand posts	122,643	70.29
Total number of metered connections	36,456	29.71
Total number of functional metered connections.	36,020	
Number of metered public stand posts	436	

(Source: City Sanitation Plan)

The domestic connections are unmetered, while the non-domestic connections are provided with meters. By number, the connections are only 21% of the units registered in property tax assessment. This is partly due to the fact that complexes and residential flats/apartment have only single connections, though for property tax assessment they are individually assessed. But this low number of water connections compared to property tax also indicates potentially a huge number of unaccounted/missing connections.

4.2.2 Water Sources and Treatment

The city of Pune draws around 1200 MLD of water from the Khadakwasla Dam, located at about 20 km southwest of the city on Mutha River. It has 374 MCM (million cubic meter) storage capacity and was constructed in 1869. Around 700 MLD of water is drawn through the closed conduit of 3000 mm diameter pipe line while the rest of the water is taken from the open canal. Withdrawal of water from the open canal is planned to shift to the constructed intake facilities at the dam and the constructed pipe line. Three more dams i.e. Panshet, Warasgaon and Temghar have been constructed on the same river, upstream of Khadakwasla. The storage capacity of these 3 dams is 900 MCM whereas the present annual requirement of city is about 200 MCM. The dams are managed by the Irrigation Department, thus PMC needs to pay charges to Irrigation Department for using the water. PMC treats and supplies the water. There are seven water treatment plants with installed capacity of 1135 MLD as shown in Table 4.6 below. Figure 4.2 is shown to indicate water supply zones which do not necessarily match with the capacities of Table 4.6. In addition, ground water is also being used by various sectors. There are reportedly around 399 dug wells and 4820 bore wells.

Table 4.6: Water Treatment Plant Capacity and Year of Commissioning

WTP		Commissioned Year	Installed Capacity (MLD)	Treatment method	Production (MLD)
1	Parvati	1969	475	Conventional	500
2	Cantonment	1893	380	Conventional	300
3	Vadgaon	2007	125	Conventional	125
	Vadgaon Extension	(Proposed)			250
4	Warje	1999	100	Conventional	100

WTP		Commissioned Year	Installed Capacity (MLD)	Treatment method	Production (MLD)
	Warje Extension	(Under construction)			200
5	Holkar old	1919	5	Conventional	25
6	Holkar New		20		
7	Wagholi	2000	30		30
Total			**1,135**		**1,530**

The major pumping mains are summarized in Table 4.7.

Table 4.7: Detail of Pumping Mains

Location of P/M	Working Capacity (BHP)	Discharge (LPS)	Head (meters)	Hours of Pumping (hrs.)	Year of Erection
Parvati	250 to 350	527.77	39	24	2000
Cantonment	400 to 500	361.11	70	24	2001
Vadgaon	425/450	541.66	41	24	1999
Warje	500	541.66	52	24	2000

(Source: Maharashtra Jeevan Pradhikaran Website)

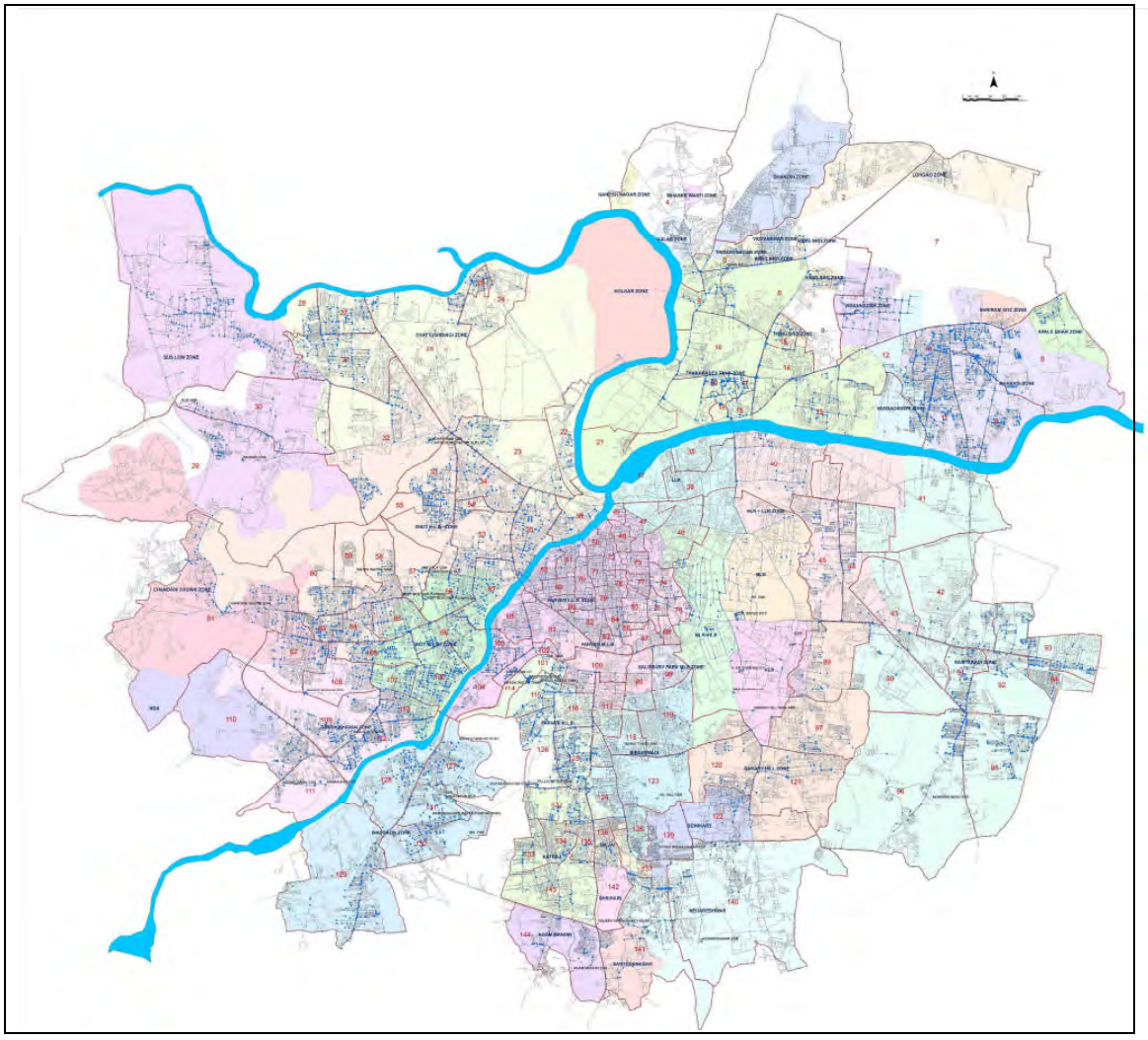


Figure 4.2: Existing Water Supply Zone in Pune (City Sanitation Plan)

4.2.3 Transmission, Distribution, and Storage Systems

For distribution the entire water supply operation of PMC is divided into 47 zones, each zone has a specified area of service. The conveyance of water from the water works is done both by pumping and by gravity, depending on available levels at the zonal reservoirs. The storage capacity of reservoirs including sumps is 463 ML.

The distribution network consists of pipelines varying from the smallest size diameter of 80 mm to the largest diameter of 1600 mm. Total length of the network is about 2400 km.

4.2.4 Administrative Structure

Pune Municipal Corporation was established on 15th February 1950 as a corporate body under the BPMC (Mumbai Prantik Municipal Corporation) Act, 1949. PMC has a sanctioned staff strength of 17,333 in total (Class-1: 88, Class-2: 363, Class-3: 4084, and Class-4: 13,242).

Followings are the prime functional departments of PMC:

General Administration	Public Works- Roads
Street Lighting	Security
Public Health	Transport Department/Workshop
Accounts and Audit	**Water Supply & Sewerage**
Municipal Secretary	Development Planning and Building Permission
Education	Law Department
Solid Waste Management	Fire Department
Slum Clearance/Improvement	Urban Community Development
Tax Assessment and Collection	Public Relation
City Development Primary Health	Land and Estate
Octroi	

4.2.5 Organizational Structure for Water Supply & Sewerage

The water supply and sewerage department is responsible for preparing, executing and operating & maintaining all works related to water supply and wastewater. The municipal area is divided in to 3 zones for the water supply and sewerage works; i) Swargate, ii) Cantonment, and iii) SNDT. The organizational structure of this department is given in Figure 4.3.

A list of junior level technical and non-technical staff in this department compiled from the PMC payroll (in Marathi Language) is as shown in Table 4.8. There are approximately 1,400 staff members in this department.

The operation and maintenance of the source, pumping stations and water treatment plants as well as distribution system in the old PMC limits is executed by the staff of PMC. The

operation of valves in the distribution system in the fringe area is, however, outsourced to contractors.

Table 4.8: List of Administrative and Junior Level Technical Staff in WS& Sewerage Dept. of PMC

Post	Number	Post	Number
Meter reader	53	Clerk	46
Telephone operator	6	Electric supervisor	3
Telephone attendant	10	Water tax superintendent	3
Filter inspector	8	Water tax collector	1
Filter attendant	14	Driver	9
Electrician	19	'Gawandi'	6
Assistant electrician	58	Plumber	3
Meter repairer	10	Machine operator	1
Pump operator	31	Welder	2
'Mokadam'	60	Blacksmith	1
Mistry	12	Security guard	17
Pump mechanic	3	Helper (Bigari)	337
Fitter	57	Cleaner	11
'Paniwala'	278	Painter	1
Chemist	4	Gardener	9
Stenographer	1	Office superintendent	1
'Arekhak'	2	Internal auditor	1

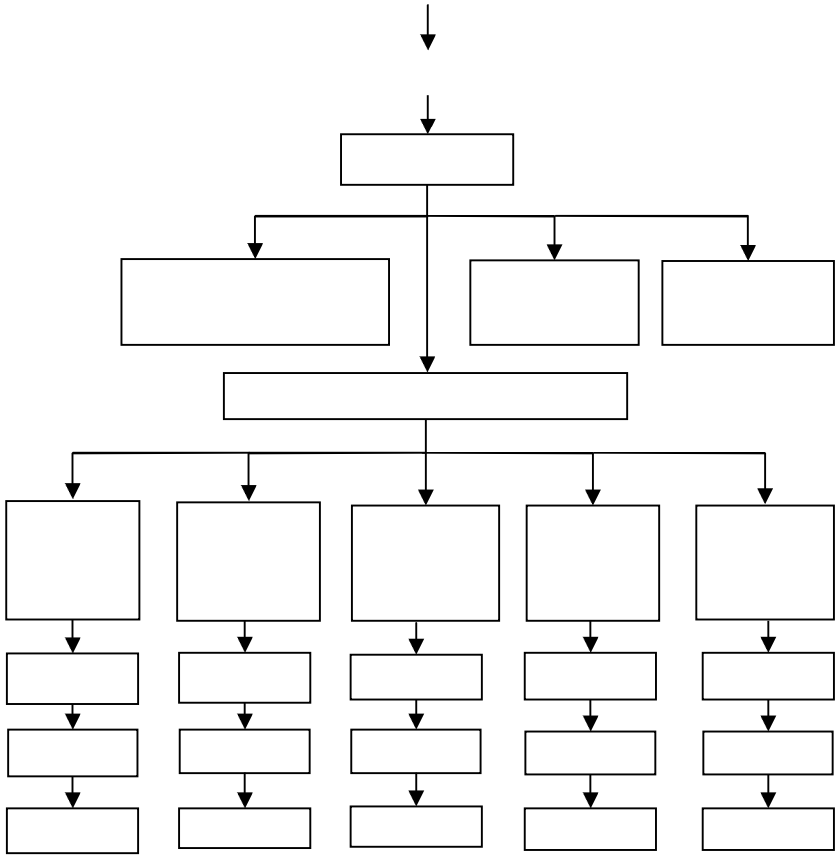


Figure 4.3: Organizational Setup of Water Supply and Sewerage

(Source: PMC)

4.2.6 Financial Status of PMC

Water Tariff and Cost Recovery

Since April 1, 2000, Domestic water (as well as sewerage) users are being billed on a system based on the Annual Rateable Value (ARV) of their property. For other categories (non-domestic, commercial, and industrial) the tariff is Rs. 21/kL. The water tariff for metered domestic connections is Rs. 3/kL while for slum is Rs. 365/ per unit per year. Current production cost is Rs. 6/kL. The tariff has not been revised in last 10 or so years putting the water supply department in loss and requiring cross subsidy from other departments. The tariff structure is summarized in Table 4.9.

Table 4.9: Water Tariff Structure

No.	Type of Consumer	Water Charges
1	Residential	Rs. 3.00 per kL
2	Residential – un metered	
	If taxable amount is <1000	Rs. 75 per month
	If taxable amount is 1000-3000	Rs. 83 per month
	If taxable amount is >3000	Rs. 92 per month
3	Pune & Khadki Cantonment Board	Rs. 5.00 per kL
4	Commercial and Industrial	Rs. 21 per kL

(Source: City Development Plan)

As per a recently published report by the World Bank, only 18,500 slum households are paying water charge while 181,500 slum households do not pay any water charge. Around 60,000 existing tax payers (businesses and registered households) are not in the water charge database.

The same report mentions that the current collection efficiency in Pune is 59%, current demand (billed) Rs. 1,333 million, and current collection of only Rs. 790 million. Table 4.10 through Table 4.12 show cost recovery, collection efficiency, and revenue potential of operation improvements in PMC. These numbers do not match each other. However, they show the degree of financial situation in Pune.

Table 4.10: Cost Recovery in Water Supply Services

Description	Amount
Total annual operating expenses (As per budget of the year 2009-2010, in crores)	176.41
Total revenue generated through property tax and water meters dept. (in crores)	124.68
Cost recovery in Water supply Services (in percent)	70.67

Table 4.11: Efficiency in Collection of Water Supply Related Charges

Description	Amount (in crores)
Current revenue billed	137.11
Current revenue collected	124.68
Efficiency in Collection of Water Supply related Charges	90.93

Table 4.12: Revenue Potential of Operational Improvements in Pune and Its Comparison with Other ULBs (Rupees in Millions)

Factors	Pune	Other Cities for Comparison					
		Dehradun	Ludhiana	Chandigarh	Indore	Hyderabad	Kochi
Reducing total nonrevenue water	164	21	181	146	35	348	21
Improving collection efficiency	410	37	165	34	280	1650	357
Increasing consumer base	119	90	252	36	391	144	23
Total revenue improvement potential (A)	693	148	598	216	706	2143	401
2006-07 Total operative income (B)	1015	130	225	492	159	2572	193
Potential for increase in operative income A/B (%)	68%	114%	226%	44%	444%	83%	208%

(Source: World Bank Report - Cost Recovery in Urban Water Services 2011)

Table 4.13: Income and Expenditure of PMC from 2009-10 to 2011-12 (Estimated)

(Rs. in crores)

Income				Expenditure			
Particulars	2009-10	2010-11	2011-12	Particulars	2009-10	2010-11	2011-12
Opening balance	00.02	3.19	-	Expenses on staff	403.00	546.00	584.46
Octroi	750.00	886.00	1266.33	Primary education	133.61	167.47	194.82
Property tax	350.32	436.75	519.52	Electricity expenses, maintenance	138.00	137.40	97.41
Water tax	214.00	239.75	227.29	Expenses on water	35.25	29.23	32.47
City development charges, construction permission charges, etc.	229.20	265.20	519.52	Medicines, interest, depreciation, petrol & diesel, other expenses, O&M exp. at ward level	314.52	14.52	357.17
Other income	283.62	262.54	292.23	Repayment of loans, interest, depreciation	84.69	80.72	64.94
Govt. grants	03.53	87.70	162.35	Capital and development works	1568.60	1053.78	1493.62
Loans	250.00	300.00	-				
JnNURM	-	429.00	259.76	JNNURM	-	581.00	422.11
Total	2680.69	2910.12	3247.00	Total	2680.69	2910.12	3247.00

(Source: City Sanitation Plan, 2011)

4.2.7 Water Supply Development Plans

Water Supply Master Plan

There exists a master plan and detailed project report on Pune water supply and sewerage prepared in February 1999. Regarding the sewerage system, a new master plan and DPR has been prepared in 2011 superseding the older one. But for water supply PMC is still working based on this 1999 master plan.

The plan adopts gross per capita water supply of 225 Lpcd with net domestic supply @ 140 Lpcd, non-domestic supply @ 30 Lpcd and losses @ 25% of gross supply. This plan covers the period up to 2025 and proposes 3-phased implementation. The three phases involved are for the needs of the years 2005, 2015, and 2025. The water demand of these three target years and proposed WTP capacity, as per this master plan, is given in Table 4.14.

Table 4.14: WTP Wise Water Demand in Three Phases

S. N.	Name of WTP	Demand in MLD		
		Phase-I: 2005	Phase II: 2015	Phase III: 2025
1	Parvati Water Works	340.25	466.72	484.04
2	Cantonment Water Works	188.45	184.75	265.23
3	Wajre Water Works	92.47	154.43	353.15
4	Vadgaon Water Works	114.66	197.40	309.84
5	Pashan Water Works	5.00	5.00	5.00
6	Holkar Water Works	22.29	37.76	60.91
7	Wagholi RRWS (W.B.)			
	Vadgaon sheri	6.6	6.6	6.6
	Kharadi	0.4	0.4	0.4
	Lohagaon	2.6	2.6	2.6
	Dhanori	2.6	2.6	2.6
	Kalas	2.0	2.0	2.0
	Dhandanagar	3.67	3.67	3.67
	Vidyanagar	3.13	3.13	3.13
	Sub total	21.00	21.00	21.00
8	Wada water supply scheme (W.B.)	7.63	7.63	7.63
	Grand total	791.48	1074.42	1506.53

(Source: Pune Water Supply and Sewerage Project DPR, February 1999)

Based on the demands shown above, existing capacity, and required plant capacity for 22 hrs working, proposed plant capacities in these three phases have been worked out in this master plan as shown in Table 4.15.

Table 4.15: WTP Wise Water Demand and Plant Capacity

S. N.	Name of WTP	Stage/ (Demand/Capacity in MLD)		
		Phase-I: 2005(2012)*	Phase II: 2015	Phase III: 2025

S. N.	Name of WTP	Stage/ (Demand/Capacity in MLD)		
		Phase-I: 2005(2012)*	Phase II: 2015	Phase III: 2025
1	Parvati Water Works			
	Demand	340.25	466.72	484.04
	Existing plant capacity	**475.00**	**475.00**	**500.00**
	Proposed plant capacity	**---**	**500.00***	**---**
2	Cantonment Water Works			
	Demand	188.45	184.75	265.23
	Existing plant capacity	**380.00***	**---**	**---**
	Proposed plant capacity	**---**	**---**	**300.00***
3	Vadgaon Water Works			
	Demand	114.66	197.40	309.84
	Existing plant capacity	**125.00**	**125.00**	**250.00**
	Proposed plant capacity	**---**	**125.00***	**125.00***
4	Wajre Water Works			
	Demand	92.47	154.43	353.15
	Existing plant capacity	**100.00**	**100.00**	**300.00**
	Proposed plant capacity	**---**	**200.00***	**---**
6	Holkar Bridge Water Works			
	Demand	22.29	37.76	60.91
	Existing plant capacity	**25.00**	**25.00**	**25.00**
	Proposed plant capacity	**---**	**---**	**???**
7	Pashan Water Works	5.00	5.00	5.00
	Wagholi RRWS – W.B. for 5 Villages	21.00	21.00	21.00
	Warje Scheme – W.B.	7.36	7.36	7.36
	Existing plant capacity	**30.00**	**30.00**	**30.00**
Total	Demand	791.48	1,074.42	1,506.53
	WTP Capacity	**1,135.00**	**1,580.00**	**1,530.00***

(Source: *Updated based on Pune Water Supply and Sewerage Project DPR, February 1999 and Field Survey, 2012)

The plan has identified other works needed for the systems namely pumping machinery, pumping mains, service reservoirs, gravity mains, augmentation of distribution system, rehabilitation of distribution system, new distribution mains, leak detection, and miscellaneous works. The estimated cost of these works for Phase-I is shown in Table 4.16..

Table 4.16: Summary of Cost for Phase I of Master Plan, 1999

S.N.	Water works	Phase-I Cost in Rs. crore
1	Wajre WTP	66.12
2	Vadgaon WTP	53.15
3	Cantonment WTP	38.97
4	Parvati WTP	26.67
5	Holkar WTP	16.48
	Total	201.38

City Development Plan

PMC has a City Development Plan prepared in April 2006. This plan identified the needs up to year 2031 and divided them into two stages; Priority needs for the period 2006-07 to 2011-12 and long term needs catering up to year 2031.

Under the priority needs, works including refurbishment and augmentation of distribution network, source development, storage capacity augmentation and provision of treatment

facilities were identified. Rs. 294.63 crores (60% of total investment need in the sector) was proposed by 2011-12. An action plan was prepared for the priority works which included construction of capital facilities, support and system sustenance measures, and other allied works. However, upon enquiry with the PMC on status of these works we have been informed that no actions at all were taken on the activities identified by CDP in water sector.

Under the long term needs a sum of Rs. 488.51 crores was estimated as the capital cost for the proposed interventions to cater to the needs of year 2031. The City Investment Plan for the water supply sector has been based on the requirements and demand for the year 2031 at a per-capita requirement of about 225 Lpcd for 56.57 lakh populations. With this, the demand by 2031 has been estimated to be in the range of 1270 MLD. Accordingly requirement of additional treatment capacity and additional elevated storage of 245 ML have been worked out to cater for the total supply by 2031.

City Sanitation Plan 2011

A City Sanitation Plan 2011 has been prepared by PMC which covers water supply, sewerage, storm water drainage, solid waste management, environment improvement, and several other aspects related to city sanitation. In this document fragmented data have been compiled and future plans have been prepared for continual improvement of city sanitation. Many data from this plan have been reproduced/ quoted in this report. Table 4.17 shows the major identified components of water supply system and required funding as per this plan.

Table 4.17: Components and Estimated Cost of Water Supply Services (in crores)

No.	Component	Total (in crores)	Year 2011-12	Year 2012-13	Year 2013-14	Year 2014-15
1	Construction of new water treatment plant of 500 MLD capacity at Parvati-(Note)	200.00*	20.00	70.00	55.00	55.00
2	Construction of new water treatment plant of 300 MLD capacity at Cantonment	95.00	-	30	35	30.00
3	Construction of new water treatment plant of 250 MLD capacity at Vadgaon	200.00*	20.00	65.00	65.00	50.00
4	Construction water line of Khadakwasla Dam to Cantonment water treatment plant	240.00*	20.00	150.00	40.00	30.00
5	Implementation of Bhama Askhed dam for North – East part of the city	250.00	25.00	75.00	75.00	75.00
6	100% water metering, water auditing and water distribution system	312.50	30.00	100.00	100.00	82.50
7	Strengthening of water distribution storage and treatment systems	195.00	48.75	48.75	48.75	48.75
8	Electricity, Water charges & chemicals	524.26	113.00	124.13	136.73	150.40

No.	Component	Total (in crores)	Year 2011-12	Year 2012-13	Year 2013-14	Year 2014-15
	Total	2016.76*	276.75	662.88	555.48	521.65

Note: Modified as 500 MLD as a result of communication with SE (Water) from the 300 MLD in the plan.
(Source: *Updated based on City Sanitation Plan)

The above table reflects the need for Rs. 2016.76 crores to improve the water supply services in the city. As per this plan, most of the expense would be incurred to improve the system of metering of water connections and construction of new water treatment plants in different parts of the city.

4.2.8 Key Issues and Improvement Needs

PMC has identified the following issues and improvement needs and also estimated approximate cost for their implementation. Actions have already been initiated under equitable supply scheme for overhauling distribution system (Items I and V below).

I. <u>Overhauling house connections and customer metering system</u>

The number of house connections is low, compared to the total number of properties in the city. The house connections are not metered and water tax is included in the property tax, based on Annual Rental Value. There is no incentive to control the use of water. In order to control wasteful use of water and raise revenue from water PMC needs to put in place a policy of 100% metering and telescopic water charge system.

II. <u>Improving the method of water intake - providing and laying 2500 mm diameter water pipe line from Khadakwasla Dam to Cantonment water works</u>

Of around 1200 MLD of water drawn from the Khadakwasla Dam, around 700 MLD is drawn through the closed conduit while the rest is taken from the open canal. There are 3 major disadvantages of taking water from the open canal.

- As the water has to travel a distance of about 20 km, around 50% of the water goes away as leakage through the existing unlined earthen canal. Hence a large quantity of water goes as waste.
- As the unlined earthen canal is used as a source of water supply to the city, it cannot be closed for repairs. Hence the strength of the canal is reducing day by day.
- The open unlined canal flows through the city with slums on both the sides of the canal. The slum dwellers throw the waste in to the canal there by polluting the canal water. This in turn has its cost implications on the water treatment.

The estimated cost of the works is Rs. 240 crores.

i) Construction of jackwell, pump house and erection of pumping machinery.

ii) Laying of 2500 mm diameter mild steel pipe line from Khadakwasla Dam to Parvati WTP (The estimated cost of the works was Rs. 142 crores according to detailed Tender No. 776-778, 2011).

iii) Laying of 2500 mm diameter steel pipe from Pravati WTP site to Cantonment water works.

III. Construction of 500 MLD capacity water treatment plant at Parvati water works

The Parvati WTP with a capacity of 500 MLD has been constructed in 1970 and has developed huge leakages. Structurally too the plant has become weak, hence requiring total replacement. There is enough space adjoining the existing treatment plant where PMC proposes to construct a new water treatment plant of capacity 500 MLD.

The estimated cost of the plant is around Rs. 200 crores. PMC has employed Tata Consulting Engineers (TCE) for design of this WTP and the design work is in progress.

IV. Construction of water treatment plant of capacity 250 MLD and allied components at Vadgaon

Presently a water treatment plant of capacity 125 MLD is in existence and serves a population of around 4 lakhs. The area adjoining the WTP and the command area under the influence of the WTP has a high potential for growth and is fast developing. It has become necessary to expand the existing WTP to cater the demands of the growing population. Considering the demand for the next 30 years a WTP of capacity 250 MLD has been proposed. The detailed project report is under formulations.

PMC has already employed a consultant (Shah Technical Consultants, Mumbai) for design of this WTP. The design work is in progress.

V. Construction of water treatment plant of capacity 300 MLD at Cantonment

PMC intends to replace the existing WTP at Cantonment with a new 300 MLD WTP upon completion of new 500 MLD WTP at Parvati. Its cost has not yet been worked out.

VI. Improving distribution system - equitable water supply scheme

As on date PMC consumes around 1200 MLD of water for a population of around 3.5 million. The gross rate of water supply works out to around 330 Lpcd. Even with this high rate of water supply there is disparity in the water supply/received by the consumers. This is basically due to the topography of the city (saucer shape). There are areas having water supply of 70 Lpcd while other consumes with 400 Lpcd.

In order to overcome this disparity and as a step towards providing round-the-clock, uninterrupted water supply on all days and to all areas in the city, the PMC Standing committee on 22nd November 2011 approved the administration's proposal of 24×7 water supply scheme. Consulting firm M/S SGI (Studio Galli Ingegneria), Italy started to implement the same in January 2012. It will take more than 10 years, consisting of 6 month-study, 5 years implementation and 5 years operation/maintenance. The study will include network analysis, take corrective measures like detecting leaks, carry out system rehabilitation and a water audit, see the flow measurement, ensure systems' reengineering and suggest cost-effective measures to meet the city's water demand for the next 30 years. As a result, the firm will prepare a detailed project report. The total cost of the project is likely to be around Rs. 1,000 to 1,200 crores.

According to the PMC, if the 24×7 water supply scheme becomes a reality, 150 Lpcd of water will be provided and a five-member family will be considered as a unit. If a family uses 150 Lpcd (750 litres in total), no extra charges will be imposed and the existing water rates will be charged. Rs. 33 will be charged for every additional 1,000 litres.

4.2.9 Source of Funding and Potential of JICA'S Assistance

Funding requirement for the equitable supply scheme is the major chunk of the total funding requirement for the PMC in near future. Customer metering is included in the equitable supply scheme. Its exact amount will only be known after the Consultant's report due in about 6 months from the start of this scheme. The Consultant is to propose means of raising the fund which may include PPP. JICA can finance this fund.

Approximate amount required for other three items (Items II to IV above) totals to Rs. 640 crore. As per PMC official, getting funding from JNNURM for these works seems unlikely due to lack of customer metering, already high per capita supply and other conditions of JNNURM.

PMC has shown interest in getting this funding from JICA as a soft loan for the above-mentioned S.N. II, III, and IV items totaling to Rs. 640 crores approximately. Upon further study the fund required for S.N. V (300 MLD WTP at Cantonment) can also be included.

4.3 Wastewater System

4.3.1 Status of Sewerage System

The city is divided into 17 sewerage districts. These districts are shown in the figures appearing the sections to follow. The city has 95% coverage of sewerage networks. The sewer

network has length of about 2,200 km. There are 6 main pumping stations, apart from influent pumping stations for the sewage treatment plant.

At present there are 9 sewage treatment plants located at various locations with a combined capacity of 527 MLD. In addition, the sewage treatment plant at Kharadi of 40 MLD capacity is under construction. Existing sewerage system and STPs in PMC are summarized in Table 4.18 and Table 4.19, respectively.

Table 4.18: Existing sewerage system in PMC

Particulars	Present Status
Coverage	95%
Length of Sewers	2,200 kms
No. of pumping stations	6 nos
Present pumping capacity	485 MLD
No. of existing sewage treatment plants	9 nos
Present treatment capacity	527 MLD
No. of sewage treatment plant under construction	1 (40 MLD) at Kharadi

Table 4.19: Existing and Proposed Sewage Treatment Plants in PMC

Sr. No.	Name	Existing Capacity in MLD	Proposed Capacity in MLD	Method of Treatment for Existing Plant
1	Bhairoba	130	70 (SBR)	Activated Sludge Process
2	Erandwane	50	-	Modified Activated Sludge Process
3	Tanajiwadi	17	-	Biotech with extended Aeration
4	Bopodi	18	-	Extend Aeration Process
5	Naidu (Old)	90	-	Activated Sludge Process
6	Mundhwa	45	45 (SBR)	Sequential Batch Reactor Process
7	Vitthalwadi	32		Activated Sludge Process
8	Naidu (New)	115	125 (SBR)	Activated Sludge Process
9	Baner	30	-	Sequential Batch Reactor Process
10	Masty Bij Kendra	-	8 (MBR)	
11	Vadgaon	-	20 (ASP)	
12	Warje	-	25 (EA)	
13	Tanajiwadi	-	19 (EA)	
14	Botanical garden	-	21 (SBR)	
15	Dhanori	-	36 (SBR)	
16	Kharadi	-	14 (SBR)	
	Sub TOTAL	527	383	
	TOTAL	910		

4.3.2 Problems Related to Sewage Collection and Treatment

The following are the key problems for ensuring 100% collection and treatment of sewage.

