PART 2 VISION AND STRATEGY FOR DEVELOPMENT OF WATER SUPPLY, SEWERAGE AND DRAINAGE FACILITIES IN LAHORE

CHAPTER 9 BASIC POLICY FOR IMPROVEMENTS OF WATER SUPPLY, SEWERAGE AND DRAINAGE FACILITIES

9.1. Fundamentals of the Design

9.1.1 Target Year and Goals

Based on the present conditions and problems analyzed in Chapter 8, basic policy is defined as improvements to the water supply, sewerage and drainage facilities in Lahore. It is based on the discussion with WASA and "Punjab urban water and sanitation policy (2007, Gov. of Punjab)". The basic policy aims at provision of public services with efficiency and stability on future WASA jurisdictional areas from a long term viewpoint of 20~30 years.

Target year, target area and goals are shown in **Table 9.1**.

Table 9.1 Development Concept

	Water Supply System	Sewerage System	Drainage System
Target Year	2035		
Target Area	Future WASA Jurisdictional Area		
Ultimate Goals	Provision of optimum quantity and acceptable quality of water and sanitation services on a sustainable basis		
Long Term Vision and Strategy	➢ Meet the increasing water demand and required water quality by using alternative water source, controlling un-accounted-for-water(UFW) and managing water quality (UFW-20%, Water and Sewerage Coverage 100% in the current WASA area with 24hr supply, until 2035)	➢ Improve water quality of Ravi River and drains to meet the environment standard and hygienic environment in Lahore by constructing waste water treatment plants and comprehensive sewerage network	➢ Substantially reduce the inundation damage by development of drainage facilities with capacity corresponding to 2 year return-period rainfall

9.1.2 Design Area

As a result of investigations into the existing conditions, it is apparent that there is a big difference in population and the availability of facilities in urban and rural areas. Collection of much basic data and formulation of a master plan is vital for facility developments in the rural areas, which needs much time and expenses. On the other hand, each problem concerning water supply, sewerage and drainage facilities in urban areas has great importance and urgency, and is in need of quick improvement.
Therefore, it is important to select an area, which has both high efficiency and practicability, as the target area for the short and mid term plan.

The current WASA jurisdictional area, which serves 70 % of all the Lahore population and important facilities such as government offices, was selected as the target design area in the short and mid term plan. This area is almost same with ex-MCL (ex- Metropolitan Corporation of Lahore) area. The following considerations are taken into account.

- High effectiveness because of large benefit population
- Quick effectiveness using existing facilities
- Efficient planning by using existing data

The Relationship between the design area and current WASA jurisdictional area is shown in **Figure 9.1** (below)

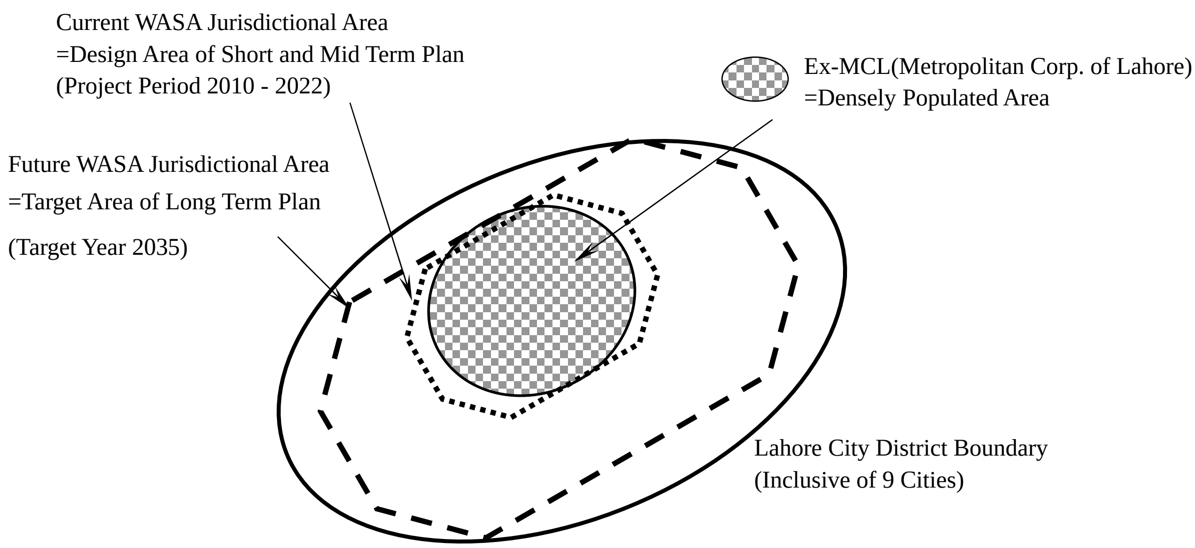


Figure 9.1 Concept of Design Area

Note: Expansion of WASA jurisdiction area

According to the devolution plan introduced under Punjab Government ordinance 2001, WASA was required to be placed under the City District Government and its functions were to be assigned to Town administration of six towns (Later in nine towns) and the responsibilities were to be extended to the whole City District area of 1770 Sq.Km.

But later on, it was decided that WASA shall retain its existing organizational setup as a separate department under the new District Government as the plan to bifurcate the agency into each town units would create difficulties in maintaining the integrated system of water supply, sewerage and drainage. It was proposed that WASA should maintain water supply, sewerage and drainage system of the area within old boundaries covering 350 Sq.Km and the question of entrusting the responsibility of water supply, sewerage and drainage services of the entire City District Lahore would be taken up at a later stage after due consideration of the financial and administrative requirements for providing the services to the extended areas.

Decision in this regards has not been taken yet.

9.1.3 Design Population

Generally, future population planning is estimated based on trends in past data and adjusting them to the target year of the long term plan. There is also need to adjust the land use plans and take into account population densities shown in higher level plans such as city planning. Moreover, not only the permanent population but also mobile populations such as tourist populations needs to be taken into consideration.

The higher level plan which would be fundamental to formulating this project is the "**Integrated Master Plan for Lahore-2021**" (Design period is up to 2021 only). In this plan, the future population in the ex-MCL area up to 2021 is estimated by transformation of an annual population growth rate based on census data (it being the most reliable under the conditions of limited data). As at 2009, this projected population is almost equal to the actual population in the current WASA area (design area). Therefore, it was decided to extend this projection up to 2035 as the design population in the designated area.

Moreover, regarding the mobile population, annual tourist population in Lahore city is around 0.16 million/year (Federal Bureau of Statistics, 2007). Even if it assumes that this tourist population visits for two months, the tourist population is about 3,000 persons per day. This is less than 1% of the future permanent population in the current WASA area.

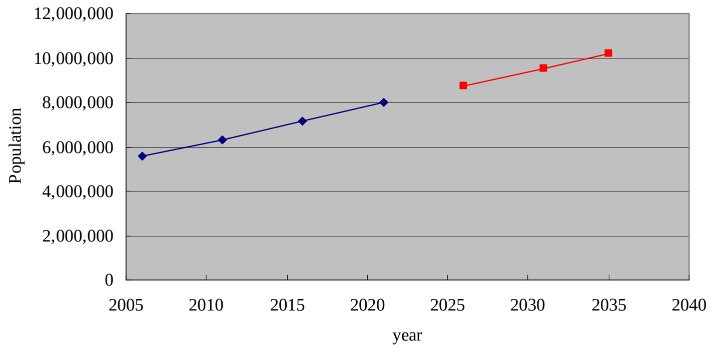
Therefore, it was decided to include the tourist population in the predicted number obtained for the permanent population.

Future population projection in the current WASA area is shown in **Table 9.2**, while future population projections by service area of water supply and sewerage are shown in **Table 9.3** and **Table 9.4** respectively. The detailed data of population projections is included in **Appendix**

9.1.

Here, the difference of served populations between water supply and sewerage is caused by the reason that some areas like private housing schemes and Model Town have their own water supply systems but discharge wastewater into WASA sewerage system.

Table 9.2 Population Projection in the Current WASA Area

Year	2009	2011	2016	2021	2026	2031	2035
Population	6,103,852	6,337,420	7,163,218	8,025,762	8,756,179	9,544,296	10,174,790
Trend							

Source: Integrated Master Plan for Lahore-2021, JICA Study Team estimates

Table 9.3 Population Projection in the Current WASA Area (Water Supply Services)

Town Name	Population						
	2009	2012	2017	2022	2027	2032	2035
Shalimar	1,139,679	1,214,128	1,369,689	1,525,804	1,664,339	1,811,492	1,899,784
Aziz Bhatti	266,159	283,546	319,875	356,334	388,687	423,053	443,673
Nishtar	641,008	682,881	770,376	858,183	936,101	1,018,867	1,068,526
Allama Iqbal	1,298,920	1,383,771	1,561,067	1,738,996	1,896,887	2,064,601	2,165,229
Ravi	1,289,374	1,373,601	1,549,594	1,726,215	1,882,946	2,049,427	2,149,316
Data Gunji Buksh	1,035,770	1,103,431	1,244,809	1,386,691	1,512,595	1,646,331	1,726,573
Total	5,670,911	6,041,357	6,815,410	7,592,223	8,281,554	9,013,771	9,453,101

Source: .Integrated Master Plan for Lahore-2021, JICA Study Team Estimates

Note: Water supply service area doesn't include the cantonment area, private housing schemes, Model Town and other localities

Table 9.4 Population Projection in the Current WASA Area (Sewerage Services)

Treatment Area	Population						
	2009	2012	2017	2022	2027	2032	2035
Shahdara	468,052	489,542	540,058	590,834	633,400	679,991	707,945
Khokhar	984,932	1,030,153	1,136,457	1,243,306	1,332,878	1,430,919	1,489,744
Mehmood Booti	942,386	985,654	1,087,365	1,189,599	1,275,301	1,369,108	1,425,392
Central	2,574,676	2,692,886	2,970,771	3,250,082	3,484,228	3,740,515	3,894,287
South East	217,042	227,007	250,432	273,978	293,716	315,321	328,284
South	916,764	1,077,338	1,350,643	1,624,047	1,894,279	2,166,067	2,329,139
Cantonment	752,463	806,884	907,109	1,062,859	1,252,278	1,373,469	1,451,970
Total	6,856,315	7,309,464	8,242,836	9,234,704	10,166,080	11,075,389	11,626,761

Source1: .Integrated Master Plan for Lahore-2021, JICA Study Team Estimates

Source2:.Feasibility Studies of Sewerage and Drainage Systems of Lahore & Walton Cantonment Areas PC-1, September 2007, Lahore & Walton Cantonment Board, Ministry of Defence, Government of Pakistan

9.1.4 Design Flow

(1)Water Demand

Generally, future water demand estimates are based on the past record of water use. Presently, the available data which can be used for future water demand estimation is only the "Bench mark indicators" prepared by WASA from 2007 data (see **Table 9.5**).

Table 9.5 Benchmark Indicators

Description	Unit	Year 2007	Year 2008	Remarks
Water Production	Lpcd	329.6	334.0	=73.5 gpcd
Water Consumption	Lpcd	211.4	221.6	
Metered Water Consumption	Lpcd	171.2	182.4	
Unaccounted for Water	Percent	35.8%	33.5%	

Source: WASA

In this plan, considering the benchmark indicators and conditions of groundwater, three scenarios of future water demand have been considered.

These are;

Scenario 1 : 75 gpcd (Keep the Water Production per Capita)

Scenario 2 : 62 gpcd (Keep the Water Consumption per Capita)

Scenario 3 : 45 gpcd (Keep the Total Water Production)

These scenarios are based on the following assumptions.

- Water consumption includes non-domestic water use such as commercial use.
- It is aimed that unaccounted for water rate will be around 20% at 2035.
- Water service rate in the service area will be 100% at 2035.

Water Demand Forecast of each scenario is shown in **Figure 9.2** (Details of water demand for each scenario is included in **Appendix 9.2**).

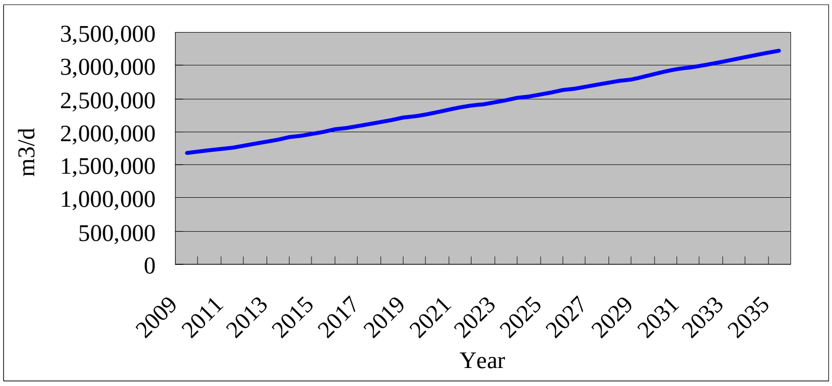
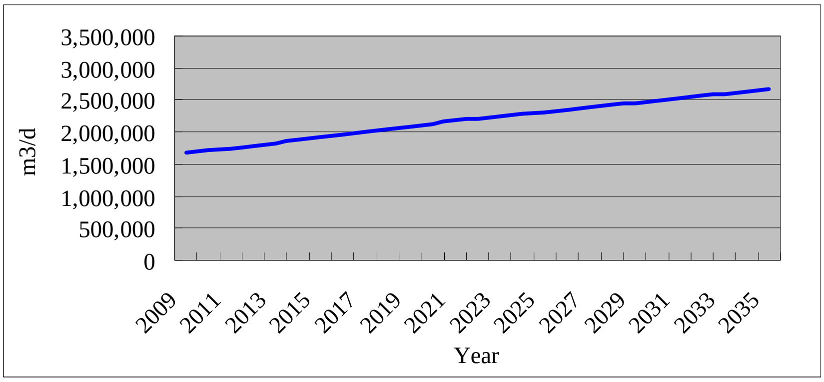
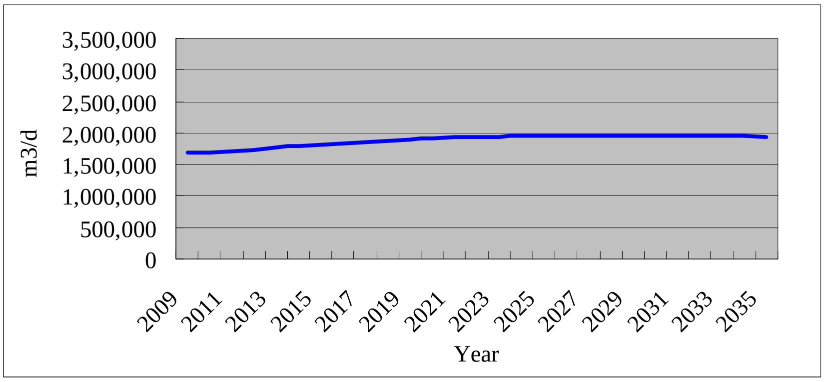
Scenario 1 Water Production per Capita 75 gpcd	
Scenario 2 Water Production per Capita 62 gpcd	
Scenario 3 Water Production per Capita 45 gpcd	

Figure 9.2 Water Demand of each scenario

Historically, Lahore's water supply has relied upon ground water. This system has in the past provided a secure and stable water supply for Lahore. However, recent rates of consumption have seen ground water levels fall approximately one metre per year.

The population in Lahore is projected to increase significantly over the next 25 years as mentioned above and WASA will have to face increasing pressure to meet this growing demand.

In the case of retaining per capita production of 75gpcd (340L/c/d) constant in the future, water demand is projected to double in 2035 relative to 2009 in Scenario-1, although it is assumed that the 34% of unaccounted-for-water in 2009 is controlled and reduces to 20% in 2035.

Besides, arsenic concentration is increasing gradually in ground water. Its concentration is mostly below the Pakistan standard value of 50μg/L, but most of them have exceeded the WHO guideline value of 10μg/L. In this regard, arsenic will be clearly an important public health threat.

Consequently, while there is no doubt that Lahore's traditional approach in supplying water had been economically and socially advantageous, it is becoming increasingly clear that it is no longer environmentally sustainable. WASA will need to control the water demand to preserve the precious water resource for future generations.

The scenario-3 shows the water demand projection with control of per capita production up to 45gpcd (205L/c/d) in 2035 relative to 75gpcd in 2009. While it is a challenge to reduce per capita production of 75gcpd to 45gcpd, WASA has an opportunity to use water more efficiently. Otherwise, groundwater levels will have decreased and arsenic concentrations would have increased to the extent that people will not be able use groundwater for drinking purposes any more.

Thus, it is recommended that scenario-3 be adopted in this project.

The best way to preserve ground water is to start increasing water efficiency immediately.

This basically involves the implementation of the following three actions; 1) control of unaccounted for water, 2) establishing a proper pricing scheme, 3) promotion of campaigns on water saving.

According to the report by the Leak Detection Cell of WASA, unaccounted-for-water (UFW) was estimated to be 32% of the system input volume in January and February 2009. While reliable metering of all water volumes must be an integral component to tackle the main causes of water loss, 49% of the customers do not have meters; while only 13% of the customers have meters that are operational.

Installing customer meters is definitely one of the key issues with respect to water balance calculations for leakage control as well as water demand management by volumetric pricing, rather than flat pricing. The current cost of water to customers does not reflect its true value as a scarce and essential resource. Traditionally, water has been supplied to Lahore consumers at fixed cost, regardless of usage levels. Promoting metering and cost-reflective pricing will be useful in reducing water demand.

To ensure the sustainability of this programme, customer education campaigns would be essential as well as raising the understanding of politicians and policy makers about the basic principles of water management, water supply and sanitation, and this would therefore encourage updating and improvement of their knowledge and skills.

WASA should start these actions as soon as possible to control water demand. In addition to this WASA should initiate seeking alternative water sources.

As the reference, water use per capita in other countries is included in **Appendix 9.3**.
225 Lpcd, current water consumption per capita in Lahore, is considerably large when compared to other cities. **Table 9.6** shows the detailed water demand for scenario-3.

Table 9.6 Water Demand Forecast [Scenario 3] (Current Total WASA Area Total)

Description	Unit	2009	2012	2017	2022	2027	2032	2035
Population	million	5.671	6.041	6.815	7.592	8.282	9.014	9.453
Water Coverage	Percent	87%	89%	91%	94%	96%	99%	100.0%
Served Population	million	4.934	5.347	6.202	7.099	7.950	8.879	9.453
Water Demand per Capita	gpcd	75	72	66	60	54	49	45
Water Demand	10^3 m^3/d	1,682	1,739	1,855	1,938	1,963	1,960	1,934
Unaccounted for Water	Percent	34%	33%	30%	28%	25%	23%	20%
Water Consumption	10^3 m^3/d	1,110	1,174	1,299	1,405	1,472	1,519	1,547
Water Supply per Capita	lpcd	225	220	209	198	185	171	164

(2)Sewage Flow

According to a WHO report, sewerage flow could be assumed as 90% of water use if water use is well defined. Considering the present sewage discharge volumes in the current WASA area, 100% is applied as the conversion rate of water use to sewage flow (Refer to **Appendix 9.4**). It is assumed that this is a result of accurately collected information.
Meanwhile, many factories in Lahore use their own water wells as their water source. The number of such water wells is about 4,000, and the discharge volume to sewer or drainage is approximately 450,000 m^3/day. These discharges are included in industrial sewage flows. Discharge volumes are assumed to be maintained at present discharge volumes as it is expected that industries would use water recycling in future.

The Sewage flow forecast is shown in the **Table 9.7**.

Table 9.7 Sewage Flow Forecast (Current Total WASA Area)

Description	Unit	2009	2012	2017	2022	2027	2032	2035
Population (Current WASA Area)	million	6.104	6.503	7.335	8.172	8.914	9.702	10.175
(Cantonment Area)	million	0.752	0.807	0.907	1.063	1.252	1.373	1.452
Sewerage Coverage	Percent	84%	86%	89%	92%	95%	98%	100%
Sewered Population	million	5.759	6.276	7.333	8.501	9.674	10.883	11.627
Water Supply per Capita	lpcd	225	220	209	198	185	171	164
Sewage Discharge Per Capita	lpcd	225	220	209	198	185	171	164
Industrial Sewage flow	10^3 m^3/d	450	450	450	450	450	450	450
Sewage Flow Total	10^3 m^3/d	1,746	1,831	1,983	2,133	2,240	2,311	2,357

9.2 Measure of Facility Provisions

9.2.1 Water Supply Facilities

The water supply of Lahore city has always relied on the abstraction of groundwater. The number of tube-wells and the amount of abstraction has been increasing in accordance with the growth of population and socio-economic uplift of urban dwellers. This results in a decrease in the storage of groundwater in the aquifer and a deterioration in water quality.

The key issues and proposed approaches to improving the water supply of WASA are shown in **Table 9.8**.

Table 9.8 key Issues and Proposed Approaches

Key issues		Proposed approaches
Deficiency of water quantity	1) Increasing water demand 2) Decreasing ground water 3) Serious UFW	• Find alternative water sources ➢ Obtain rights of surface water ➢ Develop a water supply master plan ➢ Build intake and treatment plants ➢ Develop distribution system ➢ Conjunctive management of surface and groundwater resources • Control the UFW ➢ Implementation of metering (Install bulk flow meters and customer meters) ➢ Establish regulations of service pipes ➢ Active leakage control ➢ Replacement of deteriorated pipelines
Deteriorating water quality	4) Increasing Arsenic concentration	• Regulation of abstraction of groundwater • Regular monitoring of arsenic concentration • Find alternative water sources ➢ Dilution of arsenic contaminated groundwater with treated surface water
	5) Contamination in the pipelines	• Establish regulations of service pipes and individual pumps • Install chlorinators • Develop and replace distribution system in some areas where people does not have public water and/or suffer from water problems

Following approaches are proposed to tackle these issues.

(1) Find alternative water sources

Lahore's water supply has historically relied on ground water and tubewells, however it is time to find alternative water sources, becuse WASA is facing challenges of an imbalance between increasing water demand and decreasing ground water as their exclusive water source. The concentration of arsenic has also been gradually increasing in the ground water in recent years. Data from the survey in 2009 found that arsenic is greater than the Pakistan standard value of 50μg/L in two out of ten groundwater samples and all of them are beyond the WHO guideline value of 10 μg/L. High concentrations of arsenic detected in groundwater can cause health problems ranging from skin disorders to cardiovascular disease and cancer.

The two main technological options for arsenic mitigation are (a) switch to alternative, arsenic-free water sources; or (b) remove arsenic from the groundwater source. Considering the decreasing capacity of ground water, alternatives in the first category should be taken, in other words, finding alternative water source will be the best way.

A switch to an alternative water source will bring the following benefits:

- Reduce the abstraction of ground water
- Mitigate the arsenic contaminated ground water by dilution with treated surface water

When using an alternative water source, the following sequence of actions is required:

- Obtain water right permission of surface water
- Develop a water supply master plan
- Build intake and treatment plants
- Develop distribution system such as pipelines and overhead reservoirs

First of all, water right permission of surface water must be acquired. In chapter 5, the possibility of use of surface water is described. WASA should discuss the necessity of an alternative water source for drinking water with the Irrigation Department and obtain the water right permission of use of surface water.

The next step is to develop a master plan for water supply in order to study the overall water supply strategy. When using an alternative water source, much change of existing water supply systemsis required. In particular, the distribution system should be singnificantly changed since upcoming treated surface water and existing tubewell water should be integrated together. Therefore, the total framework of water supply in WASA should be rebuilt in the master plan.

Water treatment plants should supply water equally to given places in the target area, in particular to dilute the arsenic contaminated water.

To find alternative water sources, WASA will have several issues to discuss and take into consideration as follows:

1) Approval process of water rights

Figure 9.3 shows the approval process of water rights. WASA submits applications to its super-ordinate HUD and PHED. The Chief Minister of HUD and PHED reviews and sends applications to the Irrigation Department. At the Irrigation Department the secretary and chief engineer screen the applications. After the superintendent engineer of Irrigation Department approves the applications, they are sent back to Chief Minister of HUD and PHED. He submits the applications to the Federal Government Ministry of Water and Power. The IRSA then signs the applications in effect granting the water rights. In this procedure, the superintendent engineer of the Irrigation Department is one of the most important persons, because he thoroughly examines the applications from a technical and feasible standpoint.

WASA should always maintain contact with the superintendant engineer of the Irrigation Department to exchange ideas and opinions. It will facilitate the preparation of applications and the acquisition of permission of water rights.

It would be better that stakeholder for water users sit together and discuss the reallocation of water rights of surface water, as the valuable groundwater is decreasing drastically.

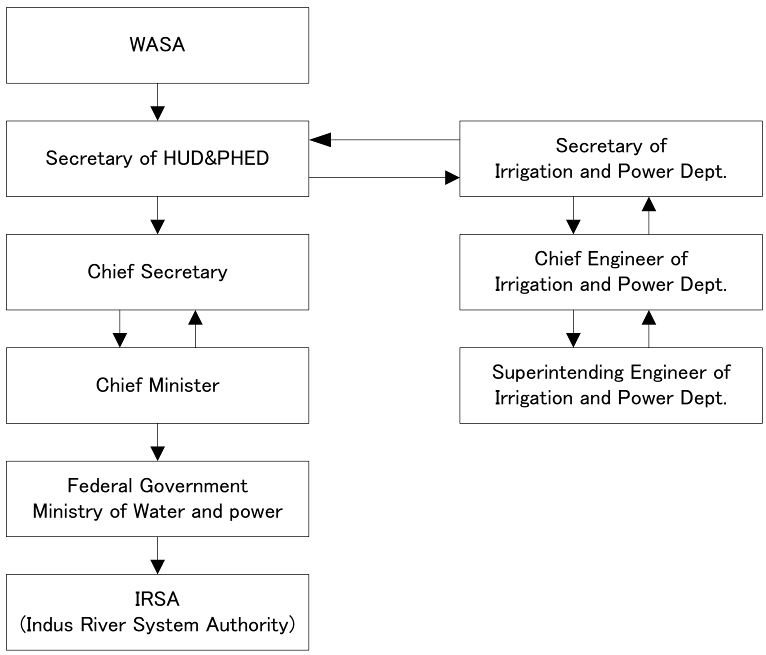


Figure 9.3 Approval process of water rights

2) Water source

There are three canals and one river which have been identified as alternative water sources; BRB Canal, Malara Canal, Lahore branch and Ravi River in **Figure 9.4**. BRB Canal and Malara Canal originate from the Chenab River, which is regulated by Pakistan, but the Ravi River originates in India, so its flow is regulated by India. However, the Malara Canal flows into the Ravi River at the upstream of Lahore after the Ravi River leaves India. So it can be said that the flow rate of the Ravi River depends on the Malara Canal. The Malara Canal is a bit too far away from Lahore to intake water for drinking water. The Ravi River around Lahore has mostly the same amount of water as the Malara's inflow to Ravi.

The BRB Canal, Lahore branch and Ravi River are options for intake.

3) Conditions for water right permission

Considering that all the water is basically used for irrigation, there are two options for WASA to take water from a canal or river; 1) request the Irrigation Department to supply more water to the BRB or Malara Canals for drinking water as much as water demand, 2) A trade-off between intake water and discharge to the canal or river, instead of asking for more water to Canals.

It might be difficult for the Irrigation Department to provide more water with to the BRB Canal or Malara Canal, since all the water including Chenab River has been dedicated to irrigation.

The Irrigation Department staff suggests that WASA may obtain water right permission of surface water, as long as WASA gives the same amount of treated sewage back to the Irrigation Department. In other words, it is a trade-off between raw water and treated sewage. WASA should check with the Irrigation Department to ensure these kind of conditions for water right permission. Incidently, the proposed capacity of the waste water treatment Plant is 790,000m3/day in South West area. That means WASA could obtain the water right permission of surface water with amount of 790,000m3/day if the conditions are met.

However, even if WASA can obtain the same amount of water as the capacity of the Waste Water Treatment plant in the South West area on the trade-off condition, it is still less than the total required water demand. At present WASA does not necessarily have to acquire the same amount of water as future water demand because WASA can use tubewells water to partially blend with treated surface water. Furthermore, once the trade-off condition is complete, WASA will obtain more water right permission by trading water from other Waste Water Treatment plants except for the South West area.

4) Available amount of water

The flow rate in 2000 or later of the Ravi River, BRB Canal and Lahore Branch is shown in **Table 9.9**. This does not include the Malara Canal but all the water of Malara inflows to the Ravi River and the Malara Canal is not a good option for an intake place because it is far away from Lahore. Note that water demand in the project area is estimated to be 1,934,000m3/day in 2035 and the proposed capacity of the Waste Water Treatment Plant is

790,000m3/day in the South West area. The flow rate of the Ravi River, BRB Canal and Lahore Branch decreases every winter and spring between November and May. In particular, the BRB Canal and Lahore Branch are emptied for clean up and maintenance in every January. Thus, if WASA uses the BRB Canal or Lahore Branch as a water source, WASA would not be able to provide water to customers in January.

The Ravi River has 200 cusec (489,000m3/d) in winter, however it seems to be small amount to intake because it is not allowed to dry up the river.

In short, it would be difficult to intake water from the canal or river in winter, particulary in January. Consequently, WASA will have to use tubewells to supply water to customers in winter, particulary in January.

Still, WASA will definately need an alternative water source in order to facilitate the supply of safe water and cut down on ground water usage all year excepting January.

Noted that it is not clear wether the Malara Canal empties in January. If not, WASA may want to request the Irrigation Department to increase water of the Ravi River via Malara Canal in winter enough to use it as water source, because the Ravi River has only 200 cusec (489,000m3/day) in winter, then WASA can use the surface water all year round by taking water from the Ravi River.

Table 9.9 Flow Rate of Ravi River, BRB Canal and Lahore Branch

Case	Alternative water source	Flow rate	
		ft3/s	m3/day
1	Ravi River	200 - 28,000 ft3/s	489,000 - 68,504,000 m3/day
2	BRB Canal	0 - 5,000 ft3/s	0 - 12,233,000 m3/day
3	Lahore Branch	0 - 130 ft3/s	0 - 318,000 m3/day

5) Structural issue

When WASA requests the Irrigation Department to provide the BRB or Malara Canals with additional water from the Chenab River for drinking water, the canal structure should be checked out completely to see if the canals can accommodate the additional water. Otherwise, additional water might result in bank collaspe or flood.

6) Location of intake

Intake and water treatment plants will be located upstream of waste water treatment plants. When WASA intakes water on the trade-off condition, WASA has to give the same amount of water back to the Canal or River. It is thought that WASA can take and give back water at any place as long as it does not affect the supply for irrigation and satisfy the trade-off conditions.

However, especially when WASA takes water from the Lahore Branch, WASA should discharge it right after the Water Treatment plant in order to maintain the amount of water in the canal. Lahore Branch has only 130 cusec (318,000m3/day) and goes through the Lahore city. If WASA took large amounts of water from the upper Lahore Branch and discharged it at the lower Lahore Branch, this canal would become empty in most parts of the city. People would be very dissapointed because Lahore Branch is one of the most popular places of recreation and relaxation for the citzens.

Table 9.10 shows advantages and disadvantages of alternative water sources. From a point of veiw of amount of water, Lahore Branch can not meet the required water demand. BRB Canal and Ravi River is more suitable for the water source. WASA needs to discuss with Irrigation Department and other staleholders, since both of them are vital water source for irrigation.

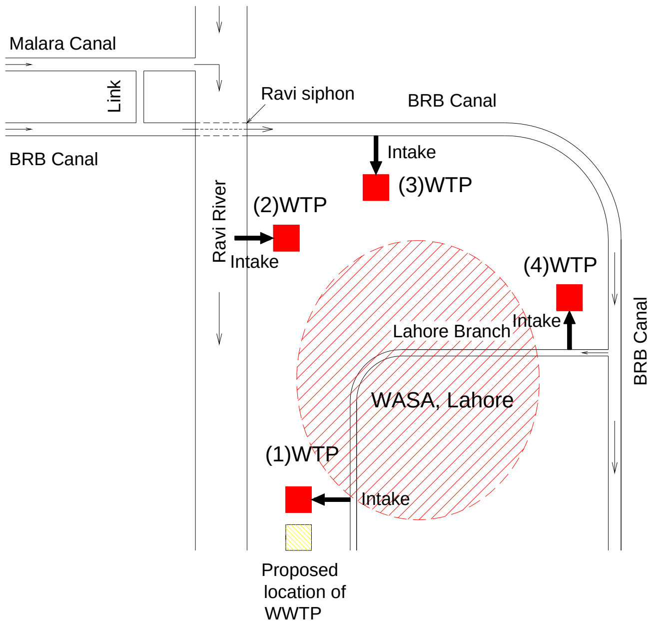


Figure 9.4 Options of location for Water Treatment Plant

Table 9.10 Alternative Water Sources

Alternative water source	Advantage and Disadvantage	Comments
1. Lower Lahore Branch	■Advantage • The Wastewater Treatment Plant will be located near the lower Lahore Branch and it can easily discharge the treated water back there. ■Disadvantage • Water can be polluted by Lahore city's drainage. • Lahore Branch does not have enough water to meet the water demand (flow:0 - 318,000 m3/day)	It is inadequate because volume of flow is less than required amount.
2. Ravi River	■Advantage • Ravi River has the most water than	It is most suitable for water source.

	other alternative water sources. （flow:489,000 - 68,504,000 m3/day） • The Wastewater Treatment Plant will be near Ravi River so that it can discharge the treated water to Ravi River easier than BRB canal. ■Disadvantage • Ravi River is so huge that it will require biggest intake facilities than others.	
3. BRB Canal	■Advantage • BRB canal has sufficient amount of water to intake. (flow: 0 - 12,233,000 m3/day） ■Disadvantage • The Wastewater Treatment Plant is far away from BRB Canal so that it is difficult to send treated water back to BRB Canal.	It is better suitable for water source. However, if the Wastewater Treatment Plant has to send the treated water back to BRB Canal, it will require more considerations.
4. Upper Lahore Branch	■Advantage • It makes sense in terms of Trade-off condition that the Water Treatment Plant takes water at upper Lahore Branch and the Wastewater Treatment Plant discharges it at the lower Lahore Branch. ■Disadvantage • Lahore Branch does not have enough water to meet the water demand（flow:0 - 318,000 m3/day） • Taking large amounts of water at the upper Lahore Branch results in empty of canal in the Lahore city. People would be very disappointed because Lahore Branch is one of the most popular places of recreation and relaxation for the citizens.	It is inadequate because volume of flow is less than required amount.

Related to use of the alternative water source, existing facilities should be improved and developed in the following way:

1) Overhead reservoirs

There are 52 overhead reservoirs in the WASA area with a total capacity of about 20,000 cu.m (4.4 million gallons), but none of them are currently used except for one, because its capacity is too small to supply water to all the customers. The total capacity of the reservoirs is estimated to be only 1.3% of the average days supply. That means the reservoirs has only 18 minutes capacity of the average day supply. Once a reservoir is filled with water, it will become empty the moment the tubewell is stopped.

Thus, these overhead reservoirs have few advantages in equalizing supply and demand, leveling out pumping requirements and providing water during pump failure.

However, these overhead reservoirs will be sufficiently used for blending tubewell water and treated surface water when WASA obtain an alternative water source. At the beginning WASA will not always be able to get enough amount of alternative water source to supply all the customers then WASA will have no choice to use both water sources at the same time for a while; ground water and surface water. In that case, ground water from tubewells should be blended with treated surface water to dilute arsenic concentration in ground water. Otherwise some people will get high arsenic concentrated water and others will get safe water. The most effective way to blend both water sources would be to use one big reservoir where all the treated surface water and ground water could mix together, however it is not practical to collect all the ground water from tubewells to a certain reservoir because tubewells are scattered all over the city. In this regard, existing overhead reservoirs look better to mix both water sources because they are scattered as much as tubewells.

This kind of method for supplying water from two different water sources should be considered in the master plan, but using existing overhead reservoirs are one of the most effective options to blend water sources. The master plan should include the consideration of necessary capacity of overhead reservoirs, location and distribution zoning as well as water supply management plan.

2) Tubewells

WASA is currently producing an average of 1,608,000 m^3/day (354 MGD) of water in January 2009 to the citizen in its service area from 412 tubewells of different capacities. On average tubewells are operated for 14-18 hours per day.

At this moment, there is no alternative water source except for ground water. Thus, WASA cannot help using tubewells and developing new ones according to the increase of water demand.

If WASA cannot obtain the alternative water source in the future, more tubewells will be required according to increasing water demand in **Table 9.11**. WASA will need a total of approximately 500 tubewells in 2035.

It is currently reported that WASA installed 69 more tubewells in 2009. That means the total number of tubewells were around 460 in 2009.

Even if WASA obtains the alternative water source, they may not use it every January because the canals are emptied for regular clean up and maintenance.

Consequently, WASA will have to maintain the existing tubewells to serve water to customers in January. If WASA maintain 460 tubewells, they will be able to manage to supply water to customers in January by increasing the operating hours of tubewells by one or two hours as stated below:

Required number of tubewells: 500

Existing tubewells: 460

Current operating hours: 17 hours

500/460=1.09, 17 hours*1.09=18.5 hours.

Table 9.11 Future Tubewell Requirements up to 2035

Year	Population	Water Caverage Percent	Served Population	Unaccounted for water Percent	Per capita demand Lpcd	Abstraction of groundwater m3/d	Required No. of tubewells
2009	6,783,000	81%	5,466,000	33%	198	1,608,000	412
2021	7,457,000	93%	6,935,000	28%	200	1,929,000	494
2031	8,867,000	98%	8,690,000	23%	174	1,963,000	503
2035	9,453,000	100%	9,453,000	20%	164	1,934,000	496

(2) Control the Unaccounted for Water (UFW)

Reduction in UFW is one of the key issues in addressing the unbalance between water demand and water productivity of the aquifer under Lahore.

According to the report by the Leak Detection Cell in WASA, unaccounted for water (UFW) is estimated to be 32% of system input volume in January and February in 2009.

The benefits of reducing NRW include:

- Need for less water to be produced, treated, and pumped, translating into the postponement of the expansion of capacity—producing less water also translates immediately into cost savings on O&M, due to savings in energy and treatment costs.
- Reduction in unauthorized consumption and metering inaccuracies, which will result in more water being billed and more revenue for utilities—it has also been shown that water metering and adequate rates reduce wasteful consumption, which will likely decrease total consumption.
- Adequate understanding of consumption patterns, which will allow utilities to optimize distribution systems.
- Better knowledge of real consumption, which will improve demand projections.
- Reduced sewage flows and pollution.

The following four principal actions concerning leakage management should be addressed;

- Implementation of metering (Install bulk flow meters and customer meters)
- Establish regulations of service pipes
- Replacement of deteriorated pipelines
- Active leakage control

The first, basic step in developing a strategy for the management of UFW is to gain a better understanding of the amount and sources of UFW to meter production and consumption (calculating the water balance) and the factors that influence its components. UFW reduction activities can then be planned using the water balance.

The second step is the regulating of material of service pipelines, since it has been reported that leakage mostly occurs at old service pipelines. Customers often use the cheapest priced pipe which is of inferior quality, resulting in leakage. Serivice pipelines should consist of durable lasting material.

The third step is the replacement of deteriorated pipelines. In Lahore, AC pipelines have been laid since the 1970s. It has been more than 30 years since the initial pipelines were laid. Pipe breakage of particularly AC pipes has increased over time. WASA should identify the pipelines that require replacement and manage network rehabilitation in an economical manner to reduce the need for corrective maintenance.

In summary, active leakage control is needed. This involves monitoring network flows on a regular basis to identify the occurrence of new leaks earlier so that they can be detected and repaired as soon as possible.

(3) Regulation of abstraction of groundwater

Even if the alternative water source is found, groundwater is still an important source of drinking water. Now sustainable management and use of groundwater is critically required. As a source of drinking water, groundwater should be protected by enacting legislation and regulations to minimize water wastage. At least the construction of tubewells should not be permitted on property where WASA water supply is reasonably available. Details are shown in chapter 10.3.

(4) Regular monitoring of arsenic concentration

The concentration of arsenic in groundwater is mostly below the Pakistan standard value of 50μg/L but sometimes it is higher than recommended level. In fact, most of them are exceeding the WHO guideline value of 10 μg/L. While that does not have a major impact on large numbers of people currently, arsenic is clearly an important public health threat.

Now that some initial surveys of arsenic have been carried out and the arsenic problems have been recognized, a program of monitoring tubewells should be undertaken in order to identify trends of arsenic.

Following three simple steps would help WASA more effectively address the arsenic issue now and in the future: (a) encourage further research in potentially arsenic-affected areas in order to better determine the extent of the problem; (b) ensure that arsenic is included as a potential risk factor in decision-making about water-related issues; and (c) develop options for populations in known arsenic-affected areas.

(5) Establish regulations of service pipes and individual pumps

Tubewells in WASA are operated for 14-18 hours per day on average. To compensate for the intermittent water supply, many customers have their individual pumps to suck more water directly from the water main. The material of water main pipes is mostly AC which has been laid since the 1970s and seems to have been deteriorated. Also, customers often choose the cheapest priced pipe which is of inferior quality and can easily be broken. When the tubewells are stopped, negative pressure develops in the pipelines which suck the sewage and other injurious material thereby causing water quality problems.

Regulations and penalties should be enacted in order to stop individuals from installing pumps directly on water mains.

In Lahore, DHA has a regulation against the installation of an individual pump on the water supply mains. Staff members of DHA carries out a survey every two months and those consumers who are found committing a violation of the aforementioned regulation are penalized as follows:

"A fine of Rs 10,000 and confiscation of the motor and pump by DHA"

When installing service pipelines, the following things are necessary;

A) Specific requirement for pipe material
B) Proper operation
C) Inspection after installation

Service pipe material should be carefully chosen to ensure its durability. Pipes must have the strength to withstand the both external and internal loads or hydraulic pressure. It must also have the durability such as long life, toughness, and the ability to maintain tight joints with little or no maintenance.

WASA should establish specific requirements and standards for materials, design and installation for pipelines. Pipelines should be approved material by WASA, and be installed by a approved contractor. The Proper installation of pipe will enable the utility to reduce or minimize maintenance problems and aid in public health protection.

After the trench has been partially backfilled, the pipe should be tested for amount of leakage and ability to hold pressure. This should be done before complete closure of the trench.

(6) Install chlorinators

WASA has commited to disinfecting the abstracted water at the tubewells but only 34% of the chlorinators are working. The remaining tubewells are disinfected by a dripping system that is not as reliable as a chlorinator.

It is reported that people sometimes contract illnesses caused by organisms that thrive in water sources contaminated by raw sewage. Most outbreaks in community systems are a result of improper treatment or breaks in the distribution system that allow for system contamination.

Chlorinators should be installed at every tubewell to destory pathogenic microorganisms and provide essential public health protection.

(7) Develop and replace the distribution system in some areas

As per the results of the survey, it was found that the community of Samanabad Town, out of WASA jurisdiction, has serious water issues. It is located right next to Gunj Baksh Town and Iqbal Town in WASA, on the Ravi River bed. It is said that 50,000-100,000 people live there and most of them cannot access the public water except for one part served by WASA. People get water by their individual shallow wells or ask neighbors in WASA's area to share water. The water from the individual pumps is often contaminated.

9.2.2 Sewerage Facilities

A number of sewerage problems were discussed in Section 8 leading to a recommended future plan for sewerage improvement. The plan identifies the required infrastructure components in this section. The following discussions outline the general sewerage plan for each area.

(1) Shahdara Area

Existing trunk sewers and branch sewers are inadequate to cater for present and future sewage flows, therefore there is a need to upgrade existing sewers. The existing sewerage system doesn't cover all of this area as yet so there is a need to improve the existing system and develop trunk and branch sewers in formerly un-serviced areas. At the Farakhabad Disposal Station, some existing pumps don't function to full design capacity and the total capacity of pumps will be inadequate to cater for future sewage flows. Therefore existing pumps need to be replaced. At present there is no waste water treatment plant in this area, and there is a need to construct a new waste water treatment plant. However, as WASA hasn't prepared any reports such as a basic design study, feasibility study or detailed design study for sewerage system improvement in this area, an in-depth study on improvement of the sewerage system in this area needs to be undertaken.

(2) Mehmood Booti Area

A few sewers in southern part of this area have already settled and are not in proper working condition and the existing sewerage system doesn't cover all of this area as yet. There is a pressing need to improve the existing system and develop the trunk and branch sewers in formerly unserviced areas. At the Mehmood Booti Disposal Station, the existing generator is unable to operate all pumps and the total capacity of pumps will be inadequate to cater for the any future sewage flows. There is therefore a need to replace the existing generator and pumps. At present there is no waste water treatment plant in this area and a new one needs to be constructed. However, as WASA has not prepared any reports such as a basic design study, feasibility study or detailed design study for the sewerage system improvement in this area, an in-depth study on improvement of the sewerage system in this area needs to be undertaken.

(3) Khokhar Road Area

The existing trunk and branch sewers are inadequate to cater for both the present and any future sewage flows, therefore there is a need to refurbish existing sewers. The existing sewerage system doesn't cover all of this area as yet, and there is a need to improve the existing system and develop the trunk and branch sewers in formerly un-serviced area. For the Shad Bagh Disposal Station, some existing pumps don't function at full design capacity due to their advanged age so they will need to be replaced. The existing generator can't operate all pumps so there is a need to provide an additional generator. The present capacity of the pumps will be inadequate to cater for any future sewage flows. For the Khokher Road Disposal Station, one pump is out of order due to mechanical problems and the existing generator also has mechanical problems so there is a need to replace both the pumps and the generator. At present there is no waste water treatment plant in this area and one needs to constructed. However, WASA hasn't prepared any reports such as a basic design study, feasibility study or detailed design study for the sewerage system improvement in this area, therefore an in-depth study for the improvement of the sewerage system in this area needs to be undertaken.

(4) Central Area

The existing sewerage system in the Central Area was laid 20 to 70 years back. The existing sewerage system is therefore already old and most of the sewers have become badly silted up. Trunk sewers especially are not in proper working condition so a number of sewers are connected to open drains. Therefore there is need to construct a new trunk sewer and improve the branch sewer system. At the Multan Road Disposal Station, the Gulshan-e-Ravi Disposal Station and Main Outfall Disposal Station, some existing pumps don't function to full design capacity and the total capacity of pumps will be inadequate to cater for any future sewage flows, therefore there is need to replace the existing pumps. At present there is no waste water treatment plant in this area and one needs to be constructed. WASA had done the preliminary design study for the improvement of the sewerage system and waste water treatment plant. In these studies, it has identified the required facility components. However, an in-depth study on the improvement of the disposal station needs to be undertaken.

(5) South Area

In the upper part of this area, most of the trunk sewers are in poor condition and inadequate to cater for both the present and any future sewage flows. In the lower part of the area, the majority of the branch sewers have already settled and are not in proper working condition. The existing sewerage system doesn't cover all of this area as yet, therefore, it needs to be improved with the development of trunk and branch sewers in formerly un-serviced areas. At the LMP Block Disposal Station, the total capacity of the pumps will be inadequate to cater for future sewage flows, therefore the existing pumps need to be replaced. At present there is no waste water treatment plant in this area and one needs to be constructed. WASA had done the preliminary design study on improvements to the sewerage system. In this study, it identified the required facility components. However, an in-depth study on the improvement of the disposal station needs to be undertaken.

(6) South East Area

This area has been experiencing very fast urban growth rates so trunk sewers have not been provided at the same rate along suitable routes. The majority of the branch sewers have already settled and are not in proper working condition. Most of the South East Area, mainly consists of new developments and no trunk sewer facilities has been provided so far by WASA. Therefore improvements are need to the existing system with development of trunk and branch sewers in formerly unserviced areas. At present there is no waste water treatment plant in this area and one needs to be constructed. However, WASA has not prepared any reports such as a basic design study, feasibility study or detailed design study for the sewerage system improvement in this area. An in-depth study on the improvement of the sewerage system in this area therefore needs to be undertaken.

(7) Cantonment Area

In the Cantonment Area, all of the waste water is discharged into open drains through sewers or lift stations, which indicates the overall inefficiencies in the system and this results in environmental nuisance, therefore, there is a need to improve the existing system. The Cantonment Board had done a preliminary design study for the sewerage system improvement and has identified the required facility components.

A summary of required sewerage facilities improvement is given in **Table 9.12**.

Table 9.12 Required Sewerage Facilities Improvement

Area		Sewer	Disposal Station	WWTP*[1]
WASA	Shahdara	New Construction New trunk and lateral sewers (The study on improvement of sewerage system in this area will be required)	Improve existing Farakhabad DS &Shahdara Town LS (total pump capacity 5.81 m^3/s (2009) → 6.99 m^3/s (2035)	Shahdara WWTP
	Mehmood Booti	New Construction New trunk and lateral sewers (The study on improvement of sewerage system in this area will be required)	Improve existing Mahmood Booti DS (6.36 m^3/s (2009) → 12.40 m^3/s (2035)	Mehmood Booti WWPT
	Khokhar Road	New Construction New trunk and lateral sewers (The study on improvement of sewerage system in this area will be required)	Improve existing Shad Bagh DS & Khokhar Road DS (11.55 m^3/s (2009) → 17.58 m^3/s (2035)	Khokhar Road WWPT
	Central Area	New Construction (1) Trunk sewer from Larex Colony to Gulshan-e-Ravi Disposal Station (2) Branch sewers from Larex Colony to Gulshan-e-Ravi Disposal Station (3) Trunk Sewer along Cantonment Drain	New Construction New Gulshan-e-Ravi Improve existing Main Outfall DS (10.48 m^3/s (2009) → 15.69 m^3/s (2035) Gulshan-e-Ravi DS (15.86 m^3/s (2009) → 19.34 m^3/s (2035) Multan Road DS (6.78 m^3/s (2009) → 10.19 m^3/s (2035)	South West WWTP Including; ・Collector Channel (7.4 km) ・Lift station
	South	New Construction (1) Sewer and Conduit System in Gulberg and Adjacent Area (2) Sewer and Conduit System from Peco Road to Mohlanwal (3) Sewer and Conduit System in North of Canal Area	New Construction (1) Disposal Station at Mohlanwal Improve existing LMP Block DS (3.55 m^3/s (2009) → 7.02 m^3/s (2035)	South West WWPT
	South East	New Construction New trunk and lateral sewers (The study on improvement of sewerage system in this area will be required)		South East WWTP
Cantonment	Lahore Cantonment	New Construction (1) Sewer along Railway Line (2) Sewer along Walton Road (3) Sewer along Rohi Nullah and Khairy Distributory		
	Walton Cantonment			

9.2.3 Drainage Facilities

A number of drainage problems were discussed in Section 8 leading to the recommended future plan for drainage improvement. It identifies the required infrastructure components in this section. The following discussion outline the general drainage plans for each area.

(1) Shahdara Area

The Railway Line is a barrier that has divided the Shahdara Area into east and west sides. For the west side, a number of sewers are connected to the Shahdara Drain so that this drain is flows to almost full capacity even during the dry season and its original cross-section in some reaches has been greatly reduced due to the dumping of solid wastes. The existing drainage system doesn't cover all of this area as yet, and therefore there is a need to improve the existing drainge system and develop main and secondary drains in the unserviced areas. In the eastern part, presently there are only road drains and house drains. The drainage system needs to be planned and constructed in this area. However, since WASA hasn't prepared design reports such as a basic design study, feasibility study or detailed design study for the drainage system improvement in this area, an in-depth study on the improvement of the drainage system in this area needs to be undertaken.

(2) Mehmood Booti Area

The existing drainage system is primarily dependent on the Shalimar Escape Drain. This drain is in comparatively better flowing condition and is well maintained, however, its original cross-section in some reaches has been reduced due to encroachment and its subsequent collapse due to livestock. A number of sewers are also connected to this drain so it is flows at almost full capacity even during the dry season. The existing drainage system doesn't cover all of this area yet and there is a need to develop the main and secondary drains in unserviced areas. However, since WASA hasn't prepared design reports such as a basic design study, feasibility study or detailed design study for the drainage system improvement in this area, an in-depth study on the improvement of the drainage system in this area needs to be undertaken.

(3) Siddique Pura Area

For the Upper Chotta Ravi Drain, a lot of dumping of solid waste was observed just near the pumping station, therefore this section is blocked with much garbage and its original cross-section has been reduced. In the northern part of this area, main trunk sewers, namely the Siddique Pura Drain, the Railway Drain and the Upper Chotta Ravi Drain and some tertiary drains had been laid by WASA under the project "Comprehensive Drainage Scheme for Northern Lahore, 1998" so there is proper drainage system. However, in the southwest part of this area, main and secondary drains have not been provided so there is a need to develop an appropriate drainage system. WASA hasn't prepared design reports such as a basic design study, feasibility study or detailed design study for the drainage system improvement in this area, therefore an in-depth study on the improvement of the drainage system in this area needs to be undertaken. For the Siddique Pura Drainage Pumping Station, 1 pump is out of order due to mechanical problems so it needs to be replaced. There are 3 flap gates but as they are all not functioning they also need repair.

(4) Chotta Ravi Area

The Lower Chotta Ravi Drain is the main drain in this area, much dumping of solid waste is observed just near the pumping station, therefore this section is blocked with much garbage and its original cross-section has been reduced. In this area, secondary drains have not been provided so there is a need to develop an appropriate drainage system. However, WASA hasn’t prepared any design report such as a basic design study, feasibility study or detailed design study for the drainage system improvement in this area. Therefore an in-depth study on the improvement of the drainage system in this area needs to be undertaken. For the Chotta Ravi Drainage Pumping Station, some pumps don’t function at full design capacity due their age so they need to be replaced. Also as one pump installed in 1990 is out of order due to mechanical problems it also needs to be replaced.

(5) Central Area

A number of sewers are connected to the main drains in this area so it is flows to almost full capacity even during the dry season thereby virtually no space is left to carry any storm water during the rainy season. Consequently, there are many inundation points in this catchment area. An appropriate drainage system needs to be developed in this area. This is because the existing drainage system is not sufficient to cope with the increased run-off caused by high population densities. There is therefore a need to improvement and rehabilitation of existing system. WASA had already done the preliminary design study on the improvement of the drainage system and has identified the required facility components.

(6) Sattu Katla Area

The existing drainage system will not be sufficient to cope with the increased run-off caused by augmented population densities and built up areas of the city. Furthermore, the existing drainage system doesn’t cover all of this area as yet, therefore, it is a need to improve the existing drainage system and develop both main and secondary drains in formerly un-serviced areas. WASA had done the preliminary design study on the improvement for the drainage system and has identified the required facility components.

(7) Hudiara Area

In this area, there is no drainage pumping station and storm water is discharged into the Hudiara Drain or into nearby storm water drains, and where no storm water drains exist, storm water is even discharged into open fields, therefore there is a need to develop an appropriate drainage system. However, since WASA hasn't prepared any design reports such as a basic design study, feasibility study or detailed design study for the drainage system improvement in this area an in-depth study on the improvement of the drainage system in this area needs to be undertaken.

(8) Cantonment Area

In the Cantonment Area, all waste water is discharged into the open drains through sewers or lift stations, which is an indication of the overall inefficiencuies within the system and results in environmental nuisance. Therefore, there is a need to improve the existing system. The Cantonment Board had done the preliminary design study for the sewerage system improvement and has identified the required facility components.

A summary of required drainage facilities improvement is given in **Table 9.13**.

Table 9.13 Required Drainage Facilities Improvement

Area		New Construction	Improvement & Rehabilitation
WASA	Shahdara	New main and secondary drain (The study on improvement of drainage system in this area will be required)	
	Mehmood Booti	New main and secondary drain (The study on improvement of drainage system in this area will be required)	
	Siddique Pura	New main and secondary drain (The study on improvement of drainage system in this area will be required)	Improve existing Siddique Pura PS
	Chotta Ravi	New main and secondary drain (The study on improvement of drainage system in this area will be required)	Improve existing Chotta Ravi PS
	Central Area	(1) Central Drain (2) Dil Muhammad Road Drain (3) Art Council Drain (4) Allama Iqbal Road Drain (5) WAPDA House Drain (6) Lawrence Road Drain (7) Nicholson Road Drain (8) Poonch Road Drain (9) Chauburji Drain (10) New Samanabad Drain (11) Morrhe Samanabad Drain (12) Multan Road Drain (13) Almumtaz Road Drain (14) Old Bund Road Drain (15) Sodewal Drain (16) Gulgasht Drain (17) Nasir Bagh Drain (18) Mall Road Drain (19) Queens Road Drain (20) Shahra Awane Tijarat Road Drain (21) Golf Road Drain (22) Kinnaird Drain (23) Shah Jamal Drain (24) Gulshan-e-Ravi Drain (25) Sanda Road Drain (26) Krishan Nagar Drain (27) Rewaz Garden Drain (28) Tertiary Drain	<u>Rehabilitation</u> (1) Governor House Drain (2) Meclod Road
	Sattu Katla	(1) Gulberg Drainage System (2) Garden Town & Model Town Drainage System (3) Town Ship & Green Town Drainage System (4) Industrial Area Drainage System (5) Raiwind Road Draiange System (6) Jubillee Town Drainage System (7) Defense Road Drainage System (8) Hudiara Drainage System (9) Multan Road Drainage System (10) Drainage System North of Lahore Branch Canal (11) Secondary / Tertiary Drains	<u>Rehabilitation</u> (1) Garden Town Drain (2) College Road Drain (3) New Industrial Drain III (4) New Industrial Drain VI (5) Link Road Drain (6) Main Industrial Drain (7) Gulberg Drain
	Hudiara	New main and secondary drain (The study on improvement of drainage system in this area will be required)	
Cantonment	Lahore Cantonment Walton Cantonment	(1) SRD1 Drain (2) SRD2 Drain (3) BRD1 Drain (4) BRD2 Drain	<u>Rehabilitation</u> (1) Cantonment Drain (2) ADA Nullah (3) Nullah along Abdul Rehman Road (4) Drain along Ferozpur Road

CHAPTER 10. ACTION PLAN FOR INSTITUTIONAL IMPROVEMENT

10.1 Institutional Improvement

(1) Policy

"Punjab Urban Water and Sanitation Policy" (2007) carries the following Vision, Goals and Objectives:

Sustainable water and sanitation for all

To provide optimum quantity and acceptable quality of water and sanitation services on a sustainable basis.

The objectives of the policy are to:

I. Provide a legal, regulatory framework and efficient institutional arrangements for sustainable water supply, sanitation and wastewater treatment services

II. Sustainable financing arrangements including Community Participation and Public Private Partnership

As described in **Chapter 8**, there are many institutional problems in both facilities and services of water supply, sewerage and drainage in Lahore. The expected project should be not only to solve or alleviate the structural problem but also to improve non-structural or institutional issues so as to meet the said "Punjab Urban Water and Sanitation Policy".

Screening was applied to the institutional problems as stated in **Chapter 8**, and the objectives/goals are brought out as shown in **Figure 10.1**. **Figure 10.2** shows the summary of action plans and **Table 10.1** shows the summary of action, administrator, staff in charge, cost, target date and indicator to verify the performance of each action.

The necessity and objectives, main contents, process and action plan are described in detail below.

The institutional improvement is classified into the following six categories:

Category 1: Development of Adequate Policy and Regulatory Environment
Category 2: Timely Data Acquisition and Preparation of Definitive Vision and Strategies
Category 3: Reduction of Unaccounted-for-water and Non-revenue-water
Category 4: Human Resource Development and Organizational Streamlining
Category 5: Improvement of Customer Services
Category 6: Groundwater Monitoring and Regulation

VISION: To provide optimum quantity and acceptable quality of water and sanitation services on a sustainable basis [*described in Punjab Urban Water and Sanitation Policy]*

Infrastructure Development

Institutional Problems	**Strategy for Institutional Improvement**	
	Objectives	**Action Plan Item**
Large coordination cost and slow decision-making with involvement of a number of institutions	1. Development of adequate policy and regulatory environment	1-1. Preparation and enactment of Punjab Urban Water Act and WASCO Act (or Lahore WASA Act)*[described in Punjab Urban Water and Sanitation Policy]*
Infrequent tariff revision in recent years (only 1998 and 2004)		1-2. Establishment of (a) a concrete road map for increasing tariff to the adequate level, (b) a mechanism for adequate tariff revision, which may include enactment of Punjab Municipal Services Regulatory Authority Act, legally-stipulated automatic tariff revision as per inflation, legally-stipulated regular tariff revision, and streamlining and accountability of revision procedure, and (c) measures of financial supports by the government, which may include establishment of the guidelines for subsidy provision and transfer of funds from external donors as subsidy *[financially sustainable tariff and regulatory authority are described in Punjab Urban Water and Sanitation Policy]*
Unclear authorities and responsibilities of WASA		
Lack of business and financial plans	2. Timely data acquisition and preparation of definite vision and strategies	2-1. Regular preparation of mid-term and annual business plans *[described in Punjab Urban Water and Sanitation Policy]*
Lack of data required for decision-making		2-2. Establishment of performance monitoring indicators and regular monitoring system *[described in Punjab Urban Water and Sanitation Policy]*
		2-3. Implementation of comprehensive asset survey and preparation of asset inventories and drawings
High un-accounted-for-water and non-revenue-water (40%)	3. Reduction of unaccounted-for-water and non-revenue-water	3-1. Clarification of rights and responsibilities in relations with customers (desirable rights and responsibilities for adequate maintenance of service pipes and meters and for timely payment should be examined and consequentially defined in legal documents (law, charter, or contract))
Substantial illegal connection (5%)		3-2. Installation of meters in all connections in phases (Issues may include handling of buildings constructed before 1997, cost sharing with customers, awareness raising of customers, equity among customers, and capacity enhancement for meter repairing) *[described in Punjab Urban Water and Sanitation Policy]*
Low meter connection (only 13% of total connections) with a majority (74%) of meters in disorder		3-3. Establishment of leakage detection teams
Unsatisfactory tariff collection (80%)		3-4. Implementation of distribution network improvement, first in the pilot area and subsequently to other areas
High arrears equal to one year of operating revenue		3-5. Implementation of stringent measures against defaulters and illegal connections and phasing-out of uncharged public stand posts
Lack of regular maintenance (inspection and repairing)		3-6. Entrustment of metering and billing to private companies *[described in Punjab Urban Water and Sanitation Policy]*
Shortfall in operating revenue (excluding subsidy) (around 30%) to cover operating expenditure (excluding depreciation)		
Lowering groundwater level and existence of arsenic beyond WHO standard		
Aging labor force (43 years old on average)	4. Human resource development and organizational streamlining	4-1. Organizational restructuring including strengthing of planning section and the section directly supporting the WASA management
Low salary level		4-2. Prepration of human resource development strategy
Lack of expertise		4-3. Implementation of comprehensive human resource development and training needs assessment
Large number of mishandling		4-4. Strengthening of WASA Academy
Overstaffing (14 per 1,000 connections)		4-5. Entrustment of certain facilities to private companies *[described in Punjab Urban Water and Sanitation Policy]*
		4-6. Improvement of personnel management system (adequate posting, salary, evaluation, promotion, etc.)
		4-7. Establishment of Management Information System
		4-8. Procurement of O&M equipment
Large number of complaints on O&M and tariff (28 thousand per year)	5. Improvement of customer services	5-1. Clarification of rights and responsibilities in relations with customers (refer to the above)
Customer's disatisfaction to WASA's services		5-2. Regular implementation of customer survey
Unclear rights and responsibilities in relation with customers		5-3. Improvement (quick and transparent) of complaint handling system
		5-4. Expansion of payment options for customers
		5-5. Preparation of public relation strategy and its implementation (media, publc meeting, brochure, events, movie etc.)

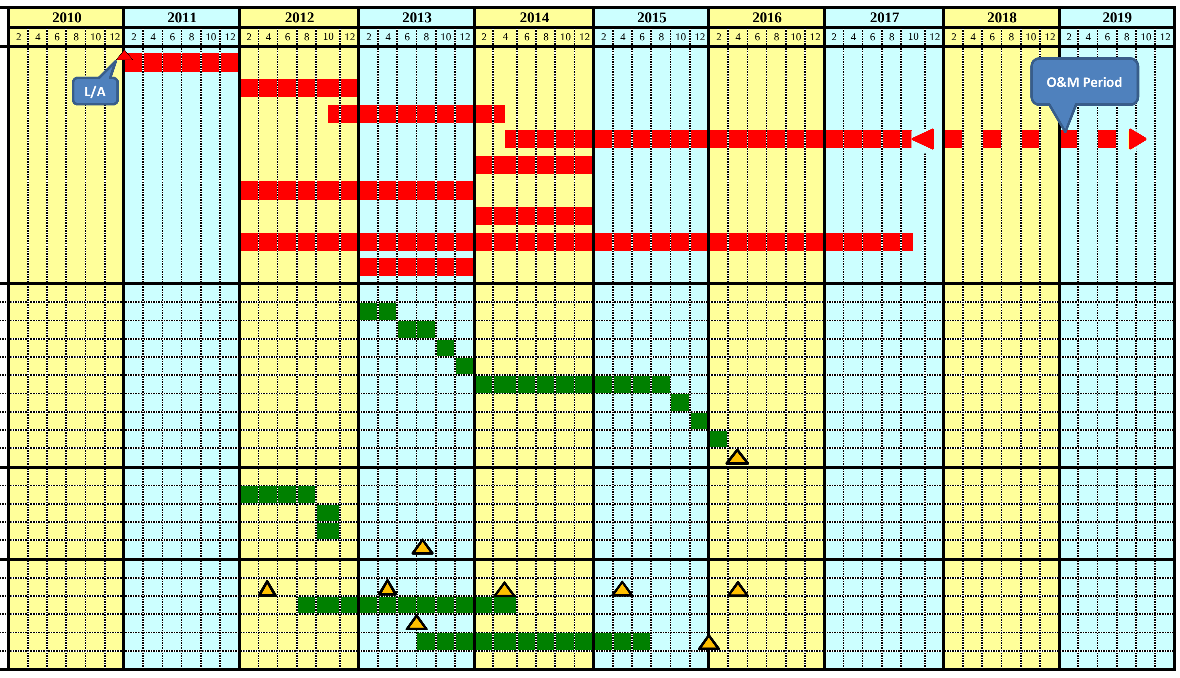
Figure 10.1 Framework of Institutional Improvement of Lahore WASA

Figure 10.2 Action Plan for Institutional Improvement of Lahore WASA

	Measures / Actions	Responsible Person (Agency)	In charge	Target Date
(1)	**Selection of Consultants**			
(2)	**Detailed Design for Phase 1 Project**			
(3)	**Tendering for Phase 1 Project**			
(4)	**Construction for Phase 1 Project**			
(5)	**Detailed Desigtn for Phase 2 Project**			
(6)	**Preparation of Master Plan for Lahore Water Supply System**			
(7)	**Detailed Desigtn of A Surface Water Supply System for Phase 2 Project**			
(8)	**Study on Institutional Improvement**			
(9)	**Preparation of M/P and F/S for Water Supply, Sewrage and Drainage outside the WASA's Current Jurisdiction**			
1-1	**Preparation and enactment of Punjab Urban Water Act and WASCO Act**			
1)	Establish the committee for the Acts	P&D+HUD		completed
2)	Prepare the draft Acts	P&D+HUD	Committee	May. 2010
3)	Revise the draft through discussions	P&D+HUD	Committee	Oct. 2010
4)	Disscuss and approve the bill in the provincial assembly	P&D+HUD	Committee	Dec. 2010
5)	Enact the Acts	Assembly		Apr. 2011
1-2	**Establishment of a mechanism for adequate tariff revision**			
1)	Establish the WASA working team	MD		Feb. 2010
2)	Prepare the road map and mechanism for adqequte tariff revision	MD	WASA WT	Jul. 2010
3)	Approve the road map and mechanism	P&D+HUD	P&D+HUD	Sep. 2010
4)	Develop the adequate rule by the provincial government	P&D+HUD	P&D+HUD	Nov. 2010
5)	Enforce the rule	P&D+HUD		Dec. 2010
2-1	**Regular preparation of mid-term and annual business plans**			
1)	Investigate the current situation of business plans		JICA Study	Completed
2)	Make a problem analysis		JICA Study	Completed
3)	Prepare the plan format by JICA experts, fill the contents by WASA, and report with recommendations by JICA experts	DMD(FA&R)	JICA Consult.	May. 2010
4)	Review and make comments on the prepared first mid-term plan for 2010/11 to 2012/13	DMD(FA&R)	DMD(FA&R)	Jul. 2010
5)	Prepare the first annual business plan for 2010/11	DMD(FA&R)	DMD(FA&R)	Jul. 2010
6)	Prepare mid-term business plan in the subsequent years	DMD(FA&R)	DMD(FA&R)	
7)	Prepare annual business plan in the subsequent years	DMD(FA&R)	DMD(FA&R)	
2-2	**Establishment of performance monitoring indicators and regular monitoring system**			
1)	Investigate the current situation of management monitoring indicators		JICA Study	Completed
2)	Set the targets for indicators		JICA Study	Completed
3)	Review the monitoring indicator which are prepared by JICA study team	DMD(FA&R)	DMD(FA&R)	Mar. 2010
4)	Consider and approve the targets for indicators	WASA IC		May. 2010
5)	Enforce (Monitor) the indicators	DMD(FA&R)		
2-3	**Implementation of comprehensive asset survey and preparation of asset inventories and drawings**			
1)	Investigate the current situation of asset management	DIR(A)	Consul	Jul. 2012
2)	Develop a comprehensive asset management system	DIR(A)	Consul	Sep. 2012
3)	Study and establish the GIS team	DIR(A)	Consul	May. 2012
4)	Prepare the bidding documents and cost estimation for GIS	DIR(P&S)	Consul	Jul. 2012
5)	Procure and set up the IT system for GIS	DIR(GIS)	Consul	Dec. 2012
6)	Prepare the facility ledger for the model area, using GIS	DIR(A)	Consul	Dec. 2013
7)	Survey the location of facility for the model area, using GIS	DIR(A)	Consul	May. 2014
8)	Review existing information and records available in WASA for GIS	DIR(GIS)	Consul	Apr. 2013
9)	Input the exisitng data in the GIS in the entire WASA area	DIR. PMU	Consul	Apr. 2014
10)	Prepare the report with recommendations	DIR(A)	Consul	Jun. 2014
11)	Start the preparation of the facility ledger for the entire WASA area	DIR(A)	Consul	Jun. 2014
12)	Prepare the facility ledger for the entire WASA area, using GIS	DIR(A)	Consul	Dec. 2015
13)	Complete the facilitiry ledger for the entire WASA area, using GIS	DIR(A)	Consul	Dec. 2015
3-1	**Clarification of rights and responsibilities in relations with customers**			
1)	Clarify the current rights and responsibilities for evaluation		JICA Study	Completed
2)	Develop the new rights and responsibilities for evaluation		JICA Study	Completed
3)	Review the new rights and responsibilities which are prepared by JICA study team	WASA IC	WASA IC	Mar. 2010
4)	Revise the rights and responsibilities through discussions with WASA IC	WASA IC	JICA Consul	Jun. 2010
5)	Finalize the rights and responsibilities through discussions	Same as 1-1		Aug. 2010
6)	Issue the customer charter	WASA IC		Sep. 2010
7)	Enact the Acts	Assembly		Apr. 2011
3-2	**Installation of meters in 40% of connections**			
1)	Investigate the condition of customer meter instalation	DMD(O&M)	Consul	Apr. 2012
2)	Study the cost burden and how to prioritise the service connections	DIR(R)	Consul	Jun. 2012
3)	Prepare the bidding documents and cost estimation	DIR(P&S)	Consul	Sep. 2012
4)	Conduct the bidding process	DIR(P&S)	DIR(P&S)	Jun. 2014
5)	Provide training to water fitting plumbers	DIR(T)	Consul	Dec. 2014
6)	Install the customer meters through contractors	DIR. PMU	Contractors	Sep. 2017
3-3	**Establishment of leakage detection teams**			
1)	Evaluate the current capacity of UFW reduction staff members and equipment	DIR. CONST:I	Consul	Apr. 2012
2)	Study the necessary organization of the UFW reduction team	DIR. CONST:I	Consul	Jun. 2012
3)	Increase the staff members for the UFW reduction	DIR(A)	DIR(A)	Dec. 2012
4)	Prepare the bidding documents and conduct bidding for UFW equipment	DIR(P&S)	Consul	Apr. 2013
5)	Procure the UFW reduction equipment	DIR(P&S)	Contractors	Dec. 2014
6)	Conduct a training and prepare the manual	DIR(LC)	Consul	Dec. 2016
3-4	**Implementation of distribution network improvement**			
1)	Select a pilot area for UFW reduction	DIR(LC)	Consul	Jun. 2012
2)	Complete the facilitiry ledger for the model area, using GIS (refer 2-3)	DIR(A)	Consul	Apr. 2014
3)	Develop the distribution network improvement plan for the pilot area	DIR(C-1)	Consul	Dec. 2014
4)	Prepare the bidding documents and conduct bidding for the pilot area	DIR(P&S)	Consul	Apr. 2015
5)	Replace the deteriorated pipes and other facilities for the pilot area	DIR. PMU	Contractors	Dec. 2016
6)	Complete the facilitiry ledger for the entire area, using GIS (refer 2-3)	DIR(A)	Consul	Dec. 2015
7)	Develop the distribution network improvement plan for the entire area	DIR(C-1)	Consul	Dec. 2016
3-5	**Imple. of stringent measures against defaulters and illegal connections and phasing-out of uncharged public stand posts**			
1)	Study current situation of measures for defaulters and illegal connections	DIR(R)	Consul	Apr. 2012
2)	Evaluate the effectiveness of current measures	DIR(R)	Consul	Jun. 2012
3)	Study the alternatives, if any	DIR(R)	Consul	Sep. 2012
4)	Prepare the report with recommendations	DIR(R)	Consul	Dec. 2012
5)	Enforce the recommendations	DMD(FA&R)		Mar. 2013
3-6	**Entrustment of metering and billing to private companies**			
1)	Investigate the current situation of entrustment of certain works in WASA	DIR(R)	Consul	Apr. 2012
2)	Evaluate the entrustment of metering and billing to private companies	DIR(R)	Consul	Jun. 2012
3)	Approve the entrustment plan	WASA IC	WASA IC	Sep. 2012
4)	Start entrustment, if any	DMD(FA&R)	DMD(FA&R)	Dec. 2012
4-1	**Organizational restructuring**			
1)	Investigate the current situation and problems of WASA organization	WASA IC	Consul	Jun. 2012
2)	Develop the draft organizational restructuring plan	WASA IC	Consul	Aug. 2012
3)	Improve the organizational restructuring plan through discussions	WASA IC	Consul	Oct. 2012
4)	Prepare the report with recommendations for organizational restructuring	WASA IC	Consul	Nov. 2012
5)	Approve the organizational restructuring plan	WASA IC	WASA IC	Dec. 2012
6)	Implement the organizational restructuring	MD	MD	Jun. 2013
4-2	**Improve. of personnel management and human resource development**			
1)	Investigate the current situation and problems	DIR(A)	Consul	Apr. 2012
2)	Develop a strategy and programme	DIR(A)	Consul	Dec. 2012
3)	Improve the strategy and programme through discussions with WASA IC	WASA IC	Consul	Feb. 2013
4)	Approve the strategy and programme	WASA IC	WASA IC	Apr. 2013
4-3	**Entrustment of certain facilities to private companies**			
1)	Investigate the current situation of entrustment of certain works in WASA	DIR(F)	Consul	Apr. 2012
2)	Extract and evaluate the possible works for entrustment	DIR(F)	Consul	Aug. 2012
3)	Approve the entructment plan	WASA IC	WASA IC	Dec. 2012
4)	Start entrustment	DMD(FA&R)	DMD(FA&R)	Jul. 2013
4-4	**Establishment of Management Information System**			
1)	Investigate the fields required for MIS	DIR(P&E)	Indiv. Consult.	Apr. 2011
2)	Design a MIS	DIR(P&E)	Indiv. Consult.	Aug. 2011
3)	Prepare the bidding documents and conduct bidding	DIR(P&S)	Indiv. Consult.	Oct. 2011
4)	Procure the devices/instruments	DIR(P&S)	Contractors	Jun. 2012
5)	Construct a MIS	DIR. PMU	Contractors	Oct. 2012
6)	Make a trial operation	DIR(P&E)	Contractors	Dec. 2012
7)	Prepare the manual for a MIS	DIR(P&E)	Contractors	Apr. 2013
8)	Make training by fields to WASA staff	DIR(T)	Contractors	Jun. 2013
9)	Turn over a MIS to WASA	DIR(P&E)	Contractors	Jun. 2013
4-5	**Procurement of O&M equipment**			
1)	Investigate the current situation of O&M equipment		JICA Study	Completed
2)	Evaluate the necessity and priority of O&M equipment		JICA Study	Completed
3)	Prepare the bidding documents and conduct bidding	DIR(P&S)	Indiv. Consult.	Apr. 2011
4)	Procure O&M equipment	DIR(P&S)	Contractors	Aug. 2012
5)	Make a trial operation and training	DIR(O&M-GB	Contractors	Feb. 2013
6)	Completely turn over O&M equipment to WASA	DMD(O&M)	Contractors	Feb. 2013
5-1	**Clarification of rights and responsibilities in relations with customers** (See **3-1**)			
5-2	**Regular implementation of customer survey**			
1)	Investigate the customer survey in other public services	DIR(P&E)	Consul	Feb. 2012
2)	Prepare the questionnaire	DIR(P&E)	Consul	Apr. 2012
3)	Conduct of the questionnaire survey using a local social survey firm	DIR(P&E)	Consul	Aug. 2012
4)	Analyze the survey results	DIR(P&E)	Consul	Oct. 2012
5)	Improve the qustionnaire and survey method	DIR(P&E)	Consul	Dec. 2012
6)	Prepare the manual for the questionnaire survey	DIR(P&E)	Consul	Dec. 2012
7)	Turn over to WASA and conduct the questionnaire survey	DIR(P&E)	Consul	
5-3	**Improvement (quick and transparent) of complaint handling system**			
1)	Evaluate the existing complaint handling system	DIR(P&E)	Indiv. Consult.	Apr. 2011
2)	Design the new complaint handling system using a MIS	DIR(P&E)	Indiv. Consult.	Oct. 2011
3)	Prepare the bidding documents and conduct bidding	DIR(P&E)	Indiv. Consult.	Apr. 2012
4)	Procure the devices/instruments	DIR(P&S)	Contractors	Oct. 2012
5)	Construct a complaint handling system	DIR. PMU	Contractors	Feb. 2013
6)	Make a trial operation	DIR(P&E)	Contractors	Apr. 2013
7)	Prepare the Manual	DIR(P&E)	Contractors	Aug. 2013
8)	Make a training to WASA staff	DIR(P&E)	Contractors	Oct. 2013
9)	Turnover to WASA	DIR(P&E)	Contractors	Oct. 2013

Figure 10.2 Action Plan for Institutional Improvement of Lahore WASA

	Measures / Actions	Responsible Person (Agency)	In charge	Target Date
(1)	**Selection of Consultants**			
(2)	**Detailed Design for Phase 1 Project**			
(3)	**Tendering for Phase 1 Project**			
(4)	**Construction for Phase 1 Project**			
(5)	**Detailed Desigtn for Phase 2 Project**			
(6)	**Preparation of Master Plan for Lahore Water Supply System**			
(7)	**Detailed Desigtn of A Surface Water Supply System for Phase 2 Project**			
(8)	**Study on Institutional Improvement**			
(9)	**Preparation of M/P and F/S for Water Supply, Sewrage and Drainage outside the WASA's Current Jurisdiction**			
5-4	**Expansion of payment options for customers**			
1)	Investigate the existingf payment methods by customers	DIR(R)	Consul	Apr. 2013
2)	Evaluate the payment methods available	DIR(R)	Consul	Aug. 2013
3)	Design the payment system	DIR(R)	Consul	Oct. 2013
4)	Prepare the bidding documents and conduct bidding	DIR(R)	Consul	Dec. 2013
5)	Procure the devices/instruments	DIR(R)	Consul	Aug. 2015
6)	Construct the payment system	DIR(R)	Consul	Oct. 2015
7)	Make a trial operation and training to WASA staff	DIR(R)	Consul	Dec. 2015
8)	Prepare the manual	DIR(R)	Consul	Feb. 2016
9)	Turn over to WASA	DIR(R)	Consul	Mar. 2016
5-5	**Preparation of public relation strategy and its implementation**			
1)	Investigate the current situation and problems of public relations	DIR(P&E)	Consul	Aug. 2012
2)	Prepare the report with recommendations	DIR(P&E)	Consul	Oct. 2012
3)	Approve the strategy	WASA IC	WASA IC	Oct. 2012
4)	Start improved public relations	DIR(P&E)		Jul. 2013
6	**Groundwater Monitoring and Regulation**			
1)	Monitor the water quality of groundwater	DIR(Hydrogy)	Consul	Every year
2)	Evaluate the groundwater resource	DIR(Hydrogy)	Consul	Jun. 2014
3)	Establish the Bari Doab Groundwater Committee (BDGC)	DIR(Hydrogy)	Consul	Dec. 2013
4)	Study the control and regualtion of groundwater	BDGC	Consul	Jun. 2015
5)	Enforce groundwater control	BDGC	Consul	Dec. 2015



SC: Steering Committee
WASA IC: WASA Internal Committee
DIR(A): for Administration
DIR(R): for Revenue
DIR(P&E): for Planning & Evaluation
DIR(P&S): for Procurement & Storage
DIR(LC): for Leakage Control
DIR(T): for Taining
DIR. PMU: for Project Management Unit
DIR. CONST:1: for Construction I
Committee: Established by the notification of "Committee for Establishment of An Authority to Regulate Drinking Water and Sanitation in The Province" dated Lahore the September 5, 2009
JICA Consul.: Consultants hired by JICA
Indiv. Consult. : Individual consultant hired under loan
Consul: Consulting firm hired under loan

Table 10.1 Summary of Institutional Improvement

Area	Action	Admin.	In Charge	Target Date	Cost (Rs. million)	Indicators
1. Development of Adequate Policy and Regulatory Environment						
1-1	Preparation and enactment of Punjab Urban Water Act and WASCO Act	P&D-HUD	Committee	Apr. 2011	-	Enactment of the Act
1-2	Establishment of (a) a concrete road map for increasing tariff to the adequate level, (b) a mechanism for adequate tariff revision, and (c) measures of financial supports by the government	CC	WASA IC	Dec. 2010	-	Enforcement of the rule
2. Timely Data Acquisition and Preparation of Definitive Vision and Strategies						
2-1	Regular preparation of mid-term and annual business plans	DMD(FA&R)	Local consult.	Jul. 2010	-	Prep. of first mid-term and annual business plans
2-2	Establishment of performance monitoring indicators and regular monitoring system	DMD(FA&R)	WASA staff	Jun. 2010	-	Submission of the first monitoring report
2-3	Implementation of comprehensive asset survey and preparation of asset inventories and drawings	DIR. Const-1	Consultant under loan	Dec. 2015		Completion of facility ledger for the entire WASA
3. Reduction of Unaccounted-for-water and Non-revenue-water						
3-1	Clarification of rights and responsibilities in relations with customers	WASA IC		Apr. 2011	-	Enactment of the Act
3-2	Installation of meters in 40% of connections	DIR. PMU	Consultant under loan	Sep. 2017	Consultant under loan Rs.43M Works Rs.1,441M	Completion of works
3-3	Establishment of leakage detection teams	DIR.(LC)	Consultant under loan	Dec. 2016	Consultant under loan Rs.17M Works Rs.37M	Manual submission
3-4	Implementation of distribution network improvement in the priority area in the central Lahore based on asset study and subsequently-prepared distribution network improvement plan in the entire WASA area	DIR.(LC) / DIR. Const-1	Consultant under loan	Dec. 2016	Consultant under loan Rs.114M Works Rs.37M	Development of the distribution network improvement plan

Table 10.1 Summary of Institutional Improvement (Cont'd)

3-5	Implementation of stringent measures against defaulters and illegal connections and phasing-out of uncharged public stand posts	DIR.(R)	Consultant under loan	Mar. 2013	Consultant under loan Rs.6M	Enforcement or measures
3-6	Entrustment of metering and billing to private companies	DIR.(R)	Consultant under loan	Dec. 2012	Consultant under loan Rs.6M	First entrustment
4. Human Resource Development and Organizational Streamlining						
4-1	Organizational restructuring	WASA IC	Consultant under loan	Jun. 2013	Consultant under loan Rs.13.7M	Start of organizational restructuring
4-2	Improvement of personnel management and human resource development	WASA IC	Consultant under loan	Apr. 2013	Consultant under loan Rs.27.5M	Approval the strategy and programme
4-3	Entrustment of certain facilities to private companies	DMD(FA&D)	Consultant under loan	Jun. 2013	Consultant under loan Rs.13.8M	First entrustment
4-4	Establishment of Management Information System	DIR.(P&E)	Consultant under loan	Jun. 2013	Local Consultant Rs.3.8M Consultant under loan Rs.27.5M Works Rs.693.5M	Turn over to WASA
4-5	Procurement of O&M equipment	DMD(O&M)	Local Consultant/ Contractor	Feb. 2013	Local Consultant Rs.11.4M Works Rs.562.5M	Turn over to WASA

Table 10.1 Summary of Institutional Improvement (Cont'd)

5. Improvement of Customer Services						
5-1	Clarification of rights and responsibilities in relations with customers (**See 3-1 above**)				-	
5-2	Regular implementation of customer survey	DIR.(P&E)	Consultant under loan	Dec. 2012	Consultant under loan Rs.23.6M	Turn over to WASA
5-3	Improvement of complaint handling system	DIR.(P&E)	Consultant under loan	Oct. 2013	Local Consultant Rs.3.8M Consultant under loan Rs.17.1M Works Rs.358.6M	Turn over to WASA
5-4	Expansion of payment options for customers	DIR.(R)	Consultant under loan	Mar. 2016	Consultant under loan Rs.17.2M Works Rs.305.7M	Turn over to WASA
5-5	preparation of public relation strategy and its implementation	DIR.(P&E)	Consultant under loan	Jun. 2013	Consultant under loan Rs.13.7M	First practice of improved public relations
6. Groundwater Monitoring and Regulation						
6-1	Follow up survey and analysis on groundwater quality and quantity	Committee	Consultant under loan	Dec. 2015	Consultant under loan Rs.47.4M	Report submission
6-2	Establishment of groundwater committee					
6-3	Preparation of groundwater control and regulation plan					
6-4	Establishment of regular monitoring of groundwater					

For how to proceed the works for each action, there are three types as follows:

(1) Actions that the works will be desirably proceeded as much as possible before the international consultant will commence the actual consultancy services in Lahore.
(2) Actions that the works will be desirably proceeded as much as possible using the individual local consultants before the international consultant will commence the actual consultancy services in Lahore, since it is possible to hire the individual local consultants under the loan after L/A conclusion.
(3) Actions that the works will be proceeded under the assistance of the international consultants after the international consultant will commence the actual consultancy services in Lahore.

The involvement of provincial department, WASA and local and international consultants are arranged under the following ideas.

(1) Category 1 and 6 and some items in Category 2 require the involvement of provincial department
(2) WASA should be involved in the problem peculiar to WASA
(3) For “2-3 Asset Management” and “3 Reduction of UFW and NRW”, the international consultants shall work mainly for the model area and a pilot area”, respectively to establish the methodology and a system. WASA shall turn over such works thereafter to extend to the entire WASA area as the works peculiar to WASA.

(2) Decision-making organization

1) Coordination Committee(CC)

CC will be formulated and the meeting will be held at least once a trimester for smooth implementation of the project and institutional improvement. Prospective role and member is as blow.

(a) Role

- To approve the proposal from WASA IC.
- To review overall process of the plan, in particular, activities implemented base on the above project and institutional improvement plan.
- To review and exchange views on major issues arising from or in connection with the Project and institutional improvement.
- To revise the original plan of operation if necessary.
- To request for necessary action to the related organization.

(b) Members

The constituent of CC is determined later on.

Chairman	Chief Secretary, Government of Punjab .
Members:	Secretary, Planning Dep.
	Head, Urban Unit

Secretary, HUD&PHED
Director General, LDA
Managing Director, WASA
JICA Pakistan office (Observer) .
Consultants (Observer)

2) WASA Internal Committee (WASA IC)

WASA IC will be formulated and the meeting will be held at least once a month for smooth implementation of the project and institutional improvement. Prospective role and members are as follows:

(a) Role

- To review the progress of each action plan, in particular, activities implemented base on the approved project and institutional plan.
- To decide next trimester’s activities based on review.
- To monitor the progress and coordinate necessary activities with related organization.
- To implement necessary countermeasureres for issues if necessary.
- To take the responsibility for in-process control of each field.

(b) Members

Chairman	MD
Members:	DMD(E)
	DMD(FA&R)
	DMD(O&M)
	DIR.(P&E)
	DIR.*
	Team Leader, Consultant

DIR.* DIR. assigned by MD as to the subject

10.1.1 Development of Adequate Policy and Regulatory Environment

(1) Preparation and Enactment of Punjab Urban Water Act and WASCO Act

1) Necessity and Objectives

Water and Sanitation Agency (WASA) should provide the customers with a good quality service at a fair price under the bilateral rights and responsibilities between WASA and customers. It requires an enactment of Punjab Urban Water Act and/or WASCO Act.

2) Main Contents

The Lahore Development (LDA) Act provides the establishment of the Water and Sanitation Authority (WASA) with some relevant clauses, but has no specification on its duty and standards of performance. For this reason, WASA defines the rules for operation as the agreements with customers in the application for water connection.

In "Punjab Urban Water And Sanitation Policy", under the vision of "Sustainable water and sanitation for all", towards the goals of "To provide optimum quantity and acceptable quality of water and sanitation services on a sustainable basis", the following objectives of the policy are set:

- Provide a legal, regulatory framework and efficient institutional arrangements for sustainable water supply, sanitation and wastewater treatment services
- Sustainable financing arrangements including Community Participation and Public Private Partnership

Statutory instruments are described as follows:

Appropriate legislation in the urban water and sanitation sector would be promulgated which includes.

- Punjab Urban Water Act for assignment and regulation of surface and ground water property rights in Cities.
- WASCO Act to establish corporate independent Water and Sanitation utilities in Cities
- Punjab Municipal Services Regulatory Authority Act for establishment of a regulator to regulate the provision of water and sanitation services by water utilities and Independent Service Providers with due consideration of property rights, quality of services, customer satisfaction and environmental sustainability. The regulator will also regulate the inter agency agreements and disputes.

The National Drinking Water Policy approved by the Federal Cabinet in September 2009 describes on the regulatory body as follows:

> *"Provincial regulatory bodies will supervise the transition envisaged under NDWP so that scarce resources are properly utilized and ownership and sustainability of schemes is ensured for the long-term. A regulatory body for water supply and sanitation may first be set up in one province, so that other provinces and territories learn from its experience."*

In September 5, 2009, the Chief Minister's Secretariat Punjab has notified the constitution of the Committee for establishment of an Authority to regulate drinking water and sanitation in the Province. The members are constituted of President of the Committee for Public Welfare (Anjuaman Samaji Behood) as a chairman, Secretary of LG&CD, Secretary of HUD&PHED and Project Director of the Urban Unit, P&D. The TOR's of the Committee are us under:

- Need for establishment of the regulatory authority
- Propose the name of the authority
- Organization structure

- Funds required for establishment of the authority
- TOR's of the authority

WASA defines the following three regulations concerned with water supply and sewerage.

(1) Water Supply Regulations, 1978
(2) Sewerage and Drainage Regulations, 1978
(3) Licensed Plumbers

"Water Supply Regulations, 1978" and "Sewerage and Drainage Regulations 1978" specifies the conditions for application for connections, installation and maintenance of services, specification for the laying of water supply pipes and fittings and sanitary sewers, specification for materials, protective measures and tests. While "Licensed Plumbers" gives the provisions that the licensed plumbers should be in compliance with in works.

"Water Supply Regulations, 1978" defines that "***Pipe Material*** *- All water service pipes shall be of galvanized iron or steel tube or such other material as the Agency may from time to time approve or as may be approved in any particular case by the Engineer.*" in Section 50 and that "***Pump Directly Connected****: - No consumer shall be permitted to install a pump mechanically or manually operated, directly on a connection. In case the consumer fails to remove such and installation within 24 hours of the serving of notice shall be guilty of an offence of these regulation.*" in Section 25. Although it is necessary to review the former provision, these regulations are not likely strictly enforceable.

While, "Sewerage and Drainage Regulations 1978" provides that "***Discharge of Industrial Wastes*** *– Industrial wastes that are likely to affect the normal quality of sewage or adversely affect the sewers shall not be discharged into Agency's sewer without the permission of the Agency in writing.*" in Section 62. This provision has assumed to regulate discharge of industrial wastes with parameters of pH (hydrogen on concentration), total dissolved solids, total suspended solids, biochemical oxygen demand, colour, coliform organisms and other bacteria and toxic contents, but such limits have never been fixed due to no construction of a wastewater treatment plant inLahore and discharge of industrial wastes into a sewer system has not been well controlled.

The Government of Punjab has prepared the draft of the Punjab Water Act, 2009 that is now under the process of public hearing. Its outline and comments are as follows:

"Part II Service Providers and Regulations" defines the administrative framework of water supply, sewerage and drainage services in Punjab as shown in **Figure 10.XX**.

According to **Figure 10.XX**, the Water Services Regulation and Standards Commission (hereinafter referred to as "Commission") will be newly established to enforce the standards for drinking water quality, water treatment process, and manufacturing process of materials to be used and to monitor their compliance in water and sewerage undertakers. While the Government will establish the Water and Sanitation Authority (hereinafter referred to as "Authority") in all 36 districts in the Province of Punjab, and appoint the Water and Sanitation Undertakers (hereinafter referred to as "Undertakers") in every area in respective districts.

Since the provision of the sub section 4) in Section 5 that a water and sanitation agency functioning under other enactments in any district of the province shall be part of the Authority established under this Act for t.hat district is applied to WASA LDA, the Lahore Water and Sanitation Authority will be composed of two parts responsible for the conventional WASA and Lahore District.

The Act provides the duty and responsibility and quality of services in "Part III Water Supply" and "Part IV Sewerage Services", water charge collection, recovery of improvement cost and finances by water and sewerage undertakers in ”Part V Finances of Water and Sewerage Undertakes”, protection and regulation of water quality of rivers, canals and water bodies in ”Part VI Protection and Management of Water Bodies and Sources” and enforcement of orders made under this Act, liabilities, management of maps and placement of markers, pipes, bottled water, juridical disqualification, framing of regulations, land acquisition and repeals and modifications in ”Part VI Miscellaneous Provisions”, respectively.

1) The new administrative framework of water supply, sewerage and drainage services results in the four-layer structure composed of the Province, Commission, Authority and Undertakers that may become more complicated than the present.
2) The Province may get almost major positions of the Commission and Authorities.
3) Is the Water and Sanitation Authority the district office of the Province or the Commission of which the structure is similar to that of Authority?
4) The functions of the Authority are not clear. As far as the Act is concerned, the Authority seems to be positioned as the simple relay station of information to and from the Undertakers. Since such similar function is also given to the Commission, the necessity of its existence is questionable.
5) As the Undertakers will get the instructions from four organizations, namely the Government, Commission, Authority and Local Government, it may cause the confusion in each Undertaker.
6) Although a company is supposed to be one of the Undertakers, does it mean that the private company will be able to be involved in water supply, sewerage and drainage services in future.
7) Section 32 specifies that every local government shall appoint such number of local water inspectors as may be necessary who will have the powers to take samples of water and have them examined by the provincial water testing laboratory. But for the water undertaker with more than a certain scale, the complaint handling and water quality monitoring should be entrusted to its self-control under the acknowledgement of EPD of its capability.
8) For “unfit” and “illness” in Section 33, does it mean that the Commission will fix their standards?
9) It seems better that Sub Sections 1) and 2) of Section 34 should be transferred from ”Part III Water Supply” to ”Part IV Protection and Management of Water Bodies and Sources".
10) Section 86 provides the repeal of Section 10 of the LDA Act which is the ground for the establishment of the WASA. Does it mean the WASA’s independence from the LDA after an enforcement of this Act? If so, how about the following provisions in the LDA Act?

    Sub Section 3 of section 27,
    Sub Section 2 of section 28
    Section 29
    Section 47
11) There is no description on water tariff which is included in the functions of the Essential Services Commission Drinking Water (PESC) referred to in the Punjab Drinking Water Management and Regulation Act according to the comments on the Draft Final Report by the Urban Unit as stated below.
12) No provision for the following, although they may be included in the WASCO Act.

    Rights and responsibilities between customers and Undertaker
    Obligation of connection to water supply and sewerage systems in the respective

served area

Punishment for illegal connections

13) Fine and/or imprisonment are summarized in **Table 10.XX**. The water undertakers are required to comply with the following service of quality besides those for omission of their administrative obligations

Duty with respect to constant supply and pressure

Regulation for pre-serving water quality

Offence for supplying water unfit for human consumption

The provisions in Sections 57, 63 and 67are notable from the following viewpoints:

Section 57: Exemption of payment to the owners with monthly income below a specified level and payment by the Government

Section 63: Obligation of wastewater treatment by sewerage undertakers and punishment

Section 67: Regulation of groundwater abstraction by privates including existing tube-well owners and collaboration with other sectors

Section 57: Charges for construction and improvement of water and sewerage systems

3) *The charge shall be payable by owners of premises in the area provided that no charges may be imposed for owners whose monthly income is below a specified level.*
4) *The Government shall pay the charges for persons who are exempted under sub section 3).*

Section 63: Protection of rivers and water bodies etc

1) *No person including a water and sewerage authority shall discharge any effluent, untreated water, contents of sewer, into any river, canal, rajbah, khala, pond, jheel or stream.*
2) *No person including a water and sewerage authority shall allow the contents of any sewer or effluent or contaminated or polluted water to run into the earth.*

Section 67: Sinking of wells without permission

1) *No person shall sink a water well or tube well or other bore which allows him to draw water for any purpose without permission of the authority.*
2) *In the granting of permissions the authority shall follow guidelines issued by the Commission. The guidelines shall be based on the need and availability of water in the aquifer and its sustainable use and shall be issued separately for water needed for agricultural purposes and other uses. Guidelines pertaining to sinking of well and drawing of water for agricultural purposes shall be done by the Commission, the department of agriculture and the department of irrigation jointly.*

The Urban Unit's comments on the Draft Final Report refers to the Punjab Drinking Water Management and Regulation Act in which the establishment of the Essential Services Commission Drinking Water (PESC) responsible for customers services codes, performance reports and tariff approval will be included This Act may be the Punjab Municipal Services Regulatory Authority Act called in "Punjab Urban Water And Sanitation Policy". Although the overall legal framework is still unknown including the WASCO Act, it should refrain from jump to comments on the legislation. However the administrative system for water supply and sewerage services seems to become increasingly complicated due to an increase of organizations to be involved. This matter will be examined by the JICA experts subsequently.

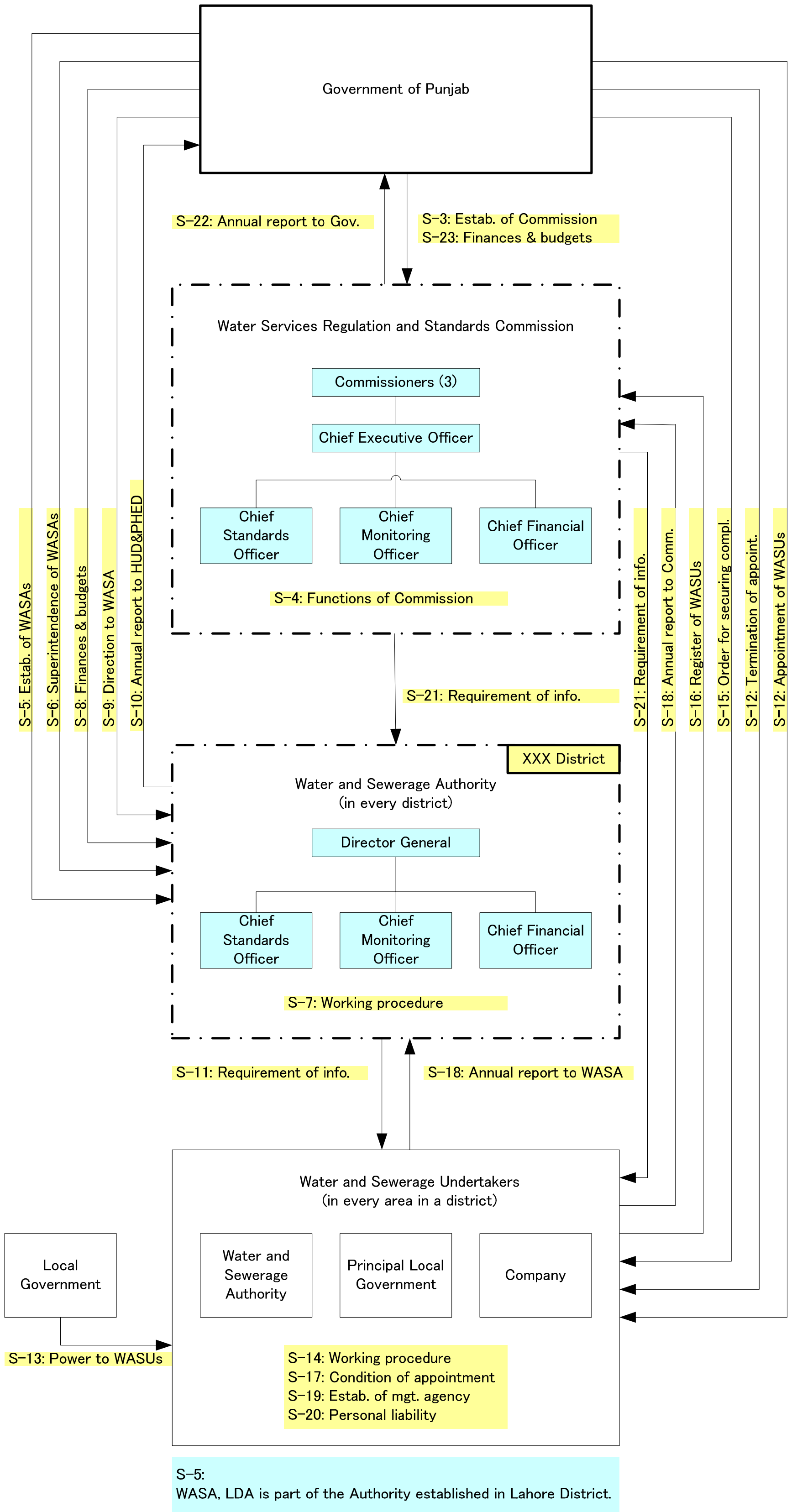


Figure 10.3 Framework Proposed in the Punjab Water Act (Draft)

Table Summary of Fine/Imprisonment Provided in the Punjab Water Act (Draft)

Section	Cause	Object	Fine/Imprison.
S-11: Power to require information for enforcement purposes	Failure to supply requisite information to the Authority	water undertaker	Rs.500,000
S-18: Reports by water and sewerage undertakers	Failure to comply with the provisions of sub section 2)	water and sewerage undertakers	Rs.1,000,000
	Non-compliance with the provisions of sub section 1)	water and sewerage undertakers	Rs.100,000 and/or 30-day imprison.
S-21: Power to require information for enforcement purposes	Failure to provide the information	water undertaker or water authority	Rs.500,000
S-29: Duty with respect to constant supply and pressure	Breach of duty under this section	water undertaker	Rs.1,000,000 for each week
S-31: Regulations for pre-serving water quality	Contravention of the regulations	water authority	Rs.500,000 and 15-day imprison.
S-32: Duties of local government with regard to water supplies	Non- performance of his duties	local water inspector	Rs,500,000 or 6-month imprison.
S-33: Offence for supplying water unfit for human consumption	Unfit for human consumption	water undertaker	Rs.1,000,000
	an illness is caused to any person because of the quality of the supplied water	water undertaker	Rs.5,000,000
	Ditto the above	persons responsible for such supply	5-year imprison.
S-35: Offences of contamination, wasting and misuse	Any person to contaminate, waste or misuse water supplied	owner or occupier of any premises	Rs.50,000 or 15-day imprison.
	Any person who uses water for a purpose other than that	owner or occupier of any premises	Rs.25,000
S-36: Regulations with respect to water fittings and pipes	Contravention of a regulation		Rs.1,000,000 or 30-day imprison.
S-46: Duties of local government with regard to sewerage services	Non-performance of his duties diligently or collusion in any manner	local sewerage inspector	Rs. 500,000 6-month imprison.
S-49: Regulations with respect to sewerage fittings and pipes	Contravention of a regulation	prescribed persons	Rs.1,000,000 or 30-day imprison.
S-56: Offences of contaminating storm water, canal water or other water body	Any person including a sewerage authority discharges the contents of any sewer or otherwise contaminates any water source, water body, canal water		Rs. 50,000 or 30-day imprison.

