

**ASIAN DEVELOPMENT BANK**

**PPA: PAK 21192**

**PROJECT PERFORMANCE AUDIT REPORT**

**ON THE**

**KARACHI SEWERAGE PROJECT  
(Loans 1001-PAK[SF] and 1002-PAK)**

**IN**

**PAKISTAN**

**November 2001**

## CURRENCY EQUIVALENTS

Currency Unit – Pakistan Rupee/s (PRe/PRs)

Evaluation	At Appraisal	At Project Completion	At Operations
	(March 1989)	(December 1998)	(May 2001)
PRe1.00 =	\$0.0471	\$0.02176	\$0.01634
\$1.00 =	PRs21.24	PRs45.95	PRs61.21

## ABBREVIATIONS

ADB	–	Asian Development Bank
BME	–	benefit monitoring and evaluation
km	–	kilometer
KMC	–	Karachi Municipal Corporation
KWSB	–	Karachi Water and Sewerage Board
ML/d	–	megaliters per day
O&M	–	operation and maintenance
OEM	?	Operations Evaluation Mission
PCR	–	project completion report
PPAR	–	project performance audit report
TA	–	technical assistance

## NOTES

- (i) The fiscal year (FY) of the federal Government, the government of Sindh, and the Karachi Water and Sewerage Board ends on 30 June. FY before the calendar year denotes the year in which the fiscal year ends.
- (ii) In this report, "\$" refers to US dollars.

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**BASIC DATA**  
**Karachi Sewerage Project**  
**(Loans 1001-PAK[SF] and 1002-PAK)**

**Project Preparation/Institution Building**

Loan/TA No.	Loan/TA Name	Type	Person-Months	Amount	Approval Date
793-PAK (SF)	Karachi Urban Development <sup>a</sup>	ADF	?	55,200,000	14 Oct 1986
1245-PAK <sup>b</sup>	Marine Outfall Study	ADTA	59.5	281,700	14 Dec 1989
1246-PAK <sup>b</sup>	Strengthening of Billing and Collection Operations of the Karachi Water and Sewerage Board	ADTA	24.5	183,700	14 Dec 1989

<sup>a</sup> About \$20.5 million of the loan was for a sewerage component.

<sup>b</sup> Accompanying TA.

**Key Project Data**

	Currency	As per ADB Loan Documents	Actual
Total Project Cost	\$ million	110.20	101.67
Foreign Exchange Cost	\$ million	29.65	37.68
Local Currency Cost	\$ million	80.55	63.79
ADB Loan Amount/Utilization	\$ million	85.00	80.15
Loan 1001-PAK(SF)	\$ million	51.00	46.15
	SDR million	39.91	31.96
Loan 1002-PAK	\$ million	34.00	34.00
Foreign Exchange Cost	\$ million	28.95	35.98
Local Currency Cost	\$ million	56.05	44.17
ADB Loan Amount /Cancellation	\$ million		10.71
	SDR million		7.95
Loan 1001-PAK(SF)	\$ million	?	10.71
	SDR million	?	7.95
Loan 1002-PAK	\$ million	?	?
Government-Financed	\$ million	23.80	18.92
Overseas Development Administration	\$ million	1.40	2.40

? = not available, ADF = Asian Development Fund, ADTA = advisory technical assistance, TA = technical assistance, ADB = Asian Development Bank, SDR = special drawing rights.

## Key Dates

Item	Expected	Actual
Fact-Finding		9-24 Dec 1987
Appraisal		27 Feb-14 Mar 1989
Loan Negotiations		10-14 Nov 1989
Board Approval		14 Dec 1989
Loan Agreement		19 Mar 1990
Loan Effectiveness	17 Jul 1990	7 Jan 1991
First Disbursement		23 Jan 1991 (L 1001-PAK[SF])
		5 Dec 1991 (L 1002-PAK)
Project Completion	31 Aug 1994	31 Dec 1997
Loan Closing	28 Feb 1995	25 Apr 1998 (L 1001-PAK[SF])
		5 Feb 1998 (L 1002-PAK)
Months (effectiveness to completion)	49	84

**Borrower:** Islamic Republic of Pakistan

**Executing Agency:** Karachi Water and Sewerage Board

## Mission Data

Type of Mission	No. of Missions	No. of Person-Days
Project Processing:		
Fact-Finding	1	30
Preappraisal/Appraisal/Follow-Up Appraisal	3	138
Consultation	1	5
Review	2	27
Subtotal	7	200
Project Administration:		
Review	21	152
Loan Administration	1	29
Consultation	1	2
Project Completion	2	30
Subtotal	25	213
Operations Evaluation	1	18
<b>Total</b>	<b>33</b>	<b>431</b>

## EXECUTIVE SUMMARY

Sewerage services (collection, treatment, and disposal) were grossly inadequate in Karachi in the late 1980s. Existing sewerage facilities could collect and treat only about 21 percent of the total volume of sewage generated, estimated at about 872 megaliters per day (ML/d). This deficiency in sewerage services resulted in sewage overflows at various locations in the city and the discharge of a large volume of raw sewage into the Arabian Sea, thus posing public health hazards and polluting coastal waters. It was also anticipated that sewage volumes would increase to 1,280 ML/d by 1996 and, therefore, there was a pressing need to develop further the city's sewerage facilities.

The main objectives of the Karachi Sewerage Project were to improve environmental sanitation conditions in Karachi; alleviate pollution in Karachi coastal waters; and strengthen the sewerage operations of the Karachi Water and Sewerage Board (KWSB). The first and second of these objectives were to contribute to the improvement of public health. The Project had four components: (i) construction of new sewers and rehabilitation of existing ones; (ii) construction of two new sewage treatment plants using stabilization ponds and the upgrading of an existing secondary sewage treatment plant; (iii) institutional strengthening of KWSB through on-the-job and overseas training in various key areas of sewerage operations; and (iv) consulting services for project implementation. The total project cost was estimated at \$110.2 million equivalent with a foreign exchange cost of \$29.65 million (27 percent) and a local currency cost of \$80.55 million (73 percent). The Asian Development Bank (ADB) approved loans 1001-PAK(SF) and 1002-PAK for the Project for \$51 million and \$34 million, respectively, to finance 77 percent of the total project cost. Grant financing of \$1.4 million was provided by the Overseas Development Administration of the United Kingdom. The government of Sindh, the Karachi Municipal Corporation (KMC), and KWSB were to meet the balance of the project costs.

Because of implementation delays and other factors that caused a major cost overrun, the Project was reformulated. The reformulated Project comprised the following components: (i) construction of two trunk sewers with a total length of 18 kilometers (km) and 30 km of secondary sewers to serve the Lyari and Baldia districts; (ii) construction of the Mauripur sewage treatment plant; and (iii) provision of consulting services and institutional strengthening, as originally proposed. The reformulated Project had an estimated cost of \$120.36 million and was approved by ADB in September 1994. The actual project cost was \$101.7 million equivalent, with a foreign exchange cost of \$37.7 million (37 percent) and a local currency cost of \$64.0 million equivalent (63 percent). The actual cost was about 16 percent lower than the reformulated estimate. Savings were realized mainly because of lower interest during construction, taxes and duties, and cost of land.

The Project was in line with ADB's country operational strategy for Pakistan to support the Government's programs for environmental and infrastructure improvements in the major cities. The Project was located in a major city and addressed an environmental issue. The Project was consistent with the World Bank-financed Sewerage Master Plan for Karachi prepared in 1987. However, there was no consultation with the intended beneficiaries of the Project to consider their priorities and views.

The process technology used for the Mauripur sewage treatment plant was appropriate. However, some components may have been oversized. For example, given the low effluent standards required by the Sindh Environmental Protection Agency, it may have been possible to design a series of facultative ponds without anaerobic process that would have resulted in significant cost savings. The redesign of the sewage treatment plant replaced the screw pumps as originally proposed with vertical centrifugal pumps. The use of screw pumps would also have resulted in significant cost savings. The project design included a second set of 18 pumps to transfer the screened and dewatered raw sewage to the six anaerobic ponds. It appears that the main pumps would have been sufficient to transfer the raw sewage to the anaerobic ponds with a better design of the site allowing gravity to transfer the sewage. The design also included two standby diesel generators rated at 1,250 kilowatts each. Since the load of the key components of the sewage treatment plant is about 900 kilowatts, one smaller generator would have been sufficient. The trunk sewer constructed along the Lyari River that connects with the Mauripur sewage treatment plant has a design capacity of about 650 ML/d, compared with the sewage treatment plant's capacity of 250 ML/d. Since there is no additional land to expand the plant based on the process technology employed at the site, the trunk sewer is substantially oversized. Adjustments to process technology could be considered in the future to restore the capacity match.

The Project was generally implemented satisfactorily according to the reformulated design, although with considerable delays. The Project exceeded its design capacity, the sewerage treatment plant being about one third greater than anticipated, and was completed within the reformulated project cost estimate. O&M arrangements are cost effective. However, some components were oversized or oversized and hence cost more than they could have done. Since the start of operations, inflows into the Mauripur sewage treatment plant have averaged 136 ML/d, about 54 percent of the completed capacity. Capacity utilization could be raised through better use of sewer cleaning equipment and the repairs and connection of existing sewers to sewer mains. In the near term, however, there are limitations to increasing inflows. Because KWSB does not allocate sufficient resources for maintenance, only 5 out of the 18 secondary pumps are in operation; those out of service are waiting for bearing and seal overhauls. If the secondary pumps are not serviced soon, operations of the sewage treatment plant are at risk.

KWSB's financial performance has been weak over the past 15 years. Revenues have been insufficient to cover costs in most years, and subsidies from KMC have been provided on an annual basis to meet operational deficits. KWSB's accounts receivable position has historically been weak and, in FY2000, stood at almost 18 months of sales. This problem has begun to affect KWSB's income statement in recent years as an ever-larger portion of the accounts receivable is being written off as doubtful debt. KWSB has been unable to consistently generate funds internally to finance its capital expenditures. Capital expenditures have normally been financed by loans and grants from the government of Sindh. Also, KWSB has not serviced the principal portion of its debt since FY1990. As a result, a number of financial covenants have not been complied with.

The Project exceeded anticipated physical capacities. The extent to which the Project contributed to the improvement of public health or the environment has not been quantified and is uncertain. The cleanliness of the Lyari River was improved but the river is still being used for sewerage disposal upstream from the project facilities. In the Baldia area with continued

evidence of initial sewage disposal in open drains, the project impact is limited. The extent to which water shortage arising from the long-standing drought affected sewer utilization has not been determined. The Project made some improvement in raw sewage treated before disposal in the sea but its overall impact on coastal water pollution is likely to be limited too.

On the positive side, the Project was relevant and its institutional impact was significant. On the negative side, the Project was on the borderline between inefficacious and partly efficacious in achieving its main objectives, was implemented less than efficiently, and its sustainability is in doubt unless remedial measures are taken. Overall, the Project is rated partly successful.