- High rate of water supply resulting in higher sewage flows,
- Inadequate/old conveyance or transmission lines causing sewage to flow in Nallas,
- Problems with the collection system (unconnected areas, leaking main lines etc),
- Insufficient treatment capacity – some existing plants inefficient,
- Space availability at the right locations for the sewage treatment, and

- Sewage flows from upstream outskirts of the city.

4.3.3 Sewage Generation and Requirement of Additional Treatment Capacity

With the projected population and sewage generation rate of 145 LPCD, PMC will have an average sewage flow rate and additional treatment capacity required in different years as shown in Table 4.20.

Table 4.20: Additional Treatment Capacity Required

Year	Population (Thousand)	Average Sewage Flow (MLD)	Cumulative Additional Capacity of STP's (MLD)	Additional Capacity of STP's (MLD)
2011	3,898	565	Current Cap. 567*	Current Cap. 567
2014	4,365	632	65	65
2024	5,939	861	294	229
2029	6,747	977	410	116
2034	7,555	1,096	529	119
2044	9,149	1,326	759	230

Note: Population is projected to be 5,657 thousands for the year 2031 in the city development plan.
* The 567 MLD capacity also includes 40 MLD of Kharadi STP which is under construction.

The following Figures show sewerage districts, existing and proposed STPs, and trunk & conveyance mains in PMC.

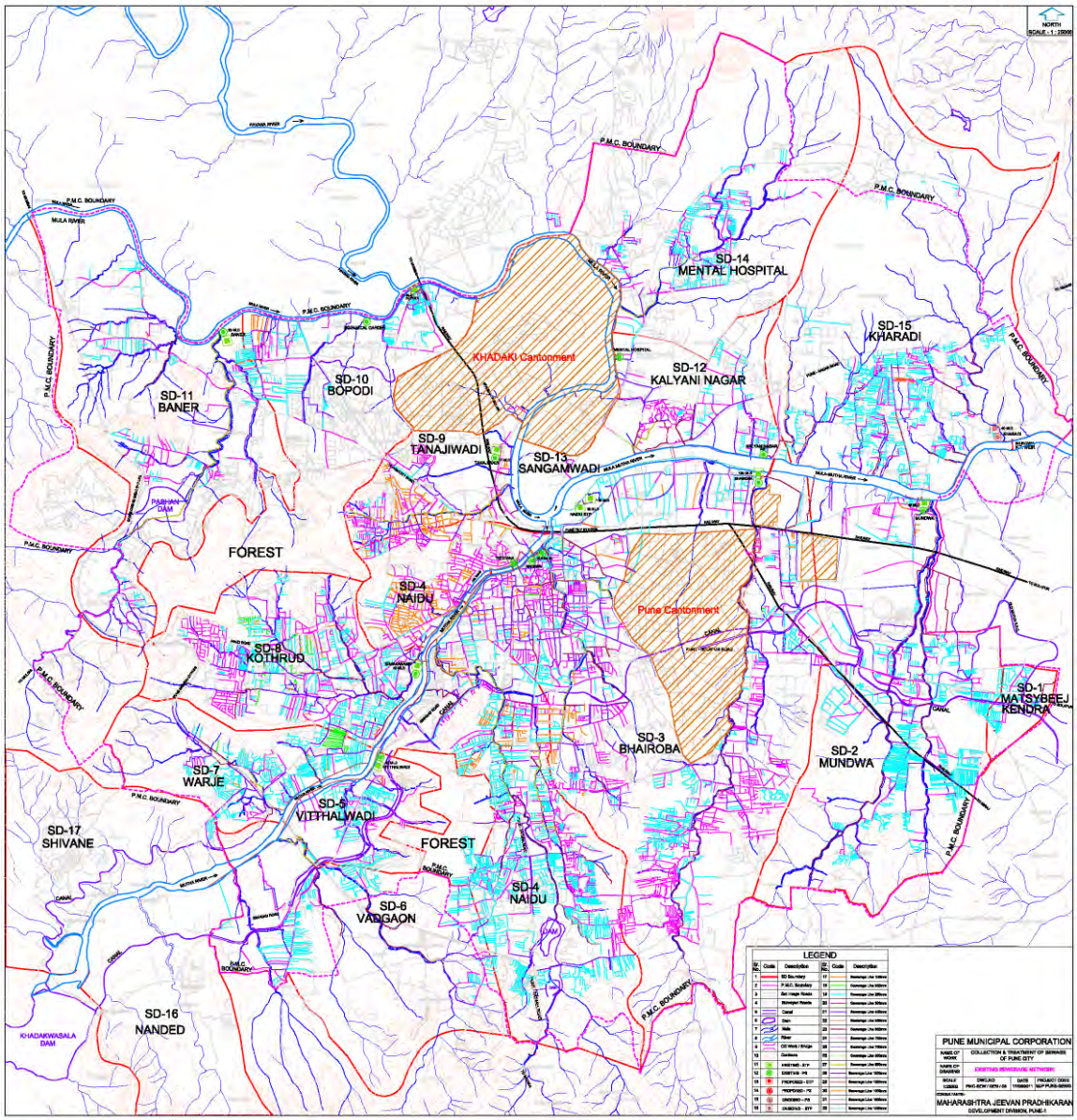


Figure 4.4: Existing Sewerage Network in PMC

(Source: Sewerage DPR 2011)

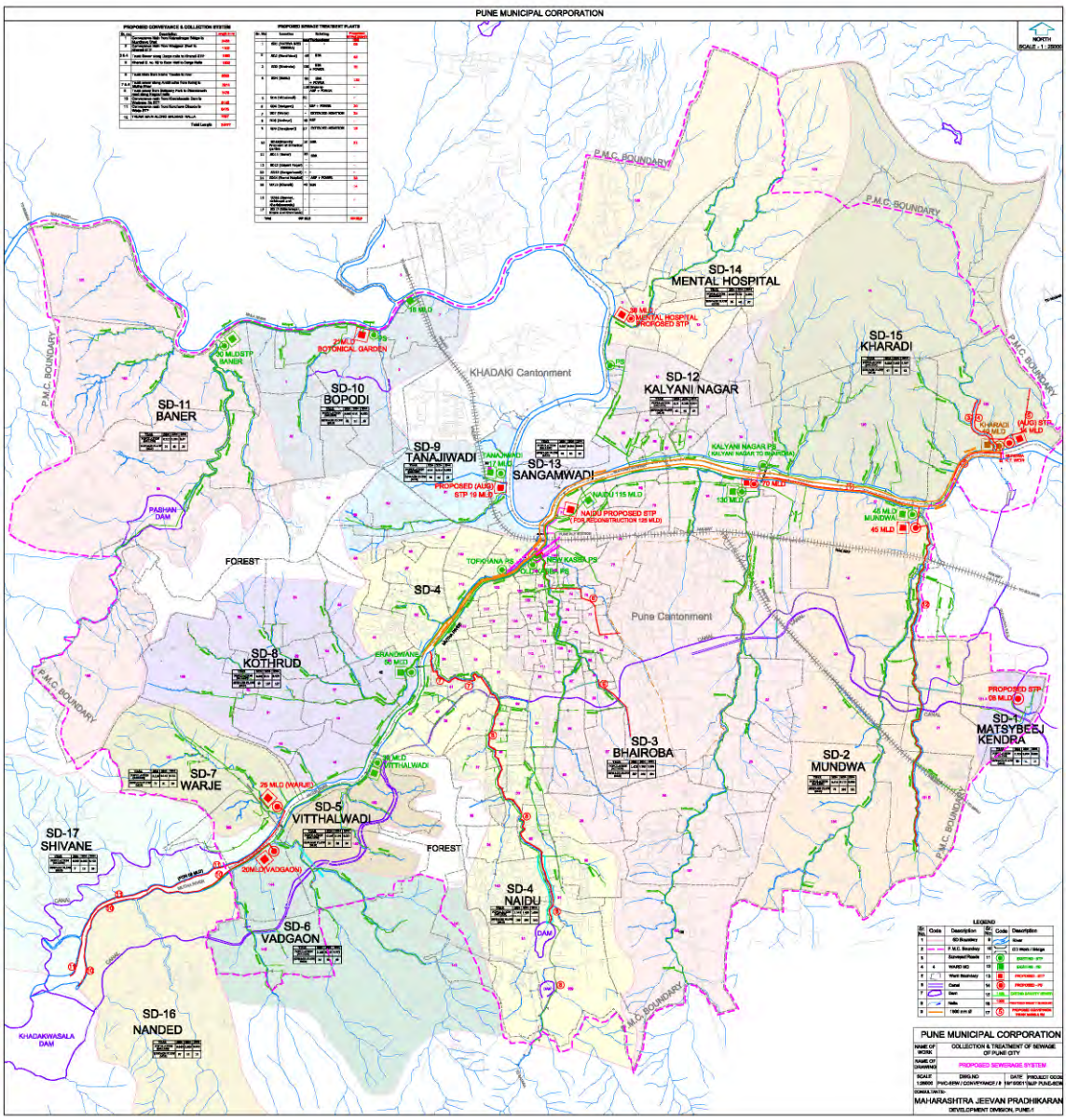


Figure 4.5: Proposed Trunk Mains, Conveyance Mains and WTP in PMC
(Source: Sewerage DPR 2011)

4.3.4 Sector Development Needs, On-Going & Proposed Projects

PMC is mandated to collect and treat 100% sewage generated in the City of Pune. To achieve this goal PMC is implementing several schemes and planning new works.

Works Under Execution

There are many ongoing works in the sewerage sector. These include:

- Laying of sewerage network in developing areas,
- Augmentation of sewers in developed areas,
- Laying of trunk and out fall sewers along Nallas and Mutha river, and
- Sewer treatment plant at Kharadi.

Table 4.21: On-going Projects and Their Status

No.	Component	Funding Source	Sanctioned Cost (Rs. crore)	Tender Cost (Rs. crore)
1	Kharadi STP - 40 MLD	JNNURM PUN 002	12.58	39.50
2	Conveyance main 1800 mm from Bund Garden to New Bahiroba STP	PMC own fund	10.00	10.00
3	Trunk sewer – Gulabrao Tathe path Karve nagar	PMC own fund	1.50	1.50
4	Conveyance main 1600 mm on both banks of Mutha River from Rajaram bridge to Kharadi	River Improvement project under JNNURM	63.00	63.00

(Source: Sewerage DPR 2011)

Planned Project

In addition to the ongoing works, PMC has also prepared a plan and its detailed project report (DPR) in October 2011 towards achieving the goal of 100% collection and treatment for up to year 2044. The components of this plan are:

- Collection system in Balewadi area (43 km)
- Trunk mains and conveyance mains (12 Nos., 46.03 km)
- STPs for 100% treatment of sewage generated by city up to year 2044
- Financial provision for 2024 – 10 STPs, 383 MLD
- Upgrade of 2 intermediate pumping stations, and
- Capacity building.

The cost estimates of this DPR are based on 'Schedule of Rates' of Pune Municipal Corporation and Maharashtra Jeevan Pradhikaran for the years 2010-2011. The costs of site development works and land acquisition are also included in the plan. The total capital cost of the project has been estimated to be Rs. 542.82 crore net and Rs. 715.05 crore including 5 year O&M charges. The summary of cost is given in Table 4.22.

Table 4.22: Summary of Cost for Planned Projects

No.	Particulars	Estimated Cost (Rs. Lakhs)
I	**CAPITAL COST**	
	A .Collection System and Trunk Mains	
1	Collection System in Baner and Balewadi	1,748.67
2	Trunk Sewer and Conveyance Mains	7,790.34
	TOTAL A	9,539.01
	B. Cost of Sewage Treatment Plants	
3	Masty Bij Kendra STP- 8MLD (MBR)	1,038.32
4	Mundhawa STP- 45 MLD (SBR)	3,789.16
5	Bhairoba STP - 70 MLD (SBR)	7,429.06
6	Naidu STP - 125 MLD (SBR)	10,800.60
7	Vadgaon STP - 20 MLD (ASP)	1,960.44
8	Warje STP - 25 MLD (EA)	1,521.69
9	Tanajiwadi STP - 19 MLD (EA)	1,118.61
10	Botanical garden STP -21MLD(SBR)	2,235.93
11	Dhanori - 36 MLD (ASP)	2,956.56

No.	Particulars	Estimated Cost (Rs. Lakhs)
12	Kharadi STP - 14 MLD (SBR)	1,563.69
	TOTAL B	34,414.07
13	C) IPS (Intermediate Pumping Stations)	470.40
14	D) Land Acquisition	3,151.08
15	E) Public Awareness and Public Participation	35.50
16	F) Capacity Building Cost	5.75
	SUB TOTAL (A+B+C+D+E+F)	47,615.80
	G. Other	
17	Preliminary Work (3%)	1,428.47
18	Establishment and Supervision (6.75 %)	3,214.07
19	Special T&P (1%)	476.16
20	Audit and Account Charges (0.25%)	119.04
21	Contingency (3%)	1,428.47
	TOTAL G	6,666.21
	TOTAL (I)	54,282.01
II	**O&M COST FOR 5 YEARS**	**17,223.40**
	TOTAL PROJECT COST (I+II)	**71,505.41 Lakhs (715.05 crores)**

Funding Source and Cost Sharing

The project is proposed to be funded under National River Conservation Program (NRCP). As per NRCP guidelines the cost sharing shall be on the following basis:

1) NRCD/Govt. of India shall contribute 70% of the total cost,
2) The State Govt. (Government of Maharashtra) shall contribute 20%, and
3) The urban local body (Pune Municipal Corporation) shall bear 10%.

For the total cost of 715.05 crore, this works out to be Rs. 500.5 crore for NRCD/Govt. of India, Rs. 143 crore for the Govt. of Maharashtra, and Rs. 71.5 crore for the PMC.

Implementation Program and Schedule

The project is planned to be implemented in three years from 2011to 2014 and next five year (i.e. up to year 2019-20) for O&M phase. Mobilization and commencement of work will be started by February 2012.

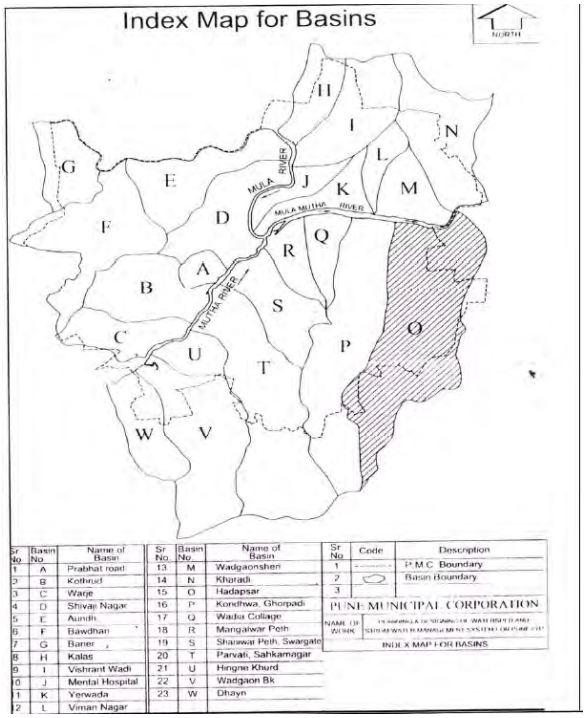
4.3.5 Scope of JICA's Assistance

PMC seems to be more or less confident in receiving the NRCD's share but is uncertain on State's share and its portion. The latter two add up to Rs. 214.5 crore. PMC intends to explore the possibility of funding this amount by JICA as a soft loan.

4.4 Stormwater Drainage System

4.4.1 Status of Drains

Pune city is situated near the foothills of the Western Ghat. The city is also surrounded by hills on the southern side. The general topography is conducive to formation of alternative ridges and valleys. This has resulted in formation of independent watersheds, each of which is draining in one of the two rivers, viz. Mutha and Mula. These rivers are principal carriers of flood waters.



The city is divided in to 23 watersheds or basins, each of which has one or more primary drains in the form of Natural Nallas discharging in the river. Each basin has adequate network of natural drains to convey the flood waters in to river. The slopes of this network are generally good enough to carry reasonable flood volumes.

Figure 4.6: Storm Water Drainage Basins

However, rapid urbanization is exerting tremendous pressure on the natural drains, with a number of them having disappeared or encroached upon. The survey carried out during the preparation of master plan shows that 18% of the surveyed natural drains in the city have been encroached upon.

The widths of the natural drains have been reduced at many places due to increasing demand for land. The development along the Nallas has not taken place in a scientific and planned manner. The rapid urbanization has significantly changed the nature of drainage areas in all watersheds with vanishing open grounds and increasing paved area.This has resulted in emergence of areas which are prone to flooding.

Due to these factors, Pune has been experiencing water logging issues during the rainy season, especially in low lying areas and slums along the river banks in recent years. Incidence of Water logging and flooding has increased since the past few years in the city especially in the low lying areas and slums along the river banks. The incidence is as high as 52 % as against the zero % requirements in Service Level Benchmark (SLB).

The total existing network coverage of storm water drainage in the city is 55 % as against 100 % requirement in SLB. This shows that to meet the SLB standard immediate steps need to be taken to improve the system of storm water drains in the city.

4.4.2 Primary Drainage Channels

The primary drainage channels are essentially natural Nallas and their tributaries. These are present in all the 23 basins in the city. These Nallas are summarized in Table 4.23.

Table 4.23: Summary of Nallas and their Length

Basin Code	Name of Basin	Basin Area (Ha)	No. of Nallas	Length of Nallas (m)	Rain water Drain length (m)	Roadside drain length (m)	Proposed drain length (m)
A	Prabhat Road	261	2	1883	0	2200	21200
B	Kothrud	1544	9	19449	1549	5386	127800
C	Warje	1000	16	15354	1943	0	35100
D	Shivajinagar	1127	5	8455	0	6077	89707
E	Aundh	1575	5	9556	200	1360	42090
F	Bavdhan & Pashan	2280	29	40599	1660	1021	76900
G	Baner	1040	18	19743	1999	0	16800
H	Kalas	827	4	5663	196	550	6689
I	Vishrantwadi	1623	12	22975	275	708	44670
J	Mental hospital	487	3	1683	668	1500	21700
K	Yerawada	714	3	4368	290	17600	34080
L	Vimannagar	466	4	7755	295	0	11550
M	Wadgaon sheri	817	14	16236	4442	0	30170
N	Kharadi	2010	11	14447	99	0	27047
O	Hadapsar	4000	31	48446	1839	5303	93615
P	Kondhawa	3370	27	40436	1491	1500	112000
Q	Wadiya college	603	2	4980	0	3130	15234
R	Mangalwar peth	634	2	4153	748	4990	24750
S	Shaniwar peth	1311	5	12519	120	11500	89272
T	Dattawadi	3714	20	34305	837	8185	117433
U	Hingane khurd	556	3	6074	531	0	18766
V	Wadgaon bk	1700	4	15310	577	438	18069
W	Dhayari	1110	5	7725	326	0	21800
	Total	**32769**	**234**	**362114**	**20085**	**55608**	**10966442**

(Source: Draft City Sanitation Plan 2011)

4.4.3 Roadside Drains and Cross Drainage Works

The drainage system network in the municipal area has limited coverage, with closed roadside drain network available for selected and major roads. In absence of integrated network, the rainwater is carried by roads, pathways etc. towards the nearest natural drain.

The roadside drains have been provided for major arterial roads and in parts of the old city area. The total length of roads in the city is around 1800 km. The total length of roadside drains is around 150 km. This indicates very low coverage of roadside drains. This may be one of the causes of recurring damages to roads during monsoon. The work of providing road side drains is in progress at many places. The cross drainage works are provided at road crossings. The total no. of cross drainage works in the city is 662 out of which 180 are in the basins included in the first phase. The summary of existing roadside drains and cross drainage works is presented below in Table 4.24.

Table 4.24: Existing Road Side Drains and Cross Drainage in the City

Basin Code	Basin Name	Road Side Drains (m)	Cross Drainage Works
G	Baner	-	38
M	Wadgaon Sheri	-	28
N	Kharadi	-	19
P	Kondwa	3845	73
V	Wadgaonbudruk	438	12
	Total	**4283**	**170**

4.4.4 Implementing Organization and Revenue Generation

At present, there is no separate tax on storm water drainage component. The activities of "Drainage Department" include domestic sewerage, as well as storm water drainage components. The strength of Class IV employees of this department is around 600. They are involved in storm water drainage line cleaning and maintenance work. The organizational structure of the Drainage Department is shown in Figure 4.7.

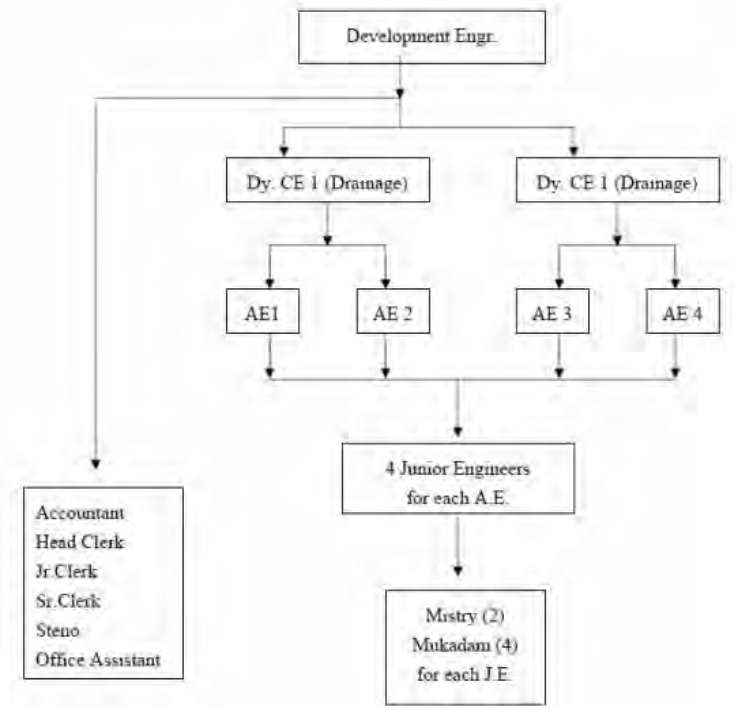


Figure 4.7: Organization of Storm Water Drainage Department

4.4.5 Storm Water Drainage Projects

PMC has prepared a Detailed Project Report (DPR) in 2008 where works are to be improved in 3 phases. The 23 major basins, which will be covered in three phases, are mentioned in Table 4.25 and Figure 4.8 .

Table 4.25: Phase wise Proposed Storm Water Drainage Works

Phase	Basins	Area Covered (sq.km.)	Area in Percentage
I	Wadgaon Sheri, Kharadi, Baner, Wadgaon Budruk, Kondwa	84.37	34.5
II	Bavdhan & Pashan, Warje, Hadapsar, Dhairi	78.40	32.0
III	Prabhat Road, Kothrud, Shivajinagar, Aundh, Kalas, Vishrantwadi, Mental, Hospital, Yerawda, Viman Nagar, Wadia College, Mangalwar Peth, Shaniwar Peth, Dattawadi, Hingne Khurd	80.73	33.5

Phase I Works

Table 4.26: Summary of Phase I Improvement Proposals

Basin Name	Nalla Improvement (km)	Roadside Drains (km)	CD Works (Nos.)
Baner	21.7	17.77	35
Wadgaon Sheri	16.10	27.84	14
Kharadi	13.65	16.56	15
Kondhawa	35.68	85.10	33
Wadgaon Bk.	7.08	18.58	13
Total	94.21	165.85	110

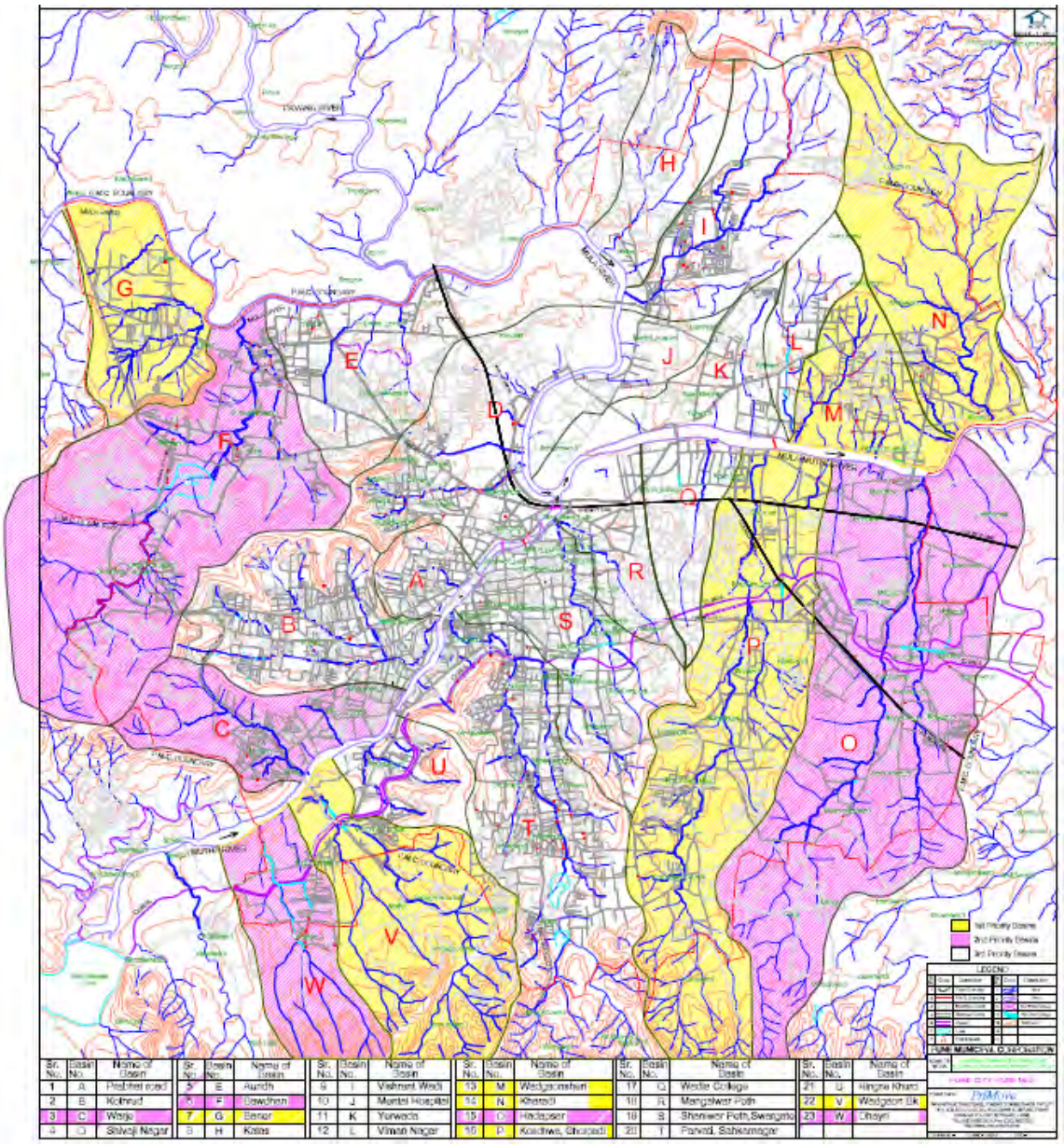


Figure 4.8: Priority of Storm Water Drainage Basins
(Yellow – 1st Priority, Pink – 2nd, and Colorless – 3rd Priority)

Proposed Budget for Phase I Works

Table 4.27: Summary of Basin Wise Costs (Phase I)

No.	Details of work	Baner BASIN (G)	Wadgaon Sheri BASIN (M)	Kharadi BASIN (N)	Kondhawa BASIN (P)	Wadgaon (Bk) BASIN (V)	Total (Rs.)	Remark
1	Nalla Channelisation and development works	451,750,423	386,027,478	350,992,389	1,027,771,872	232,792,693	2,449,334,855	
2	Road side storm water drains	115,362,307	159,921,380	114,064,431	587,501,481	107,145,319	1,083,994,918	
3	Cross drainage works	99,596,135	28,419,724	43,577,749	95,471,859	24,919,192	291,984,659	
4	Working survey & soil investigation	-	-	-	-	-	-	Deleted by CPHEEO during appraisal
	Basin wise total	**666,708,865**	**574,368,582**	**508,634,589**	**1,710,745,212**	**364,857,204**	**3,825,314,432**	
5	Drain cleaning equipments						50,000,000	
6	Environmental compliance cost						5,000,000	
	Total Base cost of Phase-1						**3,880,314,432**	
7	Contingencies @ 3%						116,409,433	
	Gross Cost of Phase-1						**3,996,723,865**	

As per the DPR, completion of storm water drainage system in 5 basins in Phase I will require a total of Rs. 399.67crores. This amount is expected to be sanctioned funded under the JNNURM. Budget requirement for development of remaining 18 basins is Rs. 2,210 crore.

PMC has undertaken the phase I work of Nalla channelization and construction of compound wall with fencing along Nalla bank under JNNURM funding.

4.4.6 Potential of JICA's Assistance

The funding requirement for implementation of SWD works in the remaining 18 basins is substantial. PMC has not yet identified the source of this funding, though a part of it may be funded by JnNURM. There is, thus potential of funding as a soft loan by JICA. PMC has shown interest for the same.

5. NASHIK MUNICIPAL CORPORATION (NMC)

5.1 City Development Plan

Nashik is an important city of Maharashtra. Proximity to Mumbai has accelerated its growth in post-independence years. Development in past two decades has completely transformed this traditional pilgrimage center into a vibrant modern city. Nashik Municipal Corporation (NMC) is presently engaged in the preparation of long-term development plans for Water Supply, Sewerage and Storm Water drainage for Nashik city covering NMC area.

The city Development Plan (CDP) for Nashik city was prepared by NMC in order to be eligible to receive grant assistance from Government of India under JNNURM Program. The plan was approved by JNNURM in September 2006. As per CDP, the following sector wise investments needs were proposed for the city; Environment services (Water Supply, Solid Waste Management, Sewerage, Storm Water Drainage), Basic Service to Urban Poor, Road and Transport, Urban Renewal Heritage and Conservation, Godavari River Front Development and Urban Renewal Heritage & Conservation of city core.

5.2 Water Supply System

5.2.1 Works Done under JNNURM Package I

Following works have been included and sanctioned under package I of JNNURM Program for water supply sector in Nashik city. These works have been almost completed at the cost of Rs. 50.52 crore with 50 % grant assistance from Government of India, 20% grant assistance from state Government and balance 30% from financial institutions by NMC.

- Supply and Installation of raw water and pure water pumping machinery
- Setting up of 48.5 MLD water treatment plant at Shivaji Nagar
- Setting up of 26 MLD water treatment plant at Gandhi Nagar
- Construction of 8 nos. of RCC, ESRs in the city
- Laying of water distribution pipe line for newly developed areas.

Existing water supply system including above works is shown in next paragraph.

