
CHAPTER 6

**OPERATIONS AND MAINTENANCE
IMPROVEMENT PLAN**

CHAPTER 6 OPERATIONS AND MAINTENANCE IMPROVEMENT PLAN

6.1 Introduction and Assumptions

This O&M improvement plan has been formulated based on the knowledge gained primarily from discussions with PWD during the three phases of the JICA study and is based on the review of current PWD O&M performance and practices. The assumptions related to water and wastewater schemes are as follows:

For water supply schemes, the premise on which this plan is based is as follows:

- ❑ The current operations and maintenance practices and poor standards of safety are not sustainable
- ❑ The feasibility study for enhancement and augmentation of existing water production facilities emphasises the use of familiar technologies (in-line with existing installations)
- ❑ Improved methods of process control will be employed including the testing and analysis of process water and final water delivered to the customer's tap
- ❑ Improved network designs will be employed and include devices for the measurement and control of pressures and flows in order to 'balance' the networks and to aid the management and control of NRW
- ❑ Improved operations management practices will be employed including the need to collect and act on asset and process data
- ❑ Improved maintenance management practices will be employed including the need to employ a more 'proactive' approach to maintenance such as the use of planned preventative maintenance practices to ensure efficient plant availability and operability
- ❑ Improved safety standards will be employed to ensure safe installation, maintenance and operation of disinfection and chlorine handling facilities

For sanitation schemes, the premise on which this plan is based is as follows:

- ❑ The current operations and maintenance practices and poor standards of safety are not sustainable
- ❑ The feasibility study for enhancement and augmentation of existing sewage treatment facilities emphasises the use of familiar technologies (in-line with existing installations) as well as the 'oxidation ditch' method of treatment
- ❑ Improved methods of process control will be employed including the testing and analysis of effluents prior to discharge into public water bodies to ensure compliance with environmental legislation in force. This includes the safe disposal of screenings, grit and sludge generated at plants as a result of the sewage treatment process

- ❑ Improved operations management practices will be employed including the need to collect and act on asset and process data
- ❑ Improved maintenance management practices will be employed including the need to employ a more 'proactive' approach to maintenance such as the use of planned preventative maintenance practices to ensure efficient plant availability and operability
- ❑ Improved sewerage network designs will be employed to ensure efficient flows to ensure self cleaning properties to minimise deposits
- ❑ Modern techniques and tools will be employed to ensure that the sewerage networks are regularly cleaned and maintained to prevent sewer blockages and sewage flooding
- ❑ Improved safety standards will be employed to ensure safe installation, maintenance and operation of equipment in potentially explosive atmospheres

6.2 Actions to be Addressed by the O&M Improvement Plan

As well as being based on the assumptions mentioned above, the O&M improvement Plan builds on the suggestions and strategies formulated in the Master Plan. Refer to Volume II Chapter 7 Operation & Maintenance.

The Plan addresses the shortfalls identified in the review of current O&M performance and practices and the need for:

- ❑ Policy formulation, setting of departmental targets and objectives
- ❑ Asset management plans and for asset information to be recorded
- ❑ O&M manuals that clearly states the parameters, procedures, schedules and responsibilities for effective plant operation
- ❑ 'Planned preventative maintenance' practices to be adopted
- ❑ Installation of devices for measuring inflow and outflow to accurately determine the volume of water into supply. Additionally, installation of good quality revenue meters to accurately determine consumption
- ❑ H&S policy/manuals and contingency/emergency plans; to raise H&S awareness and to improve the level of installation, operation and maintenance of chlorine facilities
- ❑ Statistical process control techniques and to act on process data to optimise water quality and wastewater effluent standards
- ❑ Providing and acting on meaningful and timely management information
- ❑ Improved maintenance and H&S practices at water treatment plants (WTP's), sewage treatment plants (STP's), pumping stations and when working in highways and in sewers
- ❑ Improved sewer cleaning, sludge management and trade-effluent compliance
- ❑ Improved housekeeping standards and computerisation of O&M administrative activities

- The setting up of ‘pilot offices’ to develop best practice
- Institutionalising the O&M improvement measures within each region by use of best practices developed within the pilot offices

6.2.1 Sewer Cleaning, Sludge Management and Trade Effluent Compliance

There is a need for better sewer cleaning, sludge management and trade-effluent compliance. These aspects are detailed below and will need to be addressed by PWD in conducting the O&M improvement plan.

(1) Sewer Cleaning

Currently, the sewerage systems are subject to frequent blockages due to the inflow of sand, sludge, domestic garbage etc. This diminishes the flow characteristics of the networks and reduces efficiency and effective capacity. Other than some basic hand tools there are no proper sewer cleaning equipment in Panaji and Margao service blocks, thus regular routine sewer cleaning does not take place. In order to perform regular effective sewer cleaning, introduction of sewer cleaning equipment will be necessary, unless all sewer cleaning/maintenance is contracted out to third parties.

Existing Sewer Cleaning Equipment

The existing sewer cleaning equipment owned by Panaji and Margao service blocks is listed in the following table and photos of current manual equipment are shown in Figure 62.1.

Table 62.1 List of the Cleaning Equipment for Sewers in Panaji and Margao

Panaji	1. Steel rod and rings
	2. Sucking machine. (Tanker) hired in when needed
Margao	1. Bucket and rope
	2. Steel rod and rings
	3. Balloons to close sewage line to clean the manhole.
	4. Rodding machine to remove the block in the sewage line (with different types of head shape)
	5. Sucking machine. (Tanker) hired in when needed



Inflatable Balloon Equipment

Rodding Machine with Spear Head

Figure 62.1 Existing Cleaning Equipment for Sewers in Margao

Proposed Sewer Cleaning Equipment

The length of sewers; existing and proposed are shown in the table below:

Table 62.2 Sewer Length in the Study Area

Service Area	Existing (m)	Proposed (m)	Total (m)
Panaji and Taleigao etc.	39,080	65,150	104,230
Margao	44,560	59,800	104,360
North Coastal Belt	-	85,300	85,300
Total	83,640	210,250	293,890

Types of Sewer Cleaning Equipment

Sewer cleaning equipment is categorized into two groups, namely mechanized equipment and manual equipment. The most commonly used mechanized equipment is high-pressure water tankers used with sludge vacuum tankers as illustrated in the figure below:

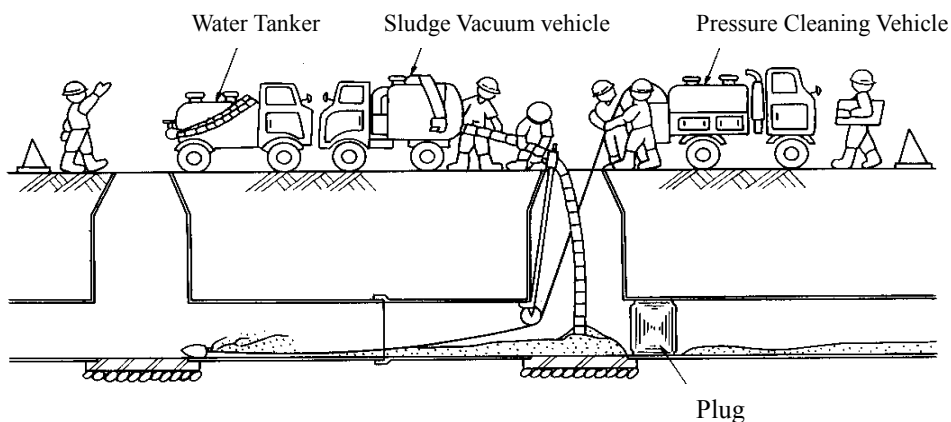


Figure 62.2 Mechanized Sewer Cleaning Equipment

Typical manual cleaning equipment such as the Hand Reel Winch type is shown in the figure below:

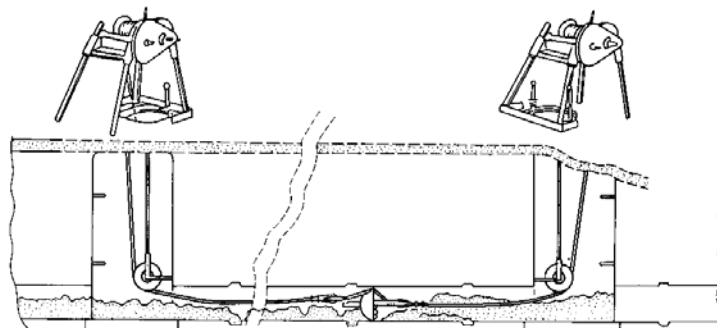


Figure 62.3 Manual Sewer Cleaning Equipment (Hand Reel Winch Type)

Requirements for Sewer Cleaning Equipment

The number of cleaning equipment (mechanized sewer cleaning) sets needed is calculated in consideration of the following requirements, based on the “Sewerage Facility Maintenance Manual” published by the Japan Sewage Works Association.

- One cycle of sewer cleaning works will be completed in 5 years
- Number of working days is 20 days per month
- Average work efficiency is 200 m sewer length/day
- Length of sewer cleaned by one equipment in 5 years: $20 \times 12 \times 5 \times 200 = 240,000\text{m}$
- The Study Area will be divided in three zones for sewer cleaning operation. Each zone will have one set of mechanized cleaning equipment as shown in Table 79.1.3. For emergency cleaning operation, one set of manual cleaning equipment will be provided to each zone.

Zone	Service Block
North Zone	Panaji, North Coastal Belt, Mapusa
South Zone	Margao

Table 62.3 Proposed Sewer Cleaning Equipment for the Study Area

Zone	Work Load	Total Length (m)	Required Set of Mechanized Equipment	Number of Manual Type Equipment
North Zone	240,000	189,530	$0.79 \approx 1$ set	1 set
South Zone	(m sewer /5years)	104,360	$0.43 \approx 1$ set	1 set
Total		293,890		2 sets

(2) Sludge Management

Sewage treatment plants constantly generate grit and screenings removed from raw sewage, and dewatered sludge from their treatment processes. Such solid wastes should be removed from STPs and properly disposed or reused in accordance with Environmental legislation in force. Generation of screenings, grit and sludge are projected in this section.

Predicted Volume of Screenings and Sands

Generation rate of screenings and grit are estimated based on CPHEEO criteria.

Screenings	: 0.010 m ³ /ML → 0.010m ³ /1,000 sewage flow
Grit	: 0.010 m ³ /ML → 0.100m ³ /1,000m ³ sewage flow

Table 62.4 Projected Generation of Screenings and Grit

Collection Area	Design Flow	Screenings		Grit	
	(m ³ /day)	(m ³ /day)	(m ³ /year)	(m ³ /day)	(m ³ /year)
Margao	14,200	0.142	52	1.42	518
Mapusa	5,400	0.054	20	0.54	197
North Coastal Belt	5,600	0.056	20	0.56	204
Total	25,200	0.252	92	2.52	920

Predicted Volume of Excess Sludge

Dewatered sludge to be generated at STPs is calculated assuming 80% water contents.

Table 62.5 Projected Generation of Dewatered Sludge

Collection Area	Design Flow	SS Quality (mg/l)		Solid Weight (ton/day)	Sludge Volume	
	(m ³ /day)	Inlet	Effluent		(m ³ /day)	(m ³ /year)
Margao	14,200	250	50	1.85	9.24	3,373
Mapusa	5,400	250	50	0.70	3.50	1,278
North Coastal Belt	5,600	200	50	0.55	2.75	1,004
Total	25,200	-	-	3.09	15.49	5,654

(3) Industrial Wastewater Management

Current situation of Wastewater Discharge from Industries

There are a number of large industrial sites located in several industrial estates, although only a

small number of small-scale industrial companies exist in the Study Area for sanitation. Goa is home to a variety of industries such as chemical, medicine, fertilizer, brewery, and bottled water companies. Among these industries, the Study Team investigated Zuari Industry Ltd which is the largest fertilizer company in Goa. This company has facilities for the treatment of all wastewater generated at the site (both human and industrial effluent). The treated effluent is reused for sprinkling purposes on-site and therefore, effluent is not discharged into the public water body.

The Pollution Control Board monitors wastewater discharge from industries in Goa and the Board gives suggestions and recommendation concerning wastewater treatment and its discharge when this is required.

Recommendations on Management of Industrial Wastewater

To secure the quality of groundwater and public water bodies, it is indispensable to apply both adequate domestic wastewater treatment via the use of on-site sewage treatment facilities as well as adequate industrial wastewater treatment. Concerning industrial wastewater treatment, it is suggested that the Pollution Control Board strengthens there efforts to manage ‘trade effluent’ through tighter controls and monitoring systems as recommended below:

- A Plan for periodical and continuous quality monitoring should be established
- Data acquired from the monitoring should be accumulated and analyzed to understand situation and tendency
- Measures against emergency case should be considered and organization should be developed to implement such measures in case of emergency without delay
- Legislation system which gives more authority and power to the Pollution Control Board

6.3 Outline of the O&M Improvement Plan

The detailed recommendations and actions needed to improve O&M performance for water and wastewater schemes are shown at Volume III Chapter 11 Section 4 Operation and Maintenance Improvement. However, the key elements of the O&M improvement plan are as follows:

Table 63.1 Outline of the O&M Improvement Plan

No	Description	Priority	Comment
O&M IMPROVEMENT PLAN			
1	Agree ownership for O&M Improvement Plan.	Urgent	Suggest CE I is 'owner' and places responsibility on the SE's to 'champion' within each region. PWD Secretary to 'sponsor' efforts
2	Agree terms of reference for the O&M Improvement Plan.	Urgent	This will specify objectives, targets, procedures, resources, budgets and responsibilities for all involved with the O&M Improvement Plan.
3	Identify staff to be involved within each Region and prioritise improvements to be tackled based on achievability on a 'pilot office' basis.	Urgent	SE's to form improvement teams. Improvements should be categorised into functional activities such as water production, networks, wastewater treatment, sewerage, maintenance practices, asset planning, safe systems of work etc.
4	Determine if 'External Technical Assistance' is required to build capacity.	Urgent	Implementing improvements will require planning, management, supervisory and functional expertise. Impart management training as appropriate. There are a number of benefits to be gained in securing additional assistance to maximise success, benefits and sustainability of the O&M Improvement Plan. Refer to 6.4.2 below
5	Benefits of improvements to be identified and shared State-wide. Establish the procedures developed at pilot offices as 'best practice'.	Short term	SE's to organise regional and central presentations of findings. Ensure 'best practice' is shared and adopted state-wide.
6	Institutionalise the O&M improvement measures within each region by use of best practices developed within the pilot offices. This will require the establishment of 'Change Management Teams' capable of systematic implementation of prioritised tangible and achievable improvements.	Medium term	PWD Secretary to 'sponsor', CE I 'owns' and Regional SE's 'champion'. A full list of Improvements measures, recommendations and actions can be found at Volume III Chapter 11 Section 4 Operation and Maintenance Improvement.

6.4 Strategies for Setting up and Running O&M Improvement Activities

There are a number of options available to PWD in tackling the current levels of O&M performance related to water treatment facilities, water distribution networks, wastewater treatment and sewerage networks and for putting measures in place to improve management capability, plant performance and availability, service standards and service delivery.

6.4.1 In-house Approach

The O&M improvement plan that PWD should consider adopting is outlined above; however, the amount of time, effort and resource necessary to make this approach a success should not be underestimated. Assuming an in-house approach, PWD would need to consider the following:

Setting up O&M Improvement Teams within ‘Pilot Offices’ within each Region (organisational arrangements)

The O&M improvement plan requires that staff with sufficient planning, management, supervisory and functional expertise are identified within each Region, trained and ‘equipped’ with the tools (systems) and methods to bring about O&M improvements. Initially within a pilot office (sub-division or division office) in each Region, followed with further offices that would benefit from a ‘best practice’ approach developed within the pilot offices, this method would systematically apply ‘best practice’ measures across the entire State within each Region. The amount of training imparted and manpower needed in this approach is paramount to success and places a major burden on staff who are already tasked with their ‘day-jobs’. Consequently, for best results, an in-house approach is best achieved through providing a dedicated resource to effect O&M improvements. This would require that staff directly involved with the pilot office activities are redeployed into dedicated ‘O&M Improvement Teams’ or ‘Change Management Teams’ or additional staff are employed specifically for this purpose. The improvement teams would act as a catalyst for ensuring improved O&M practices are adopted State-wide.

Schedule of Activities and Required Resources

It is recommended that each pilot office consists of teams with sufficient knowledge and expertise to analyse current O&M practices, identify shortfalls and to bring about improved methods of working through development and implementation of ‘best practice’. To allow sufficient time for the setting up and training of staff as well as for conducting the tasks detailed in table 64.1 below, it is recommended that ‘pilot offices’ in each Region are allowed to develop and operate for a minimum of six months. This will enable the ‘pilot office’ staff to gain confidence and ‘test’ best practice approaches prior to transferring knowledge and skills to other offices.

It is recommended that each ‘pilot office’ team consists of the following appropriately trained and experienced staff:

Table 64.1 O&M Improvement Team Responsibilities

Task	Number of Staff	Assignment
Team Leader	1	<p>Organisational set-up and management of the ‘pilot office’ project.</p> <p>Agree scope of work within the ‘pilot office’ bearing in mind that some pilot offices will have both water and sanitation responsibilities.</p> <p>Agree and procure equipment such as computers and provide other resources such as software, support staff etc.</p> <p>Agree staff required to tackle O&M improvement based on functional responsibility such as water, sanitation, H&S, Systems/MIS, asset planning etc. within the ‘pilot office’.</p> <p>Act on the results of the ‘pilot office’ findings to tackle O&M improvements across the Region.</p>
Water Treatment Team	3	<p>Improve process control methods including the use of energy and chemicals to optimise treatment parameters and to ensure water quality standards at least cost.</p>
Sanitation Team	3	<p>Improve process control methods including the use of energy and chemicals to optimise treatment parameters and to ensure effluent quality standards and safe disposal of sludge at least cost.</p>
Sewerage Network Team	3	<p>Optimise network and pumping station performance to eliminate risk of sewer flooding. Improve O&M activities and management of the sewerage networks such as introducing regular maintenance and cleaning routines.</p>
O&M Management Team	3	<p>Development of modern O&M management practices to maximise plant availability and manpower output at least cost.</p> <p>Development of O&M manuals to ensure ‘best practice’ methods are adopted at each plant.</p> <p>Development of improved H&S practices, especially in relation to the use of chlorine gas and working in potentially hazardous atmospheres such as sewers and sewage pumping stations.</p>

The following equipment is the minimum requirement to equip each O&M Improvement ‘pilot office’. Prices are assuming all equipment is procured locally and are for indicative purposes only:

Table 64.2 Equipment Requirements for Each ‘Pilot Office’

Equipment	Indicative Unit Cost Rs.	Quantity Required	Indicative Total Cost Rs.
Computers	50,000	2	100,000
A4 Printer (including running costs)	15,000	1	15,000
Software (Microsoft Office)	10,000	2	20,000
Vehicles to transport water network and sewerage network teams	180,000	2	360,000

6.4.2 External Technical Assistance Approach

Given the number of offices and staff responsible for the operation and maintenance of the water and wastewater schemes throughout the State, it will be difficult to get the O&M improvement plan ‘off the ground’ by using entirely PWD staff with out additional external technical assistance. Implementing improvements requires not only the need to develop improved methods of working but also ‘**change management**’ skills to ensure that the improved methods are successfully adopted and applied in practice. External technical assistance will provide the expertise and ‘driving force’ to formulate and initiate improvements as well as a ‘Change Management Plan’ so that PWD can implement improvements successfully. In short, external technical assistance would:

- Help PWD in planning a successful O&M Improvement Plan including the need for a ‘Change Management Plan’
- Help PWD in developing capacity to implement the O&M Improvement
- Help start-up of the State wide pilot office improvement teams and priorities tangible and achievable improvements
- Support PWD during implementation of the programme
- Support PWD in analysing the benefits of the programme

Based on the number of functional skill requirements needed to bring about changes in the management of O&M activities, it would be preferable to seek external technical assistance by means of a Technical Cooperation Project rather than arbitrary assignment of technical experts’ per-se. The tentative skill requirements for a successful technical cooperation project would be as follows:

Table 64.3 Functional Expertise Required for Technical Cooperation

Title	Assignment
Team Leader	Organisational set-up and management of the project
Water Treatment Specialist	Evaluation of water treatment process and plant performance. Improve O&M activities and management of the treatment plants. Optimise process performance
Sanitation Specialist	Evaluation of wastewater treatment process and plant performance. Improve O&M activities and management of the treatment plants. Optimise process performance
Sewerage Network Specialist	Evaluation of sewerage networks to eliminate risk of sewer flooding. Optimise network performance. Improve O&M activities and management of the sewerage networks
Operations & Maintenance Specialist	Evaluate O&M performance and development of modern O&M management practices to ensure improved performance and service delivery. Development of O&M manuals to ensure best practice methods are adopted State-wide
Systems Specialist	Development of computerised systems to improve availability of plant, process and management information
H&S Specialist	Evaluate H&S practices for water and sanitation schemes and develop best practice approach to ensure the safety of staff, consumers and the general public, whilst complying with relevant legislation in force.

Required input from PWD

PWD would need to provide sufficient counterpart staff to implement the O&M Improvement Plans within the pilot offices in each Region. Additionally PWD would need to:

- ❑ Establish ‘O&M Improvement Teams’ for pilot offices within each Region capable of prioritizing and developing improvements needed within each functional area
- ❑ Provide training for counterpart staff to conduct planning, management and supervisory activities to enable them to develop ‘best practice’ and new methods of working and to share those ideas across the state
- ❑ Provide equipment such as computers, software and other resources to conduct field work and to develop methods of capturing and sharing O&M and management data

Expected Outputs of the Technical Cooperation Project

The expected outcomes of such as technical cooperation project would include the following benefits:

- Improved efficiency of water and wastewater schemes
- Establishment of O&M Improvement Teams capable of developing and implementing improved methods and new ways of working
- Implementation of State-wide O&M improvements via the Pilot Office Teams
- Improve customer relations/PWD image through improved service delivery resulting from improved asset performance
- Increase water availability/sales through improved asset performance
- Reduce operating costs through reducing unit cost of water and wastewater treatment and disposal through improved asset performance

6.5 Outsourcing of Asset Management Planning

Due to the scale of the task, it is becoming common place for water utilities to let contracts for asset management planning including design of asset registering systems, asset registering, data collection, asset evaluation, asset valuing etc. This is one of the areas along with 'NRW Reduction and Mitigation Measures', for example, that would come under the auspices of a 'Management Contract' type arrangement. Refer to Chapter 7 on Capacity Building.

If PWD decide to outsource Asset management planning to a third party contractor, this does not negate the need for PWD to establish in-house capabilities or the need for technical assistance. Refer to Volume IV Appendix M73 Asset Management Process for details on development and setting up of Asset Management Plans.

CHAPTER 7

**INSTITUTIONAL DEVELOPMENT
AND CAPACITY BUILDING**

CHAPTER 7 INSTITUTIONAL DEVELOPMENT AND CAPACITY BUILDING

This Chapter describes in detail an institutional development plan for PHE for a 6-year period from 2007 to 2012. It puts into action the various framework and approaches described in the Master Plan.

The broad theme for the institutional development and capacity building plan will focus on sharpening organizational **directions**, strengthening management **systems** and promoting more **delegation** of duties and responsibilities. More of the current systems will have to be formalized and standardized as the PHE expands.

In the Master Plan, a broad framework for organizational growth was explained. Building on that framework, the priority strategy at this stage of growth has to focus on enhancing the stability of the organization – so that its present high performance is sustained in spite of whatever events or changes may occur beyond its control. Stage I institutional development will be done by **organizational restructuring** (to help build a broader team of managers and supervisors with clear roles and responsibilities and set the stage for even higher levels of coordination among the management team and delegation of authority and responsibility); **intensified training programs** for all staff on all aspects of utility management and operations (not just technical aspects) and **introduction of an integrated (and expandable) management information system**.

This is the basic concept behind this institutional development plan. While it seeks to address some current issues, its bases also lie in taking advantage of opportunities to prepare and organize for its future. These are presented in the succeeding section. This institutional development plan follows on from the assessments earlier done and State's water sector reform initiatives. The plan consists of a legislative and policy agenda; an organizational restructuring agenda, including a staffing plan, and; a capacity building agenda, including a training plan. The capacity building plan is presented in modules following the institutional assessment framework in the Master Plan.

Some of activities identified are recommended for PHE action; other institutional development activities which require external assistance are proposed for inclusion in this project for institutional development. An external technical assistance project has been formulated for the implementation of the capacity building plan. It is envisaged to be financed either as part of the capital investment program. It may also be parallel financed from alternative sources.

7.1 Legislative Agenda

7.1.1 Objectives and Scope

Priority objectives of policy decisions for PHE institutional development promote:

- increased financial autonomy;
- clear public accountability; and
- performance incentives.

These legislative changes should be coordinated with the current proposals put forward through the sector reform initiative. In addition, the Study recommends that legislation be provided to enforce mandatory connection to the sewerage system to protect the viability of the investments. Current laws authorize the health officer to enforce connection for specific public health reasons; and, the chief officer of each taluka, for nuisance abatement reasons.

7.1.2 Implementation

For this institutional development program to proceed, the following policy decisions need to be taken by the appropriate authority.

- Authorize reorganization of PHE.
- Authorize use of an independent accounting system which will be implemented parallel with the existing financial reporting system now implemented by PHE.
- Enable PHE to retain revenues generated, plus a state subsidy indexed on revenue generated (or other performance targets) to support water and sewerage services.
- Authorize PHE to adopt personnel rules and regulations (including, compensation enhancement schemes, incentives, sanctions, job classification, training, etc). Guarantee security of tenure of staff who may be adversely affected by these changes.
- Create mechanisms for regular dialogue with consumers and consumer groups.
- Consider a state policy requiring mandatory connection to the sewerage system within a fixed time to achieve viability of investment

7.2 An Organizational Restructuring (and staffing) Agenda

7.2.1 The need for PHE restructuring

The concern for sustainability and effectiveness have been the driving these discussions about institutional options. The Study has pointed to the need to challenge PWD to transform itself from an engineering- and facilities-oriented company into a business- and customer-oriented company. At present, this implies beefing up the institution with qualified senior financial management and senior customer service structures and personnel. This proposed structural change prepares PHE for implementation and operation of major externally-supported capital assets investments. It:

- Is more process-based; more business-oriented.
- Clarifies accountability of results to specific managers or work teams
- Consolidates and conserves resources
- Is more flexible for future organization improvements; more customer-oriented.

The Study recognizes the need for gradual transformation or transition because of human resources constraints in the State. It is also envisaged that more autonomy (and responsibility) can be given as PHE capacity is developed.

7.2.2 Objectives and Scope

The overriding objectives of the restructuring agenda are to enable PHE to:

- Lay the foundation for increased delegation of responsibilities and authority to lower levels;
- Prepare itself for implementation and operation of major, externally-supported capital investments;
- Set service and performance targets and standards by work groups; and
- Establish a flexible & responsive organization.

These will be achieved through:

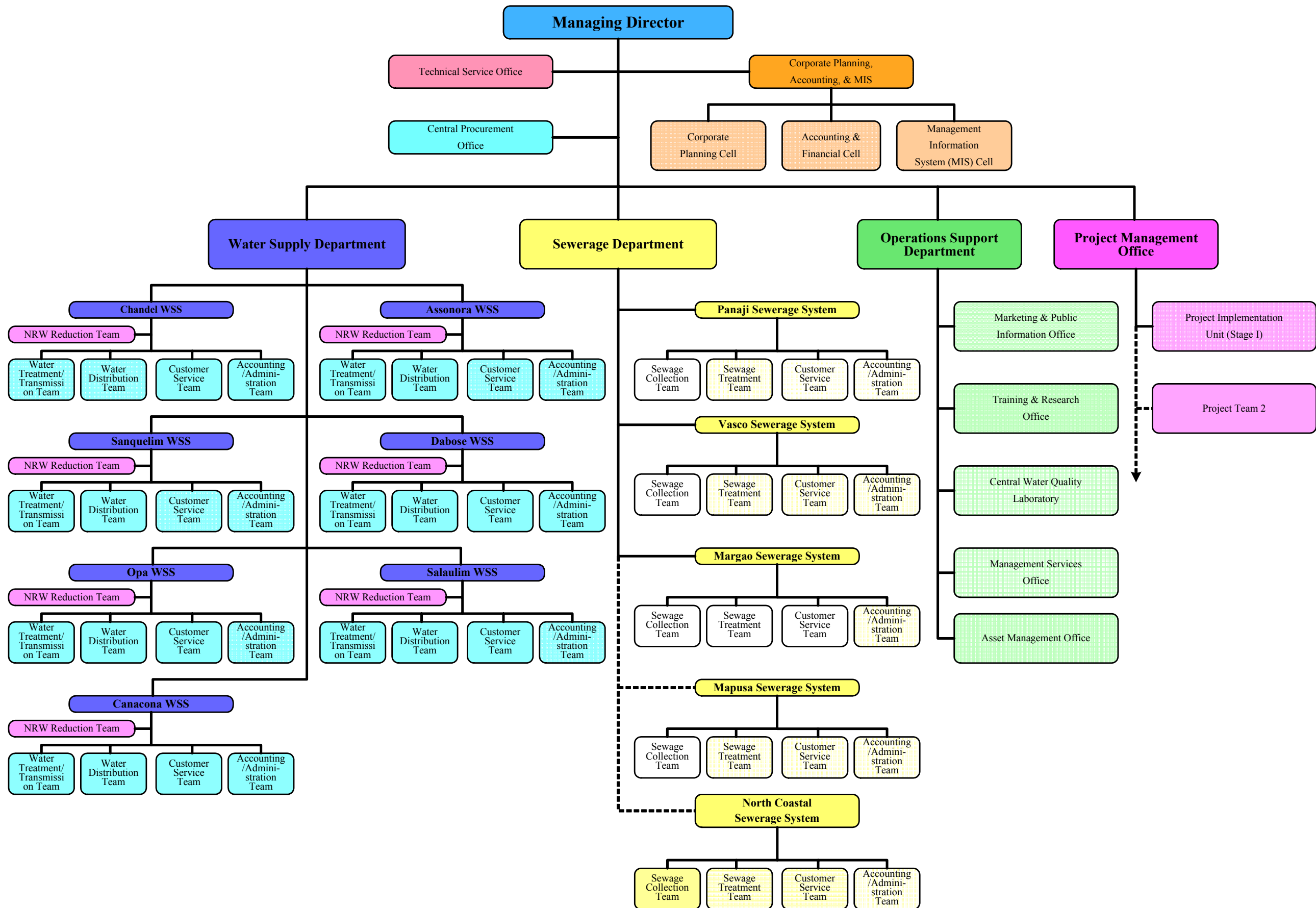
- A more process-focused, business-oriented and customer-friendly structure;
- Clear accountability for results on specific managers and work teams;
- Mechanisms for internal review and improvement (“renewal”);
- More adaptable and flexible for future organization reforms;
- Balanced responsibilities with resources and authority; and
- A policy & system for regular review and updating of departmental and office responsibilities, functions and structure.

7.2.3 Proposed New Structure

During the Study, various alternatives for restructuring were considered. In the proposed structure in the next figure, each of the water supply schemes (and sewerage schemes) is managed as a complete system. Thus the “scheme” or System Manager (either for water or for sewerage) will bear full responsibility to the customer from “source to tap” or from “collection to disposal”.

- Service area is defined by the presence of facilities; implies that the area responsibility of each water (or sewerage) system will expand in the future.
- Responsibility for expansion of services to unserved areas will be with the Technical Services Office – not with the system managers.
- Operation and maintenance of small village services will, for practical reasons, have to be managed by the “nearest” system manager.
- Revenue and cost performance will be tracked by scheme; and consolidated at the Department level.

Table 72.1 Proposed Organization Structure



7.2.4 Department Functions and Responsibilities

The following table presents the key functions and responsibilities of each of the working units.

Table 72.2 Statement of Key Functions and Responsibilities

	Key Functions and Responsibilities	Sample Performance Measurement Parameters
Office of Managing Director	PHE Strategy Overall supervision Liaison with PWD and state officials	Service coverage Budget vs. expense Operations policies
• Technical Services Office	Provide overall monitoring of technical systems performance Provide technical operating standards. Facilities planning and design; expansion of services to unserved areas. Implementation/Updating of Master Plan.	Technical standards Operation and maintenance standards
• Corporate Planning, Accounting and MIS Office	Business planning (5-year plans; annual plans) Financial projections Consolidated financial reports Institutional development plan Coordination with PWD on personnel and administrative issues and policies.	5-year rolling corporate plan. Annual business plan and budgets.
	Overall financial reports (balance sheets, income statements, financial and operating highlights, financial performance indicators)	Timely & accurate financial reports, including benchmarks. Tariff review
	Installation and expansion of the MIS. Information technology applications at PHE.	MIS program is implemented, as planned. Increased use of IT within PHE.
• Central Procurement Office	Bidding & tendering for supplies and equipment	Procurement requirements and schedules met
Water Supply Department		
• _____ Water Supply System (typical)		
○ Water Production & Transmission Team	Protection of raw water sources. O&M of water treatment plant. O&M of transmission system, including pipelines, MB reservoirs and pumping stations.	Unit production cost Water quality Control of production inputs
○ Water Distribution Team	O&M of water distribution facilities, including network pipelines, pumping stations, distribution reservoirs.	Network maintenance costs Distribution NRW.
○ Customer Service Team	Meter reading, billing and collection. Meter maintenance Response to customer service requests and other contact management activities (customer complaints system)	No of water customers Sales volumes Average collection period Collection efficiency Response time to service requests & complaints
○ Accounting & Administration Team	Proper and accurate recording of revenues and expenses incurred by the system. Budget monitoring.	Accurate and timely financial reports.
○ NRW Team	Monitoring of water production and consumption data, including customer records. Detection and repair of all leakages in the system. Implementation of the expanded NRW control program.	

	Key Functions and Responsibilities	Sample Performance Measurement Parameters
Sewerage Department	Overall supervision of sewerage operation and maintenance functions and responsibilities of PHE.	
• _____ Sewerage System (typical)		
○ Sewage Collection Team	O&M of sewage collection facilities, including sewer lines, pumping stations and other collection works.	Sewage network maintenance costs
○ Sewage Treatment Team	O&M of sewage treatment plant. Proper disposal (or reuse) of effluents and sludge.	Unit treatment cost Control of treatment and disposal Effluent quality Sludge disposal/reuse
○ Customer Service Team	Response to customer service requests and other contact management activities (customer complaints system)	No of customers Sales volumes Response time to service requests & complaints
○ Accounting & Administration Team	Proper and accurate recording of revenues and expenses incurred by the system. Budget monitoring.	Accurate and timely financial reports.
Operations Support Department	Provide operational support services to the water and sewerage work teams.	
• Marketing and Public Information Office	Development and implementation of a sustained and effective marketing and public information programs of PHE.	Effectiveness of awareness, dialogue and education programs. Consumer survey results Public communication tools.
• Training and Research Office	Planning, implementation and evaluation of all management and technical training and development programs of PHE.	Staff trained Special studies
• Central Water Quality Laboratory	Independent water and wastewater quality surveillance program (in the distribution system) Support the smaller WTP- and STP-based process laboratories	Samples tested
• Management Services Office	Assist other organizational units in developing management policy and work methods in coordination with MIS Unit (and how PHE units can work better).	Operations management guidelines and manuals.
• Asset Management Office	Central maintenance shop / for repair and maintenance of major pieces of assets. Asset monitoring and management services	Overall downtime of major assets Preventive maintenance program
Project Management Department	Plan, implement and monitor all capital development activities of PHE	
• Stage I Project Implementation Team	Manage/co-ordinate the implementation of the Stage I improvements.	Project deadlines met within budget.
• Team #2, 3, ...	[As needed, teams will be organized (and disbanded) depending on the need to implement major capital works]	

In the proposed structure for PHE, the Project Management Department is proposed to be organized directly under the Managing Director. One of the initial responsibilities of this Department is the **coordination of Stage I implementation**. At present, small capital development works are put under the responsibility of various Executive Engineers depending on the location of the improvements. With respect to Stage I improvement, the principal task of this Department will be to coordinate and supervise implementation of Stage I improvements as soon as capital funding is arranged. The Project Management Department, at the minimum, should have the following composition:

<u>Position</u>	<u>Staff Qualification</u>
Department Manager	Engineer with project management experience, particularly procurement procedures, contract administration, prequalification, bidding and award procedures. Knowledge of project management and monitoring tools.
Construction Engineer (Civil)	Civil Engineer, with experience in installation of pipelines, construction of civil works (hydraulic structures). Knowledge of project management and monitoring tools.
Construction Engineer (Electro-mechanical)	Electrical or mechanical engineer, with experience in installation of electro mechanical equipment and machineries. Knowledge of project management and monitoring tools.
Project Field Inspectors	Technical graduates, with knowledge of construction and equipment standards, construction methods and field inspection procedures. With knowledge of records keeping and reporting requirements for project management.
Support staff	Able to provide administrative and financial management support to the Department.

7.2.5 Staffing Projections 2007-2012

The following table offers a guide for PHE management in sizing the organization. Based on the anticipated growth of customer base and the need to operate and maintain additional assets, the following staffing projections have been developed. The current staffing ratio of 17.5 staff per thousand connection (as of July 2006) will gradually be raised up to about 14. This is envisaged to be feasible since much of the new facilities will be automated and there will be wider use of computers and other labor-saving equipment.

Table 72.3 Projected Total Number of Service Connections

Year	Existing	2007	2008	2009	2010	2011	2012
Salaulim	75,423	78,315	81,263	84,264	87,322	90,426	93,591
Opa	45,118	46,813	48,517	50,227	51,943	53,614	55,294
Chandel	8,428	8,656	8,886	9,118	9,351	9,591	9,834
Assanora	43,151	44,318	45,506	46,718	47,953	49,213	50,496
Sanquelim	11,643	11,977	12,315	12,657	13,002	13,350	13,701
Dabose	6,863	7,128	7,400	7,679	7,964	8,256	8,554
Canacona	3,431	3,694	3,959	4,226	4,495	4,765	5,037
TOTAL	194,057	200,901	207,846	214,889	222,030	229,215	236,507

In order to prepare the projections, the current deployment of staff was redistributed following the proposed new structure. This is reflected in the Base column in the following table. Minor adjustments were necessary to smoothen the staff distribution.

Table 72.4 PHE Manpower Projection, 2007-2012

Total Number of Staff at Base		3,396						
Existing Staffing Ratio		17.50						
Target Staffing Ratio			16.5	16	15.5	15	14.5	14
Projected PHE Staff Size			3,315	3,326	3,331	3,330	3,324	3,311
Deployed as follows:		Base	2007	2008	2009	2010	2011	2012
OFC OF THE MANAGING DIRECTOR		6	6	6	6	6	6	6
Technical Services Office		0	4	5	8	8	8	8
Corporate Planning, Accounting & MIS Ofc		0	8	10	12	12	14	14
Procurement Office		0	5	5	8	8	8	8
Various mgmt/admin staff		113						
Sub-total		119	23	26	34	34	36	36
WATER SUPPLY DEPARTMENT		0	12	12	12	12	12	12
Salaulim Water Supply System	160	1119	1,110	1,130	1,150	1,160	1,170	1,170
Opa Water Supply System	132	760	500	500	520	540	545	562
Chandel Water Supply System	15	165	143	143	143	140	140	140
Assonora Water Supply System	42	524	640	640	640	640	650	650
Sanquelim Water Supply System	52		198	197	195	195	194	192
Dabose Water Supply System	5	166	130	130	130	130	120	120
Canacona Water Supply System	5	118	120	120	110	100	100	70
Podocem Water Supply System		143	130	120	100	80	70	70
Sub-total		2995	2982	2992	3000	2997	3000	2986
SEWERAGE DEPARTMENT		14	14	20	25	25	25	25
Panaji Sewerage System		151	140	130	120	114	100	100
Margao Sewerage System		38	35	35	35	35	35	40
Vasco Sewerage System		79	75	70	65	65	67	65
North Coastal Sewerage System		0	0	0	0	0	0	0
Mapusa Sewerage System		0	0	0	0	0	0	0
Sub-total		282	264	255	245	239	227	230
OPERATIONS SUPPORT DEPT		0	3	3	3	3	3	3
Marketing & Public Information Office		0	2	3	3	3	3	3
Training and Research Office		0	3	4	4	4	4	4
Central Water Quality Laboratory		0	8	8	8	8	8	8
Management Services Office		0	4	4	4	4	4	4
Asset Management Office		0	25	25	25	30	30	30
Sub-total		0	45	47	47	52	52	52
PROJECT MANAGEMENT DEPT		0						
Stage I Project Office		0		5	5	8	8	8
Sub-total		0	0	5	5	8	8	8

7.2.6 Specific staffing requirements for Stage I facilities

For water supply, the estimate of staffing needed for new facilities and equipment (Stage I) is in the following table.

Table 72.5 Specific staffing requirement for new water supply facilities

	Synopsis of improvements	Direct staff
Expansion of Salaulim	• 5 new pumping stations (3 shifts @ 1 person @ 5 PS)	15
	• 6 reservoirs (roving staff, 2)	2
	• New transmission 80 kms and distribution lines	12
	• Silvoi MBR (3 shifts @ 1 person)	3
	• Expanded water treatment facility (3 shifts @ 15 persons)	45
	Total	77

For sewerage, the estimate of direct staffing needed to operate new facilities and equipment (Stage I) is estimated in the following table.

Table 72.6 Specific staffing requirement for new sewerage facilities

	Synopsis of improvements	Direct staff
Margao South	• New sewage pumping station (3 shifts @ 2 persons)	6
	• Expanded sewage treatment plant (3 shifts @ 4 persons)	12
North Coastal	• New sewage treatment plant (3 shifts @ 4 persons)	12
Mapusa	• New sewage treatment plant (3 shifts @ 4 persons)	12
Sewer cleaning equipment	• 3 sets @ 10 persons/set ¹ . (Note: 1 set consists on 1 vacuum truck, 1 jetter truck, 1 tanker and assorted small equipment and tools). These teams will undertake the general sewer maintenance, including the new sewer lines.	30
	Total	72

The required staff for water and sewerage should be **selected and reassigned** from among the existing staff of PWD; recruitment of new staff is not anticipated. Training and technical assistance should be provided, particularly for the operation of the new pumping station, the sewage treatment plants, and the new mechanized sewer cleaning equipment proposed to be procured.

