

CHAPTER S5

FEASIBILITY STUDY

S5.1 SCOPE OF PRIORITY PROJECTS

S5.1.1 Water Supply Project

Distribution Network Improvement (DNI) for the three towns in Zone West (i.e. North Nazimabad, Gulberg and Liaquatabad) was selected as the priority project of water supply in this JICA Study from technical, economical, financial and institutional points of view as described in the previous chapter. The scale of the water supply priority project was set based on the overall schedule of DNI for the whole Karachi City prepared in the phase of Master Plan, water demand, supply capacity and bulk water availability related to K-IV project. The selected priority project includes not only DNI for the three towns but also components for stably and safely conveying filtered water from NEK Old Filtration Plant to these three towns as shown in **Figure S51.1.1** and described below:

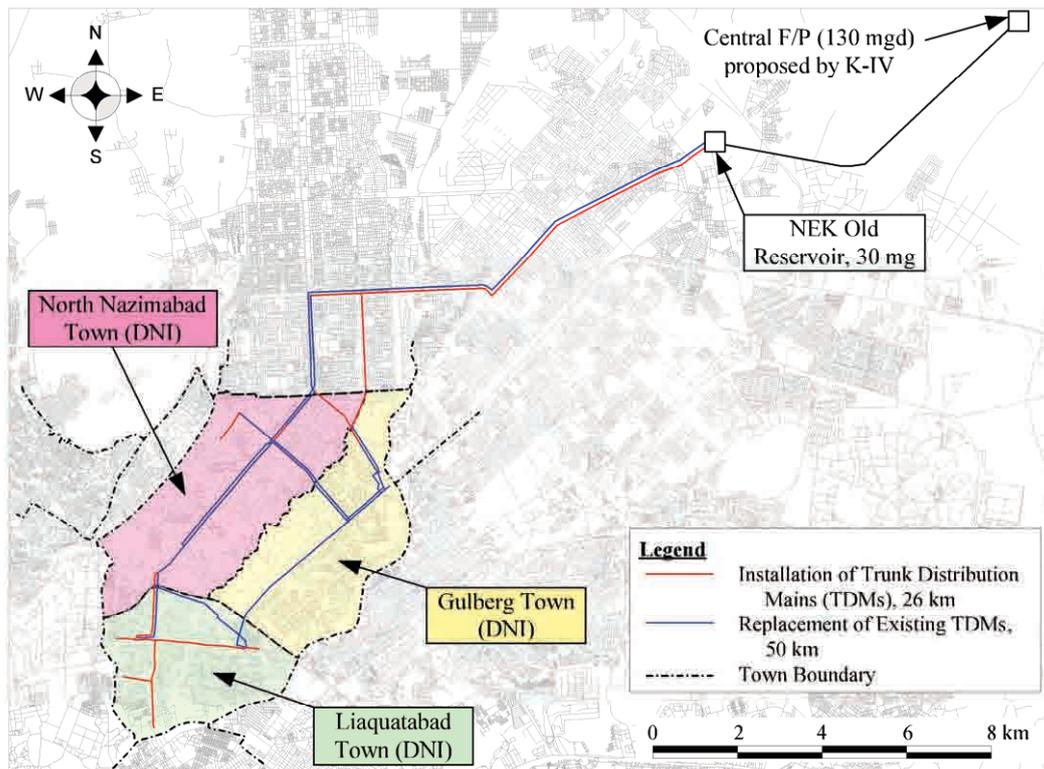


Figure S51.1.1 Components of the Water Supply Priority Project

- Replacement of all the existing distribution network mains in the three towns (about 1,000 km in total length)
- Rehabilitation/replacement of all the existing service pipes branched from the distribution network mains in the three towns (about 230,000 connections in total)
- Installation of individual flow meters at all the existing service connections in the three towns (about 230,000 connections in total)

- Replacement of about 50 km of essential existing trunk distribution mains for supplying water to the three towns (blue lines in **Figure S51.1.1**)
- Installation of about 26 km of new trunk distribution mains (red lines in **Figure S51.1.1**)
- Installation of 17 district flow meters
- Expansion of the existing NEK Old Reservoir (30 mg)

In addition to the above components, it is a precondition for the implementation of the priority project to complete the first phase of K-IV project by the year 2011 successfully. KW&SB should also rehabilitate or replace the existing trunk distribution mains other than those included in the priority project. Moreover, KW&SB should execute leakage control before, during and after the DNI in the priority project.

S5.1.2 Sewerage Projects

Sewerage projects selected as priority projects include the collection and treatment of sewage generated in three target towns of North Nazimabad, Gulberg and Liaquatabad where DNI will be implemented as priority projects for water supply. The implementation of DNI will inevitably increase sewage generation, which in turn requires the rehabilitation and extension of sewerage facilities there.

These three towns are already seweraged to the extent of 90%, but some rehabilitation works of aged sewers are needed and additional sewers have to be constructed to collect all the generated sewage. Collected sewage flows into either TP-1 or TP-3.

As a whole, sewerage projects targeted in the Feasibility Study include;

- Rehabilitation of branch sewers
- Rehabilitation of two sewage treatment plants of TP-1 and TP-3
- New installation of branch sewers to collect all the generated sewage in the target year
- New installation of sub-main and trunk sewers

Table S51.2.1 shows the major components of the sewerage priority projects and **Figure S51.2.1** shows the location of priority projects.

Table S51.2.1 Major Components of Sewerage Priority Projects

	Name	Dimension/Specification	Quantity	Remarks
Sewers	Branch sewers	10"	269 km	To rehabilitate or newly install
	Sub-main sewers	12" to 36"	43 km	To newly install
	Trunk sewers	Larger than 42"	11 km	To newly install
TP-1	Inlet pumps	0.52 m ³ /s/unit	7 units	Capacity: 110,000 m ³ /d
	Primary settling tanks	42 m diameter	4 units	Process: high rate trickling filter
	Trickling filter	41.4 m diameter	8 units	Only mechanical and associated electrical equipment
	Final settling tanks	42 m diameter	4 units	
	Connecting pipes	-	1 (LS)	Connecting inlet works, primary settling tanks, trickling filters and final settling tanks for sewage. Connecting primary/final settling tanks and sludge handling facilities for sludge.
TP-3	Secondary pumps	Vertical centrifugal type 0.83 m ³ /s/unit	18 units	Capacity: 245,000 m ³ /d Process: stabilization pond