Table Summary of Fine/Imprisonment Provided in the Punjab Water Act (Draft) (Cont'd)

Section	Cause	Object	Fine/Imprison.
	Any person including a sewerage authority contaminates any water body, water source or canal water by discharging trade effluent or fails to take adequate measures for safe disposal of effluent or waste		Rs.1,000,000 or 6-month imprison.
S-63: Protection of rivers and water bodies etc	Any person including a water and sewerage authority shall discharge any effluent, untreated water, contents of sewer, Any person including a water and sewerage authority shall allow the contents of any sewer or effluent or contaminated or polluted water to run into the earth		Rs.1,000,000 or 6-month imprison.
	Any person that washes on a commercial basis anything in a canal, river or stream		Rs. 100,000 or 3-month imprison.
S-65: Offence of contravening regulations under S-63	Any person does any act, which leads to, causes or is likely to cause a contravention of regulations		Rs.2,000,000 or 3-month imprison.
S-68: Regulations pertaining to discharge of substances by navigable craft in waters	Any person uses any water for navigation purposes and discharges any substance in the water or the craft under his control		Rs 100,000 or 90-day imprison.
S-74: Maps of water and sewerage pipes etc.	Undertaker fails to comply with the requirements		Rs.1,000,000 and 30-day imprison.
S-75: Pipe markers	Any person who does any act which destroys, hides, defaces, or alters a marker or removes a marker		Rs 10,000 or 15-day imprison.

- To clarify the scope of application of the law (WASA, urban water supply or community water supply)
- To establish the duty and standards of performance of water supply and sewerage services.
- To include the provisions of penalty against service providers in breach of the law so as to become bilateral contents.
- To clarify the rights and responsibilities between the service provider and customers.
- To define that anyone is not allowed to intervene the personnel management within WASA except for MD as provided in the LDA Act
- To define the boundary of ownership between the service provider and customers.
- Attention be paid for the limitation of services to be provided in the situation that tariff revenue is always short to expenses for O&M
- To make full discussion whether the slide clause should be included to automatically adjust the tariff reflecting the variation of wage and price.
- To examine the relevance with other legislation so as to keep no discrepancy.

3) Process

Confirmation is done on the activities such as the progress status, contents (whether about Punjab Urban Water Act, WASCO Act, and Punjab Municipal Service Regulatory Authority Act is considered in this committee), and time frame of the committee for establishment of an Authority to regulate drinking water and sanitation in the Province, established by the Chief Minister's Secretariat Punjab in September 2009.

a) To establish the committee to for the Acts, if the committee described above is not for these Acts.
b) To prepare the draft.
c) To revise the draft through discussions.
d) To discuss and approve the bill in the provincial assembly.
e) To enact the Act

4) Action Plan

Action	2010	2011	2012	2013
Establish the committee for the Punjab Urban Water Act and WASCO Act	△			
Prepare the draft				
Revise the draft through discussions				
Discuss and approve the bill in the provincial assembly				
Enact the Acts		△		

Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Establish the committee for the Punjab Urban Water Act and WASCO Act.	P&D and HUD		None	Feb. 2010
Prepare the draft	P&D and HUD	Committee		May 2010
Revise the draft through discussions	P&D and HUD	Committee		Oct. 2010
Discuss and approve the bill in the provincial assembly	P&D and HUD	Committee		Dec. 2010
Enact the Acts	P&D and HUD			Apr. 2011

Committee: To be established for enactment of the Punjab Urban Water Act and/or WASCO Act

Figure 10.4 Action Plan

(2) Establishment of a Mechanism for Adequate Water Tariff Revision

1) Necessity and Objectives

WASA has been always operated under the unstable financial condition that the revenue could not cover the operation and maintenance cost of water supply, sewerage and drainage facilities and that past attempts to increase the water tariff has resulted in partial attainment, which leads to the deterioration of service quality provided and the aging of facilities. The establishment of a concrete road map for increasing tariff to the adequate level is indispensable of the sound management of WASA in future.

2) Main Contents

It is favorable that the tariff revision will be legally stipulated or that the subsidy from the provincial government will be automatically provided in accordance with the rule legally-defined, when certain conditions will be met, so that WASA can avoid the unstable management up to now and got rid of the constitution substantially relying on the provincial subsidy. In this connection, it is due that WASA is always required to continue the management effort toward improvement. If WASA will not make the financial status open and raise its transparency, the support of the public will not be obtained easily.

As per the mechanism increasing water tariff, there are the following types:

a) Require the approval of the municipal assembly (Japan)
b) Require the approval of the Regulator Authority (UK, Malaysia, Jamaica, etc.)
   In UK, water companies apply the tariff revision to Ofwat (regulator authority), while in Malaysia service operators apply the tariff revision to SPAN (regulator authority). Ofwat/SPAN appraises the applications and approve the tariff revision, but partly approves it in some cases. For this purpose, water companies/service operators are required to submit regularly the financial statement documents and reports on operation and maintenance of facilities. If found some problems, the regulatory authority can require their improvement.
c) Tariff revision is automatically done based on the movement of major economic index or major price in accordance with the slide clause in the relevant act (SABESP in Brazil)

When the tariff cannot cover the operation and maintenance cost, the government provides the subsidy to service providers. For example, IWK or the sewerage concessionaire company with the Malaysian Government was forced to decrease the initial water tariff and has hardly kept the operation of the company by the subsidy from the Malaysian Government for a long time.

In case of a) above, it is apt to be affected by the political movement and the tariff revision is difficult before the election. Therefore, b) and c) are better than a) in the meaning to avoid the political expectation.

In case of subsidy, the conditions to provide the subsidy should be clarified

3) Process

a) To establish the WASA working team for water tariff
b) To prepare the road map and mechanism for adequate tariff revision, which may include legally-stipulated automatic tariff revision as per inflation, legally-stipulated regular tariff revision, and streamlining and accountability of revision procedure in working team (with assistance of JICA expert)
c) To approve the road map and mechanism
d) To develop the adequate rule by the provincial government
e) To enforce the rule

4) Action Plan

Action	2010	2011	2012	2013
Establish the WASA working team				
Prepare the road map and mechanism for tariff revision				
Approve the road map and mechanism				
Develop the adequate rule by the provincial government				
Enforce the rule				

Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Establish the WASA working team	MD			Feb 2010
Prepare the road map and mechanism for tariff revision	MD	WASA WT		Jul. 2010
Approve the road map and mechanism	CC	CC	None	Sep. 2010
Develop the adequate rule	CC	P&D and HUD		Nov. 2010
Enforce the rule	P&D and HUD			Dec. 2010

Figure 10.5 Action Plan

10.1.2 Timely Data Acquisition and Preparation of Definite Vision and Strategies

(1) Regular Preparation of the Mid-term and Annual Business Plans

1) Necessity and Objectives

The middle-term and annual business plans shows the management policy and the fiscal plan of a water supply, sewerage and drainage services. Since evaluations of management are the target value and the degree of achievement of each fiscal year, they need to set up the value according to each fiscal year.

2) Main Contents

The following should be taken into account in preparaing the mid-term and annual business plans.

a) Development of a management basic policy.
Before preparing business plan, management principles and goals should be clarified.
✓Philosophy of management.
A water supply project supplies safe and stable drinking water and other domestic water to citizens, On the other hand, a business is managed so that ameliorations of the public welfare and the economical efficiency as business may be improved.
✓ Management goal.

- Improvement of water supply service.
- Improvement of sewerage and drainage services.
- Improvement of efficient business management..
- Symbiosis with society;
  (Proper charge by efficient management, supply of safe water, stable water supply)
- Reservation of a comfortable life space;
  (Improvement in water quality of public water bodies)
- Disclosure of annual operation indicators

b) Analysis of management resources.

- Transition of an enterprise;
  -Analysis of water-consumption,
  -Revenue water / Unaccounted –for-water,
  -Water-consumption,
  -Comparison of water-consumption and revenue water,
  -Water amount of tap faucets,
  -Number of water taps faucets by use,
  -Welfare exemption,
  -Business receipts and payments,
  -Water selling revenue and other profit,
  -Connection fee,
  -Detail of main costs,
  -Statement of loss,
  -Balance sheet and subsidy, and etc,
- Situation of financial;
  - Settlement-of-accounts income and outgo,

- Settlement-of-accounts contrast table,
- Earnings statement,
- Balance sheet,
- Amount of capital-expenditure-and-receipt settlement of accounts,
- Fixed-assets description,
- Stored-goods consumption situation,
- Comparison of the expense items by classified departments,
- Business analysis: (unit price of water supply, water supply cost, sewage usage fee, amount of revenue water, personnel ratio, others),

● Situation of water service;
-Water-consumption in the monthly and by year,
-Flow rate,
-Amount of the electric power used / cost of electric-power,
-Chemical dosage / cost of chemical and etc,

● Situation of operation;
-Detail of Revenue water,
-Detail of the water-sale profit by use,
-Subscription number and disconnection of water supply,
-Number of billing and amount bill by use,
-Number of new meters/replacement by year,
-Number of meter reading,
-Method of receipts,
-Number of water meters by size,
-Revenue water by meter size and by use,
-Number of leakage repair works and investigation classified by area,
-Connection work and etc,

● Staff member;
-Organization,
- Dismissal
-Salary and allowance cross-level,
-Age composition,
-Length of service and etc,

● Facility of the present condition;
- Waterworks; (status of maintenance work, water pipe line, well pumps, water meters, chlorine equipment),
- Sewer; (status of maintenance, open channels, pump stations sewerage treatment plant),
- Rain water drainage; (status of maintenance, drainage equipments),
- Workshop ;(a water meter repair shop, rain water drainage repair shop),
- Water analysis room; (status of equipment),

● Business environment analysis;
-Economy,
-Population,
-Politics and law,
-Technology and Engineering,

c) Items of a mid-term business plan(3 years)

- ✓Setting of target value; (Planning of production, Amount of profit, Amount of operating revenue, Amount of operating expense),
- ✓Financial planning; (income and expenditure plan),
- ✓Revision of water rates,
- ✓Investment program;(Improvement, Add-on, extension),
- ✓Personnel program; (review of layout planning, revision of an organization, review of a job assignment),
- ✓Payroll system; (review of salary increases and promotions and review of progression schedule),
- ✓Chronological tables,
- ✓Management monitoring indicators

d) Items of an annual business plan (one year).

- ✓Setting of target value; (Planning of production, Amount of profit, Amount of operating revenue, Amount of operating expense),
- ✓Financial planning; (income and expenditure plan),
- ✓Revision of water rates,
- ✓Investment program;(Improvement, Add-on, extension),
- ✓Personnel program; (review of layout planning, revision of an organization, review of a job assignment),
- ✓Payroll system; (review of salary increases and promotions and review of progression schedule),
- ✓Chronological tables,
- ✓Management Monitoring indicators

3) Process

a) To investigate the current situation of business plans including similarities as well as the policy for management
b) To make a problem analysis
c) To employ the local consultants for examination
d) To prepare the plan format and report with recommendations
e) To prepare the first mid-term business plans for 2010/11 to 2012/13
The first mid-term and annual business plans shall be prepared by the DMD(FA&R) under the assistance of local consultants
f) To prepare the first annual business plans for 2010/11
g) To prepare the mid-term business plans in the subsequent years
The proposed format may be modified based on the experience in the actual preparation of business plans
h) To prepare the annual business plans in the subsequent years

4) Action Plan

Action	2010	2011	2012	2013
Investigate the current situation of business plans				
Make a problem analysis				
Employ the local consultants for examination				
Prepare the plan format and report with recommendations				
Prepare the first mid-term plan for 2010/11 to 2012/13				
Prepare the first annual business plan for 2010/11				
Prepare the mid-term plan in the subsequent years				
Prepare annual business plan in the subsequent years				

Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Investigate the current situation of business plans		JICA Study	None	Completed
Make a problem analysis		JICA Study		Completed
Employ the local consultants for examination	DMD(FA&R)	DMD(FA&R)		Feb. 2010
Prepare the plan format and report with recommendations	DMD(FA&R)	DMD(FA&R)		May 2010
Prepare the first mid-term plan for 2010/11 to 2012/13	DMD(FA&R)	DMD(FA&R)		Jul. 2010
Prepare the first annual business plan for 2010/11	DMD(FA&R)	DMD(FA&R)		Jul. 2010
Prepare the mid-term plan in the subsequent years	DMD(FA&R)	DMD(FA&R)		
Prepare annual business plan in the subsequent years	DMD(FA&R)	DMD(FA&R)		

Figure 10.6 Action Plan

(2) Establishment of Performance Monitoring Indicators and Regular Monitoring System

The examination implementation points of a target article and its values shall be as follows.

1) Necessity and Objectives

Performance monitoring indicators has been calculated in WASA, but no target is given to them. They should be established as the target for improvement throughout one year activities to keep the motivation of employees.

2) Main contents

The management monitoring indicators, as shown in **Tables 10.2 and 10.3**, are tentatively considered, but not limited to them.

3) Process

a) To investigate the current situation of management monitoring indicators
b) To set the targets for indicators
c) To consider and approve the targets for indicators
d) To enforce (monitor) the indicators

4) Action Plan

Action	2010						2011						2012						2013					
Investigate the current situation of management monitoring indicators																								
Set the targets for indicators																								
Consider and approve the targets for indicators																								
Enforce (monitor) the indicators			▲						▲						▲						▲		⇨	

Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Investigate the current situation of management monitoring indicators		JICA Study		Completed
Set the targets for indicators		JICA Study	None	Completed
Consider and approve the targets for indicators	WASA IC	WASA IC		Jun. 2010
Enforce (monitor) the indicators	DMD(FA&R)			

Figure 10.7 Action Plan

Table 10.2 Management Monitoring Index (Water Supply and Sewerage)

Sr. No.	Index	Unit	Present	Target					Actual					Remarks
			2009	2017	2022	2027	2032	2035	2017	2022	2027	2032	2035	
1	**Water Supply**													
1-1	Percentage of population served	%	87	91	94	96	99	100						
	Population in WASA area	pers.	5.671	6.815	7.592	8.282	9.014	9.453						
	Population served	pers.	4.934	6.202	7.099	7.950	8.879	9.453						
1-2	Ratio of Unaccounted-for water (UFW)	%	34	30	28	25	23	20						
	Amount of water supply	m^3/day	1.682	1.855	1.938	1.963	1.96	1.934						
	Accounted-for water (AFW)	m^3/day	1.11	1.299	1.405	1.472	1.519	1.547						
1-3	Ratio of non-revenue water (NRW)	%	40											
	Amount of revenue water	m^3/day												
1-4	Per capita water consumption	lpcd	225	209	198	185	171	164						
1-5	Rate of unfit taps	%												
	No. of samples analized	nos.												
	No. of unfit samples identified	nos.												
2	**Sewerage**													
2-1	Percentage of population connected	%	84	89	92	95	98	100						
	Population in WASA area	pers.	6.104	7.335	8.172	8.914	9.702	10.175						
	Population in cantonments	pers.	0.752	0.907	1.063	1.252	1.373	1.452						
	Population connected (Entire)	pers.	5.759	7.333	8.501	9.674	10.833	11.627						
2-2	Percentage of population treated		-	36.0	35.2	34.3	33.9	33.5						
	Population treaed	pers.	-	2.643	2.992	3.316	3.675	3.894						
2-3	Rate of facility utilization	%	-	89.0	94.0	96.7	98.6	100.0						
	Treatment capacity	m^3/day	-	0.789	0.789	0.789	0.789	0.789						
	Amount of wastewater treated	m^3/day	-	0.702	0.742	0.763	0.778	0.789						
2-4	Per capita wastewater	lpcd	225	209	198	185	171	164						

Table 10.3 Management Monitoring Index (Finance)

3	**Finance**														
3-1	No. of employees per 1,000 connection in water supply	pers./ 1,000conn.													
	No. of commections for water supply														
	No. of employees for water supply		2,925	*1											
3-2	No. of employees per 1,000 connection in sewerage	pers./ 1,000conn.													
	No. of commections for sewerage														
	No. of employees for sewerage		2,682	*1											
3-3	Rate of cost recovery in water supply														
	Operating revenue in water supply	MRs/year													
	Operating expenditure in water supply	MRs/year	2,069	*2											
3-4	Unit price of water supply	Rs/m^3													
3-5	Water supply cost	Rs/m^3													
3-6	Rate of cost recovery in sewerage														
	Operating revenue in sewerage	MRs/year													
	Operating expenditure in sewerage	MRs/year	633	*2											
3-7	Unit price of sewerage	Rs/m^3													
3-8	Unit price of sewerage	Rs/m^3													
3-9	Rate of Customers' satisfaction *3	%													
3-10	No. of complaints per 1,000 connections for water supply	nos./ 1,000conn.													
	No. of complaints for water supply	nos.													
3-11	No. of complaints per 1,000 connections for sewerage	nos./ 1,000conn.													
	No. of complaints for sewerage	nos.													
3-12	No. of complaints per 1,000 connections for billing and collection	nos./ 1,000conn.													
	No. of complaints for billing and collection	nos.													
3-13	Rate of No. of complaints settled within 24 hours	%													
*1	Data in 2006/07	*2	Data in 2008/09			*3	Based on the questionnaire survey								

(3) Implementation of Comprehensive Asset survey and Preparation of Asset Inventories and Drawings

1) Necessity and Objectives

The objective of comprehensive asset management is to minimize the total cost of acquiring, operating, maintaining, and replacing capital assets over their life cycle and doing so in a way that achieves the level of a service that customers desire using a new paradigm where O&M, utility efficiency, least cost expansions, financial viability, utility governance/management and consumer attention, affordability and willingness to pay are of prime importance.

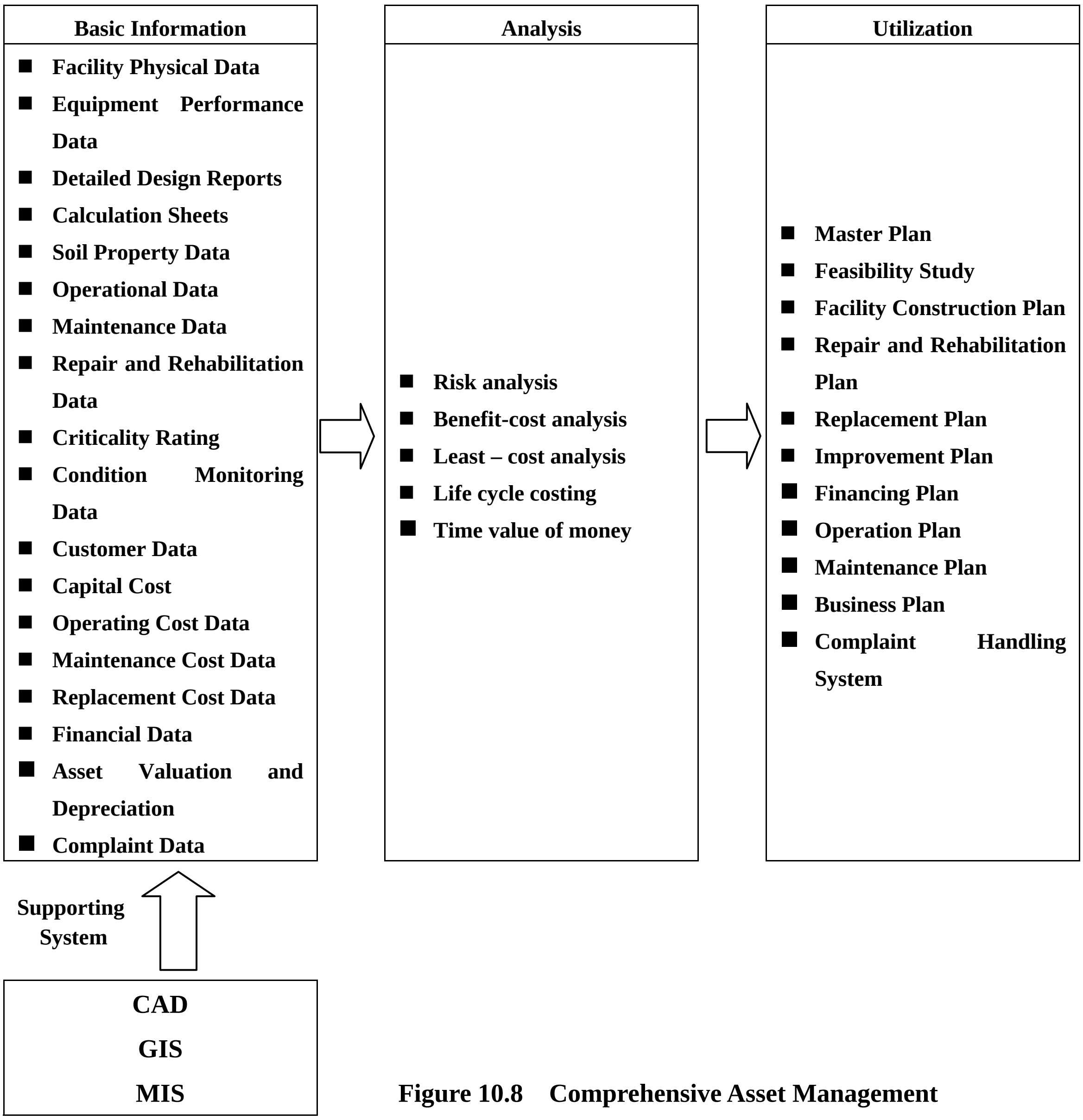


Figure 10.8 Comprehensive Asset Management

2) Main contents

Since the required data/information for comprehensive asset management is very huge as shown in Figure 10.XX, it is achieved only by accumulating existing data/information available collected and arranged step by step for a long time. The first step is started from the preparation of existing facility ledger which is the basis of information as well as the formatting for registration of equipment and for reporting of papers under the following rough phasing schedule.

a) Phase 1 (2010-2017)
- Preparation of a water distribution network ledger for the entire WASA area
- Preparation of a water distribution network rehabilitation plan for the entire WASA area
- Formatting for reporting of various kinds of papers
- Formatting for registration of mechanical and electrical equipment
- Construction of a Management Information System (MIS)
- Construction of a complaint handling system

b) Phase 2 (2018-2022)
- Data collection and arrangement of existing facilities and information
- Electronic digitization of existing data and information
- Conduct of various analyses
- Preparation of improvement some plans

c) Long-term (2023-2035)
- Full utilization of Comprehensive asset system for planning

3) Process

a) To investigate the current situation of asset management
b) To develop a comprehensive asset management system
c) To establish the GIS team
d) To prepare the bidding documents and cost estimation for GIS equipment
e) To assist the bidding process for GIS equipment
f) To prepare the facility ledger for the model area
g) To survey the location of facility for the model area, using GIS
h) To review existing information and records available in WASA for GIS
i) To input the existing data in the GIS in the entire WASA area
j) To prepare the reports with recommendations
k) To prepare the facility ledger for the entire WASA area, using GIS

4) Action Plan

Action	2012						2013						2014						2015					
Investigate the current situation of asset management																								
Develop a comprehensive asset management system																								
Establish the GIS team																								
Prepare the bidding documents and cost estimation for GIS equipment																								
Assist the bidding process for GIS equipment																								
Prepare the facility ledger for the model area, using GIS																								
Survey the location of facility for the model area, using GIS																								
Review existing information and records available in WASA for GIS																								
Input the existing data in the GIS in the entire WASA area																								
Prepare the reports with recommendations																								
Prepare the facility ledger for the entire WASA area, using GIS																								

Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Investigate the current situation of asset management	DIR(A)	Consultants under loan		Jul. 2012
Develop a comprehensive asset management system	DIR(A)	Consultants under loan		Sep. 2012
Establish the GIS team	DIR(A)	Consultants under loan		May 2012
Prepare the bidding documents and cost estimation for GIS equipment	DIR(P&S)	Consultants under loan		Jul. 2012
Assist the bidding process for GIS equipment	DIR(GIS)	Consultants under loan		Dec. 2012
Prepare the facility ledger for the model area, using GIS	DIR(A)	Consultants under loan		Dec. 2013
Survey the location of facility for the model area, using GIS	DIR(A)	Consultants under loan		May 2014
Review existing information and records available in WASA for GIS	DIR(GIS)	Consultants under loan		Apr. 2013
Input the existing data in the GIS in the entire WASA area	DIR. PMU	Consultants under loan		Apr. 2014
Prepare the reports with recommendations	DIR(A)	Consultants under loan		Jun. 2014
Prepare the facility ledger for the entire WASA area, using GIS	DIR(A)	Consultants under loan		Dec. 2015

DIR.(C-1) : Directorate for Construction 1

Figure 10.9 Action Plan

10.1.3 Reduction of Unaccounted-for Water (UFW) and Non-Revenue Water (NRW)

The average level of UFW recorded in January and February 2009 was 32%, and WASA currently attempts to reduce UFW in its jurisdiction. UFW reduction will bring WASA one step closer to less production of water and increase of revenue. In this regard, UFW control is one of the key issues for WASA to address problems with declining groundwater as their essential water source and improve the financial stability.
There are several action steps required to improve the level of UFW.

(1) Clarification of rights and responsibilities in relations with customers
(2) Installation of customer meters in all connections
(3) Establishment of leakage detection teams
(4) Implementation of distribution network improvement, first in the pilot area and subsequently to other areas
(5) Implementation of stringent measures against defaulters and illegal connections and phasing-out of uncharged public stand posts
(6) Entrustment of metering and billing to private companies

(1) Clarification of Rights and Responsibilities in Relations with Customers

1) Necessities and objectives

Currently, rights and responsibilities for service connections are mostly described in WASA's application and agreement form with customers. It is summarized as follows;

- All installation including service pipes, fittings, ferrule and water meter will be considered the property of WASA, and in case of theft or damage to any part of installations, customers will have to compensate for the loss.
- WASA will be responsible for providing connection only at main water supply line. The customer will be responsible for service pipe and all other installations outside and inside the house.
- Cost of connection and all the water fittings to the premises is borne by the owner or occupier of the premises.
- Customers can select unqualified materials of pipelines and fittings except for meters because WASA has no standards for material for service equipment. Meters are supplied by WASA.
- Responsibilities and obligations of service lines and meters have not been enacted.

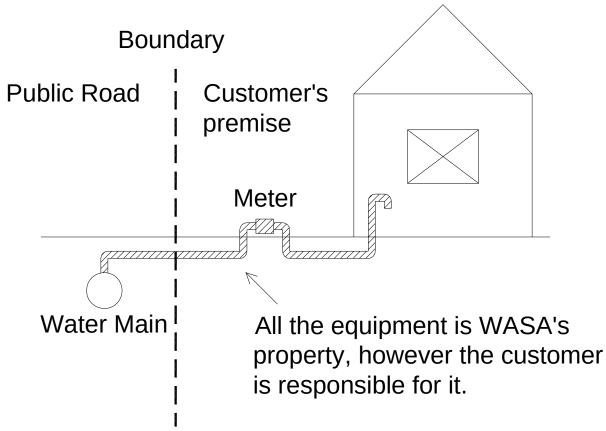


Figure 10.10 Current Status of the Rights and Responsibilities for Service Lines

This agreement looks like being weighed against customers, because customers have to pay and be responsible for everything of service connections, however all the equipment is considered the property of WASA. Customers pay for service connections and these equipment should be considered as the property of customers. In addition, customers practically cannot shoulder responsibility for pipelines under the public road. Considering the effective UFW reduction, service lines up to customer meters should be maintained by WASA, because customers may not mind pipes leaking under the public road.

2) Main contents

Here are the recommendations to improve the rights and responsibilities for service connections.

- All water service pipes and fittings carrying water from the main to the customer's premise should be the property of cutomers (see).
- Installation of service pipes and fittings is fully at the customer's cost.
- However, the water meter in customer's premises remains WASA's property.
- WASA should establish standards for material of service equipments.
- Customers must use approved material for service equipment.
- WASA will be responsible for repair of natural-cause water loss on the service lines up to the customer's meter at WASA's cost, while all water service pipes and fittings are the property of the customer. When a meter is found to be malfunctioning, WASA will also be responsible for repair at WASA's cost.
- WASA may exempt low income customers from payment of the cost of meters.
- Customers must use reasonable endeavors to protect equipment installed on customer's premises from unauthorized interference; and notify WASA of any

interference, defect or damage. Customers must pay the reasonable costs of repair or replacement of the equipment installed on customer's premises, on request, if the defect or damage was (a) caused by customers; or (b) caused by another person in circumstances where customers failed to take reasonable care to prevent that.

- WASA should have the right of access to the customer's premises at all reasonable times for the purposes of making connections, reading meters, inspecting pipes and appurtenances, checking on the use or waste of water or determining compliance with these terms and conditions.
- WASA must disconnect customer's premises from the water network if customers fail to pay an account by the due date.
- Customer meters should be replaced regularly at WASA's cost. This cost should be incorporated in water tariff.

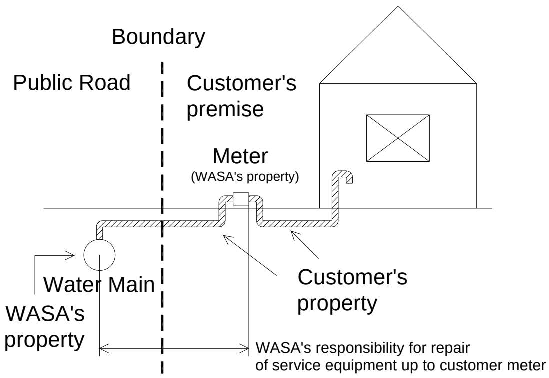


Figure 10.11 Recommended Rights and Responsibilities for Service Lines

Table 10.4 Payer, Owner Responsibility of Service Lines

	Current status			Recommendations		
	Payer	Owner	Responsibility for repairs	Payer	Owner	Responsibility for repairs
Service connections except for customer meters	customers	WASA	customers	customers	customers	WASA up to the meter, customers after the meter
Customer meters	customers	WASA	customers	WASA pays for replacement of meters. Regarding initial cost, see **Table10.4**	WASA	WASA

WASA needs to clarify and enact the responsibilities in relations with customers in the form of WASA Act or other legal documents and set up contract with customers. Also, the cost burden of meters between customers and WASA should be clarified in the same documents.

3) Process

a) To clarify the current rights and responsibilities for customers
b) To develop the new rights and responsibilities for evaluation.
c) To revise the new rights and responsibilities through discussion in WASA IC.
d) To finalize the new rights and responsibilities through discussions with SC
e) To issue the customer charter.
f) To enact the Acts

4) Action plan

Action	2010						2011						2012						2013					
Clarify the current rights and responsibilities for customers																								
Develop the new rights and responsibilities for evaluation																								
Revise the new rights and responsibilities through discussions with WASA IC.																								
Finalize the new rights and responsibilities through discussions with SC																								
Issue the customer charter						▲																		
Enact the Acts								▲																

Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Clarify the current rights and responsibilities for customers		JICA Study	None	Completed
Develop the new rights and responsibilities for evaluation		JICA Study		Completed
Revise the new rights and responsibilities through discussions with WASA IC.	WASA IC	JICA Consultant		Jun. 2010
Finalize the new rights and responsibilities through discussions with SC	SC			Aug. 2010
Issue the customer charter	WASA IC			Sep. 2010
Enact the Acts	Assembly			Apr. 2011

Figure 10.12 Action Plan

(2) Installation of Customer Meters in All Connections

1) Necessities and objectives

Meter installation had started before WASA was established in 1976. All new connections are meant to be metered since 1997. However, meters are now out of stock so that WASA is installing only service lines to customers without meters. Currently, only 13% of the total connections are in good order out of the total connection of 556,890.

To proceed a meter installation program, following things should be considered; A) principles of meter installation, B) establishment of system for meter installation, C) establishment of system for meter repair.

2) Main contents

A) Principles of meter installation

All the service connection should be equipped with meters. WASA is basically responsible for regular replacement of them and repair at their cost, however the payment should be made according to the following categories as shown in

6.

There are four categories of meter installations; 1) installation for the new application, 2) replacement for the customers who have already installed service connections including meters, 3) installation for the customers who have already installed service connections since 1997 or later but no meters due to out of stock of meters in WASA, 4) installation for the customers who had already installed service connections without meters before 1997 due to no obligations of meter installation.

In the first category, meters should be paid by customers, because this is the first time for meter installation for them. In the second and third category, customers have already paid for meters when they installed service conecctions so that WASA will pay for meters.

Problem is the forth category. Essentially, customers should pay for meters, but they have been allowed to use water without meters by contract with WASA before 1997. These customers may well be reluctant to install meters at their cost so that meters should be equipped for them at WASA's cost.

These kinds of the cost burden of meters between customers and WASA should be clarified in the WASA Act or other legal documents.

Table 10.5 Meter Installation

Categories	Meter installation	Payer for meters
The first categoly	For new applications	Cutomers will pay for meters.
The second category	For people who have already installed service connections including meters since 1997 or later.	Customers have already paid for it.
The third category	For people who have already installed service connections since 1997 or later, but no meters because meters has been out of stock in WASA.	Customers have already paid for it.
The fourth category	People who had already installed connections before 1997 without meters.	WASA will pay for meters, because customers may well be reluctant to install meters at their cost.

First, meter installation should be started in a pilot area. The pilot area is selected by asset survey with GIS and used for UFW reduction exercise and trainings. The pilot area is supposed to have significant leakage. This pilot training requires all the customers equipped with meters.

Secondly, out of the pilot area, new applicants for water are targeted for meter installation.

Thirdly, un-metered connections should be metered, in particular, Higher ARV (Annual Rental Value) connections. Currently in WASA, un-metered connections are classified by ARV (See Appendix chapter 6.7.9) and charged according to the size of ARV. High ARV means large and high income residents. They usually consume more water than others so that they should be metered immediately.

Customer meters need to be replaced regularly. It can enable WASA to ensure that the meters are providing accurate measurements as possible. For example, all the customer meters are legally replaced in every 8 years in Japan. Used meters are maintained and recycled.

B) Establishment of system for meter installation

Currently, installation of pipe line from ferrule upto the house is the responsibility of customers. They ask one of the certified plumbers to install service lines, but meter installation is the responsibility of WASA, because proper installation of meters are essential for WASA to measure comsumption of water accurately and collect bills.

Total number of connection is estimated to be 770,000 in the end of Phase-2, since served population is projected to be 6,900,000. WASA indicates in their report “Benchmark Indicators” that there are 9 people per dwelling. Assuming that customer meters are replaced in every 8 years, 96,000 meters need to be installed every year.

770,000 meters/ 8 years = 96,000 meters/year

Thus, WASA should arrange organizations to install 96,000 meters per year.

There are two options to establish systems for meter installation; 1) develop the internal resources and expertise them, 2) outsource to private companies.

If WASA develop the internal resources to install meters, it will require the 8 times of the current meter installation staff members in WASA as follows;

- There are currently 4 staff members for installation of meters in each town. Total number of staff in WASA is calculated to be 24. One technician can install two meters per day. Thus, 12,000 meters can be installed per year.

  24 members * 2 meters =48 meters/day

  = 1,000 meters/month approx. =12,000meters/year.
- WASA will need the 8 times of the current staff members for installation of 96,000 meters per year. Total number of staff members is calculated to be around 200.

  96,000/12,000= 8

  24 * 8= 192
- Plus, these mechanics will need helpers. Assuming that one helper is needed for each mechanic, 200 helpers are required.

Considering that WASA will need approximate 400 employees including helpers to install meters, outsourcing of this function would be the best option.

In 2009, WASA is testing outsources of meter billing and distributing as well as detection of illegal connections. If they achieve a satisfactory level of result, WASA will continue to hire them and expand areas to outsource. In a similar way, outsourcing of meter installation may be a good idea as long as it is more effective and economic system than internal resources.

When outsoursing this task, supervising closely them is necessary to get meters installed properly. One of WASA' staff should oversee meter settings and location. WASA's staff also should meet customers to provide explanations of meter installation to them and obtain their agreement.

C) Establishment of system for meter repair

Under the project "Identification study of water supply and sewerage services in Lahore city", customer survey of 1,500 connections was conducted. As a result, it is found that 35% of customer meters (7 year's old on average) were defective.

It is calculated that 5% of meters are broken on average per year. Assuming that WASA uses less trouble-free meters and failure rate comes to be half (2.5% per year), it is estimated that

19,000 meters out of 770,000 connections are going to be broken per year. WASA currently has only five technicians to repair meters and 1,300 meters are repaired per year. Thus, the meter repair system in WASA should be enhanced.

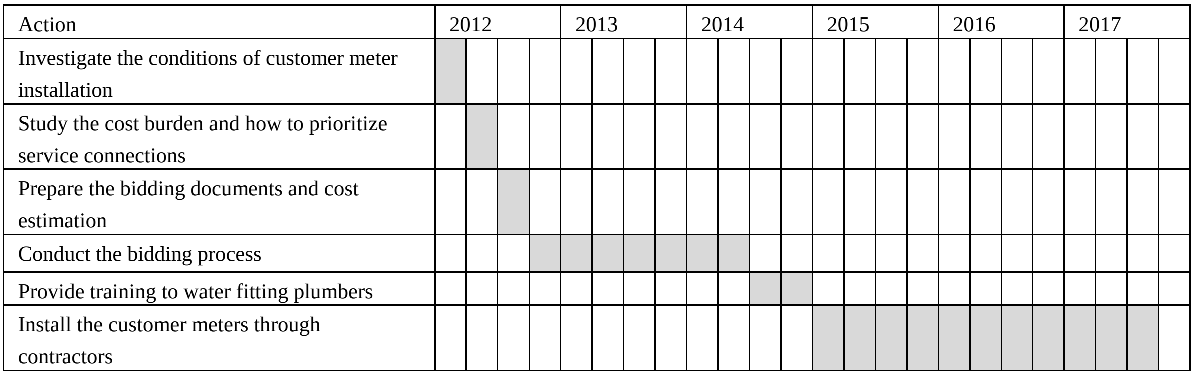
It would be best to outsource this function of repairing customer meters because it is difficult for WASA's internal resources to understand mechanism of various types of meters and repair them. Also, if WASA develop internal resources and repair meters, WASA will need 15 times more staff, 75 technicians at the end of Phase-2.

19,000/1,300 * 5 = 75

3) Process

a) To investigate the conditions of customer meter installation
b) To study the cost burden and how to prioritize service connections
c) To prepare the bidding documents and cost estimation
d) To conduct the bidding process
e) To provide training to water fitting plumbers
f) To install the customer meters through contractors.

4) Action Plan



Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Investigate the conditions of customer meter installation	DMD(O&M)	Consultant under loan		Apr. 2012
Study the cost burden and how to prioritize service connections	DIR(R)	Consultant under loan	Consultant under loan	Jun. 2012
Prepare the bidding documents and cost estimation	DIR(P&S)	Consultant under loan	Rs.43M	Sep. 2012
Conduct the bidding process	DIR(P&S)	DIR(P&S)	Works	Jun. 2014
Provide training to water fitting plumbers	DIR(T)	Consultant under loan	Rs.1,441M	Dec. 2014
Install the customer meters through contractors	DITR. PMU	Contractors		Sep. 2017

Figure 10.13 Action Plan

(3) Establishment of Leakage Detection Teams

1) Necessities and objectives

There are currently two departments in WASA to control leak; Leak Detection Cell and O&M Department. O&M Department finds visible leak and repairs pipelines. There are 6-10 staff members in O&M Department in each sub-division. Total number of staff in WASA is calculated to be 150-250, as there are 25 sub-divisions.
The Leak Detection Cell is responsible for leak detection. It has only 4-5 staff members and covers whole area in WASA.
WASA initiate repairs from reported leaks that surface above ground.

To reduce UFW significantly, WASA should undertake active leak control programs to search out unreported leaks and undertake pre-emptive repairs to minimize losses. The Leak detection team will need to build a UFW control program and detect/repair leaks effectively. To enhance the capacity of active leak control, following action steps are needed;

a) increase staff member
b) increase equipment
c) strengthen the capacity of leak detection and repair as well as comprehensive method of controlling UFW.

Active leak control will be carried out by focusing on a certain area in the city and completing leak control there, then moving to another area. WASA’s jurisdiciton will be divided into many zones. The taskforce team takes area-by-area aproach and end up finalizing all the area. Before starting area-by-area approach, the taskforce team is supposed to finish learning how best to reduce UFW in a pilot training. Details of the pilot training are described later.

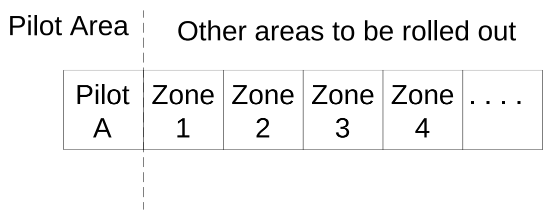


Figure 10.14 Concept of the Process of the Active Leak Control

2) Main Contents

A) Increase the staff member

There are two options to establish systems for active leak control; 1) develop the internal resources and expertise them, 2) outsource to private companies.

Outsourcing is one of the options though, it might be a good idea to develop the internal resources, because the active leak control includes a lot of fundamental tasks for WASA such as customer survey, establishment of District Meter Areas, flow and pressure measurements, identification and replacement of deteriorated pipelines as well as leak detection and repair.

Under the project financed by France in 2006 and 2007 a pilot area was selected and a taskforce team reduecd UFW there. The pilot area includes 1,500 connections and 30km of pipelines.

It is reported that the pilot study took in the end one year instead of the six months which were initially planned. This was mainly due to the delay in the installation of the customer meters, the time taken to set-up the pilot area and the repair of a probe which was unexpected.

Now that WASA will develop resources to install meters and leak detection euipment, it is expected to take half a year to implement UFW reduction activities in the same size area.

Assuming that the taskforce team will finish up the active leak control in the whole area by 2035, the following number of staff wil be required to conduct the active leak control.

Where;

Total length of pipelines in WASA; 5,000km

Total length of pipelines in a zone; 30km

Total number of zones; 5,000km / 30km = 170 zones

Planned implementation period to finish up all the pipelines; 20 years, it is completed by 2035.

170 zones / 20 years = 9 zones / year

One team can be responsible for two zones in a year.

9 zones / 2 = 5 teams

Five teams are required.

It is recommended that a department responsible for the active leak control include a director, a supervisor, five teams and some drafters. A team includes a team leader and five technicians. These teams report to the supervisor and director who will be responsible for planning the activity, managing the teams, reporting activities and coordination with repair teams in O&M department. Drafters are responsible for sketching out and updating pipeline drawings.

Existing Leak Detection Cell is in charge of reported leaks as usual.

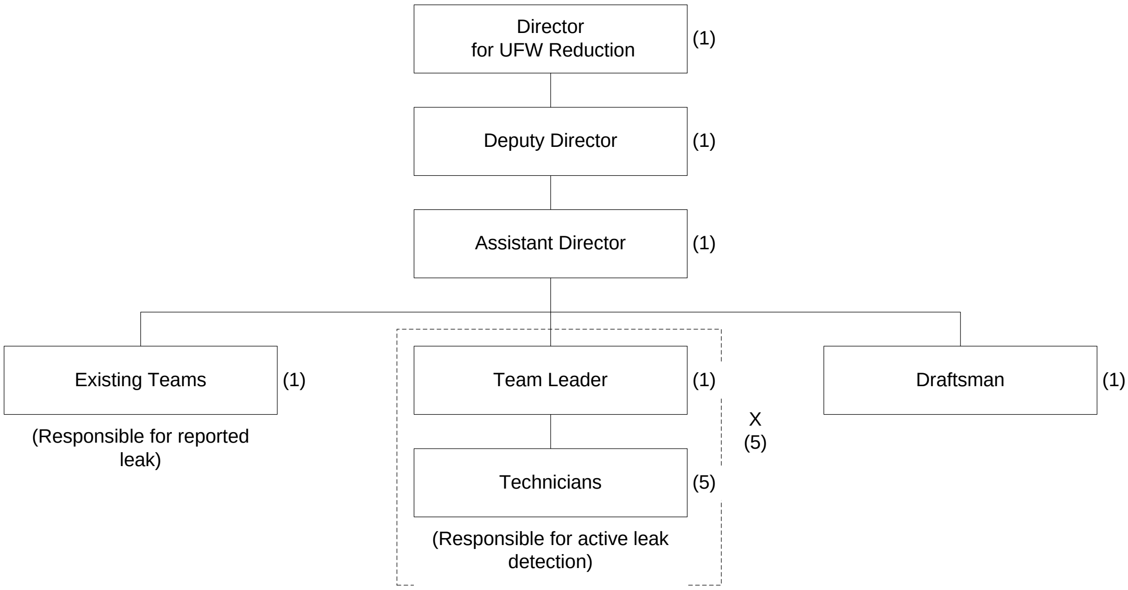


Figure 10.15 Proposed Composition of the Leak Detection Team

It is estimated that 36 persons are required to establish the active leak control team.

Table 10.6 Proposed Number of the Leak Detection Team

Director	1
Deputy Director	1
Assistant Director	1
Team Leader	5
Technicians	25
Drafters	3
Total	36

B) Increase equipment

The following equipment is required for establishment of the leak detection team.

Table 10.7 Proposed Equioment for the Leak Detection Team

Computer	20
Server	1
Printer	1
Water leak Detector	5
Listening Stick	10
Metal pipe locator	3
Non-metallic pipe locator	3
Metal Locator	3
Ultrasonic flow meter	15
Pressure recorder	15
Data Logger	30

3) Process

a) To evaluate the current capacity of the UFW reduction staff members
b) To study the necessary organization of the UFW reduction team
c) To increase staff members for the UFW reduction team
d) To prepare the bidding documents and conduct bidding for UFW equipment
e) To procure the UFW reduction equipment
f) To conduct a training and prepare the manual

4) Action Plan

Action	2012				2013				2014				2015				2016				2017			
Evaluate the current capacity of the UFW reduction staff members and equipment																								
Study the necessary organization of the UFW reduction team																								
Increase staff members for the UFW reduction team																								
Prepare the bidding documents and conduct bidding for UFW equipment																								
Procure the UFW reduction equipment																								
Conduct a trainings and prepare the manual																								

<table>
<tr><th>Action</th><th>Administrator</th><th>In Charge</th><th>Cost</th><th>Indicators/Target Date</th></tr>
<tr><td>Evaluate the current capacity of the UFW reduction staff members and equipment</td><td>DIR CONST-1</td><td>Consultant under loan</td><td rowspan="6">Consultant under loan Rs.17M

Works Rs.37M</td><td>Apr. 2012</td></tr>
<tr><td>Study the necessary organization of the UFW reduction team</td><td>DIR CONST-1</td><td>Consultant under loan</td><td>Jun. 2012</td></tr>
<tr><td>Increase staff members for the UFW reduction team</td><td>DIR(A)</td><td>DIR(A)</td><td>Dec. 2012</td></tr>
<tr><td>Prepare the bidding documents and conduct bidding for UFW equipment</td><td>DIR(P&S)</td><td>Consultant under loan</td><td>Apr. 2013</td></tr>
<tr><td>Procure the UFW reduction equipment</td><td>DIR(P&S)</td><td>Contractors</td><td>Dec. 2014</td></tr>
<tr><td>Conduct a trainings and prepare the manual</td><td>DIR. PMU</td><td>Consultant under loan</td><td>Dec. 2016</td></tr>
</table>

Figure 10.16 Action Plan

(4) Implementation of Distribution Network Improvement, First in the Pilot Area and Subsequently to Other Areas

1) Necessities and objectives

in 2006 and 2007, "Identification study of water supply and sewerage services in Lahore city" was financed and carried out by France. It included UFW reduction component. Under the project, a pilot area which consists of 1,500 connections and 30km of pipelines was selected in a newly developed residential area of Johar Town. As a result of the project, the level of UFW reduced 15% to 10%.
This indicates that the pilot area approach is a good way to reduce UFW effectively. So it is recommend that this approach should be continuously rolled out area by area in the whole city.

2) Main Contents

A) Training exercise and pipe improvement in a pilot area
It is said that most of participants of the pilot training in the French project unfortunately have already left WASA or transferred other departements in WASA unrelated to UFW control.

In the JICA Project, the UFW reduction team is planed to develop independently and permanently in WASA. It will lead to give same salaries and facilities to UFW Reduction team as other staffs according to regulations of WASA. It will also encourage staff members to continue working in the UFW Team.

As discussed previously, WASA needs more staffs to be tarined to tackle the UFW issues. Thus, a pilot area will be selected again and UFW control program will be implemented to confirm viability.

The objective of the pilot training is, 1) to give exercise to staff members, 2) to reduce UFW in the pilot area. After the completion of the pilot trainings, all the related staff members are supposed to be good enogh to carry out the active leakage control. They will select another area and roll out the UFW reduction program.

The pilot training and other UFW reduction activities are carried out according to the following procedures given in the .

The pilot area will be selected based on the network survey which will identify the configulation of pipes and its technical aspects under the “Asset management and pipe replacement plan” program.

In the meter installation program, customer meters and bulk flow meters should be installed in the pilot area first.

The pilot training includes theoretical and practical lessons. WASA staff members can learn UFW problems and solutions as well as practical activities as follows;

- UFW reduction Basics
- Water balance
- Customer survey (metered, un-metered, illegal connection, etc.）
- Terminate illegal connections
- Establishment of District Meter Areas
- Flow and pressure measurements
- Leak detection and repair
- Proper installation of service lines
- Identify deteriorated pipelines
- Replace deteriorated pipelines

The pilot training basically contains leak detection and repair as well as customer survey and crack down on illegal connections. In other words, UFW reduction team takes care of leak detection and repair as well as finding and terminating illegal connections. The results of customer survey are given feedback to GIS and the database.

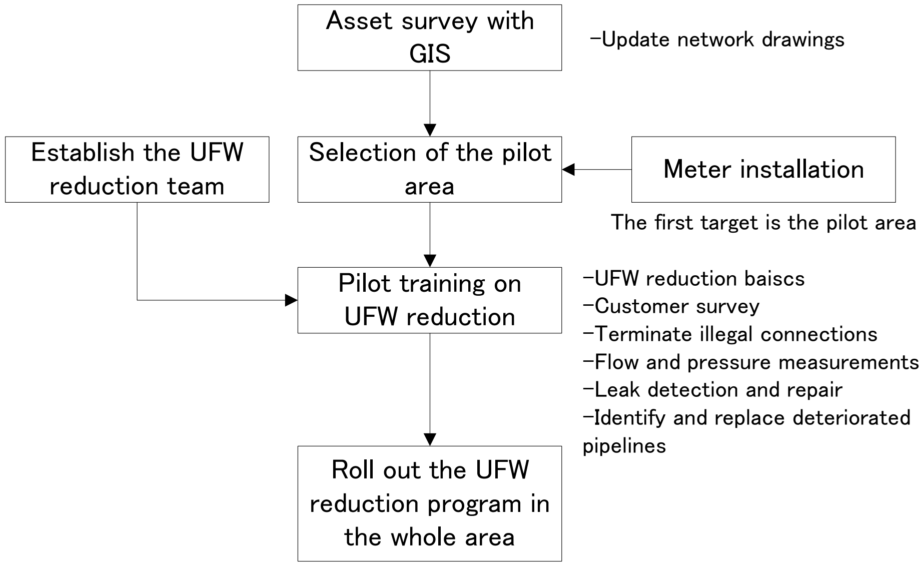


Figure 10.17 Flow Diagram of the Pilot Trainings and Other UFW Reduction Activities

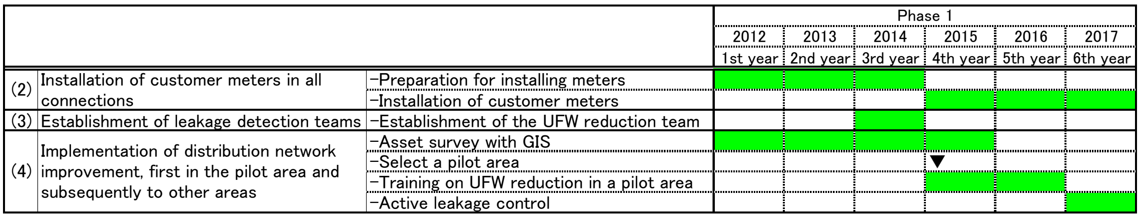


Figure 10.18 Proposed Schedule for the Pilot Trainings and Other UFW Reduction Activities

B) Asset management and pipe replacement plan

To reduce UFW, Asset management of pipelines and replacement of deteriorated pipelines is also definitely needed.

Unfortunately, there are very few drawings in WASA to show the location and specification of facilities. It is not clear that location of existing pipes, diameter, material as well as year of installation. These kind of information are essential for stratigic active leak control and investments.

WASA will need a reliable and effective tool for asset management such as a Geographical Information System (GIS). This system basically includes;

- Topographic information
- The location of the facilities;
- The technical aspect of each components (diameter, material, depth, age, etc.)
- The database of leakage
- The location of service connections

In order to develop GIS, it will be necessary to undertake the following steps;

- Set up computers and IT network
- Review existing information and records available at WASA
- Obtain an accurate background map of the jurisdiction of WASA
- Confirm the configuration of pipelines on sites
- Creating a suitable organization for aquiring and developing data

GIS facilitates the asset management of network system and development of stratigic pipe replacement plan.
In the pipe replacement plan, pipelines are prioritized in regard to the degree of deterioration and inportance, and scheduled for replacement.
Noted that the alternative water source and its water treatment plant will bring new transmission and distribution pipelines in the city. Distirbution network will be rebuilt for the integartion of the alternative water source system into existing tubewell system. Pipe replacement program has to be considered with this in mind.

It is recommended to outsource to private companies to develop GIS and pipe replacement program as well as technical transfer of GIS to WASA's staff. Then WASA's staff will be able to enter data into GIS. WASA will also need to establish a GIS team to collect all existing information, visit sites, validate and update them as well as operate and maintain the system with continuous update of the information as shown in **17** and **9**.

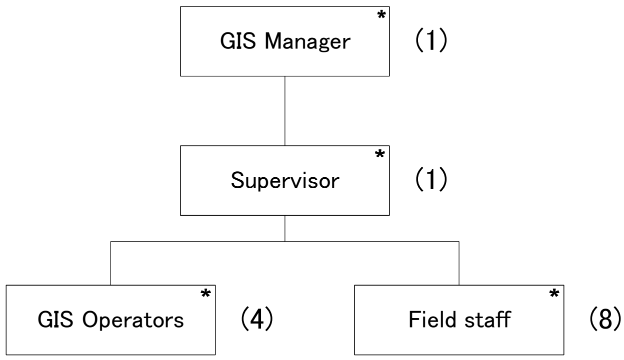


Figure 10.19 Proposed Composition of the GIS Team

Table 10.8 Proposed Number of the GIS Team

Manager	1
Supervisor	1
GIS Operators	4
Field staff	8
Total	14

Table 10.9 Proposed Equipment for the GIS Team

Computer	6
GIS Software	6
Server	1
Metal pipe locator	2
Non-metalic pipe locator	2
Metal Locator	2
Printer	1

3) Process

a) To select a pilot area for UFW reduction
b) To complete the facility ledger for the pilot area, using GIS (refer **2-1**)
c) To develop the distribution network improvement plan for the pilot area
d) To prepare bidding documents and conduct bidding for the pilot area
e) To replace the deteriorated pipelines and other facilities for the pilot area
f) To complete the facility ledger for the entire area using GIS (refer **2-3**)
g) To develop the distribution network improvement plan for the entire area

4) Action Plan

Action	2012				2013				2014				2015				2016				2017			
Select a pilot area for UFW reduction																								
Complete the facility ledger for the pilot area, using GIS (refer **2-1**)																								
Develop the distribution network improvement plan for the pilot area																								
Prepare bidding documents and conduct bidding for the pilot area																								
Replace the deteriorated pipelines and other facilities for the pilot area																								
Complete the facility ledger for the entire area using GIS (refer **2-3**)																								
Develop the distribution network improvement plan for the entire area																								

Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Select a pilot area for UFW reduction	DIR(LC)	Consultant under loan	Consultant under loan Rs.114M Works Rs.37M	Jun. 2012
Complete the facility ledger for the pilot area, using GIS (refer **2-1**)	DIR(A)	Consultant under loan		Apr.2014
Develop the distribution network improvement plan for the pilot area	DIR. CONST-1	Consultant under loan		Dec. 2014
Prepare bidding documents and conduct bidding for the pilot area	DIR(P&S)	Consultant under loan		Apr. 2015
Replace the deteriorated pipelines and other facilities for the pilot area	DIR. PMU	Contractors		Dec. 2016
Complete the facility ledger for the entire area using GIS (refer **2-3**)	DIR(A)	Consultant under loan		Dec. 2015
Develop the distribution network improvement plan for the entire area	DIR. CONST-1	Consultant under loan		Dec. 2016

Figure 10.20 Action Plan

(5) Implementation of Stringent Measures against Defaulters, Illegal Connections and Phasing-out of Uncharged Public Stand Posts

1) Necessities and objectives

The percentage of water bill collection is about 81% in 2009. It has been gradually improved as compared to 78% in 2006.
Low income people will usually pay for water bill, while the Government Departments are sometimes difficult to be collected. To ensure the fairness of payments for drinking water, WASA needs to collect bills from them.

Under the project of “Identification Study of Water Supply and Sewerage Services in Lahore City” in 2007, this report says that 3% of connections were found to be illegal. This figure is lower compared to the estimated number of illegal connections in the city more around 5% according WASA officials. This can be explained by the fact that the pilot area is recent, planned and housed by middle and upper income households. To reduce UFW, illegal connections should be eliminated.

2) Main Contents

A) Defaulters
The current process for the recovery of rate arrears is as follows; a) reminder letter to ratepayer, b) letter to ratepayer requesting payment, c) disconnect water, d) legal action.

Disconnection is undertaken in six months after the last day for payment.

Most effective way for arrears is disconnection. Now WASA is carrying out disconnection of water supply to non-payment. It should continuously be enforced rigorously.
Problems are, 1) illegal re-connections, and 2) collection from Government Departments.

Some defaulters do not mind disconnection due to the failure of payment. After WASA disconnects water supply to their premises, they call a plumber to reconnect pipelines without any notices to WASA.

To eliminate the illegal re-connection, it might be better to deprive plumbers of their licenses who help customers reconnect pipelines. These kind of customers also should be punished by a fine.

These measures should be difined in the WASA Act or other legal documents.

WASA is currently struggling against the recovery of arrears from Government Departments. WASA follows up recovery through additional secretary (junior secretary) of HUD& PHE Department against Punjab Government Departments. On WASA's request the additional secretary of HUD& PHE reminds all the concerned Executive Heads of Government Department (secretary) to intervene to settele the outstanding dues with WASA. Other than the Punjab Government Departments, District officer (finnance) is pursued for the recovery of arrears against the Heads of the Departments (Secretary) working under the supervision of the Local Government.
These efforts should be continuously enhanced to recover from Government Departments.

B) Illegal connections
When WASA finds an illegal connection, WASA carries that person a penalty charge. Offender must pay bill of one year as penalty.

It is expected that illegal connection will be detected gradually under the active leak control program cunducting area by area. These programs include the complete installation of customer meters and customer survey, that means the unauthorized connection will be found as the French project did.

In 2009, WASA has contracted four survey companies to detect illegal connections. Those companies – PEARL, ASSETS, ECS and KAP – will start their task on September 1 of

2009. the PEARL will cover Nister Town and the ASSETS will deal with Data Gunj Buksh Town and Iqbal Town, while the ECC and the CAP will cover Ravi Town, Aziz Bhatti Town and Shalimar Town. Under the agreement, the campanies will conduct door-to-door survey to point out illegal connections. Each contracter will be paid Rs 295 as service charges on detection of each unauthorized connection. Period of the contract will be one year that will be extended on satisfactory completion of the contract subject to the approval of authority concerned.

This is a very good approach to eliminate illegal connections. This type of contract may prove to be particularly beneficial to WASA. The successful achievement of UFW reduction targets will often allow WASA to defer major capital investment in developing new water resources and treatment facilities.

C) Phasing-out of uncharged public stand posts

There are 580 PSPs (Public Stand Posts) in WASA as free water supply points. All the PSPs are without meters. The Revenue Directorate in WASA assumes that the average consumption for each PSP is around 380 Gallons/day (1.7m3/day). The total consumption of PSPs are calculated to be 380*580=220,400 Gallons/day (990m3/day). The level of UFW in January 2009 is 32% (source: Accounted/ Unaccounted for Water and Revenue/ Non Revenue Water for the Period of Jan.& Feb. 2009, WASA). The total UFW of PSPs is estimated to be 220,400*32%=70,530 Gallons/day (320m3/day).

Currently, WASA has prohibited installation of public stand posts any further and there is no provision of allowing any public stand posts in the future.

3) Process

a) To study the current situation of defaulters and illegal connections
b) To evaluate the effectiveness of current measures
c) To study the alternatives, if any.
d) To prepare the report with recommendations
e) To enforce the recommendations

4) Action Plan

Action	2012	2013	2014	2015
Study the current situation of defaulters and illegal connections				
Evaluate the effectiveness of current measures				
Study the alternatives, if any.				
Prepare the report with recommendations				
Enforce the recommendations				

Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Study the current situation of defaulters and illegal connections	DIR (R)	Consultant under loan	Consultant under loan Rs.6M	Apr. 2012
Evaluate the effectiveness of current measures	DIR (R)	Consultant under loan		June. 2012
Study the alternatives, if any.	DIR (R)	Consultant under loan		Sep. 2012
Prepare the report with recommendations	DIR (R)	Consultant under loan		Dec. 2012
Enforce the recommendations	DMD(FA&R)	Consultant under loan		Mar. 2013

Figure 10.21 Action Plan

(6) Entrustment of Metering and Billing to Private Companies

1) Necessities and objectives

Revenue Department in WASA is responsible for meter reading, billing and collection. There are around 100 meter readers, 20-30 persons for billing and 150 delivery clerks. These meter readers are responsible for 73,000 customer meters which are currently working in order. Bill is issued every two month.

If WASA develop internal resources and carry out these tasks, the number of 1,000 meter readers, 200-300 staff members for billing and 1,500 delivery clerks will be required for 770,000 customer connections at the end of Phase-2. That would be 10 times of the current staff members. WASA may want to consider outsorcing this function.

2) Main Contents

As stated above, WASA would need a lot of employees and trainings if WASA developed internal resources. In this case, WASA would have to promote laborsaving and effective bill collection, for example, using handy terminal and delivering bills by meter reader. The handy terminal is an instrument for meter reading (uploading) and dumping (download) them to the base computer system. This device is portable, compact and battery powered so that meter readers can easily take it and read meters.

Outsourcing would be good to achieve metering, billing and collection effectively.
WASA currently has a plan to contract out the task of billing to a company as a trial of outsourcing. This test includes printing out and distribution of bills in a pilot area. the contracter will be paid Rs 3.77 each printing and distribution as service charges. It is said that it is more reasnable than WASA's direct management, because it costs Rs 4 for WASA only each printing. The contract out of billing has been successful in the area of electric and gas companies in Pakistan.
If this test works well, contract will be extended to target the whole area including metering and collection.

3) Process

a) To investigate the current situation of entrustment of certain works in WASA.
b) To evaluate the entrustment of metering to private companies
c) To approve the entrustment plan.
d) To start entrustment, if any.

4) Action Plan

Action	2012	2013	2014	2015
Investigate the current situation of entrustment of certain works in WASA.				
Evaluate the entrustment of metering to private companies				
Approve the entrustment plan				
Start entrustment, if any				

Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Investigate the current situation of entrustment of certain works in WASA.	DIR (R)	Consultant under loan	Consultant under loan Rs.6M	Apr. 2012
Evaluate the entrustment of metering to private companies	DIR (R)	Consultant under loan		June. 2012
Approve the entrustment plan	WASA IC			Sep. 2012
Start entrustment, if any	DIR (FA&R)			Dec. 2012

Figure 10.22 Action Plan

10.1.4 Human Resource Development and Organizational Streamlining

(1) Organizational Restructuring

1) Necessity and Objectives

Efficiency of management can be increased by utilizing talented people effectively. For this reason, activation and slimming of an organization to adequate size is essential for proper training and organization of the personnel for a continuous improvement. As a result, the efficiency of water and sewerage management will progress and consequently improvement in serving the citizens will become possible.

2) Main Contents

Responsibility division of present O&M is a 6-Town system, each Town is a subject and the work of operation and maintenance is carried out by the staff responsible for this. However, the operation management of facilities, such as Tube-wells, several kinds of wastewater pumping stations, and pipelines, is not efficiently carried out due to the fall of the vitality of the organization in recent years.

i) Establishment of its objectives.
ii) Establishment of an implementation schedule.
iii) Establishment of Organization

Items to be examined are as follows:
Important points to reform an organization are shown below.

- The number of enforcement organizations and the number of the personnel in charge are distributed based on the population served and related facilities on the Sub Division level.
- Establish & facilitate a post that creates statistical materials required for a management decision.
- Establish & facilitate a post for information and management control.
- Speed up the measures to be taken to redress a complaint and obtain a confirmation by the concerned complainant.
- Take measures to bring improvement in serving the citizens.

Expected output are tentatively as follows:

a) Data base

- Distribution of population and the number of the existing facilities at present.
- The extended plan of a WASA enterprise.

b) Proposal on the Construction of a slim organization scheme

The proposed reform plan to be improved its performance which is considered estabshment of more sectors for building their responsibility and its enhancement, according to a WASA's plan to divide the whole region into two equally is shown in **Figure 10.9**.

Examination of slimming the organization and fittest arrangements of personnel will be considered under the consultant under loan and the data is still awaited from WASA officers.

A proposed continuous-improvement organizational chart is shown in **Figure 10.9.**

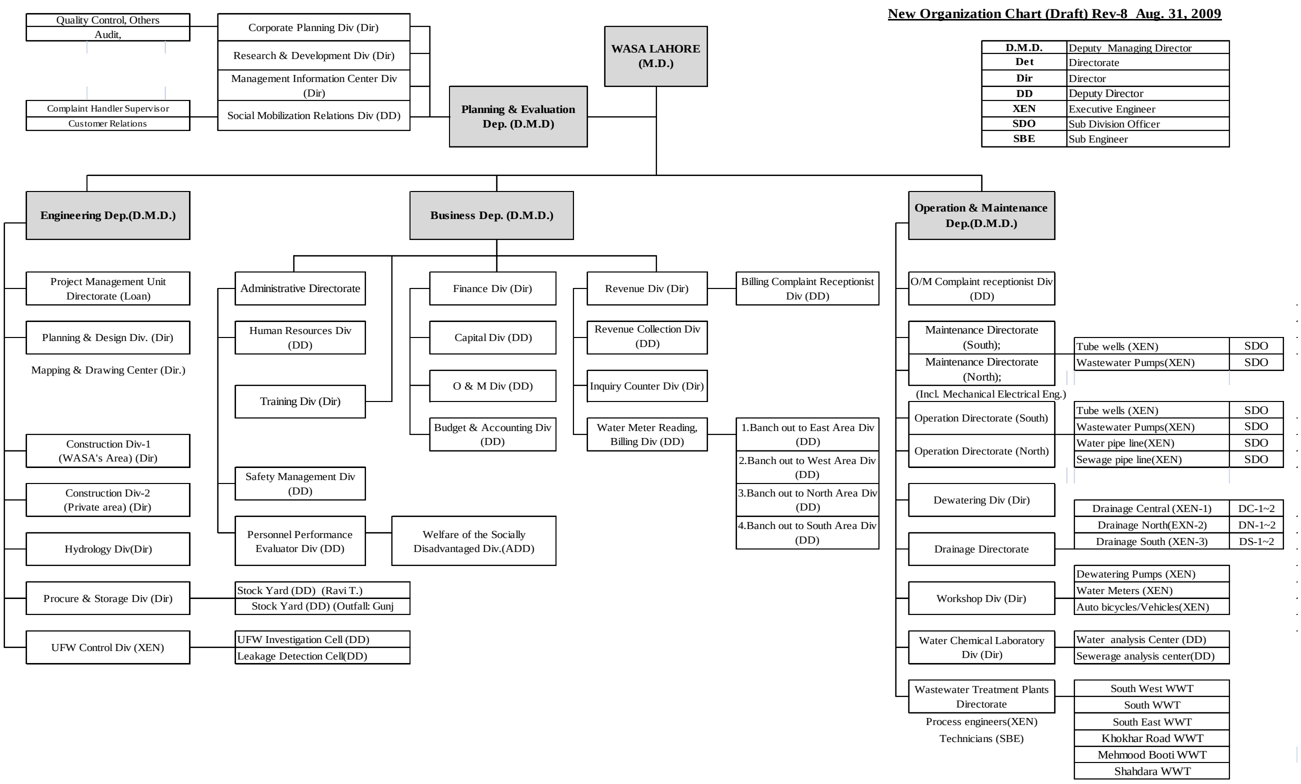


Figure 10.23 proposed Organization Chart

The main changed parts of the existing organization and a proposal organization are shown in **Table 10.11**.

Table 10.10 Outline of the Proposed Improving Point of an Organization

Items	Existing organization	Proposed organization
Responsibility range	6 Towns+ Head Office	Two Areas+ Head Office(South + North)
Main jurisdiction sections	Dep. (PE, ED, FAR, O/M, PMU (**Figure 6.2**)	PE Dep. ED, Business. O/M. (**Figure 10.9**)
PE Dep.	Div.(Audit, Quality Control, Public Relation etc)	Div (RD, MIC ,SMR, etc)
ED Dep.	Dep. (PD, PS, C-1, C-2, Hydrology)	Div. (PMU, UFW)
FAR Dep. ↓ (Change Department name) BUSINESS Dep.	Dep.(AD, Finance, Revenue, Training, etc)	-AD Div. (Human Resources, Safety Management, Personal Performance Evaluator) -Finance Div. (Capital, O/M, Budget & Accounting) -Revenue Div. (Revenue Collection, Inquiry, Water Meter reading & Billing)
	Water Meter reading & billing: 6-Local offices (Shailmar T., Aziz Bhatti T., Nishtar T., Allame Iqbal T., Ravi T., Gunj Buksh T.)	Water Meter reading & billing: 4-areas offices (East area, West area, North area, South area)
O/M Dep.	Divided into six Towns	Divided into Two Areas (to improve the operations liability by a type of the O/M work)
	1. Shalimar T. :SDO (Drainage, O/M)	1. O/M Complaint receptionist Div
	2. Aziz Bhatti T.: SDO (O/M)	2.Maintenance Directorate (South; Tube-wells, Wastewater Pumping Stations)
	3.Nishtar T.: SDO (Drainage, O/M-1, O/M-2)	3.Maintenance Directorate (North; Tube-wells, Wastewater Pumping Stations)
	4.Allame Iqbal T.: SDO (Drainage, O/M-1, O/M-2)	4.Operation Directorate (South : Tube-wells, Wastewater Pumping Stations, Water & Sewage pipeline,)
	5.Ravi T.: SDO (Drainage, O/M-1, O/M-2)	5.Operation Directorate (North: Tube-wells, Wastewater Pumping Stations, Water & Sewage pipeline,)
	6.Gunj Buksh T.: SDO (Drainage, O/M-1, O/M-2, D) Dewatering Dep. Workshop, Water Chemical Laboratory)	6.Dewatering Div.
Other	PUM: (Main Drainage line)	7.Drainage Directorate (Drainage Central、North、South)
	-	8.Workshop Div. (Dewatering Pumps, Water Meters, Auto bicycles/Vehicles)
		9.Water Chemical Laboratory Div. (Water analysis Center, Sewerage analysis center)
		10.Wastewater Treatment Plants Directorate (South West, South, South East, Khokhar Road, Mehmood Booti, Shahdara)

c) Arrangement of the personnel

d) Proposal of the Role of each post

Main organization may consist of Department, Directorate, Division, and Sub Division. The role of the main department is shown in **Appendix 10.2**.

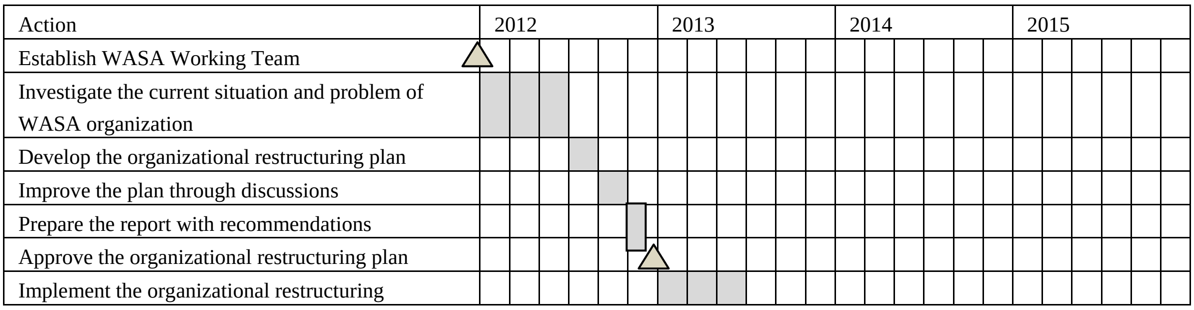
e) Proposal on the management and the command channel of the organization

- Directions come out of command to the DMD from Managing Director.
- In a Department, (from grade 20 to grade 17) Chain of command is Deputy Managing Director (DMD) > Director (Dir) > Deputy Director (DD)/Executive Engineer (XEN) > Sub Division Officer (SDO).
- DMD, Dir, DD and XEN are the managers who receive the instruction of tasks from their superior respectively, and acts for implementation control and supervision of the personnel under their charge.
- Sub Engineers (Grade 11 & 16) for engineering works and Assistant Director for administrative division carry out the job as per orders of their superiors.
- In case, MD is not available for a long period of time, the job of MD may be executed by the following priorities.
  - DMD Planning & Evaluation Department,
  - DMD Operation & Maintenance Department,
  - DMD Engineering Department.

3) Process

a) To establish WASA Working Team
b) To investigate the current situation and problem of WASA organization.
c) To develop the organizational restructuring plan.
d) To improve the organizational restructuring plan through discussions with the WASA IC
e) To prepare the report with recommendations for organizational restructuring
f) To approve the organizational restructuring plan
g) To implement the organizational restructuring

4) Action Plan



Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Establish WASA Working Team	MD			
Investigate the current situation and problem of WASA organization	WASA IC	Consultants under loan		Jun. 2012
Develop the organizational restructuring plan	WASA IC	Consultants under loan	Consultant under loan Rs.13.7M	Aug. 2012
Improve the plan through discussions	WASA IC	Consultants under loan		Oct. 2012
Prepare the report with recommendations	WASA IC	Consultants under loan		Nov. 2012
Approve the organizational restructuring plan	WASA IC	WASA IC		Dec. 2012
Implement the organizational restructuring	MD			Jun. 2013

Figure 10.24 Action Plan

(2) Improvement of Personnel Management and Human Resource Development

1) Necessity & Objectives

WASA's operating management efficiency is falling because the recruitment of requisite professionals is restricted through a ban by the Government of the Punjab since 1991. Consequently, the improvement in technological level of the organization is not progressing.
Employment of personnel to fill the vacant positions with technically qualified and trained personnel is the first priority of WASA management.

With regard to the waterworks and sewerage works, continuity of business is required from the view point of specialization, in the said business. In addition, capabilities and skills are required to appropriate leave to take care of crisis management under all conditions. Therefore, "Human Resource Development Strategy" is established to fairly transfer the expertise from senior staffs to the next generation together with the counseling on skill upgrading.

WASA should assign due priority to the regular and continuous training of its personnel. Training is “investment” and pays in the form of improved working competence.

2) Main Contents

2-1) Personnel Management

a) Improvement in WASA’s Capacity

- Improvement of WASA’s recruitment methodology.
- According to WASA service regulation, committee has been formulated for requirement of various categories of staff. But due to a ban by Government of the Punjab on new appointment, recruitments have been stopped since 1991. WASA can however seek special permission for recruitment of extremely essential staff. One such example is the recruitment of Sub Engineer & SDO's in Grade 16 & 17 respectively. But here again the requirement could not be materialized.
- Committee according to WASA service rules consisting of members from WASA along with membership from elected members of CDGL (Since year 2000).
- WASA believes that it has a dire need to hire employees but the regular committee cannot carry out recruitment because of the ban by Government of the Punjab. The special committee constituted by the order of chief minister Punjab has the permission for recruitment in relaxation of the ban. But a member of the regular committee has obtained a stay order from the court on the proceeding of recruitment by the special committee on the grounds that the new committee is devoid of member ship of any elected person of CDGL. So, the recruitment is stuck up and WASA’s efficiency is badly suffering.

b) Countermeasure

For short- term strategy to solve the issue, the new committee is required to be allowed to have membership from City District Government Lahore (CDGL). For long-term strategy, WASA may be required to become autonomous organization to avoid such obstacles from unrelated Authorities.

c) Review of existing WASA’s Personnel Evaluation System

(a) Existing Performance Evaluation Report

The employee's evaluation procedure for all employees, Grade 16 or above is shown below.

- A next higher officer evaluates employees once a year according to a predetermined form.
- Final evaluation is carried out by the DMD of each section.

The main articles evaluated on the basis of sensuous judgment are:

- ✓ Part-1 (General Information)
- ✓ Part-2 (Personal Qualities)
- ✓ Part-3 (Attitudes)
- ✓ Part-4 (Proficiency in Job)
- ✓ Part-5 (Pen-Picture; Comment on whether Useful or Not Useful)
- ✓ Part-6 (Comparing him with other officers)
- ✓ Part-7 (Remarks of the countersigning officer)
- ✓ Part-8 (Adverse remarks, Decision on representation if any)

(b) Conditions of Employee’s Promotion

For the regular employees, amount of raise in pay is prescribed by Grade, and the salary goes up uniformly automatically and periodically. For promotion of personnel in Grade 16 or above, is evaluated by ACR (Annual Confidential Report) of WASA is mandatory. The right of promotion is given to the personnel who achieved good/excellent (A/A1) continuously for five years. However, since the posts of the management are fewer, it require a long time for an individual to wait for promotion on retirement of his senior.

(c) Stipulation of Contacted Employees

It will be pertinent to point out the following stipulation for contracted employees, which is issued by the LDA vide, Admm/FI/SOF/9565 dated on May 05, 2009, Recruitment to the Post of Junior Clerk/Typist (BS-07) on Contract basis under rule 17/A/(A&CS)/1974. According to the contract agreement of personnel engaged on contract, although there is no rise in pay, the contract can continue for a maximum 2 yearly contracts. And depending on the personnel evaluation (ACR) result, a contract agreement is renewed further. On the other hand WASA, keeping its position secure, can terminate it by the payment of contract agreement cancelation money. The personnel evaluation system is almost the same as that of regular personnel.

d) Improvement of Personnel Evaluation System

The existing personnel evaluation system was effective until now. On the other hand, it is necessary to examine the fairness of a personnel evaluation as the method of activation of a WASA organization.

The following items are requested to study.

- To facilitate review of the existing evaluation method by analysis the existing data.
- To prepare a manual including new evaluation forms and its procedure through the council.
- To conduct a basic study and examine the effects of the proposal by a case study.

Expected out-put are tentatively as follows:

a) Evaluation method (ACR's evaluation method)

The employee under evaluation (regular employee) through ACR is Grade 16 or above. The opinion of the Employee who is evaluated by the next higher officer is not reflected in the ACR because only the reporting officer is authorized to evaluate and fill in the Performance Evaluation Report. As a result, the report has a fear of being influenced by feeling of the reporting officer rather than serving the objective of fair evaluation. Moreover, in case the operation order from higher officer is not given clearly, the evaluation of the junior officer may become unjust.

The Personnel evaluation procedure by the ACR system of WASA is shown in **Figure 10.23**.

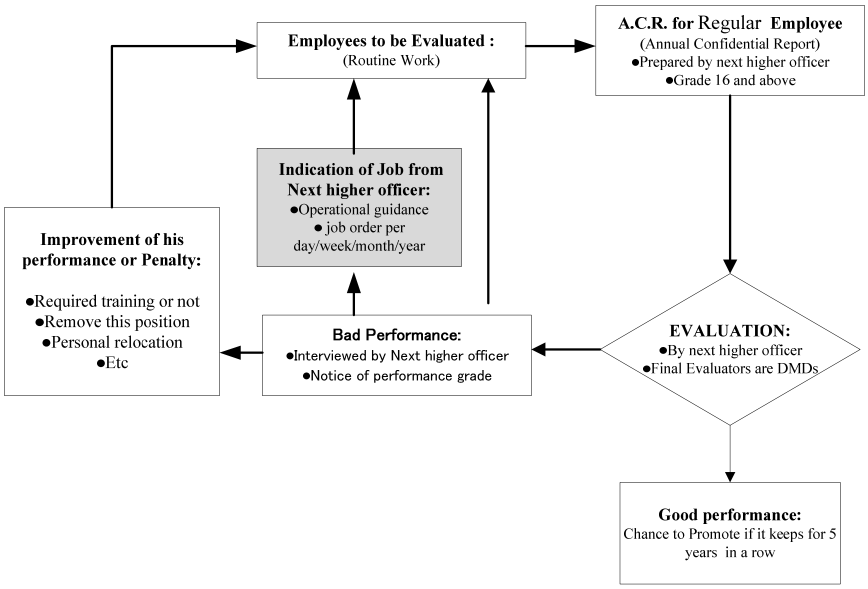


Figure 10.25 Procedure of WASA's Personnel Evaluation

b) Preparation of weekly planned work activities & Actual work activities)

To improve the communication among employees, the next higher officer should prepare a weekly planed schedule, Form-A, in which weekly work activities to be carried out should be entered at the beginning of a week. In order to check and to verify the actual work activities of the achievement, the junior officer should prepared the report, Form-B, at the end of week. This report should be evaluated by the higher officer and he should carries out the evaluation and suggests improvement in internal communication among them.

Typical forms of Weekly Schedule Activities are shown in **Table 10.12**.

c) Annual Self-Assessment (commitment) System

The proposed evaluation method which combines the "Annual Self Commitment System" with the "ACR System" takes into consideration the individuals "awareness-raising", "self development", and "fairness." As for the Self Commitment System, the personnel themselves describe their targets and objectives for evaluations at the start of the year and the result for one year is evaluated at the end of reporting year. After filling in the self-evaluation sheet, the employee submits a result to his reporting officer and thus has an opportunity to speak about himself on his performance and achievements. By this, "awareness-raising" is promoted through the friendly meeting environment and being communication between the employee and the next higher officer.

Table 10.11 Typical Weekly Schedule Activities Forms

Form A: Planned work activities for upcoming week.

Weekly Schedule and Planned Activities

Week ending (Friday) ________________

Name: ______________________

Position: ______________________

Date	Day	Working		Task No.	Planned Activities	Plannned Outputs/Deliverables
		Time	Hours			
	Monday					
	Tuesday					
	Wednesday					
	Thursday					
	Friday					
	Saturday					
	Sunday					
Comments/Notes:						

Form B: Actual work activities for previous week.

Weekly Schedule and Actual Activities

Week ending (Friday) ________________

Name: ______________________

Position: ______________________

Date	Day	Working		Task No.	Actual Activities	Actual Outputs/Deliverables
		Time	Hours			
	Monday					
	Tuesday					
	Wednesday					
	Thursday					
	Friday					
	Saturday					
	Sunday					
Comments/Notes:						

The procedure of the Self-assessment System, this is shown in **Figure 10.24**.

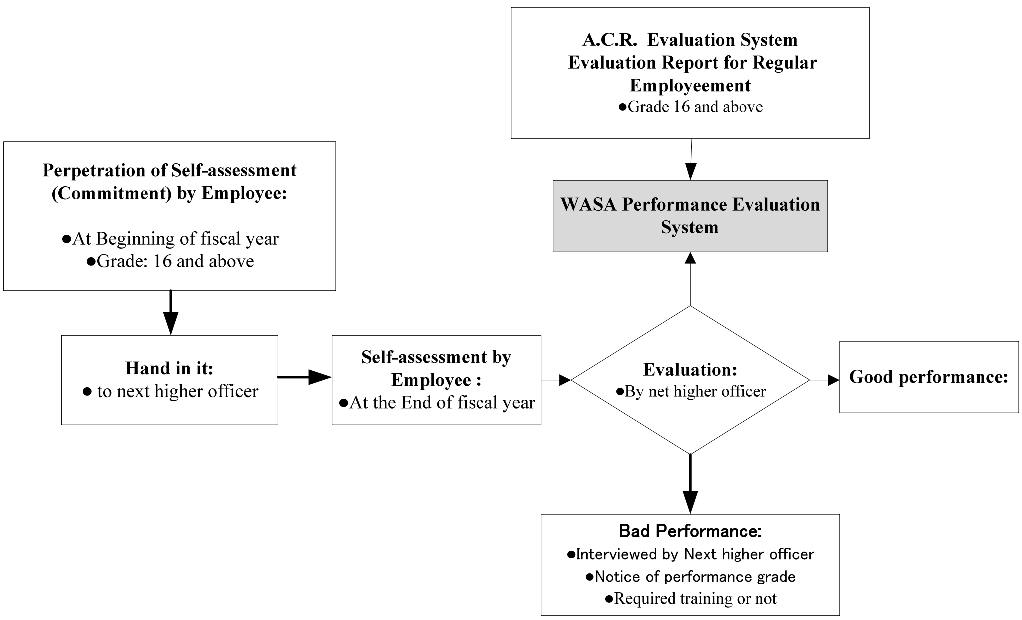


Figure 10.26 Improvement of Personnel Evaluation Procedure

Typical Annual Self-Assessment, Form-C, consists of the following items.

- ✓ General information.
- ✓ Planned activities (by Employee).
- ✓ Actual activities (by Employee).
- ✓ Analysis (by Employee)
- ✓ Development planning (by Employee & In charge)
- ✓ Summary of Evaluation (by Employer)

The Form-C is shown in **Table 10.13**, and Grading for pay scale is shown in **Table 10.14** respectively.

Table 10.12 Draft Annual Self Assessment Sheet

Draft FORM-C;

Annual Self Assessment Sheet
(Commitment/ Declaration)

1.Personal Information:

Employee Name:		
Employee Ticket No.		
Job Title:		
Officer In charge:		
Period:	**Date (Beginning of fiscal year):**	**Date (End of fiscal year)**

2. Planned Activities: (job description/ Officer In charge request), (by Employee)

Planned Activities		Key Milestones	Time Required	Output	Remarks
2.1					
2.2					
2.3					
2.4					
2.5					

3. Actual Activities/ Output (by Employee)

Actual of Activities		Key Milestones	Time Taken	Output	Remarks
3.1					
3.2					
3.3					
3.4					
3.5					

3. Analysis (by Employee)

Actual of Activities		Degree of Success	Reasons	Strength/ weakness	Remarks
2.1					
2.2					
2.3					
2.4					
2.5					

4. Development Planning (by Employee & In charge):

Actual of Activities		Comments by Employee	Comments by In charge	Measures	Remarks
4.1					
4.2					
4.3					
4.4					
4.5					

5. Summary of Evaluation (by Employer)

Description	Achievement	Grading	Remarks (To be considered)
5-1 Performance Evaluation		Excellent, Very good, Good, Fair,Below Average, and Hopeless.	5.1.1 Training 5.1.2 Achievement of annual plan 5.1.3 Ability to learn, others
5-2 Motivation		ditto	5.2.1 Achievement of annual plan 5.2.2 Eager to learn and train other, others
5-3 Ability Rating		ditto	5.3.1 education, Training, experience, others
5-4 Communication		ditto	5.4.1 communication with his in charge 5.4.2 communication with co-workers 5.4..3 Capability of making report, others
5-5 Comprehensive Summary		ditto	5.5.1 Extract problems How to convince How to improve and others

Pints for Grading: Excellent(5), Very good(4), Good(3), Fair(2), Below average(1), Hopeless (0)

Table 10.13 Typical Grading for Pay Scale

Items to be Evaluated	Appraisal Area		
	Rise in pay	Promotion	Allowance
1.Performance	45%	30%	40%
2.Motivation	30%	30%	20%
3.Ability rating	10%	20%	20%
4.Communication	15%	20%	20%

d) Other evaluation documents
- Evaluation framework.
- Evaluation formula.
- Evaluation guide.

2-2) Human resource Development

a) Development of Human Resource Program

(a) Approach on human resource development

The point of concentration on human resource development is how to encourage the “self-learning (self-development)”. The plan of personnel training is shown below.
- To develop the ability by group training conducted systematically.
- To make the sustainable training on WASA staff (Grade 10 or above) obligatory.
- To conduct the personnel management that can bring about the motivation and ability through personnel shift, promotion and evaluation etc.
- To conduct on-the-job training according to the personnel's individuality, in order to raise work incentives.
- To develop more open and comfortable workplace.
- To develop human resources those can educate the next generation.

(b) Staffing imagery

The following staffing imagery, for management-level officers Grade 16 or above, is requested to meet the diversification of operations and also obtain the confidence by citizens.
- Staff who make efforts on improving the service by adopting the perspective of citizens

- Staff who make efforts on improving the management efficiency with cost-consciousness
- Staff who make efforts on effective and accurate conducting of affairs by promoting the sense of purposefulness and requisite engineering ability to attain the project goal
- Staff who positively make efforts in everything
- Staff who win the citizen's esteem

b) Introduction of Educational Programs

It is necessary to determine the educational programs in accordance with the employees' experiences, their educational back ground, and their motivation respectively. In addition, the educational period is planned in consideration of educational requirements, the number of the attending personnel, and the target result.

The following knowledge and ability in **Appendix 10.4** are commonly required.

c) Introduction of WASA's OJT program

WASA is fundamentally concentrated on OJT education.

The candidate of a training place is shown below.

- On-the-job training of each section.
- Practical use of WASA's workshops.

d) Introduction of Items to be examined are as follows

- To achieve the goal of getting WASA staff adequately trained, it is important to prepare Personnel Training Plan and to promote the improvement of education level and expertise of supervisory as well as grass-root level staff.
- For senior staff, "excellence in management" should be one of the goals to be achieved. It should be recognized that proper training can play a key role not only in skills improvement but also for inculcating sense of responsibility among the management and field staff.
- WASA should set goals of Personnel Training and draw an action plan to achieve these goals as well as to review the improvement in education and skill levels. The ultimate aim should be creation of an attitude of "self development".

e) Implementation method on training programs

Under the condition of the citizen needs to diversify and the job to upgrading, in order to carry out consciousness reform and man-power development effectively, It is necessary to tackle the following articles synthetically and intentionally (see the details in **Appendix 10.5**).

- Personnel management
- On-the-job training method
- Formulation on working environment improvement

f) WASA Academy

WASA Academy which will be updated the present WASA educational Center, and is positioned as an educational and training center of the WASA employees including the Province of Punjab. The personnel training of WASA is pressing need and practical use of WASA Academy will be expected from now on.

According to the improvement plan of WASA Academy, PC-1, is proposed by HUD&PHED and JICA is requested to provide Technical assistance. The WASA Academy can use for wide range training program. However, WASA Academy is except in this project.

g) Ability and stance on the working posture (see in **Appendix 10.3**)

The employees as management-level officers, for Grade 16 or above, are asked for the following abilities and a working posture is shown in **Table 10.15**.

Table 10.14 Ability and Stance on the Working Posture

Classification		Definition	Ex. Required Educational Method	
			Lectures: The example of an education theme	OJT/WS
Operation Ability	Knowledge & technology	Ability promptly and exactly with to transact the duties with professional knowledge/technology for the assignment. -Ability of using IT (Information Technology). - Comprehension on law term, etc.	-Basic theory of IT -Management -Business & Strategic Planning -Understanding of Law term -Process Engineering -Ecologically-based environmental Issue -Case study of a problem	-Extraction of problem -Debate of problem-solving method -Evaluation of the optimal solution
	Information collection & applied ability	Ability to collect data / information, analysis, and utilizing for assignment, etc.	- Purpose of a WASA's business plan -Valuation method of management, financial affairs, and water tariff - Case study of a problem	Ditto
	Problem finding ability	Ability to discover the issue which should be solved, etc.	-Risk management -Understanding of management and O/M monitoring index & evaluation of the achievement degree	Ditto

			-Grasp of the trend of the complaint number -Grasp of on-site information & an operating improvement proposal, etc	
	Self-supervision ability	Ability to carry through the duties in stable manners by dispassionately corresponding without missing himself even under difficult conditions, etc.	-The purpose and promotion of an educational campaign -The method of management by objective -A life design and its sense of values	Ditto
	Comprehension/ judgment ability	Ability to correspond appropriately by grasping the circumstances	-An understanding of the state-of-the-art technology and the financial condition of self-department -The past problem tendency and measure evaluation -Promotion of strengthening of personnel training	Ditto
Implementation Ability on Policy	Planning ability	Ability to build up and perform the preparatory plans for realization by finding out a policy for problem-solving, etc.	-Decision capability of a WASA's business plan -Grasp of the directivity of the enterprise of WASA -Understanding of management and an O/M monitoring index & evaluation of the achievement degree -Creation of a self-training target, and achievement degree evaluation	Ditto
	Result management ability	Ability to be applied to procedure to next duties by evaluating the results with goal setting, plan setting and conducting in term of assignment, etc.		Ditto
Interpersonal Skills	Negotiation /presentation ability and Adjustability	Ability to tell an intention intelligibly, to persuade it and to convince the personnel of it, etc.	-Improvement in communications skills -Improvement in presentation skills -One's technical knowledge and improvement in humanity -Acquisition of the negotiation capability which private enterprises are carrying out	Ditto
	Customer's responding ability	Ability to correspond sincerely and to explain to the costumer, etc.		
Management Ability	Management ability	Ability to lead an organization to goal achievement while grasping ability as a subordinate being proper and striving for an upsurge and maintenance of morale, etc.	-Improvement in a confidential relation with the employees -Improvement in a leader ship -Promotion plan of self-education & promotion of the personnel's motivation -Improvement of a performance evaluation system -Improvement of a personnel complaint help desk	Ditto
	Human resource development ability	Ability to improve the personnel's genius suitable for individuality, etc.		Ditto

h) Expected out-put (Draft)

The target on human resource development is not only aims at the department in charge of personnel & training but also promote “Self awareness-raising” to be requested what kind of staffs in the future by involving the entire staffs including managerial staffs. Particularly, it is important that managerial staffs are conscious of “Junior Staff’s Education/Human Resource Development” as their duties assignment and thus positively tackle with the reform/improvement or their assignment and self-development by standing him to lead the employees.In addition, Employees need to act as a professional to also serve as stimulating to other employees together with making efforts on self-development.

(a) Preparation of training manual (Teaching-materials/Textbooks)

For example,

- Water treatment engineering,
- O/M (Wastewater treatment plant) technology,
- Environmental engineering,
- Electrical engineering,
- Construction management,
- Finance management,
- Business administration,
- Water service business administration,
- Safety control and risk management,
- Procedure of a price increase of water rates, etc.

(b) Proposal on Evaluation formats

- Educational evaluation standard
- Evaluation format of CD

3) Process

a) To establish of WASA Working Team
b) To investigate the current situation and problem.
c) To develop a strategy and programme.
d) To improve the strategy and programme through discussions with WASA IC
e) To approve the strategy and programme

4) Action Plan

Action	2012						2013						2014						2015					
Establish the WASA Working Team																								
Investigate the current situation and problem																								
Develop a strategy and programme																								
Improve the strategy and programme through discussions with WASA IC																								
Approve the strategy and programme																								

Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Establish the WASA Working Team				Dec. 2011
Investigate the current situation and problem	DIR(A)	Consultants under loan		Apr. 2012
Develop a strategy and programme	DIR(A)	Consultants under loan	Consultants under loan Rs.27.5M	Dec. 2012
Improve the strategy and programme through discussions with WASA IC	WASA IC	Consultants under loan		Feb. 2013
Approve the strategy and programme	WASA IC			Apr. 2013

Figure 10.27 Action Plan

(3) Entrustment of certain works to private companies

1) Necessity & Objectives

For the reduction of management cost, to control declining in efficiency of management, and for dispensing with insufficiently talented people, it is considered necessary to examine whether outsourcing of WASA (in part) is possible or not.

Factors to be considered before deciding to use the strength of private enterprises effectively are (a) comprehension of the opinion of the citizens about privatization, (b) the economic effect, (c) WASA's employment policy and (d) the required operational performance level.

2) Main Contents

a) Examination of Strategy

The strong points in favor of outsourcing are shown below:

- Slimming of the organization can be carried out and the overall number of the personnel can be reduced.
- Rationalization of costs can be attained.
- A plan of continuous improvement and increase in efficiency of the operation can be effectively implemented with manager's directions.

- Shortage of the expert staff in WASA can be covered.
- WASA employees can improve their expertise through transfer of technology from outsourcing.

b) Demerits /difficulties

The demerits /difficulties to be considered before placing an order to outsourcing are shown below:-

- Disclosure of secret information
- Reshuffle of excess personnel will have to be done.
- Promotion of the personnel's reduction and promotion of an early-retirement program will have to be implemented.

c) Candidate of outsourcing

The outsourcing candidates of business activities will be related to the under mentioned department of WASA as shown in **Appendix 10.6**.

Tables 10.16 to 10.18 which can be outsourced according to each section are shown below.

Table 10.15 Examination of the Possibility of Outsourcing (Regarding Revenue Division & Inquiry Counter Division)

Candidate operation		Enforcement situation	Future direction	Outsourcing , etc	Remarks
1	Water meter reading	WASA staff	-Introduction of the Handy Terminal system.	-Phase in However, WASA manages the SD's memory card.	-Examination of the amount of capital investment. -Confirmation of a cost reduction effect -Examination of staff, 300-400 persons, reassignment.
2	Water-rates bill issuance business	Under outsourcing in a tentative way			
3	Bill delivery operation				
4	Cash control of water rates	-Cash transfer System by WASA	-Promotion of a direct debit and a Credit payment system.	-Institutional customer and those for companies.	-Improvement of a customer file and a system is requested.
5	Management of a customer' ledger	WASA staff	-	-Phase in	- Limits to confidentiality.
6	Arrear bill collection practices	WASA staff	-Employment of a specialized staff and /or outsourcing.	-Phase in	-The measure to prevent occurrence of complaint of the citizen against force collection is needed. -Examination of the payment contract agreement to an incentive fee System.
7	Illegal connection control operation	-WASA staff , -4-Contracted NGO	-Employment of a specialized staff and /or outsourcing. -	-Phase in -WASA's measure	-Verification of the offender's improvement effect. -Examination of the payment contract agreement to an incentive fee System.
8	Pipe connection receptionist operation	WASA staff	-Registered plumbers allow helping making application form. -Cash handling by WASA.	-Phase in	-Customer is burdened for the preparation expense. -Strengthening the Surveillance of inaccurate applications. -Strengthening the Surveillance of inaccurate connections with consumer service line to WASA's Pipe Line.

Table 10.16 Examination of the Possibility of Outsourcing
(Planning & Evaluation Department)

Candidate business activities		Enforcement situation	Future direction	Outsourcing, etc	Remarks
1	O/M of uniform monitoring system	Future operation	Undecided	Undecided	-Training/employment of WASA
2	Preparation of statistical materials/data	Future operation	Partially or fully outsourcing	Undecided	-Limits to confidentiality
3	Maintenance of MIS	Future operation	Partially or fully outsourcing	Undecided	-Limits to confidentiality
4	A system /PC practical use education	Future operation	Partially or fully outsourcing	Undecided	-Limits to confidentiality
5	Data Input operation	Future operation	Partially or fully outsourcing	Phase in	-Limits to confidentiality
6	Formulation of Mapping System	Future operation	Partially or fully outsourcing	Phase in	-Limits to confidentiality
7	O/M of Mapping System	Future operation	Partially or fully outsourcing	Phase in	-Limits to confidentiality
8	Preparation of CAD drawings	Future operation	Partially or fully outsourcing	Phase in	-Limits to confidentiality

Table 10.17 Examination of the Possibility of Outsourcing
(Operation & Maintenance Department)

Candidate business activities		Enforcement situation	Future direction	Outsourcing, etc	Remarks
1	O/M T/Wells (about 460 T/wells)	WASA staff	Undecided	Undecided	-Limits to confidentiality
2	O/M of Wastewater pumping Stations	WASA staff	Partially or fully outsourcing	Undecided	-Limits to confidentiality
3	Dredging of Drainage work	WASA staff	Partially or fully outsourcing	Phase in	-Limits to confidentiality
4	Dewatering work	WASA staff	Partially or fully outsourcing	Phase in	-Limits to confidentiality
5	Work shop (Water meter repair shop)	WASA staff	Partially or fully outsourcing	Phase in	-WASA conducts acceptance test.
6	Work shop (Maintenance of Auto/vehicles)	WASA staff	Partially or fully outsourcing	Phase in	-WASA conducts acceptance test.
7	O/M of Wastewater	Future	Partially or fully	Phase in	-WASA conducts acceptance

	Treatment plants Work	operation	outsourcing		test.
8	Sampling and field tests for WTP	Future operation	Partially or fully outsourcing	Phase in	-WASA conducts acceptance test.
9	Sampling and field tests for Industrial effluent	Future operation	Partially or fully outsourcing	Phase in	-WASA is requested a final test.