5.2.2 Existing Water Supply System

(1) Existing Raw-water Source and Water Treatment Plants

Present Water Supply to the city is to the extent of 350 MLD for a population of 16 lakhs. The source of supply is Gangapur Dam and Darana River. Currently about 325 MLD is supplied

from Gangapur dam and 25 MLD from Darana River. There are total five water treatment plants (WTPs). The source and capacities of the WTP are given in Table 5.1. The table also includes the works executed under JNNURM Scheme of Package I (Package I is a financial assistance under JNNURM)

Table 5.1: Existing Raw Water Source and Water Treatment Plants

Sr. No.	Source of Raw Water	WTP Location	Existing Capacity 2006 (MLD)	Capacity Added under JNNURM 2009 (MLD)	Total Capacity 2011 (MLD)
1.	Gangapur	Shivajinagar	97	48.5	145.5
2	Gangapur	Barabunglow	81		81
3	Gangapur	Panchavati	71		71
4	Gangapur	Gandhinagar	26	26	26
5	Gangapur & Darna	Nashik Road	73		73
		Total	**348**	**74.5**	**422.5**

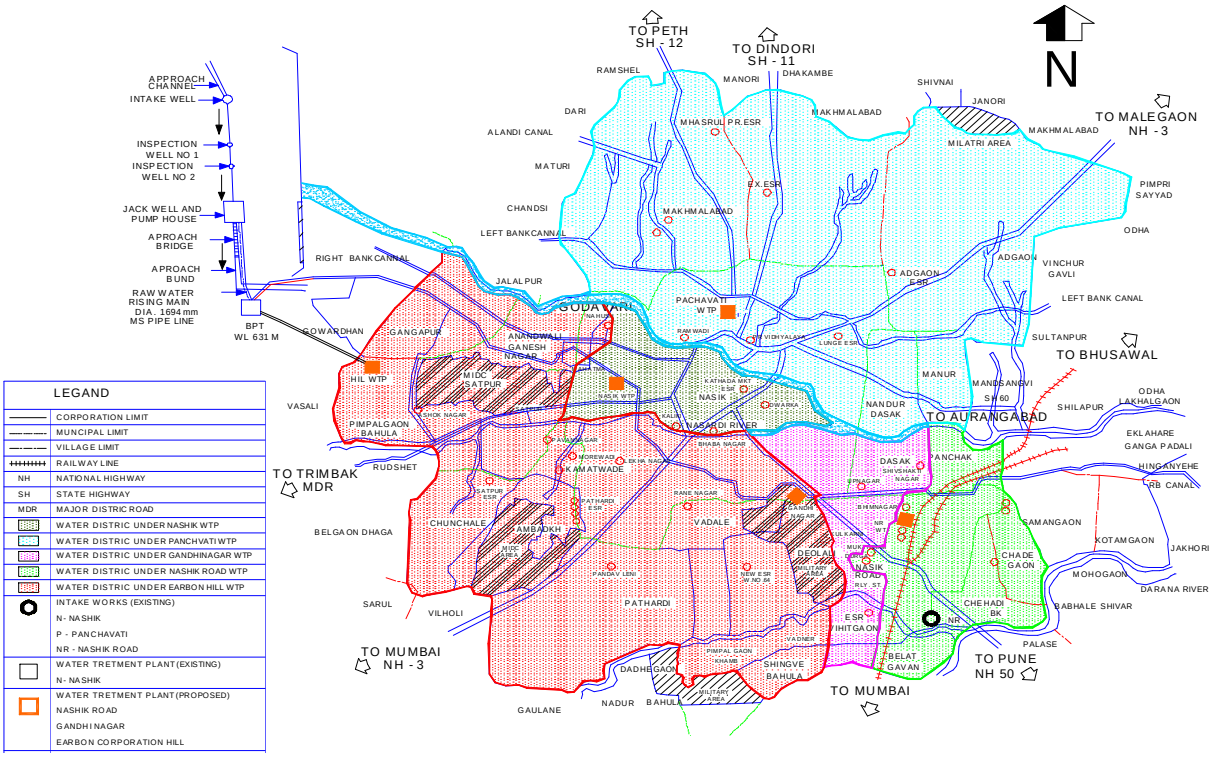


Figure 5.1: Existing Water Supply System of Nashik City

(2) Existing Break Pressure Tanks (BPTs)

There are two BPTs in between head works and Gandhinagar W.T.P. BPT-1 is near Gangapur dam head works and at the end of raw water pumping main to convert subsequent conveyance main into a gravity main and BPT-2 at Gandhinagar WTP to reduce the static pressure on the gravity main.

(3) Existing Raw Water Transmission Mains

Existing raw water transmission mains are summarized in Table 5.2.

Table 5.2: Existing Raw Water Transmission Mains

WTP	Location		Length (Km)	Diameter (mm)	Material
	From	To			
Shivajinagar	Gangapur dam	Shivajinagar	3.4	1694	M.S
	Gangapur dam	Shivajinagar	3.2	1118	M.S
Nashik	B.P.T. No. I	Bara Bungalow Junction	11.3	1200	PSC
	Bara Bungalow Junction	Nashik W.T.P	0.1	1016 813 x2 nos	M.S
Panchavati	Bara Bungalow Junction	Godavari River	2.2	711	M.S
	Godavari River	Panchavati W.T.P	3.5	914	M.S
Gandhinagar	Bara Bungalow Jn	Gandhinagar	8.0	1200	PSC
Nashik Road	Gandhinagar	Nashik Road WTP	5.3	800	PSC
	Darna river head works	Nashik Road WTP	3.5	500	C.I
	Darna river head works	Nashik Road WTP	3.5	700	M.S

(4) Existing ESR/GSR

Nashik city is divided into five water Zones as stated below. The existing 75 number of service reservoirs and (3 under execution = 78 No.s) in the entire corporation area are divided zones wise. Under the each water zone Table 5.3 shows the number of GSRs/ESRs.

The City currently has 111.82 million liters of storage capacity in 78 storage facilities (ESRs)/ (GSRs) located throughout the City's service area. The total capacity of service reservoirs is more than a quarter of 422.5 million liters of daily supply. Retenion time of service reservoirs: [service reservoir / daily supply x 24 hours] has about 7 hours.

Table 5.3: Existing ESRs/GSRs

WTP Zone	Capacity (MLD)	GSRs/ESRs		Remarks
		Nos	Capacity in MLD.	
Shivajinagar	97.0	26	39.81	
	(Under const.) 48.50	(proposed) 3	(Proposed) 6.00	3 Nos are under construction with NMC fund.
Nashik	81.0	19	26.52	
Panchavati	71.0	15	21.57	
Gandhinagar	26.0	6	9.89	
	(Under const.)26.0	-	-	
Nashik Road	73.0	9	14.03	
Total	348.0	75	111.82	
	(Under const.) 74.5 =422.5	(proposed) 3 =78	(Proposed) 6.00 =117.82	

(5) Existing Clear Water Transmission Mains

Existing clear water transmission mains are summarized in Table 5.4.

Table 5.4: Existing Clear Water Transmission Mains

Sr. No.	WTP Zone	Total length in meters	Diameter in mm		Material
			From	To	
1.	Shivajinagar	48,113	250	1300	C.I., M.S., P.S.C.,D.I.
2.	Nashik Zone	45,436	250	700	C.I.& M.S.
3.	Panchavati	32,530	200	700	C.I., M.S., P.S.C.,D.I., A.C.
4.	Gandhinagar	13,817	200	500	C.I.
5.	Nashik Road	20,540	300	600	C.I., D.I., H.S.
	Total Length	160,436			

(6) Existing Water Distribution System

The Distribution network covers a length of 1440 km., which is about 71 % of the road length. The system, presently, covers almost 95 % of the developed areas excluding the slums. NMC Water supply is intermittent and is supplying a gross of 219 Lpcd. But losses in the transmission and distribution system are exceeding 40 % so the net supply to the consumer end on an average is 131 LPCD which seems to be fair enough compared to the required 135 Lpcd standards as per CPEEHO manual, India. But looking at the uneven distribution of water one can say that in some areas supply might be less than 131 LPCD itself. NMC has network drawings in GIS format but the attributes are not updated.

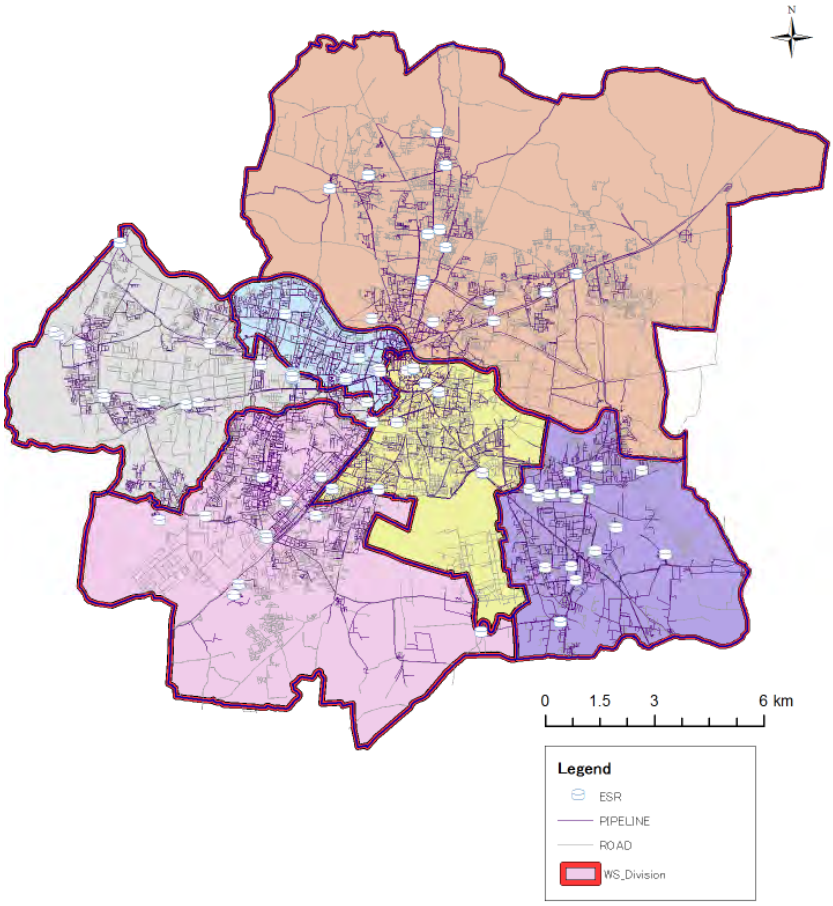


Figure 5.2: Existing Water Distribution Network and ESRs/GSRs locations

The 40 % loss in the Distribution system is mainly due to leakages from improper joints, valves, and taps. Many public stand post and taps are stolen due to which during supply hours there is wastage of water.

5.2.3 Water Tariff of NMC

NMC has levied water tariff as per size of connection and water use effective from 1-04-2000, and revised from time to time, as given in Table 5.5. The last revision was done in 2009 thereafter there was no revision in tariff till date.

Table 5.5: Details of Water Tariff

a) Metered Connection

Sr. No.	Type of Connection	Rate per 1000 lit. From 1-4-2000	From 1-4-2007	From 1-4-2008	From 1-4-2009
1.	Domestic	3.50	4.50	4.75	5.00
2.	Non – Domestic	13.50	18.00	20.00	22.00
3.	Commercial	18.00	22.50	24.50	27.00

b) Non Metered Connection (Timing connection, annual rate for domestic supply)

Sr. No.	Category of Connection	From 1-4-2000	From 1-4-2007 onwards
1.	Water Supply for 2 times	Rs. 1080.00	Rs. 1620.00
2.	Water Supply for 1 times	Rs. 810.00	Rs. 1215.00
3.	Rural Area of the city	Rs. 540.00	Rs. 1000.00
4.	Maharashtra housing colony	Rs. 173.00	Rs. 1000.00

c) Minimum Charges per month for Metered Connection

Sr. No	Size of Connection	Wef. 01-04-2000 Rate / 1000 lit. Domestic (Rs.)	Non Domestic (Rs.)	Commercial / Industrial (Rs.)	Wef. 01-04-2007 Rate / 1000 lit. Domestic (Rs.)	Non Domestic (Rs.)	Commercial / Industrial (Rs.)
1.	15 mm	60	225	300	90	300	400
2.	20 mm	113	450	600	150	600	700
3.	25 mm	225	900	1200	300	1200	1600
4.	40 mm	450	1800	2400	600	2400	3200
5.	50 mm	900	3600	4800	1200	4800	6400
6.	75 mm	1800	7200	9600	2400	9600	12800
7.	Above 75 mm	3375	13500	18000	50000	18000	25400

5.2.4 Revenue Income/Expenditure in Water Supply

O&M of Water supply Schemes, Water tax demand, Revenue income and expenditure for last 5 years are given below in Table 5.6.

Table 5.6: Details of Water Tax, Revenue Income & Expenditure

(Rs. in lakhs)

Year	Water Tax	Water Connection Charges		Other Water Services	**Total Income**	Capital Expenditure	O &M	**Total Expenditure**
		Non-Metered	Metered					
2007-08	187.72	253.82	2379.41	7.02	**2827.97**	565.55	3432.1	**3997.65**
2008-09	182.06	298.33	2613.82	5.18	**3099.39**	1633.74	3466.88	**5100.62**
2009-10	198.03	161.47	3031.23	6.45	**3397.18**	5641.23	3502.18	**9143.41**
2010-11	●310	●20	●4500	57.04	**●4887.04**	●3025	●4402	**●7427**
2011-12	*450	*0	*4500	*55.1	***5005.1**	*5105	*4714	***9819**

* Estimated in Feb 2011
● Corrected Estimate in Feb 2011

The following tables are income and expenditure for NMC.

Table 5.7: Details of Revenue Income & Expenditure of NMC

(Rs. in crore)

Description	2007 – 2008 Actual	2008 – 2009 Actual	2009 – 2010 Actual	2010 – 2011 Actual
Balance Carry Forwarded	5085.52	8592.12	8308.35	5021.32
Revenue Income	627.37	602.73	638.34	820.38
Revenue Expenditure	541.44	519.64	588.13	1185.99

Source – Annual budget Report. NMC Nashik. (Year 2011-2012)

5.2.5 NMCs Organizational Structure

Organizational structure of NMC is shown in Figure 5.3. Number of staff deployed in water supply division is given in Table 5.8.

Table 5.8: Staff Deployed in Water Supply Division of NMC

Projects and O&M Department		Billing and collection Department	
Designation	Nos	Designation	Nos
Superintendent Engineer	2	Billing and collection	83
Deputy Engg	7	Senior clerk	1
Executive Engg	2	Junior clerk	52
Section. Engg	6	Others	30
Assistant Engg	0	Cash Counter	16
Junior Engg	4	Establishment	14
Sub Junior Engg	9		
Support staff (Technical & Non Technical)	326		

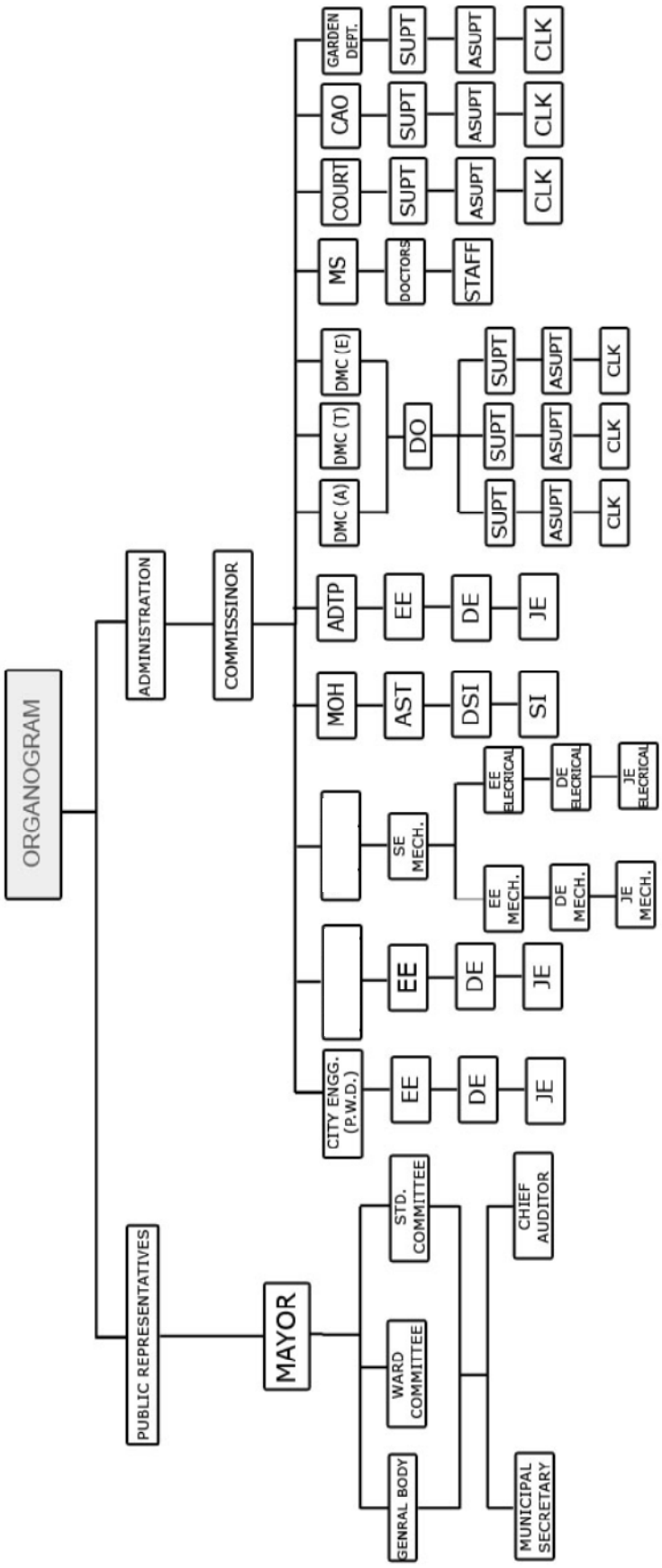


Figure 5.3: Organizational Structure of NMC

5.2.6 On-going Project

(1) Non Revenue Water Study (Funded by GIZ)

NMC's Water Supply System performance on coverage (91% population is served by piped water) and per capita supply is good (149-155 Lpcd). However, NRW is very high (about 57%). Even though 95% of the connections are metered, billing is not linked to volumetric supply due to combination of faulty meter and irregular meter reading operation. In order to know the present status and suggest improvement measures towards reduction of NRW, GIZ is presently conducting studies on NRW covering 5 DMAs in NMC area. The report is likely to be submitted to NMC by the end of February 2012.

It is expected that the study report will indicate specific recommendations/action plan for remedial actions. However, in order to know the current status of NRW in NMC area, it is essential that such study should cover all the DMAs (89 in all) of NMC. If GIZ extends the study covering all the DMAs, the clear cut recommendations would be known which NMC can implement for achieving the desired level of NRW. Otherwise, such study is needed and in that case JICA can provide financial assistance towards such study.

(2) Outline of Master Plan, DPR , Future Project or Sector Development Needs

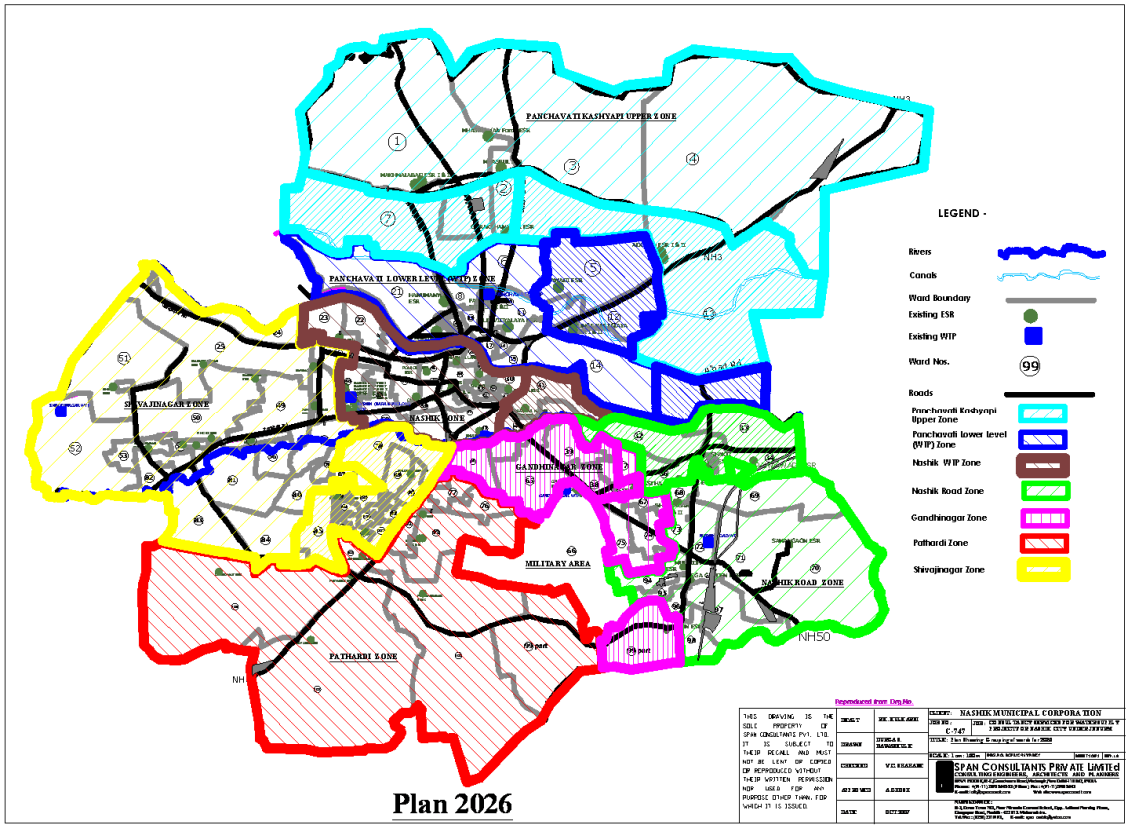
The planning horizon of the master plan is for a period of 30 years from 2011 i.e. up to 2041. The planning is to be made in two phases. The 1st phase is for 15 years from 2011 i.e. up to 2026 (Immediate Stage) and 2nd Phase is from 2026 to 2042 (Ultimate Stage) .

Taking consideration of fast growth of Nashik city, NMC has arrived at the following population and water demand as the basis for future development of water supply system in the city.

Table 5.9: Design Population and Water Demand

Year	Population (lakh)	Gross Water Demand (MLD)
2011	17.5	341
2026	31.75	617
2041	52.50	998

There are five existing water supply zones in Nasik. Two more zones have been added in the future plans. The source of raw water at present is two, namely Gangapur and Darana. The number of sources will be increased to six in the ultimate stage in 2041. The summarized information is given below in Table 5.10. NMC has obtained water reservation of 399.63 M cum from Water Resources Department, Maharashtra State to meet the water requirement up to the year 2041.



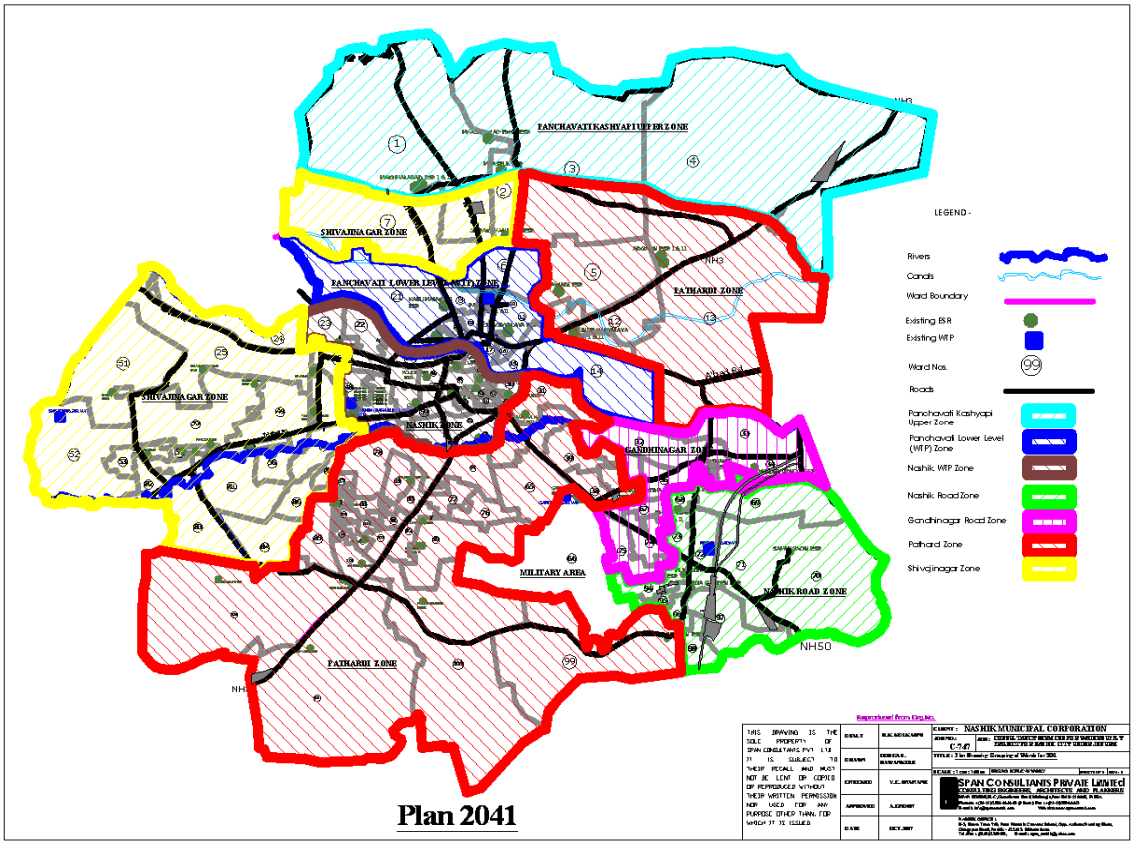


Figure 5.4: Water Supply Zones for 2026 and 2041

Table 5.10: Raw Water Source and WTP Capacity (2026 and 2041)

Sr. No	Name of the Raw- water Source	Name of WTP	Capacity of WTP (MLD)	
			Year 2026	Year 2041
1	Gangapur Dam Supplemented with discharge from Gautami Godavari and proposed Kikwi dam	Shivajinagar	145.5	194.0
2		Nashik	81.0	81.0
3		Gandhinagar	52.0	52.0
4		Panchavati	71.0	71.0
5	Darna River at Chehedi	Nashik Road	73.0	73.0
6	Kashyapi dam	Kashyapi (Panchavati)	-	115.0
7	Mukane dam	Pathardi	207.0	414.0
	Total		**629.5**	**1,000.0**

The planning frame and estimated cost for each phase are shown below.

Phase I (Target year 2026)

Works provided in two parts; Part A and Part B.

Phase I part A work includes.

- Head works at Mukane Dam
- Rawwater transmission from Mukane Dam to Pathardi WTP
- 207 MLD WTP at Pathardi
- Service reservoirs for meeting demand upto 2026 and part distribution

Phase I part B work includes.

- Construction of new Dam at Kikwi
- Rehabilitation of Head works at Gangapur
- Rehabilitation of Head works at Chehedi
- Additional Transmission mains
- Distribution system for 2011 - 2026

Phase II (Target year 2041)

- Head works at Kashyapi Dam
- 115 MLD WTP at Kashyapi
- 207 MLD WTP at Pathardi
- Clear water Transmission main
- Service reservoirs
- Distribution system for 2026- 2041

Cost Estimate (Based on 2008-2009 MJP Schedules of rates)

Table 5.11: Abstract of Cost Estimate

(Rs crores)

Sr.No	Items of Work	Phase I work for 2026		Phase II work for 2041
		Part A	**Part B**	
1	Construction of Dam at Kikwi	-	284.40	-
2	Intake and Head works including Raw Water Mains	192.52	14.92	64.78
3	WTP's	40.67	7.67	60.54

Sr.No	Items of Work	Phase I work for 2026		Phase II work for 2041
		Part A	**Part B**	
4	Clear Water Transmission Main	163.82	153.18	259.43
5	ESR/MBR/GSR	38.86	51.83	89.78
6	Water Distribution	-	98.26	100
	Sub Total	**435.87**	**610.26**	**574.53**
	Total	**1,046.13**		
	Grand Total (Phase I + Phase II)	**1620.66**		

Note: The cost estimate is based on 2008-2009 MJP Schedule of Rates

5.2.7 Scope of Japanese Cooperation

NMC needs financial assistance for implementation of future Water Supply Projects. JICA may provide fund for implementation of Phase I (Part A and Part B) targeting the Year 2026. The amount of loan will be approximately Rs. 1,046.13 crores for Phase I work (Part A and Part B).

5.3 Wastewater System

5.3.1 Existing System

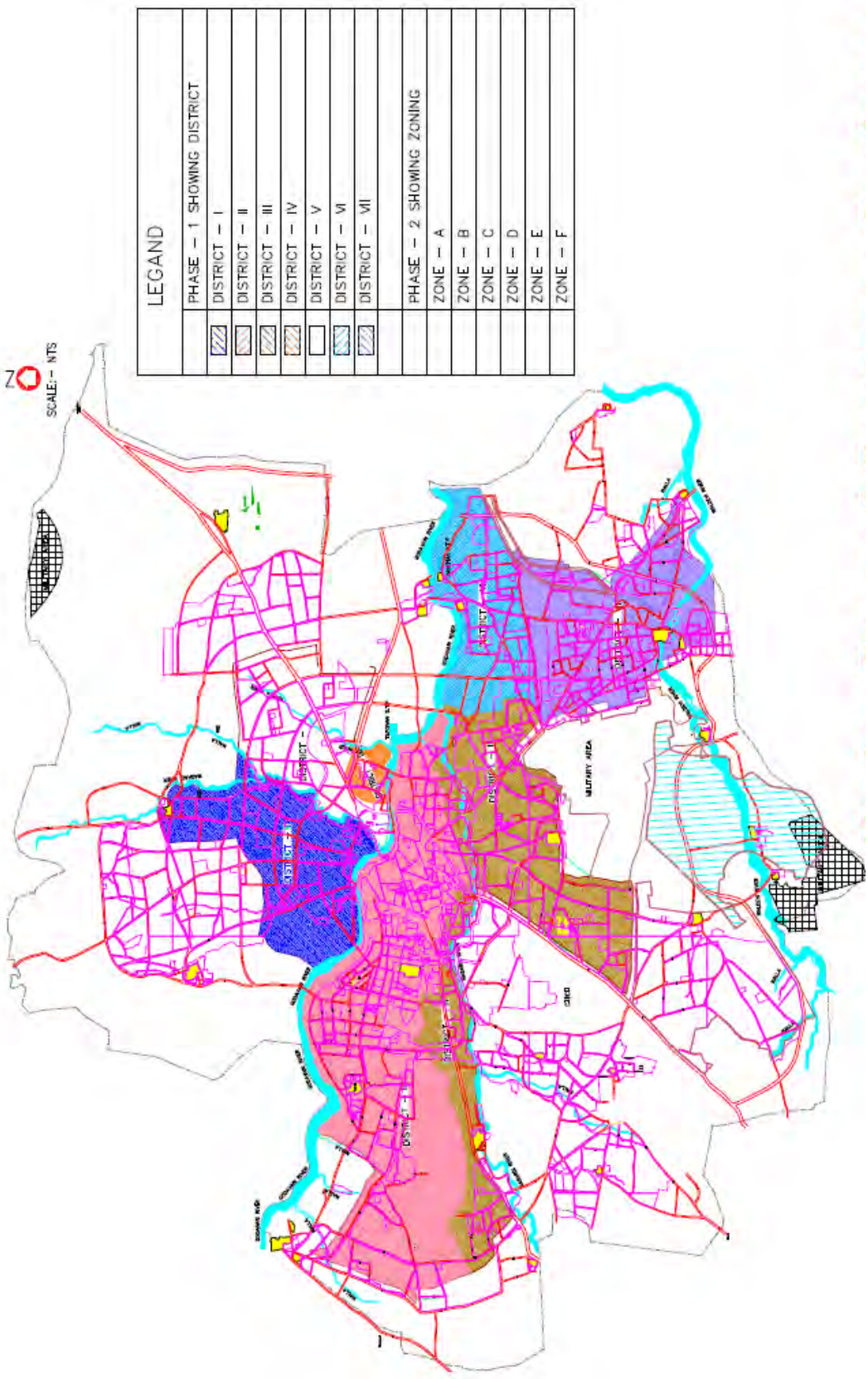
(1) JNNURM Scheme

NMC is implementing new sewerage facility in the city under JNNURM Package I and Package II Schemes. Total cost of Package I is Rs. 148 crores under which works including 185 km of sewer network etc. were completed. Total cost of Package II is Rs. 173 crores and works including 81 km of sewer network etc. are being implemented under this Package.