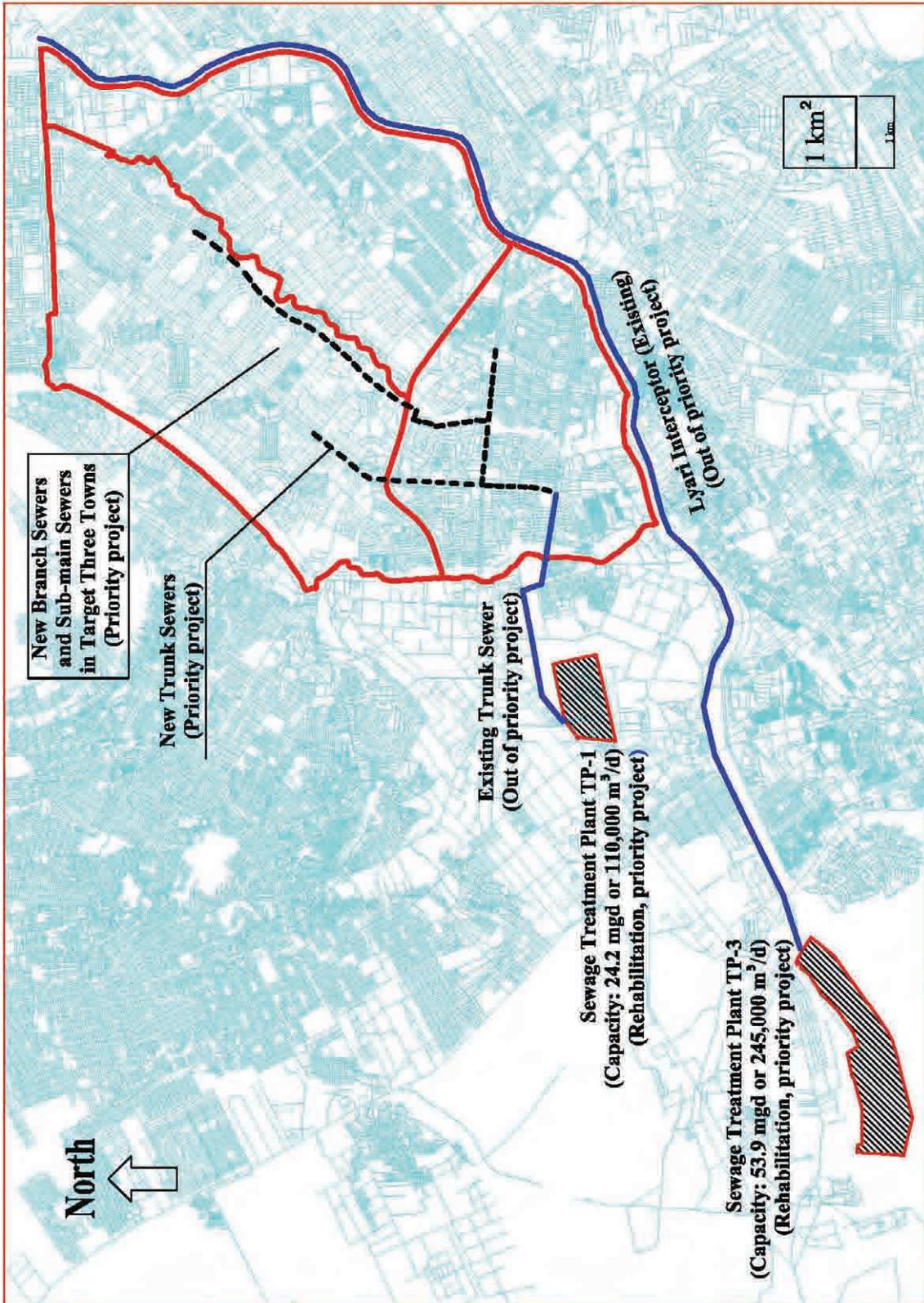


Figure S51.2.1 Components of the Sewerage Priority Project

S5.2 INSTITUTIONAL DEVELOPMENT

S5.2.1 Establishment of a ‘Corporatised’ Retail Entity in Zone West

With respect to the institutional reform, the JICA Study suggests that the Karachi city should be divided into three independent retail service zones by the Lyari and Malir Rivers (see **Figure S44.1.1**), and that in the long run the responsibilities for providing retail services (water supply and sewerage services) should gradually be transferred from KW&SB to ‘corporatised’ retail entities on a zone-by-zone basis as shown in **Figure S44.1.2**. The first stage of this reform process will take place in Zone West in early 2011. The Zone West retail entity will make improvements to the retail services (water supply and sewerage) within the Zone West through implementation of the Distribution Network Improvements (DNI) in the zone. Zone West embraces all of the three ‘priority towns’ selected in **Section S4.6.3** for implementation of DNI on a priority basis. As such, it is envisaged that DNI in these ‘priority towns’ will be implemented by the new Zone West retail entity.

The Zone West retail entity would be established as a ‘Public Limited Company (PLC)’ under the provisions of the Companies Ordinance 1984. The PLC will purchase treated water from KW&SB in bulk and distribute it to retail customers (both residential and non-residential) within Zone West. They will also be accountable for collection, transportation and treatment of sewage generated in Zone West. The PLC would take responsibility for all financial and technical aspects of the operation and management of water supply and sewerage services within Zone West including the collection of tariffs, employment of staff, dealing with customer complaints, etc. The objective of the PLC would be to undertake the operation of water supply and sewerage services in Zone West in accordance with high commercial and professional standards and without external interference in the day-to-day management of the services. There would be no political representation on the Board of the PLC and the articles of association and shareholders’ agreement would specify that members of the Board should be selected on the basis of their commercial, professional, managerial and/or technical qualifications and experience.

S5.2.2 Establishment of an Independent Regulatory Board

JICA Study proposes that an independent Regulatory Board (RB) should be formed for economic and technical regulation of water supply and sewerage services in Zone West (see **Figure S44.1.3**). The RB should have the obligation to ensure that the new retail entity in Zone West is able to recover the reasonable financial and economic costs of providing water supply and sewerage services in Zone West. The RB would monitor the performance of the Zone West retail entity against the prescribed service standards and will also act as ‘Ombudsman’ in dealing with customer complaints and related issues of customer service. It would also be responsible for setting out and enforcing ‘Water Supply and Sewerage Services Regulations’ which define clearly the statutory rights and obligations of both the Zone West retail entity and its customers in delivering and receiving the services.

S5.2.3 Way Forward

It should be noted that the ‘JICA Study Team’ are primarily concerned with the identification of possible reform options and therefore has sought to provide an outline of suggested reforms in principle at this stage. It is expected that detailed studies related to the suggested reforms will be carried out by the Water and Sanitation Program (WSP) and the ADB assisted ‘Karachi Mega City Sustainable Development Program (KMCSDP)’.

In order to put the institutional reforms suggested by the JICA Study into effect, separate studies will need to be conducted:

- To draft amendments to relevant laws, ordinances and/or regulations that are necessary to enable KW&SB to relinquish responsibility for provision of retail

- services (water supply and sewerage) in Zone West
- To draft articles of association and shareholders agreement of the Zone West retail entity
- To develop a tariff structure which would be applied in areas where DNI has already been completed, and which, while providing adequate protection for the poor and a strong incentive for efficient use of water, ensure that the Zone West retail entity is able to recover the reasonable costs of providing the services including debt service on loans borrowed for financing DNI.
- To establish a mechanism for the transfer of KW&SB's employees currently engaged in provision of retail services in Zone West to the Zone West retail entity, including transfer of employees' pension rights, severance funds, etc.
- To establish a mechanism to determine the condition of retail assets and for the valuation and transfer of retail assets to the Zone West retail entity
- To establish a mechanism for dealing with the liabilities and receivables associated with the retail assets and customer base transferred to the Zone West retail entity
- To establish an independent Regulatory Board for economic and technical regulation of the water supply and sewerage services
- To draft 'Bulk Treated Water Purchase Agreement' between KW&SB and the Zone West retail entity

It is expected that the reform process would be put into effect through the 'Reform Committees' that have already been established under WSP's initiatives, which would take responsibility for ensuring the progressive implementation of reforms in close coordination with the Local Support Unit (LSU)-CDGK of the ADB assisted KMCS DP.

It is envisaged that the preparatory stage for DNI in Zone West will start from early 2011 and it will be followed by the actual implementation of DNI from mid-2012. It is likely that this timing will coincide with the availability of additional water (130 mgd) from the K-IV Project. In order to achieve these goals, the following actions as a minimum will need to be put into effect between now and mid-2012.

- KW&SB relinquish their responsibility for retail services within Zone West
- A new Public Limited Company (PLC) which provides retail services in Zone West is established
- An independent Regulatory Board is established
- KW&SB's employees, assets, debts, receivables associated with Zone West are transferred to the new PLC
- A 'Bulk Treated Water Purchase Agreement' between KW&SB and the new PLC is established and enforced
- A 'Raw Sewage Transfer Agreement' between KW&SB and the new PLC is established and enforced
- The new PLC develops business strategies for efficient operations and service delivery
- Employees of the new PLC are well trained, developed and motivated to deliver improved performance in O&M, revenue collection and customer services
- The new PLC raises funds for implementation of DNI
- The new PLC establishes a specialist unit (PIU) dedicated to implementation of DNI

Timeframes in which each of these actions will need to be put into effect are given in **Figure S52.3.1**.

Action	Year									
	2008	2009	2010	2011	2012	2013	2014	2015	2016	
I. Transition Stage (mid-2008 to end-2010)	[Gantt bar spanning 2008 to 2010]									
I-1. Various detailed studies (as described in Section 12.2) are conducted and stakeholders' consensus is reached on the conclusions of these studies.	[Gantt bar: 2008-2009]									
I-2. KW&SB relinquish their responsibility for retail services within Zone West.	[Gantt bar: 2009-2010]									
I-3. An independent Regulatory Board (RB) is established.	[Gantt bar: 2009-2010]									
I-4. A new Public Limited Company (PLC) which provides retail services in Zone West is established.	[Gantt bar: 2009-2010]									
I-5. KW&SB's employees, assets, debts, receivables, etc associated with retail services in Zone West are transferred to the new PLC.	[Gantt bar: 2010-2011]									
I-6. A 'Bulk Treated Water Purchase Agreement' between KW&SB and the new PLC is established and enforced.	[Gantt bar: 2010-2011]									
I-7. A 'Raw Sewage Transfer Agreement' between KW&SB and the new PLC is established and enforced.	[Gantt bar: 2010-2011]									
II. DNI Preparation Stage (early 2011 to mid-2012)	[Gantt bar spanning 2011 to 2012]									
II-1. The new PLC develop business strategies for efficient operations and service delivery	[Gantt bar: 2011-2012]									
II-2. Employees of the new PLC are well trained, developed and motivated to deliver improved performance in O&M, revenue collection and customer services	[Gantt bar: 2011-2012]									
II-3. The new PLC raises funds for DNI improvements	[Gantt bar: 2011-2012]									
II-4. The new PLC establishes a special PIU dedicated to implementation of DNI	[Gantt bar: 2011-2012]									
III. DNI in Three Priority Towns (mid-2012 to mid 2014)	[Gantt bar spanning 2012 to 2014]									
IV. DNI in Other Towns (mid-2014 to end-2016)	[Gantt bar spanning 2014 to 2016]									

Figure S52.3.1 Institutional Reform Roadmap for Zone West

S5.3 PLANS FOR OPERATION AND MAINTENANCE OF PRIORITY PROJECTS

S5.3.1 Water Supply Projects

(1) Maintenance of Distribution Network

After completion of DNI, the distribution network will be maintained by leakage/NRW reduction survey teams. With the use of a portable flow meter, they will measure the minimum night flow (MNF) in small District Metering Areas (DMAs) with a view to reducing leakage assuming that MNF represents the magnitude of leakage occurring within the DMA.