The Study anticipates that new staff needs to be recruited externally for some of the newly-proposed organizational units within PHE since the skill required does not currently exist within.

¹ It is estimated the vacuum truck and the jetter will each be manned by 4 persons; while the tanker will be manned by 2 persons. (4+4+2=10)

Table 72.7 Specific staffing requirement for new organizational units

New Organization Unit	Staff needed	Skill needed (to be recruited)
Technical Services Office	4	Staff with planning and monitoring experience. Knowledge in hydraulic modelling and water resources planning.
Corporate Planning, Accounting & MIS Subdivision.	8	Staff with strong business planning and finance background. Staff with computer software/hardware background.
Procurement Office	5	Staff with knowledge of procurement and contracting processes and knowledge of standards and specifications.
Marketing and Public Information Office	2	Staff with strong customer service and marketing background.
Training and Research Office	3	Staff who can plan and organize management and technical training programs.
Water/wastewater Quality Laboratory (Central Laboratory)	8	Existing staff needs to be augmented.
Management Services Office	4	
Asset Management Office	25	Staff who can organize preventive maintenance programs for all the major asset of PHE and implement the asset management system.

7.2.7 Implementation

The Study recommends a detailed description of the functions and responsibility of each work group, including proposed staffing levels and transition arrangements. PHE should review the proposed restructuring of PHE and identify other implementation arrangements; seek authorization and approval of new organization structure; implement new PHE structure and work out the staff redeployment plan. Finally, it should introduce a system and methodology for regular review of organization structure and staff competency mix in each of the working groups in the future.

This restructuring agenda should be implemented by PHE prior to the implementation Stage I improvements.

7.3 Improvement of Financial Management and Control

7.3.1 Planning and Design of Independent Accounting System

(1) Purpose of Independent Accounting System

Purpose of independent accounting system was explained in the Volume II Chapter 8 Section 5 Improvement of Financial Management and Control, summary of the explanation is written below.

Presently, the accounting system of PHE, which engages water supply and sanitation services, is combined to the accounting system of PWD. There are no independent accounting systems for PHE to understand its own financial condition precisely. In order to maintain the existing water supply and sanitation facilities appropriately by allocating relevant operation and maintenance fund, and to prepare the sustainable investment plan and to provide the data for tariff revision, it is indispensable to understand the latest financial condition of the water supply and sanitation service. The compilation of independent accounting system tailored for water supply and sanitation services shall be strongly recommended. The introduction of an independent accounting system is not intended to replace, but rather, strengthen the existing accounting system of the PWD. The intent is to make available to PHE and PWD managers, timely and vital financial information affecting their internal operations as a business (or as a cost-revenue center). PHE will continue to provide the financial information and reports required by the larger financial reporting system of PWD. The introduction of this system helps to bring PHE operations more transparent; and help sector policymakers and concerned State officials make informed decisions about tariff, service levels and so on.

(2) Necessary Accounting Documents / Financial Indicators

Financial statement is composed of three major documents: Balance Sheet, Income Statement, and Cash Flow Statement. Basic concept of these three financial statements is compactly explained below, more detailed explanation and sample format was described in the Volume II Chapter 8 Section 5 Improvement of Financial Management and Control.

Basic three accounting documents are also raised and explained. These three documents, journal book, general ledger, and trial balance are indispensable to prepare the balance sheet, income statement, and cash flow statement through the daily routine works. As shown in the Figure 73.1, journal book is firstly prepared by recording daily transactions. General ledger is made by sorting the transactions of journal book into each account. Trial balance is prepared by listing all the balances of each account of general ledger. Income statement and balance sheet is

compiled by dividing all the account balances of trial balance into two financial documents. Cash flow statement is finally compiled from the data of balance sheet and income statement.

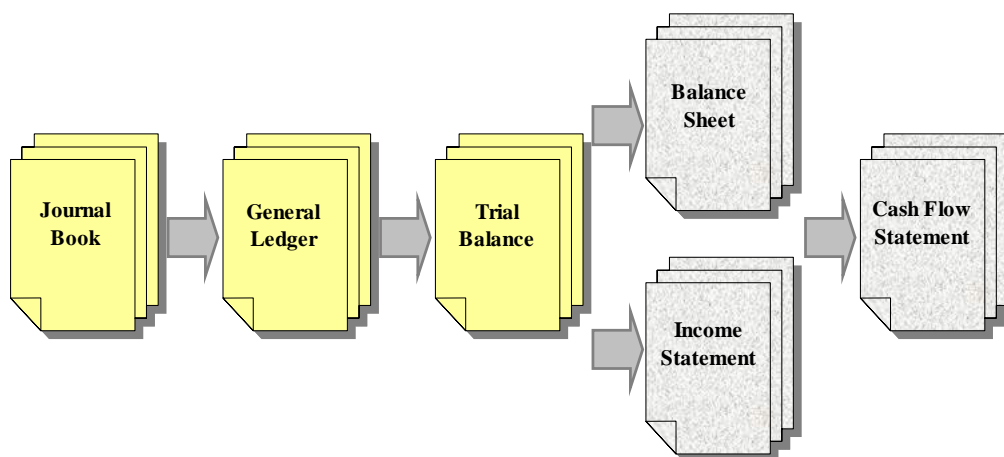


Figure 73.1 Flow chart of accounting / financial documents preparation

1) Balance Sheet

It shows the composition of assets, liabilities, and equity at a certain point of time; at the beginning of the fiscal year, or at the end of the fiscal year. Amount of assets shall be put on the left hand side of the Balance sheet. Liabilities and equity are put on the right side of the Balance sheet. By means of the double-entry bookkeeping, assets side and liabilities and equity side are equated.

2) Income Statement

The income statement shows the summary of financial activity through the financial year. It summarizes revenues and expenditures during the fiscal year. Income statement is also called Profit and Loss Statement. It describes the financial performance of the entity during the fiscal period from the view point of revenue and expenditure. The result from operating revenues and operating expenses is operating profit or loss. Other incomes and expenditures and interest payments shall be deducted from operating profit (loss). The residual is the 'Net profit (loss) before tax'.

3) Cash Flow Statement

Cash flow statement shows the manner in which the entity obtains and uses the cash. In other words, it shows from what sources cash has come into the work and on what the cash has been spent. The statement contains the items of 'Cash flows from operating activities', 'Cash flows from investing activities', and 'Cash flows from financial activities'. Cash flows from operating

activities are calculated from the net profit of the last period, and increase or decrease of account receivable, inventory, advance payment, depreciation, account payable, etc. Cash flows from investing activities shall be expressed as negative number for the purchase of property, facilities, and equipment, and so on. Cash flows from financial activities shall increase as the entity increase the amount of debt or issuing of the capital stock.

4) Journal Book

All business transactions are first recorded in the Journal book by double entry book-keeping in chronological order. After recording in the Journal book, the data will be transcribed into the General Ledger. The journal book is categorized into two journal book, which are the General Journal and the Special Journal. The special journal included the sales, purchases, cash receipts, and payroll journals whose transactions occur more frequently than those in general journal. The general journal is used to record miscellaneous transactions that are not covered by special journal. Sample of the journal book is shown in the Volume V Appendix F73 Improvement of Financial Management and Control.

5) General Ledger

The general ledger is compiled by sorting each transactions recorded in journal book chronologically into each item of account in general ledger. The general ledger contains all the accounts that make up the entity's financial statements, e.g., water sales, account receivable, cash, long term debt, inventory. There are many separate accounts for assets, liabilities, equity, revenue, and expenditure. For each accounts, balances are calculated at the end of certain accounting period. Therefore, general ledger is prepared for calculating the balance of transactions of each item of account. Sample of the general ledger is shown in the Volume V Appendix F73 Improvement of Financial Management and Control.

6) Trial Balance

The trial balance is the list of all the account balances resulted from the general ledger, prepared at the end of accounting period. Total debits must be equal to total credits, otherwise, errors has been made. The trial balance is the work sheet for the preparation of balance sheet and income statement. When the trial balance is correctly prepared, balance sheet and income statement will be compiled without any difficulties. Sample of the trial balance is shown in the Volume V Appendix F73 Improvement of Financial Management and Control.

7) Financial Indicator

Financial analysis shall be conducted by keep watching the Financial Indicators of the entity.

Financial Indicators are calculated from the information on the financial statements and show the relationship between various components of the entity's financial statements. There are many financial indicators which are categorized to the several view points such as; Liquidity, Profitability, Solvency, Efficiency, Productivity, Current asset management capability. Entity is able to investigate its financial situation by comparing the numbers of indicators to those of the other countries, or by tracking the movement of the number of entity's indicators for several years. Followings are the major financial indicators including managerial indicators for water supply and sanitation enterprise. Definition and explanation of each indicator are mentioned in the Volume II Chapter 8 Section 6 Improvement of Financial Management and Control.

Table 73.1 Major financial and managerial indicators for water supply and sanitation sector

Aspects of capability of entity	Indicators
Liquidity	Current ratio
Profitability	Operating ratio Return on assets Unit production cost Unit price
Solvency	Debt to equity ratio
Current asset management capability	Collection efficiency Accounts receivable turnover ratio
Debt management capability	Debt service coverage ratio Gearing ratio
Efficiency	Non-revenue water ratio Ratio of facility utilization
Productivity	Staff per 1,000 connections Water volume accounted for per staff member

8) Annual Financial Report

Publication of financial statements and these financial indicators internally or externally shall contribute to the transparency as the public nature of water supply and sanitation services, in addition to helping the understanding of the present difficult management condition by customers. Annual report shall be paper-based and/or electrical data through the internet. Followings are the sample of contents of annual report.

Table 73.2 Sample of Contents of Annual Financial Report of PHE

No.	Title	Contents	Pages
1	Background economic financial condition of the year for compilation of financial statement	Economic condition of Goa State, Financial condition of State Government	1
2.	Customer data of PHE	Number of customer of each category, Present tariff system (tariff table)	2
3.	Financial Statements of PHE in the fiscal year: 200X/200Y	Balance Sheet, Income Statements, Cash Flow Statements, including conditions and assumption of the compilation, if any. Explanation of the financial statements shall be briefly described.	5
4.	Financial Analysis of PHE	Trend of major financial indicators, Comments and explanation for the trend of indicators, including the graphs for public relations to the customers	7
5.	Long-term financial management policy of PHE	Explanation of financial management goal and policy of PHE for the period several to 10 years	1
6.	Degree of attainments of financial management targets in the last year	Expression of degree of attainment of numerical targets of PHE in the last year by figure and comments on the results	3
7.	Financial management numerical targets of PHE for the next fiscal year	Explanation of financial management target of PHE, numerically, for the next year. i.e., target of profit, NRW ratio, staff per 1,000 connections, number of sewerage connections,	2
8.	Financial management schemes of PHE for the next fiscal year	Explanation of financial management schemes of PHE for the next year	2
	Attachments	Back data of financial indicators	

In the financial analysis, breakdowns of operation and maintenance costs should be comprehended and be opened to the public. Breakdown of O&M costs shall include personnel cost, repair cost, electricity cost, etc. Regarding sanitation service, it is better to disclose the percentages of subsidy from State Government and sewerage tariff revenue within the total operation and maintenance costs. In terms of water supply services, percentages of usage of water tariff per 1m³ tap water, for example, depreciation cost, interest payment, water treatment cost, distribution cost, shall be informed to the public for public relations.

(3) Work Allocation for Accounting and Compilation of Annual Financial Report

Detailed work allocation or task assignment shall be prepared during Stage I by PHE with the support of management consultant. Proposal of general work allocation is mentioned as follows.

1) Work Allocation for accounting procedure

Work allocation and process of financial documents are shown in the Figure 73.2. As a daily routine work, accounting staffs in sub-division office responsible for the record of the journal book, general ledger. Record of these accounting documents requires the skill of double entry

book-keeping. It is recommended that account for water supply and sanitation shall be distinguished separately. At the end of each month, accounting staffs in each sub-division make the trial balance. Total of each debit and credit must be equalized, or in other word, balanced.

Trial balance, with journal book and general ledger as supporting documents, shall be sent to the accounting staff of division office once a month at early next month. Accounting staff of division office responsible for the compilation of all the trial balances prepared by the sub-division offices. Accounting staffs of division office shall make journal book, general ledger, and trial balance for the transaction of division head office itself and shall include them. Accounting staffs in division office prepare the one trial balance as division and send it to PHE headquarters. In case that any faults are found, correction of the trial balance of sub-division office, and therefore including the correction of journal book and general ledger, shall be conducted by accounting staff of sub-division office.

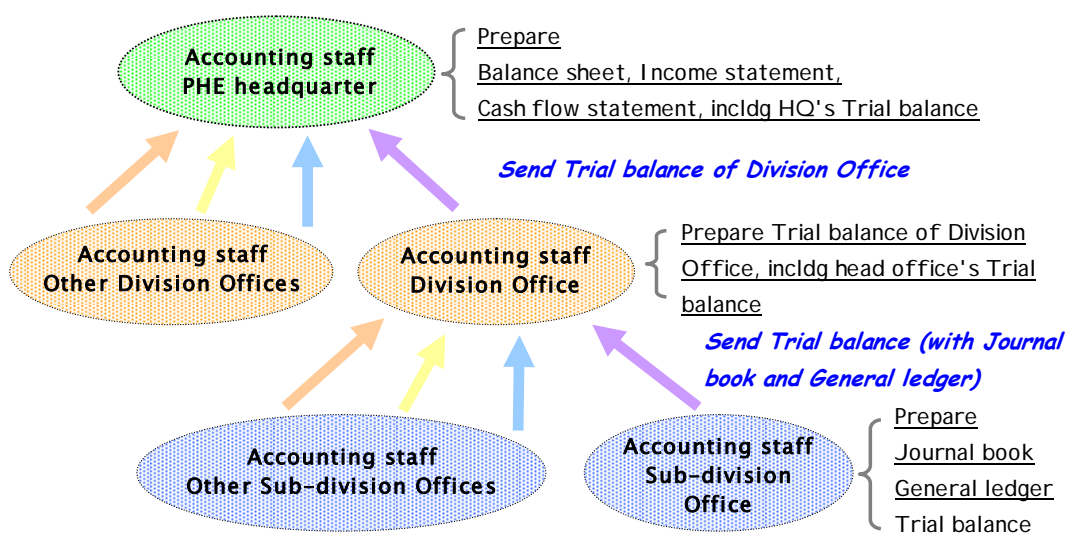


Figure 73.2 Work Allocation of Accounting Procedure

Accounting staffs in PHE headquarters responsible for the compilation of trial balance as PHE and preparation of balance sheet, income statement, and cash flow statement. Accounting staffs of PHE headquarters shall make journal book, general ledger, and trial balance for the transaction of PHE headquarters itself and shall include them. Formal balance sheet, income statement, and cash flow statement is compiled once in a year. Draft of these statements is prepared monthly bases. Work allocation for accounting staff of each sub-division and/or division office is described in the Table 73.3.

Table 73.3 Work Allocation for Accounting Procedure

Position of staff	Contents of work	Timing of work
Accounting staffs, Sub division offices	1. Preparation of journal book, general ledger	Daily routine work
	2. Compilation of trial balance	Early next month (e.g., 5 th day of next month)
Accounting staffs, Division offices	1. Preparation of journal book, general ledger for the transaction of head office of the Division	Daily routine work
	2. Compilation of trial balance as Division office, including trial balance of all Sub division offices	Early next month (e.g., 10 th day of next month)
Accounting staff, PHE headquarters	1. Preparation of journal book, general ledger for the transaction of PHE headquarters	Daily routine work
	2. Compilation of trial balance as PHE, including trial balance of all Division offices	Early next month (e.g., 15 th day of next month)
	3. Compilation of Balance sheet, Income statement, and Cash flow statement	Early next fiscal year (e.g., Next May)

Basic qualifications of accounting staff in each office are presented in Table 73.4. Of course, existing accounting staff shall be utilized as much as possible. Followings are the basic qualification when the new staff is recruited. Presently, it is advisable to assign the staff exceeding the following qualification at least one or few persons in each office. In the future, it is recommended to allocate the staff exceeding the qualifications more than half of the accounting staff.

Table 73.4 Qualification of accounting staff

No.	Position of Staff	Qualifications
1.	<i>Accounting staff in PHE HQ</i>	More than 10 years accounting experiences, with preferably B.A. in Accounting
2.	<i>Accounting staff in Division offices</i>	More than 7 years accounting experiences, with preferably B.A.
3.	<i>Accounting staff in Sub-division offices</i>	More than 5 years accounting experiences

2) Work Allocation for compilation of annual financial report

Annual Financial Report is compiled basically once in a year after completion of financial statements of the previous fiscal year. The draft annual financial report shall be prepared by the unit for compilation of financial report, which composed of total several delegates from division offices. The unit shall include delegates of accounting staffs of some division offices and

Assistant Engineers, if necessary. Draft annual financial report shall be checked by managements of PWD, and PHE at last, after checked, revised, and obtained the approvals of managements of each division. The report shall be publicized after the approval of the managements of PWD, and PHE. Through the preparation of annual financial report, every management staffs of PWD, PHE, and division offices are able to have the same understanding of the financial conditions and targets for the future.

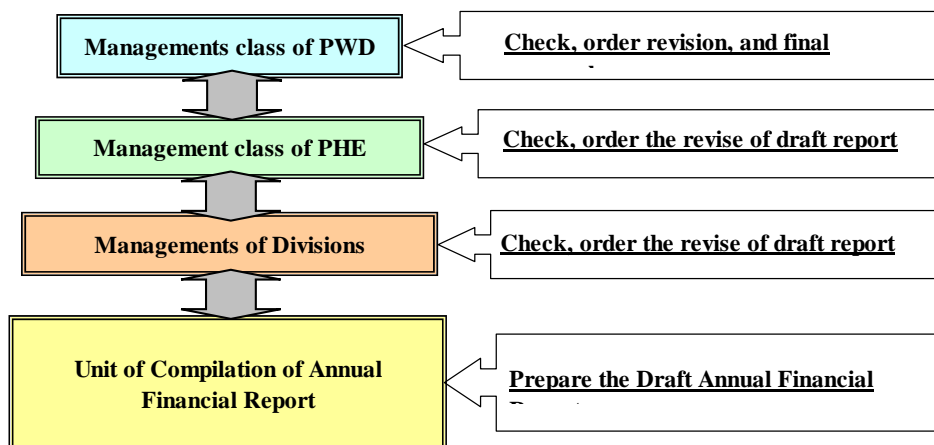


Figure 73.3 Work Allocation for compilation of annual financial report

Basic qualifications of Unit of Compilation of Annual Financial Report are presented in Table 73.5. PHE does not have to allocate staff for the Unit in full time bases, but Unit shall be organized by the capable middle class staffs in several Division offices and PHE headquarters in part time bases such as a committee. Following qualifications are utilized to ask the candidates from Division offices and to select the members.

Table 73.5 Qualification of staff for Unit of Compilation of Annual Financial Report

No.	Category of Staff	Qualifications
1.	<i>Accounting staffs</i>	More than 10 years accounting experiences in HQ or Div. office, with preferably B.A. in Accounting
2.	<i>Engineering staffs</i>	More than 10 years engineering experiences in PWD, with basic knowledge of tariff, customer service, and financial matters

(4) Accounting System Improvement Plan

In order to make the accounting system of water supply and sanitation sector (PHE) independent from the whole accounting system of PWD, PWD must negotiate with and obtain approval of State Government. For the first several years, it is recommended that PHE tries to prepare financial statements by corporate accounting system, with keeping the present accounting

system as a transition period. Even in that case, PHE has more merits to do it than present system, since PHE is able to comprehend the annual profit and loss and general management condition of water supply and sanitation services. After successful implementation of new corporate accounting system, PHE shall negotiate with PWD and other related governmental department concerning the withdrawal from present accounting system. PHE will keep the corporate accounting system only, if the withdrawal is allowed by the State Government. Independent accounting system would be realized at this moment. Steps for independent accounting system of PHE from PWD are shown in the Figure 73.4 and described below the Figure.

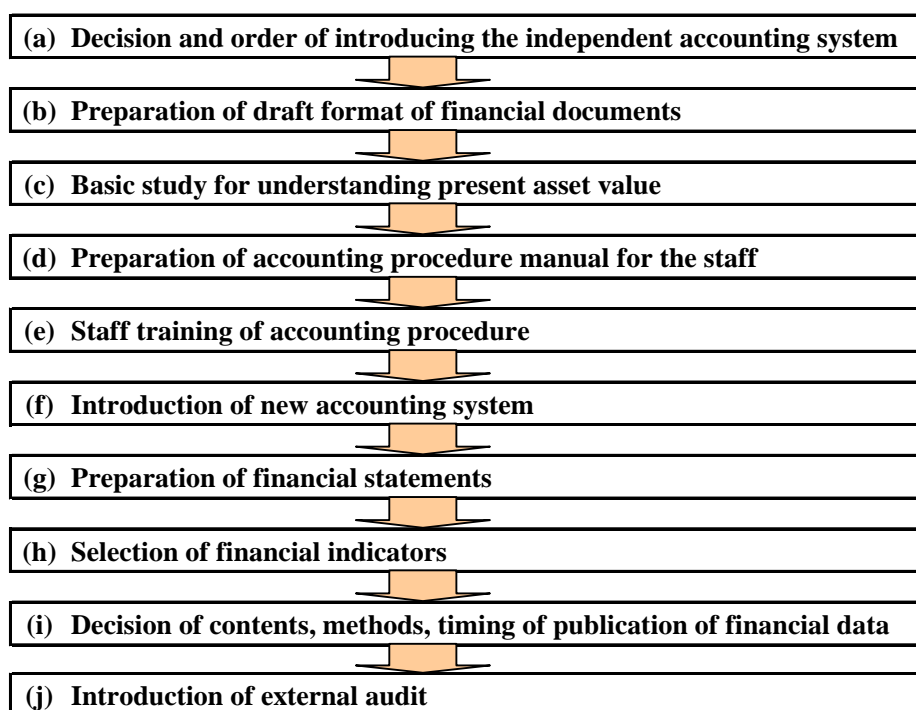


Figure 73.4 Flow of the introduction of independent accounting system

(a) Decision and order of introducing the independent accounting system
 Decision by management top of PWD should be passed and order should be given to the whole PHE regarding the introduction of independent accounting system. Target year of the start of the system shall also be mentioned in the order. It shall be also mentioned clearly that present accounting system is continued for several years until the establishment of independent accounting system. Introduction of the system requires the full cooperation of all the divisions and sub-divisions. Order from the top of the organization is indispensable for the smooth implementation.

(b) Preparation of draft format of financial documents

Draft formats of financial statements shall be prepared by deciding the major items of account of the statements. Major items of accounts are shown in the Table 73.6, as sample. Definition and coverage of each account title, in other words, which business transactions are recorded as a certain item of account, must be decided based on the actual business transactions. Blank formats of account ledgers for compiling the financial statements have also to be considered and prepared. Journal book, general ledger, and trial balance, whose samples are included in the Volume V Appendix F73 Improvement of Financial Management and Control, shall be included in the account ledgers to be made. Task assignment for each accounting staff shall be decided, such as record of specific accounting documents. Deadline of submission of accounting documents and the contents of documents from sub-division office to division office, and from division office to PHE headquarters shall also be determined.

Table 73.6 Sample of major items of accounts for water supply and sanitation

No.	Component in balance sheet or income statement	Account titles
1.	Asset, Balance sheet	Cash & bank account, Account receivable, Inventory, Land, Work in progress, Building, plant & equipment, Accumulated Depreciation, Advances, Allowance for doubtful account,
2.	Liability, Balance sheet	Short term loan, Long term loan, Account payable, Customer deposits, Allowance for employees' retirement benefits, Corporate bond
3.	Equity, Balance sheet	Capital, Accumulated profit/loss
4.	Revenue, Income statement	Water sales, Sewerage charge, Water connection charge, Sewerage connection charge, Meter rent fee, Other income
5.	Expenditure, Income statement	Electricity cost, Chemical cost, Raw water cost, Maintenance cost, Personnel cost, Office & administration, Depreciation cost, Interest expenses, Tax payment, Governmental subsidy

(c) Basic study for understanding present asset value

Preparation of Balance Sheet requires the understanding of present value of fixed assets including land, building, plant, equipment, and work in progress. Investigation of this information shall require great effort and enough time. This work must be conducted before all of the following tasks along with the implementation of Asset Management of the Institutional Development. In case that the establishment of Asset Management System is delayed, tentative estimation of assets shall be set for PHE to be able to proceed to the next step. Amount of asset

shall be revised after the completion of the Asset Management System. Tentative estimation of assets shall be calculated for each category of fixed assets and current assets of financial documents designed in the previous stage.

(d) Preparation of accounting procedure manual for the staff

Introduction of double entry book-keeping is necessary for compilation of financial statements. This procedure should be mastered by every accounting staff of sub-division and division offices. For the purpose of staff training, easy to understand and specific manual for accounting staff should be newly prepared with the attachment of necessary formats of financial statements and accounting documents. The manual should describe the definition and coverage of each account, procedure to fill in the journal book, how to transcribe to general ledger, and how to combine all the trial balances of sub-division offices and/or division offices. The manual shall also include the task allocation, the contents of and submission deadline of the accounting documents, requirements of these documents. Followings are the sample of general contents of the accounting manual;

- Purpose of the manual,
- Financial /accounting documents and their relationship,
- Concept of double entry book-keeping,
- Definition of account titles,
- Methodology of depreciation,
- How to record the journal book, general ledger, and trial balance,
- How to combine the trial balances of sub-division and division offices,
- How to compile the balance sheet, income statement, cash flow statement,
- Work allocation,
- Requirements and transmission of necessary accounting documents.

In preparing the manual, actual business transactions are investigated in detail for each sub-division office, division office, and PHE headquarters. When preparing the manual, it is necessary to ask involvements of a few accounting staffs from PHE HQ, division office and sub-division office to hear the actual transactions of each office.

(e) Staff training of accounting procedure

Lectures and workshops shall be conducted to the accounting staff for training of preparing journal book, general ledger, trial balance, and financial statements utilizing double entry book-keeping system. Accounting staff must also understand the reason and how to calculate the

depreciation cost of each facilities, machinery, and equipment. Methodology to calculate monthly amount of cost and benefit, concerning electricity cost, depreciation cost, and interest payments etc., is taught and mastered by the staff. General subjects of training follow the items of accounting manual shown in the above. Training shall be conducted second times, once for training to raise several trainers, and second training by trainers to the other staffs in each region as shown in the Figure 73.5.

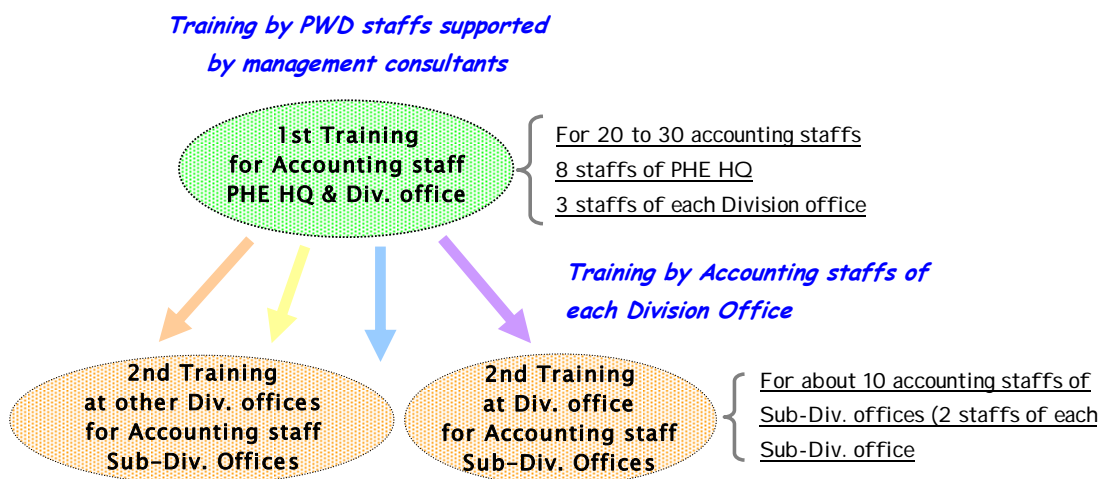


Figure 73.5 Staff training plan for independent accounting system

In the workshop, actual past business transaction must be included in the lecture and used for training in recording them into each accounting documents. Especially, for sub-division office, training will be focused on how to record the daily transaction into journal book by double entry book-keeping, along with the transcription to the general ledger and trial balance. For PHE HQ and division office, training will also be focused on how to combine the trial balances of several sub-division offices and/or division offices.

(f) Introduction of new accounting system

Introduction shall be started at 1st of the month. Estimation of asset value must be concluded before the introduction of the new accounting system. It is recommended to introduce the new accounting system firstly in several typical sub-division offices, or a division office including its sub-divisions, for 2 to 3 months period as the trial. It should be noted that there may be specific transactions for division office or PHE HQ, such as loan repayment, salary payment, retirement allowance which are not observed in the trial case on sub-division offices. It might be better to include the division office and/or PHE HQ in the trial cases. After solving the problems occurred in these trial cases, accounting manual shall be revised and informed to the accounting staff of all the sub-divisions. Formats of subsidiary books are added to the manual, if necessary.

Formal introduction of the system shall be started at the same time for all of the sub-divisions in PHE by the order of the top management class of PHE.

(g) Preparation of financial statements

Results of the accounting documents for the month shall be sent early next month to headquarters of PHE through the division offices, and is compiled to trial balance for the whole PHE every month, as indicated in the Figure 73.6. At the early next fiscal year, balance sheet, Income statement, and cash flow statement for 1 year period shall be compiled as soon as possible. It is recommended to compile the draft balance sheet and draft income statement of each month for the whole PHE at headquarters.

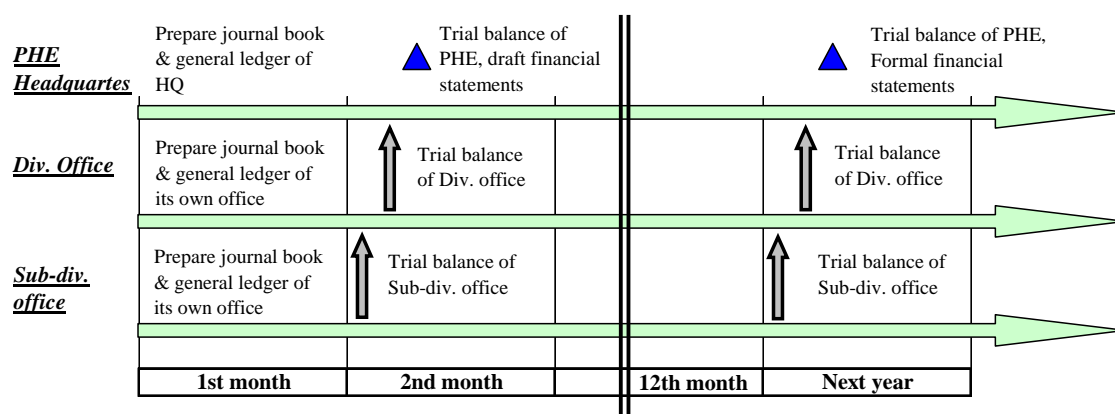


Figure 73.6 Preparation of accounting documents and financial statements

(h) Selection of financial indicators

Necessary financial indicator shall be selected by management class of headquarters to evaluate the financial / managerial condition of the water supply and sanitation services from the aspects of profitability, liquidity, efficiency, productivity, and so on, as was shown in the Table 73.1. Results of financial indicators are evaluated by comparing those of the water supply enterprises in other countries and/or observing the time series changes of those of PHE. Selected indicators shall be added and deducted by the time passing and by accumulating the experiences.

(i) Decision of contents, methods, timing of publication of financial condition

After completing the cycle of accounting procedure in one fiscal year, plan of publication of financial data shall be considered. Plan of publication includes contents of information, method of information transmission, and timing of the first disclosure. Data, which shall be publicized, does not have to include all of the detailed data, but summarized and easy to understand data with the graphs and figures. Preparation of annual financial report proposed in Table 73.2 shall

conduct only meter reading once in two month and preparing bill every month as shown in Figure 73.8.

In Figure 73.8, meter reading is conducted once in June and July and bill is prepared once every month. Meter reading staff must finish reading all the responsible customers for 60 days. Billed amount in June is predicted at water consumption data at May. Half of the actual water consumption volume for April and May is used for billed amount volume for June. On the other hand, billed amount in July is calculated by subtracting billed amount in June from actual read amount for June and July. By utilizing the procedure, PHE is able to reduce the workload and cost for meter reading with the slight disadvantage from prediction of user consumption once in two months.

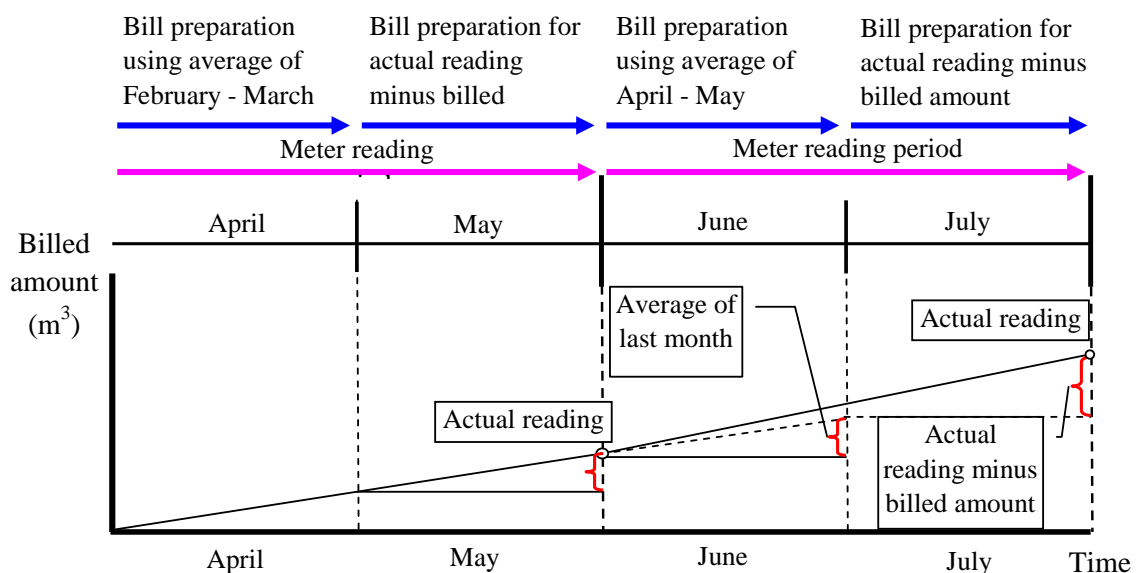


Figure 73.8 Sample of meter reading and bill preparation

Divisions or sub-divisions are able to employ private computer companies for data processing and bill preparation in case of overload for existing staff, as it is presently conducted in Division IX, XXI, XX, and some sub-divisions in Division XVII. By unifying the meter reading and billing period, PHE is able to find the malfunction of water meter of the user in addition to obtaining the useful management / financial information. In case that PHE staff finds unusual water consumption of a customer, it is better for PHE staff to ask the customer for the reason in order to find the meter malfunction earlier. It is also recommended that PHE shall transmit the data of meter reading and billing, collected amount between headquarters and divisions / sub-divisions through the MIS.

1) Actions to be taken for unifying the meter reading period

General actions to be taken for unifying the meter reading period are as follows;

(a) Plan of detailed work change of meter reading, data input, and bill preparation

For the related staffs to change their work smoothly, paper for meter reading, data input, and bill preparation shall be made. The paper will be the base of written directive in the next action. It is necessary for PHE to discuss and coordinate with the private bill preparation companies.

(b) Decision and order of unifying the meter reading period

Decision by CEO should be passed and order should be given to the whole PHE regarding the introduction of new meter reading and billing system. The paper describing detailed work change shall be sent to each sub-division offices through division office as written directive.

(c) Official report from PHE or PWD to the customers regard introduction of new billing system

Customers had better know the change of billing system beforehand. Benefits of unifying the meter reading period, such as equation of one time billed amount, receipt of bill at almost the same timing of the month, early finding of malfunction meter, shall be informed to the customers to obtain their understanding.

(d) Introduction of new meter reading and bill preparation system

New system shall be introduced at the same time for all of the sub-division office. Condition of introduction shall be monitored by division offices and PHE headquarters. Necessary supports or orders are provided for the sub-division offices with low performance.

(3) Promotion of connection to the public sewer system

In Margao, the 'Subsidized Connection Scheme' by State Government had been introduced for few months in the year 2005 and 2006. The number of customers has been increased impressively since then. Housing units benefited on December 2004 is 1,074 after 4 years from service commencement. After introduction of the scheme, housing units benefited were counted at 1,972 on December 2005, and increased to 2,576 on May 2006. Subsidized scheme depends on the decision by State Government and, as for now, there is no plan to implement it continuously.

Without the scheme, general customers have to pay several times of household income for the construction of sewer pipe and fittings inside their own lands in addition to the connection

charge at Rs.200 or Rs.350 for domestic. For example, by ‘One Time Subsidized Sewerage Connection Scheme’ that was implemented during April to August 2005, 1,508 customers were newly connected to the public sewer system. On the other hands, Rs. 3 crores public funds were required as the total cost for all the connections. As a result, it is calculated that on average Rs.19,894 was required for the sewer connection per customer. This initial burden by an applicant is one of the major constraints for PHE to increase the customers of public sanitation system.

1) General explanation of Installment Plan

It is recommended to implement the installment plan for initial cost of public sewer. Installment plan shall be realized by borrowing the certain amount of money from private bank or preferably public lending organization with lower interest rate.

PHE, or division office, receives the applicants without full amount of money to invest for connection. PHE makes loan agreement with the applicant which mentions the terms and period of loan repayment. PHE utilizes the fund from borrowed money from bank and construct the connections to the public sewer for applicants. New customers shall pay the installment payment every month including the interests in addition to the tariff to the PHE. PHE shall make loan repayments to the bank by the installment payments from the customers.

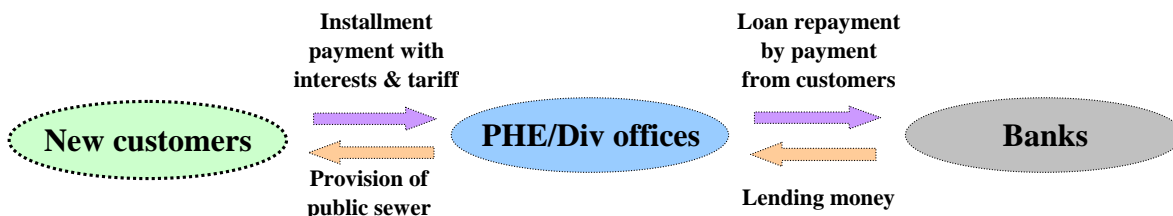


Figure 73.9 Stream of service and fund of the initial cost installment plan

2) Loan from the Bank to PHE/Division Offices

PHE will negotiate with private bank or public lending organization for the terms and amount of loan. First loan had better be small amount as a trial for the safety of PHE, e.g., enough to cover several dozens of applicants. After observing the real number of applicants and progress of repayments by customers, amount of next loan shall be decided cautiously. Loan repayment to the bank from PHE would be monthly bases. It is better to fully expend the total amount of loan, which indicates PHE receives enough applicants, within one month before starting the loan repayment, so as to receive the payments from applicants as soon as possible.

3) Agreement between PHE/Division Offices and Applicants

PHE and/or division offices and applicants make agreement with each other concerning the amount of loan, timing and interest rate of loan repayment. Loan agreement must include the punitive provision, e.g., water supply stoppage, in case that customer defaults the loan repayment. Amount of loan shall be decided based on the cost estimate of each sewer connection and the initial budget paid by the applicant. Interest rate for applicant shall include the modest risk premium in addition to the loan interest of the bank. Repayment period of each applicant shall be basically same as that of the terms between PHE and bank. Monthly repayment schedule for each applicant is prepared and attached to the agreement with the applicant.

It should be noted that customers utilizing the installment plan might go to legal action after constructing the sewer connection to cancel debt obligations. PHE must design the terms of loan agreement between PHE and customers with much caution and must consider including special terms in the agreement with the signature of customers in order to avoid such legal action. The terms of loan agreement must be explained to the applicants clearly and detailed, especially concerning this topic before the agreement is signed.

4) Sample of repayment schedule of installment plan

For the purpose of reference, repayment schedule of the customer are shown in the Table 73.7 and Table 73.8, with the interests of 11% (supposing private bank) and 7% (supposing public lending organization) respectively for the repayment period of 10 years. Loan amount of the reference is assumed at Rs.13,000, which equals to the general necessary cost (Rs.16,000) minus initial payments by the applicant (Rs.3,000).

Table 73.7 Repayment schedule of the customer (fund from private bank)

(unit: Rs.)

Year	Loan amount	Interest rate	Interest of the year	Repayment per year	Balance at the end	Repayment per month
1	13,000	11%	1,430	2,208	12,222	184
2	12,222	11%	1,344	2,208	11,358	184
3	11,358	11%	1,249	2,208	10,400	184
4	10,400	11%	1,144	2,208	9,336	184
5	9,336	11%	1,027	2,208	8,155	184
6	8,155	11%	897	2,208	6,844	184
7	6,844	11%	753	2,208	5,389	184
8	5,389	11%	593	2,208	3,773	184
9	3,773	11%	415	2,208	1,980	184
10	1,980	11%	218	2,198	0	183

The repayment per month in the Table 73.7 is the 3.59% of the present average household income. When it is included in the water supply and sewerage charge, the percentage of total payment in average household income is 5.88% currently. It is considered to be within the affordability level of the customers.

Table 73.8 Repayment schedule of the customer (fund from public lending organization)

(unit: Rs.)