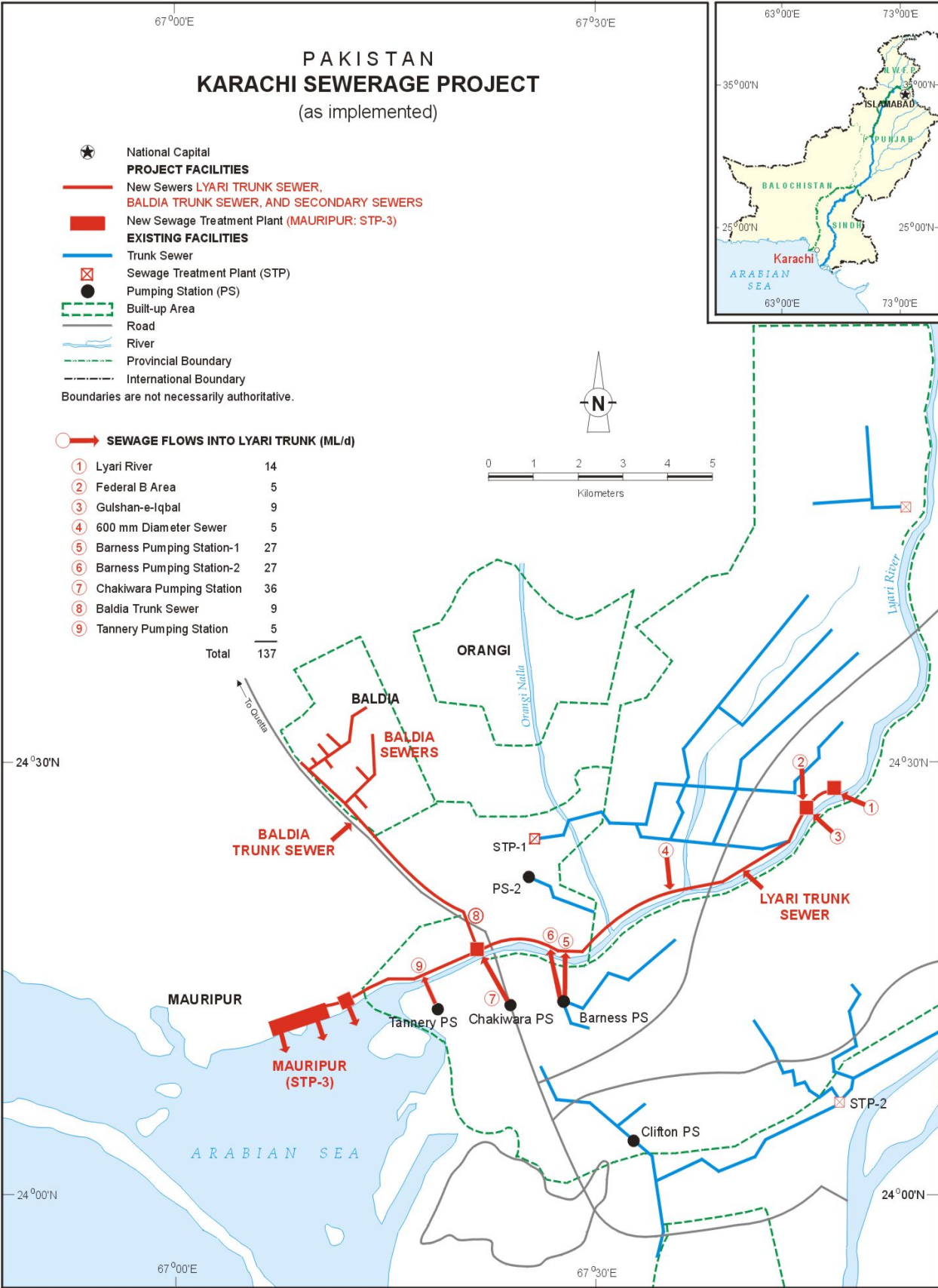
The Project highlighted several lessons. In cases where the appraisal cost estimates are based on inaccurate standard unit rates, ADB should closely monitor any redesign to ensure that it is efficient and least cost. Participation of beneficiaries should be a part of project design and any subsequent redesign to ensure that their priorities and needs are incorporated. Land and other legal issues should also be resolved before the loan for a project is approved by ADB.

Sustainability of sewerage projects can only be assured if the executing agency is in good financial health. This is not the case of KWSB, which is unable to allocate sufficient resources for maintenance of project facilities. As a result, the Mauripur sewage treatment plant is at risk of ceasing operations. The financial impact of a sewerage project on the executing agency needs to be assessed carefully. In cases where major reform is needed, an assessment of the political will to carry out such reform is required.

Project objectives should be clear and monitorable. It was not sufficient to state that the Project's purpose was to improve environmental sanitary conditions and alleviate pollution in coastal waters. Some quantifiable targets should have been established. When a project is reformulated, its objectives should also be reviewed and adjusted accordingly.

The loan covenant establishing a project performance monitoring system needs to be effective. The project performance monitoring system should be established early in the project cycle and the executing agency should have the required skills to establish such a system. An assessment of an executing agency's capacity for establishing a project performance monitoring system should be undertaken during the project preparation stage.





## I. BACKGROUND

### A. Rationale

1. Sewerage services (collection, treatment, and disposal) were grossly inadequate in Karachi in the late 1980s. Existing sewerage facilities could collect and treat only about 21 percent of the total volume of sewage generated, estimated at about 872 megaliters per day (ML/d). This deficiency in sewerage services resulted in sewage overflows at various locations in the city and the discharge of a large volume of raw sewage into the Arabian Sea, thus posing public health hazards and polluting the coastal waters (including with heavy metals from industrial sites). It was also anticipated that sewage volumes would increase to 1,280 ML/d by 1996 and, therefore, there was a pressing need to develop further the city's sewerage facilities.

### B. Formulation

2. Pakistan's Seventh Five-Year Plan (FY1989-FY1993) recognized that the severe deficiencies in water supply and sewerage services had adverse impacts on public health, living standards, and environmental quality; and constrained economic development in large cities such as Karachi. During the 1988 country assistance program discussions, the Government requested assistance from the Asian Development Bank (ADB) to expand the sewerage services in Karachi to supplement other ongoing efforts, including ADB's Karachi Urban Development Project<sup>1</sup> and the World Bank-assisted second Karachi water supply and sanitation project. Using a feasibility study prepared earlier for the Government's Karachi Special Development Program, ADB formulated the Karachi Sewerage Project to continue the development of the sewerage component under the Karachi Urban Development Project. The Project was appraised during 27 February-14 March 1989. ADB approved two loans, one out of its ordinary capital resources and the other out of the Asian Development Fund, on 14 December 1989. ADB also approved two technical assistance (TA) grants to examine the long-term options for sewage disposal and to strengthen the billing and collection operations of the Karachi Water and Sewerage Board (KWSB).<sup>2</sup> The loan became effective on 7 January 1991.

### C. Purpose and Outputs

3. The main objectives of the Project were to improve environmental sanitation<sup>3</sup> conditions in Karachi; alleviate pollution in Karachi coastal waters; and strengthen sewerage operations of KWSB. The first and second of these objectives were to contribute to the improvement of public

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<sup>1</sup> Loan 793-PAK(SF): *Karachi Urban Development*, for \$55.2 million, approved on 14 October 1986 and completed in 1996. About \$20.5 million of the loan was for a sewerage component.

<sup>2</sup> TA 1245-PAK: *Marine Outfall Study*, for \$281,700, and completed in June 1993; and TA 1246-PAK: *Strengthening of Billing and Collection Operations of KWSB*, for \$183,700, and completed in July 1992.

<sup>3</sup> It should be noted that the term "environmental sanitation" is imprecise and seems to be a rubric that combines two separate and distinct concepts. Sanitation normally refers to the cleanliness of surroundings and its impact on health, whereas environment refers to natural resources such as air, water, soil, and vegetation that may or may not affect public health. Since the intention of the Project seems to be the improvement of sanitation and environment to better public health, the two concepts should have been stated separately to facilitate project design and subsequent evaluation. Otherwise, the term "environmental sanitation" should have been clearly defined.

health. To achieve the objectives the Project was to include expansion of the collection capacity of the sewerage systems to minimize the volume of sewage discharged into natural drains in the city and expansion of the treatment capacity to reduce the amount of pollutants (including heavy metals) reaching the coastal waters. However, the Project's objectives did not clearly identify the intended beneficiaries or how the beneficiaries would benefit from the Project.

4. The Project had four components: (i) construction of new sewers and rehabilitation of existing ones; (ii) construction of two new sewage treatment plants using stabilization ponds and the upgrading of an existing secondary sewage treatment plant; (iii) institutional strengthening of KWSB through on-the-job and overseas training in various key areas of sewerage operations; and (iv) consulting services for project implementation.

#### **D. Cost, Financing, and Executing Arrangements**

5. At appraisal, the total cost of the Project was estimated at \$110.2 million equivalent with a foreign exchange cost of \$29.65 million (27 percent) and a local currency cost of \$80.55 million (73 percent). ADB loans 1001-PAK(SF) and 1002-PAK for \$51 million and \$34 million, respectively, were to finance nearly all of the foreign exchange and 72 percent of the local currency costs of the Project (Basic Data and Appendix 1). Grant financing of \$1.4 million was provided by the Overseas Development Administration of the United Kingdom. The government of Sindh, the Karachi Municipal Corporation (KMC), and KWSB were to provide the balance of the project costs. ADB and Overseas Development Administration financing covered about 77 percent and 1 percent of the total project cost, respectively.

6. Loan 1001-PAK(SF) had a term of 35 years, including a grace period of 10 years, with a service charge of 1 percent per annum. Loan 1002-PAK had a term of 25 years, including a grace period of 5 years, at an interest rate determined from time to time in accordance with ADB's pool-based variable lending rate system. The Borrower was the Government of the Islamic Republic of Pakistan. Loans 1001-PAK(SF) and 1002-PAK were relented to the government of Sindh on the same terms as to the Government of Pakistan. The loans were subsequently onlented to KWSB for a term of 25 years, including a grace period of 5 years, at an interest rate of 7 percent per annum. The Executing Agency for the Project was KWSB.

#### **E. Completion and Self-Evaluation**

7. A project completion report (PCR) for the Project prepared in July 1999 discussed its design, scope, implementation, and operational aspects, and provided detailed project information. The PCR rated the Project partly successful<sup>4</sup> because of implementation delays and doubts regarding the sustainability of the Project. The main issue that the PCR identified was the weak financial position of KWSB. However, the PCR did not provide KWSB's financial statements to support this. Financial data that KWSB subsequently provided to the Operations Evaluation Mission (OEM) showed that KWSB was indeed in a weak financial position, but it also showed that KWSB did not meet some of the financial covenants of the Loan Agreement, contrary to what the PCR stated. The PCR did not adequately assess the design of the Project.

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<sup>4</sup> The rating was based on the former three-category rating system comprising "generally successful", "partly successful", and "unsuccessful."

There were problems regarding the sizing of some components and the technology employed. Inclusion of a sanitation engineer in the PCR Mission would have brought these problems to light. The PCR made errors in assessing the testing laboratory at KWSB where it stated that the laboratory became fully operational in February 1999. The OEM visited the laboratory and found that staff at that time were not appropriately trained to function effectively and that most of the equipment procured was rarely used. The PCR should also have discussed more thoroughly the Project's two TAs (footnote 2). The assessment of the TAs was essentially descriptive and provided little analysis of the rationale, implementation, conclusions, and recommendations of the TAs.

## **F. Operations Evaluation**

8. By focusing on the pertinent aspects of the Project, this project performance audit report (PPAR) presents an assessment of the Project's effectiveness in terms of achieving its objectives and generating benefits, and of the sustainability of the Project's operations.

9. The PPAR is based on a review of the PCR, the Report and Recommendation of the President, the appraisal report, material in ADB files, other relevant documentation (including World Bank project reports), a report by a consultant engaged by the OEM, and discussions with the provincial government and KWSB by the OEM during 30 April to 10 May 2001. Copies of the draft PPAR were provided to the Borrower, the provincial government, KWSB, and ADB staff concerned for review and comments. Comments received were taken into consideration in finalizing the report.

## **II. PLANNING AND IMPLEMENTATION PERFORMANCE**

### **A. Formulation and Design**

10. The strategic focus of ADB's country operational strategy in Pakistan in the late 1980s was to promote economic growth, improve equity, and to further develop the social sectors. In the social sectors, the strategy highlighted urban development, particularly in terms of supporting the Government's programs for environmental and infrastructure improvements in the major cities. The Project was in line with this strategy. It was located in a major city and addressed an environmental issue. However, there was no consultation with the intended beneficiaries of the Project to consider their priorities or to solicit their views on the need for the Project.

11. Nevertheless, the Project was consistent with the World Bank-financed Sewerage Master Plan for Karachi prepared in 1987. The Plan was based on the assumption that Karachi would have 100 percent water supply coverage given the ongoing and prospective water supply projects to be implemented.

12. The Project as originally proposed was well designed. Sewers were to be provided in areas previously not serviced, and trunk sewers and simple sewage treatment plants were to be constructed. Sewerage facilities that had deteriorated were also to be rehabilitated. The design of the sewage treatment plant at Mauripur included Archimedean screw pumps to provide lift for the sewage at the intake facility (Map). Screw pumps are a cost-effective alternative to centrifugal pumps and are suitable for low-lift situations of less than 12 meters. At Mauripur, the required lift for the raw sewage was only 3 meters.

13. Because of delays in implementing the Project (para. 25), the cost of the Project increased substantially. Other factors also contributed to the major cost overrun. When tenders for key civil works were opened and evaluated between October 1992 and February 1993, tender prices were much higher than the appraisal estimates. The cost estimates made at appraisal appear to have been based partly on preliminary designs and used the standard schedule of rates of the provincial government for unit prices. The preliminary designs underestimated the quantity of works involved, while the provincial government's schedule of rates was unsuitable for the type of civil works involved in the Project. A relative lack of competition (only two of five prequalified bidders participated in tendering) may also have contributed to higher prices.