Each survey team will consist of one engineer, one technical assistant and three workers, and will be equipped with one portable ultrasonic flow meter, one leak detector, two listening rods, one metal pipe locator, one metal detector, and three pressure recorders.

On average, one survey team would be able to cover about 8 km length of distribution mains per week or 32 km per month. It is estimated that after completion of DNI the total length of distribution network mains in one town will be approximately 370 km. Thus, if covered by two teams, it will take about six months ($370 / 64 = 5.8$) to complete the survey in one town. This will ensure that each and every distribution main in the town will be subject to the survey once in every six months, which is more or less in line with international practices. Ultimately, two survey teams will need to be established for each town or six teams for the three 'Priority Towns'. The number of survey teams can be increased gradually corresponding to the progress of DNI.

In the past, leakage/NRW reduction surveys were not conducted by KW&SB. As such, extensive training will need to be provided to staff who take on leakage/NRW reduction surveys. They will require the training on how to isolate a DMA from the rest of the distribution network, how to measure the minimum night flow in the DMA, and how to use ultrasonic flow meters,

leakage detectors, pressure recorders and other survey equipment. To this end, it is recommended that the retail entity should request the Japan International Cooperation Agency (JICA) for its technical assistance through implementing a 'Technical Cooperation Project (TCP)'. TCP would be able to offer a comprehensive package of technical assistance to support the self-help efforts of the retail entity, which would include (a) the dispatch of leakage/NRW reduction experts from Japan to provide technical supports, (b) training of relevant local staff in Japan or in other countries, and (c) the supply of necessary equipment on a grant basis.

(2) Meter Reading/Billing

After implementation of DNI, the distribution network and customer base will be managed by the Zone West retail entity. It is predicted that the number of service connections in Zone West at the start of DNI (2011) will be approximately 600,000 and in the three 'Priority Towns' there will be approximately 217,000 connections.

DNI will be operated on the basis of 100% metering of bulk and retail customers and therefore will require the installation of revenue meters to every service connection. As household metering will be a new concept for Karachi (currently KW&SB do not meter households), extensive training will be provided to transferred staff from KW&SB to the retail entity, in the use of modern billing and meter reading techniques including the hardware, software and technologies employed. Meters will be read on a monthly basis to maximise revenues and cash flows.

Based on the number of service connections in the three 'Priority Towns', it is expected that approximately 100 qualified and trained meter readers will be required ultimately. This is based on the assumption that each meter reader will be capable of reading approximately 100 meters per day on each of the 22 working days per month which is line with international standards with use of modern meters and electronic 'hand held devices'. The number of meter readers can be increased gradually corresponding to the actual progress of DNI. The 'hand held device' will be linked locally at the town office for downloading meter reading routes to the device from the billing system and for uploading meter readings back to the billing system to update customer accounts. The hardware and software for modern hand held devices as well as proprietary billing/data management systems such as CIS are readily available on the market. Necessary training can be provided by the manufactures of these hardware and software and therefore it should be included as part of the procurement contract.

The hand held devices will deploy modern technology capable of 'local bill presentment' which means that the meter reader will be able to print the bill after reading the meter and present this to the customer at the time of reading. This will minimise the chance of frauds by meter readers and will also eliminate the need for centralised bill printing and bill delivery, thus reducing operating costs and the time for the customer to pay the bill. The use of modern technology such as this (instead of the traditional manual methods) will be prerequisite to processing as many as 10,000 (100 meter readers × 100 meters per meter reader per day) meter readings and consumer bills per day.

(3) Meter Repair/Testing

It is expected that good quality domestic meters will be purchased and installed that will comply with international standards to ensure a long service life. Meters will be the property of the retail entity who rent them out to customers. The retail entity will recover the cost of the meter through tariffs in the long run. Whilst the unit price will be higher than cheaper meters available locally, good quality meters would be expected to last trouble-free between 5-10 years in service and therefore the overall life-cycle cost will be lower.

On this basis it is expected that household meters would be replaced periodically (every 5-10 years and will be determined by field experience over time) and as such it is envisaged that it will not be cost effective for the retail entity to operate a meter repair workshop. Instead, it is suggested that a service contract will be let to a specialist contractor certified by the meter manufacturer for repair of household meters.

The retail entity will invest in and deploy portable meter test equipment (that will be certified and regularly calibrated for accuracy) to test household meters (0.5 to 2 in) where customers complain of irregularities. The retail entity will also need to invest in a meter test bench to conduct the regular calibration of the test equipment. The test meter is taken to site and installed in series with the existing meter to test the revenue meter's recording accuracy. It is estimated that approximately 200 sets of such portable meter test equipment (60 sets for 0.5 in, 50 sets for 0.75 in, 30 sets each for 1.0, 1.5 and 2.0 in) will be required for each town ultimately, but this number can be increased gradually corresponding to the actual progress of DNI.

Bulk meters (3 to 24 in) are limited in number at present, but are expected to increase substantially in future since they will be installed at all multi-storey condominiums and apartment buildings in the three 'Priority Towns' during the implementation of DNI. As such it is recommended that the retail entity will invest in bulk meter (3 to 24 in) calibration equipment and facilities (similar to that provided at COD filtration plant) in order to check and confirm bulk meter recording accuracy at the request of bulk customers. Bulk meters will also be the property of the retail entity who rent them out to customers. The retail entity will recover the cost of the bulk meters through tariffs in the long run. It is suggested that a service contract will be let for repair of malfunctioning bulk meters. This is a specialist job and therefore the service contract will be let to the meter manufacturer or a specialist contractor certified by the meter manufacturer. It is also suggested that the retail entity should maintain a stockpile of approximately 50 standby bulk meters which consist of 10 meters each for 3 and 4 in, 8 meters each for 6, 8 and 12 in, 4 meters for 15 in, and 2 meters for 24 in. These bulk meters will be used to replace customer meters while they are being calibrated or repaired.

S5.3.2 Sewerage Projects

O&M activities and improvement plans for the sewerage facilities are designed to fit in with the priority projects identified during the Feasibility phase; namely the rehabilitation of branch sewers, installation of branch and trunk sewers, to collect generated sewage as well as rehabilitation of two associated treatment plants of TP-1 and TP-3. The priority will be to operate and maintain sewerage facilities to ensure efficient sewage collection and its treatment, safe effluent discharge and sludge disposal that complies with environmental standards.

After implementation of DNI, the sewers, the pumping stations and the sewage treatment plants associated with Zone West will be managed by the Zone West retail entity. The retail entity will therefore be responsible for the O&M of TP-1, TP-3 and related facilities.

Modern O&M methods employed by the Zone West retail entity will include mainly:

- Asset management plans and the recording of asset information
- O&M manuals that clearly state the parameters, procedures, schedules and responsibilities for effective operation of collection and treatment systems
- 'Planned preventative maintenance' practices

It is estimated that the length of sewers in the three towns will be approximately 1,018km in 2016. Maintenance of sewers includes three major tasks of regular inspection, cleaning and repairs. Maintenance manuals will be used to document procedures for the maintenance of sewers and will be used for training purposes. This will ensure the deployment of standard

operating procedures and practices for the entire sewer networks located within three towns. Regular maintenance of sewers or every five years at least will include the need to periodically remove deposits, grit and debris. For larger diameter sewers, it will be necessary to use mechanised sewer cleaning equipment including high pressure cleaning vehicle and sludge vacuum vehicle. For smaller diameter sewers, on the other hand, manual cleaning equipment will be deployed extensively such as rodding and swabbing tools.