(2) Existing Sewerage System

NMC area is divided into seven sewerage zones (Tapovan, Agar Tkali, Chehedi, Panchak, Kamathwada, Pimpalgaon Khamb and Gangapur zones). Existing as well as the planned sewerage zones are shown in the map (Figure 5.5).

The City has total Sewer line of 1200 km consisting of Trunk/Intercepting/Branch and lateral sewers. At present about 250 MLD of sewage is generated. There are six existing sewage Pumping Stations and three existing STP's. Ten more Sewage pumping stations and seven STPs are being constructed under JNNURM program some of these facilities are ready. The details are given below.


LEGAND
PHASE – 1 SHOWING DISTRICT
DISTRICT – I
DISTRICT – II
DISTRICT – III
DISTRICT – IV
DISTRICT – V
DISTRICT – VI
DISTRICT – VII
PHASE – 2 SHOWING ZONING
ZONE – A
ZONE – B
ZONE – C
ZONE – D
ZONE – E
ZONE – F
SCALE:- NTS
MILITARY AREA

5.3.2 Sewerage Tariff & Expenditure/Revenue of Sewerage Department, NMC

NMC is charging one time connection charges to the users while providing the house sewer connection. Charges are as under.

1) For individual house - Rs. 1000/-per connection
2) For Society/Apartment - Rs. 2000/- per connection
3) For commercial establishment - Rs. 3000/- per connection

In addition to this sewerage benefit tax up-to 5% of house tax is charged every year from the beneficiaries. The Revenue Collection & O&M Expenditure (at the end of financial year) is given in Table 5.12.

Table 5.12: Revenue Income & Expenditure of Sewerage Department, NMC

(Rs. in Lakhs)

Year	Income				Expenditure		
	One time Connection charges	Sewerage Benefit Tax		Total	Capital	O& M	Total
		Demand	Recovery				
2001-02	23.89	260.50	251.60	275.49			-
2002-03	73.45	320.00	258.88	332.33		138.03	-
2003-04	96.97	320.00	286.30	383.27		274.31	-
2004-05	66.38	457.00	309.80	376.18		447.40	-
2005-06	24.42	460.00	330.40	354.82	2450.00	515.50	2965.50
2007-08	47.16	-	441.17	488.33	1744.02	698.84	2442.86
2008-09	47.16	-	441.44	488.60	657.56	798.58	1456.14
2009-10	48.53	-	490.14	538.67	380.69	804.61	1185.30
2010-11	*66.75	-	**650.00	**716.75	**550.00	**1080.00	1630.00
2011-12	*50.00	-	*964.00	*1014.00	*820.00	*1220.00	2040.00

* Estimated in Feb 2011 ** Corrected Estimate in Feb 2011

(Source – CDP Nashik & Annual Budget Book, NMC)

5.3.3 Organizational Structure of Sewerage (Underground Drainage) Department of NMC

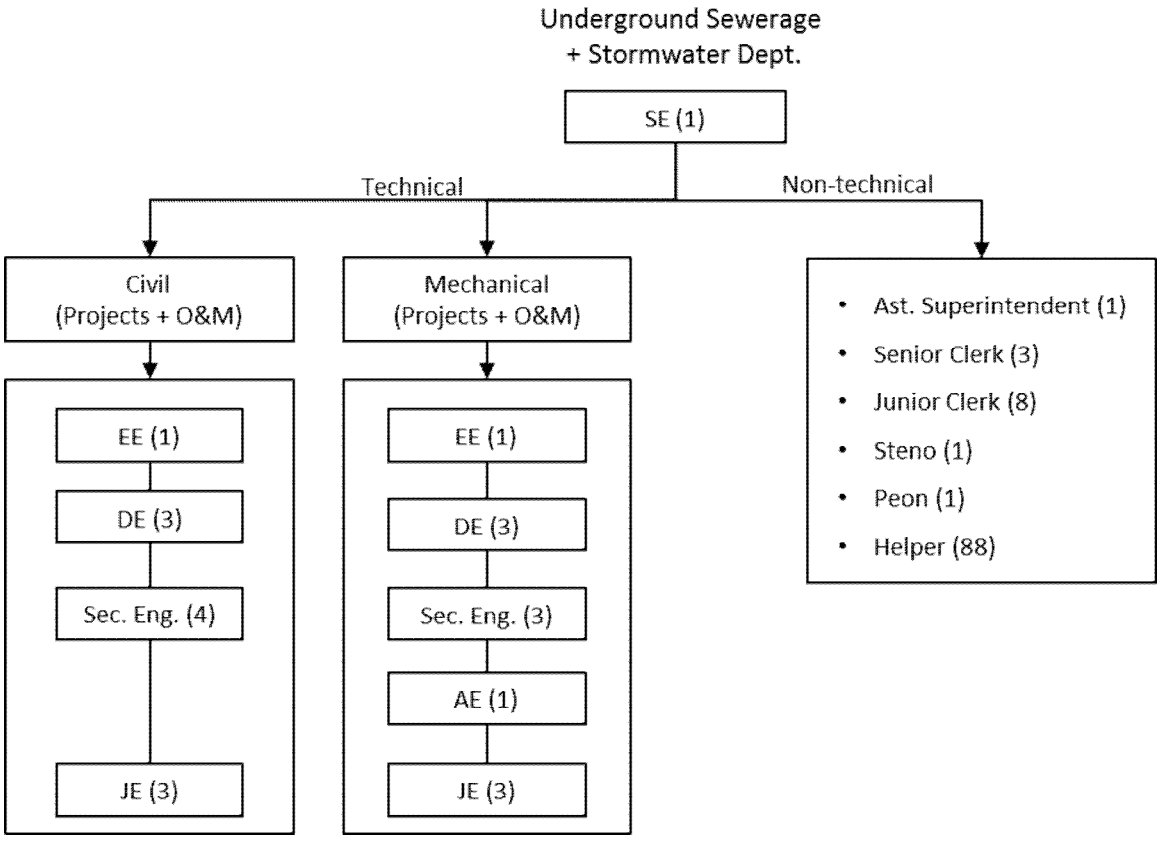


Figure 5.5: Organizational Structure of Sewerage and Stormwater Department
Note: Sec. Eng.- Sectional Engineer, numbers in the parenthesis indicate number of staff

5.3.4 Outline of Master Plan, DPR , Future Project or Sector Development Needs

The Planning horizon is 30 years i.e. from 2011 to 2041. The salient features of the Master Plan which was prepared in 2009, are given below.

(1) Design Years

Master Plan, Sewer and Pumping Station (Civil) : 2041 (Ultimate Design Year)
Pumping Station (E & M)and Sewage Treatment Plant : 2026

(2) Water Demand

As per Water Supply Master Plan.

(3) Sewage Generation

Table 5.13: Sewage Generation

Year	Total Water Demand (MLD) *	Sewage Generation (80% of Water Supply) (MLD)	Total Sewage Generation with 5% Infiltration (MLD)
2011	289.70	231.76	243.35
2021	432.45	345.96	363.26
2026**	524.48	419.58	440.56
2031	616.50	493.20	517.86
2041	852.20	681.76	715.85

* excluding leakage
** an interpolation value

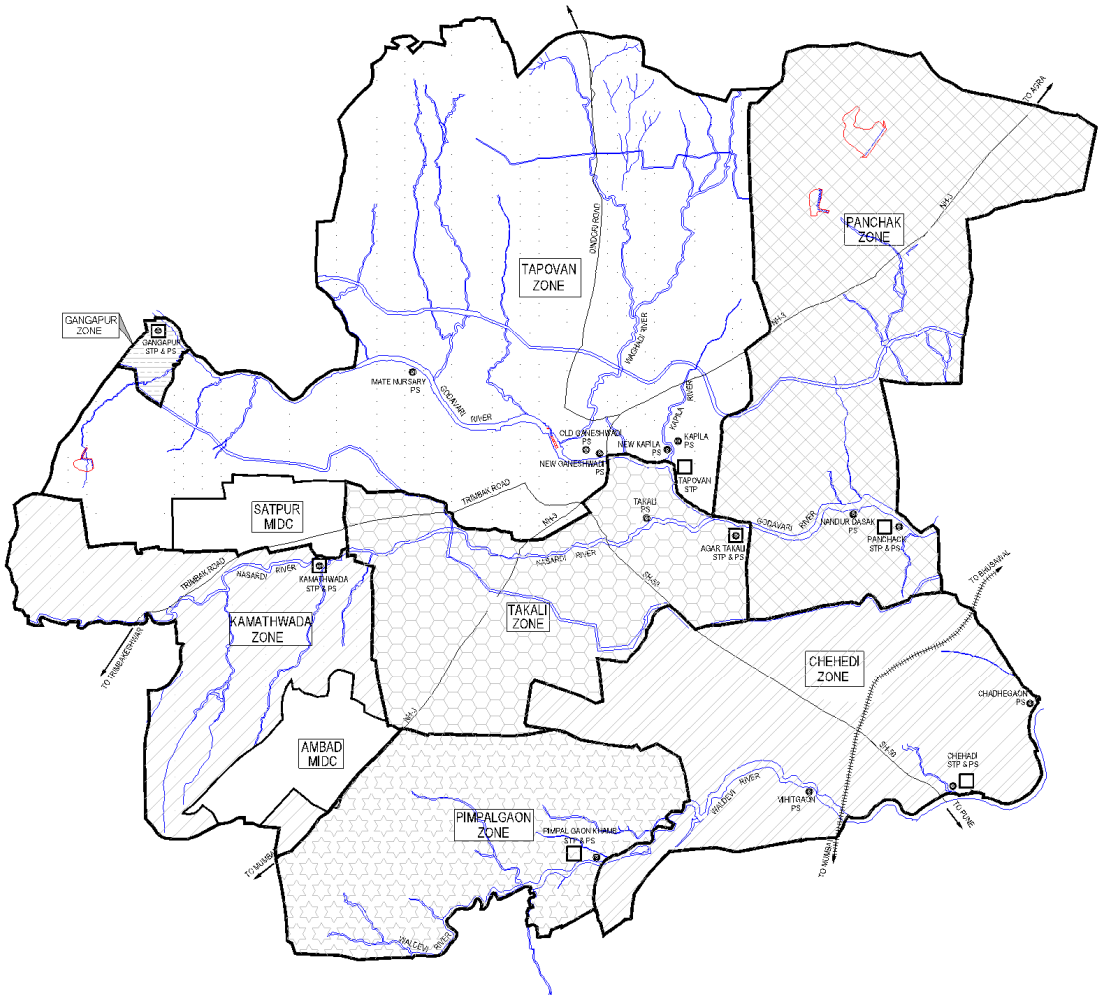


Figure 5.6: Sewerage Zones

(4) Sewage Treatment Plants

Table 5.14: Sewage Treatment Plants

Sr.No	STP Sewerage Zone	Existing Capacity (MLD)	JNNURM Package I (MLD)	STP under Package II (MLD)	Proposed STP (MLD)		Total Capacity (MLD)
					2026	2041	
1	Tapovan	78.0	52	-	-	9.0	139.0
2	Makhamalabad	-	-	-	27	18.0	45.0
3	Agartakli	-	70	40	-	67.0	177.0
4	Chehedi	22.0	20	-	-	28.0	70.0
5	Panchak	7.5	21	32	-	43.0	103.5
6	Kamathwada	-	-	-	36	18.0	54.0
7	Pimpalgaon Khamb	-	-	-	32	22.5	54.5
8	Gangapur	-	-	18	-	10.5	28.5
	Total	**107.5**	**163**	**90**	**95**	**216.0**	**671.5**
			253		**311**		

(5) Sewage Pumping Stations

Total number of Sewage Pumping Stations (Existing and Proposed) in various sewerage zones is twenty to lift Sewage to STPs. The list of the Pumping Station is given in Table 5.15.

Table 5.15: Details of the Sewage Pumping Stations (20 nos) as per Master Plan

Pumping Station Location		Proposed Capacity (MLD)				
		Existing Capacity (MLD)	JNNURM Package I (MLD)	PS under Package II (MLD)	2026	2041
1. Tapovan Zone						
*	New Kapila PS		52		60.36	95.63
*	Old Kapila PS	7.5			1.64	2.34
*	Old Ganeshwadi PS	25			21.04	26.28
*	New Ganeshwadi PS	45			26.93	30.97
*	Takali (Kathegalli PS)	21			20.00	0.00
1A. Makhamalabad Sub Zone						
	Gangapur PS				18.89	25.56
	Makhamalabad STP. PS				10.67	21.69
	Makhamalabad Nalli PS				6.57	13.52
2. Agar Takali Zone						
*	Agar Takali PS		210.0		87.91	142.19
●	Nasardi Sangam PS			40	30.62	38.29
●	Bhadrakali PS			14	10.05	11.41
3. Panchak Zone						
*	Panchak STP PS	7.5			15.04	21.80
*	Dasak Panchak PS		36.5		31.33	54.89
	Nandur PS				33.01	57.84
●	Manur PS			55		
4. Chehedi Zone						
*	Chehedi PS	67			53.82	82.16
*	Chahegaon PS		1.0		2.80	5.01
5. Kamathwada Zone						
	Kamathwada PS				43.68	64.64

Pumping Station Location		Proposed Capacity (MLD)				
		Existing Capacity (MLD)	JNNURM Package I (MLD)	PS under Package II (MLD)	2026	2041
●	Untawadi PS			28		
6. Pimplgaon Zone						
	Pimplgaon Khamb PS				40.97	66.64
7. Gangapur Zone						
●	Gangapur PS			4.5	3.71	5.54
●	Chikhali PS			25	18.42	28.23
TOTAL		**173.0**	**299.5**	**166.5**	**537.46**	**794.63**

Note * Existing PS ● PS under construction (Under JNNURM)

(6) Estimated Cost

The block cost estimate in the sewerage master plan provides the cost of sewer network for the ultimate design period i.e. 2041, for pumping Station (Civil Work) 2041 and pumping Station (E&M) 2026. Sewage Treatment plant cost is estimated for 2026.

Table 5.16: Estimated Cost (Rs. crore)

Sr .No	Component	JNNURM-Pac1&II For2026	Funding by NMC For2041	Capital Cost from M/P For2041
1	Sewerage Network	107.29	291.28	398.57
2	Sewage Pumping Station	53.00	40.28	93.28
3	Sewage Treatment Plant	150.64	20.66	171.30
Total		**310.93**	**352.22**	**663.15**
Contingency (3%)		**10.07**	**9.82**	**19.89**
Grand Total		**321.00**	**362.05**	**683.05**

Source –Master Plan for Sewerage System Revision-2, 2009

5.3.5 Future Projects

NMC is at present carrying out Sewer laying works, constructing Sewage Pumping Stations and installing E & M equipment to meet the demand of 2026 and setting up STPs to treat 253 MLD of Sewage under JNNURM Package I and Package II. Thus the total Sewage Treatment capacity in the city (Existing + JNNURM Package I & II) will be 360.5 MLD. Out of total estimated cost of Rs. 338.55 crores as per the DPR, NMC is implementing facilities costing Rs. 268.76 crores under JNNURM Package I & Package II.

Table 5.17: Estimated Cost for 2026 (Rs. crore)

	Capital cost		JNNURM	GoI&GoM	NMC
	Package I	Package II	Package I	Package II	
Total	166.85	171.70	148.57	85.85+ 34.34	69.79
Grand Total	338.55		268.76		69.79

Source – Detailed Project Report for Underground Sewerage Scheme under JNNURM and Detailed Project Report (Package – II) for Sewerage Scheme under JNNURM

NMC needs additional STP of total 311 MLD capacity in future to treat the wastewater that will be generated in the year 2041. Also, Sewer lines and Pumping plants to lift 311 MLD of Wastewater needs to be constructed, procured and installed to convey wastewater.

5.3.6 Scope of Japanese Cooperation

The future fund requirement to meet 2026 demand under wastewater system for the Nashik city is Rs. 69.79 crores only. Since all the wastewater works indicated in the DPRs for 2026 will be implemented under JNNURM, hence no fund is needed for future work and Japanese cooperation in this field is not required.

5.4 Stormwater Drainage System

5.4.1 Existing System

As per the topography of Nashik, the entire area which is almost 259.13 sq. km is divided into three drainage sub basins namely Godavari, Waldevi and Nasardi sub basins. Various natural drains/Nallas in the sub basins carry rainwater/stormwater runoff from the basin area and discharge the flow into respective rivers. Most of these drains are untrained. However NMC has constructed stone pitching/lining in few of these Nallas. Due to rapid urbanization and construction activities, blocking or reductions in waterways in Nallas have taken place. Road side stormwater drains exist in few locations mostly in highly developed area of the city. The average rainfall is about 737 mm per year. During heavy rains inundation and flooding takes place at number of locations where natural drainage channels are blocked due to unplanned development activities. Existing stormwater drainage system in various parts of the city is given below.

(1) Satpur and Nashik West (50 Sq. km)

In old Nashik city, covered drain of 0.6m X 1.2 m deep exists which starts from Sarda circle and ends at balaji temple near Garge Maharaj bridge and finally outfalls into Godavari River. Another drain lined with masonry wall meets Saraswati Nalla and finally into Godavari. 300 mm dia Stormwater drain on both sides of road Dhanta market meets river Godavari near Grage Maharaj statue. At Papayan Nursery on northside of Nasardi River, 900mm dia RCC pipes are laid. Open drains of 1.5m X 1.5m on average bed level of 1.6 m at Papayan Nursery Northside to Maule Mangal Kartalaya to Nilkantheshwar Nagar are laid to drain off stormwater. 1200 mm dia RCC pipe drain exists in Godavari Right Bank Canal Sr.No 25/27 to Anandwali School to drainoff surrounding area. Similarly Gangapur Road to Anandwali leading to Godavari River, an open Gutter of stone masonry exists.

(2) Panchavati Division (120 Sq. km)

The Stormwater drains in this area are laid in a piecemeal manner, 300 mm dia RCC pipe with M.S jali is laid for immediate relief of Stormwater from Saraswati Nagar, Sainagar and from Bhagwatinagar to Waghadi Nalla. An open Nalla is trained in between Peth road to Ashamedh society. 1000 mm dia pipe is laid from Dindoli Nalla which joins Aruna Nalla. Stone pitching Gutter is constructed from NH3 to Gorabshanagar Dindoli road for Partial disposal of Stormwater. There is no planned underground Stormwater drainage System in this area.

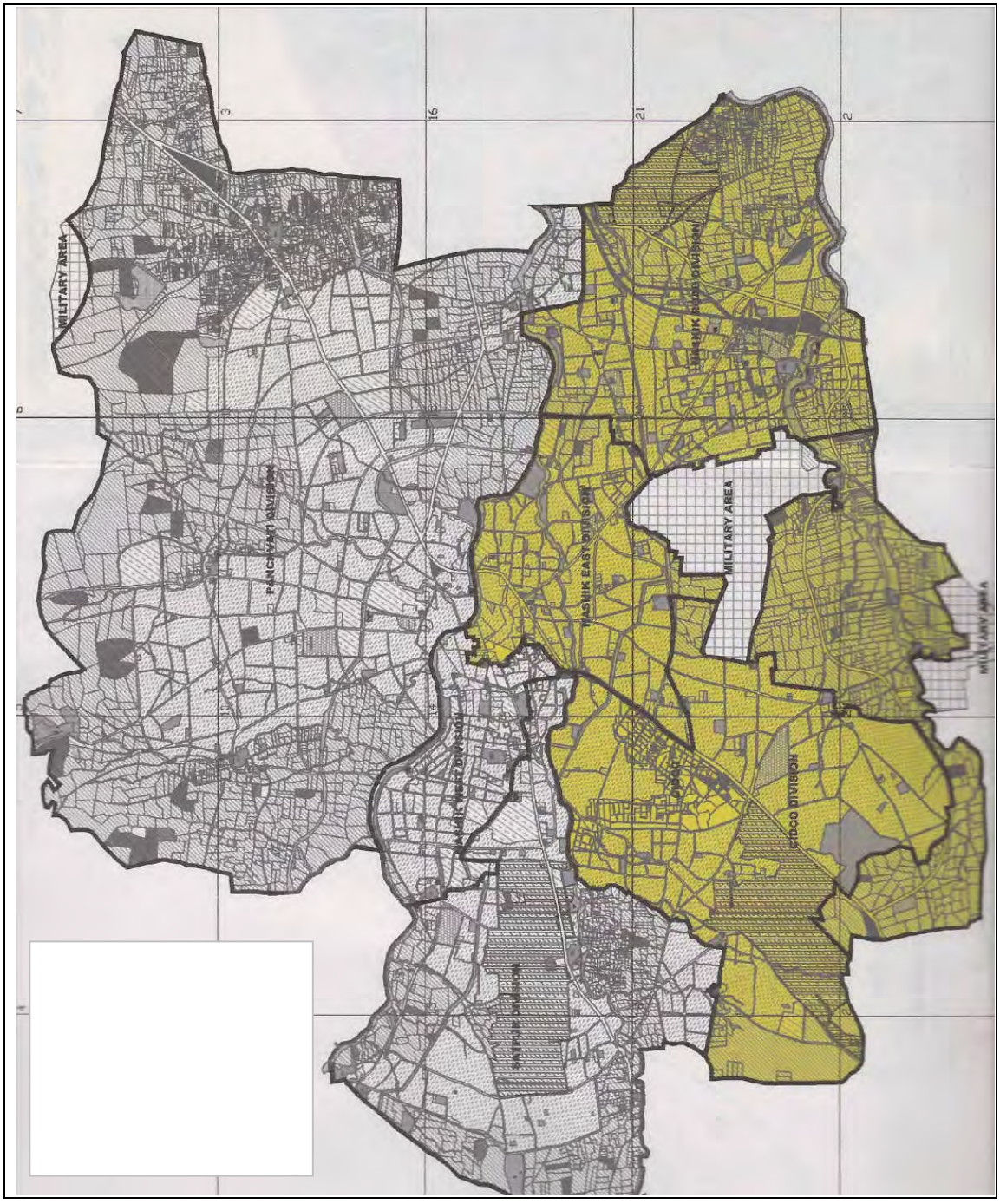


Figure 5.7: Storm-water Drainage Basins in NMC

(3) Nashik East, Nashik Road & CIDCO division (80 Sq.km)

Following Gutters are constructed for the disposal of Stormwater from surrounding pockets.

- Vijay-Mamta to Nasradi River – Stone masonry
- Gandhinagar compound to Takli – Built up gutter
- Pimpla chowk to Matangwada to Saraswati Nalla – Stone Masonry gutter
- Pankhal road to Ashok Marg- Stone masonry and open drain
- Gajanan Maharaj Mandir Nalla – Open drain

In certain areas like Gadage Maharaj statue to Grain market 300 mm dia RCC pipe line is laid on both sides of road leading to Godavari River. 450 mm dia RCC drain pipe exists from Tagorenagar to Auravga Bodkar society. These are also short term measures for disposal of Stormwater. The entire Stormwater drainage system that exists in the city is a temporary relief to the area from flooding.

5.4.2 Expenditure of Storm-Water Department, NMC

Table 5.18: Expenditure of Storm-Water Department, NMC

(Rs. in Lakhs)

Year	O / M	Capital	Total
2007-08	189.06	141.21	330.27
2008-09	254.78	198.73	453.51
2009-10	227.56	673.02	900.58
2010-11**	150.00	401.00	551.00
2011-12*	200.00	821.00	1021.00

* Estimated in Feb 2011 ** Corrected Estimate in Feb 2011

(Source – Annual Budget Book 2011-2012, NMC)

5.4.3 Organizational Structure of Stormwater Department, NMC

NMC has a single department handling both the sewerage and stormwater drainage. Thus, the organizational chart is same as shown in Figure 5.5. Number of staff allocated to the stormwater section is given in Table 5.19.

Table 5.19: Staff Strength of the Stormwater Section

Projects and O&M Department	
Designation	No. of Personnel
Superintendent Engineer	1
Executive Engg	1
Deputy Engg	3
Assistant Engg	1
Section. Engg	2

5.4.4 Outline of Master Plan, DPR , Future Project or Sector Development Needs

A Master Plan and DPR for stormwater drainage system for NMC area has been prepared in June 2007. M/S Multi Mantech International Pvt Ltd. of Ahmedabad was entrusted with the job by NMC.

(1) Design Consideration

The entire proposed stormwater drainage system of the city will have gravity discharge and no stormwater pumping is needed. Design considerations are;

- Separate stormwater drainage system (separate system)
- Mostly underground pipes with manholes and catch basins
- Estimate of runoff by rational method
- Frequency of storm for the design of storm drainage system

  Residential area: twice in a year

  Central high value area: once a year

  Commercial high price area: once in 2 years
- Intensity of Rainfall

  The Intensity value adopted for the design is given below.

Table 5.20: Design Rainfall Intensity

Time "t" (Minute)	Intensity "i" (mm/hr)
5	33.54
10	19.81
15	14.31
20	11.72
30	8.43
40	6.87
50	4.98
60	4.46
70	3.68

- Imperviousness Coefficient

Table 5.21: Imperviousness Coefficient

Type of Area	Percentage of Imperviousness	Adopted value
A) Residential Area		
(i) High density	60-75	65
(ii) Low density	35-50	40
(iii) Parks & undeveloped areas	10-20	30 (Rocky)
B) Commercial Area & Industrial Area	70-90	80

- Velocity of flow

  Minimum Velocity 0.3-0.6 m/sec

  Max Velocity 3.0 m/sec

(2) Estimated Cost of the Stormwater Drainage Works

The Estimate is based on Maharashtra Jeevan Pradhikarnn Region Nashik Schedule of Rates for 2006-2007 and Government of Maharasthra Public Works Department, Nashik Region for the year 2006-2007. Estimated cost is summarized in Table 5.22.

Table 5.22: Estimated Cost

Sr No	Description	Amount in Rs Cores
1)	Satpur & Nashik West division (50 Sq Km Area)	61.71
2)	Panchavati Division (120 Sq. Km)	83.49
3)	Nashik East, Nashik Rd & CIDCO Division (80 Sq. Km)	110.14
4)	River Training Works	45.93
	Total	301.27
	Contingency	9.04
	Grand total	**310.31**

As per feedback from the concerned S.E., the items from Sr. No. 1) to 3) in the above table will be included in road construction as integral parts of the road design and hence they need not to be included here. Instead, a new item of Natural Nalla training should be included and the Department of sewerage and drainage in NMC should concentrate on river and natural Nalla training works. Necessary survey works and preparation of DPR should be a part of the further study.

5.4.5 On-going Project (including Financial Source)

Stormwater drainage facilities are being implemented under JNNURM program, and are likely to be completed by March 2012.

5.4.6 Future Projects

All the stormwater drainage works will be completed under JNNURM and no further work is needed.

5.4.7 Scope of Japanese Cooperation

Since all the stormwater drainage works indicated in the Master Plan for this city will be implemented under JNNURM, hence no fund is needed for future work and Japanese cooperation in this field is not needed.

6. AURANGABAD MUNICIPAL CORPORATION (AMC)

6.1 General

Aurangabad is one of the fastest developing cities of India. It is becoming a major industrial, educational and tourism center of India. In next two decade demography of Aurangabad will change rapidly due to the major project planned in and around in Aurangabad. Aurangabad has been included in the **"Delhi Mumbai Industrial Corridor"**.

6.1.1 Population

Between 1961 and 1971, the population of the city increased by 65% and reached the level of 1.65 lakhs. There was a very rapid decadal growth of population between 1971-81, (95.5%) and 1981-91 (87.7%). The city achieved the distinction of being the fastest growing city in Asia. In 2001, the population of Aurangabad City, which includes Aurangabad city, CIDCO Area, and the Cantonment area, has reached 8.73 lakh spread over on area of about 137.40 sq.km. Taking into account the past trends of the population growth of the city, it is likely to cross 14 lakh by 2011. The main factors responsible for the rapid growth of population of Aurangabad City during last 3 decades are rapid expansion of its industrial sector and growth of educational facilities.

6.1.2 Location

The city is a tourist hub, surrounded with many historical monuments, including the Ajanta Caves and Ellora Caves, which are UNESCO World Heritage Site. Aurangabad is located almost in the central part of the State of Maharashtra at an altitude of approximately 513 meters above the sea level.

6.1.3 Climate

Aurangabad features a semiarid climate under the Koppen climate. Annual temperatures range from 9 to 40 °C, with the most comfortable time to visit in the winter - October to February. In the cold season, the district is sometimes affected by cold waves in association with the eastward passage of western disturbances across north India, when the minimum temperature may drop down to about 2°C to 4 °C. Most of the rainfall occurs in the monsoon season from June to September. Average annual rainfall is 725 mm.

6.1.4 Municipal Corporation

The Municipal Council was established in 1936. It was elevated to the status of Municipal Corporation from 8th December 1982 and simultaneously including eighteen peripheral villages making total area under its jurisdiction to 138.5 sq. km. AMC has been divided into 99 wards.

6.1.5 MIDC

The Shendra, Chikalthana and Waluj MIDC Industrial Areas are prominent industrial zones on the outskirts of the city, with various major multinational groups having set up manufacturing or processing plants in and around the city.