Year	Loan amount	Interest rate	Interest of the year	Repayment per year	Balance at the end	Repayment per month
1	13,000	7%	910	1,851	12,059	154
2	12,059	7%	844	1,851	11,052	154
3	11,052	7%	774	1,851	9,975	154
4	9,975	7%	698	1,851	8,822	154
5	8,822	7%	618	1,851	7,589	154
6	7,589	7%	531	1,851	6,269	154
7	6,269	7%	439	1,851	4,857	154
8	4,857	7%	340	1,851	3,346	154
9	3,346	7%	234	1,851	1,729	154
10	1,729	7%	121	1,850	0	154

5) Flow of implementation process of installment plan

General processes for the implementation of installment plan are as follows;

a) Plan of detailed system of installment plan

Following items shall be considered at least; form of loan agreement between PHE and applicant standards for examination of the applicant, calculation method for deciding monthly loan repayment by customer, and punitive action against default of loan repayment. On the other hand, PHE shall explain the system of installment plan to lending organization and discuss amounts, conditions including interest rates, with lending organization.

b) Official decision of introducing the installment plan and Report of the installment plan to the public

After preparing the system plan and completing the negotiation with lending organization, official decision shall be made. It is important to report the introduction of installment plan to the public. Deadline of application, limit of the approximate number of applicants, shall be informed with the simple explanation of the installment system.

c) Accepting the application and screening of the applicants

Application form shall be prepared beforehand, which cover the necessary information for PHE to examine the applicants. The purpose of the screening is to reject the applicants who are seen

to have no economic potential to repay the loan. Clear and easy to understand standards shall be set for examination and discretionary standards shall be limited. After finishing the screening of applicant, notice by PHE should be sent to the applicants.

d) Loan agreement between PHE and lending organization

Based on the loan amount that is the total of loans of final applicants, loan agreement will be made between PHE and lending organization.

e) Loan agreement between PHE and each applicant

Based on the loan agreement between PHE and lending organization, loan agreement will be made between PHE and each applicant.

f) Receipt of loan and implementation of sewer connection construction

PHE will receive the loan amount from lending agency and start the construction of sewer connections of the applicants.

g) Collection of loan repayment from customers and payment to the lending organization

Loan repayments from customers will be preferably sent to the bank account of the PHE, and then, loan repayment will be made to lending organization from PHE.

(4) Reduction of Public Stand Post by promoting the house connection

Presently, PWD is promoting the reduction of PSP and application to the house connection. Consumption of water from PSP is usually not billed and does not originate revenue. Unbilled PSP is one of the major causes for the high NRW rate in Goa. Promotion of the reduction of PSP by PHE is appreciated in the aspect of financial management. Introduction of installment payment described in '(3) Promotion of connection to the public sanitation system' is also useful to promote the application to house connection, in case the initial investment cost is the hurdle for new customers.

7.4 A capacity building agenda

The capacity building agenda includes a series of activities and actions intended to improve the internal management systems and staff competencies. These activities are intended to improve the efficiency and effectiveness of PHE in delivering sustainable water and sewerage services

7.4.1 Components of capacity building plan

The following table describes in detail the components of the capacity building plan, including the expected impact of the improvements.

Table 74.1 Synopsis of Capacity Building Plan and Indicative Timetable

Current weakness & opportunities ² to be addressed	Expected 2012 Outcome		Proposed Capacity Building Activities	2007				2008				2009				2010				2011				2012					
	"PHE is better able to..."	"... through:"		1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4		
A. Physical (operation and maintenance) System																													
O&M deficiencies																													
<ul style="list-style-type: none"> Not all O&M procedures and standards written, documented and readily available for both water supply and sewerage. Limited operation and maintenance skills and equipment. 	<ul style="list-style-type: none"> Operate and maintain properly all water supply production, treatment and distribution facilities and sewerage collection, treatment and disposal facilities. 	<ul style="list-style-type: none"> Operation and maintenance standards & guidelines (OMG's). These guidelines will also be the basic training materials for O&M. <i>[Process Owner: Technical Services Office]</i> 	A-1	Agree on overall scope, content and structure of the PHE Operation and Maintenance Guidelines – from specific intake structures to specific pumping stations to specific brands of water meters (in use).	█																								
			A-2	Gather and review all existing O&M documents.	█																								
			A-3	Draft/update OMG's. Compile OMG's as the PHE O&M Manual		█	█	█																					
			A-4	Conduct a detailed technical review of the OMG drafts.			█	█																					
			A-5	Design & implement a system for regular internal review, upgrading and formal adoption of the OMG.						█																			
Water supply system monitoring																													
<ul style="list-style-type: none"> Difficulty in quickly assessing impact of pressure-flow variations in the water system along transmission lines and network. 	<ul style="list-style-type: none"> Take operating or design decisions based on rapid considerations of several demand, flow and pressure conditions. 	<ul style="list-style-type: none"> Use of hydraulic modeling software. 	A-6	Evaluate, procure and install appropriate hydraulic modeling software. Train staff on use of the software in daily operation decisions.			█																						
High NRW																													
<ul style="list-style-type: none"> NRW is high due to various reasons. Pilot exercise has demonstrated benefits of an NRW program; staff trained; equipment available. 	<ul style="list-style-type: none"> Reduce NRW resulting in more water availability for use/sale; higher revenues, reduced operating expense; and possible capital deferment. 	<ul style="list-style-type: none"> An expanded program for Control of Non-revenue water <i>[Process Owner: NRW Reduction Team]</i> 	A-7	Implement expanded Non-Revenue Water Reduction Plan and 'active leakage teams' to reduce NRW to an 'economic' level (based on pilot project)	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█			
			A-8	Evaluate viability of outsourcing leakage reduction plans, including meter replacement, leakage repair, operation and/or maintenance of assets etc.											█														
Outsourcing opportunities																													
<ul style="list-style-type: none"> Good experience with outsourcing of bill preparation function. 	<ul style="list-style-type: none"> Promote and engage more public-private partnerships in service provision. 	<ul style="list-style-type: none"> Clearer PHE outsourcing policy and procedures. <i>[Process Owner: Management Services Office]</i> 	A-9	Assess PHE experience and lessons from current outsourced activities. Identify and assess other possible areas of current operations which may be outsourced or provided through service contracts and assess the advantages or benefits of doing so.																									
			A-10	Draft a policy note adopting principles to use in deciding when to outsource; how to outsource (transparency), including sample agreements.																									
Project management deficiencies																													
<ul style="list-style-type: none"> No experience with major externally-funded capital investments. 	<ul style="list-style-type: none"> Manage major externally financed capital investment and project management effectively. Utilize project funds on investments that deliver best return for PHE based on master plans and asset planning criteria. 	<ul style="list-style-type: none"> Formal project management standards and procedures for externally-financed projects, particularly project supervision, accounting and reporting requirements and procurement of goods and services by international competitive bidding procedures. <i>[Process Owner: Project Management Department]</i> 	A-11	Organize Project Management Unit to supervise and monitor implementation (procurement, project planning and monitoring, project supervision, reporting, project accounts, etc.)	█																								
			A-12	Familiarize with of existing project management policies, systems, procedures and other requirements of external funding agency; comparison and coordination with local management requirements.			█																						
			A-13	Set-up required project management support systems.				█																					
B. Organization Planning System																													
Planning Deficiencies																													
<ul style="list-style-type: none"> Goa State's annual development plans are not translated into a PHE corporate or business plan. Minimal participation of managers and supervisors, and possibly other stakeholders, in planning. 	<ul style="list-style-type: none"> Prepare, update and monitor annual & 5-year plans to ensure that the strategic intent and corporate objectives are supported, assigned, measured, monitored and met by all key players. 	<ul style="list-style-type: none"> Adoption of a PHE business model Introduction of formal corporate planning and annual business planning process. Input and participation from more managers and staff in the process. <i>[Process Owner: Corporate Planning Office]</i> 	B-1	Review strategic intent, vision and mission statements and share these with the entire workforce.	█																								
			B-2	Adopt proposed new business model and corporate planning model. Facilitate a series of discussion meetings / training with participation up to section heads and supervisors in the process.			█	█																					
			B-3	Pilot/facilitate a corporate (and annual) planning and review exercise, including budgeting, for the following year					█				█			█				█						█			
			B-4	Review the pilot experience and institutionalize the process.												█													

² As presented in the progress report and interim report.

C. Customer Service System			Process Owner: Marketing and Public Information Office																						
<ul style="list-style-type: none"> Low customer service orientation among PHE staff. Customer complaints about difficulties in dealing with PHE. 	<ul style="list-style-type: none"> Increased responsiveness to customer service requests; 	<ul style="list-style-type: none"> Streamlined procedures for convenience of customers (a Customer Focus Program). MIS-based Customer Service Management (CSM) module. [Process Owner: Marketing & Public Information Office] 	C-1	Implement independent survey of public perception about PHE and common business transactions with public.	■																				
			C-2	Analyze survey results and formulate a customer focus program and community relations program		■																			
			C-3	Design a customer service management module, including database, service request tracking system.																					
			C-4	Verify and input current customer records into the database.																					
			C-5	Install, test the new Customer Service Management module.																					
			C-6	Train customer service staff on the use of the CSM module.																					
<ul style="list-style-type: none"> No formal customer service standards (example, billing cycles not standardized, response time to complaints) 	<ul style="list-style-type: none"> Meet the service expectations of its customers. 	<ul style="list-style-type: none"> Complaints and response time analysis done monthly Formal customer service standards [Process Owner: Management Services Office] 	C-7	Review meter reading, billing and collection cycle practices; identify measures to improve procedures, such as spot billing, handheld registers, etc	■																				
			C-8	Review current practices and develop a clear set of customer service standards or norms which PHE will commit to provide to each customer.																					
			C-9	Adopt the upgraded customer service standards and revise the Customer Charter (and service contract) to reflect the customer service standards. Disseminate to the public.																					
<ul style="list-style-type: none"> Lack of customer participation. Lack of customer confidence in PHE. 	<ul style="list-style-type: none"> Get timely feedback from customers by implementing a systematic customer focus program and by promoting more regular dialogue with the public. 	<ul style="list-style-type: none"> Systematic customer feedback system. Public confidence-building tools, such as Citizen Advisory Councils, Annual Consumer Confidence Report, etc. Implementation of public awareness, information and education program. [Process Owner: Marketing & Public Information Office] 	C-10	Design and implement a more pro-active customer feedback system (Go out and get feedback; do not just wait for it to come; engage in dialogue with customers and customer groups).																					
			C-11	Organize Citizens Advisory Council. Assess and develop other means to enable due consideration of consumers' views in the planning of services.																					
			C-12	Assess, formulate and implement a continuous community relations program for current and prospective customers. Introduce community relations activities such as open days, schools liaison, road shows, customer literature, customer surveys etc.																					
<ul style="list-style-type: none"> Low connection rates to sewer systems 	<ul style="list-style-type: none"> Enable customers to connect to the sewerage system. 	<ul style="list-style-type: none"> Loan program which is funded, widely-used and operational. 	C-13	Design a system and proposal to offer customers a soft loan to connect to the water and sewerage system, including toilet improvement. (i.e., formulate documentation and assist PHE in seeking financing of the revolving fund)	■																				
D. Financial Management and Control System			Process Owner: Accounting Office																						
<ul style="list-style-type: none"> Difficult to assess financial performance of PHE as a public utility due to absence of readily-available data. Current data and reports more suited to an asset creation (or project) organization. 	<ul style="list-style-type: none"> Prepare standard financial accounting reports for water and sewerage utilities. 	<ul style="list-style-type: none"> Accurate and timely financial and operating reports – operating highlights, monthly income statements, balance sheets. Benchmarked performance indicators reports [Process Owner: Accounting Office] 	D-1	Decide on & authorize introduction of independent accounting system	■																				
			D-2	Prepare draft format of financial documents																					
			D-3	Undertake asset valuation exercise																					
			D-4	Prepare accounting procedure manual for the staff																					
			D-5	Train staff on new accounting procedure																					
			D-6	Install, implement and monitor new accounting system																					
			D-7	Pilot preparation of financial statements																					
			D-8	Identify key financial performance indicators																					
			D-9	Decide on content, method and timing of publication of financial data																					
			D-10	Introduce external audit																					
			D-11	Formulate, test and implement benchmarking report format.																					
<ul style="list-style-type: none"> PHE is not able to assess the impact of tariff structure adjustments on the overall revenue. 	<ul style="list-style-type: none"> Determine, on an factual and continuing basis, the appropriate tariff structure (including blocking) with due consideration for low-income groups. 	<ul style="list-style-type: none"> Simple simulation models to forecast revenues. Monitoring access of low-income groups to PHE services. 	D-12	Develop a simulation model to examine the impact of adjusting tariff structure on revenues and consumption patterns of various customer groups.																					
E. Administrative Support System			Process Owner: Asset Management Office																						
<ul style="list-style-type: none"> No formal system to guide decision-making on asset acquisition and maintenance matters, i.e., not based on data about serviceability, demand, risk analysis, value analysis and other 'life cycle' parameters No analysis of maintenance expenditures. 	<ul style="list-style-type: none"> Implement a systematic preventive maintenance program Control asset expenditures (equipment justification, financing, operation and control) in line with strategic intent, i.e., funds are used on assets that deliver best return based on life cycle parameters 	<ul style="list-style-type: none"> Introduction of an asset management system, integrated with the MIS, which contains asset history and analysis of maintenance expenditure, breakdown frequency, burst frequency etc. [Process Owner: Asset Management Office] 	E-1	Organize the Asset Management Office and adopt a methodology for asset planning that links overall strategic direction with financial planning and project delivery.	■																				
			E-2	Design, identify software (part of integrated MIS), install, train and start up the PHE asset Management System																					
			E-3	Review existing asset management system; evaluation and valuation of existing assets. Monitor application.																					
			E-4	Implement a computerized Asset Register for all above and below ground assets and determine asset conditions for all assets.																					
			E-5	Introduce a preventive maintenance program for all assets using the asset maintenance management program.																					
<ul style="list-style-type: none"> Inventory and spare parts system needs to be better planned and controlled. 	<ul style="list-style-type: none"> Efficiently manage level of supplies and materials inventories through better inventory controls. 	<ul style="list-style-type: none"> Effective inventory and spare parts control and availability [Process Owner: Asset Management Office] 	E-6	Examine the current inventory planning and control policies and practices in PHE.	■																				
			E-7	Recommend and implement policy and system management improvements to inventory and property management systems, including Inventory Management Module.																					

F. Human Resources Management & Development System			[Process Owner: Training & Research Office]																									
<ul style="list-style-type: none"> Insufficient job descriptions and qualification standards for all job titles 	<ul style="list-style-type: none"> Define clearly the job requirements, standards and qualification for all job titles 	<ul style="list-style-type: none"> Job descriptions, with clear qualification requirements 	F-1	Develop, review and update existing job descriptions for all PHE job titles.	[Gantt bar]																							
			F-2	Propose practical qualification requirements and productivity standards and indicators for each of the job titles.	[Gantt bar]																							
<ul style="list-style-type: none"> No method for determining staffing requirements and skill specifications 	<ul style="list-style-type: none"> Deploy the appropriate number of staff and skill mix in each work team. Project future skill and staffing requirements. 	<ul style="list-style-type: none"> Adoption of rational staffing and manpower projection methods 	F-3	Conduct simple observation, work load analysis to propose a reasonable initial criteria or target to apply for staffing projections.	[Gantt bar]																							
			F-4	Identify and define practical (more job specific) staffing indicators to be introduced, for example, no. of treatment operators/process train or no of water meter readers/HH/month, etc. in each department.	[Gantt bar]																							
			F-5	Propose a system for regular annual updating of manpower needs based on type of skills and competency needs (not only number of staff needed).	[Gantt bar]																							
<ul style="list-style-type: none"> Inadequate performance evaluation and incentive system. 	<ul style="list-style-type: none"> Assess the performance of staff and work groups; Provide reasonable incentives for outstanding performance. 	<ul style="list-style-type: none"> Objectives-based performance review system and additional performance-based incentives. 	F-6	Formulate and get approval for an enhanced performance review and incentive system.	[Gantt bar]																							
			F-7	Implement new performance review and incentive program.	[Gantt bar]																							
<ul style="list-style-type: none"> Unsafe working conditions, particularly in the chlorination facilities, along the major roads and streets and in confined-space facilities. 	<ul style="list-style-type: none"> Provide staff basic safe working conditions 	<ul style="list-style-type: none"> Worker safety program Health Safety and Security audits 	F-8	Appoint a "process owner" for health, safety and welfare matters in each working subunit. "	[Gantt bar]																							
			F-9	Design and implement a H&S Strategy and site-specific System of Local Organization and Arrangements (LOAD) to handle hazards.	[Gantt bar]																							
			F-10	Conduct Health Safety and Security audits and ensure that all operational and commercial sites are upgraded.	[Gantt bar]																							
<ul style="list-style-type: none"> Lack of long-term human resources development plan. Limited opportunities for staff development and training. Narrow "competencies". Financial analysis skills limited. 	<ul style="list-style-type: none"> Provide high quality training opportunities for all staff by expansion of in-company training systems and capacity. 	<ul style="list-style-type: none"> Regular year-round program of in-company training for all staff. (See Training Plan for details) Establishment of training and research office. 	F-11	Organize the PHE Training and Research Office to plan and implement an year-round program of staff development activities.	[Gantt bar]																							
			F-12	Review and adoption of the overall framework for technical and managerial training proposed in this Study.	[Gantt bar]																							
			F-13	Adopt a training management system (planning & monitoring, including records keeping)	[Gantt bar]																							
				Establish linkages with other training and development centers in the country and Asia.	[Gantt bar]																							
			F-14	Develop, implement and evaluate training plan (as proposed in this Study)	[Gantt bar]																							
			F-15	Organize trainer training and materials development.	[Gantt bar]																							
			F-16	Establish a staff library (for information and research) at a central location with hi-speed Internet access as part of the Training Center for use of all staff.	[Gantt bar]																							
G. Management information system (MIS)			Process Owner: MIS Unit																									
<ul style="list-style-type: none"> Data and record keeping not standardized; "individualized" information systems. Minimal sharing ("consolidation") of information among working units. Limited familiarity with information systems and information technology. 	<ul style="list-style-type: none"> Standardize, share and exchange information across departments on a regular and continuing basis for sound decision making with improved data collection, processing, information integrity, reporting and dissemination. Use information technology effectively. 	<ul style="list-style-type: none"> Use of appropriate Management Information System 	G-1	Design comprehensive integrated MIS Development Plan, with initial focus on the following application modules: <ul style="list-style-type: none"> Asset Management Module Financial Management and Control (Accounting) Module. Customer Service Module (including customer database, billing & collection and complaints monitoring) Inventory Control Module 	[Gantt bar]																							
			G-2	Install hardware and software; train managers and staff; start-up system.	[Gantt bar]																							
			G-3	Develop MIS expansion plan for other application areas (such as Project Management, Human Resources Management, etc)	[Gantt bar]																							

7.5 The training plan, 2007 - 2012

This section describes in detail the training plan envisages under the capacity building agenda. Based on the assessments, the proposed training priorities in Stage I will be on:

- Management Development – focus on middle managers & supervisors. Management of sections and even smaller work teams and crews; communications, leadership, motivation and working relationships. Include computer training.
- Operation & Maintenance. Development of local O&M specialists, for such areas as pipes and appurtenances, treatment processes, electro-mechanical & telemetry equipment, etc).
- Project Management (PM). Development of local PM specialists, such as designers (hydraulics, treatment, electro-mechanical, etc), construction specialists and inspectors, socio-economist and financial analysts for future feasibility study, design and construction activities. Include computer training.
- Customer Service.
- Financial Management and Control.

Table 75.1 Training Plan

Target participants	Training objectives: To:	Scope of training	Expected impact (Monitoring targets)	Notes and Assumptions
Finance and accounting staff and managers.	Implement the new financial management and control system.	Financial planning and control; Forecasting; Budgeting (capital and O&M); Tariff planning; Utility accounting; Accounts receivables; Audits	Annual PHE revenue & expense projections, budgets and financial reports developed. Timely and accurate PHE financial reports. Stronger commercial orientation. Decision making	Integrated with introduction of financial accounting system. Follow-up workshops to be contracted out to financial training service provider or local trainers.
Technical staff and managers (engineers & senior technical staff and field supervisors)	Demonstrate an understanding of appropriate technical operating procedures, guidelines & policies for system operation and maintenance.	Management of maintenance	Asset management system functioning. Annual maintenance schedules & plans prepared.	Integrated with introduction of asset management & annual maintenance planning system. Follow-up workshops to be led by national trainer.
		O&M of electromechanical equipment; Pumps & Motors (Engines); Control panels	Appropriate O&M guidelines and policies for electro-mechanical equipment are adopted and implemented.	
		O&M of water production and treatment; Source protection; Transmission; Balancing reservoirs; Water quality; Intake structures; Treatment process; Chlorination	Water production and treatment costs under control. Adequate quantity and quality produced. Quality meets national standards.	Implemented prior to new system start-up.
		Management of NRW; NRW reduction strategy; Sources of NRW; Leak detection; Customer registration; Meter management.	Water losses due to leakages and meter under-registration reducing. Company has a written, regular program to control losses.	To be done as part of the pilot program to reduce NRW to be introduced and started up. Follow-up workshops to be led by national trainer or institutes.
		O&M of distribution networks; Valves; Pipes & Fittings; Reservoirs; Service connections	Improvement in operating pressures and water quality through proper operation of the distribution systems	
		O&M of sewage collection works	Sewer cleaning equipment are properly used.	
		O&M of sewage treatment plants and sludge disposal	Effluents and sludge safely disposed. Sewage treatment cost under control.	
Customer service staff	Organize effective customer service and customer relations system.	Managing customer service; Marketing; Handling service requests; Public relations.	New customer service centers functioning. Timely response to customer service requests.	Integrated with development of the customer service centers. Follow-up workshops to be led by local trainer or institute.
All Managers & Supervisors	Demonstrate an understanding of management principles, functions, tools & techniques.	Utility management and supervision; Planning; Organizing; Leadership; Controls; Management Information Systems	Competent corps of managers and supervisors. All managers and supervisors can use the MIS effectively	To be arranged with management training institute.
Project management staff	Address problems related to implementation of externally-funded investment projects	Project accounting & reporting	Accurate & timely project financial reports. Familiarity with project accounting and reporting required by external support agencies.	Integrate with MIS.

All training activities will include basic input on PHE's mission and corporate values.

7.6 Technical Assistance to support institutional development at PHE

7.6.1 Preliminary Cost Estimates (for Phase 1) and Financing

It is estimated that a budget³ of about US\$ 6.3 M will be needed to support this external assistance project for institutional development during the period 2007-2012. This constitutes about 4% of the capital investment required. The following is an indicative budget (in US\$) for the external support for institutional development. This estimate has been included in the budget for Stage I improvements.

Alternative sources of financing the external support may be organized through the various capacity building support programs implemented by JICA and other external support agencies.

7.6.2 Advisory Team to PHE

The inclusion of a full-time utility management adviser to provide guidance in management development and inputs from various short-term consultants and experts has been proposed.

Table 76.1 Proposed deployment of PHE advisers

Man-Months	2007	2008	2009	2010	2011	2012
Long-Term Adviser						
Fulltime Utility Management Adviser	12	12	12	12	12	12
Short-term Advisers						
NRW Adviser	6	6	6	6	6	6
O&M Adviser	6	6	6	6	6	6
Financial Management Adviser	4	4	3	3		
Human Resources Adviser	2	2	3	3	3	2
Customer Service Adviser	2	3	3	3	2	2

7.6.3 Overall Budget Support for Capacity Building

This budget will provide the services of long-term and short-term capacity building specialists, counterpart support for equipment and software, training and other resources needed to implement the institutional development program. The following table summarizes the anticipated budget requirement for capacity building.

³ Budgeting Assumptions Used: Full-time adviser for 48 m-m at \$30,000 per man-month, including DSA; Short term consultants for 4 m-m/year @ \$ 25,000/m-m, including DSA. International travel @ US\$ 4,000/RT.

Table 76.2 Indicative Budget Required for Institutional Development

	2007	2008	2009	2010	2011	2012	Total
Full-time Utility Mgmt Adviser	360,000	360,000	360,000	360,000	360,000	360,000	2,160,000
NRW Adviser	150,000	150,000	150,000	150,000	150,000	150,000	900,000
O&M Adviser	150,000	150,000	150,000	150,000	150,000	150,000	900,000
Financial Mgmt Adv	100,000	100,000	75,000	75,000	-	-	350,000
Human Res. Adviser	50,000	50,000	75,000	75,000	75,000	50,000	375,000
Cust. Service Adv	50,000	75,000	75,000	75,000	50,000	50,000	375,000
Subtotal: Advisory Costs	860,000	885,000	885,000	885,000	785,000	760,000	5,060,000
No of trips	6	7	7	6	6	6	
Subtotal: International Travel	24,000	28,000	28,000	24,000	24,000	24,000	152,000
Basic MIS Platform	20,000						20,000
Hydraulic Modeling	16,000						16,000
Financial Accounting Module		14,000					14,000
Asset Management Module			14,000				14,000
Customer Service Module				14,000			14,000
Inventory & Spare Parts Module					14,000		14,000
Subtotal: Software & Services	36,000	14,000	14,000	14,000	14,000	-	92,000
Computers, servers & peripherals ⁴	15,000	15,000	15,000	15,000	15,000	15,000	90,000
Miscellaneous Equipment	2,400	2,400	2,400	2,400	2,400	2,400	14,400
Subtotal: Equipment & Hardware	17,400	17,400	17,400	17,400	17,400	17,400	104,400
Training Support	25,000	25,000	30,000	30,000	30,000	30,000	170,000
Supplies & Materials	12,000	12,000	12,000	12,000	12,000	12,000	72,000
Office Services	10,000	10,000	10,000	10,000	10,000	10,000	60,000
Contingencies, 10%	98,440	99,140	99,640	99,240	89,240	85,340	571,040
Subtotal: Miscell.	145,440	146,140	151,640	151,240	141,240	137,340	873,040
TOTAL, in US\$	1,082,840	1,090,540	1,096,040	1,091,640	981,640	938,740	6,281,440
In Million Rs.	48.99	49.34	49.58	49.39	44.41	42.47	284.18

⁴ PHE has budget for computer hardware acquisition under a separate program.

CHAPTER 8

COST ESTIMATION AND IMPLEMENTATION SCHEDULE

CHAPTER 8 COST ESTIMATION AND IMPLEMENTATION SCHEDULE

8.1 Water Supply System

8.1.1 Implementation Schedule

Implementation schedule for the water supply component is presented in Figure 81.1.

Item	2010	2011	2012
1. Expansion			
1) Intake			
(1) Structural Construction	■	■	■
(2) M&E works			■
2) Water Treatment Plant			
(1) Structural Construction	■	■	■
(2) M&E works			■
(3) Trial Operation			■
3) Transmission Main	■	■	■
4) Reservoir	■	■	■
5) Pumping Station	■	■	■
2. Rehabilitation Works			
1) Water Treatment Plant		■	■
2) Transmission Main	■	■	■
3) Pumping Station	■	■	■
3. Flow Examination			■

Figure 81.1 Implementation Schedule for the Water Supply Scheme

The construction period of the Salaulim water treatment plant expansion is expected to be three years. The structural construction will be carried out in the first two years, while the M&E work and the test operation will be carried out in the last year. In particular, the construction of intake structure must be carried out in dry season when the water level in Salaulim dam is low.

Rehabilitation work of the existing water treatment plant is to be carried out in parallel to the expansion works. M&E work, which does not have effect in operation of the water treatment plant will be carried out first. Equipment related sand-filters will be replaced after the operation of the expanded water treatment plant.

Work on transmission mains, reservoirs and pumping stations can be carried out at any convenient time within the period of two and half years as there are no restrictions for these works. Flow examination and pipe cleaning will be carried out after laying transmission main. In addition, the reservoir will be checked for any sign of leakage after its completion.

8.1.2 Procurement Planning

Construction materials and equipment which are needed for constructions of water supply system as well as the M&E equipment can be procured in Indian market.

All the instruments being used in the existing water treatment plant are also Indian made. A procurement plan is shown in Table 81.1.

Table 81.1 Procurement Plan

Item		Domestic	Foreign made but available in Indian market	Import	Remarks
Common materials	Concrete	×			
	Cement	×			
	Re-bar	×			
	Gravel	×			
Pipe materials	Mild steel pipe		×		
	Ductile iron pipe		×		
	PVC pipe		×		
Mechanical equipment	Pump		×		
	Clarifier		×		
	Filter basin equipment		×		
	Chemicals equipment		×		
Electrical equipment	Measuring instrument		×		
	Control panel		×		
	Power receiving equipment		×		
	Generator		×		
Construction equipment	Truck crane	×			
	Dump truck	×			
	Bulldozer	×			
	Backhoe	×			
	Trench less method		×		

8.1.3 Construction Cost

Basically construction cost of the priority projects are based on the same approach as explained in Volume II Chapter 9 Preliminary Cost Estimates and Implementation Schedule.

In consideration of the requirements for geographical and geological conditions, appropriate construction methods have been assumed and are reflected in construction costs.

Cost estimates together with annual disbursement are shown in Table 81.2.

Table 81.2 Disbursement Schedule for Water Supply Components

Item	Amount (Rs. In Million)					
	Total	2008	2009	2010	2011	2012
1. Construction Cost	3,519.38			737.91	1,906.20	875.27
1) Expansion Project	2,256.72			451.39	1,280.29	525.04
(1) Water Treatment Plant	738.01			147.61	369.01	221.39
(2) Transmission Main	1,395.20			279.07	837.16	278.97
(3) Reservoir	114.75			22.95	68.85	22.95
(4) Pumping Station	8.76			1.76	5.27	1.73
2) Rehabilitation Works	955.30			191.22	536.91	227.17
(1) Water Treatment Plant	362.80			72.71	181.40	108.69
(2) Transmission Main	537.86			107.58	322.72	107.56
(3) Pumping Station	54.64			10.93	32.79	10.92
3) Water Quality Control	17.50			0.00	17.50	0.00
4) O&M Improvement	289.86			95.30	71.50	123.06
(1) Water Supply System O&M	266.06			71.50	71.50	123.06
(2) NRW Reduction Improvements	23.80			23.80	0.00	0.00
2. Engineering Cost	351.94	70.00	130.00	43.79	70.62	37.53
3. Administration Cost	193.57	3.50	6.50	39.09	98.84	45.64
4. Land Acquisition	0.00	0.00	0.00	0.00	0.00	0.00
5. Physical Contingency	387.13	7.00	13.00	78.17	197.68	91.28
6. Price Contingency	1,240.57	5.15	19.78	184.71	645.11	385.82
Total excluding Price Contingency	4,452.02	80.50	149.50	898.96	2,273.34	1,049.72
Total	5,692.59	85.65	169.28	1,083.67	2,918.45	1,435.54
Total (in Million US\$1.00=Rs.45.24)	125.82	1.89	3.74	23.95	64.51	31.73

Notes: 1) Improvement and rehabilitation of distribution system and installation of house connections should be conducted as routine work of the PWD. Therefore, costs for these portions are not included in table above. However, these costs are taken into account for following economic/financial analysis.

2) Components of 3) Water Quality Control and 4) O&M Improvement are derived from improvement of O&M improvement plan, therefore, these components are not listed as priority projects for water supply as shown on Table 52.1.

8.1.4 Operation and Maintenance Costs

Operation and maintenance costs for the priority project are shown in Table 81.3.

Table 81.3 Operation and Maintenance Costs for the Water Supply Scheme of the Priority Projects

Item		Amount (Rs. In Million)																		
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Electricity	W.T.P.	0.00	0.00	0.00	0.00	0.00	0.00	41.78	43.35	44.98	46.69	48.47	37.18	38.61	40.11	41.67	43.31	45.02	46.81	48.69
	Others	0.00	0.00	0.00	0.00	0.00	0.00	1.12	1.19	1.25	1.32	1.39	1.47	1.54	1.62	1.70	1.78	1.86	1.94	2.03
	Sub Total	0.00	0.00	0.00	0.00	0.00	0.00	42.90	44.54	46.23	48.01	49.86	38.65	40.15	41.73	43.37	45.09	46.88	48.75	50.72
Chemical		0.00	0.00	0.00	0.00	0.00	0.00	3.51	3.65	3.79	3.93	4.08	2.92	3.03	3.15	3.27	3.40	3.54	3.68	3.83
Personnel Expenses		0.00	0.00	0.00	0.00	0.00	0.00	32.70	32.70	32.70	32.70	32.70	32.70	32.70	32.70	32.70	32.70	32.70	32.70	32.70
Maintenance		0.00	0.00	0.00	0.00	0.00	0.00	19.78	20.22	20.68	21.16	21.66	18.57	18.97	19.40	19.84	20.30	20.78	21.28	21.81
Administration		0.00	0.00	0.00	0.00	0.00	0.00	2.97	3.03	3.10	3.17	3.25	2.79	2.85	2.91	2.98	3.05	3.12	3.19	3.27
Total (in Million Rs.)		0.00	0.00	0.00	0.00	0.00	0.00	101.86	104.14	106.50	108.97	111.55	95.63	97.70	99.89	102.16	104.54	107.02	109.60	112.33
Total (in Million US\$) (US\$=Rs.45.24)		0.00	0.00	0.00	0.00	0.00	0.00	2.25	2.30	2.35	2.41	2.47	2.11	2.16	2.21	2.26	2.31	2.37	2.42	2.48

8.1.5 Required Costs Other than the Priority Projects

Construction costs stated in Table 81.2 are only for the priority projects. In addition to the priority projects, the PWD should install new distribution pipelines and house connections corresponding to the demand increase and system expansion of 100 MLD under the Stage I. Required costs for new distribution pipelines and house connections including the costs for rehabilitation works are shown in Table 81.4 and Volume IV Appendix M91.2 Breakdown of Water Supply Cost.

Table 81.4 Disbursement Schedule for Distribution Pipeline and House Connection for Stage I

(× 1,000 Rs.)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Distribution Pipeline	55,794	56,426	57,032	57,681	58,214	58,910	59,609	60,354	61,093	61,825	62,610
Proposed	32,994	33,626	34,232	34,882	35,414	36,110	36,809	37,554	38,293	39,025	39,810
Rehabilitation	22,800	22,800	22,800	22,800	22,800	22,800	22,800	22,800	22,800	22,800	22,800
House Connection	32,306	32,441	32,568	32,705	32,818	32,964	33,110	33,266	33,422	33,576	40,682
Proposed	6,941	7,075	7,202	7,339	7,450	7,596	7,745	7,901	8,057	8,210	8,376
Rehabilitation	25,366	25,366	25,366	25,366	25,366	25,366	25,366	25,366	25,366	25,366	32,306

8.2 Sewerage System

8.2.1 Implementation Schedule

Implementation schedule for the sewerage component is presented in Figure 82.1.

Item	2010	2011	2012
1. Margao			
1) Sewer Construction			
(1) Trunk Sewer	█		
(2) Branch Sewer	█		
2) Pumping Station			
(1) Structural Construction		█	
(2) M&E Works			█
3) STP			
(1) Structural Construction	█		
(2) M&E Works			█
2. Mapusa			
1) Sewer Construction			
(1) Trunk Sewer	█		
(2) Branch Sewer	█		
2) Pumping Station			
(1) Structural Construction		█	
(2) M&E Works			█
3) STP			
(1) Structural Construction	█		
(2) M&E Works			█
3. North Coastal Belt			
1) Sewer Construction			
(1) Trunk Sewer	█		
(2) Branch Sewer	█		
2) Pumping Station			
(1) Structural Construction		█	
(2) M&E Works			█
3) STP			
(1) Structural Construction	█		
(2) M&E Works			█

Figure 82.1 Implementation Schedule for the Sewerage Scheme

The construction period of each sewage treatment plant is expected to be three years. The structural construction will be carried out in the first two years and the M&E works and test operation will be carried out in the last year.

Construction of each pumping station will take two years. Structural construction will be performed in the 1st year and M&E work with test operation is planned in the 2nd year.

It is scheduled to divide sewer construction into two or more construction phases and to be constructed in three years. Although, in principle, the construction should start from the section near a sewer treatment plant, the high density city area and railroad crossing whose construction takes more time needs to start at an early stage. Moreover, even if it is a branch, local residents should be consulted and informed well in order to obtain their cooperation and achieve timely progress as scheduled.

The social features of construction of each scheme are as shown below.

- Margao

- One sewer railroad crossing is required.
- Sewer construction in busy city area is required.
- One medium-scale pumping station is required.
- Bearing capacity of supporting layer of STP and pumping stations were confirmed by geotechnical investigations. (evaluated by N-value)

- Mapusa

- Trunk sewer will pass a commercial establishment with density population and heavy-traffic area.
- Bearing capacity of supporting layer of STP was confirmed by geotechnical investigations. (evaluated by N-value)

- North Coastal Belt

- Trunk sewer is laid in the central city area, which is a tourist resort.
- There is one medium-scale pumping station.
- Bearing capacity of supporting layer of STP and pumping stations were confirmed by geotechnical investigations. (evaluated by N-value)

8.2.2 Procurement Planning

Construction materials and equipment which are needed for constructions of water supply system as well as the M&E equipment can be procured in Indian market.

All the instruments being used in the existing water treatment plant are also Indian made. A procurement plan is shown in Table 82.1.

Table 82.1 Procurement Plan

Item		Domestic	Foreign made but available in Indian market	Import	Remarks
Common materials	Concrete	×			
	Cement	×			
	Re-bar	×			
	Gravel	×			
Pipe materials	Cast iron pipe		×		
	PVC pipe		×		
	Concrete pipe		×		
Mechanical equipment	Pump		×		
	Mechanical screen		×		
	Aerator		×		
	Clarifier		×		
	Dewaterer		×		
Electrical equipment	Measuring instrument		×		
	Control panel		×		
	Power receiving equipment		×		
	Generator		×		
Construction equipment	Truck crane	×			
	Dump truck	×			
	Bulldozer	×			
	Backhoe	×			
	Trench less method		×		

8.2.3 Construction Cost

Basically construction cost of the priority projects are based on the same approach as explained in Volume II Chapter 9 Preliminary Cost Estimates and Implementation Schedule.

In consideration of the requirements for geographical and geological conditions, appropriate construction methods have been assumed and are reflected in construction costs.

Cost estimates together with annual disbursement are shown in Table 82.2.

Table 82.2 Disbursement Schedule Sanitation Components

Item	Amount (Rs. In Million)					
	Total	2008	2009	2010	2011	2012
1. Construction Cost	881.20			262.92	314.34	303.94
1) Margao	344.97			98.91	123.03	123.03
(1) Trunk Sewer	108.18			36.06	36.06	36.06
(2) Branch Sewer	132.15			44.05	44.05	44.05
(3) Pump	10.84			0.00	5.42	5.42
(4) Sewage Treatment Plant	93.80			18.80	37.50	37.50
2) Mapusa	234.56			68.12	85.22	81.22
(1) Trunk Sewer	77.73			25.91	25.91	25.91
(2) Branch Sewer	75.33			25.11	25.11	25.11
(3) Pump	0.00			0.00	0.00	0.00
(4) Sewage Treatment Plant	81.50			17.10	34.20	30.20
3) North Coastal Belt	286.67			80.89	106.09	99.69
(1) Trunk Sewer	79.23			26.41	26.41	26.41
(2) Branch Sewer	103.44			34.48	34.48	34.48
(3) Pump	10.40			0.00	5.20	5.20
(4) Sewage Treatment Plant	93.60			20.00	40.00	33.60
4) O&M Improvement	15.00			15.00	0.00	0.00
2. Engineering Cost	105.74	20.00	40.00	11.55	17.72	16.47
3. Administration Cost	49.34	1.00	2.00	13.72	16.60	16.02
4. Land Acquisition	18.20	9.10	9.10	0.00	0.00	0.00
5. Physical Contingency	100.52	2.91	4.91	27.45	33.21	32.04
6. Price Contingency	318.16	2.11	7.40	64.86	108.36	135.43
Total excluding Price Contingency	1,155.00	33.01	56.01	315.64	381.87	368.47
Total	1,473.16	35.12	63.41	380.50	490.23	503.90
Total (in Million US\$1.00=Rs.45.24)	32.57	0.78	1.40	8.41	10.84	11.14

8.2.4 Operation and Maintenance Cost

Operation and maintenance costs for the priority projects are shown in Table 82.3.

8.3 Institutional/Organizational Improvement

Institutional/Organizational Improvement costs are estimated in chapter 7 Annual cost estimate is shown in Table 83.1.

Table 82.3 Operation and Maintenance Costs for the Sewerage Scheme of the Priority Projects

Item		Amount (Rs. In Million)																		
		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Electricity	S.T.P.	0.00	0.00	0.00	0.00	0.00	0.00	7.84	9.40	10.12	10.49	10.71	10.93	11.15	11.38	11.61	11.80	11.93	12.01	12.09
	Others	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.49	0.53	0.55	0.56	0.57	0.59	0.60	0.61	0.62	0.63	0.63	0.63
	Sub Total	0.00	0.00	0.00	0.00	0.00	0.00	8.25	9.89	10.65	11.04	11.27	11.50	11.74	11.98	12.22	12.42	12.56	12.64	12.72
Chemical		0.00	0.00	0.00	0.00	0.00	0.00	1.97	2.37	2.55	2.64	2.69	2.75	2.81	2.86	2.92	2.97	3.00	3.02	3.04
Personnel Expenses		0.00	0.00	0.00	0.00	0.00	0.00	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32	3.32
Maintenance		0.00	0.00	0.00	0.00	0.00	0.00	2.03	2.34	2.48	2.55	2.59	2.64	2.68	2.72	2.77	2.81	2.83	2.85	2.86
Sewer Cleaning		0.00	0.00	0.00	0.00	0.00	0.00	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Administration		0.00	0.00	0.00	0.00	0.00	0.00	0.52	0.59	0.62	0.63	0.64	0.65	0.66	0.67	0.68	0.69	0.70	0.70	0.71
Total		0.00	0.00	0.00	0.00	0.00	0.00	17.69	20.11	21.22	21.78	22.11	22.46	22.81	23.15	23.51	23.81	24.01	24.13	24.25
Total (in Million US\$) (US\$=Rs.45.24)		0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.44	0.47	0.48	0.49	0.50	0.50	0.51	0.52	0.53	0.53	0.53	0.54

Table 83.1 Annual Cost of Capacity Building, Institutional/Organizational Improvement

	Amount (Rs. In Million)						
	2007	2008	2009	2010	2011	2012	Total
1. Institutional /Organizational Improvement Cost	48.99	49.34	49.58	49.39	44.41	42.47	284.18
2. Engineering Cost	5.01	5.05	5.07	5.06	4.55	4.35	29.09
3. Administration Cost	2.70	2.72	2.73	2.72	2.45	2.34	15.66
4. Physical Contingency	5.40	5.44	5.47	5.45	4.90	4.68	31.34
5. Price Contingency	0.00	4.00	8.31	12.87	15.98	19.79	60.95
Total minus Price Contingency	62.10	62.55	62.85	62.62	56.31	53.84	360.27
Total	62.10	66.55	71.16	75.49	72.29	73.63	421.22
Total (in Million US\$1.00=Rs.45.24)	1.37	1.47	1.57	1.67	1.60	1.63	9.31

8.4 Summary of the Total Project Costs

Total Project costs are summarized as shown on Table 84.1.