Operation and maintenance manuals will be used to document procedures for plant operation and maintenance and will be used for training purposes. This will ensure the deployment of standard operating procedures and practices at each plant.

Running maintenance includes regular inspection, oiling and greasing of plant and equipment. The TP's will be operated on a 24-7 basis and all facilities will be subject to daily and periodic inspection of concrete structures, mechanical and electrical equipment.

Concrete structures include inlet pumping station, grit chambers, primary settling tanks, trickling filters and final settling tanks. Mechanical and electrical equipment include pumps, screens, rakes, grit collectors, scrapers of primary and final settling tanks and sprayers of trickling filters.

Treatment control parameters will be monitored as a minimum such as flow rate, water level at treatment facilities, water qualities including pH, BOD and SS at the inlet and the outlet of the plant, and sludge layer at the bottom of anaerobic and facultative ponds.

Sewage treatment plants constantly generate grit, screenings and sludges removed during sewage treatment. Such solid wastes shall be removed from the TP's and properly disposed of or reused.

S5.4 PRELIMINARY COST ESTIMATES AND IMPLEMENTATION SCHEDULES & PLANS

S5.4.1 Preliminary Cost Estimates

(1) Construction Cost

Table S54.1.1 shows the construction cost for the priority projects. The cost for water supply project is Rs.12,452 million and that for sewerage projects is Rs.3,976 million. The total cost for the priority projects is Rs.16,428 million.

(2) Operation and Maintenance Cost

Table S54.1.2 shows the operation and maintenance cost for the priority projects in 2016. The O&M cost for water supply project is Rs.864 million and that for sewerage project is Rs.90 million. The total cost for the priority projects is Rs. 954million.

Table S54.1.1 Construction Cost

Component	Construction Cost (Rs. Million)	
Water Supply Project		
Direct Construction Cost	9,166.8	
Reservoir		490.9
Trunk Distribution Main		4,606.0
Flow Meter		46.1
Distribution Network Main		2,988.3
House Connection		1,035.5
Engineering Fee	687.5	
Land Acquisition	3.7	
Physical Contingency	492.9	
Price Contingency	1,916.8	
Project Administration	184.0	
Sub-total	12,451.7	
Sewerage Project		
Direct Construction Cost	2,649.6	
Rehabilitation of TP-1		337.3
Rehabilitation of TP-3		198.7
Branch Sewer and Trunk sewer		2,113.6
Engineering Fee	198.7	
Land Acquisition	-	
Physical Contingency	142.4	
Price Contingency	927.0	
Project Administration	58.8	
Sub-total	3,976.5	
Total	16,428.2	

Table S54.1.2 Operation and Maintenance Cost

Component	O&M Cost (Rs. Million/year)		
Water Supply Project			
Purchased Water Fee	643.8		
Trunk distribution main	92.1		
Distribution Network Main	59.8		
House connection	68.5		
Sub-total	864.2		
Sewerage Project			
Sewage Treatment Plant TP-1	42.5		
Operation Cost		41.1	
Personnel			13.8
Electricity			16.1
Diesel			4.2
Polymer			0
Sludge Disposal			4.2
Laboratory and other			2.8
Maintenance Cost		1.4	
Sewage Treatment Plant TP-3	37.8		
Operation Cost		36.9	
Personnel			9.6
Electricity			18.8
Diesel			4.2
Polymer			0
Sludge Disposal			1.7
Laboratory and other			2.6
Maintenance Cost		0.9	
Branch and Trunk Sewer	9.7		
Operation Cost		0.0	
Maintenance Cost (Cleaning)		9.7	
Sub-total	90.0		
Total	954.2		

S5.4.2 Implementation Schedule

(1) Water Supply System

As engineering services, detail design will begin in 2012 followed by construction supervision which will be finalized in mid 2014. Reservoir, trunk distribution main, distribution network main, house connection will begin to be constructed simultaneously along with the installation of flow meters and water meters.

(2) Sewerage System

As engineering services, detail design will begin in 2012 followed by construction supervision which will be finalized in mid 2014. Rehabilitation of two sewage treatment plants of TP-1 and TP-3, installation of branch and trunk sewers will begin simultaneously and end in mid 2014.

S5.4.3 Financing Plans

The Zone West retail entity will need to raise funds for the implementation of the Priority Projects. The total project cost of the Priority Projects is estimated at Rs. 16.4 billion as shown in **Table S54.3.1**.

Table S54.3.1 Summary of Priority Project Cost

Items	Rs. (million)	US\$ (million)
Base Costs	11,817	194.4
Water Supply	9,162	150.8
Sewerage	2,650	43.6
Other Costs	4,612	75.9
Engineering Fee	886	14.6
Land Acquisition	4	0.1
Physical Contingency	635	10.4
Price Contingency	2,844	46.8
Project Administration	243	4.0
Total Project Cost	16,429	270.3

It is assumed that about 80% of the total project cost would be financed by external sources of funds while the remaining 20% by the internal sources of funds of the Zone West retail entity. There are two prospective external sources of fund which would possibly be used for financing the implementation of the Priority Project. They are ADB and JBIC loans.

(1) ADB Loan

The Asian Development Bank (ADB) fielded an appraisal mission to Pakistan from 21 - 25 January 2008 to conduct loan appraisal of the Karachi Mega City Sustainable Development Program (KMCS DP). The Government of Pakistan (GOP) has requested ADB to provide financing through a 'Multitranch e Finance Facility (MFF)' for US\$ 800 million over 8 years, for selected infrastructure investments and associated public sector reform and institutional development initiatives in Karachi.

The Investment Program under KMCS DP will comprise the following parts:

Part A: Institutional Reform, Implementation Support and Capacity Development.

Part B: Water Supply and Wastewater Management.

Part C: Urban Transport.

Part D: Katchi Abadi Improvement and Low-income Housing.

An MFF of up to US\$ 800 million equivalent will provide loans for (i) up to an aggregate of US\$ 710 million equivalent from ADB's ordinary capital resources (OCR) under ADB's London interbank offered rate (LIBOR)-based lending facility, and (ii) up to US\$ 90 million equivalent in Special Drawing Rights from ADB's Special Fund Resources.

Financing from OCR resources will be subject to interest to be determined in accordance with ADB's LIBOR based lending facility, and commitment charge of 0.75% per annum and other terms and conditions. The Special Funds resources will have a 32-year term including a grace period of 8 years, and with an interest rate of 1.0% per annum during the grace period and 1.5% per annum thereafter.

The borrower of the loan will be GOP. All loans from OCR and the Special Funds will be onlent by GOP to the Government of Sindh (GOS) at the same terms and conditions as those of the ADB loans to the GOP. GOS will bear the foreign exchange risk for all loans. The Finance Department of the GOS will be the Executing Agency (EA).

It is currently expected that about 46% of the US\$ 800 million loan (US\$ 368 million) will be allocated for Part B: Water Supply and Wastewater Management. Although US\$ 93 million has already been allocated for Part B in the first PFR, a large portion of the balance US\$ 275 million can be allocated in the subsequent tranches for financing the implementation of the Priority Projects.

(2) JBIC Loan

In the past, JBIC provided a Japanese Yen Loan (L/A No.PK-P40 dated November 22, 1994) for the implementation of the 'Karachi Water Supply Improvement Project'. The JBIC loan amounted to JPY 10.3 billion was a general untied loan carrying 2.6% interest rate and 30 years repayment period including 10 years of grace period.

JBIC loan for the main components of the Priority Projects would be a general untied loan carrying an interest rate of 1.2% with 30 years repayment period including 10 years of grace period. For consulting services, the interest rate will be minimal (0.01%) and the repayment, grace period and conditions for procurement will be the same as those for main components.

JBIC loan would be able to cover almost the entire project cost shown in **Table S54.3.1** except for the costs associated with land acquisition and project administration.

S5.4.4 Plans for Construction

Plans for construction are prepared based on the implementation schedule. Construction materials are procured according to plan for procurement of equipment/material. In order to obtain high quality outcome of the construction works, plans for construction will include routine quality control, schedule control and safety management. Vibration, noise, liquid and solid wastes that are expected to be generated during the construction works have to be minimized, which will be incorporated in the plans for construction.

As-built drawings are to be prepared at the time of construction completion for concrete structures, water supply pipes, sewers, mechanical and electrical equipment and to be used for operation and maintenance purposes at the later stage.

The following items will be taken into account in the preparation of the plans for construction.