6.1.6 Services Level

Table 6.1: Services Level Benchmarking

No.	INDICATORS	BENCHMARK	EXISTING STATUS	AIM FOR PROGESS TILL MARCH 2012
WATER SUPPLY				
1	Coverage of water supply connection	100%	70%	100%
2	Per capita supply of water	135 LPCD	80 LPCD	?
3	Extent of metering of water connection	100%	-	25%
4	Extent of non-revenue water	20%	55%	40%
5	Continuity of water supply	24x4	Alternate day	-
6	Quality of water supplied	100%	100%	100%
7	Efficiency in redressal of customer complaints	80%	50%	60%
8	Cost recovery in water supply	100%	100%	100%
9	Efficiency in collection of water supply related charges	90%	40%	70%
SEWERAGE				
10	Coverage of toilets	100%	60%	75%
11	Coverage of sewage network services	100%	60%	75%
12	Collection efficiency of the sewage network	100%	60%	75%
13	Adequacy of sewage treatment capacity	100%	5-6%	30%
14	Quality of sewage treatment	100%	80%	100%
15	Extent of reuse and recycling of sewage	20%	0%	5%
16	Efficiency in redressal of customer management	80%	60%	70%
17	Extent of cost recovery in sewage	100%	0%	50%
18	Efficiency in collection of sewage charges	90%	0%	50%
STORM WATER DRAIN				
27	Coverage of storm water drainage network	100%	25%	50%
28	Incidence of water logging/flooding	0%	30%	10%

Source: DRAFT CITY SANITATION PLAN AURANGABAD 2011

6.1.7 Financial Status of AMC

For the Fiscal Year 2009-10 AMC's income and expenditure was as follows:

- Revenue Income Amount Rs. 242.82 crores
- Expenditure Amount Rs. 261.54 crores

Water billing and collection for fiscal year 2009-10:

- Billing – Rs. 573,977,364
- Collected – Rs. 167,454,312
- Expenditure – Rs. 386,135,000

(Source: City Sanitation Plan)

As per the information from AMC, it has about 400 crores annual budget for FY 2010-11. It generates about 300 crores from internal sources, mainly from Local Body Taxes and the balance 100 crores is obtained as grants from state and central governments. It collects about 25 crores from water tax and additional 9 crores from sewerage. Expenditure in these sectors is about twice that amount.

6.1.8 Organizational Structure

AMC has 17 Departments in total. Departments for water supply and sewerage are separate. The sewerage department also handles the storm water.

City Engineer heads the water supply and sewerage departments. There are 1 EE, 5 DEs, 16 JEs, and 250 line men in water supply department. The numbers in sewerage department are 1 EE, 4 DEs, and 10 JEs. Field work of sewerage department is outsourced.

6.2 Water Supply System

6.2.1 Present Water Supply System

AMC manages water supply services through 6 administrative divisions with staff strength of 370 employees. The water supply department is responsible for capital work, regular operation and maintenance of the system, water supply to the city of Aurangabad, and the related billing and collection. Currently AMC charges flat yearly tariff to its customers, for about 100,000 water connections under its jurisdiction.

At present, AMC supplies 162 MLD water to 11 lakh population. The gross per capita supply is about 147 Lpcd. Due to high leakage resulting partly from the old pipes, actual supply is below that amount. Hence, AMC has started alternate days water supply since September 2001.

6.2.2 Source of Water

1) Before Jayakwadi dam water

There are two small-sized water supply systems. One is Nahar-E-Ambri. It is a gravity water supply scheme. It was completed in 1618 and available drinking water is about 1.5 MLD.

Another is Wohar (Harsol) Dam, constructed across the river Kham and its capacity is 6.67Mm^3 a year. The Harsol dam source is very old constructed during 1954 with a capacity of 10 MLD. This source is located within the city, and presently about 8 MLD of water is drawn from this source. The Harsol dam was constructed for a very small population, and is not reliable source. There are two small transmission mains of 450 mm diameter RCC pipes for Harsool water supply scheme and treated at Delhi gate in the city.

2) The Jaykwadi Dam Water

The dam is constructed on the river Godavari at 50 km distance from the city. Its water is used mainly to irrigate agricultural land.

There are two water treatment plants adjacent to each other in Pharora taking water from this dam. The older system with pipeline of 700 mm produces 56 MLD and the newer system with pipeline of 1200 mm diameter produces 100 MLD drinking water. The sources of water supply and features of WTPs are summarized in Table 6.2.

Table 6.2: Water Supply Sources of AMC

Sr No.	Name of Scheme	Distance From	Capacity	Year of Commissioning	Year for completion of Design Life	Life of Scheme	Present Status – Lifting at Head Works
1	Neher - E - Ambari	4.5 km	2 MLD	1616	---	---	1.5 MLD
2	Harsul	6 km	10 MLD	1956	1986	50 years	10 MLD
3	Jaikwadi(Old)						
	a) 1st Phase	45 km	28 MLD	1975	2005	30 years	56 MLD
	b)2nd Phase	45 km	28 MLD	1985	---	20 years	
4	Jaikwadi(New)	45 km	100 MLD	1991	2021	30 years	100 MLD
Total					167.5 MLD		

(Source: City Sanitation Plan, 2011)

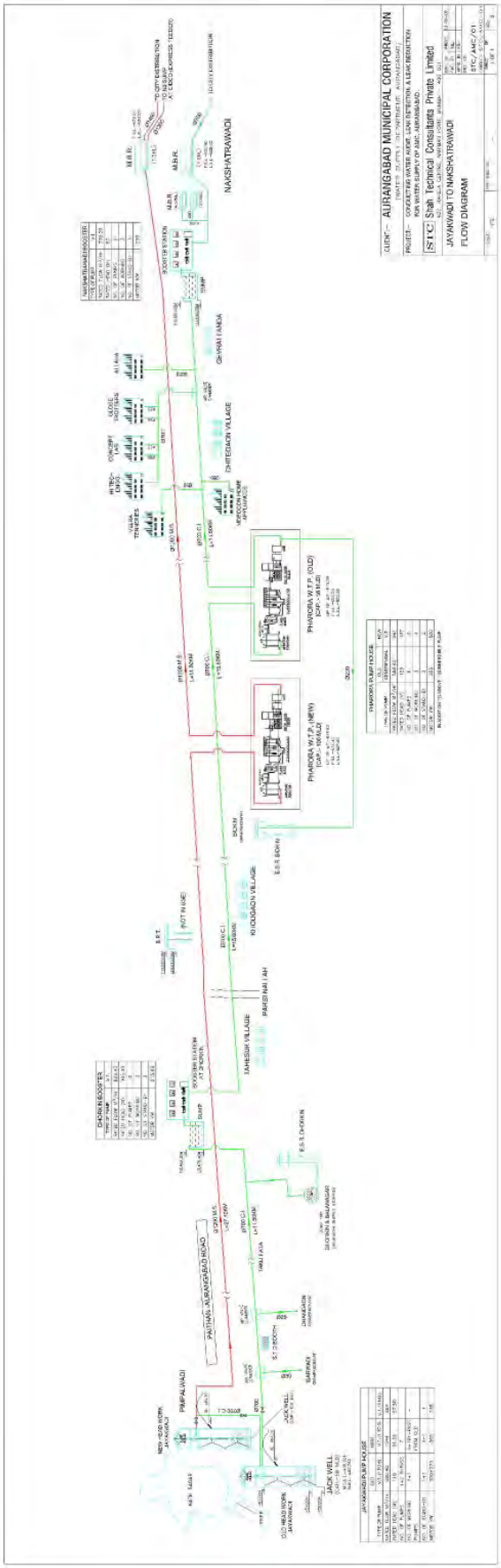


Figure 6.1: A Parallel Water Supply Scheme for Aurangabad

6.2.3 Distribution Network

On an average of about 70% to 80% of the city area is covered with distribution network while the rest of the city takes water through tankers or bore wells. Many of the pipes are 30 year old and their condition is not good. Aurangabad city with aging and poorly maintained distribution systems and increasing water losses in the utilities have been forced to reduce hours of service. Most part of the city is provided alternate day water supply for about 60 to 90 minutes.

At present the distribution system has a pipeline network, including feeder mains of about 970 km, serving 6 water districts (zones). Currently there are 63 service reservoirs having total capacity of 800.55 lakhs litres . As per the records, about 100,000 domestic connections are given.

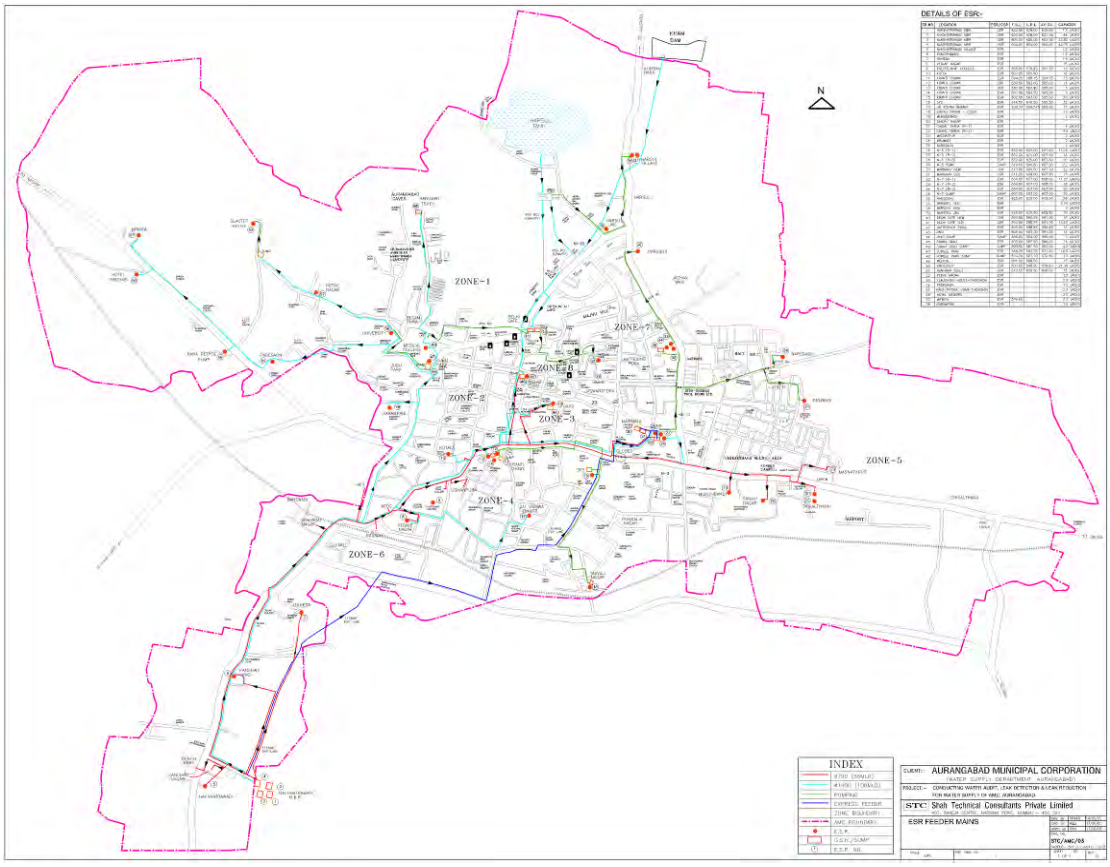


Figure 6.2: Existing Water Supply Distribution System

<u>Existing Water Distribution System – Issues</u>

Currently NRW stands at about 50%. The estimated real losses are at about 33% and apparent/commercial losses are at about 17%. Reducing non-revenue water (NRW) is one of the most important issues in Aurangabad.

Following are the issues identified with the existing water distribution system in Aurangabad:

- Very high NRW;
- Unequal distribution of water;
- Estimated rate of water supply, at around 80 LPCD, lower than CPHEEO norm of 135 LPCD;
- Inadequacy of water supply;
- Use of AC pipes in distribution network, causing water losses;
- Higher energy cost, as a result of booster pumping; and
- Number of parallel lines on the same road

6.2.4 Aurangabad water supply scheme

There is a deficit of water on the part of demand and supply in the city and, a comprehensive planning is required for the water supply to the city. The scheme has to be planned for the ultimate stage which can be reached in the year 2031. For the augmentation of water supply scheme, the water requirement of the city is at the rate of 160 LPCD at source with system losses as 15% considering water supply at consumer end as 135 LPCD is 323 MLD.

A parallel water supply scheme submitted to Ministry of Urban Development (MoUD) in 2006 under UIDSSMT and sanctioned in 2009. The project has two sub-components;

i) Building a new bulk water pipeline with a WTP; and
ii) Refurbishment of an existing distribution system.

Project scope is 320 MLD for 2038 for 23.58 lakh population @135 LPCD, 1st stage by 2023 (160 MLD) and 2nd stage by 2038 (320 MLD).

AMC initiated a comprehensive project aimed at improving the water supply system of the Aurangabad City on PPP basis. The PPP had passed a General Body resolution in August, 2009 and competitive bidding process was initiated in September, 2009. The approximate cost of the project was Rs. 638.38 Crores, which had the following main components with design period of 30 years (horizon year of 2041):

(i) Construction of a new parallel water pipeline from Jaikwadi dam to Nakshtrawadi major balancing reservoir. This construction includes the construction of a new water treatment plant between Jaikwadi dam and Nakshtrawadi major balancing reservoir;
(ii) Construction and rehabilitation of transmission mains (Harsool scheme), trunk mains and feeder mains;
(iii) Rehabilitation of the existing distribution and transmission water supply system of Aurangabad city;
(iv) Increasing the piped water supply coverage to the entire population of the Aurangabad

city and maintaining water supply at 24x7 through building new/rehabilitated distribution and transmission systems;

(v) Reduction of non-revenue water by reduction of technical losses through leakage management and reduction of commercial losses in water supply system through identification and regularization of illegal connections;

(vi) Operating and maintaining the Aurangabad water supply scheme in accordance with the service level requirements; and

(vii) Undertaking metering, improving billing and collection system in relation to the water supplied via the Aurangabad water supply scheme on behalf of AMC.

The estimated cost of the Project as specified above (INR 638.38 crores) will be contributed to the Project as described in Table 6.3.

Table 6.3: The estimated cost of the Project

Rs. crore	Transmission System	Distribution System	Transmission, trunk, feeder mains	Metering	Total
Total Cost Estimate	346.22	166.36	69.17	56.63	638.38
Total Grant	274.54	125.75	NA	39.64	439.93
UIDSSMT	203.04	85.14	-	-	288.18
GoM – original	25.38	10.64	-	-	36.02
GoM – additional	46.12	29.97	-	-	76.08
MSNA	-	-	-	39.64	39.64
Concessionaire's contribution	71.68	40.61	69.17	16.99	198.45

* UIDSSMT: Urban Infrastructure Development Scheme for Small and Medium Towns
(Source: DRAFT CITY SANITATION PLAN AURANGABAD & REQUEST FOR PROPOSAL for Aurangabad Water Supply Project)

In April 8, 2011, a Consortium of SPML Infra Limited, VA-Tech Wabag, and National Water and Sewerage Corporation (the Consortium selected as preferred Bidder Concessionaire) was established as a special purpose corporation (SPC). A Concession Agreement was then signed with AMC on 22nd September 2011. The SPC will undertake the above activities, operate and maintain the entire system for a specific duration after which all the assets have to be transferred to AMC.

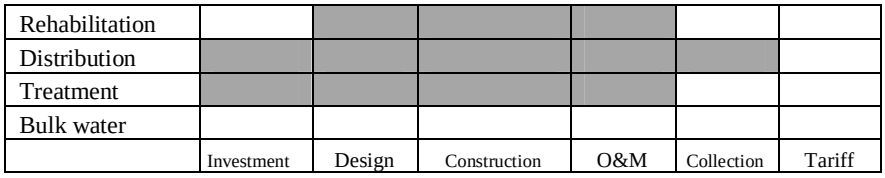
The outline of PPP scheme is indicated as below.

Scheme:	Build, Refurbish, Operate & Maintain the Water Supply System of the Aurangabad City
Period:	20 years (Construction and rehabilitation period: less than 3 years, O&M period: after construction period)
Contract value:	Rs. 7,920,000,000 (Project grant Rs. 3,995,300,000 from GoI and GoM)

Role & Responsibilities :

	SPC (Aurangabad City Water Utility Company Ltd.)	AMC (Urban Local Body)
Primary task	- designs, plans, constructs a new water treatment plant, major balancing reservoir, new parallel water pipeline	- supplies raw water - set the base rate for raw water annually
	- operates and maintains facilities	- oversees construction, O&M activity
	- reduces non-revenue water through leakage management	
	- extend water supply coverage area when requested and required	
Billing and revenue collection	- undertakes metering, and improving billing and collection system - generate bills, collects revenue from users	- determines the tariff level - schedule for change
Asset ownership	- only given right to use the existing assets from AMC - Return assets at the end of contract period	

Conceptual diagram of PPP scheme



6.2.5 Future Project or Sector Development Needs

There is no scope of Japanese assistance.

6.3 Sewerage System

6.3.1 Current Situation

The area of the AMC is divided in to administrative and institutional set up as city area, CIDCO area and MIDC area. In MIDC area the sewerage is taken care by the individual industrial units whereas in the city area and CIDCO area the sewer lines are laid by Municipal Corporation and CIDCO.

AMC has a combined sewer system, *i.e*, the wastewater and stormwater is collected together before treating or discharging untreated. The city sewer system consists of about 892 km of sewers ranging in size from 150 mm to 21 inches in diameter. The system operates almost totally by gravity, having only two small pump stations. Besides these 892 km of city sewers, there are additional 48 km of large-diameter trunk sewers that are owned and operated by AMC and that convey the City's wastewater to the STP at Chikalthana. There are also additional 9 km of small-diameter sewers serving unauthorized localities that are owned and operated by the AMC.

Currently about107 MLD of sewage is generated in AMC. Although two STPs exist, only one is working, thus out of about 107 MLD sewage generated only 6.5 MLD is treated. The rest finds its way to nearby Nallas and then to the rivers.

6.3.2 Future Project or Sector Development Needs (Objective and Goal)

AMC has prepared a Master Plan and subsequently the DPR for sewerage system covering a period upto 2045. The MP envisages providing sewerage system for 100% area in 99 Wards of AMC, in the phased manner.

Table 6.4: Projection of Sewage Generation

Year	Incremental Increase	Water supply rate (LPCD)	Water Requirement in MLD	Projected Residential Sewage Generation (MLD)	Additional generation from other areas such as commercial, industrial and institutional	Total Sewage Generation (MLD)
2011	1175278	135	158.66	133.27	22.76	156.03
2013	1241929	135	167.66	140.83	24.05	164.88
2028	1849037	135	249.62	209.68	35.81	245.49
2043	2438750	135	329.23	276.55	47.23	323.78

(Source: Sewerage DPR)

Salient features of the sewerage project are summarized in Table 6.5.

Table 6.5: Salient Features of the Sewerage Project

S.N.	Description	Quantum
1	Sewage generation and sewerage system	
a)	Per capita water supply / day	135 LPCD
b)	Total wastewater / day in (Year 2013)	164.88 MLD
c)	Total wastewater / day in (Year 2028)	245.4 MLD
d)	Total wastewater / day in (Year 2043)	323.78 MLD
e)	No. of sewerage zones	7
f)	No. of Phases	1
g)	No. of collecting sump & pumping station	3
h)	Diameter of sewers proposed	150 mm (min) & 1600 mm (max). Total length of sewer pipe - 544 km.
i)	Treatment process proposed	I. Sequential Batch Reactor (SBR) for new treatment plant, II. Upgradation and refurbishment of existing STP by extended sludge age
j)	No of treatment plant and capacities in MLD	6 Nos., 183.74 MLD
2	Cost of the scheme	Rs. 406.4 crores
3	Cost sharing	
	GoM share – 50%	Rs 203.2 crores
	Loan component – 50%	Rs 203.2 crores
4	Operation & maintenance cost	Rs. 66.13 crores including loan repayment
5	Sanitary / Sewerage tax / tariff	Rs. 1300/ house

(Source: Adapted from the Sewerage DPR)

Table 6.6: Summary of Existing and Proposed STPs

S.N.	Name of STP	Total Capacity Required (MLD)	Existing STP (MLD)	Capacity of STP Proposed for 2028 (MLD)	Type of Treatment	Capacity of STP Proposed for 2045 (MLD)	Remarks
1	Banewadi	60		30	SBR		
2	Kanchanwadi	177.2		100	SBR	109.74	
3	Siddhartha Garden	4.5		4.5	SBR	0	
4	Salim Ali	8.04	5.5	0	SBR	0	Construction under progress
5	Padegaon	17.17		12.88	SBR	4.29	
6	Cidco	26.2	6.5	13.34	Upgrade of existing plant with disc filter and centrifuge	12.86	Existing STP of 6.5 to be upgraded to 13.44
7	Zalta	30.6	5.4	23.02	Extended aeration	7.58	Existing STP of 5.4 to be upgraded to 23.02
	Total	323.71	17.4	183.74		134.47	

(Source: Sewerage DPR)

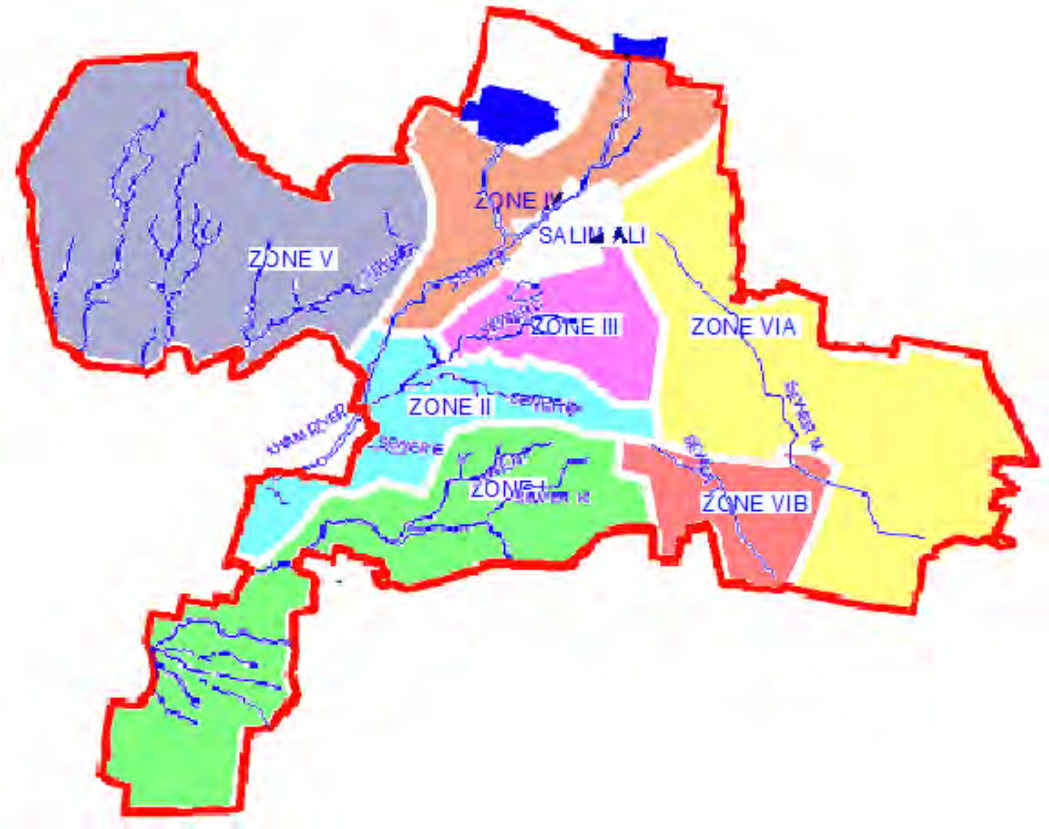


Figure 6.3: Proposed Trunk Sewers for Aurangabad

The cost estimate is based on Schedule of Rates 2010-11 for MJP Aurangabad region.Proposed cash flow of the project is as follows:

(a) First year: Rs. 121.92 crores
(b) Second year: Rs. 203.20 crores
(c) Third year: Rs. 81.28 crores

As per the information from AMC, the DPR has been submitted to the Government of Maharashtra for funding under "Maharashtra Suvarna Jayanti Nagarutthan Mahabhiyan" Program with funding pattern of 50% as grant and 50% as loan from GoM. Government resolution on Maharashtra Suvarna Jayanti Nagarutthan Mahabhiyan program was passed on February 2010 and aims at the development and augmentation of the urban infrastructure of Urban Local Bodies of the Maharashtra State. AMC is awaiting the further steps from the GoM.

6.3.3 Scope of Japanese Cooperation

As Master Plan and DPRs have already been prepared there is no need for any technical assistance but depending upon the availability of funding from GoM, JICA's financial assistance may be helpful. Being a comparatively small and in not-so-sound financial situation AMC is of the view that if JICA can provide the amount as Grant Aid rather than loan. From the field survey it is clear that the sewerage system improvement of AMC is of utmost importance.

6.3.4 Storm Water System

In Aurangabad most of the rainfall occurs in the monsoon season from June to September. Average annual rainfall is 725 mm. As AMC adopts combined sewerage system the stormwater finds its way to sewer network and gets discharged into rivers along with the sewage.

6.3.5 Topography and Drainage System

Topographically area of Aurangabad city is divided in to two natural drainage systems. Zone A comprises of Kham River and its tributaries and Nallahas, whereas Zone B comprises of Sukhana River and its tributaries. The majority of area (75 % to 80 %) is having slope towards Kham river basin.

Primary Drain (Nallahs)

Major natural canals, which are running in north-south direction and a few natural canals cut across the sand bars. The primary canals which convey the storm water runoff is highly degraded because of encroachments, waste dumping, silting, weed growth, low maintenance and lack of protective measures. It is found that almost all the canals are in filthy conditions. This is due to the dumping of wastes into the canals and lack of facilities for cleaning them due

to inaccessibility of cleaning vehicles and machines. It is very necessary that this canal and the shorelines are protected and maintained properly for better living of the people.

Secondary Drains

Secondary drains are the feeder drains/canals of primary canal. The man-made secondary drain encompasses major roadside drains, which go beyond the level of area, drains and which link with the Primary drains (Nallahas) running in north-south direction.

Area Drains

The area drains are the drains which discharge the storm water and sullage from a neighbourhood to secondary drain. The city has large network of area drains, which act as major storm water receivers. There is no regular pattern for this and lies along small roads and bye lines. The area drains are absent in many of the areas especially in areas with urban proliferation. These drains need immediate attention.

6.3.6 Plans and Programs for Improvement

AMC does not have any specific plans to improve stormwater drainage system except to the extent covered by the proposed sewerage system improvement program. However, AMC intends to train the Nallahas by constructing retaining walls on both sides. According to AMC record the total length of the Nallahas in the city is 68 km and at prevailing rate it would cost about Rs. 200 crore for their training. Further study and a DPR will be required for the implementation.

The draft City Sanitation Plan has proposed Nallahas training of 50 km and roadside drain of 500 km with estimated cost of Rs. 625 crore.

6.3.7 Scope of Japanese Cooperation

Due to the reasons that the total rainfall amount is only about 725 mm per year; there is a combined sewerage system; and a new project for sewerage system is on line, the storm water management may be given less priority. If AMC intends to pursue the Nallaha training work it may be necessary to first conduct a study and JICA may provide technical assistance for the study.

7. SCOPE OF CANDIDATE CO-OPERATION PROJECTS

The potential for Japanese cooperation can be summarized in Table 7.1, based on the collected information described in Chapter 1-6. The evaluation rank (A - C) of the candidate cooperation projects is also given to each option of the Table, based on the Study team evaluation[3].

In water sector, efficient distribution network management and NRW reduction in downstream can be main fields to be improved through a Technical Cooperation (T/C) Project in Great Mumbai city and Nashik city. Procedures of distribution network management are explained in Appendix 3. Funding by the ODA-loan can be potentially proposed to assist to implement the water resource development project in Greater Mumbai city or the existing project for improvement of water supply system in Pune city and Nashik city.

In sewerage sector, funding by the ODA-loan can be potentially proposed to assist to implement the existing project in Great Mumbai city and Pune city.

In drainage (storm water) sector, the potential for Japanese cooperation could exist in developing storm water drainage system for the remaining 18 basins in Pune city through a technical cooperation for development planning (M/P, F/S).

[3] Evaluation criterias are Relevance, Effectiveness, Efficiency, Impact, Sustainability, Main Constraint, which indicated in each project summaries.

Table 7.1: Summary of Potential for Japanese Cooperation

Sector \ City	Greater Mumbai	Pune
Water Supply	**1. ODA-Loan（1,200 crore Rs./ 17.9 bil. JPY） rank: B** Water Resource Development Project • *Funding to Gargai dam construction* [Observation 1] • F/S is expected to be completed in May 2012. C/P hasindicated preference to the soft-loan **2. T/C for Development Planning (MP, F/S) rank: A** [Observation 2] • After the project, it will be effective to start 3. Technical Cooperation project. **3. T/C Project rank: A** Capacity Development on Distribution Network Management and NRW Reduction through the Establishment of GIS Database and DMA zoning [Observation 3] • High need for rationalization of distribution system and NRW reduction with a strong request from C/P • Precondition to the above work is to have a study on basic information on supply demand, population in each zone etc beforehand. • Delivered Application Form for T/C Project	**5. ODA-loan (640 crore Rs./ 9.6 bil. JPY) rank:A** Water Supply System Improvement Project • *Funding to the construction of transmission pipeline and WTP* [Observation 5-a] • Desirable priority order of the works is: 1) Construction of a new WTP at Parvati , 2) Replacement of aged Cantonment WTP, 3) Construction of Vadgaon WTP. • *Funding to the distribution network management and O&M works* [Observation 5-b] • "*Distribution network management and O&M works*" is commissioned to an Italian consulting firm, started in January 2012. • DPR for the above work is being prepared. PPP model will be considered.
Sewerage	**4. ODA-loan (20,000-25,000 crore Rs./ 299-374 bil. JPY) rank: B** Sewerage System Development Project • *The funding is assumed to cover a part of Phase III-V works due to the long plan for15 years with 3 phases* • *Phase III-V works include development of STP, PS and sewer network, and sulm sanitation. STP construction in 3 zones in Phase III-V has been launched.* • *Phase I-II works are mostly being implemented* [Observation 4] • A Consulant is already in place for the detailed design/ supervision of overall work. If the loan is realized, a management consultant will need to be employed. • Focus on the divided works by zone or by facility is better for increasing efficiency and effectiveness. • In the above case, the divided work by facility (STPs for 4 zones, PSs, etc) is better for increasing efficiency and effectiveness.	**6. ODA-loan (215 crore Rs./ 3.2 bil. JPY) rank: B** Sewerage System Development Project • *70% of the project cost (500 crore Rs.) will be funded by NRCP, State Gov.'s share of 20% is uncertain.* • *PMC is looking for the State Gov.'s share as above plus its portion (10%) funding possibility from JICA.*
Drainage (Storm Water)	No potential • *The augmentation project is on-going.*	**7. T/C for Development Planning (MP, F/S) rank: C** Improvement of Storm Water Drainage System

Table 7.1: Summary of Potential for Japanese Cooperation (Contd..)