Expected output are btentatively as follows:

a) Proposal on the enforcement method
- Outsourcing of a part of O/M operation of facility and /or plant.
- Outsourcing of whole O/M of facility and /or plant.
- Outsourcing of all the business management of a facility and /or plant.
- Combination of the above-mentioned outsourcing of functions.

b) Proposal on the Measures report of the subject expected
- If enterprise management right moves to a private sector by outsourcing, governmental instruction authority will fall.
- Since private enterprises become a profits principle, maintenance of public responsibility, the control of increase in a charge rate and continuation of citizen service, becomes difficult.
- If a working profit is not acquired, the Private Company will force the government to make choice of a preferential treatment measure or the tariff increase or reduction of water supply hours or drop the service level. The solution of the question may go in a stale made and the citizens may face problem.
- On the other hand, the Private Company will face financial hardship if collection of water and sewerage dues becomes difficult.

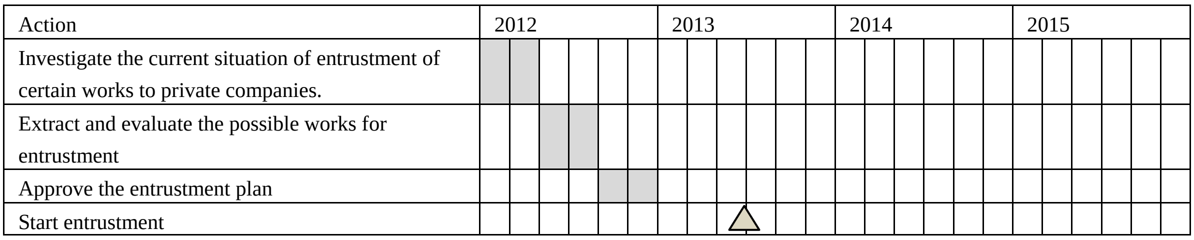
c) Case study on the enforcement effect
- Estimation of an economic effect and the management effect, which is included implementation cost, profits and the reduction number of the employees.
- The recovery fiscal year of the amount of investment/

d) Proposal on the implementation schedule

3) Process

a) To investigate the current situation of entrustment of certain works to private companies.
b) To extract and evaluate the possible works for entrustment.
c) To approve the entrustment plan
d) To start entrustment

4) Action Plan



Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Investigate the current situation of entrustment of certain works to private companies.	DIR(R)	Consultant under loan	Consultant under loan Rs.13.8M	Apr. 2012
Extract and evaluate the possible works for entrustment	DIR(R)	Consultant under loan		Aug. 2012
Approve the entrustment plan	WASA IC			Dec. 2012
Start entrustment	DMD(FA&R)			Jul. 2013

Figure 10.28 Action Plan

(4) Establishment of Management Information System(MIS)

1) Necessity & Objectives

A Comprehensive Centralized Management Information System is examined as a measure against efficiency improvement of management. This information is used effectively to understand as the actual the management condition and as the improvement data for the problem solving, when required.

Following target is achieved through the improvement project.

- Grasp of a timely management condition,
- Clarification of the degree of achievement of a management-index value,
- Extraction of problems,
- Examination of a measure,
- Improvement in Citizen service,

2) Main Contents

a) Outline of the System

The information prepared by each person in charge post is brought together into the Center in WASA head office by a communications system. The information and data will be analyzed statistically by the task team of Planning & Evaluation Department using Management software and the useful information is provided to managers.

The following results are acquired by the improved system.

- Preparation of management decision data.
- Perusal of various reports.
- Unification of formal data. Grasp of the business circumstances.
- Storage of related data.

The outline of the system is shown in **Figure 10.27** and **Figure 10.28** shows Draft of the Concept of Information Management System

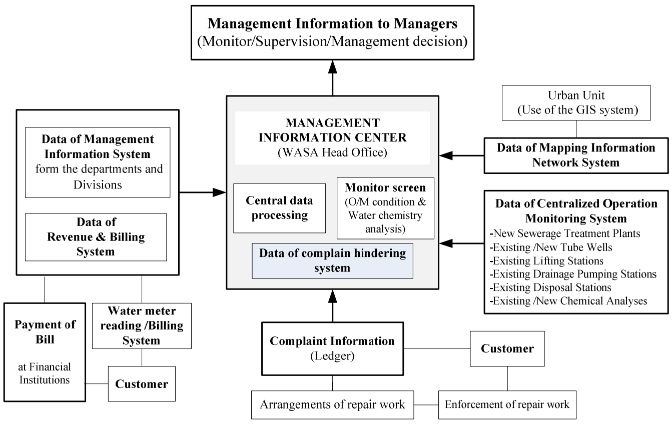


Figure 10.29 Outline of Comprehensive Management Information System

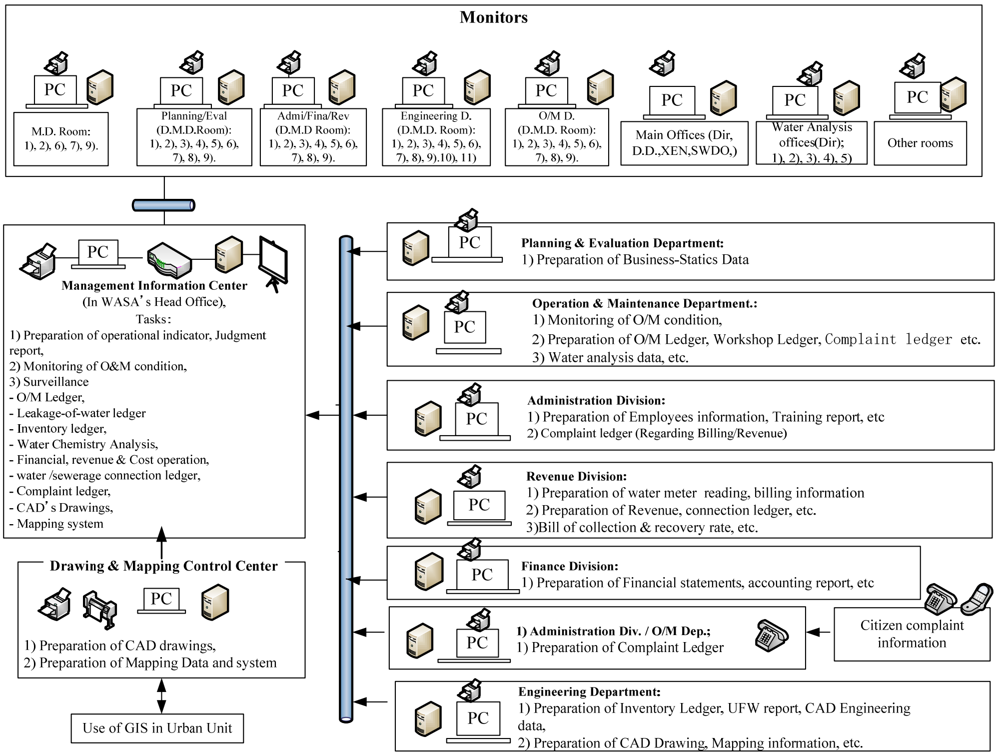


Figure 10.30 Draft of the Concept of Information Management System

b) Main Individual System

The details of the following systems are described in **Appendix 10.7**.

- Examination of Management Information System,
- Examination of Centralized Operation Monitoring System,
- Examination of Water Meter Reading, Billing and Bill Delivery System,
- Examination of Complaint Handing System,
- Examination of Mapping Information Network System (MINS) for Drinking Water,

3) Process

a) To investigate the fields required for a MIS.

b) To design a MIS.

c) To Prepare the bidding documents and conduct bidding.

d) To procure the devices/instruments.

e) To construct a MIS.

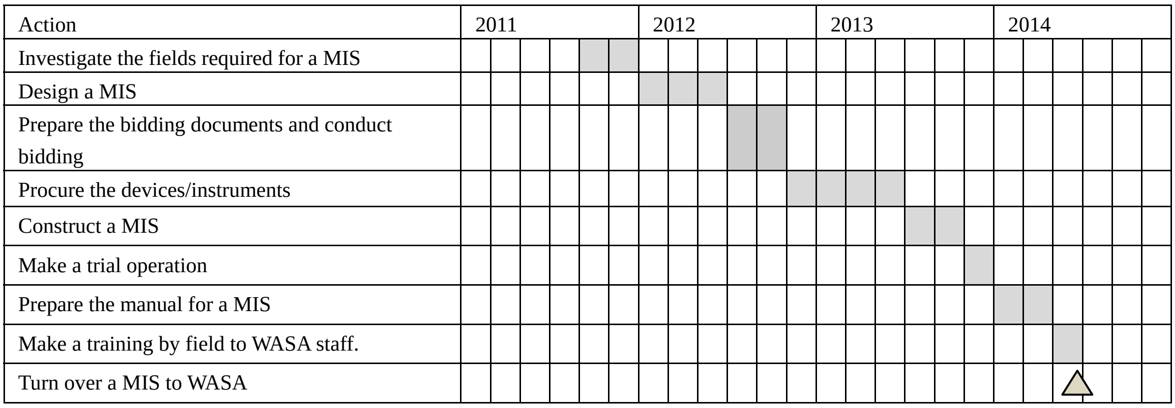
f) To make a trial operation.

g) To prepare the manual for a MIS.

h) To make a training by field to WASA staff.

i) To turn over a MIS to WASA.

4) Action Plan



Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Investigate the fields required for a MIS	DIR(P&E)	Local Consul.		Apr. 2011
Design a MIS	DIR(P&E)	Local Consul.		Aug. 2011
Prepare the bidding documents and conduct bidding	DIR(P&S)	Local Consul.	Local consultant	Oct. 2011
Procure the devices/instruments	DIR(P&S)	Contractors	Rs.7.3M	Jun. 2012
Construct a MIS	DIR. PMU	Contractors	Consultants under loan	Oct. 2012
Make a trial operation	DIR(P&E)	Contractors	27.5M	Dec. 2012
Prepare the manual for a MIS	DIR(P&E)	Contractors	Works	Apr. 2013
Make a training by field to WASA staff.	DIR(T)	Contractors	Rs.693.5M	Jun. 2013
Turn over a MIS to WASA	DIR(P&E)	Contractors		Jun. 2013

Figure 10.31 Action Plan

(5) Procurement of O&M equipment

1) Necessity & Objectives

In order stabilize and enable the organization to utilize equipments over a long period of time, it is necessary to make the facility update periodically. On the other hand, proper operation and maintenance of the facilities and the equipment is desired. As a result, the economical Facility operation can secure the stable quality of treated water. Moreover, abatement of complaints and workers' working condition shall be improved. The present equipment is short in number, and since obsolescence is remarkable, efficiency of management is declining. As a remedial action, the purchase schedule of facilities and equipment has to be examined.

2) Main Contents

a) Shopping List

The O/M facilities and equipment for which renewal and addition of the number are needed shown blow.

- Dewatering equipment,
- Water supply equipment and sewer cleaning equipment (vehicles),
- Drainage equipment (nothing in Phase-1),
- Maintenance shop of desilting equipment (nothing in Phase-1),
- Water meter repair workshop equipment,
- Water quality analyzer (Central Laboratory and wastewater treatment plant),
- Vehicles for employees' transportation,
- On-site measuring instrument,

b) Expected output (Tentative)

Review of priority schedule is described in detailed in Appendix 10.8.

The following proposals are needed for detailed review.

In order to address the complaints properly and for improving management level, the under mentioned prioritization is recommended. At the same time, it should be kept in mind that the priority is for skeleton budget and a detailed review will have to be carried out at the time of a detailed design. Furthermore, for the decision regarding the order of precedence, specification, and the required number of items will also depend on the running cost and urgency of the requirement.

(a) Action against Inundation

The order of priority of improvement of the facility which can reduce the inundation damage in the rainy season to the minimum is high. Special sewer cleaning vehicles, vacuum vehicles and Jetting units are necessary urgently.

(b) Remedial Action against Sewer Blockage

There are many complaints of sewer blockage. Moreover, the actual manual sewer cleaning condition is very unsatisfactory and its operating efficiency is also bad. Special vehicles, such as Vacuum vehicles and Jetting units are necessary urgently.

(c) Improvement of Water Examination Facilities

Renewal of obsolete equipment is also a matter of priority because the quality and quantity of the facility has run short. Since it related to the water quality complaint needing immediate attention and supplying the safe water, the old examination facility is necessary to update and to provide the sampling facility of adequate level.

(d) Improvement of Water Meter Repair Work Shop

In order to expand the operating revenue from now onward, the metering of the water consumption is to be promoted. The repair of meter needing replacement of parts, and the dead water meters with miner defect need to be repaired. Moreover, in order to achieve fairness of the burden of the water charge, it is necessary to check the water meter performance periodically in the repair work shop by calibration.

(e) Other facilities

It is necessary to discuss every facility of urgency and to improve whenever the priority is raised.

3) Process

a) To investigate the current situation of O&M equipment.
b) To evaluate the necessity and priority of O&M equipment.
c) To prepare the bidding documents and conduct bidding.
d) To procure the O&M equipment.
e) To make a trial operation and training.
f) To completely turn over O&M equipment to WASA.

4) Action plan

Action	2010						2011						2012						2013					
Investigate the current situation of O&M equip.																								
Evaluate the necessity and priority of O&M equip																								
Prepare the bidding documents and conduct bidding																								
Procure the O&M equipment																								
Make a trial operation and training																								
Completely turn over O&M equip. to WASA																			△					

Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Investigate the current situation of O&M equip.		JICA Study		Completed
Evaluate the necessity and priority of O&M equip		JICA Study	Local Consul. Rs.11.4M	Completed
Prepare the bidding documents and conduct bidding	DIR(P&S)	Local Consultant		Apr. 2011
Procure the O&M equipment	DIR(P&S)	Contractors	Works Rs.562.5M	Aug. 2012
Make a trial operation and training	DIR(T)	Contractors		Feb. 2013
Completely turn over O&M equip. to WASA	DMD(O&M)	Contractors		Feb. 2013

Figure 10.32 Action Plan

10.1.5 Improvement of Customer Services

(1) Clarification of Customers' Rights and Responsibilities

(See **10.1.3 (1))**

(2) Regular Implementation of Customer Survey

1) Necessity and Objectives

The objectives of the survey are:

- To check to what extent the customer satisfies the products and services that WASA provides
- To grasp on what points of the products and services that WASA provides the customer has complaints
- To know to what extent the customer satisfies the response of WASA staff on his complaint or inquiry.

2) Main Contents

Here, the products that WASA provides mean drinking water, and water supply, sewerage and drainage facilities, while the services mean the quality and quantity of drinking water, water pressure, the continuity of supply, swift drainage of wastewater from a living environment, no overflow from a manhole in the sewer network, no occurrence of inundation during the wet weather, response at the emergency like the suspension of water supply, inundation, etc.. In addition, to what extent the WASA staff responds to the customer’s complaint or inquiry sincerely or the attitude of WASA staff toward violence of the regulations is one of big factors that the customer builds up the image for WASA.

If the customer has inadequate satisfaction with the products, services and/or response that WASA provides, it may lead to insufficient comprehension on an increase in the water rate, reluctant cooperation to the installation of a customer’s meter, the neglect of campaign for water-saving, and so on that WASA will extend from now on.

Therefore, consideration will be paid for the following in the preparation and conduct of the questionnaire survey:

- The survey shall be carried out every three years using the local consultants.
- The questionnaire will be arranged so as to measure an extent of improvement numerically in the comparison with that of the previous year.
- The questionnaire will be arranged so as to identify the customer’s complaint such as the location, facility and/or cause to use the basic data for future improvement.
- The questionnaire shall include the evaluation items on WASA’s staff response with the customer’s complaint to use the basic data for the future staff training

The example of the questionnaire is shown in Appendix 10.9.

3) Process

a) To investigate the customer survey in other public services, if any.
d) To prepare the questionnaire.
c) To conduct the questionnaire survey using a local social survey firm
d) To analyze the survey results.
e) To improve the questionnaire and survey method.
f) To prepare the manual for the questionnaire survey.
g) To turn over to WASA and conduct the questionnaire survey

4) Action Plan

Action	2010	2011	2012	2013
Investigate the customer survey in other public service				
Prepare the questionnaire				
Conduct the questionnaire survey using a local social survey firm				
Analyze the survey results				
Improve the questionnaire and survey method				
Prepare the Manual for the questionnaire survey				
Turn over to WASA and conduct the questionnaire survey				

Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Investigate the customer survey in other public service	DIR. (P&E)	Consultant under loan	Consultant under loan Rs.23.6M	Feb. 2012
Prepare the questionnaire	DIR. (P&E)	Consultant under loan		Apr. 2012
Conduct the questionnaire survey using a local social survey firm	DIR. (P&E)	Consultant under loan		Aug. 2012
Analyze the survey results	DIR. (P&E)	Consultant under loan		Oct. 2012
Improve the questionnaire and survey method	DIR. (P&E)	Consultant under loan		Dec. 2012
Prepare the Manual for the questionnaire survey	DIR. (P&E)	Consultant under loan		Dec. 2012
Turn over to WASA and conduct the questionnaire survey	DIR. (P&E)			Dec. 2012

DIR.(P&E): Directorate for Planning & Evaluation

Figure 10.33 Action Plan

(3) Improvement (Quick and Transparent) of Complaint Handling System

1) Necessity & Objectives

Claim Information is civic precious voice which shows the directional movement of a WASA management. It is necessary to analyze this Information and to implement an effective countermeasure.

The number of item of the claim of O/M is about 40 times that of the revenue-related claim. The claim of O/M is overflow in the drainage by blockage of a sewer, and occupies not less than about 80%. Although WASA corresponds hard in organization for 24 hours, still, the effect of a complaint improvement is not enough. Citizens are only bearing the arrear in the countermeasure against service. WASA needs to implement an effective countermeasure.

a) Countermeasure against a Claim of O/M

- Claim Information is behind in the statistical procedure for the handwriting ledger. Computer communication is indispensable in order to share the information.
- Repair Task is carrying out the establishment of 24 hours all the year round. However, the claim number of occlusion of a sewer is still high.
- In the short term, it is effective to update old cleaning equipment and increasing in the units. On the other hand, Cost goes up.
- In the long run, according to a result of the analysis, renewal of a sewer pipe and renewal of a manhole are effectively indispensable.

b) Countermeasure against a Claim of Revenue

The ameliorations point of the claim about water revenue is shown below.

- A claim decreases by charging water billing according to a water meter reading.
- Acceptance of the system which will be able to issue of the billing at the time of the inspection of a meter will decrease a claim.
- An addendum and adjustment of a ledger need the disengagement with insufficient renewal and number of the superannuated personal computer.

By implementing the above countermeasure, the claim number of item is dissolved gradually.

2) Main Contents

a) Improvement of complaint handling system

The complaint solution of existing O/M is a sub division base as it is shown in **Figure 6.11**. However, a measure is the delay in renewal of cleaning equipment, and is behind in correspondence.

The countermeasure against a complaint is changed from the existing SDO base to Town base. As a result, cleaning equipment is used effectively and makes the measure time of a complaint reduce.

A Characteristic of a proposed improvement system is shown below.

- Personal computer arrangement and statistical processing of the ledger's datum.
- Formulation of an effective improvement step.
- Improvement of a site working condition.

-Effective use of cleaning equipment.

The ameliorations conception of the countermeasure against a claim is shown in **Figure 10.32**.

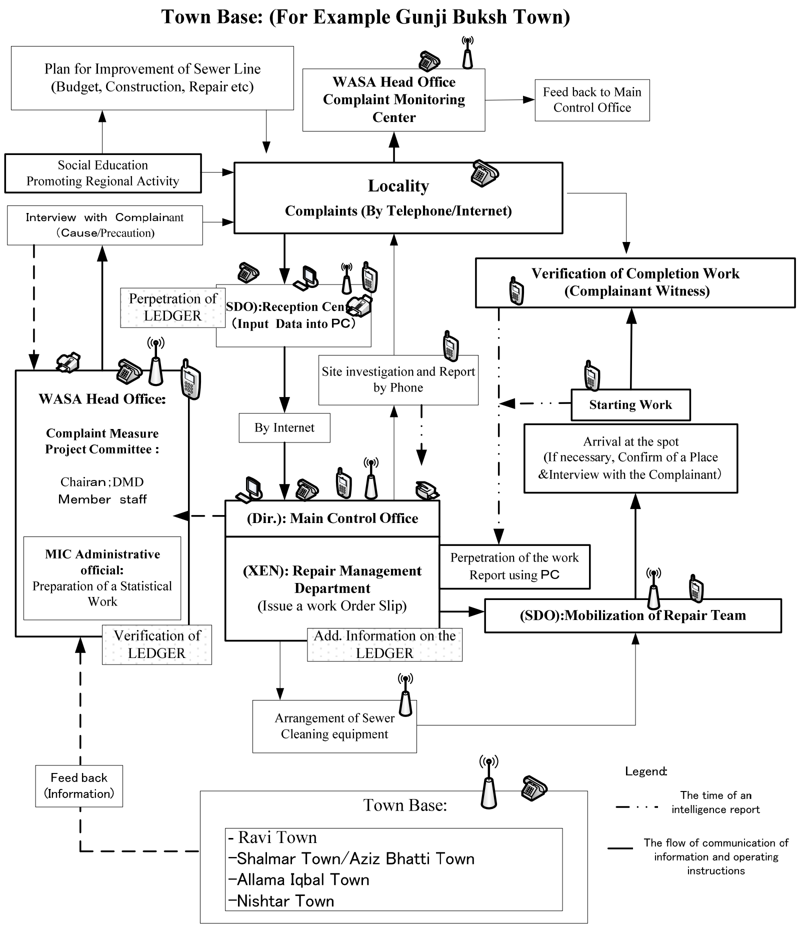


Figure 10.34 Conception of ameliorations System

b) Improvement of the complaint ledger

The existing complaint receptionist center has entered the message from a telephone in the ledger in handwriting. As a result, precious customer data are not judged by the management decision. The concept is shown in **Figure 10.28.**

It is necessary to fix PC at each complaint receptionist office, to bundle up by WASA head office on the Internet, and to manage complaint information.

The following proposal on Improvement of complains handling system is needed for detailed review.

(a) Main ameliorations points

- Establishment of Complaint Measure Project Committee against a claim and setting ameliorations target, and its performance period.
- Management of the information on a claim will be carried on by Town Base.
- All of related information will be managed in a unified manner by MIC in WASA Head Office.
- The ledger will be managed with a personal computer.
- Claim Material is break down the statistics.
- Claim Information is supervised by the controller.
- In the block area where the frequency of a claim is high, an effective countermeasure, an educational campaign, renewal of a superannuation pipe, others, is implemented preferentially.

(b) Arrangement point for promoting improvement.

- Establishment of Complaint Measure Project Committee
- Improvement of personal computers.
- Improvement of the vehicle ledger.
- Disposition of employees
- Ensure of the main control office and other offices.
- Improvement of the telecommunications equipment.
- Improvement of office equipment and facility.
- Review of the ledger's description.

(c) Role of Each Post

－Establishment of Complaint Measure Project Committee

; Establishment in the WASA head office.

; Chairman: DMD.

; Member staffs: Engineering Dep./Business Dep./I/M Dep./PE Dep.

－MIC administrative official (In Head Office)

; Preparation of a statistical work (complaint frequency, type of repair work and the scale, application for type of vehicle, cost, preparation of improvement plan, social education, etc.

-Reception Centers (In each SDO)

: Preparation of ledger in Computer.

; Send it to the main control office by Internet.

－Main Control Office (Town Base)

; Control all of ledger's information of each SDOS,

; Send an engineer for site investigation & confirmation (report to main control office by telephone).

; Make an order for the direction of work plan & the cleaning equipment.

; Instruction the action of priority to the repair management department.

; Follow-up the ledger.

-Repair Management Department(Town Base)

; Issue a work order slip to the repair team,

; Arrangement of sewer cleaning equipment (Vacuum cars, Jetting Units, Water tankers, Truck- mounted Cranes, Vehicles, etc),

; Amendment of a report.

－Repair team

; Mobilization of repair team with team leader + Driver /assistant Driver+3 workers,

; Apparition of Sewer cleaning equipment,

; Confirmation of point and interview with the complaint,

; Starting repair work,

; Verification of completion work with complainant witness,

; Preparation of the work report using Computers.

(d) Addendum of the Written Point of the Ledger (O/M)

The point of the present ledger is enough as telephone contact as the 1st news. However, it is necessary to input the Information on the slips into computers for data analysis and output of the required statistical information for providing to make the effective countermeasure for the improvement plan from now on. Required statistical information per every work instruction is shown below.

－Required registry points

; General information.

(Claim registration time/date and name of SD, Customer's address, Telephone number, Contact time to one's related post, SD representative's name, a ledger reference number issued, etc),

; Time required for the repair work.

(Site Investigation time/date, Time of an operating instruction issued, Time/date which arrived at the field, Operation time, Time which task ended, Time when customer signed, Time when Report is drawn up, etc),

; Classification of description of a claim.

(Sewer: Damaged pipe, Leakage of wastewater, Deterioration of the environment, Water contamination, Inundation, Security and safety, etc), (Drinking water: Damaged pipe, Leakage of wastewater, Defect of amount of water, Defect of water pressure, Aberration in water quality, etc),

; The number of used cleaning equipment and the number of the employees.

(Type of cleaning equipment, its registered #, its number of cleaning equipment, etc),

; Manner of action of obtains the cleaning equipment. (Own house and/or free borrowing, and/or rental),

; The repair method and its description. (Combination with Manpower and/or cleaning equipment, etc),

; Scale of Repair works. (Diameter of a sewer, Total distance of pipe line, Number of house connections, etc),

; Probable cause. (Sewer: Occlusion and breakage of a sewer, Damaged manholes and/or Covers and/or missing, Poor construction works, Laying depth, Lack of ability of a pumps, Defect of acreage of a pipeline, Defect of the flow velocity, Breakage of a manhole screen, etc),

; (Drinking water: Deteriorated water pipeline, Poor construction works, Debasement of pump’s Capability, Blackout, etc),

; Customer's degree of satisfaction. (Mobility, Content of repair work),

; Cost of task: (Labor cost, operational cost, subcontract cost, in addition to this),

- New or Repetitive Complaint. (Trend of an accrual locus and a area, etc),
- Assurance and evaluation of the improvement effect. (Decline of number of complaint, Change of clam classification, Reduction of countermeasure Cost, Improvement in civic manners, Improvement in a civic sense of responsibility, etc)
- Planning of the countermeasure improvement. (Planning of an educational campaign, Planning of renewal, Reinforcement of cleaning equipment, Estimation of cost, etc),

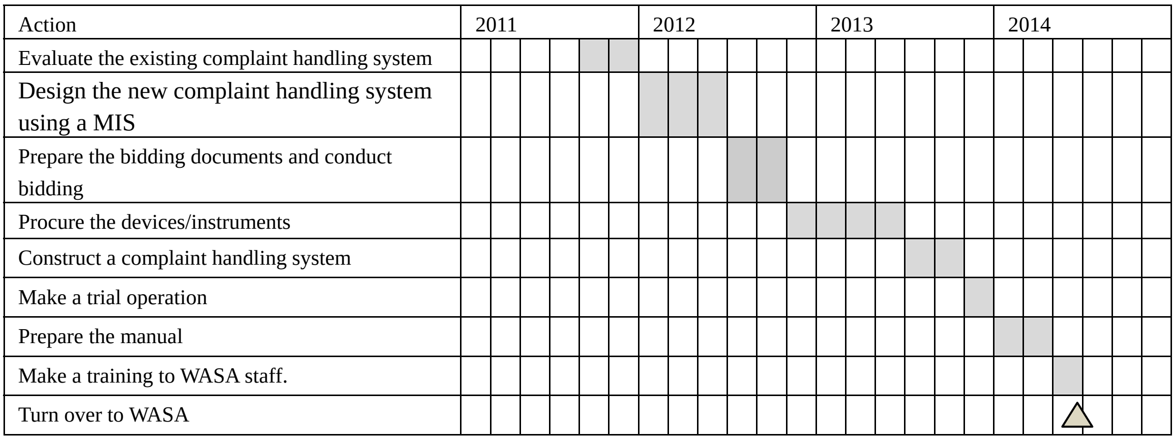
- Business decision making. (Implementation of improvement plan, Reservation of budget, Implementation of renewal Plan of claiming equipment, etc)

3) Process

a) To evaluate the current complaint handling system.
b) To design the new complaint handling system using a Management Information System (MIS).

c) To prepare the bidding documents and cost estimation.
d) To procure the devices/instruments.
e) To construct a complaint handling system.
f) To make a trial operation.
g) To prepare the manual for a complaint handling system.
h) To make a training to WASA's staff.
i) To turn over to WASA.

4) Action plan



Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Evaluate the existing complaint handling system	DIR(P&E)	Local Consultant		Apr. 2011
Design the new complaint handling system using a MIS	DIR(P&E)	Local Consultant	Local Consultant	Oct. 2011
Prepare the bidding documents and conduct bidding	DIR(P&S)	Local Consultant	Rs.3.8M	Apr. 2012
Procure the devices/instruments	DIR(P&S)	Consul. under loan	Consultant	Oct. 2012
Construct a complaint handling system	DIR. PMU	Consul. under loan	Under loan	Feb. 2013
Make a trial operation	DIR(P&E)	Consul. under loan	Rs.17.1M	Apr. 2013
Prepare the manual	DIR(P&E)	Consul. under loan	Works	Aug. 2013
Make training to WASA staff.	DIR(P&E)	Consul. under loan	Rs.358.6M	Oct. 2013
Turn over to WASA	DIR(P&E)	Consul. under loan		Oct. 2013

Figure 10.35 Action Plan

(4) Expansion of Payment option for Customers

1) Necessity & Objective

The method to pay the water bill has been mainly through transfer of cash by the banking facility, the Government Post Office, and the NADRAs' office. The cash payment procedure at the banking facility takes about 1 hour, and the customer feels inconvenience for it. Moreover, there is a possibility of office work mistake by an authorized person of financial institution. The charge collection division of WASA spends time on the Confirmation of documents every day. In order to improve this situation, the method to pay water rates is received.

2) Main Contents

A method to pay the water bill which WASA (Lahore) has published is shown below.

a) Payment made via bank deposit transfer

The most common payment method is at the window of financial institutions. However, the detail information on the number of transfer in each financial institution is not available.

The specific cash transfer banking facilities are NBP (20% of a transfer amount in 2008), NADRA (35%), Bank of Punjab (20%), and GOP (25%). In addition, NADRA has tied up with ABL.

b) Cash Dispenser (CD)

The franchised NADRA has mainly adopted this system. This system reads the bar code on the water bill by an optical sensor, and receives the payment of cash. This CD was purchased from China, 400-set (Stand type and wall-through type) in 2006. Now, 84 sets are under operation because the rest of these CDs became old and are having mechanical problem. However, since the following problem occurred besides the above, the CD is scheduled to be abolished one by one. (As an alternative, NADRA is shifting to Electronic Payment System instead).

- A helper is required for an illitate person.
- Collection of money from all franchised NADRA takes time and requires a lot of effort (a guard is required in order to carry out cash sending to a bank every day).
- Snatching aimed at the customer's cash occurs.
- Theft at the office of local branches occurs.

c) Electronic Facility (Inter-net)

NADARA started the payment servicing, by direct debit, of the water rates using the Internet from around 2008. The feature of this System is as follows. The customer who acquired the personal identification number (a personal computer is also registered) from NADARA can access from individual PC, and can complete charge payment.

- Account redemption is made from the PC in the franchised NADARA office.
- A transfer receipt is printed.
- The fees of using system which a customer pays are Rs.8 per transaction.
- Other public utility charges can pay from their account.

In addition, the number of annual system used including all the public utility charges is about 25 million. A mechanism of electronic facility is shown in **Figure 10.34**.

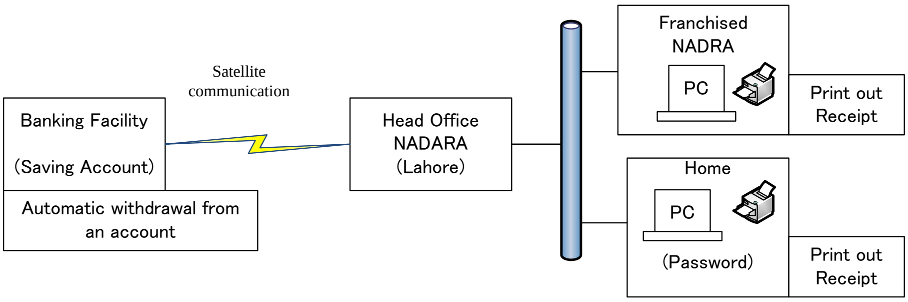


Figure 10.36 Mechanism of Electronic Facility Payment System

In addition, since the customer demands a receipt, a receipt is printed.

d) ATM (automated teller [telling] machine)

ATM system is the method of paying water bill using a credit card. The system is an automatic draft for the credit card payment.

e) Checking account

It is a system which attaches a check to a water-rates bill and is mailed to a bank. If a mail system is trustworthy, it is possible as a method of paying. However, the payment is generally delayed beyond due date.

f) Cellular phone

If the payment of water rates is requested from a credit company by a cellular phone, it will be by automatic withdrawal from personal account. If a credit company is accessed, the value of the payout amount of money will be displayed on a cellular phone. A cellular phone payment system is shown in **Figure 10.35**.

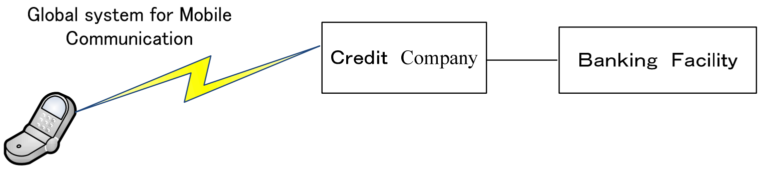


Figure 10.37 Mechanism of a Cellular Telephone Payment System

Expected output is as follows:

The payment of the water rates via a cellular phone can cancel the inconvenience of the conventional bank transfer because the long waiting time which goes to a bank, and the working hours of a bank are short

It is predicted that the convenience of civic life develops with economic and social development. Moreover, establishment of a financial account by the common person to use a credit card and cellular phones should be encouraged. Therefore, even if the payment of water rates requires some charges, it predicts that a convenient and easy payment system will promoted. It is necessary to promote Internet usage and to improve the system as well as to use popularized ATM payment system from a bank transfer as part of customer services.

a) Review following proposals.
   - Cellular phone system,
   - Other systems,

b) Detail examination is required.
   - Investment cost,
   - The future subject and measure method,
   - The effect to toll collection system,.

3) Process

a) To investigate the existing payment methods by customers.
b) To evaluate the payment methods currently available.
c) To design the payment system.
d) To prepare the bidding documents and conduct bidding.
e) To procure the devices/instruments.

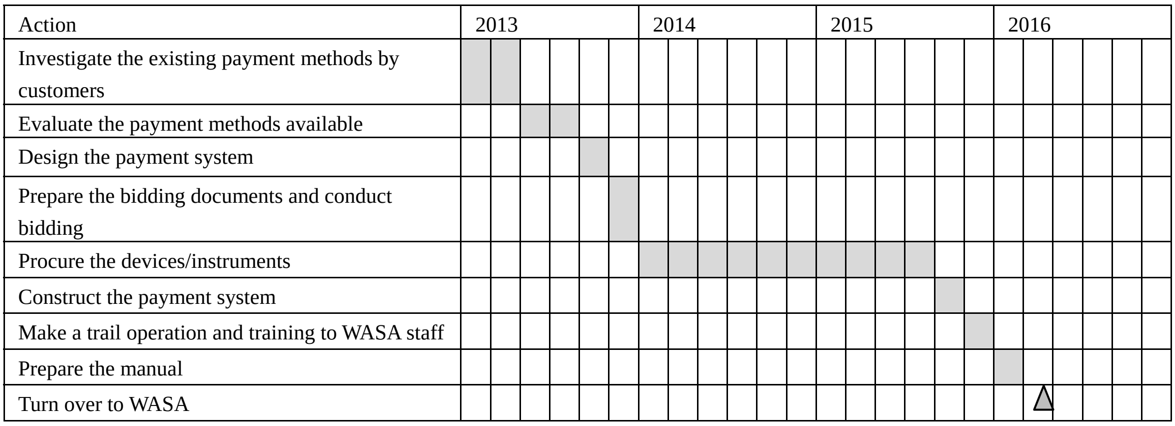
f) To construct the payment system.

g) To conduct of unmanned payment machines.

h) To make a trial operation and training to WASA staff

i) To turn over to WASA

4) Action plan



Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Investigate the existing payment methods by customers	DIR(R)	Consultant under loan	Consultants under loan Rs. 17.2 M Works Rs.305.7M	Apr. 2013
Evaluate the payment methods available	DIR(R)	Consultant under loan		Aug. 2013
Design the payment system	DIR(R)	Consultant under loan		Oct. 2013
Prepare the bidding documents and conduct bidding	DIR(P&S)	Consultant under loan		Dec. 2013
Procure the devices/instruments	DIR(P&S)	Consultant under loan		Aug. 2015
Construct the payment system	DIR. PMU	Consultant under loan		Oct. 2015
Make a trail operation and training to WASA staff	DIR(R)	Consultant under loan		Dec. 2015
Prepare the manual	DIR(R)	Consultant under loan		Feb. 2016
Turn over to WASA	DIR(R)	Consultant under loan		Mar. 2016

DIR(R): for Revenue

Figure 10.38 Action Plan

(5) Preparation of Public Relation Strategy and Its Implementation (Media, Public Meeting, Brochure, Events, Movie etc.)

1) Necessity and Objectives

The water supply, sewerage and drainage services, which link directly to a daily life, must be performed being based on a confidential relation with residents more than other public services.
Public relation is regarded as necessary activity to gain the support to projects, asking residents for an understanding widely about "Role and effect of projects", "Projects development plan", "Structure of projects finance", etc.

Generally, as for the public relation of administration, the emphasis tends to be put on the public announcement as a communicative function which asks residents for an understanding and cooperation by offering information. However, it is important to enrich public hearing as an information gathering function which hears the opinion of the residents to administration from now on.

2) Main Contents

a) Typical methods of public relations to be evaluated

Typical methods of public relations to be evaluated are shown below.

Table 10.18 Typical Methods of Public Relations

Public announcement	a) General announcement ・Publicity（TV, radio, newspaper） ・Printed material（brochure, poster, booklet） ・Image（movie, video, CD-ROM） ・Information offered municipality（public relations magazine） ・Various occasion（visiting of facility, event, campaign） ・Interactive media（homepage） ・Others（Signboard of construction etc.） b) Individual announcement ・Briefing（about construction, about house connection, about payment by beneficiary） ・Individual information service c) Others ・Resident correspondence in daily work
Public hearing	a) General hearing ・Gathering（town meeting） ・Research（questionnaire, monitor survey） ・Consultation（complaint report, resident proposal） ・Interactive media（homepage） ・Others (conversazione etc.） b) Individual hearing ・Briefing（about construction, about house connection, about payment by beneficiary） ・Individual information service c) Others ・Resident correspondence in daily work

b) Consideration for Public Relations

It is important to care about the following point in implementation of public relations.

- Effective and efficient public relations
  It should be carried out utilizing bilateral work with other public service such as a waste solid management service, cooperation with a civic organization or a volunteer, cooperation request to a school, etc.
- Clarification of purpose and object
  It should be carried out after clarifying what is transmitted to whom.
- Planned public relations
  It should be carried out from long-term viewpoints, such as a check of implementation timing or frequency, and selection of effective methods.

3) Process

a) To investigate the current situation of public relations in the WASA.
c) To prepare the report with recommendations for public relations.
c) To approve the strategy.
d) To start improved public relations.

4) Action Plan

Action	2010						2011						2012						2013					
Investigate the current situation of public relations in WASA																								
Prepare the report with recommendations																								
Approve the strategy																								
Start improved public relations																						△		

Action	Responsible Person (Agency)	In Charge	Cost	Indicators/Target Date
Investigate the current situation of public relations in WASA	DIR(P&E)	Consultant under loan	Consultant under loan Rs.13.7M	Aug. 2012
Prepare the report with recommendations	DIR(P&E)	Consultant under loan		Oct. 2012
Approve the strategy	WASA IC	WASA IC		Oct. 2012
Start improved public relations	DIR(P&E)			Jul. 2013

Figure 10.39 Action Plan

10.2 Water Quality Monitoring in the Public Water Bodies

10.2.1 Proposals for Improvement

(1) EPD

The EPD has conducted the water quality monitoring at the designated points in the public water bodies to check the water pollution status and for commercial and industrial wastewater from establishments and factories or point sources to check the compliance status of NEQS in addition to the monitoring to the raw and tap water for water supply.

The actual performance of Punjab-EPA is 687 samples in 2003, 784 samples in 2004 and 550 samples in 2000, and the breakdown of 2005 is 400 samples for chemical analysis of drinking water, 400 samples for bacteriological analysis of drinking water and 150 samples for analysis of industrial and urban wastewater. In consideration that a number of factories are located in Punjab, such monitoring system is quite inadequate.

To improve and complement such lack of human and funding resources, the following measures are proposed to be taken.

- For the continuous implementation of environmental monitoring to be carried out by public organization like the provincial government, it is necessary to clarify the legal ground for its budgetary steps. The environmental standard of the public water bodies has not yet been established in Pakistan. Its establishment is an indispensable factor for building an environmental monitoring system.
- At present, “National Environmental Quality Standard for Municipal and Liquid Industrial Effluent (NEQS)” is enforced in Pakistan, which is the effluent standard but not the environmental water quality standard, and is composed of three categories as follows:
  1) Into Inland Waters
  2) Into Sewage Treatment
  3) Into Sea

  Categories of 1) and 3) out of them are to monitor the water pollution status in the public water bodies, while Category of 2) is deeply concerned with treatment function of the wastewater treatment plant if it will be constructed. Therefore, it is recommended that the monitoring function will be transferred to the public organizations having a laboratory like WASA as well as surveillance of industrial wastewater discharged into a public sewerage system to alleviate the burden on EPA. As more than 2,000 factories are located in Lahore, its impact is expectedly so big. For this purpose, the legal amendment that EPA will entrust the authority to the acknowledged organizations limiting the function and area is required. Such an organization to be authorized is responsible for reporting the monitoring results to the EPD.

- The SMART system that only 35 establishments have registered in Punjab should be promoted for the further spread. The title of “Eco-friendly Factory” may be used as an incentive for this purpose.
- The current entry and monitoring to the factories are mainly carried out based on the public complaints as stated in **3.2.4**. This is a kind of ex post facto response. Although such situation is unavoidable due to limited budgets and human resources, it is desirable to shift the programmed response in the earliest time. For this purpose, the annual monitoring programme must be prepared for efficient implementation by the end of the previous year, assuming that a factory is monitored at least once a year, which requires to limit factories through the categorization of the type of industry and identification of problematic factories that give a big impact on the environment. The contents of entry and monitoring to the factories include the facility verification with the registration, discharge status of wastewater, manufacturing process, raw materials used, condition of drains/sewers and outlet. When the factory has an industrial wastewater treatment facility, the operational status of the facility, chemical consumption, condition of maintenance equipment, treated wastewater quality and O&M records are added to the above. If there is an obvious violence of the law, the order of improvement must be delivered to the owner, fixing the deadline for improvement that will be followed up after a certain term. The monitoring results should be disclosed to the public as much as possible using the website of the ERD.
- The use of the external laboratories shall be considered. However, this measure can complement the human resource but receives budgetary constraint.

(2) WASA

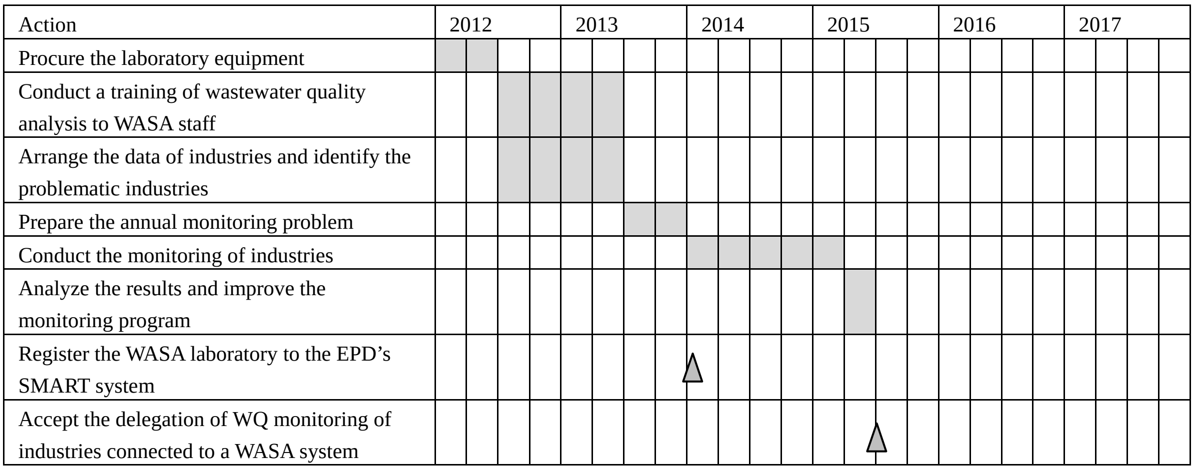
The WASA laboratory currently monitors the water quality of groundwater at the tube-wells and water at the taps to check the fitness as drinking water, but nothing is done for industrial wastewater discharged into a sewerage system and wastewater discharged into the public water body from a sewerage system. However, when the wastewater treatment plant will be commissioned, as the water quality of influent to a plant deeply affects on its treatment function, the interfering factors, if any, must be removed from influent to a plant. It is recommended that the WASA laboratory must be able to analyze the water quality of wastewater categorized into “Into Sewage Treatment” in NEQS and furthermore that of all wastewater categorized into “Into A sewerage System” by the commissioning of the wastewater treatment plant, accepting the delegation from the EPD to share the monitoring works with the EPD and reduce the load on the

EPD.

The following steps must be cleared by the WASA Laboratory

1) Procure the laboratory equipment.
2) Conduct a training of wastewater quality analysis to WASA staff.
3) Arrange the data of industries and identify the problematic industries.
4) Prepare the annual monitoring problem.
5) Conduct the monitoring of industries.
6) Analyze the results and improve the monitoring program.
7) Register the WASA laboratory to the EPD’s SMART system.
8) Accept the delegation of WQ monitoring of industries connected to a WASA system.

10.2.2 Action Plan



Action	Administrator	In Charge	Cost	Indicators/Target Date
Procure the laboratory equipment	DIR(P&S)	DIR(P&S)	None (see Note)	Jun. 2012
Conduct a training of wastewater quality analysis to WASA staff	DIR(O&M-GBT)	Water Chemical Laboratory		Jun. 2013
Arrange the data of industries and identify the problematic industries	DIR(O&M-GBT)	Water Chemical Laboratory		Jun. 2013
Prepare the annual monitoring problem	DIR(O&M-GBT)	Water Chemical Laboratory		Dec. 2013
Conduct the monitoring of industries	DIR(O&M-GBT)	Water Chemical Laboratory		Mar. 2015
Analyze the results and improve the monitoring program	DIR(O&M-GBT)	Water Chemical Laboratory		Jun. 2015
Register the WASA laboratory to the EPD’s SMART system	DIR(O&M-GBT)	Water Chemical Laboratory		Dec. 2013
Accept the delegation of WQ monitoring of industries connected to a WASA system	DIR(O&M-GBT)	Water Chemical Laboratory		Jun. 2015

Note: The cost of laboratory equipment is included in “(5) Procurement of O&M Equipment” in **Chapter 10.1.4.**

Figure 10.40 Action Plan

10.3 Groundwater Control and Regulation

10.3.1 Proposals for Improvements

The groundwater abstraction in the Bari Doab is summarized in **Figure 10.39** based on the description in **Chapter 5.1**.

			Tube-wells (nos.)	Groundwater abstraction (million m3/day)
Bari Doab	Lahore Urban	WASA	417	1.610
		Cantonment	173	0.774
		Private	4,003	0.450
	Lahore Rural	PHED/TMAs	16	??
		For Irrigation	5,829	0.987
	For Irrigation	Tube-wells	194,258	32.879
		Lift Stations	669	??

Figure 10.41 Summary of Groundwater Abstraction in the Bari Doab

Many organizations/people are involved in groundwater abstraction. From such a situation, it is necessary to take the followings steps so as to share the common understanding among the stakeholders and decide the feasible goals of respective stakeholders to be addressed.

(1) Conduct the follow-up study of the arsenic concentration in groundwater

The PCRWR's study on the arsenic concentration in groundwater in Lahore shows the ascending trend that all samples exceed the WHO standard (10 ppb) and some samples over the Pakistani tentative standard (50 ppb). Groundwater is safe due to an arsenic concentration below the Pakistani tentative standard is losing its basis. WASA has installing the 69 new tube-wells this year and groundwater abstraction will undoubtedly increase. Therefore the follow-up study on the arsenic concentration in groundwater should be conducted from now on. Although it is better that WASA laboratory will be able to analyze the arsenic concentration in groundwater, it will take a time for the provision of analytical instrument and training on analytical technology and the analysis must be contracted out to the external laboratory with the past experience for a while. When WASA will have completed the provision, it is proposed that the laboratory will join the follow-up study in the form of cross-check initially and take the full responsibility for analysis a few years later..

It may be necessary to make a survey on the selective abstraction from the different elevation for checking the arsenic concentration in groundwater.

(2) Conduct the groundwater resource evaluation with the latest knowledge and information

The previous study on groundwater was conducted in 1901and the mathematical aquifer model was developed but it is no longer used in WASA. There is the situational change represented by the Thein Dam operation which has brought the significant change in the discharge of the Ravi River as shown in **Figure 5.8**. Although the 1901 report referred to the Thein Dam and such element might have already included in the developed model. It is recommended to make a study on the groundwater resource evaluation again with the latest knowledge and information, including whether the assumptions at that time were reasonable. For example, it considered only the approximately 700 tube-wells in Lahore District but not those in the same Bari Doab groundwater basin.

(3) Establish the Bari Doab groundwater committee

The organizations such as WASA, PHED and the Irrigation and Power Department are concerned with the permission of tube-well installations, and a various kinds of individuals and commercial, industrial and agricultural sectors rely on groundwater for living and business. For this reason, such stakeholders have common understanding on the groundwater situation and consider what they can do respectively. The movement of the arsenic concentration in groundwater and the results of the study on the groundwater resource evaluation with the latest knowledge and information will be the basis for their discussion.

Besides WASA, PHED and the Irrigation and Power Department that give the permission of tube-well installations, the EPD, P&D and users' representatives are proposed for committee members

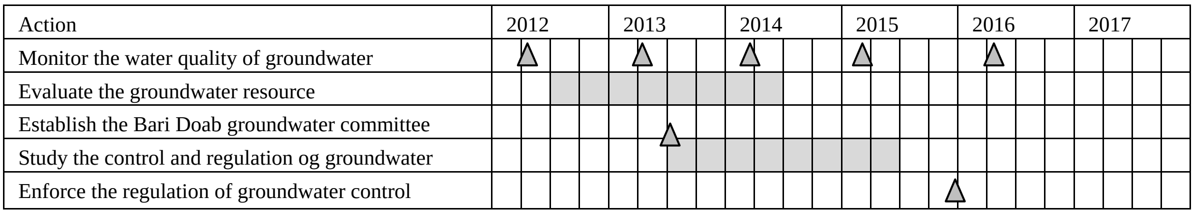
(4) Study the control and regulation of groundwater

The following measures must be discussed in the committee:

- ✓ Restriction of new groundwater development
- ✓ Monitoring of illegal groundwater development
- ✓ Control of use for private existing tube-wells by increasing the charge of sewerage or drainage for private tube-wells that the owner of a tube-well is currently required to pay
- ✓ Provision of the substitute for water source for the existing tube-well users

(5) Enforce the regulation of groundwater control

10.3.2 Action Plan



Action	Administrator	In Charge	Cost	Indicators/Target Date
Monitor the water quality of groundwater	DIR(Hydrogy)	Consultant under loan	Consultant under loan Rs.49.4M	Every year
Evaluate the groundwater resource	DIR(Hydrogy)	Consultant under loan		Jun. 2014
Establish the Bari Doab groundwater committee	HUD&PHED	Committee		Jun. 2013
Study the control and regulation og groundwater	HUD&PHED	Committee		Jun. 2015
Enforce groundwater control	Assembly			Dec. 2015

Figure 10.42 Action Plan for Groundwater Control and Regulation

10.4 Industrial Water Recycling

10.4.1 Proposals for Improvement

In Lahore city, total quantity of groundwater intake by a manufacturer is about 450,000m^3/d. This is equivalent to about 25% to total quantity of groundwater intake by WASA. In the present condition which is insufficient of the water sources, industrial water recycling of manufacturer is one of the important measures for efficient management of water supply and sewerage project. Although a central control system like industrial water system needs to be studied in the future, the measure based on cooperation of each manufacturer is indispensable for the moment.

At present, there is no regulation to intake groundwater for manufacturer. If manufacturer pay the discharge fee, they can use groundwater freely. Therefore, in order to promote the industrial water recycling, provision of law and regulations, for example "*Industrial Water Recycling Act*", is required. In this law and regulations, at least following items should be defined.

- Time Limit of enforcement
- Goal (e.g. Recycle volume, Recycle rate by category and size of factory)
- Target manufacturers
- Penalties

On the other hand, provision of scheme which raise the incentive of manufacturer is also needed to promote the industrial water recycling. This scheme should be studied to include;

- System of subsidy and fund for manufacturers
- Preferential tax treatment for achieved manufacturer
- Official announcement of achieved manufacturer

In order to execute such measures, formulation of an action plan is required. Action plan should be include concrete action, schedule and responsible authorities. Furthermore, the action plan must be performed continuously.
The following three concepts are defined in formulation of the action plan.

- Formation of mechanism

  Formation of mechanism, such as establishment of law and regulations, for promotion of recycling
- Human resources development

  Capacity building for stuff who tackle industrial water recycling in the public and private part
- Improvement of environmental consciousness

  Improvement of consciousness about industrial water recycling for citizens, manufacturer and government

Based on these concepts, following actions for industrial water recycling are required. To execute these actions efficiently, it is desirable to also take into consideration financing by loan from international organization and practical use of a consultant.

Table 10.19 Actions for Industrial Water Recycling

Actions	Items which should be examined
(1) Establish the law and regulations	➢ Establish the "Industrial Water Recycling Act" ➢ Selection of target manufacturer for the law ➢ Setup of recycling rate by category, size, etc.
(2) Existing condition survey of factory about industrial water use	➢ Compile the manufacturer List ➢ Study the possibility of industrial water recycling ➢ Suggestion to the law
(3) Orientation to manufacturer	➢ Selection of target manufacturer for the orientation ➢ Methods and frequency of the orientation ➢ Contents of the orientation
(4) Prepare the Recycling plan (by manufacturer)	➢ Water recycling methods ➢ Financing plan ➢ Implementation schedule
(5) Examine the Recycling Plan	➢ Support to formulate the plan ➢ Validity check of the plan in the view of technical and financial aspects ➢ Permission of the plan
(6) Implementation of work	➢ Construction supervise system ➢ Responsibility of the work ➢ Payment procedure in case of using loan
(7) Monitoring	➢ Methods and frequency of the monitoring ➢ Administrative penalty ➢ Coordination with other environmental programs
(8) Personal training for Advisory stuff	➢ Training programs ➢ Target organization, stuff ➢ Training for Factory
(9) Public relations to citizen and factory	➢ Target of public relations ➢ Contents of public relations ➢ Method of public relations

10.4.2 Action Plan

Action plan consists of actions, deadline, completion indicators and responsible agencies. Implementation in about five years is assumed. Action plan and time schedule are shown in **Figure 10.41**.

Action	2010				2011				2012				2013				2014				2015			
Establish the law and regulations																								
Existing condition survey of factory about industrial water use																								
Orientation to manufacturer																								
Prepare the Recycling plan																								
Examine the Recycling Plan																								
Implementation of work																								
Monitoring																								
Personal training for Advisory staff																								
Public relations to citizen and factory																								

Action	Administrator	In Charge	Cost	Indicators/Target Date
Establish the law and regulations	HUD	HUD	None	Dec. 2015
Existing condition survey of factory about industrial water use	DIR(P&E)	DIR(P&E)		Dec. 2011
Orientation to manufacturer	DIR(P&E)	DIR(P&E)		June. 2011
Prepare the Recycling plan	DIR(P&E)	DIR(P&E)		Dec. 2012
Examine the Recycling Plan	WASA IC	WASA IC		Jun. 2013
Implementation of work	DIR(P&E)	DIR(P&E)		Dec. 2014
Monitoring	DIR(P&E)	DIR(P&E)		Every year
Personal training for Advisory staff	DIR(T)	DIR(T)		Every year
Public relations to citizen and factory	DIR(P&E)	DIR(P&E)		Every year

Figure 10.43 Action Plan

CHAPTER 11 PRIORITIZATION AND PHASING OF THE PROJECT

11.1 General

This project comprises Phase 1 and Phase 2 and extends until the year 2022, while the target year is set at 2035. The target year is being used for determining the size of facilities and systems so that the period after Phase 2, from 2023 to 2035, is not included in the current project period. However, the period after Phase 2, referred to as the Long-Term Period shows the long-term project vision.

Phase 1 includes the immediate, essential actions to improve the system as well as preparations for the following phases. In other words, it includes high-priority issues. Phase 2 which follows on from Phase 1, includes secondary prioritized actions; and the Long-term period is devoted to further development of WASA on a long-term basis.

Table 11.1 Phases of the Project

Phase		Year	Periods
Project period	Phase 1	2010 – 2017	8 years
	Phase 2	2018 – 2022	5 years
Additional period	Long-term	2023 – 2035	13 years

Long-term vision and strategy and a summary of the implementation of the whole project with each phase is outlined in **Table 11.2** and **Table 11.3**, respectively.

Table 11.2 Long-term Vision and Strategy

	Long-term Vision and Strategy
Water Supply	to meet the increasing water demand and required water quality by using alternative water source, controlling un-accounted-for-water (UFW) and managing water quality (UFW-20%, water and sewerage coverage-100% in the current WASA area with 24/7 supply, until 2035)
Sewerage	to improve water quality of Ravi River and drains to meet the environment standard and hygienic environment in Lahore by construction of waste water treatment plants and comprehensive sewerage network
Drainage	to substantially reduce the inundation damage by development of drainage facilities with capacity corresponding to 2 year return-period rainfall
Management	1. development of adequate policy and regulatory environment 2. timely data acquisition and preparation of definitive vision and strategies 3. reduction of unaccounted-for-water and non-revenue-water 4. human resource development and organizational streamlining 5. improvement of customer services 6. groundwater monitoring and regulation 7. transform WASA Lahore into independent Utility/Authority with optimum levels of administration, financial and operational autonomy.

Table 11.3 Summary of Implementation of the Project in Each Phase

	Phase 1 (2010-2017)	**Phase 2 (2018-2022)**	**Long term (2023-2035) *[1]**
Water Supply	**1. Preparation of A Master Plan Using Alternative Water Source for Drinking Water** 1-1: preparation of a master plan to develop alternative water sources and related facilities, including examination of the integration of the existing groundwater supply and new surface water supply systems 1-2: implementation of preparatory activities including acquisition of rights for surface water **2. Reduction of Unaccounted-for-water and Non-revenue-water** 2-1: installation of meters in 40% of the connections 2-2: installation of bulk flow meters for all tube-wells 2-3: execution of an asset study and preparation of a distribution network improvement plan in the entire WASA area 2-4: implementation of distribution network improvement in the priority area in central Lahore within the agreed upon loan amount and time period (refer to Institutional Improvement on other institutional measures) **3. Improvement of Water Quality** 3-1: installation of chlorinators for all tubewells (certain measures for UFW reduction are also relevant for improvement of water quality) **4. Procurement of Operation and Maintenance Equipment** 4-1: Dewatering equipment 4-2: Water supply equipment and sewer cleaning equipment (vehicles) 4-3: Water meter repair workshop equipment 4-4: Water quality analyzer 4-5: Vehicles for employees' transportation 4-6: On-site measuring instrument **5. Consulting Services** 5-1: detailed design, tender assistance, construction supervision and support to institutional improvement, etc on the proposed project phase 1 5-2: master plan/feasibility study outside the WASA's current jurisdiction	**1. Development of Infrastructure for Alternative Water Sources** 1-1: construction of intake and treatment plants 1-2: development of transmission and distribution network system including reservoirs, relevant for development of surface water sources **2. Reduction of Unaccounted-for-water and Non-revenue- water** 2-1: installation of customer meters in 100% of connections 2-2: expansion of DNI (Distribution Network Improvement) to other areas outside the pilot area (refer to Institutional Improvement on other institutional measures) **3. Consulting Services**	**1. Development of Water Supply Network outside the Current WASA Area** **2. Development of Water Supply System in Uncovered Area in the Current WASA Area** **3. Replacement of Deteriorated Tube-wells**
Sewerage	**1. Sewer – Central Area –** connecting to South West Treatment Plant 1-1: construction of trunk sewer from Larex Colony to Gulshan-e-Ravi Disposal Station (DS) 1-2: construction of branch sewers from Larex Colony to Gulshan-e-Ravi Disposal Station 1-3: construction of trunk sewer along Cantonment Drain **2. Disposal Station – Central Area –** connecting to South West Treatment Plant 2-1: new construction of New Gulshan-e-Ravi DS **3. Wastewater Treatment Plant– Central Area –** 3-1: construction of South West Wastewater Treatment Plant including collector channel and pumping station 4. **Consulting Services** 4-1: detailed design, tender assistance, construction supervision and support to institutional improvement, etc on the proposed project phase 1 4-2: study on various technological options including locations and scale of sewerage treatment plants and reuse of treated water 4-3: detailed design on the proposed project phase 2 4-4: master plan/feasibility study outside the WASA's current jurisdiction	**1. Sewer – South Area –** 1-1: construction of sewer and conduit systems in Gulberg and Adjacent Area 1-2: construction of sewer and conduit systems from Peco Road and Mohlanwal DS 1-3: construction of sewer and conduit systems in North of Canal Area **2. Disposal Station– South Area –** 2-1: new construction of Mohlanwal Disposal Station 2-2: new construction of Kattar Bund Disposal Station 2-3: improvement of existing LMP Block Disposal Station **3. Wastewater Treatment Plant – South Area –** 3-1: construction of South Wastewater Treatment Plant **4. Sewer, Disposal Station, and Wastewater Treatment Plant – South East Area –** (If Government of Punjab using its own resources does not do any implementing during the Phase 1 period, this component would be considered under the scope of Phase 2). **5. Consultant Services (including feasibility study and detailed design on the scope outside the project)**	**1.Sewer in the other areas including Shahdara Area, Mehmood Booti Area, Khokhar Road Area, and TMA Area** 1-1: construction of new trunk and lateral sewers **2. Disposal Station –the above areas–** 2-1: improvement of existing Farakhabad, Shahdara Town, Mehmood Booti, and Khokhar Road Disposal Station **3. Wastewater Treatment Plant** in Shahdara, Mehmood Booti, and Khokhar Road **4. Sewer - Cantonment Area -** 4-1: construction of sewer along Railway Line 4-2: construction of sewer along Walton Road 4-3: construction of sewer along Rohi Nullah and Khairy Distributory
Drainage	**1. New Construction of Drains in Central Lahore**	**1. New Construction of Drains in South Lahore**	**1. New Construction of Main and Secondary Drain in Other Areas**

	Phase 1 project for drainage system consist of 2 packages, namely Package-A and Package-B as below. Package-A is a first priority project. **Package A** 1-1: Central Drain 1-2: Dil Muhammad Road Drain 1-3: Art Council Drain 1-4: Allama Iqubal Road Drain 1-5: WAPDA House Drain 1-6: Lawrence Road Drain 1-7: Nicholson Road Drain 1-8: Poonch Road Drain 1-9: Chauburji Drain 1-10: New Samanabad Drain 1-11: Morrhe Samanabad Drain 1-12: Multan Road Drain 1-13: Almumtaz Road Drain 1-14: Old Bund Road Drain 1-15: Sodewal Drain 1-16: Gulgasht Drain 1-17: Nasir Bagh Drain 1-18: Mall Road Drain **Package B** 1-19: Queens Road Drain 1-20: Shahra Awane Tijarat Road Drain 1-21: Golf Road Drain 1-22: Kinnaird Drain 1-23: Shah Jamal Drain 1-24: Gulshan-e-Ravi Drain 1-25: Sanda Road Drain 1-26: Krishan Nagar Drain 1-27: Rewaz Garden Drain 1-28: Tertiary Drain **2. Improvement and Rehabilitation of Drain in Central Lahore** **Package A** 2-1: Improvement and rehabilitation of Governor House Drain and Meclod Road Drain/Lakshmi Drain **3. Consulting Services** 3-1: detailed design, tender assistance, construction supervision and support to institutional improvement, etc on project phase 1 3-2: detailed design on the proposed project phase 2 3-3: master plan/feasibility study outside the WASA's current jurisdiction	1-1: Gulberg Drainage System 1-2: Garden Town & Model Town Drainage System 1-3: Town Ship & Green Town Drainage System 1-4: Industrial Area Drainage System 1-5: Raiwind Road Drainage System 1-6: Jubillee Town Drainage System 1-7: Defense Road Drainage System 1-8: Hudiara Drainage System 1-9: Multan Road Drainage System 1-10: Drainage System North of Lahore Branch Canal 1-11: Secondary / Tertiary Drain **2. Improvement and Rehabilitation of Drains in South Lahore** 2-1: Garden Town Drain 2-2: College Road Drain 2-3: New Industrial Drain III 2-4: New Industrial Drain VI 2-5: Link Road Drain 2-6: Main Industrial Drain 2-7: Gulberg Drain **3. Consulting Services (including feasibility study and detailed design on the scope outside the project)**	**2. Improvement Pumping Station in Other Areas**
Institutional Improvement	**1. Development of Adequate Policy and Regulatory Environment** 1-1: preparation and enactment of Punjab Urban Water Act and WASCO Act (or Lahore WASA Act) 1-2: Establishment of (a) a concrete road map for increasing tariff to the adequate level, (b) a mechanism for adequate tariff revision, and (c) measures of financial supports by the government **2. Timely Data Acquisition and Preparation of Definitive Vision and Strategies** 2-1: regular preparation of mid-term and annual business plans 2-2 : establishment of performance monitoring indicators and regular monitoring system 2-3 : implementation of comprehensive asset survey and preparation of asset inventories and drawings **3. Reduction of Unaccounted-for-water and Non-revenue-water**	**1. implementation of remaining items for institutional improvement under the framework for phase 1 including the following;** 1-1: completion of customer meter installation 1-2: expansion of DNI to other areas outside the pilot area 1-3: establishment of financial sustainability (cover the operating expenses (excluding depreciation) by the operating revenue (excluding subsidies)) **2. Consultancy Services**	**1. Remaining Works Not Included in Phase-1, Phase-2 and Outside the Project**

	3-1 : clarification of rights and responsibilities in relations with customers 3-2 : installation of meters in 40% of connections 3-3 : establishment of leakage detection teams 3-4 : implementation of distribution network improvement in the priority area in the central Lahore within agreed loan amount and period, based on asset study and subsequently-prepared distribution network improvement plan in the entire WASA area 3-5 : implementation of stringent measures against defaulters and illegal connections and phasing-out of uncharged public stand posts 3-6 : entrustment of metering and billing to private companies **4. Human Resource Development and Organizational Streamlining** 4-1 : organizational restructuring 4-2 : preparation of personnel management and human resource development strategy 4-3 : entrustment of certain facilities to private companies 4-4: establishment of Management Information System 4-5 : procurement of O&M equipment **5. Improvement of Customer Services** 5-1 : clarification of rights and responsibilities in relations with customers 5-2: regular implementation of customer survey 5-3 : improvement of complaint handling system 5-4 : expansion of payment options for customers 5-5 : preparation of public relation strategy and its implementation **6. Groundwater Monitoring and Regulation** 6-1 : follow up survey and analysis on groundwater quality and quantity 6-2 : establishment of groundwater committee 6-3 : preparation of groundwater control and regulation plan 6-4 : establishment of regular monitoring of groundwater **7. Consulting Services** 7-1: implementation of comprehensive asset survey and preparation of asset inventories and drawings 7-2: Reduction of Unaccounted-for-water and Non-revenue-water 7-3: Human Resource Development and Organizational Streamlining 7-4: Improvement of Customer Services 7-5: Groundwater Monitoring and Regulation		
Outside the Project	**Water Supply** **1. Development of Water Supply Network outside the Current WASA Area** **2. Development of Water Supply System in Uncovered Area in the Current WASA Area** **3. Replacement of Deteriorated Tube-wells** **Sewerage** **1.Sewer in the other areas including Shahdara Area, Mehmood Booti Area, Khokhar Road Area, and TMA Area** 1-1: construction of new trunk and lateral sewers **2. Disposal Station –the above areas–** 2-1: improvement of existing Farakhabad Disposal Station and Shahdara Town Disposal Station, Mehmood Booti Disposal Station and Khokhar Road Disposal Station, **3. Wastewater Treatment Plant** in Shahdara, Mehmood Booti, and Khokhar Road **4. Sewer - Cantonment Area –** **Drainage** **1. New Construction of Main and Secondary Drain in Other Areas** **2. Improvement Pumping Station in Other Areas**		

Note: *1 The Scope of the long-term project is basically composed of those that are not included in Phase 1, Phase 2 and Outside the Project in **Table 11.2**.

11.2 Water Supply

(1) Use of alternative water sources

One of the key issues in water supply is effective utilization of alternative water sources. This task will take time to achieve because WASA has no prior experience in using surface waters. Initially, obtaining water rights for surface water is an absolute necessity. According to the water demand forecast outlined in **9.1.4**, water demand is estimated to be 1,934,000 m^3/day in 2035. Canals or rivers represent important alternative water sources, but all their water is under the control of the Irrigation Department. WASA should therefore initiate discussions with the Irrigation Department to obtain the water rights for surface water as soon as possible. Next, a new master plan for water supply is required. When using an alternative water sources, the framework of the existing water supply will have to be changed. In particular, integration between the existing tubewell system and new surface water system should be taken into consideration. In Phase 1, water rights for alternative water sources will be secured, a new master plan for water supply will be prepared for further development and the land required for a surface water system such as, for example, a water treatment plant should be acquired. In Phase 2, according to the new master plan, the infrastructure of water supply will be developed.

(2) Control of Unaccounted for water (UFW)

At the same time that an alternative water source is being used, Unaccounted for water (UFW) should be reduced to improve the efficiency of utilization of existing groundwater sources. Installing bulk flow meters and customer meters, as well as establishing regulations for service pipelines and replacement of deteriorated pipelines will be very helpful to reduce and control leakage. In Phase 1, bulk flow meters are to be installed at all the tubewells. Customer meters will be mainly installed during Phase 2, after the organization for installment, maintenance, reading and data collection is completed in Phase 1.

To reduce UFW, the existing organization in WASA in charge of reducing UFW should be built up in Phase 1. This will include an increase in staff and strengthening the capacity for detecting leaks, repairing pipes and planning leakage control. In Phase 2, pro-active leakage control will be commenced.

Regulations on service pipes will be established in Phase 1. According to the regulations, pipelines constructed with suitable materials will be selected and installed for new customers.

In WASA, it is reported that most of the pipelines are AC (Asbestos-Concrete) pipes and that they have been laid in the 1970s. That means it is about time to replace some of the aged pipelines because they are susceptible to leakage and contamination. In Phase 1, deteriorated pipelines will be identified and a replacement program developed. In Phase 2, the deteriorated pipelines will be replaced according to the programme developed.

(3) Prevention of contamination in pipelines

As mentioned above, regulations concerning service pipes and individual pumps should be established in Phase 1, because inferior pipe materials and aggressive suction due to individual pumps has caused contamination of water. Illegal individual pumps will be controlled following completion of these regulations in Phase 1.

To disinfect water adequately, chlorinators will be installed at every tubewell in Phase 1.

Table 11.4 Phase-wise Implementation of Water Supply System Improvement

Implementation Period	Items
Phase 1	1) Prepare for using alternative water source for drinking water ➢ Preparation of a master plan to develop alternative water sources and related facilities, including examination of the integration of the existing groundwater supply and new surface water supply systems ➢ Implementation of preparatory activities including acquisition of rights for surface water ➢ Land acquisition for water intake work, water treatment plant and elevated service reservoirs proposed for a surface water system 2) Reduction of Unaccounted-for-water and Non-revenue-water ➢ Installation of meters in 40% of connections ➢ Installation of bulk flow meters for all tube-wells ➢ Execution of asset study and preparation of a distribution network improvement plan in the entire WASA area ➢ Implementation of distribution network improvement in the priority area in the central Lahore 3) Improvement of Water Quality ➢ Installation of chlorinators for all tube-wells 4) Procurement of Operation and Maintenance Equipment ・Dewatering equipment ・Water supply equipment and sewer cleaning equipment (vehicles) ・Water meter repair workshop equipment ・Water quality analyzer ・Vehicles for employees' transportation ・On-site measuring instrument
Phase 2	1) Development of Infrastructure for Using Alternative Water Source ➢ Construction of intake and treatment plants ➢ Development of transmission and distribution network system including reservoirs, relevant for development of surface water source 2) Reduction of Unaccounted-for-water and Non-revenue- water ➢ Installation of customer meters in 100% of connections ➢ Expansion of DNI to the other areas outside the pilot area
Long Term	1) Remaining works that are not included in Phase-1 and Phase-2 Projects

11.3 Sewerage

11.3.1 Priority of Area

As described in **9.1.2**, the WASA service area is a high priority area in this study. The WASA service area is sub divided into 6 sewerage sub-catchment areas, namely the Shahdara Area, the Mehmood Booti Area, the Khokhar Road Area, the Central Area, the South Area and the South East Area. For each of these 6 sub-catchment areas, it will necessary to decide their priority ranking. The priority ranking will be determined on a point system based on the following criteria:

(a) Population numbers

The highest population is given 5 points. For other areas, calculate the ratio of highest population number to that of the other area's population number and multiply the calculated ratio by 5.

(b) The number of lift stations

The largest number of lift stations is given 5 points. For other areas, points are calculated by determining the ratio of largest number of lift stations to that of the other area's number of lift stations and multiplying the calculated ratio by 5.

(c) Present status of study progress

Where the preliminary study is completed: 5 points

In the process of preliminary study: 3 points

Where a master plan has been completed or no study has been conducted yet: 1 point

(d) Current situation with respect to land acquisition

Where land acquisition is completed: 5 points

In the process of land acquisition: 3 points

Where land acquisition is not completed: 0 point

Criterion (a) is an important factor in prioritizing the projects from the viewpoint of number of project beneficiaries. The project will be more effective if there are many beneficiaries involved. Criterion (b) is a key factor to reduce operation and maintenance costs. At a number of locations, wastewater is discharged into open drains through a lift station because there is no proper sewerage system. The lift station is a temporary facility, therefore, after improvement of the sewerage system, it is expected that it will be eliminated. If the number of lift stations is reduced then operation and maintenance costs also will be reduced. Criteria (c) and (d) are also significant factors to guide the project forward. The criteria considered and priorities assigned for the 6 sub-catchment areas are shown in **Table 11.5**. This indicates that the Central Area has the top priority in the Phase 1 Project while the South Area will have the top priority in the Phase 2 Project.

Table 11.5 Priority of Area for Sewerage System Improvement Project

	Shahdara	points	Khokhar Road	points	Mehmood Booti	points	Central Area	points	South	points	South East	points
Population (2035)*1	707,945	1	1,489,744	2	1,425,392	2	3,894,287	5	2,329,139	3	328,284	1
Number of Lift Stations	6	1	18	3	10	2	27	5	17	3	1	1
Study Level	M/P	1	M/P	1	M/P	1	Preliminary Design	5	Preliminary Design	5	M/P	1
WWTP Land Acquisition	Not Yet	0	Not Yet	0	Not Yet	0	Completed	5	Not Yet	0	Completed	5
Priority of Area*2	Long-term	3	Long-term	6	Long-term	5	**Phase 1**	20	**Phase 2**	11	Long-term	8

NOTE *1: Source: Integrated Master Plan for Lahore-2021 and JICA Study Team Estimates

*2: Phase 1 : 2010-2017, Phase 2: 2018-2022, Long-term: 2023-2035

11.3.2 Timing for Implementation of Sewerage Components

A phase wise summary of required sewerage facilities improvements is presented in **Table 11.6**.

Table 11.6 Phase-wise Implementation of Sewerage System Improvement

Implementation Period	Sewer	Disposal Station	WWTP
Phase 1 (2010 to 2017)	Central Area (1) Trunk sewer from Larex Colony to Gulshan-e-Ravi Disposal Station (DS) (2) Branch sewers from Larex Colony to Gulshan-e-Ravi Disposal Station (3) Trunk Sewer along Cantonment Drain	New Construction • New Gulshan-e-Ravi DS Improve existing • Gulshan-e-Ravi DS • Multan Road DS • Shad Bagh DS	• South West WWTP Including; 1) Collector Channel 2) Lift Station
Phase 2 (2018 to 2022)	South Area (1) Sewer and Conduit System in Gulberg and Adjacent Area (2) Sewer and Conduit System from Peco Road to Mohlanwal (3) Sewer and Conduit System in North of Canal Area	New Construction • Mohlanwal DS • Katar Bund DS Improve existing • LMP Block DS	• South WWTP
Long-term (2023 to 2035)	South East Area New trunk and lateral sewers Shahdara Area New trunk and lateral sewers Mehmood Booti Area New trunk and lateral sewers Khokhar Road Area New trunk and lateral sewers TMA Area New trunk and lateral sewers Cantonment Area (1) Sewer along Railway Line (2) Sewer along Walton Road (3) Sewer along Rohi Nullah and Khairy Distributory	Improve existing • Farakhabad DS &Shahdara Town LS • Mehmood Booti DS • Khokhar Road DS	• South East WWTP • Shahdara WWTP • Mehmood Booti WWTP • Khokhar Road WWTP

Regarding to existing Gulshan-e-Ravi Disposal Station, Multan Road Disposal Station and Shad Bagh Disposal Station, JICA started another study, “Preparatory Survey (Basic Design) on Urgent Rehabilitation Project for Sewerage and Drainage System in Lahore (Retrieval of Sewerage and Drainage System in Lahore City (Phase-II))”, in August 2009. Therefore, it doesn’t examine about these 3 existing disposal stations in this study.

New Gulshan-e-Ravi Disposal Station is proposed for Phase 1 Project. A proposed New Gulshan-e-Ravi Disposal Station will be constructed in the site of existing Gulshan-e-Ravi Disposal Station. However, existing and proposed disposal stations will have different catchment area and wastewater collection system, therefore, existing disposal station and proposed disposal station will be totally another facilities and do not need to affect each other on hydraulics. Catchment areas for existing and proposed disposal station is showing in **Figure 11.1**. The preliminary design of proposed New Gulshan-e-Ravi Disposal Station would be examined under the Preparatory Study.

Proposed sewerage facilities of the Phase 1 and Phase 2 Project are presented in **Figure 11.2** and **Figure 11.3**, respectively.

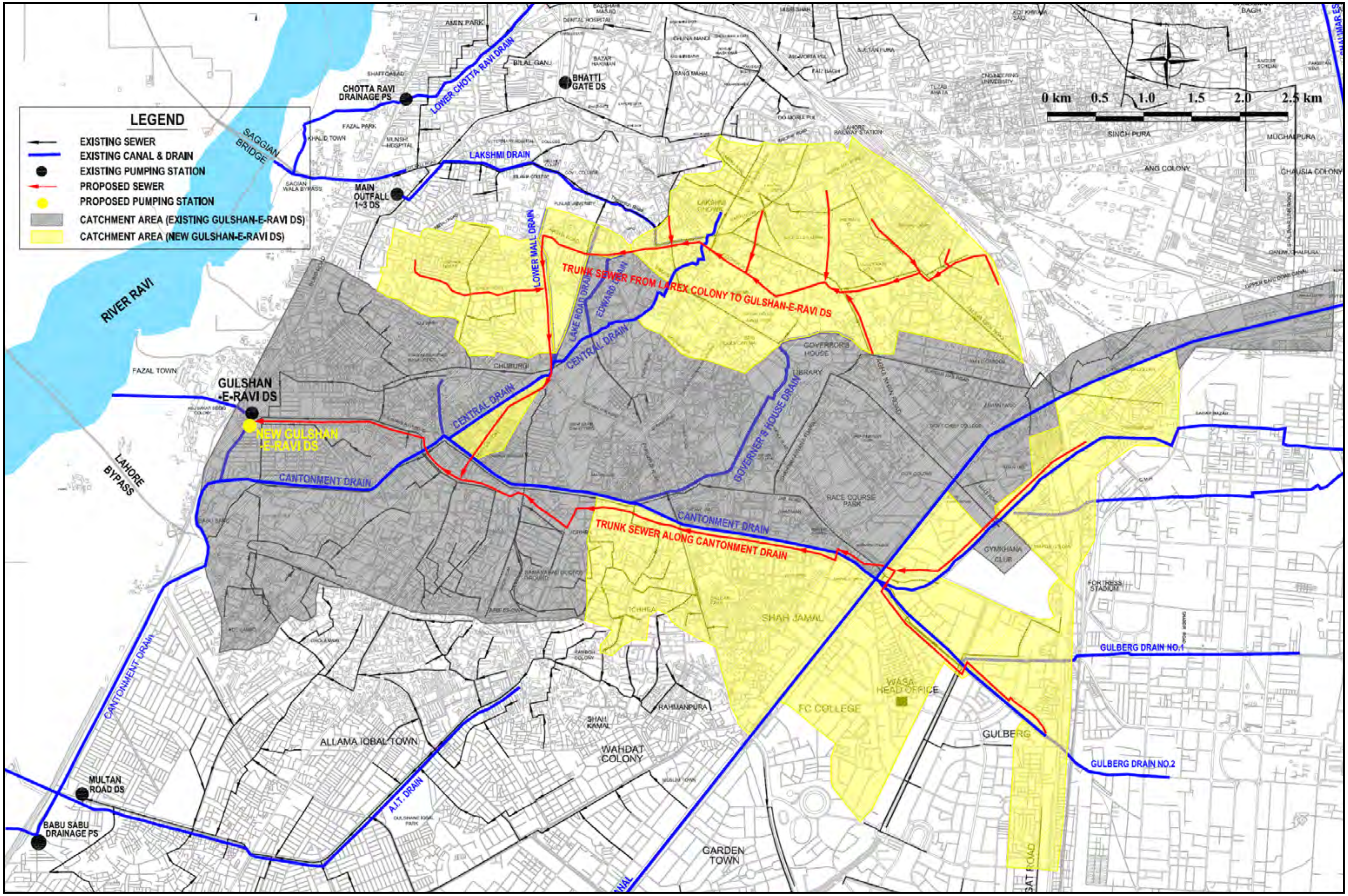


Figure 11.1 Catchment Area of Existing and New Gulshan-e-Ravi Disposal Station

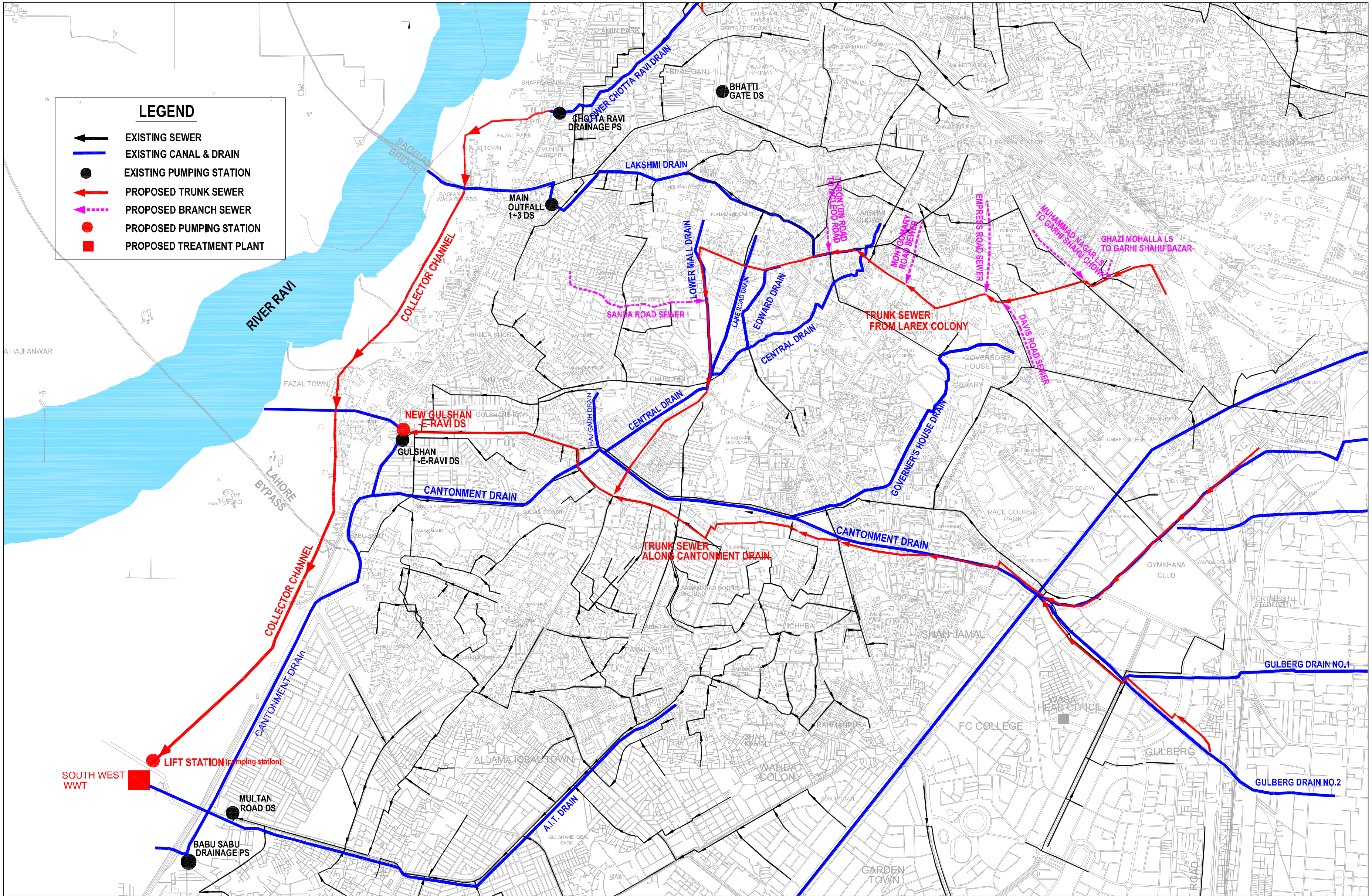


Figure 11.2 Plan of Proposed Sewerage Facilities of Phase1 Project

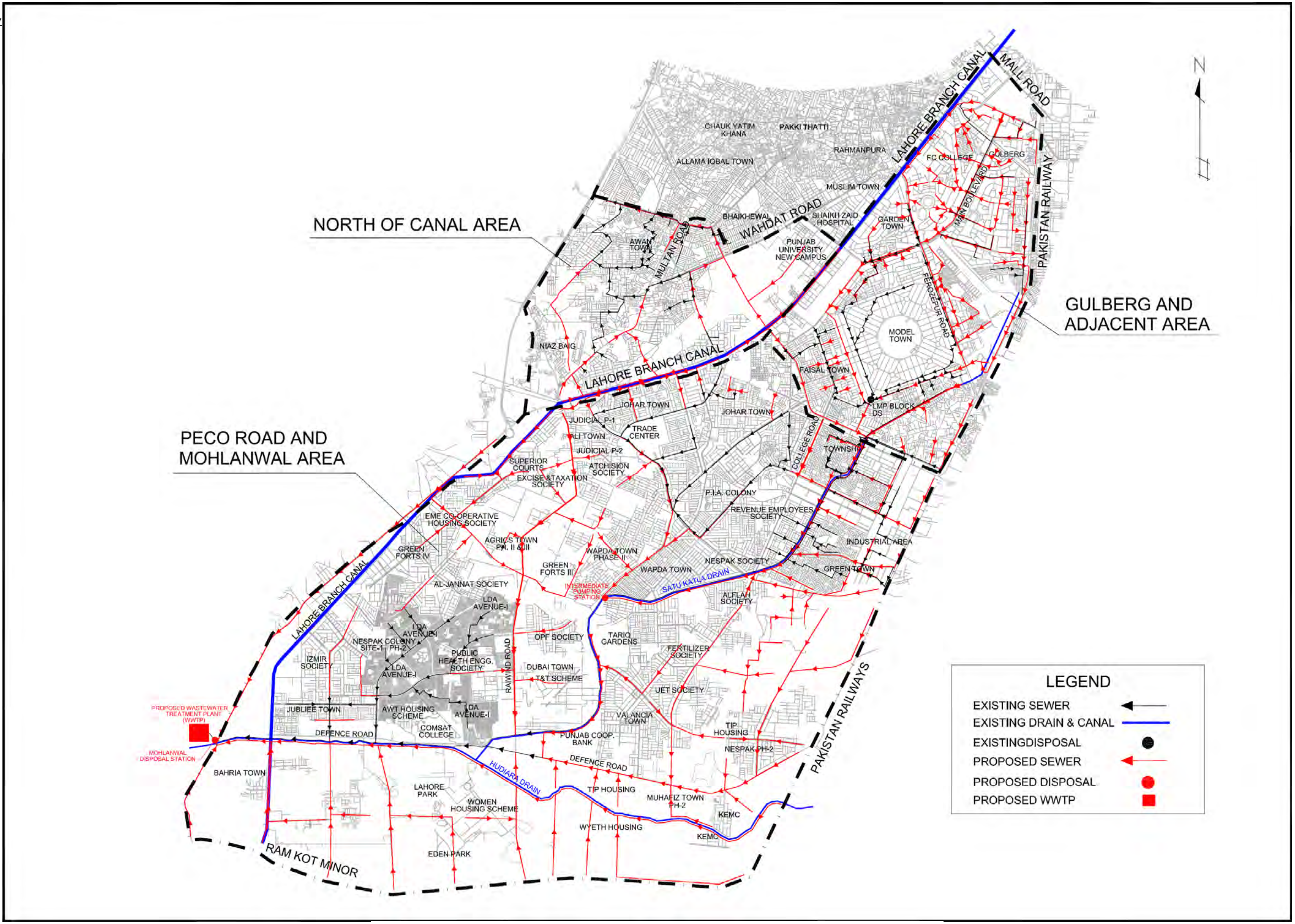


Figure 11.3 Plan of Proposed Sewerage Facilities of Phase 2 Project

11.4 Drainage

11.4.1 Priority of Area

The WASA service area is sub divided into 7 drainage sub-catchment areas, namely Shahdara Area, Mehmood Booti Area, Siddique Pura Area, Chotta Ravi Area, Central Area, Sattu Katla and Hudiara Area. For these 7 sub-catchment areas, it is necessary to decide their priority rankings. The priority ranking is determined on a point system based on the following criteria:

(a) Population numbers
The highest population is given 5 points. For other areas, points are calculated by obtaining the ratio of the highest population number to the other area's population numbers and by multiplying the calculated ratio by 5.

(b) The area of inundation
The largest total area undergoing inundation is given 5 points. For other areas, points are calculated by obtaining the ratio of largest total area inundated to other area's total area of inundation and multiplying the calculated ratio by 5.

(c) Current situation with respect to study progress
When the preliminary study is completed: 5 points
In the process of carrying out the preliminary study: 3 points
When a master plan has been completed or no study has been conducted as yet: 1 point

Criterion (a) is an important factor in prioritizing the projects from the viewpoint of the number of project beneficiaries. The project will be more effective if there are many beneficiaries involved.

The main purpose of the drainage improvement project is to mitigate flood damage. Therefore, criterion (b) is the most important factor in any attempt to improve the current situation. The criterion (c) is also a significant factors to guide the project forward. The criteria considered and the priorities assigned to the 7 sub-catchment areas are shown in **Table 11.7**. From this it is evident that the Central Area has the top priority in the Phase 1 Project while the Sattu Katla Area has the highest priority in the Phase 2 Project.

Table 11.7 Priority of Area for Drainage System Improvement Project

	Shahdara	points	Siddique Pura	points	Mehmood Booti	points	Chotta Ravi	points	Central Area	points	Sattu Katla	points	Hudiara	points
Population (2035)*1	707,945	1	1,489,744	2	1,425,392	2	185,664	1	3,708,623	5	2,329,139	3	328,284	1
Total Area of Inundation (Number of Inundation Point)	9.90 ha (2 locations)	1	3.10 ha (11 locations)	1	1.40 ha (5 locations)	1	2.22 ha (1 location)	1	47.54 ha (49 locations)	5	21.18 ha (12 locations)	2	No Data	0
Study Level	M/P	1	M/P	1	M/P	1	Preliminary Design	5	Preliminary Design	5	Preliminary Design	5	M/P	1
Priority of Area*2	Long-term	3	Long-term	4	Long-term	4	Long-term	7	**Phase 1**	15	**Phase 2**	10	Long-term	2

NOTE *1: Source: Integrated Master Plan for Lahore-2021 and JICA Study Team Estimates

*2: Phase 1 : 2010-2017, Phase 2: 2018-2022, Long-term: 2023-2035

11.4.2 Timings for the Implementation of Drainage Components

A phase wise summary of required drainage facility improvements is presented in **Table 11.8**.

Table 11.8 Phase wise Implementation of Drainage System Improvement

Implementation Period	New Construction		Improvement & Rehabilitation
Phase 1 (2010 to 2017)	Central Area **Package-A (First priority)** (1) Central Drain (2) Dil Muhammad Road Drain (3) Art Council Drain (4) Allama Iqbal Road Drain (5) WAPDA House Drain (6) Lawrence Road Drain (7) Nicholson Road Drain (8) Poonch Road Drain (9) Chauburji Drain (10) New Samanabad Drain (11) Morrhe Samanabad Drain (12) Multan Road Drain (13) Almumtaz Road Drain (14) Old Bund Road Drain (15) Sodewal Drain (16) Gulgasht Drain (17) Nasir Bagh Drain (18) Mall Road Drain	**Package-B** (1) Queens Road Drain (2) Shahra Awane Tijarat Road Drain (3) Golf Road Drain (4) Kinnaird Drain (5) Shah Jamal Drain (6) Gulshan-e-Ravi Drain (7) Sanda Road Drain (8) Krishan Nagar Drain (9) Rewaz Garden Drain (10) Tertiary Drain	**Package-A (First priority)** (1) Governor House Drain (2) Meclod Road/Lakshimi Drain
Phase 2 (2018 to 2022)	Sattu Katla Area (1) Gulberg Drainage System (2) Garden Town & Model Town Drainage System (3) Town Ship & Green Town Drainage System (4) Industrial Area Drainage System (5) Raiwind Road Draiange System (6) Jubillee Town Drainage System (7) Defense Road Drainage System (8) Hudiara Drainage System (9) Multan Road Drainage System (10) Drainage System North of Lahore Branch Canal (11) Secondary / Tertiary Drains		Sattu Katla Area (1) Garden Town Drain (2) College Road Drain (3) New Industrial Drain III (4) New Industrial Drain VI (5) Link Road Drain (6) Main Industrial Drain (7) Gulberg Drain
Long-term (2023 to 2035)	Hudiara Area, Shahdara Area, Mehmood Booti Area, Siddique Pura Area and Chotta Ravi Area New main and secondary drain TMA Area New main and secondary drain	Cantonment Area (1) SRD1 Drain (2) SRD2 Drain (3) BRD1 Drain (4) BRD2 Drain	Improvement Siddique Pura PS Chotta Ravi PS Cantonment Area (1) Cantonment Drain (2) ADA Nullah (3) Nullah along Abdul Rehman Rd. (4) Drain along Ferozpur Rd.

Phase 1 project for drainage system consist of 2 packages, namely Package-A and Package-B as showing in **Table 11.8**. The content of package was determined in “Detailed Engineering Design Report, Aug. 2005, NESPAK” and it was given Package-A the highest priority on phase 1 project. The storm water from Central Area is collected into existing Babu Sabu Drainage Pumping Station through main drains such as Cantonment Drain, Central Drain, Governor House Drain and so on. The storm water from Central Area will be collected into the Babu Sabu Drainage Pumping Station effectively and smoothly after phase 1 project was completed. However, catchment area of the Babu Sabu Drainage Pumping Station has not been changed, therefore it is not necessary to improve the Babu Sabu Drainage Pumping Station.

Proposed drainage facilities of the Phase 1 and Phase 2 Project are presented in **Figure 11.4** and **Figure 11.5**, respectively.

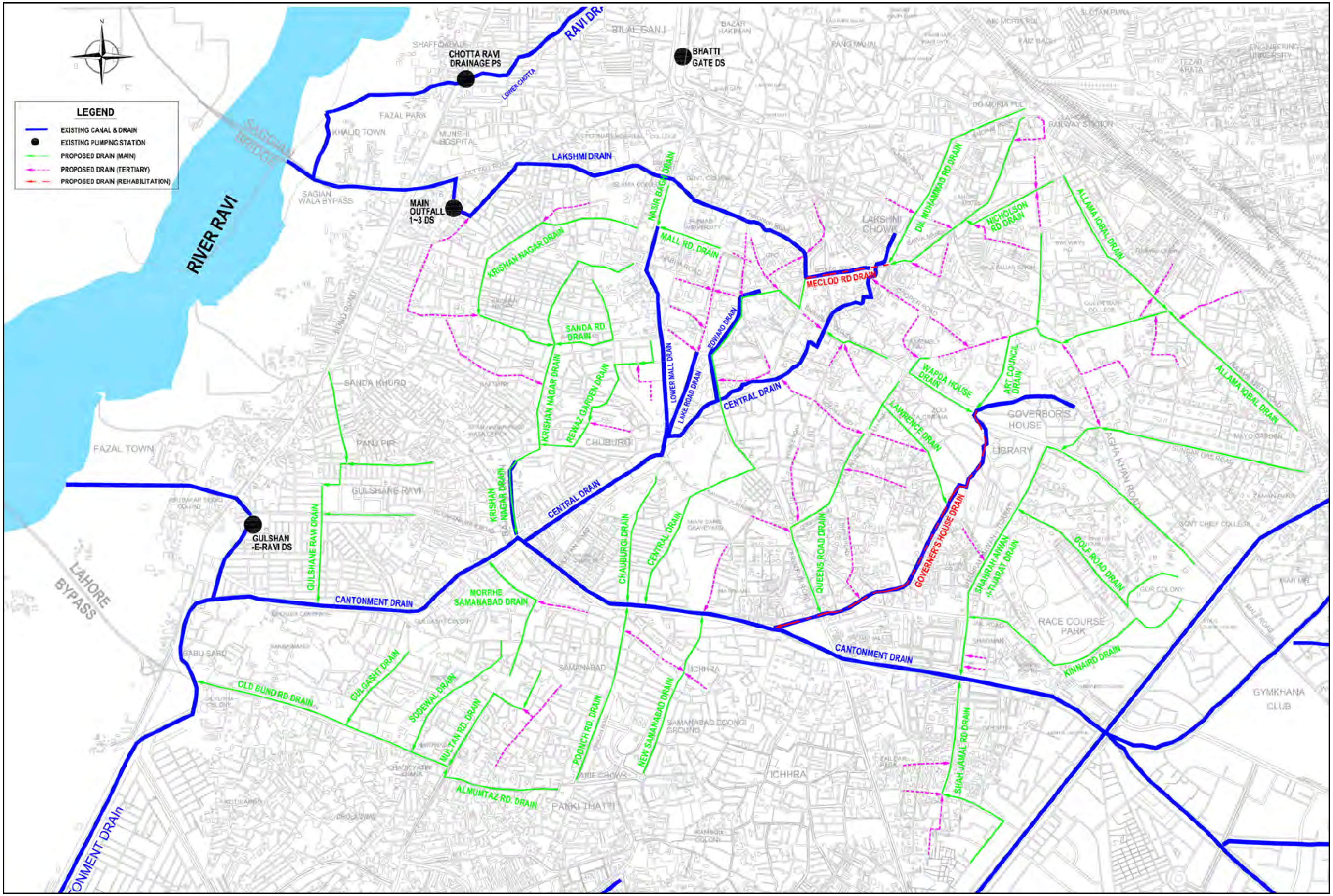


Figure 11.4 Plan of Proposed Drainage Facilities of Phase 1 Project

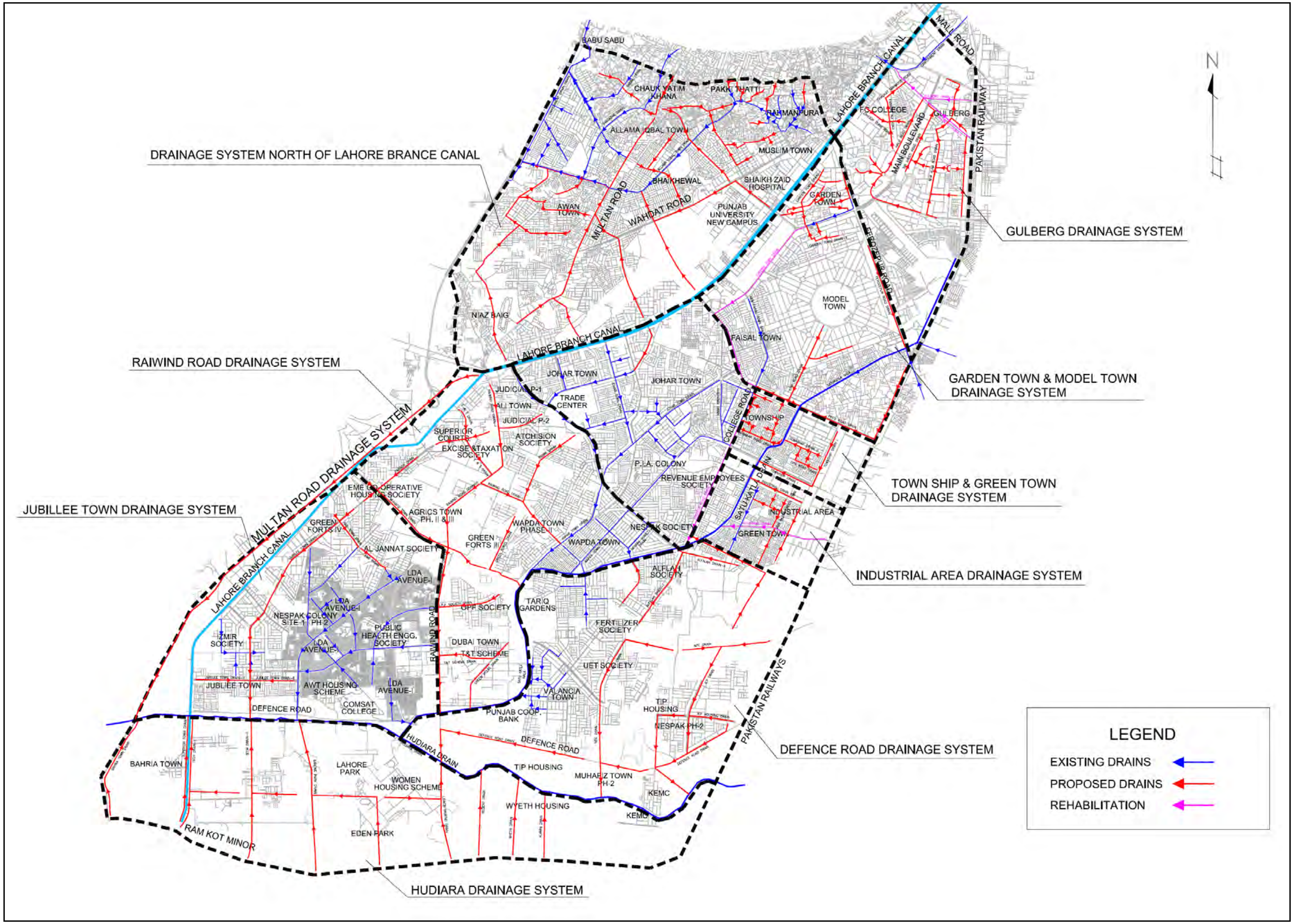


Figure 11.5 Plan of Proposed Drainage Facilities of Phase 2 Project

CHAPTER 12 SCOPE OF PHASE I PROJECT

The Study aims to formulate "the Lahore Water Supply, Sewerage and Drainage Improvement Project" through basic study, review of vision and strategy on development and management of water supply, sewerage, and drainage facilities in Lahore and based on this study, preparation of the project plan and of plan for implementation, operation and maintenance, confirmation of environment, social considerations, thereby improving efficiency of water supply, improving sanitary environment and water quality in public water bodies, alleviating flooding and improving management capacity.