Table 84.1 Summary of Total Project Cost

	Amount		
	(In Million Rs.)	(In Million US\$)	(In Million Yen)
Water Supply Projects			
1.Construction Cost	3,519	77.79	9,051
1) Expansion Project	2,257	49.88	5,804
2) Rehabilitation Works	955	21.12	2,457
3) Water Quality Control	18	0.39	45
4) O&M Improvement	290	6.41	746
2. Engineering Cost	352	7.78	905
3. Administration Cost	194	4.28	498
4. Land Acquisition	0	0.00	0
5. Physical Contingency	387	8.56	996
6. Price Contingency	1,241	27.42	3,190
Total excluding Price Contingency	4,452	98.41	11,450
Water Supply Projects Total	5,693	125.83	14,640
Sewerage Projects			
1.Construction Cost	881	19.48	2,266
1) Margao	345	7.63	887
2) Mapusa	235	5.18	603
3) North Coastal Belt	287	6.34	737
4) O&M Improvement	15	0.33	39
2. Engineering Cost	106	2.34	272
3. Administration Cost	49	1.09	127
4. Land Acquisition	18	0.40	47
5. Physical Contingency	101	2.22	258
6. Price Contingency	318	7.03	818
Total excluding Price Contingency	1,155	25.53	2,970
Sewerage Projects Total	1,473	32.56	3,788
Capacity Building Projects			
1.Capacity Building Contract Cost	284	6.28	731
2. Engineering Cost	29	0.64	75
3. Administration Cost	16	0.35	40
5. Physical Contingency	31	0.69	81
6. Price Contingency	61	1.35	157
Total excluding Price Contingency	360	7.96	927
Capacity Building Projects Total	421	9.31	1,084

	Amount		
	(In Million Rs.)	(In Million US\$)	(In Million Yen)
Total Project Costs			
1. Construction Cost	4,684	103.55	12,048
2. Engineering Cost	487	10.76	1,252
3. Administration Cost	259	5.72	665
4. Land Acquisition	18	0.40	47
5. Physical Contingency	519	11.47	1,335
6. Price Contingency	1,620	35.80	4,165
Total excluding Price Contingency	5,967	131.90	15,347
Grand Total	7,587	167.70	19,512

8.5 Schedule of Pre-Construction Stage

Before award of contracts for contractors, there are several procedures or stages are required such as detailed design, pre-qualification of contractors, bidding, and bid evaluation as pre-construction stage.

Schedule of the pre-construction stage is prepared as shown on Figure 85.1 to be able to commence the constructions or services for capacity development from the year 2010. As shown on this schedule, it is recommended to complete budgetary arrangements by the end of fiscal year 2007.

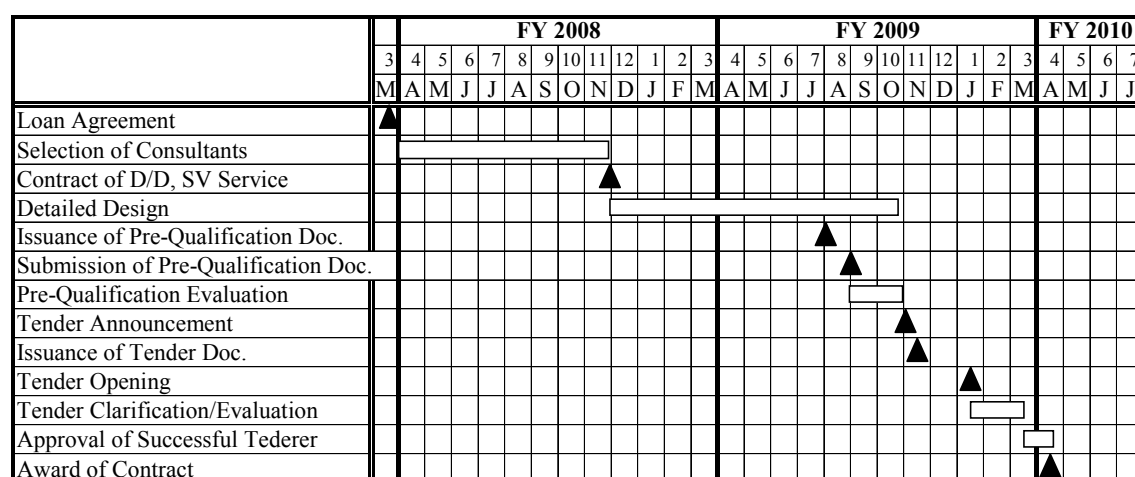


Figure 85.1 Schedule of Pre-construction Stage

CHAPTER 9

ECONOMIC AND FINANCIAL EVALUATION

CHAPTER 9 ECONOMIC AND FINANCIAL EVALUATION

9.1 Methodology of Economic and Financial Evaluation

9.1.1 Methodology of Economic Evaluation

(1) Methodology of Economic Evaluation

The methodology of economic evaluation is the same as that described in the master plan. In the feasibility study, cost estimation of priority projects is more precise than that in the master plan, since preliminary design was prepared based on topographic and geological investigations which were conducted during the feasibility study. The economic viability of priority projects are analyzed on the basis of discounted cash flow method.

Economic Internal Rate of Return (EIRR), Net Present Value (NPV), and Benefit Cost Ratio (B/C) are also calculated in economic evaluation in F/S. Definition of EIRR, NPV, B/C is described in the Volume II Chapter 10 Section 1 Methodology of Economic and Financial Evaluation. EIRR is set as the most important indicator among the three indicators, NPV, B/C, EIRR, to judge the economic viability.

Sensitivity Analysis is conducted in F/S in order to respond to the uncertainty and to raise the credibility of the economic evaluation. Sensitivity analysis is to assess the fluctuations of EIRR, corresponding to the certain changes of benefit and/or cost.

(2) Assumptions for Economic Evaluation

Regarding the economic evaluation of the master plan, followings are considered as the major conditions and assumptions for this evaluation.

- | | | |
|-----|-----------------------------|---|
| (a) | Base year | : Year 2007 (Start of the project) |
| (b) | Project life | : 2013 – 2042 (30 years from start of the services) |
| (c) | Evaluation period | : 2007 – 2042 |
| (d) | Price level | : Year 2007 |
| (e) | Exchange rate | : 45.24 Indian Rupees per US\$1.00 and 116.35 Japanese Yen per US\$1.00
at December 19, 2006 ^{*1} |
| (f) | Opportunity cost of capital | : 12 % per annum |

Source: ^{*1}; Representative Exchange Rates for Selected Currencies for December 2005, The International Monetary Fund

(3) Conversion from Financial Value to Economic Value

The purpose of the economic evaluation is to judge whether to implement the project or not in view of the priorities of many other projects for the national economy. At first, project costs and benefits of the projects are identified and quantified in monetary terms all through the evaluation period. The total costs shown in Chapter 8 are enumerated in terms of market price, or in other words, 'financial value'. For the purpose of economic evaluation, this financial value must be converted into economic value.

Following points were considered, in order to convert the financial cost into economic cost.

- Exclusion of transfer payment: Tax, interest, subsidy are considered as the transfer payment among the government bodies, and not as the true consumption of the resources for the project.
- Adjustment of the exchange rate distortion: Avoid the price distortion of the foreign exchange rate of the country, which are originated from the import tax, export duty, export subsidy, etc. In this analysis, domestic price level is applied to the whole items of cost and the costs are expressed in local currency (Indian Rupee). Prices of imported goods/materials must be adjusted to avoid the exchange rate distortion through multiplying the Shadow Exchange Rate, Rs.49.90/US\$, whose calculation is included in the Volume II Chapter 10 Economic and Financial Evaluation.
- Consideration of opportunity cost: Costs of labor and land are calculated by opportunity costs, not by market prices. In this analysis, opportunity costs of unskilled labor are assumed to be 70% (= Shadow Wage Rate) of market price, and 100% of market price for skilled labor.

9.1.2 Methodology for Financial Evaluation

(1) Methodology for Financial Evaluation

The methodology of financial evaluation is the same as described in the master plan. In the feasibility study, cost estimation of priority projects is more precise than that in the master plan. The financial feasibility of priority projects are analyzed on the basis of discounted cash flow method.

In order to judge whether the project is financially feasible or not, three indicators are used. These are the Financial Internal Rate of Return (FIRR), Net Present Value (NPV), and Benefit Cost Ratio (B/C). The general explanation of the three indicators is included in the Volume II Chapter 10 Economic and Financial Evaluation. Among the above three, the FIRR is set as the most important indicator due mainly to needlessness of establishing discount rate and easiness

in comparing with interest rates and rate of return with which every decision maker is familiar to. In the evaluation of the priority projects, however, the three indicators are computed in order to analyze the financial feasibility in detail.

Sensitivity Analysis is conducted in F/S in order to respond to the uncertainty and to raise the credibility of the financial evaluation. Sensitivity analysis is to assess the fluctuations of FIRR, corresponding to the certain changes of benefit and/or cost.

(2) Assumptions for Financial Evaluation

Regarding the financial evaluation in the feasibility study, followings are considered as the major conditions and assumptions for the study. In the financial analysis of feasibility study, 5.15% discount rate is applied for the computation of NPV and B/C, which is obtained from 3.1% of Interest rate of official creditor to India (Risk Free Rate) plus 2.05% (Risk Premium Rate) reported as Premium Base Rate of infrastructure/natural resources project by Overseas Private Investment Corporation. Calculation of risk premium rate is shown in the Volume V Appendix F91 Methodology of Economic and Financial Evaluation. Interest rate of official creditors (3.1%) is quoted from '9. Average Terms of New Commitments' in the data book of "Global Development Finance, Mobilizing Finance and Managing Vulnerability" published by the World Bank in 2005.

- (a) Base year : Year 2007 (Start of the project)
- (b) Project life : 2013 – 2042 (30 years from start of the services)
- (c) Evaluation period : 2007 – 2042
- (d) Price level : Year 2007
- (e) Exchange rate : 45.24 Indian Rupees per US\$1.00 and 116.35 Japanese Yen per US\$1.00 at December 19, 2006
- (f) Discount rate : 5.15 % per annum*1

Note: *1; Discount rate is set by 3.1% average of interest rate of India from Official creditors during 1999 – 2003 (Risk free rate) plus 2.05% (Risk premium rate). Risk Premium Rate is set at 2.05% based on the data of "Premium Base Rate" of 'Infrastructure/ Natural Resources' by Overseas Private Investment Corporation (OPIC), United States, which is one of the largest and oldest providers of Political Risk Insurance.

9.2 Economic and Financial Evaluation of Priority Projects for Water Supply

9.2.1 Economic Evaluation of Priority Projects for Water Supply

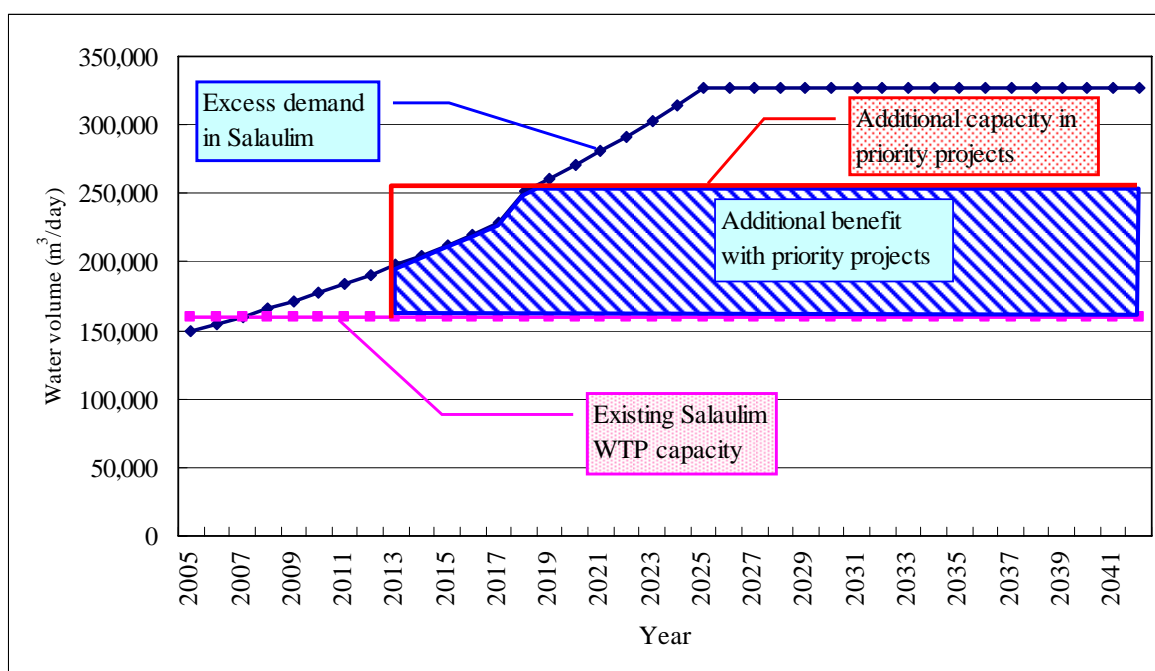
(1) Economic Benefits of Proposed Projects

Water supply project has the many tangible and intangible economic benefits. All the tangible and intangible benefits are expressed in the Volume II Chapter 10 Section 2 Economic and Financial Evaluation of Master Plan for Water Supply. The following table shows the tangible benefits of the water supply priority projects.

Table 92.1 Tangible Economic Benefits of the water supply project

1	Cost reduction effects	1-1	Saving of alternative water procurement costs other than public water supply
		1-2	Saving of incurred costs by public water supply stoppages
		1-3	Saving costs for purchasing bottled water
2	Improvement of public hygiene	2-1	Saving of medical expenditures by decrease of waterborne diseases
		2-2	Reduction of absence from work caused by waterborne diseases

Economic benefits of the priority projects are calculated by subtracting benefit without project case from the total benefit with the project case. Figure 92.1 describes these additional benefits in terms of water supply volume, which is the additional water supply volume by priority projects in Salaulim water supply schemes during the evaluation period. Additional water supply volume is calculated by subtracting water supply volume without project from the total water supply volume with the project. Shaded area of the Figure 92.1 delineates the additional benefit of priority projects in terms of water supply volume. This additional benefit is utilized for calculating economic benefit and financial benefit of the priority projects.



Source: calculation based on the water demand projection of JICA Study Team

Figure 92.1 Benefit of Priority Projects in Terms of Water Supply Volume

- 1) Estimation of economic benefit by cost reduction effects
 - (a) Saving of alternative water procurement cost: Domestic user

Assumed without the Project case, increased water demand in priority project areas shall be satisfied with alternative water supply systems. Alternative water acquisition costs shall be saved by incremental water supply by priority projects. The amount of saved costs is one of the economic benefits of the projects. Economic benefit of each year shall be calculated by multiplying the 'Unit Cost for water acquisition' in Table 92.2 to each percentage of additional water supply volume by priority projects, whose data were estimated in the master plan.

Table 92.2 Composition and Unit Cost of Alternative Water Acquisition Methods

Type of Water Supply	Unit cost for water acquisition (Rs./m ³)	% of each alternative water acquisition methods
Hand Pump	79.5	1.9%
Tube well	92.5	1.6%
Open well	7.9	84.2%
Pond, lake	19.4	1.9%
River, Canal	19.4	2.3%
Spring	19.4	6.5%
Any other	19.4	1.6%

(b) Saving of alternative water procurement cost: Non Domestic

a) Hotels

Economic benefit of each year shall be calculated by multiplying the 'Annual unit cost' to each percentage of additional water supply volume by the project. Data in the table was estimated in the master plan.

Table 92.3 Composition and Unit Cost of Alternative Water Acquisition Methods

Type of Water Supply	Annual unit cost (Rs./m ³)	% of volume of water from each alternative water acquisition methods
Own well	34.7	56.9%
Private Water Vendor	50.0	43.1%

b) Other Non Domestic

Annual unit cost for alternative water supply system for other non-domestic than hotels is estimated in master plan as follows;

Table 92.4 Unit cost of Alternative Water Acquisition Methods

Type of Water Supply	Annual cost for construction, O&M	Annual water demand of Non-Domestic without Tourism (m ³ /year per user)	Annual unit cost (Rs./m ³)
Tube well with Submersible Pump	41,828	1,115.1	37.5

(c) Saving of incurred costs by public water supply stoppages

The Project is planned to secure 24 hour water supply to the customers. After the completion of the project, existing water tank users do not have to invest for the renovation of water tank. These economic benefits shall be estimated in Table 92.5 utilizing the same methodology in the master plan by changing the total number of households for the Salaulim water supply scheme.

Table 92.5 Total Economic Benefit of Saving Water Tank Cost

Year	Number of served household	Total Water Tank Cost (Rs./year)			% of reduction of tank users	Total Economic Benefit of Saving Water Tanks (Rs./year)
		Ground Water Tank & Pump	Overhead Tank	TOTAL		
2012	122,511	104,059,618	36,971,370	141,030,988	5%	7,051,549
2013	125,906	106,943,297	37,995,913	144,939,210	10%	14,493,921
2014	129,369	109,884,735	39,040,977	148,925,712	15%	22,338,857
2018	143,895	122,222,974	43,424,633	165,647,607	35%	57,976,662
2020	143,895	122,222,974	43,424,633	165,647,607	45%	74,541,423
2025	143,895	122,222,974	43,424,633	165,647,607	50%	82,823,804

Source: JICA Study Team

‘Total Water Tank Cost’ in Table 92.5 is the sum of the annualized construction and O&M costs for all of the water tank users. Therefore, total amount will be counted as economic benefit every year, if all the customers stop using the water tank forever. For the calculation of this project, it is assumed that 5% of the total households shall stop using the facility additionally for 10 years from 2012 to 2021. For modesty on economic benefit estimation, it is assumed that 50% of the users shall continue using the water tank, therefore, 50% of the benefit is estimated for economic evaluation after 2021.

(d) Saving cost for purchasing bottled water

With the project case, the number of bottled water bought by household shall be decreased because of the improvement of the water quality of public water supply. The total economic benefit by saving bottled water cost is described in the Table 92.6, utilizing the same methodology in the master plan by changing the total number of households for Salaulim water supply scheme.

Priority projects will serve for the excess demand until 2018, therefore, the amounts of the benefits increase until 2018 and are stable after 2019 regarding saving cost for purchasing bottled water.

Table 92.6 Total Economic Benefit with the Project by Saving Cost for Bottled Water

Year	Number of household served by PWD	Total cost for bottled water (Rs.x1,000)	Total saved amount with the project (Rs.x1,000)
2012	122,511	429,279	214,640
2015	132,898	465,675	232,838
2018	143,895	504,208	252,104

2) Estimation of economic benefit by improvement of public hygiene

(a) Saving of medical expenditures by decrease of waterborne diseases

With the project case, it is assumed that the percentage of patients in total population for each disease will reduce by 30% same as the assumption made in master plan. Total economic benefits for saving of medical expenditures by decrease of waterborne diseases are included in Volume V Appendix F92 Economic and Financial Evaluation of Priority Projects for Water Supply through the evaluation period.

(b) Reduction of absence from work caused by waterborne diseases

Economic benefit of each year shall be estimated by utilizing the same procedures in master plan and included in the Volume V Appendix F92 Economic and Financial Evaluation of Priority Projects for Water Supply for each waterborne disease until the year 2025.

Priority projects will serve for the excess demand until 2018, therefore, the amounts of the benefits increase until 2018 and are stable after 2019 regarding economic benefit by improvement of public hygiene.

Total amount of economic benefits during the evaluation period is shown in the Table 92.7.

Table 92.7 Economic Benefit Stream of Proposed Water Supply Project

Year	Incremental supply above existing supply capacity				Benefit (Rs.1,000)								
	Domestic (m ³ /day)	Tourism (m ³ /day)	Non-domestic except Tourism (m ³ /day)	Total (m ³ /day)	Alternative water supply				Saving water tank cost	Saving bottled water cost	Saving from reduction of water borne disease	Grand Total	
					Domestic	Tourism	Non-domestic except Tourism	Total					
-5 2007	0	0	0	0	0	0	0	0	0	0	0	0	0
-4 2008	0	0	0	0	0	0	0	0	0	0	0	0	0
-3 2009	0	0	0	0	0	0	0	0	0	0	0	0	0
-2 2010	0	0	0	0	0	0	0	0	0	0	0	0	0
-1 2011	0	0	0	0	0	0	0	0	0	0	0	0	0
0 2012	16,169	835	10,482	27,486	70,988	12,585	143,472	227,046	7,052	214,640	25,694	474,432	
1 2013	19,592	1,026	13,066	33,684	86,017	15,464	178,841	280,322	14,494	220,588	26,055	541,459	
2 2014	23,092	1,226	15,843	40,161	101,383	18,479	216,851	336,713	22,339	226,655	26,455	612,162	
3 2015	26,663	1,435	18,822	46,920	117,061	21,629	257,626	396,316	30,598	232,838	26,855	686,607	
4 2016	30,304	1,654	22,014	53,972	133,047	24,930	301,317	459,293	39,281	239,134	27,255	764,963	
5 2017	34,020	1,882	25,435	61,337	149,361	28,366	348,142	525,869	48,404	245,557	27,696	847,526	
6 2018	44,971	2,521	34,607	82,099	197,441	37,998	473,683	709,122	57,977	252,104	28,096	1,047,299	
7 2019	48,568	2,759	38,473	89,800	213,233	41,585	526,599	781,417	66,259	252,104	28,096	1,127,876	
8 2020	48,007	2,764	39,148	89,919	210,770	41,660	535,838	788,268	74,541	252,104	28,096	1,143,009	
9 2021	47,439	2,768	39,832	90,039	208,276	41,720	545,201	795,197	82,824	252,104	28,096	1,158,221	
10 2022	46,867	2,770	40,521	90,158	205,765	41,751	554,631	802,147	82,824	252,104	28,096	1,165,171	
11 2023	46,289	2,772	41,218	90,279	203,227	41,781	564,171	809,179	82,824	252,104	28,096	1,172,203	
12 2024	45,707	2,773	41,921	90,401	200,672	41,796	573,794	816,262	82,824	252,104	28,096	1,179,286	
13 2025	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
14 2026	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
15 2027	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
16 2028	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
17 2029	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
18 2030	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
19 2031	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
20 2032	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
21 2033	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
22 2034	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
23 2035	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
24 2036	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
25 2037	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
26 2038	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
27 2039	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
28 2040	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
29 2041	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	
30 2042	45,120	2,773	42,631	90,524	198,095	41,796	583,512	823,403	82,824	252,104	28,096	1,186,427	

(2) Economic Costs of Proposed Projects

Construction costs include all of the expansion work in priority projects and the rehabilitation work for the existing water supply facilities in the scope of priority projects. Major parts of the financial cost and economic cost are listed in the Table 92.8. Construction costs after the year 2012 are expended for the construction of distribution pipe and house connection necessary for the priority projects. Methodology for conversion from financial cost to economic cost is mentioned in Section 9.1. Annual disbursement is described in the Volume V Appendix F92 Economic and Financial Evaluation of Priority Projects for Water Supply.

Total economic cost of the project is Rs. 4,758.97 million. Future mechanical and electrical equipment replacement costs of expanded facilities are also considered as one of the necessary costs, but are not included in the Table 92.8. They are included in the Cost Benefit Stream for the calculation of EIRR (refer to the Table 92.9). Residual values of replaced equipments are

not deducted from the cost in the last evaluated year, since the values are negligible.

Table 92.8 Economic and Financial Costs of Proposed Water Supply Project

(Unit: In million)

Item	Financial Cost		Economic Cost	
	Rs.	US\$	Rs.	US\$
1. Construction cost	4,094.87	90.51	3,842.50	84.94
2. Engineering cost	354.82	7.84	351.29	7.77
3. Administration cost	195.12	4.31	145.79	3.22
4. Land acquisition cost	0.00	0.00	0.00	0.00
5. Physical contingency	464.50	10.27	419.39	9.27
TOTAL	5,109.31	112.93	4,758.97	105.20

Note; Price contingency is excluded for financial analysis, since the inflation is not considered in financial benefit, either. Exchange rate between Rupee per US Dollar is Rs. 45.24/US\$.

(3) Economic Evaluation

Economic cost and benefit stream during evaluation period is shown in the Table 92.9. As a result of the economic analysis of the water supply priority projects, EIRR is calculated as 16.3%, NPV as Rs.1,064 million, and B/C as 1.35. Comparing the opportunity cost of capital, 12%, EIRR is over the figure, therefore, water supply priority projects are said to be economically viable. Also under the discounted rate of 12%, the project obtained the positive Net Present Value of Rs.1,064 million, and present value of Benefit is 1.35 times larger than the present value of Cost.

Table 92.9 Economic Cost and Benefit Stream of Proposed Water Supply Project

(Unit: Rs. in million)

Year	Cost				Benefit	Balance
	Const- ruction	O&M	Replac- ment	Total	Total	
-5 2007	6.67	0.00		6.67	0.00	-6.67
-4 2008	85.55	0.00		85.55	0.00	-85.55
-3 2009	152.64	0.00		152.64	0.00	-152.64
-2 2010	843.49	0.00		843.49	0.00	-843.49
-1 2011	2,120.71	0.00		2,120.71	0.00	-2,120.71
0 2012	1,027.41	0.00		1,027.41	474.43	-552.98
1 2013	46.81	90.78		137.59	541.46	403.87
2 2014	47.74	93.05		140.79	612.16	471.37
3 2015	48.66	95.39		144.05	686.61	542.56
4 2016	49.57	97.84		147.41	764.96	617.55
5 2017	49.65	100.40		150.05	847.53	697.48
6 2018	52.80	84.59		137.39	1,047.30	909.91
7 2019	55.25	86.65		141.90	1,127.88	985.98
8 2020	56.34	88.82		145.16	1,143.01	997.85
9 2021	57.30	91.07		148.37	1,158.22	1,009.85
10 2022	58.38	93.44		151.82	1,165.17	1,013.35
11 2023		95.90		95.90	1,172.20	1,076.30
12 2024		98.47		98.47	1,179.29	1,080.82
13 2025		101.17		101.17	1,186.43	1,085.26
14 2026		101.17	69.15	170.32	1,186.43	1,016.11
15 2027		101.17	172.85	274.02	1,186.43	912.41
16 2028		101.17	103.70	204.87	1,186.43	981.56
17 2029		101.17		101.17	1,186.43	1,085.26
18 2030		101.17		101.17	1,186.43	1,085.26
19 2031		101.17		101.17	1,186.43	1,085.26
20 2032		101.17		101.17	1,186.43	1,085.26
21 2033		101.17		101.17	1,186.43	1,085.26
22 2034		101.17		101.17	1,186.43	1,085.26
23 2035		101.17		101.17	1,186.43	1,085.26
24 2036		101.17		101.17	1,186.43	1,085.26
25 2037		101.17		101.17	1,186.43	1,085.26
26 2038		101.17		101.17	1,186.43	1,085.26
27 2039		101.17		101.17	1,186.43	1,085.26
28 2040		101.17		101.17	1,186.43	1,085.26
29 2041		101.17	69.15	170.32	1,186.43	1,016.11
30 2042		101.17	172.85	274.02	1,186.43	912.41

EIRR: 16.3%

NPV: 1,064 million Rs.

B/C: 1.35

(4) Sensitivity Analysis

The purpose of sensitivity analysis is to comprehend the size of influences on the economic viability by the change of estimated parameters. In evaluation of the water supply priority projects, the construction costs, and the economic benefits are selected as key parameters. The analysis is conducted for the variation of the costs and benefits changes in plus minus 5% and 10%, respectively. The results of 25 cases are shown in Table 92.10 and Figure 92.2.

Table 92.10 Sensitivity Analysis of EIRR of Priority Projects for Water Supply

%		Benefit				
		-10%	-5%	0%	5%	10%
Cost	-10%	16.26%	17.10%	17.92%	18.73%	19.52%
	-5%	15.45%	16.26%	17.06%	17.84%	18.60%
	0%	14.70%	15.49%	16.26%	17.02%	17.76%
	5%	14.00%	14.77%	15.53%	16.26%	16.98%
	10%	13.36%	14.11%	14.84%	15.56%	16.26%

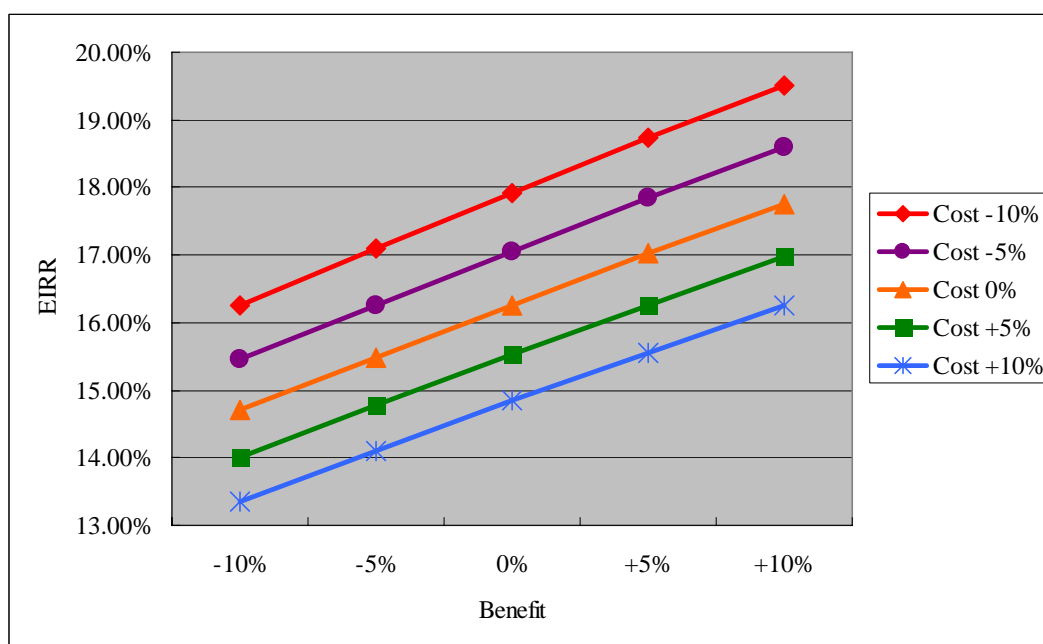


Figure 92.2 Sensitivity Analysis of EIRR of Priority Projects for Water Supply

In any 25 cases, EIRRs are more than opportunity cost of capital at 12%, as shown in the Table 92.10 and Figure 92.2. Therefore, the priority projects for water supply are economically viable within the ranges of plus minus 10% fluctuations of costs and benefits. The projects are worth implementing for the view point of state or country, even under the condition of costs increase at 10% with benefits reduction at 10%.

9.2.2 Financial Evaluation of Priority Projects for Water Supply

(1) Revenue from Proposed Projects

Financial revenue of the proposed project is originated from the tariff revenue from the customers for the portion of incremental water supply volume and the number of customers. Tariff revenue of the customer is composed of water charge, installation charge, and meter rent charge. Regarding water charge, incremental water supply volume is divided to domestic and non-domestic to apply distinct unit prices for computerizing total water charge billed. Incremental water supply volume, shown in the Figure 92.1, is the water volume over the existing supply capacity of Salaulim water supply scheme that is planned to be satisfied by the priority projects. For domestic users, unit price of water charge is set at Rs.4.41/m³ for the year 2007. For non-domestic users, unit price of water charge is set at Rs.27.49/m³ for the year 2007. Unit prices for installation charge for each domestic and non-domestic are Rs.500/case and Rs.2,804/case, respectively. Unit prices for meter rent charge for each domestic and non-domestic are Rs.15.53/case and Rs.26.03/case, respectively. These unit prices are calculated in the master plan. Non revenue water ratio and collection efficiency is considered for calculating the water revenue. The total financial benefit and breakdown of the water supply priority projects are included in the Volume V Appendix F92 Economic and Financial Evaluation of Priority Projects for Water Supply for each year through the evaluation period. Table 92.11 is the digest of the total financial benefits from the priority projects for water supply.

Table 92.11 Total Financial Benefits from the Priority Projects for Water Supply

(Unit: Rs. In million)

Item	2012	2015	2020	2025	After 2025
Domestic					
1. Total Water Revenue	17.43	29.66	56.16	55.39	55.39
2. Total Installation Revenue	1.67	1.76	0.00	0.00	0.00
3. Total Meter Rent Revenue	2.99	4.93	6.98	6.98	6.98
TOTAL REVENUE	22.09	36.35	63.14	62.37	62.37
Non-Domestic					
1. Total Water Revenue	76.05	140.48	305.62	347.44	347.44
2. Total Installation Revenue	0.49	0.52	0.00	0.00	0.00
3. Total Meter Rent Revenue	0.26	0.43	0.62	0.62	0.62
TOTAL REVENUE	76.80	141.43	306.24	348.06	348.06
GRAND TOTAL	98.89	177.78	369.38	410.43	410.43

(2) Costs for Proposed Projects

Financial costs of the proposed projects consist of Initial investment cost, replacement cost, and operation and maintenance (O&M) cost.

Initial investment costs at the price level of 2007 are composed of construction costs, administration cost, engineering cost, physical contingency, and price contingency. Price contingency is calculated until 2025, nevertheless, not included in the financial analysis, because inflation is not considered for the financial revenue either. Construction costs cover mainly the expansion work and rehabilitation work for the existing facilities. Construction costs after the year 2012 are expended for the construction of distribution pipe and house connection necessary for the priority projects. Construction costs also include the costs for water quality control system establishment, operation and maintenance improvement, and institutional/organizational improvement. Replacement costs cover replacement of machinery and equipment for expanded facilities of the proposed project. O&M costs consist of electricity cost, chemical cost, personnel cost, maintenance cost and administration cost. Each item of O&M cost covers only for the expanded facilities, since financial revenue is also limited to incremental water supply generated by the priority projects. Estimation of the costs for proposed water supply priority projects is described in Volume V Appendix F92 Economic and Financial Evaluation of Priority Projects for Water Supply.

(3) Financial Evaluation

Cost and benefit stream of proposed water supply projects during the evaluation period is shown in the Table 92.12. In case without unit price increase of water supply in constant price, financial internal rate of return (FIRR) is calculated at 1.99%. NPV is minus 1,449 million Rupees. Benefit cost ratio is 0.724. As a result, proposed water supply priority projects are not financially feasible without tariff raise more than inflation adjustment.

(4) Case Study of Financial Analysis

Based on the existing unit price of water charge, proposed priority projects for water supply are not financially feasible. Four tariff increase patterns are considered to calculate feasibility of proposed projects under the condition that tariff increase is conducted regularly until year 2025, same as the financial analysis of M/P for water supply. It should be noted that percentage of tariff increase in each case shows real term (constant price), excluding inflation rate.

On the other hands, annual tariff increase rate for non-domestic user is always set lower than that of domestic, in order to eliminate the large unit price gap between non-domestic and domestic to reduce the risk of cross subsidy by non-domestic tariff revenue.

Table 92.12 Cost and Benefit Stream of Proposed Water Supply Project

(Unit: Rs.in million)

Year	Cost				Benefit			Balance
	Const- ruction	O&M	Replace- ment	Total	Domestic	Non- domestic	Total	
-5 2007	6.20	0.00		6.20	0.00	0.00	0.00	-6.20
-4 2008	87.09	0.00		87.09	0.00	0.00	0.00	-87.09
-3 2009	156.41	0.00		156.41	0.00	0.00	0.00	-156.41
-2 2010	909.12	0.00		909.12	0.00	0.00	0.00	-909.12
-1 2011	2,288.84	0.00		2,288.84	8.74	2.09	10.83	-2,278.01
0 2012	1,107.73	0.00		1,107.73	22.09	76.80	98.89	-1,008.84
1 2013	49.01	101.86		150.87	26.66	96.45	123.11	-27.76
2 2014	50.00	104.14		154.14	31.41	117.99	149.40	-4.74
3 2015	50.99	106.50		157.49	36.35	141.43	177.78	20.29
4 2016	51.95	108.97		160.92	41.44	166.70	208.14	47.22
5 2017	53.01	111.55		164.56	46.73	194.38	241.11	76.55
6 2018	56.36	95.63		151.99	60.44	266.67	327.11	175.12
7 2019	58.98	97.70		156.68	63.21	298.17	361.38	204.70
8 2020	60.14	99.89		160.03	63.14	306.24	369.38	209.35
9 2021	61.16	102.16		163.32	63.05	314.47	377.52	214.20
10 2022	62.32	104.54		166.86	62.87	322.44	385.31	218.45
11 2023		107.02		107.02	62.74	330.97	393.71	286.69
12 2024		109.60		109.60	62.61	339.66	402.27	292.67
13 2025		112.33		112.33	62.37	348.06	410.43	298.10
14 2026		112.33	73.81	186.14	62.37	348.06	410.43	224.29
15 2027		112.33	184.51	296.84	62.37	348.06	410.43	113.59
16 2028		112.33	110.70	223.03	62.37	348.06	410.43	187.40
17 2029		112.33		112.33	62.37	348.06	410.43	298.10
18 2030		112.33		112.33	62.37	348.06	410.43	298.10
19 2031		112.33		112.33	62.37	348.06	410.43	298.10
20 2032		112.33		112.33	62.37	348.06	410.43	298.10
21 2033		112.33		112.33	62.37	348.06	410.43	298.10
22 2034		112.33		112.33	62.37	348.06	410.43	298.10
23 2035		112.33		112.33	62.37	348.06	410.43	298.10
24 2036		112.33		112.33	62.37	348.06	410.43	298.10
25 2037		112.33		112.33	62.37	348.06	410.43	298.10
26 2038		112.33		112.33	62.37	348.06	410.43	298.10
27 2039		112.33		112.33	62.37	348.06	410.43	298.10
28 2040		112.33		112.33	62.37	348.06	410.43	298.10
29 2041		112.33	73.81	186.14	62.37	348.06	410.43	224.29
30 2042		112.33	184.51	296.84	62.37	348.06	410.43	113.59

FIRR: 1.99%

NPV: -1,449 million Rs.

B/C: 0.724

Table 92.13 Results of Financial Evaluation for 4 Cases

Case	Tariff increase per annum *1		FIRR	NPV(Million Rs.)	B/C
Case 1	Domestic	0 %	1.99%	-1,449	0.724
	Non-domestic	0 %			
Case 2	Domestic	3.00%	4.50%	-350	0.933
	Non-domestic	1.50%			
Case 3	Domestic	3.50%	5.20%	26	1.005
	Non-domestic	2.00%			
Case 4	Domestic	4.00%	5.88%	427	1.081
	Non-domestic	2.50%			

Note: *1; Rate of tariff increase excludes the inflation adjustment.

From the above table, the project is feasible under the conditions of Case 3 and Case 4, since the FIRR exceeds the discount rate at 5.15% (3.1% risk free rate plus 2.05% risk premium rate). If PHE can realize the tariff increase in the Case 3 continuously until 2025, proposed priority projects for water supply are said to be feasible.

Per capita Net State Domestic Products (NSDP) was estimated to have been grown at approximately 6% without inflation rate for the last 20 years, as was described in the Volume II Chapter 10 Economic and Financial Evaluation. It is assumed in the master plan that household income would be growing at 3% per annum at constant price for the next 20 years, which is half of the past trend of per capita NSDP growth rate. Under the assumptions that household income will be grown at 3% annually and that water charge will be raised 4% every year, percentage of monthly water charge for 20m³ in average household income was estimated to 2.25% in the year 2025 as was explained in master plan. This is lower than the percentage of WTP in household income (2.48%), and much lower than the affordability to pay ceilings estimated by international organization (3.5% or 4.0%).

The annual 3.5% water charge increase until 2025, which is less than the above condition, is under the WTP and ATP of customers with the assumption of household income growth at 3% per annum. Therefore, proposed priority projects for water supply will be financially feasible. It should be noted that continuous 3.5% water charge increase plus inflation rate is possible but not easy for PHE to obtain the understanding of the customers. PHE should make more effort to make efficient the operation and maintenance and to improve the service quality for customers continuously. Furthermore, minimum water consumption volume of low income group should be carefully investigated, as was explained in the master plan.

(5) Sensitivity Analysis

Sensitivity analysis is conducted in the same method as was conducted in the economic evaluation. Case 3, with the tariff raise in 3.50% for domestic and 2.00% for non-domestic, are set as the base for sensitivity analysis. In evaluation of the priority project, the construction costs, and the revenues are selected as key parameters. The analysis is conducted for the variation of the costs and revenues changes in plus minus 5% and plus minus 10%, respectively. The results of 25 cases are shown in Table 92.14 and Figure 92.3.

Table 92.14 Sensitivity Analysis of FIRR of Priority Projects for Water Supply

%		Benefit				
		-10%	-5%	0%	5%	10%
Cost	-10%	5.20%	5.71%	6.20%	6.66%	7.12%
	-5%	4.69%	5.20%	5.68%	6.14%	6.59%
	0%	4.21%	4.71%	5.20%	5.66%	6.10%
	5%	3.76%	4.26%	4.74%	5.20%	5.64%
	10%	3.33%	3.83%	4.30%	4.76%	5.20%

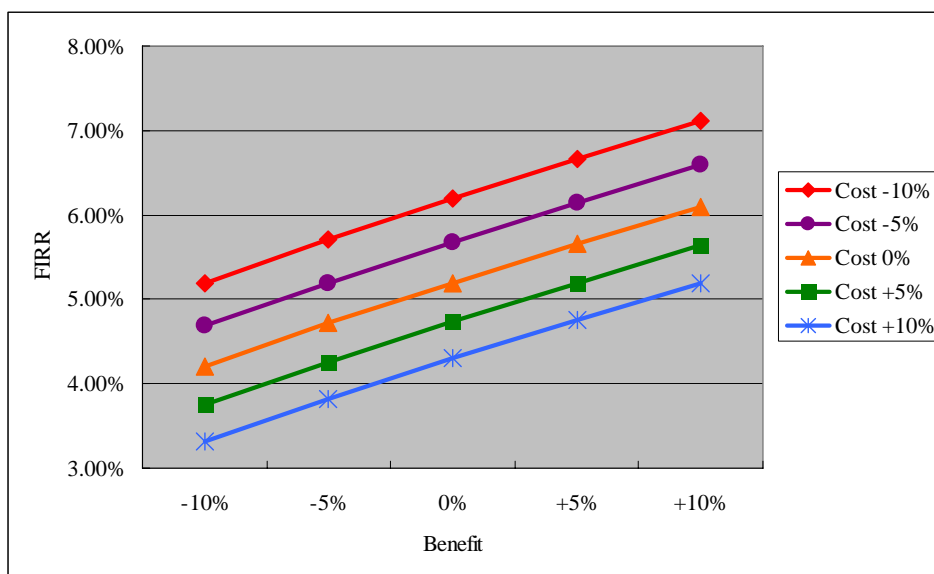


Figure 92.3 Sensitivity Analysis of FIRR of Priority Projects for Water Supply

Shaded areas in Table 92.14 are the combinations of cost and benefit changes that make the priority projects not to be financially feasible with the FIRR less than discount rate at 5.15%. Basically, when the costs increase, benefits must be raised at the same percentage of cost increase in order to secure the projects feasibility. On the other hands, by reducing the total costs of projects including O&M costs, PHE is able to restrain the increase of the benefit, in other words, necessary tariff revenues.