City / Sector	Nashik	Aurangabad
Water Supply	**8. T/C Project rank: A** Capacity Development on Distribution Network Management and NRW Reduction through the DMA zoning [Observation 8] • A study on NRW reduction is under implementation by GIZ, it will be completed in Feb. 2012. This work most likely be not continued according to NMC information. • High need for rationalization of distribution system. • Strong request from C/P • Delivered Application Form **9. ODA-loan (1,693 crore Rs./ 25.3 bil. JPY) rank: C** Water Supply System Development Project • *Funding for replacement/ augumentation of WTPs and construction of transmission pipeline targeting for the year 2026.* • *NMC has looked for the funding for Phase I work of Package II in the project.* • *Interested in the funding from JICA.* [Observation 9] • The population growth rate is high at 64% during a recent decade, the potential to become a large city exists.	No potential • *The project is already launched under PPP scheme.*
Sewerage	Low potential • *Most of construction works for facilities to meet the demand of the year 2026 is already on-going* .	**10. ODA-loan (203 crore Rs./ 3.0 bil. JPY) rank: A** Sewerage System Development Project • *Funding to the work of new construction/ expansion of STP and development of sewers targeting the year 2026* • *50% of the project cost (203 crore Rs.) will be funded by the State Gov., but the remaining 50% fund is not determined.* [Observation 10] • The treatment capacity of the limited number of STPs is still small, therefore a high development need exists.
Drainage (Storm Water)	No potential • *All storm water drainage works are under implementation by the JNNURM resource.*	Less potential • *Storm water management may have less priority*

[Note]: Exchange rate: 1 Indian Rupees = 1.494 JPY (JICA, December 2011)

7.1 Greater Mumbai (Option No.1) - Water Supply Sector

A feasibility study for construction of Gargai and Pinjal dams for development of additional water source is being implemented by MCM through a consulting firm. The final report is expected in May 2012. MCGM has been looking for the funding of this project and shown interest in the funding from JICA.

7.1.1 Summary of the Project

The project outline based on the collected information by the Study can be summarized as below, although the detail information will only be available after completion of the F/S report.

City / Sector/ No.	**Greater Mumbai City**	**Water Supply**	**No.1**
Type of Scheme:	**ODA-Loan**	**Rank: B**	
Title (E):	**Project for Water Resource Development in Great Mumbai city**		
Estimated Loan Amount:	17.9 billion JPY (1,200 crore Rs.)		
Borrower:	Maharashtra State Gov/ Great Mumbai Municipal Corporation (MCGM)		
Project period:	Uncertain, need to wait for the compilation of the F/S report		
Project Objectives:	1. To construct dams at Garoai Lake to ensure water resource for sufficient water supply in order to meet future water demands 2. To contribute to improve the living environment for the people in the Greater Mumbai city		
Project Components:	1. Construction of Gargai dam 2. Consulting services - Detailed design - Tender assistance - Construction supervision - Strengthening of institutional capacity - Monitoring for environment and land acquisition		
Evaluation Criteria:			
Relevance	• Even though the water demand volume will be reduced by proposed NRW reduction project, this alone will not be sufficient to meet the increase in demand due to population growth by 2020. In order to meet the demand targeting 2020, the need of dam construction can be acknowledged. • Assistance for water supply and sewage systems is set up as one of the priority areas of "improvement of environmental issues" in the Country Assistance Program. This project is in line with the Japanese foreign aid policy.		

City / Sector/ No.	**Greater Mumbai City**	**Water Supply**	**No.1**
Type of Scheme:	**ODA-Loan**	**Rank: B**	
Effectiveness	• The project objective is clearly defined and stable water supply as an objective is expected to be achieved through the project. The effectiveness can be recognized as high. • There is a possibility that environmental and social issues such as resettlement and land acquisition become significant constraints of the project along with dam construction.		
Efficiency Impact Suatinability	• Environmental and social impact on dam construction is uncertain at present. The result of Feasibility Study needs to be confirmed.		
Main Constraint	• Sufficient environmental and social consideration on environmental conservation, land acquisition, resettlement etc. should be given to the dam construction project.		

7.1.2 Implementation Schedule

It is desirable to start this project in 2013 and to complete in 2018 according to MCGM's willingness.

7.2 Greater Mumbai (Option No.2) - Water Supply Sector

The situations surrounding Greater Mumbai city have changed so significantly that a existing master plan prepared in 1999 should be timely reviewed and revised for the future development targeting the year 2041 as well as for the optimization of the water services.

In addition, despite leakage detection unit was established by MCGM in the early 1970s, its activity did not reach the initial expectation. Thereby distribution network management and reduction of NRW including both real loss and apparent loss in the downstream network are still remained as the essential challenges for MCGM. NRW reduction is involved in one component of pilot projects in this study.

7.2.1 Summary of the Project

The outline of candidate technical assistance can be summarized as follows.

City / Sector/ No.	**Greater Mumbai City**	**Water Supply**	**No.2**
Type of Scheme:	**Technical Cooperation for Development Planning (M/P, F/S)**		**Rank: A**
Title (E):	**Master Plan and Feasibility Study on Improvement of Water Supply System for NRW reduction in Great Mumbai city**		
Period:	1.5 - 2.0 years		
Man-Month:	70 MM		
Experts:	1 Team Leader/ Water Supply Planning 2 Water Supply Facility Planning 3 Water Supply Pipeline Planning 1 4 Water Supply Pipeline Planning 2 5 GIS Database Establishment 6 NRW Reduction Planning 7 Cost Estimation/ Supervision Planning 8 Water Service Operation and Management 9 Institutional Development/Legislation/ Social Analysis 10 Social and Environmental Consideration 11 Economic and Financial Analysis		
Scope:	**Phase 1. Basic Study** **1. Review of the Master Plan formulated in 1999** 1-1 Collection and analyses of existing data and information 1-2 Survey and investigation of existing water supply system 1-3 Survey on development plan, socio-economic conditions, land utilization etc. 1-4 Review and analysis of the plan and projects related to the Study		

City / Sector/ No.	**Greater Mumbai City**	**Water Supply**	**No.2**
Type of Scheme:	**Technical Cooperation for Development Planning (M/P, F/S)**		**Rank: A**

Scope:

1-5 Evaluation of present water supply conditions and identification of problems

Phase 2. Master Plan and Feasibility Study on Priority Project

2. Revision of the Master Plan (target year 2041)

2-1 Formulation of scope, goals and strategies for water supply

2-2 Forecast of planning framework

2-3 Formulation of the revised Master Plan (target year 2041)

2-4 Enhancement of NRW reduction by using DMA through a pilot project (see Box 1)

2-5 Enhancement of customer data management based on GIS through a pilot project (see Box 2)

2-6 Plan for enhancement of institutional capacity

2-7 Initial environmental examination (IEE) and workshop

2-8 Preliminary cost estimation and financial plan

2-9 Evaluation of the revised Master Plan

2-10 Selection of priority project

3. Feasibility Study on priority project

3-1 Supplemental survey

3-2 Confirmation of the framework of the plan

3-3 Outline of future facilities

3-4 Operation, management, and maintenance plan

3-5 Economic and financial analysis

3-6 Project cost

3-7 Environmental impact assessment (EIA) and holding workshop(s)

3-8 Implementation plan

3-9 Project evaluation

4. Seminar(s) for technical transfer

Box 1: Pilot Project 1

Enhancement of NRW Reduction by using DMA (pilot zones)

1. Survey and identification of the DMA's boundary
2. Investigation of the existing network and facilities in the DMAs
3. Construction of chambers and installation of bulk meters and valves
4. Collecting and updating customer data within the DMAs
5. Updating the network map in GIS format
6. Monitoring and analysis of meter flow

Box 2: Pilot Project 2

Enhancement of Customer Data Management based on GIS (pilot zones)

1. Examination on the existing network management, ledger system and customer data management
2. Database design
3. Collection of the necessary data on network and customer management through a field survey
4. Compilation of data in database programs and computerization of network
5. Development of GIS based network and customer management system

City / Sector/ No.	**Greater Mumbai City**	**Water Supply**	**No.2**
Type of Scheme:	**Technical Cooperation for Development Planning (M/P, F/S)**		**Rank: A**
Evaluation Criteria:			
Relevance	• Because the surrounding environment of Mumbai city has been changing rapidly, it is necessary to review and revise the master plan and strategic plans developed in 1999. • The review of strategic plan for the improvement of distribution network is also essential for achieving rationalization of the network. • Systematic strategy and action plans are necessary for effective distribution network management; therefore the relevance of this project can be seen. • The Japanese foreign aid policy states that the priority will be given to assistance for "water supply and sewerage sector" as an assistance objective within the framework of "improvement of environmental problems". This project is in line with the Japanese foreign aid policy.		
Effectiveness	• This project intends to conduct the appropriate rationalization of distribution network and NRW reduction through a pilot project after review of the existing master plan. This approach is logical and clear. • It is assumed that the effectiveness is more enhanced if "3. Technical Cooperation Project" is launched after this project.		
Efficiency Impact Suatinability	• After the existing master plan is reviewed, it is expected that appropriate development plan and distribution network management plan are clearly established. The systematic management of distribution network may be disseminated to other areas of Mumbai city.		
Main Constraint	-		

7.3 Greater Mumbai (Option No.3) - Water Supply Sector

As described in 7.1, distribution network management and reduction of NRW including both real loss and apparent loss are the essential challenges for MCGM. A comprehensive approach for the rationalization of distribution network management and NRW reduction can be taken by T/C project under the JICA scheme. Meanwhile, it is expected that the accumulated wealthy experience and technology of Japan on NRW reduction can effectively provide benefit to MCGM through T/C project.

Because of the significant and urgent challenge, it is desirable to start this project as soon as possible.

7.3.1 Summary of the Project

The outline of candidate project can be summarized as follows.

City / Sector/ No.	**Greater Mumbai City**	**Water Supply**	**No.3**
Type of Scheme:	**Technical Cooperation Project**	**Rank: A**	
Title (E):	**Project for Capacity Development on Distribution Network Management and NRW Reduction through the Establishment of GIS Database and the DMA zoning in Great Mumbai city**		
Period:	3.5 - 4.0 years		
Man-Month:	65 MM		
Experts:	1 Chief Adviser 2 Water Supply Pipeline Management 3 NRW Reduction Planning/ GIS 4 NRW Detection 5 Water Service Operation and Management 6 Water Tariff / Human Resource Development		
Project Objectives:	1 To enhance management capacity of the Municipal Corporation Great Mumbai (MCGM) on rationalization of distribution network and NRW reduction 2 To enhance management capacity of the Municipal Corporation Great Mumbai (MCGM) on water service operation		
Activity components:	**1. Development of GIS Database** 1-1 Examination on the existing network management, ledger system and customer data management 1-2 Database design 1-3 Collection of the necessary data on network, assets and customer management through a field survey 1-4 Compilation of data in database programs and computerization of network 1-5 Development of GIS based network and customer management system **2. Preparation of DMA** 2-1 Survey and identification of the DMA's boundary 2-2 Investigation of the existing pipeline network in DMAs 2-3 Construction of chambers and installation of bulk meter and valves in the target zones		

City / Sector/ No.	**Greater Mumbai City**	**Water Supply**	**No.3**
Type of Scheme:	**Technical Cooperation Project**	**Rank: A**	
	2-4 Collecting and updating customer data within the DMAs 2-5 Hydraulic modeling of the entire network and DMA 2-6 Updating the network map in GIS format in the target zones 2-7 Monitoring and analysis of meter flow **3. Enhancement of Leakage Control Activities through OJT** 3-1 Institutionalization and identification of leakage detection team 3-2 Identification of pilot distribution areas 3-3 Undertaking leakage assessment on sites and analysis 3-4 Development of an action plan for NRW reduction 3-5 Repairing leakages in pilot study areas and capacity building of the staff through OJT 3-6 Management of leakages information by using GIS and introduction of SCADA as a distribution management tool **4. Enhancement of Water Service Operation and Financial Management** 4-1 Understanding and analysis of current operational and financial situation 4-2 Implementation of a customer survey on water meter connections and water tariff 4-3 Assessment of the connection and preparation of a guideline of meter installation 4-4 Consideration on the improvement of water tariff and tariff collection and recommendations 4-5 Enhancement of operational efficiencies of billing and collection works 4-6 Operationalization of NRW assessment and enhancement of financial management		
Evaluation Criteria:			
Relevance	• Distribution network management is neither well-planned nor sufficiently systematic, thus NRW ratio is high at 40-60%. Priority is given to these issues by MCGM, and through the Study it was confirmed that their expectation to JICA's technical cooperation on these fields is strong. • Rationalization of distribution network and NRW reduction are urgent and significant matters for MCGM. These will help MCGM not only to make most efficient use of water resources but also meet expected increase in water demand in near future. • Japan has a rich experience on NRW reduction. Competitive advantage of Japan can be seen in that field in collaboration with local municipalities. • The Japanese foreign aid policy states that the priority will be given to assistance for "water supply and sewerage sector" as an assistance objective within the framework of "improvement of environmental problems". This project is in line with the Japanese foreign aid policy. • Water supply policy in India targets stable and 24 x 7 supply, thus this project is in line with this policy.		
Effectiveness	• The project objective is expected to be achieved by the reduction of NRW, the effectiveness can be recognized as high.		
Efficiency Impact Suatinability	• Sufficient consideration should be given to the implementation of the project because many improvement works for distribution network is located in slum areas.		
Main Constraint	• The master plan for the rationalization of distribution network, is a prerequisite. • Selection of pilot areas (of about a half million population/ area) from 27 areas is required due to large population. • Potentially long project duration（distribution network length: 4000 km/ replacement: 170 km/year＝23.5 years）. • Insufficient staff's capacity for operation and maintenance.		

City / Sector/ No.	**Greater Mumbai City**	**Water Supply**	**No.3**
Type of Scheme:	**Technical Cooperation Project**	**Rank: A**	
	• Seemingly lack of people's awareness and understanding of NRW reduction. • Difficulty of executing works in slums whose residents make up almost half of the total population, difficulty in working in the field due to narrow roads, high traffic density, and frequent traffic jams.		

7.3.2 Implementation Shcedule

The implementation schedule of the Technical Cooperation Project is shown as below.

	2013	2014	2015	2016
Implementation of a baseline survey				
Basic technical training for rationalization of distribution netwirk				
DMA zoning, installation of meter & equipment, monitoring				
Establishment of GIS database and the modification				
Activity on leakage reduction through OJT (Pilot project)				
Enhancement of waterworks management and financialmanagement				
Implementation of local matching seminar				
Training in Japan (Study tours for local water bureaus/ companies, exhibition)				

7.3.3 Staffing Plan (Draft)

The staffing plan for the Project is shown as below.

Experts	2013	2014	2015	2016	M/M
Chief Advisor					15
Water Supply Pipeline Management					10
NRW Reduction/ GIS					10
NRW Detection					10
Water Service Operation and Management					12
Revenue Collection /Water tariff					8
Total					65

7.4 Greater Mumbai (Option No.4) - Sewerage Sector

A part of funding is expected to get from JNNURM, the State government and the internal sources, therefore the potential for Japanese cooperation can be seen in the funding to the remaining portion.

MCGM intends to implement most of the components as Design, Build, Operate and Transfer (DBOT) scheme for 5 years.

7.4.1 Summary of the Project

The outline of candidate project can be summarized as follows.

City / Sector/ No.	**Greater Mumbai City**	**Sewerage**	**No.4**
Type of Scheme:	**ODA-Loan**	**Rank: A**	
Title (E):	**Project for Sewerage System Development in Great Mumbai city**		
Estimated Loan Amount:	299-374 billion JPY (20,000-25,000 crore Rs.)		
Borrower:	Maharashtra State Gov/ Great Mumbai Municipal Corporation (MCGM)		
Project period:	2012 - 2025 (14 years)		
Project Objectives:	1. To develop and improve sewerage facilities in Great Mumbai city through Design Build Operate and Transfer (DBOT) scheme in order to provide the improved sewerage service to the areas 2. To contribute to improve the living environment for the people in these areas		
Project Components:	1. Construction and expansion of STPs and pumping stations 2. Installation, upsizing, and rehabilitation of sewers 3. Slum sanitation program 3-1 Provision and rehabilitation of toilet blocks 4. Consulting services - Detailed design - Tender assistance - Construction supervision - Strengthening of institutional capacity - Monitoring for environment and land acquisition		
Evaluation Criteria:			
Relevance	• Sewage is directly discharged into sea with only a primary treatment in current condition; the project need is high in order to preserve water quality in the gulf		

City / Sector/ No.	**Greater Mumbai City**	**Sewerage**	**No.4**
Type of Scheme:	**ODA-Loan**	**Rank: A**	
	sea and also to meet the future requirement of increasing waste water volume and treatment standard. • Enhancing sanitation activity such as facility development and dissemination of sanitation awareness to slum residents who share almost half of the total population is a large challenge but essential for MCGM. • The Japanese foreign aid policy states that the priority will be given to assistance for "water supply and sewerage sector" as an assistance objective within the framework of "improvement of environmental problems". This project is in line with the Japanese foreign aid policy. • This project is in line with the Indian policy on development of sanitation facilities and dissemination of local people's sanitation awareness.		
Effectiveness	• Collecting all the sewage generated and treating to secondary level meeting the requirement of Central Pollution Control Board as well as Maharashtra Pollution Control Board will be very effective in reducing pollution of water bodies in and around Mumbai. • This project will be co-financed with Indian government institutions, therefore it will be better to formulate the project not by facilities-base but zone-base. The zone-based approach will make financial management and implementation schedule management easier. More effectiveness could be also expected. • In case of zone-based project, it will be convenient and manageable to target one zone as 30-40 km^2 in width and about 1 million population from the effectiveness view point.		
Efficiency Impact Suatinability	• Collection and treatment of sewage to secondary level will have a strong positive impact on Mumbai's water environment. • Being one of the most advanced and capable municipal corporations in India, MCGM will be in a position to sustain the collection and treatment system developed, although it may need some capacity building during project implementation stage.		
Main Constraint	• Difficulty of sewage collection from slums,, difficulty in laying sewer lines due to narrow roads, high traffic density,and frequent traffic jams .		

7.4.1 Project Cost

The approximate project cost estimated in the Master Plan in 1999 for MSDP Stage II accounted for Rs.5570.4 crore. Out of this, the cost of both Phase I as completed and Phase II as on-going account for Rs.1552.0 crore. MCGM is interested in the funding from JICA on the remaining III – Vworks. The revised cost for Phase III – V could be, in case of, 1) without the state funding: Rs.20,000 – 25,000 crore , 2) with the state funding:Rs. 6,600 – 8,200 crore.
In practice, the realistic way for the funding could be financing to the part of III-V works, because 1) MCGM has sufficient internal financing resources, 2) there is a possibility to obtain the funding from JNNURM and the state government.

（Unit: Rs. crore）

	MSDP Stage II Total Project Cost	Phase I & II	Estimated Loan Amount (Phase III-V)
Project Cost (Estimated in M/P, 1999)	5570.4	1552.0	2000.0
Revised Project Cost (III-V) （Estimated maximum loan amount）			20,000 – 25,000

The assumed cost of each activity item is calculated by using the cost ratio indicated in the master plan, as shown below.

（Unit: Rs. crore）

Item	Phase 3 2011-15	Phase 4 2016-20	Phase 5 2021-25
Slum sanitation	2524.9	2524.9	2524.9
Upsizing of sewers	711.8	416.1	6.1
New sewers	93.4	63.0	95.1
Rehab of sewers	0.0	0.0	0.0
Survey	0.0	0.0	0.0
Sewers	1928.9	1928.9	1928.9
Manholes	0.0	0.0	0.0
Area sewers	367.8	713.8	373.6
Pumping stations	929.2	411.4	953.4
Pumping mains	151.4	10.4	15.8
Illegal connections	9.0	0.0	0.0
Outfall	0.0	0.0	0.0
Transfer	0.0	813.6	625.4
Sewage treatment plant	3572.1	89.8	1216.3
Total	10288.5	6971.9	7739.6

7.4.2 Implementation Schedule

The provisional implementation schedule of the Project based on the collected information through this study is shown as below. The total implementation schedule is 5 years consisted of 3 years for signing and selection of consultant, 14 years for construction works. MCGM wishes to complete this project up to 2017, it is desirable to start the project as soon as possible.

	Period	2013	2014	2015	2016 – 20
Signing of L/A	-	▼			
Selection of Consultant	12 months	■			
Detailed Design	12 months		■		
Tender Evaluation	12 months			■	
Selection of Contractor	12 months			■	
Consultant Supervision	168 months				■
Onstruction Works	168 months				■

7.4.3 Phase-wise and Zone-wise Project Component

Phase-wise and zone-wise component of the Project designed in the MSDP Stage-II is shown as below.

	Component	Zone	Phase 3	Phase 4	Phase 5
1	Slum Sanitation	All	All areas in zone 2 - 7	All areas in zone 2 - 7	All areas in zone 2 - 7
2	New Trunk Sewers	2	Poonam Chamber, Lovegrove	Worli village sewer	
		3	Sakinaka trunk sewers, Maroi and Kherani road		Barkat Ali Dargah road trunk
		5	Commerce Madh village, Erangel beach, Madh beach, Aksa beach, Dharavali/ Malvani village, Marve village developable areas	Complete Madh village, Erangel beach, Madh beach, Aksa beach, Dharavali/ Malvani village, Marve village developable areas	Manori village, Manori developable areas, Gorai village, Gorai developable areas trunk sewer
		6	Commence East of bundup station	Complete commence East of bundup station	
		7	Collector Colony Sewer	Turbe village sewer, Shivaji nagar sewer	Panvel road sewer, Ramabai Nagar sewer
3	Upsized Trunk Sewers	3	North Andheri (E), Mahim, Khar, Kurla, Sion hospotal, Bandra	Kalina	
		4	50% of zone		
		5	50% of remainder of zone	50% of remainder of zone	
		6	50% of zone		
		7	50% of zone		
4	Rehabilitatio n of sewerers	2	25% of zone	25% of zone	25% of zone
		3	25% of zone	25% of zone	25% of zone
		4	33% of zone	33% of zone	33% of zone
		5	33% of zone	33% of zone	33% of zone
		6	33% of zone	33% of zone	33% of zone
		7	33% of zone	33% of zone	33% of zone
5	Area sewers	2	Phoonam Chamber, Lovegrove	Worli village	
		3	25% of all areas	25% of all areas	25% of all areas
		4	Further overloaded area sewers		
		5	Ram Mandir Rd, Goregaon Commercial centre, Millal Nagar, Chicholi Bundar, charkop, Marve village	Madh village, Erangel beach, Madh beach, Aksa beach, Dharavali/ Malvani village, Marve & Malvani developable areas	Manori village, Manori developable areas, Gorai village, Gorai developable areas trunk sewers
		6	Commence east of Bandup station	Completed East Bhandup station	Gavanpada Gaothan, Hoechst
		7	Collector Colony & nearby areas	Turbhe village, Shivaji Nagar, Chedda nagar	Ramabai Nagar

	Component	Zone	Phase 3	Phase 4	Phase 5
6	Pumping Station (PS)	1	Colaba PS, Robert Rd PS	Merry Weather PS, NF Rd PS, Kitndge Rd PS	
		2	Mazgaon PS	Lovegrove PS, tank Bunder PS, Wylie Rd PS, Carrol Rd PS, Banganga PS, Worti village PS	Sant Sawt Marg PS, Globe Mill PS, Tulsi Pipe Rd PS, Dadar PS, Sant Gadge Maharaji PS, Churchfgate PS
		3		Sion Koliwada PS, Saltpan PS	Matunga PS, Dharavi PS, Mahim PS, Wadai PS, Kalina PS, Salinaka PS, Bandra Kurla Complex PS
		4			Vorsovn No2 PS, Manori PS
		5		Malvani PS	
		6	Bhandup PS	Powai PS	BUDP PS
		7	New Ghatkopar PS, Collector Colony PS, Mysore Colony PS	Turbe village PS	
7	Pumping mains	2		Woril village PS to Balancing Ch	Napean Sea Rd
		5			Manori PS to Gorai
		6		Powai PS to Balancing Ch	
		7	Ghatkopar PS to Ghatkopar WWTP	Turbe village PS to VN Purav Marg	
8	Transfers & Effuluent PS	3		Commence Transfer Sewer Z3 (N) to Versova 2 PS	Dharavl EPS & Pump main to Bandra
		4		Versova EPS & Pump main to Erangel	
9	Sewerage Treatment Works (STWs)	1	Primary treatment	Design of secondary treatment	Secondary treatment
		2	Primary treatment	Design of 50% secondary treatment	50% of secondary treatment
		3	Primary treatment	Dharavl waste water treatment works (WwTW)	Bandra CEPT, Dharavi WwTW
		5	Construction lagoons - 2 stage	Design of secondary treatment	Gorai
		6	Construction lagoons - 2 stage	Convert lagoons - 3 stage	
		7	Construction lagoons - 2 stage	Design convert lagoons - 3 stage	Convert lagoons - 3 stage
10	SCADA	All	Install SCADA system	Extend SCADA to new equipment	Extend SCADA to new equipment

7.5 Pune (Option No.5) - Water Supply Sector

The DPR for water supply system to meet the demand for the next 30 years is currently under formulation by an Italian consultant which will also maintain the project for five years. The consultant will propose means of the fund-raising by using Public-Private Partnership (PPP) scheme. PMC has shown interest in the funding possibility from JICA for the items II – IV of the project.

7.5.1 Summary of the Project

The outline of candidate project can be summarized as follows.

City / Sector/ No.	**Pune City**	**Water Supply**	**No.5**
Type of Scheme:	**ODA-Loan**	**Rank: A**	
Title (E):	**Project for Improvement of Water Supply System in Pune city**		
Estimated Loan Amount:	9.6 bilion JPY (640 crore Rs.)		
Borrower:	Maharashtra State Gov/ Pune Municipal Corporation (PMC)		
Project period:	2013-2020 (8 years)		
Project Objectives:	1 To improve water supply facilities through replacement and expansion of water treatment plants, and installation of transmission pipeline 2 To contribute to improve the living environment of regional residents in Pune city		
Project Components:	**1 Review of the existing Master Plan** 1-1 Review of the Master Plan formulated in 1999 1-2 Identification of modification points for the scope, the goals, the planning framework **2 Construction of transmission line** 2-1 Construction of jackwell, pump house and installation of pumping machinery 2-2 Installation of φ2500 transmission pipeline instead of open unlined canal from Khadakwasla Dam to Cantonment WTP **3 Construction of Parvati WTP and Cantonment WTP** 3-1 Total replacement of current WTPs and the new construction (500 MLD) **4 Construction of Vadgaon WTP** 4-1 Expansion of Vadgaon WTP (250 MLD) **5 Consulting services** - Detailed design and formulation of Detailed Project Reports (DPRs) - Tender assistance - Construction supervision - Strengthening of institutional capacity - Monitoring for environment and land acquisition		

City / Sector/ No.	**Pune City**	**Water Supply**	**No.5**
Type of Scheme:	**ODA-Loan**	**Rank: A**	
Evaluation Criteria:			
Relevance	• Parvati WTP and Cantonment WTP are very old, the replacement is an urgent issue for both WTPs which provide 800 MLD of the total supply volume. • The level of current supply volume is relatively high at 315 LPCD from simple calculation of current population and production. But there are issues of inequitable supply; fringe areas getting far less water than the core areas. • The Japanese foreign aid policy states that the priority will be given to assistance for "water supply and sewerage sector" as an assistance objective within the framework of "improvement of environmental problems". This project is in the line with the Japanese foreign aid policy.		
Effectiveness	• The project objective is expected to be achieved by replacement and expansion of WTPs and development of transmission pipeline. The effectiveness can be recognized as high.		
Efficiency Impact Suatinability	• The project is simple and straight forward. It will have a significant positive impact to continue providing enough water supply. • A project implementation for distribution improvement and continuous supply by using PPP scheme is planned, so appropriate project management by PMC is a significant element to secure the efficiency.		
Main Constraint	-		

7.5.2 Project Cost

The approximate project cost on Item II - IV estimated in the Master Plan in 1999 accounts for Rs.640 crore. The Study team assumes this amount as the loan amount.

7.5.3 Implementation Schedule

The provisional implementation schedule of the Project based on the collected information through this study is shown as below. The total implementation schedule is 8 years consisted of 3 years for signing and selection of consultant, 5 years for construction works. Because Parvati WTP and Cantonment WTP are heavily aged facilities, it is desirable to start these replacement works.

	Period	2013	2014	2015	2016	2017	2018	2019	2020
Signing of L/A	-	▼							
Selection of Consultant	12 months	■							
Detailed Design	12 months		■						
Tender Evaluation	12 months			■					
Selection of Contractor	12 months			■					
Consultant Supervision	168 months				■	■	■	■	■
Onstruction Works	168 months				■	■	■	■	■

7.6 Pune (Option No.6) - Sewerage Sector

70% of the total cost is proposed to be funded by NRCP, while the remaining 30% of that is uncertain on the State government and PMC portion. Therefore, the potential for Japanese financing assistance can be seen in the funding to the remaining project cost. The project period is scheduled to be for 3 years for implementation and next 5 years for Operation and Maintenance phase. PMC is planning to implement the project by Design, Build and Operate type of contracts.

7.6.1 Summary of the Project

The outline of candidate project can be summarized as follows.

City / Sector/ No.	**Pune City**	**Sewerage**	**No.6**
Type of Scheme:	**ODA-Loan**	**Rank: B**	
Title (E):	**Project for Sewerage System Development in Pune city**		
Estimated Loan Amount:	3.2 billion JPY (215 crore Rs.)		
Borrower	Maharashtra State Gov/ Pune Municipal Corporation (PMC)		
Project period:	2013-2023 (11 years)		
Project Objectives:	1 To promote sewerage and wastewater treatment prevalence by new construction and upgrading of sewerage and waste water facilities 2 To contribute to improve water quality of rivers in Pune city and the living environment of regional residents in the area		
Project Components:	**1 Construction of 12 STPs (383 MLD)** (Masty Bij Kendra, Mundhawa, Bhairoba, Naidu, Vadgaon, Warje, Tanajiwadi, Botanical garden, Dhanori, Kharadi) **2 Development of collection system and trunk mains** 2-1 Collection system in Baner and Balewadi 2-2 Trunk sewer and conveyance mains **3 Construction of intermediate pumping stations** **4 Land acquisition** **5 Public awareness and public participation** **6 Consulting services** - Detailed design - Tender assistance - Construction supervision - Strengthening of institutional capacity - Monitoring for environment and land acquisition		

City / Sector/ No.	**Pune City**	**Sewerage**	**No.6**
Type of Scheme:	**ODA-Loan**	**Rank: B**	
Evaluation Criteria:			
Relevance	• Current sewerage coverage is 95%, and it is necessary to implement further sewerage system development by this project to meet the sewerage demand of 2024. • It is inferred that the project is not so urgent. • The Japanese foreign aid policy states that the priority will be given to assistance for "water supply and sewerage sector" as an assistance objective within the framework of "improvement of environmental problems". This project is in the line with the Japanese foreign aid policy. • This project is in line with the Indian policy on development of sanitation facilities and dissemination of local people's sanitation awareness.		
Effectiveness	• The project objective is expected to be achieved by sewerage and drainage facility development, the effectiveness can be recognized as high.		
Efficiency Impact Suatinability	• Since the proposed project covers only a minor fraction of the total area, the rest being already covered, its impact will not be that significant. • Continuous capacity enhancement of operation and maintenance for facilities is necessary to secure the long-term effectiveness of the project. • The important challenges are appropriate sewerage tariff collection and increase of collection efficiency to secure the project sustainability.		
Main Constraint	• Insufficient staff's capacity for operation and maintenance		

7.6.2 Project Cost

The approximate loan amount, Rs. 215 crore, is assumed by deducting the amount of governmental subsidy for 70% provided by the NRCD from the total cost, based on the DPR developed in October 2011. Meanwhile, if PMC will fail to obtain the funding from the NRCD, the loan amount coule be Rs.715 crore. The priority of this project coule be moderate at rank B, because 1) this project is in the line of the national project, 2) there is a possibility to obtain the funding fron the NRCD.