12.1 Water Supply

The Unaccounted-for Water (UFW) should be reduced to improve the efficiency of utilization of existing groundwater sources. Installing bulk flow meters and customer meters as well as establishing regulation of service pipelines and replacement of deteriorated pipelines will helps a lot to reduce and control leakage. In Phase 1, bulk flow meters are to be installed to all the tube-wells. Customer meters will be mainly installed in Phase-1 (40%) and Phase-2 (60%), respectively. For UFW reduction, the pilot area is selected to give exercise to leakage detection teams, replace the deteriolated pipes identified and verify the UFW reduction effect. This approach is extended to other areas in Phase-2 to roll out the active leakage control program. In Phase 1, some areas will be selected for 100%water metering.

1) Installation of meters in 40% of connections
   : Ø 15mm (typical) × 308,000 units
2) Installation of Bulk Flow Meters (BFMs)
   : Ø 8” × 159 units for 1.0 to 2.5 cusec tube-wells
   : Ø 10” × 233 units for 3.0 to 4.0 cusec tube-wells
   Including the installation of a pressure gauge and disinfectant injection unit at each tube-well for improvement of tube-well operation.
3) Implementation of distribution network improvement in the priority area in the central Lahore
   Details will be fixed based on the study in the pilot area during the detailed design stage

12.2 Sewerage

12.2.1 Necessity of the Project

The necessity for the projects is discussed in this section.

The proposed sewerage project phase 1 consists of 2 projects. These projects and their components are shown in **Table 12.1**.

Table 12.1 Proposed Sewerage Projects Phase 1

No.	Project		Component (Facility Construction Works)
(1)	Improvement to the sewerage system in the Central Area	(a)	Trunk and branch sewer from Larex Colony to New Gulshan-e-Ravi Disposal Station
		(b)	Trunk sewer along Cantonment Drain
		(c)	New Gulshan-e-Ravi Disposal Station
(2)	Construction of the South West Wastewater Treatment Plant	(a)	South West Wastewater Treatment Plant
		(b)	Collector Channel
		(c)	Lift Station

The necessity of projects is the subject of discussion in this section.

(1) Improvement of Sewerage System in the Central Area

The existing sewerage system in the Central Area, which was laid in the early twentieth century, has proved to be grossly inadequate to cater for the flows generated from very critical areas of the city. In the recent past, there has been significant increases in the population making these systems inadequate for the present population. Therefore, the existing sewerage system does not function well. In order to improve the existing situation, and as a temporary countermeasure, a number of lift stations were constructed to pump the wastewater into open drains. However, this countermeasure caused many other problems such as environmental problems around the open drains, increases in operation and maintenance costs for lift stations and decreases in the original cross-section of the open drains for storm water. Therefore, the proposed project for the improvement of the sewerage system in the Central Area will be an essential requirement. Detailed descriptions of project components are given below.

(a) Trunk and Branch Sewer from Larex Colony to New Gulshan-e-Ravi Disposal Station

The present sewerage system consists of oval shaped brick masonry sewers 24” x 36” (0.61 x 0.91 m) to 36” x 54” (0.91 x 1.37 m) size of old British vintage and the R.C.C sewers from 9”

(0.23 m) to 60” (1.52 m) laid during the last 25 years by WASA. The old brick sewers have become choked with the passage of time because of siltation and this sewer system is therefore inadequate for the present population. In this area, 3 lift stations are present which are located at Muhammad Nagar, Ghazi Muhallah and Larex Colony. These lift stations were constructed as a temporary facility to pump wastewater into the nearby drains. It has had a negative impact on the environmental condition in the surrounding areas. In order to improve the existing situation, a proposed trunk sewer has been designed in such a way that it will be adequate to cater for both the present and future sewage flows and when instituted the existing 3 lift stations can then be eliminated.

(b) Trunk Sewer along Cantonment Drain

The Cantonment Drain is the main drain in the Central Area. The total length of the drain starting from Al Faisal Town to the Babu Sabu Drainage Pumping Station is around 15.40 km. Due to the inadequacy of the existing trunk sewer along the Cantonment Drain, the Cantonment Drain is being used as a sullage carrier. Currently, the wastewater from areas along Cantonment Drain is discharged into the Cantonment Drain without any treatment through 8 lift stations. The environmental hazard becomes acute during the dry season, when the flow in this drain consists only of high concentrations of raw domestic wastewater and in addition due to it flowing at extremely low velocities, deposition of suspended solids results. As a result, foul smells are produced due to the decomposition of the settled solids, which pollutes the environment and air of surrounding areas. In addition the original capacity of the Cantonment Drain has been reduced due to it also carrying wastewater, therefore, only a small cross-section is left to carry the storm water during periods of rain. In view of the above problems, the situation warrants immediate arrangements for providing a new trunk sewer system along the Cantonment Drain. A trunk sewer system has been proposed to improve the existing environmental condition of the Cantonment Drain by separating wastewater and storm water flow. The proposed trunk sewer system has been designed in such a way that the existing 8 lift stations can subsequently be eliminated.

(c) New Gulshan-e-Ravi Disposal Station

The proposed trunk sewer from the Larex Colony to the New Gulshan-e-Ravi Disposal Station will be connected to the proposed trunk sewer along the Cantonment Drain at the intersection of the Multan and the Gulshan-e-Ravi roads. In this proposed sewer system, collected wastewater will be finally conveyed to the proposed New Gulshan-e-Ravi Disposal Station. This new disposal station has been proposed to be sited on the premises of existing Gulshan-e-Ravi Disposal Station. The total required capacity of pumps is 400 cfs(11.33 m^3/s). This exceeds the pump capacity of the existing Gulshan-e-Ravi Disposal Station, so the construction of a new Gulshan-e-Ravi Disposal Station is required.

(2) Construction of the South West Wastewater Treatment Plant

At present, all of wastewater from the Central Area is discharged directly into the River Ravi without treatment through pumping stations, namely the Chotta Ravi Drainage Pumping Station, the Main Outfall Disposal Station, the Gulshan-e-Ravi Disposal Station and the Multan Road Disposal Station. The total wastewater flow for the year 2009, from the Central Area is estimated at about 640,000 m^3 in a day, so this is a very serious environmental issue. In order to improve the existing situation, construction of a wastewater treatment plant including collector channels and lift stations has been proposed. The collector channel will intercept the wastewater from each pumping stations and covey it to the proposed lift station. Detailed descriptions of each component is given below.

(a) South West Wastewater Treatment Plant

All of wastewater discharged into the River Ravi has to meet the National Environmental Quality Standards (NEQS). Wastewater without treatment would affect the ground water and irrigation water quality used downstream of the River Ravi. From the viewpoint of preservation of the river water source and reuse of treated wastewater in the near future, construction of the wastewater treatment plant is a pressing issue.

(b) Collector Channel

As described above, wastewater from the Central Area is presently discharged directly into the River Ravi without treatment through pumping stations. To collect the flows from the 3 pumping stations, namely Chotta Ravi Drainage Pumping Station, Main Outfall Disposal Station and Gulshan-e-Ravi Disposal Station, construction of a collector channel will be required.

(c) Lift Station

To increase flows from the end of the collector channel into the South West Wastewater Treatment Plant, a new lift station will need to be constructed.

12.2.2 Components of the Project

The components of project are shown in **Table 12.2** to **Table 12.7**. The specifications of proposed sewerage facility for each component are as follows:

(1) Improvement of the Sewerage System in the Central Area

(a) Trunk & branch sewer from Larex Colony to New Gulshan-e-Ravi Disposal Station

Table 12.2 Major Specification of Trunk & Branch Sewers from Larex Colony to New Gulshan-e-Ravi Disposal Station

Item	Stretch	Specification		Construction Method
		Dimension ϕ (inch)	**Length (ft)**	
Trunk Sewer	Larex Colony to Garhi Shahu Bazar	24 (0.61m)	2,559 (780m) 150 (46m)	Open Cut Method Pipe Jacking Method
	Garhi Shahu Bazar to Allama Iqbal Road	30 (0.76m)	1,356 (413m)	Open Cut Method
	Allam Iqbal Road to Shimla Hill	48 (1.22m)	2,721 (829m)	Open Cut Method
	Shimla Hill to Montgomary Road Chowk	60 (1.52m)	3,775 (1,151m)	Open Cut Method
	Montgomary Road Chowk to Imperial Cinema Chowk	72 (1.83m)	1,965 (599m)	Open Cut Method
	Imperial Cinema Chowk to Sanda Road	84 (2.13m)	5,759 (1755m) 550 (168m)	Open Cut Method Pipe Jacking Method
	Sanda Road to the new Trunk Sewer along Cantonment Drain	90 (2.29m)	7,748 (2,362m) 200 (61m)	Open Cut Method Pipe Jacking Method
		Total	26,783 (8,163m)	
Branch Sewer	Ghazi Muhallah LS to Garhi Shahu Bazar	15 (0.38m)	480 (146m)	Open Cut Method
	Muhammad Nagar LS to Garhi Shahu Chowk	30 (0.76m)	1,350 (411m)	Open Cut Method
	Davis Road Sewer	36 (0.91m)	2,450 (747m)	Open Cut Method
	Empress Road Sewer	24 (0.61m)	3,391 (1,034m)	Open Cut Method
	Montgomary Road Sewer	42 (1.07m)	2,270 (692m)	Open Cut Method
	Thronton Road to Mcleod Road	36 (0.91m)	899 (274m)	Open Cut Method
	Sanda Road Sewer	54 (1.37m)	4,483 (1,366m) 300 (91m)	Open Cut Method Pipe Jacking Method
		Total	**15,632 (4,765m)**	

(b) Trunk sewer along the Cantonment Drain

Table 12.3 Major Specification of Trunk Sewer along Cantonment Drain

Stretch	Size of Sewer			Length (ft)	Construction Method
	ϕ (inch)	**Width (ft)**	**Height (ft)**		
Sunny Flour Misll LS to New Gulshan-e-Ravi DS	48 (1.22m)			2,025 (617m)	Open Cut Method
	54 (1.37m)			4,850 (1,478m)	
	66 (1.68m)			2,025 (617m)	
	78 (1.98m)			4,325 (1,318m)	
		6 (1.83m)	6 (1.83m)	3,000 (914m)	
		7 (2.13m)	6 (1.83m)	1,500 (457m)	
		8 (2.44m)	6 (1.83m)	7,000 (2,134m)	
		12 (3.66m)	8 (2.44m)	8,275 (2,522m)	
Mustafabad LS to Junction Point	42 (1.07m)			2,500 (762m)	
	48 (1.22m)			4,500 (1,372m)	
	54 (1.37m)			2,580 (786m)	
			Total	**42,580 (12,978m)**	

(c) New Gulshan-e-Ravi Disposal Station

Table 12.4 Major Specifications of New Gulshan-e-Ravi Disposal Station

Pump Type	Total Capacity	Total Number of Pump	Total Number of Trash Screen	Remark
Vertical Axial Flow Pump	520 cfs (14.72 m^3/s)	13 pumps x 40 cfs (1.13 m^3/s) (Out of the 13 pumps, 3 are stand-by pumps)	4	Site is in the lot of existing the Gulshan-e-Ravi Disposal Station

(2) Construction of South West Wastewater Treatment Plant

(a) South West Wastewater Treatment Plant

Table 12.5 Major Specifications of South West Wastewater Treatment Plant

Target Area	Design Population	Design Flow	Treatment Method	Remark
South West 100.26 km^2	3,894,300	323 cfs [790,000m^3/d] (Daily Average)	Trickling Filter Process	

Note: Detail of treatment method is mentioned in **Table 13.1** of **Chapter 13**.

(b) Collector Channel

Table 12.6 Major Specifications of Collector Channel

Node		Size		Length (m)	Construction Method
From	To	Width (m)	Height (m)		
Chotta Ravi	Main Outfall	3.0	1.8	1,490	Open Cut Method
Main Outfall	Gulshan-e-Ravi	5.5	1.8	2,750	
Gulshan-e-Ravi	Lift Station	10.0	2.2	3,150	
Total				**7,390**	

(c) Lift Station

Table 12.7 Major Specifications of Lift Station

Pump Type	Total Capacity	Total Number of Pump	Remark
Screw Pump	960 cfs (27.18 m^3/s)	12 pumps x 80 cfs (2.27 m^3/s) (Out of the 12 pumps, 2 are stand-by pumps)	Land acquisition for lift station has completed already (150 x 200 ft = 30,000 Sft (45.72 x 60.96 m =2,787 m^2)

12.3 Drainage

12.3.1. Necessity for the Project

The drainage system in the Central Area is primarily dependent on the Cantonment Drain in addition to other main and secondary drains. Initially, these drains were designed and constructed only for storm water disposal but with the passage of time, wastewater outfalls from a number of adjoining areas have been connected to them either by gravity or through lift stations without considerations of future planning and growth. Therefore, the existing drains have become sullage carriers at present. Also as drains usually pass through residential and commercial areas it has negative impacts on the overall environment of the region. As the cross-section of drain has been reduced due to the sullage flow in the drain there is inadequate space left to carry storm water during the rainy season. Since the surface run-off has also increased due to rapid urbanization in the Central Area the existing drainage system is not sufficient to cope with the increased surface run-off as well. As a result of these problems, this area is always at risk of flooding in the rainy season and it habitually suffers from inundation and poor environmental conditions through stagnation at a number of locations.

In view of the above problems, the project for drainage improvement in Central Area will be an absolute necessity.

In order to improve the existing drainage system, new drains will be proposed, however, due consideration should be given to fully utilize the existing system since construction of new drains may prove to be difficult due to limited space, problems concerning underground utilities and attendant traffic problems.

As for the surface water drainage catchments, these are fixed on the basis of topographic features, existing drain networks and site investigations. The project area is divided into several sub-catchment areas as shown in **Figure 12.1** and each sub-catchment area has to have appropriate drains. Proposed new drains also are shown **Figure 12.1**.

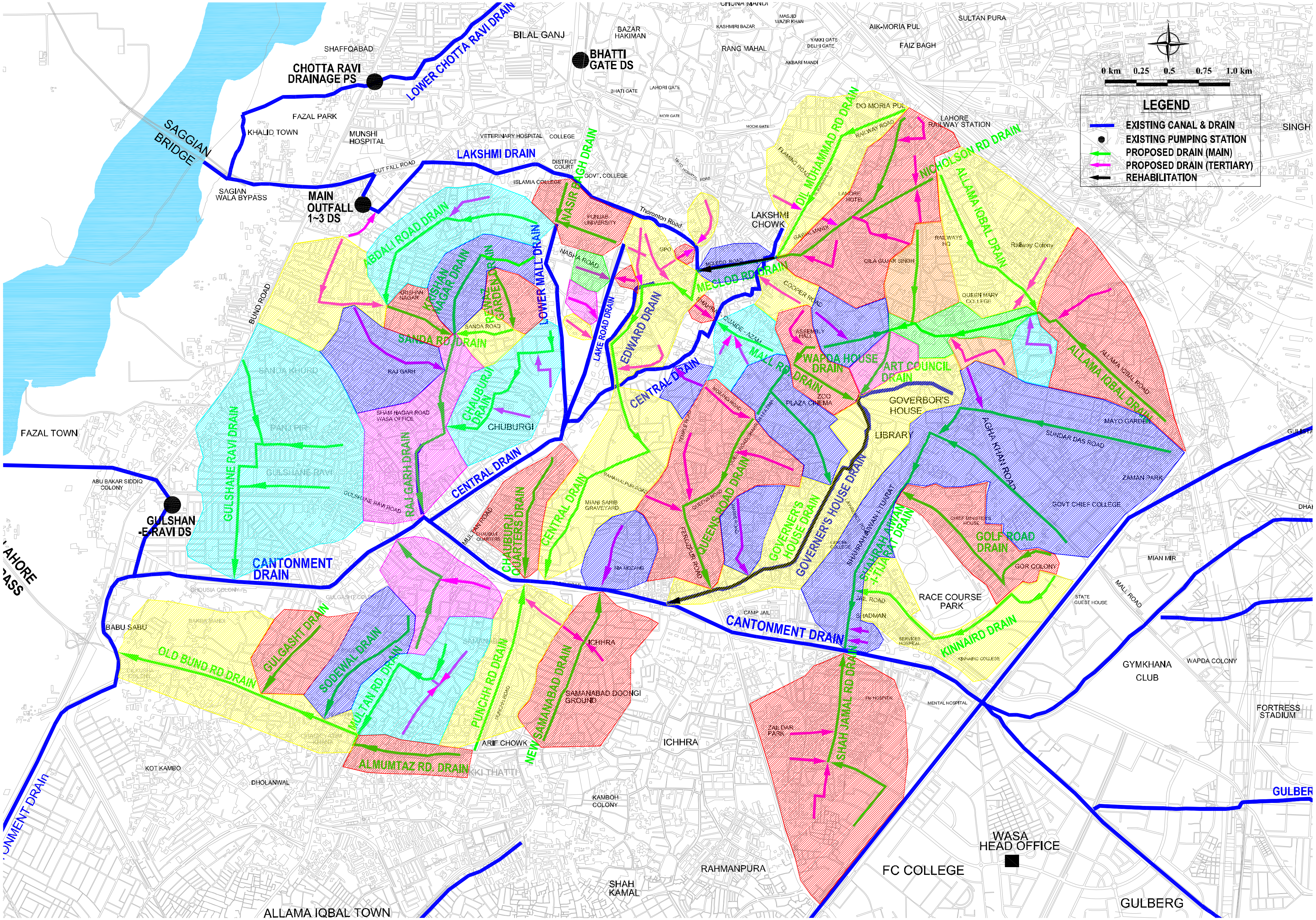


Figure 12.1 Drainage Sub-catchment Area of Proposed Drains

12.3.2 Components of the Project

The components of project and major specifications are as follows:

(1) New Construction of Drains in the Central Area

Table 12.8 Major Specification of Newly Constructed Drains

No.	Line	Size		Length (ft)	
		Width (ft)	Height (ft)	Each	Total
1	Central Drain	3.0 (0.91m) 6.0 (1.83m) 10.0 (3.05m) 12.0 (3.66m)	4.0 (1.22m) 5.0 (1.52m) 6.0 (1.83m) 6.0 (1.83m)	5,100 (1,554m) 500 (152m) 5,500 (1,676m) 6,500 (1,981m)	17,600 (5,364m)
2	Dil Muhammad Road Drain	3.5 (1.07m) 4.0 (1.22m)	3.0 (0.91m) 4.0 (1.22m)	3,500 (1,067m) 2,000 (610m)	5,500 (1,676m)
3	Art Councel Drain	7.5 (2.29m)	5.0 (1.52m)	2,900 (884m)	2,900 (884m)
4	Allama Iqbal Road Drain	4.0 (1.22m) 4.0 (1.22m) 3.5 (1.07m) 7.5 (2.29m) 3.0 (0.91m)	3.0 (0.91m) 4.0 (1.22m) 4.0 (1.22m) 6.0 (1.83m) 3.0 (0.91m)	2,300 (701m) 2,000 (610m) 3,500 (1,067m) 3,538 (1,078m) 2,500 (762m9	13,838 (4,218m)
5	WAPDA House Drain	3.0 (0.91m)	3.0 (0.91m)	3,110 (948m)	3,110 (948m)
6	Lawrence Road Drain	3.5 (1.07m)	3.0 (0.91m)	3,688 (1,124m)	3,688 (1,124m)
7	Nicholson Road Drain	3.0 (0.91m)	3.0 (0.91m)	2,463 (751m)	2,463 (751m)
8	Poonch Road Drain	5.0 (1.52m)	4.0 (1.22m)	4,838 (1,475m)	4,838 (1,475m)
9	Chauburji Drain	3.5 (1.07m)	4.0 (1.22m)	3,548 (1,081m)	3,548 (1,081m)
10	New Samanabad Drain	4.0 (1.22m) 4.5 (1.37m)	4.0 (1.22m) 4.0 (1.22m)	3,106 (947m) 1,434 (437m)	4,540 (1,384m)
11	Morrhe Samanabad Drain	3.5 (1.07m)	4.0 (1.22m)	3,548 (1,081m)	3,548 (1,081m)
12	Multan Road Drain	3.5 (1.07m) 4.0 (1.22m)	3.0 (0.91m) 4.0 (1.22m)	1,203 (367m) 3,039 (926m)	4,242 (1,293m)
13	Almumtaz Road Drain	3.5 (1.07m)	3.0 (0.91m)	3,188 (972m)	3,188 (972m)
14	Old Bund Road Drain	4.5 (1.37m) 5.0 (1.52m)	4.0 (1.22m) 4.0 (1.22m)	2,757 (840m) 3,958 (1,206m)	6,715 (2,047m)
15	Sodewal Drain	4.0 (1.22m)	3.0 (0.91m)	5,038 (1,536m)	5,038 (1,536m)
16	Gulgasht Drain	3.5 (1.07m)	3.0 (0.91m)	2,435 (742m)	2,435 (742m)
17	Nasir Bagh Drain	3.0 (0.91m)	3.0 (0.91m)	1,100 (335m)	1,100 (335m)
18	Mall Road Drain	3.0 (0.91m)	2.0 (0.61m)	1,725 (526m)	1,725 (526m)
19	Queens Road Drain	4.0 (1.22m)	5.0 (1.52m)	5,382 (1,640m)	5,382 (1,640m)
20	Shahra Awane Tijarat Road Drain	4.0 (1.22m) 8.0 (2.44m) 4.0 (1.22m)	3.0 (0.91m) 4.0 (1.22m) 4.0 (1.22m)	6,277 (1,913m) 6,538 (1,993m) 4,675 (1,425m)	17,490 (5,331m)
21	Golf Road Drain	3.0 (0.91m) 4.0 (1.22m)	3.0 (0.91m) 4.0 (1.22m)	2,148 (655m) 3,500 (1,067m)	5,648 (1,722m)
22	Kinnaird Drain	4.0 (1.22m)	5.0 (1.52m)	6,690 (2,039m)	6,690 (2,039m)
23	Shah Jamal Drain	3.0 (0.91m) 4.0 (1.22m) 6.0 (1.83m)	3.0 (0.91m) 3.0 (0.91m) 4.0 (1.22m)	1,794 (547m) 1,640 (500m) 2,522 (769m)	5,956 (1,815m)
24	Gulshan-e-Ravi Drain	3.5 (1.07m)	4.0 (1.22m)	2,384 (727m)	

		4.5 (1.37m)	4.0 (1.22m)	1,882 (574m)	
		10.0 (3.05m)	5.0 (1.52m)	2,354 (718m)	
		3.5 (1.07m)	3.0 (0.91m)	2,176 (663m)	
		8.0 (2.44m)	5.0 (1.52m)	2,617 (798m)	11,413 (3,479m)
25	Sanda Road Drain	3.5 (1.07m)	3.0 (0.91m)	3,579 (1,091m)	3,579 (1,091m)
26	Krishan Nagar Drain	4.0 (1.22m)	3.0 (0.91m)	3,842 (1,171m)	
		3.0 (0.91m)	3.0 (0.91m)	2,679 (817m)	
		4.0 (1.22m)	4.0 (1.22m)	3,000 (914m)	
		7.0 (2.13m)	5.0 (1.52m)	2,000 (610m)	
		10.0 (3.05m)	6.0 (1.83m)	3,000 (914m)	
		12.0 (3.66m)	6.0 (1.83m)	2,500 (762m)	17,021 (5,188m)
27	Rewaz Garden Drain	2.0 (0.61m)	3.0 (0.91m)	1,031 (314m)	
		3.5 (1.07m)	4.0 (1.22m)	4,000 (1,219m)	5,031 (1,533m)
28	Tertiary Drain	2.0 (0.61m)	2.0 (0.61m)		
		2.0 (0.61m)	3.0 (0.91m)		
		3.0 (0.91m)	3.0 (0.91m)		74,646 (22,753m)

(2) Improvement and Rehabilitation of Drains in the Central Area

Table 12.9 Improvement and Rehabilitation of Drains

No.	Line	Size		Length (ft)	
		Width (ft)	Height (ft)	Each	Total
1	Meclod Road/Lakshimi Drain	6.0 (1.83m)	5.0 (1.52m)	2,000 (610m)	2,000 (610m)
2	Governor House Drain	7.5 (2.29m)	7.0 (2.13m)	341 (104m)	
		8.0 (2.44m)	5.0 (1.52m)	2,594 (791m)	
		10.0 (3.05m)	6.0 (1.83m)	5,500 (1,676m)	8,435 (2,571m)

12.4 Institutional Improvement

Institutional improvement includes the following items:

1. Development of Adequate Policy and Regulatory Environment

1-1 preparation and enactment of Punjab Urban Water Act and WASCO Act (or Lahore WASA Act)

1-2 Establishment of (a) a concrete road map for increasing tariff to the adequate level, (b) a mechanism for adequate tariff revision, and (c) measures of financial supports by the government

2. Timely Data Acquisition and Preparation of Definitive Vision and Strategies

2-1 regular preparation of mid-term and annual business plans

2-2 establishment of performance monitoring indicators and regular monitoring system

2-3 implementation of comprehensive asset survey and preparation of asset inventories and drawings

3. Reduction of Unaccounted-for-water and Non-revenue-water

3-1 clarification of rights and responsibilities in relations with customers
3-2 installation of meters in 40% of connections
3-3 establishment of leakage detection teams
3-4 implementation of distribution network improvement in the priority area in the central Lahore, based on asset study and subsequently-prepared distribution network improvement plan in the entire WASA area
3-5 implementation of stringent measures against defaulters and illegal connections and phasing-out of uncharged public stand posts
3-6 entrustment of metering and billing to private companies

4. Human Resource Development and Organizational Streamlining

4-1 organizational restructuring
4-2 preparation of personnel management and human resource development
4-3 entrustment of certain facilities to private companies
4-4 establishment of Management Information System
4-5 procurement of O&M equipment

5. Improvement of Customer Services

5-1 clarification of rights and responsibilities in relations with customers
5-2 regular implementation of customer survey
5-3 improvement of complaint handling system
5-4 expansion of payment options for customers
5-5 preparation of public relation strategy and its implementation

6. Groundwater Monitoring and Regulation

6-1 follow up survey and analysis on groundwater quality and quantity
6-2 establishment of groundwater committee
6-3 preparation of groundwater control and regulation plan
6-4 establishment of regular monitoring of groundwater

Some of items mentioned above are assisted by the consultants to be hired at the time of detailed design, tender assistance and construction supervision for Phase-1 Project. TOR for consulting services concerning the institutional improvement is presented in the next section, or “**12.5 Engineering Services**”.

12.5 Engineering Services

(1) Engineering Services

The engineering services are composed of the following works:

1) Detailed design for Phase-1 Project

2) Tender assistance for Phase-1 Project
3) Construction supervision for Phase-1 Project
4) Detailed design of sewerage and drainage facilities for Phase-2 Project
5) Preparation of master plan for Lahore Water Supply System
6) Detailed design of Lahore Water Supply System for Phase-2 Project
7) Study on institutional improvement
8) Preparation of master plan and feasibility study for water supply, sewerage and drainage outside the WASA's current jurisdiction

Terms of Reference of Consulting Services
for
Detailed Design, Tender Assistance and Construction Supervision for Phase-1 Project

(1) Project Background

Lahore is the second largest city in Pakistan with a population of more than 7 million. Whereas 87% population has access to safe water supply, increase in water supply and efficiency improvements through water conservation and water loss reduction are required to meet the demands of rapidly increasing population. As for sewerage and drainage facilities, underdeveloped sewer network has caused aggravated sanitary environment for the people in Lahore. Lack of wastewater treatment facilities has been caused by underdeveloped drainage facilities, lack of sufficient capacity and aging of the existing drainage facilities. To address such issues in water supply, sewerage and drainage in Lahore, Government of Pakistan submitted to Government of Japan an official request for studies and loan assistance through Japan International Cooperation Agency (JICA). And JICA, prioritizing water supply and sanitation under this assistance strategy, recognizes the need for the Preparatory Study ("the Study") to formulate the Lahore Water Supply, Sewerage, and Drainage Improvement Project ("the Project"), for which loan assistance may be considered subsequently.

(2) Phase-1 Project Description

The Phase-1 Project comprises the following scopes

Table 12.10 Facility/Equipment to Be Constructed/Installed in Phase 1 Project

Phase-1 (2010-2017)	**Specifications**
Water supply	
1. Preparation of A Master Plan Using Alternative water Source for Drinking Water 1-1: Preparation of a master plan to develop alternative water source and related facilities, including examination on integration of the existing groundwater supply system and new surface water supply system 1-2: Implementation of preparatory activities including acquisition of rights of surface water	**(Refer to Water Supply 1 in Consulting Services)**
2. Reduction of Unaccounted-for-water and Non-revenue-water 2-1: installation of meters in 40% of the connections 2-2: installation of bulk flow meters for all tube-wells 2-3: execution of an asset study and preparation of a distribution network improvement plan in the entire WASA area 2-4: implementation of distribution network improvement in the priority area in central Lahore within the agreed upon loan amount and time period (refer to Institutional Improvement on other institutional measures)	 Water meter Ø 15mm (typical) × 308,000 units Bulk Flow Meter (BFM) Ø 8" × 159 units for 1.0 to 2.5 cusec tube-wells Ø 10" × 233 units for 3.0 to 4.0 cusec tube-wells Each tube-well equipment include one (1) unit of pressure gauge **(Refer to Institutional Improvement 2-3)** **(Not Specified)** Details will be fixed based on the study in the pilot area during the detailed design stage.
3. Improvement of Disinfection 3-1: Installation of chlorinators for all tube-wells (certain measures for UFW reduction are also relevant for improvement of water quality)	 For each tube-well Chemical feed pump with a storage container (10 liter/hr x 10 bar) x 342 units
4. Procurement of Operation and Maintenance Equipment 4-1: Dewatering equipment 4-2: Water supply equipment and sewer cleaning equipment (vehicles) 4-3: Water meter repair workshop equipment 4-4: Water quality analyzer 4-5: Vehicles for employees' transportation 4-6: On-site measuring instrument	(see **Appendix 10.8**)
Sewerage	
1. Sewer – Central Area – connecting to South West Treatment Plant 1-1: Construction of trunk sewer from Larex Colony to Gulshan-e-Ravi Disposal Station 1-2: Construction of branch sewers from Larex Colony to Gulshan-e-Ravi Disposal Station 1-3: Construction of trunk sewer along Cantonment Drain	 Ø 24" – 90" × 34.766 ft Ø 15" – 54" × 15,632 ft Ø 42" – 78" × 22,805 ft 6.0 ft W x 6.0 ft H x 3,000 ft 7.0 ft W x 6.0 ft H x 1,500 ft

	8.0 ft W x 6.0 ft H x 7,000 ft 12.0 ft W x 8.0 ft H x 8,275ft
2. Disposal Station – Central Area – connecting to South West Treatment Plant 2-1: Construction of New Gulshan-e-Ravi DS	 Volute pimps : 13 units (including 3 units as standby) 40 cusecs
3. Wastewater Treatment Plant– Central Area – 3-1 : Construction of Collector Channel 3-2 : Construction of Lift Station 3-3: Construction of South West Wastewater Treatment Plant including collector channel and pumping station	 3.0 m W x 1.8 m H x 1,490 m 5.5 m W x 1.8 m H x 2,750 m 10.0 m W x 2.2 m H x 3,150 m Screw Pumps : 12 units (including 2 units as standby) Q = 80 cusecs Q = 323 cusecs (790,000 m^3/day) Anaerobic ponds + Trickling filters + Sedimentation ponds
Drainage	
1. New Construction of Drains in Central Lahore **Package A**	
1-1: Central Drain	3.0 - 12.0 ft W x 4.0 - 6.0 ft H x 17,600 ft
1-2: Dil Muhammad Road Drain	3.5 - 4.0 ft W x 3.0 - 4.0 ft H x 5,500 ft
1-3: Art Council Drain	7.5 ft W x 5.0 ft H x 2,900 ft
1-4: Allama Iqubal Road Drain	3.0 – 7.5 ft W x 3.0 - 6.0 ft H x 13,838 ft
1-5: WAPDA House Drain	3.0 ft W x 3.0 ft H x 3,110 ft
1-6: Lawrence Road Drain	3.5 ft W x 3.0 ft H x 3,688 ft
1-7: Nicholson Road Drain	3.0 ft W x 3.0 ft H x 2,463 ft
1-8: Poonch Road Drain	5.0 ft W x 4.0 ft H x 4,838 ft
1-9: Chauburji Drain	3.5 ft W x 4.0 ft H x 3,548 ft
1-10: New Samanabad Drain	4.0 – 4.5 ft W x 4.0 ft H x 4,540 ft
1-11: Morrhe Samanabad Drain	3.5 ft W x 4.0 ft H x 3,548 ft
1-12: Multan Road Drain	3.5 – 4.0 ft W x 3.0 - 4.0 ft H x 4,242 ft
1-13: Almumtaz Road Drain	3.5 ft W x 3.0 ft H x 3,188 ft
1-14: Old Bund Road Drain	4.5 – 5.0 ft W x 4.0 ft H x 6,715 ft
1-15: Sodewal Drain	4.0 ft W x 3.0 ft H x 5,038 ft
1-16: Gulgasht Drain	3.5 ft W x 3.0 ft H x 2,435 ft
1-17: Nasir Bagh Drain	3.0 ft W x 3.0 ft H x 1,100 ft
1-18: Mall Road Drain	3.0 ft W x 2.0 ft H x 1,725 ft
Package B	
1-19: Queens Road Drain	4.0 ft W x 5.0 ft H x 5,382 ft
1-20: Shahra Awane Tijarat Road Drain	4.0 – 8.0 ft W x 3.0 - 4.0 ft H x 17,490 ft
1-21: Golf Road Drain	3.0 – 4.0 ft W x 3.0 - 4.0 ft H x 5,648 ft
1-22: Kinnaird Drain	4.0 ft W x 5.0 ft H x 6,690 ft
1-23: Shah Jamal Drain	3.0 – 6.0 ft W x 3.0 - 4.0 ft H x 5,956 ft
1-24: Gulshan-e-Ravi Drain	3.0 – 10.0 ft W x 3.0 - 5.0 ft H x 11,413 ft
1-25: Sanda Road Drain	3.5 ft W x 3.0 ft H x 3,579 ft
1-26: Krishan Nagar Drain	3.0 – 12.0 ft W x 3.0 - 6.0 ft H x 17,021 ft
1-27: Rewaz Garden Drain	2.0 – 3.5 ft W x 3.0 - 4.0 ft H x 5,031 ft
1-28: Tertiary Drain	2.0 – 3.0 ft W x 2.0 - 3.0 ft H x 74,646 ft
2. Improvement and Rehabilitation of Drain in Central Lahore	
2-1: Meclod Road/Lakshmi Drain	6.0 ft W x 5.0 ft H x 2,000 ft
2-2: Governor House Drain	7.5 – 10.0 ft W x 5.0 - 7.0 ft H x 8,435 ft

(3) Objectives of the Consultancy Services

The key objectives of the Consultancy Services (the Services) are as follows:

1) Detailed Design for Phase-1 Project
2) Tender Assistance for Phase-1 Project
3) Construction Supervision for Phase-1 Project
4) Detailed Design for Phase-2 Project
5) Preparation of Master Plan for Lahore Water Supply System
6) Detailed Design of Lahore Water Supply System for Phase-2 Project
7) Study on Institutional Improvement
8) Preparation of master plan and feasibility study for water supply, sewerage and drainage outside the WASA's current jurisdiction

(4) Scope of the Services

The scope of services for Phase-1 Project is divided into three phases mainly the Detailed Design, Tender Assistance and Construction Supervision, whereas the Consultant will take over certain responsibilities from WASA (hereinafter referred to as "the Client"). The scope of the Services to be undertaken by the Consultant shall cover all but not restricted to the activities mentioned in (3) above. Throughout the Services, the Consultant shall all the times exercise all reasonable skill, care and diligence in the discharge of his duties and shall remain responsible for the accuracy and completeness of his work. In all professional matters, the Consultant shall act as a faithful advisor to the Client. In the case of a difference of opinion between the Client and the Consultant on any matter that might affect the Project, the Consultant shall promptly submit to the Client a detail written report. Thereafter the Client in consultation with JICA shall communicate the decision to the Consultant.

1) Detailed Design for Phase-1 Project

- Review, comment and propose changes, if any, on the preliminary designs of facilities/equipment proposed
- Review, comment and propose changes, if any, on planning conditions in the preliminary designs.
- Review the preliminary design conducted by JICA preparatory study.
- Undertake supplemental topographic surveys and geo-technical investigation.
- Prepare proper project management and construction management plan for quality assurance of detailed design and construction supervision stages.
- Undertake all necessary engineering works for the detailed design.
- Prepare prequalification document for each package.

- Prepare drawings, specifications and bidding documents including evaluation criteria for each package.
- Prepare detailed designs of civi1 and building structures and mechanical and electrical equipment including structura1, hydraulics, capacity and other engineering computation and analysis
- Prepare construction plan and implementation program of the Project
- Prepare detailed conditions of contract, specifications, schedules and bills of quantities for carrying out the Project.
- Assist WASA in obtaining approvals where necessary from local authorities, utility bodies, and other approving authorities in connection with the Project.
- Prepare engineering design report containing the description of the Project.

2) Tender Assistance for Phase-1 Project

- Review of the final design and the bidding documents if necessary, including preparation of final bidding documents for invitation of Contractors.
- Liaison with JICA for compliance with their requirements in respect of procedural aspects of bidding and related conditions.
- Invitation of shortlisted Contractors for each package and answering additional questions during bidding period.
- Evaluation of tender documents received including the evaluation report
- Assistance during contract negotiations and establishment of Contractors contracts.
- Assistance on right-of-way and land acquisition, if necessary
- Preparation of Monthly Project Reports comprising:
  - ✓ Project details
  - ✓ Current projects status
  - ✓ Problems outstanding
  - ✓ Matters to be dealt with in the following month
  - ✓ Revised program
  - ✓ Financial aspects
  - ✓ Action log

  and any other item identified by the Client which would enhance the contents of the report.

  This Monthly Project Reports should be prepared as a synopsis of the important issues in a short and clear manner.
- Assistance in the implementation of action log.

3) Construction Supervision for Phase-1 Project

Services under the construction stage are specified as normal and additional services as follows:-

3-1) Normal Services

(a) Subsequent to the award of each contract, Consultants will assume the role of the Engineer as defined in FIDIC Construction Contract documents and shall be responsible for the administration of the works, including:

- Advising the Client on the appointment of the resident site staff of the Contractor in accordance with the terms and provisions;
- Ensuring all construction and installation works are to the details and required standards as specified;
- Advising the Client on the necessity for the inspection and testing of materials and plant supplied under the contract and arranging for these to be carried out on his behalf as approved, where applicable;
- Implementation of the Action Log;
- Arranging and guiding regular progress meetings with the Contractor;
- Monitoring of progress and total costs with a view to completion within time and budget. The Client shall be advised, on a regular basis, on these matters. Progress Reports shall be submitted to the Client on a monthly basis;
- Planning, coordination and liaison as necessary, to minimize the impact of the works on other parties, such as the Client, nearby property owners, service authorities, the public, etc.;
- Issuing certificates for payment to Contractors with appropriate make-up sheets;
- Preparing reinforcement schedules and any further designs and drawings necessary for the information of the Contractors to enable them to carry out the works;
- Technical quality assurance should be provided according to ISO 9001 which has to be built in as general overhead expenditures.
- Advice on amendments/changes to the present construction works to optimize.
- Commissioning of the works and assisting the Client with respect to acceptance of the works;
- Establishing operating and maintenance procedures, if required.
- Delivering to the Client on completion of the works three sets of such records as are necessary for operation and maintenance including "as-built" drawings (with reinforcement details) and making arrangements through the Contractors for the supply of the associated documents, such as manufacturers' manuals, recommended maintenance schedules and list of spares required for proper maintenance;
- Assisting in settling disputes or differences, which may arise between the Client and Contractor except litigation and arbitration.
- Ensuring that health and safety procedures are respected by Contractors.

- Evaluation of shop drawing and instruct contractors to modify in case.
- Prepare the O&M manual.

(b) Reports

Monthly Project Reports

The Consultants shall prepare Monthly Reports outlining the status on each Contract, the difficulties experienced and the incidents occurring which would require Clients attention.

Quarterly Project Reports

Quarterly Project Report will have to comprise project details, progress during last quarter, current project status, problems outstanding, matters to be dealt with in the following quarter revised program, financial aspects, action log and any other important item identified by the Client and/or requested by the financing agency.

Special Project Reports

The Consultants shall draw up special reports and send them to the Client as quickly as possible when on-site difficulties or technical problems arising can only be solved by modifying the contract documents and thereby incurring major unforeseen expenditure. The reports shall include details of the cost of any proposed methods of solving the problem.

(c) Liaison with JICA and Clients Representative

The Consultants will, in close cooperation with the Client, liaise with the Funding Agency (JICA) for compliance with their requirements in respect of the technical and financial aspects of the Project and to streamline any of the procedural requirements. .

The Consultants shall furthermore liaise closely with the Project Management Unit (PMU) of the WASA or his authorized representative, nominated by the Client, who will be responsible for the approval of all technical and financial matters and who would assume the responsibility for the role of the Client.

(d) Transfer of Technology

For on-the-job training of the WASA personnel nominated for the purpose throughout the period of the services, the Consultant shall prepare a training program for technical and management officials of the WMA on the supervision for the operation and maintenance of the Pumping Stations and Wastewater Treatment Plant.

3-2) Additional Services

Services under this section comprise: ·

(a) Preparation of the Final Completion Report and final account.

On completion of the works, the Consultants shall draw up a final confidential report, treating the following points in full:

- a breakdown of the final cost of the works under subheads to be given by the PMU, including in particular assessment of extra expenditures and its causes
- assessment of any claims made by the Contractor
- a description of the works carried out and of the techniques employed
- a critical study of important technical problems posed during the execution of the works;
- as built drawings
- other items as requested by the Client and JICA.

(b) Performing any duties, which the Consulting Engineer may be required to carry out under any contract for the execution of the works.

4) Detailed Design of Sewerage and Drainage Facilities for Phase-2 Project

The Phase-2 Project comprises the following scopes:

The scope of services described in “1) **Detailed Design for Phase-1 Project**” above are also applied to this consultancy services.

Table 12.11 Facility/Equipment to Be Constructed/Installed in Phase 2 Project

Phase-2 (2018-2022)	Specifications
Water supply	
1. Development of Infrastructure for Alternative Water Source 1-1: construction of intake and treatment plants 1-2: development of transmission and distribution network system including reservoirs, relevant for development of surface water source **2. Reduction of Unaccounted-for-water and Non-revenue-water** 2-1: installation of customer meters in 100% of connections 2-2: expansion of DNI to the other areas outside the pilot area (refer to Management section on other institutional measures)	
Sewerage	

1. Sewer – South Area – 1-1: construction of sewer and conduit system in Gulberg and Adjacent Area 1-2: construction of sewer and conduit system from Peco Road and Mohlanwal 1-3: construction of sewer and conduit system in North of Canal Area **2. Disposal Station– South Area –** 2-1: new construction of Mohlanwal and Kotar Bund Disposal Station 2-2: improvement of existing LMP Block Disposal Station **3. Wastewater Treatment Plant – South Area –** 3-1: construction of South Wastewater Treatment Plant **4. Sewer, Disposal Station, and Wastewater Treatment Plant – South East Area –** (If Government of Punjab with its own resources does not implement during the phase 1 period, this component would be considered as the phase 2 scope.)	
Drainage	
1. New Construction of Drain in South Lahore 1-1: Gulberg Drainage System 1-2: Garden Town & Model Town Drainage System 1-3: Town Ship & Green Town Drainage System 1-4: Industrial Area Drainage System 1-5: Raiwind Road Drainage System 1-6: Jubillee Town Drainage System 1-7: Defense Road Drainage System 1-8: Hudiara Drainage System 1-9: Multan Road Drainage System 1-10: Drainage System North of Lahore Branch Canal 1-11: Secondary / Tertiary Drain **2. Improvement and Rehabilitation of Drains in South Lahore** 3-1: Garden Town Drain 3-2: College Road Drain 3-3: New Industrial Drain III 3-4: New Industrial Drain VI 3-5: Link Road Drain 3-6: Main Industrial Drain 3-7: Gulberg Drain	

5) Preparation of Master Plan for Lahore Water Supply System

(a) Project Background

The current water source of Lahore water supply system fully relies on groundwater, but due to the lasting drawdown of groundwater by over-pumping and an increase of arsenic concentration in groundwater, it becomes difficult to further rely on groundwater only and the development of surface water source is required for safe water supply.

This master plan is to develop the surface water supply system including the construction of intake works, water treatment plant, raw and clear water transmission pipes and distribution networks and other facilities necessary for conjunctive water management system of ground and surface water

(b) Consulting services

- To conduct water quality survey of groundwater and surface water.
- To assist WASA to prepare the application for surface water intake from the River Ravi.
- To make future population and water demand projection.
- To prepare the Master Plan for Lahore Water Supply System.
- To undertake necessary site survey for land acquisition, topographic surveys and geo-technical investigation.
- To establish the conjunctive water management plan of groundwater and surface water.
- To identify the locations of water intakes, water treatment plant, and overhead reservoirs.
- To identify the routes of raw water and clear water transmission mains.
- To make preliminary design of a surface water supply system including intake works, raw water transmission mains, water treatment plant, clear water transmission mains, overhead water reservoirs, water distribution network and so on.
- To conduct required engineering calculation such as hydraulics, capacity, power load, etc.
- To analyze water distribution pipe network.
- To identify the scope of work for a surface water supply system to be implemented in Phase-2 Project.

6) Detailed Design of Lahore Water Supply System for Phase-2 Project

The facilities/equipment of Lahore Water Supply System for Phase-2 Project shall be identified in “5) Preparation of Master Plan for Lahore Water Supply System” above, which will tentatively include intake works, raw water transmission mains, water treatment plant, clear water transmission mains, overhead water reservoirs and so on.

The scope of works described in “1) **Detailed Design for Phase-1 Project**” above are also applied to this consultancy services.

7) Study on Institutional Improvement

[2. Timely data acquisition and preparation of definite vision and strategies]

(a) Implementation of comprehensive asset survey and preparation of asset inventories and drawings

[refer to “2-3 of the Framework for Institutional improvement” in **Figure 10.1**]

1) To study the current situation of asset management in the WASA.
2) To develop a comprehensive asset management system for WASA.
3) To select a pilot area.
4) To carry out the asset survey for a pilot area.
5) To evaluate the proposed comprehensive asset management system based on the results on asset survey
6) To modify the proposed comprehensive asset management system.
7) To conduct the training on the proposed comprehensive asset management system and asset survey to the WASA’s staff
8) To prepare the manual for the proposed comprehensive asset management system

[3. Reduction of unaccounted-for-water and non-revenue-water]

(b) Clarification of rights and responsibilities in relations with customers (desirable rights and responsibilities for adequate maintenance of service pipes and meters and for timely payment should be examined and consequentially defined in legal documents (law, charter, or contract))

[refer to “3-1 of the Framework for Institutional improvement” in **Figure 10.1**]

1) To clarify the current rights and responsibilities in relations with customers
2) To evaluate the current rights and responsibilities
3) To develop the new rights and responsibilities.
4) To revise the new rights and responsibilities through discussion.
5) To finalize the new rights and responsibilities at the steering committee.

(c) Installation of meters in all connections in phases (Issues may include handling of buildings constructed before 1997, cost sharing with customers, awareness raising of customers, equity among customers, and capacity enhancement for meter repairing) [described in Punjab Urban Water and Sanitation Policy]

[refer to “3-2 of the Framework for Institutional improvement” in **Figure 10.1**]

1) To investigate the conditions of customer meter installation
2) To prepare the standard drawing for customer meter installation
3) To prepare the bidding documents and cost estimation

4) To assist the bidding for procurement and installation of customer meters
5) To assist the WASA's training to Licensed water fitting plumbers to be subcontracted
6) To supervise the customer meter installation works

(d) Establishment of leakage detection teams
[refer to "3-3 of the Framework for Institutional improvement" in **Figure 10.1**]

1) To investigate the tools and equipment required for leakage detection.
2) To prepare the bidding documents and cost estimation
3) To assist the bidding for procurement of leakage detection equipment
4) To assist the establishment of leakage detection teams
5) To conduct a training to WASA's leakage detection teams
6) To prepare the manual for leakage detection

(e) Implementation of distribution network improvement, first in the pilot area and subsequently to other areas
[refer to "3-4 of the Framework for Institutional improvement" in **Figure 10.1**]

1) To select the pilot area
2) To investigate all the existing water supply facilities in the pilot area
3) To install the bulk flow meters at the relevant tube-wells and water meters at all customers' house
4) To conduct the leakage detection survey in the pilot area.
5) To conduct the first measurement at the bulk flow meters and water meters
6) To collate the results between the first measurement and results of leakage detection survey
7) To prepare a rehabilitation plan of water distribution pipes.
8) To prepare the bidding documents and cost estimation
9) To recommend the issuance of the change of order.

(After the completion of rehabilitation works)

10) To conduct the second measurement at the bulk flow meters and water meters
11) To evaluate the performance of a rehabilitation plan of water distribution pipes.
12) To prepare the manual for preparation of a rehabilitation plan of water distribution pipes.
13) To hold a seminar for preparation of a rehabilitation plan for WASA's staff.

(f) Implementation of stringent measures against defaulters and illegal connections and phasing-out of uncharged public stand posts

[refer to "3-5 of the Framework for Institutional improvement" in **Figure 10.1**]

1) To investigate the current measures against defaulters and illegal connections.
2) To evaluate the effectiveness of current measures
3) To study the alternatives, if necessary.
4) To prepare the reports with recommendations for measures of defaulters and illegal connections.
5) Enforcement

(g) Entrustment of metering and billing to private companies
[refer to "3-6 of the Framework for Institutional improvement" in **Figure 10.1**]

1) To investigate the current situation of entrustment of certain works to private companies.
2) To evaluate the direct metering by WASA itself and entrustment of metering to private companies
3) To prepare the reports with recommendations for entrustment of metering and billing.
4) To hold a seminar for the entrustment of metering and billing for WASA's staff.
5) Enforcement

[4. Human resource development and organizational streamlining]

(h) Organizational restructuring including strengthening of planning section and section directly supporting the WASA management
[refer to "4-1 of the Framework for Institutional improvement" in **Figure 10.1**]

1) To investigate the current situation of WASA organization.
2) To make the problem analysis of WASA organization.
3) To develop the organizational restructuring plan.
4) To improve the organizational restructuring plan through discussions with the WASA IC
5) To prepare the report with recommendations for organizational restructuring
6) Enforcement

(i) Improvement of personnel management and human resource development
[refer to "4-2, 4-3 and 4-4 of the Framework for Institutional improvement" in **Figure 10.1**]

1) To investigate the current situation of personnel management and human resource

development.

2) To make the problem analysis of personnel management and human resource development.
3) To develop a strategy and programme of personnel management and human resource development.
4) To improve the strategy and programme through discussions with WASA IC
5) To finalize the strategy and programme through discussions with SC
6) To prepare the report with recommendations for personnel management and human resource development

(j) Entrustment of certain works to private companies
[refer to “4-5 of the Framework for Institutional improvement” in **Figure 10.1**]

1) To investigate the current situation of entrustment of certain works to private companies.
2) To extract and evaluate the possible works for entrustment.
3) To improve the entrustment plan through discussions with WASA IC
4) To prepare the reports with recommendations of the works for entrustment.
5) Enforcement

(k) Establishment of Management Information System
[refer to “4-7 of the Framework for Institutional improvement” in **Figure 10.1**]

1) To investigate the fields required for a Management Information System in WASA.
2) To evaluate the necessity and priority of fields to be handled in MIS
3) To design a Management Information System.
4) To prepare the bidding documents and cost estimation for MIS.
5) To assist the bidding process for MIS.
6) To construct a Management Information System.
7) To make a trial operation.
8) To prepare the manual for a Management Information System.
9) To make a training by field to WASA’s staff.
10) To turn over a Management Information System to WASA.

(l) Procurement of O&M equipment
[refer to “4-8 of the Framework for Institutional improvement” in **Figure 10.1**]

1) To survey the current situation of O&M equipment proposed for Phase-1 Project.
2) To evaluate the necessity and priority of O&M equipment for Phase-1 Project.

3) To check the necessity of training by a manufacturer's instructor.
4) To prepare the bidding documents of O&M equipment for Phase-1 Project and cost estimation.
5) To assist the bidding of O&M equipment for Phase-1 Project..
6) To make a trial operation.
7) To make a training to WASA's staff, if necessary.
8) To turn over O&M equipment to WASA.

[5. Improvement of customer services]

(m) Regular implementation of customer survey
[refer to "5-2 of the Framework for Institutional improvement" in **Figure 10.1**]

1) To investigate the customer survey in other public services, if any.
2) To study the items to be included in the questionnaire.
3) To study the questionnaire survey method.
4) To prepare the questionnaire.
5) To conduct the questionnaire survey using a local social survey firm
6) To analyze the results of the questionnaire survey.
7) To review the questionnaire and survey method.
8) To prepare the manual for the questionnaire survey on customer satisfaction.
9) To hold a seminar for the questionnaire survey for WASA's staff

(n) Improvement (quick and transparent) of complaint handling system
[refer to "5-3 of the Framework for Institutional improvement" in **Figure 10.1**]

1) To investigate the current situation of a complaint handling system in WASA.
2) To evaluate the complaint information communication system.
3) To study the new complaint handling system using a Management Information System (MIS).
4) To design the format used in the complaint information communication system.
5) To study the devices/instruments required for a MIS.
6) To procure the devices/instruments.
7) To construct a complaint handling system with a MIS.
8) To make a trial operation.
9) To prepare the manual for a complaint handling system with a MIS.
10) To make a training to WASA's staff.
11) To turn over a complaint handling system with a MIS to WASA.

(o) expansion of unmanned payment options for customers

[refer to “5-4 of the Framework for Institutional improvement” in **Figure 10.1**]

1) To investigate the current situation of payment methods by customers.
2) To study the currently available alternative payment methods
3) To evaluate the payment methods.
4) To prepare the reports with recommendations for payment methods
5) To prepare the bidding documents of unmanned payment machines and cost estimation, if necessary
6) To procure the unmanned payment machines.
7) To install the unmanned payment machines.

(p) Preparation of public relation strategy and its implementation (media, public meeting, brochure, events, movie etc.)
[refer to “5-5 of the Framework for Institutional improvement” in **Figure 10.1**]

1) To study the current situation of public relation in the WASA.
2) To study other possible methods for public relation.
3) To evaluate the methods for public relation.
4) To recommend the proposed methods for public relation.
5) To practice the proposed methods for public relation.

(q) Study on groundwater monitoring and regulation
[refer to “6” of “**12.4 Institutional Improvement**”]

1) To monitor the water quality of groundwater.
2) To survey the present situation of groundwater use in the Bari Doab regarding the location, pumpage, well depth and so on.
3) To estimate an amount of groundwater use by sector and season.
4) To evaluate groundwater resources.
5) To assist the establishment of Bari Doab Groundwater Committee.
6) To support the operation of Bari Doab Groundwater Committee.
7) To study and propose the plan to control and regulate the groundwater use.
8) To study and propose the regular monitoring programme of groundwater

8) Preparation of master plan and feasibility study for water supply, sewerage and drainage outside the WASA’s current jurisdiction

(a) Project Background

In the outside the WASA's current jurisdiction, the water supply, sewerage and drainage facilities are planned and constructed by the Public Health Engineering Department (PHED) on the community basis and there is no master plan covering such areas.

The development of the Lahore core area currently covered by WASA has led to the development of the suburban area where now requires the blueprint for the provision of water supply, sewerage and drainage facilities.

(b) Study Area

The study area shall be outside the WASA's current jurisdiction under the CDGL administration.

(c) Consulting services

- To collect and arrange the existing data/information concerned with water supply, sewerage and drainage facilities.
- To survey the current status of existing water supply, sewerage and drainage facilities.
- To make future population and water demand projection.
- To prepare the Master Plan for water supply, sewerage and drainage systems.
- To undertake necessary site survey for land acquisition, topographic surveys and geo-technical investigation.
- To identify the locations of major facilities for water supply, sewerage and drainage.
- To identify the routes of major water distribution pipes, sewers and drains as required..
- To make preliminary design of major facilities for water supply, sewerage and drainage
- To conduct required engineering calculation such as hydraulics, capacity, power load, etc.
- To analyze water distribution pipe network.
- To conduct the feasibility study for water supply, sewerage and drainage in the prioritized area.
- To make a cost estimation for construction of proposed facilities.
- To prepare the reports of master plan and feasibility study for water supply, sewerage and drainage systems outside the WASA's current jurisdiction under the CDGL administration.

(2) Consultants' Engineers to Be Required.

Table 12.12 Consultants' Engineers to Be Required

Category	Engineers to be required
	Project Manager
Water supply for Phase 1	Water planning engineer, UFW expert, Leak detection specialist, Leak repair specialist, Pipeline engineer, Construction planner, Quantity surveyor, Bidding document specialist, Survey expert, Water supply engineer, Water supply supervisor
Sewerage for Phase 1&2	Sewerage planning engineer, Structural engineer I&II, Geologist/material engineer, Mechanical engineer, Electrical Engineer, Construction planner, Quantity surveyor, Architect, Bidding document specialist, Project economist, Environmentalist, Survey expert, Sewage engineer, Sewage treatment Plant supervisor, Sewer system supervisor I&II
Drainage for Phase 1&2	Drainage planning engineer I&II, Structural engineer, Hydrologist, Geologist/material engineer, Construction planner, Quantity surveyor, Bidding document specialist, Project economist, Environmentalist, Survey expert, Drainage supervisor
Master plan for water supply	Water treatment engineer I&II, Intake facility engineer, Pipeline engineer, Geologist/material engineer, Mechanical engineer, Electrical Engineer, Construction planner, Quantity surveyor, Architect, Project economist, Environmentalist, Survey expert
Water supply For Phase 2	Water treatment engineer I&II, Intake facility engineer, Pipeline engineer I&II, Structural engineer, Geologist/material engineer, Mechanical engineer, Electrical Engineer, Construction planner, Quantity surveyor, Architect, Bidding document specialist, Survey expert
Institutional improvement	Institutional specialist I&II, Groundwater specialist
M/P and F/S for water supply, sewerage and drainage outside WASA area	Water planning engineer, Sewerage planning engineer, Drainage planning engineer, Geologist/material engineer, Mechanical engineer, Electrical Engineer, Construction planner, Quantity surveyor, Architect, Project economist, Environmentalist, Survey expert

Total man-month required

Foreign consultants	788 M/M
Local consultants	1,239 M/M
Support staff (engineering)	714 M/M
Support staff (administration)	483 M/M

CHAPTER 13 PRELIMINARY DESIGN OF PHASE-I PROJECT

13.1 Topographic Survey and Soil Investigation

To confirm the topographic features on site of the collector channels and wastewater treatment plant, a Topographic Survey and Soil Investigations were conducted. The results are shown in **Appendix 13.7**.

13.2 Water Supply

The details of design considerations for UFW reduction measures being considered are described in **Chapter 10.1.3**.

13.3 Wastewater Treatment Plant

13.3.1 Basic Conditions

(1) Design Flow

The design flow of the south west treatment plant is shown in brief in **Table 13.1** (see **Appendix 13.1** for details).

Table 13.1 Sewage Flow in South West Treatment Plant

Description	Year	2011	2016	2021	2026	2031	2035
Population	million	2.638	2.912	3.204	3.433	3.689	3.894
Sewered Ratio	%	85%	88%	91%	95%	98%	100%
Sewered Population	million	2.249	2.573	2.930	3.246	3.602	3.894
Sewage Discharge per Capita	Lpcd	221	212	200	188	174	164
Industrial Sewage Flow	m^3/d	150,000	150,000	150,000	150,000	150,000	150,000
Sewage Flow	m^3/d	646,950	695,432	736,013	760,160	776,781	788,663

(2)Sewage Quality

1) Influent Sewage Quality (BOD_5)

According to the water quality survey conducted in this study, the average concentration of BOD_5 in the existing drainage is 164 mg/L. Meanwhile, water consumption per capita is 225 liters. Therefore, it can be assumed that the pollutant load per capita is 36.9g ($164\times225\div10^3=36.9$).

If it is assumed that the pollutant load per capita will increase by about 10% in the future, the pollutant load per capita will be 40.6g ($36.9\times1.1=40.6$). In this case, considering future water consumption estimate which is 164 liters per capita, influent sewage quality will be 247.5 mg/L ($40.6\div164\times10^3=247.5$). Additionally, taking into consideration the effluent quality of industrial wastewater into the sewerage system which is 250 mg/L, it can be determined that the overall influent sewage quality (BOD_5) is about 250 mg/L.

2) Effluent Sewage Quality (BOD_5)

Effluent sewage quality (BOD_5) flowing into a public water body is set at less than 80 mg/L by NEQS (National Environmental Quality Standards). This standard is not severe when compared with international standards so that the effect on a public water body by the provision of a wastewater treatment plant is not significant. However if more severe standards (such as EU standards of 25 mg/L) is used in this project, complicated treatment processes will have to be adopted and it will not be achievable from a sustainable O&M point of view. Therefore, as an interim target, 50 mg/L will be accepted and adopted as effluent sewage quality. This means that the wastewater treatment plant is required to achieve an 80% removal rate of BOD_5.

(3) Summary of Basic Conditions

Table 13.2 shows the summary of basic conditions in the south west wastewater treatment plant.

Table 13.2 Summary of Basic Conditions in South West Wastewater Treatment Plant

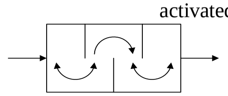
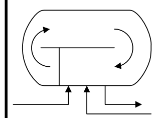
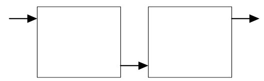
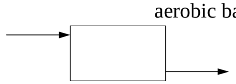
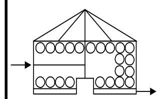
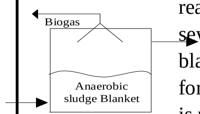
Items	Conditions	Remarks
(1) Target Year	2035	
(2) Service Area	Central Area (100.26 km^2)	
(3) Design Population	3,894,300	
(4) Design Flow	790,000 m^3/d (Daily Average)	323 Cft/s (Daily Average)
(5) Sewage Quality (BOD_5)		
Influent	250 mg/L	
Effluent	50 mg/L (Removal rate of 80% or more)	Less than 80 mg/L (NEQS)
(6) Site		
Area	7300 Kanal (304.3 ha)	Already acquired
Ground level (Existing)	+199.0 m	
Effluent River	Ravi River through the Existing Canal	
Surrounding Condition	Agricultural land, Highway	
Wind Direction	from north-west (in winter) from south-east (in summer)	
Temperature	Av. 14.3 °C	Lowest Quarter Term

13.3.2 Treatment Process

(1) Outlines of Treatment Process

The main features of treatment processes generally applied in the case of domestic wastewater are shown in **Table 13.3**.

Table 13.3 Outlines of Treatment Process (1/2)

Treatment Method	Composition of Treatment Process	Theory of Reactor for Tank	Features of Treatment Process
Conventional Activated Sludge	→ P.S.T. → R.T. → F.S.T. → Sludge Treatment facility	 Sewage flows down together with activated sludge organic substance is absorbed and assimilated by activated sludge.	Retention time in reactor tank is relatively short and load is high. Thus, a primary sedimentation tank is needed to cope with the fluctuations in sewage flow and quality and to equalize/mitigate the load. A sludge treatment facility is necessary as well.
Oxidation Ditch	→ R.T. → F.S.T. → Sludge Treatment facility	 Sewage is circulated together with activated sludge and contained organic substance is absorbed and assimilated by activated sludge.	This process is flexible to the fluctuation of sewage flow and quality by its long retention time in reactor tank. A primary sedimentation tank is not necessary, however, a sludge treatment facility is needed.
Stabilization Pond	→ R.T.(1) → R.T.(2) → R.T.(3) →	 Sewage is purified by oxidation of aerobic bacteria activated by oxygen supply through algae or anaerobic bacteria.	Since oxygen supply in reactor tank is conducted by natural oxidation and photosynthesis of algae retention time is extremely long. Sludge treatment facility is not needed . Anaerobic pond, maturation pond and aerobic ponds are allocated individually or combined.
Aerated Lagoon	→ R.T. → F.S.T. →	 Sewage is purified by oxidation of aerobic bacteria.	Since supply in reactor tank will be done by compulsory oxidation, retention time is shorter than that of flowing stabilization pond. Sludge treatment facility will not be needed.
Trickling Filter	→ P.S.T. → R.T. → F.S.T. → Sludge Treatment facility	Section  Sewage is sprinkled on bio-filter by rotating distributor. Contained organic substance is absorbed/assimilated by bacteria attaching on the bio-filter. Enlarged bacteria membranes fall out and are removed.	Primary sedimentation tank must be installed to prevent clogging in the bio filter and distributor's nozzle. A sludge treatment facility is needed as well.
UASB (Upflow Anaerobic Sludge Blanket)	→ R.T. →	Section  The sewage to be treated is introduced in the bottom of the reactor. Treatement occurs as the sewage comes through a sludge blanket composed of biologically formed granules or particles. The gas is produced under anaerobic conditions.	The key feature of the UASB process that allows the use of high volumetric COD loadings is the development of a dense granulated sludge. It is affected by the wastewater characteristics such as pH, nutrient addition and also upflow velocity. Several months may be required to develop the granulated sludge.

Note: P.S.T(Primary Sedimentation Tank), R.T(Reactor Tank), F.S.T(Final Sedimentation Tank)

Table 13.3 Outlines of Treatment Process (2/2)

Treatment Method	General Features	Operation and Maintenance
Conventional Activated Sludge	* BOD removal rate is superior, 85-95%. * Transparency of treated effluent is high. * Stability in sewage temperature fluctuation is inferior in comparison with other methods. * Generated sludge volume is larger than from other methods.	* The system has many maintenance and inspection points. Thus, advanced/complicated operational techniques are needed. * There is much energy consumed.
Oxidation Ditch	* BOD removal rate is worse than conventional method. * Transparency of treated effluent is high. * Stability in sewage temperature fluctuation is good. * Generated sludge volume is less than from conventional methods. * Denitrification is possible by choosing operational conditions.	* Operation and Maintenance is easy as since no advanced/complicated operational techniques are needed. * Trere is much energy consumed.
Stabilization pond	* Although BOD removal rate is affected by sewage temperature and retention time, approximately 75-90% BOD removal can be expected. * Stability in sewage flow and temperature fluctuation is relatively good but once deteriorated, recovery takes a long time. * Odours and harmful insects are generated:	* Easiest in O&M due to "Equipment-free" process. * Algae control is important for stable treatment efficency. * Ponds should be drained periodically, once in 1 to 5 years. Sludge should be hauled off-site/disposed of after drying by sun light.
Aerated Lagoon	* BOD removal rate is affected by sewage temperature and retention time as well as stabilization pond, the rate will be 75-90% approximately. * Stability in load fluctuation is superior. * Less odour generation.	* O&M is easy since there's simple equipment like aerators are used. * There is much energy consumed.
Trickling Filter	* BOD removal rate is 80-90%. * Transparency of treated effluent is worse than Activated Sludge Method. * Less affected by sewage temperature fluctuation compared with Activated Sludge Method. * Flies and Odours are generated.	* O&M is easy since no advanced/complicated operational technique is needed. * There is little energy consumed. * Attention must be paid to flies/odour generation.
UASB	* BOD removal rate is 60-80%. * Transparency of treated effluent is worse. * Additional process may be required depend on the effluent quality standard. * Odours are generated.	* O&M is easy since no advanced/complicated operational techniques are needed. * There is very little energy consumed.

(2) Comparison of Treatment Process

Table 13.4 shows the comparison of treatment systems. This is based on the "*Master Plan for Urban Wastewater Treatment Facilities in Pakistan Final Report, June 2002, Ministry of Environment, Pakistan*" as quoted from the World Bank's report. Based on this comparison, waste stabilization ponds are strongly recommended in developing countries. Moreover comparisons of rough project costs are shown in **Table 13.5**. Details of the rough project cost estimations are shown in **Appendix 13.2**.

Table 13.4 Comparison of Wastewater Treatment Systems

Criteria	Trickling Filter	Activated Sludge	Oxidation Ditch	Aerated Lagoon	Stabilization Pond	UASB
BOD_5	++	++	+++	+++	+++	+
FC Removal	+	+	++	+++	+++	+
SS Removal	+++	+++	+++	++	++	++
Virus Removal	+	++	++	+++	+++	+
Effluent Reuse Possibilities	+[1]	+[1]	++	+++	+++	+
Simple and Cheap Construction	+	+	++	++	+++	+++
Simple Operation	++	+	++	+	+++	++
Land Requirement	+++	+++	+++	++	++	+++
Maintenance Cost	++	+	+	+	+++	+++
Energy Demand	++	+	+	+	+++	+++
Minimization of Sludge for Removal	++[2]	++[2]	+	++	+++	++

LEGEND: +++ (Good), ++ (Fair), + (Poor)

Note:

1. The effluents from activated sludge, trickling filter frequently have high ammonia levels (>5mg/L) and faecal bacterial concentrations, and are usually not suitable for irrigation or fish farming without tertiary treatment.
2. Assumes provision of sludge digesters

Source: Master Plan for Urban Wastewater (Municipal and Industrial) Treatment Facilities in Pakistan Final Report, June 2002, Government of Pakistan, Ministry of Environment, Local Government and Rural Development

Note: UASB (Upflow Anaerobic Sludge Blanket) was added by the JICA Study Team

Table 13.5 Comparison of Capital and Running Costs of Wastewater Treatment Systems

(Unit: Million Rs)

Item	Activated Sludge	Oxidation Ditch	Aerated Lagoon	Trickling Filter	Waste Stabilization Pond	UASB
Construction cost	16,998	12,239	8,499	11,389	14,397	15,128
Land Acquisition	-	-	-	-	1,139	-
O&M cost (Electricity) (for 30 years)	32,635	41,783	24,482	9,148	0	7,513
O&M cost (Sludge Disposal) (for 30 years)	2,487	1,872	3,010	2,654	2,180	1,351
Total Project Cost	52,120 (100%)	55,894 (107%)	35,991 (69%)	23,191 (44%)	17,716 (34%)	23,992 (46%)

Note: (1) Cost of waste stabilization ponds will involve additional land purchase. (2) Cost for land purchase is estimated by information of "Lahore South-West WWTP, Review of Parameters (1994, Balfour Maunsell)"

(3) Evaluation (Primary evaluation)

Activated Sludge, Oxidation ditch, Aerated lagoon

According to the results of a comparison, project costs of suspended-growth biological treatment processes such as activated sludge, oxidation ditch and aerated lagoon are high when compared with other processes. This is mainly a result of high operating costs, especially electricity costs. Electricity costs of these treatment processes are approximately Rs. 90 million per month which is almost equivalent to a whole month's electricity cost for WASA. Moreover, the required electrical energy for these treatment processes is approximately 4 w/person. Electric energy consumption per capita in Pakistan is 358 kwh/year (Water and Power Development Authority, 2002) so that the electrical energy for these treatment processes equals almost 10 % of the per capita total electric energy consumption ($4w \times 24hr \times 365day \div 358 \times 10^{-3} = 0.098$). Considering the financial status of WASA and the electricity supply conditions in Pakistan, these treatment processes are not desirable.

Stabilization Pond

If the necessary land can be purchased on conditions of application of the "Land Acquisition Act", the waste stabilization pond is the most economical process. However the quantity which can be treated in the existing acquired land is only 250,000 m^3/d against the currently required treatment capacity of 640,000 m^3/d (refer to **Appendix 13.3**).

Whether the necessary appropriation of land will be carried out is not clear at the present time.

UASB

Since the Upflow Anaerobic Sludge Blanket (UASB) process has low removal ratios, independent adoption of this methodology is difficult to justify. UASB process is used as a primary treatment process in many cases in which a high concentration inflow is received. It needs an additional process, such as a trickling filter process, for domestic wastewater treatment. In that case, the project cost of UASB including the additional process is almost the same as the projected cost of using the trickling filter process alone. Therefore, there is no added advantage in adopting the UASB process because it needs the operation of two different processes.

Trickling Filiter

As mentioned above, when the current financial status and O&M capability of WASA, and the electricity supply conditions in Pakistan are taken into consideration, the trickling filter process is the most suitable treatment method in order to treat the total amount of sewage within the existing acquired land.

Additionally, in case of adopting the trickling filter process, the following combination (below) can be considered as a variation.

Table 13.6 Combinations of Trickling Filter Process

Primary Treatment	Secondary Treatment	
	Biological Process	Sedimentation Process
- Anaerobic pond - Primary settling tank - UASB	- Trickling Filter	- Secondary settling tank - Sedimentation pond

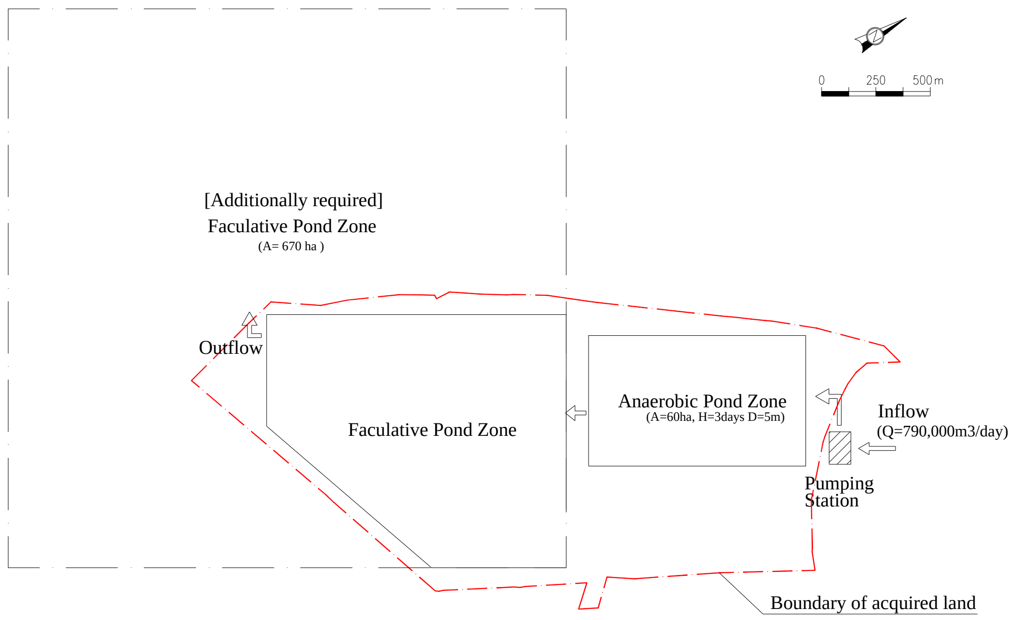
Combination of treatment processes should be selected by considering the simplicity of operation, electrical energy used, sludge disposal options, land availability and so on. In this case, the land extent of 7,300 kanal (kanal = 1/8th of an acre) has already been acquired and all combinations of treatment processes can be applicable for this acquired land. In other words, this acquired land is a prior investment and should be utilized as much as possible. Therefore, it is recommended that a combination of “Anaerobic Pond + Trickling Filter + Sedimentation Pond” be adopted.
(This combination is described by “Domestic wastewater treatment in developing countries [Duncan Mara, 2004]”)

It is noted that although the O&M of the trickling filter process is comparatively simple it is not entirely free of maintenance. For example, control of recirculation flow is needed to upkeep the proper condition of filters. Under inadequate conditions, problems such as the production of odours and breeding of flies may arise. Moreover, adoption of trickling filter processes for new wastewater treatment plants, especially on a large scale such as in Lahore city, has not been used much recently.

(4) Suggestions
Based on the primary evaluation, following options are suggested as the treatment process for the south west treatment plant.

- Option-1 : Stabilization Pond
- Option-2 : Trickling Filter
- Option-3 : Aerated Lagoon

General layout and main merits/demerits of each option are shown in **Figure 13.1** to **Figure 13.3.**



Composed by: Anaerobic Pond + Facultative Pond

Outline of Stabilization pond (Sample)

- Basically, operational control is not needed.
- Periodic removal of sludge which accumulates in the pond is necessary.

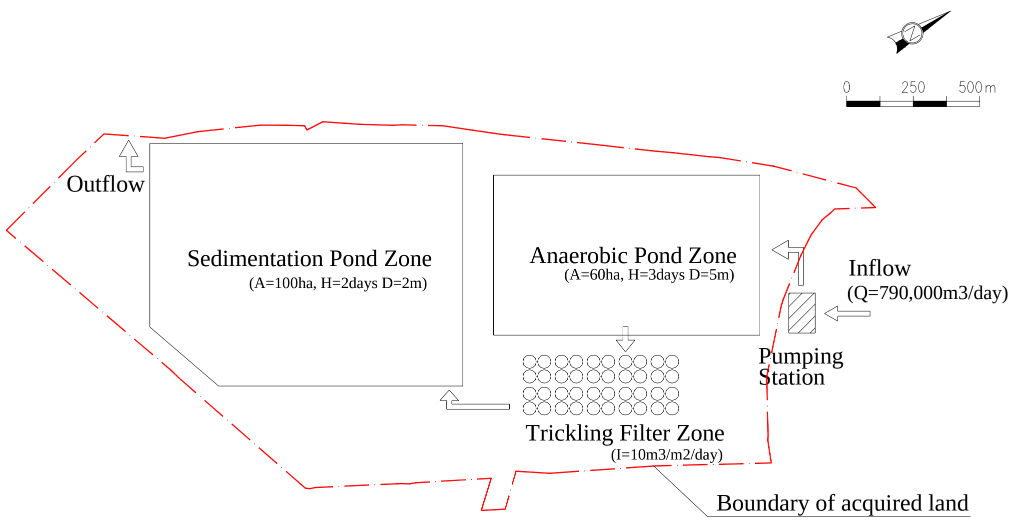
Merits;

- Project cost is most economical.
- O&M is simple.
  (However, O&M may be uncontrollable because of the required site being too large)

Demerits;

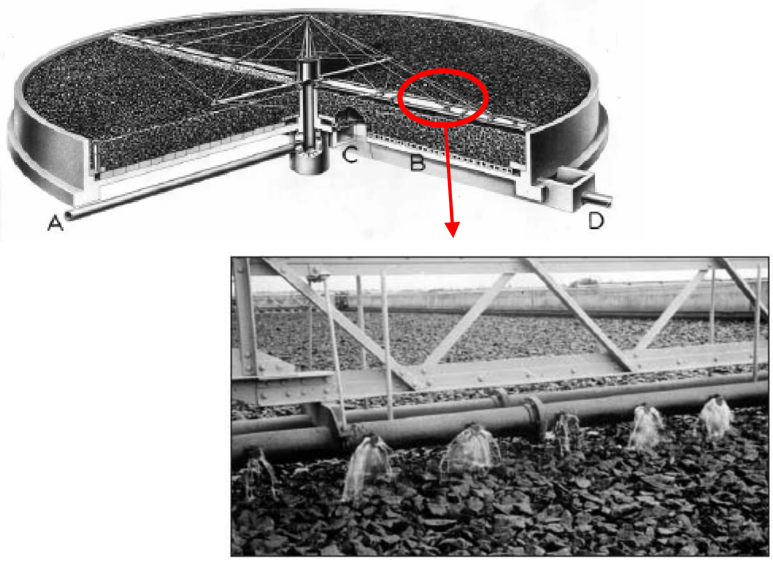
- ***Additional Land purchase is necessary for treatment of full design flow.***

Figure 13.1 Option 1: Stabilization Pond



Composed by: Anaerobic Pond + Trickling Filter + Sedimentation Pond

Outline of Trickling Filter (Sample)



- Maintenance of rotating distributor and cleaning of filter material in the tank are needed.
- Control of recirculation flow is necessary for proper operation.

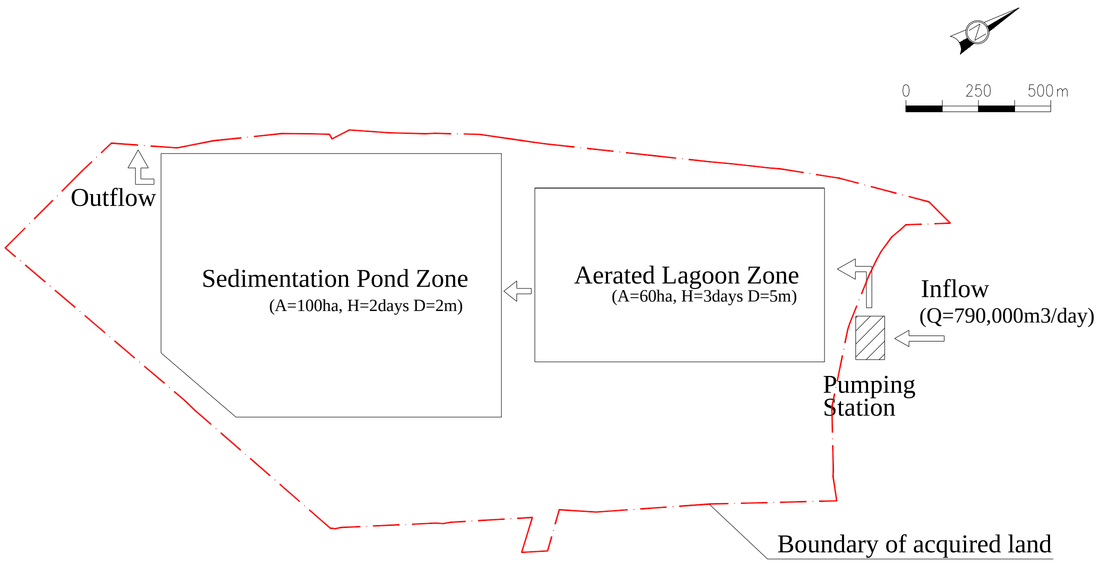
Merits;

- ➢ All amounts of sewage can be treated in the existing land already acquired.
- ➢ Running cost and required energy of electricity are less than aerated lagoon process.

Demerits;

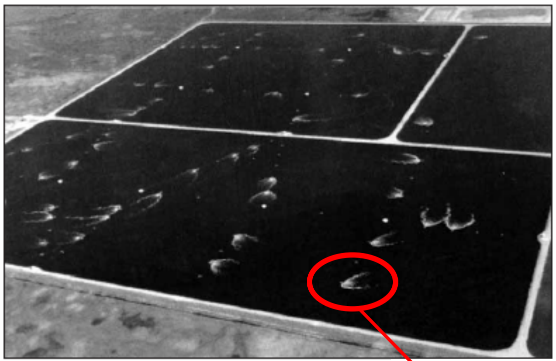
- ➢ ***Problems such as nuisance of odour and flies may arise under inadequate conditions***.

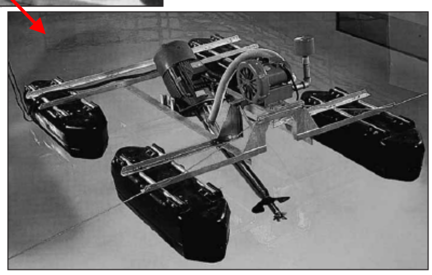
Figure 13.2 Option 2 : Trickling Filter



Composed by: Aerated Lagoon + Sedimentation Pond

Outline of Aerated Lagoon (Sample)





- Maintenance of aeration equipment (aerator) is needed.

Merits;

- All amount of sewage can be treated in the existing land already acquired.
- There are many cases where there is adoption of this methodology in developing countries.

Demerits;

- ***Running costs and required amounts of electrical energy are high.***

Figure 13.3 Option 3 : Aerated Lagoon

(5) Final evaluation and Recommendation

Comparison of the three options is summarized below. All these options have enough treatment functions but there are differences in energy demand, simplicity of operation and land required.

Table 13.7 Comparison of the Three Treatment Options

Items	Aerated Lagoon	Trickling Filter	Stabilization Pond
Energy Demand (Electricity Cost)	***Poor***	***Fair***	***Good***
Simple Operation	***Fair***	***Fair***	***Good***
Land Requirement	***Good***	***Good***	***Poor***
Overall Judgement		◎	

Note: Good (+++), Fair (++), Poor (+)

With regard to the stabilization pond, if additionally land acquisition is available, then the total area will be more than 20,000 kanal approximately. It is an unrealistic area for operations because stabilization ponds also require sludge removal periodically. In many instances, stabilization ponds operated without proper maintenance do not unfortunately function properly. Meanwhile as mentioned above, aerated lagoons have high energy demands. Its energy demand would be a problem given both the current financal condition of WASA and the power supply conditions in Pakistan. Improvement of these conditions are not expected in the short term.

Therefore, considering these reasons, the ***Trickling Filter method*** is recommended.

Even if the trickling filter method is adopted, the problem of insufficient technical capabilities (experiences) of operational staff in WASA still remains. However, these problems are solvable by the consideration of following methods.

- Technology Transfer by the Contractor during the Operation and Maintenance Period when the manufacturer’s engineer will be required to be stationed in Lahore for two years after the handover according to the specifications.
- Based on the performance of technology transfer to WASA operators by the Contractor, a long-term service contract for operation and maintenance may also need to be considered.

Note; This conclusion was accepted during the several meetings of the technical committee which was chaired by the Secretary of HUD & PHED as the chairman.

13.3.3 Facility Planning

(1) Layout plan

Basic conditions for facility layout plan are as follows

- Inflow location

  Inflow points are from two locations. One is from the collector channel and the other is from the Multan Road Disposal Station (DS). Design inflows on an average basis are 244.8 cfs (from the Collector channel) and 78.7 cfs (from the Multan road DS) respectively.
- Discharge canal and high water level

  The existing canal on the site can be used as a discharge canal. This canal connects to the River Ravi. With regard to the high water level in this canal, it must be remembered that originally this area was the flood plain of the River Ravi. However, there has been no flood recently since the dam was constructed upstream of River Ravi in Indian territory. Meanwhile, the existing ground level in the site is between +199.0 m and +197.0 m approximately. It means that the water level of this existing canal cannot go over +197.0 m. Therefore +197.50 m was decided as the high water level for the existing canal.
- Disinfection facility

  Generally, the disinfection facility is installed in the wastewater treatment plant for water use in downstream areas. In this project, water use downstream is only for irrigation. The main intake point for irrigation downstream of the WWTP is Balloki headworks located about 50km downstream. The design flow of the Rver Ravi at Balloki headworks is 35,000 Cft/s. This means that the discharge flow of the WWTP (323 Cft/s) is only 1 % of the Design flow of the River Ravi at the Balloki headworks. It should be noted that the effect of disinfection at WWTPs is generally quite limited. Additionally, a certain level of coliform can be treated without the disinfection facility and there are no standards for coliform levels in the NEQS at present. Therefore disinfection facility will not be installed in the Phase 1 project. However, in future this issue will need to be discussed with the related authority taking into consideration the condition of water use.
- High voltage power cable

  There are many existing towers for high voltage power cables at the site. According to the meeting with the Water and Power Authority (WAPDA) of Pakistan, they can be removed but it is not desirable because it is both costly and time consuming. Therefore, the basic layout of the WWTP is being planned without removal of the existing towers. Typical section of pylon is shown in **Appendix 13.7**. It seems that removal and protective measure of existing tower is generally not needed. However, it should be discussed again when detailed design starts.

(2) Phased construction plan

Generally, WWTPs are constructed to a design inflow. However, considering the construction period of Phase 1 and 2, design flows will increase up to 93% of the total design flow. Moreover, this forecast is based on a reduction of waste of water use and therefore it might even be over that of the design flow. Therefore, a phased construction plan has not been taken into consideration. That is, facilities for the total capacity at the WWTP will be constructed in the Phase 1 project.

(3) Operation and Maintenance [O&M] plan

Main works for O&M are;

- Inspection and cleaning of the anaerobic pond, and the sedimentation pond
- Maintenance of the rotating distributor
- Inspection and cleaning of filter medium/material in the trickling filter
- Control of recirculation flow in the trickling filter process

Considering the scale of the WWTP and capacity of the WASA staff, necessary staffing is given in **Table 13.8**.

Table 13.8 Staffing for South –West WWTP

Qualifications	Number	Remarks
Foreman/Supervisor	1	
Mechanical Engineer	3	
Laboratory Technician	6	
Assistant Foreman	6	(2×3shift)
Labourers	30	(10×3shift)
Administrator	3	
Driver	6	
Guard	15	(5×3shift)
Total	70	

2) Sludge disposal

Considering simple/economical operations and land availability, an anaerobic pond and sedimentation pond is to be adopted in this plan. However, it still requires periodic removal of accumulated sludge in these ponds for proper operation. It is quite important that this work be undertaken for sustainability of the WWTP. Specifically, one-quarter of the total ponds (2 ponds of the 8 ponds) must be cleaned annually in rotation. Sludge removal is conducted by drawing of sewage (supernatant water) in the pond and dewatering of the sludge at the bottom of the pond, which is then disposed of at the dumping site.

While this work is absolutely necessary, as the next step, reuse of the sludge should be discussed in the near future considering the social and economic conditions in Lahore.

Considering the conditions mentioned above, the general layout plan of the WWTP is shown in **Figure 13.4**. The capacities and hydraulic calculations are shown in **Appendix 13.4 and 13.5**

Other preliminary design drawings of the WWTP are shown in **Appendix 13.6**.

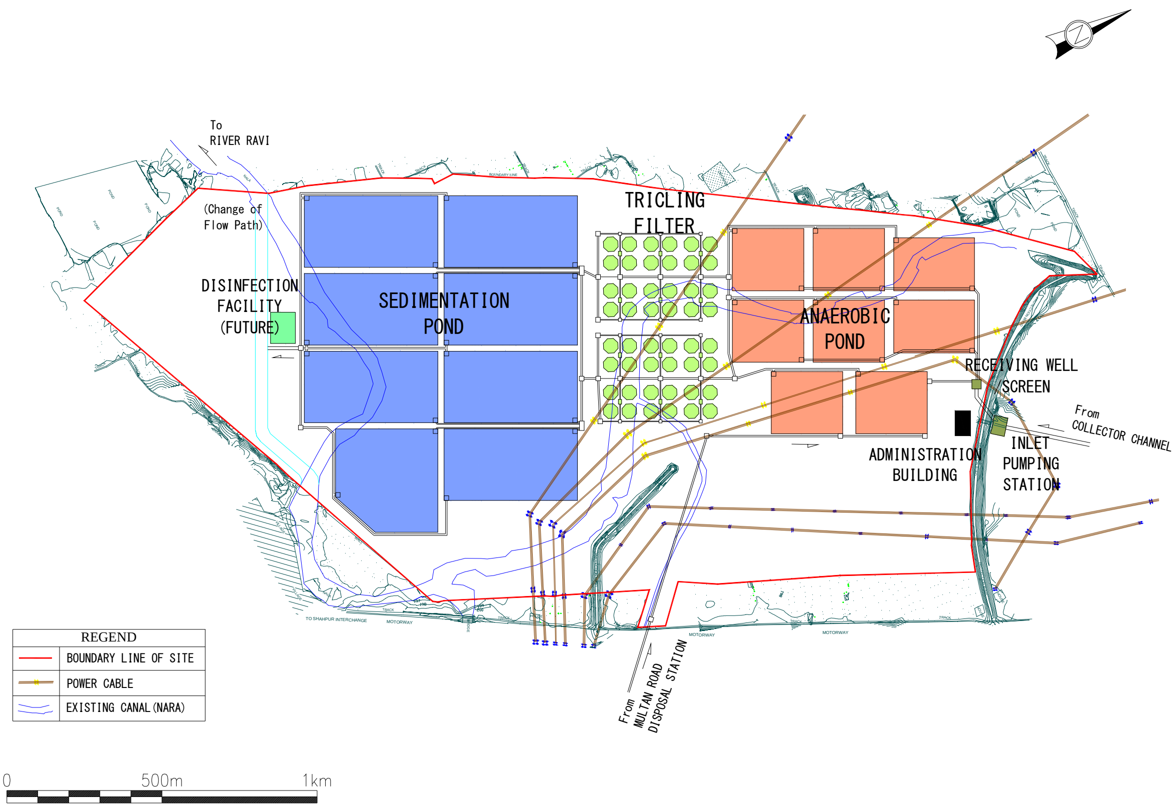


Figure 13.4 General Layout of South-West WWTP

13.4 Trunk Sewers and Collector

13.4.1 Design Basis for Sewerage Network

(1) General

For the design and evaluation of the sewerage system, the Water and Sanitation Agency (WASA), has adopted its parent organization, the Lahore Development Authority (LDA) design criteria . The following design parameters are recommended to be adopted during the course of study.

(2) Target Year

As mentioned in **9.1**, the target year is 2035 for the proposed sewerage system.

(3) Design Population

The design population was estimated by using population density. Three categories of population density are presented in the "Integrated Master Plan for Lahore 2021" and it was applied to this project. Population density factors are shown in **Table 13.9** and zones of population density are shown in **Figure 13.5**.

Table 13.9 Population Density Factors

Sr.	Category	Population Density Factor
1	Low	9 persons/Kanal (175 persons/ha)
2	Medium	16 persons/Kanal (325 persons/ha)
3	High	25 persons/Kanal (500 persons/ha)

Note: 1ha=19.768 Kanal

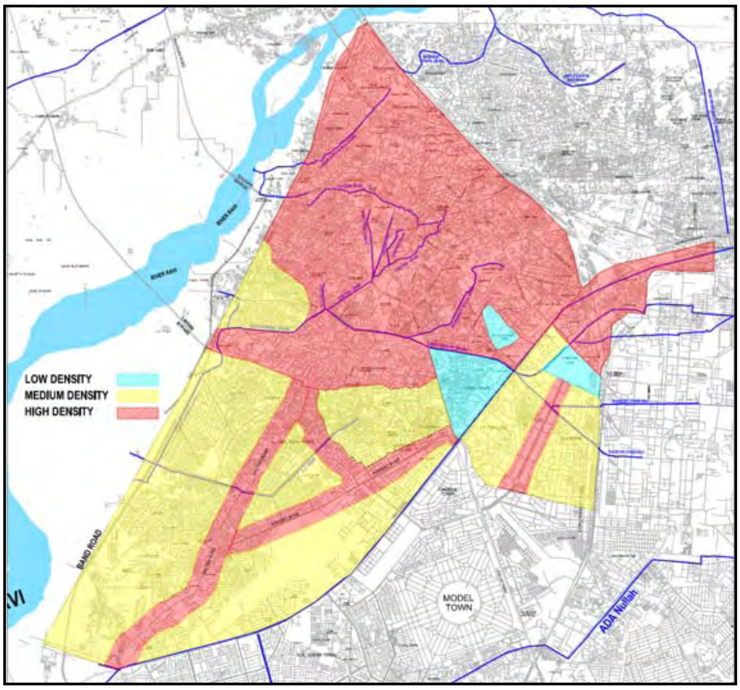


Figure 13.5 Zone of Population Density in Central Area

(4) Per Capita Sewage Flow

Various factors influence the per capita wastewater production including population density, economic conditions, social and living habits of the people and level of service of water supply and sewerage available. From all these factors and using the recommendations of the WASA Design Criteria, the per capita sewage flow is taken as suggested to be 70 gpcd for the domestic population.

(5) Infiltration

Based on design criteria the following allowance will be provided for infiltration while designing and checking existing sewers.

Sewer 9 to 24 inch size	5 % of average sewage flow
Sewer above 24 inch size	10 % of average sewage flow

(6) Peak Factors for Sewage Flows

The design criteria give peak factors for various dry weather flows. These will be adopted :

Flow (cfs)			**Peak Factor**
Up to 1 (0.028 m^3/s)			4.00
1.1 (0.031 m^3/s)	-	2.0 (0.057 m^3/s)	3.40
2.1 (0.059 m^3/s)	-	4.0 (0.113 m^3/s)	3.10
4.1 (0.116 m^3/s)	-	10.0(0.283 m^3/s)	2.70
11.0 (0.311 m^3/s)	-	20.0 (0.566 m^3/s)	2.50
21.0 (0.595 m^3/s)	-	40.0 (1.133 m^3/s)	2.30
41.0 (1.161 m^3/s)	-	100.0 (2.832 m^3/s)	2.15
101.0 (2.860 m^3/s)	-	200.0 (5.663 m^3/s)	2.08
Over 200 (5.663 m^3/s)			2.00

(7) Storm Water Allowance

The allowance for storm water in sewers can be chosen arbitrarily depending on the nature of the area under review.

(8) Sewer Gradients

According to the design criteria, the following criteria will be adopted for calculating minimum sewer slopes:

i)	Manning “n” value for R.C. Pipe	= 0.013
ii)	Manning “n” value for R.C. Conduit	= 0.015
iii)	Preferred minimum velocity, when sewer is running full	= 2.5 ft/s (0.76 m/s)
iv)	Absolute minimum velocity when sewer is running full	= 2.0 ft/s (0.61 m/s)
v)	Maximum velocity in the force main	= 6.0 ft/s (2.44 m/s)

(9) Minimum Cover for Sewers

A minimum cover of 3.0 ft. (0.91 m) will be adopted for sewers/pipes under roads. When a sewer pipe is buried across or close to other underground facilities, at least one foot distance from them should be maintained to allow for repair and maintenance.

(10) Piping Material

The reinforced concrete pipe (RC pipe) is used for a sewer system in principle. It should be noted that the RC pipes is deteriorated due to the hydrogen sulfide generated in pipes except for the case of use as storm sewers and the use of Polyvinyl chloride pipes have been increasing for sanitary and combined sewers in other countries. Replacement or internal lining is required in general 30 years after installation.

(11) Manhole Details and Spacing

Manhole details will be in accordance with the latest WASA drawings and standards. The storm drains in streets and narrow roads will be covered with removable cover slabs/manhole covers/hanging gratings for ease of maintenance at appropriate locations. Manholes will be provided at the end of each sewer line, at all changes in grade or alignment, at all intersections and spaced at the following intervals:

Pipe size	Interval
9 – 15 inch (0.23-0.38m)	100 – 300 ft (30 – 91 m)
18 – 30 inch (0.46-0.76m)	400 ft (122 m)
36 inch (0.91m) and above	500 ft (152 m)

(12) Drop Manhole

Where possible, the slope of the incoming sewer should be selected to avoid any drop of 2 feet (0.61 m) or more at a manhole. However drop manholes will be provided where this is unavoidable. Drawing of drop manholes are shown in **Appendix 13 Drawings TSL-20** and **TSC-22**.

13.4.2 Trunk and Branch Sewer from Larex Colony to New Gulshan-e-Ravi Disposal Station

(1) Review of Existing Documents

The JICA Study Team reviewed following documents while designing the proposed trunk and branch sewers from the Larex Colony to the New Gulshan-e-Ravi Disposal Station.