(6) Conclusion

Proposed priority projects for water supply are financially feasible with the condition that 3.50% and 2.00% tariff raises, without inflation adjustment, are conducted every year until 2025.

For the reference, 4.00% and 2.50% annual tariff increase at constant price for each domestic and non-domestic are required to secure the full cost recovery for water supply services covering the existing and expanded facilities by water supply master plan. For securing the cost recovery only for operation and maintenance costs excluding depreciation costs and interest expenses, it is necessary for PHE to raise the tariff at 3.00% and 2.00% annually at constant price for each domestic and non-domestic. Those analyses are described in detail in the Volume II Chapter 10 Section 4 Financial plan of PHE with the Master Plan for Water Supply and Sanitation.

In the year 2025, water charge for 20m³ of water consumption applying the tariff raise at 4.00% is estimated below the WTP and ATP of customer, in case the household income is grown at 3% per annum at constant price, which is the half of the actual growth rate of Net State Domestic Products at constant price for the last 20 years in Goa State.

Sensitivity analysis indicated that benefits, or tariff revenues, must be raised at the same percentage of cost increase in order to secure the projects feasibility, in case of the cost increase.

9.3 Economic and Financial Evaluation of Priority Projects for Sewerage

9.3.1 Economic Evaluation of Priority Projects for Sewerage

(1) Economic Benefits of Proposed Projects

Sanitation project has the many tangible and intangible economic benefits. All the tangible and intangible benefits are expressed in the Volume II Chapter 10 Section 3 Economic and Financial Evaluation of Master Plan for Sanitation. The following table shows the tangible benefits of the sewerage priority projects.

Table 93.1 Tangible Economic Benefits of the Sewerage Priority Projects

1	Cost reduction effects	1-1	Saving cost for alternative sanitation facilities for present and future sewage flow over existing capacity
2	Environment preservation effects	2-1	Preservation of water environment expressed by willingness to pay of tourists

Economic benefits of the priority projects are calculated by subtracting tangible benefit without project case from the total tangible benefit with the project case. Figure 93.1 shows additional benefits in terms of sewage flow per day, which are calculated by summing up the excess sewage flows of all the priority project areas, North Coastal area, Mapusa, and Margao. Excess sewage flow of Margao is computed by subtracting the existing treatment capacity from the future sewage flow prediction of the project area. Shaded area of the Figure 93.1 delineates the additional benefit of priority projects in terms of sewage flow, since sewage treatment capacity expansions in the priority projects always cover the sewage flow of orange dot line by the year 2021. This additional benefit in terms of sewage flow is utilized for calculating economic and financial benefits of the priority projects.

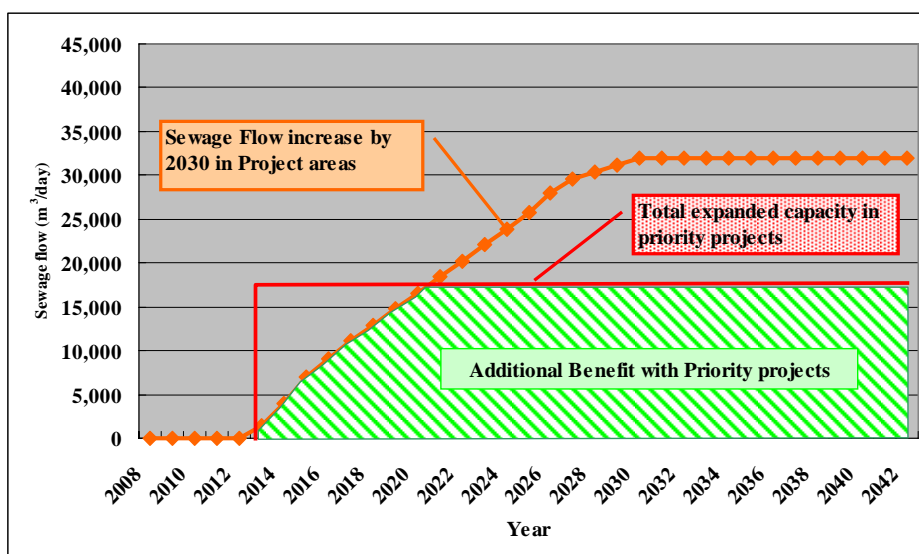


Figure 93.1 Benefits of Priority Projects for Sewerage

1) Estimation of economic benefit by cost reduction effects

(a) Saving cost for alternative sanitation facilities: Domestic user

Assumed without project case, public sewerage system in Margao will not be able to cover the excess sewage flow over the existing treatment capacity in the future. Also in the other project areas at Mapsa and North Coastal areas, present and future sewage flow must be treated by private sanitation system, since there are no public sewer systems presently.

In other words, alternative sanitation cost shall be saved by incremental sewage volume treated by priority projects. The amount of saved cost is one of the economic benefits of the sewerage projects. Unit cost and usage of each alternative sanitation method were estimated in master plan. Economic benefit of each year shall be calculated by multiplying the 'Unit Cost for Sanitation' to each percentage of treated sewage flow of priority projects.

Table 93.2 Unit Cost and Composition for Alternative Sanitation Methods

Type of Water Supply	Unit Cost for Sanitation (Rs./m ³)	% of each alternative sanitation method
Simple Pit Latrine	5.9	10.0%
Pour-Flush Latrine without Septic Tank	6.1	8.9%
Double Pit Pour-Flush Latrine	8.3	21.1%
Septic Tank connected to Soak Pit	17.9	60.0%

(b) Saving cost for alternative sanitation facilities: Non-domestic user

For simplification, non-domestic users are assumed to utilize Septic Tank connected to Soak Pit, in order to cover their sewage, without the project case in this analysis. Annual unit cost for sanitation for non-domestic is estimated in master plan and shown in Table 93.3.

Table 93.3 Unit Cost for Alternative Sanitation for Non-Domestic

Type of Water Supply	Unit Cost for Sanitation (Rs./m ³)
Septic Tank connected to Soak Pit	17.9

2) Estimation of economic benefit by environment preservation effects

(a) Preservation of water environment expressed by willingness to pay of tourists

Without the project case, sewage flow over the existing sewerage treatment capacity will be received by on-site sanitation methods. With the project case, the sewage flow will be treated by sewage treatment plant and treated water will be discharged into the river and sea.

Therefore, with the project case, water environment, including river and sea, shall be preserved in better condition regarding water quality and odor, comparing to without project case. In this analysis, contingent valuation method is introduced to calculate the benefit of water environment preservation. Stakeholder Interview for Tourists in the Public Awareness Survey by JICA Study Team obtained the result of the willingness to pay (WTP) of the tourists regarding the following question;

Increasing Wastewater and Need for Sewerage

Following the future increase of water demand due to the development of tourism, the amount of water supply is planned to be increased in Goa. The more water is supplied, the more wastewater will be generated which may cause in water pollution of rivers and beaches. Therefore, sewerage projects are also being planned to reduce the pollution of rivers and seaside for tourism as well as to avoid any waterborne diseases. However, the construction and maintenance of sewerage facilities will require large amount of money.

Question: How much are you willing to pay per day as your contribution (tourist tax) to the cost of running sewerage facilities which will keep the value of tourism in Goa by preserving the water and ecosystem in rivers and costal areas?

Based on the data of Stakeholder interview and the “Tourist Statistics 2004”, Department of Tourism, the annual average amount of WTP per tourist is estimated in the master plan as follows;

Domestic Tourist: 90 Rs./year (18 Rs./day)
 Foreign Tourist: 2,160 Rs./year (240 Rs./day)

For the modest estimation of the economic benefit, 50% of the above amounts of WTP were used for the calculation of the economic benefit.

Number of tourists who stay in the project area and amount of accrued economic benefit are briefly shown in the Table 93.4. Detailed data for the whole evaluation period is included in the Volume V Appendix F93 Economic and Financial Evaluation of Priority Projects for Sewerage.

Table 93.4 Number of Tourists Staying in the Sewerage Priority Project Areas and Amount of Economic Benefit

		Unit	2013	2014	2015	2020	2021
Total number of staying tourists	Domestic	persons × 1,000	224	235	245	303	315
	Foreign		93	96	100	114	117
Total benefit of tourists expressed by WTP	Domestic	Rs.×1,000	10,080	10,575	11,025	13,635	14,175
	Foreign		100,440	103,680	108,000	123,120	126,360

Number of tourists who visit Calangute (North Coastal Area) but not staying there should also

be included in the number of beneficiaries as one day tourist, in addition to the tourists staying in the project areas. In this analysis, it can be assumed that 10% of total numbers of tourists who stay in Bardez taluka go to Calangute & Candolim and 6% of total number of tourists who stay in Bardez taluka go to Calangute beach for one day trip. This is not overestimation, since Tiswadi taluka and Mormugao taluka are located within the day trip distance for Calangute beach, they are not included in the number of day trip tourists for Calangute for the modest estimation. Results and calculation of the economic benefit for day trip tourists are shown in Table 93.5 for several years. Volume V Appendix F93 Economic and Financial Evaluation of Priority Projects for Sewerage includes the data whole through the evaluation period.

Table 93.5 Number of Tourists to Bardez Taluka and Amount of Economic Benefit derived from Day Trip Tourists

(Unit: ×1,000)

Year	Domestic	Foreign	Total	Bardez		Benefit of water environment preservation of the day trip tourists (Rs.×1,000)		
				Domestic	Foreign	Domestic	Foreign	Total
2013	2,038	472	2,510	424	180	229	1,296	1,525
2014	2,127	487	2,614	442	186	239	1,339	1,578
2015	2,219	502	2,721	462	192	249	1,382	1,631
2020	2,742	576	3,318	570	220	308	1,584	1,892
2021	2,860	591	3,451	595	226	321	1,627	1,948

Priority projects will treat the excess sewage flow until 2021, therefore, the amounts of the benefits increase until 2021 and are stable after 2021 regarding economic benefit by environment preservation effects.

Total amount of economic benefit accrued from sewerage priority projects during the evaluation period is shown in the Table 93.6.

Table 93.6 Economic Benefit Stream of Proposed Sewerage Projects

Year	Sewage volume to be treated by Priority Projects (m ³ /day)			Benefit (Rs.1,000)						Grand Total
				Saving of alternative sanitation cost			Benefit of water environment preservation (WTP of Tourist)			
	Domestic	Non-domestic	Total	Domestic	Non-domestic	Total	Domestic	Foreign	Total	
-5 2007	0	0	0	0	0	0	0	0	0	0
-4 2008	0	0	0	0	0	0	0	0	0	0
-3 2009	0	0	0	0	0	0	0	0	0	0
-2 2010	0	0	0	0	0	0	0	0	0	0
-1 2011	0	0	0	0	0	0	0	0	0	0
0 2012	0	0	0	0	0	0	0	0	0	0
1 2013	1,195	244	1,439	5,943	1,594	7,537	10,309	101,736	112,045	119,582
2 2014	3,354	697	4,051	16,679	4,554	21,233	10,814	105,019	115,833	137,066
3 2015	5,760	1,222	6,982	28,644	7,984	36,628	11,274	109,382	120,656	157,284
4 2016	7,474	1,625	9,099	37,167	10,617	47,784	11,735	111,578	123,313	171,097
5 2017	9,082	2,016	11,098	45,163	13,172	58,335	12,286	115,942	128,228	186,563
6 2018	10,530	2,388	12,918	52,364	15,602	67,966	13,333	119,225	132,558	200,524
7 2019	11,971	2,770	14,741	59,530	18,098	77,628	13,345	121,421	134,766	212,394
8 2020	13,401	3,166	16,567	66,641	20,685	87,326	13,943	124,704	138,647	225,973
9 2021	14,247	3,453	17,700	70,848	22,560	93,408	14,496	127,987	142,483	235,891
10 2022	14,181	3,519	17,700	70,520	22,991	93,511	14,496	127,987	142,483	235,994
11 2023	14,117	3,583	17,700	70,201	23,410	93,611	14,496	127,987	142,483	236,094
12 2024	14,057	3,643	17,700	69,903	23,802	93,705	14,496	127,987	142,483	236,188
13 2025	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
14 2026	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
15 2027	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
16 2028	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
17 2029	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
18 2030	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
19 2031	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
20 2032	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
21 2033	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
22 2034	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
23 2035	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
24 2036	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
25 2037	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
26 2038	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
27 2039	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
28 2040	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
29 2041	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278
30 2042	13,999	3,701	17,700	69,615	24,180	93,795	14,496	127,987	142,483	236,278

(2) Economic Costs of Proposed Projects

Construction costs include all of the expansion work in priority projects. Major parts of the financial and economic costs are listed in the Table 93.7. Methodology for conversion from financial cost to economic cost is mentioned in 9.1 Methodology of Economic and Financial Evaluation. Annual disbursement is included in the Volume V Appendix F93 Economic and Financial Evaluation of Priority Projects for Sewerage.

Total economic costs of the project is Rs.1,093.46 million. Future mechanical and electrical equipment replacement costs of expanded facilities are also considered as one of the necessary costs, and are included in the Cost Benefit Stream for the calculation of EIRR (refer to the Table 93.8).

Table 93.7 Economic and Financial Costs of Proposed Sewerage Project

(Unit: In million)

Item	Financial Cost		Economic Cost	
	Rs.	US\$	Rs.	US\$
1. Construction cost	909.43	20.10	851.94	18.83
2. Engineering cost	108.62	2.40	107.55	2.38
3. Administration cost	50.89	1.12	38.02	0.84
4. Land acquisition cost	18.20	0.40	18.20	0.40
5. Physical contingency	103.64	2.29	95.95	2.12
TOTAL	1,190.78	26.32	1,111.66	24.57

Note; Price contingency is excluded for financial analysis, since the inflation is not considered in financial benefit, either.

Exchange rate between Rupee per US Dollar is Rs. 45.24/US\$.

(3) Economic Evaluation

Economic cost and benefit stream during evaluation period is shown in the Table 93.8. As a result of the economic analysis of the sewerage priority projects, EIRR is calculated as 12.7%, NPV as Rs.47 million, and B/C as 1.06. Comparing the opportunity cost of capital, 12%, EIRR is over the figure, therefore, sewerage priority projects are said to be economically viable. Also under the discounted rate of 12%, the project obtained the positive Net Present Value of Rs.47 million, and present value of Benefit is 1.06 times larger than the present value of Cost.

Table 93.8 Cost and Benefit Stream of Proposed Sewerage Project

(Unit: Rs. In million)

Year	Cost				Benefit	Balance	
	Const- ruction	O&M	Replac- ment	Total	Total		
-5	2007	5.77	0.00		5.77	0.00	-5.77
-4	2008	37.43	0.00		37.43	0.00	-37.43
-3	2009	59.98	0.00		59.98	0.00	-59.98
-2	2010	299.56	0.00		299.56	0.00	-299.56
-1	2011	360.83	0.00		360.83	0.00	-360.83
0	2012	348.09	0.00		348.09	0.00	-348.09
1	2013		16.51		16.51	119.58	103.07
2	2014		18.91		18.91	137.07	118.16
3	2015		20.01		20.01	157.28	137.27
4	2016		20.57		20.57	171.10	150.53
5	2017		20.90		20.90	186.56	165.66
6	2018		21.25		21.25	200.52	179.27
7	2019		21.59		21.59	212.39	190.80
8	2020		21.93		21.93	225.97	204.04
9	2021		22.29		22.29	235.89	213.60
10	2022		22.59		22.59	235.99	213.40
11	2023		22.78		22.78	236.09	213.31
12	2024		22.90		22.90	236.19	213.29
13	2025		23.02		23.02	236.28	213.26
14	2026		23.13		23.13	236.28	213.15
15	2027		23.18	78.66	101.84	236.28	134.44
16	2028		23.19		23.19	236.28	213.09
17	2029		23.20		23.20	236.28	213.08
18	2030		23.20		23.20	236.28	213.08
19	2031		23.20		23.20	236.28	213.08
20	2032		23.20		23.20	236.28	213.08
21	2033		23.20		23.20	236.28	213.08
22	2034		23.20		23.20	236.28	213.08
23	2035		23.20		23.20	236.28	213.08
24	2036		23.20		23.20	236.28	213.08
25	2037		23.20		23.20	236.28	213.08
26	2038		23.20		23.20	236.28	213.08
27	2039		23.20		23.20	236.28	213.08
28	2040		23.20		23.20	236.28	213.08
29	2041		23.20		23.20	236.28	213.08
30	2042		23.20	78.66	101.86	236.28	134.42

EIRR: 12.7% NPV: 47 million Rs. B/C: 1.06

(4) Sensitivity Analysis

Sensitivity analysis is also applied to the economic evaluation of the sewerage priority projects utilizing the same method as for water supply priority projects. In evaluation of the priority projects, the construction costs, and the economic benefits are selected as key parameters. The analysis is conducted for the variation of construction costs and economic benefits changes within the ranges of plus minus 10%, respectively. The results of 25 cases are shown in Table 93.9 and Figure 93.2.

Table 93.9 Sensitivity Analysis of EIRR of Priority Projects for Sewerage

%		Benefit				
		-10%	-5%	0%	5%	10%
Cost	-10%	12.74%	13.40%	14.05%	14.68%	15.29%
	-5%	12.09%	12.74%	13.37%	13.98%	14.58%
	0%	11.48%	12.12%	12.74%	13.34%	13.92%
	5%	10.92%	11.55%	12.15%	12.74%	13.31%
	10%	10.39%	11.01%	11.60%	12.18%	12.74%

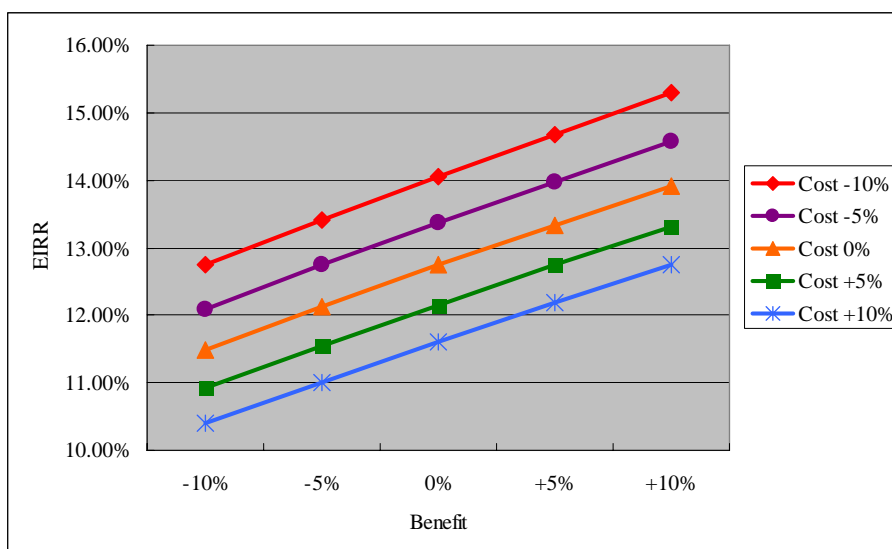


Figure 93.2 Sensitivity Analysis of EIRR of Priority Projects for Sewerage

Shaded areas in Table 93.9 are the combinations of cost and benefit changes that make the priority projects not to be economically viable with the EIRR less than opportunity cost of capital at 12%. It must be careful that the projects may become economically inviable if the project costs increase nearly equal or greater than 10% without benefits increase.

9.3.2 Financial Evaluation of Priority Projects for Sewerage

(1) Revenue from Proposed Projects

Tariff revenue of the customer is composed of sewerage charge and installation charge. Sewerage charge is billed at 25% of the water consumption charge. Therefore, the sewerage charge of the proposed projects is calculated based on the water consumption volume of the sewerage customers. In the sewerage planning, sewerage flow volume is assumed as 80% of the water consumption volume in the priority project areas. In other words, total water consumption volume for sewerage customers is calculated at 125% of the estimated total sewerage flow volume in priority project areas. Regarding sewerage charge, distinct unit prices are set for domestic and non-domestic, to computerizing total charge billed. For domestic users, unit price of sewerage charge is calculated at Rs.1.12/m³ for unit water consumption volume. For non-domestic users, unit price of sewerage charge is calculated at Rs.6.85/m³ for unit water consumption volume. Unit prices for installation charge for each domestic and non-domestic are Rs.215/case and Rs.520/case, respectively. These unit prices are the same as those of financial evaluation in the master plan. The total financial benefit and breakdown of the sewerage priority projects are included in the Volume V Appendix F93 Economic and Financial Evaluation of Priority Projects for Sewerage for each year through the evaluation period. Table 93.10 is the digest of the total financial benefit from the priority projects for sewerage.

Table 93.10 Total Financial Benefit from the Priority Projects for Sewerage

(Unit: Rs. In million)

Item	2012	2015	2020	2025	After 2025
Domestic					
1. Total Sewerage Revenue	0.00	2.84	6.64	6.97	6.97
2. Total Installation Revenue	0.13	0.60	0.42	0.00	0.00
TOTAL REVENUE	0.13	3.44	7.06	6.97	6.97
Non-Domestic					
1. Total Sewerage Revenue	0.00	3.68	9.59	11.27	11.27
2. Total Installation Revenue	0.02	0.08	0.05	0.00	0.00
TOTAL REVENUE	0.02	3.76	9.64	11.27	11.27
GRAND TOTAL	0.15	7.20	16.70	18.23	18.23

(2) Costs for Proposed Projects

Financial costs of the proposed projects consist of Initial investment costs, replacement costs, and operation and maintenance (O&M) costs.

Initial investment costs at the price level of 2007 are composed of construction costs, administration cost, engineering cost, physical contingency, and price contingency. Price

contingency is calculated until 2025, nevertheless, not included in the financial analysis, because inflation is not considered in the financial revenue either. Construction costs cover mainly the expansion work. Construction costs also include the cost for operation and maintenance improvement, and institutional/organizational improvement. Replacement costs cover replacement of machinery and equipment for expanded facilities of the proposed projects. O&M costs consist of electricity cost, chemical cost, personnel cost, maintenance cost, sewer cleaning cost, and administration cost. Each item of O&M costs covers only for the expanded facilities, since financial revenue does not include the revenue from existing facilities either. Estimation of the costs for proposed sewerage priority projects are described in the Volume V Appendix F93 Economic and Financial Evaluation of Priority Projects for Sewerage.

(3) Financial Evaluation

Cost and benefit stream of proposed sewerage projects during the evaluation period is shown in the Table 93.11. In case without unit sewerage price increase more than inflation adjustment, financial internal rate of return (FIRR) is not obtained, since project benefits are much smaller than project costs. NPV is minus 1,075 million Rupees. Benefit cost ratio is 0.13. As a result, proposed sewerage projects are not financially feasible without adequate tariff increase or input of Government subsidy.

In the Volume II Chapter 10 Section 4 Financial plan of PHE with the Master Plan for Water Supply and Sanitation, financial plan for PHE was presented including every revenues and costs of water supply and sewerage services. Financial plan was prepared under the condition to aim the cost recovery for operation and maintenance (including personnel & administration cost) in the long run, as it was recommended in the Chapter 8 Section 5 Improvement of Financial Management and Control in Volume II Main Report: Master Plan. Necessary amounts of sewerage tariff increase were calculated at 7.5% for domestic and 6.0% for non-domestic in constant price, in order to recover the operation and maintenance cost.

For securing the sustainability of the proposed projects, it is necessary for State Government to provide the budget as subsidy for the sewerage priority projects as explained in the Chapter 10 Section 4 Financial plan of PHE with the Master Plan for Water Supply and Sanitation, Volume II Main Report: Master Plan. Required subsidy from State Government is estimated at around Rs.100 to 350 million by the year 2025 per annum. Around Rs.200 million is necessary after the year 2026 per annum. Subsidy (budget) provision from the State Government more than these amounts shall reduce the necessary tariff raise for sanitation and consolidate the management of sanitation service.

Table 93.11 Cost and Benefit Stream of Proposed Sewerage Project

(Unit: Rs. In million)

Year	Cost				Benefit			Balance
	Const- ruction	O&M	Replace- ment	Total	Domestic	Non- domestic	Total	
-5 2007	6.18	0.00		6.18	0.00	0.00	0.00	-6.18
-4 2008	39.22	0.00		39.22	0.00	0.00	0.00	-39.22
-3 2009	62.24	0.00		62.24	0.00	0.00	0.00	-62.24
-2 2010	321.86	0.00		321.86	0.04	0.01	0.05	-321.81
-1 2011	387.46	0.00		387.46	0.09	0.01	0.10	-387.36
0 2012	373.82	0.00		373.82	0.13	0.02	0.15	-373.67
1 2013		17.69		17.69	1.03	0.79	1.82	-15.87
2 2014		20.11		20.11	2.18	2.17	4.35	-15.76
3 2015		21.22		21.22	3.44	3.76	7.20	-14.02
4 2016		21.78		21.78	4.18	4.96	9.14	-12.64
5 2017		22.11		22.11	4.95	6.15	11.10	-11.01
6 2018		22.46		22.46	5.63	7.27	12.90	-9.56
7 2019		22.81		22.81	6.35	8.44	14.79	-8.02
8 2020		23.15		23.15	7.06	9.64	16.70	-6.45
9 2021		23.51		23.51	7.49	10.52	18.01	-5.50
10 2022		23.81		23.81	7.04	10.68	17.72	-6.09
11 2023		24.01		24.01	7.01	10.88	17.89	-6.12
12 2024		24.13		24.13	6.99	11.08	18.07	-6.06
13 2025		24.25		24.25	6.97	11.27	18.24	-6.01
14 2026		24.36		24.36	6.97	11.27	18.24	-6.12
15 2027		24.41	83.97	108.38	6.97	11.27	18.24	-90.14
16 2028		24.42		24.42	6.97	11.27	18.24	-6.18
17 2029		24.43		24.43	6.97	11.27	18.24	-6.19
18 2030		24.43		24.43	6.97	11.27	18.24	-6.19
19 2031		24.43		24.43	6.97	11.27	18.24	-6.19
20 2032		24.43		24.43	6.97	11.27	18.24	-6.19
21 2033		24.43		24.43	6.97	11.27	18.24	-6.19
22 2034		24.43		24.43	6.97	11.27	18.24	-6.19
23 2035		24.43		24.43	6.97	11.27	18.24	-6.19
24 2036		24.43		24.43	6.97	11.27	18.24	-6.19
25 2037		24.43		24.43	6.97	11.27	18.24	-6.19
26 2038		24.43		24.43	6.97	11.27	18.24	-6.19
27 2039		24.43		24.43	6.97	11.27	18.24	-6.19
28 2040		24.43		24.43	6.97	11.27	18.24	-6.19
29 2041		24.43		24.43	6.97	11.27	18.24	-6.19
30 2042		24.43	83.97	108.40	6.97	11.27	18.24	-90.16

FIRR: N.A.

NPV: -1,075 million Rs.

B/C: 0.13

(4) Sensitivity Analysis

Sensitivity analysis is also applied to the financial evaluation of the sewerage priority projects with the same method as for water supply priority projects. In evaluation of the priority projects, the construction costs, and the revenues are selected as key parameters. The analysis is conducted for the variation of construction costs and revenues changes within the ranges of plus minus 10%, respectively.

In any 25 cases, FIRR are not calculated since the benefits accrued from sewerage tariff are much smaller than the costs. Priority projects for sewerage is financially not feasible, even under the condition of 10% benefit increase with the 10% cost reduction. Subsidy provision is indispensable for sewerage projects by State Government so as to keep the sustainability of the proposed projects.

(5) Conclusion

Priority projects for sewerage are not financially feasible in the aspect of negative FIRR. Sensitivity analysis also indicated that cost and benefit fluctuations within the range of plus minus 10% does not make any changes to the feasibility.

Generally, it is not easy to recover the full costs of sewerage project including capital expenditure, since sewerage charge is usually not high enough to recover the full cost. On the other hands, benefits of sewerage are not limited to the users. Eliminating water pollution significantly improves sanitary conditions in urban areas in the region and, if including the sewage treatment, downstream basin will benefit in many ways in improved sanitation and enhanced tourism and fishery. Following the above consideration, it is recommended for sanitation services to aim the cost recovery for operation and maintenance in the long run and provision of public fund as subsidy.

Financial plan was compiled regarding sanitation service of PHE covering all the existing and expansion facilities with sanitation master plan, as shown in Chapter 10 Section 4 Financial plan of PHE with the Master Plan for Water Supply and Sanitation, Volume II Main Report: Master Plan. Annual tariff raise until 2025 was calculated at 7.5% for domestic and 6.0% for non-domestic at constant price to secure the cost recovery of the operation and maintenance costs excluding depreciation costs and interest expenses.

Sewerage tariff raise at 7.5% per annum at constant price will reach at 1.03% for sewerage charge in average household income in 2025 under the assumption of 3% annual growth of

average household income at constant price. The percentage is less than the ceiling of ATP at 1.5%, estimated by Pan American Health Organization, and also less than WTP for sanitation in average household income at 1.29%.

Required subsidy from State Government is estimated by financial plan at around Rs.100 to 350 million by the year 2025 per annum. Around Rs.200 million is necessary after the year 2026 per annum.

Implementation of required tariff raise and input of estimated subsidy will secure the sustainability of sewerage priority projects.

CHAPTER 10

**SOCIAL CONSIDERATIONS AND
ENVIRONMENTAL IMPACT ASSESSMENT**

CHAPTER 10 SOCIAL CONSIDERATIONS AND ENVIRONMENTAL IMPACT ASSESSMENT

10.1 Background

10.1.1 General Purpose of the EIA Study

The purpose of performing the Rapid Environmental Impact Assessment (Rapid-EIA) for the *Study on Augmentation of Water Supply and Sanitation for the Goa State* is to identify various environmental factors affected by priority projects implementation for the Feasibility Study. The Rapid-EIA undertaken as part of the Goa Water Supply and Sewerage Projects considers the potential and predictable environmental and social impacts on the construction phase and operation & maintenance phase of the priority projects. Only the Rapid-EIA study of the priority projects was required for environmental clearance complying with the Guidelines for Environmental & Social Considerations for international donor agencies. In case of this priority projects, Public Works Department of Goa State is responsible proponent for carrying out the Rapid-EIA study.

10.1.2 Implementation of Rapid-EIA

In practice, Water Supply and Sewerage Projects are not included targeted sectors for EIA requirement in National level. However, environmental clearance is necessary in relation to any development projects within Goa State. Accordingly, the Rapid-EIA report must be submitted to the Impact Assessment Wing as soon as practicable to obtain the permission of environmental and social consideration clearance.

EIAs have been carried out since the late 1970s as a requirement of foreign donor agencies. The legal basis for EIA lies under the Notification under the Environment (Protection) Act, 1986, which requires certain projects to have environmental clearance from the Ministry of Environment and Forests. Each State Pollution Board implements the legislation, issues rules and regulations and sets emission standards. Direct responsibility for EIA lies with the “Impact Assessment Division” of the Ministry and its “Impact Assessment Wings” which are the Division’s decentralized authorities. The 1994 Notification on Environmental Impact Assessment gives mandatory status for the EIA of certain identified activities. The proponent of any development project is responsible itself for carrying out the EIA study. Screening of proposals is carried out by the relevant “Impact Assessment Wing” and may result in rapid EIA or full EIA. Scoping of the EIA study is carried out by the Environmental Appraisal Committee (sector-based) who also liaises with proponent and the Impact Assessment Wing.

Water Supply and Sewerage Projects are not included objected Sectors for EIA requirement in National level. That means full EIA study doesn't need for a clearance. The regional EIA law of Goa State has not been established yet. The results of the environmental scoping provided prior to the implementation of EIA shall be reviewed in accordance with the impacts items recommended to be studied for water supply and sewerage schemes. Figure 101.1 shows flowchart of EIA process in the overleaf.

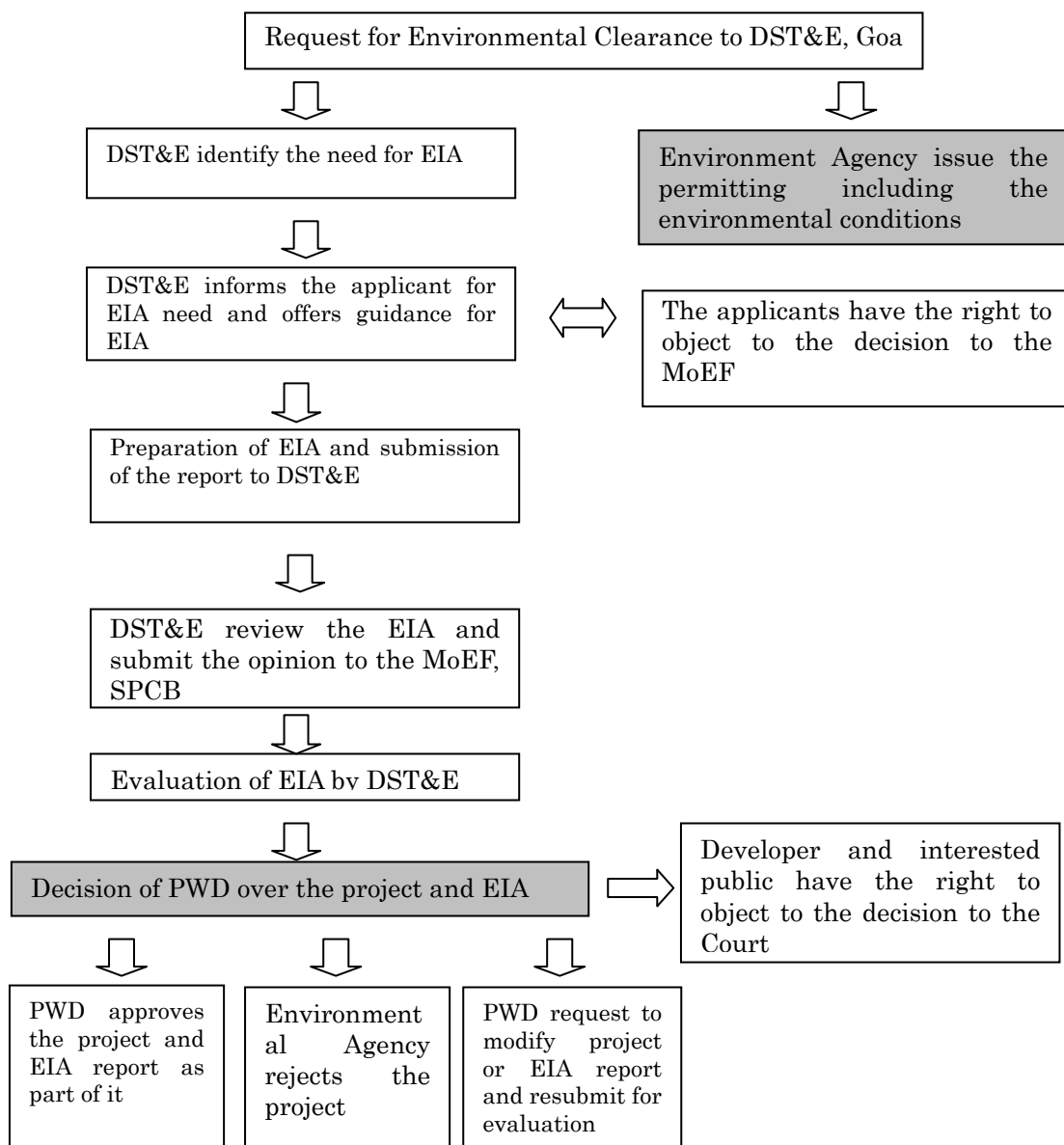


Figure 101.1 Flowchart of EIA Process

In conclusion, a rapid-EIA document prepared by the proponent (PWD) must submit to the DST&E without delay. The baseline survey for the rapid EIA was initiated at the same time as

the Feasibility Study. Relevant EIA staff in the PWD carried out the necessary consultations and meetings with the DST&E.

10.2 Public Consultation for the Implementation of Priority Projects

10.2.1 Public Participation/Awareness

The public participation has an important aspect of the EIA. The concerned persons were invited through press advertisement to review information and provide their views on the proposed development requiring environmental clearance.

The related law requires that the public must be informed and consulted on a proposed development. Anybody likely to be affected by the priority project is entitled to have access to the project information. The persons should be affected may include:

- Local / community residents;
- Local associations;
- Environmental groups: NGO's active in the area
- Any other person located at the project site

They are to be given an opportunity to make oral/written suggestions to the State Pollution Control Board as per Schedule IV of the EIA Notification.

10.2.2 Stakeholder Meetings held in the Early Study Stage

Stakeholder participation has been incorporated into this study from an early stage. The participation has focused on the consideration of a wide range of environmental and social impacts. It is important to consult with the stakeholders to generate support for the projects.

The 1st and the 2nd stakeholder meetings were held early stage of the Study. Active exchange of opinions could do with the meeting. Record of discussion and list of attendant for the 1st and the 2nd stakeholder meeting have been summarized in Volume II Chapter 11 Section 1 Public Consultation and related Appendix.

Figure 102.1 shows the continuous process of public consultation. The consultation has been carried out by the PWD in three stages inline with the three phases of the Study, in cooperation with the JICA Study Team. This figure was used at the first stakeholder meeting to explain the

public consultation approach that was being adopted. As shown in the figure, the consultation process started even before the Master Plan was developed and went through until the end of the whole Study.

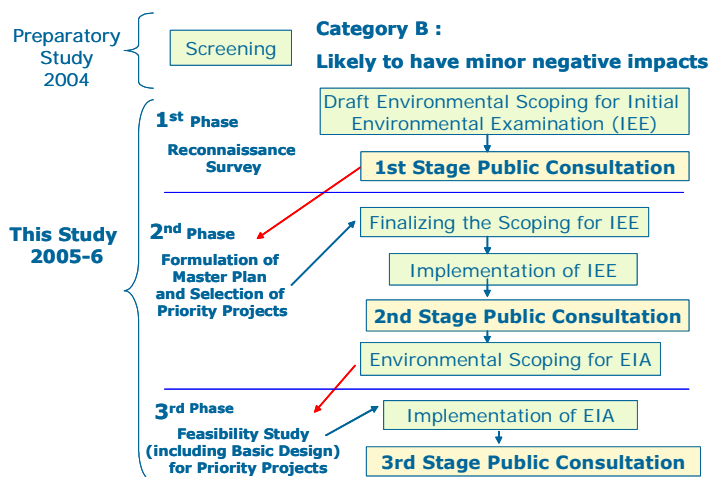


Figure 102.1 Process of Continuous Public Consultation

The results of the public awareness survey were presented in the Main Report: Master Plan, Chapter 3 and were referred to during the preparation of the master plan. Some of the main results were explained directly to the stakeholders during the second stakeholder meeting that was held on 23 December 2005. Also, some of the results from the stakeholder interviews with the residents living near the existing STPs were used to assess the potential negative impacts of the proposed sewerage projects as part of the IEE.

A discussion paper for the first stakeholder meeting was provided to the public by posting it on the notice boards in the PWD's head office and regional offices. The discussion paper is attached in Volume IV Appendix M111.1 Note of Discussion from and Attendance Sheet of the First Workshop and Stakeholder Meeting. Two local newspapers (Herald and Navhind Times) were requested to run advertisements to inform the public that the discussion paper was available on the notice boards of the PWD.

The second stakeholder meeting was held by the PWD in cooperation with the JICA Study Team on 23 December 2005. More than 100 stakeholders were invited and around half of the invitees attended (54 attendants / 107 invitees). A detailed list of the invitees and attendants, record of discussion is provided in Volume IV Appendix M111.2 Note of Discussion From and Attendance Sheet of the Second Stakeholder Meeting.

10.2.3 Description of the Third Stakeholder Meeting

The main component of the third stage of public consultation was a 3rd stakeholder meeting. The third stakeholder meeting was held by the PWD in cooperation with the JICA Study Team on 18 July 2006. Officially, 73 stakeholders were invited and more than 70% of the invitees attended (54 attendants / 73 invitees). Table 102.1 shows the numbers of invitees and attendants for each stakeholder group. This meeting was held after a summary of the discussions from the second stakeholder meeting has been provided to the public. The results of the Feasibility Study for the selected priority projects were explained to the stakeholders at this meeting. At this stage of public consultation, the stakeholders living just nearby the proposed STP sites that have been nominated as priority projects were consulted more intensively with regards to the environmental and social considerations.

Table 102.1 Number of Invitees and Attendants at the Third Stakeholder Meeting

Type of Stakeholder	Number of Invitees	Number of Attendants
MOUD	1	1
Goa Sate	5	1
PWD	14	22
JICA Study Team	5	5
Stakeholders living/working around the proposed sites for STPs, WTPs, etc.	9	12
Chairperson, Vice Chairperson, Councillor, Sarpanch, etc.	19	2
Journalists	4	2
NGO	3	2
College	4	2
Pvt. Engineer Consultant	2	1
Others (Port Trust and Military)	7	4
Total	73	54

Any significant results from the Rapid-EIA study were also presented to the stakeholders at this third meeting. These results could include the impact of the priority projects, analysis of alternative project options, recommended mitigation measures, and environmental monitoring programs. Figure 102.2 shows a flow chart of the Environmental Clearance procedure which has been explained in the third Stakeholder Meeting. Public consultation needs to be undertaken at the same time as executing the Rapid-EIA.