14. To accommodate the financing available, the Project was reformulated in 1994. The reduced scope comprised the following components: (i) construction of two trunk sewers with a total length of 18 kilometers (km) and 30 km of secondary sewers to serve the Lyari and Baldia districts; (ii) construction of the Mauripur sewage treatment plant; and (iii) provision of consulting services and institutional strengthening, as originally proposed. The reformulated Project had an estimated cost of \$120.36 million (compared to \$234 million for the original project design) and was approved by ADB in September 1994. The closing date of the loans was extended by two years and seven months to 30 September 1997.

15. The process technology used for the Mauripur sewage treatment plant was appropriate. When land is available, the use of lagoons for the treatment of sewage is cost effective, particularly in tropical climates where high temperatures enhance the biological process. However, the Project may have been overdesigned. Given the low effluent standards required by the Sindh Environmental Protection Agency,<sup>5</sup> it may have been possible to design a series of facultative ponds without anaerobic process that would have resulted in significant cost savings in construction, materials, equipment, and operating costs.<sup>6</sup>

16. The redesign of the sewage treatment plant replaced the screw pumps with vertical, dry-pit, centrifugal pumps. The change in technology was based on KWSB's uncertainty about maintenance of the lower, submerged bearing.<sup>7</sup> The use of screw pumps would have resulted in significant cost savings in terms of capital and recurrent costs. Based on preliminary estimates, screw pumps would also have been 30-40 percent more efficient. The main pump station comprises three centrifugal pumps, two duty and one standby, and four intake valves fitted with manually operated gate valves. The station is designed for the installation of a fourth pump. The fourth gate valve was an unnecessary expense, and should only have been installed if and when the fourth pump is installed. Another design shortcoming of the main pump station was

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<sup>5</sup> Eighty milligrams per liter of biological oxygen demand and 150 milligrams per liter of suspended solids. The effluent based on the Sindh Environmental Protection Agency's standard may still be considered weak sewage.

<sup>6</sup> The design information suggests that the depth of the anaerobic ponds is 4 meters. However, the OEM found that the depth is only 2.5 meters, thus reducing the process effectiveness of these units substantially. This may also have been a factor in the anaerobic ponds not producing any sludge, even after three years of operation. Although KWSB provided no explanation for this anomaly, it is believed that possibly a higher than expected groundwater table was encountered during construction.

<sup>7</sup> However, there are many successful such installations in the world.

the 45-degree suction bells (the British Hydraulics Institute and other international standards for sump pumps recommend 90-degree suction bells) and the lack of channeling walls. These design shortcomings were ameliorated with some concrete baffling.<sup>8</sup>

17. The project design included a second set of pumps to transfer the screened and degrittied raw sewage to six anaerobic ponds. Each pond is served by three submersible pumps, two duty and one standby, for a total of 18 pumps. It appears that the main pumps would have been sufficient to transfer the raw sewage to the anaerobic ponds with a better design of the site that allows gravity flow of the sewage. The incremental cost of elevating the raw water pump station, the pretreatment facilities, and the raw sewage channels would have been substantially less than the cost of the 18 pumps and their recurrent expenses. The design of the Mauripur sewage treatment plant also included three dredges. The purpose of the dredges is to remove sludge from the facultative ponds. This operation could have been accomplished by a design that allowed removal by a tractor or manually, at a lower cost. The project design also included two V-12 twin-turbo Perkins standby diesel generators rated at 1,250 kilowatts each, one for the main pump area and one for the secondary pump area. Given the poor reliability of the power supply system in Karachi, standby power is necessary. However, since the load of the key components of the sewage treatment plant is about 900 kilowatts at design flow, one smaller generator would have been sufficient. Moreover, because the generators are oversized, operation of the generators is hampered because it does not comply with the manufacturer's recommendation to operate at a minimum power draw of 35 percent of the rated capacity.

18. The trunk sewer constructed connects with the Mauripur sewage treatment plant and has a design capacity of about 650 ML/d, compared with the sewage treatment plant's completed capacity of 250 ML/d. There is no additional land to expand the plant based on the process technology employed at the site. The trunk sewer was substantially overdesigned and some modification should have taken place during the reformulation of the Project. In order to restore the capacity match between the sewage treatment plant and the trunk sewer, the process technology could be altered. Plant capacity could be increased by adding aeration to the ponds. If this is insufficient, part of the site could be used to house a mechanical plant. Ultimately, all sewage inflows could be treated in such a plant, thereby making some land available for other purposes.

19. The prevailing winds at the sewage treatment plant are on-shore much of the time and have high humidity and salt content. Metal parts that are exposed to the winds are corroded, requiring extra maintenance. The cooling radiator of one of the standby diesel generators corroded after about two years. The design of the plant should have taken into consideration corrosion by replacing some metal parts with parts made from other materials, such as plastic.

20. The Project included procurement of equipment for the surveying and monitoring of industrial effluent. The equipment procured included two atomic absorption spectrophotometers (one flame and one carbon furnace), incubators, refrigerators, other laboratory equipment, and a computer. The primary purpose of this equipment was for the chemical analysis of heavy

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<sup>8</sup> KWSB should check the integrity of the concrete baffling at the first opportunity.

metals in industrial effluent. It was anticipated that the proposed Korangi sewage treatment plant would be constructed; industrial sites would be connected to this plant via sewer systems to be constructed for the purpose; and legislation for sewer-use bylaws would be promulgated to require industry to pretreat its effluent to municipal sewage strength and to remove heavy metals. However, the construction of the Korangi sewage treatment plant and sewer lines was canceled, and the required legislation was not passed. Therefore, the two atomic absorption spectrophotometers were not needed. Since the purchase of the spectrophotometers in 1998, they have been rarely used even though training has been provided.<sup>9</sup> This component should have been deleted during the reformulation of the Project and should have been considered only when the proposed Korangi plant was being designed. The cancellation of the Korangi sewage treatment plant and sewer lines cut out a component important to achieving the objective to alleviate pollution in coastal waters, particularly from heavy metals. The Project as reformulated thus could, at best, only attain this objective to a limited degree.

21. Disposal of raw sewage into the ocean is an alternative to sewage treatment. The Marine Outfall Study TA (footnote 2), which was provided along with the ADB loans for the Project, identified several marine outfall sites, designed marine outfall systems for these sites, and designed a water quality monitoring program. It is not clear why financing was provided for this study. Since it was already decided that sewage was to be treated before disposal and it was known that marine outfalls were not economically viable,<sup>10</sup> the study was essentially superfluous. If marine outfalls were to be considered as longer-term options, then the study should have been undertaken closer to the time when the decision on marine outfalls was to be taken. There was no urgency, if indeed there was a need, for the study. Nevertheless, the study resulted in some recommendations, although it was subsequently decided that again none of the options identified was economically viable.

## **B. Achievement of Outputs**

22. The Project was implemented generally according to the reformulated design. The length of the two trunk sewers constructed slightly exceeded the designed 18 km. The length of secondary sewers almost attained the designed 30 km with 29.4 km constructed. The collection capacity of the sewers slightly exceeded the design level. Two pumping stations and the sewage treatment plant were constructed. The capacity of the sewage treatment plant is about one third greater than anticipated at the design stage. OEM estimates that since operations began, inflows into the plant have averaged about 136 ML/d.<sup>11</sup> The average inflow compares to the completed capacity of 250 ML/d (and the design capacity of 186 ML/d). Capacity utilization could be raised through better application of sewer cleaning equipment and the repair and connection of existing sewers to sewer mains. However, there are limitations in the near term to increasing inflows.<sup>12</sup>

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<sup>9</sup> One week of training was provided; however, training for up to a year may be required for proficiency in their use.

<sup>10</sup> The Project's appraisal report (para. 35) states that "At present, it is not economical to dispose sewage ... into the sea through marine outfalls."

<sup>11</sup> The PCR estimated inflows of about 180 ML/d after completion.

<sup>12</sup> The limitations are attributable to an absence of maps showing the location of sewer lines in the city and the effect of KWSB's financial situation on its ability to implement civil works to divert sewage flows to the treatment plant. Nevertheless, KWSB was able to undertake in the second half of 1997 a program of civil works to repair and connect existing sewers to sewer mains (footnote 17).

23. Thirteen KWSB staff were trained on the job in sewerage operations. KWSB considered this to be a sufficient number. However, only 1.5 person-years of postgraduate international training in environmental engineering was utilized out of 14.5 person-years available. Although two KWSB staff were sent on overseas training, one returned before completing his course of studies because of insufficient background in the subject. The 14.5 person-years were not completely utilized because too few staff had the appropriate background for this kind of training.

### **C. Cost and Scheduling**

24. The actual Project cost was \$101.7 million equivalent, with a foreign exchange cost of \$37.7 million (37 percent) and a local currency cost of \$64.0 million equivalent (63 percent). The actual cost was about 16 percent lower than the reformulated estimate (Appendix 1). Savings were realized mainly because of lower interest during construction, taxes and duties, and cost of land.

25. At appraisal, the Project was expected to have been implemented in less than five years with completion by August 1994 (Appendix 2). Actual project completion was December 1997 after testing and commissioning of the project facilities. There were several reasons for this delay. First, the effectiveness of the loans was delayed by more than one year because of protracted negotiations between the government of Sindh and KWSB on the terms of the subsidiary loan agreements.<sup>13</sup> Second, ADB suspended contract awards for 19 months because of KMC's and KWSB's nonpayment of arrears for electricity purchases from the Karachi Electric Supply Corporation. Third, delays were incurred because of the need to reformulate the Project (para. 14). Full-scale construction of the sewage treatment plant began only in 1995 after the lifting of a court restraining order that allowed the government of Sindh to take possession of part of the land for the plant. Other impediments to implementation were Karachi's security problems causing frequent work stoppages and the monsoon floods of 1994. The loans were closed in April 1998 (Loan 1001-PAK[SF]) and February 1998 (Loan 1002-PAK).

### **D. Procurement and Construction**

26. Procurement of plant and equipment was carried out according to ADB's *Guidelines for Procurement*. No significant problems were encountered in preparing tender documents, evaluating bids, and awarding contracts. Some delay was experienced in the procurement of effluent monitoring and survey equipment because of inadequate tender packaging and separate procurement of equipment, vehicles, and computers. Performance of the contractors and suppliers of the equipment and associated services under the Project was generally satisfactory, except in one instance (para. 27). The equipment supplied was generally according to specification and was satisfactorily installed.

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<sup>13</sup> At the time, Karachi was administered by an independently elected local government to which KWSB reported.



27. The three centrifugal pumps at the main pump station were poorly selected. Testing of the pumps proposed by the manufacturer showed significantly greater capacity than that called for in the design, indicating that it was known that the proposed pumps would operate in excess of the required capacity.<sup>14</sup> During commissioning, daily reports often recorded bearing noise or mechanical problems, consistent with operation near the run-out point along the pump curve.<sup>15</sup> Smaller, less expensive pumps consistent with the requirements of the main pump station should have been selected.

28. The OEM uncovered one irregularity in the tendering of the construction contract. The winning bid included three sludge dredges at a cost of about \$30,000 each. The actual cost was about \$300,000 each and the bidder alleged that the lower price was the result of a typographical error. KWSB insisted that the contractor honor its original commitment to supply the dredges at \$30,000 each. Although there was no apparent cost to KWSB, the project implementation consultant should have noted this discrepancy when reviewing the bids and brought it to KWSB's and the bidder's attention before the contract was awarded. Contractors that suffer significant losses because of mistakes in costing have an incentive to recover these losses through other means that could result in less than optimal performance.

29. Out of 1,097 person-months available for engineering services, 821 were utilized for detailed design, preparation of tender documents, bid evaluation, construction supervision, commissioning of civil works, and institutional development. Out of the 48 person-months available for institutional consultants for the management and administration of the Project, plant operation, and industrial effluent management, only 18 person-months were utilized because supervision services for cleaning, surveying, and mapping were no longer required. These services were replaced by cleaning and repair equipment when the Project was reformulated. The performance of the project implementation consultants should have been better. The design of the Project tended to oversize components in many areas and included features that were not necessary. As a result, components of the Mauripur sewage treatment plant cost more than they could have.

## **E. Organization and Management**

30. KWSB implemented the Project through its development wing. The project director and manager were well qualified and had substantial experience in sewerage construction and operations. Sixteen KWSB staff that assisted in the implementation of the Project were also well qualified and had experience previously gained in implementing projects under the Karachi Urban Development Project (footnote 1). Overall, the development wing of KWSB was effectively organized.

31. A number of covenants were included in the Loan Agreement in addition to the standard covenants required by ADB for reporting requirements and the use of loan proceeds

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<sup>14</sup> Pump tests were witnessed by a project implementation consultant and KWSB staff at the manufacturer's premises. The OEM's review of the test results indicates that the manufacturer enhanced the performance of the pump for the test, likely by hand-finishing the impeller.