- Integrated Master Plan for Lahore-2021 NESPAK, Nov. 2002
- Master Plan for Improvement of Sewerage & Drainage Systems of Central Zone, Lahore –Preliminary Design Report NESPAK, Dec. 2003
- Master Plan for Improvement of Sewerage & Drainage Systems of Central Zone, Lahore –Final Design Report NESPAK, July. 2004

- Master Plan for Improvement of Sewerage & Drainage Systems of Central Zone, Lahore –PC-1 NESPAK, Jan. 2005
- Master Plan for Improvement of Sewerage & Drainage Systems of Central Zone, Lahore –PC-1 NESPAK, Jun. 2005
- Master Plan for Improvement of Sewerage & Drainage Systems of Central Zone, Lahore –Detailed Engineering Design Report NESPAK, Aug. 2005

(2) Proposed Route of the Trunk sewer and the Branch Sewers

A proposed trunk sewer starts from Durand Road to the new proposed Trunk Sewer along Cantonment Drain. The total length of the new trunk sewer is 26,783 ft. (8.16 km). The following branch sewers will contribute to the trunk sewer.

i) Ghazi Mohalla LS to Garhi Shahu Bazar
ii) Muhammad Nagar LS to Garhi Shahu Chowk
iii) Davis Road Sewer
iv) Empress Road Sewer
v) Montgomary Road Sewer
vi) Thronton Road to Mcleod Road
vii) Sanda Road Sewer

The total length of the new branch sewers is 15,632 ft. (4.76 km).

Proposed route of trunk and branch sewers is shown in **Figure 13.6**. Detailed of plans of proposed trunk and branch sewers are shown in **Appendix 13.6 Drawings TSL-01 to TSL-10.**

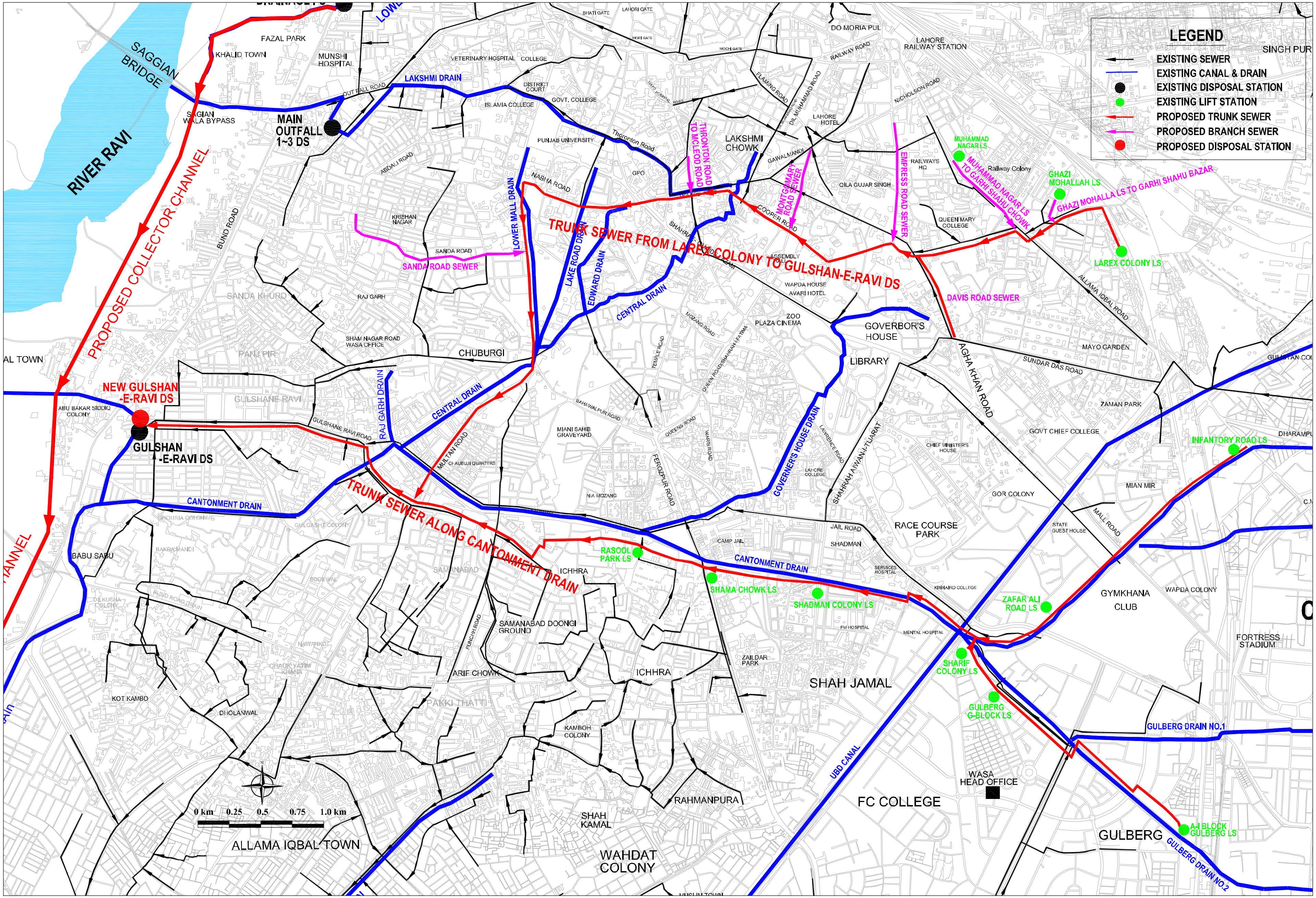


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Figure 13.6 Proposed Route of Trunk and Branch Sewer

(3) Design Discharge of Trunk and Branch Sewer

Design discharges for trunk and branch sewers estimated in the Detailed Engineering Design Report were applied. The hydraulic analyses for trunk and branch sewer are as given in **Appendix 13.5.1** and **Appendix 13.5.2**, respectively. The estimated design discharge for trunk and branch sewers is presented in **Figure 13.7**.

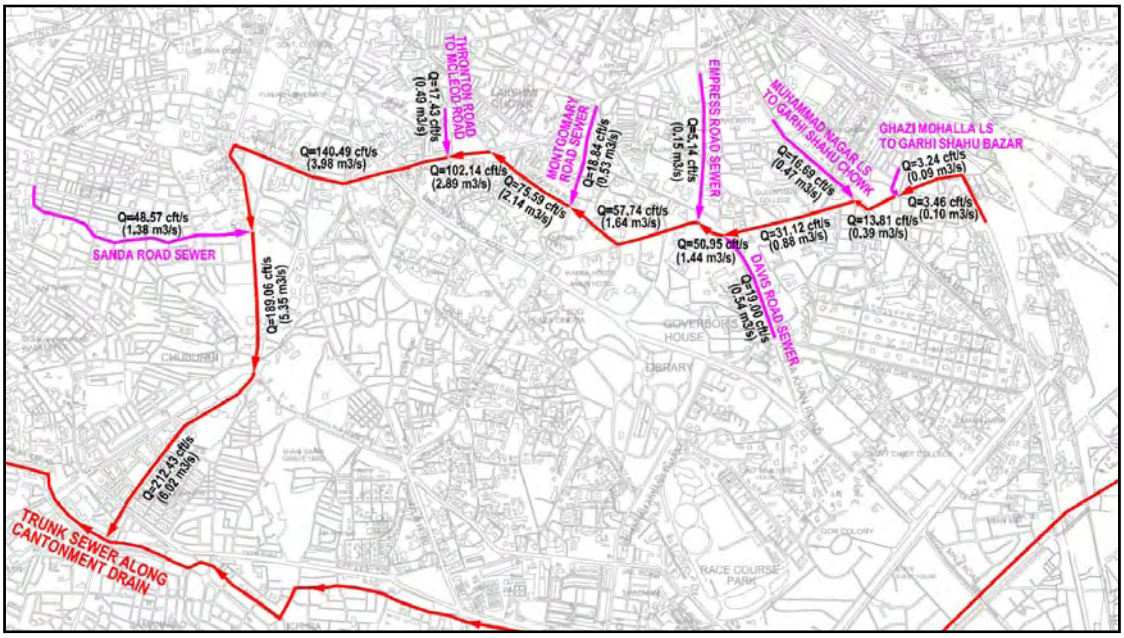


Figure 13.7 Design Discharge of Trunk and Branch Sewers

(4) Preliminary Design of Trunk and Branch Sewer

Sewers, trunk and branch sewers were designed in accordance with the relevant design criteria .

- The proposed trunk and branch sewer network consists of reinforced concrete pipe with a total length of 42,415 ft (12.93 km).
- The carrying capacities of proposed sewers have been computed in accordance with Manning's formulae with values of 'n' = 0.013 corresponding to concrete pipe and sewage quantities in **Appendix 13.5.1** are the peak flows that the collection system has to sustain.
- The trunk sewer is divided into several sections depending on design discharges. The main features of trunk and branch sewers are shown in **Figure 13.8**. The longitudinal profiles of trunk and branch sewers are showing in **Appendix 13.6 Drawings TSL-11 to TSL-13** and **TSL-14 to TSL-15**, respectively.
- In order to operate and maintain the trunk and branch sewers smoothly and effectively, manholes are installed. The details of manholes are shown in **Appendix 13.6 Drawings TSL-16 to TSL-20**. The interval between manholes will be in accordance with design

criteria. The number of manholes will be as follows:

Name of Sewer	No. of Manholes	Diameter. of Sewer (inches)
Trunk Sewer	139	24” ~ 90” (0.61~2.29m)
Branch Sewer		
Ghazi Mohalla LS to Garhi Shahu Bazar	6	15” (0.38m)
Muhammad Nagar LS to Garhi Shahu Chowk	10	30” (0.76m)
Davis Road Sewer	14	36” (0.91m)
Empress Road Sewer	24	24” (0.61m)
Montgomary Road Sewer	13	42” (1.07m)
Thronton Road to Mcleod Road	7	36” (0.91m)
Sanda Road Sewer	34	54” (1.37m)
Total	247	

- 3 existing lift stations, namely the Larex Colony LS, the Ghazi Mohallah LS and the Muhammad Nagar LS, will be eliminated. The location of the lift stations is shown in **Figure 13.8**.
- The open cut method will be applied in the construction methodology for the proposed trunk and branch sewers in this project, however pipe jacking methods will be applied in some stretches of the proposed sewer network to avoid construction problem such as traffic problems, limited space problems and underground utilities problems. Seven (7) proposed sites using the pipe jacking method are shown in **Figure 13.8**. The main features of the proposed site are tabulated in **Table 13.10**.

Table 13.10 Pipe Jacking Method Stretches

Sr.	Stretch	Length (ft)	Dia. (inch)	Physical Condition
J1	Empress Rd. – Abbot Rd.	150 (46m)	24 (0.61m)	Heavy traffic
J2	Mcleod Rd. – Hall Rd.	200 (61m)	84 (2.13m)	Heavy traffic
J3	Mcleod Rd. – Mall Rd.	200 (61m)	84 (2.13m)	Heavy traffic
J4	Mcleod Rd. – Nabha Rd.	150 (46m)	84 (2.13m)	Heavy traffic
J5	Sanda Rd. – Bank Rd.	200 (61m)	54 (1.37m)	Heavy traffic
J6	Sanda Rd. – Main Bazar	100 (30m)	54 (1.37m)	Heavy traffic and narrow road
J7	Multan Rd. – Gulshan Ravi Rd.	200 (61m)	90 (2.29m)	Heavy traffic

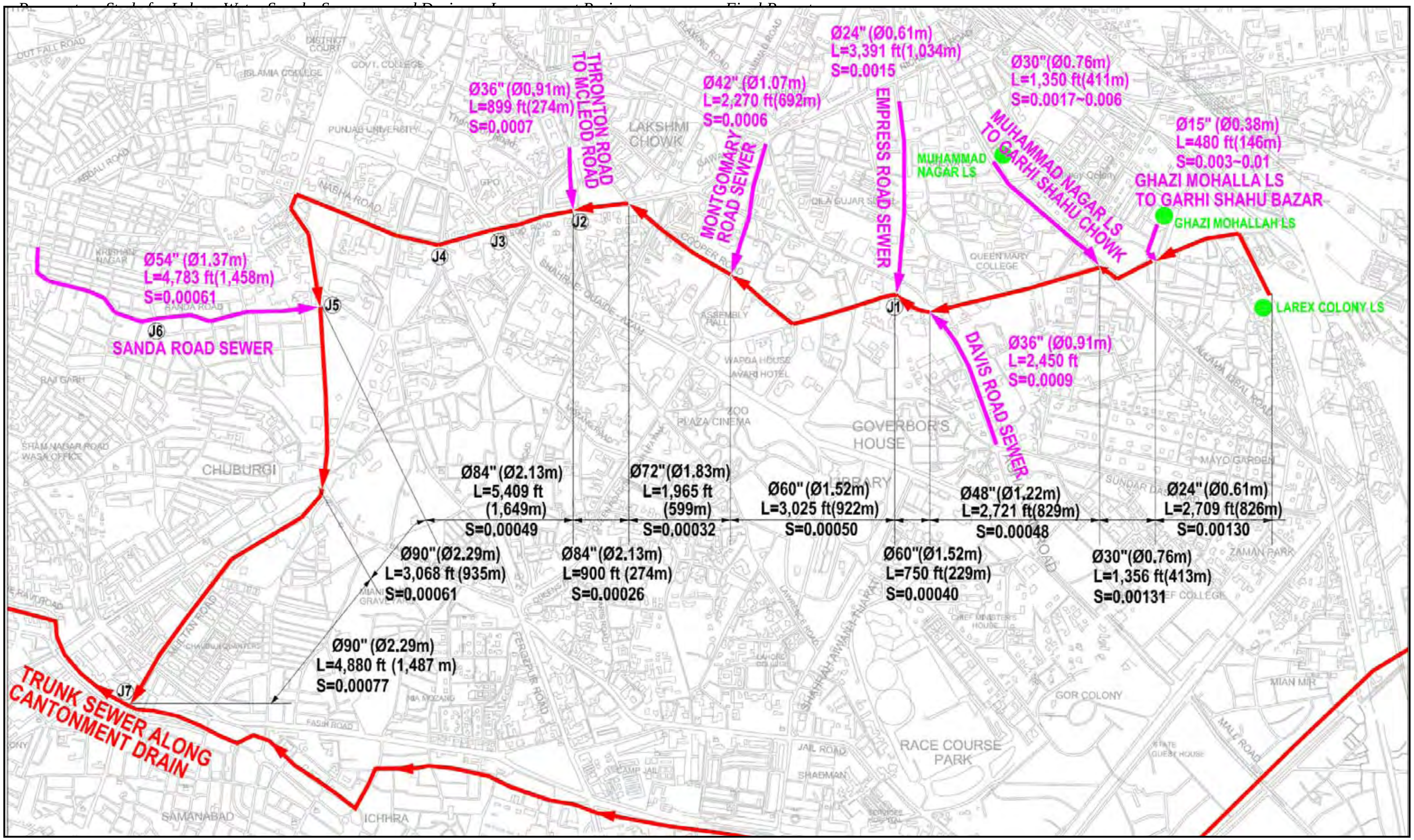


Figure 13.8 The Main Features of Trunk and Branch Sewers

13.4.3 Trunk Sewer along the Cantonment Drain

(1) Review of Existing Documents

The JICA Study Team reviewed the following documents while designing the proposed trunk sewer along the Cantonment Drain.

- Separation of Sewage from Cantonment Drain, Lahore WASA, 2009
- Laying of Trunk Sewer along Cantonment Drain Lahore PC-1 NESPAK, Jun. 2009

(2) Proposed Route of the Trunk Sewer along Cantonment Drain

A proposed trunk sewer is to be aligned in parallel with the Cantonment Drain. The total length of the new trunk sewer is 42,580 ft (12.98 km).

The proposed route of the trunk sewer is shown in **Figure 13.6**. Detailed of the plan of the proposed trunk sewer are shown in **Appendix 13.6 Drawings TSC-01 to TSC-08.**

(3) Design Discharge of the Trunk Sewer along the Cantonment Drain

Design discharges for the trunk sewer were estimated in the PC-1 Report and the hydraulic analysis as given in **Appendix 13.5.3**. This hydraulic analysis, however, is not the final version. According to WASA, this proposed trunk sewer will collect additional wastewater and storm water from the south area of the Cantonment Drain and it is estimated that the additional design discharge is about 40 cfs (1.13 m^3/s). WASA is preparing the new hydraulic calculation sheet which revise that done by NESPAK. WASA and the JICA Study Team have discussed this matter and both sides have agreed that the proposed trunk sewer would include the additional discharge. The estimated design discharges for trunk and branch sewers are presented in **Figure 13.9**.

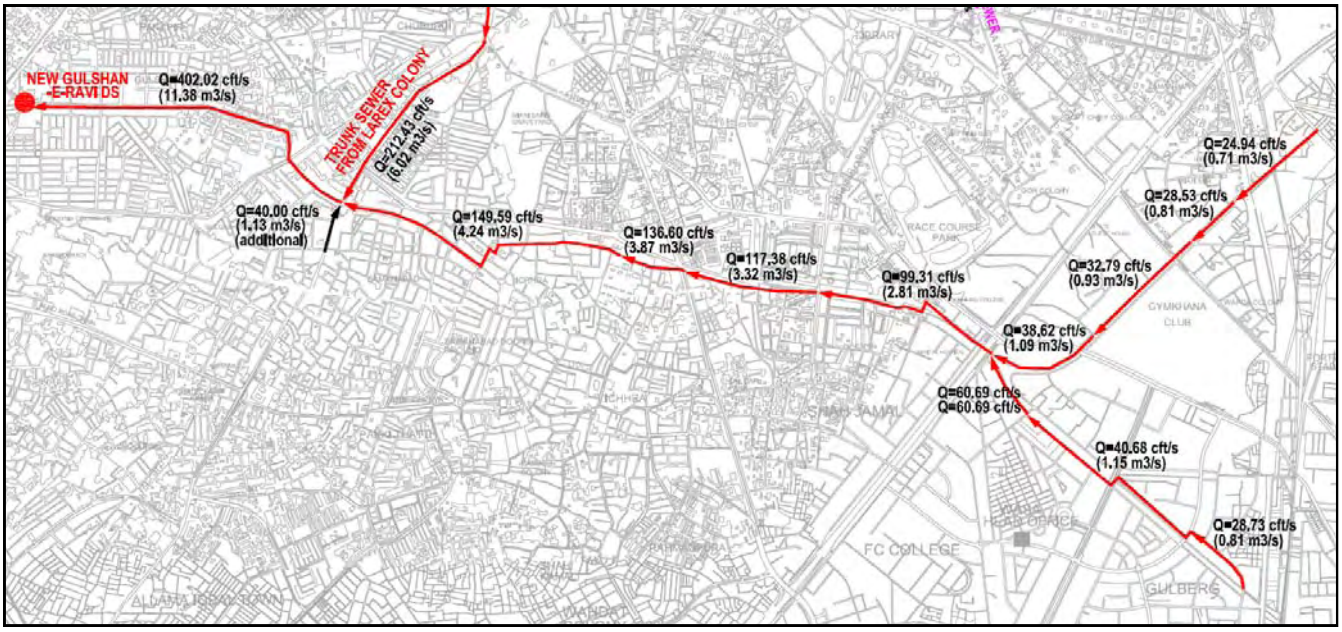


Figure 13.9 Design Discharge of Trunk Sewer along Cantonment Drain

(4) Preliminary Design of the Trunk Sewer along the Cantonment Drain

The trunk sewer was designed in accordance with the design criteria for sewers,

- The proposed trunk and branch sewers consist of reinforced concrete pipes and box culverts with a total length of 42,580 ft (12.98 km).
- The carrying capacities of the proposed sewers have been computed in accordance with Manning's formulae with values of 'n' = 0.013 corresponding to concrete pipe and sewage quantities given in **Appendix 13.5.3** are the peak flows that the collection system has to sustain.
- The trunk sewer is divided into several sections depending on design discharges. The main features of the trunk sewer is shown in **Figure 13.10**. The longitudinal profiles of the trunk sewer are shown in **Appendix 13.6 Drawings TSC-09 to TSC-17**.
- In order to operate and maintain the trunk and branch sewer smoothly and effectively, manholes are installed. The details of manholes are shown in **Appendix 13.6 Drawings TSC-18 to TSC-22**. The interval of manholes placed will be in accordance with the design criteria and the number of manholes will be 100.
- The following 8 existing lift stations will be eliminated. The location of lift stations is shown in **Figure 13.10**.
    - A-I Block Gulberg LS
    - Gulberg G-Block LS
    - Shrif Colony LS
    - Infantory Road LS
    - Zafar Ali Road LS
    - Shadman Colony LS
    - Shama Chowk LS
    - Rasool Park LS
- The open cut method will be applied to construction method used in laying the proposed trunk sewer.

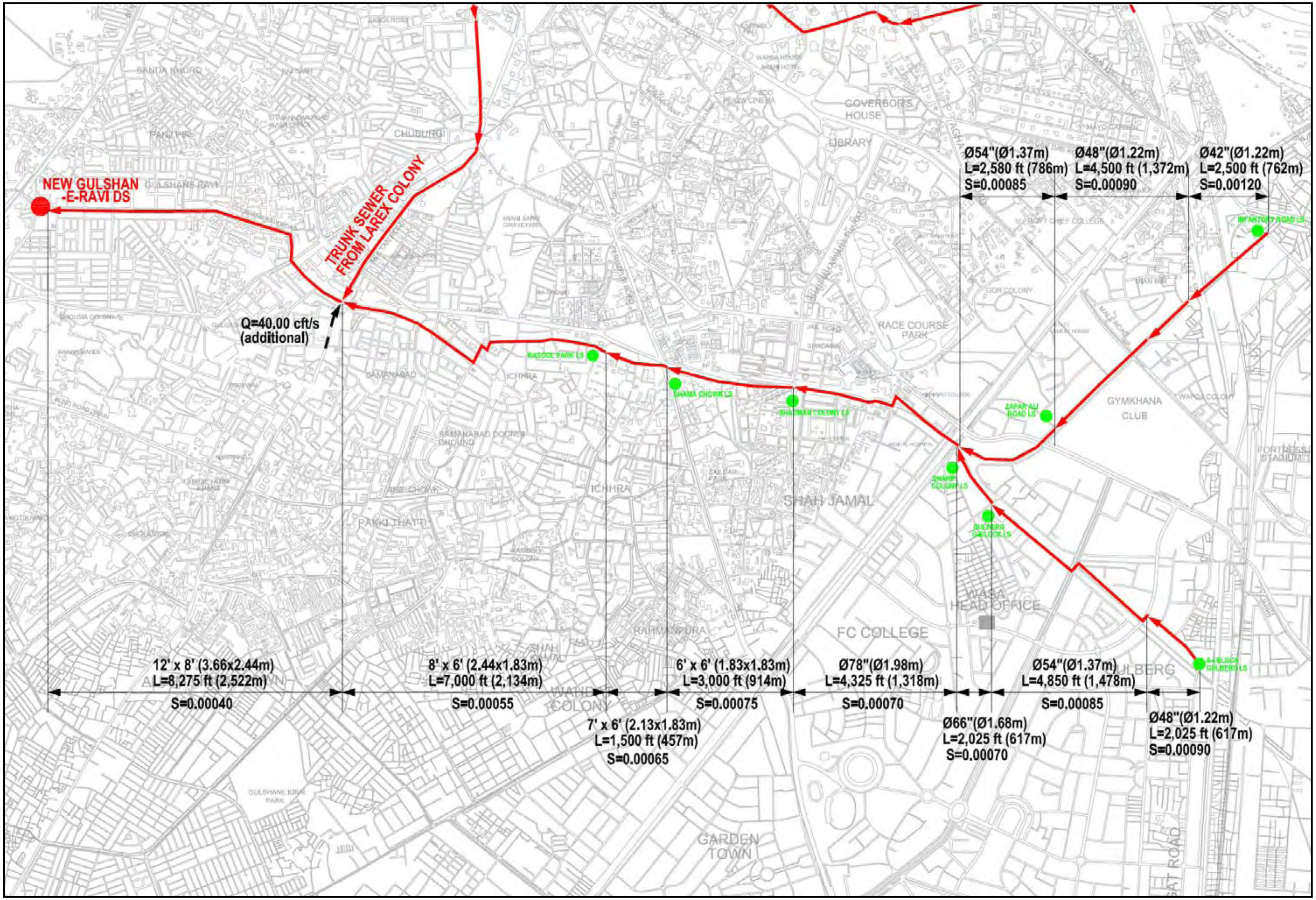


Figure 13.10 The main features of Trunk Sewer along Cantonment Drain

13.4.4 Collector Channel

(1) Review of Existing Documents

The JICA Study Team reviewed the following documents while designing the proposed collector channel.

- Punjab Urban Development Project, Lahore Wastewater Treatment Plants and Sewage Pumping Station, Balfour Maunsell & Engineering Consultants, Jul. 1993
- Punjab Urban Environmental Project, Lahore Southwest Wastewater Treatment Plant, Balfour Maunsell, Oct. 1994
- Identification Study for Provision of Water Supply and Sewerage Services in Lahore City, Seureca, Aug. 2007

(2) Proposed Route of the Collector Channel

A proposed collector channel starts from Chotta Ravi Drain to the proposed South West Wastewater Treatment Plant. The total length of the proposed collector channel is about 7.39 km.

The proposed route of the collector channel is shown in **Figure 13.11**. Detailed plans of the proposed collector channel is shown in **Appendix 13.6 Drawings CC-01 to CC-11.**

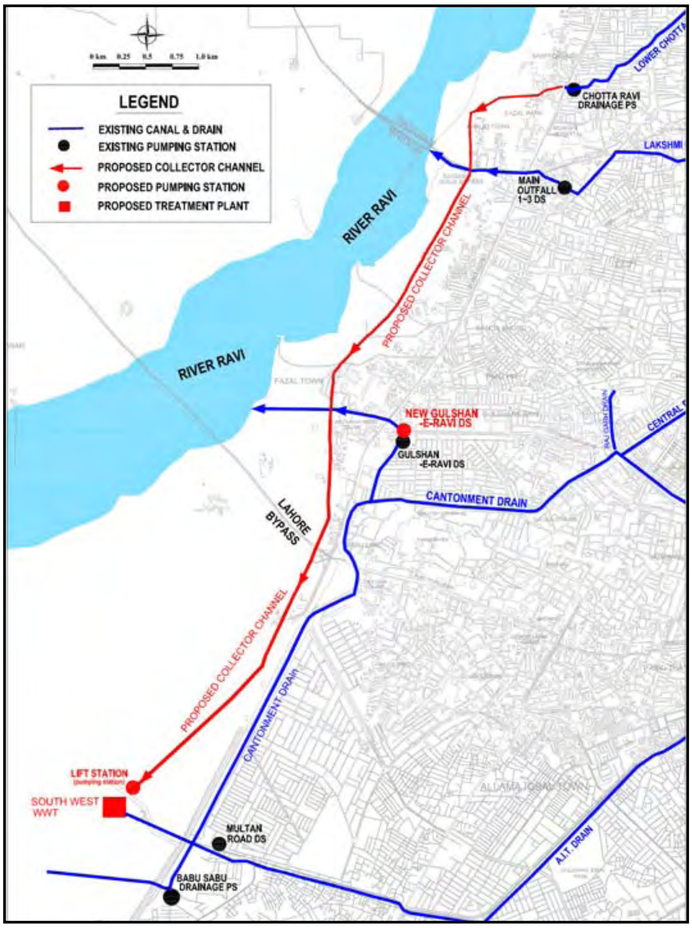


Figure 13.11 Proposed Route of Collector Channel

(3) Design Discharge of the Collector Channel

The proposed collector channel will intercept the flow from the Chotta Ravi Drainage Pumping Station, the Main Outfall Disposal Station and the Gulshan-e-Ravi Disposal Station (wastewater flow from the proposed New Gulshan-e-Ravi Disposal Station will also utilize the existing sullage carrier of the Gulshan-e-Ravi Disposal Station). The proposed collector channel will not intercept the flow from the Multan Road Disposal Station, it will discharge into the proposed South West Wastewater Treatment Plant directly. Design discharges for the collector channel have been estimated in accordance with the design criteria. The related data and estimated design discharges of the collector channel is shown in **Table 13.11**.

Table 13.11 Design Discharge of Collector Channel

Pumping Station	Catchment Area*[1] (km^2)	Population*[2] (persons)	Average Flow (m^3/day)	Design Flow (m^3/s)
Chotta Ravi	5.00	250,000	51,000	1.95
Main Outfall	10.20	510,000	105,000	3.83
Gulshan-e-Ravi	23.00	1,150,000	235,000	15.38
New Gulshan-e-Ravi	20.40	1,020,000	208,000	
Multan Road	29.10	934,838	191,000	6.63
Total	87.70	3,864,838	790,000	27.79

Note: *1: after the completion of construction of the New Gulshan-e-Ravi Disposal Station
*2: Estimated population in 2035, JICA Study Team estimates

(4) Preliminary Design of the Collector Channel

In accordance with the design criteria, collector channel was designed.

- The land acquisition for the collector channel had been already completed by WASA. The area of land acquisition was based on the design of the collector channel by Balfour Maunsell & Engineering Consultants in 1993. The acquired land area is shown below.

Stretch	Acquired Land Area (width from temporary centerline of collector channel)
From Chotta Ravi to Main Outfall	15.0 ft (4.57m) (total width=30 ft (9.14m))
From Main Outfall to Gulshan-e-Ravi	37.5 ft (11.43m) (total width=75 ft (22.86m))
Gulshan-e-Ravi to Sta. 0+750	45.0 ft (13.72m) (total width=90 ft (27.44m))
Sta. 0+750 to Proposed Lift Station	50.0 ft (15.24m) (total width=100 ft (30.48m))

  The detail boundary line of acquired land is shown in **Appendix 13.6 Drawings CC-01 to CC-11**

- The conduit type was applied for the collector channel section. It is not a reinforced concrete open channel. The proposed collector channel consists of concrete, brick masonry and reinforced concrete with a total length of 7.39 km.
- The carrying capacities of the proposed collector channel has been computed in accordance with Manning’s formulae with values of ‘n’ = 0.015 corresponding to

reinforced conduit sewage. Flow quantities shown in **Table 13.12** are the peak flows that the collection system has to sustain.

Table 13.12 Hydraulic Calculation for the Collector Channel

Node		Contributory Population		Design Flow (m3/s)	Size (m)		Length (m)	Gradient	Design Capacity	
From	To	Each	Cumulative		Width	Height			Velocity (m/s)	Discharge (m/s)
Chotta Ravi	Main Outfall	250,000	250,000	1.95	3.00	1.80	1,490	4000	0.79	3.80
Main Outfall	Gulshan-e-Ravi	510,000	760,000	5.78	5.50	1.80	2,750	4000	0.94	8.40
Gulshan-e-Ravi	Lift Station	2,170,000	2,930,000	21.16	10.00	2.20	3,150	3500	1.26	24.80
Multan Road	WWTP	934,838	934,838	6.63	5.00	1.80	300	4000	0.92	7.50
	Total		3,864,838							

- The collector channel is divided into several sections depending on the design discharges as shown in **Table 13.12**. The main feature of collector channel is shown in **Appendix 13.6 Drawings SGE-01.** Typical cross-sections of drains and details of covers are shown in **Appendix 13.6 Drawings CC-12**. The longitudinal profiles of the collector channel are shown in **Appendix 13.6 Drawings CC-01 to CC-11**.
- In order to ensure smooth maintainance of the collector channel , a maintenance road of 4.0m width will be constructed on both sides of the collector channel.. The proposed alignment is shown in **Appendix 13.6 Drawings CC-01 to CC-11**.

13.5 Sewage Pumping Station

13.5.1 Design Basis for the Sewage Pumping Station

(1) General

Selection of the type of pumping station adopted has got to relate to specific requirements and hence a few rigid criteria cannot be used in the selection of all stations. The following discussion indicates certain basic parameters which will be followed for the proposed pumping stations. In this regard WASA Design Criteria and past experience have been adopted for certain design parameters.

(2) Type of Pumping Station

Sewage pumping stations will be of the dry well type, with the pumps and discharge lines installed in the dry well. The sewage wet well will be completely separate.

(3) Influent Chamber

The influent chamber will receive sewage from the incoming sewers, and divide the flow as necessary to the influent channels and wet walls. There will be more than one influent channel and wet wall, to facilitate repairs and cleaning without totally shutting down pumping station operations. Conveniently operated sluice gates should be provided at the influent chamber outlets.

(4) Pumping Station Overflow

An overflow and emergency discharge conduit will be provided for each sewage pumping station, for use in the event that the pumping station must be shut down, e.g. in situations where it is required to prevent immersion damage to electric motors, switching gear, and/or other equipment.

(5) Influent Channels and Bar Screens

There should be more than one influent channel, each designed to carry an equal proportion of flow from the influent chamber. Each chamber will have a manually/mechanically cleaned bar screen (exclusive use of only mechanically cleaned bar screens were considered to involve too many operational and maintenance problems for use in Lahore). Suggested details of the screening chamber are as bellows:

a) Bar screen inclined 45 to 60 degrees from the horizontal,
b) Clear opening between bars to be at least 2 inches (0.05 m) but not more than 2.5 inches (0.06 m).
c) Velocity of flow through bars to be 1.5 (0.46 m) to 2.5 (0.76 m) feet per second, to facilitate manual cleaning.
d) A convenient operating platform to be provided for manual cleaning and draining of screening
e) An adequate manually operated hoist to be provided for lifting screenings containers from the operating platform to grade level.
f) A stairway to be provided for access from the grade level to the operating platform.

(6) Wet Well

1) Wet Well Size

The effective capacity of the wet well should provide a holding time not exceeding 10 minutes for the average sanitary (dry weather) flow. For the ultimate anticipated flow conditions, it is suggested that an effective wet wall capacity be selected to provide a holding time of approximately 5 minutes at average sanitary design flows.

(7) Sewage Pumps and Drives

1) Type

The sewage pumps will be of the vertical, centrifugal, non clog type suitable for installation in a dry well with the drive motor located above on a separate motor floor.

2) Shafting

Intermediate shafting between the pump and motor shall be provided as needed, complete with suitable couplings, steady bearings and supports.

3) Motors

The drive motors shall be of the vertical, open, drip-proof, solid shaft, squirrel cage, induction type designed for operation on the electric current available in Lahore for large horsepower units.

4) Pump selection

The number of pumps and capacities of individual pumps will be selected to generally suit the flow conditions, to the greatest feasible extent. Normal practice should be to provide sufficient units so that, with any one pump out of operation, the remaining units will still have sufficient maximum hourly design flow rate.

(8) Suction and Discharge Piping

1) Materials

All pump suction and discharge piping within the pumping station wet well and dry well should be constructed of cast iron or ductile iron, with flanged joints.

2) Suction piping

A separate suction pipe shall be provide for each sewage pump, including a flange and flare intake elbow, wall casting, shutoff valve and necessary connecting pipes and fittings. Suction piping shall be sized adequately to avoid high flow velocities under the normal design conditions. Velocities should preferably by within a range of 2.0 to 4.0 ft/s (0.61 to 1.22 m/s) at the flare inlet and 4.0 to 8.0 ft/s (1.22 to 2.44 m/s) in the suction pipe.

3) Discharge piping

The discharge line from each sewage pump should include a flexible connection, swing type check valve, shut off valve, and necessary connecting pipes and fittings. Velocity should preferably be within a range of 6.0 to 10.0 ft/s (1.83 to 3.05 m/s) in the discharge pipes.

4) Pipe supporting

Ample supports should be provided for sunction and discharge piping, to prevent loads from reaching the sewage pumps and to resist hydraulic thrust.

(9) Miscellaneous Design Details

1) Access

Suitable and safe means of access shall be provided to pump station dry wells, consisting of stairways of satisfactory dimensions with rest landings at vertical intervals not exceeding 10 feet (3.05 m). Similar access stairways should be provided for wet wells containing either bar screens or mechanical equipment needing inspection or maintenance. Stairway and rest landings should have suitable handrails.

2) Electrical equipment

Electrical equipment in sewage pump stations which are located in enclosed places where gas may accumulate, such as the wet well or dry well pump room, should be rated explosion-proof.

3) Pump removal

Provisions shall be made to facilitate the removal of sewage pumps and motors. Adequate monorails, hoisting equipment, hatches, doors and floor areas should be provided for this purpose.

4) Stand-by power source

Electric power from at least 2 different independent sources should be available at each sewage pumping station, one of which should be used as a stand-by power source.

5) Stand-by pump

Stand-by pumps should be provided at each pump station. It is recommended that the capacity of the stand-by pump be about 30 % of design discharge.

13.5.2 New Gulshan-e-Ravi Disposal Station

(1) Review of Existing Documents

There is no existing study/design report with regard to the New Gulshan-e-Ravi Disposal Station,.

(2) Proposed Site for the New Gulshan-e-Ravi Disposal Station

With in the site of the existing Gulshan-e-Ravi Disposal Station, there is large space available for a new disposal station. Therefore, the proposed New Gulshan-e-Ravi Disposal Station is to be constructed at the site of the existing Gulshan-e-Ravi Disposal Station.

Proposed site the of New Gulshan-e-Ravi Disposal Station is shown in **Figure 13.12**.

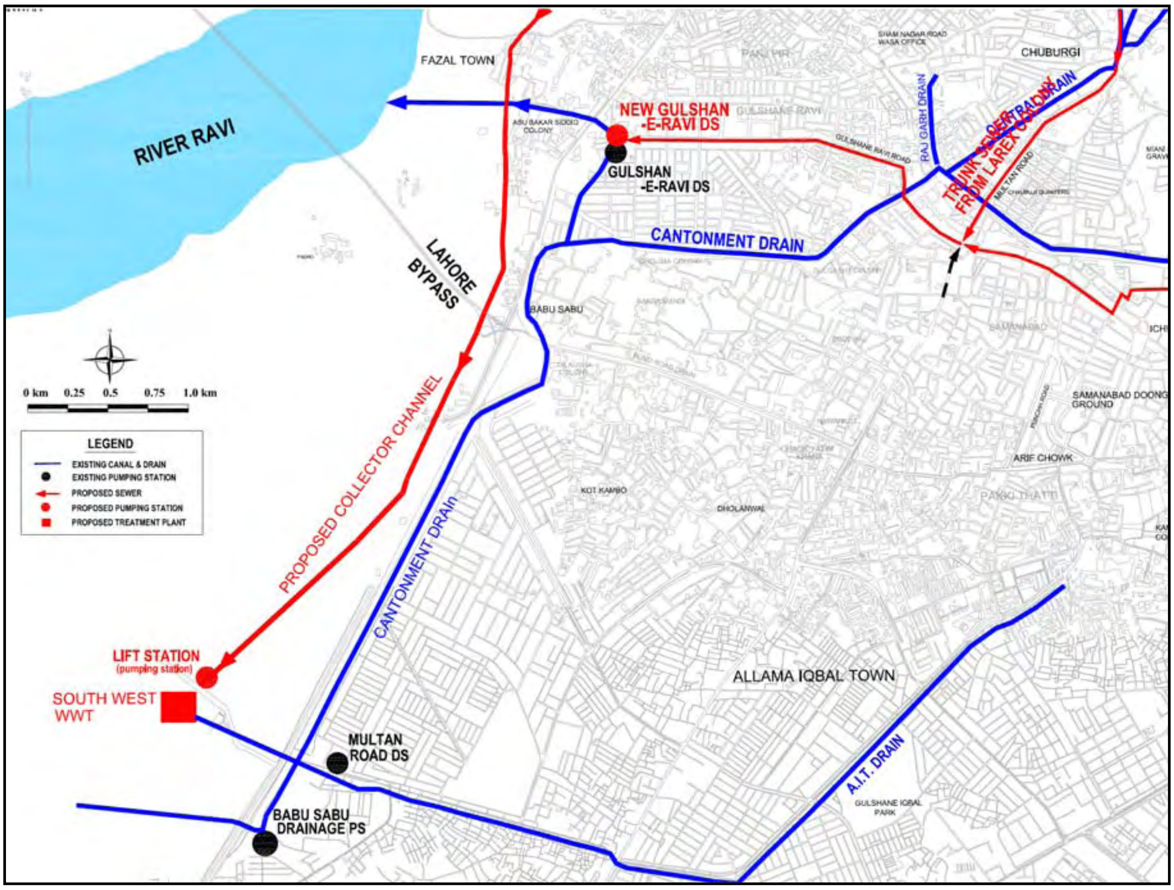


Figure 13.12 Proposed Site of New Gulshan-e-Ravi Disposal Station

(3) Design Capacity of the New Gulshan-e-Ravi Disposal Station

The New Gulshan-e-Ravi Disposal Station will receive the wastewater from the proposed Trunk Sewer along the Cantonment Drain including that from the proposed Trunk Sewer from the Larex Colony. Design discharge of the new trunk sewer to this proposed disposal station is 400 cfs (11.33 m^3/s).

The design criteria suggests use of the stand-by pump for maintenance and emergency. According to the design criteria, it is recommended that the capacity of the stand-by pump is about 30 % of design discharge. Therefore, the New Gulshan-e-Ravi Disposal Station is to be designed for total installed capacity of 520 cfs (14.72 m^3/s).

(4) Preliminary Design of the New Gulshan-e-Ravi Disposal Station

As mentioned above, the New Gulshan-e-Ravi Disposal Station will be proposed for construction on the site of the existing Gulshan-e-Ravi Disposal Station. WASA and the JICA Study Team had discussed the design concept of the New Gulshan-e-Ravi Disposal Station and both sides agreed that the layout, required equipment and facilities of the new disposal station be planned with reference to the existing disposal station for easy operation and maintenance (it will be able to share part of the equipment in case of an emergency). The results on the preliminary design for the new disposal station are as described below.

- Proposed layout of New Gulshan-e-Ravi Disposal Station is shown in **Figure 13.13** and **Appendix 13.6 Drawings DS-01**.

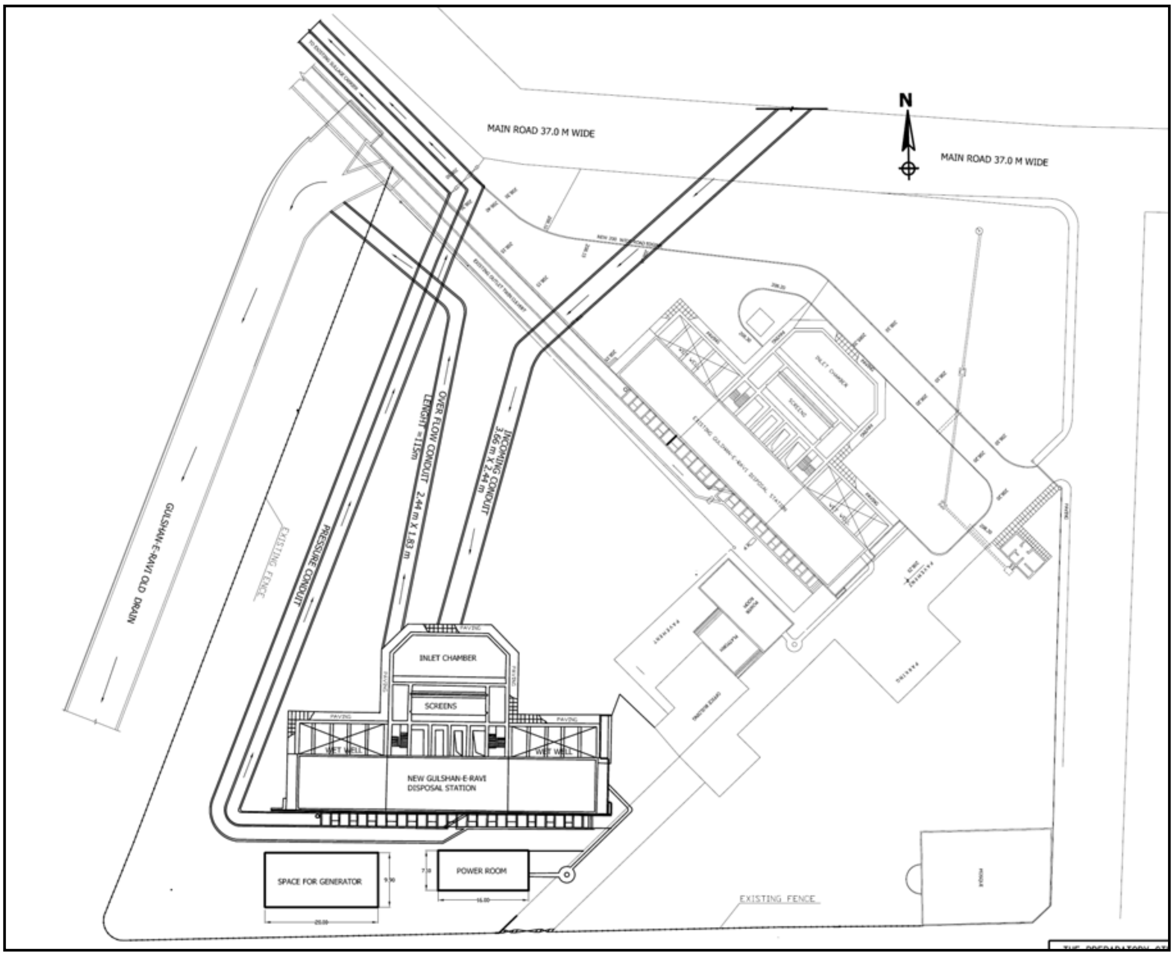


Figure 13.13 Proposed Layout of New Gulshan-e-Ravi Disposal Station

- The new disposal station was designed for a total installed pump capacity of 520 cfs (14.72 m^3/s) with a pump arrangement of 13 numbers of 40 cfs (1.13 m^3/s).
- Regarding the type of pump, it was decided that it be a vertical axial flow pump which is the same type as used in the existing Gulshan-e-Ravi Disposal Station.
- According to the design criteria, an overflow and emergency discharge conduit should be provided for the pumping station, for use in the event the pumping station must be shut down, e.g. in the instance where it is required to prevent immersion damage to electric motors, switch gear, and/or other equipment. Therefore, the overflow conduit will be installed with a size of 6’ x 8’ (1.83 x 2.44 m). The size of the overflow conduit was decided during the discussions between WASA and the JICA Study Team. It was agreed to apply 50 % capacity of the incoming conduit for the new disposal station. It will

discharge into the existing the Gulshan-e-Ravi Old Drain. The proposed alignment of overflow conduit is shown in **Figure 13.13**.

- The wastewater from the existing Gulshan-e-Ravi Disposal Station discharges into River Ravi through the sullage carrier with size 40' x 7' (12.19 x 2.13 m). This existing sullage carrier will be utilized for wastewater from the new disposal station. The design discharges from the existing and the new disposal stations are 560 cfs (15.86 m^3/s) and 520 cfs (14.72 m^3/s), respectively so the required capacity of sullage carrier will be about 1,100 cfs (31.15 m^3/s). At present, carrying capacity of the existing sullage carrier is about 900 cfs (25.49 m^3/s). Therefore, the existing sullage carrier will be re-modeling to a size of 40' x 8' (12.19 x 2.44 m) it has only to be raised by 1 foot (0.30 m) in height) to carry the required discharge. The wastewater carrying capacity of the new sullage carrier will be approximately 1,200 cfs (33.98 m^3/s).

The major specification of the New Gulshan-e-Ravi Disposal Station is tabulated in **Table 13.13**. Detailed plans and sections of the New Gulshan-e-Ravi Disposal Station are shown in **Appendix 13.6 Drawings DS-02 to DS-04.**

Table 13.13 Major Specification of New Gulshan-e-Ravi Disposal Station

Pump Type	Vertical Axial Flow Pump
Total Capacity	520 cfs (14.72 m^3/s)
Total Number of Pumps	13 pumps x 40 cfs (1.13 m^3/s) (Out of the 13 pumps, 3 are stand-by pumps)
Diameter of Pump	600 mm
Motor Power	180 kw
Material	stainless steel
Generator & Transformer	1,000 KVA: 3 units
Total Number of Trash Screens	4
Overflow Conduit	Size: Width 6'(1.83m) x Height 8'(2.44m), Length: 115 m

13.5.3 Lift Station for South West Wastewater Treatment Plant

(1) Review of Existing Documents

There is no existing study/design report with regard a lift station for the South West Wastewater Treatment Plant,.

(2) Proposed Site for the Lift Station

To raise flows from the collector channel into the South West Wastewater Treatment Plant, a new lift station will be constructed. The proposed site of the lift station will be at the end of the collector channel. Land acquisition for this lift station has already been completed by WASA. The area of land for the lift station is about 30,000 sq.ft (2,787 m^2). The proposed site of the lift station is shown in **Figure 13.12.**

(3) Design Capacity of the Lift Station

The proposed lift station will receive wastewater from the collector channel and the design discharge of the collector channel is 21.16 m^3/s (≒ 800 cfs) as described in **13.4.4**.

The design criteria suggests setting up a stand-by pump for maintenance and emergency. According to the design criteria, it is recommended that the capacity of the stand-by pump be about 30 % of design discharge, however it is impossible to setup the stand-by pump required by the design criteria due to the limited space available. Therefore, WASA and the JICA Study Team discussed this matter and agreed to apply a capacity of 20 % of the design discharge for the stand-by pump.

As a result, the new lift station is designed for a total installed capacity of 960 cfs (27.18 m^3/s).

(4) Preliminary Design of the Lift Station

The results on preliminary design for the new disposal station are as described below.

- The proposed lift station was designed for a total installed capacity of 920 cfs with pump arrangement of 12 numbers of 80 cfs (2.27 m^3/s).
- The layout of the pumping station and selection of the type of pump should be considered very carefully because of the limited space available. As mentioned before, required capacity of the pump is 960 cfs (27.18 m^3/s). which is quite a large capacity, however available land for this lift station is only 30,000 sq. ft (2,787 m^2). WASA and the JICA Study Team had discussed the design concept for the lift station and the type of pump decided upon was a screw pump. Screw pumps were selected due to the advantages indicated below.
  - Simple design, open structure and slow rotation speeds make it a heavy duty pump with minimal wear that will operate for at least one year without trouble.
  - Because of the open structure and large passage between the flights a screw pump can pump raw sewage without the need for a coarse screen before the pump. Both floating debris and heavy solids are simply lifted up. This saves considerably on equipment costs for a coarse screen and its subsequent maintenance.
  - A screw pump scoops water directly from the surface and does not need a collection sump.
  - When the incoming water level goes down, as during dry weather flows, the screw pump automatically pumps less water. Therefore, no special control system is required to adapt pump performance.
  - A screw pump requires very little maintenance. In addition no highly skilled maintenance staff are required which makes this type of pump very suitable for remote locations.

The major specification of the proposed lift station is tabulated in **Table 13.14**. Details of the plan and sections of the lift station are shown in **Appendix 13.6 Drawings LS-01 to LS-03.**

Table 13.14 Major Specification of Lift Station

Pump Type	Screw Pump
Total Capacity	960 cfs (27.18 m^3/s)
Total Number of Pump	12 pumps x 80 cfs (2.27 m^3/s) (Out of the 12 pumps, 2 are stand-by pumps)
Diameter of Screw	2,600 mm
Motor Power	315 kw
Material	mild steel, epoxy coated
Generator & Transformer	2,000 KVA: 1 unit + 1,500 KVA: 2 units

13.6 Drainage Facilities

13.6.1 Design Basis for the Drainage Network

(1) General

The Water & Sanitation Agency (WASA), will adopt LDA design criteria for the drainage system. Updated rainfall data and the run-off coefficients, based on the present estimated land use and other design parameters approved in the "Master Plan for Improvement of Sewerage and Drainage System of Central Zone, Lahore" will be followed.

(2) Computation of peak Run-off

1) Rainfall

Rainfall intensity duration curves for 2 years and 5 years have been developed based on the data from 1947-98. The rainfall intensity curves are shown in **Figure 13.14**. From the available data six hourly rainfall patterns at 2 and 5 years respectively have been prepared as shown in **Figure 13.15 and Figure 13.16**. These will form the basis for calculation of storm flows generated from different areas of the Central Area.

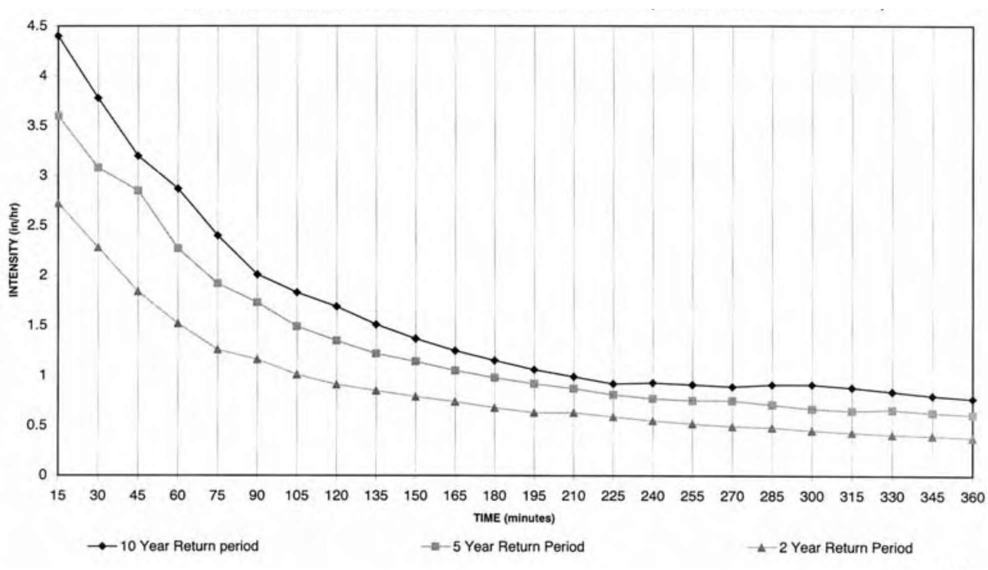


Figure 13.14 Rainfall Intensity Duration Curves

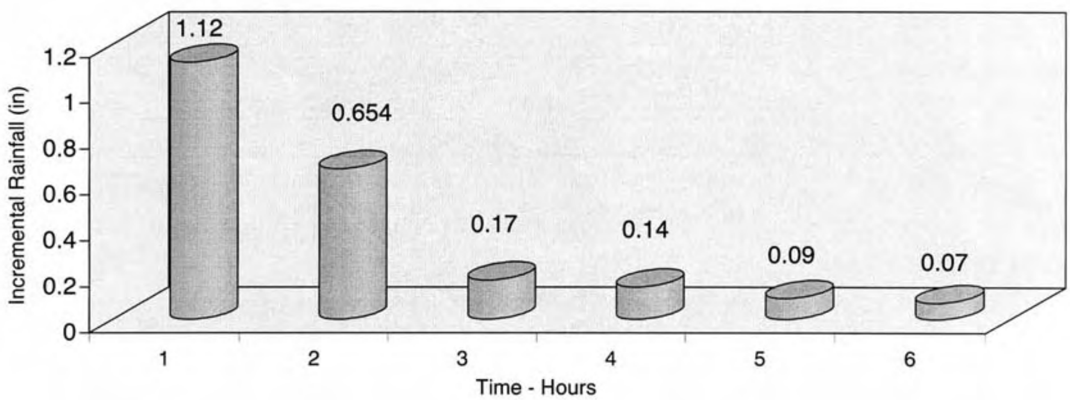


Figure 13.15 Six Hourly Rainfall Pattern 2-year Return Period

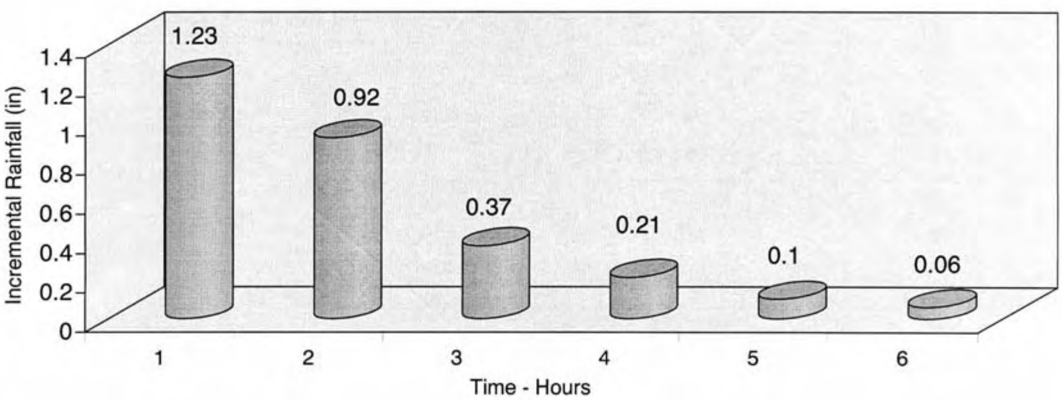


Figure 13.16 Six Hourly Rainfall Pattern 5-year Return Period

2) Rainfall – Runoff Relationship

Storm water does not flow solely in the drains alone. Part of it forms the surface runoff while the rest of the storm water is lost in various forms such as storage in depressions, evaporation, infiltration and interception. To account for the above factors, the rainfall excess, available for runoff after losses has been considered and will be calculated by subtraction of 0.1 inch (3 mm) for the first hour. Subsequently an appropriate runoff coefficient will be applied to all 6 hours of rainfall.

3) Runoff Coefficient

The run-off coefficients will depend on the built up area, type of pavement, type of soil and ambient moisture conditions. **Table 13.15** shows the values of C for different areas.

Table 13.15 Runoff Coefficient, C

Locality	C-Value
Sadar	0.30
Cantonment	0.30
Shahrah-e-Quaid-i-Azam	0.30
Gulberg Drain + Crossing to Drain	0.30
Ferozepur Road	0.40
Ferozepur Road to Gulshan-e-Ravi	0.40
Gulshan-e-Ravi Main Boulevard Crossing	0.60
Gulshan-e-Ravi Drain	0.70
Allama Iqbal Town Drain	0.46
New Babu Sabu Pumping Station	0.46

4) Peak Runoff

More than one method is available to estimate the total amount of runoff. They range from the widely used rational formula to a hydrographic method. The rational method is used for relatively small areas as it is based on the assumption that the rainfall intensity is uniform over the entire watershed area during duration of the entire storm and that the maximum runoff occurs when the rainfall lasts as long as, or longer than, the time of its highest concentration. The hydrographic method is commonly used when dealing with larger drainage areas or when designing a major system. For the design & evaluation of the Lahore Central Zone drains, the hydrographic method will therefore be used.

The following equations will be used while developing hydrographs for different points along the drains:

$$Q_P = \frac{KAQ}{T_p}$$

$$T_p = \frac{1}{2} D + 0.6\, T_c$$

$T_b = 2.67\ T_p$

Where Q_P = Peak run-off rate, in cusecs

A = Tributary area, in square miles

K = Constant for particular watershed (Value of K varies from 600 in steep terrain to 300 in flat areas, the adopted value in this case is 300)

Q = Incremental excess rain, in inches

T_p = Time from start of runoff to peak rate, in hours

T_c = Time of Concentration, in hours

D = Incremental rainfall excess period, in hours

T_b = Time base of hydrograph, in hours

The above equations have been taken from the design criteria.

The time of concentration (T_c) has been calculated considering the velocity of flow of 2.5 ft/sec (0.76 m/s) within the drain reach and in this flow time a provision of half hour has been added to take care of flow time from the surrounding areas of the drain. Mathematically the expression for T_c is given below:

$$Tc = (L\ (ft) / 2.5\ (ft/s)) + 0.5\ (hours)$$

The peak runoff (Q_P) calculated by the above formula is the incremental runoff, when such peak runoff is calculated for each hour of the rainfall period. The peak stormwater flow at a particular point is then obtained by the graphical addition of hydrographs developed at this point.

5) Return Period

The return period is not found in the WASA design criteria for the design of drainage structures and facilities. However, 2 years and 5 years return period were recommended in existing report. The selection of return period is dependent on various factors like available space for the construction/remodeling of the drain, the cost of the drain, the number of pumping stations and the average annual damages and disruption cost. The drains can be designed on a 2 years or a 5 years return period. Also tributary drains become inadequate for 5 years return periods due to the limited available space. In keeping view of the limitations of the existing drain capacities and space available for widening of existing drains, it is therefore appropriate to use the 2 year return period for the design criteria.

Large initial investment is necessary for the construction of the drainage system and it is very difficult to re-modeling the scale of drainage facility from 2 years return period to 5 years return period. Therefore, a in-depth examination is necessary for the selection of return period and it should be use 5 years return period for design of drainage facilities as much as possible.

(3) Hydraulic Design

The manning formula will be used for the design of drains:

$$V = 1.486 \frac{1}{n} R^{2/3} S^{1/2}$$

Where V = Flow velocity in feet per second

n = Co-efficient of roughness, Manning's Co-efficient

R = Hydraulic radius in feet

S = Mean slope of hydraulic gradient

The values of Manning's 'n' are given as below

Material	Manning's Coefficient
R.C. Conduit	0.015
R.C. Pipe	0.013

13.6.2 Improvement of Drainage System in Central Area

(1) Review of Existing Documents

JICA Study Team has reviewed the following documents while designing the proposed drains.

- Integrated Master Plan for Lahore-2021 NESPAK, Nov. 2002
- Master Plan for Improvement of Sewerage & Drainage Systems of Central Zone, Lahore –Preliminary Design Report NESPAK, Dec. 2003
- Master Plan for Improvement of Sewerage & Drainage Systems of Central Zone, Lahore –Final Design Report NESPAK, July. 2004
- Master Plan for Improvement of Sewerage & Drainage Systems of Central Zone, Lahore –PC-1 NESPAK, Jan. 2005
- Master Plan for Improvement of Sewerage & Drainage Systems of Central Zone, Lahore –PC-1 NESPAK, Jun. 2005
- Master Plan for Improvement of Sewerage & Drainage Systems of Central Zone, Lahore –Detailed Engineering Design Report NESPAK, Aug. 2005

(2) Proposed Route of New Drains and Improvement & Rehabilitation of Existing Drains

In order to improve the drainage system, construction of the following 27 new main drains and tertiary drains, and improvement & rehabilitation of 2 existing drains was proposed.

No.	Line	No.	Line
New Construction			
1	Central Drain	15	Sodewal Drain
2	Dil Muhammad Road Drain	16	Gulgasht Drain
3	Art Councel Drain	17	Nasir Bagh Drain
4	Allama Iqbal Road Drain	18	Mall Road Drain
5	WAPDA House Drain	19	Queens Road Drain
6	Lawrence Road Drain	20	Shahra Awane Tijarat Road Drain
7	Nicholson Road Drain	21	Golf Road Drain
8	Poonch Road Drain	22	Kinnaird Drain
9	Chauburji Drain	23	Shah Jamal Drain
10	New Samanabad Drain	24	Gulshan-e-Ravi Drain
11	Morrhe Samanabad Drain	25	Sanda Road Drain
12	Multan Road Drain	26	Krishan Nagar Drain
13	Almumtaz Road Drain	27	Rewaz Garden Drain
14	Old Bund Road Drain	28	Tertiary Drain
Improvement & Rehabilitation			
1	Meclod Road Drain	2	Governor House Drain

Proposed route of main drains, tertiary drains and rehabilitation drains are shown in **Figure 13.17 and Appendix 13.6 Drawings DGE-01**. The detailed plans for the main drains and improvement & rehabilitation of existing drains are shown in **Appendix 13.6 Drawings DP-01 to DP-39.**

(3) Design Discharge of New Main Drains

The design discharges for the new main drains and the improved/rehabilitated drains with a 2-year return period of design scale as estimated in the Detailed Engineering Design Report will be applied. The hydraulic analyses are as given in **Appendix 13.5.4** to **Appendix 13.5.28**. The estimated design discharges for the new main drains are presented in **Figure 13.18**.

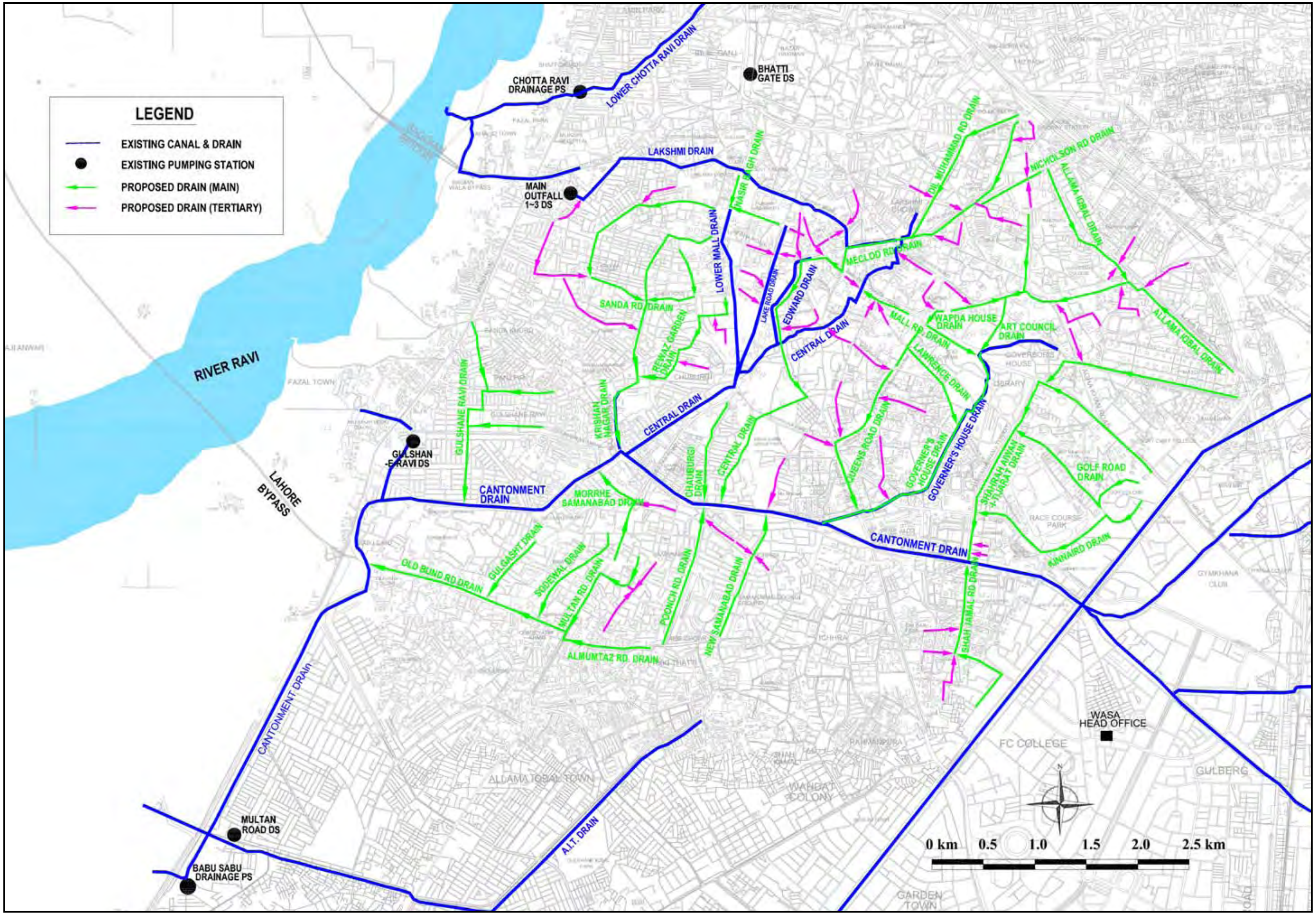


Figure 13.17 Proposed Route of Drains

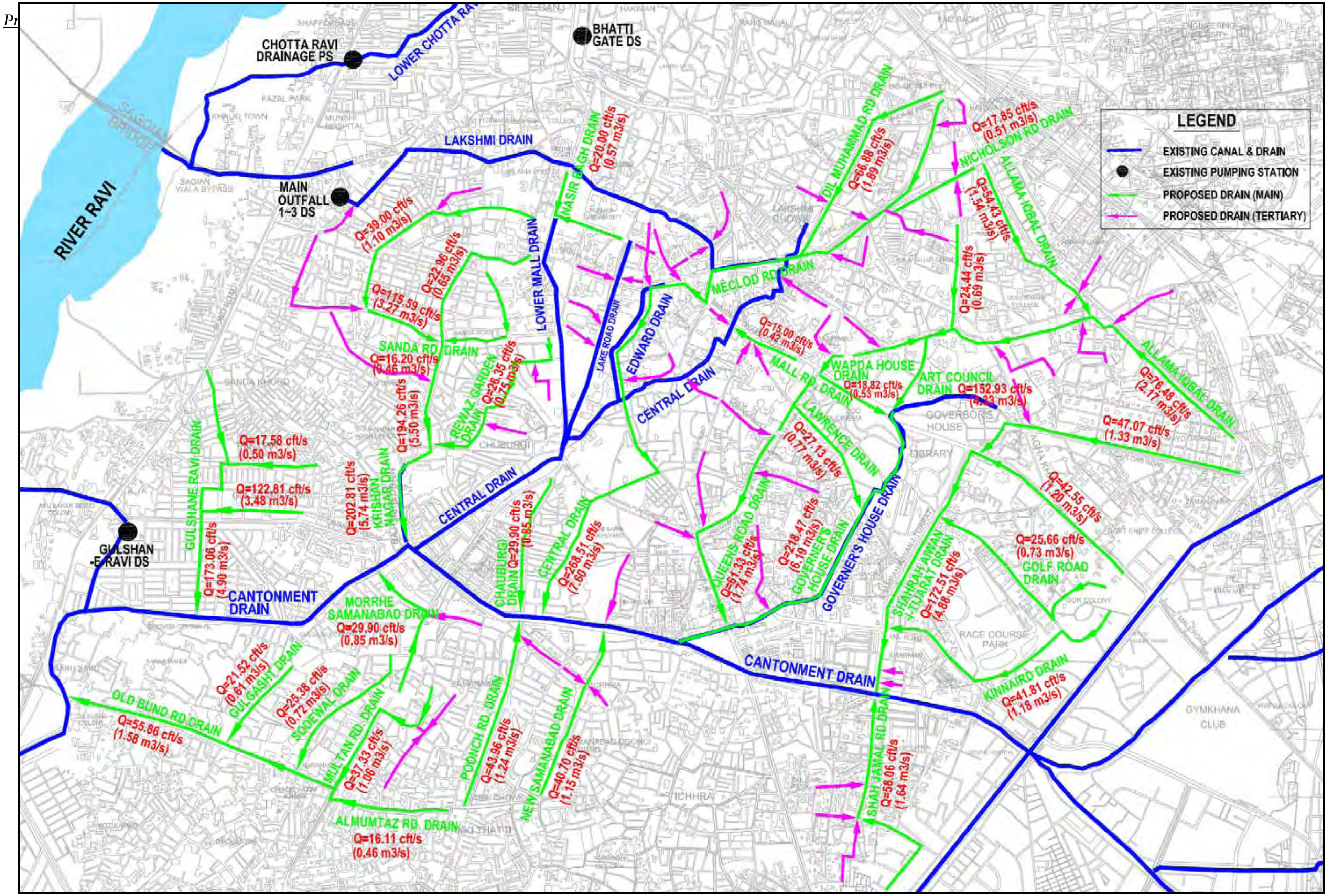


Figure 13.18 Design Discharge of New Main Drains

(4) Preliminary Design of Proposed Drains

The new drains were designed in accordance with the design criteria for sewers shown below,.

- The total length of the new main drains and tertiary drains are 168,226 ft (51.28 km) and 74,646 ft (22.75 km), respectively.
- The conduit type was applied for the proposed drain section. It is not a reinforced concrete box culvert. The applied conduit consists of concrete, brick masonry and reinforced concrete slab. Typical cross sections of the drains and details of covers are showing in **Appendix 13.6 Drawings DG-01** and **DG-02**.
- The carrying capacities of proposal drains were computed in accordance with Manning's formulae with values of 'n' = 0.015 corresponding to concrete conduit and drainage discharges are shown in **Appendix 13.5.4 to 13.5.29** and are the flows the collection system will have to sustain.
- The proposed drains have several sections depending on design discharges. The major features of drains are shown in **Table 13.16 and Appendix 13.6 Drawings DGE-01**. The longitudinal profiles of proposed drains are showing in **Appendix 13.6 Drawings DP-01 to DP-39**.
- Regarding construction methodology, the open cut method will be applied at all sites.

Table 13.16 The Major Features of Proposed Drains

No.	Drain (total length)	Size (width x height (ft))	Length (ft)	Slope
Construction of New Drain				
1	Central Drain (17,600 ft (5,364m))	3.0 x 4.0 (1.22 x 0.91m)	5,100 (1,554m)	0.00030
		6.0 x 5.0 (1.83 x 1.52m)	500 (152m)	0.00070
		10.0 x 6.0 (3.05 x 1.83m)	5,500 (1,676m)	0.00017
		12.0 x 6.0 (3.66 x 1.83m)	6,500 (1,981m)	0.00011
2	Dil Muhammad Road Drain	3.5 x 3.0 (1.07 x 0.91m)	1,000 (305m)	0.0040
	(5,500 ft (1,676m))		2,500 (762m)	0.0036
		4.0 x 4.0 (1.22 x 1.22m)	2,000 (610m)	0.0013
3	Art Councel Drain (2,900 ft (884m))	7.5 x 5.0 (2.29 x 1.52m)	3,500 (1,067m)	0.00065
4	Allama Iqbal Road Drain	4.0 x 3.0 (1.22 x 0.91m)	800 (244m)	0.0025
	(13,838 ft (4,218m))		500 (152m)	0.0020
			1,000 (305m)	0.0018
		4.0 x 4.0 (1.22 x 1.22m)	500 (152m)	0.0009
			1,500 (457m)	0.0008
		3.5 x 4.0 (1.07 x 1.22m)	3,500 (1,067m)	0.0022
		7.5 x 6.0 (2.29 x 1.83m)	3,538 (1,078m)	0.0003
		3.0 x 3.0 (0.91 x 0.91m)	2,500 (762m)	0.0007
5	WAPDA House Drain (3,110 ft (948m))	3.0 x 3.0 (0.91 x 0.91m)	3,110 (948m)	0.0015
6	Lawrence Road Drain (3,688 ft (1,124m))	3.5 x 3.0 (1.07 x 0.91m)	3,688 (1,124m)	0.0006
7	Nicholson Road Drain (2,463 ft (751m))	3.0 x 3.0 (0.91 x 0.91m)	2,463 (751m)	0.00041
8	Poonch Road Drain (4,838 ft (1,475m))	5.0 x 4.0 (1.52 x 1.22m)	4,838 (1,475m)	0.00028
9	Chauburji Drain (3,548 ft (1,081m))	3.5 x 4.0 (1.07 x 1.22m)	3,548 (1,081m)	0.00036

No.	Drain (total length)	Size (width x height (ft))	Length (ft)	Slope
10	New Samanabad Drain (4,540 ft (1,384m))	4.0 x 4.0 (1.22 x 1.22m)	3,106 (947m)	0.00030
		4.5 x 4.0 (1.37 x 1.22m)	1,434 (437m)	0.00032
11	Morrhe Samanabad Drain (3,548 ft (1,081m))	3.5 x 4.0 (1.07 x 1.22m)	3,548 (1,081m)	0.00036
12	Multan Road Drain (4,242 ft (1,293m))	3.5 x 3.0 (1.07 x 0.91m)	1,203 (367m)	0.00040
		4.0 x 4.0 (1.22 x 1.22m)	3.039 (926m)	0.00039
13	Almumtaz Road Drain (3,188 ft (972m))	3.5 x 3.0 (1.07 x 0.91m)	3,188 (972m)	0.00040
14	Old Bund Road Drain (6,715 ft (2,047m))	4.5 x 4.0 (1.37 x 1.22m)	983 (300m)	0.00037
			1,774 (541m)	0.00040
		5.0 x 4.0 (1.52 x 1.22m)	3,958 (1,206m)	0.00045
15	Sodewal Drain (5,038 ft (1,536m))	4.0 x 3.0 (1.22 x 0.91m)	5,038 (1,536m)	0.00036
16	Gulgasht Drain (2,435 ft (742m))	3.5 x 3.0 (1.07 x 0.91m)	2,435 (742m)	0.00042
17	Nasir Bagh Drain (1,100 ft (335m))	3.0 x 3.0 (0.91 x 0.91m)	1,100 (335m)	0.00051
18	Mall Road Drain (1,725 ft (526m))	3.0 x 2.0 (0.91 x 0.61m)	1,725 (526m)	0.0008
19	Queens Road Drain (5,382 ft (1,640m))	4.0 x 5.0 (1.22 x 1.52m)	5,382 (1,640m)	0.00059
20	Shahra Awane Tijarat Road Drain (17,490 ft (5,331m))	4.0 x 3.0 (1.22 x 0.91m)	815 (248m)	0.0015
			5,462 (1,665m)	0.0013
		8.0 x 4.0 (2.44 x 1.22m)	6,538 (1,993m)	0.0012
		4.0 x 4.0 (1.22 x 1.22m)	4,675 (1,425m)	0.0006
21	Golf Road Drain (5,648 ft (1,722m))	3.0 x 3.0 (0.91 x 0.91m)	2,148 (655m)	0.00045
		4.0 x 4.0 (1.22 x 1.22m)	3.500 (1,067m)	0.00030
22	Kinnaird Drain (6,690 ft (2,039m))	4.0 x 5.0 (1.22 x 1.52m)	6,690 (2,039m)	0.00036
23	Shah Jamal Drain (5,956 ft (1,815m))	3.0 x 3.0 (0.91 x 0.91m)	1,794 (547m)	0.00045
		4.0 x 3.0 (1.22 x 0.91m)	1,640 (500m)	0.00058
		6.0 x 4.0 (1.83 x 1.22m)	2,522 (769m)	0.00030
24	Gulshan-e-Ravi Drain (11,413 ft (3,479m))	3.5 x 4.0 (1.07 x 1.22m)	2,384 (727m)	0.00035
		4.5 x 4.0 (1.37 x 1.22m)	1,882 (574m)	0.00040
		10.0 x 5.0 (3.05 x 1.52m)	2,354 (717m)	0.00036
		3.5 x 3.0 (1.07 x 0.91m)	2,176 (663m)	0.00040
		8.0 x 5.0 (2.44 x 1.52m)	2,617 (798m)	0.00034
25	Sanda Road Drain (3,579 ft (1,091m))	3.5 x 3.0 (1.07 x 0.91m)	3,579 (1,091m)	0.0004
26	Krishan Nagar Drain (17,021 ft (5,188m))	4.0 x 3.0 (1.22 x 0.91m)	3,842 (1,171m)	0.00035
		3.0 x 3.0 (0.91 x 0.91m)	2,679 (817m)	0.00060
		4.0 x 4.0 (1.22 x 1.22m)	3,000 (914m)	0.00040
		7.0 x 5.0 (2.13 x 1.52m)	2,000 (610m)	0.00042
		10.0 x 6.0 (3.05 x 1.83m)	3,000 (914m)	0.00030
		12.0 x 6.0 (3.66 x 1.83m)	2,500 (762m)	0.000187
27	Rewaz Garden Drain (5,031 ft (1,533m))	2.0 x 3.0 (0.61 x 0.91m)	1,031 (314m)	0.00072
		3.5 x 4.0 (1.07 x 1.22m)	4,000 (1,219m)	0.00035
28	Tertiary Drain (74,646 ft (22,752m))	2.0x2.0~3.0x3.0 (0.61 x 0.61 ~ 0.91 x 0.91m)	-	-
Improvement & Rehabilitation				
1	Meclod Road Drain (2,000 ft (610m))	6.0 x 5.0 (1.83 x 1.52m)	2,000 (610m)	0.0007
2	Governor House Drain (8,435 ft (2,571m))	7.5 x 7.0 (2.29 x 2.13m)	341 (104m)	0.00075
		8.0 x 5.0 (2.44 x 1.52m)	2,594 (791m)	0.00065
		10.0 x 6.0 (3.05 x 1.83m)	5,500 (1,676m)	0.00036

CHAPTER 14 PROJECT IMPLEMENTATION

14.1 Outline of Project Components for Phase 1

The project components for Phase 1 are shown in **Table 14.1**.

Table 14.1 Outline of Project Components for Phase 1

(1) Facility/Equipment to Be Constructed/Installed

Phase 1 (2010-2017)	Specifications
Water supply	
1. Preparation for Using Alternative water Source for Drinking Water 1-1: Preparation of a master plan to develop alternative water source and related facilities, including examination on integration of the existing groundwater supply system and new surface water supply system 1-2: Implementation of preparatory activities including acquisition of rights of surface water	**(Refer to Water Supply 1 in Consulting Services)** The surface water is indispensable for water supply in future due to chronic groundwater drawdown and the ascending trend of arsenic concentration in groundwater. For this purpose, consulting services is necessary for the study of acquisition of rights of surface water, preparation of a master plan and for conjunctive management of surface- and groundwater.
2. Reduction of Unaccounted-for-water and Non-revenue-water	
2-1: Installation of meters in 40% of connections	Water meter Ø 15mm (typical) × 308,000 units
2-2: installation of bulk flow meters for all tube-wells	Bulk Flow Meter (BFM) Ø 8” × 159 units for 1.0 to 2.5 cusec tube-wells Ø 10” × 233 units for 3.0 to 4.0 cusec tube-wells Each tube-well equipment include one (1) unit of pressure gauge.
2-3: Execution of asset study and preparation of a distribution network improvement plan in the entire WASA area	**(Refer to Institutional Improvement 2-3)** The consultants to be employed at the D/D stage assists the asset study and prepare the distribution network plan, based on the results of a pilot study
2-4: Implementation of distribution network improvement in the priority area in the central Lahore within agreed loan amount and period (refer to Management section on other institutional measures)	**(Not Specified)** Details will be fixed based on the study in the pilot area during the detailed design stage. 1) The priority is given to the town with high UFW ratio. 2) The pipes that leakage is found will be replaced by new pipes. 3) If the trend that the older the pipes installed the more the leakage becomes clear, the older pipes will be replaced with priority.
3. Improvement of Disinfection 3-1: Installation of chlorinators for all tube-wells (certain measures for UFW reduction are also relevant for improvement of water quality)	For each tube-well specified in 4-5 below Chemical feed pump with a storage container (10 liter/hr x 10 bar) x 342 units
4. Procurement of Operation and Maintenance Equipment 4-1: Dewatering equipment 4-2: Water supply equipment and sewer cleaning equipment (vehicles) 4-3: Water meter repair workshop equipment 4-4: Water quality analyzer 4-5: Vehicles for employees’ transportation	(see **Appendix 10.8**)

4-6: On-site measuring instrument	
Sewerage	
1. Sewer – Central Area – connecting to South West Treatment Plant	
1-1: Construction of trunk sewer from Larex Colony to Gulshan-e-Ravi Disposal Station	Ø 24” – 90” × 34.766 ft
1-2: Construction of branch sewers from Larex Colony to Gulshan-e-Ravi Disposal Station	Ø 15” – 54” × 15,632 ft
1-3: Construction of trunk sewer along Cantonment Drain	Ø 42” – 78” × 22,805 ft 6.0 ft W x 6.0 ft H x 3,000 ft 7.0 ft W x 6.0 ft H x 1,500 ft 8.0 ft W x 6.0 ft H x 7,000 ft 12.0 ft W x 8.0 ft H x 8,275ft
2. Disposal Station – Central Area – connecting to South West Treatment Plant	
2-1: Construction of New Gulshan-e-Ravi DS	Volute pimps : 13 units (including 3 units as standby) 40 cusecs
3. Wastewater Treatment Plant– South West Area –	
3-1 : Construction of Collector Channel	3.0 m W x 1.8 m H x 1,490 m 5.5 m W x 1.8 m H x 2,750 m 10.0 m W x 2.2 m H x 3,150 m
3-2 : Construction of Lift Station	Screw Punmps : 12 units (including 2 units as standby) Q = 80 cusecs
3-3: Construction of South West Wastewater Treatment Plant including collector channel and pumping station	Q = 323 cusecs (790,000 m^3/day) Anaerobic ponds + Trickling filters + Sedimentation ponds
Drainage	
1. New Construction of Drains in Central Lahore	
1-1: Central Drain	3.0 - 12.0 ft W x 4.0 - 6.0 ft H x 17,600 ft
1-2: Dil Muhammad Road Drain	3.5 - 4.0 ft W x 3.0 - 4.0 ft H x 5,500 ft
1-3: Art Council Drain	7.5 ft W x 5.0 ft H x 2,900 ft
1-4: Allama Iqubal Road Drain	3.0 – 7.5 ft W x 3.0 - 6.0 ft H x 13,838 ft
1-5: WAPDA House Drain	3.0 ft W x 3.0 ft H x 3,110 ft
1-6: Lawrence Road Drain	3.5 ft W x 3.0 ft H x 3,688 ft
1-7: Nicholson Road Drain	3.0 ft W x 3.0 ft H x 2,463 ft
1-8: Poonch Road Drain	5.0 ft W x 4.0 ft H x 4,838 ft
1-9: Chauburji Drain	3.5 ft W x 4.0 ft H x 3,548 ft
1-10: new Samanabad Drain	4.0 – 4.5 ft W x 4.0 ft H x 4,540 ft
1-11: Morrhe Samanabad Drain	3.5 ft W x 4.0 ft H x 3,548 ft
1-12: Multan Road Drain	3.5 – 4.0 ft W x 3.0 - 4.0 ft H x 4,242 ft
1-13: Almumtaz Road Drain	3.5 ft W x 3.0 ft H x 3,188 ft
1-14: Old Bund Road Drain	4.5 – 5.0 ft W x 4.0 ft H x 6,715 ft
1-15: Sodewal Drain	4.0 ft W x 3.0 ft H x 5,038 ft
1-16: Gulgasht Drain	3.5 ft W x 3.0 ft H x 2,435 ft
1-17: Nasir Bagh Drain	3.0 ft W x 3.0 ft H x 1,100 ft
1-18: Mall Road Drain	3.0 ft W x 2.0 ft H x 1,725 ft
1-19: Queens Road Drain	4.0 ft W x 5.0 ft H x 5,382 ft
1-20: Shahra Awane Tijarat Road Drain	4.0 – 8.0 ft W x 3.0 - 4.0 ft H x 17,490 ft
1-21: Golf Road Drain	3.0 – 4.0 ft W x 3.0 - 4.0 ft H x 5,648 ft
1-22: Kinnaird Drain	4.0 ft W x 5.0 ft H x 6,690 ft
1-23: Shah Jamal Drain	3.0 – 6.0 ft W x 3.0 - 4.0 ft H x 5,956 ft
1-24: Gulshan-e-Ravi Drain	3.0 – 10.0 ft W x 3.0 - 5.0 ft H x 11,413 ft
1-25: Sanda Road Drain	3.5 ft W x 3.0 ft H x 3,579 ft

1-26: Krishan Nagar Drain 1-27: Rewaz Garden Drain 1-28: Tertiary Drain	3.0 – 12.0 ft W x 3.0 - 6.0 ft H x 17,021 ft 2.0 – 3.5 ft W x 3.0 - 4.0 ft H x 5,031 ft 2.0 – 3.0 ft W x 2.0 - 3.0 ft H x 74,646 ft
2. Improvement and Rehabilitation of Drain in Central Lahore 2-1: Meclod Road Drain 2-2: Governor House Drain	 6.0 ft W x 5.0 ft H x 2,000 ft 7.5 – 10.0 ft W x 5.0 - 7.0 ft H x 8,435 ft
Institutional Improvement	
2. Timely Data Acquisition and Preparation of Definitive Vision and Strategies 2-3: implementation of comprehensive asset survey and preparation of asset inventories and drawings in the entire WASA area	
3. Reduction of Unaccounted-for-water and Non-revenue-water 3-2 installation of meters in 40% of connections 3-3 establishment of leakage detection teams 3-4 implementation of distribution network improvement in the priority area in the central Lahore based on asset study and preparation of distribution network improvement plan in the entire WASA area. 3-5 implementation of stringent measures against defaulters and illegal connections and phasing-out of uncharged public stand posts 3-6 entrustment of metering and billing to private companies	 **See Water Supply 2-1 above, Assisted by the consulting firm** **Assisted by the consulting firm** **See Water Supply 2-3 above, Assisted by the consulting firm** **Assisted by the consulting firm** **Assisted by the consulting firm**
4. Human Resource Development and Organizational Streamlining 4-1 organizational restructuring 4-2 improvement of personnel management and human resource development 4-3 entrustment of certain facilities to private companies 4-4 establishment of Management Information System 4-5 procurement of O&M equipment	 **Assisted by the consulting firm** **Assisted by the consulting firm** **Assisted by the consulting firm** **Assisted by the individual consultant** **Assisted by the individual consultant**
5. Improvement of Customer Services 5-2 regular implementation of customer survey 5-3 improvement of complaint handling system 5-4 expansion of payment options for customers 5-5 preparation of public relation strategy and its implementation	 **Assisted by the consulting firm** **Assisted by the individual consultant** **Assisted by the consulting firm**
6. Groundwater Monitoring and Regulation 6-1 follow up survey and analysis on groundwater quality and quantity 6-2 establishment of groundwater committee 6-3 preparation of groundwater control and regulation plan 6-4 establishment of regular monitoring system of groundwater	**Assisted by the consulting firm**
Consulting Services	
1. Detailed design for Phase-1 Project 2.Tender assistance for Phase-1 Project 3. Construction supervision for Phase-1 Project 4. Detailed design of sewerage and drainage facilities for Phase-2 Project 5. Preparation of master plan for Lahore Water Supply System 6. Detailed design of Lahore Water Supply System for Phase-2 Project	

7. Study on institutional improvement 8. Preparation of master plan and feasibility study for water supply, sewerage and drainage outside the WASA's current jurisdiction	

14.2 Conditions and Assumptions for Cost Estimation

The following conditions and assumptions are set for cost estimations.

14.2.1 Estimation of Capital Cost

(1) Eligible Portion

1) Exchange Rate

- Base year : September 2009
- Exchange Rate : US$ 1 = JY 92.53
  : Rs. 1 = JY1.26

(Average of T.T.S at Bank of Tokyo-Mitsubishi UFJ in September, 2009)

2) Construction Costs

The unit prices for locally available material/equipment, labour and construction works are based on "Market Rate for the year 2009 Third Quarter (July-September), Lahore etc." prepared by the Government of the Punjab.

3) Consulting Services

The remuneration of consulting services is estimated based on the Personnel work schedule

4) Physical Contingency

Physical contingency is estimated at 5% of the direct construction costs.

5) Price Escalation

The applicable rate is as follows:

For foreign currency : 2.6 %
For local currency : 3.6%

(2) Non-Eligible Portion

1) Custom Duty

The custom duty is based on "Custom Tariff [2009-2010]" available at the official website of FBR (Federal Board of Revenue, Government of Pakistan)

For services provided or rendered by professionals and consultants etc., a custom tariff of 16% is applied to the charge in accordance with Chapter 98.15 of the "Pakistan

Custom Tariff”

2) Sales Tax and Special Federal Excise Duty

The applicable rates of sales tax, income tax and special federal excise duty are as follows:

Sales tax	: 16%
Special federal excise duty	: 1%

The sales tax and special federal excise duty are calculated with the following equations:

Sales tax = (Net value + Custom duty) x 0.16

Special federal excise duty = (Net value + Custom duty) x 0.01

(3) Commitment Charge

Commitment charge is calculated by multiplying the loan balance not-used on and after the effective date of loan agreement by 0.1% per annum.

(4) Interest during Construction

Interest during construction is calculated with the following equation by category:

For sewerage and drainage

Interest during Construction = direct construction cost x 0.65% x 10 years

For water supply and institutional improvement

Interest during Construction = direct construction cost x 1.40% x 10 years

For consultancy services

Interest during Construction = direct construction cost x 0.01% x 10 years

14.2.2 Estimation of Operation and Maintenance Costs

(1) Expected lifetime

The applicable expected lifetime is as follows:

- Concrete structures : 40 years
- Pump : 15 years
- Water meter : 8 years
- Mechanical equipment : 15 years
- Electrical equipment : 20 years

(2) Energy cost (Rs./year)

Energy Cost = Power consumption (kWh/day) x 8 (Rs./kWh) x 365 (day/year)

(3) Personnel Cost (Rs./year)
Personnel Cost = Required M/M x Monthly rate (Rs./month) x 12 (month/year)

(4) Repair Cost (Rs./year)
Repair cost = [(Energy cost) + (Personnel Cost)] x 0.01

14.3 Capital Cost

14.3.1 Capital Cost of Phase 1 Project

The Capital Cost of Phase 1 Project is presented in **Table 14.2** for full component.

14.3.2 Options for Phase 1 Package

The total amount of the proposed direct construction cost is huge as JY37.1 billion including the remuneration of consulting services. The ideas for prioritizing the project components are as follows:.

(1) The phased construction is applicable to the construction of a wastewater treatment plant (WWTP). The actual construction is started from, for example, one-fourth of a full design capacity which is augmented subsequently so as to meet an increase of incoming wastewater flow and finally reaches to the full design capacity. In this case, as the WWTP staff have mastered the operation and maintenance practice and water quality analysis of a WWTP, got the data of required man-power and O&M cost and then confronted next expansion, there is less risk in failure. If any, it has an advantage that it can be minimized.
In Lahore, the construction of a WWTP has been sincerely considered so that its construction site has been purchased in the beginning of 1990s, but it has been unfortunately left due to failure in financing to it. While, to cope with an increase in population and industrial development, the sewer system has been provided in its way to discharge wastewater into the public water bodies through disposal stations. A WWTP to be constructed can collect only wastewater discharged from those disposal stations for treatment, it requires a big treatment capacity from the first. The proposed South West WWTP has the biggest design capacity (790,000 m^3/day) in Lahore. There is almost no antecedent to construct such scale plant from the first in the world. Taking into account the facts that the construction of a WWTP is the first in WASA and WASA has no knowhow and experience of O&M of a WWTP, there is a high risk to construct a WWTP with a full design capacity. Therefore, the phased approach to construct a WWTP with a one-quarter or half scale of a full design capacity to have full experience and then to proceed the next step has full rationality.

(2) It is necessary to discuss about the priority of project components among departments/agencies concerned. The Chief Minister's Office and WASA gives the first priority to network provision of sewerage and drainage systems followed by the construction of the South West WWTP, however, HUD&PHED and P&DD places the latter at the top priority.

(3) For the purpose that the South West WWTP can treat the wastewater, it is necessary to lead the wastewater to the plant. Therefore, the construction of the South West WWTP and collector channel should be done together with the connection work of existing disposal stations to the collector channel.

(4) The laying/construction of sewerage/drainage networks in Central Lahore is aiming at separating sanitary sewers from Cantonment Drain and connect them to trunk sewers to be newly laid along Cantonment Drain, leading to the new Gulshan-e-Ravi Disposal Pumping Station. Instead, Cantonment Drain will be able to receive the new drains. They are an interaction regarding the segregation of sanitary wastewater and storm water. Accordingly, the provision of sewer and drain networks in Central Lahore should be done at the same time.

Under the assumption that the South West WWTP will be divided into two modules and constructed one by one in Phase 1 and Phase-2 continuously, **Table 14.3** shows the costs for Option 1 (WWTP: half design capacity), while **Table 14.4** for Option 2 in which all the components are included in the project except for the WWTP.