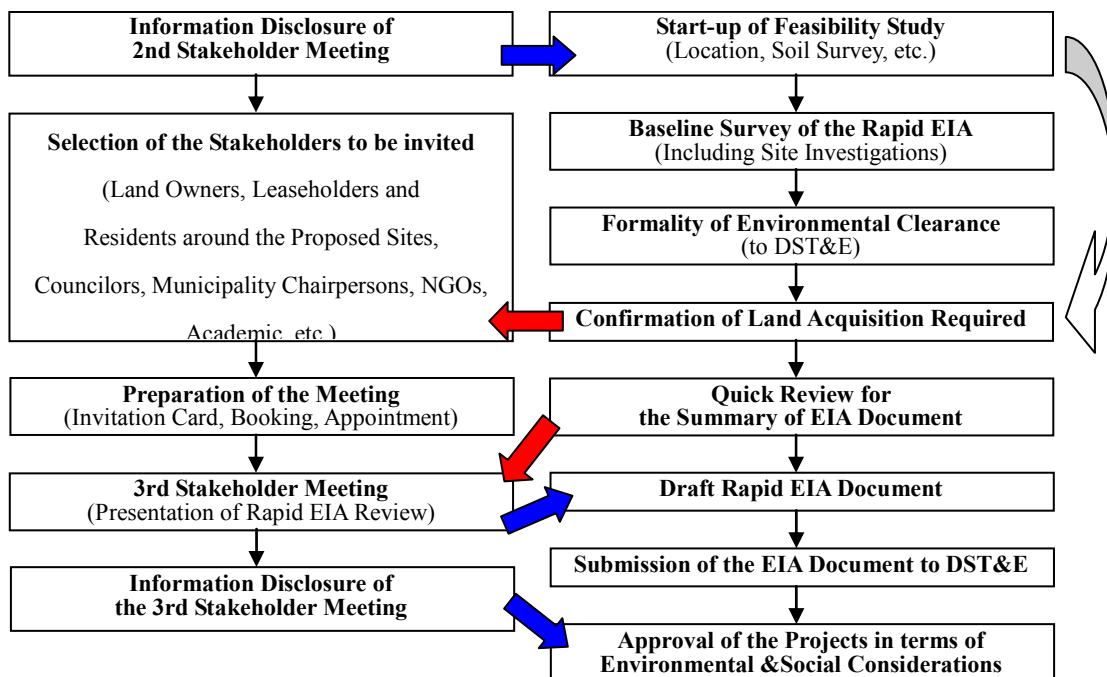


Figure 102.2 Flow Chart of the Third Stakeholder Meeting and the Environmental Clearance Process

The invitation card to the third stakeholder meeting was distributed by the PWD. These were accompanied by a brochure outlining the Feasibility Study and the environmental and social considerations (see Volume V Appendix F102.2 Brochure on the Feasibility Study and Environmental & Social Considerations). The brochure was prepared specially for the third stakeholder meeting by the PWD with support from the JICA Study Team. The invitation cards were directly distributed by hand to concerned stakeholders living/working around the proposed sites for the STPs, WTPs, etc. The locations of proposed sites and types of projects were briefly explained by the PWD staff to those representatives when the invitations were handed to them. Identification of these prominent stakeholders was based on recommendations made by local people. And PWD staff directly made contact with common local NGO groups to provide invitation for the meeting, too.

In the third stakeholder meeting, the following six presentations were given to the stakeholders by the PWD, with support from the JICA Study Team, before discussions were initiated.

Two Main Presentations:

- Outlines of the Study and Public Participation (Progress of Feasibility Study, a report of second stakeholder meeting)
- Explanation of the Priority Projects for Water Supply & Sewerage and the likely Environmental and Social Impacts
 - 1) Priority Projects for Water Supply Scheme
 - 2) Sewerage Scheme in the Feasibility Study
 - 3) Project Benefits and Likely Impacts as regard to Environmental & Social Considerations

Two Additional Presentations:

- Welcome speech by the Secretary, PWD
- NRW Reduction Pilot Project by PWD Goa

Although some of the presentations explained the potential environmental impacts of the proposed STPs and supplementary facilities. Rather, most of the topics raised were related to the current discontent of the public toward the PWD with regards to its water supply services and administrative issues. The need for the PWD to provide better daily customer services was highlighted in the discussion as well as second stakeholder meeting.

This stakeholder meeting was the last public consultation for this Study. However, a condition of funding from international financial institutions or international aid agencies were for the PWD to hold additional stakeholder meetings for public consultation during the next stage, at the same time as the consents for establishment/construction and operation of the facilities are obtained.

10.3 Environmental and Social Considerations

10.3.1 Basic Approaches

The JICA Study Team is assisting the PWD to consider the environmental and social aspects of this priority project. The role of the JICA Study Team is to:

- Assist the PWD implement the augmentation of the water supply and sewerage/sanitation systems smoothly, using finance from international donors. Preparing an Initial Environmental Evaluation (IEE) or Environmental Impact Assessment (EIA) is a condition of international funding.
- Prepare an effective selected priority projects which are not cause significant negative environmental or social impacts.
- Assist the PWD to consult with stakeholders when preparing the master plan and Feasibility Study to generate support for the projects.

The Study Team assisted the PWD to prepare the Rapid-EIA for the priority projects. The Rapid -EIA report was prepared in accordance with JICA's Environmental and Social Consideration Guidelines.

During the Reconnaissance Survey, the Study Team, in conjunction with the PWD, prepared the draft environmental scoping and draft TOR for the IEE. When preparing the Master Plan, the Study Team assisted the PWD with the finalization of the TOR and its implementation. The Study Team had also been assisting the PWD with public consultation. This had included informing the public of the Master Plan, possible issues, and impacts at the proposed projects. During the Feasibility Study, the Study Team also assisted the PWD undertake the locally required environmental clearance procedure for the priority projects. The environmental clearance documents have to be prepared in consultation with the local government department responsible for reviewing and assessing Rapid-EIA.

10.3.2 JICA Environmental and Social Consideration Guidelines

The Preparatory Study (which was conducted by JICA in 2004) concluded that this study requires considerations of environmental and social assessment. This categorization is in accordance with JICA's Environmental and Social Considerations Guidelines, which were revised during 2004. The Study was classified as "B" because it is expected the construction and operation activities could result in some minor environmental and social impacts in terms of land acquisition, landscaping, water pollution, and offensive odour, etc..

10.3.3 EIA-related Regulations in India and Goa State

The *Water (Prevention and Control of Pollution) Act* and the *Environment Protection Act*, passed in 1974 and 1986 respectively, deal with the prevention and control of water pollution. The latter is an umbrella act covering all aspects of the environment. Under this Act the Central Government can take appropriate measures for protecting and improving the quality of the environment, and preventing, controlling and abating environmental pollution.

Pollution Control Boards were established under this Act both at the central government level, and for each state at the state government level. The water supply and sanitation projects for Goa including planning, construction, operation and maintenance are executed by Goa's PWD. The PWD should co-ordinate the assessment of the environmental and social issues with the different state government departments (e.g. the Forest Department, the Science, Technology & Environmental Department (DST&E), and the State Pollution Control Board) at various stages of project implementation and also during the operation phase of the projects.

Since the late 1970s foreign donor agencies have required EIAs to be undertaken. EIAs are legally required under the *Notification under the Environment (Protection) Act, 1986*, which requires certain projects to have environmental clearance from the Central Government's Ministry of Environment and Forests (MoEF). This Ministry is responsible for planning, promotion and co-ordination of environment and forestry programs. Each State Pollution Control Board implements the legislation, issues rules and regulations, and sets effluent standards. Direct responsibility for EIA lies with the "Impact Assessment Division" of the Ministry and its "Impact Assessment Wings" which are the division's decentralized authorities.

The 1994 Notification on Environmental Impact Assessment made it mandatory for EIAs to be undertaken for certain identified activities. Several States have also enacted their own EIA legislation in addition to the national provisions. The Director of the DST&E indicated that the state-owned EIA legislation has not yet been constituted in Goa. The proponent of any development project is personally responsible for undertaking the EIA study. Environmental screening of proposals is carried out by the relevant "Impact Assessment Wing" (e.g. the DST&E). The screening determines whether a rapid or full EIA is required. The scoping of the EIA study is carried out by the Environmental Appraisal Committee (sector-based). This committee liaises with the proponent and the Impact Assessment Wing.

In 1994 the MoEF listed 32 categories of industry which require mandatory EIA studies. These categories are specified in Schedule I of the Environmental Laws Acts (see Volume IV

Appendix M112.1 The Notification of Environmental impact assessment and the List of Projects Requiring Environmental Clearance from the Central Government (The Schedule I) Hand Book. The industries specified in Schedule I include fertilizer, petrochemical, pharmaceutical, dyes and paint, iron and steel manufacturing industries, thermal power plants, mining industries, port and harbour, and river valley projects.

The priority projects proposed as part of this Study are not included on the Schedule I “List of Projects Requiring Environmental Clearance from the Central Government”. This means an EIA report does not need to be submitted to the Central Government. However, the PWD needs their EIA (or other documents) to gain official approval from the Goa State Pollution Control Board, DST&E. The EIA approval procedures are shown in Figure 103.1.

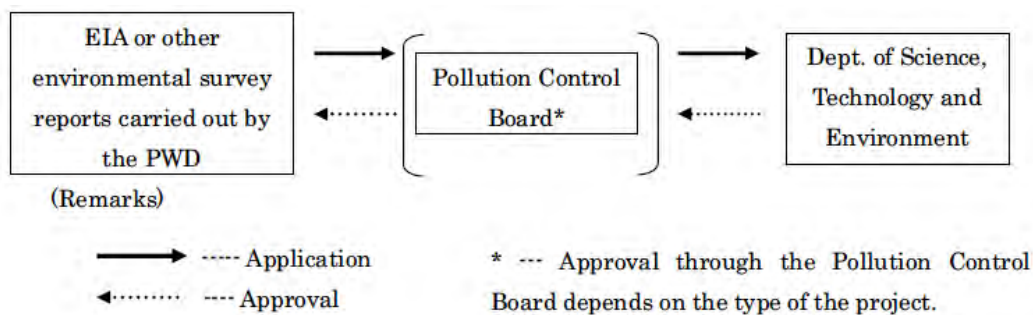


Figure 103.1 EIA Approval Procedures in Goa

After the Rapid-EIA is undertaken, approval at the national level from the Central Pollution Control Board (CPCB) and the MoEF is not necessary. This is because the any water supply and sewerage projects are not included in Schedule I. However, it is necessary for the PWD to submit a report on the Rapid-EIA to the State Pollution Control Board (SPCB), because the SPCB has jurisdiction over water supply and sewerage schemes within its territory.

It is necessary to submit an 'Application Form', which includes the project details, to the SPCB. The application form must describe pollution impacts, such as the predicted air quality effects, water quality impacts, and characteristics of solid waste generation and disposal. Two separate application forms are required. One is needed before the proposed facilities can be constructed, and the other is needed before the facilities can begin operation. Prior to construction, the proponent must submit an application form seeking consent to establish. Another application form must also be submitted seeking consent to start operating the facilities, and for renewal of consent to continue operating existing facilities (such as wastewater treatment and sludge disposal facilities under Section 26 of the *Water Act*). This is one of the environmental

clearances that the PWD must obtain before implementing the priority sewerage projects. Water supply projects are not required to follow the same procedure because water supply projects are not targeted at the state level for environmental clearance.

10.4 Results of Rapid-Environmental Impact Assessment

10.4.1 Scoping Study and the Need for an Environmental Impact Assessment

India's Ministry of Environment, established in 1985, set up the Environmental Appraisal Committee that has the responsibility of scrutinising projects from the environmental point of view and suggesting safeguards to mitigate adverse environmental impacts.

According to the Terms of Reference a separate detailed Rapid-Environmental Impact Assessment (EIA) of the priority projects to assist the PWD in making planning and design decisions, in carrying out construction, and in operating the complete facilities in an environmentally sound manner was undertaken at the conclusion of this feasibility study.

In the Rapid-EIA, in addition to the major environmental issues specific to each site, the existing environmental baseline data and socio-economic status of the population in the project area, the maximum environmental benefits, improvement in living conditions and human health that are gained from the investment which was made, are discussed together with the possible negative impacts and related mitigation measures during the implementation and operation phases of the project. In view of these aspects, the options proposed for each component are assessed from the environmental point of view so as to ensure the sustainability of the Project.

10.4.2 Legislative and Regulatory Framework

(1) General

The Water (Prevention and Control of Pollution) Act and the Environment Protection Act promulgated in 1974 and 1986 respectively deal with the prevention and control of water pollution. The latter is considered as an umbrella act covering all aspects of the environment, under which the Central Government can take appropriate measures for:

- protecting and improving the quality of the environment, and
- preventing, controlling and abating environmental pollution.

The Pollution Control Boards (PCB) was established under this Act both at the Central Government and also at the State Government level.

The Priority Projects of Study for Augmentation of Water Supply and Sanitation for the Goa State will be executed by the Public Works Department (PWD), State Government of Goa. The PWD has to co-ordinate with different government Departments like Revenue Department, Forest Department, Water Resource Department, and State Pollution Control Board at various stages of the implementation of the project and also during the operation phase of the project.

During the construction phase mitigation measures necessary as per Water Pollution Control Act, 1974, Air Act, 1981 and Environmental Protection Act, 1986 must be taken. Since the State Pollution Control Board is the enforcing agency for these Acts, the PWD will seek their advice, whenever necessary.

(2) Environment Protect Act

After implementation of the above mentioned Acts, the Environment Protection Act, 1986 came into practice. This Act has an overriding effect on the other earlier environment Acts. The Ministry of Environment and Forest (MoEF) was established under this Act. The Director of MoEF is the administrative head of this organisation.

The Act is an Omnibus Act subsuming the various pollution control, wildlife, forest conservation acts. The Act therefore links the pollution control and natural resource conservation issues. It also empowers the Union Government to make rules regarding handling, storage, manufacture and import of hazardous substances including wastes. Violation of these rules constitutes a crime which is punishable by imprisonment and/or fine.

(3) Notification of Environmental Impact Assessment

The MoEF enforced the notification in January 1994 for conducting Environmental Impact Assessment (EIA) studies which are obligatory for the establishment of certain categories of industries specified in Schedule I. The Schedule I industries include the fertiliser, petrochemical, pharmaceutical, dyes and paint, iron and steel manufacturing industries, thermal power plants, mining industries and also port and harbour and the river valley projects. The Notification, Schedule I is detailed in Volume IV Appendix M112 Environmental and Social Considerations for Implementation.

The appraisal committees comprising experts, Governmental official and non-government

organisations (NGOs) were set up by the MoEF to scrutinise various EIAs prepared for the establishment of such industries and projects. The appraisal committees would accord an environmental clearance to the project in consultation with MoEF after scrutinising the EIA report for the priority projects.

10.4.3 Natural Environment

(1) Biodiversity

India is a Party to the Convention on Biological Diversity (1992). Recognizing the sovereign rights of States to use their own biological resources, the Convention expects the parties to facilitate access to genetic resources by other Parties subject to national legislation and on mutually agreed upon terms (Article 3 and 15 of CBD). Article 8(j) of the Convention on Biological Diversity recognizes contributions of local and indigenous communities to the conservation and sustainable utilization of biological resources through traditional knowledge, practices and innovations and provides for equitable sharing of benefits with such people arising from the utilization of their knowledge, practices and innovations.

Biodiversity is a multi-disciplinary subject involving diverse activities and actions. The stakeholders in biological diversity include the Central Government, State Governments, institutions of local self-governmental organizations, industry, etc. One of the major challenges before India lies in adopting an instrument, which helps realise the objectives of equitable sharing of benefits enshrined in the Convention on Biological Diversity.

The parameters set out in this report are to assist in the identification of specific areas in different regions of India which could be categorized as ecologically fragile or sensitive. They aim to help in ensuring that they are not subjected to environmentally unacceptable activities. Some fragile or sensitive ecosystems are listed. They include ecosystems: with unique properties; with intrinsically low resilience; with high species richness and biological diversity; susceptible to species loss; linking two or more protected ecosystems; with aquifers and water recharge areas of mountain springs; and those with active geological faults and seismic hazards. The parameters are outlined in sections on various ecosystems: deserts, Himalayas, glaciated areas, seismic zones, landslide zones, and watersheds.

(2) Forest Resources

Much before it became concerned about the negative impacts of pollution on the environment, India became concerned about the diminishing natural resource represented by forests. Initially, forests were perceived as a source of revenue, this perception has recently given way to

the concept of forests as a vital link in maintaining the environment and halting its degradation.

In response to the former perception, the Forest Act was enacted in 1927 to consolidate all existing laws relating to forests and control trade in timber and other forest produce. The Act defined “Reserved” and “Protected” forests and laid down the procedure for acquiring land deemed reserved or protected forests under the Land Acquisition Act, 1894. However, measures in this Act proved inadequate to halt the rapid depletion of India’s forests after independence.

This resulted in the Union Government enacting a law, the Forest Conservation Act, in 1980, to control India’s rapid deforestation. It supplements the Forest Act, 1927 by: (1) imposing restrictions on the provision to reserved forests in the Forest Act, 1927; (2) requiring prior approval of the Central Government for diversion of forest areas for non forest purposes; and in case of approval, (3) requiring compensatory afforestation of equivalent area of non forest land. The administrative agency in case of the provisions of the Forest Conservation Act, 1980, is the Union Government. However, as long as it does not involve felling of trees, only limited information needs to be given about the status of the forested area. A compensatory afforestation plan has to be submitted for all activities requiring clearance from the Ministry of Environment and Forests.

10.4.4 Environmental Standards

(1) Water Pollution

In order to protect various water bodies, standards for treated industrial waste / treated domestic waste have been prescribed by the Central Pollution Control Board (CPCB), New Delhi. These standards are different for different types of receiving bodies. Treated effluent / treated sewage to be discharged into any of the following shall meet the relevant standards as prescribed by Goa Pollution Control Board:

- into inland surface waters,
- into municipal sewers,
- on land for irrigation,
- into marine coastal waters.

If treated sewage is to be used for irrigation, as is proposed in the sanitation project, upper limits for important parameters will be:

Table 104.1 Treated Water Quality for Irrigation

Parameter	Unit	Limits
BOD ₅	mg/l	100
Suspended Solids	mg/l	200
Dissolved Solids	mg/l	2100
pH		5.5-9.0
Oil & Grease	mg/l	10
Arsenic	mg/l	0.2
Boron	mg/l	2.0
Cyanide	mg/l	0.2
Chloride	mg/l	600
Sulphate	mg/l	1000

Source: CPCB, Standards for discharge of Industrial/Domestic wastewater

In addition to the standards prescribed by the CPCB, the project proposes to take into account the WHO guidelines for wastewater reuse for irrigation of level B (cereals, industrial and fodder crops, pasture and trees). These guidelines were elaborated by WHO after reviewing epidemiological studies of untreated wastewater reuse. This review led to the conclusion that the danger of infection is:

- high with intestinal nematodes;
- moderate with bacteriological infections and diarrheas;
- minimal with viral infections and diarrheas, and hepatitis A; and
- high to non existent with trematode and cestode infections, schistosomiasis, clonorchiasis, and taeniasis, depending on local practices and circumstances.

The WHO guidelines are given in the following table.

Table 104.2 Recommended Microbiological Quality Guidelines for Wastewater Use in Agriculture

Category	Reuse conditions	Group exposed	Intestinal nematodes (arithmetic mean no of eggs per liter)	Fecal coliforms (geometric mean no. per 100ml)	Wastewater treatment expected to achieve required microbiological quality
A	Irrigation of crops likely to be eaten uncooked; sports fields, public parks.	Workers, consumers, public	≤1	≤ 1,000	Series of stabilization ponds designed to achieve the microbiological quality indicated, or equivalent treatment
B	Irrigation of cereal crops, industrial and fodder crops; and pasture and trees.	Workers	≤ 1	No standard recommended	Retention in stabilization ponds for 8-10 days for equivalent helminth and fecal coliform removal
C	Localized irrigation of crops in category B if exposure of workers and the public does not occur.	None	Not applicable	Not applicable	Pretreatment as required by irrigation technology, but not less than primary sedimentation

Source: Health Guidelines for the Use of Wastewater in Agriculture and Aquaculture. Technical Report No.778. WHO, Geneva. 1989

(2) Air Quality

It needs to be necessary for the project execution agency to maintain air quality within mentioned limits for various parameters. The detailed ambient air quality standards are given in Table 104.3

Table 104.3 Ambient Air Quality Standards

Pollutant	Time weighted average	Concentration in ambient air as $\mu\text{g}/\text{m}^3$		
		Industrial Areas	Residential and Rural Areas	Sensitive Areas
Sulphur Dioxide	Annual average	80	60	15
	24 hours	120	80	30
Oxides of Nitrogen as NO_2	Annual average	80	60	15
	24 hours	120	80	30
Suspended particulate matter (SPM)	Annual average	360	140	70
	24 hours	500	200	100

(3) Noise

The noise levels at project sites and residential areas nearby should be as per stipulated standards given in Table 104.4

Table 104.4 Ambient Noise Level Standards

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

Source : Central Pollution Control Board, Delhi, 1981

Day time is considered as 6.00 AM to 9.00 PM.

10.4.5 Project Description**(1) Water Supply Project**

1) Background of the Project

Augmentation of Salaulim Water Supply Scheme was selected as the priority project because it is the most urgent. The first stage of this Scheme is recommended for the priority project, because

- Shortage of water in year 2025 for Salaulim Water Supply Scheme will be the most serious problem among 7 water schemes in Goa.

- Salaulim Scheme supplies treated water to the major municipalities, which are Vasco, main port of the Goa State, Verna, the largest industrial area of the Goa State, Margao, the most populated city of Goa State, and part of capital city Panaji.

For other water supply scheme, the PWD is implementing projects for expansion of Assonora (40 MLD), Dabose (10MLD) and Canacona (10MLD).

The project scale was set based on a careful examination of water demand, supply capacity, raw water availability and the PWD's financial capabilities. The priority projects are described below.

2) Objectives of the Project

The objectives of priority projects are to improve water supply situation in Goa,

- Through expanding the existing water supply schemes by constructing new water treatment plants
- Through enhancing the capacities of water transmission and distribution systems of major water supply schemes by rehabilitation of existing facilities, installment of new pipelines and construction of reservoirs, etc. and
- Through the improvement of the operation and maintenance of water supply system.

3) Component of the Priority Project

- Expansion of Salaulim Water Supply Scheme (for Mormugao, Salcete, Quepem, Sanguem)
 - ✧ Expansion of the Salaulim Treatment Plant by 100,000 m³/day, resulting in a total capacity of 260,000 m³/day.
 - ✧ Rehabilitation and Improvement of the Existing Salaulim Treatment Plant, which has a production capacity of 160,000 m³/day.
 - ✧ Construction of a 20,000 m³ Master Balancing Reservoir (MBR) in Sirvoi.
 - ✧ Installation of approximately 80 km of Transmission Mains.
 - ✧ Construction of six Reservoirs.
 - ✧ Construction of five Pumping Stations.
 - ✧ Replacement of Pumping Equipment at the Verna Pumping Station.

4) Location map and Proposed Facilities for Priority Project

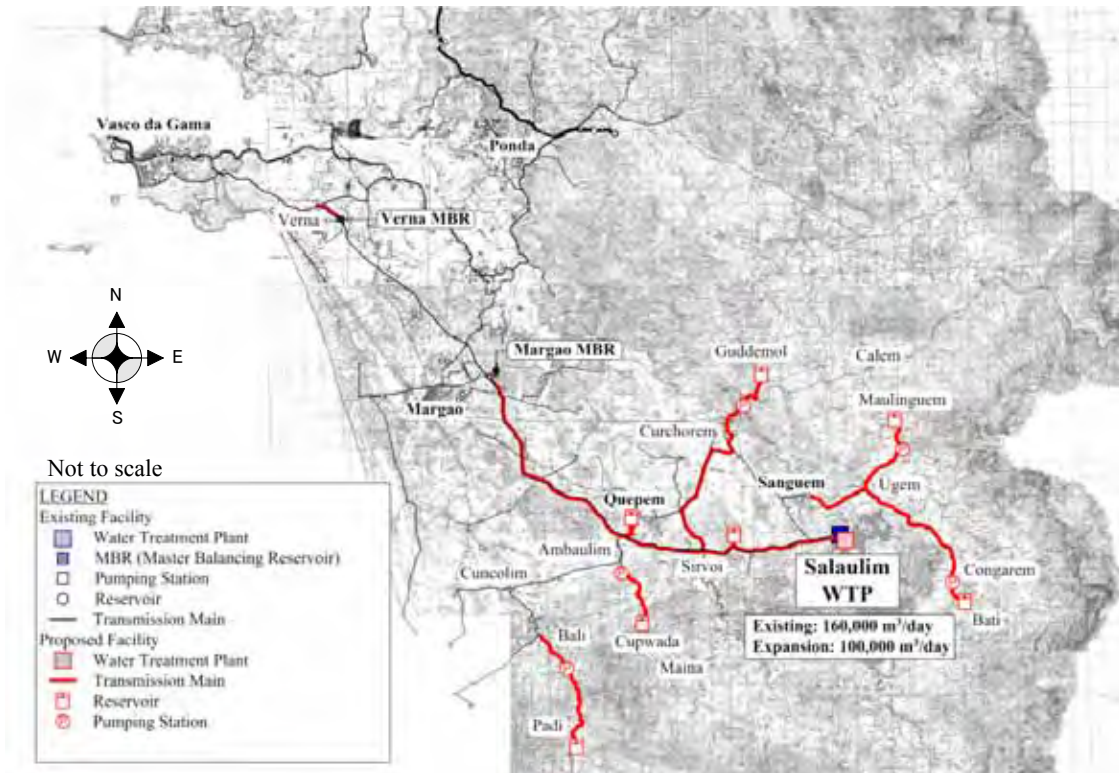


Figure 104.1 Location Map of Priority Projects in Salaulim Water Scheme

(2) Sewerage Project

1) Background of the Project

On the selection of priority projects, each project selected for sewerage was evaluated from the aspect of beneficiary, cost effects, positive impacts and urgency. The evaluation procedures are as follows:

- Resident and tourist population were taken into account as beneficiaries, five (5) points were given for the largest population and points were given proportional to the population, respectively for resident and tourist.
- Unit construction cost and O&M cost per sewage flow were considered for cost effects, five (5) points were given for the lowest value and zero (0) point was given for the highest value, others were calculated proportional to their value.
- The treatment plant capacity was evaluated as a positive impact; five (5) points were given for the largest STP. Points were given proportional to their capacities.
- Urgency was evaluated by the current condition of groundwater contamination (two (2) points), overflow from soak pit (one (1) point) and dependency on well (two (2) points). The service block with the worst current condition received the maximum point.

The evaluation result is shown in the Table 104.5. The result shows that North Coastal Belt received the highest point, and Margao came second. The third is Mapusa and its point is very close to Margao.

At the formulating of the Master Plan, plan of all sewerage schemes were designed in consideration of environmentally-sound. For example, all proposed sites are public or semi-public open land avoiding involuntarily land acquisition and locates of far from human habitation, commercial & tourism area. Although those projects are implementing, negative impacts are kept to the minimum. On the other hand, there is strong evidence that positive impacts such as improvement of sanitation condition and reduction of water-borne infectious diseases make a great contribution to enhance living environment in the targeted area. From this standpoint, project selection point for negative impacts is all flat in the lowest level.

Regarding the present situation of the sewerage services in the Study Area, the PWD Goa does not have sufficient institutional setup to run their services, resulted in low house connection rates. Under this situation, it is recommended to limit the number of priority projects in order to manage and run sewerage systems at an appropriate level.

Considering above aspects, three (3) projects, namely North Coastal Belt, Margao and Mapusa were selected as priority projects. The Summary of the priority projects is shown in Table 104.2.

Table 104.5 Selection of Priority Sewerage Project

	Panaji	St. Cruz	Porvorim	Margao	Ponda	Mapusa	Colva	North Coastal Belt	Max Point
Beneficiary:									
Additional Population									
Resident	26,144	16,918	47,848	56,907	19,401	68,255	5,279	39,358	
Point	1.9	1.2	3.5	4.2	1.4	5.0	0.4	2.9	5
Tourist	8,737	0	1,653	2,605	2,097	1,703	5,231	20,261	
Point	2.2	0.0	0.4	0.6	0.5	0.4	1.3	5.0	5
Point for Beneficiary	4.1	1.2	3.9	4.8	1.9	5.4	1.7	7.9	10
Cost Effects									
Cost / Sewage capacity									
Construction cost	394,000	115,000	370,000	513,000	142,000	469,000	111,000	493,000	
Construction cost/Sewage	44.3	44.2	48.1	38.3	40.6	43.4	50.5	44.0	
Point	2.5	2.6	1.0	5.0	4.1	2.9	0.0	2.6	5
OM cost	30,800	7,000	15,300	34,100	7,900	17,100	7,400	17,700	
OM cost/Sewage	3.9	7.4	5.4	4.5	6.2	4.3	9.2	4.3	
Point	5.0	1.7	3.6	4.5	2.9	4.6	0.0	4.6	5
Point for Cost Effects	7.5	4.3	4.6	9.5	6.9	7.5	0.0	7.3	10
Positive Impacts									
Additional STP Capacity	8,900	2,600	7,700	13,400	3,500	10,800	2,200	11,200	
Point for Positive Impacts	3.3	1.0	2.9	5.0	1.3	4.0	0.8	4.2	5
Urgency									
Groundwater Contamination	52%	67%	100%	33%	N.A	83%	N.A	63%	
Point	1.0	1.3	2.0	0.7		1.7		1.3	2
Overflow from Soak pit	18%	12%	12%	35%	31%	73%	18%	14%	
Point	0.2	0.2	0.2	0.5	0.4	1.0	0.2	0.2	1
Dependence on Own Well	N. A.	N. A.	N. A.	N. A.	N. A.	N. A.	7%	43%	
Point							0.3	2.0	2
Point for Urgency	1.2	1.5	2.2	1.2	0.4	2.7	0.5	3.5	5
Total Point	16.1	8.0	13.6	20.5	10.5	19.6	3.0	22.9	30
Rank	4	7	5	2	6	3	8	1	
Priority Project				★		★		★	

*Anticipated negative impacts are describing in 10.4.8 with those mitigation measures.

Table 104.6 Summary of Priority Sewerage Project

Location	Unit	Margao	Mapusa	North Coastal Belt	Remarks
Population in the Expansion Area	Person	36,779	34,942	22,129	
Trunk Sewer Construction	km	6.0	3.9	6.1	
Branch Sewer Construction	km	44.2	31.5	47.8	
Pumping Station Construction	Nos.	1	0	1	
Treatment Plant Capacity	MLD	(7.5)+6.7	5.4	5.6	(Existing)

2) Objectives of the Project

The objectives of sewerage projects in the F/S are to improve urban sanitation in Goa,

- Through expanding the existing sewerage systems to areas around south part of Margao.
- Through constructing new sewerage systems in Mapusa and part of North Costal Belt.
- Through the improvement of the operation and maintenance of sewerage.

3) Component of the Priority Project

- a) Expansion of existing sewerage systems including sewer, pumping station and treatment plants
 - ✧ Expansion of Margao STP (See Figure 104.2)
 - ✧ South Zone (Trunk sewer, Branch Sewer and 1 Pumping Station)

4) Location map and Proposed Facilities for Priority Project

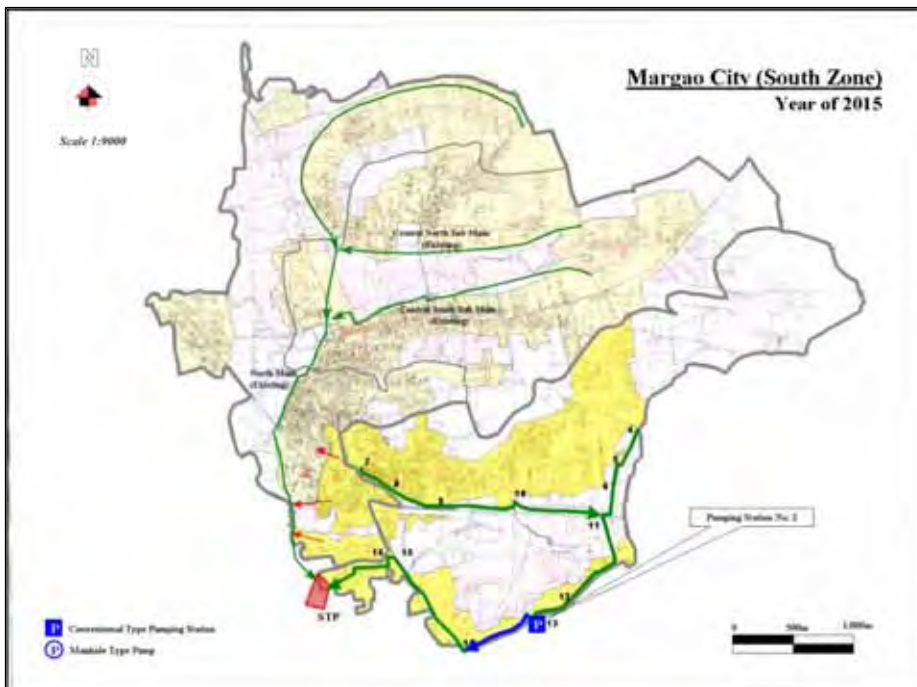


Figure 104.2 Location Map of Priority Projects in Margao Scheme

- b) Construction of new sewerage system including sewer, treatment plant and pumping station
- ◇ Mapusa (Mapusa STP, Trunk Sewer, Branch Sewer) (See Figure 104.3)
 - ◇ North Coastal Belt (Baga STP, Trunk Sewer, Branch Sewer and 1 Pumping Station) (See Figure 104.4)

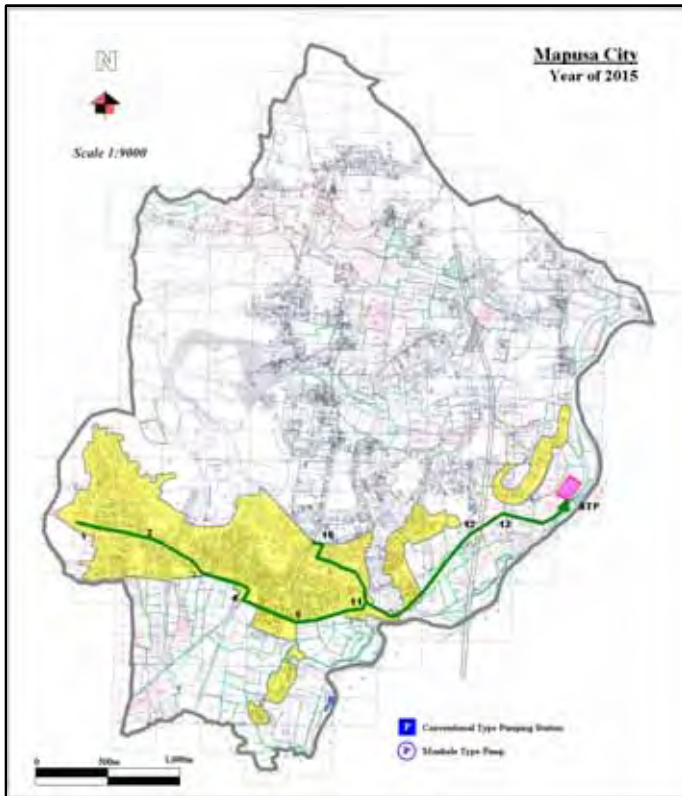


Figure 104.3 Location Map of Priority Projects in Mapusa Scheme

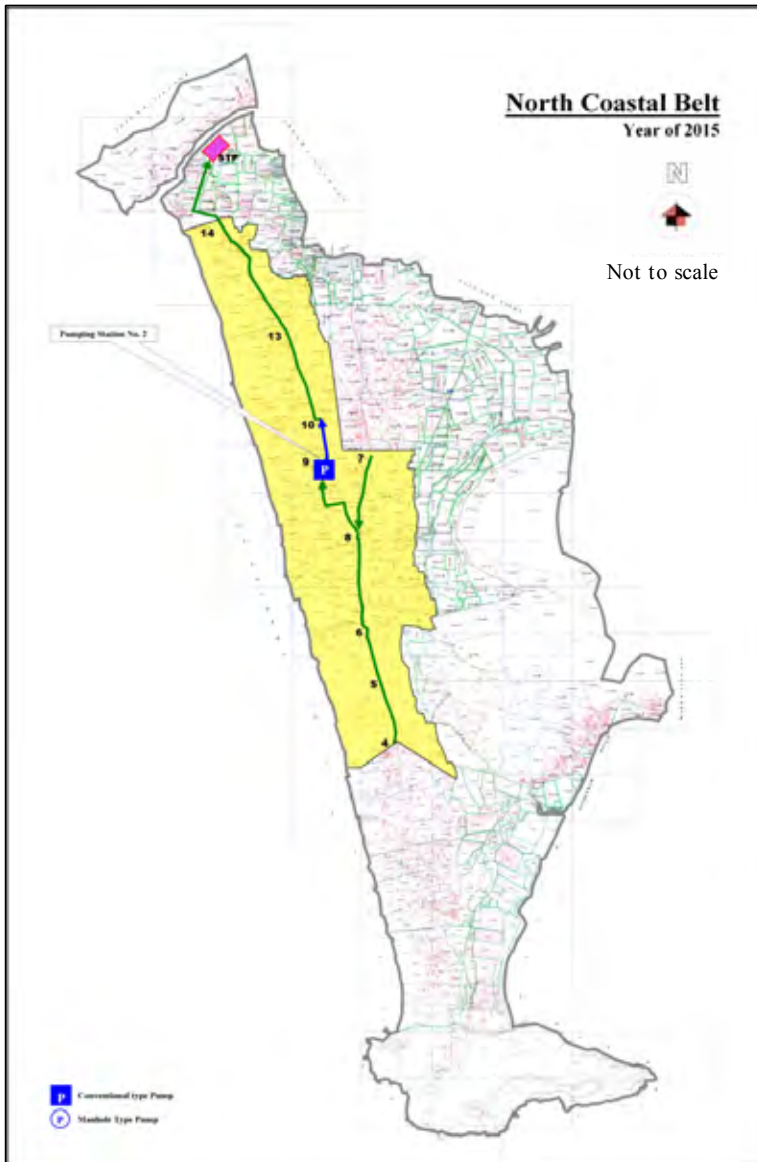


Figure 104.4 Location Map of Priority Projects in North Coastal Belt Scheme

More detail maps of proposed facilities are shown in Volume V Appendix F104.1 Rapid-Environmental Impact Assessment Report for the Priority Projects of Water Supply and Sewerage in Goa

- c) Installation of Sewer Cleaning Equipment
 - ✧ Mechanized Sewer Cleaning Equipment (Sludge Vacuum vehicle and Pressure Cleaning vehicle)
 - ✧ Manual Sewer Cleaning Equipment (Hand Reel Winch Type)

10.4.6 Baseline Environmental Data

(1) Study Area

The state of Goa is located on the western seaboard of India, about 600km south of Mumbai. The state is relatively small having an area of 3,702 km². Goa has 11 talukas which are divided into the two districts of North Goa and South Goa. The state capital is Panaji and the commercial capital is Margao.

(2) Physical Environment

1) Topography

The land of Goa is a narrow strip of earth 105 km long and 65 km. Goa is a part of the West Coast region and is similar in physical features to the neighbouring regions of Karnataka and Maharashtra. However, some features contribute the Goan landscape and scenery a distinctive charm of their own.

There are three main physical divisions: the mountainous region of the Sahyadris in the east, the middle level plateaus in the centre and the low-lying river basins with the coastal plains. The most well-known part of Goa is the coastal belt that runs from north to south, while the least known is the Western Ghat region, which also runs from north to south in the barbaric land. Sandwiched in between is the midland region, apparently nondescript, but nevertheless with its own significant ecological and cultural characteristics

2) Geology and Soil Quality

The political boundaries of Goa correspond quite closely with its natural, geological features. The northern boundary, for example, runs along the Tiracol River. On the eastern side, the boundary is demarcated by the *Sahyadris*; on the west, by the Arabian Sea. The southern section is closed off by a peak about 111 meters high near Polem.

The principal geological feature of the land is the extensive laterization which occurs because of Goa's position in the tropical moist climate, subject to vast seasonal changes. The laterite caps are extensive over most of the terrain, mountains, plateaus or plains.

3) Climate and Meteorology

Goa has balmy tropical weather, with temperatures generally ranging between 25°C to 32°C (during April-May and October-November the temperature exceeds 30°C by noon). Goa has torrential monsoon rains between June and September. In Goa, about 90 percent of total rainfall occurs in a short period of 3 to 4 months, during the summer. Actually, the average

annual rainfall is approximately 3000 mm, while the average rainfall during the monsoon season (June-September) is approximately 2700mm.

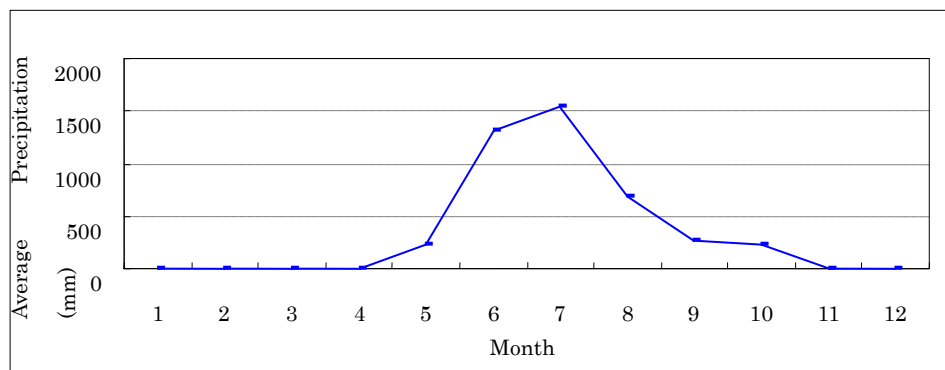


Figure 104.5 Average Rain Fall in Each Month

This rain occurs in the form of heavy showers with raindrops on the average 10 times bigger than the raindrops of the mid-latitude region. There are two major consequences of this: 7 to 8 months of the year, large tracts of the State are rainless. Part of this is a hot season: March to May in some parts of Goa. So the water that falls during the monsoon period loosens the soil and runs off the surface, filling *nallahs* and channels with valuable silt, and finally through the river system ends in the sea.