<sup>15</sup> Run-out is the region along the pump's performance curve past a certain flow rate where the pump sump level is too high and causes abnormal stress on the pump.

(Appendix 3). KWSB was required to adjust its tariffs so that it could meet its operation and maintenance (O&M) costs and debt service requirements from FY1992. This covenant was not complied with, and KWSB has not serviced the principal portion of its debt since FY1990 because of insufficient revenues. From FY1994 onwards, KWSB was required to meet its O&M and depreciation costs or debt service requirements (whichever was greater) and produce internal funds to meet not less than 20 percent of annual capital expenditures. This covenant was not complied with. KWSB was required to establish a conservancy charge to cover the costs of its sewerage operations. The amount of revenue generated from the conservancy charge was sufficient to cover the costs of sewerage operations for most years; therefore this covenant was complied with. KWSB was required to implement a program of metering to encourage water conservation and to ensure cost recovery and an equitable sharing of costs. This covenant was not complied with. KWSB's accounts receivable were to be kept at a level of no more than three months billing. This covenant was not complied with either—the accounts receivable issue is a chronic problem for KWSB. The federal Government, the government of Sindh, and KMC were to ensure that their water bills and conservancy charges were promptly paid. This covenant was not complied with. KWSB was required to reorganize and rationalize staff based on the recommendations of an organizational and management study. This covenant was complied with. A project benefit monitoring and evaluation (BME) system was to be established in KWSB. This covenant was not sufficiently complied with. KWSB arranged for a study of the benefits of sewerage, however, the study was superficial and did not provide sufficient data on which to base judgments. A BME system that would meet the requirement of the loan covenant was not established.

32. The noncompliance with the main financial covenants has been attributable to several factors related to KWSB's water supply operations. KWSB generates insufficient revenues and receives an inadequate subsidy from KMC to meet operating costs, service its debt, and contribute to the financing of its capital investments. It has not been possible to raise tariffs in recent years because of the drought that began in 1997 and the consequent water shortages, and consumers are resistant to paying more for an inadequate service. KWSB is also reluctant to introduce water metering and modify the tariff schedule to charge for water and sewerage services on a per unit basis. Because of the drought and water shortages, KWSB generates more revenue based on the current tariff that charges most consumers by floor area or net annual rental value of their premises. If all customers were metered and revenue was based on actual water consumption and the current water tariff, revenues would fall substantially. Consumers are unwilling to pay for the intermittent service provided by KWSB and the perceived unfair tariff structure. As a result, KWSB's accounts receivable are well above the covenanted level of three months of sales. The accounts receivable problem is compounded by the unwillingness of federal and provincial government departments and local government agencies to pay their water bills or pay in a timely manner.

### III. ACHIEVEMENT OF PROJECT PURPOSE

#### A. Operational Performance

33. The Mauripur sewage treatment plant has treated an average of about 136 ML/d of raw sewage, corresponding to about 54 percent of its actual capacity<sup>16</sup> (Map). The original design evidently provided for the redirection of some sewage inflows from KWSB's Sewerage Treatment Plant 1,<sup>17</sup> thereby allowing that plant to take increased inflows from other locations. KWSB is uncertain when the capacity of the Mauripur plant or Sewerage Treatment Plant 1 will be fully utilized.

34. The Mauripur sewage treatment plant is operated by a private sector company under a three-year contract, renewable every year. The contractor provides labor while KWSB provides the materials and equipment and on-site supervision by two KWSB staff. This is KWSB's first attempt at contracting out the O&M of its facilities and the arrangement seems to be working well. KWSB plans to extend this arrangement to its other facilities because it has proved to be cost effective. Overall, the sewage treatment plant is adequately operated and maintained, except in the following instances.

35. The centrifugal pumps in the main pump stations run hot and high-temperature trips occur almost daily. KWSB could not provide an explanation for this, but it is suspected that the ventilation motors may be malfunctioning. KWSB needs to address the problem before the useful life of the pump motors is reduced.

36. Only 5 out of 18 secondary pumps are in operation; those out of service are waiting for bearing and seal overhauls. As a result, when raw sewage inflows are in excess of about 2,000 liters per second, they overflow untreated into the sea. This situation occurs on a daily basis because KWSB does not allocate sufficient resources for the high cost of maintenance of the secondary pumps.

37. Corrosion caused by improperly selected materials and inadequate coatings in the humid, marine environment is evident everywhere. Hand railings and local push-button stations have rusted substantially. This indicates that insufficient effort is being made to arrest the problem. One of the standby diesel generators was also out of service during the OEM because of a leaking radiator caused by external corrosion. This is a re-occurrence after only three years of operation and could have been avoided at the design stage if the correct radiator material was specified. However, there is also internal corrosion that may be caused by the use of cooling fluid of an incorrect grade.

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<sup>16</sup> Or about 73 percent of the design capacity (para. 22).

<sup>17</sup> Sewerage Treatment Plant 1, together with Sewerage Treatment Plant 2, was rehabilitated and upgraded under the Karachi Urban Development Project (footnote 1). The PPAR for that project (PPA: PAK 19076: *Karachi Urban Development Project*, December 1999) noted that Sewerage Treatment Plant 1 was used at about half capacity, an increase from the 22 percent utilization rate noted in the PCR for that project (PCR: PAK 19076: *Karachi Urban Development Project*, December 1997). This increase may have been attributable to a program of works initiated by KWSB in August 1997 to repair and connect existing sewers to the sewer mains.

38. When the sewage treatment plant experiences unplanned power outages, KWSB's standard operating procedures dictate that the standby diesels be put into operation only after 2½ hours of no power. In the meantime, raw sewage is diverted untreated into the sea because there is little storage capacity in the plant. This operating procedure seems to negate some of the benefits for which the sewage treatment plant was constructed.

39. The sludge produced by KWSB's other sewage treatment plants is dried and sold as a soil conditioner (a low-grade fertilizer). However, after three years of operation, the Mauripur sewage treatment plant has not yet produced any significant amount of sludge (footnote 6). This is contrary to expectations at the design stage when it was estimated that 27 truckloads per day would be produced after only nine months of operation. If the plant ever produces sludge, KWSB should conduct a rigorous test on it to determine the presence and concentration of metals.

## **B. Performance of the Operating Entity**

40. In 1996, KWSB was separated from KMC and became an independent entity. The government of Sindh now has oversight responsibility for KWSB. KWSB's financial performance has been weak (Appendix 4). Revenues have been insufficient to cover costs in most years, and subsidies from KMC have been provided on an annual basis to meet operational deficits.<sup>18</sup> The conservancy charge to generate funds to recover the costs of sewerage operations was established on 1 July 1990. It is set at 50 percent of the water rate. The charge was subsequently adjusted upward along with the water rate in 1992, 1994, 1995, and 1998 (Appendix 5). There has been no increase in KWSB's tariff since 1998 and there are no plans to raise the water or conservancy charges at this time because of the drought in the Karachi area and the water shortages. As a result, KWSB's return on fixed assets valued in historical terms has been inadequate.

41. Accounts receivable comprise a substantial portion of KWSB's assets. KWSB's accounts receivable position has been historically weak and, in FY2000, this item stood at almost 18 months of sales. The problem has begun to affect KWSB's income statement in recent years as an ever-larger portion of the accounts receivable is being written off as doubtful debt. As of 30 June 2000, KWSB was owed PRs2,040 million (\$40 million) by the federal and provincial governments and local government agencies. This amount accounts for about half of the total accounts receivable.

42. Until FY1997, KWSB was unable to generate any funds internally to finance its capital expenditures. Capital expenditures were normally financed by loans and grants from the government of Sindh. Since FY1997, some funds have been generated internally, primarily owing to the tariff increase in 1998. However, in FY2000, revenues were again inadequate to meet the covenanted 20 percent self-financing ratio. In addition, KWSB has not serviced its debt since FY1990. This is in noncompliance with KWSB's obligations under the subsidiary loan agreements with the government of Sindh that were covenanted under ADB loans to KWSB.

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<sup>18</sup> The KWSB Act of 1996 requires KMC to provide a subsidy to KWSB for an amount of up to 10 percent of KMC's total revenues or any amount fixed by the government of Sindh.

43. KWSB's tariff does not explicitly charge for sewerage services. The conservancy charge, which KWSB collects and of which it receives half for sanitation services,<sup>19</sup> is set to meet KWSB's overall revenue requirement and KMC's cost of solid waste disposal. Therefore, the amount received for sewerage services is an arbitrary amount and no financial internal rate of return for the Project can be calculated that would result in a meaningful number.<sup>20</sup>

44. KWSB's weak financial position is a major concern. KWSB is essentially insolvent and cannot operate without subsidies from KMC. To bring KWSB back to financial health over the longer term, new sources of raw water need to be tapped, the provision of water and sanitation services needs to be improved, and more investment in water supply and sanitation needs to be undertaken. Some form of financial assistance from the federal government and the government of Sindh will be required in the meantime to ensure that KWSB is solvent and operational.

45. Since January 2000, KWSB has been under new management that set as its goal the improvement of the operational efficiency of KWSB and provision of better services to its customers. Steps taken by KWSB include the elimination of "ghost" employees and unauthorized allowances from KWSB's payroll, and stricter application of administrative discipline to root out corrupt practices. These measures have reduced KWSB's expenditures by about \$1.5 million annually. On the revenue front, KWSB is actively negotiating with the federal and provincial governments over the payment of their outstanding bills. KWSB regularized some illegal water connections and disconnected others and has expanded the computerization of its customer service centers and updated its customer database. It is also investing more of its resources to expand the water supply and sewerage systems into the poor areas of Karachi. In areas where KWSB provides water by tanker, KWSB is assisted by the Pakistan military to ensure that the water is delivered to the intended beneficiaries and sold at the prescribed price. These measures taken by KWSB are encouraging and should contribute to the improvement of its operations.

46. In 2001, the government of Sindh will be devolving some of KWSB's responsibilities to the district level in Karachi. The intention is to transfer responsibility for the O&M of water supply distribution and some sewer lines, and the collection of water bills, to 18 district administrations in the Karachi region. The government of Sindh expects that the devolution will improve bill collection and cash flow, and relieve some of KWSB's financial pressures. The government of Sindh's plan seems to be sound.

### **C. Economic Reevaluation**

47. The objectives of the Karachi Sewerage Project were to improve environmental sanitation conditions in Karachi; alleviate pollution in Karachi coastal waters; and strengthen the sewerage operations of KWSB. Since no BME system was established as required by the Loan Agreement, project benefits cannot be quantified and an economic evaluation of the Project cannot be undertaken.

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<sup>19</sup> The other half of the conservancy charge is passed on to KMC for solid waste collection.

<sup>20</sup> The PCR calculated an FIRR of 2.7 percent. The OEM considers the methodology applied (as also at appraisal) to be inappropriate.

48. People who live within the Lyari River basin are the main intended beneficiaries of the Project. The enhanced collection capacity of sewerage systems reduced the volume of raw sewage discharged into the river. The cleanliness of the environment was improved. However, the river is still being used for sewage disposal upstream from the project facilities. The increase in the population of the catchment area will, over time, strain the Project's collection capacity. However, without the Project, or alternative intervention, the situation would likely have deteriorated further. In terms of public health, the benefit to the people from whom the sewage originated is uncertain. In the Baldia area, with evidence of continued initial sewage disposal in open drains, the project impact, if any, is limited. Whether water shortages caused by the long-standing drought (para. 32) have influenced behavior and the utilization of sewers has not been determined.

49. The impact of the Project on the pollution of coastal waters is also limited. The additional treated sewage disposed in the sea is an improvement, but the overall impact is likely to be small. With the cancellation of the Korangi sewerage treatment plant, a component considered critical in this respect, this objective may have become overambitious.

50. The Project exceeded its design capacity and was completed within the reformulated project cost estimate.<sup>21</sup> The contracting out of O&M by KWSB has proved to be cost effective (para. 34). However, the Project was implemented with substantial delays, and some components were overdesigned or oversized and hence cost more than they could have.

#### **D. Sustainability**

51. Sustainability is a key issue. KWSB is in a weak financial position and has allocated insufficient resources for the maintenance of project facilities. For example, the budget for maintenance of the Mauripur sewage treatment plant for FY2001 is sufficient only to overhaul the bearings and seals in one third of the secondary pumps. The five pumps that are still in operation are at the end of their operating lives and urgently need overhauling. Since the other secondary pumps are out of service, any failure in these pumps will bring the entire plant to a standstill. As the current budget allocated is sufficient only to overhaul some of the secondary pumps, no maintenance can be carried out on any other part of the sewage treatment plant if these secondary pumps are overhauled. The lack of maintenance will likely lead to major problems in the sewage treatment plant in the near future.