Table 14.2 Cost for Phase-1 Project (Full Components)

Annual Fund Requirement

Base Year For Cost Estimation:	September 2009		FC & Total:	49,228 million	JPY
Exchange Rates	PK･Rupee = yen	1.26	LC :	21,821 million	PK･Rupee
PriceEscaration:	FC: 2.6%	LC: 3.6%			
Physical Contingency	5%				
Physical Contingency for Consultant	5%				

Item	Total			2010			2011			2012			2013		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION															
I) Procurement / Construction	15,683	13,813	33,088	0	0	0	0	0	0	0	0	0	0	0	0
Water Supply	1,384	326	1,795	0	0	0	0	0	0	0	0	0	0	0	0
Sewerage	8,592	7,588	18,153	0	0	0	0	0	0	0	0	0	0	0	0
Drainage	0	2,690	3,389	0	0	0	0	0	0	0	0	0	0	0	0
Management	2,699	7	2,708	0	0	0	0	0	0	0	0	0	0	0	0
Base cost for JICA financing	12,675	10,611	26,045	0	0	0	0	0	0	0	0	0	0	0	0
Price escalation	2,261	2,545	5,468	0	0	0	0	0	0	0	0	0	0	0	0
Physical contingency	747	658	1,576	0	0	0	0	0	0	0	0	0	0	0	0
II) Consulting services	3,053	728	3,970	0	0	0	0	0	0	748	122	902	278	49	340
Base cost	2,567	576	3,293	0	0	0	0	0	0	660	105	792	239	41	290
Price escalation	347	120	499	0	0	0	0	0	0	53	12	68	26	6	34
Physical contingency	145	35	189	0	0	0	0	0	0	36	6	43	13	2	16
Total (I +II)	18,736	14,542	37,059	0	0	0	0	0	0	748	122	902	278	49	340
B. NON ELIGIBLE PORTION															
a Land acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b Administration cost	0	1,176	1,482	0	0	0	0	0	0	0	29	36	0	11	14
(Environmental and social consideration cost)	0	40	50	0	0	0	0	0	0	0	7	8	0	7	8
c Custom duty	0	3,100	3,906	0	0	0	0	0	0	0	112	141	0	43	54
Base cost	0	2,495	3,143	0	0	0	0	0	0	0	101	127	0	37	47
Price escalation	0	606	763	0	0	0	0	0	0	0	11	14	0	6	7
d Sales tax	2,998	2,823	6,554	0	0	0	0	0	0	120	38	167	44	15	63
e Special federal excise duty	0	180	226	0	0	0	0	0	0	0	7	9	0	3	3
Total (a+b+c+d+e)	2,998	7,279	12,170	0	0	0	0	0	0	120	185	353	44	71	134
TOTAL (A+B)	21,734	21,821	49,228	0	0	0	0	0	0	868	308	1,255	322	120	474
C. INTEREST DURING CONSTRUCTION	2,031	0	2,031	0	0	0	0	0	0	0	0	0	0	0	0
D. COMMITMENT CHARGE	153		153						37			36			36
GRAND TOTAL (A+B+C+D)	21,734	21,821	49,228	0	0	0	0	0	0	868	308	1,255	322	120	474

Item	2014			2015			2016			2017			2018			2019		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION																		
I) Procurement / Construction	5,207	5,942	12,694	2,500	2,767	5,986	4,261	2,872	7,879	3,716	2,233	6,529	0	0	0	0	0	0
Water Supply	496	117	642	323	76	418	323	76	418	244	57	316	0	0	0	0	0	0
Sewerage	3,866	3,415	8,169	1,718	1,518	3,631	1,718	1,518	3,631	1,289	1,138	2,723	0	0	0	0	0	0
Drainage	0	1,210	1,525	0	538	678	0	538	678	0	403	508	0	0	0	0	0	0
Management	0	0	0	0	0	0	1,350	4	1,354	1,350	4	1,354	0	0	0	0	0	0
Base cost for JICA financing	4,362	4,742	10,336	2,041	2,131	4,727	3,391	2,135	6,081	2,882	1,603	4,901	0	0	0	0	0	0
Price escalation	597	917	1,753	340	504	975	667	600	1,423	657	524	1,317	0	0	0	0	0	0
Physical contingency	248	283	604	119	132	285	203	137	375	177	106	311	0	0	0	0	0	0
II) Consulting services	1,125	234	1,419	371	130	535	300	118	448	182	71	271	24	2	27	25	2	28
Base cost	942	187	1,177	303	100	429	239	88	349	141	51	205	18	1	20	18	1	20
Price escalation	129	36	174	50	24	80	47	25	78	32	17	53	5	1	5	5	1	6
Physical contingency	54	11	68	18	6	25	14	6	21	9	3	13	1	0	1	1	0	1
Total (I +II)	6,332	6,176	14,113	2,871	2,897	6,521	4,561	2,989	8,327	3,898	2,304	6,800	24	2	27	25	2	28
B. NON ELIGIBLE PORTION																		
a Land acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b Administration cost	0	448	565	0	207	261	0	264	333	0	216	272	0	1	1	0	1	1
(Environmental and social consideration cost)	0	7	8	0	7	8	0	7	8	0	7	8			0			0
c Custom duty	0	1,057	1,332	0	496	625	0	752	947	0	640	806	0	0	0	0	0	0
Base cost	0	886	1,116	0	401	506	0	587	740	0	482	608	0	0	0	0	0	0
Price escalation	0	171	216	0	95	120	0	165	208	0	158	199	0	0	0	0	0	0
d Sales tax	1,013	1,157	2,471	459	543	1,143	730	599	1,484	624	471	1,217	4	0	4	4	0	4
e Special federal excise duty	0	61	77	0	28	35	0	44	55	0	37	47	0	0	0	0	0	0
Total (a+b+c+d+e)	1,013	2,723	4,445	459	1,274	2,065	730	1,659	2,820	624	1,364	2,343	4	1	6	4	1	6
TOTAL (A+B)	7,345	8,899	18,557	3,330	4,171	8,586	5,290	4,648	11,147	4,522	3,668	9,143	28	3	33	29	4	33
C. INTEREST DURING CONSTRUCTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. COMMITMENT CHARGE			22			15			7			0			0			0
GRAND TOTAL (A+B+C+D)	7,345	8,899	18,557	3,330	4,171	8,586	5,290	4,648	11,147	4,522	3,668	9,143	28	3	33	29	4	33

Administration Cost = 4% of the Eligible portion
Sales Tax= 16% of the Eligible portion
Special Federal Excise Duty= 1% of the expenditure in foreign currency of the eligible portion

Price Escalation

	2010 FC	2010 LC	2011 FC	2011 LC	2012 FC	2012 LC	2013 FC	2013 LC	2014 FC	2014 LC
Price Escale	1.026	1.036	1.052676	1.073296	1.080046	1.111935	1.108127	1.151964	1.136938	1.193435
d Price Escal	0.026	0.036	0.052676	0.073296	0.080046	0.111935	0.108127	0.151964	0.136938	0.193435

	2015 FC	2015 LC	2016 FC	2016 LC	2017 FC	2017 LC	2018 FC	2018 LC	2019 FC	2019 LC
Price Escale	1.166498	1.236399	1.196827	1.280909	1.227945	1.327022	1.259871	1.374795	1.292628	1.424287
d Price Escal	0.166498	0.236399	0.196827	0.280909	0.227945	0.327022	0.259871	0.374795	0.292628	0.424287

Loan interest during const.
Financing rate 100% ← Non-eligible Percentage 24.7%
Interest rate for YEN loan

	Total	2010		2011		2012		2013		2014		2015		2016		2017		2018		2019	
Temporaly alocation	49,228	0	0	0	0	1,255	1,255	474	474	18,557	18,557	8,586	8,586	11,147	11,147	9,143	9,143	33	33	33	33
Debt at the end of term		0		0		1,255		1,729		20,286		28,872		40,019		49,162		49,195		49,228	
Interest during const		0		0		0		0		0		0		0		0		0		0	

Cumulative Disbursement

Item	Total			0			1			2			3			4			5			6			7			8			9		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
									0			902			1,242			15,355			21,876			30,204			37,004			37,031			37,059

Table 14.3 Cost for Phase-1 Project (Option 1: WWTP-Half Design Capacity)

Annual Fund Requirement (Option 1)

Base Year For Cost Estimation:	September 2009			FC & Total:	37,057 million	JPY
Exchange Rates	PK･Rupee = yen	1.26		LC :	15,434 million	PK･Rupee
PriceEscaration:	FC: 2.6%	LC:	3.6%			
Physical Contingency	5%					
Physical Contingency for Consultant	5%					

Item	Total			2010			2011			2012			2013			2014		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION																		
I) Procurement / Construction	10,745	9,449	22,651	0	0	0	0	0	0	0	0	0	0	0	0	3,045	4,051	8,149
Water Supply	1,384	326	1,795	0	0	0	0	0	0	0	0	0	0	0	0	496	117	642
Sewerage	4,567	5,418	11,393	0	0	0	0	0	0	0	0	0	0	0	0	2,055	2,438	5,127
* Drainage	0	1,507	1,899	0	0	0	0	0	0	0	0	0	0	0	0	0	678	854
Management	2,699	7	2,708	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Base cost for JICA financing	8,650	7,258	17,795	0	0	0	0	0	0	0	0	0	0	0	0	2,550	3,233	6,624
Price escalation	1,583	1,742	3,778	0	0	0	0	0	0	0	0	0	0	0	0	349	625	1,137
Physical contingency	512	450	1,079	0	0	0	0	0	0	0	0	0	0	0	0	145	193	388
II) Consulting services	3,053	728	3,970	0	0	0	0	0	0	748	122	902	278	49	340	1,125	234	1,419
Base cost	2,567	576	3,293	0	0	0	0	0	0	660	105	792	239	41	290	942	187	1,177
Price escalation	347	120	499	0	0	0	0	0	0	53	12	68	26	6	34	129	36	174
Physical contingency	145	35	189	0	0	0	0	0	0	36	6	43	13	2	16	54	11	68
Total (I +II)	13,798	10,178	26,622	0	0	0	0	0	0	748	122	902	278	49	340	4,169	4,285	9,568
B. NON ELIGIBLE PORTION																		
a Land acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b Administration cost	0	845	1,065	0	0	0	0	0	0	0	29	36	0	11	14	0	304	383
(Environmental and social consideration cost)	0	40	50	0	0	0	0	0	0	0	7	8	0	7	8	0	7	8
c Custom duty	0	2,285	2,879	0	0	0	0	0	0	0	112	141	0	43	54	0	704	887
Base cost	0	1,836	2,314	0	0	0	0	0	0	0	101	127	0	37	47	0	590	743
Price escalation	0	448	565	0	0	0	0	0	0	0	11	14	0	6	7	0	114	144
d Sales tax	2,208	1,994	4,720	0	0	0	0	0	0	120	38	167	44	15	63	667	798	1,673
e Special federal excise duty	0	132	167	0	0	0	0	0	0	0	7	9	0	3	3	0	40	51
Total (a+b+c+d+e)	2,208	5,256	8,830	0	0	0	0	0	0	120	185	353	44	71	134	667	1,846	2,993
TOTAL (A+B)	16,005	15,434	35,452	0	0	0	0	0	0	868	308	1,255	322	120	474	4,836	6,131	12,561
C. INTEREST DURING CONSTRUCTION	1,495	0	1,495	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. COMMITMENT CHARGE	110		110						27			26			25			16
GRAND TOTAL (A+B+C+D)	17,610	15,434	37,057	0	0	0	0	0	0	868	308	1,255	322	120	474	4,836	6,131	12,561

Item	2015			2016			2017			2018			2019		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION															
I) Procurement / Construction	1,514	1,897	3,903	3,249	1,970	5,731	2,938	1,532	4,868	0	0	0	0	0	0
Water Supply	323	76	418	323	76	418	244	57	316	0	0	0	0	0	0
Sewerage	913	1,084	2,279	913	1,084	2,279	685	813	1,709	0	0	0	0	0	0
* Drainage	0	301	380	0	301	380	0	226	285	0	0	0	0	0	0
Management	0	0	0	1,350	4	1,354	1,350	4	1,354	0	0	0	0	0	0
Base cost for JICA financing	1,236	1,461	3,077	2,586	1,464	4,431	2,278	1,100	3,664	0	0	0	0	0	0
Price escalation	206	345	641	509	411	1,027	519	360	972	0	0	0	0	0	0
Physical contingency	72	90	186	155	94	273	140	73	232	0	0	0	0	0	0
II) Consulting services	371	130	535	300	118	448	182	71	271	24	2	27	25	2	28
Base cost	303	100	429	239	88	349	141	51	205	18	1	20	18	1	20
Price escalation	50	24	80	47	25	78	32	17	53	5	1	5	5	1	6
Physical contingency	18	6	25	14	6	21	9	3	13	1	0	1	1	0	1
Total (I +II)	1,885	2,027	4,438	3,549	2,087	6,179	3,120	1,603	5,139	24	2	27	25	2	28
B. NON ELIGIBLE PORTION															
a Land acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b Administration cost	0	141	178	0	196	247	0	163	206	0	1	1	0	1	1
(Environmental and social consideration cost)	0	7	8	0	7	8	0	7	8			0			0
c Custom duty	0	334	420	0	583	735	0	509	641	0	0	0	0	0	0
Base cost	0	270	340	0	455	574	0	384	483	0	0	0	0	0	0
Price escalation	0	64	80	0	128	161	0	125	158	0	0	0	0	0	0
d Sales tax	302	378	777	568	427	1,106	499	338	925	4	0	4	4	0	4
e Special federal excise duty	0	18	23	0	34	43	0	30	38	0	0	0	0	0	0
Total (a+b+c+d+e)	302	871	1,398	568	1,241	2,131	499	1,040	1,809	4	1	6	4	1	6
TOTAL (A+B)	2,186	2,897	5,837	4,117	3,328	8,310	3,619	2,643	6,948	28	3	33	29	4	33
C. INTEREST DURING CONSTRUCTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. COMMITMENT CHARGE			11			5			0			0			0
GRAND TOTAL (A+B+C+D)	2,186	2,897	5,837	4,117	3,328	8,310	3,619	2,643	6,948	28	3	33	29	4	33

Administration Cost = 4% of the Eligible portion
Sales Tax= 16% of the Eligible portion
Special Federal Excise Duty= 1% of the expenditure in foreign currency of the eligible portion

Price Escalation

	Total			2010			2011			2012			2013			2014		
Price Escale				1.026	1.036		1.052676	1.073296		1.080046	1.111935		1.108127	1.151964		1.136938	1.193435	
d Price Escal				0.026	0.036		0.052676	0.073296		0.080046	0.111935		0.108127	0.151964		0.136938	0.193435	

	2015			2016			2017			2018			2019		
Price Escale	1.166498	1.236399		1.196827	1.280909		1.227945	1.327022		1.259871	1.374795		1.292628	1.424287	
d Price Escal	0.166498	0.236399		0.196827	0.280909		0.227945	0.327022		0.259871	0.374795		0.292628	0.424287	

Loan interest during const.
Financing rate 100% ← Non-eligible Percentage 24.9%
Interest rate for YEN loan

	Total			2010			2011			2012			2013			2014		
Temporaly alocation			35,452	0		0	0		0	1,255		1,255	474		474	12,561		12,561
Debt at the end of term				0			0			1,255			1,729			14,290		
Interest during const				0			0			0			0			0		

	2015			2016			2017			2018			2019		
Temporaly alocation	5,837		5,837	8,310		8,310	6,948		6,948	33		33	33		33
Debt at the end of term	20,127			28,437			35,386			35,418			35,452		
Interest during const	0			0			0			0			0		

Cumulative Disbursement

Item	Total			0			1			2			3			4		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
									0			902			1,242			10,811

Item	5			6			7			8			9		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
			15,249			21,428			26,567			26,594			26,622

Note: * In **Table 14.3**, drains are classified into two groups based on the covering area and the priority is given to the Drainage A group in Phase-1.

Table 14.4 Cost for Phase-1 Project (Option 2: WWTP-Not Included)

Annual Fund Requirement (Option 2)

Base Year For Cost Estimation:	September 2009			FC & Total:	25,669	million	JPY
Exchange Rates	PK･Rupee	= yen	1.26	LC :	12,517	million	PK･Rupee
PriceEscaration:	FC: 2.6%	LC:	3.6%				
Physical Contingency	5%						
Physical Contingency for Consultant	5%						

Item	Total			2010			2011			2012			2013		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION															
I) Procurement / Construction	5,807	8,164	16,094	0	0	0	0	0	0	0	0	0	0	0	0
Water Supply	1,384	326	1,795	0	0	0	0	0	0	0	0	0	0	0	0
Sewerage	541	3,248	4,634	0	0	0	0	0	0	0	0	0	0	0	0
Drainage	0	2,690	3,389	0	0	0	0	0	0	0	0	0	0	0	0
Management	2,699	7	2,708	0	0	0	0	0	0	0	0	0	0	0	0
Base cost for JICA financing	4,625	6,270	12,526	0	0	0	0	0	0	0	0	0	0	0	0
Price escalation	905	1,505	2,802	0	0	0	0	0	0	0	0	0	0	0	0
Physical contingency	277	389	766	0	0	0	0	0	0	0	0	0	0	0	0
II) Consulting services	2,726	607	3,492	0	0	0	0	0	0	748	122	902	251	44	307
Base cost	2,299	483	2,908	0	0	0	0	0	0	660	105	792	216	36	262
Price escalation	299	96	421	0	0	0	0	0	0	53	12	68	23	6	30
Physical contingency	130	29	166	0	0	0	0	0	0	36	6	43	12	2	15
Total (I +II)	8,533	8,772	19,585	0	0	0	0	0	0	748	122	902	251	44	307
B. NON ELIGIBLE PORTION															
a Land acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b Administration cost	0	622	783	0	0	0	0	0	0	0	29	36	0	10	12
(Environmental and social consideration cost)	0	40	50	0	0	0	0	0	0	0	7	8	0	7	8
c Custom duty	0	1,412	1,779	0	0	0	0	0	0	0	112	141	0	38	48
Base cost	0	1,133	1,427	0	0	0	0	0	0	0	101	127	0	33	42
Price escalation	0	279	352	0	0	0	0	0	0	0	11	14	0	5	6
d Sales tax	1,365	1,629	3,418	0	0	0	0	0	0	120	38	167	40	13	57
e Special federal excise duty	0	82	103	0	0	0	0	0	0	0	7	9	0	2	3
Total (a+b+c+d+e)	1,365	3,745	6,084	0	0	0	0	0	0	120	185	353	40	63	120
TOTAL (A+B)	9,898	12,517	25,669	0	0	0	0	0	0	868	308	1,256	292	107	427
C. INTEREST DURING CONSTRUCTION	1,152	0	1,152	0	0	0	0	0	0	0	0	0	0	0	0
D. COMMITMENT CHARGE	81		81						20			19			18
GRAND TOTAL (A+B+C+D)	9,898	12,517	25,669	0	0	0	0	0	0	868	308	1,256	292	107	427

Item	2014			2015			2016			2017			2018			2019		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION																		
I) Procurement / Construction	882	3,494	5,285	528	1,640	2,594	2,238	1,704	4,385	2,159	1,326	3,830	0	0	0	0	0	0
Water Supply	496	117	642	323	76	418	323	76	418	244	57	316	0	0	0	0	0	0
Sewerage	244	1,462	2,085	108	650	927	108	650	927	81	487	695	0	0	0	0	0	0
Drainage	0	1,210	1,525	0	538	678	0	538	678	0	403	508	0	0	0	0	0	0
Management	0	0	0	0	0	0	1,350	4	1,354	1,350	4	1,354	0	0	0	0	0	0
Base cost for JICA financing	739	2,789	4,253	431	1,263	2,023	1,781	1,267	3,377	1,675	952	2,873	0	0	0	0	0	0
Price escalation	101	539	781	72	299	448	350	356	799	382	311	774	0	0	0	0	0	0
Physical contingency	42	166	252	25	78	124	107	81	209	103	63	182	0	0	0	0	0	0
II) Consulting services	1,084	213	1,352	270	98	394	205	84	311	151	45	208	8	1	9	8	1	9
Base cost	908	170	1,122	221	75	316	163	62	242	117	32	158	6	0	7	6	0	7
Price escalation	124	33	166	37	18	59	32	18	54	27	11	40	2	0	2	2	0	2
Physical contingency	52	10	64	13	5	19	10	4	15	7	2	10	0	0	0	0	0	0
Total (I +II)	1,966	3,707	6,637	798	1,738	2,988	2,443	1,788	4,695	2,310	1,371	4,038	8	1	9	8	1	9
B. NON ELIGIBLE PORTION																		
a Land acquisition	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
b Administration cost	0	211	265	0	95	120	0	149	188	0	128	162	0	0	0	0	0	0
(Environmental and social consideration cost)	0	7	8	0	7	8	0	7	8	0	7	8			0			0
c Custom duty	0	342	430	0	153	193	0	397	500	0	370	466	0	0	0	0	0	0
Base cost	0	286	361	0	124	156	0	310	391	0	279	351	0	0	0	0	0	0
Price escalation	0	55	70	0	29	37	0	87	110	0	91	115	0	0	0	0	0	0
d Sales tax	315	648	1,131	128	303	509	391	350	831	370	279	721	1	0	1	1	0	1
e Special federal excise duty	0	19	24	0	8	10	0	23	29	0	22	28	0	0	0	0	0	0
Total (a+b+c+d+e)	315	1,219	1,851	128	558	831	391	919	1,549	370	799	1,376	1	0	2	1	0	2
TOTAL (A+B)	2,281	4,926	8,488	926	2,296	3,819	2,833	2,707	6,244	2,680	2,170	5,414	9	1	11	10	1	11
C. INTEREST DURING CONSTRUCTION	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. COMMITMENT CHARGE			12			9			4			0			0			0
GRAND TOTAL (A+B+C+D)	2,281	4,926	8,488	926	2,296	3,819	2,833	2,707	6,244	2,680	2,170	5,414	9	1	11	10	1	11

Administration Cost = 4% of the Eligible portion
Sales Tax= 16% of the Eligible portion
Special Federal Excise Duty= 1% of the expenditure in foreign currency of the eligible portion

Price Escalation

Item	Total	2010		2011		2012		2013		2014		2015		2016		2017		2018		2019	
Price Escale		1.026	1.036	1.052676	1.073296	1.080046	1.111935	1.108127	1.151964	1.136938	1.193435	1.166498	1.236399	1.196827	1.280909	1.227945	1.327022	1.259871	1.374795	1.292628	1.424287
d Price Escal		0.026	0.036	0.052676	0.073296	0.080046	0.111935	0.108127	0.151964	0.136938	0.193435	0.166498	0.236399	0.196827	0.280909	0.227945	0.327022	0.259871	0.374795	0.292628	0.424287

Loan interest during const.
Financing rate 100% ← Non-eligible Percentage 23.7%
Interest rate for YEN loan

Item	Total	2010		2011		2012		2013		2014		2015		2016		2017		2018		2019	
Temporaly alocation	25,669	0	0	0	0	1,256	1,256	427	427	8,488	8,488	3,819	3,819	6,244	6,244	5,414	5,414	11	11	11	11
Debt at the end of term		0		0		1,256		1,682		10,170		13,989		20,233		25,647		25,658		25,669	
Interest during const		0		0		0		0		0		0		0		0		0		0	

Cumulative Disbursement

Item	Total			0			1			2			3			4		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
									0			902			1,209			7,846

Item	5			6			7			8			9		
	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total	FC	LC	Total
			10,834			15,529			19,567			19,576			19,585

14.4 Operation and Maintenance Cost

Operation and Maintenance Costs are presented in **Table 14.5**, **Table 14.6** and **Table 14.7**.

Table 14.5 Operation and Maintenance Costs (Full Component)

(Unit: Rs. Thousand)

Year	Water Supply	Sewers and Collector Channel	Disposal Station	Lift Station and WWTP	Drainage	O&M Equipment	Total
2016	10,288	9,932	103,902	449,784	56,036	22,571	652,514
2017	10,474	10,053	105,083	455,091	56,717	22,845	660,263
2018	10,660	10,175	106,382	460,397	57,406	23,122	668,142
2019	10,846	10,299	107,563	465,704	58,103	23,403	675,917
2020	11,031	10,424	108,743	471,011	58,809	23,687	683,706
2021	11,217	10,551	110,042	476,318	59,523	23,975	691,626
2022	11,330	10,679	110,751	479,424	60,246	24,266	696,696
2023	11,443	10,809	111,459	482,531	60,978	24,561	701,781
2024	11,556	10,940	112,167	485,637	61,719	24,859	706,879
2025	11,669	11,073	112,876	488,743	62,469	25,161	711,992
2026	11,782	11,207	113,584	491,850	63,228	25,467	717,119
2027	11,868	11,343	114,057	494,050	63,996	25,776	721,090
2028	11,954	11,481	114,647	496,251	64,773	26,089	725,194
2029	12,039	11,620	115,119	498,451	65,560	26,406	729,195
2030	12,125	11,761	115,592	500,651	66,356	26,727	733,212
2031	12,210	11,904	116,182	502,852	67,162	27,052	737,362
2032	12,267	12,049	116,536	504,534	67,978	27,381	740,745
2033	12,323	12,195	116,890	506,217	68,804	27,714	744,144
2034	12,380	12,343	117,245	507,900	69,640	28,051	747,558
2035	12,493	12,493	118,071	511,265	70,486	28,392	753,200

Table 14.6 Operation and Maintenance Costs (Option 1)

(Unit: Rs. Thousand)

Year	Water Supply	Sewers and Collector Channel	Disposal Station	Lift Station and WWTP	Drainage	O&M Equipment	Total
2016	10,288	9,932	103,902	230,133	36,237	22,571	413,064
2017	10,474	10,053	105,083	231,491	36,677	22,845	416,623
2018	10,660	10,175	106,382	232,848	37,122	23,122	420,309
2019	10,846	10,299	107,563	234,206	37,573	23,403	423,889
2020	11,031	10,424	108,743	235,563	38,029	23,687	427,478
2021	11,217	10,551	110,042	243,709	38,491	23,975	437,985
2022	11,330	10,679	110,751	244,504	38,959	24,266	440,489
2023	11,443	10,809	111,459	245,299	39,432	24,561	443,003
2024	11,556	10,940	112,167	246,093	39,911	24,859	445,527
2025	11,669	11,073	112,876	246,888	40,396	25,161	448,063
2026	11,782	11,207	113,584	251,656	40,887	25,467	454,584
2027	11,868	11,343	114,057	252,219	41,384	25,776	456,647
2028	11,954	11,481	114,647	252,782	41,887	26,089	458,840
2029	12,039	11,620	115,119	253,345	42,396	26,406	460,925
2030	12,125	11,761	115,592	253,908	42,911	26,727	463,023
2031	12,210	11,904	116,182	257,285	43,432	27,052	468,066
2032	12,267	12,049	116,536	257,716	43,960	27,381	469,909
2033	12,323	12,195	116,890	258,146	44,494	27,714	471,763
2034	12,380	12,343	117,245	258,577	45,034	28,051	473,629
2035	12,493	12,493	118,071	261,590	45,581	28,392	478,620

Table 14.7 Operation and Maintenance Costs (Option 2)

(Unit: Rs. Thousand)

Year	Water Supply	Sewers and Collector Channel	Disposal Station	Lift Station and WWTP	Drainage	O&M Equipment	Total
2016	10,288	9,932	103,902	0	40,437	22,571	187,131
2017	10,474	10,053	105,083	0	40,928	22,845	189,383
2018	10,660	10,175	106,382	0	41,425	23,122	191,764
2019	10,846	10,299	107,563	0	41,928	23,403	194,038
2020	11,031	10,424	108,743	0	42,437	23,687	196,323
2021	11,217	10,551	110,042	0	42,952	23,975	198,737
2022	11,330	10,679	110,751	0	43,474	24,266	200,500
2023	11,443	10,809	111,459	0	44,002	24,561	202,274
2024	11,556	10,940	112,167	0	44,536	24,859	204,059
2025	11,669	11,073	112,876	0	45,077	25,161	205,856
2026	11,782	11,207	113,584	0	45,624	25,467	207,665
2027	11,868	11,343	114,057	0	46,178	25,776	209,222
2028	11,954	11,481	114,647	0	46,739	26,089	210,909
2029	12,039	11,620	115,119	0	47,307	26,406	212,491
2030	12,125	11,761	115,592	0	47,882	26,727	214,086
2031	12,210	11,904	116,182	0	48,464	27,052	215,812
2032	12,267	12,049	116,536	0	49,053	27,381	217,286
2033	12,323	12,195	116,890	0	49,649	27,714	218,772
2034	12,380	12,343	117,245	0	50,252	28,051	220,270
2035	12,493	12,493	118,071	0	50,862	28,392	222,311

14.5 Cost Reduction

Main cost reduction items examined in this study are shown in **Table 14.8**.

In **Table 14.8**, the cost reduction in the direct cost is converted to the project cost which is the summation of the direct cost, consulting fee, land acquisition cost, administrative cost, custom duty, sales tax, special federal custom duty, interest during construction and commitment charge (see **Table 14.2**) to calculate the cost reduction rate, which is 22.5% in this project.

The basis of cost reduction is described below.

Table 14.8 Cost Reduction

No.	Cost Reduction Item	Cost Reduction (Rs. Million)	
		Direct Cost	Project Cost
(1)	Cost reduction by treatment process of WWTP	5,609	8,500
(2)	Cost reduction by pump type of lift station	948	1,444
(3)	Cost reduction by bulk flow meter (BFM) type for tube-wells	916	1,403
(4)	Total cost after cost-reducing measures		40,860
(5)	Total cost before cost-reducing measures = (1)+(2)+(3)+(4)		52,207
Reduction ratio =[(5) - (4)] / (5)			21.7%

Note: Project cost = Direct cost + Consulting services + Non-eligible portion + Interest during construction + Commitment charge

Considering the purpose of facility, O&M capability of WASA staff, easiness to procurement of equipment etc, following items for cost reduction were examined.

(1) Review of treatment process of WWTP

Treatment method of WWTP was reviewed from activated sludge process to trickling filter process. Detail of this review is mentioned in **Chapter 13.3**.

Activated sludge process: Rs.16,998 million

Trickling filter process: Rs.11,389 million

Reduction cost: Rs.5,609 million (= 16,998 - 11,389)

(2) Review of pump type of lift station

Pumping station type was reviewed from vertical axial pump to screw pump.

Vertical shaft pump: Unit cost Rs.1.37 million/cusec

(Refer to cost estimation for New Gulshan-e-Ravi PS)

Rs.1.37 million/cusec × 80 cusec × 13 units = Rs.1,424.8 million

Screw pump: Rs.476.8 million

Reduction cost: Rs.948 million = (1,424.8 - 476.8)

(3) Review of bulk flow meter type for tube-wells

Flow meter type was reviewed from electromagnetic flow meter to Waltman flow meter.

Electromagnetic flow meter: (159+233) units × Rs.3,000,000/unit = Rs.1,176 million

Waltman flow meter: Rs.260 million

Reduction cost: Rs.916 million (= 1,176 – 260)

14.6 Bidding Procedure

14.6.1 General Procedure for Bidding in WASA

WASA basically follows “Punjab Procurement Rules, 2009” dated Lahore 2nd October, 2009 by the Punjab Procurement Regulatory Authority as shown in **Figure 14.1**.

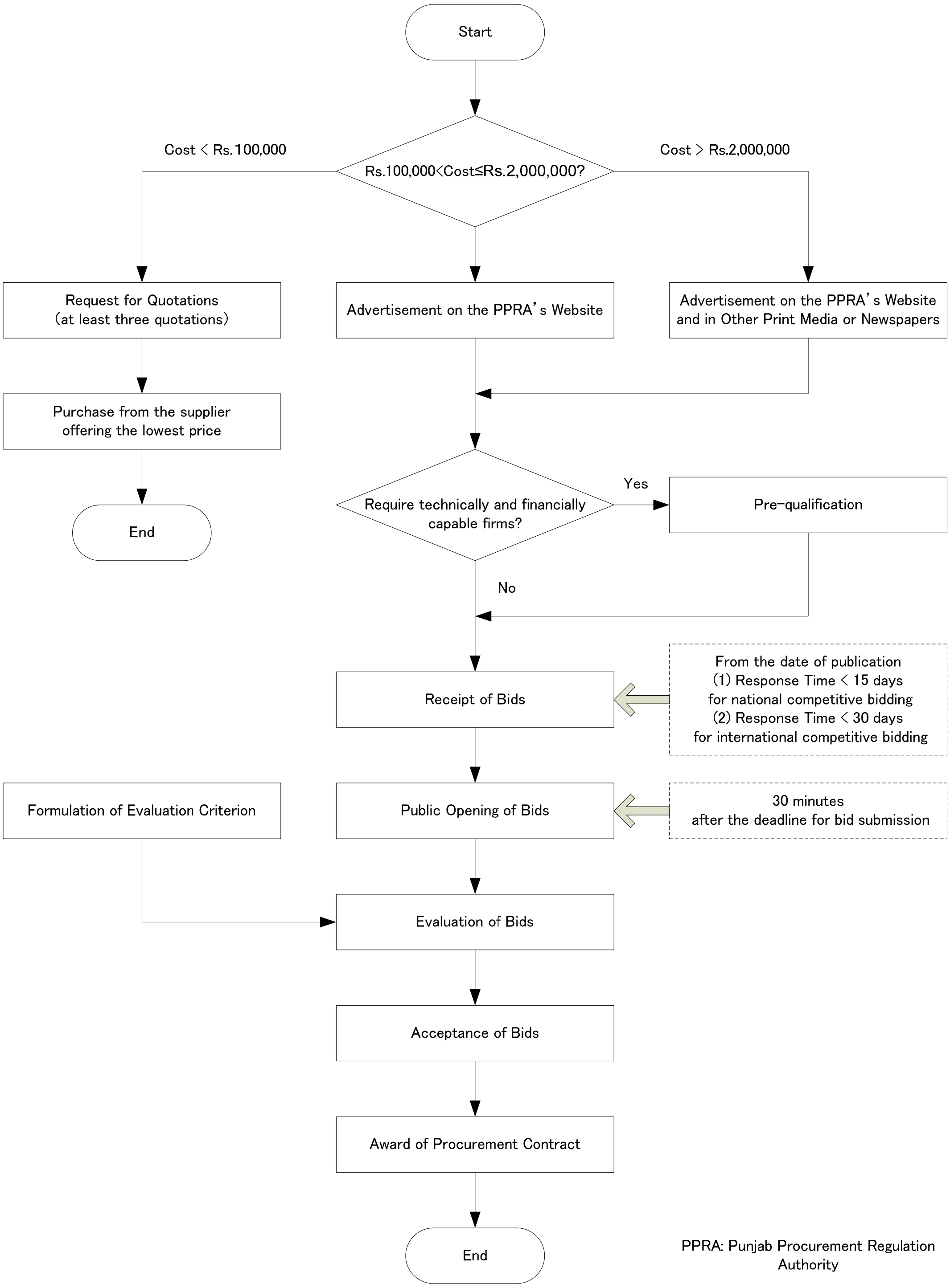


Figure 14.1 Bidding Procedure in the Province of Punjab

This bidding procedure has no contradiction with that of JICA except for the limitation by a contract amount.

In WASA, the construction work is usually estimated by the division in charge as well as the preparation of detailed designs and taken over by DIR(P&S) (P&S: Procurement and Storage) who prepares the bidding documents for bidding. In case of equipment procurement, DIR(P&S) directly prepares the bidding documents.

The number of staff of relevant directorates are as follows (see **Figure 6.2** for other directorates):

DIR(P&S)	:40 persons
DIR. CONST-1	:29 persons
DIR. CONST-2	:33 persons

Technical specifications used by WASA is a blend of BS specifications, AWWA specifications and specifications adopted by Public Health Engineering Department for engineering works.

The contractors with a concern on the works of WASA are required to register with WASA first. DIR(P&S) categorizes them into five classes based on the estimated construction cost as shown in **Table 14.9**. For Classes A and B, if the contractor has not registered with WASA, but with HUD&PHED only, he has a qualification to attend the bidding in WASA.

Table 14.9 Contractors' Qualification for Bidding

Rating	Qualification for Bidding
Class A	No limitation
Class B	Estimated contract amount up to Rs.20,000,000
Class C	Estimated contract amount up to Rs.5,000,000
Class D	Estimated contract amount up to Rs.1,000,000
Class E	Estimated contract amount up to Rs.500,000

The bidding is carried out in accordance with the flowchart in **Figure 14.2** and the contractors are generally given 15 days for cost estimation, preparation and submission of their bids. The bids are opened in the attendance of bidders. In case of a contract amount of up to Rs.2,500,000, the contract is awarded by DIR(P&S), but in case of over Rs.2,500,000, the papers are passed on to DMD(Engineering). It usually takes about one month from the advertisement of tender notice to the issuance of Work Order in the former but more than one month in the latter. The lowest bidder is the successful contractor in principle.

For equipment procurement, the Evaluation Committee composed of DIR(P&S), DIR(P&E), DIR(Const), DIR(Finance) and Auditor of the Government of the Punjab assesses both the technical and financial proposals. The financial proposal submitted with a technical proposal that does not meet the specifications is not opened.

According to DIR(P&S), all processes from the advertisement of tender notice to the issuance of Work Order is done within WASA and no provincial department/authority is involved in bidding, which is also applicable to the international bidding executed under the loan agreement.

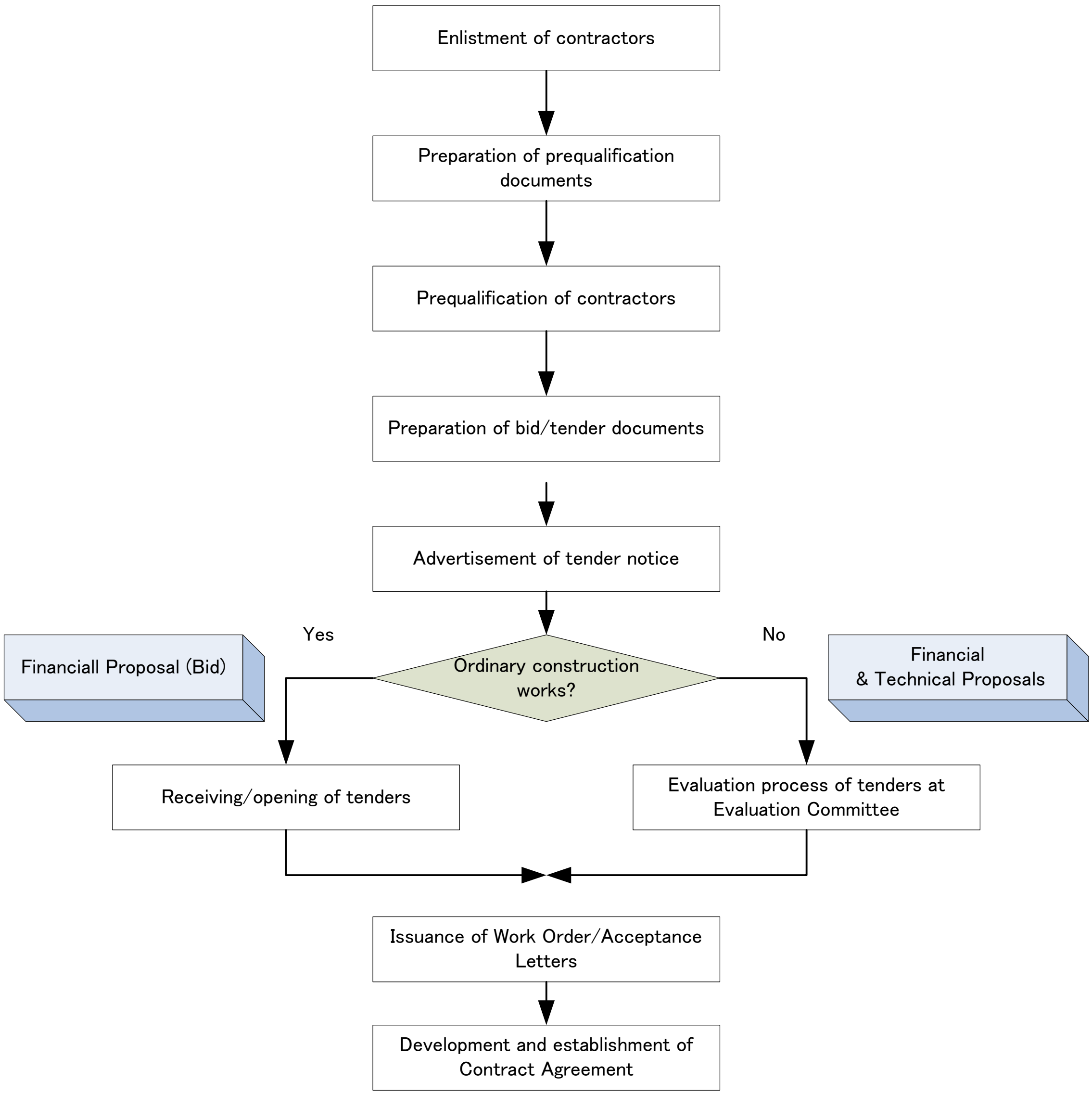


Figure 14.2 General Procedure for Bidding in WASA

The government of Punjab has modified the instructions regarding Supervisions of Developments Works by Engaging Consultancy Services vide letter No. 4 (24) RO (Cons)

P&D/97-Vol-iii, Dated: 15-09-2008. (Copy attached).

According to the above referred new instructions, supervision of works relating to water and sewerage costing Rs. 200 Million and above is required to be carried out by engaging consultancy firms. Furthermore, there is no distinction between works requiring Top Supervision or Resident Supervision. It has been left to the sponsoring/executing agency to draw TOR for the supervision of a specific work.

For the sake of information, the difference between the terms, “Top Supervision” and “Resident Supervision” is described below.

(1) Top Supervision

Responsibilities of the Consultancy Firms engaged for supervision include but not restricted to:

- Occasional visits for checking the work by Senior Engineers of the Firm to ensure that the work is carried out in accordance with the specifications and that the quality of work meets the required standards. The Firm is only responsible for the checking carried out by its representatives.
- The Consultancy Firm has no responsibility for checking the accounts relating to work done.

(2) Resident Supervision

- The Consultancy Firm will depute a Resident Engineer along with necessary team of Engineers plus fields staff to assist the Resident Engineer in carrying out 100% checking of work and ensure presence of Engineer’s representatives at the work sites for all the time when the work is being carried out.
- 100% responsible for checking the account of the cost incurred on the work carried out.
- 100% responsible to ensure that the quality and quantity of the work carried out is in accordance with the specification and condition of the contract.

14.6.2 Bidding Procedure

The possible contract packages are as follows:

(1) Packaging by type of work

- Civil and building (Customer meter installation, UFW reduction-related measure works, network development, collector channel. WWTP and drainage facilities)

- Mechanical and electrical (Tube-well equipment installation, WWTP equipment）
- IT system (Construction of management information system)

(2) Packaging by type of infrastructure

- Water supply (Customer meter installation, UFW reduction-related measure works, and Tube-well equipment installation
- Sewerage (network development, collector channel and WWTP)
- Drainage (network development)
- IT system (Construction of management information system)

(3) Packaging by construction site

- Customer meter installation
- Tube-well equipment installation (BFM, pressure gauge, check valve and disinfectant feeding unit)
- UFW reduction-related measure works
- Network development (Sewers and drains)
- Collector channel
- WWTP (Civil, building, mechanical and electrical)
- IT system (Construction of management information system)

Water supply works are divided into customer meter installation, UFW reduction-related measure works, and Tube-well equipment installation in detail. The reasons are as follows:

- Less relevance among these works
- Different contents of work
- UFW reduction-related measure works will be behind other bidding, since the scope of works will be fixed based on the results of leakage detection survey

The customer meter installation work aims at installing approximately 308,000 water meters at respective customer houses. Due to its huge amount, most WASA-licensed water fitting plumbers will be mobilized in the actual works. The problem is to whom WASA will make a contract. One option is to make a contract with one contractor who will use water fitting plumbers as sub-contractors and the other option is that WASA will make a contract with water fitting plumbers directly. Under the circumstances that the customer meter installation is not necessarily welcome to respective customers, most careful construction supervision will be required due to face-to-face work. In some cases, WASA staff will have to directly visit the customer house to get a consent for meter installation. Therefore, WASA should take firm stance that plumbers with low quality or many complaints will be excluded from the works and direct contract with plumbers seems desirable to WASA from this viewpoint. But it will be physically impossible due to a large number of contracts and local competitive bidding by WASA town office basis is recommended as the second best. Even in this case, WASA is required to increase the number of staff in charge of meter installation. Until the metering system will be establish in the entire WASA service area, there is big demand for meter installation, but thereafter there will be big demand for meter replacement. WASA should tackle this work with a basic policy to bring up the excellent and reliable water fitting plumbers.

The situation for meter installation will be different by customer, the contract shall be made with the cost based on standard drawing. In the actual installation works, the contractor shall prepare the current situation drawing first and when it is largely different from the standard drawing, the confirmation will be done in the witness of WASA staff for final liquidation. The water meter shall be procured in a lump by international competitive bidding and supplied to the contractors in accordance with the respective contract.

In addition, as it is expected that some people will not be welcome to the meter installation, the training on the responding manner to the customers' supposed questions/complaints and response to unexpected situation that may occur in the field should be done to the WASA staff and employees of the contractors as well as preliminary declaration and campaign on the intention and implementation method of customer meter installation.

The tube-well equipment is composed of the bulk flow meter (BFM), pressure gauge, check valve and disinfectant feeding unit. Out of them, BFM installation is a pair of customer meter installation, that is to say, the former shows the inflow to the water distribution system and the latter the outflow therefrom. The procurement and installation of all these equipment in a lump is reasonable to assure the quality of works. It should be noted that at the time of tube-well equipment installation, as the particular tube-well will be not in use, it is very important to minimize the inconvenience caused by the work through the shortest period, full preliminary provision and establishment of a back-up system including the use of water tankers. Therefore, the contractor will be required to submit the monthly schedule for tube-well equipment installation so as not to concentrate the works at one specified area.

In UFW reduction-related works, some equipment is required for the survey in consultancy services like personal computers, water leak detectors, metal and non-metal pipe locators, GIS equipment and so on, since it takes expectedly much time to identify the location of existing underground pipelines necessary for preparation of the facility ledger and master plan of a water supply system. Although such equipment is actually almost imported from other countries, it is recommended to apply the local competitive bidding to them so as not to waste the time and to start the works as early as possible. The total amount of those equipment is small as Rs.44.1 million (JY55.9 million).

In this connection, the pilot area is selected to identify leakage points through leakage detection survey, while the water meters are installed at every customer's house as well as the installation of a bulk flow meter at the tube-well concerned to check the leakage flow from the distributed flow and water consumption. The pipes causing the leakage points will be then repaired or replaced by a new pipe and the volume of inflow from a tube-well and outflow from taps are measured again to verify the effect of leakage protection works. Such works will be applied to an entire service area of WASA. Since the volume of works depend on the result of leakage detection survey in the pilot area, it is better to determine the volume of works based on the result of leakage detection survey and disburse its cost from the physical contingency than to predict it assuming that what percentage of total pipeline length in the pilot area will be replaced. Although the volume of leakage protection works depend on the extent of a pilot area, it will be probably small in comparison with other works, the works shall be included in the installation work of tube-well equipment as an additional work. From such situation, the installation of a BFM and water meters at every customer's house may be required to be carried out preceding those in other areas.

The reason why the sewer laying and drain construction are handled in the same category of network development, there are some duplications of construction sites and if one work will be carried out with no consideration for other work, a variety of and many troubles are not avoidable to occur. To minimize traffic jam and inconvenience of residents as well as adjustment of construction period and traffic control accompanied with construction works, and handle the complaints to be received smoothly, there are big advantages for three parties, namely WASA, contractor and residents due to less adjustment, if both works will be undertaken by one contractor. The construction of a collector channel shall be also included in this contract.

Packaging by type of work includes the works that are not necessarily adaptable to international competitive bidding like customer meter installation, while packaging by type of infrastructure has the possibility that the different works will be done by the different contractors at the same construction site as described above. Both packaging methods are therefore not suitable in this Project

The construction work of the South West WWTP is composed of four kinds of works, or civil, building, mechanical and electrical. However, since all works is done at one construction site, it is better that all works will be undertaken by one contractor. There are few contractors to undertake such works, the joint venture of construction company specialized in civil and building works and engineering company in mechanical and electrical works is an acceptable contractor.

The construction of a management information system (Phase 1) is small in cost and it requires the after-service and support until the system will become stable after completion and the WASA staff as users will be familiar with the system and operation of equipment. Therefore, local competitive bidding is justifiable. However, the international competitive bidding is applied to O&M equipment.

From the studies mentioned-above, the recommendable contract package and procurement procedure is summarized in **Table 14.10** by contract package, taking into account that the works will be more attractive for international contractors.

Table 14.10 Contract Package List

Package 1: Procurement of water meters	
(1) Bidding procedure	International competitive bidding
(2) Scope of work	Procurement of customer meter Ø 15mm (typical) × 308,000 units
(3) Estimated cost	Rs.928,900,000.- (JY1,170,400,000.-)
Package 2: Installation of customer meters	
(1) Bidding procedure	Local competitive bidding by town office using WASA-licensed water unit plumbers as subcontractors
(2) Scope of work	Installation of customer meter Ø 15mm (typical) × 308,000 units
(3) Estimated cost	Rs.203,300,000.- (JY256,100,000.-)
Package 3: Installation of tube-well equipment including distribution network improvement in a pilot area	
(1) Bidding procedure	International competitive bidding
(2) Scope of work	Installation of tube-well equipment Bulk Flow Meter (BFM) Ø 8” × 159 units for 1.0 to 2.5 cusec tube-wells Ø 10” × 233 units for 3.0 to 4.0 cusec tube-wells Each tube-well equipment include one (1) unit of pressure gauge one set of disinfectant feeding unit
(3) Estimated cost	Rs.248,000,000.- (JY312,500,000.-)
Package 4: Procurement of UFW Control Equipment	
(1) Bidding procedure	Local competitive bidding
(2) Scope of work	UFW reduction equipment
(3) Estimated cost	Rs.44,100,000.- (JY55,900,000.-)
Package 5: Development of sewerage and drainage networks including a collector channel	
(1) Bidding procedure	International competitive bidding
(2) Scope of work	1. Sewer – Central Area – connecting to South West Treatment Plant 1-1: Construction of trunk sewer from Larex Colony to

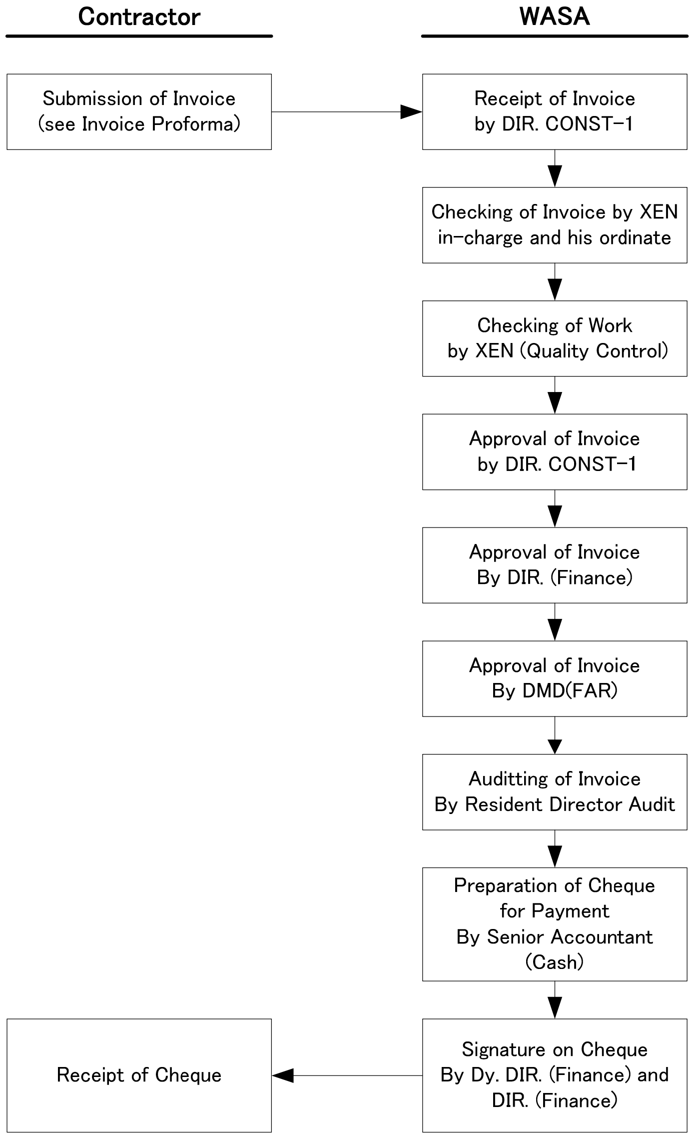
	Gulshan-e-Ravi Disposal Station 1-2: Construction of branch sewers from Larex Colony to Gulshan-e-Ravi Disposal Station 1-3: Construction of trunk sewer along Cantonment Drain
	2. Disposal Station – Central Area – connecting to South West Treatment Plant 2-1: Construction of New Gulshan-e-Ravi DS
	3.: Construction of Collector Channel
	4. Drainage
(3) Estimated cost	Rs.6,367,300,000.- (JY8,022,800,000.-)
Package 6: Construction of South West Treatment Plant	
(1) Bidding procedure	International competitive bidding
(2) Scope of work	1. Construction of Lift Station 2. Construction of South West Wastewater Treatment Plant
(3) Estimated cost	Rs.10,729,300,000.- (JY13,519,000,000.-)
Package 7: Management Monitoring System (MIS)	
(1) Bidding procedure	Local competitive bidding
(2) Scope of work	IT system (Construction of MIS)
(3) Estimated cost	Rs.1,586,900,000.- (JY1,999,500,000.-)
Package 8: O&M Equipment	
(1) Bidding procedure	International competitive bidding
(2) Scope of work	O&M equipment
(3) Estimated cost	Rs.562,500,000.- (JY708,800,000.-)

Note: Estimated cost shows the direct construction cost and does not include price escalation and physical contingency.

14.7 Payment Procedure in WASA

Figure 14.3 shows the current procedure of payment for construction in WASA. When the invoice is submitted by a contractor, the engineering department checks it in terms of the performance, quantity and quality of the work by different engineers-in-charge respectively, the financial department prepares the payment details, the Resident Director Audit (RDA), who belongs to the Government of Punjab and has a office in WASA audits it, and finally the cheque is prepared for payment by the Senior Accountant of the financial department

Flow of payment documents and persons involved in the process are described as follows:



Note: The Resident Director Audit (RDA) has a Government Office in WASA.

Figure 14.3 Current Procedure of Payment for Construction Works in WASA

(1) In the Office of Director Construction (DIR. CONST-1)

1) DIR. CONST-1 sends the invoice to XEN for checking and verification.
2) XEN sends the invoice to SDO for checking and certifying the payable amount.
3) SDO sends the invoice to sub engineer for checking quantities of work done and make entries in the Measurement Book (MB is issued by Audit Department of the Government of Punjab for making record entries of all engineering works and remains secured in Finance Directorate).
4) Prior to verification of payment, XEN (Quality Control) who has an independent office under DMD (Engineering) also checks the works and gets the materials tested

through an authorized laboratory. XEN (QC) issues a certificate to the effect that the work done and the tests of materiel meet the prescribed specifications.

5) Circulate the invoice to DIR. CONST-1 along with quality certificates issued by XEN (QC).
6) DIR. CONST-1 sends the certified invoice to DIR.(F) for payment.

(2) In the Office of Director Finance:-

7) Circulate the invoice to Dy. Director Finance (DDF) and Assistant Director Finance (ADF) for checking and preparing the payment details on the following proforma.
    - Cash payment voucher
    - Statement of deduction of income-tax
    - Purchase journal voucher
8) The verified invoice goes back to DIR.(F) and DMD (FA&R) for approval.

(3) In the Office of RDA:-

9) RDA gets the invoice checked through his subordinate and auditors, and sends the audited invoice to the Senior Accountant for preparations of cheque.

Regarding the case of construction works executive against the Loans, the same procedure will be adopted except the following:-

1) In case of World Bank Loans, the procedure was that the World Bank transferred a lump sum say 1.00 Million Dollars as floating funds, out of which WASA could make disbursements for the works executed. Subsequently, more amount as per requirement was released by World Bank against application of WASA.
2) JICA has a different procedure for disbursements.

14.8 Promotion of Connection to A Sewerage System

According to the WASA's Benchmark Indicators, the served populations are 4.827 million for water supply and 4.576 million for sewerage in the WASA area with a total population of 5.548 million in 2006/07. Taking into account that no special measure has been taken for promotion of connection to a sewerage system at present, no obligation of connection is imposed and connection charge is reportedly Rs. 10,000 to 20,000, the percentage of sewerage coverage is rather high and shows the people's high awareness for rapid drainage of wastewater from their surrounds and maintenance of comfortable living environment. The unconnected people to a sewerage system are classified into three types, namely (a) those with no concern for connection, (b) those with illegal connections and (c) the poor who has no allowance for connection. It is considered that Type (a) may be less than Type (b), since the living environment is deteriorated with blames from the surrounding people, if not connected. It is recommended to enact the Urban Water and Sanitation Act as early as possible and define the obligation to connect to a sewerage system within the sewered area and the penalty clause for the people who has no concern for connection from the viewpoint of groundwater pollution as well as the punishable penalty clause for the people with illegal connections. The results that WASA has currently carried out the survey on illegal connections entrusting to NPOs is worth noticing, since there is high possibility that the people with illegal connections to water pipes also has illegal connections to a sewerage system.

For socially vulnerable, the discount of connection charge and water rate and acceptance of installment payment should be considered to reduce the burden on them to promote connections to a sewerage system.

14.9 Project Implementation Schedule

Project implementation schedule is shown in **Table 14.11** and **Figure 14.4**, respectively, which is prepared on the assumption that the procedures in both the Pakistani side and Japanese side will be smoothly progressed, starting from the Loan Agreement to be expectedly concluded by the end of the year 2010.

This project implementation schedule is tentative and would be discussed later.

Table 14.11 Project Implementation Schedule

Action	Date/ Required Period
Signing of Exchange of Notes	Nov. 30, 2010
Conclusion of Loan agreement	Dec. 31, 2010
Consulting Services	
Selection of Consultants	12 months
Preparation of Request for Proposal and Shortlist	2 months
Concurrence of JICA for PRP and Shortlist	1 month
Request for Proposal & Shortlist	Mar. 31, 2011
Preparation of Proposal by Consultants	2 months
Evaluation of Consultants' Proposals	2 months
Concurrence of JICA for Proposal Evaluation	2 months
Contract Negotiation	2 months
Conclusion of Contract for Consulting Services	Nov. 30, 2011
Concurrence of JICA for Contract	1 month
Detailed Design	12 months
Preparation of PQ & Bidding Documents	9 months
Concurrence of JICA for PQ Documents	1 month
Concurrence of JICA for Bidding Documents	1 month
Construction Supervision	42 months
Study on Institutional Improvement	69 months
Master Planning	24 months
Construction Works	
Selection of Contractor for Local competitive Bidding (LCB)	3 months
Preparation of PQ Documents	1 month
Evaluation of PQ Documents and Conclusion of Contract	2 months
Selection of Contractor for International Competitive Bidding (ICB)	18 months
PQ Process by Concurrence of JICA	4r months
Preparation of Bidding Documents	2 month
Evaluation of Bidding Documents	3 months
Concurrence of JICA for Bidding Documents Evaluation	1 month
Contract Negotiation	2 month
Conclusion of Contract for Construction Works	Nov. 30, 2013
Concurrence of JICA for Contract	1 month
Opening of Letter of Credit (L/C)	3 months

The operation and maintenance period shall be two years after the completion of construction works including three month trial operation accompanied with the training to WASA staff. During this period, if any defects will be found in facilities/equipment, the contractor shall be required for their repair and/or replacement with no cost to WASA. In addition, the contractor shall provide a training on operation and maintenance of facilities/equipment in collaboration with the consultants under loan.

Preparation of Short List

(1) Once JICA and WASA have agreed on the Terms of Reference for the consulting services required, as described in **Chapter 12.5**, WASA shall prepare a Short List of Consultants to be invited to submit proposals, taking into account the following factors:

1) Experience of firm
   - Experience of international projects of comparable size, complexity and technical speciality
   - Experience in developing countries under comparable conditions
   - Experience in Japanese ODA projects

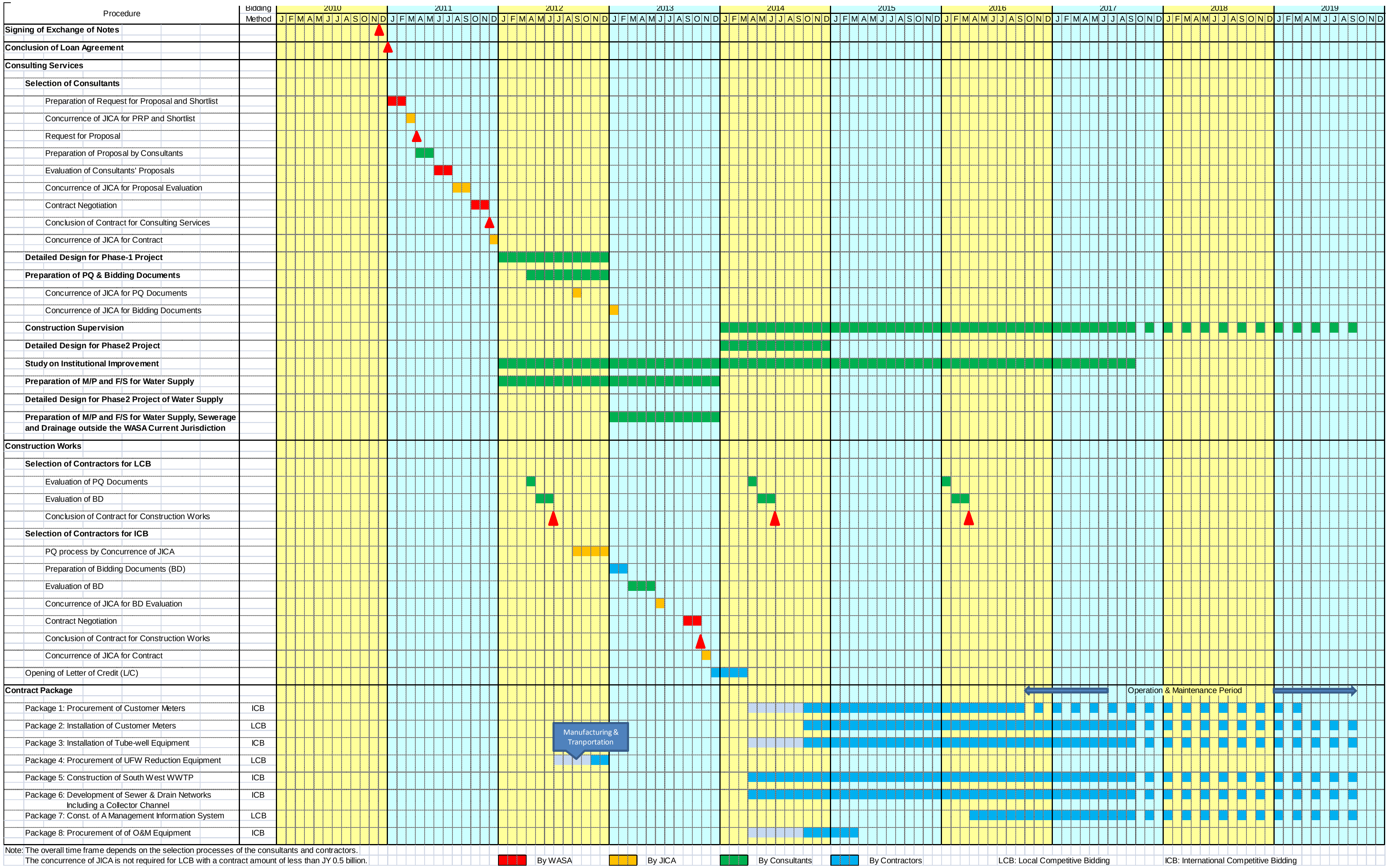
2) Proposal
   - Approach and methodology
   - Work Plan (including staffing schedule)

3) Personnel
   - Project Manager
   - Engineers

(2) Such a Short List shall normally consist of not less than three and not more than five consultants. There is usually little advantage in inviting more than five consultants to submit proposals, because with a larger number some are likely to be less interested and the quality of proposals is likely to suffer.

(3) Should WASA find it difficult to compile a satisfactory Short List of qualified consultants from the information available to it from its own past experience and other sources, JICA will, at the request of WASA, make available information on consultants, from which WASA may draw up its own Short List.

Figure 14.4 Project Implementation Schedule



Note: The overall time frame depends on the selection processes of the consultants and contractors.
The concurrence of JICA is not required for LCB with a contract amount of less than JY 0.5 billion.

14.10 Funding Schedule

The fund to be used for the implementation of projects should be prepared in accordance with the implementation schedule. The funding schedule and the percentages of the eligible portion to the total project cost are shown in **Table 14.12**.

Table 14.12 Funding Schedule and Share of Eligible Portion

(Unit: JPY Million)

Component	Portion	2012	2013	2014	2015	2016	2017	2018	2019	Total	Percentage
Water Supply	Eligible Portion	129	225	1,209	625	595	467	0	0	3,251	70.6
	Non-eligible Portion	50	88	500	263	252	199	0	0	1,352	29.4
	Sub-total	179	314	1,709	888	847	665	0	0	4,602	100.0
Sewerage	Eligible Portion	402	89	10,619	4,895	5,033	3,870	22	22	24,952	75.5
	Non-eligible Portion	157	35	3,415	1,578	1,624	1,249	9	9	8,077	24.5
	Sub-total	559	125	14,034	6,473	6,657	5,120	31	32	33,029	100.0
Drainage	Eligible Portion	310	0	2,264	995	990	708	0	0	5,267	81.3
	Non-eligible Portion	115	0	521	221	213	142	0	0	1,211	18.7
	Sub-total	425	0	2,784	1,215	1,203	850	0	0	6,477	100.0
Institutional Improvement	Eligible Portion	98	26	25	9	1,711	1,756	11	11	3,646	70.2
	Non-eligible Portion	38	10	10	3	731	753	5	5	1,555	30.0
	Sub-total	136	37	35	12	2,442	2,509	5	16	5,191	100.0
Total	Eligible Portion	939	340	14,117	6,524	8,329	6,801	33	33	37,116	75.3
	Non-eligible Portion	360	133	4,446	2,065	2,820	2,343	14	14	12,195	24.7
	Total	1,299	476	18,562	8,588	11,149	9,144	36	48	49,299	100.0

Any eligible portion of the components can be funded fully by JICA loan in case that the 85% rule of eligible portion is applied. In terms of the non-eligible portions, they should be funded by the Government or their loans should be backed by the Government because of present financial situations of WASA, which are examined in **15.3 Cash Flow Analysis**.

14.11 Organization for Project Implementation

For the project implementation, the following organization is proposed to control the construction works and to solve a variety of problems to be faced, assuming the case that all proposed components will be included in Phase 1 Project.

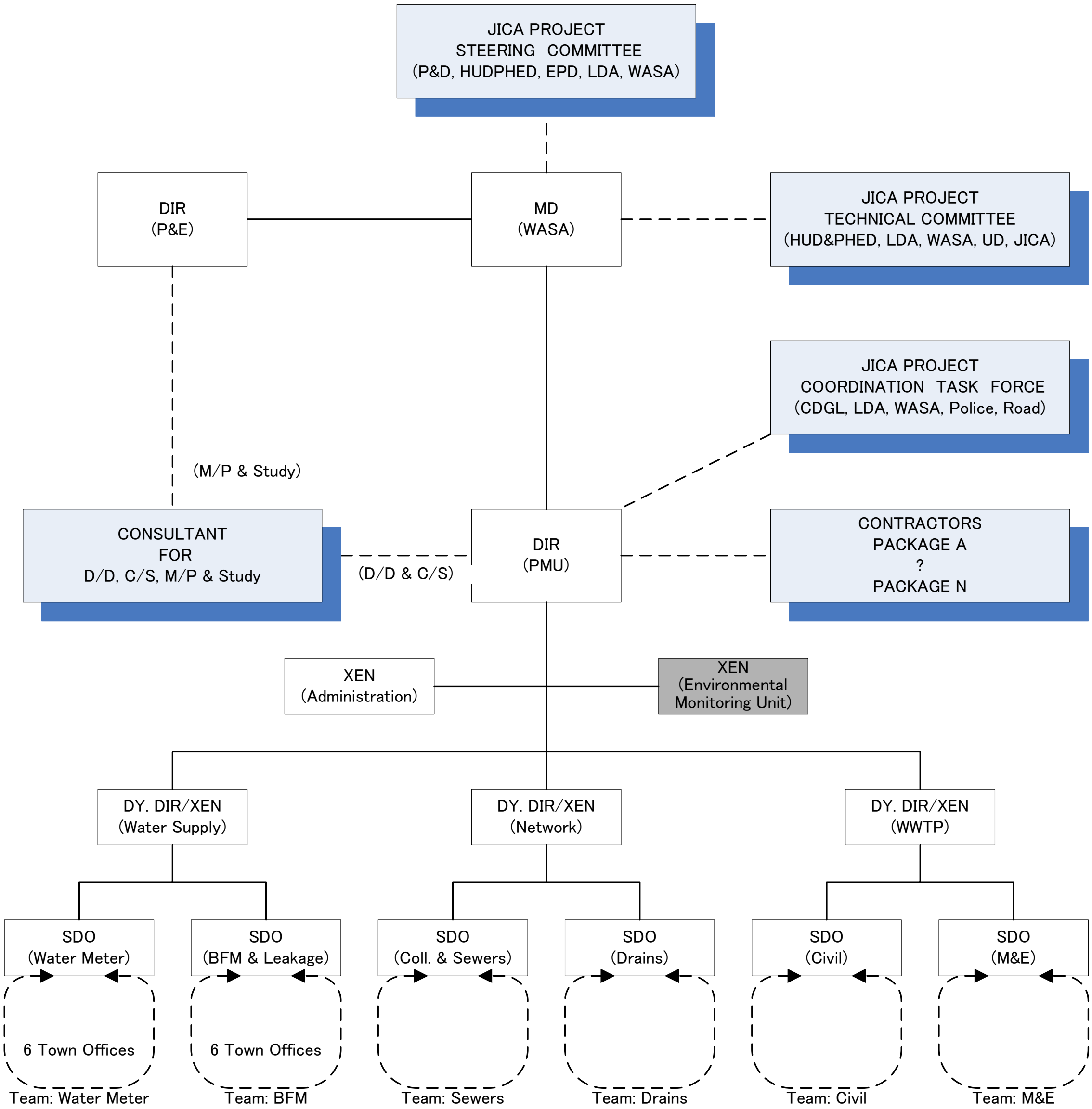


Figure 14.5 Organization During the Project Implementation

The members expected and the Terms of Reference (TOR) of respective committees and task force are shown below.

(1) Steering Committee for JICA Project

Members (Eight)

- i) Secretary, P&D Department
- ii) Secretary, HUD&PHED
- iii) Secretary, EPD
- iv) Joint Secretary EAD, Government of Pakistan
- v) District Coordination officer, Lahore
- vi) Director General, LDA

vii) Managing Director, WASA
viii) Project Director, Urban Unit, P&DD

The Terms of Reference of Steering Committee

1) Oversight of the overall progress and implementation of the construction works
2) Liaison with the departments, provincial government and JICA
3) Review recommendation of Technical Committee

Frequency of Meeting

Every half year

(2) Technical Committee for JICA Project

Members (Six)

i) Secretary, HUD&PHED
ii) Director General, LDA
iii) Managing Director, WASA (Lahore)
iv) Project Director, Urban Unit, P&DD
v) Chief (UD), P&DD, Lahore
vi) Representative of JICA

The Terms of Reference of Technical Committee

1) To coordinate and advise on the technical conceptual and fundamentals framework of thee Project
2) To review deliverables and recommend improvements to Steering Committee
3) To resolve the technical problems that may arise with the progress of the construction works

Frequency of Meeting

Every quarter

(3) Coordination Task Force for JICA Project

Members (Eight)

i) Assigned by the Chief Minister's Office
ii) Project Manager, DIR(PMU), WASA
iii) Deputy Project Manager, Deputy DIR(PMU), WASA
iv) Representative of CDGL

v) Representative of Police
vi) Representative of Road
vii) Project Manager, Consultants
viii) Project Manager, Contractors

The Terms of Reference of Coordination Task Force

1) To discuss the implementation/instruction of the resident's measures accompanied with the construction works
2) To discuss the implementation/instruction of the safety measures accompanied with the construction works
3) To discuss the implementation/instruction of the traffic control accompanied with the construction works
4) To discuss the complaint handling accompanied with the construction works
5) To discuss the simplification of administrative procedures that may be faced during the construction works

Frequency of Meeting

As required

(4) Project Management Unit (PMU)

1) To review and approve the consultants' assignment
2) To review and approve the prequalification (PQ) documents for the contractors
3) To review and approve the evaluation report of prequalification
4) To review and approve the bidding documents of the Phase 1 Project including the drawings, specifications, cost estimates, etc.
5) To call for the pre-construction meeting
6) To review and approve the technical evaluation report of bidding submitted by the contractors
7) To check and approve the letter of request that consultants/contractors may submit in the course of construction works
8) To issue the change of order
9) To check and approve the invoices from consultants and contractors
10) To prepare the letter of request for concurrence to JICA
11) To issue the authorization to pay
12) To call for the meeting of the Coordination Task Force for JICA Project, as required
13) To conduct the environmental monitoring

The staff requirement is one director, five deputy directors (DY.DIR.)/ executive engineers

(XEN) and six sub deputy directors (SDD) for full components. Since the proposed Phase 1 Project is composed of a variety of works and facilities such as civil, architectural, mechanical and electrical works and pipes, drains, pumping station, wastewater treatment plant, water meters and bulk flow meters, and the scale of works are so big that WASA has never experienced up to now, it goes without saying that the well-experienced engineers in the field of water supply, sewerage and drainage should be maintained as many as possible for the construction works. However, WASA has currently many vacant seats for posts, especially in the middle class like 3 vacant seats for 17 posts in the director class (Grade 19), 9 for 53 in the deputy director class (Grade 18), 28 for 133 in the assistant director class (Grade 17), and 17 for 99 in the senior staff/sub engineer class (Grade 16) as shown in **Table 6.21**. Therefore, it seems difficult to meet the staff requirement of the PMU with the WASA internal staff. As it is better that more than half staff will be occupied by the WASA internal staff that is familiar with the conditions of WASA, the hiring of two deputy directors (DY.DIR.)/executive engineers (XEN) and three sub deputy directors (SDD) from relevant provincial departments or private companies is advisable as the upper limit. In addition, it is advisable to hire the engineer in charge of environmental monitoring from the outside due to no experience in this field in WASA.

The engineers for detailed engineering and construction supervision shall be recruited through the appeal to the public. All the applicants shall be interviewed by the WASA IC. The conditions of engineers for recruitment shall be tentatively as follows:

DY.DIR/XEN class

Experience in construction supervision	More than 15 years
Salary	Rs.80,000/month
Employment period	Five years
No. of required engineers	Two + One

(One is the engineer for environmental monitoring)

SDD class

Experience in construction supervision	More than 7 years
Salary	Rs.50,000/month
Employment period	Five years
No. of required engineers	Three

As the installation sites of water meter at customers and bulk flow meters at tube-wells are extended throughout the WASA area, the cooperation of WASA Town offices for O&M is indispensable in the response to the customers, adjustment of tube-well operation, inspection and so on during the installation works.

(5) Environmental Monitoring Unit

1) To implement a necessary water quality monitoring in public water bodies discussed in **Chapter 10.2.**
2) To implement environmental monitoring in accordance with the Environmental Management Plan (EMP) including an Environmental Monitoring plan
3) To prepare the Annual and/or periodic Environmental Monitoring Report for EPD and JICA
4) To carry out the survey on employment status after evacuation of illegal farmers at the WWTP construction site including income and living condition
5) To carry out the situational survey on buildings partly occupying the construction site for a collector channel during the construction period

(6) DIR(P&E)

DIR(P&E) is responsible for arrangement of and coordination with internal/external organizations that are involved in the institutional improvement as shown in **Figure 10.2**, and in the preparation of the master plan for water supply in addition to its own task assigned in **Figure 10.2**.

The preparation of the master plan for water supply shall be monitored by DIR(P&D) in cooperation with relevant directorates in WASA.

(7) Consultants under Loan

The Terms of Reference for Consultancy Services is described in "**12.5 Engineering Services**"

14.12 Organization after Project Completion

Figure 14.6 shows the organization after project completion. The detailed description is given in (1) of **Chapter 10.1.4**.

The major changes accompanied with the facility construction under the Project are as follows:

1) The directorate of Project Management Unit will remain for the subsequent Phase-2 Project.

2) The directorate for environmental monitoring will be established to continue the environmental monitoring

   May be responsible for:-

   a) Coordination with and reporting to EPD on Water Quality Monitoring discussed in

Chapter 10.2 in consultation and cooperation with the WASA Chemical Laboratory (See **Figure 14.4**)

b) The following Environmental Monitoring Items to be discussed in EMP in the course of EIA (See **Chapter 16.9**)

- Social Impacts relating to the evacuation of 95 farmers from land for the WWTP
- Social impacts relating to the demolitions of some of building structure on the land of Collector Channel
- Social Impacts on living and livelihood during the construction stage such as noise and vibration by equipment and vehicles, traffic safety and management, dust control, etc.
- Environmental Impacts on air pollution and noise and vibration during and implementation stages of the projects
- Environmental Impacts relating to sludge treatment during the operation stage of the projects

c) Periodic Environmental Report to JICA which will be requested based on JBIC Environmental and Social Consideration Guidelines, which may be one of the conditions of Japanese Loan Agreements (See **Chapter 16.10**)

3) The UFW control will be upgraded to the directorate for workshop due to an increase of its importance and working volume.

May be responsible for:-

a) Analysis of data and information for UFW reduction
b) Investigation of leakage detection from a service pipe or a water supply network
c) Preparation of a distribution pipe rehabilitation plan
c) Upkeep of tools and instruments for leakage detection
d) GIS survey

4) The workshop will be upgraded to the directorate for workshop due to an increase of its importance and working volume.

May be responsible for:-

a) Repair of dewatering sets
b) Repair of water meters and calibration
c) Maintenance and repair of O/M vehicles

5) The laboratory will be upgraded to the directorate for water chemical laboratory due to an increase of its importance and working volume.

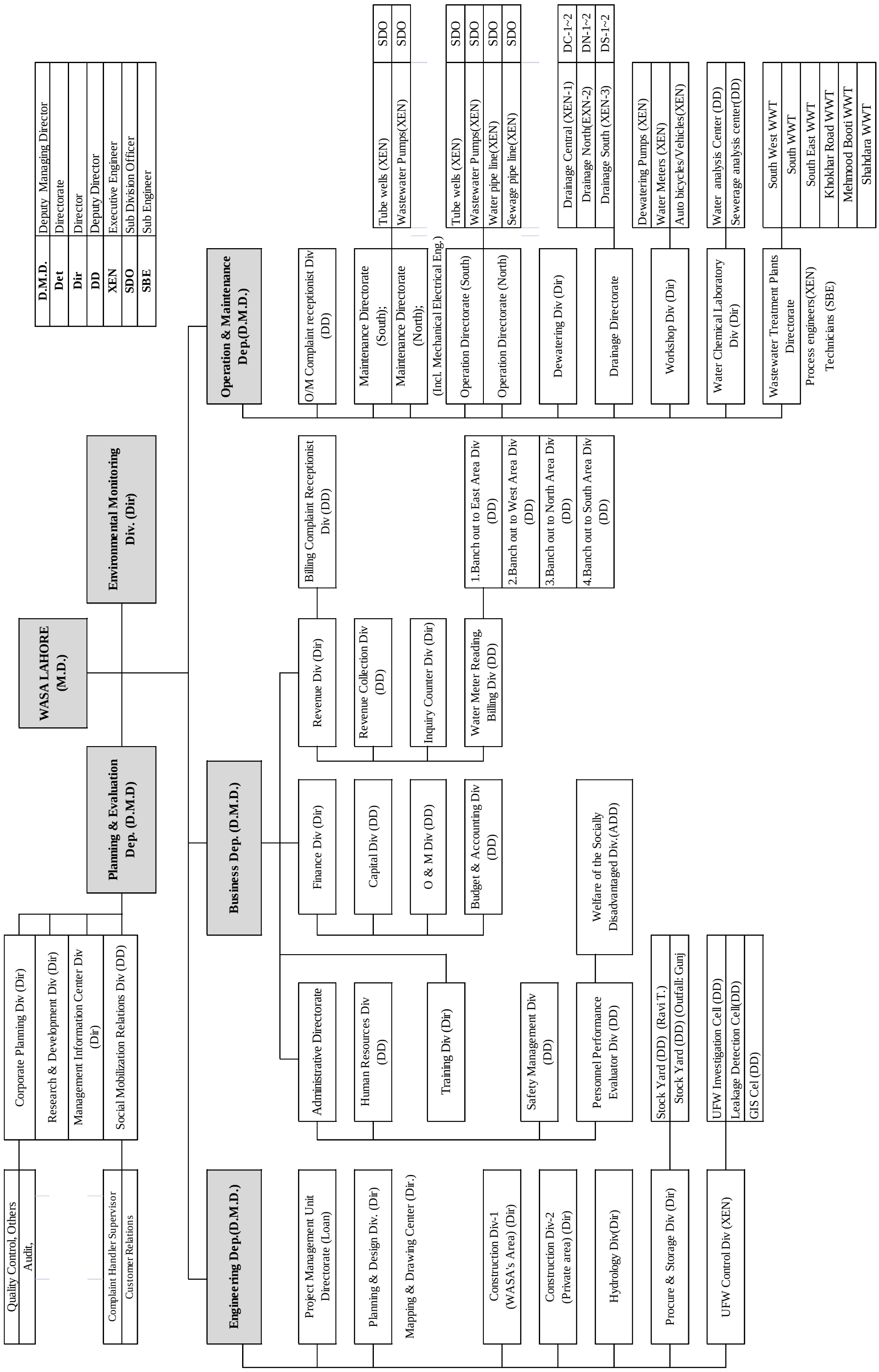
May be responsible for:

a) Monitoring of drinking water quality.
b) Monitoring of chlorination at all tube-wells in the water supply system.
c) Monitoring of wastewater quality as and when required
d) Surveillance/instruction/water testing on the effluent quality from specific industrial plants and preventing obstacles for treatment at WWTP

6) The directorate for WWTP will be established for operation and maintenance of plants. May be responsible for:

a) Operation and Maintenance of WWTPs
b) Sludge handling and disposal at WWTPs
c) Security of land acquired for wastewater treatments plant

Figure 14.6 Organization After the Project Completion



14.13 Operation and Effect Indicators

The purpose to set operation and effect indicators is to understand the situation of not only the entire WASA but also individual systems in order to identify the location and cause of problems. The entire WASA is composed of individual systems such as water supply, sewerage and drainage. Furthermore, for example, the service area by a sewerage system is subdivided into the areas covered by respective WWTPs to be constructed in future. The data should be collected so as to clarify the system covered by each WWTP as much as possible, since each system is basically operated and maintained independently from others. For this purpose, the adequate instruments to measure the flow, weight, power, etc. should be provided at the construction of new WWTP. The administrative and financial data stocked in WASA should be also categorized so as to meet such operational units, even though such works are complicated and take a time.

The management monitoring indicators as shown in **Table 14.13** are proposed for respective components.

Table 14.13 Operation and Effect Indictors for Water Supply, Sewerage and Drainage

	Indicators	Unit	2009 (Base)	2019 (Target)	Remarks
1. Water Supply					
(1)	**Operation Indicator**				
1-1	Population served by water supply	mil. pers.	4.934	6.505	
1-2	Amount of water supply	MGD	244.2	296.1	
		Mm^3/day	1.110	1.346	
1-3	Number of functional metered connections	nos.	68,576	376,600	+308,000
1-4	Rate of unaccounted-for water (UFW)	%	34	29	
1-5	Rate of non-revenue water (NRW)	%	40	36.4	
1-6	Amount of groundwater abstraction	MGD	370.0	416.9	
		Mm^3/day	1.682	1.895	
1-7	Rate of tap water unfitness for drinking	%			
(2)	**Effect Indicator (For Entire WASA Area)**				
1-11	Percentage of population served	%	87	92	
1-12	Water supply per capita	Lpcd	225	2055	
1-13	Revenue on water supply	Rs. mil.	1,819.3	5,260.0	
2. Sewerage					
(1)	**Operation Indicator**				
2-1	Population served by sewerage	mil. pers.	5.759	7.799	Entire area

2-2	Population treated	mil. pers.	0.0	2.784	
2-3	Rate of facility utilization	%	-	35.7	Entire area
2-4	Influent BOD_5	mg/L	-	250	
	Effluent BOD_5	mg/L	-	50	
	BOD_5treatment efficiency	%	-	80	
2-5	Influent SS	mg/L	-	350	
	Effluent SS	mg/L	-	70	
	SS treatment efficiency	mg/L	-	80	
2-6	Amount of dried sludge	DS t/day	-	100	+85,251 m^3/y (70%)
(2)-1	**Effect Indicator (For Project Area: Central)**				
2-11	Percentage of population served	%	84	90	
2-12	Improvement of water quality in the receiving water body	%	-		
2-13	Total length of sewers	Km	1,325	1,348	+34,766 ft +15,632 ft +7,390 m
(2)-2	**Effect Indicator (For Entire Area)**				
2-21	Percentage of population served	%	84	90	
2-22	Percentage of wastewater treated	%	-		
2-23	Total length of sewers	km	3,508	3,531	+34,766 ft +15,632 ft +7,390 m
3. Drainage					
(1)	**Operation Indicator**				
3-1	Annual highest water level at the base point		-		
(2)-1	**Effect Indicator (For Project Area)**				
3-11	No. of inundated areas at the maximum rainfall	areas	50		
3-12	Total inundated area at the maximum rainfall	ha	49.75		
3-13	Frequency of inundation at the typical point	times			
3-14	Total length of sewers	Km	79.94	122.52	+42,580 m
(2)-2	**Effect Indicator (For Entire Area)**				
3-21	No. of inundated areas at the maximum rainfall	areas	80		
3-22	Total inundated area at the maximum rainfall	ha	85.33		
3-23	Frequency of inundation at the typical point	times			
3-24	Total length of sewers	Km	215.68	258.26	+42,580 m

Note:

1 MGD = 4545.96 m^3/day

(1-7: Rate of unfitness for drinking water at taps) = (No. of unfit samples) x (No. of total samples)

(1-12: Water supply per capita) = (1-2: Amount of water supply) / (1-1: Population served by water supply) x 1,000

(2-3: Rate of facility utilization) = (2-3:Amount of wastewater treated) / (2-1: Design capacity) x 100

(2-4: BOD_5 treatment efficiency) = [(2-4: Influent BOD_5) -(2-4: Effluent BOD_5)] / (2-4: Effluent BOD_5) x 100

(2-5: SS treatment efficiency) = [(2-5: Influent SS) -(2-5: Effluent SS)] / (2-5: Effluent SS) x 100

(2-13: Rate of cost recovery) = (Operating expenditure for sewerage) / (Operating Revenue for sewerage) x 100

CHAPTER 15 ECONOMIC AND FINANCIAL EVALUATION

Economic and financial evaluation made in this chapter will be further developed in the future study.

15.1 Methodology of Economic and Financial Evaluation

15.1.1 Methodology of Economic Evaluation

(1) General

A main objective of the economic evaluation here is to examine the efficiency of the project investment in Phase I from the viewpoint of the national economy using cost-benefit analysis. Market prices have been converted to economic ones where the influence of market distortion is removed, (the so-called shadow prices). Opportunity costs are used for the costs of goods and services whose markets do not exist. Willingness-to-pay is used for benefits whose markets do not exist. An Internal Rate of Return (IRR) is used here as the indicator of the efficiency of a project investment. IRR is defined as the discount rate which makes the present value of the flow of costs incurred in the project the same as that of benefit, or which makes the Net Present Value (NPV) 0 (zero), showing what percentage of profit the investment will be paid back with. IRR used in economic evaluation is called Economic Internal Rate of Return (EIRR).

(2) Preconditions

The following preconditions are assumed in the economic evaluation. Additional preconditions will be clarified as necessary.

1) With-project and Without-project

Without-project is the case where the water supplied, wastewater and storm water are managed by the current existing systems respectively. With-project is the case where the project components are respectively implemented into the current systems. By comparing the with-project and without-project, the additional costs and benefits incurred can be estimated to calculate an EIRR.

2) Evaluation Period

The Evaluation period is from 2011 to 2047 (30 years after the completion of the construction).

3) Standard Conversion Factor (SCF)

SCF is the ratio of the economic price value of all goods in an economy at their border price equivalent values to their domestic market price value. Prices of goods and services procured domestically are converted to economic ones by the SCF. This study employs an SCF of 0.88, which is the value employed in *the Study on Water Supply and Sewerage System in Karachi in the Islamic Republic of Pakistan, July 2008, JICA.*

4) Other Preconditions

Price level	:	Year of 2009
Exchange rate	:	USD 1.00 =JPY 92.53 Pakistan Rupee 1.00 = JPY 1.26
Social discount rate	:	12%, the same figure that is employed in the *Study on Water Supply and Sewerage System in Karachi in the Islamic Republic of Pakistan, July 2008, JICA.*

(3) Costs

Additional costs are included in the evaluation by comparing with-project and without-project. The costs are calculated in the form of cash flow of each year during the evaluation period. The following cost items are calculated:

1) Investment Cost

Investment cost includes costs of construction of the facility, equipment, and consulting services. Economic evaluation excludes physical contingencies but includes price escalations. Reinvestment costs of facility and equipment is calculated at the end of their effective lifespans. Salvage value of construction, facility and equipment is added as a negative cost at the end of the last year of the evaluation period.

2) Operation and Maintenance Costs

Operation and maintenance costs for each year is included. Price escalation is not included.

3) Depreciation

As the money allocated and subject to depreciation is not actually spent at that time, it is not included in the cost items.

(4) Benefits

Additional benefits are included in the evaluation by comparing with-project and without-project. The benefits are calculated in the form of cash flow of each year during the evaluation period. As each project component has different effects, their benefits should be identified for each project component. Components, expected effects and their benefits are summarized below:

Table 15.1 Project Component, Expected Effect, and Benefit

Project Component	Expected Effect	Benefit
<Water Supply>		
• Install bulk flow meters to control the Unaccounted for water (Target: All the rube-wells)	• To help decrease UFW and increase the revenue of WASA	• As the effect is the transfer of money, no additional benefit is expected.
• Install customer meters to control the Unaccounted for water (Target: Establish the system of installing meters and install meters to 40% of customers)	• To help decrease UFW and increase the revenue of WASA	• As the effect is the transfer of money, no additional benefit is expected.
• Establish the system of UFW control (Target: Increase the number of staff and strengthen the capacity enough to control UFW)	• To increase the water supply within the existing water supply system	• Water is supplied in an increased amount.
• Install chlorinators for complete disinfection (Target: All the rube-wells)	• To improve the water quality and reduce water-born diseases	• Medical costs are reduced. • Time which has been spent for medical treatment can be allocated to productivity or leisure.
<Sewerage>		
• Construction of new treatment plant in Central Area	• To increase the water quality of Ravi River	• Agricultural productions using the water of Ravi River increase.
• Interception of drains and diversion for treatment	• To improve the sanitary conditions of the area	• Living environment of the residents in the area improves.
• Major trunk sewer and new disposal station required to service densely populated areas and convey waste water to treatment works	• To improve the sanitary conditions of the area • To eliminate lift stations which pump up the wastewater into drainage lines	• Living environment of the residents in the area improves. • The operation and maintenance cost of the lift stations is reduced.
<Drainage>		
• Construction of new main and secondary drains in Central Area	• To reduce inundation	• Production activities which have been halted by inundation can be reduced.
• Rehabilitation and cleaning of existing drains in Central Area	• To reduce inundation	• Production activities which have been halted by inundation can be reduced.
<Management>	• To improve the management of WASA	• As this component helps other components realize their effects effectively, it has no additional benefit by itself.

15.1.2 Methodology of Financial Evaluation

(1) General

A main objective of the financial evaluation here is to examine the efficiency of a project investment in Phase I from the viewpoint of the project implementation body using cost-benefit analysis. Market prices are used. An Internal Rate of Return (IRR) is used here for the indicator of the efficiency of a project investment. IRR used in financial evaluation is called the Financial Internal Rate of Return (FIRR).

(2) Preconditions

The following preconditions are assumed in the financial evaluation. Additional preconditions are clarified as necessary.

1) With-project and Without-project

Without-project is the case where water supplied, wastewater and storm water are managed by the current systems respectively. With-project is the case where the project components are implemented into the current systems respectively. By comparing the with-project and without-project, additional costs and benefits incurred are estimated to calculate an FIIR.

2) Evaluation Period

Evaluation period is from 2011 to 2047 (30 years after the completion of the construction).

3) Other Preconditions

Price level	:	Year of 2009
Exchange rate	:	USD 1.00 =JPY 92.53
		Pakistan Rupee 1.00 = JPY 1.26
Social discount rate	:	12%, the same figure that is employed in the *Study on Water Supply and Sewerage System in Karachi in the Islamic Republic of Pakistan*, *July 2008, JICA.*

(3) Costs

Costs include any money value in market prices actually spent for the project. Additional costs are included in the evaluation by comparing with-project and without-project. The costs are calculated in the form of cash flow in each year during the evaluation period. The following cost items were calculated:

1) Investment Cost

Investment cost includes costs incurred in construction of the facility, equipment, and for consulting services. Financial evaluation excludes physical contingencies but includes price escalations. Reinvestment cost of facility and equipment is calculated at the end of their effective lifespans. Salvage value of the construction, facility and equipment is added as a negative cost at the end of the last year of the evaluation period.

2) Operation and Maintenance Cost

Operation and maintenance cost for each year is included. However, price escalations are not included.

3) Depreciation

As the money allocated is subject to depreciation but is not actually spent at that time, it is not included in the cost estimates.

(4) Benefits

Benefits are any money value in market price actually gained by the project. Additional benefits are included in the evaluation by comparing with-project and without-project. The benefits are calculated in the form of cash flow in each year during the evaluation period.

15.2 Economic and Financial Evaluation

15.2.1 Economic Evaluation

As the Management component helps other components realize their effects efficiently and as it has no additional benefit, the economic evaluation of this component is not conducted separately, and its cost is allocated to other components pro rata their cost sizes.

(1) Water Supply

The benefits of the water supply component include (a) reduction of medical treatment costs for water-borne diseases, (b) time spent for the medical treatment can be used for productive/liesure activities and (c) increase in water supply. The effect of decrease in UFW and increase in the revenue of WASA is not an increase in benefit from the viewpoint of the national economy because they are just transfers of money. Other effects to be expected include 1) improvement of conscious water saving, and 2) postponement of facility expansion. Such effects are not direct ones and it is very difficult to calculate them in monetary terms.

The Deputy Programme Manager of the Directorate of General Health Services, Punjab said that the reduction of water-borne diseases needs a strategic approach. Unless the disinfection by chlorine is accompanied by an awareness campaign for people and good maintenance of pipelines, its effect would be limited. The Deputy Programme Manager estimates the effect as follows:

If chlorinators are installed for all the rube-wells and water pipelines are renovated and public awareness campaigns are conducted, 60 to 70% of the medical costs which would be otherwise incurred can be decreased.

It is not clear by how many percent increase the project will realize through reduction of medical treatment costs. So, the calculation of EIRR is excluded here. Instead, the potential benefit of the strategic approach is calculated.

1) Reduction of Medical Treatment Costs for Water-borne Diseases

According to the Deputy Programme Manager, the present conditions of water-born diseases are as follows:

- Morbidity rate of waterborne diseases in Lahore: 17% ±2%,
- Ratio of in-patients with water borne diseases to all other patients in Lahore: 30%,
- Average days of stay in hospitals for inpatients with waterborne diseases: 4 days,
- Average times in going to and spending hours in hospitals for outpatients of waterborne diseases: 20 hours/year; out patients go to hospitals repeatedly in a given year,
- Average medical costs for one inpatient and one outpatient of waterborne diseases:
  Inpatient $10 in public hospitals and $20 in private hospitals
  Outpatient $25/year in public hospitals and $100/year in private hospitals, and
- Share of patients in public hospitals and private ones:
  Inpatient $10 in public hospitals and $20 in private hospitals
  Outpatient 20% go to public hospitals and 80% go to private hospitals.

The medical cost of water-borne disease is estimated from the conditions mentioned above.

Table 15.2 Reduction of Medical Cost for Water-Borne Diseases

(Unit: Million)

	2018	2021	2026	2031	2035
WB Disease Case	1.184	1.268	1.383	1.507	1.607
Total Cost (US$)	75	80	88	96	102
70% of Total Cost (US$)	53	56	61	67	71
70% of Total Cost (JPY)	4,862	5,205	5,679	6,190	6,599
Conversion (JPY)	4,279	4,581	4,998	5,447	5,807

2) Time Spent for the Medical Treatment Can Be Used for Production oriented Activities
The time (days) spent for medical treatment is estimated from conditions mentioned above. Additional assumptions made for the calculation are as follows:

- The working-age population (from 15 years old to 64 years old) in Lahore is 58.7% from the 1998 census. Vision 2030 projects that the working-age population of Pakistan will increase to around 65.5% by 2030. Thus, in Lahore it can be assumed that the working age population will increase constantly by 0.3% point every year up to 65.5% in 2030,
- The median household income per earning member per day is calculated at Rs. 338.51 in 2009 from the results of the Socio-economic Survey. This amount is assumed to increase by the same growth rate of per capita GDP of Pakistan, and
- Vision 2030 projects that the per capita GDP of Pakistan will increase by 7-8% annually up to 2030. However, the ADB report, *Is Pakistan's Growth Rate Balance-of-Payments Constrained? Policies and Implications for Development and Growth, 2009,* points out that "Evidence presented suggests that Pakistan's

maximum growth rate is consistent with equilibrium on the basic balance at approximately 5% per annum." Considering that the population growth rate is projected at 1.47% - 2.09% up to 2030 by Vision 2030, the growth rate of per capita GDP can be assumed to be 3.5% annually.

Table 15.3 Reduction of Time for Medical Treatment on Working-Age Patients

	2018	2021	2026	2031	2035
WB Disease Case	1.184	1.268	1.383	1.507	1.607
Working-age Population (%)	61.6%	62.6%	64.2%	65.5%	65.5%
Total Time Spent of Working-age Patients (Million Days)	1.301	1.415	1.583	1.761	1.877
Income per Day (Rupee)	461.36	511.52	607.52	721.55	827.99
Total Income (Million Rupees)	600.220	723.689	961.998	1,270.514	1,554.255
70% of Total Income (Million Rupees)	420.154	506.582	673.399	889.359	1,087.978
70% of Total Income (Million JPY)	529.394	638.294	848.482	1,120.593	1,370.853
Conversion (Million JPY)	465.867	561.699	746.664	986.122	1,206.351

3) Water Supply Increase

EIRR with the effect of water supply increase is calculated here.

(a) Cost

Cost is converted economic one and that of Management component is included in accordance with the ratio of construction cost.

Following items are included in the cost calculation:

- Construction: installation of customer meters, installation of bulk flow meters for Rube-wells, equipments for UFW control
- Physical contingencies
- Consulting services
- Share of the management component
- Replacement cost
- O&M
- Salvage value (as a negative cost)

Detailed calculation is shown in **Appendix 15.1**.

(b) Benefit

The several economic prices of water are calculated in the *Study on Water Supply and Sewerage System in Karachi in the Islamic Republic of Pakistan, July 2008, JICA.* 61,000 Rupee/10^3m^3 is employed here. The total economic benefit is calculated as follows:

Table 15.4 Total Economic Benefit of Water Supply Increase

(Unit: Million)

	2018	2021	2026	2031	2035
UFW	29.8%	28.0%	26.0%	23.0%	20.0%
Accounted Water (10^3m^3/d)	1,314	1,347	1,385	1,441	1,497
Increased Water (10^3m^3/y)	8,976	21,271	34,932	55,424	75,916
Money Term (Rp. Million)	547.5	1,297.5	2,130.9	3,380.9	4,630.9
Money Term (JPY Million)	689.9	1,634.9	2,684.9	4,259.9	5,834.9

(c) Working Level

As the facilities works at the level less than their full capacity before 2035, the benefits are assumed to come about pro rata such level

Table 15.5 Working Level of Facilities

	2018	2021	2026	2031	2035
Working Level	85.3%	89.8%	94.3%	97.7%	100.0%

(d) Calculation Result

EIRR is calculated at 25.3%. Detailed calculation is shown in **Appendix 15.1**.

(2) Sewerage

The construction of a new treatment plant is separated from the other sub-components since its effect in improving the water quality of the Ravi River is very limited considering that the volume of wastewater treated is very little compared with the volume of the Ravi River and its high degree of pollution. The effect of the designed plant on the river water quality is blow the measurement limitation. Other effects by the plant such as technology transfer, improvement of the national prestige among the neighboring countries, improvement of the awareness on sanitation of the people, etc. can be listed up but it is difficult to calculate them in the framework of the economic analysis.

1) Construction of a new treatment plant

The Least cost method is employed here to evaluate the economic appropriateness of the selection of technological alternatives to be applied to a new treatment plant. The evaluation is conducted here by comparing the present value of each technological alternative from the economic viewpoint. Technical explanations of alternatives and their comprehensive evaluation are made in **Chapter 13 Preliminary Design of Phase I Project**.

(a) Cost of Each Technological Alternative

Costs in Market Price

Cost of each alternative is estimated in market prices as follows:

Table 15.6 Cost of Technological Alternatives in Market Price

(Unit: Million)

Treatment Method	Construction Cost	O&M Cost (annual)		Additional Land Acquisition
		Electricity	Sludge Disposal	
Stabilization Pond	14,397	0.0	72.7	1,139
Aerated Lagoon	8,449	816.1	100.3	0
Trickling Filter	11,389	304.9	88.5	0
USAB (+Secondary Process)	15,128	250.4	45.0	0
Oxidation Ditch	12,239	1,392.8	62.4	0
Activated Sludge	16,998	1,087.8	82.9	0

Note: 1) Tax and duties are excluded.
2) Electricity of the inlet pumping station is not included.
3) Costs for existing land, engineering services and administration cost are not included because they are assumed to be the same for all alternatives.

Costs in Economic Price

Firstly, the alternative of "Stabilization Pond" was rejected by the Technical Committee for the reason that it involves additional land acquisition. Costs for other alternatives are converted to economic ones as follows:

Table 15.7 Cost of Technological Alternatives in Economic Price

(Unit: Million)

Treatment Method	Construction Cost	O&M Cost (annual)		Additional Land Acquisition
		Electricity	Sludge Disposal	
Aerated Lagoon	8,043	718.1	88.3	0
Trickling Filter	10,842	268.3	77.9	0
USAB (+Secondary Process)	14,402	220.4	39.6	0
Oxidation Ditch	11,652	1,225.6	54.9	0
Activated Sludge	16,182	957.3	73.0	0

Note: 1) The ratio of imported goods/services to local ones of the construction cost are assumed as 60:40 for all the alternatives.
2) O&M cost is assumed to be procured locally.
3) The Standard Conversion Factor is applied to the costs for goods/services that are locally procured.

(b) Present Value of Costs

Present Value (PV) of the cost is calculated as follows:

Table 15.8 Present Value of Costs

(Unit: Million)

Treatment Method	Present Value of Cost
Aerated Lagoon	11,063
Trickling Filter	10,665
USAB (+Secondary Process)	13,021
Oxidation Ditch	16,670
Activated Sludge	18,862

Note: 1) Effective life of the facilities is assumed as 30 years for all the alternatives.
2) Construction period is assumed as 3 years for all the alternatives.
3) Social discount rate (12%) is applied in the calculations.

The least cost treatment method is therefore the use of Trickling Filters.

(c) Supplementary Discussion - Potentiality of the Benefit

If the treatment plant has enough capacity for improvement of water quality of the Ravi River, the agricultural production can be increased using river water for its irrigation. The agricultural lands on both sides of the Ravi River in Lahore District and Pattoki Tehsil (= sub-District) use the river water for irrigation. The farmers use the river water which is diluted by mixing with the groundwater to an extent where any pollution has no effect on production. Thus, the actual effect of the improvement of the river water quality is the reduction of the amounts of groundwater used for mixing. However, as it can be assumed that the effect of any river water quality improvement is the same as that obtained with groundwater mixtures, the benefit in the reduction of groundwater consumption can then be evaluated by reduction of agricultural production unless the river water quality is improved.

Cultivated area, production and net profit of the production are summarized below:

Table 15.9 Agricultural Production at Ravi River Side (Lahore District)

Crop	Total Cultivated Area (ha)	Total Production (ton)	Production Cost (Rs./ton)	Gate Price (Rs./ton)	Total Net Profit (Rs. Million)
Paddy Rice	67,532	16,046	22,145	21,500	10
Wheat	219,478	62,578	26,265	25,500	48
Sugarcane	50,649	216,615	44,290	43,000	279

Source: Extra Assistant Settlement Officer, Lahore District

Table 15.10 Agricultural Production at Ravi River Side (Pattoki Tehsil)

Crop	Total Cultivated Area (ha)	Total Production (ton)	Production Cost (Rs./ton)	Gate Price (Rs./ton)	Total Net Profit (Rs. Million)
Paddy Rice	14,388	3,419	22,145	21,500	2
Wheat	46,762	13,333	26,265	25,500	10
Sugarcane	10,791	46,152	44,290	43,000	60

Source: Deputy Director Revenue, Pattoki Tehsil, Kasur District

Data on the relationship between water quality and production is available only for paddy rice in Japan. The water quality standard for irrigation (paddy rice) is COD = 6 mg/L in Japan. The relation between water quality and production is as follows:

Table 15.11 Relation between Water Quality and Production in Japan

COD (mg/L)	6	9	12	15	18
Production Rate of Paddy Rice (%)	99	95	92	90	89
Damage Rate of Paddy Rice (%)	1	5	8	10	11

Source: Agricultural Experiment Station of Aichi Prefecture 1964

Considering that the COD of the Ravi River at Baloki Headwoks is 22.6 mg/L, severe damage would ensue for agricultural production if the river water is not diluted by the groundwater. Thus, the potential of the benefit is at least 11 ÷ 89 = 12.4% of the production in the case of paddy rice. Supposing that all the production in these areas were paddy rice, the total benefit would be as follows:

Table 15.12 Potential Benefit in a Year

Area	Production Increase (ton)	Net Profit (Rs./ton)	Total Benefit (Rs. Million)
Lahore District	40,259	645	26
Pattoki Tehsil	8,578	645	6
Total	48,837	-	32

2) Interception and Major Trunk Sewer and New Disposal Station

(a) Cost

Cost is a converted economic one and that of the Management component is included in accordance with the ratio of construction costs.

The following items are included in the cost calculation:

- Construction: laying of sewers, disposal station, collector channel

- Land acquisition (Even if the land has been prepared before, the resource is used for the project from the viewpoint of the national economy.)
- Physical contingencies
- Consulting services
- Share of the management component
- Replacement cost
- O&M
- Salvage value (as a negative cost)

Detailed calculation is shown in **Appendix 15.2**.

(b) Benefit

These sub-components have positive effects on improvement of the living environment of the residents in the target area, whose benefit can be calculated by their willingness-to-pay. Further, as the lift stations are to be eliminated, their operation and maintenance costs will also be saved, resulting in an additional benefit of these sub-components.

Willingness-To-Pay (WTP)

According to the results of Socio-economic Survey conducted by the JICA Study Team (See **2.3 Socio-Economic Survey** for the details of the survey), the median of WTP for the improvement of sanitary conditions is Rs. 135.96 per month and the median of the number of family members in a household is 4.97. It can be assumed that the WTP per person per year is Rs. 328.32. The total of WTP in the target area, Central Area is calculated as follows:

Table 15.13 Total WTP for the Improvement of Sanitary Conditions in South West

(Unit: Million)

	2018	2021	2026	2031	2035
Population (Million)	3.03	3.20	3.43	3.69	3.89
Total WTP (Rp. Million)	993	1,052	1,127	1,211	1,279
Total WTP (JPY Million)	1,252	1,326	1,420	1,526	1,611
Conversion (JPY Million)	1,102	1,167	1,250	1,343	1,418

Savings of Operation and Maintenance Cost for Lift Stations

The O&M cost for the existing 11 lift stations will be saved. This amounts to Rs. 33.3 million or JPY 42.0 million annually, which is finally converted to JPY 36.9 million in economic price.

(c) Working Level

As the facilities will work at the level less than their full capacity before 2035, the benefits are assumed to come about from pro rata of such levels

Table 15.14 Working Level of Facilities

	2018	2021	2026	2031	2035
Working Level	90.1%	93.2%	96.2%	98.4%	100.0%

(d) Calculation Result

EIRR is calculated at 12.7%. Detailed calculation is shown in **Appendix 15.2**.