（Unit: Rs. crore）

	Total	NRCD Subsidy	Loan amount
Project Cost (Detailed Project Report, 2010)	715.0	500.5	214.5

7.6.3 Implementation Schedule

The provisional implementation schedule of the Project based on the collected information through this study is shown as below. The total implementation schedule is 11 years consisted of 3 years for signing and selection of consultant, 5 years for construction works and 3 years

for operation and maintenance. After getting the approval for the fund from NRCD, PMC intends to start this project, however the funding possibility is currently unknown.

	Period	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Signing of L/A	-	▼										
Selection of Consultant	12 months	■										
Detailed Design	12 months		■									
Tender Evaluation	12 months			■								
Selection of Contractor	12 months			■								
Consultant Supervision	36 months				■	■	■					
Construction Works	36 months				■	■	■					
Operation & maintenance	60 months							■	■	■	■	■

7.7 Pune (Option No.7) - Drainage (Storm Water) Sector

The DPR for Phase I in the storm water drainage project was prepared in 2008 and is targeting 5 basins, out of 23 basins. The funding for Phase I is expected to be sanctioned by JNNURM. Meanwhile, the development of 18 basins substantially remains. The potential of Japanese cooperation could be to support to develop the holistic master plan for storm water drainage system and the DPR for 18 basins through technical assistance in the first step. Because the project is not so urgent, the priority rank is at low.

7.7.1 Summary of the Project

The outline of candidate technical assistance can be summarized as follow.

City / Sector/ No.	**Pune City**	**Drainage (Storm Water)**	**No.7**
Type of Scheme:	**Technical Cooperation for Development Planning (MP, F/S)**		**Rank: C**
Title (E):	**Master Plan and Feasibility Study on Improvement of Storm Water Drainage System in Pune city**		
Period:	1.5 - 2.0 years		
Man-Month:	70 MM		
Experts:	1 Team Leader/ Flood Control and Drainage Panning 2 Flood mitigation/ Hydraulics 3 River administration 4 Sewerage and drainage works 5 Drain facilities 6 GIS 7 Solid waste management 8 Cost Estimation/ Supervision Planning 9 Institutional Development/Legislation/ Social Analysis 10 Social and Environmental Consideration 11 Economic and Financial Analysis		
Study Objectives:	1 To formulate a Master Plan for improvement of storm drainage water system in 18 basins of Pune city 2 To conduct a feasibility study on the priority projects/ areas identified in the Master Plan 3 To transfer technology and knowledge of the method and management for improvement of comprehensive storm water drainage system to the counterparts of PMC		
Scope:	Phase 1. Basic Study **1.Review of the existing (current) storm water drainage system** 1-1 Collection and analyses of existing data and information 1-2 Survey and investigation of existing storm water drainage system 1-3 Survey on land use, urban housing condition including informal settlers etc. 1-4 Geological and hydrological survey, if necessary 1-5 Review and analysis of the plan and projects related to the Study 1-6 Evaluation of present drainage conditions and identification of problems Phase 2. Master Plan and Feasibility Study on Priority Project		

City / Sector/ No.	**Pune City**	**Drainage (Storm Water)**	**No.7**
Type of Scheme:	**Technical Cooperation for Development Planning (MP, F/S)**		**Rank: C**
	2. Formulation of the Master Plan and Detailed Project Report (DPR) for 18 basins 2-1 Formulation of scope, goals and strategies for storm water drainage management 2-2 Forecast of planning framework 2-3 Formulation of the Master Plan for 18 basins 2-4 Formulation of the DPR for 18 basins 2-5 Plan for enhancement of institutional capacity 2-6 Initial environmental examination (IEE) and holding of workshop 2-7 Preliminary cost estimation and financial plan 2-8 Selection of priority project within 18 basins **3. Feasibility Study on priority project** 3-1 Supplemental survey 3-2 Confirmation of the framework of the plan 3-3 Outline of future facilities 3-4 Operation, management, and maintenance plan, institutional plan 3-5 Solid waste control plan 3-6 Economic and financial analysis 3-7 Project cost 3-8 Environmental impact assessment (EIA) and workshop (s) 3-9 Implementation plan 3-10 Project evaluation **4. Seminar(s) for technical transfer**		
Evaluation Criteria:			
Relevance	• Storm water and drainage development in the city center has been already launched, It is inferred that the development of other 18 basins targeted by this project might be relatively not urgent issue. • The Japanese foreign aid policy states that the priority will be given to assistance for "improvement of urban environment" including urban drainage as an assistance objective within the framework of "improvement of environmental problems". This project is in the line with the Japanese foreign aid policy.		
Effectiveness	• The project objective is expected to be achieved by development of overall master plan for storm water and drainage development and assistance on detailed design for 18 basins, the effectiveness can be recognized as high.		
Efficiency Impact Suatinability	• After the master plan and detailed design are developed, it is expected that storm water and drainage development plans for 18 basins is clearly established.		
Main Constraint	• Sufficient consideration should be given to the residents in slum area and in the development area along the river.		

7.8 Nashik (Option No.8) - Water Supply Sector

The NRW ratio is very high at 57% due to both real and apparent losses in Nashik city. GIZ has conducted a study on NRW in five pilot areas. After evaluation of pilot area result, GIZ is learnt to prepare NRW reduction action plan covering the entire NMC area and submit to NMC by the end of February 2012. Through NMC and GIZ local contact in Nashik we have learned that GIZ will not continue with the implementation of the action plan. However, this has not been verified with the GIZ India office. If GIZ does not continue with the implementation which is most likely, a technical cooperation project as outlined below can be taken up.

The priority of the project is at high because of the high needs of system rationalization.

7.8.1 Summary of the Project

The outline of candidate project can be summarized as follows.

City / Sector/ No.	**Nashik City**	**Water Supply**	**No.8**
Type of Scheme:	**Technical Cooperation Project**	**Rank: A**	
Title (E):	**Project for Capacity Development on Distribution Network Management and NRW Reduction through an Establishment of GIS Database in Nashik city**		
Period:	3.5 - 4.0 years		
Man-Month:	65 MM		
Experts:	1 Chief Adviser 2 Water Supply Pipeline Management 3 NRW Reduction Planning/ GIS 4 NRW Detection 5 Water Service Operation and Management 6 Revenue Collection/ Water Tariff		
Project Objectives:	1 To enhance management capacity of the Nashik Municipal Corporation (NMC) on rationalization of distribution network and NRW control 2 To enhance management capacity of NMC on water service operation		
Activity Components:	**1. Development of GIS Database** 1-1 Examination on the existing network management, ledger system and customer data management 1-2 Database design 1-3 Collection of the necessary data on network, assets and customer management through a field survey 1-4 Compilation of data in database programs and computerization of network 1-5 Development of GIS based network and customer management system **2. Preparation of DMA** 2-1 Survey and identification of the DMA's boundary 2-2 Investigation of the existing pipeline network in DMAs 2-3 Construction of chambers and installation of bulk meter and valves in the target zones		

City / Sector/ No.	**Nashik City**	**Water Supply**	**No.8**
Type of Scheme:	**Technical Cooperation Project**	**Rank: A**	
	2-4 Collecting and updating customer data within the DMAs		
	2-5 Hydraulic modeling of the entire network and DMA 2-6 Updating the network map in GIS format in the target zones 2-7 Monitoring and analysis of meter flow **3. Enhancement of Leakage Control Activities through OJT** 3-1 Institutionalization and identification of leakage detection team 3-2 Identification of pilot distribution areas 3-3 Undertaking leakage assessment on sites and analysis 3-4 Development of an action plan for NRW reduction 3-5 Repairing leakages in pilot study areas and capacity building of the staff through OJT 3-6 Management of leakages information by using GIS system and documentation **4. Enhancement of Water Service Operation and Financial Management** 4-1 Understanding and analysis of current operational and financial situation 4-2 Implementation of a customer survey on water meter connections and water tariff 4-3 Assessment of the connection and preparation of a guideline of meter installation 4-4 Consideration on the improvement of water tariff and tariff collection and recommendations 4-5 Enhancement of operational efficiencies of billing and collection works 4-6 Operationalization of NRW assessment and enhancement of financial management		
Evaluation Criteria:			
Relevance	• NRW is an urgent issue for NMC due to the extremely high NRW ratio. • The priority is given to the reduction of NRW by NMC, and NMC has been received GIZ assistance which includes NRW reduction in the pilot area, and preparation of NRW reduction action plan for the rest. The high necessity and high priority should be continuously given to the issue, because of the predicted rapid population growth in near future. • Japan has a rich experience on NRW reduction. Competitive advantage of Japan can be seen in that field in collaboration with local municipalities. • The Japanese foreign aid policy states that the priority will be given to assistance for "water supply and sewerage sector" as an assistance objective within the framework of "improvement of environmental problems". This project is in the line with the Japanese foreign aid policy. • Water supply policy in India targets stable and 24 x 7 supply, thus this project is in line with this policy.		
Effectiveness	• Effectiveness of this project will depend upon NMC's commitment to NRW reduction. If NMC takes this issue very seriously and commits itself, the project will be very effective because Nashik is still a small scale city not yet fully developed and NRW countermeasures are easier to implement.		
Efficiency Impact Suatinability	• NMC can be developed as a model city for NRW management. • For sustainability the project will need to focus in developing capacity of NMC not only to operate and maintain but also as a regulatory body for private entities. Private operators are likely to play bigger roles in operation and maintenance of water systems in future.		
Main Constraint	• Insufficient staff's capacity for operation and maintenance • NRW countermeasures in slums which constitute a significant portion of total city population.		

City / Sector/ No.	**Nashik City**	**Water Supply**	**No.8**
Type of Scheme:	**Technical Cooperation Project**	**Rank: A**	

7.8.2 Implementation Shcedule

The implementation schedule of the Technical Cooperation Project is shown as below.

	2013	2014	2015	2016
Implementation of a baseline survey				
Basic technical training for rationalization of distribution netwirk				
DMA zoning, installation of meter & equipment, monitoring				
Establishment of GIS database and the modification				
Activity on leakage reduction through OJT (Pilot project)				
Enhancement of waterworks management and financialmanagement				
Implementation of local matching seminar				
Training in Japan (Study tours for local water bureaus/ companies, exhibition)				

7.8.3 Staffing Plan (Draft)

The staffing plan for the Project is shown as below.

Experts	2013	2014	2015	2016	M/M
Chief Advisor					15
Water Supply Pipeline Management					10
NRW Reduction/ GIS					10
NRW Detection					10
Water Service Operation and Management					12
Revenue Collection /Water tariff					8
Total					65

7.9 Nashik (Option No.9) - Water Supply Sector

The potential for Japanese cooperation can be seen in the funding to the implementation of Phase I work in Package II, indicated in the Master Plan and DPR for Nashik city. The 1st phase work was designed to meet the demand up to 2026 in the immediate stage.
The priority of the project is not at high.

7.9.1 Summary of the Project

The outline of candidate project can be summarized as follows.

City / Sector/ No.	**Nashik City**	**Water Supply**	**No.9**
Type of Scheme:	**ODA-Loan**	**Rank: C**	
Title (E):	**Project for Improvement of Water Supply System in Nashik city**		
Estimated Loan Amount:	25.3 bilion JPY (1,693 crore Rs.)		
Borrower:	Maharashtra State Gov/ Nashik Municipal Corporation (NMC)		
Project period:	2013-17 (Phase I Part A: 3 years, Part B: 4 years)		
Project Objectives:	1 To construct and improve water supply facilities through replacement and expansion of water treatment plants, and installation of transmission pipeline 2 To contribute to improve the living environment of regional residents in Nashik city		
Project Components:	Funding for Phase I work of Package II **1. Phase I** [Part A] 1-1 Intake and head works at Mukane Dam 1-2 Construction of raw water transmission from Mukane Dam to Pathardi WTP 1-3 Construction of Pathardi WTP (207 MLD) 1-4 Construction of service reservoirs and a part of distribution line [Part B] 1-5 Construction of a new dam at Kikwi 1-6 Rehabilitation of head works at Gangapur 1-7 Rehabilitation of head works at Chehedi 1-8 Construction of additional transmission line 1-9 Construction of distribution system for 2011 to 2026 **2. Consulting services** - Detailed design - Tender assistance - Construction supervision - Strengthening of institutional capacity - Monitoring for environment and land acquisition		

City / Sector/ No.	**Nashik City**	**Water Supply**	**No.9**
Type of Scheme:	**ODA-Loan**	**Rank: C**	
Evaluation Criteria:			
Relevance	• An increase of water demand by rapid population growth is predicted, thus the necessity of water facility development targeting 2026 is high. The Japanese foreign aid policy states that the priority will be given to assistance for "water supply and sewerage sector" as an assistance objective within the framework of "improvement of environmental problems". This project is in the line with the Japanese foreign aid policy.		
Effectiveness	-		
Efficiency Impact Suatinability	• Environmental and social impact on dam construction is uncertain at present. The result of Feasibility Study needs to be confirmed.		
Main Constraint	• Sufficient environmental and social consideration on environmental conservation, land acquisition, resettlement etc. should be given to the dam construction project.		

7.9.2 Summary of the Project

The approximate loan amount is assumed by multiplying price escalation as 8% by the Project cost for Part A and Part B in Phase I works, based on the cost estimation of the Master Plan.

(Unit: Rs. crore)

	Part A	Part B	Loan amount
Project Cost (Master Plan 2009)	435.87	610.26	1046.13
Price Contingency (8%)	268.13	378.14	646.27
Total	704.00	988.40	1692.40

7.9.3 Implementation Schedule

The provisional implementation schedule of the Project based on the collected information through this study is shown as below. The total implementation schedule is 7 years consisted of 3 years for signing and selection of consultant, 4 years for construction works.

	Period	2013	2014	2015	2016	2017	2018	2019
Signing of L/A	-	▼						
Selection of Consultant	12 months	■						
Detailed Design	12 months		■					
Tender Evaluation	12 months			■				
Selection of Contractor	12 months			■				
Consultant Supervision	36 months 48 months				■	■	■	
Construction Works	36 months 48 months				■	■	■	■

7.10 Aurangabad (Option No.10) - Sewerage Sector

50% of the project cost is proposed to be funded under the Maharashtra Suvarna Jayanti Nagarutthan Mahabhiya Program of the State government, while AMC will have to raise a loan for the remaining 50% portion, from the State government or other sources. Therefore, the potential for Japanese financing assistance may be seen in the funding to the 50% of the project cost. The project period is scheduled to be for 4 years for implementation. PMC is planning to implement the part of project components related to STPs by Design, Build, Own, Operate and Transfer (DBOOT) type of contracts.

Because the swewrage system with the limited number of STP is mostly not developed, the priority of the project is at high.

7.10.1 Summary of the Project

The outline of candidate project can be summarized as follows.

City / Sector/ No.	**Aurangabad City**	**Sewerage**	**No.10**
Type of Scheme:	**ODA-Loan**	**Rank: A**	
Title (E):	**Project for Sewerage System Development in Aurangabad city**		
Estimated Loan Amount:	3.0 bil. JPY (203 crore Rs.)		
Borrower:	Maharashtra State Gov/ Aurangabad Municipal Corporation (AMC)		
Project Period:	2013-2019 (7 years)		
Project Objectives:	1 To promote sewerage and wastewater treatment prevalence by new construction and upgrading of sewerage and waste water facilities 2 To contribute to improve water quality of rivers in Pune city and the living environment of regional residents in the area		
Project Components:	**1. Development of new sewerage lines for future developed areas** 1-1 Development of sewer lines to the new residential areas (1,380 ha) such as Nakshatrawadi and Satara Parishar etc. **2. Upgradation of existing sewers lines** 2-1 Install additional line in parallel in six zones covering the whole city 2-2 Upgrading pipe diameter in six zones covering the whole city **3. Development of main seven Sewers (A-G: 46.4) in Kham basin** **4. Development of main two sewers (L, M: 15.0 km) in Sukhana basin** **5. Construction and development of STPs** 5-1 Construction of 4 new STPs (Banewadi, Kanchanwadi, Siddhartha Garden, Padegaon)		

City / Sector/ No.	**Aurangabad City**	**Sewerage**	**No.10**
Type of Scheme:	**ODA-Loan**	**Rank: A**	
	5-2 Refurbhishment and upgradation of CIDCO STP 5-3 Upgradation of Zalta STP **6. Construction of pumping stations** 6-1 Construction of intermediate pumping stations at Ward 6-2 Construction of terminal pumping stations at Golwadi to Kanchanwadi STP **7. Consulting services** - Detailed design - Tender assistance - Construction supervision - Strengthening of institutional capacity - Monitoring for environment and land acquisition		
Evaluation Criteria:			
Relevance	• Wastewater treatment capacity is almost non-existent largely due to the limited number of STP. Therefore, the necessity of the project is very high. The project is consistent with regional needs. • The Japanese foreign aid policy states that the priority will be given to assistance for "water supply and sewerage sector" as an assistance objective within the framework of "improvement of environmental problems". This project is in the line with the Japanese foreign aid policy. • This project is in line with the Indian policy on development of sanitation facilities and dissemination of local people's sanitation awareness.		
Effectiveness	• The project objective is expected to be achieved by construction of STPs, the effectiveness can be recognized as high. • Sufficient consideration should be given to the issue of land acquisition at the river side and slum area, since it may be one of the project constraints potentially.		
Efficiency Impact Suatinability	• Continuous capacity enhancement of operation and maintenance for facilities is necessary to secure the long-term effectiveness of the project. • The important challenges are appropriate sewerage tariff collection and increase of collection efficiency to secure the project sustainability. • In order to do so, people's awareness-rising on sanitation and enhancement of understanding on tariff payment are essential.		
Main Constraint	• Insufficient staff's capacity for operation and maintenance. • Implementing sewage collection system from slums.		

7.10.2 Estimated Loan Amount

The approximate project cost is estimated for Rs.203.2 crore as 50% of the total after excluding the expected subsidy from GoM based on the DPR.

（Unit: Rs. crore）

	Total	Grant subsidy from GoM	Loan amount
Project Cost (Detailed Project Report 2011)	406.4	203.2	203.2

7.10.3 Implementation Schedule

The provisional implementation schedule of the Project based on the collected information through this study is shown as below. The total implementation schedule will be for 7 years consisted of 3 years for signing and selection of consultant 4 years.

	Period	2013	2014	2015	2016	2017	2018	2019
Signing of L/A	-	▼						
Selection of Consultant	12 months	■						
Detailed Design	12 months		■					
Tender Evaluation	12 months			■				
Selection of Contractor	12 months			■				
Consultant Supervision	36 months				■	■	■	■
Construction Works	36months				■	■	■	■

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APPENDIX 1

Officials Met and Consulted during the Study

Name	Position
JICA-India	
Ms. Mino SATO	Representative
Ms. Kaori IWATA	Programme Specialist
Mr. Chichiro FUKUDA	Representative
Ms. Emi DOYLE	Programme Specialist

Municipal Corporation of Greater Mumbai (MCGM)	
Mr. Rajiv Jalota	Add. Commissioner (Projects)
Mr. Dinesh M. Gondalia	Dy. Municipal Commissioner (Special Engineering)
Mr. Haribhau S. Nikam	Chief Accountant (W.S. & S.D.)
Mr. B. P. Patil	Dy. Municipal Commissioner (Engineering)
Mr. P. V. Kulkarni	JNNURM Cell
Ms. Seema Redkar	Officer on Special Duty (ALM)
Water Supply	
Mr. Shrikant Ramkrishna Argade	E.E., Water Works (Planning and Research)
Mr. Anil Kotkar	Deputy Engineer (Planning and Research)
Sewerage	
Mr. P. P. Joshi	Chief Engineer, Sewerage (Projects)
Mr. N. B. Achrekar	Ex Assistant to AMC (Sewerage)
Mr. Solapurkar	Chief Engineer, Sewerage (Operation)
Storm Water Drainage	
Mr. L.S.Vhatkar	Chief Engineer (S.W.D.)
Mr. N.H.Kusnur	Ex Assistant to AMC (P), SWD Mapping
Mr. Sanjay Singh	Mechanical Engineer, SWD Mapping
Mumbai Middle Vaitarna Water supply Project	
Mr. Parag V.Sheth	Astt. Engr. Water supply Projects M.C.G.M.
Mr. Suhas S. Kusugkag	Sub. Engr. Water supply Projects M.C.G.M.

Pune Municipal Corporation (PMC)	
Mr. Mahesh Pathak	Municipal Commissioner
Water Supply	
Mr. V. G. Kulkarni	Superintending Engineer, Water Supply and Sewerage
Mr. Shreekant P.Bhanage	Ex. Engineer (Ele), Parvati WTP
Sewerage and Drainage	
Mr. Pramod S. Nirbhavane	Additional City Engineer, Roads

Nashik Municipal Corporation (NMC)	
Mr. B.D.Sanap	Commissioner
Water Supply	
Mr. R.K. Pawar	Superintending Engineer (M/E) Water Supply Department
Mr. Magre	Executive Water Production Engineer
Mr. Garjul	Water Distribution Engineer
Mr. B.G. Mali	Deputy Engineer (Mech.), Production and Distribution
Mr. Gangurde	Engineer
Mr. Pagare	Engineer
Mr. Dharmadhakari	Executive Engineer

Nashik Municipal Corporation (NMC)	
Sewerage and Drainage	
Mr. U.B. Pawar	S.E. (Sewerage and Drainage)
Mr. Karmarkar Prasad	Process Incharge, Tapovan STP
Mr. H.R. Joshi	Supervisor, Tapovan STP
Mr. S.R. Matale	Sr. Chemiest, Tapovan STP
Others	
Mr. Pankaj Rakibe	SPAN Consultants, Project Engineer
Mr. Yadav	GIZ

Aurangabad Municipal Corporation (AMC)	
Mr. Purusottam Bhapkar	Municipal Commissioner
Mr. M.D.Sonavane	City Engineer
Mr. S. Sikander	BOT/Chief (E･E)
Ms. Dr. Jayashree Kulkarni	Medical officer of Health
Water Supply	
Mr. Panzade S. D.	Executive Engineer
Mr. K. M. Phalak	Deputy Engineer
Mr. Manoj Baniskar	Engineer
Sewerage and Drainage	
Mr. Afsar Siddiqui	Deputy Engineer (Sewerage /STPs)
Mr. Naglot R. M.	Engineer

Other Organizations	
Mr. Mohansundar Radhakrishnan	Project Officer, Sustainable Urban Habitat, giz India
Mr. J. L. Nagesh	Dy. Manager (Projects); Enviro Control Associates (I) Pvt. Ltd., Naidu STP Pune
Mr. Sagar Singh	Asst. Manager (Operations), Studio Galli Ingegneria, India
Mr. Ajeet Oak	Director, Primove Infrastructure Development Consultants Pvt. Ltd.
Mr. Abhay Kantak	Head, Urban Practice, CRISIL Risk & Infrastructure Solutions Limited
Ms. Gayatree Oak	Analyst, Urban Practice, CRISIL Risk & Infrastructure Solutions Limited
Mr. Digbijoy Bhowmik	Team Leader, Urban, CRISIL Risk & Infrastructure Solutions Limited

APPENDIX 2

JNNURM

Jawaharlal Nehru National Urban Renewal Mission (JNNURM) in a major initiative by the Government of India aiming at improving and augmenting the economic and social infrastructure of cities as well as affordable housing and basic services to the urban poor.

Launched in December 2005 for a period of seven years, the JNNURM comprises four schemes. It funds specific projects for urban infrastructure and basic urban services in 65 cities of India through two schemes, i.e. the Scheme for Urban Infrastructure and Governance (UIG) and the Scheme for Basic Services to the Urban Poor (BSUP). The other two schemes, i.e. the Urban Infrastructure Development Scheme for Small and Medium Towns (UIDSSMT) and the Integrated Housing and Slum Development Programme (IHSDP) cover non-Mission cities and towns with the aim of integrated provision of basic entitlements and services to all including the urban poor.

Under the JNNURM, the Government of India enters into partnership with state governments and Urban Local Bodies (ULBs). As a first step, the ULB has to prepare a perspective plan or a City Development Plan (CDP), which is followed by a Detailed Project Report (DPR) in line with the priorities laid out in the CDP. The state government and the ULB of a Mission city are required to sign a memorandum of agreement (MoA) with the Government of India, where both the state government and the ULB commit to a set of reforms and they all agree to share in the funding of the project.

The state government and the ULB are expected to make specified parallel financial contributions along with the Government of India. For large cities with population of more than 4 million, a 35 % grant is made by the Government of India, 15 % by the state government, and 50 % by the ULB. In the case of cities with population between 1 and 4 million, 50 % is provided by the Government of India, 20 % by the state government, and 30 % by the ULB. For all other cities, the Government of India provides 80 % of the grant, while the state government and the ULB contribute 10 % each. Cities in north-eastern states and Jammu and Kashmir receive 90 % grant from the Government of India and 10 % from the state government.

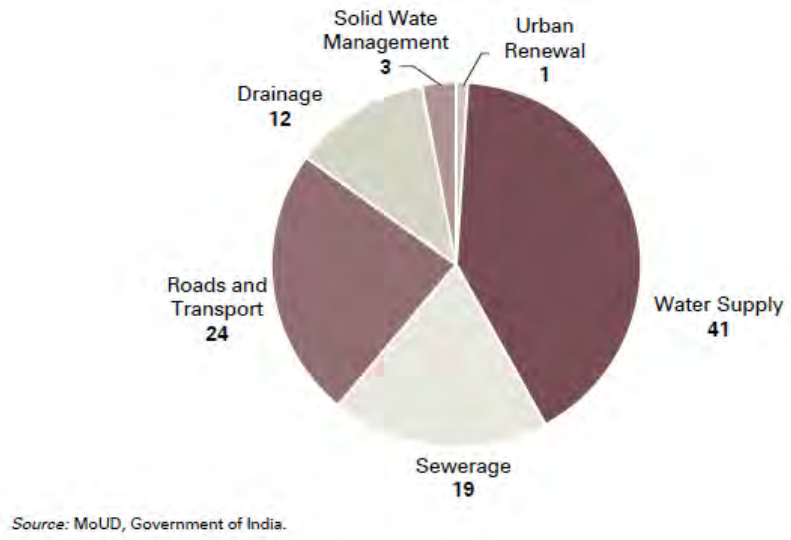
A summary view of the physical progress as well as financial approvals, commitments, and releases in the projects is presented in Table-1 and Figure-1. The Government of India has allocated a little over Rs 66,000 crore. The total project cost approved as of the same date is Rs 109,700 crore. A total amount of Rs 28,650 crore has been released as of 31 December, 2010.

The water sector accounts for the single largest share (41 %) of the funds disbursed under the JNNURM for infrastructure development, while water, sewerage, and drainage together account for over 70 %.

Table-1: JNNURM- A Work in Progress (as on 31 December, 2010)

	UIG	UIDSSMT
	(Number)	
Cities/Towns Covered	62*	641
Projects Approved	**528**	**764**
Projects Completed	84	123
	(Rs crore)	
Allocation	31500	11400
Approved Project Cost	**60215**	**12929**
GoI Funds Committed	27878	10363
GoI Funds Released	**11860**	**7110**
	BSUP	IHSDP
	(Number)	
Cities/Towns Covered	64	820
Projects Approved	**477**	**966**
Dwelling Units for the Poor Approved	1028503	515244
Dwelling Units for the Poor Completed	**264965**	**108416**
Dwelling Units for the Poor in Progress	318151	137373
	(Rs crore)	
Allocation	16356	6828
Approved Project Cost	**26844**	**9712**
GoI Funds Committed	13567	6614
GoI Funds Released	**6103**	**3577**

* For 3 cities out of a total of 65 eligible cities no project was sanctioned.
Source: MoUD and Ministry of Housing and Urban Poverty Alleviation, Government of India (GoI).



Source: MoUD, Government of India.

Figure-1: JNNURM- Spending by Sector for UIG and UIDSSMT (as on 1 December, 2010)

In the light of the experience gained from the functioning of the JNNURM and in view of the need for the Government of India to push for urban infrastructure development because of its crucial role in supporting faster and more inclusive growth of the economy, the High Power Expert Committee on the Committee for Estimating the Investment Requirement for Urban Infrastructure Services has proposed a new improved JNNURM.

The main features of the New Improved JNNURM (NIJNNURM) are as follows:

- **Coverage.** Must be accessible to all cities/towns – big and small.
- **Capacity Building**
  - Should have a strong programme of capacity creation and training which should include creation of institutional and human resource capacity, which is needed at all levels but particularly for preparing the small ULBs for accessing NIJNNURM.
  - Of the total NIJNNURM funds, 5 % will be spent on building capacity. This would still meet only half of the total funding requirements of capacity building for the entire 20-year programme. State governments, ULBs and the private sector will have to play a partnership role in building capacity, particularly of ULBs for them to play a major role in transforming urban India.
- **Programme Approach**
  - ULBs should be required to lay out a programme detailing (i) the current state of affairs at ULB level including service-level indicators, (ii) city vision, mission and end goal in terms of where the ULB will be at the time of completion of the programme including a number of municipal service indicators, (iii) the proposed asset-creation programme including the financing and operating plans, (iv) the proposed reforms including clear indicators of progress and timelines, (v) a framework for monitoring programme and associated reform, and (vi) the capacity available, the capacity needed, and the time by which it will be in place.
- **City Differentials**
  - Recognise that smaller cities and towns will need to be treated differently from larger cities and metros – for funding, capacity building and reform content and timelines. Funds for smaller ULBs should be channeled through intermediary institutions which may be set up at regional level and they should be encouraged to go in for pooled financing to best leverage funds from the NIJNNURM. These ULBs must commit to progressive realisation of service level norms prescribed by the Ministry of Urban Development and progressive reforms in governance, e.g. progressive recovery of costs.
  - For Municipal Corporations and Municipalities, in addition to a regular window, a special window should be created specifically for projects that could be financed and executed via PPP route, or by leveraging private sources of funding. Special

infrastructure funding vehicles and PPP mechanisms should be designed and integrated into the process of project sanctioning and disbursal.