Reservoir: The soil bearing capacity of its base has to be verified by plate bearing test. The reservoir functions to store potable water and no water leakage should occur.

Trunk distribution main: Pipe material is steel and the accuracy of joint welding is very important. The possibility of electric corrosion occurrence has to be checked and anticorrosion measures need to be taken if necessary.

Distribution network main: Plans for construction need to be prepared mitigating traffic jams and protecting pedestrians. Many asbestos cement pipes are used for existing distribution network main. Asbestos dust can be carcinogens and asbestos cement pipes should be left as they are underground for safety reasons.

House connection: It is important to employ the contractors with sufficient expertise in house connection works including water meter setting to minimize water leakage.

Sewage treatment plants of TP-1 and TP-3: Plans for construction have to be prepared by minimizing interrupted operation, since these two plants in operation are to be rehabilitated. TP-3 is close to the sea and salt resistant paint will be used for mechanical equipment.

Trunk and branch sewers: Sheet piles and other soil retaining apparatus will be adopted for larger diameter pipe and deeper excavation. Replacement of sewers is planned with smooth flow diversion and abandoned sewers are left underground as they are.

S5.4.5 Plans for Procurement of Equipment/Materials

(1) Water Supply System

Concrete, reinforcing steel bars, steel/polyethylene pipes and flow metres can be procured domestically while valves and water meters have to be imported.

(2) Sewerage System

Electrical and mechanical equipment, concrete pipes, concrete and reinforcing steel bars can be procured domestically while cast iron pipes, valves and pumps have to be imported.

S5.5 ENVIRONMENTAL IMPACT ASSESSMENT

The regulation concerning the EIA of Pakistan requires EIA Study for water supply and sewerage projects with the project cost of Rs. 25 million or more, and the project cost of the priority project is Rs. 16,428 million. Therefore, the EIA Study concerning the priority project was carried out, and the findings of the EIA Study are described as below.

The components of the priority project are the following items:

- Expansion of reservoir (NEK Old reservoir) for water supply system;
- Distribution network improvement for water supply system;
- Collection and conveyance network improvement for sewerage system, and
- Rehabilitation of sewage treatment plants (TP-1 and PT-3).

The expected positive impacts of the priority project include:

- Realization of the living condition which has possibility to access safe water during all day;
- Possibility to collect all of generated sewage and to treat appropriately, and expectation of the health, sanitary and environmental improvement as the result;
- Enhanced employment opportunities particularly in the construction stage. Furthermore, promotion of the regional economy by improvement of the living environment of the overall project area is expected.

Based on the findings of the EIA Study, the following items should be considered as mitigation measures for project implementation.

Land acquisition for extension of reservoir (NEK Old)

The site (land owner is the Sindh Province) which adjoins the east side of the existing reservoir is not used for other project and there is sufficient area as the construction site for the extension of reservoir (NEK Old Reservoir). If this site is determined as a proposed site, it is expected that adverse impacts of land acquisition are very small.

Construction of water distribution network and sewer collection network

The main adverse impacts in the construction phase of water distribution network and sewer collection network are effects on the economic activity, traffic situation, public health condition, air pollution, noise and vibration.

Especially, when appropriate measures are not performed, it is expected that serious traffic disturbance will occur. However, these are short-term impacts, and these can be reduced by appropriate construction site management including an announcement and traffic control.

Impact on the tanker water service by implementation of the Distribution Network Improvement

The Distribution Network Improvement in the priority project area will be completed by 2014. Consequently, it is predicted that the tanker water service will become unnecessary in the project area and its business will end. However, the water supply facilities in the Karachi city will be constructed step by step till 2025, the demand for tanker water supply will not decrease immediately. Therefore, it is expected that adverse impacts on the tanker water service are not significant.

Water pollution and offensive odour from sewage treatment plants (TP-1 and TP-3)

According to the sewerage system planning, if the treatment plants are properly operated and maintained, the effluent will meet the effluent water quality standards and no significant adverse impacts may be expected. Similarly, it is expected that when proper operation and maintenance is performed, odour emission can be controlled.

Impact due to disruption of operation of the water supply facilities and the sewage treatment plants (power cut and electrical accident)

A power failure can be compensated for by the installation of power generator. The social infrastructure improvement concerning electricity progresses in the future, and it is expected that power failure will less frequently occur. Furthermore, the adverse Impacts can be controlled to the minimum by preparation of the spare electrical & mechanical equipment, operation manual for emergency, and training to the operation staff for the emergency situation. As a conclusion, though the above adverse impacts can be considered on the implementation of the priority project, all the adverse impacts are controlled to the minimum by taking the common measures.

In addition, the project owner should establish monitoring system to assess the quality of the neighbouring environment after the commissioning of the project. An environmental monitoring programme is important as it provides useful information and helps to:

- Verify the predictions on environmental impacts presented in this study,
- Assist in detecting the development of any unwanted environmental situation, and thus, provides opportunities for adopting appropriate control measures.

The Environmental Monitoring Programmes are summarized in **Table S55.1.1**.

Table S55.1.1 The Environmental Monitoring Programme

Object	Monitoring Point	Parameters
Water Supply System		
Raw water and distributed water	NEK Old reservoir	Basic items for water supply: Escherichia Coli, Turbidity and etc. Hazardous substance: According to the WHO Guideline
Tap water	House connections	Water pressure, pH, Turbidity, Escherichia Coli and etc.
Sewerage System		
Influent and treated effluent	TP-1 and TP-3	Basic parameters: Temp., pH, SS, BOD, COD, Nitrogen and etc. Hazardous substance: According to the effluent Standards.
Sludge characteristics		Hazardous substance and etc.
Air quality		Ammonia, Methyl Mercaptan, Hydrogen Sulphide, and etc.

S5.6 EVALUATION OF PRIORITY PROJECTS

S5.6.1 Economic and Financial Evaluation and Economic Impacts

(1) Objectives

The priority project was evaluated from economic and financial points of view. The economic evaluation was conducted in the same manner as described in **Section S4.6.2**. In the financial evaluation, the priority project was examined with a view to identify the levels of water supply and sewerage charges that would have to be applied in order to make the project financially viable. This was done using certain indices, such as financial internal rate of return (FIRR), net present value (NPV) and benefit-cost ratio (B/C). Finally, the financial conditions/arrangements which would ensure the financial sustainability of the Zone West retail entity were studied through financial simulation analyses.

(2) Economic Evaluation

At first, the economic evaluation of the priority projects was conducted for water supply and sewerage separately. Then, both projects were combined and evaluated as one scheme as was the case for the master plan.

1) Water Supply Project

Tangible economic benefits of the water supply priority project were quantified based on the same data and information as used for the evaluation of the master plan. The structure of

benefits is the same as discussed in **Section S4.6.2**. It is expected that the benefits will emerge immediately after the completion of the distribution network improvement (DNI) in the project area, i.e. from the latter half of the year 2012. The total economic benefit was estimated at Rs.8.1 billion in the target year 2015.

In the economic evaluation, the total economic cost was estimated as the sum of three cost components: (a) DNI in the priority project area; (b) costs associated with the use of existing water supply facilities in the project area which were assumed as being sunk costs; and (c) costs associated with the bulk water supply to the project area, including the costs of reservoirs and transmission pipelines. In addition, operation and maintenance costs of relevant facilities and replacement costs of electrical and mechanical equipment were also included as part of the economic cost.

The economic evaluation of the water supply project revealed 23.5% in EIRR, Rs.17.9 billion in NPV and 2.35 in B/C. The project was found to be quite viable from an economic point of view, since its EIRR is much higher than the social discount rate i.e.12%. One reason for this is that the project area has already been fully urbanised and as such the intended benefits of the project are expected to emerge immediately after the completion of the DNI in the project area. Another reason is that most of the residents in the project area belong to a group of relatively high income and spend a large amount of indirect costs associated with the use of piped water from the system of KW&SB. The sensitivity test of the economic evaluation suggested no risk in terms of economic viability of the priority project.

2) Sewerage Project

Tangible economic benefits of the sewerage priority project were quantified based on the same data and information as used for the economic evaluation of the master plan. It is expected that the benefits would emerge just after the rehabilitation of the treatment plants in the second half of the year 2014. The matured benefit was estimated at Rs.1,246 million in 2015.

Sewers have already been installed in most of the project area. It is therefore proposed that only 20% of the existing sewers would be rehabilitated under the priority project. It is also proposed that major mechanical and electrical equipment at the existing sewage treatment plants would be rehabilitated under the project. The residual values of existing sewers and sewage treatment plants were included in the project cost as sunk cost. In addition, O&M and replacement costs were also included in the project cost.