Therefore, although the rainfall is more than 1000mm over, about 60 percent of it is wasted as runoff, there being naturally little time for the water to percolate into the ground. In other words, an effective rainfall when not properly harvested or husbanded is only 200mm to 300mm.

4) River System

Tiracol, Mandovi, Zuari, Colvale, Sal, Talpona, Saleri, Canacona and Galgibaga are the main nine rivers of Goa. Due to the extent of their drainage areas and the human attraction they hold, these nine river and their 42 tributaries are significant. These rivers are not only the source of potable water but also support the Goan ecosystem. The surface water system of Goa is intimately linked up with their development since they provided irrigation facilities for agriculture, produce biotic and mineral resources, transport ore from the mining areas to the port and ferry people and goods to different parts of the state.

Goa's rivers are tidal and rainfed. The huge volumes of monsoon water fall within the watershed areas and are then drained out through the major rivers to the sea.

(2) Biological Environment in Goa

1) The Western Ghats Ecosystem in Goa

The Western Ghats are one of the richest reservoirs of diversity in the world. The sections that within Goa (the Sahyadris) and which dominate its ecosystems readily reflect this bewildering complexity in plant, animal and bird life. Official recognition of the ecological value of this area has come in the form of gazette notifications declaring huge areas as sanctuaries or biosphere reserves. The most important topographic feature of peninsular India is the Western Ghats range extending along its western margin. However, the Western Ghats are acknowledged to be one of 'hot spots' of biological diversity and endemism in the world.

All coastal fisheries on the west coast depend on the nutrient discharge into the coastal seas and subsequent marine productivity. The nutrients originate and are transported by rivers from the Western Ghats.

2) The Alluvial and Coastal Plains

The district ecological component of the Goa bioregion after the Western Ghat area and the lateritic plateaus is the alluvial lowland. These comprise the stretches of rivers which have over the centuries received the eroded material from higher levels of the Sahyadris.

3) The Coastal Region

The Goan coastal system is initially connected with the catchments areas of tidal rivers and streams. These are the source not only of water, but also of sediments, and hence, play an important part in the formation and maintenance of the coastal topography and ecosystem. The Goan coastal system has, for instance, over many centuries adapted to inputs from the rivers, particularly the Mandovi and the Zuari. Areas near the river mouths cope with natural fluctuations caused by floods and cyclones.

(3) Socio-Cultural Environment in Goa

1) Population

The population census of 2001 estimated the population of Goa to be 1,343,998. Four censuses have been completed for Goa (1971, 1981, 1991 and 2001). The census data shows that the population growth rate of Goa decreased from 16.08% during 1981-1991 to 14.89% during 1991-2001 as shown in Table 104.7.

Table 104.7 Population of Goa

Year	Population	Decadal growth rate	Urban Population as percentage of total Population
1971	795,120	-	25.56%
1981	1,007,745	26.74%	32.03%
1991	1,169,793	16.08%	41.01%
2001	1,343,998	14.89%	49.77%

Source: Economic survey 2003-2004

In Goa, half of the total population lives in urban area. For example, in 1981 32% of the population lived in urban areas, in 1991 this had grown to 41% and by 2001 49% of the population was living in urban areas. The urbanization in Goa is closely related to the development of the tertiary industry (service sector) in urban area.

2) Tourism Environment

The packaging Goa as a major international tourist destination is still actively underway. Tourism has come to dominate the economy and landscape of Goan life in a way that no other activity does. Tourism is ubiquitous and except for the fortunate few in the interior talukas, no Goan can live without acknowledging its existence and importance, or being affected by its fallout. Goa now receives more tourists per annum than its total resident population. The strain this places on scarce resources and infrastructure is enormous.

Basic problem of tourism in Goa is that most of the foreign tourists appear during the winter season from November to January. Very few people with visiting Goa during the monsoons; as a result most tourist establishment work for only 6 months in the year (October to April) and are forced to lay off their workers for the remaining 6 months. Tourism in Goa therefore does not provide steady and uninterrupted employment and it is a common experience that after working for a few years in the tourist sector, most people are unable to cope with the interruption and try to move on to the other professions.

The contribution of the tourist industry to the Goan economy has increased substantially and is second only to mining. In 1994 the contribution was 11% to the State GDP, 7% to employment and 7% to total revenues.

3) Land Use

The main land use characteristics are as follows:

- Most of the settlement and road development is concentrated in the coastal talukas.
- Agricultural areas are located mainly along the rivers or near the coast.
- The areas used exclusively for plantations are located in the midlands, while the plantations that are interspersed with settlements are usually located in coastal areas.

4) Public Health

The most serious aspect of environmental hygiene seems to be related to the problem of disposal of sewage and industrial waste by cities, industries and beach resorts into the river and the sea. Modern life is also generating large quantity of garbage which Goans cities and towns are no longer able to cope with, since the bulk of it is non-biodegradable.

10.4.7 Overall Impact Identification

(1) Scoping Checklist of Potential Impact

The result of the Rapid-EIA is summarized in Table 104.8 and Table 104.9.

Table 104.8 Scoping Check List of Priority Water Supply Projects

No	Environmental Items	Evaluation	Reason
Socio-Economic Environment			
1	Resettlement	D	Land acquisition is necessary but human settlement is possibly avoidable by selecting no-settlement land.
2	Economic Activities	B	Adversary affects of the living conditions of inhabitants by changes in land use due to the project. Positive impact is also expected such as increase of employment in construction phase.
3	Traffic / public facilities	B	Traffic jam during construction phase may be expected.
4	Split of Communities	D	Since no large-scale construction will be undertaken, the separation of the communities may not occur.
5	Cultural Property	B	The proposed site was close to an archeological site. But the area is out of archaeological properties where protected limits by law.
6	Water rights / Rights of Common	D	Water rights problem is not expected.
7	Public health condition	D	Positive impact is expected.
8	Waste	B	The sludge from treatment plant will be generated. It will be re-used as a material of cement or disposed properly at the final dumping site. During construction, construction waste and excavation material will be generated.
9	Hazard	D	No significant impact. Scale of facilities is small.
Natural Environment			
10	Topography & Geology	D	No significant impact. Scale of facilities is small.
11	Soil Erosion	B	Soil erosion and run-off of top soil will be expected. After the completion of construction activity, top soil is necessary to be replaced and afforestation plan should be done properly.
12	Groundwater	D	No significant impact is expected. Raw water will be intaked from surface water.
13	Hydrological situation	D	No significant impact.
14	Coastal zone	D	No coastal line exists. Major water supply facilities are located in-land
15	Fauna and flora	D	No significant impact.
16	Meteorology	D	No significant impact.
17	Landscape	D	No large scale construction is expected. But master balancing reservoir may be constructed at suburb area and it is important to harmonize the facilities with the surrounding environment.
Environmental Pollution			
18	Air pollution	D	No significant impact
19	Water pollution	D	Back washed water from filtration process will be generated, but the water will be made re-treat ment.
20	Soil contamination	D	No impact is expected
21	Noise and vibration	B	Some noise and vibration during construction period is expected.
22	Land subsidence	D	Since ground water will not be used for the Project, the land subsidence with the Project would not occur.
23	Offensive odor	D	No smell anticipated from the treatment plant

A: Significant impact anticipated, B: Slight impact anticipated, C: Unknown, D: Almost no impact anticipated

Table 104.9 Scoping Check List of Priority Sewerage Projects

No	Environmental Items	Evaluation	Reason
Socio-Economic Environment			
1	Resettlement	D	Land acquisition is necessary but human settlement is possibly avoidable by selecting no-settlement land.
2	Economic Activities	B	Adversary affects of the living conditions of inhabitants by changes in land use due to the project. Positive impact is also expected such as increase of employment in construction phase.
3	Traffic / public facilities	B	Traffic jam during construction phase may be expected.
4	Split of Communities	D	Since no large-scale construction will be undertaken, the separation of the communities may not occur.
5	Cultural Property	D	No cultural properties are identified in and around the project area.
6	Water rights / Rights of Common	D	Water rights problem is not expected.
7	Public health condition	D	Positive impact is expected.
8	Waste	B	The sewage sludge from treatment plant will be generated. It will be ecologically re-used as fertiliser or disposed properly at the final dumping site. During construction, construction waste and excavation material will be generated.
9	Hazard	D	No significant impact. Scale of facilities is small.
Natural Environment			
10	Topography & Geology	D	No significant impact.
11	Soil Erosion	D	No significant impact. Proposed facilities are situated in flat land area.
12	Groundwater	D	No significant impact is expected.
13	Hydrological situation	B	Treated effluent will be discharged into the nearest Rivers. No significant impact because quantity of effluent is not huge.
14	Coastal zone	D	No significant impact is expected. No proposed site situated in CRZ.
15	Fauna and flora	C	No endangered species or conservation areas confirmed yet.
16	Meteorology	D	No significant impact.
17	Landscape	D	No large scale construction is expected. But sewage treatment plant facilities may be constructed at suburb area and it is important to harmonize the facilities with the surrounding environment.
Environmental Pollution			
18	Air pollution	D	No significant impact
19	Water pollution	B	Treated sewage will be discharged into the nearest Rivers with appropriate treatment.
20	Soil contamination	D	No impact is expected
21	Noise and vibration	B	Some noise and vibration during construction period is expected.
22	Land subsidence	D	Since ground water will not be used for the Project, the land subsidence with the Project would not occur.
23	Offensive odor	B	Some smell anticipated from the treatment plants. But suitable treatment method may be tempered its impact.

A: Significant impact anticipated, B: Slight impact anticipated, C: Unknown, D: Almost no impact anticipated

(2) Impact Identification

In the matrix table, the activities are arranged in columns and environmental parameters in rows (Figure 104.8). The matrix thus *identifies* the environmental factors likely to be affected, and the activities responsible for this. The cells which fall at the junction of an activity and an affected parameter have been shaded. The impacts may be negative or positive. This is analysed further during the evaluation stage.

The environmental parameters that can be affected are:

- Natural parameters: soil, offensive odour, noise/vibration, water, flora and fauna
- Socio-cultural parameters: waste/sludge, land use, socio-economic, public health, traffic, land acquisition
- Project implementation parameters: worker health

Phases	Construction Phase						Operation Phase							
Parameter	Site Clearance	Excavation	Transportation	Construction	Soil Compaction	Constru. Camps	Energy Utilization	Treatment Plant O&M	Effluent Discharge	Sludge Disposal	Transport			
Soil Quality														
Offensive Odour														
Noise/Vibration														
Water Pollution														
Flora & Fauna														
Waste/Sludge														
Land use														
Socio-Economic														
Public Health														
Traffic														
Land Acquisition														
Worker Health														

Figure 104.6 Impact Identification Matrix

A preliminary scrutiny has been made for the two phases of the project such as construction and operation plans.

(2) Construction Phase:

The first activity of the Construction Phase involves site clearance and site access. This activity may have impacts on water, noise, soil, and land use within the project area. Construction of the components of the priority projects has some negative impacts on air, noise/vibration, water, etc. due to excavation works, civil and related construction works. These impacts may come up for short duration. However, green belt and tree plantation development plan to be undertaken during the construction may have positive impacts not only on ecology but also on air and noise quality of the region after the plants come to the desired heights and density. Marginal impacts are anticipated on aesthetics and human interest also.

(3) Operation Phase:

Operation of the system does not affect the quality of air, water, noise and soil/land substantially. The generation of fugitive and process dust is minimised.

The glossary for the impact identification of the following socio-cultural parameters - land use, land acquisition, socio-economic, and population - is as follows:

- The parameter "Land Use" is expected to be affected during the following actions of the project as they involve use of land: site and route identification, site clearance and excavation, soil compaction, sewage treatment, treated water disposal and sludge disposal.
- "Land acquisition" is considered separately. Land acquisition changes land use and it is affected only once, when the land is acquired. It can have positive and/or negative impacts.
- "Socio-economic" parameter should be understood as the income generation and employment opportunities available to the local public in the project area. This parameter is positively affected during each stage of the project.
- "Population" is the number of people or settlements that can be positively or negatively affected by the project. For instance due to the increase of agricultural activities as a result of availability of treated effluent, the population downstream of the treatment plant site can increase.

10.4.8 Anticipated Environmental Impacts & Mitigation Measures

(1) Impacts during Construction Phase

1) Land acquisition and compensation procedures

Projects sites have been selected avoiding residential, commercial and industrial areas. Therefore, the selected project sites for STPs, WTPs, etc. are vacant lands, woodlands or open land, which belong to the state government, government agencies, communities (comunidade). With suchlike background, involuntarily resettlement of residents and removal of valuable structures are not expected even if the acquisition of those lands is required. Moreover, the land types of these sites are not particular in the contexts of surrounding environment, therefore it is unlikely to be difficult to require nearby similar lands by the original land owners of the proposed sites. For these reasons, the level of negative impacts caused by the land acquisitions is considered not to be significant.

The practical and presumable mitigation measures of the impacts caused by the land acquisitions include the provisions of compensation money and substitute land. The following explains the procedures of land acquisition and its compensation.

According to the Land Acquisition Act, a land acquisition plan has to be proposed to the Collector of either North Goa or South Goa to acquire a land in Goa. Then the Collector appoints a land acquisition officer in the region to implement the land acquisition. The PWD have one land acquisition officer in Panaji for their concerned work. Although the Land Acquisition Act specifies the compensation procedure, there is not regulation for providing substitute land as an alternative of compensation. If substitute land is required instated of providing the compensation money, a proper application letter has to be submitted by the concerned land owner/user to the Revenue Department so that Councilor of Minister can make decision on it.

2) Observation of the woodlands to be deforested

The sites for New Salaulim WTP located near the Dam and the Master Balancing Reservoir at Sirvoi are presently covered by some trees. Part of the proposed routes of new transmission mains also go through woodland. As a result, the deforestation must be required for the construction of these facilities.

Fortunately, those sites and route are neither the lands protected by law such as national parks nor valuable tropical forests for which special considerations are required. It was also observed that the soil type of those sites is hard laterite soil so that land slide is unlikely caused

by the impacts of deforestation.

Since the site is located in a forest area, loss of top soil or soil erosion is likely to have adverse impacts on the green cover in the area. Due to excavation and earthwork, soil erosion, loss of top soil, which can cause slush will damage to existing forests. Whatever the alternative, the top soil of the area that will be covered by the water supply facilities will be definitely lost. The top soil of the outskirts of the proposed site that will be excavated during the construction phase will have to be restored after construction. After the completion of construction activity, top soil is necessary to be replaced and afforestation should be done properly.

As a mitigation measure of the deforestation, it is recommended to plant trees within the premises of the constructed facilities. However, it would be difficult to completely recover the impacts of deforestation by planting trees in the premises after the construction due to the land limitations. Therefore, it is preferable to try to plant the same amount of trees as that of deforestation in other areas near the sites.

3) Noise and vibration causing by construction work

During the construction phase, noise and vibration are expected to generate due to loading of heavy vehicles and operation of heavy construction machineries including pneumatic tools (bull dozers, scrapers, concrete mixers, pumps, vibrators, cranes, compressors etc.) that are known to emit sounds with moderate to high decibel (dB) value. The construction activity will increase the noise levels up to around 80dB at peak hours. This value is actually exceeding the national standards. It can be said generally that installation of sound insulating wall is very effective to reduce the noise level. Noise generated from sources mentioned above may be intermittent and of short duration mostly during daytime. Therefore, no significant impact is anticipated on account of noise generation around the project site.

4) Traffic delay by construction

Traffic at a part of the sites of sewerage priority projects, namely Margao, Mapusa and North Coastal Belt are comparatively heavy. During the construction of the trunk sewer lines, traffic congestion will take place, which will have some temporary impact on the social environment. Though the impact may be temporary and of short duration.

(2) Impacts during Operation Phase

1) Disposal of Sludge and Treated Water from STP and WTP

Sludge is composed of by-products collected from the water and sewage treatment process.

Especially for sewage sludge, it contains both compounds of agricultural value (including organic matter, nitrogen, phosphorus and potassium, and to a lesser extent, calcium, sulphur and magnesium), and pollutants which might consist of heavy metals, organic pollutants and pathogens. The characteristics of sludge depend on the original pollution load of the treated water, and also on the technical characteristics of the wastewater and sludge treatments carried out. Sludge is usually treated before disposal or recycling in order to reduce its water content, its fermentation propensity or the presence of pathogens. Several treatment processes exist, such as thickening, dewatering, stabilisation and disinfection, and thermal drying.

Currently, the sludge is treated on sludge drying beds in the existing STP. The PWD sometimes provides the dried sludge to village farmers around the STPs without charge. Based on the prepared Master Plan, the volume of wet sludge to be generated be around 50m³/d. In the future, the sludge could be used as fertilizer. This would be subject to testing to confirm the quality and therefore safety of the sludge for this purpose.

Treated waters and sludge can also be used for the irrigation of forest and farmland areas for the cultivation of different plant species. The back wash water from some of the existing WTP such as Canacona WTP is already used for the irrigation of nearby plantation during the dry season.

2) Water quality observation

The following table shows the discharge points of the sewerages based upon the Master Plan.

Table 104.10 Proposed Discharge Point of Treated Effluent

Sewage Treatment Plant	Discharge Point
Margao STP	Small stream connecting to Sal River
Mapusa STP	Tributary of Mandovi River
Baga (Calangute North Coastal Belt) STP	Baga River

As a result of the environmental scoping, it was found that only Margao STP currently discharges continuously discharges its treated water into a small stream. The designed discharged points of the other proposed STPs of the priority projects are rivers which have enough flow to significantly dilute the effluent discharged from the STPs so that any occurrence of significant environmental and social impacts of the effluent are not expected.

Continuous water quality monitoring is indispensable to check the functional treatment capability of the sewerage facilities. It is also required to continuously operate and maintain the proposed STPs in order to avoid the inflow of untreated sewage into the rivers and surrounding environments even during power cuts. As mitigating measures to reduce this risk, the installment of emergency power generator at each proposed STP should be considered in addition to the preparation and implementation of sustainable operation and maintenance plan for the proposed STPs.

3) Effects of odour from STPs.

Margao STP is currently operated at far below its treatment capacity and the pollution load of the raw wastewater is thin due to groundwater intrusion into sewers. Therefore, the current odour level in Margao STP is usually very low. Accordingly, problem of offensive odour is not remarkable impact at present. Because the proposed sites for the new STPs are set apart from residential areas, the odour seems not to have significant impacts. Therefore, mitigation measures to reduce the offensive odour are especially required for the further expansion of the existing STPs and for the construction of new STPs. Recommended main mitigation measure is the application of appropriate wastewater and sludge treatment technologies which cause less odour such as Oxidation Ditch.

However, it is easily predicted that residential areas have been developed around not only Margao STP but also new STP after its construction. If this is the case, the installment of air sealing cover on wastewater and sludge treatment facilities is also possible mitigation measure. Another mitigation measure is to design the facility layout of STP in the way odour causing facilities are located at the far side of nearby residential areas as possible. The application of these mitigation measures must be considered in the basic design of the wastewater and sludge treatment facilities in the Detailed Design for the projects.

10.4.9 Analysis of Alternatives

(1) General

The various alternatives have been already presented and are compared below in more detail. The suggested integrated approach aims at recommending the most likely preferred option according to the following criteria:

- Environmental constraints regarding water quality, offensive odour, sludge disposal, public health should be minimised.
- Social impacts should be reduced and careful management is needed to do so. The

acceptance of the project by the community is required in order to allow its smooth implementation and prevent negative reactions from local residents.

(2) With and Without Priority Project

If the project are implemented with the scenario, sewage/night soil discharged to the rivers at present will be treated while if the projects are not implemented (without the project scenario), no sewage is treated and all the sewage discharged finds its way to the major rivers which finally flow into the sea degrading seriously its water quality and environment.

When an effluent with high BOD load is discharged in a natural river/stream, the BOD value of receiving water increases considerably which, in turn, results in the fall in DO value in the water. Therefore, it may be shown that the BOD value may be deteriorated dramatically at any water environment without the project in proportion as growth in population. Meanwhile, the BOD value will be expected to decrease with totally covering of the project. Consequently, the projects can leave irreplaceable water environment to posterity.

(3) Alternative Water Supply Facilities Locations

This environmental scoping identified the following as a likely significant impact regarding to the selected water supply scheme.

1) Salaulim Water Supply Scheme

The Salaulim Water Supply Scheme (WSS) is selected as priority project. Salaulim Dam is the only water source that can meet the increasing water demand in the future. Therefore, there is no possible alternative to the expansion of Salaulim Water Supply Scheme. It was already agreed in a written form that the land ownership of 6 ha should be transferred from the Forest Department of the State Government to the PWD for the new WTP after the boundary of the site is finalized.

The site that the PWD previously proposed for the construction of new WTP was close to the lakefront of Salaulim Dam, which is a good condition for water intake. However, it was found that there was one household living within the trees of that area and that the original proposed site was close to an archeological site, namely Mahadev Temple. This temple was relocated to this location to avoid being submerged at the bottom of the Dam after construction of the Salaulim Dam. It was also found that a sign board of Archaeological Survey of India at the temple says that within 100 meter from the protected limits, no construction work is allowed and prior approval should be obtained from Archaeological Survey of India for construction and excavation work within 200 m from the protected limits. The site previously proposed by the PWD was too close to the archaeological site.

Therefore, during the formulation of Master Plan, the new alternative sites for the new WTP were sought within the area around the existing Salaulim WTP. By conducting site investigation, it was found that there are other available areas whose sizes are enough to accommodate the new WTP. The exact boundary of the new site was finalized at the resulting of the Feasibility Study.

The other major project components of Salaulim Water Supply Scheme are the constructions of another transmission pipeline from Salaulim to Margao and new master balancing reservoir on the hill at Sirvoi (the largest master balancing reservoir to be constructed) which performs as a relay point between Salaulim and Margao.

The both project components don't have alternative sites. The new transmission pipeline will be installed along with the existing transmission mains in the road already constructed and

owned by the PWD especially for water supply transmission. The road goes mainly through rural areas where households are very scattered and there is enough space to install another transmission pipeline at its road shoulder. Therefore, its construction is considered not to have any major environmental and social impacts.

The proposed site for the new Master Balancing Reservoir is located along the road constructed for water transmission mains and is on the hill at Sirvoi which is the best and only suitable place for the new master balancing reservoir in terms of hydraulic conditions. Fortunately, there is no resident living on the hill. Possible major impact of its construction would be only the deforestation for the construction at the site.

(4) Alternative Sewerage Facilities Locations

This environmental scoping identified some likely significant impacts regarding to selected sewerage projects. The identified key impacts include:

- Wastewater discharge from Sewage Treatment Plants (STPs);
- Offensive odour from STPs;
- Acquisition of lands currently used for agriculture and horticulture; and
- Disposal of sludge.

These impacts mainly depend on the location of the STPs in relation to nearby residential areas and rivers. Therefore, appropriate sites for the STPs were well considered through alternative analysis and most suitable sites have been identified through the Master Plan Study. To conduct better alternative analysis, new sets of alternative sites have been specified during the formulation of Feasibility Study, which were added to the sites previously proposed by the PWD. The most suitable site for each STP was presented in the second stakeholder meeting with some of the other alternative sites to confirm the most suitable site and its possible negative impacts.

The following shows the results of alternative analysis on each set of alternative sites for the selected sewerage projects, which were conducted through the rapid-EIA scoping process.

1) Expansion of Margao STP

Margao has an existing STP, which is surrounded by paddy fields and some residential areas. The existing STP has enough land to accommodate future expansion within the own premises. Installation of a new STP in the separate place may be impractical plan in respect of all evaluation parameters like cost efficiency, technical aspect and also environmental aspects.

The existing inflow of sewerage is currently well below the treatment plant's design capacity because only small proportion of Margao's population have connected to the sewers. However, the inflow is expected to increase significantly after the expansion of its service area to the South Zone of Margao by the priority project and after the increase of household connections.

The existing STP discharges its treated water to the adjacent small stream. The stream passes through nearby paddy field about 400m before joining tributary of Sal River. There is a potential risk of discharging untreated sewage into the small stream if there are power cuts or in case of the facility breaks down. This risk would increase if the volume of sewage being treated rises.

Although the current odour level at Margao STP is not significant because raw sewage is significantly diluted by ground water intruding into sewers and the current inflow is well below the designed inflow volume of the facilities. However, the planned increase of the inflow has potential to cause significant odour problem especially during the dry season. After the construction of the expanded STP, a closely-spaced residential area has been developed at the east side of the STP. The boundary of the residential areas is now reaching the STP. The offensive odour from the STP has presumable significant impact on the residential area.

2) Construction of Mapusa STP

The results of the public awareness survey by the JICA Study Team and the first stakeholder meeting have indicated that the overflow of effluent from septic tanks often annoys local residents especially in Mapusa. The underlying geology in Mapusa is a key reason for the overflows. Installation of new sewerage systems in Mapusa is therefore prior to be developed.

The selected site for Mapusa STP, which was proposed by the PWD, is far from the populated area of Mapusa and is next to a river that has a relatively large flow. It is difficult to find alternative land as large as proposed site due to geographical and technical disadvantages. The site is a part of "comunidade", which is community land and is supposed to be used for public purposes such as STPs and other essential infrastructures. This community land is currently being temporally rented to locals as paddy fields. Therefore appropriate compensation or substitute paddy fields have to need to be considered for the loss of the economic opportunity that the farmers currently enjoy. The possibility that the area surrounding the site could be used for urban development in the future is considered to be low based on the site investigation and available land use plan.

3) Construction of a STP in North Coastal Belt

The PWD previously proposed new sewerage schemes covering most of North Coastal Belt. Several sites were previously proposed for the STP in North Coastal Belt by the PWD in past study reports. It was found that these sites are not suitable in terms of social impacts on the surrounding areas. Therefore more suitable alternative sites are sought by the PWD and the Study Team in collaboration.

Two alternative sites for the STP covering Calangute and Candolim were newly attempted, for the two alternative sewerage plans of separated and integrated sewerage systems, at the north end of Calangute Panchayat (Baga) and at the south end of Candolim Panchayat. Judging from the environmental point of view, the site in Baga, which is open area at the moment, is more suitable for STP, because the alternative site in Candolim is limited in space, currently used as paddy field, and rather close to a residential area.

As results of the alternative analysis from different aspects by Feasibility Study, the separate sewerage system is selected for Calangute. Accordingly, the site in Baga is selected for the separate sewerage system. The selected site is a large area apart from residential areas. The STP site is around 700m away from the CRZ. A stream goes nearby the site into the right side of Baga Beach

10.4.10 Environmental Mitigation Plan

(1) General Mitigation Measures

1) Detailed Design Phase

During the detail design stage, attention should be paid to the following aspects:

- Route selection should be made to minimise land acquisitions, to avoid rehabilitation and resettlement, damage to historical or cultural properties, damage to existing infrastructure, indiscriminate felling of avenue trees, etc.
- Safety measures will be taken care of by following relevant codes of practice.
- Clearly sort out land acquisition issues to avoid delay in implementation of the project due to disruptions by public. Realistic monetary compensations should be made for private land acquisitions.

2) Construction Phase

The construction phase impacts have been outlined in 10.4.11 Anticipated Environmental Impacts & Mitigation Measures, (1). All these adverse impacts have been taken into consideration. Following measures should be adopted in general for all activities:

- Minimum damage to existing flora and fauna, structures, electricity and telephone cables.
- Minimum disturbance to the local activities and business should be ensured.
- The sewer pipes should be stacked properly in a pre determined location and should not be cluttered around blocking the pedestrian area alongside the roads.
- Excavated earth should be prevented from getting washed into drainage channels, rivers and canals.
- Surplus excavated earth should be disposed of immediately.
- Measures should be taken to prevent direct discharge of polluted waters from construction activities into lake, rivers and irrigation canals.
- Pavements and roads should be repaired immediately following the construction activity and the project and surrounding area should be restored to as near as possible pre-project conditions.
- Adequate measures should be taken to minimise construction related noise.
- Proper precautions should be taken against risk of accidents.

3) Operation Phase

The operation phase impacts have been outlined in 10.11. Anticipated Environmental Impacts & Mitigation Measures, (2). All these adverse impacts have been taken into consideration. The following measures should be adopted in general for all activities:

- The treated water quality should be maintained as per the requirements at all times.
- Air and noise quality should be monitored and corrective action taken in case it exceeds applicable norms.
- Proper precautions should be taken for the good health of the operatives and the population.

Table 104.11 Environmental Mitigation Plan

	Environmental Issues	Adverse Impact	Nature of Impact	Proposed Mitigation Measures	Implementing Authority
1. DETAILED ENGINEERING PHASE					
1.1	Route Selection for Trunk Sewers and Transmission Mains	<ul style="list-style-type: none"> • Land acquisition leading to resettlement with unrealistic compensation • Improper right of way selection temporarily affecting telecommunication/ electricity • Reckless felling of avenue trees 	Significant and permanent	The trunk sewer right of way has been selected or to be selected: <ul style="list-style-type: none"> • to minimise land acquisition, damage to cultural properties • to minimise road/river/canal crossings • to avoid water transmission lines, felling of avenue trees 	Consultant/ PWD
1.2	Corrosion of Sewers / Transmission Mains	<ul style="list-style-type: none"> • Short life of trunk mains • Rampant corrosion can lead to public health problems due to leakage of untreated sewage 	Significant	<ul style="list-style-type: none"> • To propose proper design and construction of sewers, with adequate ventilation, and, if needed, an effective protective lining • Proper precaution to be taken to control mixing of industrial wastewater with domestic sewage 	Consultant/ PWD
1.3	Safety of Sewers / Transmission Mains	<ul style="list-style-type: none"> • Unsafe sewers can lead to public health problems and cause general nuisance to public 	Significant	<ul style="list-style-type: none"> • Relevant codes of practice to be followed during design and construction stages 	Consultant/ PWD
1.4	Misuse of Sewers for Storm water	<ul style="list-style-type: none"> • Leads to blockages of the sewers and overflows • Leading to potential public health problems and causing general nuisance 	Significant	<ul style="list-style-type: none"> • Completely separate sewerage and storm water drain is not possible; misuse should be prevented 	Consultant/ PWD

	Environmental Issues	Adverse Impact	Nature of Impact	Proposed Mitigation Measures	Implementing Authority
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2. CONSTRUCTION PHASE

2.1	Soil Quality	<ul style="list-style-type: none"> • Due to excavation and earthwork: soil erosion, loss of top soil, silting and blocking of drainage/ nallahs, which can cause slush; damage to existing structures • Due to compacting: loss of original quality, reduction in fertility 	Significant and Permanent	<ul style="list-style-type: none"> • Stabilise all slopes with provision of benches/pitching • Avoid earthwork during monsoon • Provide adequate cross drainage facilities • Preserve top soil to be replaced after the completion of construction activity; avoid wet soils • Dispose of surplus earth after raising levels and refilling trenches, in low lying areas with proper compacting and planting of surfaces • Plant shrubs/trees on exposed slopes and surfaces 	Contractor/ PWD
2.2	Air Quality	<ul style="list-style-type: none"> • Localised increase in dust due to excavation & earthwork • Temporary increase in the levels of SO₂/NO_x, from construction equipment and vehicles 	Significant and Temporality	<ul style="list-style-type: none"> • Dust control through sprinkling / washing of construction sites and access roads particularly in congested areas • Use of dust cover over construction material • Dust collectors should be used in all drilling operations • Construction material trucks to be covered to minimise spills • Construction requiring heavy traffic street closing/ diversion to be carried out during night time 	Contractor
2.3	Noise Pollution	<ul style="list-style-type: none"> • Increase in noise levels due to construction work, transport of construction materials etc. 	Significant and Temporality	<ul style="list-style-type: none"> • Equipment emitting noise over 90 dB should be avoided • Where residences are located within 200 m and in sensitive areas like hospitals, schools, zoos, noisy construction work should be carried out in day time only • Equipment maintenance strengthened to keep them low noise • Sound barriers should be installed if needed 	Contractor

	Environmental Issues	Adverse Impact	Nature of Impact	Proposed Mitigation Measures	Implementing Authority
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2. CONSTRUCTION PHASE

2.4	Water Quality/ Drainage	<ul style="list-style-type: none"> • Increase in turbidity affecting surface water quality • Sanitary pollution 	Significant	<ul style="list-style-type: none"> • Ensure steps to prevent earth and stone from silting up the nallahs and drainage systems • Control run off and soil erosion through proper drainage channels and structures; improve existing cross drainage and provide extra cross drainage works wherever necessary • Provide adequate sanitation facilities to construction site workers 	Contractor/ PWD
2.5	Traffic	<ul style="list-style-type: none"> • Traffic jams, bottlenecks, delays and inconveniences to general public • Serious disruptions of vehicular traffic, pedestrian access and commerce 	Significant and Temporary	<ul style="list-style-type: none"> • Co-ordinate and plan all activities in advance • Adequate actions to direct traffic in consultation with highway and traffic police • Minimise vehicle movements • Preference for unused or low traffic roads • Construction of temporary roads and diversion of traffic • Use local construction materials to avoid long distance transportation, especially of earth and stones • Seek public co-operation through public awareness 	Contractor/ PWD/ Traffic Police
2.6	Risk of Accidents	<ul style="list-style-type: none"> • Endangering lives of people/workers during construction due to inadequate safety measures 	Significant	<ul style="list-style-type: none"> • Adequate traffic control measures should be taken • Sign board warning presence of open sewer trench • Guard rails to protect pedestrians • Strong safety policy for workers; protective helmets to be provided 	Contractor/ PWD
2.7	Aesthetic Conditions	<ul style="list-style-type: none"> • Visually anaesthetic conditions due to cluttering of waste, and spoils, dug up roads and pavements 	Significant and Temporary	<ul style="list-style-type: none"> • Enhance aesthetics through proper housekeeping of construction site • Disposal of construction wastes at the approved sites quickly • Repair pavements and roads after sewer laying work is completed • Completing the construction activity by removing all spoils 	Contractor

	Environmental Issues	Adverse Impact	Nature of Impact	Proposed Mitigation Measures	Implementing Authority
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2. CONSTRUCTION PHASE

2.8	Land Acquisition	<ul style="list-style-type: none"> • Inadequate compensation • Inadequate utilities in the rehabilitation area • Relocation trauma and infections and other diseases in the new location 	Significant and Permanent	<ul style="list-style-type: none"> • Minimise relocation • Advance realistic payments to be made to relocated (estimation for compensation for land and property should be made on the prevailing market rates) • Provision of clean drinking water to national potable water standards, sanitation, proper drainage at new locations 	PWD
2.9	Construction Camps	<ul style="list-style-type: none"> • Prevalence of unsanitary conditions and practices like open air defecation • Possibilities of public health problems • Piling of garbage from workers 	Significant and Temporary	<ul style="list-style-type: none"> • Adequate measures such as provision of septic tanks/pit latrines around the construction camp sites • Provision of clean drinking water to potable water standards • Collection of garbage in garbage cans in fixed places and disposal of it regularly 	Contractor
2.10	Public and Workers' Health	<ul style="list-style-type: none"> • Adverse health of workers due to unsanitary practices and spreading of diseases from vectors 	Significant and Temporary	<ul style="list-style-type: none"> • Workers are the immediately affected people • Proper sanitation and drinking water should be provided • Medical facilities to be provided to prevent communicable diseases 	Contractor/ PWD

	Environmental Issues	Adverse Impact	Nature of Impact	Proposed Mitigation Measures	Implementing Authority
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3. OPERATION PHASE

3.1	Air Quality	<ul style="list-style-type: none"> Problems of bad odour from the treatment plant 	Significant	<ul style="list-style-type: none"> Some bad odour from sewage treatment plant is unavoidable; however, steps should be taken to minimise odour by proper maintenance and housekeeping of the treatment plant 	PWD/ Operator
3.2	Water Quality	<ul style="list-style-type: none"> Overflow of sewers and breakdown of treatment plant leading to failure in meeting the requisite standards Poor performance will affect the proposed reuse for irrigation, and also the receiving water body 	Significant	<ul style="list-style-type: none"> Preventive maintenance of all components should be performed regularly Relevant standby equipment and spare parts should be provided; standby power generation should be provided at pumping stations, if any Proper response plan must be prepared 	PWD/ Operator
3.3	Sludge Treatment & Disposal	<ul style="list-style-type: none"> Improper treatment of sludge could lead to putrefaction and other related problems such as bad odour, health effects etc. 	Significant	<ul style="list-style-type: none"> Sludge should be treated properly and dewatered Dried sludge should be given for land application to farmers, if it can be handled properly by them 	PWD/ Operator
3.4	Offensive Odour	<ul style="list-style-type: none"> Raw sewage and excess sludge lead to generation of offensive odour 	Significant	<ul style="list-style-type: none"> Appropriate wastewater and sludge treatment technologies which cause less odour such as Oxidation Ditch The installment of air sealing cover on wastewater and sludge treatment facilities 	PWD
3.5	Public Health	<ul style="list-style-type: none"> Mixing of sewage with drinking water Outbreak of waterborne diseases Unhealthy conditions: mosquito breeding over sludge drying beds, etc. 	Significant	<ul style="list-style-type: none"> Any such health risk to public should be minimised by proper maintenance and operation of sewers, pumping stations, treatment plant etc. In case of failure, inform relevant authorities to alert public at risk so that precautions might be taken 	PWD/ Operator

	Environmental Issues	Adverse Impact	Nature of Impact	Proposed Mitigation Measures	Implementing Authority
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3. OPERATION PHASE

3.6	Workers Health & Safety	<ul style="list-style-type: none"> Workers may be inflicted by endemic & other diseases such as malaria or respiratory ailments Accidents and loss of lives may occur during sewer cleaning & maintenance Non availability of emergency medical facilities at all times during day & night 	Significant and Permanent	<ul style="list-style-type: none"> Proper house keeping of the plant to prevent unsanitary conditions Regular medical check ups and immediate treatment of affected workers Maintenance personnel should not perform dangerous tasks when alone, enter the manholes without checking for gas and without proper protective clothing, enter the manholes without ropes and harnesses firmly tied Manholes should not be left open especially in busy roads, near schools and residential areas 	Operator/ PWD
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(2) Mitigation Measures for Sewage System and Water Distribution System

Selection of route for sewers and transmission mains is one of the most important activities in the pre-construction phase. In order to minimise negative environmental impacts and land acquisitions, to avoid involuntary resettlement and rehabilitation problems and in general, from a social point of view, to minimise severance and other problems due to pipe laying activities, the sewers and transmission mains must be laid along the roads.

Pumps and associated equipment form generally the weakest point in the system. In addition, sewage and water pumping is always a management problem. It results in environmental impact of noise and odour and there are significant environmental risks associated with the failure of pumping stations.

Construction of the sewerage system and water distribution network comprise: carrying the pipes to the site, excavation, laying the sewer and water pipeline, making good of the site after laying the pipeline, disposal of spoil/excavated material. All relevant codes of practice should be followed during detail engineering and construction phases to ensure pipelines safety and protection against corrosion.

The risk of accidents should be minimised by taking all the proper precautions during the sewer and transmission mains laying activity. In some narrow roads and busy crossings, care must be taken for proper diversions of the traffic with the help of the traffic police. Care should also be taken to avoid damaging existing infrastructure, telephone and power supply electric cabling, poles etc. and minimising the construction level impacts.

(3) Mitigation Measures for Sewage Treatment Plant

1) Water Quality of Effluent

First and foremost, care should be taken to ensure adequate treatment to meet the discharge effluent standards. Treated water quality should be monitored carefully so as to meet the discharge standards effectively.

2) Sludge Disposal

The sludge from the WTP and STP should be disposed of in an environmentally acceptable manner. The sludge should be dewatered in sludge drying beds and the dried sludge is proposed to be used as fertiliser since it is biological in nature and has soil quality enhancing properties. However, the following precautions should be taken in the treatment, handling and disposal of the sludge:

- to facilitate proper drainage to avoid standing water leading to mosquito breeding,
- to develop a green / planting belt all around treatment plant, especially around sludge drying bed to reduce odour nuisance,
- to take care that the operatives handling the sludge are properly clothed with gloves and gum boots and not handle the sludge with bare hands.

3) Offensive Odour

Most of the proposed sites for the new STPs are set apart from residential areas, the odour seems not to have significant impacts. However, it is easily predicted that residential areas have been developed around not only Margao STP but also new planned STP after its construction.

Mitigation measures to reduce the offensive odour are especially required for the further expansion of the existing STPs and for the construction of new STPs. Recommended main mitigation measures are follows:

- to apply appropriate wastewater and sludge treatment technologies which cause less odour such as Oxidation Ditch
- to install air sealing cover on wastewater and sludge treatment facilities

10.4.11 Environmental Management, Training, and Monitoring Plan

(1) General

Mitigation measures are implemented and their effectiveness should be monitored description of administrative aspects of ensuring. The success of the Environmental Monitoring Programme depends on the efficiency of the organisational / institution set up responsible for the implementation of the programme.

For a water supply & sewerage projects of proposed capacity, the Environmental Management Plan needs to be entrusted, in both the construction and the operation phases, to an Environmental Management Group, and regular monitoring of various environmental parameters is also necessary to evaluate the effectiveness of the management programme so that necessary corrective measures could be taken in case there are some drawbacks in the proposed programme.

The Environmental Management Plan has to consist in:

- setting up an Environmental Management Group to implement the mitigation measures in operation phase;
- ensuring a proper operation and maintenance of the treatment works;
- ensuring a proper maintenance of the sludge drying beds and the disposal of dry sludge with a proper treatment;
- monitoring the treated water quality;
- monitoring the built in pollution control equipment, for vehicles and equipment;
- maintaining tree plantations around the STP facilities and the periphery of the water treatment plant.

(2) Environmental Management Group

The Environmental Management Group (EMG) is part of the staff in charge of the operation and maintenance of the water supply facilities. However, these staffs are in charge of the overall management of the environmental aspects of the Projects.

The staffs convene to provide by the operator of the Water Treatment Plant, Sewage Treatment Plant and Pumping Station. Under the supervision of an Environmental Engineer, the EMG comprises an Environmental Scientist, a Chemist and a Biologist, plus three assistants.