### **IV. ACHIEVEMENT OF OTHER DEVELOPMENT IMPACTS**

#### **A. Socioeconomic Impact**

52. The project benefits to the targeted population in terms of improvement in public health through an improved environment have been varied in impact and may have been limited in some locations. The conservancy charge of KWSB (para. 43) was raised three times from November 1994 to April 1998. The PCR cited information indicating affordability of the charges

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<sup>21</sup> The Mauripur sewerage treatment plant notably being about one third larger in capacity than anticipated at the design stage (para. 22).

for lower income households. Although the OEM was not able to undertake an affordability analysis, there is some concern as to the possible impact on the poorest though it is evident that a number of households may not actually be paying KWSB's water and conservancy charges (para. 32).

## **B. Environmental Impact**

53. The Project had an apparent positive impact on the environment. An additional 136 ML/d of raw sewage per day is collected and processed by the sewage treatment plant, thus reducing suspended solids and biological and chemical oxygen demand. This may also have improved the quality of the coastal waters. However, it is not possible to readily determine the degree of environmental impact. The Mauripur sewage treatment plant has a hydraulic retention time of about two weeks at current flow rates, but tests by KWSB's laboratory are conducted on influent and effluent qualities based on samples taken the same day.<sup>22</sup> Therefore, the test results are not meaningful. Sample results should take into account the two-week time lag corresponding to the plant's retention period.

## **C. Impact on Institutions and Policy**

54. The main institutional impact of the Project was through the TA, Strengthening of Billing and Collection Operations of KWSB (footnote 2). The objectives of the TA were to assist KWSB in strengthening its financial management through improved recovery of consumer arrears and collection of current accounts receivable. The scope of work included reviewing the existing billing and collection system, developing an action plan to strengthen this system, and on-the-job training. The consultant prepared an unpaid bill analysis report that identified unrecoverable water bills and made recommendations for the repayment of the balance. The consultant also made recommendations for strengthening the billing and collections department of KWSB. The recommendations were sound and most were implemented by KWSB. The work of the consultant contributed significantly to the strengthening of KWSB's financial management systems and provided useful guidance to KWSB staff.

55. The Project also provided on-the-job and international training that contributed to staff development in technical areas. A project covenant required that KWSB be reorganized according to an organizational and management study previously completed. The reorganization led to the elimination of about 5,700 jobs and to the streamlining of the institution. Overall, the Project had a positive institutional impact.

# **V. OVERALL ASSESSMENT**

## **A. Relevance**

56. The Project was generally consistent with ADB's country operational strategy and the Government's priorities. It was also a component of the Sewerage Master Plan for Karachi that envisaged a parallel expansion of the sewerage system with the water supply system.

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<sup>22</sup> The PCR indicated that 78 percent of pollutants were being removed though for the above reasons, the OEM has doubts as to the reliability of the reported test results.

However, there was no consultation with the intended beneficiaries to solicit their views and priorities. Moreover, the TA for the study of marine outfalls was irrelevant. Nevertheless, the Project is rated relevant overall.

## **B. Efficacy**

57. The Project was implemented satisfactorily, although with considerable delays. Physical capacities of the components as anticipated at reformulation were exceeded, but the rate of utilization has detracted from outcome.<sup>23</sup> The extent to which the Project contributed to the improvement of public health or made a positive impact on the environment has not been quantified and is uncertain. The cleanliness of the environment in the Lyari River basin was improved but the river is still being used for sewage disposal upstream from the project facilities. However, the situation may likely have deteriorated without the Project or alternative interventions. In the Baldia area, evident continued sewage disposal in open drains will have resulted in limited impact, if any. The extent to which water shortages arising from the long-standing drought affected sewer utilization has not been determined. The Project likely has a limited impact on coastal water pollution too. Following the cancellation of the Korangi sewerage treatment plant, this objective probably became overambitious. The Project strengthened the institutional capacity of KWSB, but the financial position of KWSB is still weak and the accounts receivable issue remains unresolved after 15 years. The Project failed to train staff in environmental engineering as intended. The Project is on the borderline between inefficacious and partly inefficacious.

## **C. Efficiency**

58. The Project exceeded design capacities at a cost lower than that estimated at reformulation. O&M arrangements are cost effective. However, some components were oversized or overdesigned, hence costing more than they could have done, and the Project was implemented with substantial delays. The average amount of sewage treated has represented about 54 percent of completed treatment plant capacity. Capacity utilization could be raised through better use of sewer cleaning equipment and the repair and connection of existing sewers to sewer mains. In the near term, however, there are limitations to increasing inflows. Project benefits have likely had a varied impact depending on location but have not been quantified and hence are uncertain. The Project is rated less efficient.

## **D. Sustainability**

59. The Project does not seem to be sustainable. Although staff are well trained in maintaining the project facilities, KWSB is in a poor financial position to allocate more resources for the upkeep of the project facilities. KWSB revenues are insufficient to cover O&M costs and to service its debt. From the sales that are made, KWSB has a great deal of difficulty in actually getting paid for the services provided. It also has little prospect of raising tariffs because of the drought that Karachi has been experiencing since 1997. KWSB continues to be operational because of the subsidies that it receives from KMC.

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<sup>23</sup> As measured against completed rather than anticipated capacity.



## **E. Institutional Development and Other Impacts**

60. The Project provided institutional strengthening and capacity building through a TA and the loan covenants. These measures resulted in a measure of improvement in billing and revenue collection and a more streamlined organizational set-up. The shortcomings in revenue collection are a problem at the political level rather than with KWSB's efforts. The training provided on project facilities was effective and enhanced technical skills of staff. The institutional development impact of the Project has been significant.

## **F. Overall Project Rating**

61. Based on the above five key evaluation criteria, the Project is rated partly successful.

## **G. Assessment of ADB and Borrower Performance**

62. ADB fielded 22 missions to review and monitor project implementation. The first 10 review missions originated from ADB headquarters in Manila, after which the Project was administered by ADB's Pakistan Resident Mission. Over the eight years that the Project was implemented, ADB fielded an average of about three review missions per year. The review missions focused on issues related to KWSB's electricity arrears, land acquisition, physical progress in the implementation of civil works, procurement of equipment and machinery, and staff training. The review missions also discussed issues with the government of Sindh and KWSB related to KWSB's financial performance, tariffs, and compliance with the loan covenants. Overall, ADB's supervision of the Project was satisfactory.

63. KWSB's performance was also satisfactory. KWSB took advantage of the experience gained from the implementation of the sewerage component of the Karachi Urban Development Project to improve its own performance in implementing projects. It financed some project components out of its own resources to avoid further delays when implementation delays became inevitable. The performance of the government of Sindh could have been better: it was slow in resolving the electricity arrears issue and did not fully exert its influence to enable KWSB to recover overdue billings from its own departments, agencies, or local bodies.

## **VI. ISSUES, LESSONS, AND FOLLOW-UP ACTIONS**

### **A. Key Issues for the Future**

64. The OEM visited the Community Health Sciences Department of the Aga Khan University in Karachi that trains medical professionals, provides health services to the poor of Karachi, and conducts research on health-related issues in Karachi. According to staff there, investment in environmental projects in Karachi may be premature. If the purpose of a sewerage project is to promote public health, then investment in water supply combined with education in personal hygiene would be more effective in reducing morbidity from water-related diseases. About one half of the population of the city lives in slums, has no access to piped water supplies, and is at substantial risk from diarrheal diseases, such as gastroenteritis, and

other diseases such as typhoid and cholera. Adequate supplies of nonpotable, but clean, water would also be preferable to limited supplies of potable water. Sewerage facilities in Karachi should be considered only after water supply (either potable or nonpotable) has been provided to the majority of the population.<sup>24</sup> Most people in the city already have some kind of rudimentary sewerage system that puts sewage into creek beds and eventually into the sea. Thus, the Project highlights the need to firmly establish the priority of a sewerage project vis-à-vis other investments oriented to public health.

65. If it is deemed that a sewerage project is appropriate and resources are a constraint, consideration should be given to providing primary treatment<sup>25</sup> to sewage in the first instance. Such provision would have a greater beneficial impact than secondary treatment to only a smaller part of the community. Such an approach would also be more equitable. Primary treatment facilities could be later upgraded to secondary treatment as public demand and environmental concerns warrant.

## **B. Lessons Identified**

66. The main weaknesses of the Project were related to its design and operation. In cases where the appraisal cost estimates for a project are based on inaccurate standard unit rates, ADB should closely monitor any redesign of the project to ensure that the design is efficient and least cost. Participation of beneficiaries should be a part of project design and any subsequent redesign, to ensure that their priorities and needs are incorporated. Land and other legal issues should also be resolved before the loan for a project is approved by ADB.

67. Sustainability of sewerage projects can only be assured if the executing agency is in good financial health. This is clearly not the case of KWSB, which is unable to allocate sufficient resources for the maintenance of project facilities. As a result, the Mauripur sewage treatment plant is at risk of halting operations. The financial impact of a sewerage project on the executing agency needs to be assessed carefully. Although the financial difficulties of KWSB were well known during project preparation, it was probably overly optimistic to expect that the federal Government and the government of Sindh had the political will to address this issue. The 19-month delay in resolving the accounts receivable problem of the Karachi Electric Supply Corporation attests to this. In cases where major reform is needed, an assessment of the political commitment to carrying out such reform is required.

68. The Project's objectives were vague and could not be monitored. It was insufficient to state that the Project's purpose was to improve environmental sanitary conditions and alleviate pollution in coastal waters. Some quantifiable targets should have been established. In addition, when a project is reformulated, its objectives should be reviewed and amended accordingly.

69. The loan covenant for establishing a BME system in KWSB was ineffective. The BME system was to be established too late in the project cycle and KWSB did not have the required

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<sup>24</sup> As noted in para. 11, the Sewerage Master Plan for Karachi assumed that Karachi would have 100 percent water supply coverage. However, this did not occur.

<sup>25</sup> Primary treatment of sewage involves the screening and removal of the larger solid material in the sewage, settling out other solid material, and the removal of solids that float.

skills to establish such a system. An assessment of an executing agency's capacity for establishing a BME or any other project performance monitoring system should be undertaken during the project preparation stage.

### **C. Follow-Up Actions**

70. The Pakistan Resident Mission should maintain policy dialogue with the concerned authorities on the urgent need to allocate sufficient resources for maintenance of the Mauripur sewage treatment plant including the repair and rehabilitation of all the secondary pumps; replacement of the radiator of one of the standby diesel generators; and provision of sufficient fuel for the diesel generators so that the plant does not discharge sewage untreated into the sea during power outages. It will be important to ensure that the resources allocated to the Mauripur plant are incremental and not reallocated from other areas of operations. Because of KWSB's limited financial resources, KMC will likely have to provide a larger subsidy to KWSB for this purpose.

71. In the longer term, KWSB needs to take steps to better utilize not only the Mauripur sewage treatment plant but also Sewage Treatment Plant 1 and Sewage Treatment Plant 2 whose rehabilitation and upgrading was financed under the Karachi Urban Development Project (footnote 1). Existing sewer lines need to be unclogged and rehabilitated where necessary. New trunk sewer lines need to be built and connected to sewage systems already in place that dispose of waste in creeks and rivers. For example, sewage discharged into the Orangi creek could be intercepted near its confluence with the Lyari River and diverted into the Lyari trunk sewer. The intercepting structure should include a storm overflow. This would be a relatively simple and inexpensive undertaking. The sewage generated by the approximately 1 million people of Orangi alone would serve to fully utilize the capacity of the Mauripur sewage treatment plant. A follow-up project could convert the Orangi creek into a boxed combined sewer (draining both sewage and storm water in a combined sewer). This could proceed in stages from Orangi downstream, matching expenditures to resource availability.

72. ADB should undertake economic sector work to determine the relative efficacy of sewerage investments in urban areas on public health and the environment. Some research in this area has already been done, but there is a need to establish the relative benefits to public health of sewerage projects and water supply projects. This will likely have important implications for ADB's investment strategy in the social sectors.