The economic evaluation of the sewerage project indicated 20.3% in EIRR, Rs.2.1 billion in NPV and 1.82 in B/C. The project was considered to be quite viable from an economic point of view, since its EIRR is significantly higher than the social discount rate i.e.12%. The sensitivity test of the economic evaluation suggested no risk in terms of economic viability of the priority project.

3) Integrated Project

The water supply and sewerage projects were combined as one project and subjected to economic evaluation. The results indicated 23.0% in EIRR, minus Rs.18.1 billion in NPV and 2.29 in B/C. Thus, the integrated project was also found to be quite viable from an economic point of view.

(3) Financial Evaluation

The following indices were used for the financial evaluation of the priority projects: financial internal rate of return (FIRR); net present value (NPV) and B/C (benefit-cost ratio). The financial benefits would be derived from water sales to consumers, that is, the revenue of water sales. The financial viability of the priority projects was judged by comparing the FIRRs of

the projects with a likely interest rate of foreign loans applicable to finance the projects. According to the latest information available from concerned agencies and major foreign donors, the likely interest rate falls somewhere between 7% and 9% per annum (8% is applied in this evaluation as medium rate) including the charges for averting the risks associated with foreign exchange rates.

1) Water Supply Project

The current water supply charge for metered supply is Rs.44/1000 gallons (Rs.9.7/m³) for domestic use and Rs.73/1000 gallons (Rs.16.1/m³) for non-domestic use. The revenue to be derived from the priority projects was calculated as the product of (a) the volume of water supplied to consumers and (2) water tariff. It was found that the FIRR of the project would be negative if the present levels of tariffs were applied, but it would increase to 8% if tariffs were increased to Rs.128/1000 gallons (Rs.28/m³) for domestic use and Rs.212/1000 gallons (Rs.47/m³) for non-domestic use.

2) Sewerage Project

The current sewerage charge is 25% of water charge. It was found that the FIRR of the priority sewerage project was also found to be negative if the current level of sewerage charge was applied, but it would increase to 8% if the charge was increased to 50% of water charge.

3) Economic Impacts

An average water and sewerage service charge paid by the residents of the priority project area is estimated at Rs.290/month per household (5,300 gallons/month times Rs.44/1000 gallons plus 25% of surcharge). This accounts for 1.9% of the average household income (Rs.15,600/month) in the priority project area. However, the charge would increase to Rs.1,014/month per household if the increased tariffs as discussed above are applied; it would account for 6.5% of the average household income, exceeding the level of affordability-to-pay suggested by World Bank (5%).

(4) Financial Management of the Zone West Retail Entity

The financial sustainability of the Zone West retail entity was examined, by adopting the following assumptions, through a financial simulation analysis based on the schemes proposed in the master plan and priority projects.

- 1) Prices and escalation
 - Domestic water Rs.88/1000 gallons (2 times of the current price)
 - Non-domestic water Rs.146/1000 gallons (2 times of the current price)
 - Sewerage Service 40% of water charge
 - Price escalation 10% per 3 years
- 2) Procurement of financial sources for the capital investment
 - Equity Rs.14 billion (25% of the total investment)
 - Transferred Assets Rs.12 billion of the existing facilities in Zone West as of 2008
Rs.18 billion of the facilities to be constructed between 2008 and 2011
 - Foreign Loans Rs.45 billion (80% of the capital investment)
Repayment period: 30 years Grace period: 10 years
Interest rate: 8% Other charges: 1%
- 3) Bulk treated water from KW&SB: Rs.23/1000 gallons
- 4) Stock dividend for share holders
10% (when net profit after tax exceeds 10% of the total equity)
- 5) Income tax 35% of the profit of the year

The results of this simulation are shown as 'Base Case' in **Figure S56.1.1**. In this case, the

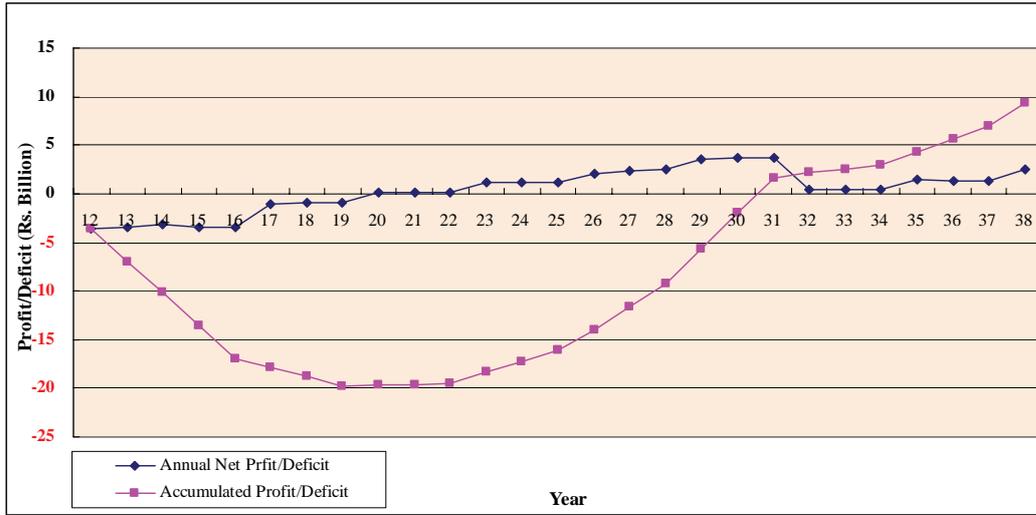
retail entity would only be able to make profits in 2020 for the first time after 9 years of its operation and its accumulated deficits would not be able to be eliminated until 2031. Then, the following changes were made to the assumptions adopted in 'Base Case' and another simulation analysis was conducted.

- 1) The rate of bulk treated water from KW&SB is Rs.15/1000 gallons for the initial 5 years of operation and thereafter Rs.25/1000 gallons;
- 2) Interest rate of foreign loans is 4% per annum.

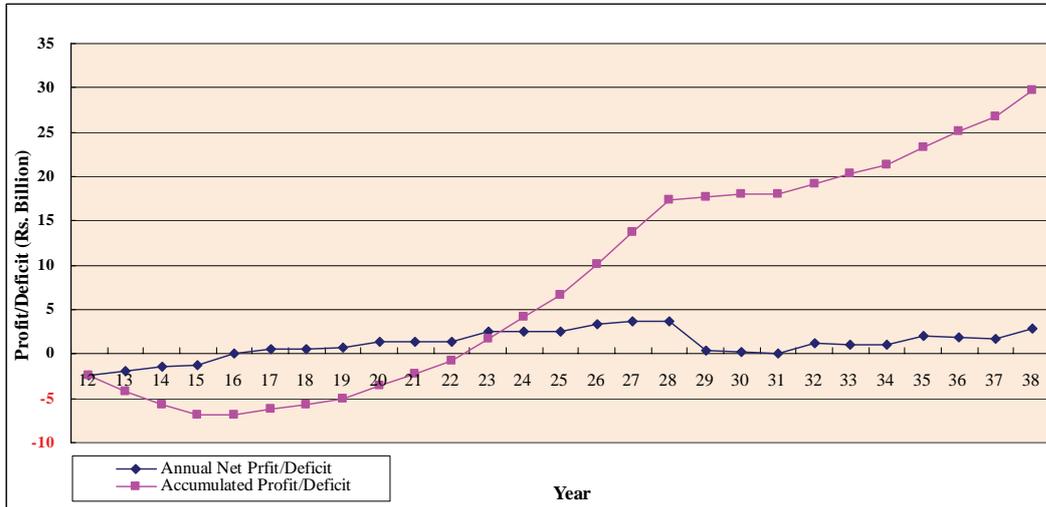
The results of this simulation analysis are shown as 'Case 1' in **Figure S56.1.1**. It was indicated in this case that the retail entity would be able to start making profits in 2016 and its accumulated deficits would be able to be eliminated in 2023.

Finally, another simulation analysis was conducted as 'Case 2' shown in **Figure S56.1.1**. It was assumed in this case that the water supply and sewerage charges would be escalated at a rate of 15% per 3 years. Other assumptions are the same as that used for 'Case 1'. The results of this 'Case 2' analysis indicated that the retail entity would be able to eliminate its accumulated deficits in 2020. It is considered that this 'Case 2' would ensure the financial sustainability of the Zone West retail entity.