(3) Drainage

1) Cost

Cost is a converted economic one and that of Management component is included in accordance with the ratio of construction costs.

The following items are included in the cost calculation:

- Construction: construction of, improvement and rehabilitation of drainage system
- Physical contingencies
- Consulting services
- Share of the management component
- Replacement costs
- O&M
- Salvage value (as a negative cost)

Detailed calculation is shown in **Appendix 15.3**.

2) Benefit

The benefit of the drainage component is to reduce the down time of economic activities due to inundation. This down time is converted to an economic value with per capita GDP per hour. The annual average inundation depth and time are estimated with WASA's observation data in a 2007-2009, field survey and an interview survey. It is assumed that when the inundation depth reaches 0.05m, 0.1m, 0.15m, 0.2m, the economic activities of the area are reduced to 30%, 20%, 15% and 0% respectively.

Table 15.15 Inundation and Down Time

Location	Inundation Depth (m)	Inundation Time (hr)	Economic Activity Rate	Down Time (hr)
Laxami Chowk	0.47	5.37	0%	5.37
GPO	0.20	3.29	0%	3.29
Kashmir Road	0.23	6.10	0%	6.10
Thorton Road	0.26	4.48	0%	4.48
Cooper Road	0.16	4.89	15%	4.16
Bashir Sons	0.17	3.94	15%	3.35
Rehman Gallian	0.23	7.56	0%	7.56
Lytton Road	0.10	2.90	20%	2.32
Plaza Cinema	0.27	5.37	0%	5.37
Nabha Road	0.19	3.81	15%	3.24
Church Road	0.10	5.25	20%	4.20
Mozang Chungi	0.15	6.10	15%	5.19
Shadman/Shah Jamal	0.10	4.50	20%	3.60
Waris Road	0.30	6.35	0%	6.35
Galaxy Plaza	0.16	8.15	15%	6.93
Park Lane Road	0.11	6.76	20%	5.41
Chauburji	0.13	4.75	20%	3.80
Lake Road	0.09	4.86	30%	3.40
PU Ground, HCC	0.10	2.30	20%	1.84
Rewaz Garden	0.05	6.73	30%	4.71
Sanda Road	0.08	5.40	30%	3.78
Fazlia Colony	0.13	4.00	20%	3.20
SSP Office Dev Samaj Road	0.20	3.30	0%	3.30
Malik Park	0.05	3.40	30%	2.38
Nasir Park (Tonga Adda)	0.05	5.67	30%	3.97
Secondary Board	0.30	5.83	0%	5.83
Central Point	0.20	8.00	15%	6.80
Gari Shahu	0.26	8.45	0%	8.45
Muhammad Nagar	0.24	9.11	0%	9.11
Bibi Pak Daman	0.25	5.74	0%	5.74
Empress Road	0.25	5.89	0%	5.89
Railway Station	0.23	3.18	0%	3.18
Hussain Chowk	0.17	5.83	15%	4.95
Mini Market Gulberg	0.05	6.00	30%	4.20
Shairanwala Gate	0.17	3.85	15%	3.28
O/S Bhati Gate	0.29	4.14	0%	4.14
Scheme More	0.13	4.18	20%	3.34
Rachna Block Road	0.10	3.96	20%	3.17
Al-Hamad Colony	0.08	4.18	30%	2.93
H-Block Sabzazar	0.10	1.65	20%	1.32
Poonch Road	0.18	2.57	15%	2.18
Millat Chowk	0.17	3.08	15%	2.62
Multan Road Bhalla Stop	0.10	1.93	20%	1.54
Sultan Ahmed Road Rehmanpura	0.24	5.83	0%	5.83
Zaildar Road Ichhra	0.20	5.03	0%	5.03
Chowk Yateem Khana	0.06	1.97	30%	1.38
Infantory Road	0.10	1.80	20%	1.44
Allama Iqbal Road Mustafabad	0.10	1.80	20%	1.44
Shabab Chowk	0.10	0.77	20%	0.61

Source: WASA and JICA Study Team

Table 15.16 Value of Down Time in Economic Activities

	2018	2021	2026	2031	2035
Total Population of the Area	176,263	186,663	199,980	214,910	226,853
Per Capita GDP Per Hour (US$)	0.197	0.219	0.260	0.298	0.298
Total Down Time (hr)	746,692	790,748	847,163	910,407	961,003
Total Time Value (US$)	147,207	172,840	219,926	271,210	286,283
Total Time Value (JPY Million)	13.62	15.99	20.35	25.10	26.45
Conversion (JPY Million)	11,99	14.07	17.91	22.08	23.31

Multiplier Effect

An increase in GDP triggers an additional increase in GDP. According to a macro economic theory, GDP consists of consumption and saving, and an increase in the consumption causes increase in GDP finally by a factor of

$$\frac{1}{1-c}$$

where,

c : Consumption share of GDP (%)

The consumption share of GDP in Pakistan is 88.3% in 2007/08 (Source: *Pakistan Economic Survey 2007-2008, Government of Pakistan*). Thus, the multiplier is 8.54. The total benefit is increased by 8.54 times.

[Note on Multiplier Effect]

National income consists of consumption and saving.

$$Y = C + S$$

Increase in Y causes increase in C, which in turn causes Y as follows:

$$\Delta C_1 = \Delta Y_2 = c\Delta Y_1$$
$$\Delta C_2 = \Delta Y_3 = c\Delta Y_2 = c(c\Delta Y_1) = c^2\Delta Y_1$$
$$\Delta C_3 = \Delta Y_4 = c\Delta Y_3 = c(c\Delta Y_2) = c\{c(c\Delta Y_1)\} = c^3\Delta Y_1$$
$$\cdots$$
$$\Delta C_n = \Delta Y_{n+1} = c\Delta Y_n = c(c\Delta Y_{n-1}) = c\{c(c\Delta Y_{n-2})\} = \cdots = c^n\Delta Y_1$$
$$\cdots$$

Thus, the total of increase is

$$\Delta Y = c\Delta Y_1 + c^2\Delta Y_1 + \cdots + c^n\Delta Y_1 + \cdots = (c + c^2 + \cdots + c^n + \cdots)\Delta Y_1 .$$

Finally, the formula of infinite geometric series is applied.

$$\Delta Y = \frac{1}{1-c}\Delta Y_1$$

3) Calculation Result

EIRR is calculated at 0.8%. Detailed calculations are shown in **Appendix 15.3.**

15.2.2 Combined Economic Evaluation

EIRR for the combined components is calculated as follows.

Table 15.17 EIRR for Combined Components

Combination	EIRR
Original[1)]	15.7%
Option 1[1)]	16.7%
Option 2[1)]	14.9%[2)]

Note: 1) Installation of chlorinators and construction of WWTP are excluded from the calculation.
2) The reason why the EIRR decreases is the increase of the cost share of the management component.

Detailed calculation is shown in **Appendices 15.4 - 6.**

15.2.3 Financial Evaluation

Since the purpose of the sewerage component and the drainage component is not to increase the revenue of WASA, FIRR calculation, which is the tool for checking the investment efficiency from the viewpoint of WASA, for the said components is not appropriate. The financial impacts of the said components should be considered in the framework of WASA's total financial situations. Such financial impacts for household use in the framework of WASA's total financial situations are calculated in **15.3.3 Calculation Water and Sewerage Price for Households**. The chlorination of the water supply is also excluded here with the same reason.

In addition, as the Management component helps other components realize their effects efficiently and as it has no additional benefit, the financial evaluation of this component is not conducted separately, and its cost is allocated to the water supply component pro rata its construction cost size.

(1) Water Supply

1) Cost

The following items are included in the cost calculation:

- Construction: installation of customer meters, installation of bulk flow meters for Rube-wells, equipment for UFW control
- Physical contingencies
- Price escalation
- Consulting services
- Share of the management component
- Replacement cost
- O&M
- Salvage value (as a negative cost)
- Taxes and duties

Detailed calculations are shown in **Appendix 15.7**.

2) Benefit

Reduction of UFW are expected by this component (excluding installation of chlorinators) as benefit. It is assumed that the increase of water is supplied to households.

The charge for the water supply is examined in **15.3.3 Calculation Water and Sewerage Price for Households.** With such water prices, the expected revenue increase of WASA is as follows:

Table 15.18 Revenue Increase of WASA

	2018	2021	2026	2031	2035
Served Population (Million)	6.4	6.4	6.4	6.4	6.4
UFW	29.8%	29.8%	29.8%	29.8%	29.8%
Accounted Population (Million)	4.5	4.5	4.5	4.5	4.5
Increase in Accounted Population from 2017 (Million)	0.16	0.16	0.16	0.16	0.16
Per Capita Water Supply (10^3m^3.)	0.0002072	0.0002	0.000188	0.000174	0.000164
Water Price (10^3m^3.)	12,550.4	11,700.5	12,106.0	11,146.1	11,146.1
Working Level of Facilities	85.3%	89.8%	94.3%	97.7%	100.0%
Revenue Increase (Rp. Million)	129.4	122.5	125.2	110.6	106.6
Revenue Increase (JPY Million)	163.1	154.4	157.7	139.3	134.3

Note: 1) In order to eliminate the effect of increase in coverage, "Served Population" is kept constant from 2016.
2) "Working Level of Facilities": As the facilities works at the level less than their full capacity before 2035, the benefits are assumed to come about pro rata such level.

3) Calculation Result

FIRR is calculated at -18.2%. Detailed calculation is shown in **Appendix 15.7**.

FIRR of the water supply component in the combined components is calculated as follows:

Table 15.19 FIRR of Water Supply Component in Combined Components

Combination	EIRR of Water Supply Component[1)]
Original	-18.2%
Option 1	-22.0%[2)]
Option 2	-18.6%[2)]

Note: 1) Installation of chlorinators is excluded from the calculation.
2) The reason why the FIRR decreases is the increase of the cost share of the management component.

15.3 Cash Flow Analysis

WASA prepares a Profit and Loss Statement (P/L) for every fiscal year. Based on the P/L, a cash flow table was developed by the JICA Study Team.

15.3.1 Past Trends of the Cash Flow

The trends of cash flow was examined for the last ten years. Most of the past net cash flows were negative except for one fiscal year. (Note: Depreciation is offset from the viewpoint of cash flow analysis because it is a matter of bookkeeping and it is retained internally.)

Table 15.20 Cash Flow (2000/01 - 2009/10)

(Unit: Rs. Million)

	Actual 2000/01	Actual 2001/02	Actual 2002/03	Actual 2003/04	Actual 2004/05	Actual 2005/06	Actual 2006/07	Actual 2007/08	Actual 2008/09	Estimate 2009/10
CASH INFLOW:										
OPERATION										
WATER										
Sales	599	674	692	727	975	951	982	1,017	1,013	1,057
Connection fee	2	2	2	3	3	3	3	3	3	3
SEWERAGE										
Sales	381	434	445	458	651	637	654	680	743	775
Connection fee	6	3	6	7	5	4	3	3	5	5
PROPERTY TAX SHARE	235	237	321	285	242	311	289	410	403	405
AQUIFER FEE	28	25	21	34	51	20	0	0	0	0
OTHER	22	40	26	38	38	44	78	75	32	34
OPERATION TOTAL	1,273	1,415	1,513	1,552	1,965	1,970	2,009	2,188	2,199	2,279
INTEREST INCOME	12	37	41	47	47	70	117	192	202	145
OTHER INCOME	22	40	26	38	38	44	78	75	32	34
CASH INFLOW TOTAL	1,307	1,492	1,580	1,637	2,050	2,084	2,204	2,455	2,433	2,458
CASH OUTFLOW:										
OPERATION										
Salaries and wages	271	296	303	377	435	528	669	794	966	1,189
Repairs and Maintenance	121	103	141	176	223	314	406	538	645	765
Fuel and Power	695	701	836	992	1,013	1,067	1,124	1,193	1,549	1,692
Other Expenses	61	72	100	115	141	75	89	95	97	119
Allowances for Uncollectibles	69	82	82	26	46	48	49	51	55	56
OPERATION TOTAL	1,217	1,254	1,462	1,686	1,858	2,032	2,337	2,671	3,312	3,821
DEBT SERVICE	392	478	434	529	539	554	0	0	0	0
CASH OUTFLOW TOTAL	1,609	1,732	1,896	2,215	2,397	2,586	2,337	2,671	3,312	3,821
NET CASH FLOW	-303	-240	-316	-578	-347	-502	-133	-216	-879	-1,363

Source: WASA

[Notes on the Cash Flow]

(1) "Property Tax Share" is a subsidy from the Government of the Punjab Province. Its is precisely the same as the U.I.P Tax (Urban Immovable Property Tax), which is collected by the Excise Department, Government of Punjab. The amount collected by the Excise Department is distributed to WASA, Lahore Development Authority (LDA) for road drainage and City District Government of Lahore (CDGL) for solid waste management in accordance with the ratios of 50%, 25% and 25% respectively after deducting 15% department charges.

(2) The tariff rates were increased in 2004/05.

(3) "Aquifer Fee" is a charge for a ground water taken from the user's own land. As the courts ruled that it was illegal, it has been withdrawn since 2006/07.

(4) WASA had borne the payment for the interests on loans. The Government of Punjab decided that WASA was exempted from the interest payment in 2006/07.

Main items of the cash inflow are "Water Sales" and "Sewerage Sales." They have been increasing steadily, which can be approximated in a linear formula ($y = ax + b$). The gap seen in 2004/05 was the result of the tariff rate increase.

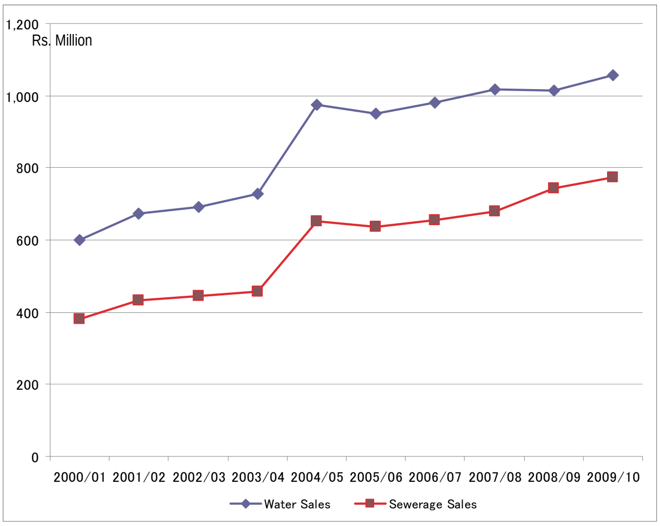
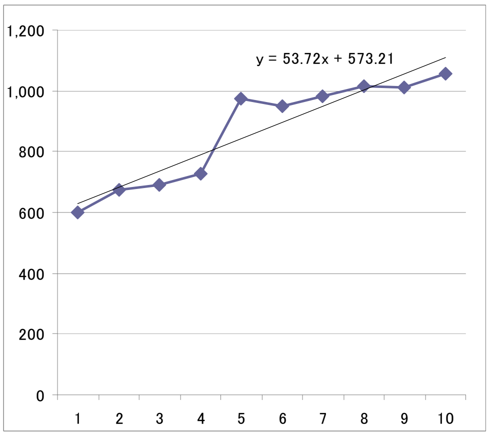
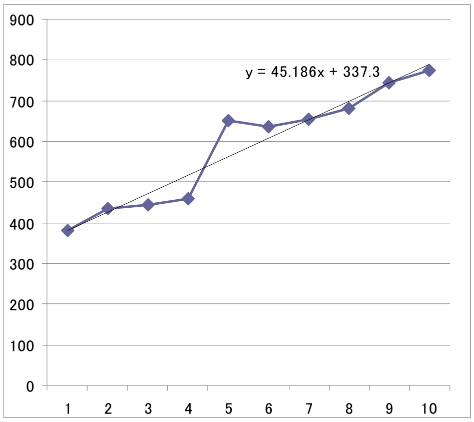


Figure 15.1 Water and Sewerage Sales



Note: 1) *x*: fiscal year, *y*: Rs. Million
2) Fiscal year is converted as follows: 2000/01 = 1, 2001/02 = 2, ..., 2009/10 = 10

Figure 15.2 Approximation of Water Sales graphed in a Linear Form



Note: 1) *x*: fiscal year, *y*: Rs. Million
2) Fiscal year is converted as follows: 2000/01 = 1, 2001/02 = 2, ..., 2009/10 = 10

Figure 15.3 Approximation of Sewerage Sales graphed in a Linear Form

On the other hand, main items of the cash outflow are "Salaries and Wages", " Repairs and Maintenance" and "Fuel and Power." The first two items have been increasing sharply, and can be approximated by an exponential formula ($y = ae^{bx}$).

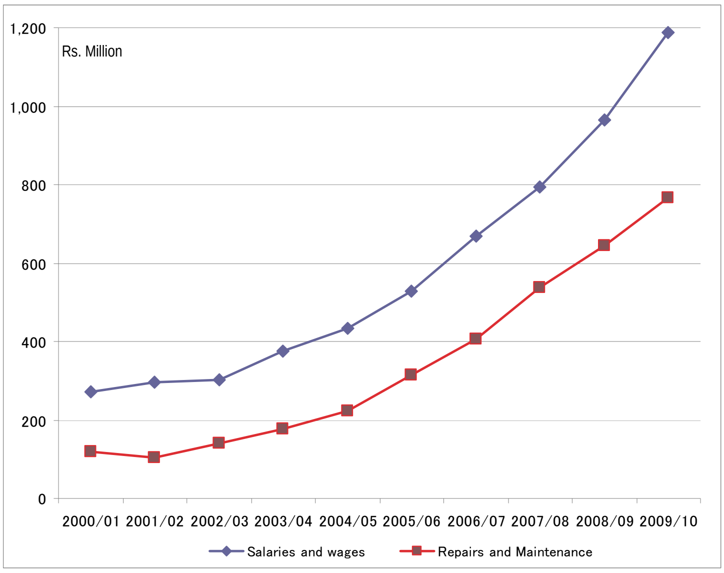
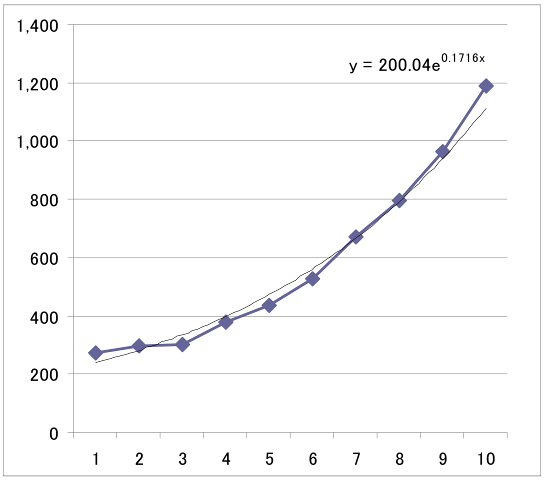


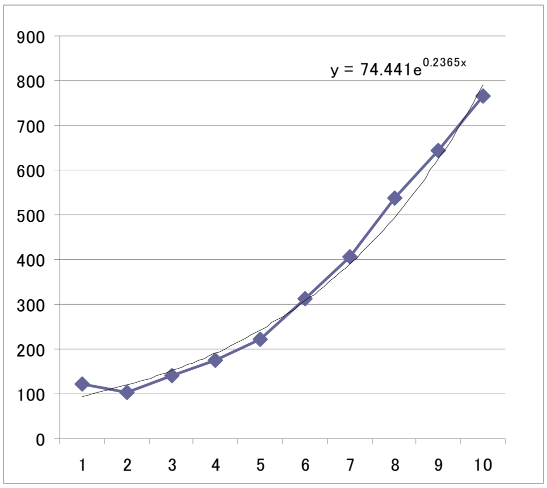
Figure 15.4 Expenses for Salaries and Wages, and Repairs and Maintenance



Note: 1) *x*: fiscal year, *y*: Rs. Million

2) Fiscal year is converted as follows: 2000/01 = 1, 2001/02 = 2, ..., 2009/10 = 10

Figure 15.5 Approximation of Salaries and Wages in Exponential Form



Note: 1) *x*: fiscal year, *y*: Rs. Million
2) Fiscal year is converted as follows: 2000/01 = 1, 2001/02 = 2, ..., 2009/10 = 10

Figure 15.6 Approximation of Repairs and Maintenance in Exponential Form

Further, the third item ("fuel and power") has been increasing steadily and increased dramatically around 2003/04 and also the last couple of years due to inflation in the Pakistani economy. This item is sensitive to inflation. The recent inflationary trend is expected to continue for the next several years.

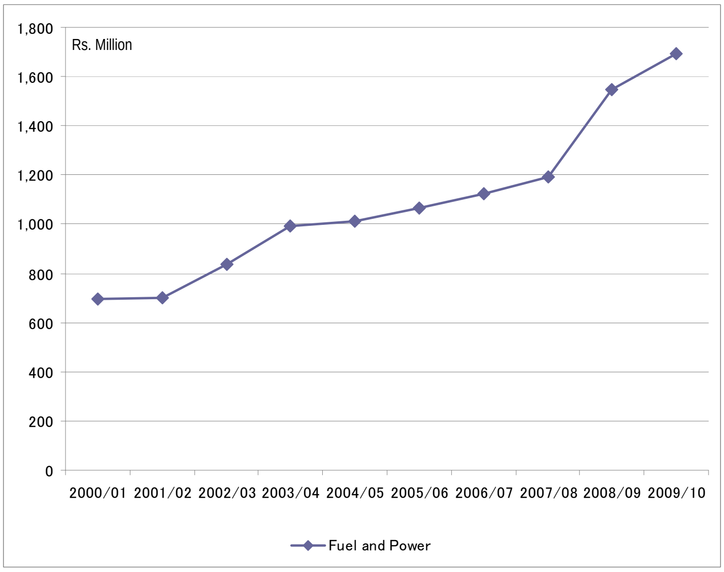


Figure 15.7 Expenses for Fuel and Power

Based on the observation of the past trends in the cash flow, it is evident that there is a *disparity between the speed of increase in cash outflow and that in cash inflow*, hence the negative cash flow of WASA's finances is structural. Human resource management as well as repair and maintenance work needs increased efficiencies and the tariff rates should be more flexible to keep up with the inflationary trend.

15.3.2 Cash Flow Projection

Using the trend of the cash flows for last ten years, future cash flows for next five years have been projected.

Table 15.21 Cash Flow (2010/11 - 2014/15)

(Unit: Rs. Million)

	Projection 2010/11	Projection 2011/12	Projection 2012/13	Projection 2013/14	Projection 2014/15
CASH INFLOW:					
OPERATION					
WATER					
Water Sales	1,164	1,218	1,272	1,325	1,379
Water Connection fee	3	3	3	3	3
SEWERAGE					
Sewerage Sales	834	880	925	970	1,015
Sewerage Connection fee	5	5	5	5	5
PROPERTY TAX SHARE	417	430	443	456	470
AQUIFER FEE	0	0	0	0	0
OTHER	34	34	34	34	34
OPERATION TOTAL	2,457	2,569	2,681	2,793	2,906
INTEREST INCOME	145	145	145	145	145
OTHER INCOME	34	34	34	34	34
CASH INFLOW TOTAL	2,636	2,748	2,860	2,972	3,085
CASH OUTFLOW:					
OPERATION					
Salaries and wages	1,321	1,568	1,862	2,210	2,624
Repairs and Maintenance	1,004	1,272	1,611	2,041	2,585
Fuel and Power	1,861	2,047	2,252	2,477	2,725
Other Expenses	131	144	158	174	192
Allowances for Uncollectibles	59	62	65	68	71
OPERATION TOTAL	4,376	5,093	5,948	6,971	8,197
DEBT SERVICE	0	0	0	0	0
CASH OUTFLOW TOTAL	4,376	5,093	5,948	6,971	8,197
NET CASH FLOW	-1,739	-2,344	-3,088	-3,998	-5,112

Source: WASA and JICA Study Team

[Assumptions for the Projection]

(1) "Water Sales," "Sewerage Sales," "Salaries and Wages," and "Repairs and Maintenance" are projected using the trends in the last ten years.

(2) "Fuel and Power" is assumed to increase by 10% annually, which is the projection made by WASA, considering future inflation and increases in infrastructure that need to be maintained by WASA.

(3) "Property Tax Share" is as projected by WASA.

(4) Items other than those mentioned above are assumed to remain constant.

The projection results show that negative net cash flow increases steadily to 2.7 times, which exceeds the cash inflow from 2012/13. The requirement is to introduce a new tariff system and an efficient management system.

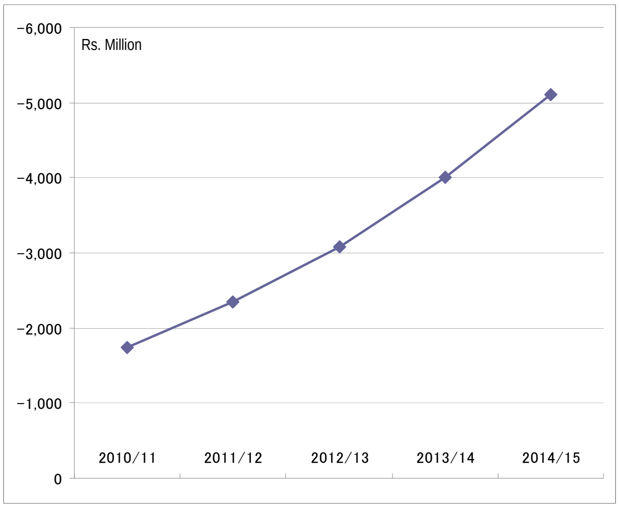


Figure 15.8 Projection of Net (Negative) Cash Inflow

[Note on Cash Flow Projection beyond Fiscal Year 2014/15]
Projections on financial matters beyond 5 years should contain various uncertain factors such as inflation rates. It is not appropriate to make a projection for a long time period if you want to avoid misleading. Projections until 2035 are made for cash flow for household use with various assumptions based on insubstantial grounds such as exclusion of inflation factors. Please refer to **15.3.3 Calculation of Water and Sewerage Price for Households** for such projections.

15.3.3 Calculation of Water and Sewerage Price for Households

Prices of Water and sewerage for households are calculated with the following assumptions:

[Assumptions for the Calculation]

(1) Prices are set to just cover the costs both with existing facilities and those to be installed in the proposed projects. They are set from 2011 and revised at every five years.
(2) Costs with existing facilities are those projected above. After 2015, they are kept constant, which means there will be no other projects other than the proposed projects.
(3) Costs with the facilities with the proposed projects include (a) operation and maintenance, (b) replacement, (c) loan (repayment and interest) and (d) non-eligible costs. Inflation factor is not included.
(4) Loan conditions are as follows:

Component	Interest Rate	Repayment Period	Grace Period
Consulting	0.01%	30 years	10 years
Water Supply	1.40%	30 years	10 years
Sewerage and Drainage	0.65%	40 years	10 years
Institutional Improvement	1.40%	30 years	10 years

(5) Costs for commercial use (16%) and public use (1%) are excluded from water price. Costs for commercial use (16%) and that for public use (1%) and that for cantonment areas (6.15%) are excluded from sewerage price. Cost for drainage is excluded from the prices with the consideration that it should be borne by the government budget.

(6) Cost for the management component is shared by other components pro rata cost amount.

(7) Sewerage cost is shared by all the users with the consideration that the price should be kept low and simplified as much as possible.

The calculation results are as follows:

Table 15.22 Water and Sewerage Price for Households (Original)

	2011	2016	2021	2026	2031
Total Cost for Household Use (Rs. Million)	3,391.7	8,615.1	7,105.0	7,795.0	7,950.2
Water Price (Rs./10^3m^3)	7,267.0	13,516.8	11,762.5	11,724.1	11,363.5
Water Price per Capita (Rs./day)	1.6	2.9	2.4	2.2	2.0
Affordability for Water (Rs./day)	4.5	5.3	6.3	7.5	8.9
Water Price for 5 Year Average (Rs./10^3m^3)	10,052.0	12,550.4	11,700.5	12,106.0	11,146.1
Sewerage Price (Rs./10^3m^3)	2,493.5	8,967.5	5,643.2	6,855.9	6,848.1
Sewerage Price per Capita (Rs./day)	0.6	1.9	1.1	1.3	1.2
Affordability for Sewerage (Rs./day)	1.1	1.3	1.6	1.9	2.2
Sewerage Price for 5 Year Average (Rs./10^3m^3)	6,085.4	6,790.8	5,954.5	6,963.2	6,907.7

Table 15.23 Water and Sewerage Price for Households (Option 1)

	2011	2016	2021	2026	2031
Total Cost for Household Use (Rs. Million)	3,391.7	8,070.8	6,848.1	7,357.8	7,481.7
Water Price (Rs./10^3m^3)	7,267.0	13,675.9	11,765.2	11,733.0	11,377.2
Water Price per Capita (Rs./day)	1.6	2.9	2.4	2.2	2.0
Affordability for Water (Rs./day)	4.5	5.3	6.3	7.5	8.9
Water Price for 5 Year Average (Rs./10^3m^3)	10,052.9	12,613.5	11,703.8	12,119.0	11,159.0
Sewerage Price (Rs./10^3m^3)	2,493.5	7,387.8	5,011.2	5,804.9	5,761.3
Sewerage Price per Capita (Rs./day)	0.6	1.6	1.0	1.1	1.0
Affordability for Sewerage (Rs./day)	1.1	1.3	1.6	1.9	2.2
Sewerage Price for 5 Year Average (Rs./10^3m^3)	5,099.8	5,850.5	5,210.9	5,862.0	5,843.4

Table 15.24 Water and Sewerage Price for Households (Option 2)

	2011	2016	2021	2026	2031
Total Cost for Household Use (Rs. Million)	3,391.7	7,343.7	6,580.7	6,894.3	6,981.5
Water Price (Rs./10^3m^3)	7,267.0	13,628.4	11,767.9	11,741.6	11,389.3
Water Price per Capita (Rs./day)	1.6	2.9	2.4	2.2	2.0
Affordability for Water (Rs./day)	4.5	5.3	6.3	7.5	8.9
Water Price for 5 Year Average (Rs./10^3m^3)	10,052.6	12,594.6	11,707.0	12,130.7	11,170.5
Sewerage Price (Rs./10^3m^3)	2,493.5	5,537.8	4,353.4	4,691.4	4,603.4
Sewerage Price per Capita (Rs./day)	0.6	1.2	0.9	0.9	0.8
Affordability for Sewerage (Rs./day)	1.1	1.3	1.6	1.9	2.2
Sewerage Price for 5 Year Average (Rs./10^3m^3)	4,062.7	4,811.7	4,441.4	4,696.3	4,711.5

Detailed calculation is shown in **Appendix 15.8 - 15.10**.

According to the present tariff rate for metered connections for households, the water and sewerage prices are Rs. 12.88 per 1,000 Gallons or Rs. 2,833.0 per 1,000 m^3 and Rs. 1,983.1 per 1,000 m^3 respectively. Thus, in order to implement the new price smoothly, the price should be increased gradually in the first five years as follows:

Table 15.25 Gradual Installation of New Water and Sewerage Prices (Original)

	2011	2012	2013	2014	2015
Water Price (Rs./10^3m^3)	4,452.6	6,072.1	7,691.7	9,311.3	10,930.8
Sewerage Price (Rs./103m3)	2,784.4	3,585.7	4,386.9	5,188.2	5,989.5

Table 15.26 Gradual Installation of New Water and Sewerage Prices (Option 1)

	2011	2012	2013	2014	2015
Water Price (Rs./10^3m^3)	4,463.1	6,093.2	7,723.2	9,353.3	10,983.4
Sewerage Price (Rs./103m3)	2,627.7	3,272.2	3,916.8	4,561.4	5,206.0

Table 15.27 Gradual Installation of New Water and Sewerage Prices (Option 2)

	2011	2012	2013	2014	2015
Water Price (Rs./10^3m^3)	4,459.9	6,086.9	7,713.8	9,340.7	10,967.7
Sewerage Price (Rs./103m3)	2,454.5	2,926.0	3,397.4	3,868.8	4,340.2

The net cash flow for household use of each case is shown below:

Table 15.28 Cash Flow of Household Use (Original)

(Unit: Rs. Million)

	2011	2016	2021	2026	2031	2035
Cash Inflow	1,674	7,411	7,207	8,000	7,881	8,188
Cash Outflow	3,391.7	8,615.1	7,105.0	7,795.0	7,950.2	7,936.7
Net Cash Flow	-1,718.2	-1,204.3	101.7	205.2	-68.9	251.6

Table 15.29 Cash Flow of Household Use (Option 1)

(Unit: Rs. Million)

	2011	2016	2021	2026	2031	2035
Cash Inflow	1,674	7,075	6,905	7,544	7,422	7,711
Cash Outflow	3,391.7	8,070.8	6,848.1	7,357.8	7,481.7	7,469.9
Net Cash Flow	-1,718.2	-996.1	56.4	185.9	-59.4	241.6

Table 15.30 Cash Flow of Household Use (Option 2)

(Unit: Rs. Million)

	2011	2016	2021	2026	2031	2035
Cash Inflow	1,674	6,669	6,592	7,060	6,933	7,203
Cash Outflow	3,391.7	7,343.7	6,580.7	6,894.3	6,981.5	6,971.2
Net Cash Flow	-1,718.2	-674.3	11.1	165.3	-48.3	232.1

Detailed calculation is shown in **Appendix 15.11 - 15.13**.

15.4 Tariff Revision

15.4.1 Water Tariff

(1) Goals of the Tariff Revision

According to ADB's research paper, *Setting User Charges for Urban Water Supply, June 2006*, tariffs should at the very least try to meet the five goals, of 1) good governance, 2) financial sustainability, 3) distributive justice, 4) economic efficiency and 5) fair pricing. Each of these goals will be reviewed and their application to WASA's case examined below.

1) Good Governance

Tariffs should be simple, transparent and predictable. These are necessary if users are to accept the tariff change smoothly. Also changes should be announced well before they take place, and major changes should be introduced gradually.

2) Financial Sustainability

Water utilities should be financially independent and sustainable, be supported by tariff revenues, and their financial obligations be forecast based on cash needs. In the event that the water supply business makes a deficit, such a loss would finally have to be made up by governmental subsidy whose source is from taxes levied on all the people. As a result, costs of water supply would not be allocated on the basis of the benefit received. Consequently, people would perceive cost allocations to be unfair. On the other hand, if such governmental subsidy were to be expected, there would be no incentive for efficient business operation. Thus, governmental subsidy should be avoided as much as possible (short-term sustainability).

In addition, water utilities require large amounts of capital investment so that the business should be operated from a long-term point of view to fulfill the needs of users in both a timely and appropriate manner. Such long-term sustainability also should be taken into consideration during tariff setting.

3) Distributive Justice

Water supply is typically one of the most basic needs to sustain life and no other commodity can substitute the function of water. Thus, from primarily a viewpoint of justice support should be extended to help the poor in accessing water to the extent where they can sustain their lives. ADB encourages using "lifeline tariffs or a low charge to the meet the basic needs for water, with a usage charge above that of the basic needs set on other criteria. While ADB does not detail the level of support, World Bank presented the benchmark for the affordability of households as 4% of their disposable income and UNDP's *Human Development Report 2006* concluded that "no household has to spend more than 3% of its income to meet its water needs."

4) Economic Efficiency

Ideally, water should be supplied at least cost and without losses yielding maximum satisfaction to the society, where the resource is being utilized. Although standard economic theory concludes that prices decided in the competitive market are the most efficient ones, water supply is usually a monopolized business in order to derive scales of economy as it requires a huge capital investments. Thus, some schemes should be devised to realize production at least cost.

5) Fair Pricing

The meaning of fairness is vague and ADB does not have an explicit position on fairness. Formally, fairness can be deemed as a benefit principle where everyone should pay the cost with which water is supplied to himself/herself. From this point of view alone, tariff with cross-subsidy from the poor to the rich, which is the goal of distributive justice, cannot be justified. Thus, fairness should find some compromise to realize distributive justice. In this case, the government is required to persuade relatively rich users to accept distributive justice.

(2) Pricing Methods

Several methods are proposed and applied to pricing water supply services. Typical ones are discussed below. Those methods, except Cost Coverage, have been devised to promote economic efficiency of the services in the privatization of industry, whose market is characterized as a natural monopoly in economics.

1) Cost Coverage

Price is decided for total revenue based on the principle that such price will cover the total cost of water supply services and necessary capital costs to keep the business sustainable. In the case of the privatized companies, a reasonable profit is included into the price. This method is employed by Japanese water utilities, which are owned and operated by local governments. This idea is very simple to understand and any information gap posing an obstacle to deciding the pricing is small for governmental companies, which are supervised and required to report detailed business results to the government. The largest shortcoming of this method is that the operating body has little incentive internally to improve efficiency of the business as the "essential" costs are automatically covered.

2) Yard Stick

Pricing is decided by referring to the business results of other companies with similar characteristics in the industry. In this method, a company's business result is compared with those of other similar companies. If a company reduces its operational costs more than other companies, it will reap the rewards of increasing profit, which in turn promotes business efficiency. In Japan, each water company is classified by its coverage size and its business result is evaluated in comparison with other companies belonging to the same class in order to make up the shortcomings in the cost coverage method.

This method also has its own shortcomings, namely:

- A company is sometimes constrained by its special geographic conditions. Differences due to such conditions which include demand density and revenue structure cannot necessarily be overcome by a company's business efforts;
- Each company has a motivation to conspire with other companies in exaggerating its costs; and
- If the actual price implied by the profit differs by a huge amount from prices set by the government, it may cause a distortion of resource allocation.

3) Price Cap Regulation

Price increases are restricted by an index which is outside of the control of the company. The index used in the price cap regulation is normally a common price index such as CPI (consumer price index). This method is formulated as follows:

$$M_t = p_{t-1} + p_{t-1}\left(\frac{\Delta I}{I} - X + Q\right)$$

where,

M_t	:	Price cap in year *t*
P_{t-1}	:	Price in year *t*-1
I	:	Price index
$\frac{\Delta I}{I}$	:	Inflation rate (%)
X	:	Efficiency improvement factor (%) set by the government
Q	:	Upward cost for quality improvement (%) set by the government

A company can decide the price at any level within the cap. -*X* is the pressure posed to the company, requiring efforts to improve efficiency. +*Q* represents the cost increase due to improvement of service quality including its service coverage (Factors *X* and *Q* are normally revised every 5 years). This method does not require detailed financial information, which takes time and money, once the formula is decided on so that the company can, in a timely manner, set the price by itself. Thus any cost savings in excess of *X* can be retained by the company as profits. If the cap is revised frequently and is closely related to the cost of services, this method becomes very similar to the cost coverage method.

15.4.2 Sewerage Tariff

Presently, in principle, sewerage charge is set at 70% of water supply. As meters for sewerage are not installed, it is a simple and practical that the volume of water supplied is assumed to be that of wastewater discharge. Thus, the appropriateness of the figure "70%" should be examined. The percentage of the sewerage cost to the water supply cost has been around 30% for the last 5 years in WASA. See **Table 15.31.**

Further, World Bank has presented the benchmark for the affordability of households as 4% of their disposable income for water supply and 1% for sewerage. This can be interpreted from the viewpoint that the percentage of sewerage expenditure to that of water supply is assumed to be 25%. Therefore, the present figure 70% can be deemed too high from the viewpoint of the benefit principle. Also it can still be too high from the viewpoint of the affordability benchmark (if water supply charges are set at the affordability benchmark).

Table 15.31 Operating Costs of WASA

(Unit: million Rupees)

	2004/05	2005/06	2006/07	2007/08	2008/09
Water Supply	1,278.595	1,380.614	1,595.831	1,748.300	2,069.704
Sewerage	325.813	383.302	449.668	530.190	633.435
Drainage	150.387	176.922	207.555	244.722	292.377
% of Sewerage to Water Supply	25.48%	27.76%	28.18%	30.33%	30.61%

Note: 1) Water supply and sewerage cost for public facilities are excluded. They amount to 1 % of the total costs respectively.
2) Sewerage cost for the wastewater drained from the cantonment area is excluded. It amounts to 6.15 % of the total costs.
3) Costs of sewerage and drainage are not recorded separately. They are divided into 70% and 30% respectively.

Source: WASA

15.4.3 Recommendations

(1) Water Supply Tariff

Based on the considerations given before, it can be recommended that the water tariff for households be revised according to the following policy:

Price of water supply is regulated and managed by price-cap regulation method to cover necessary operating costs with due consideration of affordability for the households and "lifeline tariff" for the poor.

The implications of this policy are explained stepwise below.

1) Price-cap regulation method to cover necessary operating costs

Firstly, the water tariff is decided by price cap regulation, where price set based on CPI, efficiency improvement factor (-*X*) and cost for quality improvement (+*Q*). Factors -*X* and +*Q* are decided by the government of Punjab and City District Government of Lahore (CDGL) considering the financial conditions of WASA and similar water utilities in other cities and revised every 5 years. WASA can increase the charge rates within the cap.

2) Considerations of affordability by households

Secondly, if the expenditure for water supply of each household implied by the charge rate decided by WASA in 1) exceeds the affordability of the household, the charge rate is reduced to an appropriate level so that this expenditure of the household is within its affordability. It will also be decided by the government of Punjab and City District Government of Lahore (CDGL) and revised every 5 years.

Affordable charge rate for the households is estimated as follows:

(a) Income and water consumption of households are surveyed using sufficient samples every 5 years.
(b) Correlation of income and water consumption of these households is estimated with the survey data in (a).
(c) The income of households consuming at the lower limit of the charge bracket is identified by using the results of (b).
(d) A certain percent of the income identified in (c) is set assuming the affordability of the households consuming at the lower limit of the charge bracket. (e.g. 4% of disposable income indicated by World Bank.)
(e) The affordable expenditure divided by the lower limit is set for the price rate of water supply for the charge bracket.
(f) For the lowest charge bracket, a certain point lower than the upper limit is employed (named the "Least Point").
(g) "Lifeline tariff" is applied to the households consuming less than the Least Point.

3) Considering "lifeline tariff"

"Lifeline tariff" is set at very low or is free of charge from the viewpoint of attaining the goal of distributive justice. For example, Cebu Water, Philippines applies this policy by offering 10 m^3 per month at no usage charge, according to ADB's research paper, *Setting User Charges for Urban Water Supply, June 2006*.

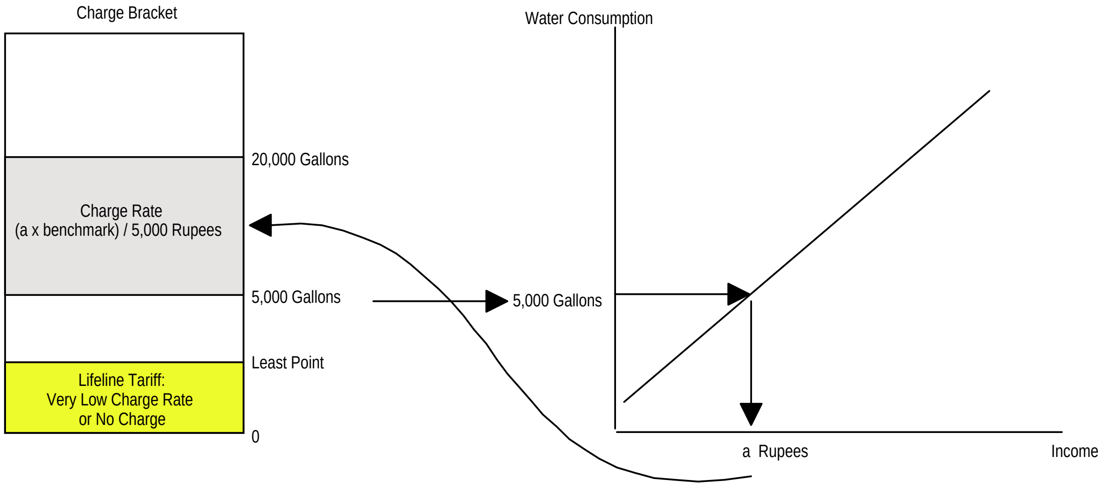


Figure 15.9 Estimation of Affordable Charge Rate for Households

(2) Sewerage Tariff

It is important to keep in view the users for keeping the sewerage tariff at 70% of the water supply tariff. If this reduction of the percentage is difficult for the reason of revenue shortage, the increase in the charge of the lowest bracket should be postponed for a certain period because the charge for the lowest bracket is assumed to be that applied to the poorest households.

(3) Actual Application of Price Cap Regulation

At this moment, actual application of Price Cap Regulation has to be based on various assumptions with less reliability. To avoid that such figures will got out of control, the calculation for actual application of price-cap regulation shall be conducted by the JICA expert in the subsequent technical assistance through the discussion with persons concerned in the provincial government and CDGL.

CHAPTER 16 ENVIRONMENTAL & SOCIAL CONSIDERATIONS

16.1 Review of Statute Framework on Environment and Social Aspects

16.1.1 Relevant Ordinance, Strategy, Policy and Action Plan

Table 16.1 summarizes relevant statute including ordinance, strategy, policy, and action plan on environment and social aspects in Pakistan.

Table 16.1 Relevant Ordinance, Strategy Policy and Action Plan on Environment & Social Aspect

Title	Year	Outline
Pakistan Environmental Protection Ordinance (PEPO)	1983	The Pakistan Environmental Protection Ordinance (PEPO), 1983 was the first piece of legislation designed specifically for the protection of the environment. In 1984, the promulgation of PEPO was followed by the establishment of the Pakistan Environmental Protection Agency, the primary government institution dealing with environmental issues.
National Conservation Strategy (NCS)	1992	Pakistan National Conservation Strategy (NCS) is the principal policy document that deals with the core environmental issues in Pakistan at macro level and recommends an action plan to address these issues. NCS works on a ten-year planning and implementation cycle. Based on NCS, policies are being framed for institutional strengthening and human resource development for environmental protection, especially at the local and provincial level. However, project specific mitigation prescriptions cannot be expected in the NCS document, the principles of environment protection, conservation and management provided in the NCS document have to be used as guidelines during the planning and execution of projects.
Biodiversity Action Plan (BAP)	1992	As a signatory to the Convention on Biological Diversity in 1992, it was also felt necessary for Pakistan to develop a national strategy for the conservation of biodiversity. Accordingly, the Government of Pakistan constituted a Biodiversity Working Group, under the auspices of the Ministry of Environment, to develop a Biodiversity Action Plan (BAP) for the country, which was completed after an extensive consultative process. The plan, which has been designed to complement NCS and the proposed provincial conservation strategies, identifies the causes of biodiversity loss in Pakistan and suggests a series of proposals for action to conserve biodiversity in the country. PEPC has approved the action plan and steering committees at federal and provincial levels have been formed to implement it. BAP recognizes that an EIA at project level is used as a tool to identify environmental impacts of a proposed project and to plan for reducing adverse impacts. BAP further stipulates that an EIA should be initiated at an early stage in project development cycle and that public participation in the review of potential effects is important.
National Environmental Policy	2005	The National Environmental Policy (NEP) provides an over reaching framework for addressing the environmental issues facing Pakistan, particularly pollution of fresh water bodies and coastal waters, air pollution, lack of proper waste management, deforestation, loss of biodiversity, desertification, natural disasters and climate change. It also provides directions for addressing the cross-sectoral issues as well the underlying causes of environmental degradation and meeting international obligations. NEP, while recognizing the goals and objectives of National Conservation Strategy (NCS), National Environmental Plan and other existing environment related national policies, strategies and action plans, provides broad guidelines to the Federal Government, Provincial Governments, Federally Administrated Territories and Local Governments for addressing environmental concerns and ensuring effective management of their environmental resources. The Provincial, AJK (Azad Jammu and Kashmir), Northern Areas and Local Governments, however, may devise their own strategies, plans and programmes in pursuit of this policy. 1) NEP aims to protect, conserve and restore Pakistan's environment in order to improve the quality of life of citizens through sustainable development. 2) The objectives of the Policy include; ・ Conservation, restoration and efficient management of environmental resources. ・ Integration of environmental considerations in policy making and planning processes. ・ Capacity building of government agencies and other stakeholders at all levels for better environmental management. ・ Meeting international obligations effectively in line with the national aspirations. ・ Creation of demand for environment through mass awareness and community mobilization.

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16.1.2 Relevant Act, Regulation and Rule

Table 16.2 summarizes relevant acts, regulations and rules on environment and social aspects in Pakistan.

Table 16.2 Relevant Act, Regulation and Rule on Environment & Social Aspect

Title	Year	Outline
The Land Acquisition Act	1894	The Land Acquisition Act (1894) deals with the acquisition of private properties for public purposes including large development projects like major roads. There are 55 sections in this Act mainly dealing with area notifications, surveys, acquisition, compensation, apportionment awards, disputes resolution, penalties and exemptions. This law is for the acquisition of land needed for public purposes and for companies and for determining the amount of compensation to be made on account of such acquisition.
Mines Act	1923	This Act, originally adopted by the Government of (British) India in 1923, consolidates and amends the law relating to the regulation and inspection of mines. All valid amendments to 1981 are included. Contents include: role of the Chief Inspector of Mines and of Inspectors; operation and management of mines; provisions as to health and safety (powers of Inspectors in the case of dangers arising to mine workers; accident reports; notice of occupational accidents; accident investigation); working hours; employment of women (prohibited in underground work) and children (absolutely prohibited to work in mines); restrictions of work for young persons; leaves and holidays; scope of Regulations that can be issued under the Act.
The Forest Act	1927	It is advantageous to consolidate the law relating to forests, the transit of forest-produce and the duty levy able on timber and other forest-produce. This Act prescribed the frame and enforce plans providing for the improvement, development and exploitation of forests and maintain, plan and work forests in accordance with such plans.
Gas Cylinder Rules	1940	The Gas Cylinders Rules were first published in 1940 after Govt. of India Notification No. M-1272 (1), dated 28th September, 1938 declaring any gas when contained in any metal container in a compressed or liquefied state to be an explosive within the meaning of Explosives Act, 1884. The above rules were replaced by the Gas Cylinders Rules, 1981, after a comprehensive review in the light of the development of the gas industry after independence. Eighties & Nineties witnessed massive expansion in the gas and related industries triggered by economical liberalization and globalization, use of LPG as industrial and domestic fuel, introduction of CNG and LPG as environmental friendly automotive fuels, entry of new technologies, etc, which necessitating another round of review and bringing out the new Gas Cylinders Rules, 2004.
Explosive Rules	1940	The Explosives Act, 1884 had already been promulgated and subsequently the Explosives Rules, 1918 were framed. Those Acts and Rules were subsequently amended/repealed by Explosives Rules, 1940. The explosive Rules, 1940 deal with condensed explosives and ensure public safety and security of the country owing to hazards arising from fire and explosion during manufacture, storage, and transportation etc. of such hazardous substances.
Regulation of Mines and Oil Fields and Mineral Development Act	1948	This legislation provides regulatory procedures for the quarrying and mining of construction material from state-owned as well as private land.
West Pakistan Land Reforms Rules	1959	These rules may be called as the West Pakistan Land reforms Rules, 1959. They extend to all the areas to which the West Pakistan Land Reforms Regulation extends, except the Federal capital and they come into force at once. These rules explains the powers of Chief Land Commissioner and of the Officers and proceeding it further, explain the procedure for appeal, review and revision.
Natural Gas Safety Rules	1960	These rules cover the use of gas distributed by Metropolitan Utilities District, and the installation of mains, services, meters, piping and appliances. Then these rules explain the general conditions and applications for the use of natural gas. These rules also give some of the liabilities for meters, regulators, services and for the occupational safety of the persons
West Pakistan Wildlife Protection Act	1975	It extends to the whole of the North West Frontier Province, except the tribal areas and come into force at once. It consolidates the law relating to protection, conservation, preservation and management of wildlife in the North-West Frontier Province. For the protection of wildlife, it does not authorise any person hunt in the reserved or protected forest or protected waste land. Overall, it depicts some of the points and gives solution for the protection and conservation of the wildlife.

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Table 16.2 Relevant Act, Regulation and Rule on Environment & Social Aspect (Continued)

Title	Year	Outline
Antiquities Act	1975	The Antiquities Act of 1975 ensures the protection of cultural resources in Pakistan. The act is designed to protect "antiquities" from destruction, theft, negligence, unlawful excavation, trade and export. Antiquities have been defined in the Act as ancient products of human activity, historical sites, or sites of anthropological or cultural interest, national monuments etc. The Act prohibits new construction in the proximity of a protected antiquity and empowers the Government of Pakistan to prohibit excavation in any area, which may contain articles of archaeological significance. The guideline on procedure for Environment Assessment recommended by Pakistan EPA reads as follows: ・ If the proponent or the consultant identifies an archaeological site that appears to be of importance but the site is not listed they should discuss the site with the Federal Department of Archaeology and Museum. ・ The relevant conservation authority should inform the Responsible Authority (EPD in Punjab) of their assessment of the significance of likely impact of the proposed development early in the process in order for the Responsible Authority to determine the level of documentation required. ・ The EPA will then be in a position to review the level of reporting required in the light of advice from the Federal Department of Archaeology and Museum". ・ The Federal Department of Archaeology and Museum, Government of Pakistan is the sole custodian of all articles of archaeological finds and historical heritage.
Pakistan Environmental Protection Act (PEPA)	1997	A comprehensive legislation was evolved over-time to prepare and implement the National environmental policies. It is entitled as "the Pakistan Environmental Protection Act (PEPA) 1997" which was enacted repealing PEPO. PEPA provides the framework as shown in; ・ Implementation of NCS ・ Protection and conservation of species, wildlife habitats and biodiversity ・ Conservation of renewable resources ・ Establishment of standards for the quality of the ambient air, water and land ・ Establishment of Environmental Tribunals ・ Appointment of Environmental Magistrates ・ Initial Environmental Examinations (IEE) ・ Environmental Impact Assessments (EIA), and ・ Promotion of public education and awareness of environmental issues through mass media In addition, PEPA is the basic legislative tool empowering the Government to frame regulations for the protection of the environment. The act is applicable to a broad range of issues and extends to air, water, soil, marine, and noise pollution, as well as to the handling of hazardous wastes. Penalties have been prescribed for those contravening the provisions of the Act.
National Environmental Quality Standards (Self Monitoring and reporting by Industry) Rules	2000	It explains the rules and responsibilities of environmental monitoring for different categories of industries and also explains about the reporting and time frame of it. It specifies and emphasise the following: ・ It contains two schedules which classify the industrial unit for liquid effluent and for gaseous emissions respectively and then gives the values for allowable concentrations ・ Maximum allowable concentration of priority pollutants in municipal and liquid industrial effluents discharged into inland waters, sewage treatment facilities, and the sea (three separate sets of numbers) ・ Maximum allowable concentration of priority pollutants in gaseous emissions from industrial sources
Pollution charge for industry (Calculation and Collection) Rules	2001	In response of the power referred by Section 31 of the Pakistan Environmental Protection Act, 1997, the Federal Government made the Pollution charge for industry Rules, 2001, which explains as follows; ・ Determination of Pollution Charge ・ Responsibility for calculation, reporting and payment ・ Determination of pollution level ・ Calculation and payment ・ Re-determination of pollution level ・ Costs of determination of pollution level, and ・ Collection through industrial associations and chambers of commerce and Industry
Provincial Sustainable Development Fund Board (procedure) Rules	2001	It specifies the rules for the board and explains the schedule of the meeting of the board. It allocates number of the members of the board and explains the responsibilities of board members. These rules depict the following points; ・ The agenda listing the matter or business to be brought before the meeting, along with explanatory memorandum ・ The board shall make every effort to take decision by consensus, failing which decision shall be taken by majority of votes ・ For facilitation, the board shall constitute a committee including one non-official member and can also invite experts for assistance in performance

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Table 16.2 Relevant Act, Regulation and Rule on Environment & Social Aspect (Continued)

Title	year	Outline
Provincial Sustainable Development Fund (Utilization) Rules	2003	In exercise of the powers conferred by Section 31 of the Pakistan Environmental Protection Act, 1997, the Federal Government made the Provincial Sustainable Development Rules, 2003. These rules deal with; ・ Filing of Project proposal ・ Appraisal of Project proposal ・ Criteria for sanction of financial assistance ・ Post sanction formalities ・ Implementation ・ Audit and accounts And, the schedule I of these rules deal with the guidelines of feasibility report and finally rules explain the instructions for filing of feasibility reports.
National Bio Safety Guidelines/Rules	2005	These rules may be called as Pakistan Bio-safety Rules, 2005 and shall come into force at once. These rules shall be applicable to; ・ Manufacture, import and storage of micro-organism and gene technological products for research whether conducted in laboratories of teaching and research and development institutes or private companies involved in the uses and applications of genetically modified organisms and product thereof ・ All work involved in the field trial of genetically plants, animals 9including poultry and marine life), micro-organisms and cells, and ・ Import, export, sale and purchase of living modified organisms, substances or cells and products thereof for commercial purposes
Hospital Waste Management Rules	2005	In exercise of the powers conferred by Section 31 of the Pakistan Environmental Protection Act, 1997, the Federal Government made the Hospital Waste Management Rules, 2005. According to these, every hospital shall be responsible for the proper management of the waste generated by it till its final disposal in accordance with the provisions of the Act. It also explains the responsibilities of the management and finally gives details about the segregation, collection and disposal of the waste.

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16.1.3 Relevant Guidelines

Table 16.3 summarizes relevant Guidelines on environment and social aspects in Pakistan.

Table 16.3 Relevant Guidelines on Environment & Social Aspect

Title	year	Outline
Environmental Guidelines of the Pakistan EPA	1997	Pak-EPA has also published environmental assessment procedures and guidelines in October, 1997, which contains the following sets of information relevant to the proposed Project: i) <u>Guidelines for Policy and Procedures for Filing, Review and Approval of Environmental Assessment Reports:</u> It describes environmental policy and administrative procedures to be followed for filing of environmental assessment reports by the proponents and its review and approval by the concerned environmental protection agency/department. ii) <u>Guidelines for the Preparation and Review of Environmental Reports</u>; These guidelines are developed to facilitate both the proponents and decision makers to prepare reports (inclusive of all the information contained therein) and carry out their review so as to take informed decisions.
Guidelines for Public Consultation	1997	These guidelines deal with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures that their concerns are incorporated in any impact assessment study.
Guidelines for Sensitive and Critical Areas	1997	These guidelines will help in following ways; ・ In identifying what are the officially notified protected areas in Pakistan. These may include critical ecosystems including wildlife reserves and forests, archeological sites, monuments, buildings, antiquities,, or cultural heritage sites ・ If a proposed development is on a notified protected area or within the vicinity of such an area, then the approach detailed guideline should be adopted
Sectoral Guidelines	1997	Pakistan Environmental Assessment Procedures deals with general guidelines as well as the Sectoral guidelines for the Environmental Assessment Studies. The Sectoral Guidelines have been given for some categories of the projects and deals with the following; 1. Major thermal power stations 2.Major Chemical and manufacturing plants 3.Municipal waste disposal 4.New township development 5.Oil and Gas exploration and production 6.Major roads 7.Water supply projects (Only for NWFP) 8.Sewerage Schemes 9.Industrial estates, etc
Guidelines for Solid Waste Management	2005	Guidelines for Solid Waste Management have been issued as a draft by the Pakistan Environmental Protection Agency in coordination with JICA and UNDP. It contains the following three parts; 1. Part A explains the Current Solid Waste Situation of Pakistan 2. It gives details of Solid Waste Guidelines 3. It gives a solid waste management Action Plan These guidelines explain the waste generation, discharge and composition.

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16.1.4 International Treaties and Agreements on Environment

Pakistan is a signatory to various international treaties and conventions on the conservation of the environment and wildlife protection. The country is thus obliged to adhere to the commitments contained in these treaties. Relevant international treaties and conventions to which Pakistan is a party are summarized in **Table 16.4**.

16.4 International Conventions and Treaties

No.	Name of Convention	Pakistan	
		Signing date	Date of Ratification
1	Ramsar Convention on Wetlands	1971	January, 1976
2	Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES)	1973	April 1976
3	Vienna Convention		December 1992
4	Montreal Protocol on Ozone Depleting Substances	January 1989	December 1992
5	Basal Convention on Tran boundary Movement of Hazardous Wastes & Their Disposal	May 1992	October 1994
6	Convention in Biological Diversity	June 1992	July 1994
7	United Nations Framework Convention on Climate Change (UNFCCC)	June 1992	June 1994
8	Kyoto Protocol to UNFCCC	December 1997	January 2005
9	United Nations Convention to Combat Desertification (UNCCD)	October 1994	February 1997
10	Rotterdam Convention on Prior Informed Consent (PIC) for certain Hazardous Chemicals and Pesticides	September 1999	July 2005
11	Stockholm Convention on Persistent Organic Pollutants (POPs)	December 2001	April 2008
12	Cartagena Protocol on Bio-safety to the Convention on Biological Diversity	June 2001	Not yet ratified
13	Convention on Law of Seas	December 1982	February 1997
14	Convention of Migratory Species (CMS) of Wild Animals	December 1981	1987

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16.2 Environmental Impact Assessment (EIA) System

As mentioned in Section 12(1) of PEPA, Environmental Impact Assessment (EIA) is mandatory for all the development projects to be implemented. Without the submission of an environmental report to EPA, proponent of any projects can not start construction of the project.

16.2.1 Pakistan Environmental Protection Agency Review of Initial Environmental Examination and Environmental Impact Assessment Regulations, 2000

In exercise of the powers referred by the Section 33 of PEPA 1997, Pakistan EPA (Pak-EPA), with the approval of the Federal Government, made the rules, namely “Pakistan Environmental Protection Agency Review of Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) Regulations, 2000”.

The regulations categorize the projects in different schedules requiring an IEE or EIA depending upon the nature of the severity of impacts of the projects. These Regulations further describe the detail process of filing environmental reports with review fees to the EPA.

After receiving the EIA report, EPA conducts the public hearing for the project inviting all the stakeholders to participate and express their concerns. The EPA then conveys his decision to the proponent in the light of these concerns and resubmits the EIA report after incorporating necessary comments.

16.2.2 Pakistan (Federal) EPA Environmental Assessment Procedures

The Federal EPA (Pak-EPA) has published a set of environmental guidelines for conducting environmental assessments and the environmental management of different types of development projects. The guidelines that are applicable to various development projects are shown in **Table 16.5**.

Table 16.5 Environmental Guidelines for Environmental Assessments and Managements

Guidelines	Outline
Policy and Procedures for Filing, Review and Approval of Environmental Assessments, Pakistan Environmental Protection Agency, September 1997	The guidelines define the policy context and the administrative procedures that govern the environmental assessment process, up to the approval of the environmental report. The section on administrative procedures has been superseded by the IEE-EIA Regulations, 2000.
Guidelines for the Preparation and Review of Environmental Reports, Pakistan Environmental Protection Agency, 1997	The guidelines on the preparation and review of environmental reports specify the following for project proponents; ・ The nature of the information to be included in environmental reports ・ The minimum qualifications of the EIA conductors appointed ・ The need to incorporate suitable mitigation measures at every stage of project implementation ・ The need to specify monitoring procedures TORs for the reports are to be prepared by the project proponents themselves. The reports must contain baseline data on the project area, detailed assessment thereof, and mitigation measures.
Guidelines for Public Consultation, Pakistan Environmental Protection Agency, May, 1997	The guidelines deal with possible approaches to public consultation and techniques for designing an effective program of consultation that reaches out to all major stakeholders and ensures the incorporation of their concerns in any impact assessment study.

Source; Pakistan EPA

16.2.3 Environmental Licensing System in Pakistan (Both Federal and Provincial)

After receiving a final EIA Report, the EPA issues the approval (NOC ; No Objection Certificate)to the proponent with conditions of the approval mentioning necessary mitigation measures to be followed which is discussed in the EIA report. The proponent then submit the request for confirmation of compliance, in response to this request, EPA may carry out the inspection of the site any time.

The four-month period is required for getting environmental approval (NOC) from the environment agency. This period shall commence from the date of filing of an IEE or EIA in respect of which confirmation of completeness is issued by the Federal Agency. The EPA requires carrying out its review of the IEE within 45 days and of the EIA within 90 days of issuance of confirmation of completion. After 45 days review, approval is issued for the IEE, if agency considers it complete report. But for EIA, 4 months period is required from the date of filing of an EIA to its final approval from the concerned Environmental Agency. The approval accorded by a Federal Agency shall be valid, for commencement of construction, for a period of three years from the date of issue. The proponent may apply to the Federal Agency for extension in the validity periods, which may be granted by the Federal Agency in its discretion for such period not exceeding three years at a time, if the conditions of the approval do not require significant change: Provided that the Federal Agency may require the proponent to submit a fresh IEE or EIA, if in its opinion changes in location, design, construction and operation of the project so warrant.

During the construction, the EPA staff is entitled to visit the project site for purposes of verification of any matter relating to the review or to the conditions of approval of an IEE or EIA prior to, during or after commencement of construction or operation of a project. The proponent shall ensure full cooperation of the project staff at site to facilitate the inspection by the Federal Agency. After issue of approval, the proponent shall submit a report to the Federal Agency on completion of construction of the project. If at any time, on the basis of information or report received or inspection carried out, the Federal Agency is of the opinion that the conditions of an approval have not been complied with, or that the information supplied by a proponent in the approved IEE or EIA is incorrect, it can issue notice to the proponent to show cause, within two weeks. If no reply is received or if the reply is considered unsatisfactory, the Federal Agency may, after giving the proponent an opportunity of being heard: require the proponent to take such measures and to comply with such conditions within such period as it may specify, failing which the approval shall stand cancelled or cancel the approval.

(1) Pakistan Environmental Protection Agency Guidelines for the preparation and review of environmental reports

These guidelines are developed to facilitate both the proponents and decision makers to prepare reports (inclusive of all the information contained therein) and carry out their review so as to take informed decisions. These guidelines cover:

- The Initial Environmental Report (scoping, alternatives, site selection, format of IEE)
- Assessing impacts (identification, analysis and prediction, baseline data, significance)
- Mitigation and impact management (and preparing an environmental management plan)
- Reporting (drafting style, main features, shortcomings, other forms of presentation)
- Review and decision making (role, steps, remedial options, checks and balances)
- Monitoring and auditing (systematic follow up, purpose, effective data management)
- Project management (inter disciplinary teams, programming & budgeting)

(2) IEE/EIA Procedural Flow

Figure 16.1 depicts the EIA process in Pakistan as per IEE/EIA Regulations, 2000. It describes that EIA process in Pakistan should be applied to all those development proposals which may cause significant impacts. Screening is the line initiative of the process, which leads to the decision whether full EIA is required for the project or not. If the project is likely to cause significant impacts then according to the flow chart given above, EIA is required (as per schedule-II of IEE/EIA Regulations, 2000) for that developmental proposal. And, if it is likely to cause low impacts then IEE is required (as per schedule-I of IEE/EIA Regulations, 2000). But, if the project is not causing any impact then no IEE or EIA is required.

For the preparation of EIA report, scoping is required or information will be collected from any source and through site visits and public consultation, resulting to analyze the impacts which will take place during construction and operation phase. Next to the impact analysis is consideration of mitigation measures. According to the flow chart, after mitigating the anticipatory impacts, Environment Management Plan (EMP) will be prepared by the proponent authority resulting to the completion of EIA report. Later on, after its preparation, EIA report will be submitted to a concerned department for review and decision making including the involvement of the public through consultation. If the EIA report is not approved then the project would be redesigned and EIA report would be resubmitted through the same process. But on the other hand, if EIA is approved then the project would be implemented.

According to the chart, screening also leads to the IEE. The chart shows that after the preparation of IEE report it would be submitted to a concern EPA for finding of non-significant impacts. If the project will have less impact then approval from the concern EPA will be required. Finally, the flow chart is also illustrating that if the project is not causing any impact then no IEE or EIA is required.

(3) Schedules in the IEE/EIA Procedural Flow

The Schedules in the IEE/EIA procedural flow are summarized in **Table 16.6**.

Table 16.6 Schedules in IEE/EIA Procedure

Schedule	Description
Schedule I	List of project categories for which a proponent shall file an IEE with the Federal Agency and the provisions of section 12 of PEPA Act 1997 apply to that project.
Schedule II	List of project categories for which a proponent shall file an EIA with the Federal Agency and the provisions of section 12 of PEPA Act 1997 apply to that project.
Schedule III	Nonrefundable Review Fee to the Federal Agency, as per rates shown in schedule which the proponent has to pay, at the time of submission of an IEE or EIA.

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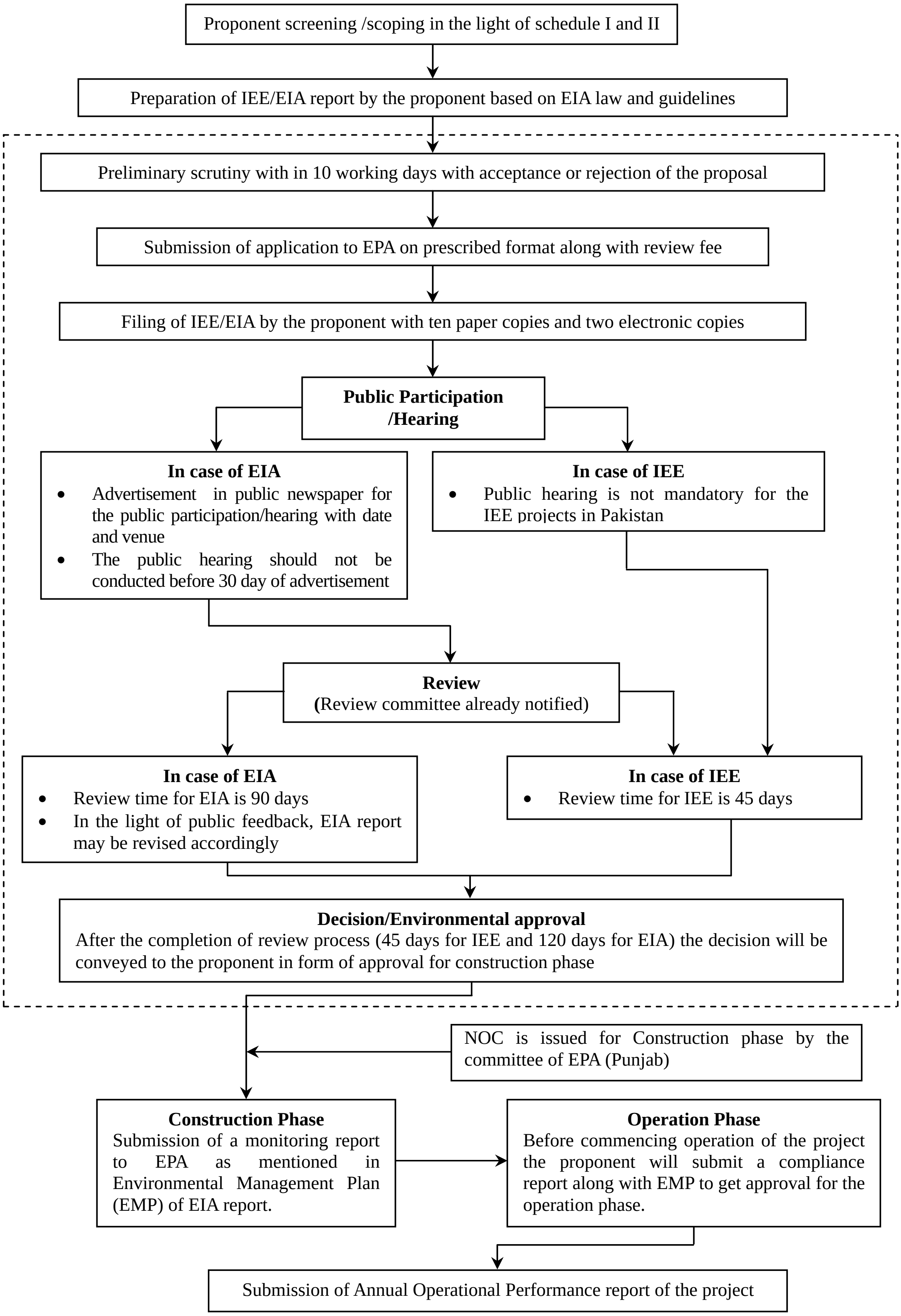


Note: Validity of EIA is 3 years, if project is not started within 3 years or if the construction work is started within the 3 years, then validity period is further extended to more 3years

Source: Punjab EPA

Figure 18.1 IEE/EIA Procedural Flow-chart

16.2.4 Resettlement Plan to be Required in the EIA System

The review of the available environmental policies and legislations does not highlight formulation of a Resettlement Action Plan (RAP) to be required for the development projects. However, a Draft National Resettlement Policy (NRP), March 2002 has been developed by Ministry of Environment, Local Government and Rural Development, but has not yet been approved. It is currently in a draft form with the Pak-EPA as follows.

- The Policy focuses to prepare the comprehensive RAP in case the impact of the project is severe such than more than 200 people (about 40-50 families) are displaced by the Project, its components or subproject (the number of people of 200 is noted in an EIA regulation).
- In case the impact of the project is marginal or minor and such that less than 200 people (about 40-50 families) are affected or displaced or where the impacts are minor although the more than 200 people may be affected an “Abbreviated Resettlement Action Plan” is required to prepare by the sponsors of the project and get approved.

16.3 Organization for Environmental Management

16.3.1 Federal Government Institutions

(1) Ministry of Environment, Local Government and Rural Development

Headed by a federal minister, the Ministry of Environment, Local Government and Rural Development is the main government organization responsible for protection of environment and resource conservation. The Ministry works in collaboration with the Pakistan Environmental Protection Council (PEPC) and the Federal and Provincial Environmental Protection Agencies formed under PEPA (Pakistan Environmental Protection Act) 1997 (In Punjab, formerly it was Environmental Agency but now it is Environmental Protection Department i.e. EPD-Punjab). The PEPC and Pak-EPA (Federal Environmental Protection Agency) are primarily responsible for administering the provisions of the PEPA 1997. The PEPC oversees the functioning of the Pak-EPA.

(2) Pakistan Environmental Protection Council (PEPC)

The Federal Government has formed the PEPC which consists of the following members;

- President of Pakistan, or a person appointed by the President, as the Chairperson
- Minister of the Ministry of Environment, Local Government and Rural Development as the Vice-Chairperson
- Governors of the Provinces
- Ministers in-charge of the Ministry of Environment in the Provinces (There is a Ministry of Environment in each province)

- Secretary to the Federal Government in-charge of the Ministry of Environment, Local Government and Rural Development
- (Federal Secretary) Director General of Federal EPA (Pak-EPA)
- Heads of federal and provincial environmental protection departments, and
- Environmentalists and community representatives including scientists

The functions and powers of PEPC include formulation of national environmental policy, enforcement of PEPA, approval of NEQS, incorporation of environmental considerations into national development plans and policies and to provide guidelines for the protection and conservation of biodiversity in general and for the conservation of renewable and non-renewable resources.

The Federal Government has also formed the Federal EPA (Pak-EPA), which is headed by a Director General and has wide ranging functions given in PEPA 1997. These include preparation and co-ordination of national environmental policy for approval by PEPC, administering and implementing PEPA 1997 and preparation, revision or establishment of NEQS.

(3) Federal Environmental Protection Agency (Federal EPA or Pak-EPA)

The Federal EPA (Pak-EPA) has over all jurisdictions over EIA/IEE issues. The Federal jurisdiction is applicable to the projects as follows;

- On Federal land
- Military projects
- Involving trans-country impacts, and
- Bearing trans-province impacts

For all other cases, the concerned provincial Responsible Authority shall have jurisdiction. Federal EPA reserves the rights to review any environmental reports at any time and to suspend the powers it has delegated to any Responsible Authority if it believes those powers have not been properly used.

16.3.2 Provincial Government Institutions (Punjab EPD/EPA)

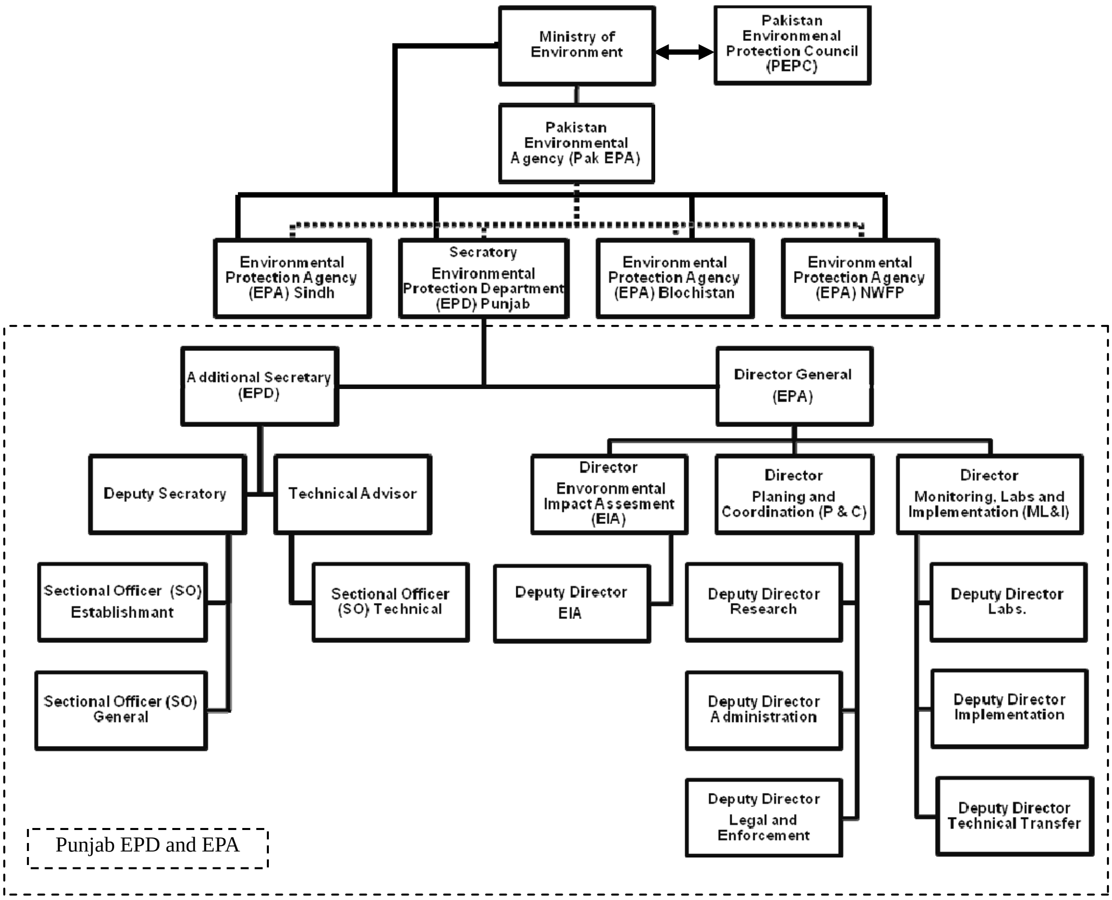
(1) Provincial Environmental Protection Agencies/Departments (EPAs/EPD)

Each provincial government has its own environmental protection institution responsible for pollution control. The Provincial Environmental Protection Agencies or Environmental Protection Department (EPAs/EPD) are the provincial counterparts of the Federal EPA (Pak-EPA), which is authorized to delegate powers to its provincial counterparts.

EPAs/EPD are formed by the respective provincial governments. A Director General who exercises powers delegated to him by the concerned provincial government heads the provincial EPA. The reports covering IEEs and EIAs are submitted to the concerned provincial EPAs/EPD for approval.

(2) Organizational Setting on Environment and Punjab EPD &EPA

Figure 16.2 depicts organizational setting on environment from the national level to provincial level. Especially, only for Punjab province there are two functions of EPD (Environmental Protection Department; is for administrative function) and EPA (Environmental Protection Agency; is for technical function including EIA) as shown in **Figure 16.2**. Namely it is a full fledged department under the Government of Punjab. EPD is under administrative control of the Secretary, Government of Punjab. The Director General EPA is under secretary EPD, and heads all EPA Punjab. All functions in PEPA 1997 are dealt by the Director General EPA.



Source: Pak-EPA, Punjab EPD, Modified by JICA Study Team

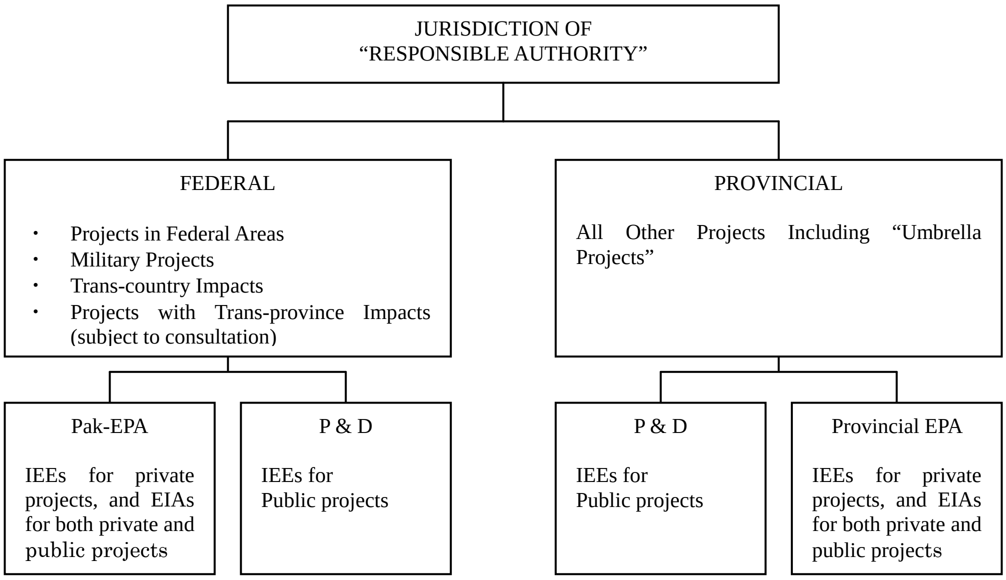
Figure 16.2 Organizational Setting on Environment in Pakistan, Punjab EPD & EPA

(3) Planning and Development Departments (P&Ds)

For public works, responsibility for IEE management & review and granting or refusing environmental approval, will be vested in the Planning and Development Departments (referred as P&Ds) responsible for economic and development planning at federal and provincial levels.

16.3.3 Jurisdiction of Federal and Provincial Responsible Authorities

The Jurisdiction of federal and provincial responsible authorities (EPAs/EPD) is described in **Figure 16.3**.



Source; Environmental Impact Assessment in Pakistan – Overview, Implementation and Effectiveness, 2006 ISSN 1651-06X, Partially modified by JICA Study Team

Figure 16.3 Jurisdictions of Federal and Provincial Responsible Authorities

16.3.4 Local Government Institutions

At the district level, District Environment Officer (DEO) is the responsible person to look after the environmental issues in all the sectors. The issues identified by DEO are referred to the provincial government for legal proceedings. DEO can take action against any development activities resulting in the environmental degradation of the country.

16.4 Land Acquisition, Resettlement and Compensation Systems

16.4.1 Related Laws and Regulations on Land Actuation and Resettlement

For the acquisition of land, Land Acquisition Act, Punjab Land Acquisition Rules and Standing as summarized in **Table 16.7** are followed whether the acquisition is for WASA or any other agency.

Table 16.7 Related Laws and Regulations on Land Actuation and Resettlement

Title	Year	Outline
Land Acquisition Act	1894	The present general law for acquisition of land for public purposes such as urban development, new roads, railway lines and canals etc, was introduced in the year 1894 as the Land Acquisition Act (LAA) 1894. This Act remains the primary law governing land acquisition in Pakistan today and is the principal general statute laying down the framework for the exercise of the right of eminent domain of the State. The land acquired under the Act vests in the Province and it is only thereafter that the Province may transfer it to someone else. LAA lays down definite procedures for acquiring private land for projects and payment of compensation. The rights of people whose land is to be acquired are fully safeguarded. Even for entering private land or carrying out surveys and investigations, specified formalities have to be observed and notifications have to be issued. Damage to the crops during survey and investigations has to be compensated. The affected persons, if not satisfied, can go to the Court of Law to contest the compensation award of the Land Acquisition Collector (LAC).
Punjab Land Acquisition Rules	1983	In addition to LAA, regulations setting out the procedure for land acquisition have been provided in the 'Punjab Land Acquisition Rules, 1983' published in the Gazette of the Punjab Extraordinary, dated February 22, 1983. The rules are applicable in the Punjab.
Standing Order No. 28		There is another body of general regulations called the Standing Order No. 28, which is followed by the NWFP as well as the Punjab.
Project Implementation and Resettlement of the Affected Persons Ordinance	2001	The Government has proclaimed an ordinance entitled "Project Implementation and Resettlement of the Affected Persons Ordinance 2001", later referred to as the "Resettlement Ordinance". This ordinance will be used to safeguard the interests of persons/groups involuntarily resettled. This ordinance establishes that the resettlement of the involuntarily displaced persons is done as a matter of right and not by way of charity or any such sentiment, also the Affected Persons (APs) shall be accepted as special groups, who in the supreme interest of the country have accepted/undergone involuntary displacement. The proposed ordinance shall be supplementary to LAA as well as other Laws of Pakistan, and wherever applicable under resettlement policy.
Resettlement Policy of Pakistan	2002	An important aspect of environmental impact assessment is the relocation and resettlement of the project affected population. The resettlement policy has not yet been approved. It is currently in a draft form with Pak-EPA. The policy has been formulated to ensure an equitable and uniform treatment of resettlement issues all over Pakistan. This policy will apply to all development projects involving adverse social impacts, including land acquisition, loss of assets, loss of income, loss of business etc. It addresses those areas, which are not taken care of in LAA and will be applicable wherever any public sector or private development project affects people, families or communities, even when there is no displacement. The policy also aims to compensate for the loss of income to those who suffer loss of communal property including common assets, productive assets, structures, other fixed assets, income and employment, loss of community networks and services, pastures, water rights, public infrastructure like mosques, shrines, schools, hospitals, graveyards etc.

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16.4.2 Organizational Systems for Land Acquisition, Resettlement and Compensation

Land acquisition requires interaction between the Requiring Body (RB), which is normally a government agency responsible for national infrastructure development, such as WASA, and the Acquiring Body (AB), which is normally the Provincial Revenue Board which delegates some of its authority to the District Officer of Revenue (DOR) at the District level.

The division of responsibility between RB and AB, in broad terms, is that RB provides technical input and the Acquiring Body provides the legal input in the land acquisition process. It is RB which must ensure that the Project, for which the acquisition of land is required, is approved by the authorities and that funds are available. RB must also justify the need for land and other property on the basis of field surveys including detailed engineering design and prepare all necessary documents required for decision making.

The legal aspects of the land acquisition process begin with RB submitting an application to DOR with a request to acquire land under LAA, giving full justification of the public purpose involved and minimum area required by it. The application contains the following items of information:

- Statement including such information as the amount of land required, a timetable for acquisition, and the purpose for which the land is to be acquired
- Layout plan showing the project's location on map
- Site plan, showing the area on a Mouza (the smallest revenue unit i.e. village) map
- Land schedule, showing land classification and ownership of plots to be acquired; and
- Certificate of minimum requirement, issued by RB stating that the quantity of land proposed for acquisition is the absolute minimum for a proper implementation of the project

After examining the feasibility of application, AB processes the land acquisition cases including determination of the level of compensation and payment to the concerned people. When the land acquisition process is completed, the land is handed over to RB (See **Figure 16.4**).

16.4.3 Institutional Arrangements

(1) Land Acquisition Collectors

In cases of land acquisition for public purposes, Land Acquisition Collectors (LACs)/ Deputy District Officer of Revenue (DDOR), who are the representatives of the respective District Collectors, are normally appointed. The Collector is usually DOR of a District. It may also mean any other officer specially appointed by the Provincial Government to perform the function of a Collector under LAA. If the Project involves two provinces, the services of two LACs will be required. LACs will be taken on deputation from the respective provinces.

(2) Proponent's Staff

After the land required for the project has been marked out in the field, Proponent will prepare an inventory of built-up properties and assess their costs according to engineering practices, on a market cost basis. The revenue staff of a Proponent attached to LACs will carry out field measurements of the land and prepare statements of ownership on the basis of the records maintained in revenue section of the District Collector, which will have been updated specifically for the project area.

16.4.4 Compensation Systems

According to LAA, any person who is being affected due to notification of any land acquisition, may, within thirty days after the issuance of the notification, object to the acquisition of the land under Section 5-A. The Collector shall hear the objection, make necessary enquiries and submit a report within 90 days to the Executive District Officer of an appropriate Government Authority (in case of Punjab; Revenue Department of Punjab). This authority must announce his decision which shall be final, within 90 days, otherwise the objection shall be deemed to have been admitted and the acquisition proceedings will come to an end. LAA, thus also give an opportunity to the affected persons to redress their grievances.

As per LAA, in calculating compensation, the land acquisition officials in the district have to take into account the available records of transfer of property. Households having clear title to land are eligible for getting the full package of compensation on land, houses and other structures, on crops and trees in the fields, and on agriculture infrastructures. There are other categories of people who suffer less directly, perhaps, but nonetheless substantially from land acquisition but who are yet not entitled to any compensation or resettlement benefits under the law. Tenant farmers and laborers fall into these categories.

16.4.5 Public Consultation on Land Acquisition

(1) Public Consultations

National Resettlement Policy, 2002 highlights the need to consult the affected people before the preparation of Resettlement Action Plan (RAP).

It describes that the affected persons will be informed about the objectives, likely impacts and essential provisions of Resettlement Policy through various activities like information campaigns using media, posters etc, arranging interviews with the affected people and their stakeholders groups, formation of focus groups involving key stakeholders like local leaders, setting up various committees for planning, implementation and monitoring purposes, involving affected persons in grievance redress process and introduction of a social preparation phase.

In order to discuss and seek opinions from the affected persons, their representatives will be formally invited to participate in various meetings regarding resettlement as convened by the district and provincial administrations.

The Resettlement Policy is still in a draft form and it is not approved but in most of mega projects of various sectors, its objectives and principles are followed and efforts are being made for better settlement of the affected persons adopting a monetary compensation system at market rates.

(2) Monitoring and Evaluation Committee

For monitoring purpose, there is provision in the Policy that Monitoring and Evaluation (M&E) Committees headed by the respective Director General Projects (DGP) from the Ministry of Environment, shall be established, drawing representatives from the concerned EPA (i.e. Provincial Environmental Protection Agencies), the project proponents and the project NGO/CBO, for supervising the monitoring and evaluation of resettlement components of the project. All M&E activities shall be undertaken as per advice of the committee.

16.4.6 Land Acquisition Process

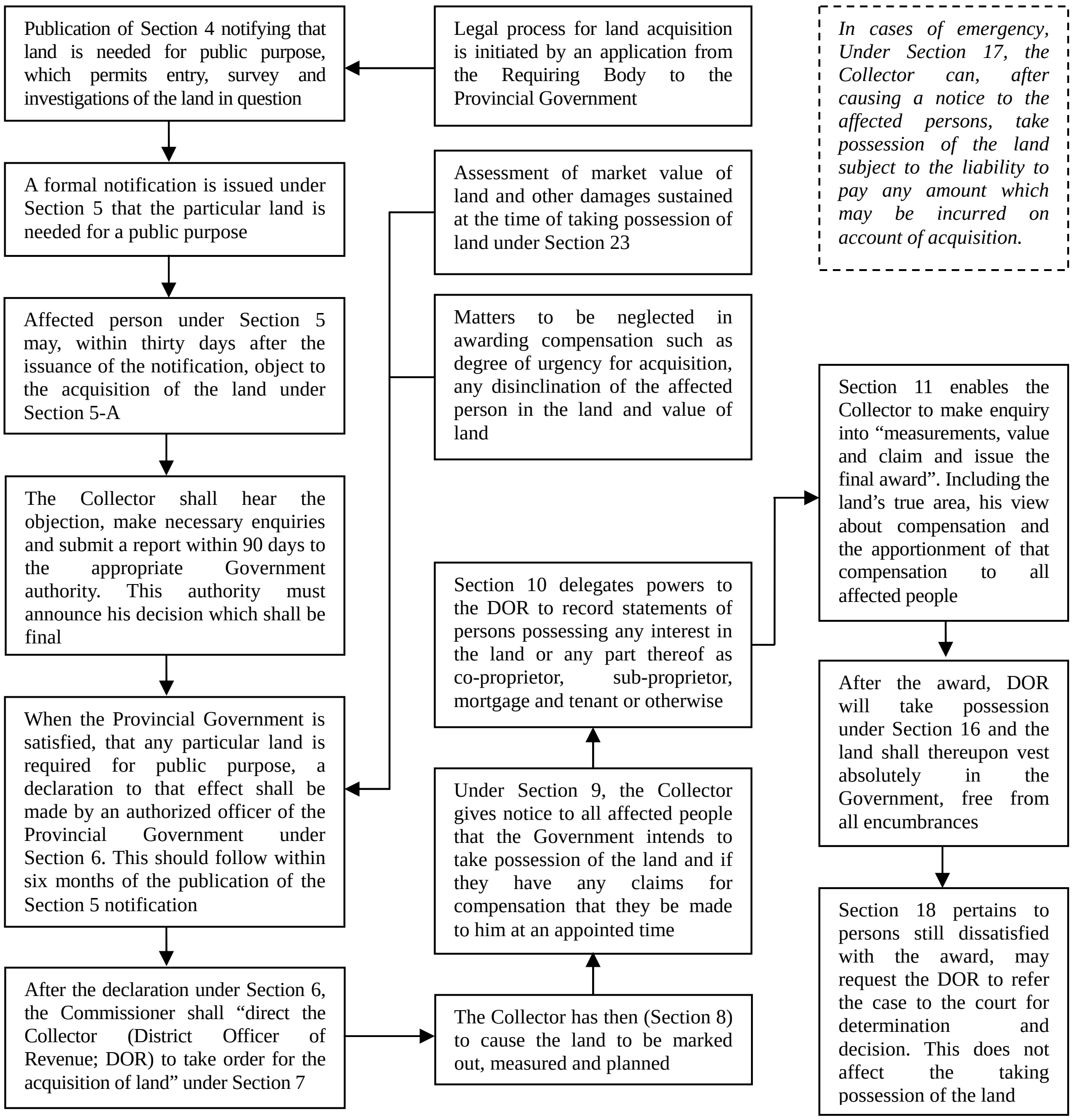
In accordance with LAA, the legal process is initiated by an application from the Government agency that requires the land (Requiring Body). As land is a provincial subject according to the Constitution, the next step is for the Provincial Government to deem it necessary to acquire land and it then takes the actions as shown in below and depicted in **Figure 16.4**.

- Under Section 4, it causes the publication of preliminary notification notifying that the land is needed for a public purpose. This permits entry, survey and investigations of the land in question by an authorized Government servant (a District Collector). He shall pay compensation for any damage caused by such an entry.
- The purpose of a notification under Section 4 is to enable the authorities to carry out preliminary investigations for deciding whether the land intended to be acquired is suitable for the purpose for which it is needed. The process of acquisition must start with a notification under Section 4. It is a condition precedent to the exercise of any further powers under the Act.
- Under Section 5, a formal notification is issued that the particular land is needed for a public purpose. This notification is published in the official Gazette and the Collector is required to cause public notice to be given of the substance of the notification. Issuance of Section 5 has to take place not later than one year after notification of Section 4.
- Any person interested in any land which has been notified under Section 5 may, within thirty days after the issuance of the notification, object to the acquisition of the land under Section 5-A. The Collector shall hear the objection, make necessary enquiries and submit a report within 90 days to the appropriate Government authority (Executive District Officer of Revenue). This authority must announce his decision which shall be final, within 90 days, otherwise the objection shall be deemed to have been admitted and the acquisition proceedings will come to an end.

- When the Provincial Government is satisfied, after considering the report, if any, made under Section 5-A that any particular land is required for public purpose, a declaration to that effect shall be made by an authorized officer of the Provincial Government under Section 6. This should follow within six months of the publication of the Section 5 notification.
- After the declaration under Section 6, the Commissioner shall “direct the Collector to take order for the acquisition of land” under Section 7.
- The Collector has then (Section 8) to cause the land to be marked out, measured and planned (if this was not done after Section 4).
- Under Section 9, the Collector gives notice to all interested people that the Government intends to take possession of the land and if they have any claims for compensation that they be made to him at an appointed time.
- Section 10 delegates powers to the Collector to record statements of persons possessing any interest in the land or any part thereof as co-proprietor, sub-proprietor, mortgage and tenant or otherwise.
- The most important section of the Act is Section 11; it enables the Collector to make enquiry into “measurements, value and claim and issue the final award”. Included in the award is the land’s true area, his view of what compensation is warranted, and the apportionment of that compensation to all interested people.
- Though this section is the one that contains the final award, there are two other sections (Section 23 and Section 24) which actually take place prior to section 11. This is because these two sections pertain to compensation and the criteria to be followed (Section 23) or not to be followed (Section 24) in arriving at appropriate compensation.
- Under Section 23 are included such items as the market value of the land at the time of notification of Section 6, and various damages that have been sustained at the time possession was taken.
- Matters to be neglected in awarding compensation (Section 24) include such items as the degree of urgency which led to the acquisition, any disinclination of the person interested in the land to part with it, any expected increase in value to the land from its future use, etc.
- When the Collector has made an award under Section 11, he will then take possession under Section 16 and the land shall thereupon vest absolutely in the Government, free from all encumbrances.
- Another section of note is Section 18 which pertains to persons still dissatisfied with the award who may request the Collector to refer the case to the court for determination and decision. This does not affect the taking possession of the land.
- In cases of emergency, where the Board of Revenue considers it expedient to take possession of any land at any time before an award under Section 11 has been made, it shall notify this act in writing to the Collector intimating in addition the date by which the land is required by it. Under Section 17, the Collector can, after causing a notice to this effect to be

served on the person or persons interested in the land, take possession of the land subject to the liability to pay any amount which may be incurred on account of acquisition.

For land acquisition process in Pakistan, all the provisions of various Sections of LAA are necessary to be followed. Without notification of these Sections, land acquisition process can not be started because the principles of Resettlement Policy, 2002 have not yet become part of the established body of law and regulations in Pakistan. In the absence of any specific legislative guidelines, resettlement is left to the understanding and judgment of the incumbent authorities.



DOR: District Officer of Revenue

Figure: JICA Study Team

Figure 16.4 Land Acquisition Process Flow

16.5 Identification of Projects required for IEE/EIA

16.5.1 Summarization of IEE/EIA framework for the Projects

As reviewed in the **item 16.2** of this chapter, Schedules are stipulated in the EIA System for projects in Pakistan. **Table 16.8** summarizes sectors in the field of Water supply, irrigation, food protection and waste disposal and the schedules regulated by Review of IEE and EIA of EPA 2000.

Table 16.8 Sectors and Schedules Regulated by Review of IEE and EIA of EPA 2000

Sectors	SCHEDULE I* projects requiring an IEE	SCHEDULE II** projects requiring an EIA
Water management, dams, irrigation and flood protection	1. Dams and reservoirs with storage volume less than 50 million cubic meters of surface area less than 8 square kilometers	1. Dams and reservoirs with storage volume of 50 million cubic meters and above or surface area of 8 square kilometers and above
	2. Irrigation and drainage projects serving less than 15,000 hectares	2. Irrigation and drainage projects serving 15,000 hectares and above
	3. Small-scale irrigation systems with total cost less than Rs.50 million	–
Water supply and treatment	Water supply schemes and treatment plants with total cost less than Rs.25 million	Water supply schemes and treatment plants with total cost of Rs.25 million and above
Waste disposal	–	1. Waste disposal and/or storage of hazardous or toxic wastes (including landfill sites, incineration of hospital toxic waste)
	Waste disposal facility for domestic or industrial wastes, with annual capacity less than 10,000 cubic meters	2. Waste disposal facilities for domestic or industrial wastes, with annual capacity more than 10,000 cubic meters

***Schedule I:** is the list of project categories for which a proponent shall file an IEE with the Federal Agency and the provisions of section 12 of PEPA Act 1997 apply to that project.

****Schedule II:** is the list of project categories for which a proponent shall file an EIA with the Federal Agency and the provisions of section 12 of PEPA Act 1997 apply to that project.

Source; Pak EPA (Review of IEE and EIA) Regulations, 2000

16.5.2 Project Components of Proposed in Phase 1

(1) Project Components in Phase1

Table 16.9 shows the project components in Phase 1 proposed by JICA study team.

Table 16.9 Project Components of Proposed in Phase 1

Sectors	Phase 1(2010-2015)
Water supply	**1**. Preparation for Using Alternative water Source for Drinking Water 1-1: preparation of a master plan to develop alternative water source and related facilities, including examination on integration of the existing groundwater supply system and new surface water supply system 1-2: implementation of preparatory activities including acquisition of rights of surface water 2. Reduction of Unaccounted-for-water and Non-revenue-water 2-1: installation of meters in 40% of connections 2-2: execution of asset study and preparation of a distribution network improvement plan in the entire WASA area 2-3: implementation of distribution network improvement in the priority area in the central Lahore within agreed loan amount and period 3. Improvement of Water Quality 3-1: installation of chlorinators for all tubewells (certain measures for UFW reduction are also relevant for improvement of water quality) 4. Procurement of Operation and Maintenance Equipment ・water quality analysis equipment, ・cleaning and desilting equipment ・vehicles ・performance check equipment ・bulk flow meters for all tubewells 5. Consulting Services

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Table 16.9 Project Components of Proposed in Phase 1 (Continued)

Sectors	Phase 1(2010-2015)
Sewerage	1. Sewer – Central Area – connecting to South West Treatment Plant 1-1: construction of trunk sewer from Larex Colony to Gulshan-e-Ravi Disposal Station 1-2: construction of branch sewers from Larex Colony to Gulshan-e-Ravi Disposal Station 1-3: construction of trunk sewer along Cantonment Drain 2. Disposal Station – Central Area – connecting to South West Treatment Plant 2-1: new construction of New Gulshan-e-Ravi DS 3. Wastewater Treatment Plant– South West Area – 3-1: construction of South West Wastewater Treatment Plant including collector channel and pumping station 4. Consulting Services
Drainage	1. New Construction of Drains in Central Lahore (Necessity, priority, and design of each drain would be examined under the Preparatory Study. The present list (omitted) contains only drains connecting to Babu Sabu drainage pumping stations, but the drains with the high priority may be added. The priority should be justified by data on inundation damages.) 2. Improvement and Rehabilitation of Drain in Central Lahore 2-1: improvement and rehabilitation of Governor House Drain and Meclod Road Drain 3. Consulting Services
Management	1. Development of Adequate Policy and Regulatory Environment 2. Timely Data Acquisition and Preparation of Definitive Vision and Strategies 3. Reduction of Unaccounted-for-water and Non-revenue-water 4. Human Resource Development and Organizational Streamlining 5. Improvement of Customer Services 6. Groundwater Monitoring and Regulation

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(2) Project Components may be Required for IEE or EIA

In accordance with the Pak-EPA (Review of IEE and EIA) Regulations 2000 summarized in **Table 16.8** and the project components summarized in **Table 16.9**, some portions of water supply, sewerage and drainage sectors among those components proposed by the JICA study team may be subject to IEE (Schedule I) and/or EIA (Schedule II) as shown in **Table 16.10**.