- **Funding**
  - Should be linked to a ULB-specific programme of development and reform (which, of course, would be contingent on some reforms taking place at the state level) where the design of the reform should take note of the differences that exist on the ground between the governance structures of Municipal Corporations, Municipalities, and Nagar Panchayats.
  - All funding requirements of the ULBs should be routed through the state governments. State governments will not be required to make any financial contribution towards the NIJNNURM because of the proposal for devolution and state action to empower local bodies as the third tier
  - The contribution of the smaller ULBs should be lower than that of the larger cities and metros.
- **Governance and Efficiency Considerations**
  - Need for a state level mechanism for monitoring reforms at ULB level, located at the Reform and Performance Management Cell in the state government.
  - Focus on improvement in procurement systems by having standardized tender documents for key categories of urban infrastructure based on international best practices.

The major differences between JNNURM and NIJNNURM are:

i. The JNNURM is largely directed at a selected few cities as is always the case with a pilot. The NIJNNURM will be open to all.

ii. The JNNURM is a project-based Mission. The NIJNNURM will have a programme approach.

iii. The JNNURM linked a broad set of reforms to specific projects and was not able to drive reforms through project lending. The NIJNNURM will give funding linked to a set of reforms which will be differentiated across different types of ULBs.

iv. The JNNURM has a separate funding window (UIDSSMT/IHSDP) for smaller cities and towns. The NIJNNURM will differentiate between smaller cities and towns, on the one hand, and larger cities and metros, on the other, by specifying separate processes of capacity building, reform content and timelines as well.

v. Recognising that ULBs need to be made reform-ready, the NIJNNURM places prime emphasis on capacity building.

APPENDIX 3

TECHNICAL ASPECTS APPLIED FOR DELHI WATER MASTER PLAN AND OF RELEVANCE TO THIS STUDY

1.1 Non-revenue Water and its Reduction Measures

Water systems in most Indian urban centers have high levels of non-revenue water (NRW). Reducing NRW not only saves precious treated water but also improves revenue generation of water utilities. The saved water can be taken as an additional source; to reduce the demand-supply gap if there is any, or to supply to other areas. The additional revenue generated by the reduction of NRW helps improve financial health of the utility. A financially strong utility can take steps to further improve the system.

NRW is one of the main subjects of this Study. NRW is composed of two main components; real losses and apparent losses. Our experiences elsewhere in Indian cities indicate that apparent losses (such as missing customers, illegal connections, problems related to metering and billing) are equally or even more important than real losses (such as utility's tank overflow or leakage from distribution network). This is due to short supply duration and low system pressure generally prevalent in Indian cities. In such situations NRW reduction starting with the apparent losses becomes easier and more cost-effective. Reduction of real losses becomes important as the system pressure and supply duration increase and where the pipe network is older. NRW reduction process requires time and effort and includes many interrelated activities. A simplified flow of NRW reduction process is shown in Figure1.

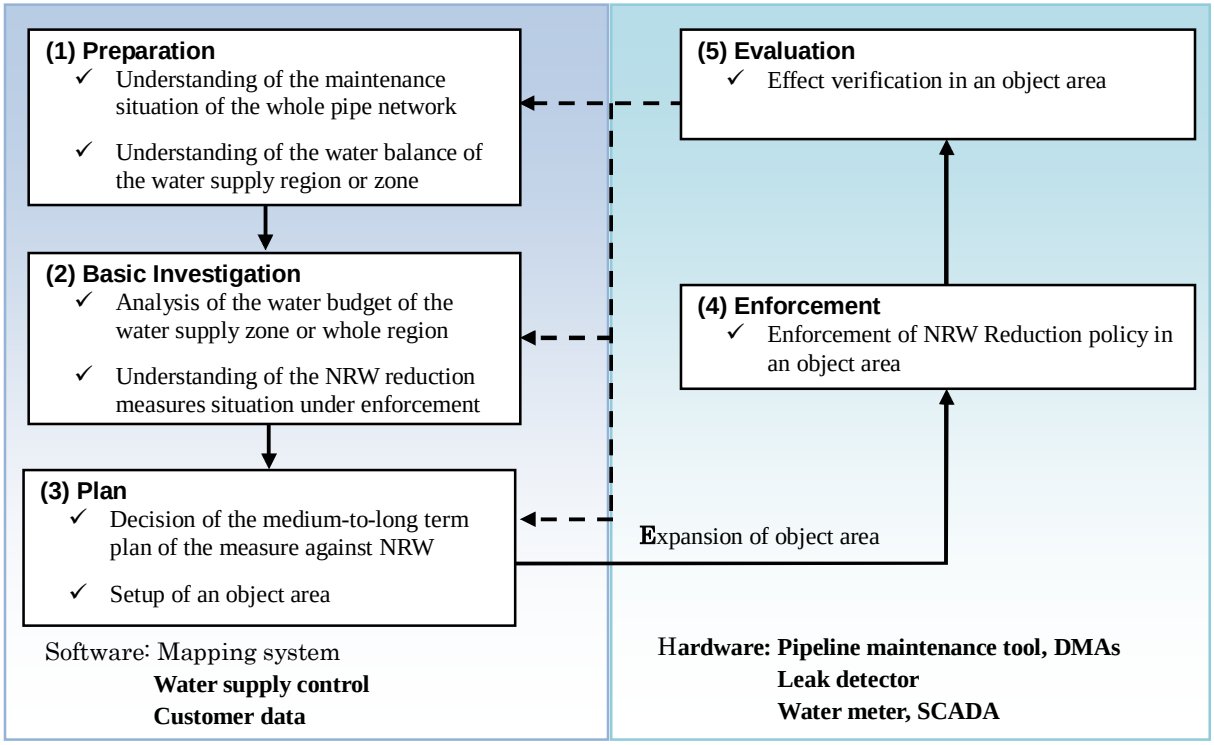


Figure1: Flow of a NRW Reduction System

The process starts with the preparation and ends with evaluation. Depending upon the target and achievement level, the process may start again but not necessarily from the very beginning. A good mapping system and customer data are pre-requisite for an effective NRW reduction program. Similarly, tools such as leak detection and repair equipment, division of bigger network into smaller and more manageable areas (District Metered Areas or DMAs), functioning water meters, water flow & pressure monitoring system such as SCADA are also essential to implement NRW reduction program.

During the Study, we will collect and analyze data on NRW. A questionnaire has been prepared for the water utility which will provide important data on NRW. We will also conduct interviews, and refer to utility publications and published literatures. Reference will also be made to any ongoing and planned NRW reduction activities. The findings will then be discussed and based on the findings; measures to reduce NRW to the level set by MoUD will be proposed.

1.2 GIS Based Institution Ledger System

Geographical Information System (GIS) is being increasingly used in water supply system for various purposes. Among others, GIS based applications for network mapping, assets management, customer data management, and maintenance management have a wide potential for improving operation of water systems. An example of such system which is being used in Yokohama City water supply is shown in Figure2 and Figure3.

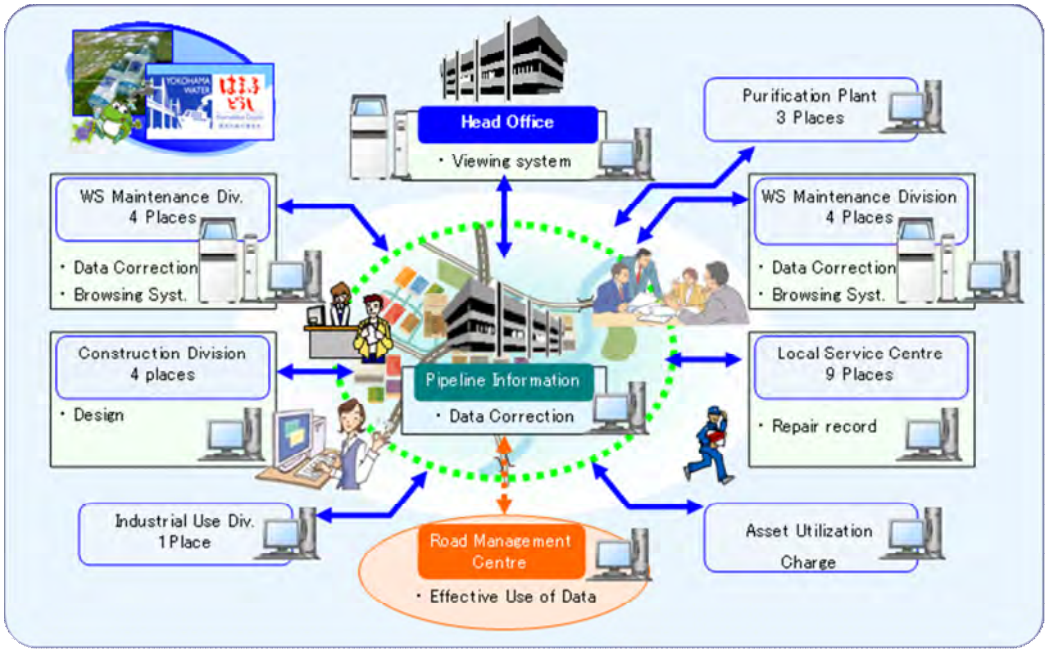


Figure2: Arrangement Image of Institution Ledger System (Example of Yokohama City)

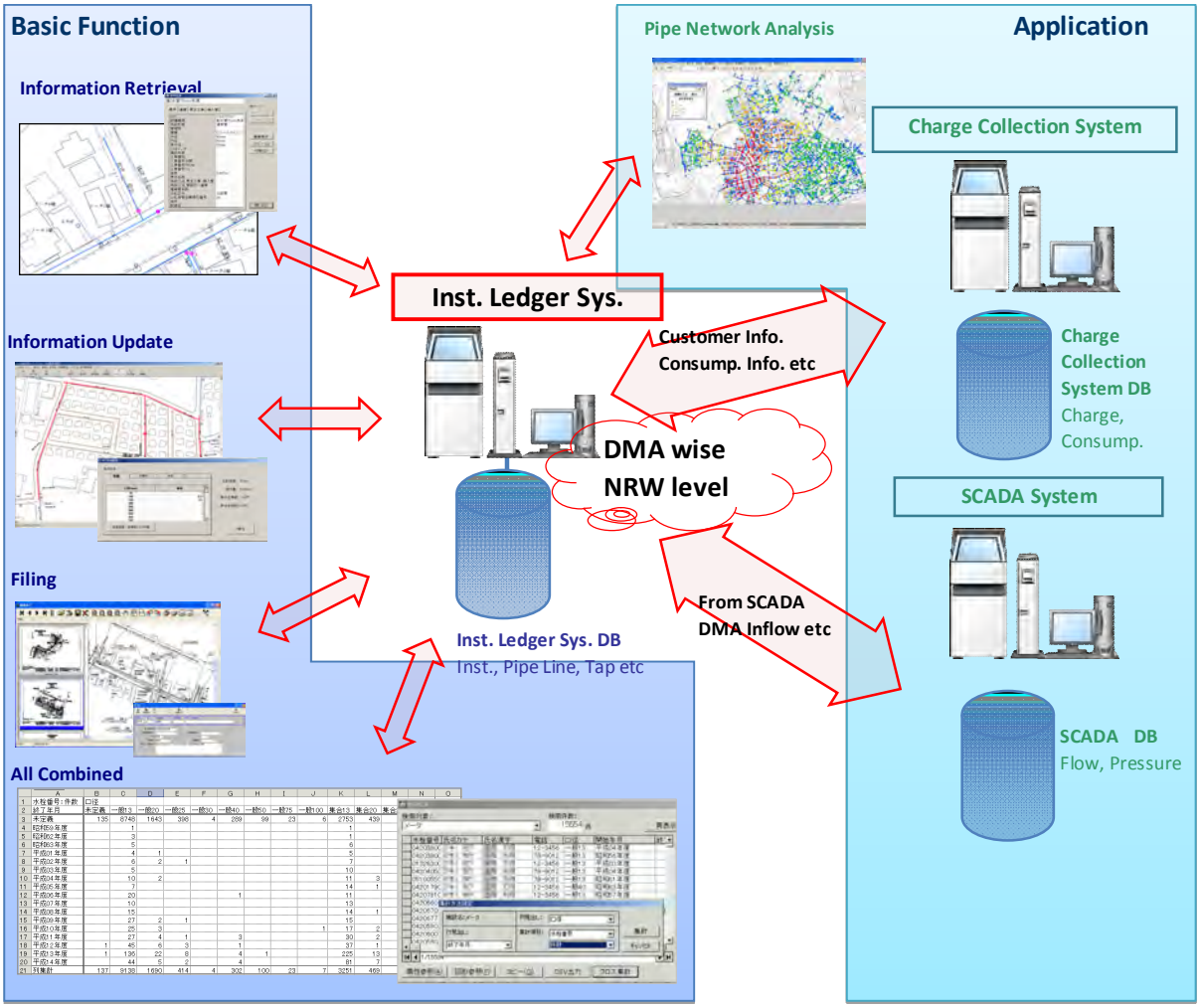


Figure3: Image of the Functions of Institution Ledger System

During the study, the Study Team will examine the existing ledger system in the subject city and based on the findings, propose improvement measures of existing or establishment of a new system. While proposing improvement or a new ledger system, experience and lessons learned in Japan will be utilized. This will likely save the water utility from the glitches and bugs that generally develop in the initial stage of such programs.

1.3 GIS Based Customer Data Management

An efficient customer data management system greatly facilitates billing, customer service related operations, and NRW reduction works. Traditionally customer data is collected and stored in database programs which do not have spatial reference. For example, a spreadsheet based database will not be able to tell where exactly is the customer located on the map. This limitation is overcome with recent introduction of GIS based customer data management systems.

In GIS based customer data management system customers' location on map can easily be identified. Conversely, customers' detail such as billing status and water consumption can be displayed on the map. It is very useful for locating missing customers which is considered to be a major source of apparent loss in many Indian cities.

During the Study, existing customer data management system of the water utility will be examined. Need to improve existing or establish a new system will be evaluated.

1.4 Distribution System Improvement

An efficient distribution system should be able to distribute available water equitably with hydraulic gradient (head loss per unit length of pipe) remaining within a defined range. The distribution system should also be easy to manage and cause minimum of water leakage.

The Study will carefully observe and analyze existing condition of the distribution system in the object city. Recent approach to distribution management includes dividing big distribution system into smaller more manageable units. For a city with multiple water sources and treatment plants a '3-tier distribution system' approach (as shown in Figure4) is preferable.

Under this 3-tier system, the whole distribution system is first divided into bigger areas, each area covering command area of a WTP, then medium sized areas covering command area of each service reservoir, and the smallest units covering from about 500 to 5,000 connections, known as district metered areas (DMAs). The first tier covers distribution system from WTP to service reservoir, the second tier from service reservoir to DMA inlet and the last tier within

DMA. As implied by its name, each DMA is equipped with a bulk meter and is the smallest entity for which an independent water balance can be made. This helps to identify NRW in each DMA and prioritize improvement works for optimum use of available resources.

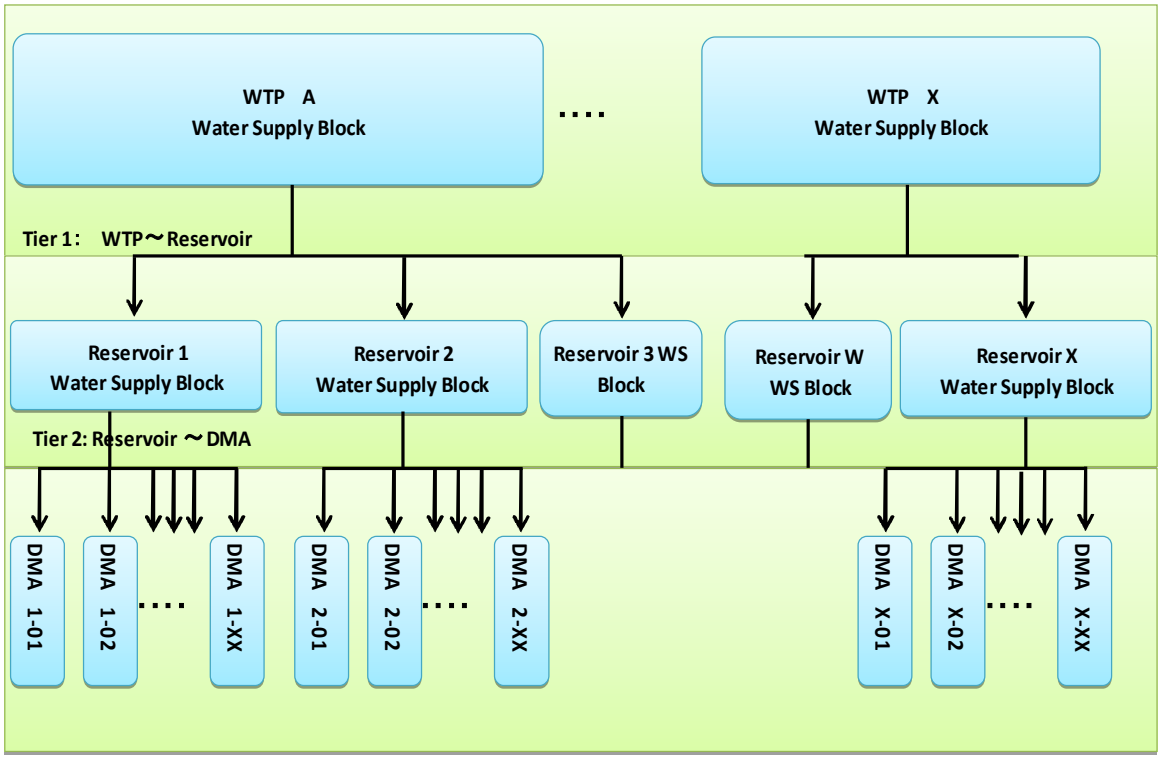


Figure4: Concept of 3-tier Distribution System

For the 3-tier system to function most effectively, the administrative division of the area should also coincide with those of 3-tier system divisions. This usually requires some adjustment of administrative units.

Another aspect of distribution system improvement is its need to expand to include new, generally sub-urban, areas. This often requires reallocation of water sources, and introduction of new water conveyance and storage facilities.

During the study, all important aspects of distribution system improvement as mentioned above will be analyzed and outline measures for improvement will be prepared.

1.5 Shift to Continuous (24×7) Supply

As also defined by MoUD, the ultimate goal of any water supply system should be continuous supply. Intermittent supply creates many problems; individual customers need to have their own storage, increased chance of water contamination from network and during storage, exposure of network to repeated surges, and so on.

Shifting an intermittent supply system to a continuous one requires consideration on several fronts. Adequacy of water quantity, storage reservoirs, and pumping stations/ pumps should be assured. A distribution network working under intermittent system is generally adequate in terms of its carrying capacity for a continuous system. The utility should be prepared to deal with the likely challenges of transitional stage, for example, leakage increases substantially at this stage due to longer run time.

The Study will evaluate improvement needs and potential challenges for shifting to 24×7 supply. Steps and recommendations for the same will be made.

1.6 SCADA System

Supervisory Control and Data Acquisition system (SCADA) in a water supply is a tool to assist the above-mentioned three-tier system operation. Through SCADA, data from WTPs, UGRs and DMAs are collected and after analysis of the data, water flows to WTPs, UGRs and DMAs are adjusted for equitable water distribution/allocation. Continuous monitoring of flow and pressure through SCADA also helps to detect new pipe burst by showing abnormality in flow and pressure patterns.

The three components, as shown in Figure5; GIS based ledger system, 3-tier distribution management, and SCADA system together form a strong backbone of an efficient water supply system and help achieve the target of 24×7 supply with acceptable NRW level.

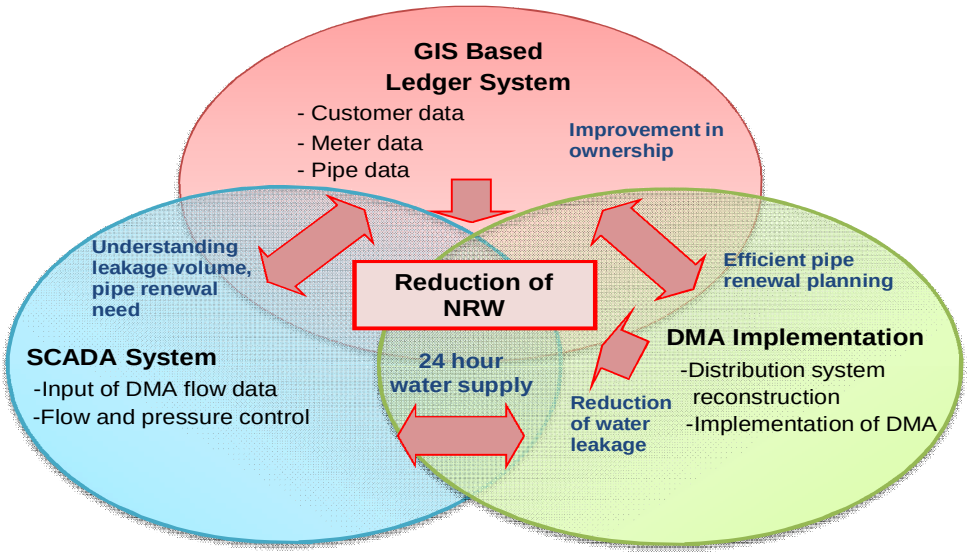


Figure5: Three Main Components Proposed For the Study and Their Role in Achieving the Defined Goals

Appendix 4: Phasing Summary of Mumbai Sewage Disposal Project (MSDP) Stage-II

	Component	Zone	Phase 1 2002 to 05 Description	Phase 2 2005 to 10 Description	Phase 3 2011 to 15 Description	Phase 4 2015 to 20 Description	Phase 5 2020 to 25 Description
1	Slum Sanitation	All zones	All areas & specialty W side Zone 6	All areas	All areas in Zones 2 to 7	All areas in Zones 2 to 7	All areas in Zones 2 to 7
					Zone 1 completed		
2	New Trunk Sewers	1	None	None	None	None	None
		2	None in Ph 1	Churchgate to VT	Poonam Chamber, Lovegrove	World village sewer	Completed
		3	Wadata fire station to Saltpan + S11 connections	Chandlvali trunk sewers	Sakinaka trunk sewers	None in Ph 4	Barkat Ali Dargah Rd trunk
					Marol and Kherani Road		
		4	None	None	None	None	None
		5	Commence Dahisar (N), Dahisar (E), Lokhanwalla, Kurar	Complete Dahisar (N), Dahisar (E), Lokhanwalla, Kurar + Thakur (exSTs)	Commence Madh village, Erangel beach, Madh beach, Aksa beach & Dharavali / Malvani village / Marve village developable areas	Commence Madh village, Erangel beach, Madh beach, Aksa beach & Dharavali / Malvani village / Marve village developable areas trunk sewers	Mariori village, Manori developable area. Gorai village, and Gorai developable area trunk sewers
		6	Private PS connection (Kannam Nagar & Tagore Nagar)	Sewers to connections on W side, Dargah Rd sewer, Octroi sewer	Commence East of Bhandup station	Commence East of Bhandup station	
		7	None in Ph 1 except S11 connections	Bharat petroleum trunk	Collector Colony Sewer	Turbe Village sewer & Shivaji N sewer	Panvel Rd sewer, Ramabal Nager sewer
3	Upsized Trunk Sewers	1	None	None	None	None	None
		2	None in Ph 1	100% of zone	Completed		
		3	None in Ph 1	Connecting link Andheri (E) to WEH. Sattpan, Dharavl	North Andheri (E), Mahlm, Khar, Kuria. Slori hospital, Bandra	Xalina	Completed
		4	Jayprakash Road sewer	50% of zone	50% of zone	Completed	
		5	Shimpolt to Goregaon sewers	NE area	50% of remainder of zone	50% of remainder of zone	Completed
		6	Village Rd link sewer	50% of zone	50% of zone	50% of zone	
		7	None in Ph 1	50% of zone	50% of zone	Completed	
4	Rehabilitation of sewers	1	Survey starts	Whole zone	Completed	Completed	
		2	Survey starts	25% of zone	25% of zone	25% of zone	25% of zone
		3	Survey starts	25% of zone	25% of zone	25% of zone	25% of zone
		4	None in Ph 1	Survey starts	33% of zone	33% of zone	33% of zone
		5	None in Ph 1	Survey starts	33% of zone	33% of zone	33% of zone
		6	None in Ph 1	Survey starts	33% of zone	33% of zone	33% of zone
		7	None in Ph 1	Survey starts	33% of zone	33% of zone	33% of zone
5	Rehabilitation of manholes	1	Commence all areas	Complete all areas	All areas completed		
		2	Commence all areas	Complete all areas	All areas completed		
		3	Commence all areas	Complete all areas	All areas completed		
		4	None Reported	None	None	None	None
		5	None Reported	None	None	None	None
		6	None Reported	None	None	None	None
		7	None Reported	None	None	None	None
6	Diversion of illegal connections	1	Commence programme	Complete programme	Completed		
		2	Commence programme	Complete programme	Completed		
		3	None in Ph 1	Commence programme	Complete programme	Completed	
7	Area Sewers	1	None	None	None	None	None
		2	None in Ph 1	4 existing areas – Connect Only	Poonam Chamber, Lovegrove	Worlf Village	Completed
		3	None in Ph 1	All areas 25%	All areas 25%	All areas 25%	All areas 25%

	Component	Zone	Phase 1 2002 to 05 Description	Phase 2 2005 to 10 Description	Phase 3 2011 to 15 Description	Phase 4 2015 to 20 Description	Phase 5 2020 to 25 Description
		4	None in Ph 1	Identified overloaded area sewers	Further overloaded area sewers	Completed	
		5	Complete Dahisar (N), Dahisar (E), Lokhabwalla, Kurnr	Complete Dahisar (N), Dahisar (E), Thakur, Lokhabwalla, Kurnr	Ram Maridir Rd, Goregaon Commercial centre, Millal Nagar, Chicholi Bundar, Charkop, Marve village	Madh village, Erangel beach, Madh beach, Aksa beach & Dharavali / Malvani village / Marve & Malvani developable areas	Mariori village, Manori developable area. Gorai village, and Gorai developable area trunk sewers
		6	Commence west side slum areas	Chandivali, Complete west side slum areas, Octroi	Commence East of Bhandup station	Complete East of Bhandup station	Gavanpada Gaothan, Hoachst
		7	None in Ph 1	Bharat petroleum areas	Collector Cotony & nearby areas	Turoha Village, Shivai Nagar, Chedda Nagar	Ramabat Nagar
8	Pumping Station	1	None in Ph 1	Alghan Church PS	Colaba PS, Robert Rd PS	Merry Wealher PS, NF Rd PS. Kitndge Rd PS	Completed
		2	Works for interlace problems	Napean Sea Road, Chinchpokli PS, Heavey Road PS	Mazgaon PS	Lovegrove PS, Tank Bunder PS, Wylle Rd PS, Carrot Rd PS, Banganga PS, Worli Village PS	Sant Sawt Marg PS, Globe Mill PS, Tulsi Pipe Rd PS, Oadar PS, Sant Gadge Maharaj PS, Churchagate PS
		3	None in Ph 1, Duncan Causeway PS	Jal Bharat PS, Chirmbai PS. Bramariwadi PS	None in Ph 3	Sion Kollwada PS, Saitpan PS	Malunga PS, Dheravi PS, Mahim PS, Wadal PS, Kalina PS, Sakinaka PS, Bandra Kuria Complex PS
		4	Versova PS	None in Ph 2	None in Ph 3	None in Ph 4	Vorsovn No2 PS, Vorsoven Village PS
		5	Shimpoli PS, Goregaon PS, Charkop PS	Vafabh Nagar PS, Gornd PS, Malad PS		Malvant PS	Goral No2 PS, Manori PS
		6	None in Ph 1	None in Ph 2	Bhandup PS	Powal OS	BUDP PS
		7	None in Ph 1	Vikrohli PS, New Bharat Petroleum PS	New Ghatkopar PS, Collector Colony PS and Mysore Colony PS	Turbe Village PS	Completed
8A	Pumping Mains	1	None in Ph 1	Afghan Chudh PS to Blncng Chmbr	None in Ph 3	None in Ph 4	Completed
		2	None in Ph 1	None in Ph 2	None in Ph 3	Worll Village PS to Balancing Ch	Napean Sea Road
		3	None in Ph 1	None in Ph 2	None in Ph 3	None in Ph 4	None in Ph 5
		4	Versova PS to Versova WWTP	None in Ph 2	None in Ph 3	None in Ph 4	None in Ph 5
		5	None in Ph 1	Vallabn Nagar PS to Bincng Chmby, Malad PS to Malad WWTP		None in Ph 4	Manori PS to Gorel
		6	None in Ph 1	Bhandup PS to Bhandup WWTP	None in Ph 3	Powai PS to Balancing Ch	None in Ph 5
		7	None in Ph 1	Vikhreli PS to Bincng Chmtr, New Bharat Petroleum PS to Blncng Cmbr	Ghatkopar PS to Ghatkopar WWTP	Turbe Village PS to VN Purav Marg	Completed
9	Transfers & Effluent PS	3	None in Ph 1	None in Ph 2	None in Ph 3	Commence Transfer Sewer Z3 (N) to Versova 2 PS	Complate Transfer Sewer Z3 (N) to Versova 2 PS Dharavl EPS & Pump Main to Bandra
		4	None in Ph 1	None in Ph 2	None in Ph 3	Versove EPS & Pump Main to Eranget	Completed
		5	None in Ph 1	Maiad EPS & Pump Main to Erangel	Completed		
10	STWs	1	None in Ph 1	Design of Primary Treatment	Primary Treatment	Design of Secondary Treatment	Secondary Treatment
		2	None in Ph 1	Design of Primary Treatment	Primary Treatment	Design of 50% Secondary Treatment	50% Secondary Treatment
		3	None in Ph 1	Design of Primary Treatment	Primary Treatment	Dharavl WwTW	Bandra CEPT, Dharavl WwTW
		4	Convert lagoons – 2 Stage	Complete			
		5	Upgrade preliminary treatment	Design lagoons -2 stage	Construct lagoons – 2 stage	Design of Secondary Treatment	Gorai
		6	None in Ph 1 except Stage 1 aerators	Design convert lagoons -2 stage	Convert lagoons – 2 stage	Convert lagoons – 3 stage	Completed
		7	None in Ph 1 except Stage 1 aerators	Design convert lagoons -2 stage	Convert lagoons – 2 stage	Design convert lagoons – 3 stge	Convert lagoons – 3 stage
11	Outfall	4/5	Design only	Erangel outran – construct & commes	Completed		
12	SCADA	all zones	Design of system	Install Design of system	Install SCADA system	Extend SCADA to new equipment	Extend SCADA to new equipment

APPENDIX 5

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