Base Case



Case 1



Case 2

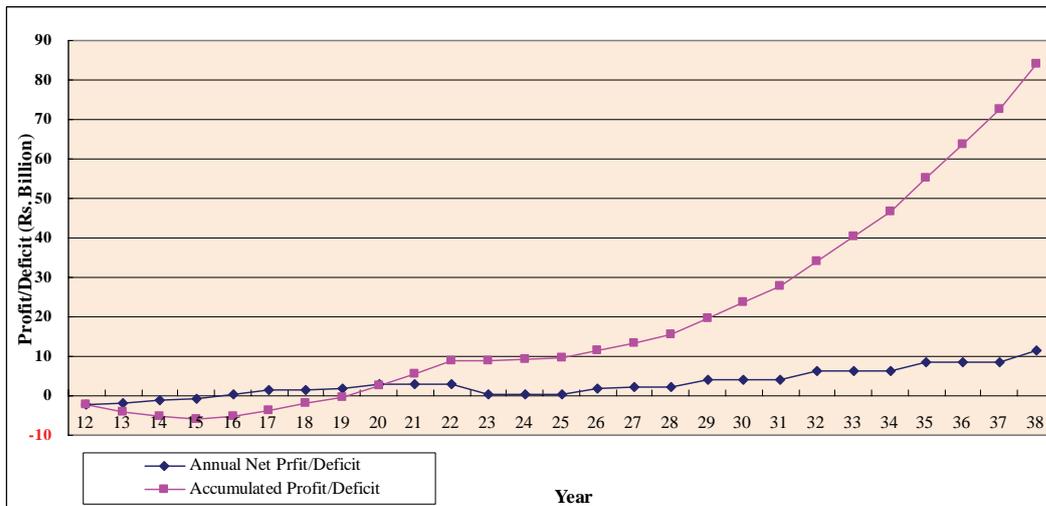


Figure S56.1.1 Results of financial Simulation

S5.6.2 Evaluation of Environmental and Social Impacts

Components of the priority project are classified into two categories; one is water supply system with expansion of reservoir and distribution network improvement (DNI), and the other is sewerage system with improvement of sewage collection network and replacement of electrical equipment in TP-1 and TP-3 sewage treatment plants (STPs). Implementation of these components will bring about the following benefits and positive impacts.

Water supply system

- DNI enables access to safe water and sufficient amount of water on 7-24 basis.
- Improvement of the rate of leakage is expected.
- Introduction of a metre-charge system, and it is expected to lead to the improvement in users' water-saving awareness.
- By improving water supply service and reducing individual compulsory associated fees concerning water use, enhancement in the charge collection rate is expected.
- Financial improvement in the management of water and sewerage services is expected by improvement in the charge collection rate.

Sewerage system

- Improved sewage collection will collect all the sewage in the priority project area and convey it to STPs.
- By replacement of equipment in STPs, proper sewage treatment is possible, and the water quality of the treated effluent will be possible to meet the effluent water quality standards.
- Consequently, reduction of the discharged pollution load to the public water bodies and water quality improvement in the public water bodies are expected.

According to the findings of the EIA Study, there are some adverse impacts that require mitigation measures in the priority project implementation. Main adverse impacts are following items:

- Adverse impacts due to the land acquisition by the extension of reservoir
- Adverse impacts due to the construction for improvement of water distribution network and sewage collection network
- Adverse impacts on the water environment by the increase in the amount of sewage
- Adverse impacts from sewage treatment plants
- Adverse impacts on the tanker water supply business

As a conclusion, though the above adverse impacts may be expected, all the adverse impacts could be controlled to the minimum by taking appropriate measures. In addition, not only the above-mentioned benefits and positive impacts by implementation of the priority project, but improvement of the local economy and sanitary conditions as multiplied effects are also expected.

S5.6.3 Evaluation of Technical Feasibility

(1) Water Supply Project

1) Evaluation

The project includes the installation/replacement of pipelines and the expansion of a reservoir as its major construction components. Since KW&SB has enough experiences in constructing pipelines and reservoirs, required knowledge and skills to implement the project are already available within KW&SB. In conclusion, no major technical constraints are envisaged during and after the implementation of the water supply priority project, as long as the new corporatised entity, which will be established in Zone West, inherits the experiences, knowledge and skills of KW&SB efficiently.

2) Recommendations

a. Confirmation of Optimum Facility Designs in the Stage of Detailed Design

The preliminary design of distribution network was undertaken during the feasibility study of this JICA Study to identify potential pipe alignments and to propose a possible distribution network system for the three towns. The results of the preliminary design was used to estimate the project costs for conducting economic and financial analyses and to provide basic information on the project for KW&SB and international donors. However, the preliminary design of distribution network is not suitable for the reference during the implementation of pipe construction works, as matter of off course, in terms of accuracy and details. Therefore, the detail design of distribution network including more accurate hydraulic analysis should be prepared, before implementing the project, based on detailed topographic and line surveys and geotechnical investigations.

b. Implementation of K-IV Projects without Delay

KW&SB are implementing the first phase of K-IV project at present. The project includes the construction of 260 mgd bulk water supply system from Kinjhar Lake to Karachi and the construction of 130 mgd filtration plant at the central part of Gadap Town. KW&SB should execute the first phase of K-IV project without any delay or suspension.

c. Coordination during DNI

It is important to cooperate with concerned authorities when installing pipes and related facilities by cutting, excavating, refilling and restoring paved roads.

d. Equitable Water Supply

It is necessary for equitable water supply to take records of district and sub-district flow meters and water consumption of each customer and to control the flow entering into each water supply block.

e. Update of GIS Database

KW&SB or the new corporatised entity of Zone West should update and add pipeline information, on a day-to-day basis before, during and after DNI, to the GIS database of water supply network system which was established during the JICA Study and handed over to the newly established GIS Department of KW&SB.

(2) Sewerage Project

Priority project of sewerage targets three towns of North Nazimabad, Gulberg and Liaquatabad. These three towns are also the target of water supply project in which DNI is implemented. The implementation of DNI will bring about constant water supply which will inevitably increase sewage generation. Increased sewage has to be collected and treated as required.

Priority projects of sewerage will collect the increased amount of sewage generated in these three towns through new installation of branch sewers in currently unsewered areas and

rehabilitation of existing sewers. One of the principal roles of sewage works to promptly collect generated sewage can be played by installation and/or rehabilitation of sewers while making full use of existing facilities.

Another principal role of sewage works is to treat collected sewage at the required level. Increased sewage will be collected and conveyed either to TP-1 or to TP3 where the collected sewage will be treated with the effluent BOD of less than 80 mg/l as stipulated in NEQS. Priority project also includes the rehabilitation of these two treatment plants to restore their original function.

The new installation and rehabilitation of sewerage facilities in these three towns and two sewage treatment plants do not apply any sophisticated treatment processes or construction methods. Operation and maintenance of implemented/rehabilitated facilities can be done by currently available techniques.

From above mentioned discussions, it is judged that the priority project proposed here is technically feasible.

S5.6.4 Overall Evaluation and Recommendations

(1) Overall Evaluation

It is anticipated that the Priority Project (i.e. the water supply and sewerage priority projects) would, through the implementation of DNI, make a substantial improvement to water supply and sewerage services in the three towns located in the western part of Karachi, namely North Nazimabad, Gulberg and Liaquatabad. The total population in these three towns is approximately 2.5 million at present. Almost the entire area covered by these three towns have already been urbanised with the current average population density of the area being as high as 580 persons per hectare. Under the circumstances, the Priority Project is considered to be a highly cost-effective investment, in which intended benefits of the project could emerge immediately upon completion of DNI.

The primary objective of DNI is to provide a 24-hour continuous supply on a regular basis at an adequate pressure. It is expected that once DNI has been completed, it would substantially reduce the indirect costs associated with the use of piped water in Karachi. They would include the costs for providing ground-level water reservoirs, suction/booster pumps, roof-top storage tanks and water filters, as well as electricity charges for pumping and fuel costs for boiling water prior to drinking. Many households who are compelled to use expensive tanker supplies would also be able to reduce their expenditure on water considerably.

Currently, low and negative pressures in the distribution system exposes the system to contamination from polluted ground water and there is a sever danger to public health. In addition, many households are obliged to use poor quality subsoil water from shallow wells. The expense of not having an adequate supply of potable water is compounded by the inevitable medical bills resulting from the treatment of water-borne diseases (typhoid, cholera, and hepatitis are common) and the loss of income due to sick leave. It is expected that once DNI has been completed, the distribution system would be kept always full of water and under pressure, and as a result the chances of contamination would be drastically reduced, and so would be the risks of infection from water-borne diseases, spending on medical bills, and loss of time due to sickness.