## APPENDIXES

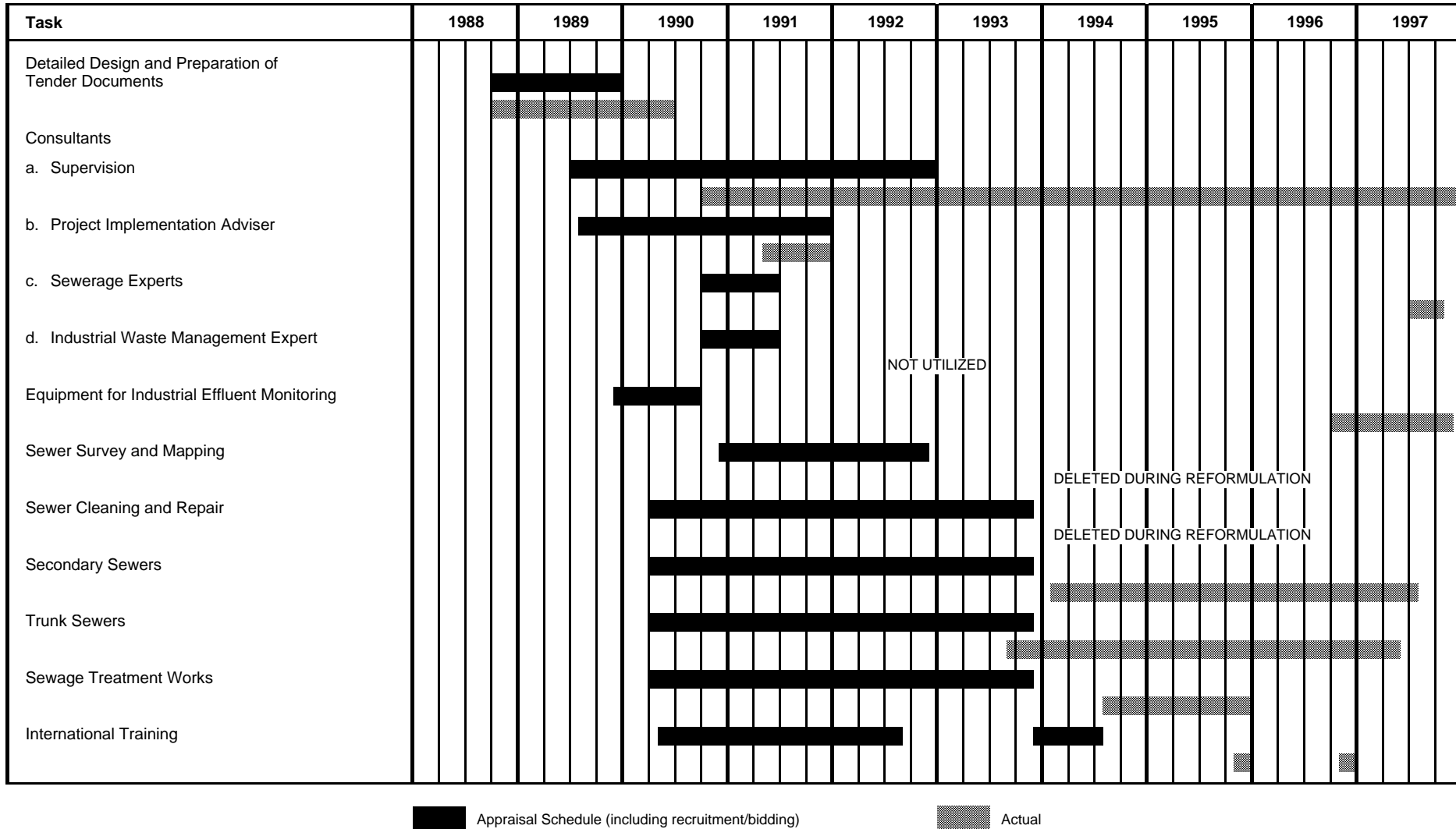
<b>Number</b>	<b>Title</b>	<b>Page</b>	<b>Cited on (page, para.)</b>
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**COMPARISION OF PLANNED AND ACTUAL PROJECT COST AND FINANCING PLAN**  
(\$ million)

	Appraisal Estimate						Reformulation						Actual					
	ADB		ODA		GOS/ KWSB	Total	ADB		ODA		GOS/ KWSB	Total	ADB		ODA		GOS/ KWSB	Total
	FCC	LCC	FCC	LCC	LCC		FCC	LCC	FCC	LCC	LCC		FCC	LCC	FCC	LCC	LCC	
A. Base Cost																		
Civil Works	8.76	35.00	0	0	0	43.76	13.40	47.74	0	0	0	61.14	19.80	42.04	0	0	3.29	65.13
Equipment	6.62	0.90	0	0	0	7.52	6.65	0.20	0	0	0	6.85	7.13	0.20	0	0	0	7.33
Engineering Consultants	3.10	1.70	0.70	0.70	0	6.20	4.26	2.01	1.69	0.70	0	8.66	4.62	1.92	1.69	0.70	0	8.93
Training and Institutional Consultants	0.90	0.10	0	0	0	1.00	0.33	0.01	0	0	0	0.34	0.23	0.01	0	0	0	0.24
Land	0	0	0	0	0	0	0	0	0	0	3.31	3.31	0	0	0	0	1.35	1.35
Taxes and Duties	0	0	0	0	9.70	9.70	0	0	0	0	7.69	7.69	0	0	0	0	4.77	4.77
KWSB Supervision Cost	0	0	0	0	4.00	4.00	0	0	0	0	1.51	1.51	0	0	0	0	0.85	0.85
<b>Subtotal (A)</b>	<b>19.38</b>	<b>37.70</b>	<b>0.70</b>	<b>0.70</b>	<b>13.70</b>	<b>72.18</b>	<b>24.64</b>	<b>49.96</b>	<b>1.69</b>	<b>0.70</b>	<b>12.51</b>	<b>89.50</b>	<b>31.78</b>	<b>44.17</b>	<b>1.69</b>	<b>0.70</b>	<b>10.26</b>	<b>88.60</b>
B. Contingencies																		
Physical Contingency	1.75	3.75	0	0	0	5.50	1.26	2.51	0	0	0	3.77	0	0	0	0	0	0
Price Escalation	3.70	14.60	0	0	0	18.30	2.51	4.96	0	0	0	7.47	0	0	0	0	0	0
<b>Subtotal (B)</b>	<b>5.45</b>	<b>18.35</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>23.80</b>	<b>3.77</b>	<b>7.47</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>11.24</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
C. Interest During Construction	4.12	0	0	0	10.10	14.22	6.06	0	0	0	13.56	19.62	4.21	0	0	0	8.86	13.07
<b>Total</b>	<b>28.95</b>	<b>56.05</b>	<b>0.70</b>	<b>0.70</b>	<b>23.80</b>	<b>110.20</b>	<b>34.47</b>	<b>57.43</b>	<b>1.69</b>	<b>0.70</b>	<b>26.07</b>	<b>120.36</b>	<b>35.99</b>	<b>44.17</b>	<b>1.69</b>	<b>0.70</b>	<b>19.12</b>	<b>101.67</b>

ADB = Asian Development Bank, FCC = Foreign currency cost, GOS = Government of Sindh, KWSB = Karachi Water and Sewerage Board,  
LCC = Local Currency cost, ODA = Overseas Development Administration.

## PROJECT IMPLEMENTATION SCHEDULE



## COMPLIANCE WITH KEY LOAN COVENANTS

Loan Agreement/Loan Covenant	Status of Compliance
<b>A. Project Implementation</b>	
<b>Project Management</b>	
1. The Project shall be executed by the Karachi Water and Sewerage Board (KWSB) and implemented by the Development Wing of KWSB. The Project Director of the Development Wing who will be assisted by a Project Manager for sewerage projects and a Project Implementation Adviser shall be responsible for Project implementation (Schedule 6, para. 1).	Complied with
2. KWSB shall increase the number of professional and supporting staff of the Development Wing as may be required to ensure timely and efficient implementation of the Project (Schedule 6, para. 2).	Complied with
<b>Land Acquisition</b>	
3. The Borrower and the government of Sindh (Sindh) shall ensure that all necessary land and land-use rights and privileges, including building permits and development rights, shall be acquired by or transferred to Karachi Municipal Corporation (KMC) for KWSB on a timely basis, to ensure effective implementation and completion of the Project. Sindh shall also ensure that the Asian Development Bank (ADB) is kept informed about the status of land acquisition for the Project (Schedule 6, para. 3).	Not complied with. There were delays in the transfer of land for the Mauripur sewage treatment plant due to its partial occupation and a court restraining order.
<b>B. Other Project-Related Matters</b>	
<b>Overseas Training</b>	
4. KWSB shall, not later than three months prior to the commencement of the overseas training, consult with and seek the approval of ADB for (a) institutions to be used for training; (b) the proposed level and type of training to be provided; (c) timetable for the implementation of such training; (d) financial arrangements; and (e) criteria for selection of trainees. KWSB shall ensure that such trainees shall be assigned upon their return responsibilities relating to such training and to the sewerage operations of KWSB (Schedule 6, para. 4).	Complied with
<b>Project Benefit Monitoring and Evaluation</b>	
5. Commencing FY1992, KWSB shall undertake project benefit monitoring and evaluation (PBME) and report to ADB on the PBME findings in the annual performance reports. The contents of such reports shall be as previously agreed by KMC and ADB (Schedule 6, para. 5).	Not complied with

Loan Agreement/Loan Covenant	Status of Compliance
<b>Operation and Maintenance</b>	
<p>6. KWSB shall carry out proper operation and maintenance (O&amp;M) of the Project facilities and for this purpose, KMC shall cause to be provided to KWSB sufficient funds, including the revenues from the conservancy charges referred to in para. 12 (b) of this schedule, as well as timely grants to meet shortfalls in the budget for the sewerage operations of KWSB (Schedule 6, para. 6).</p>	Not complied with
<b>C. Financial Matters</b>	
<b>Financial Objectives</b>	
<p>7. Sindh and KMC shall take such measures to enable KWSB to achieve the financial performance objectives, including full cost recovery set forth in para. 8 of this schedule. Such measures shall include implementation and adjustments, as required of water tariffs and conservancy charges, reduction of non-revenue water and of accounts receivable, and improvement of KWSB's operations (Schedule 6, para. 7).</p>	Not complied with
<p>8. KWSB, with the assistance of Sindh and KMC, shall generate gross revenues</p>	
<ul style="list-style-type: none"> <li>from its combined water supply and sewerage operations sufficient (i) to meet its O&amp;M costs and debt-service requirements commencing with FY1992; and (ii) to meet its O&amp;M costs and depreciation or debt-service requirements, whichever is greater, and to produce internal funds adequate to meet not less than 20 percent of annual capital expenditures commencing with FY1994; and</li> </ul>	Not complied with
<ul style="list-style-type: none"> <li>from its sewerage operations, sufficient (i) to meet its O&amp;M costs and debt-service requirements, commencing with FY1992; and (ii) to meet its O&amp;M costs and depreciation of debt-service requirements, whichever is greater, and to produce internal funds adequate to meet not less than 10 percent of annual capital expenditures, commencing with FY1994.</li> </ul>	Complied with
(Schedule 6, para. 8 [A])	
<b>Water Tariff and Metering</b>	
<p>9. Sindh and KMC shall cause KWSB to prepare and commence implementing a new water-tariff structure based on metered consumption and a metering program to encourage water conservation and to achieve equitable sharing of costs and full cost recovery.</p>	Not complied with



Loan Agreement/Loan Covenant	Status of Compliance
<ul style="list-style-type: none"> <li>KMC shall ensure that ADB and the International Development Association (IDA) have had an opportunity to review no later than 30 March 1990 the recommendations of the metering study financed by the Overseas Development Association in connection with the IDA Project and undertaken to assist KWSB in preparation of the new water-tariff structure and metering program prior to their implementation (Schedule 6, para. 10 [A]).</li> </ul>	Complied with
<ul style="list-style-type: none"> <li>After approval of the new water tariff structure and metering program by ADB and IDA, Sindh and KMC shall enable KWSB to implement no later than 1 July 1990 implementation on a gradual basis of the new water tariff structure and metering program (Schedule 6, para. 10 [B]).</li> </ul>	Complied with
<p>10. Sindh and KMC shall cause KWSB, pending full implementation of the new water tariff structure, to revise the water tariffs under the present structure in consultation with ADB and IDA (Schedule 6, para. 11).</p>	Complied with
<p><b>Conservancy Charges</b></p>	
<p>11. For the purpose of generating sufficient revenue from KWSB's sewerage operations, Sindh and KMC shall cause KWSB to commence collection of the conservancy charges from (i) retail consumers of water no later than 1 July 1990; and (ii) bulk consumers of water wherever KWSB facilities are available no later than 1 July 1990 (Schedule 6, para. 12 [A]).</p>	Complied with
<p>12. KMC shall ensure that not less than one half of the revenue from the conservancy charge is used by KWSB for its sewerage operations (Schedule 6, para. 12 [B]).</p>	Complied with
<p>13. No later than three years from the effective date KMC shall review in consultation with ADB the conservancy charges scheme, including the basis for determining the conservancy charges and the structure thereof (Schedule 6, para. 12 [C]).</p>	Complied with
<p><b>Accounts Receivable</b></p>	
<p>14. The Borrower, Sindh, and KMC shall enable KWSB to take, with the assistance of the consultants engaged under the ADB-financed technical assistance, all such measures necessary</p>	
<ul style="list-style-type: none"> <li>To implement KWSB's action plan for collection of consumer arrears agreed to by ADB; and to strengthen KWSB's billing and collection operations in order to maintain accounts receivable for new billing at no more than the equivalent of three months billing by FY1991; and</li> </ul>	Not complied with