Table 16.10 Project Components may be Required for IEE or EIA

Sectors	Phase 1(2010-2015)
Water supply	2. Reduction of Unaccounted-for-water and Non-revenue-water 2-1: installation of meters in 40% of connections 3. Improvement of Water Quality 3-1: installation of chlorinators for all tubewells
Sewerage	1. Sewer – Central Area – connecting to South West Treatment Plant 1-1: construction of trunk sewer from Larex Colony to Gulshan-e-Ravi Disposal Station 1-2: construction of branch sewers from Larex Colony to Gulshan-e-Ravi Disposal Station 1-3: construction of trunk sewer along Cantonment Drain 2. Disposal Station – Central Area – connecting to South West Treatment Plant 2-1: new construction of New Gulshan-e-Ravi DS 3. Wastewater Treatment Plant– South West Area – 3-1: construction of South West Wastewater Treatment Plant including collector channel and pumping station
Drainage	1. New Construction of Drains in Central Lahore 2. Improvement and Rehabilitation of Drain in Central Lahore 2-1: improvement and rehabilitation of Governor House Drain and Meclod Road Drain

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(3) Necessity of IEE/EIA for the Projects of Water Supply Sector

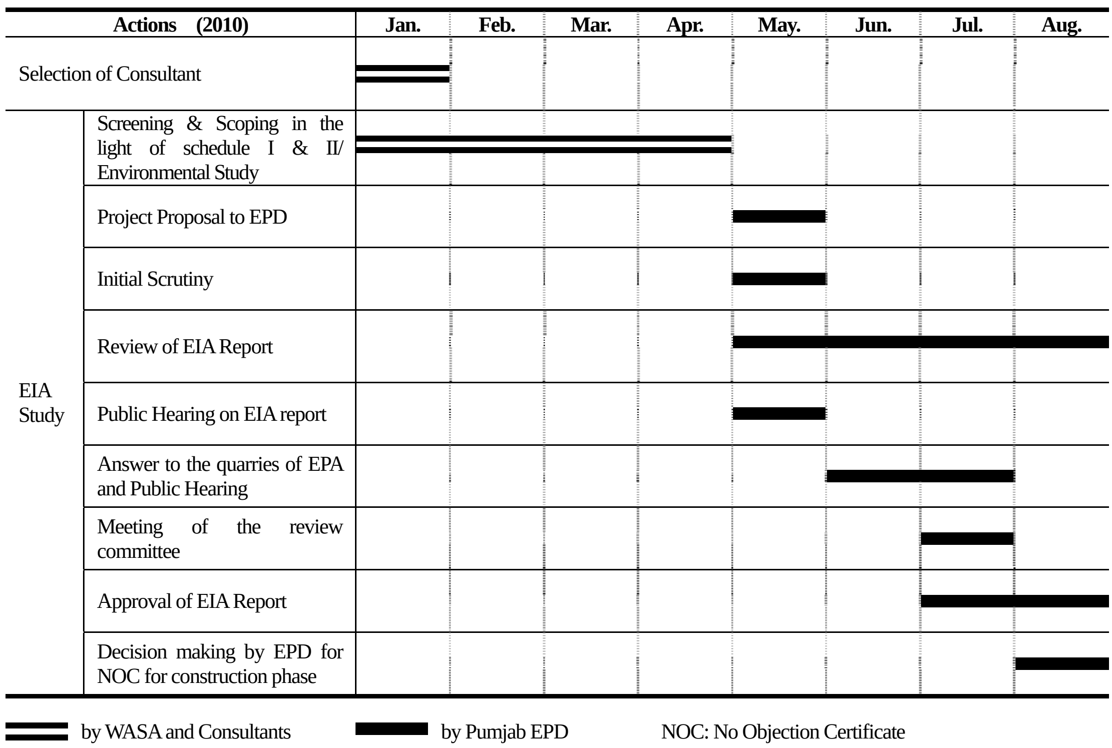
With regard to the water supply sector which is in principle required for IEE or EIA by the criteria of the regulation (especially in terms of total project cost) as summarized in **Table 16.8**, however, discussions were made among the Punjab EPD, WASA and JICA Study Team whether or not IEE/EIA is necessary if considering the project description of “Water Supply”.

Due to the fact of the nature and description of "Water Supply Project" which is to install and/or replace water meters and chorine (Sodium Hypochlorite solution: HOCl) injectors in some extend, the discussion concluded that significant negative impact during and after installation by the water supply project is naturally predicted. Therefore, Director of EIA section EPA of Punjab EPD has recognized the water supply component in the projects is not necessary for IEE as well as EIA at all.

16.5.3 Preparation of EIA studies for the Projects

(1) Draft EIA Study Schedule

According to M/D on August 2009 between the JICA F/F mission team and WASA which mentions that an EIA study to be required shall be terminated by the commencement of D/D, as well as the discussions mentioned in item (3) at **16.5.2**, a draft EIA schedule for the Sewer project of the construction of a Wastewater Treatment Plant (WWTP) including Collector channel and a New Pumping Station, and Drain project has been prepared in consultation with relevant officials at Punjab EPD and WASA getting assistance from the JICA Study Team as shown in **Figure 16.5**.



Source; WASA in association with Punbjab EPD and JICA Study Team

Figure 16.5 Draft EIA schedule for Sewerage and Drainage projects

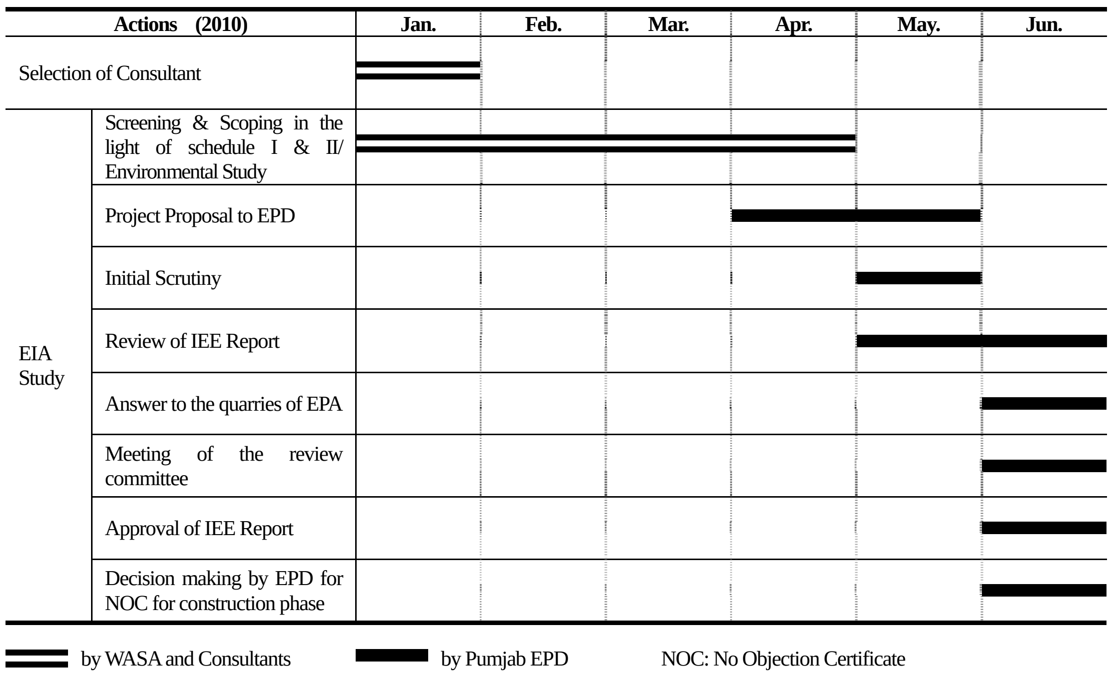
(2) Initiation of Screening and Scoping for the Projects by WASA

WASA has initiated actions for EIA procedures for the projects sending an official letter from the Director (P&E) WASA to Punjab EPA (EPD) dated on 20th October 2009, No. D (P&E)/ 4011-14 under the heading of "Screening and Scoping for EIA/IEE of Water Supply, Sewerage Improvement and Wastewater Treatment Plant Projects in Lahore" for asking the EPA to guide WASA whether the projects come under the schedule of IEE or EIA, so that WASA may prepare the study for environmental approval from the EPA (EPD). In the letter the projects are divided four components as follows, by which EIA studies may be applied to the EPD accordingly (See **Appendix 16.1**).

1. Construction of trunk sewers and branch sewers in the central areas of Lahore and construction of new Gulshan-e-ravi disposal station
2. Construction of South West wastewater treatment plant (WWTP) including the collector channel
3. Construction of new drains and improvement of existing drains in Lahore
4. Reduction of unaccounted-for-water in public water supply through metering system and Improvement of water quality through replacement of Chlorinators at tube wells.

(3) Draft IEE Study Schedule

In cases where an IEE study is required for water supply project, a draft IEE procedural schedule for the project has been prepared in consultation with relevant officials at Punjab EPD and WASA getting assistance from the JICA Study Team as shown in **Figure 16.6**.



Source; WASA in association with Punbjab EPD and JICA Study Team

Figure 16.6 Draft IEE schedule for Water Supply Project

16.6 Specific Environmental and Social Aspects in the Projects Sites

16.6.1 Social Aspects

(1) Specific Settlements located around the Project Sits

1) Illegal Settlement next to the Gulshan -e- Ravi Disposal Station

An illegal settlement located in next to the Gulshan -e- Ravi Disposal Station has been identified as summarized in **Table 16.11**, and shown in **Figure 16.7** and **Photo 1 - 4**.

Table 16.11 Illegal Settlement next to the Gulshan -E- Ravi Disposal Station

Item	Description
1. Name of the settlement	There is no specific name of the settlement because they are migrants from different villages.
2. Population/Households	About 50 houses with population of approximately 500
3. Brief history of the settlement	The settlements are residing on the LDA road along the west wall of the WASA office Gulshan-e-Ravi. The road connects the main road to housing colony. The settlement is about 20 years old. They were few in number in the beginning and then gradually the settlement increased.
4. Original ownership of the land	LDA owns the land and there is a mettle road constructed by the LDA. Settlement is present on the drain on its west side and WASA office, Gulshan-e-ravi on its east side.
5. Evacuations by LDA	LDA notified and evacuated the land several times but migrants occupy the area again.

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JICA Study Team (Survey Point of GPS: N 31° 30.006', E74° 16.316')

Figure 16.7 Aerial View of Illegal Settlement next to the Gulshan -e- Ravi Disposal

Photo1 DS Gate and Illegal Settlement

Photo 2 Illegal Settlement's Houses

Photo3 Inside of the Illegal Settlement

Photo4 South Gate of the Illegal Settlement

Possible impacts on the settlement by the projects, especially both stages of construction and operation of a new pumping station, are not predicted at all by the following reasons;

- A proposed new pumping station is planned to be constructed on the premises of WASA for the existing Gulshan-e-Ravi Disposal Station (DS)
- Location of necessary pipes to the new station are planned to be constructed on not immediate area of the illegal settlements and to be laid underground

Therefore, those who are living in the settlement are not affected ones by the project.

2) Settlement located in next to the Preset Site for South West WWTP

A settlement located in next to the WASA's premises for proposed WWTP. Outlines of the settlement are summarized in **Table 16.12** and shown in **Figure 16.8** and **Photo 5 and 6**.

Based on the reconnaissance survey conducted by the JICA Study Team and reviews of existing data and information on environment such as prevail wind direction , it can be evaluated that the settlement is not affected one by the project (See **Item 16.8.4**).

Table 16.12 A Settlement next to the Preset Site for South West WWTP

Item	Description
1. Name of the settlement	Shadewal acer is the name present on the south of the proposed WWPT in Babu Sabu.
2. Population/Households	According to the local resident and WASA, total household are approximately 100 and population of about 1,000-1,200.
3. Brief history of the settlement	Shadewal acer is a private land near the proposed Wastewater Treatment facility. It was established in 1988 after WASA purchased the land for the wastewater treatment facility. Residents are immigrants from different villages and purchased that land for agricultural purposes. The major sources of income of the residents are agriculture and livestock.

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Figure 16.8 Aerial View of a Settlement in South to Preset Site for the WWTP

Photo 5 North side of the Settlement

Photo 6 South side of the Settlement

(2) Local People Affected by the Projects

1) Illegal occupation(by former owners) of the Preset Site for the WWTP

The proposed wastewater treatment plant (WWTP) is planned to be constructed in the land of a former flooding area of the Ravi River where was purchased by WASA in the year of 1992 and 1996. On and along the WASA's premises for the proposed WWTP, settlements including slums are not identified at all. In addition, no major buildings were found in the land. However, some farmers are temporally using the land. According to WASA, there were 95 farmers who are occupying total area of 711 acres on the WASA's premises for the proposed WWTP and are to be evacuated as shown in **Table 16.13**.

Table 16. 13 Number of Illegal Occupation by Former Owners to be Evacuated

No.	Name of the occupant	Area (Acre)	Address/village	No.	Name of the occupant	Area (Acre)	Address/village
1	*- omitted -*	5	Niaz beg, Lahore	49	*- omitted -*	2	Jinaz Gah Chuberji, Lahore
2	*- omitted -*	6	Jhugian nagra, Lahore	50	*- omitted -*	5	Babu Sabu, Lahore
3	*- omitted -*	5	Kot muhamadi, Lahore	51	*- omitted -*	10	Babu Sabu, Lahore
4	*- omitted -*	4	Jhugian shahab Din, Lahore	52	*- omitted -*	10	Babu Sabu, Lahore
5	*- omitted -*	1	Shadewal acer, Lahore	53	*- omitted -*	5	Babu Sabu, Lahore
6	*- omitted -*	3	Shadewal acer, Lahore	54	*- omitted -*	5	Niaz Beg, Lahore
7	*- omitted -*	3	Niaz beg, Lahore	55	*- omitted -*	5	Babu Sabu, Lahore
8	*- omitted -*	5	Kharak Haidri colony, Lahore	56	*- omitted -*	2	Shadewal acer, Lahore
9	*- omitted -*	4	Niaz Beg, Lahore	57	*- omitted -*	8	Niaz Beg, Lahore
10	*- omitted -*	8	Niaz Beg, Lahore	58	*- omitted -*	10	Niaz Beg, Lahore
11	*- omitted -*	3	Hunjerwal, Lahore	59	*- omitted -*	10	Shadewal acer, Lahore
12	*- omitted -*	8	Shadewal acer, Lahore	60	*- omitted -*	14	Babu sabu, Lahore
13	*- omitted -*	3	Shadewal acer, Lahore	61	*- omitted -*	4	Shadewal acer, Lahore
14	*- omitted -*	5	Shadewal acer, Lahore	62	*- omitted -*	2	Shadewal acer, Lahore
15	*- omitted -*	6	Shadewal acer, Lahore	63	*- omitted -*	9	Shadewal acer, Lahore
16	*- omitted -*	5	Niaz Beg, Lahore	64	*- omitted -*	20	Hunjerwal, Lahore
17	*- omitted -*	6	Shadewal acer, Lahore	65	*- omitted -*	8	Niaz Beg, Lahore
18	*- omitted -*	6	Shadewal acer, Lahore	66	*- omitted -*	25	Niaz Beg, Lahore
19	*- omitted -*	8	Meher dera, Awan town, Lahore	67	*- omitted -*	12	Niaz Beg, Lahore
20	*- omitted -*	12	Meher pura, Awan town, Lahore	68	*- omitted -*	8	Niaz Beg, Lahore
21	*- omitted -*	6	Niaz beg, Lahore	69	*- omitted -*	9	Niaz Beg, Lahore
22	*- omitted -*	15	Babu sabu, Lahore	70	*- omitted -*	5	Shadewal acer, Lahore
23	*- omitted -*	5	Shah di Khoi, Lahore	71	*- omitted -*	3	Shadewal acer, Lahore
24	*- omitted -*	15	Konj pora, Lahore	72	*- omitted -*	4	Shadewal acer, Lahore
25	*- omitted -*	4	Konj pura, Lahore	73	*- omitted -*	20	Niaz Beg, Lahore
26	*- omitted -*	5	Dholan wal, Lahore	74	*- omitted -*	20	Kharak, Lahore
27	*- omitted -*	3	Chugian nagra, Lahore	75	*- omitted -*	6	Shadewal acer, Lahore
28	*- omitted -*	8	Chugian nagra, Lahore	76	*- omitted -*	2	Shadewal acer, Lahore
29	*- omitted -*	4	Chugian nagra, Lahore	77	*- omitted -*	8	Shadewal acer, Lahore
30	*- omitted -*	5	Chugian nagra, Lahore	78	*- omitted -*	4	Shadewal acer, Lahore
31	*- omitted -*	5	Chugian nagra, Lahore	79	*- omitted -*	40	Babu Sabu, Lahore
32	*- omitted -*	5	Chugian nagra, Lahore	80	*- omitted -*	7	Chugain Nagra, Lahore
33	*- omitted -*	8	Babu Sabu, Lahore	81	*- omitted -*	20	Babu Sabu, Lahore
34	*- omitted -*	4	Babu Sabu, Lahore	82	*- omitted -*	5	Koonj Pura, Lahore
35	*- omitted -*	5	Chigian Shanab Din, Lahore	83	*- omitted -*	3	Koonj Pura, Lahore
36	*- omitted -*	5	Babu Sabu, Lahore	84	*- omitted -*	3	Shadewal acer, Lahore
37	*- omitted -*	12	Babu Sabu, Lahore	85	*- omitted -*	5	Shadewal acer, Lahore
38	*- omitted -*	20	Babu Sabu, Lahore	86	*- omitted -*	3	Shadewal acer, Lahore
39	*- omitted -*	8	Babu Sabu, Lahore	87	*- omitted -*	5	Shadewal acer, Lahore
40	*- omitted -*	4	Babu Sabu, Lahore	88	*- omitted -*	5	Babu Sabu, Lahore
41	*- omitted -*	3	Babu Sabu, Lahore	89	*- omitted -*	5	Chugian Nagra, Lahore
42	*- omitted -*	4	Babu Sabu, Lahore	90	*- omitted -*	5	Dholan Wal, Lahore
43	*- omitted -*	20	Babu Sabu, Lahore	91	*- omitted -*	20	Niaz Beg, Lahore
44	*- omitted -*	5	Chugain Nagra, Lahore	92	*- omitted -*	3	Shadewal acer, Lahore
45	*- omitted -*	5	Chugain Nagra, Lahore	93	*- omitted -*	10	Niaz Beg, Lahore
46	*- omitted -*	8	Chugain Nagra, Lahore	94	*- omitted -*	8	Niaz Beg, Lahore
47	*- omitted -*	2	Babu Sabu, Lahore	95	*- omitted -*	2	Shadewal acer, Lahore
48	*- omitted -*	8	Babu Sabu, Lahore		**Total**	**711**	-

Source: WASA

Note: Name of the occupants were omitted by the JICA Study Team

According to WASA present situation of those 95 are as follows;

1. All 95 farmers who are illegally (temporary) cultivating the land including all farm crops and stumpages were compensated by WASA (when WASA purchased the land in 1992 and 1996).

2. After that, no farmer did emergence at all to the land for the cultivation other than those 95 farmers, which was confirmed by WASA as of 2nd December 2009.
3. Namely all cultivators remain the same of the former 95 owners identified in 2002 as illegal occupation, which was confirmed by WASA as of 2nd December 2009.

Principal crops cultivated by those who are using the land illegally (temporary) in the proposed WWTP are as follows.

- Rice - Wheat - Veterinary fodder - Vegetables - Corns

2) Owners of Encroachments/buildings in the Preset Site for Collector Channel

On and along the WSAS's premises where was purchased in 1992 and 1996 for the collector channel, 74 buildings and crop land/fields owned by 74 peoples respectively have been identified by a perambulation survey conducted in October 2009 by the JICA study team and drawings (See No. CC-01-11 of **Appendix 13.6**) of which results are summarized in **Table 16.14**. These buildings/ encroachments covered a small portion in the WASA's land where the access road is proposed to be constructed (See No.CC12 of **Appendix 13.6**).

Table 16. 14 Owners of Encroachments along/on the Site for the Collector Channel

No.*	Type of Encroachment (Build/House/Shop/UC)	Distance from** WWTP Site (m)	Location** (Left/Right)	No.*	Type of Encroachment (Build/House/Shop/UC)	Distance from** WWTP Site (m)	Location** (Left/Right)
1	Building	700-750	Left	38	Building	2950-3000	Left
2	Wall	700-800	Right	39	Well and Tank	3100-3150	Left
3	UC	750-800	Right	40	Gate	3300-3350	Left
4	Pylon	750-800	Right	41	Building	3300-3350	Left
5	Wall	800-900	Right	42	Building	3350	Left
6	Building	900	Right	43	Building	3400-3450	Left
7	Building	900-950	Right	44	Building	3400-3450	Left
8	Field	1000	Left	45	Building	3450	Left
9	Field	1000-1050	Left	46	Building	3500	Right
10	Building	1150-1200	Left	47	Field	3550	Left
11	Building	1150-1200	Left	48	Factory	4450-4650	Right
12	Wall	1200-1250	Left	49	House	4650	Left
13	Building	1200-1250	Left	50	Field	4650-470	Left
14	Field	1200-1250	Left	51	House	4650-4750	Right
15	Building	1200-1300	Left	52	House	4700-4750	Right
16	Pylon	1300	Right	53	House	4750-4800	Left
17	Building	1300	Right	54	House and wall	4750-4850	Right
18	Field	1300-1350	Left	55	Field	4900-4950	Right
19	Building	1300-1400	Left	56	House	4950-5000	Left
20	Building	1400	Left	57	Building	5000-5050	Left
21	Building	1350-1450	Left	58	Building	5000-5050	Right
22	Building	1400-1500	Left	59	Building	5050	Right
23	House	1500-1550	Left	60	Wall	5150	Left
24	Building	2000-2050	Left	61	Wall	5200-5300	Right
25	Building	2050	Right	62	Field	5300-5350	Left
26	Wall	2300-2400	Right	63	Wall	5350-5400	Right
27	Factory	2400-2450	Right	64	Wall	5350-5450	Right
28	Factory	2450-2550	Right	65	Building	5500-5550	Right
29	Building	2650-2700	Right	66	Building	5600-5700	Right
30	Gate	2650-2700	Left	67	Building	5700-5800	Right
31	Building	2750-2800	Left	68	Building	5700-5750	Left
32	Building	2750-2800	Right	69	Wall	5750	Left
33	Building	2800-2850	Left	70	Building	5950-6100	Right
34	Building	2800-2850	Left	71	Building	6150-6300	Right
35	Building	2850-2900	Left	72	House	6950-7050	Right
36	Dera	2950-3000	Right	73	Shops and Houses	7250-7400	Right
37	Building	2950-3000	Left	74	Shops and Houses	7300-7400	Left

* Owned by 74 peoples respectively (confirmed by WASA as of 2nd December 2009
** See Appendix 13.6 (No. CC-01-11), UC; Under Construction (as of Oct. 2009), Dera; Small Sitting Place

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(3) Other Social Environment of locations for Trunk Sewer and Drain Projects

Figure 16.9 shows the present land use in Lahore. In addition, **Figure 16.10 and 16.11** show locations of public facilities, and historical, archeological, cultural sites and parks & gardens.

Based on the review and basic recognitions of socially and culturally important sites, perambulatory surveys were conducted on and along existing roads as shown in **Table 16.15 and 16.16**, under which sewer and drain projects are proposed to be constructed (Refer to **Figure 11.1 and 11.3**).

As a result of the surveys, illegal settlement, socially and culturally important site on those existing roads are not identified at all.

In addition, according to EPD, and the Guidelines for Sensitive and Critical Areas Oct. 1997, total six world heritage sites are in Pakistan out of which two are located in city of Lahore which are about 8-10 Km from the proposed WWTP site.

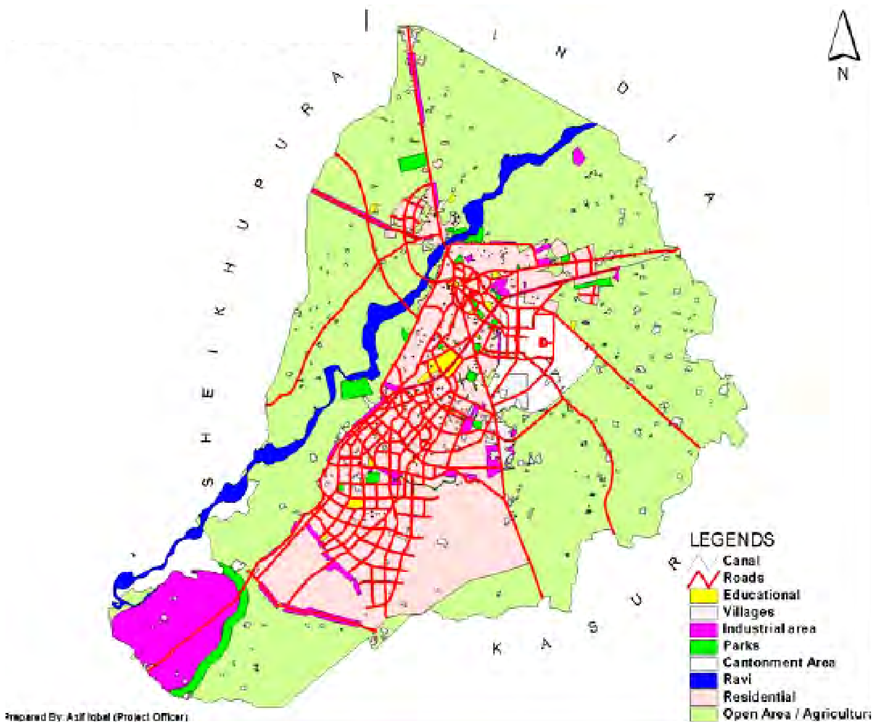

Figure 16.9 Land Use Map of Lahore

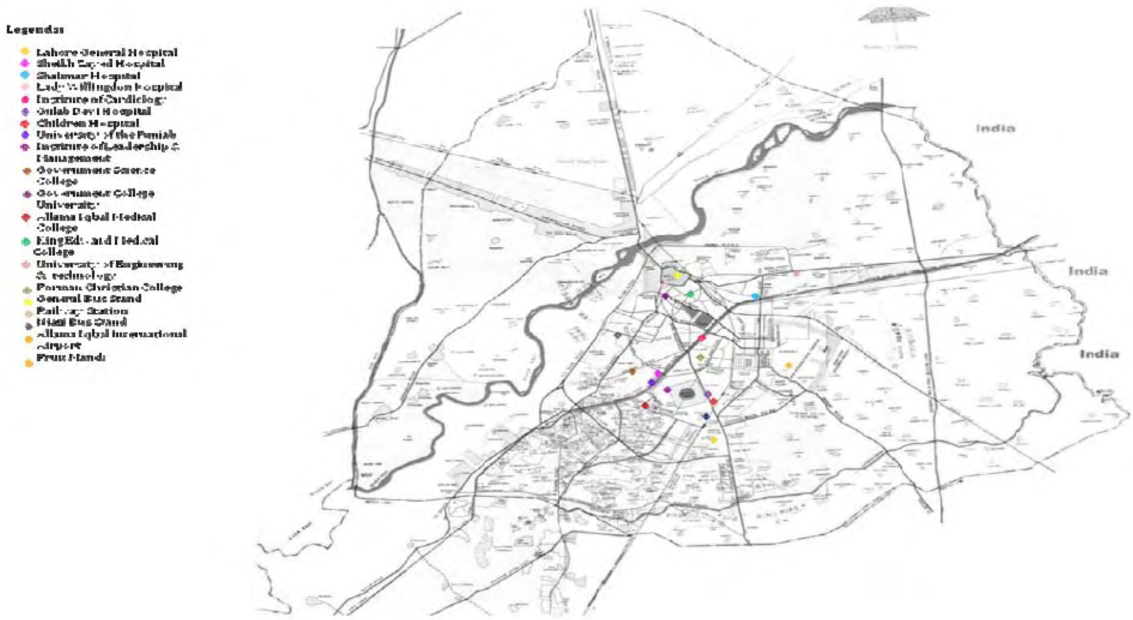

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Figure 16.10 Public Facilities in Lahore

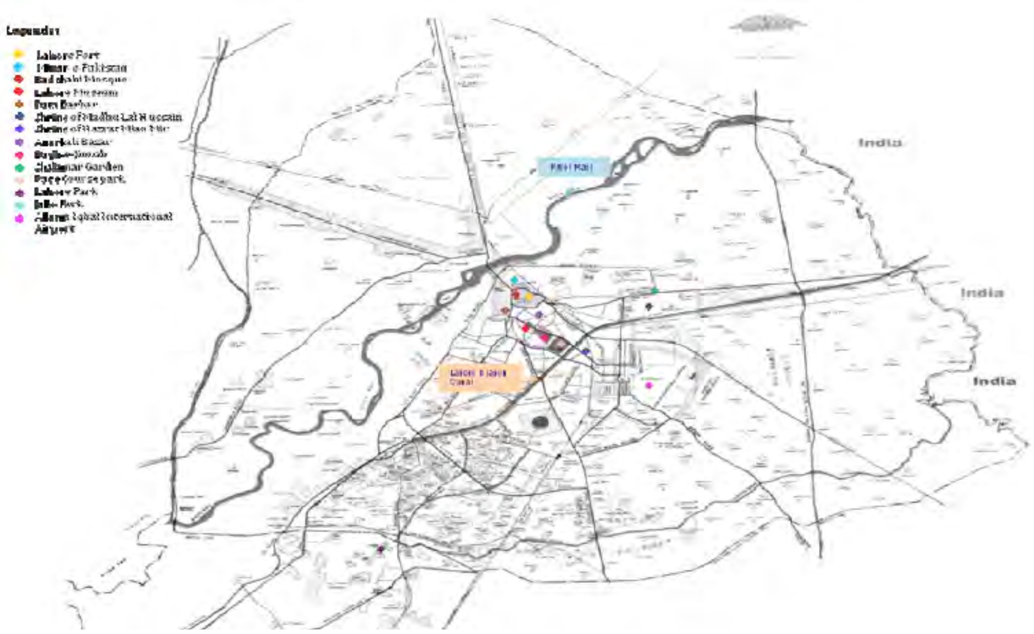

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Figure 16.11 Historical, Archeological, Cultural Sites, Parks& Gardens in Lahore

Table 16.15 Survey along Proposed Trunk Sewer

from Gulshn-e-ravi pumping station to Mian Meer and Gulberg

Point No.	Survey Point*	North (N)	East (E)
1	Within Slums near Gulshan-e-ravi pumping station	31°30.006’	74°16.316’
2	Near Samanabad Mor	31°32.813’	74°17.464’
3	Rasul Park	31°32.482’	74°18.375’
4	New Mozang	31°32.470’	74°18.820’
5	Near Camp Jail	31°32.375’	74°19.198’
6	Near Mental Hospital	31°32.211’	74°20.170’
7	Near Jail Road Underpass (west)	31°32.071’	74°20.386’
8	Near Jail Road Underpass (east)	31°32.047’	74°20.462’
9	MM Alam Road	31°31.847’	74°20.628’
10	Mangat Road	31°31.595’	74°21.351’
11	Zafar Ali Road	31°31.091’	74°20.854’
12	Mian Meer	31°32.648’	74°21.565’
13	Pumping station at Larex Colony	31°33.756’	74°21.239’
14	Ghari Shau Bazar	31°33.833’	74°20.878’
15	Pumping Station Ghazi Mualla	31°33.884’	74°20.892’
16	At start of Ghari Shau Bazar	31°33.793’	74°20.777’
17	Ghari Shau Ckowk	31°33.821’	74°20.739’
18	Near Railway Head Quater	31°34.135’	74°20.386’
19	Starting point of drain at Davis road	31°33.357’	74°20.391’
20	Near Press Club	31°33.698’	74°20.193’
21	Starting point of drain near Haji Camp	31°34.302’	74°20.116’
22	Starting point of drain near Lahore Hotel	31°34.136’	74°19.707’
23	Near Cathedral Church Mall Road	31°33.959’	74°18.974’
24	Starting point in Krishan Nagar	31°33.832’	74°17.415’
25	Near MAO college	31°33.744’	74°18.252’
26	Near Chauburi Chowk	31°33.229’	74°18.268’
27	Near Morr Samanabad	31°32.656’	74°17.696’

* Refer to **Figure 11.1**

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Table 16.16 Survey along Proposed Main and Tertiary Drains

Point No.	Survey Point**	North (N)	East (E)
1	Starting point of main drain at Sunder Das Road	31°33.149’	74°21.346’
2	Near Press Club Shimla Hill	31°33.685’	74°20.231’
3	At Davis Road Near Ambassador Hotel	31°33.584’	74°20.330’
4	At Habibullah Road	31°33.575’	74°20.408’
5	In front of Naval College on Mall Road	31°32.757’	74°20.857’
6	Near Governor House	31°33.247’	74°20.153’
7	At Sharae (road) Ewan-e-tijarat near Baghe-e-Jinnah Gate	31°33.000’	74°20.013’
8	Within GOR near round- about	31°32.529’	74°20.553’
9	At the starting point main drain within GOR.	31°32.885’	74°20.252’
10	Within GOR near Kinnaired College	31°32.477’	74°20.492’
11	At Shadman Chowk Jail Road	31°32.535’	74°19.763’
12	Near Shadman Market	31°32.368’	74°19.734’
13	At Chowk Dar-ul-shifa Shadman	31°32.899’	74°19.657’
14	Starting point of main drain at Shah Jamal Road	31°31.792’	74°19.631’
15	Near WASA revenue office in Shadman	31°31.719’	74°19.625’
16	Near F.C under pass	31°31.686’	74°19.914’
17	At starting point of main sewer line in shadman	31°31.520’	74°19.759’
18	At junction of Cantonment and Governor House drain in Samanabad	31°32.515’	74°18.316’
19	Bridge at Cantonment drain in new samanabad	31°32.559’	74°18.489’
20	At start of Tertiart Drain in New Mozang	31°32.858’	74°18.590’
21	Near Eid Gah on Bhawal Pur road	31°30.074’	74°18.445’
22	At junction of Central (proposed) and Cantoment drain in Islamia Park	31°32.613’	74°18.209’
23	Near Chauburji Chowk at Punch Road	31°33.139’	74°18.267’
24	On Lake road near Punjab University	31°33.652’	74°18.459’
25	At start of old Anarkali Bazaar	31°33.749’	74°18.498’
26	At Nabha road near Food Street	31°33.909’	74°18.543’
27	At Mall road near Anarkali Bazar	31°34.073’	74°18.593’
28	At Lower Mall road near Post Master General	31°34.212’	74°18.285’
29	At Lower Mall road near G.C. University	31°34.358’	74°18.354’
30	At start of proposed Abdali road drain near Punjab Secretariat	31°34.002’	74°18.071’
31	Neeli-Bar Mor Islampura	31°34.045’	74°17.905’
32	Near Main Outfall Disposal station	31°34.322’	74°17.482’
33	Near Main Outfall Disposal station(2)	31°34.098’	74°17.191’
34	Near Darbar Mehmud Shah, Islampura	31°33.835’	74°17.084’
35	Main Bazaar Sandha road, Sandha	31°33.811’	74°17.258’
36	Near NADRA office, Sandha	31°33.833’	74°17.409’
37	Rajhghar Chowk, Rajhghar	31°33.519’	74°17.743’
38	Rajhghar Chowk, Rajhghar(2)	31°33.714’	74°18.069’
39	Firdous Cenima chowk, Sandha	31°33.710’	74°17.864’
40	Firdous Cenima chowk, Sandha(2)	31°33.552’	74°18.088’
41	In Sham Nagar Near Chaubuji	31°33.275’	74°17.877’
42	Abid Market Queens road	31°32.952’	74°18.929’
43	Starting point at Waris Road	31°32.983’	74°19.178’
44	Near Fatima Jinnah Medical College at Queens road	31°33.241’	74°19.205’
45	At Mozang Road near Ganga Ram hospital	31°33.337’	74°19.281’
46	Near Plaza Cinema at Queens Road	31°33.463’	74°19.381’
47	Near Punjab Assembly	31°33.578’	74°19.507’
48	Near Islamia College Cooper road	31°33.807’	74°19.568’
49	Lakshmi Chowk	31°34.042’	74°19.509’
50	Naulakha Church near Railway Station	31°34.333’	74°20.107’
51	Near Railway Station	31°34.627’	74°20.099’
52	Regal Chowk	31°33.663’	74°19.186’

** Refer to **Figure 11.3**

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Table 16.16 Survey along Proposed Main and Tertiary Drains (continued)

Point No.	Survey Point**	North (N)	East (E)
53	Near Sfan wala Chowk at Temple road	31°33.456'	74°19.032'
54	Near Mozang adda at Mozang road	31°33.557'	74°18.847'
55	Near Hamdard Building at Lytton road	31°33.551'	74°18.539'
56	Near Jain Mandar	31°33.725'	74°18.505'
42	Abid Market Queens road	31°32.952'	74°18.929'
43	Starting point at Waris Road	31°32.983'	74°19.178'
44	Near Fatima Jinnah Medical College at Queens road	31°33.241'	74°19.205'
45	At Mozang Road near Ganga Ram hospital	31°33.337'	74°19.281'
46	Near Plaza Cinema at Queens Road	31°33.463'	74°19.381'
47	Near Punjab Assembly	31°33.578'	74°19.507'
48	Near Islamia College Cooper road	31°33.807'	74°19.568'
49	Lakshmi Chowk	31°34.042'	74°19.509'
50	Naulakha Church near Railway Station	31°34.333'	74°20.107'
51	Near Railway Station	31°34.627'	74°20.099'
52	Regal Chowk	31°33.663'	74°19.186'
53	Near Sfan wala Chowk at Temple road	31°33.456'	74°19.032'
54	Near Mozang adda at Mozang road	31°33.557'	74°18.847'
55	Lytton road near Hamdard building	31°33.551'	74°18.539'
56	Near Jain Mnader at Lytton road	31°33.725'	74°18.505'
57	2nd Round-About in Samanabad	31°32.355'	74°18.380'
58	Main market Samanabad	31°32.422'	74°18.262'
59	1st Round-About in Samanabad	31°32.508'	74°18.097'
60	3st Round-About in Samanabad	31°31.882'	74°18.183'
61	Paki Thati Stop Samanabad	31°31.850'	74°17.867'
62	Paki Thati Bazaar	31°31.830'	74°17.763'
63	Junction of Multan Road and Mumtaz Road	31°31.880'	74°17.241'
64	Zubaida Park Samanabad	31°32.002'	74°17.465'
65	Near Larek Cinema at Multan road	31°32.220'	74°17.463'
66	At Bund road near start of proposed Sodiwall Drain	31°32.101'	74°16.758'
67	At Bund road near start of proposed Gulshn-e-ravi drain in Sandha	31°33.591'	74°16.680'
68	D-Block in Gulshn-e-ravi	31°33.210'	74°16.754'
69	Near Foot-ball ground in Gulshn-e-ravi	31°33.124'	74°16.720'
70	Tube well near Foot-ball ground in Gulshn-e-ravi	31°33.028'	74°16.651'
71	Near Cantonment drain in Gulshan-e-ravi	31°32.635'	74°16.646'
72	At junction of Cantonment drain and proposed Bund road drain	31°32.288'	74°16.046'
73	Near Skyways Bus station at Bund road	31°32.223'	74°16.354'
57	2nd Round-About in Samanabad	31°32.355'	74°18.380'
58	Main market Samanabad	31°32.422'	74°18.262'
59	1st Round-About in Samanabad	31°32.508'	74°18.097'
60	3st Round-About in Samanabad	31°31.882'	74°18.183'
61	Paki Thati Stop Samanabad	31°31.850'	74°17.867'
62	Paki Thati Bazaar	31°31.830'	74°17.763'
63	Junction of Multan Road and Mumtaz Road	31°31.880'	74°17.241'
64	Zubaida Park Samanabad	31°32.002'	74°17.465'
65	Near Larek Cinema at Multan road	31°32.220'	74°17.463'
66	At Bund road near start of proposed Sodiwall Drain	31°32.101'	74°16.758'
67	At Bund road near start of proposed Gulshn-e-ravi drain in Sandha	31°33.591'	74°16.680'
68	D-Block in Gulshn-e-ravi	31°33.210'	74°16.754'
69	Near Foot-ball ground in Gulshn-e-ravi	31°33.124'	74°16.720'
70	Tube well near Foot-ball ground in Gulshn-e-ravi	31°33.028'	74°16.651'
71	Near Cantonment drain in Gulshan-e-ravi	31°32.635'	74°16.646'
72	At junction of Cantonment drain and proposed Bund road drain	31°32.288'	74°16.046'
73	Near Skyways Bus station at Bund road	31°32.223'	74°16.354'

** Refer to **Figure 11.3**

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16.6.2 Environmental Aspects

(1) Industrial Wastewater and Heavy Metals

In Lahore, total 2,697 factories of 118 types of industry are registered among which 75 factories are categorized as "large scale factories". As reviewed in **Chapter 3**, environmental monitoring for wastewater quality from these factories has not fully been implemented so far.

Due to the fact of extremely limited implementation of industrial wastewater quality monitoring, it is considered that some of the factories may discharge wastewater including heavy metals to existing sewers and drains without sufficient evaluation of the wastewater qualities to be met with the National Environmental Quality Standards (NEQS).

On the one hand, as the result of wastewater monitoring surveys conducted by EPA once a year at 19 points, and by the JICA study team for the projects at total 24 points (See **Figure 16.12**) where are the project's catchment area (River: 6 points, Drain; 13 points, and Canal; 5 points) individually (See P.3-5 of **Chapter 3** and **Appendix 3.4, 3.11, 3.12 and 3.13**), several heavy metals have been detected in the wastewater in Lahore.

However, each concentration of these heavy metals monitored was less than NEQS for Municipal and Liquid Industrial Effluents (See **Appendix 3.1**). **Table 16.17** summarizes heavy metals monitored by the JICA Study Team.

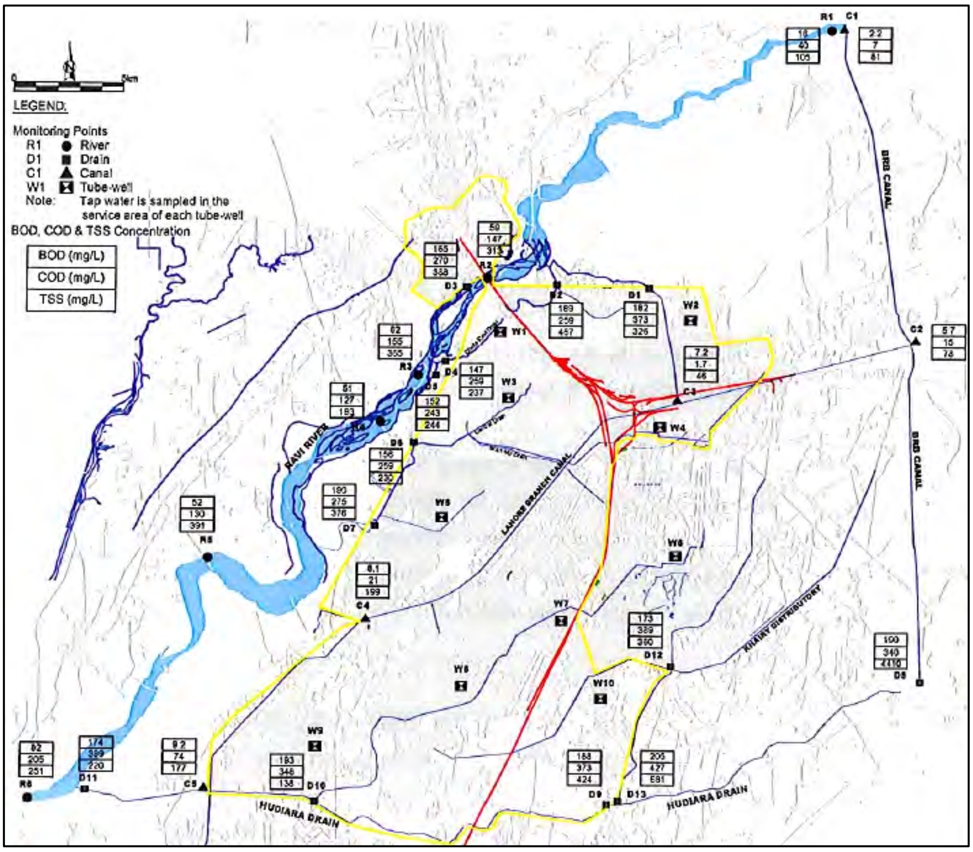

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Figure 16.12 Monitoring Points

Table 16.17 Summary of Monitoring Results of Heavy Metals

Sr. No. (Sampling Points)	Heavy Metals	Fe	Mn	As	Hg	$Cr^{+3,+6}$
	NEQS Standards * (mg/l)	8.0	1.5	1.0	0.01	1.0
	Standards of Japan** (mg/l)	10.0	1.0	0.1	0.005	0.5***
R1- R6	Maximum	1.11	BDL	0.02540	0.0006774	0.121
	Minimum	1.11	BDL	0.01038	0.0000256	0.003
D1-D13	Maximum	nil	nil	0.07460	0.0008956	0.515
	Minimum	nil	nil	0.02230	BDL	0.052
C1-C5	Maximum	3.86	0.04	0.01302	0.0002090	BDL
	Minimum	1.86	BDL	0.00342	0.0002044	BDL

Note R; Sampling from Ravi River, D; Sampling from Drainages, C; Sampling from Canals (See Appendix 3.1)
BDL: Below Detection Level
* NEQS Register No. of M-302 l.7646, August 10, 2000,
** Wastewater Discharge Standards, Ministry of Environment of Japan,
***Only Cr^{+6}

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In addition, **Table 16.18** shows an immediate comparison between NEQS and similar standards (Wastewater discharge standards) of Japan. Based on the comparison, it can be evaluated that NEQS adopts a nearly equal level of the Japanese standards of wastewater discharge regulated by Ministry of Environment of Japan.

Table 16.18 Comparison of Heavy Metal Standards for Wastewater (mg/l)

S.No. NEQS	NEQS Parameter for Heavy Metals	Revised Standards of NEQS* Into Inland Waters	Into Sewage Treatment	Into Sea	Wastewater Discharge Standards of Japan**
17.	Cadmium	0.1	0.1	0.1	0.1
18.	Chromium (trivalent and hexavalent)	1.0	1.0	1.0	0.5 (only Cr^{+6})
19.	Cropper	1.0	1.0	1.0	3.0
20.	Lead	0.5	0.5	0.5	0.1
21.	Mercury	0.01	0.01	0.01	0.005
26.	Zinc	5.0	5.0	5.0	5.0
27.	Arsenic	1.0	1.0	1.0	0.1
29.	Iron	8.0	8.0	8.0	10.0
30.	Manganese	1.5	1.5	1.5	1.0

Source: *NEQS Register No. of M-302 l.7646, August 10, 2000
**Ministry of Environment of Japan

The basic concept of the WWTP to be constructed by this project is to reduce 80% of BOD load which discharges those heavy metals as they are (less than NEQS) to environment. Therefore, no negative impact on environment is predicted by the operation of WWTP at all.

(2) Heavy Metals in Sludge

Heavy metals existing in sewers' and channels' sludge/silt were monitored and assessed by WASA in 2004 as part of an IEE study for the "Project for the Retrieval of Sewage and Drainage System in Lahore City" which is a Japanese Grant Aid Project. **Table 16.19** and **Table 16.20** show the monitoring results.

Table 16.19 Composition of Sewer Sludge

#	Sampling Point	% Organics	Cd (mg/kg)	Hg (ug/kg)	As (mg/kg)	Pb (mg/kg)	Cr (mg/kg)
1	Main Outfall No.2 (A)	9.48	25.7	20	Nil	Nil	155
2	Shad Bagh P.S(B)	5.0	21	10	Nil	Nil	145
3	Main Outall No.1 (G)	32.4	BDL	BDL	Nil	23.8	151
4	Gulshan . eRavi P.S (H1)	4.48	81.7	10	Nil	3.46	117

Note: Total Cynides remain Below Detection Level (BDL)
Source: Initial Environmental Examination Report, Project for the Retrieval of Sewage and Drainage System in Lahore City 2004 WASA

Table 16.20 Composition of Channel Sludge

#	Sampling Point	% Organics	Cd (mg/kg)	Hg (ug/kg)	As (mg/kg)	Pb (mg/kg)	Cr (mg/kg)
1	Chota Ravi Drain near Ravi Road (A)	7.4	25.7	8	BDL	11.3	122
2	Siddique Pura Drainage Station(B)	6.4	21	22	BDL	7	95
3	Lakshmi Chowk Drain (G)	28.3	BDL	BDL	BDL	19.3	62
4	Babu Sabu Drainage Station (G + H1)	11.9	81.7	13	BDL	14	168

Note: Total Cynides remain Below Detection Level (BDL)
Source: Initial Environmental Examination Report, Project for the Retrieval of Sewage and Drainage System in Lahore City 2004 WASA

Due to the fact that standards for the disposal of sludge and silt do not exist in NEQS of Pakistan, the IEE has assessed the value of the heavy metals identified in the monitoring studies above based on US EPA standards of land application of Biosolids (Sludge/Silt) as shown in **Table 16.21**. The land application includes "agricultural land", "forest land", "disturbed land" and "dedicated land disposal site".

Table 16.21 Metals Concentration for Loading Rates of Biosolids

#	Pollutant	Ceiling Concentration	
		lb/tons	mg/kg
1	Arsenic (As)	0.15	75
2	Cadmium (Cd)	0.17	85
3	Chromium (Cr)	-	-
4	Lead (Pb)	1.68	840
5	Mercury (Hg)	0.11	57

Ref MetCalf & Eddy, Ed 2003
Source: Initial Environmental Examination Report, Project for the Retrieval of Sewage and Drainage System in Lahore City 2004 WASA

The IEE report concluded the assessment of the heavy metals as follows;

- Silt/sludge removed from sewers and channels meet (less than) the US EPA standards for disposal at dedicated landfill site
- It is worth mentioning here that US EPA has made no standards for Chromium (Cr) concentration in the land application of sludge/silt
- Therefore (Cr) standards of other countries were consulted which are given in **Table 16.22**.
- A comparison (of Cr) shows that silt removed from drains and channels meet the internationally acceptable standards for Cr

Table 16.22 Chromium containing sludge standards for reuse in agriculture in different Countries

Parameter	France	Germany	Netherlands	Belgium	Sweden
Max Permissible Limits of Cr (mg/kg)	1,000	900	500	500	200

Study on the Safe Disposal of Tannery Sludge, UNIDO, 1998
Source: Initial Environmental Examination Report, Project for the Retrieval of Sewage and Drainage System in Lahore City 2004 WASA

(3) Protected Areas and Ecosystem

According to EPD, and the Guidelines for Sensitive and Critical Areas Oct. 1997, there are about 64 protected areas (ecosystems) in Punjab. However, none of them is located in Lahore.

In addition, in April 2007, an “EIA study for the South west Sewage Treatment Plant, Lahore” was prepared by a French assistance on the same premises (the lands purchased by WASA in 1992 and 1996 are exactly utilized for the JICA projects' sites) for the WWPT and collector channel. In the EIA report in 2007, no such protected areas and ecosystem in all project sites identified at all.

On the other hand, the projects are summarized as follows;

- Proposed sewers and drains are constructed under the existing roads
- Proposed pumping station is constructed in the Gulshan -e- Ravi Disposal Station
- Proposed collector channel is excavated under the ground level on the WASA's premises used as a temporally drain

- Proposed WWPT is constructed in the land of a former flooding area of River Ravi where is being used as farming land.

In addition, as a result the perambulatory surveys by the JICA study team, such areas are not identified at all.

(4) Fauna and Flora

3) Fauna

In urban Lahore, there are areas which can truly be classified as places of breeding, nesting and roosting for several bird species. According to a study conducted in 1965 there were 240 bird species in Lahore. In another study (1992) only 101 bird species from the parks of Lahore were recorded. However, with an increase in the rate of urbanization, the ecology of Lahore has been considerably affected and population of birds in Lahore has reduced to just 85 including the resident and migratory ones. **Table 16.23** shows a list of birds present in Lahore.

Table 16.23 List of Birds Present in Lahore

#	Common Name	Zoological Name
1	Bank Myna	*Acridotheres ginginianus*
2	Blackbird	*Turdus merula*
3	Black drongo	*Dicrurus macrocerus*
4	Rock Pigeon	*Columbia livia*
5	Common babbler	*Turdoides caudate*
6	Common Myna	*Acridotheres tristis*
7	Garden Warbler	*Sylvia borin*
8	Indian Robin	*Saxicoloides*
9	Whiite-browed wagtail	*Motacilla madaraspatensis*
10	Little green bee-eater	*Merops orientalis*
11	Asian Pied Starling	*Sturnus contra*
12	Red turtle dove	*Streptopelia tranquebarica*
13	Red-vented bulbul	*Pycnonotus cafer*
14	Ring-necked dove	*Streptopelia capicola*
15	Lang-tailed Shrike	*Lanius schach*
16	Great spotted woodpecker	*Dendrocopos major*
17	White-browed wagtail	*Motacilla maderaspatensis*
18	Asian Koel	*Eudynamys scolopacea*
19	Common hawk-cuckoo	*Cuculus varius*
20	Coomon Koel	*Eudynamys scolopacea*
21	Pied Cuckoo	*Clamator jacobinus*
22	Red turtle dove	*Streptopelia tranquebarica*
23	Ring-neck dove	*Streptopelia risoria*
24	Rose-ring parakeet	*Psittacula krameri*
25	White-backed vulture	*Gyps africanus*
26	White-breasted kingfisher	*Halcyon smynensis*

Source: Zoo Office, Lahore

Not only the birds, but different other classes of the animal species also play an important role for the habitat of the area as shown in **Table 16.24**.

Table 16.24 List of Different Classes of Animals

Mammals	Reptiles	Amphibians	Insects
Stray dogs	Monitor Lizard	Indus valley bullfrog	Dragonfly
Feral cats	Geckos	Common frogs	Damselfly
Donkeys	-	Toads	Butterflies
Cows	-	-	Honey bees
Bats	-	-	Earthworms
Goats	-	-	Centipedes
Small Indian mongoose	-	-	-
Indian palm squirrel	-	-	-
Buffalo	-	-	-
Mole	-	-	-
Horse	-	-	-
Sheep	-	-	-

Source: WWF

However, due to the urbanization, Lahore does not contain any of the wildlife species.

4) Flora

Several types of floral species are present in Lahore, some of the principal trees, shrubs (plants) and herbs (ground covering plants). In addition, there are few floral species which are at the risk of extinction. **Table 16.25** shows the list of endangered and prohibited floral species prepared by the Forest and Wildlife Departments, Lahore.

However, there are no species to be threatened in Lahore reported by the Forest and Wildlife Departments, which are included in the IUCN Red data book.

Table 16.25 Endangered & Prohibited Species in Lahore

Endangered Species	Prohibited Species
Dalbergia sissoo	Eucalyptus species
Salvedora persica	Broussonetia papyrifera
Ficus bengalensis	Salmalia malabarica
Ficus religiosa	Populus nigra/Alba
Ficus enfectoria	Nerium odorum
Ficus glomerata	Thevetia nerifolia
Albbizia procera	-
Albizzia lebbek	-
Anogeissus acuminit	-
Artocarpus integrifolia	-
Artocarpus lakoocha	-
Azadirachta indica	-
Bischofia javanica	-
Berser Serrata	-
Dillenia indica	-
Meringa oleifera	-
Prosopis spiligera	-
Ziziphus mauritiana	-
Cassia alata	-
Jaguinia aristata	-
Tecoma undalata	-
Prosopis juliflora	-
Tamyrix articulate	-
Magnolia grandiflora	-

Source: Forest and Wildlife Department, Lahore

16.6.3 Sensitive Areas

As reviewed **item 16.6.1**, and (2) & (3) of 16.6.2 above, socially, culturally and environmentally sensitive areas in all projects areas are not identified at all.

16.7 Identification of Possible Impacts by the Projects

By considering the characteristics of environmental and social aspect in Lahore and project components of Phase 1, the following environmental and social impacts are predicted during construction and operation stages.

16.7.1 Social Impacts

Table16.26 shows an initial assessment of possible social impacts.

Table16.26 Initial Assessment of Possible Social Impacts by each Project

Proposed Projects	Possible Impacts					
	Resettlement		Evacuation/ Demolition		Living and Livelihood	
	Construction	Operation	Construction	Operation	Construction	Operation
Sewers[1]	No	No	No	No	In some degree	No
WWTP[2]	No	No	In some degree	No	In some degree	No
Drains[3]	No	No	No	No	In some degree	No
Water[4]	No	No	No	No	No	No

Note
1. Construction of trunk sewers and branch sewers in Lahore central areas and construction of new Gulshan-e-ravi disposal station
2. Construction of South West wastewater treatment plant (WWTP) including the collector channel
3. Construction of new drains and improvement of existing drains in Lahore
4. Reduction of UFW in public water supply through metering system & Improvement of water quality through replacement of Chlorinators at tube wells.

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(1) Evacuation and Demolition during Construction Stage

- There are 95 farmers who are occupying total area of 711 acres on the WASA's premises for the proposed WWTP
- On and along the WASA's land for the collector channel, there are encroachments of 74 buildings and crop land/fields (owned by 74 peoples respectively) which covered a small portion in the land where the access road is proposed.

Those who are using lands for the WWTP and Collector Channel are illegal act so that before the construction these projects, sooth evacuation of occupation, demolition of some of encroachment and necessary coordination and consultation are required accordingly (See **Item 16.6.1 and 16.8.1**).

(2) Living and Livelihood during Construction Stage

During constriction stage of these projects excluding water supply project, heavy vehicles and equipment are used for excavations and constructions. Therefore, road traffics will be increased and especially cordoned for the sewer and drain constructions which cause to negative impacts on living and livelihood such as circumvention of daily transportation routes as well as traffic accidents.

16.7.2 Environmental Impacts

Table16.27 shows an initial assessment of possible Environmental impacts.

Table16.27 Initial Assessment of Possible Environmental Impacts by Each Project

Proposed Projects	Possible Impacts					
	Noise, Vibration		Air pollution (Exhaust)		Treatment Sludge	
	Construction	Operation	Construction	Operation	Construction	Operation
Sewers[1]	Yes	No	Yes	No	No	In some degree
WWTP[2]	Yes	In some degree	Yes	In some degree	No	Yes
Drains[3]	Yes	No	Yes	No	No	In some degree
Water[4]	No	No	No	No	No	No

Note
1. Construction of trunk sewers and branch sewers in Lahore central areas and construction of new Gulshan-e-ravi disposal station
2. Construction of South West wastewater treatment plant (WWTP) including the collector channel
3. Construction of new drains and improvement of existing drains in Lahore
4. Reduction of UFW in public water supply through metering system & Improvement of water quality through replacement of Chlorinators at tube wells.

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(1) Noise and Vibration during Construction and Operation Stages

- During the constriction stage of these projects excluding water supply project, heavy vehicles and equipment are used for excavations and constructions. Therefore, road traffics volume will be increased especially for the sewer and drain constructions which cause to emergence of noise and vibration.

- During the operation stage of these projects excluding water supply project, de-sludge operation and transportation of sludge will generate noise and vibration in some degree.

(2) Air pollution during Construction and Operation Stages

- During the constriction stage of these projects excluding water supply project, heavy vehicles and equipment are used for excavations and constructions. Therefore, the use of the vehicles and equipment will generate exhaust gases and dusts, especially for dry seasons.

- During the operation stage of these projects excluding water supply project, de-sludge and dry up of sludge, operation, and transportation of sludge will generate exhaust gases and bad odour in some degree.

(3) Generation of Sludge during operation Stage

- During the operation stage of these projects excluding water supply project, sludge will be generated especially from WWTP, as well as raw sludge will be generated from the sewers and drains. The sludge may cause other environmental impacts such as bad odour if those are not properly treated and disposed.

16.8 Environmental and Social Considerations for the Projects

16.8.1 Evacuation and Demolition for WWTP and Collector Channel Projects

(1) Public Notice in 2002

As of 27th August, 2002, WASA identified 95 people who were doing illegal cultivation on the premises of WASA's land for WWTP. Against the circumstances of the cultivation WASA issued a notice to the occupants to evacuate the land. The notice translated into English is as follows:

> Afsar Khan
> S/O Ferzand Ali
> Niyaaz Beg, Lahore.
>
> Subject: Illegal settlement and cultivation of land
>
> It is to inform you that I was notified about the WASA, LDA land that you acquired and cultivating crops illegally, although you know that this is government's land and it is prohibited by law to interfere, acquire and cultivate.
>
> So you are notified that you should evacuate this land and cultivation with in 15 days, otherwise you will be strictly charged by law and no excuses would be accepted.
>
> If you have any quarries and objection regarding this, you can contact the office and file a written application.
>
> Executive Engineer,
> Wastewater Treatment,
> Directorate WASA, LDA.
>
> Cc: DMD(E), Director(WWT)

(2) Public Hearing in 2007

A public hearing was convened on 14th July 2007 for an EIA report for the South West Wastewater Treatment Plant, Lahore prepared in April 2007 for previous similar projects (of which lands were purchased by WASA in 1992 are exactly utilized for the JICA projects' sites) proposed by French assistance. (See **Appendix 16.2**)

The EIA in 2007 for the French project was approved and obtained an Environmental Approval (NOC) on 22nd July 2007 by EPD.

(3) Public Consultation in 2009

Prior to public hearings to be held in the course of EIA for the JICA projects, a public consultation meeting was held in 19th October 2009 by WASA with a letter dated on 16th October 2009 of No. DD (P&E) 3975-83 which was sent to all stakeholders regarding construction of the South West Wastewater Treatment Plan and collector channel to discuss the various environmental and social aspects of the project including smooth evacuation of the illegal usage of the WASA's lands parched in 1996 for the (JICA) project. Total 25 stakeholders including officials of WASA, EPD and others were participated in the consultation (See Appendix 16.3). The Minutes of Meeting for the consultation mentioned as follows;

- Representative of WASA welcomed the participants and stated the purpose of the meeting and inform the stakeholders that WASA is going to implement the construction of Wastewater Treatment Plant on the proposed site acquired by the Government during the year of 1992. WASA will give notices of evacuation in July 2010 and subsequent possession taken over by WASA in November 2010. All stakeholders were asked to express views of this issue.
- Most of the participants gave the consent that they will evacuate the land as soon as the WASA will ask them to do so. Few persons stressed that they will evacuate the land however, they expect that some compensation will be paid for their trees and crops on the land in question.
- The representative of WASA informed the stakeholders that the occupants of the land have been using this land for cultivation of crops since 1992 in spite of the fact the WASA is the owner of this land. Therefore, the income enchased by the occupants is extra compensation. Therefore, no extra claim is acceptable in this regards, however, any aggrieved person can resort to the tribunal of LDA, which is constituted especially for such issue, or any court of law.
- Representative of DD Revenue explained that 15% excess price was paid to the owners of these lands at the time of acquiring the land which included the compensation of trees and crops altogether.

Figure 16.13 shows a draft schedule of the evacuation and demolition plan attached the Minutes of Meeting for the consultation.

Sr. No.	Actions	Oct. 2009	June 2010	Sep. 2010	July 2010	Nov. 2010	Dec. 2010	Jan. 2011
1	Copy of notice to stakeholders	—						
2	Consultation meeting	—						
3	Notice for evacuation				—			
4	Evacuation					—		
5	Notice for Demolition for collector channel		—					
6	Demolition			—				
7	Compensation						—	
8	Project Implementation (Proposed)							—

Source: WASA

Figure 16.13 Draft Evacuation and Demolition Plan by WASA

(4) Public Hearing to be held for EIA Reports for the JICA projects

In the course of EIA studies to be implemented for the projects, public hearings which will include the evacuation and demolition are naturally required by the Pak-EPA Review of IEE and EIA Regulations (2000) and the EPA Guidelines for Public Consultation Oct., 1997. The draft schedule of the public hearing for the projects is prepared by WASA as shown in **Figure 16.13**.

(5) Social Considerations for WWTP and Collector Channel

1) Evacuation of Illegal Cultivators on the premises for WWTP

In spite of those 95 illegal cultivators who are not eligible for new compensations (compensated already), in order to avoid negative social impacts such that the living standards of those 95 are fallen by the implementation of the projects, WASA is planning to do the following as social consideration for the evacuation;

- To carry out scrutiny on the present situation of the cultivation and cultivators before the evacuation
- To elaborate an evacuation plan based on results of the scrutiny
- To convene stakeholders (including those 95 cultivators) consultation/meeting on the evacuation periodically in order to come to terms with sooth evacuations
- To manage the civil and construction work will be stated after harvesting
- To monitor their occupational, income and living conditions after the evacuation periodically based on an environmental monitoring plan will be discussed in an EIA report to be elaborated for the project
- To take individually care of those who would be impacted (such as job introduction) in order to recover their living standards at the time of before the project implementation.

2) Encroachments on the premises for Collector Channel

Magnitude of social impacts by the construction of the collector channel is not such a level as heavily affecting the lives of the people. On the other hand it is identified that some portion of building walls and encroachments are partially protruded on the construction premises of the WASA land. However, the following countermeasures will be taken in order to mitigate and avoid possible impacts on the walls and encroachments by the construction of collector channel (Refer to No. CC-121 of **Appendix 13.6**);

- Access roads to be constructed on the both sides will be adjusted and narrowed.
- Depth of the Collector channel is to be made deeper as the narrowing the width of the collector channel

In cases where acquisitions of some of the land can not be avoided by the construction of the collector channel, WASA will consider replacement compensations for those whose lands can not be acquired.

16.8.2 Living and Livelihood during Construction Stage

(1) Traffic Management

Sewers and drains projects are proposed to be constructed under the existing roads. During the construction, a traffic management plan and all the relevant information is shared with the Traffic Engineering and Planning Agency (TEPA). TEPA reacts in order to maintain the traffic flow and collaborate with City Traffic Police department. Contractor is responsible for showing all the safety signs and other related information regarding traffic management.

(2) Signboards, Warning Boards

These issues are addressed by the constructor/contractor and covered in an Occupational Health and Safety (OHS) department of the contractor. Some pictures are attached hereby as samples.

Some traffic signs and warning signs used during the construction are also shown in below:

(3) Coordination with Solid Waste Management

In the construction stage, solid waste management issues are addressed by the constructor and the proponent. According to WASA's past experiences, WASA collaborates with CDGL and SWM department, and arranges the transportation of rabble and other wastes related to the construction.

(4) Deployment of Security Guards

To deploy security guards for the safety of the workers, pedestrians and all the goods is responsibility of the contractor. According to the past experiences, WASA also deploys security guards in the wastewater treatment facility to keep the intruders out. They were employees of WASA.

(5) Occupational Safety

Labor and Human Resource Department is responsible for ensure the safety of the workers at the industries and other occupations. The major labor laws are as follows:

- Factories Act 1934.
- West Pakistan Shops and Establishment Ordinance, 1969
- Payment of Wages Act, 1936
- Workmen Compensation Act, 1923
- Standing Orders Ordinance, 1968
- Industrial Relations Ordinance, 2002
- Employment of Children Act, 1991
- Road Transport Workers Ordinance, 1961
- Minimum Wage Ordinance, 1961

Based on those acts and ordinances, workers are protected and educated accordingly.

Occupational health and safety issue are addressed in the past during construction activities as shown in the following pictures as samples.

16.8.3 Noise and Vibration

Most of the noise and vibration are generated from vehicles and heavy equipment during construction stage, but in Pakistan there is no environmental standards of Noise and Vibration, but emission standards of Vehicular emission is 85dB (A).

In addition, there are no specific laws and standards present related to construction of drains and sewer lines in Pakistan. There are other documents related to rules, guidelines and regulations relating the specific projects; e.g.

- Lahore Development Act 1975
- Sectoral guidelines for major sewerage schemes
- Sectoral guidelines for small water supply schemes (NWFP)
- Sectoral guidelines for Housing Estates
- Major Roads and Industrial Estates

Based on the relevant guidelines and past experiences of WASA, those impacts are reduced by education for labours/drivers, keep within the speed limit and working time controls.

As for the proposed pumping station which is planned to be constructed on the premises of existing pumping station of the Gulshan-e-Ravi Disposal Station (DS) with same structure of inside of building.

In addition, pumps to be used for trickling filters are submersible pump (installed in the facility) and pumps for the disposal station are installed in a building to be constructed which is a standard structure seen in Pakistan.

According to WASA, there has been no complaint on the noise and vibrations from public at all so far.

16.8.4 Air Pollution during Construction and Operation Stages

(1) Air Pollution

Same as Noise and Vibration above, based on the relevant guidelines and past experiences of WASA, air pollution during both stages are reduced by labour/driver education, periodic vehicle maintenance keep within the speed limit, working time controls and periodic water spray to dusty soils.

(2) Bad Odor

Main bad odor source will be from sludge drying beds constructed in the WWTP. There is no receptor along the land for the WWTP excluding a settlement (Shadewal acer, See **Table 16.11**) located in south of the proposed site with a minimum distance of approximately 200m from the borderline of the land.

However;

- North side of the settlement abuts on the existing drain of which wastewater will be collected and treated by the facility
- Prevailing wind direction of Lahore is that in winter (November-February) the direction are West and North West, in summer (March-June) the direction is South-East and in monsoon/ summer season (July-October) the direction is South East.
- A green buffer zone is proposed to be constructed along the edge of the WWTP.

Based on the above circumstances, bad order in the settlement will be considerably improved and will be avoided the present direct impact by the construction of the WWTP.

16.8.5 Generation of Sludge during Operation Stage

(1) Sludge Treatment and Disposal

The treatment sludge is periodically cleaned up from the WWPT, which is dry up under the sunshine at several cells to be sealed in the anaerobic sedimentation ponds and then to the transfer it to two landfill sites located in the City as presently operated and dumped for treating of raw sludge excavated from existing sewer lines and canals.

In addition, WASA plans to construct some sludge drying beds in the plant for treat the sludge and further utilize it for soil conditioner for the agricultural purposes in near future.

(2) Contamination by the Sludge

According to the monitoring results of existing drains and canal by the JICA study team, concentrations of heavy metals are under NEQS.

In addition, a review of an IEE report in 2002 prepared by WASA for the "Project for the Retrieval of Sewage and Drainage System in Lahore City" confirmed that heavy metals found in the sludge/silt removed from sewers and channels meet (less than) the US EPA standards for disposal in dedicated landfill site and other standards employed by several developed countries like France as noted in (2) of Item 16.6.2. Therefore, no impact caused by heavy metals in sludge is predicted.

And dried-up sludge is properly dumped including periodical covering soil at the landfills.

16.8.6 Other Possible Impacts

(1) Discharge Water Quality for WWTP

The proposed WWTP is a trickling filter method which is designed to meet the national effluent water quality standard of NEQS. In addition, the method is an established technology applying to many developing countries as an appropriate technology of which designing capacity of reduction of BOD pollutant load is 80%.

(2) Surplus Soils

Surplus soils generated during construction of each project are planed to be utilized for the embankment and green buffer zone of Waste Water Treatment Plant.

(3) Protected Areas and Heritage

- Proposed sewers and drains are constructed under the existing roads
- Proposed pumping station is constructed on the premises of existing pumping station of the Gulshan-e-Ravi Disposal Station (DS)
- Proposed collector channel is excavated under the ground level on the WASA's premises used as a temporally drain
- Proposed wastewater treatment plant is constructed in the land of a former flooding area of River Ravi

In addition, the lands for the wastewater treatment plant and collector channel, an EIA study was conducted on the same premises by a French project proposal. No such protected areas, archeological, historical, cultural, and religious heritage sites identified at all on the EIA.

(4) Landscape

- Proposed sewer and drain are constructed under the existing roads
- Proposed pumping station is constructed on the premises of existing pumping station of the Gulshan -e- Ravi Disposal Station (DS)
- Proposed collector channel is excavated under the ground level on the WASA's premises
- The proposed WWTP which consists of trickling filters with a height of about 204 m from the ground level (almost same height of the ring road highway located along the site) and a pond is constructed in the land of a former flooding area of River Ravi which was acquired by WASA
- In addition, a green buffer zone is planed to be constructed on the edge of the land for the WWTP

16.9 Environmental Monitoring

16.9.1 Environmental Monitoring Required by EIA system

An environmental monitoring required by the EIA system of Pakistan shall be conducted by WASA of which results will be prepared and combined as "Annual Operational Performance Report of the Projects" and reported to the Punjab EPA (EPD) (See **Item 16.2.3** and **Figure 16.1**). Items to be monitored will be discussed in an Environmental Management Plan (EMP) based on the negative impacts to be assessed in EIA report(s) for the Projects and posed in NOC. However, in this study stage, initial assessments of possible impacts caused by the projects have been discussed in the **item 16.7** in this chapter. Therefore, the following are the possible items to be monitored;

- Social Impacts relating to the evacuation of 95 farmers from land for the WWTP
- Social impacts relating to the demolitions of some of building structure on the land of Collector Channel
- Social Impacts on living and livelihood during the construction stage such as noise and vibration by equipment and vehicles, traffic safety and management, dust control, etc.
- Environmental Impacts on air pollution and noise and vibration during and implementation stages of the projects
- Environmental Impacts relating to sludge treatment during the operation stage of the projects

16.9.2 Operational Environmental Monitoring

On the other hand, other than the EIA system, a PMU has been proposed for the construction stage as shown in **Item 14.10** at **Chapter 14** (See **Figure 14.3**) as well as a new organization has been proposed for WASA in **Item 14.11** at **Chapter 14** (See **Figure 14.4**). In the PMU and the new WASA organization, an Environmental Monitoring Unit (for PMU) and a Diivison of

Environmental Monitoring (for WASA) are respectively proposed to be set up to carry out each operational environmental monitoring during the construction stage as well as the implementation stage. According to EPD, the important components of the monitoring are;

- NEQS of air and waste water which have been notified in 2000/01
- The parameters mentioned in NEQS are monitored by the project management and frequency of this reporting is categorized in SMART (Self Monitoring and Reporting Programme) rules 1999 (revised in 2005) (See **Item 10.2 Water Quality Monitoring in Public Water Bodies**)
- The industrialist or proponent submits the testing report according to Monitoring plan and submit it to EPA
- Field offices of EPA can check any time or on receiving of public complaint
- The monitoring report is basically to check the compliance level of NEQS and compliance of those conditions posed in NOC

16.9.3 Necessary Coordination on the Environmental Monitoring

A reasonable coordination between the Environmental Monitoring to be discussed in EMP (Environmental Monitoring Plan) in the course of EIA and the operational monitoring required by NEQS and EPD (Punjab EPA) will be made by WASA to avoid overlap of monitoring, double assignment of personnel and double reporting to EPD (See **Item 14.10** and **14.11)**.

In this regards, it can be considered that monitoring items to be discussed in EMP in the course of EIA system are not so wide range of monitoring activities. Therefore, these Environmental Management Unit and Environmental Management Division shall respectively assign one official as combination of offices for the consultation, coordination, management, and preparation of necessary reports required by EPD and JICA as proposed in **Table 16. 28**.

Table 16.28 Proposed Environmental Monitoring System

Stages		Construction	Operation
Organization		PMU	New WASA
Environmental Monitoring		Environmental Monitoring Units (EMU)	Environmental Management Division
Official-in-charge		One WASA Official in the Units	One WASA Official in the Division
Qualification		Deputy Director Level	Deputy Director Level
Undertakings	Operational Monitoring	- Management and data collection of a necessary water quality monitoring in public water bodies from EMU - Reporting to the water quality monitoring to EPD	- Management of coordination with and reporting to EPD on necessary water quality monitoring in consultation and cooperation with the WASA Chemical Laboratory
	Environmental Monitoring	- Coordination between Operational monitoring and Environmental Monitoring for avoiding overlap activities - Handling of Environmental Monitoring Items to be discussed in EMP in the course of EIA - Submission of Annual Operational Performance report of the project to EPD - Periodic Environmental Report to JICA based on JBIC Environmental and Social Consideration Guidelines	- Coordination between Operational monitoring and Environmental Monitoring for avoiding overlap activities - Handling of Environmental Monitoring Items to be discussed in EMP in the course of EIA - Submission of Annual Operational Performance report of the project to EPD - Periodic Environmental Report to JICA based on JBIC Environmental and Social Consideration Guidelines

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16.10 JBIC Environmental & Social Consideration Guidelines

(1) Screening Form and Environmental Check Lists

Based on the JICA's policy on the environmental and social consideration for Japanese loan projects, WASA in cooperation with the JICA study team has prepared the following;

1. "Screening Form" in the JBIC Environmental & Social Consideration Guideline (for loan projects by Japanese ODA) which was prepared by Director (P&E) WASA dated on 6th October 2009 (See **Appendix 16.4**)
2. Sectoral Environmental Check lists of No.19 Sewage & Wastewater Treatment and No.18 Water supply are attached as follows.

(2) Monitoring Form

As for the implementation and reporting of the environmental monitoring, JICA has prepared a "Monitoring Form" in the JBIC Environmental & social Consideration Guidelines as attached in **Appendix 16.5**.

WASA and/or the PMU (Project Management Unit) for the projects shall refer the monitoring form for the periodic submissions of the environmental monitoring reports to JICA during construction stage and/or after implementation stage of the projects.

16.11 Draft Terms of Reference (TOR) for EIA study

The following shows a draft TOR for EIA study.

TERMS OF REFERENCE

Consultancy for IEE/EIA of Lahore Water Supply, Sewerage and Drainage Improvement Project

1. Background

Given the high priority of the Government of Pakistan on water supply, sewerage and drainage, Japan International Cooperation Agency (JICA) is assisting WASA in the "**Lahore Water Supply, Sewerage and Drainage Improvement Project".** The Project particulars are

i. Construction of trunk sewers and branch sewers in the central areas of Lahore and construction of new Gulshan-e-ravi disposal station.
ii. Construction of South West wastewater treatment plant (WWTP) including the collector channel
iii. Construction of new drains and improvement of existing drains in Lahore.
iv. Reduction of unaccounted-for-water and non revenue water in public water supply through metering system and Improvement of water quality through replacement of Chlorinators at tube wells

As per "Pakistan Environmental Protection Act 1997" read with "Review of Initial Environmental Examination (IEE) and Environmental Impact Assessment (EIA) Regulations 2000", WASA has to submit IEE/EIA reports to EPA-Punjab regarding above mentioned project to obtain NOC .

2. Scope of the Work

i. To prepare IEE/EIA reports to be submitted to EPA-Punjab.
ii. To assist WASA in scoping meeting(s) and in discussion with stake holders.
iii. To Carry out environmental and social surveys and public consultation as per required for the preparation of IEE/EIA.
iv. Coordination with the JICA team for Environmental and social issues.
v. To help WASA in implementing the approved Environmental Management Plan (EMP).
vi. Give response to the queries of stakeholders during public hearing of EIA.

3. Deliverables

i. 20 Copies of executive summaries of IEE/EIA
ii. 16 Paper copies of IEE/EIA
ii. 2 Electronic copies on compact disc (CD)
iii. Reply of the queries of EPA- Punjab after review of IEE/EIA.
iv. Presentation to EPA in public hearing.

4. Duration

i. Submission of interim (draft) IEE/EIA report - 2 months
ii. Submission of final report - 3 months

5. Schedule of Payment

i. Advance payment - 10% of total amount
ii. Payment on interim (draft) report submission - 50% of total amount
iii. Payment on final report submission - 40% of total amount

6. Experience and Registration

i. Consultant firm should have experience of IEE/EIA studies of large projects of similar nature.
ii. Consultant firm should be listed with EPA-Punjab/Federal.

7. Submissions

The consultant firms must submit previous working record and detailed financial and technical proposals in two separate envelops before December 1st 2009.

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Environmental Check List: 19. Sewage and Wastewater Treatment (1)

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
1 Permits and Explanation	(1) EIA and Environmental Permits	① Have EIA reports been officially completed? ② Have EIA reports been approved by authorities of the host country's government? ③ Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? ④ In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	① EIA studies to be required among the Phase 1 projects proposed by the JICA preparatory study team are Sewerage and Drainage components, which may be fall under the category of Schedule 1 in accordance with Section 12 Pakistan Environmental Act (1997) and Pak-EPA Review of IEE and EIA Regulations (2000) and relevant guidelines. - A Seeing Form of the JBIC guidelines was prepared by Director (P&E) at WASA dated on 6th October 2009 for the projects. - A letter of Screening and Scorping for EIA/IEE of Water Supply, Sewerage/Drainage Improvement and Wastewater Treatment Plant Projects in Lahore was submitted to EPA Punjab by WASA dated on 20th October 2009 of No. D (P&E) 4011-14 for making request the EPA for guiding WASA whether these projects come under the schedule of IEE or EIA. - Formal applications for the necessary EIA procedures are submitted to the Punjab EPD by WASA after receiving the Final Report of the Study Team. - The EIA studies will be terminated as an attached Draft EIA schedule prepared by WASA in consultation with EPD. ② ③ ④ Environmental permissions of NOC (No Objection Certificate) for the projects will be issued after the completion of EIA reports approval and necessary procedures based on the relevant law and regulation of EIA of Pakistan and Punjab EPD.
	(2) Explanation to the Public	① Are contents of the project and the potential impacts adequately explained to the public based on appropriate procedures, including information disclosure? Is understanding obtained from the public? ② Are proper responses made to comments from the public and regulatory authorities?	① In the course of the EIA studies to be implemented, public hearings are naturally required by Pak-EPA Review of IEE and EIA Regulations (2000) and the EPA Guidelines for Public Consultation Oct. 1997. - However, a public hearing was convened on 14th July 2007 for an EIA study for the South west Sewage Treatment Plant, Lahore prepared in April 2007 for previous similar projects (of which lands parched by WASA in 1992 & 1996 are exactly utilized for the JICA projects' sites) proposed by French assistance, of which Minutes of Meeting was came to an end that the public hearing concluded with a vote of thanks from the chair. - WASA identifies 95 illegal cultivation (by former owner compensated already) on the premises of WASA for WWPT. Against the circumstances of the cultivation WASA issued a notice to the occupants to evacuate the land. - In addition, prior to public hearings to be held in the required EIA for the JICA projects, a public consultation meeting was held in 19th October 2009 by WASA with a letter dated on 16th October 2009 of No. D (P&E) 3975-83 which was sent to the all stakeholders regarding construction of the South West Wastewater Treatment Plan (WPPT) and collector channel to discuss the various environmental and social aspects of the project including smooth evacuation of the illegal usage of the WASA's lands parched in 1992 for the (JICA) project. Total 25 stakeholders including officials of WASA, EPD and others were participated in the consultation. ② The EIA in 2007 for the French project was approved and obtained an Environmental Approval on 22nd July 2007 by EPD in which a public hearing was convened as mentioned above. Therefore, proper responses were made to the stakeholders. For the JICA project, same procedures and manners of the public hearing for the EIA study for the French projects will be followed accordingly as for public hearings to be held in the course of the EIA studies for the (JICA) projects.
2 Mitigation Measures	(1) Water Quality	① Do pollutants, such as SS, BOD, COD, pH contained in treated effluent from a sewage treatment plant comply with the country's effluent standards?	- Proposed Wastewater treatment plant is a trickling filter method which is designed to meet the national effluent water quality standard of NEQS. - In addition, the method is an established technology applying to many developing countries as an appropriate technology of which capacity of reduction of BOD pollutant load is 80%.
	(2) Wastes	① Are wastes, such as sludge generated by the facility operations properly treated and disposed of in accordance with the country's standards?	- The treatment sludge is periodically cleaned up from the wastewater treatment plant, which is dry up under the sunshine at several cells to be sealed in the anaerobic sedimentation ponds and then to the transfer it to two landfill sites located in the City as presently operated and dumped for treating of law sludge excavated from existing sewage lines. - In addition, WASA plans to construct some sludge dry beds in the plant for treat the sludge and further utilize it for soil conditioner for the agricultural purposes in near future.

Environmental Check List: 19. Sewage and Wastewater Treatment (2)

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
2 Mitigation Measures	(3) Soil Contamination	① If wastes, such as sludge are suspected to contain heavy metals, are adequate measures taken to prevent contamination of soil and groundwater by leachate from the wastes?	- According to the monitoring results of existing drains and canal by the JICA study team, concentrations of heavy metals are under the NEQS (National Environmental Quality Standards). And dry up sludge is properly dumped including periodical covering soil at the landfill. - In addition, as secondary data of an IEE study for a Japanese Grant Aid project in Lahore, heavy metals found in raw sludge are under the US EPA Biosolid (sludge) standards which can apply for landfills and other developed countries ones such as French and etc. Therefore, negative impact is not predicted.
	(4) Noise and Vibration	① Do noise and vibrations generated from the facilities, such as sludge treatment facilities and pumping stations comply with the country's standards?	Pumps to be used for trickling filters are submersible pump (installed in the facility) and pumps for the disposal station are installed in a building to be constructs which is a standard structure seen in Pakistan. As for the proposed pumping station which is planned to be constructed on the premises of existing pumping station of the Gulshan -E- Ravi Disposal Station (DS) with same structure of inside of building. In addition, according to WASA there has been no complaint on the noise and vibrations from public at all so far. Therefore, negative impact is not predicted.
	(5) Odor	① Are adequate control measures taken for odor sources, such as sludge treatment facilities?	Main bad odor source will be from sludge dry beds constructed in the wastewater treatment plant. There is no receptor along the land for plant excluding a settlement located in south of the proposed site with a minimum distance of 200m from the borderline of the land. 1. North side of the settlement abuts on the existing drain of which wastewater will be collected and treated by the facility 2. Prevailing wind direction of Lahore is that in winter (Nov.-Feb.) the direction are West and North West, in summer (Mar.-Jun.) the direction is South-East and in monsoon/summer season (Jul.-Oct.) the direction is South East. 3. A green buffer zone is proposed to be constructed along the edge of the wastewater treatment facility. Based on the above circumstances, order situation in the settlement will be considerably improved and will be avoided the present direct impact by the construction of the plant.
3 Natural Environment	(1) Protected Areas	① Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	According to EPD, and the Guidelines for Sensitive and Critical Areas Oct. 1997, there are about 64 protected areas (ecosystems) in Punjab. However, none of them is located in Lahore. Project sites are planed to be constructed as follows. 1. Proposed swears and drains are constructed under the existing roads 2. Proposed pumping station is constructed on the premises of existing pumping station 3. Proposed collector channel is excavated under the ground level on the WASA's premises used as a temporally drain 4. Proposed wastewater treatment plant is constructed in the land of a former flooding area of River Ravi In addition, for the lands for the wastewater treatment facility and collector channel, an EIA study was conducted on the same premises by a French project proposal. No such protected areas identified at all on the EIA.
	(2) Ecosystem	① Does the project site and discharge area encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? ② Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? ③ If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? ④ Is there a possibility that the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	According to EPD, and the Guidelines for Sensitive and Critical Areas Oct. 1997, there are about 64 protected areas (ecosystems) in Punjab. However, none of them is located in Lahore. Project sites are planed to be constructed as follows. 1. Proposed swears and drains are constructed under the existing roads 2. Proposed pumping station is constructed on the premises of existing pumping station 3. Proposed collector channel is excavated under the ground level on the WASA's premises used as a temporally drain 4. Proposed wastewater treatment plant is constructed in the land of a former flooding area of River Ravi No specific and rare ecosystem is identified at all. In addition, the project collects wastewater (which are presently discharged to River Ravi as they are) and treat it under NEQS for the discharge to River Ravi. Therefore, positive impact on the river water quality is predicted.

Environmental Check List: 19. Sewage and Wastewater Treatment (3)

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
4 Social Environment	(1) Resettlement	① Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? ② Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? ③ Is the resettlement plan, including proper compensation, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? ④ Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? ⑤ Are agreements with the affected persons obtained prior to resettlement? ⑥ Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? ⑦ Is a plan developed to monitor the impacts of resettlement?	Project sites are planed to be constructed as follows. 1. Proposed swears and drains are constructed under the existing roads 2. Proposed pumping station is constructed on the premises of existing pumping station 3. Proposed collector channel is excavated under the ground level on the WASA's premises which was purchased by WASA in the year of 1992 and 1996 4. Proposed WPPT is constructed in the land of a former flooding area of River Ravi which was purchased by WASA in the year of 1992 and 1996. Along the roads and on the WASA's premises, settlements including slums are not identified at all. Therefore, no resettlement is predicted
	(2) Living and Livelihood	① Is there a possibility that changes in land uses and water uses due to the project will adversely affect the living conditions of inhabitants? ② Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?	- There are 95 former owners who were compensated cultivating temporary the WASA's land for the proposed WWTP. 711 acres of land is being occupied. But no major buildings were found in the proposed in the land for WWTP. - In the collector channel there are 74 buildings and crop land/fields were identified. These buildings/ encroachments covered a small portion in the WASA's land where the access 1.For the evacuation of 95 cultivators (former owners); - To carry out scrutiny on the present situation of the cultivation and cultivators before the evacuation - To elaborate an evacuation plan based on results of the scrutiny - To convene stakeholders (including those 95 cultivators) consultation/meeting on the evacuation periodically in order to come to terms with sooth evacuations - To manage the civil and construction work will be stated after harvesting - To monitor their occupational, income and living conditions after the evacuation periodically based on an environmental monitoring plan will be discussed in an EIA report to be elaborated for the project - To take individually care of those who would be impacted (such as job introduction) in order to recover their living standards at the time of before the project implementation. 2. For the encroachments on the collector channel land; - Access roads to be constructed on the both sides will be adjusted and narrowed. - Depth of the Collector channel is to be made deeper as the narrowing the width of the collector channel - In cases where acquisitions of some of the land can not be avoided by the construction of the collector channel, WASA will consider replacement compensations for those whose lands can not be acquired.

Environmental Check List: 19. Sewage and Wastewater Treatment (4)

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
4 Social Environment	(3) Heritage	① Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	According to EPD, and Guidelines for Sensitive and Critical Areas Oct. 1997, total six world heritage sites are in Pakistan out of which two are located in city of Lahore which are about 8-10 Km from the proposed WWTP site. Project sites are planed to be constructed as follows. 1. Proposed swears and drains are constructed under the existing roads 2. Proposed pumping station is constructed on the premises of existing pumping station 3. Proposed collector channel is excavated under the ground level on the WASA's premises used as a temporally drain 4. Proposed wastewater treatment plant is constructed in the land of a former flooding area of River Ravi In addition, for the lands for the WWPT and collector channel, an EIA study was conducted on the same premises by a French project proposal. No such local archeological, historical, cultural, and religious heritage sites identified at all on the EIA. Therefore, impacts on the local archeological, historical, cultural, and religious heritage sites are not predicted at all.
	(4) Landscape	① Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	Project sites are planed to be constructed as follows. 1. Proposed sewer and drain are constructed under the existing roads 2. Proposed pumping station is constructed on the premises of existing pumping station 3. Proposed collector channel is excavated under the ground level on the WASA's premises 4. Proposed wastewater treatment plant which consists of trickling filters with a height of about 204 m from the ground level（almost same height of the ring road highway located along the site), and a pond is constructed in the land of a former flooding area of River Ravi which was acquired by WASA. In addition, a green buffer zone is proposed to be constructed on the edge of the land for plant. Therefore no impact on the landscape.
	(5) Ethnic Minorities and Indigenous Peoples	① Does the project comply with the country's laws for rights of ethnic minorities and indigenous peoples? ② Are considerations given to reduce the impacts on culture and lifestyle of ethnic minorities and indigenous peoples?	Ethnic minorities and indigenous people are not identified in the project sites at all.

Environmental Check List: 19. Sewage and Wastewater Treatment (5)

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
5 Others	(1) Impacts during Construction	① Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? ② If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? ③ If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? ④ If necessary, is health and safety education (e.g., traffic safety, public health) provided for project personnel, including workers?	①Most of the Noise and Vibration are from vehicle and heavy equipment during construction, but there is no environmental standards of Noise and Vibration, but emission standards of Vehicular emission is 85dB (A). In addition, there are no specific laws and standards present related to construction of drains and sewer lines in Pakistan. There are other documents related to rules, guidelines and regulations relating the specific projects. e.g. Lahore Development Act 1975. Sectoral guidelines for major sewerage schemes, Sectoral guidelines for small water supply schemes (NWFP), Sectoral guidelines for Housing Estates, Major Roads and Industrial Estates. Based on the relevant guidelines and past experiences of WASA, those impacts will be reduced by labor/driver education, keep within the speed limit, working time controls and periodic water spray to dusty soils. Surplus soils during construction will be utilized for the embankment and green buff zone of Waste Water Treatment Plant. Therefore, no impact is predicted. ②No large scale excavation such as dam constructions is proposed, and there is no specifies ecosystem in the project area, therefore no impacts on ecosystem is predicted. ③ Proposed pumping station is constructed on the premises of existing pumping station and proposed collector channel is excavated under the ground level on the WASA's premises used as a temporally drain. Therefore no such impact is predicted during construction. But proposed swears and drains are constructed under the existing roads. However, during the construction, a traffic management plan and all the relevant information is shared with the Traffic Engineering and Planning Agency (TEPA). TEPA reacts in order to maintain the traffic flow and collaborate with City Traffic Police department. Constructor is responsible to show all the safety signs and other related information regarding traffic management. In addition, During the construction solid waste management issues are addressed by the constructor and the proponent. According to WASA's past experiences they collaborate with the CDGL and SWM department and arrange the transportation of rabble and other wastes related to the construction. Based on the circumstances and experiences of WASA, there is no impacts on social impact during the construction. ④ Labor and Human Resource Department is responsible for ensure the safety of the workers at the industries and other occupations. The major labor laws are as follows; - Factories Act 1934. - West Pakistan Shops and Establishment Ordinance, 1969. - Payment of Wages Act, 1936. - Workmen Compensation Act, 1923. - Standing Orders Ordinance, 1968. - Industrial Relations Ordinance, 2002. - Employment of Children Act, 1991. - Road Transport Workers Ordinance, 1961. - Minimum Wage Ordinance, 1961 and others. Based on those acts and ordinances, workers are protected and educated accordingly.

Environmental Check List: 19. Sewage and Wastewater Treatment (6)

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
5 Others	(2) Monitoring	① Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? ② Are the items, methods and frequencies included in the monitoring program judged to be appropriate? ③ Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? ④ Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	A new organization has been proposed by the JICA Study Team for WASA as well as similar Unit has been proposed for PMU. In the proposed organization chart and PMU, each Environmental Monitoring Unit is also organized to carry out operational monitoring during construction and implementation stages. Environmental Management and Monitoring are requited in accordance with relevant laws on EIA as follows.1. Construction Phase; Submission of a monitoring report to EPA as mentioned in Environmental Management Plan (EMP) of EIA report.2. Operation Phase; Before commencing operation of the project the proponent will submit a compliance report along wit EMP to get approval for the operation phase3. Submission of Annual Operational Performance report of the project is required.WASA will follow the above mentioned monitoring and EMP system for the projects which may be discussed in the EIA reports to be prepared.
6 Note	Note on Using Environmental Checklist	① If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	Not applicable

1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are made, if necessary.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan' experience).

2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the

Environmental Check List: 16. Water Supply (1)

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
1 Permits and Explanation	(1) EIA and Environmental Permits	① Have EIA reports been officially completed? ② Have EIA reports been approved by authorities of the host country’s government? ③ Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? ④ In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country’s government?	With regard to the water supply sector which is in principle required for IEE or EIA by the criteria of the regulation (especially in terms of total project cost) as summarized in Table 19.8, however, discussions were made among the Punjab EPD, WASA and JICA Study Team whether IEE or EIA is necessary or not if considering the project description of “Water Supply”. Due to the fact of the nature and description of “Water Supply Project” which is to install and/or replace water maters and chorine (Hypochlorous acid: HOCl) injectors in some extend, the discussion concluded that significant negative impact during and after installation by the water supply project is naturally predicted. Therefore, Director of EIA section EPA of Punjab EPD has recognized the water supply component in the projects is not necessary for IEE as well as EIA at all. However, WASA has initiated actions for EIA procedures for the projects sending an official letter from the Director (P&E) WASA to Punjab EPA (EPD) dated on 20th October 2009, No, D (P&E)/ 4011-14 under the heading of “Screening and Scoping for EIA/IEE of Water Supply, Sewerage Improvement and Wastewater Treatment Plant Projects in Lahore” for asking the EPA to guide WASA whether the projects come under the schedule of IEE or EIA, so that WASA may prepare the study for environmental approval from the EPA (EPD) .
	(2) Explanation to the Public	① Are contents of the project and the potential impacts adequately explained to the public based on appropriate procedures, including information disclosure? Is understanding obtained from the public? ② Are proper responses made to comments from the public and regulatory authorities?	As WASA's past experiences, explanation to the public on the water supply project will be conducted accordingly, especially for the installment /replacement of water meter for households
2 Mitigation Measures	(1) Air Quality	① Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Do chlorine concentrations within the working environments comply with the country’s occupational health and safety standards?	The chlorinators are replaced with the existing ones for getting more effective disinfection of water. The chlorinators are a small size device by which HOCl (hypochlorous acid as liquid substance) is used to be melted with water and inject to the pumped water for disinfection.
	(2) Water Quality	① Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country’s effluent standards?	Not applicable
	(3) Wastes	① Are wastes, such as sledges generated by the facility operations properly treated and disposed of in accordance with the country’s standards?	Not applicable
	(4) Noise and Vibration	① Do noise and vibrations generated from the facilities, such as pumping stations comply with the country’s standards?	Not applicable
	(5) Subsidence	① In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	Not applicable
3 Natural Environment	(1) Protected Areas	① Is the project site located in protected areas designated by the country’s laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	Not applicable

Environmental Check List: 16. Water Supply (2)

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
3 Natural Environment	(2) Ecosystem	① Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? ② Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? ③ If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? ④ Is there a possibility that the amount of water (e.g., surface water, groundwater) used by the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?	Not applicable
4 Social Environment	(1) Resettlement	① Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? ② Is adequate explanation on relocation and compensation given to affected persons prior to resettlement? ③ Is the resettlement plan, including proper compensation, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? ④ Does the resettlement plan pay particular attention to vulnerable groups or persons, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? ⑤ Are agreements with the affected persons obtained prior to resettlement? ⑥ Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?⑦ Is a plan developed to monitor the impacts of resettlement?	Not applicable
	(2) Living and Livelihood	① Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? ② Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	Not applicable
	(3) Heritage	① Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage sites? Are adequate measures considered to protect these sites in accordance with the country's laws?	Not applicable
	(4) Landscape	① Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	Not applicable

Environmental Check List: 16. Water Supply (3)

Category	Environmental Item	Main Check Items	Confirmation of Environmental Considerations
4 Social Environment	(5) Ethnic Minorities and Indigenous Peoples	① Does the project comply with the country's laws for rights of ethnic minorities and indigenous peoples? ② Are considerations given to reduce the impacts on culture and lifestyle of ethnic minorities and indigenous peoples?	Not applicable
5 Others	(1) Impacts during Construction	① Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? ② If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? ③ If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? ④ If necessary, is health and safety education (e.g., traffic safety, public health) provided for project personnel, including workers?	Each water meter and chlorinator is installed with several hours on site. Impacts during construction is not predicted
	(2) Monitoring	① Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? ② Are the items, methods and frequencies included in the monitoring program judged to be appropriate? ③ Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? ④ Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	A new organization has been proposed by the JICA Study Team for WASA as well as similar Unit has been proposed for PMU. In the proposed organization chart and PMU, each Environmental Monitoring Unit is also organized to carry out operational monitoring during construction and implementation stages. In case EIA is not required for the water supply project then daily operation and maintenance is done for the project. In case EIA is required for the water supply project then Environmental Monitoring and management are requited in accordance with relevant laws on EIA as follows. 1. Construction Phase; Submission of a monitoring report to EPA as mentioned in Environmental Management Plan (EMP) of EIA report. 2. Operation Phase; Before commencing operation of the project the proponent will submit a compliance report along with EMP to get approval for the operation phase 3. Submission of Annual Operational Performance report of the project is required. WASA will follow the above mentioned monitoring and EMP system for the projects which may be discussed in the EIA reports to be prepared.
6 Note	Note on Using Environmental Checklist	① If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	Not applicable

1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are made, if necessary.
In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan' experience).

2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the

16.12 Consideration of Water Supply and Sewerage Services for Socially Vulnerable

The definition of socially vulnerable covers the gender, aged people, children and the poor, but here it means the poor that could not enjoy the water supply and sewerage services due to the poverty. There are two types of the poor, namely the people that have their own houses and that do not have it. These people get water from other house, public post or PET bottle. The people who rely on a PET bottle make a living with the minimum water, even though it costs.

For the people that have their own houses, as they may have illegal connections, they should be check first the fact. The possible solutions are the low-interest loan or subsidy for the connection work, acceptance of installment payment, discount of connection charge or its exemption. The loan and installment payment are the measures to avoid a burden tentatively but do not reduce the total payment. The service coverage by water supply varies in the range of 85 to 90 percent in respective towns and shows that no specified area is problematic in water supply coverage. Therefore, it is advisable to consider the combined application of discount of connection charge and acceptance of installment payment.

For the people that do not connect their houses to a water supply system due to the possession of their own tube-wells, the sift of groundwater pumping to piped water supply is promoted to them, as they are considered rich.

For the people that do not have their own houses, the public post is considered effective, although in Lahore it is regarded as the cause to waste water and in a direction to be abandoned. Therefore, the actual condition should be surveyed for respective public posts before abandonment to check the necessity of their continuance. It is advisable to apply the discount rate. The collection from the community under the joint responsibility is one option.