It is expected that the Priority Project would considerably reduce the potential health risks associated with the repair, replacement, and demolition of existing asbestos cement pipes in the distribution system. For many years, asbestos cement pipes have been used for water mains in Karachi. As a result, they now constitute about 65% of existing water mains in the distribution system. Most of them have already been deteriorated and undersized, and despite the low

system pressure the level of leakage in the distribution system is unacceptably high. It is anticipated that leakage and the incidence of pipe bursts would significantly increase when the system pressure is raised by the completion of DNI. This would require all or part of the existing asbestos cement pipe network to be removed or disposed. However, asbestos, in an air borne condition, is a hazardous material. Asbestos cement pipe is non-friable in its intact state but is likely to become friable upon removal, demolition and/or disposal. Once it becomes friable, it will require special safety measures and procedures for handling, containerizing, transporting and disposal, which would also be very costly. It is therefore planned that DNI will develop an entirely new distribution network while leaving the existing distribution network intact. Upon completion of DNI, the new distribution network will replace the existing one completely. The completion of DNI will therefore make the use of the existing distribution network totally unnecessary, and therefore it is expected that no repair, demolition, or replacement work of existing asbestos cement pipes would become necessary in future. It is suggested that existing asbestos cement pipes should continue to remain underground and maintain their non-friable state.

It is anticipated that the Priority Project would greatly enhance the efficient and effective use of water resources. DNI would bring about a substantial improvement to water service quality by significantly reducing leakage and other water losses and introducing metered supplies with a volumetric tariff to all consumers. Introduction of a volumetric charging system would provide a strong incentive for the efficient use of water when it is accompanied by block tariff pricing with increased charges for consumption beyond essential use. This is necessary to prevent the households in areas where DNI has been completed from wasting/misusing water. The tariff structure should differentiate essential use from non-essential use. Low tariffs should be applied to the level of essential use while significantly high tariffs should be applied to the level of consumption that is considered non-essential. This would provide a strong incentive for the efficient use of water and also enable the cross-subsidization of water tariffs from the rich to the poor.

(2) Recommendations

It is recommended that DNI should use good quality pipe materials which comply with internationally accepted standards and competent contractors who would be able to execute pipe laying works in an orderly and disciplined manner. Despite the higher level of initial costs required, this would ensure the quality of constructed pipelines and the smooth execution of pipe installation works. The enforcement of stringent quality control would be required throughout the construction stage, in particular with respect to the pressure and leakage tests of pipelines. It is suggested that the Zone West retail entity should establish a special Project Implementation Unit dedicated to the implementation of DNI and to employ a foreign consultant/s who have had similar experience in other large cities in the past to manage the unit.

It is recommended that the cost for providing service connections should be included as part of the total project cost and recovered in the long run through water tariffs. This is necessary to ensure that proper materials and workmanship are used for the construction of service connections and to minimize the chances of leakage in service connections in the future. This also applies to water meters. Meters should be the property of the Zone West retail entity who rent them out to customers. This is necessary to maintain the quality of water meters and to minimize the types of water meters used in the distribution system for ease of maintenance. It is recommended that a regulatory board to be established as part of the proposed institutional reform should be responsible for setting out and enforcing 'Water Supply and Sewerage Services Regulations' which clearly define the statutory rights and obligations of both the Zone West retail entity and its customers in delivering and receiving the services. The regulations should clearly define that although meters are the property of the Zone West retail entity, the responsibility for maintenance of meters invariably remains with customers.

It is recommended that bulk meters should be installed at all existing high-rise condominiums and apartment buildings. This is because of the difficulty of installing individual household meters in those buildings. However, in the absence of individual water meters, it is necessary to develop a special charging mechanism which will effectively prevent the tenants of the buildings from wasting/misusing water. Meanwhile, it is strongly suggested that individual water meters should be installed from the outset at all new high-rise condominiums and apartment buildings in the future.

With respect to the actual implementation of DNI, considerable attention should be drawn to the fact that approximately 65% of existing water distribution mains in Karachi are asbestos cement pipes. It is recommended that contractors should be made fully aware of this prior to the submission of tenders and they should be instructed not to cut, damage or demolish any pipes which are not picked up by metal detectors. Other utility service operators should also be informed about the danger and the Zone West retail entity should try to provide them with as much information on the existing distribution system as possible. In addition, both contractors and utility service operators should be informed about the procedures that should be followed by them when they accidentally or unknowingly disturbed existing asbestos cement pipes and thereby causing them to become friable.

There are not so many Katchi Abadis in North Nazimabad, Gulberg and Liaquatabad Towns. Nonetheless, where services must be provided free of charge the Zone West retail entity should be compensated by the relevant local body responsible for social welfare services. Although it is necessary to ensure that residents of Katchi Abadis will receive water for their essential use, it should not be realized at the expense of the Zone West retail entity.

DNI will involve not only physical improvement works; it will also include improvements to many institutional aspects, such as the introduction of a dual pricing system, elimination of illegal and unauthorised connections, and the strict enforcement of laws on payment defaulters. As such, it is very likely that the implementation of DNI would face severe political interference if it is financed by Government subsidies. It is therefore necessary to create a new institutional framework, whereby DNI can be implemented on a loan financing basis without any Government subsidies. We have provided in this report an outline of suggested reforms in principle at this stage, which would be necessary to create such a new institutional framework. It is expected that detailed studies related to the suggested reforms will be carried out under the assistance of ADB and WSP. It is also expected that the reform process would be put into effect through the two Reform Committees (one at provincial level and the other at CDGK level) that have already been established under WSP's initiatives, which would take responsibility for ensuring the progressive implementation of reforms in close coordination with the Local Support Unit of the ADB assisted Karachi Mega City Sustainable Development Program.

Understanding and cooperation of the public are indispensable for the smooth and effective execution of DNI. It is therefore recommended that the Zone West retail entity should endeavour to inform the public in advance about the objectives, targets and components of DNI through mass media such as newspapers, TV and radio. Since DNI is expected to take many years to complete across all areas of Karachi, it could only be implemented on an area-by-area basis. This creates the situation where some neighbourhoods enjoy an improved level of service whereas other neighbourhoods continue to suffer from the current poor level of services. This, although being unfavourable from the viewpoint of social justice and equity, is unavoidable unless and until DNI has been completed across all areas of Karachi. It would therefore be absolutely necessary for the Zone West retail entity to inform the public about this and ask for their understanding. It would also be important for the retail entity to maintain

close coordination with NGOs, CBOs, CCBs, UCs, TMAs, traffic police and other utility service operators.

It is recommended that customers in areas where DNI has already been completed (and receiving an improved service under which they are guaranteed that water will be available for 24 hours per day on a regular basis) would pay a water charge that is some multiple of the current level of water charges, whereas customers in areas where DNI has not been completed (and continuously receiving the current level of service with intermittent supply) would continue to pay the current level of water charges. This dual pricing structure is necessary: (a) to generate the revenues in the short to medium term that will be needed to service the loans taken to finance DNI (and thereby implement DNI on a financially sustainable basis); (b) to provide a strong incentive for the efficient use of water in areas where DNI has been completed (and customers are receiving an improved service); and (c) to avoid creating an impression that an improvement in service in one neighbourhood is at the expense of the level of service in other neighbourhoods. We consider that the introduction and enforcement of the dual pricing structure is a prerequisite for the successful implementation of DNI.

It is suggested that the KW&SB's assets relating to the water supply and sewerage system in Zone West would be transferred to CDGK initially and then from CDGK to the Zone West retail entity. CDGK would have an initial shareholding of less than 30% of the voting shares but would, in addition, hold convertible preference shares reflecting the value of the assets transferred from CDGK to the Zone West retail entity. Provisions would be made for converting these shares to voting share after the retail entity's first 5 years of operation. This would allow CDGK the option to ensure that the Zone West retail entity remains under public control after its first 5 years of operation.

All staff transferred from KW&SB to the Zone West retail entity would be on probation for a period of 12 months and would be paid in accordance with their existing contracts of employment. At the end of this period the retail entity will offer new terms and conditions of employment to the staff that it wishes to retain as employees of the retail entity. The staff who do not wish to accept this offer or are not offered continued employment would become the employees of KW&SB and would be eligible for immediate voluntary redundancy.

Because of the extremely poor conditions of the existing distribution network, huge investments would be required to make a substantial improvement to the service quality. Hence, it is likely that the Zone West retail entity's expenses would increase more rapidly than its revenues during the first 5 years of its existence. This implies that special arrangements would have to be made to finance the losses that the Zone West retail entity is likely to make during its first 5 years of operation.