Loan Agreement/Loan Covenant	Status of Compliance
<ul style="list-style-type: none"> <li>The Borrower, Sindh, and KMC shall also take all such measures including sufficient allocation of budgetary funds by the borrower, Sindh and KMC to their respective departments and agencies, necessary to pay their water and conservancy charges.</li> </ul> <p>(Schedule 6, para. 13)</p>	Not complied with
<b>D. Institutional Matters</b>	
<b>Reorganization</b>	
<p>15. KMC shall cause KWSB to reorganize as part of KWSB's overall reorganization and management development to be implemented no later than 31 December 1992, its operations including its water supply and sewerage operations in accordance with the recommendations of the organization and management study, the recommendation of which shall be agreed by ADB and IDA prior to their implementation (Schedule 6, para. 14).</p>	Complied with
<b>Staffing Requirements</b>	
<p>16. KWSB shall undertake measures necessary to (i) restrict for a period of five years from the effective date the employment of new staff at levels lower than technical; and (ii) increase the number of engineers and other technical professional staff required for sewerage operations in accordance with the manpower development plan (Schedule 6, para. 15[A]).</p>	Complied with
<p>17. KMC shall cause KWSB to prepare and implement commencing in FY1992 a comprehensive manpower development plan covering work incentives, personnel management, and guidelines for personnel control and training. The plan shall be prepared as part of the organization and management study undertaken in connection with the IDA Project and shall be submitted to ADB for review and comment no later than 31 December 1990 (Schedule 6, para. 15 [B]).</p>	Complied with
<b>Sewerage By-Laws</b>	
<p>18. Sindh, KMC, and KWSB shall cause to be promulgated not later than 1 July 1991, sewerage by-laws</p>	
<ul style="list-style-type: none"> <li>(i) providing KWSB with responsibility and authority for the review and approval of sewerage schemes to be constructed by private or public entities in the Project area; (ii) requiring all residential, business, industrial, commercial, and public establishments to discharge their wastewater into KWSB's sewers if any exist within a reasonable distance, and pay for the services related thereto; and (iii) defining appropriate institutional arrangements between KWSB and other public entities for effective management of sewage and industrial effluent in the Project area (Schedule 6, para. 16).</li> </ul>	Complied with

Loan Agreement/Loan Covenant	Status of Compliance
<b>Sindh Environmental Protection Agency</b>	
19. Sindh shall provide all required support and finance the Sindh Environmental Protection Agency established to undertake not later than 1 July 1991, routine monitoring of the environmental quality of the Project area's coastal waters and of industrial effluent discharge (Schedule 6, para. 17).	Complied with
<b>Project Agreement</b>	
20. KMC shall cause KWSB to (i) maintain separate accounts for KWSB's overall operations for KWSB's sewerage operations and for the Project; (ii) have such accounts and related financial statements audited annually by auditors acceptable to ADB; and (iii) furnish to ADB not later than six months after the close of the fiscal year certified copies of such audited accounts and financial statements and the report of the auditors.	Not complied with
21. Not later than three months after physical completion of the Project KMC shall prepare and furnish to ADB a report on the execution and initial operation of the Project (Section 2.09).	Complied with
22. Except as ADB may otherwise agree, Sindh shall onlend the proceeds of the Loans, together with other funds required for the Project, to KMC, under the Subsidiary Loan Agreement, on terms and conditions satisfactory to ADB. Except as ADB may otherwise agree, the terms for onlending the proceeds of the Loans to KMC under the Subsidiary Loan Agreement shall include interest at the rate of 7 percent per annum, inclusive of a foreign-exchange risk fee, and a repayment period of 25 years including a grace period of five years (Section 3.03).	Complied with
23. KMC through KWSB shall furnish to ADB quarterly reports on the execution of the Project and the operation and management of the Project facilities. Such reports shall be submitted in such form and details as ADB shall reasonably request and shall indicate progress made and problems encountered during the quarter under review, steps taken or proposed to be taken to remedy these problems, and proposed program of activities and expected progress during the following quarter (Section 4.02 [A]).	Complied with
24. KMC through KWSB shall, commencing with FY1991, furnish to ADB annual performance reports on the operations of KWSB and PBME. Such reports shall be submitted in such form and details as ADB shall reasonably request within three months of the end of the fiscal year to which they relate. Such reports shall be submitted to ADB for a period of eight years after completion of the Project and thereafter at the request of ADB. (Section 4.02 [B])	Not complied with

# KARACHI WATER AND SEWERAGE BOARD FINANCIAL STATEMENTS

**Table A4.1 Income Statement**  
(year ending 30 June, PRs million)

Year	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00
<b>Revenue</b>														
Water supply charges	311.67	340.64	453.67	490.06	496.40	504.63	703.86	831.00	916.19	1,338.57	1,334.89	1,737.57	2,143.17	2,213.28
Sewerage charges	0	0	0	0	0	0	48.48	79.46	78.52	77.49	365.56	462.82	580.01	589.04
Other income	11.59	9.58	13.71	15.31	12.45	14.29	15.45	11.95	11.29	29.18	39.25	40.56	65.86	40.00
<b>Total revenue</b>	<b>323.26</b>	<b>350.21</b>	<b>467.37</b>	<b>505.36</b>	<b>508.85</b>	<b>518.93</b>	<b>767.79</b>	<b>922.41</b>	<b>1,006.00</b>	<b>1,445.24</b>	<b>1,739.70</b>	<b>2,240.95</b>	<b>2,789.04</b>	<b>2,842.33</b>
<b>Expenses</b>														
Cost of raw water	31.03	4.82	4.51	5.00	3.00	3.00	0.12	0.12	0.76	1.25	4.40	1.31	2.83	1.76
Labor	169.71	201.71	218.53	243.46	267.95	365.36	411.92	457.41	576.67	684.29	593.57	547.23	441.10	471.86
Chemicals	8.19	9.61	5.62	9.32	10.89	12.01	9.86	8.33	11.21	10.75	9.61	9.99	12.11	20.34
Petroleum, oil, lubricants	15.40	12.21	14.01	12.86	18.06	16.30	23.82	31.75	23.93	32.83	44.45	44.98	45.77	45.86
Electricity cost	60.27	66.32	77.16	141.01	54.73	48.68	324.46	336.55	400.21	363.75	405.15	339.15	514.36	1,007.52
Repair and maintenance	106.38	90.87	53.89	69.99	75.16	87.16	94.47	274.87	344.49	151.58	229.74	340.55	470.49	258.83
Cost of tanker water	8.77	5.93	16.82	25.48	40.00	32.01	22.07	44.03	24.99	46.93	25.81	24.02	24.88	59.88
Vehicle costs	6.21	6.51	6.45	7.11	6.48	8.66	3.14	2.42	12.11	13.13	14.42	16.34	23.38	28.42
Administrative costs	20.15	19.67	38.24	45.40	58.59	63.33	60.64	84.58	51.88	69.67	83.82	93.89	329.73	228.77
Provision for doubtful debts	15.58	17.03	22.68	24.50	24.82	25.23	35.19	41.55	45.81	66.93	157.78	260.62	272.32	290.64
Depreciation	63.00	61.09	58.70	56.75	54.47	52.38	65.86	63.01	118.57	149.60	208.57	198.44	188.60	376.52
<b>Total expenses</b>	<b>504.68</b>	<b>495.75</b>	<b>516.61</b>	<b>640.89</b>	<b>614.14</b>	<b>714.12</b>	<b>1,051.54</b>	<b>1,344.62</b>	<b>1,610.62</b>	<b>1,590.70</b>	<b>1,777.31</b>	<b>1,876.51</b>	<b>2,325.56</b>	<b>2,790.39</b>
<b>Operating Income</b>	<b>-181.43</b>	<b>-145.53</b>	<b>-49.24</b>	<b>-135.52</b>	<b>-105.28</b>	<b>-195.20</b>	<b>-283.75</b>	<b>-422.20</b>	<b>-604.62</b>	<b>-145.46</b>	<b>-37.61</b>	<b>364.44</b>	<b>463.47</b>	<b>51.93</b>
Interest payments	6.52	6.78	7.51	6.98	6.34	6.34	27.17	20.83	82.98	103.69	174.66	173.70	349.71	385.74
<b>Net Income before subsidy</b>	<b>-187.94</b>	<b>-152.31</b>	<b>-56.75</b>	<b>-142.50</b>	<b>-111.63</b>	<b>-201.54</b>	<b>-310.92</b>	<b>-443.03</b>	<b>-687.60</b>	<b>-249.15</b>	<b>-212.28</b>	<b>190.74</b>	<b>113.77</b>	<b>-333.81</b>
KMC subsidy	133.69	170.50	97.39	113.18	134.52	159.58	310.47	363.79	283.91	267.93	221.01	249.19	177.05	297.91
<b>Net Income after subsidy</b>	<b>-54.25</b>	<b>18.19</b>	<b>40.64</b>	<b>-29.32</b>	<b>22.90</b>	<b>-41.96</b>	<b>-0.45</b>	<b>-79.24</b>	<b>-403.69</b>	<b>18.77</b>	<b>8.73</b>	<b>439.93</b>	<b>290.82</b>	<b>-35.90</b>
Prior year adjustments	0	0	0	0	0	-764.19	200.86	0	79.40	-9.97	587.75	36.85	0	0
<b>Net Income after subsidy and prior year adjustments</b>	<b>-54.25</b>	<b>18.19</b>	<b>40.64</b>	<b>-29.32</b>	<b>22.90</b>	<b>-806.15</b>	<b>200.41</b>	<b>-79.24</b>	<b>-324.29</b>	<b>8.80</b>	<b>596.48</b>	<b>476.78</b>	<b>290.82</b>	<b>-35.90</b>
<b>Rate Base</b>	<b>1,196.59</b>	<b>1,219.09</b>	<b>1,129.79</b>	<b>1,025.90</b>	<b>988.83</b>	<b>949.13</b>	<b>1,059.84</b>	<b>1,166.77</b>	<b>1,673.13</b>	<b>3,527.63</b>	<b>5,674.19</b>	<b>6,387.77</b>	<b>6,174.45</b>	<b>7,846.93</b>
<b>Return on Rate Base</b>														
- before subsidy	-15.16%	-11.94%	-4.36%	-13.21%	-10.65%	-20.57%	-26.77%	-36.19%	-36.14%	-4.12%	-0.66%	5.71%	7.51%	0.66%
- after subsidy	-3.99%	2.05%	4.26%	-2.18%	2.96%	-3.75%	2.52%	-5.01%	-19.17%	3.47%	3.23%	9.61%	10.37%	4.46%