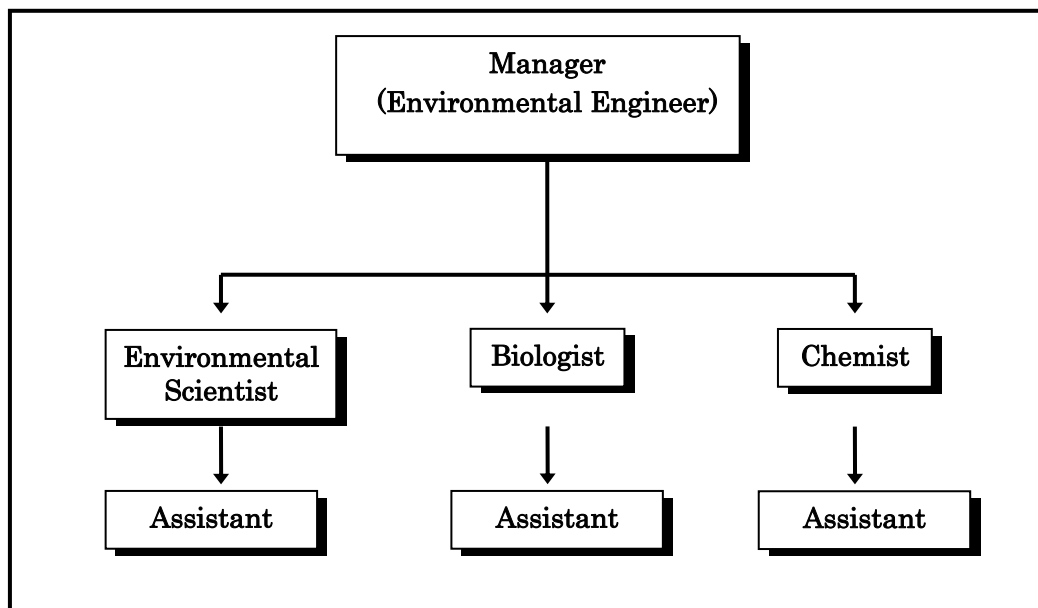


Figure 104.7 Model Organisation of Environmental Management Group

(3) Monitoring Plan

To make an evaluation the effectiveness of the Environmental Management Plan, regular monitoring of the important environmental parameters must be taken up by PWD themselves with / without the help of outside agencies.

1) Water Quality

The sampling of various inlets and outlets was carried out for analysis of relevant parameters. The analysis must be done at least once in a month both at the inlet and outlet of the STP & WTP. Some of the parameters should be tested daily if possible. This routine practice would help PWD evaluate the performance of individual units of the sewage treatment plant and take corrective measures if the results are not satisfactory.

2) Air Quality

Ambient air quality should be monitored for SO₂, NO_x, SPM, etc. At the STP, H₂S and CH₄ should be monitored. Instruments like high volume air samplers and other monitoring kits should be used for the purpose of air quality monitoring. For the operation period, monitoring

points should be fixed in consultation with the Pollution Control Board in Goa.

3) Noise Monitoring

Noise levels should be monitored in working space and main noise producing sources such as the equipment using motors, pumping stations, over the boundary and around the sewage treatment plant.

4) Environmental Testing Laboratory

A well equipped laboratory for routine analysis of raw water / sewage and treated water as well as for ambient air quality and sludge analysis should be provided at the sewage treatment plant site. The biological testing facility should be provided in the laboratory in addition to chemical analysis of water. The record of analyses should be maintained at the plant on-site for all the parameters mentioned in the Monitoring Programme.

5) Environmental Training and Budget Planning

The environmental monitoring programme will be successful only if it is implemented by trained and skilled staff. The training of the qualified staff should be necessary not only in day to day operation and maintenance of the treatment plant, but also in environmental aspects.

It is essential to involve the staff who will be responsible for the execution of the Environmental Management Plan, in the construction phase, as well as to train the staff in practising the mitigation actions.

The training should include:

- Concepts of pollution control techniques in the various methods of sewage treatment,
- Operation and maintenance of the sewage treatment plant,
- Emergency preparedness to handle adverse situations,
- Principles of water quality analysis,

This training is different from the mandatory training required for operation and maintenance of the water treatment plant.

Assumable details about the annual costs of the Monitoring Plan as mentioned above for the monitoring components are as follows:

- | | |
|--|---------------|
| i. Cost price of environmental parameters (12 times) | Rs. 600,000 |
| ii. Setting up the Environmental Testing Lab. | Rs. 3,000,000 |

iii. Training in environmental management (6 persons)	Rs. 300,000
iv. Miscellaneous expense	<u>Rs. 100,000</u>
TOTAL	Rs. 4,000,000

After establishment of Environmental Testing Laboratory, envisioned administrative and maintenance expense will cost about 1 million Indian Rupees annually.

10.5 Evaluation and Conclusion of the Rapid-EIA Study

10.5.1 Project Benefits and Positive Impacts

(1) Environmental Aspect

Objective of implementation of the water supply and sewerage schemes are to improve the public health and hygiene, lead to improvement in quality of living and gaining economic growth. Therefore, implementation of each scheme will be brought about following benefits and positive impacts:

- The collection and treatment of untreated sewage before entering the rivers can improve water quality of the rivers.
- Proper collection, treatment and disposal system of sewage can reduce the risks of parasitic infections, incident of various water-borne diseases.
- A proper sewage handling and disposal arrangement can minimize the chances of contamination of ground and surface water.
- Controlled reuse of sewage sludge may be enhanced agricultural activities and development and also sustenance of environmental protection.
- Improvement in the existing sewerage system can help a function of urban drainage to reduce the nuisance in streets and road blockages that set up floods.
- Nutrient rich treated water and dried sludge can be used for irrigation, as a material of cement.

Especially sewerage schemes, implementation of priority projects can make significant contributions to improve living environment, sanitary conditions for populations and to conserve irreplaceable natural environment.

(2) Social Aspect

The proposed water supply and sewerage systems are social infrastructures and are mainly benefit the local residents directly and indirectly through environmental improvement.

The expected positive impacts of the selected water supply projects include:

- increase in the population supplied with safe piped water,
- improvement of supplied water quality,
- continuous water supply,
- reduction of waterborne diseases,
- improvement of financial situation by NRW reduction,
- more water supply available to tourist facilities,
- more water supply available to industries, etc.

Currently, many water consumers have complains about water shortage, limited and irregular timing of water supply, risk of water supply to be contaminated by sewage, improper costumer services such as broken water meters. These problems will expectedly solved by the implementation of the Priority Projects which include the improvement of water supply facilities, information management system, and costumer services.

The priority projects cover the increase of water demand necessary up to 2018 in Goa. At a domestic level, convenience of water supply will be significantly had access to 24 hours-7days water supply in widely areas. Large water consumers such as hotels and factories can also be provided with sufficient water. From a viewpoint of fairness, the regional gap in water supply service, between towns near WTPs and tail-end towns of water transmission are also significantly reduced by the increase of water supply

On the other hand, the expected positive impacts of the sewerage priority projects include:

- improvement of water quality in rivers and beaches,
- improvement of living environment including gutter and local streams,
- reduction of the overflows from existing septic tanks,
- improvement of the sanitary conditions and images of towns and costal areas,
- reduction of the risk of disease and enhancement of human health,
- improvement of socio-economic conditions to attract more tourists especially in tourism destinations,

Currently, many residents have complains about overflows from their septic tanks, unsanitary living environment due to open defecation, etc. These problems can expectedly be solved by the implementation of the priority projects which includes a basic plan to expansion of existing sewerage facilities in Margao as well as development of new sewerage systems. The priority projects also address the importance to enhance the public awareness on sanitation for the

effective use of the proposed sewerages. The awareness enhancement should be carried out in the Total Sanitation Campaign subsidized by the central government of India.

In the above, the social benefits of the priority projects are evaluated qualitatively. The expected level of environmental improvement by the sewerage projects is qualitatively evaluated more detailed in Volume II Chapter 13 Section 4 Environmental Aspects. Moreover, the benefit of saving time and medical cost by the reduction of water-borne diseases and the benefit of water environment preservation for tourism are qualitatively evaluated in the economical evaluation of the Feasibility Study (see Volume III Chapter 9 Economic and Financial Evaluation).

10.5.2 Minimization Negative Environmental & Social Impacts

(1) Environmental Aspect

In planning network of sewerage system, the points such as site location and space availability for sewage treatment plant, early start of treatment, initial and O&M cost etc. are considered;

In the former F/S study taken by PWD, locations of some new sewage treatment plants (STP) were close to the township and populated area. In this plan, there are some negative impacts not only transmigration/land acquisition but also urban environmental nuisance such as noise, vibration, water pollution and destroy the scenery. However, proposed sites of the priority projects are in the empty lots avoiding from the residential and commercial areas of objective cities.

(2) Social Aspect

The minimization of presumable negative social impacts caused by the priority projects has been considered through the process of environmental and social considerations while implementing the Feasibility Study. The following summarizes the level of negative social impacts after their recommended mitigation measures are appropriately applied.

The following two items are identified as presumable negative social impacts of the priority projects through the environment scoping of the Rapid-EIA.

- The offensive odour from STPs
- The acquisition of lands currently used for agriculture and horticulture for the proposed new STPs and WTP

The odour from STPs can be reduced significantly by the appropriate adoption of sewage and

sludge treatment technologies. The selection of most suitable technologies for each STP was conducted in the phase of Feasibility Study along with considering the other mitigation measures.

The negative impacts of the land acquisition of can be minimized thorough the compensation measure. Concerned residents living or working around the proposed STP and WTP sites have been already invited to the stakeholder meetings. The compensation measure will be explained to more residents around the sites to reduce the social impact by early notification.

CHAPTER 11

RECOMMENDATIONS AND ACTIONS TO BE TAKEN BY PHE

CHAPTER 11 RECOMMENDATIONS AND ACTIONS TO BE TAKEN BY PHE

Confirmation of the design through the Detailed Design phase

The preliminary design conducted during the feasibility study stage of this project described in this report was based on a preliminary topographic survey and preliminary geotechnical investigations. The preliminary design was undertaken to identify possible locations and land area requirements for the proposed facilities, and potential pipe alignments. The preliminary design was also used to estimate the project costs used in the economic/financial analysis and to provide basic information for international lending agencies. The preliminary design is not suitable to inform construction work.

Construction work should be based on detailed design drawings, not the preliminary design drawings. The detailed design drawings will be prepared as part of the next stage of the project. The detailed design drawings will be based on more detailed topographic survey and further geotechnical investigations. A more detailed topographic survey may provide more accurate information about land ownership. Further geotechnical investigations are required to locate any underground utilities such as telephone and electric cables. Depending on the location of these utilities the location of the proposed facilities, the pipe alignments, or the foundation types of facilities may need to be revised from those proposed in the preliminary design.

11.1 Water Supply System

(1) Preparation of Asset Drawings

The PHE does not have asset drawings of the current water supply facilities or maps that cover all the water supply areas. Therefore the PHE should prepare at least the following drawings and maps with adequate scales, and keep those not only at the headquarters, division offices and sub-division offices but also at the site of each facility.

- General location maps and general layout plans for the facilities
- Intake Facilities
- Treatment Facilities
- Transmission Mains
- Reservoirs and MBRs
- Pumping Stations
- Distribution Networks
- House Connections

(2) Collection of Operation and Maintenance Data

The PHE does not maintained records and data of the operation and maintenance of the schemes in uniformed format. Therefore the PHE should collect and maintain at least the following data and records, and keep those not only at the headquarters, division offices and sub-division offices but also at the site of each facility.

- Water Quality Data concerning raw water, treated water and tap water
- Asset Data
- Operational and Maintenance Records

(3) Preparation of Operation and Maintenance Manuals and Plans

There are no standard operation and maintenance manuals or plans for the treatment plants, transmission systems or distribution systems. Therefore the appropriate operation and proactive maintenance are difficult. The PHE should prepare the operation and maintenance manuals and plans for all facilities and equipment.

(4) Cleaning up the Facilities

Chemical storage conditions are inadequate and poor at almost all WTPs. The PHE is recommended to clean up at all facilities and to keep clean not only for appearance and keeping of good condition and quality but also for as safety measures.

(5) Repair of Visible Leaks

There are many visible leaks at the WTPs and at the air and scour valves located along the transmission and distribution mains. It is recommended to repair all visible leaks as soon as possible.

(6) Implementation of On-going Projects without Delay

The PHE is implementing the following projects at present. For preparation of the master plan and feasibility study has taken these projects into account. The PHE should execute these projects without any delays or suspensions.

- Augmentation of Dabose WSS, 10MLD WTP
- Augmentation of Canavona WSS, 10MLD WTP
- Augmentation of Assonora WSS, 50MLD WTP
- Installation of ϕ 900DI Pipes to Panjim
- Replacement of ϕ 1400PSC Pipes with MS Pipes from Salaulim to Margao

(7) Ganjem and Maisal Schemes

The PHE has plans of implementation of the Ganjem (25 MLD) and Maisal (10 MLD) Schemes for securing the water supply to Panjim as emergency measures. General plans on these schemes have prepared respectively according to the request and information from the PHE and the results are attached to Volume IV Appendix for Master Plan. It is, however, recommended that the PHE should study in detail the necessary capacity of each scheme based on the demand projection and possibility of supply area from each scheme comparing with costs required.

(8) Development of Distribution Network

It should be noted that since the priority projects cover only transmission pipelines upto the reservoirs, the PHE should develop distribution network systems from the reservoirs depending on the expansion of the service area for the Salaulim WSS and install the distribution pipelines and house connections every year as the routine works. If the PHE does not install adequate distribution pipelines, the Salaulim WTP after the expansion works will not be able to supply the treated water of additional 100,000 m³/day to the expected service areas to be expanded.

11.2 NRW Reduction Recommendations and Actions

PWD will need to consider implementation of the NRW Reduction Roll-out Plan as detailed in Volume III Chapter 4 section 4 Outline of the Roll-out Plan and Table 44.1 and in doing so will need to progressively implement the detailed NRW mitigation measures as detailed in Table 44.2 in order to bring NRW under control now and into the future.

The scale of the tasks involved in tackling NRW reduction as detailed in the tables mentioned above should not be underestimated and PWD will therefore need to decide on the best strategic approach in bringing NRW under control as well as maintaining it within acceptable and economic levels in future bearing in mind the desire to augment schemes and to provide 24 hour supply capability.

The key questions that PWD will need to consider are as follows:

1. Do PWD have the required desire, leadership, commitment and resources to implement a successful and sustained approach to reducing NRW and maintaining it under control?

2. Do PWD have the in-house capabilities to implement the NRW reduction roll-out plan and to conduct the NRW mitigation measures detailed in Table 44.2?
3. Will PWD require additional external technical assistance to help them build capacity in order to successfully implement the NRW reduction roll-out plan?
4. Will PWD need to 'contract out' the initial NRW reduction to an acceptable target level by means of a 'management contract' and then take-over NRW management once this target level has been achieved?
5. Will Salaulim be targeted as a priority area for NRW reduction based on the fact that this scheme will be refurbished and expanded as part of the feasibility phase? If so, how will the necessary NRW mitigation measures be managed?
6. Will other schemes and supply areas be prioritised for NRW reduction based on their relative size; volume into supply, contribution to revenue, number of customers supplied, or on other factors such as water scarcity?
7. Will NRW reduction efforts and priorities be driven on commercial, social or political grounds?

11.3 Sanitation System

11.3.1 Sanitation Improvement Outside the Sewerage Area

It is recommended that the PWD undertake sanitation improvement for the areas outside of the sewerage service area. To achieve this, the PWD should provide technical and financial assistance to residents for the construction and maintenance of on-site and decentralized treatment facilities. It is also recommended that the PWD improve its public relations regarding sanitation.

11.3.2 Improvement and Replacement of Existing Facilities

The oldest part of the existing sewerage system in Panaji was constructed in the 1960s. Parts of the existing sewers have decrepit internal conditions and may not have enough capacity to cater for increasing populations in the service area.

11.3.3 Sewer Cleaning

The blockage of sewers causes serious problems for sewerage systems. Blockages not only generate odour, but can also cause sewage overflow into gutters and contamination of groundwater. Periodic sewer cleaning is necessary to prevent blockages and to prevent a decline in the sewer capacity (caused by the accumulation of sand, soil and other materials). It is therefore recommended to undertake a survey of sewer conditions, to prepare a cleaning schedule, to procure cleaning equipment, to secure appropriate personnel, and to prepare a budget.

11.3.4 Management and Utilization of Asset Data and O&M Records

The PWD does not have a proper management system for their asset data or water supply and sewerage system records. During the study, the Study Team tried to collect the following data and drawings, but these were not available in a standard and easily accessible format in the PWD office:

- ✧ List of assets and their current status;
- ✧ Asset drawings and specifications;
- ✧ Past records of operation and maintenance

Therefore, it is recommended that the PWD prepare and keep systematic written records and data on their assets and activities. This is very important for water supply and sewerage not only for management but also for routine operation and maintenance.

11.3.5 Ambient Water Quality Monitoring

Water quality data analyzed by PWD or agencies concerned are not adequately accumulated and it is difficult to utilize these data for evaluation of environmental conditions. The PWD should monitor surface and groundwater, in order to assess and improve water quality. An effective monitoring system should involve relevant organizations and agencies, such as the pollution control board, the health department, and the water resource department. It is recommended that water quality monitoring data be shared between the related organizations and agencies. For this purpose, the proposed pilot projects include setting up a central laboratory for water quality monitoring.

11.4 Operations & Maintenance Recommendations and Actions

11.4.1 Water Supply Schemes

Based on the review of current O&M practices undertaken during the first and second phases of the JICA study, PHE will need to consider implementing a number of recommendations over the life of the Master Plan as shown below.

Table 114.1 Water Supply Schemes Improvement Recommended Actions

No	DESCRIPTION	PRIORITY	COMMENT
WATER TREATMENT FACILITIES AND SUPPLY NETWORKS			
1	Refurbish all out of service plant and equipment such as chemical mixing and dosing equipment	Short term to medium term	Will require investment program based on plant criticality
2	Develop plant criticality assessment model	Short term	Assign criticality levels to key plant and equipment and priorities maintenance
3	Develop and implement planned maintenance schedules	Short term	Carry out tasks accordingly including lubrication schedules
4	Prepare Strategic mains plans	Short term to medium term	Digitise all networks starting with the strategic mains
5	Stop all reservoirs and water towers from overflowing	Short term	Use of inlet controls or indicators back to the pump control or treatment facility
6	Introduce a system of key performance measures	Short term	Monitor performance against agreed targets for each team/division/region
7	Ensure that all Contractors are 'qualified' (certified) to work on PHE networks both existing and new	Short term	Introduce a system of contractor certification or accreditation, set appropriate standards of repair and enforce standards
8	Centralise responsibility for water quality sampling, analysis and reporting at plants, reservoirs, network critical control points and customer taps	Short term	Ensure procedures, equipment and staff training for to collection and analyses of samples in accordance with Indian
9	Practice open style of management, encourage cross process working and sharing of best practice	Medium term	Introduce a system of 'knowledge management'. Provide and act on management information

No	DESCRIPTION	PRIORITY	COMMENT
10	Develop staff competencies to meet current and future technological improvements such as computer, instrumentation, PLC, telemetry skills	Medium term	Buy in skills where development is not possible
11	Introduce system for continuous process reviews to ensure that all treatment processes conform to agreed quality standards at least cost.	Medium term	Will require some process re-engineering
12	Ensure networks are analysed for optimum flows/pressures.	Medium term	Introduce appropriate software and train staff on network analysis. This will require installation of flow and pressure measuring devices at 'critical control points'
13	Consider the introduction of a system to capture spatial information.	Medium term	As part of the IS strategy, consider introduction of a Geographical Information System (GIS) as well as other systems for asset management such as a computerised maintenance management system (CMMS)
14	Design Zones and DMA's for 24 hour supply systems and automate for speed of response	Medium term	Refer to the 'NRW Reduction Improvement Plan'

11.4.2 Sanitation Schemes O&M Improvement Plan – Recommended Actions

Based on the review of current O&M practices undertaken during the first and second phases of the JICA study, PHE will need to consider implementing a number of recommendations over the life of the Master Plan as shown below.

Table 114.2 Sanitation Schemes Improvement Plan – Recommended Actions

NO	DESCRIPTION	PRIORITY	COMMENT
SEWAGE TREATMENT PLANTS, SEWAGE PUMPING STATIONS AND SEWERAGE NETWORKS			
1	Chlorine facilities (currently Panaji STP only)	Short term	Introduce safe systems of work including written procedures for handling and connection of cylinders to chlorinators, maintenance of equipment, including replacement intervals for copper piping etc. Install gas detectors and ensure that immersion tanks are fit for purpose. Ensure forced air breathing apparatus is available, used and properly maintained
2	Install meters at ‘intake’ and ‘effluent discharge’ points	Short term	Use good quality electromagnetic or ultrasonic flow meters that comply with international standards
3	Develop and implement Best Practice Operating Manuals for plants, pumping stations and networks	Short term	Contents of manuals are suggested in ‘O&M management practice’.
4	Provide appropriate tools for cleaning and unblocking sewers	Short term to medium term	These can be hand tools as well as power tools such as cleaning rods, swabs, gully suckers etc. Implement program of regular cleaning and maintenance or contract out these services
5	Develop plant criticality assessment model	Short term	Assign criticality levels to key plant and equipment
6	Prepare Strategic sewer plans	Short term	Digitise all sewer networks starting with the strategic sewers and consider systematic replacement/refurbishment of inadequate or defective sewers
7	Introduce a system of key performance measures	Short term	Monitor performance against agreed targets for each team/division/region

NO	DESCRIPTION	PRIORITY	COMMENT
8	Ensure that all Contractors are 'qualified' (certified) to work on PHE sewers both existing and new	Short term	Introduce a system of contractor certification or accreditation, set appropriate standards of repair and enforce standards
9	Centralise responsibility for effluent sampling, analysis and reporting at STP's	Short term	Ensure procedures, equipment and staff training for the collection and analyses of samples in accordance with Indian standard parameters
10	Implement systems for recording asset and maintenance data	Medium term	Computerise the capture of asset and maintenance data and implement system of planned preventative maintenance (CMMS)
11	Introduce system of performance management and key Performance indicators in accordance with 'balanced scorecard'	Medium term	Measure performance against standards
12	Develop staff competencies to meet current and future technological improvements such as computer, instrumentation, PLC, telemetry skills	Medium term	Buy in skills where development is not possible
13	Introduce system for continuous process reviews to ensure that all treatment processes conform to agreed quality standards at least cost.	Medium term	Will require some process re-engineering
14	Consider the introduction of a system to capture spatial information.	Medium term	As part of the IS strategy, consider introduction of a Geographical Information System (GIS) as well as other systems for asset management such as a computerised maintenance management system (CMMS)

11.5 Institutional Development

11.5.1 Preparatory Activities for the Capacity Building Agenda

Based on the Capacity Building Plan presented in the previous Chapter, PHE can take various preparatory measures immediately.

Physical System

PHE can immediately take the following steps prior to the implementation of the capacity building plan with respect to the management of the physical water and sewerage systems.

- Prepare an initial list of areas where operation and maintenance guidelines should be developed. There are areas suggested in the O&M assessments.
- Draft a standard format for how each guideline should look like;
- Gather and centralize all existing written equipment manuals and “as-built” drawings;
- Implement the expanded NRW Reduction Program based on the pilot study to other key areas following Section 12.2 above; and,
- Identify and agree on other areas of current operations which could be outsourced for public private partnerships.

Organization Planning System

On the organization planning system, much of the improvements will have to be initiated during the period of external technical assistance itself. Many of the improvements needed are founded on a new set of corporate values and processes which need to be understood.

Customer Service System

The following steps can be initiated by PHE with respect to the customer service system improvements.

- Review and update its present “Citizens Charter” with a view towards challenging its own ability to provide high quality services to the consumers.
- Continue holding regular consultations with the public on current issues, similar to those Stakeholders Meetings initiated during the Study period.
- Clean up and verify customer database using independent house-to-house surveys in preparation for the implementation of a computerized system.
- Organize and implement the concept of Citizens Advisory Councils to advise PHE management on how to proceed.

Financial Management and Control System

In order to pave the way for the smooth introduction of a unified financial management and accounting system, PHE can take the following steps immediately.

- Organize a series of meetings or workshops on basic accounting concepts and processes for engineers (an appreciation-level training activity – accounting for non-accountants).
- Identify, based on the discussion on financial performance indicators in this Study, the most important and crucial parameters which PHE should use.

Administrative System

To facilitate the introduction of an asset management system and an improved inventory control system, PHE can immediately take up the following tasks.

- Initiate a simple registry of available existing assets, including the current condition of the asset.
- Prepare a unified process map starting from the requisition, procurement, store-keeping, issuance and reporting of all supplies and commonly-used spare parts.

Human Resources Management and Development System

In preparation for the human resources management system improvements, PHE should:

- Conduct a detailed review of the existing available job description in the CPWD Manuals and prepare additional annotations and remarks about other tasks which the incumbents are currently doing or are responsible for.
- Implement the health and safety improvement recommendations indicated in the O&M improvement plans.
- Organize, on an interim basis, a training committee to start planning and implementing basic training programs; identify local resources in the State who may be tapped to provide the training services. Trainers or speakers may be invited to make presentations as part of the regular management staff meetings of PHE.

Management Information System

In the immediate future, PHE should continue to keep abreast of the current initiatives to set up the MIS of the PWD (which currently focuses on capital investment monitoring for roads projects). It should take advantage of the training programs currently underway. The expanded MIS for PHE will seek to be integrated into (and be part of) the broader MIS of PWD.

- Attend the basic MIS training programs currently being organized for PWD staff.

11.5.2 Preparatory Activities for Internal Re-structuring Agenda

PHE management should undertake a detailed review and plan to implement the proposed restructuring, including the movement of staff and transfer of responsibilities. The initial set of the activities involve securing the needed approvals for the restructuring.

11.5.3 Preparatory Activities for the Policy and Legislative Agenda

Much of the needed institutional and managerial improvements will need to be initiated by PHE itself. With respect to the legislative and policy agenda, the Study recommends that PHE an initial paper be put together for discussion first among the PHE management team and for consideration of PWD and State officials. As presented in the Study, the key recommendations involve:

- Authorization of PHE to undertake internal restructuring;
- Authorization of PHE to use of independent financial accounting systems and other financial management guidelines, such as proper treatment of depreciation and use of external auditors and other safeguards;
- Enable PHE to retain revenues generated (plus a state subsidy indexed on revenue generated (or other performance targets) to support water and sewerage services);
- Authorization of PHE to adopt personnel rules and regulations (including, compensation enhancement schemes, incentives, sanctions, job classification, training, etc) based on ;
- Guarantee security of staff to be affected by the reforms; and
- Create mechanisms for regular dialogue with consumers and consumer groups.

The Water Sector Reform initiatives also suggest consideration of new sector policy legislation. The recommendations mentioned above are consistent with the intent and spirit of that reform. It is envisaged that all these policy recommendations will be taken up as a single policy reform action.

The Strategy will be to coordinate with the legislative agenda of ongoing sector reform. If the reform recommendations are fully accepted, the Institutional Development Plan will certainly be more challenging. The scope and scale of the Plan will be tailored to suit the policy decision made.

11.6 Improvement of Financial Management

(1) Planning and design of independent accounting systems

The compilation of independent accounting system tailored for water supply and sanitation services shall be strongly recommended. The intent is to make available to PHE and PWD managers, timely and vital financial information affecting their internal operations as a business. The introduction of this system helps to bring PHE performances more transparent; and help sector policymakers and concerned State officials make informed decisions about tariff and service levels.

Detailed introduction plan of independent accounting system is described in Volume III Chapter 7 Institutional Development and Capacity Building.

Three documents, journal book, general ledger, and trial balance are indispensable to prepare the balance sheet, income statement, and cash flow statement through the daily routine works. Journal book is firstly prepared by recording daily transactions. General ledger is made by sorting the transactions of journal book into each account. Trial balance is prepared by listing all the balances of each account of general ledger. Income statement and balance sheet is compiled by dividing all the account balances of trial balance into two financial documents. Cash flow statement is finally compiled from the data of balance sheet and income statement.

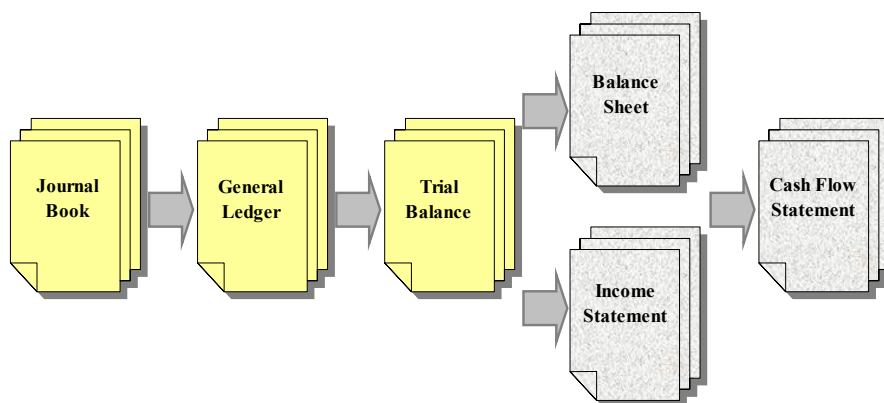


Figure 116.1 Flow chart of accounting / financial document preparation

Publication of financial statements in the form of “Annual Report” and these financial indicators internally or externally shall contribute to the transparency as the public nature of water supply and sanitation services. Followings are the sample of contents of annual report.

Table 116.1 Sample of Annual Financial Report of PHE

No.	Title
1.	Background economic financial condition of the year for compilation of financial statement
2.	Customer data of PHE
3.	Financial Statements of PHE in the fiscal year: 200X/200Y
4.	Financial Analysis of PHE
5.	Long-term financial management policy of PHE
6.	Degree of attainments of financial management targets in the last year
7.	Financial management numerical targets of PHE for the next fiscal year
8.	Financial management schemes of PHE for the next fiscal year

Work allocation and process of financial documents are shown in the Figure 116.2. As a daily routine work, accounting staffs in sub-division office responsible for the record of the journal book, general ledger. At the end of each month, accounting staffs in each sub-division make the trial balance. Trial balance with supporting documents shall be sent to the division office once a month at early next month. Accounting staffs of division office responsible for the compilation of all the trial balances of sub-division offices. Accounting staffs of division office shall make journal book, general ledger, and trial balance for the transaction of division head office itself and shall include them. Accounting staffs in division office prepare the trial balance as division and send it to PHE headquarters.

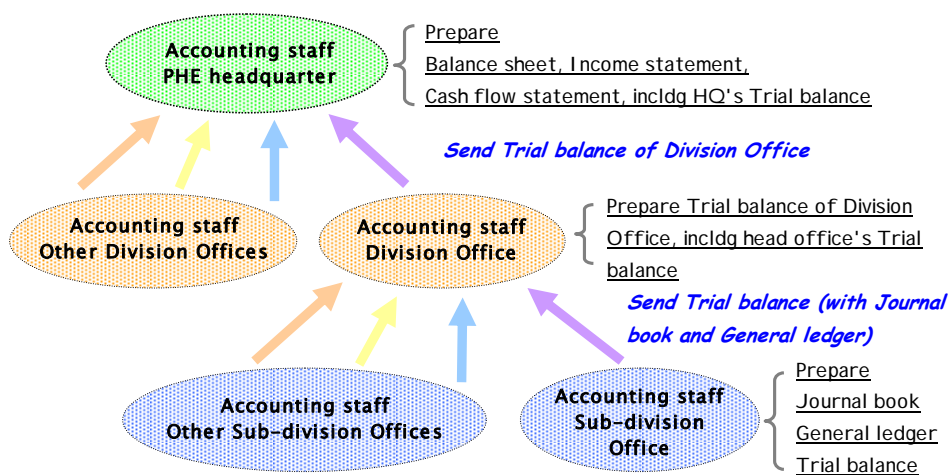


Figure 116.2 Work Allocation of Accounting Procedure

Accounting staffs in PHE headquarters responsible for the compilation of trial balance as PHE and preparation of balance sheet, income statement, and cash flow statement. Accounting staffs of PHE headquarters shall make journal book, general ledger, and trial balance for the transaction of PHE headquarters itself and shall include them. Formal balance sheet, income statement, and cash flow statement is compiled once in a year.

Implementation schedule of the accounting system improvement plan is indicated in the Figure 116.3. It is assumed to take three years for the introduction of independent accounting system. Detailed contents of each action are explained in Volume III Chapter 7 Institutional Development and Capacity Building.

Actions to be taken	1st year				2nd year				3rd year				
(a) Decision and order of introducing the independent accounting system	■												
(b) Preparation of draft format of financial documents	■	■											
(c) Basic study for understanding present asset value		■	■	■									
(d) Preparation of accounting procedure manual for the staff		■	■	■	■	■	■	■	■				
(e) Staff training of accounting procedure			■	■									
(f) Introduction of new accounting system					■	■	■	■	■	■	■	■	■
(g) Preparation of financial statements										■	■		
(h) Selection of financial indicators										■	■	■	
(i) Decision of contents, methods, timing of publication of financial data											■	■	■
(j) Introduction of external audit													■

Figure 116.3 Implementation schedule of accounting system improvement plan

(2) Meter Reading and Bill Collection Procedure

Currently, the meter reading period varies according to the capability of each sub-division. This variation makes it difficult for PHE to understand the management conditions. It is strongly recommended that the PHE standardize the period of meter reading for all sub-divisions. In cases where there is no enough capacity to conduct monthly meter reading, data input, bill preparation or bill delivery, the sub-division are able to conduct meter reading once every two months as described in Volume III Chapter 7 Institutional Development and Capacity Building.

By having consistent meter reading and billing periods across all divisions, the PHE will be able to identify malfunctioning water meters and data input mistakes at bill preparation, in addition to obtaining much useful management and financial information.

(3) Promotion of connection to the public sewer system

Especially in Margao, low connection rate to the public sewer is one of the important problems for PHE's enterprise management. Initial burden on an applicant is one of the major constraints for PHE to increase the customers of public sewer system, since the initial construction cost to connect sewer in their own land is approximately as much as several times of average household income.

Firstly, it is necessary that state government shall establish the legal framework which obligates residents to connect to the public sewer system. Even after the development of the legal system, the initial construction cost is still heavy burden on the residents. Therefore, it is recommended to implement the installment plan for initial cost of public sewer. Installment plan shall be realized by PHE borrowing the certain amount of money from private bank or public lending organization. PHE utilizes the fund from borrowed money from bank and construct the connections to the public sewer for applicants. New customers shall pay the installment payment every month including the interests in addition to the tariff to the PHE. PHE shall make loan repayments to the bank by the installment payments from the customers.

Firstly, installment plan shall be introduced as trial bases, which borrows small amount of money for limited number of applicants. After monitoring the reaction by the applicants such as progress of loan repayment, loan amount and condition shall be considered at the next implementation of installment plan. General processes for the implementation of installment plan are as follows;

It should be noted that there are some possibilities of debt default of customers by taking legal action. Loan agreement between PHE and customers must include the terms avoiding this kind of debt default.

Table 116.2 Implementation process of installment plan

Order	Actions
1	Plan of detailed system of installment plan
2	Official decision of introducing the installment plan and Report of the installment plan to the public
3	Accepting the application and screening of the applicants
4	Loan agreement between PHE and lending organization
5	Loan agreement between PHE and each applicant
6	Receipt of loan and implementation of sewer connection construction
7	Collection of loan repayment from customers and payment to the lending organization

(4) Reduction of Public Stand Post by promoting the house connection

Presently, PWD is promoting the reduction of PSP and application to the house connection. Consumption of water from PSP is usually not billed and does not generate revenue. Unbilled PSP is one of the major causes for the high NRW rate in Goa. Promotion of the reduction of PSP by PHE is appreciated in the aspect of financial management. Introduction of installment payment described above is also considered useful to promote the application to house connection, in case the initial investment cost is the hurdle for new customers. It is recommended that installment plan for water connection shall also be implemented as one of the emergency measures.

11.7 Need for Project Implementation

11.7.1 Project Components

The feasibility study assesses three key components of the target priority projects. The first component is the development of the water supply system. The second component is the development of the sewerage system. These two components require facility improvement and include construction work. These components can be categorized as hardware improvements. The third component is capacity building of the PWD/PHE, including reduction of NRW and asset management. This component is a fundamental part of the first and the second components because it will help to secure the sustainability of the water supply and sanitation systems.

The policy, strategy and action plan for capacity building is discussed in the feasibility study. These items are not only for discussion in the feasibility study but also represent key actions that need to be implemented to support the facility improvement.

The feasibility study recommends actions that would build the capacity of the PWD/PHE. External assistance would be required to implement these actions. A contracted management consultant would provide this assistance. The contractor would develop a detailed action plan for presentation to the PWD/PHE. The action plan would be based on the capacity building plan described in the feasibility study. The contractor would work with the PWD/PHE to assist them implement the action plan. This component would include various kinds of training (including on-the-job-training), and asset inventory surveys to help with asset management.

Utilization of JICA Expert Scheme might be one of alternative external assistances as part of the priority projects.

The technical, financial, and environmental feasibility of the three components of the priority projects have been analyzed in previous chapters. To be financially feasible full O/M cost recovery would be required. This does not currently occur in India. For the water supply project to be financially feasible not only would full O/M cost recovery be required, but part of the capital investment cost would also need to be recovered.

Increases to the water and sewage tariff would be required to recover these costs. The proposed tariff increase plan is presented in the feasibility study. The proposed tariff increases have been carefully set so as not to exceed the customers' willingness to pay and affordability to pay during the design life of the project (through to 2025). The proposed rate for increasing tariffs does not to exceed the historical rate of increases.

In this context, it can be concluded that the project is feasible and that sustainable management of the water supply and sewerage system can be strengthened by undertaking capacity building (which is the third component of the project).

11.7.2 Need for Project Implementation

(1) Reducing water shortages and improving environmental conservation

Water demand has been increasing as a result of population growth, improved living standards, industrial development and the increased number of tourist visiting Goa. The demand now exceeds the supply capacity and water shortages are expected in the near future. To reduce the

likelihood of water shortages the development of the water supply system is required as soon as possible. Increased water usage increases wastewater generation from domestic and non-domestic customers.

Goa is a world famous beach resort. Approximately 1.8 million tourists visited Goa during 2005. The number of tourists is expected to increase to 4 million by 2025. Tourism is one of the most important industries in Goa. Improving the water supply and sanitation situation is fundamental to supporting the development of the industry. Improvements to the sewerage system will help to prevent further contamination of the beautiful natural environment in Goa.

NRW reduction is one of the main components of the capacity building program. NRW reduction will also help to avoid water shortages. JICA Expert Scheme might be applicable for NRW reduction introducing Japanese experiences of leakage and NRW reductions.

(2) Delivering a Continuous Water Supply (24 hours a day, 7 days a week)

Goa's water is currently supplied intermittently, meaning people can only access water several hours each day. The water supply master plan was developed to help move the system from providing intermittent supply to providing a continuous water supply. Currently, no water supply authority in India supplies water continuously. The measures that are needed to provide for a continuous water supply are described in the previous section. As the previous section indicates, to achieve a continuous water supply both technical changes and capacity building are required.

(3) Internal Structural Reform and Independent Accounting System

To transform the PWD/PHE into a more customer oriented, accountable, and effective organization, the feasibility study proposes internal structural reform. The capacity building required for this reform will be undertaken with external assistance.

Currently, the PWD does not undertake financial management because all of the tariff revenue is transferred to the state government. Also, the annual PWD budget is provided by the state government. This situation means there are no strong incentives for the PWD to generate revenue or to reduce expenditure. Therefore, in the long term, it is recommended that the PWD operates to be financially self sufficient. The feasibility study recommends that an independent accounting system be introduced during the transition period. Introduction of an independent account system does not need any changes to the existing legislative framework. The independent accounting system will allow the PWD to improve its financial management

ability gradually. As the PWD becomes aware of and responsible for its financial situation cost savings and increases in revenue will result.

These structural reforms and the introduction of an independent accounting system are recommended for implementation as part of the capacity building project.

(4) Poverty Alleviation

There are very few “notified slums” in Goa, however Margao and Vasco have some small scale slums. These slum areas are covered by the priority water supply project. According to the Government of Goa’s policy, new water connections to low income groups in “notified slums” will be provided by the government but the monthly tariff should be paid by the consumer.

(5) Using this Project as an Example of Best Practice in India

Development indices for Goa state (such as socio-economic levels, living standard, infrastructure, culture and education) are higher than the average figures for India. Therefore Goa has significant potential capability to establish a sustainable, accountable, customer oriented, and reliable public service provider. The priority projects proposed in the feasibility study include aspects of best practice such as providing continuous water supply, capacity building including NRW reduction, asset management, cost recovery, an independent accounting system, and institutional reform. These practices have proven very difficult for India in the past. If these best practices are implemented in Goa, other states in India can learn from Goa’s experiences. This will make it easier to implement similar practices in the other states in the future.

These practices can be implemented in the short and medium term without changing the existing legislative framework or the status of the PWD/PHE as a public service provider. Although the PWD/PHE will remain a public authority, outsourcing some of the services, such as meter reading/billing, operation and maintenance of plant, and sewer cleaning, should be considered as a means of improving the service efficiency.

11.7.3 Actions for Project Implementation

(1) Vigorous Approaches of the Government of Goa

To implement proposed projects and to attract external financial sources, the Indian side understood the importance of vigorous approaches of the Government of Goa to central government or international lending agencies.

(2) Establishment of Project Implementation Unit

To implement to project smoothly, the PWD/PHU should establish the Project Implementation Unit (PIU). Roll and formation of the PIU is described in Volume III Chapter 7 Institutional Development and Capacity Building.. The PIU shall be central control center of entire project implementation from budgetary arrangements for project implementation to handing over the facilities to PHE department concerned.

(3) Reserving Land Space Required for the Projects

According to the consultation with the Government of Goa, land spaces required for the projects are owned by government or communities, therefore, land acquisition will not be required. However, to reserve the land spaces as planned in the feasibility study, coordination with other departments which have jurisdiction of the land and with communities is indispensable and such coordination should be started as soon as possible.

(4) Arrangements of Organization for Operation & Maintenance of the New Facilities

Several new facilities are planned to be constructed under the projects. Organization with adequate staffing should be arranged for susustainable operation and maintenance. Details of arrangements required for the new facilities are described in Volume III Chapter 7 Institutional Development and Capacity Building..