**Table A4.2 Balance Sheet**  
(year ending June 30, PRs million)

Year	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00
<b>Assets</b>														
<b>Current Assets</b>														
Cash	33.37	70.73	145.64	77.73	110.09	246.09	151.33	263.77	699.54	1,005.43	719.22	730.07	1,116.19	1,104.44
Advances and prepayments	5.43	6.03	6.53	7.16	29.18	8.67	5.85	8.25	13.44	93.97	164.14	189.51	167.32	355.65
Accounts receivable	262.21	386.11	559.83	782.71	883.40	976.89	955.78	1,136.47	1,219.18	1,417.43	2,292.35	2,973.56	3,448.82	4,150.05
<b>Total current assets</b>	<b>301.01</b>	<b>462.86</b>	<b>712.00</b>	<b>867.60</b>	<b>1,022.66</b>	<b>1,231.65</b>	<b>1,112.96</b>	<b>1,408.49</b>	<b>1,932.16</b>	<b>2,516.83</b>	<b>3,175.71</b>	<b>3,893.13</b>	<b>4,732.33</b>	<b>5,610.15</b>
<b>Fixed assets</b>														
Gross fixed assets	1,597.12	1,652.67	1,538.99	1,560.33	1,576.07	1,587.66	1,915.61	1,930.38	3,109.92	5,907.54	7,790.13	7,797.80	7,777.71	11,707.87
Accumulated depreciation	374.93	436.69	495.39	552.14	606.60	658.86	724.72	787.73	906.30	1,055.90	1,293.39	1,519.00	1,707.60	2,084.12
Net fixed assets	1,222.19	1,215.98	1,043.60	1,008.19	969.47	928.80	1,190.89	1,142.65	2,203.62	4,851.64	6,496.74	6,278.80	6,070.11	9,623.75
Work in progress	0	0	181.37	434.76	1,117.74	2,586.42	3,565.65	5,387.92	7,198.40	11,713.05	13,014.51	16,223.04	18,290.90	16,812.63
<b>Total fixed assets</b>	<b>1,222.19</b>	<b>1,215.98</b>	<b>1,224.97</b>	<b>1,442.95</b>	<b>2,087.21</b>	<b>3,515.23</b>	<b>4,756.53</b>	<b>6,530.56</b>	<b>9,402.02</b>	<b>16,564.69</b>	<b>19,511.25</b>	<b>22,501.84</b>	<b>24,361.01</b>	<b>26,436.37</b>
<b>Total assets</b>	<b>1,523.20</b>	<b>1,678.84</b>	<b>1,936.98</b>	<b>2,310.55</b>	<b>3,109.87</b>	<b>4,746.88</b>	<b>5,869.49</b>	<b>7,939.05</b>	<b>11,334.18</b>	<b>19,081.51</b>	<b>22,686.96</b>	<b>26,394.98</b>	<b>29,093.34</b>	<b>32,046.52</b>
<b>Liabilities</b>														
<b>Current liabilities</b>														
Current debt	121.87	135.09	149.67	156.65	163.00	37.40	37.40	37.40	20.09	20.09	20.09	20.09	710.39	487.55
Contractor deposits	38.21	52.71	169.97	174.86	219.55	370.97	261.42	303.69	311.91	368.93	380.52	391.58	391.67	392.87
Accounts payable	173.34	209.83	348.64	361.31	521.12	750.11	649.96	888.93	1,129.26	1,549.84	1,244.22	226.70	87.45	480.44
Pension liabilities	67.97	74.25	83.84	86.03	86.63	0	0	0	0	0	31.15	27.17	0	0
<b>Total current liabilities</b>	<b>401.38</b>	<b>471.88</b>	<b>752.12</b>	<b>778.84</b>	<b>990.30</b>	<b>1,158.48</b>	<b>948.79</b>	<b>1,230.02</b>	<b>1,461.26</b>	<b>1,938.86</b>	<b>1,675.99</b>	<b>665.54</b>	<b>1,189.51</b>	<b>1,360.86</b>
<b>Long-term debt</b>														
Consumer deposits	14.36	18.04	20.39	25.55	29.87	33.98	40.91	47.36	54.79	63.13	74.99	85.73	105.48	118.39
Long-term loans	263.81	268.94	325.82	551.17	1,106.82	2,442.07	3,540.60	4,630.10	6,588.96	10,017.53	12,955.34	15,799.19	17,353.75	19,903.55
Other long-term debt	0	154.23	0	0	0	0	0	0	0	0	0	0	0	0
<b>Total long-term debt</b>	<b>278.17</b>	<b>441.21</b>	<b>346.21</b>	<b>576.72</b>	<b>1,136.69</b>	<b>2,476.06</b>	<b>3,581.51</b>	<b>4,677.46</b>	<b>6,643.75</b>	<b>10,080.66</b>	<b>13,030.32</b>	<b>15,884.92</b>	<b>17,459.23</b>	<b>20,021.94</b>
<b>Equity</b>														
Capital reserve	982.81	905.51	944.84	1,090.50	1,095.50	2,031.11	2,269.64	3,041.26	4,563.16	8,387.17	8,709.35	10,096.43	10,405.70	10,660.71
Retained earnings	139.15	139.75	106.19	(135.51)	112.62	918.78	930.45	1,009.69	1,333.98	1,325.18	728.70	251.92	38.90	3.00
<b>Total equity</b>	<b>843.66</b>	<b>765.76</b>	<b>838.65</b>	<b>954.99</b>	<b>982.88</b>	<b>1,112.34</b>	<b>1,339.19</b>	<b>2,031.57</b>	<b>3,229.17</b>	<b>7,061.99</b>	<b>7,980.65</b>	<b>9,844.51</b>	<b>10,444.60</b>	<b>10,663.71</b>
<b>Total liabilities</b>	<b>1,523.20</b>	<b>1,678.84</b>	<b>1,936.98</b>	<b>2,310.55</b>	<b>3,109.87</b>	<b>4,746.88</b>	<b>5,869.49</b>	<b>7,939.05</b>	<b>11,334.18</b>	<b>19,081.51</b>	<b>22,686.96</b>	<b>26,394.98</b>	<b>29,093.34</b>	<b>32,046.52</b>
<b>Current ratio</b>	0.75	0.98	0.95	1.11	1.03	1.06	1.17	1.15	1.32	1.30	1.89	5.85	3.98	4.12
<b>Debt ratio</b>	0.25	0.37	0.29	0.38	0.54	0.69	0.73	0.70	0.67	0.59	0.62	0.62	0.63	0.65
<b>Accounts receivable (months)</b>	10.10	13.60	14.81	19.17	21.36	23.23	15.24	14.98	14.71	12.01	16.18	16.22	15.20	17.77

**Table A4.3 Source and Applications of Funds Statement**  
(year ending June 30, PRs million)

Year	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00
<b>Sources of Funds</b>														
<b>Internal Sources</b>														
Net income	-187.94	-152.31	-56.75	-142.50	-111.63	-201.54	-310.92	-443.03	-687.60	-249.15	-212.28	190.74	113.77	-333.81
Depreciation	63.00	61.09	58.70	56.75	54.47	52.38	65.86	63.01	118.57	149.60	208.57	198.44	188.60	376.52
Extraordinary items	0.00	-110.30	0.00	0.00	0.00	-764.32	-11.22	0.00	96.71	-12.89	587.75	36.85	0.00	0.00
<b>Total Internal Sources</b>	<b>-124.94</b>	<b>-201.53</b>	<b>1.95</b>	<b>-85.75</b>	<b>-57.16</b>	<b>-913.48</b>	<b>-256.28</b>	<b>-380.02</b>	<b>-472.32</b>	<b>-112.44</b>	<b>584.04</b>	<b>426.03</b>	<b>302.37</b>	<b>42.71</b>
<b>External Sources</b>														
Long-term loans	65.83	15.13	46.89	225.35	555.65	1,335.26	1,098.53	1,089.50	1,941.56	3,428.57	2,937.81	2,843.85	1,554.56	2,549.80
Consumer deposits	2.81	3.69	2.34	5.16	4.32	4.11	6.93	6.45	7.42	8.35	11.85	10.75	19.75	12.91
Government grant	32.09	33.00	39.33	1.43	5.00	935.61	238.53	771.61	1,521.90	1,063.77	328.00	1,414.25	334.82	279.05
KMC subsidy	133.69	170.50	97.39	113.18	134.52	159.58	310.47	363.79	283.91	267.93	221.01	249.19	177.05	297.91
<b>Total External Sources</b>	<b>234.42</b>	<b>222.31</b>	<b>185.94</b>	<b>345.12</b>	<b>699.49</b>	<b>2,434.56</b>	<b>1,654.46</b>	<b>2,231.35</b>	<b>3,754.78</b>	<b>4,768.61</b>	<b>3,498.67</b>	<b>4,518.05</b>	<b>2,086.18</b>	<b>3,139.67</b>
<b>Total Sources</b>	<b>109.48</b>	<b>20.79</b>	<b>187.89</b>	<b>259.37</b>	<b>642.33</b>	<b>1,521.08</b>	<b>1,398.18</b>	<b>1,851.33</b>	<b>3,282.46</b>	<b>4,656.16</b>	<b>4,082.71</b>	<b>4,944.08</b>	<b>2,388.55</b>	<b>3,182.38</b>
<b>APPLICATION OF FUNDS</b>														
Acquisition of fixed assets	114.12	55.54	67.69	274.73	698.72	1,338.86	1,307.17	1,837.04	2,990.02	4,549.10	3,184.05	3,216.21	2,073.32	2,475.92
Debt amortization	6.33	18.75	7.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
<b>Total applications</b>	<b>120.45</b>	<b>74.29</b>	<b>74.76</b>	<b>274.73</b>	<b>698.72</b>	<b>1,338.86</b>	<b>1,307.17</b>	<b>1,837.04</b>	<b>2,990.02</b>	<b>4,549.10</b>	<b>3,184.05</b>	<b>3,216.21</b>	<b>2,073.32</b>	<b>2,475.92</b>
<b>CHANGE IN WORKING CAPITAL</b>														
Current liabilities	-66.40	-215.35	-136.01	-170.95	-211.46	-155.25	209.70	-281.24	-231.24	-477.60	262.87	1,010.45	-523.97	-171.35
Current assets excluding cash	40.08	124.49	174.24	223.50	122.70	72.99	-23.93	183.08	87.91	278.78	921.99	706.58	453.08	889.56
Cash	15.36	37.36	74.91	-67.91	32.36	264.48	-94.77	112.45	435.77	305.89	-286.20	10.84	386.12	-11.74
<b>Net change in working capital</b>	<b>-10.97</b>	<b>-53.50</b>	<b>113.13</b>	<b>-15.36</b>	<b>-56.39</b>	<b>182.22</b>	<b>91.01</b>	<b>14.29</b>	<b>292.44</b>	<b>107.06</b>	<b>898.66</b>	<b>1,727.87</b>	<b>315.23</b>	<b>706.47</b>
<b>Self-financing ratio</b>														
- without subsidy	-112.56%	-389.95%	-4.11%	-29.33%	-7.56%	-67.92%	-19.08%	-20.34%	-15.55%	-2.29%	18.71%	13.58%	15.54%	2.25%
- with subsidy	4.58%	-82.98%	139.76%	11.86%	11.69%	-56.00%	4.68%	-0.53%	-6.05%	3.60%	25.66%	21.33%	24.08%	14.28%
<b>Debt service ratio</b>	<b>-19.75</b>	<b>-10.75</b>	<b>0.28</b>	—	—	—	—	—	—	—	—	—	—	—

— = not applicable

## HISTORY OF CONSERVANCY CHARGE

Effective Date	Monthly Conservancy Charge (PRs)				
	1 July 1990	4 August 1992	1 November 1994	1 July 1995	1 April 1998
Residential Housing (square yards)					
Up to 60	4	7	10	13	17
Up to 61 to 120	6	9	15	20	26
Up to 121 to 200	14	20	25	33	43
Up to 201 to 300	20	30	35	46	60
Up to 301 to 400	28	42	45	59	77
Up to 401 to 600	40	60	70	91	118
Up to 601 to 1,000	56	84	105	137	178
Up to 1,001 to 1,500	113	169	210	273	355
Up to 1,501 to 2,000	140	210	275	358	465
Up to 2,001 to 2,500	173	259	350	455	592
Up to 2,501 to 3,000	210	315	445	579	753
Up to 3,001 to 3,500	247	371	540	702	913
Up to 3,501 to 4,000	285	427	645	839	1,091
Up to 4,001 to 4,500	322	484	750	975	1,268
Up to 2,501 to 5,000	368	551	885	151	1,496
Above 5,000	413	619	1,020	1,326	1,724
Additional Storeys	(75% of GF)	(75% of GF)	(75% of GF)	(75% of GF)	(75% of GF)
Flats (square feet)					
Up to 500	6	9	10	13	17
Up to 501 to 800	9	14	15	20	26
Up to 801 to 1,000	12	18	20	26	34
Up to 1,001 to 1,200	22	33	35	46	60
Up to 1,201 to 1,500	34	51	55	72	94
Up to 1,501 to 1,800	56	84	100	130	169
Up to 1,801 to 2,000	68	101	125	163	212
Up to 2,001 to 2,500	83	124	155	202	263
Up to 2,501 to 3,000	98	146	190	247	321
Up to 3,001 to 3,500	113	169	230	299	389
Up to 3,501 to 4,000	128	191	270	351	456
Up to 4,001 to 5,000	180	270	395	514	668
Above 5,000	225	337	510	663	862
Commercial/Industrial	50% of water rate	50% of water rate	50% of water rate	50% of water rate	50% of water rate
Bulk Supply (per 1,000 gallons)	All property connected to sewerage line within KMC limits: 50% of water rate	All property connected to sewerage line within KMC limits: 50% of water rate	All property connected to sewerage line within KMC limits: 50% of water rate	All property connected to sewerage line within KMC limits: 50% of water rate	All property connected to sewerage line within KMC limits: 50% of water rate

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Appendix 5

GF = ground floor.