

**REPORT AND RECOMMENDATION**

**OF THE**

**PRESIDENT**

**TO THE**

**BOARD OF DIRECTORS**

**ON A**

**PROPOSED LOAN**

**TO THE**

**PEOPLE'S REPUBLIC OF CHINA**

**FOR THE**

**TIANJIN WASTEWATER TREATMENT AND WATER**

**RESOURCES PROTECTION PROJECT**

**November 2000**

## **CURRENCY EQUIVALENTS**

(as of 31 October 2000)

Currency Unit	–	Yuan (Y)
Y1.00	=	\$0.12
\$1.00	=	Y8.28

The exchange rate of the yuan is determined under a managed floating exchange system. This was the rate prevailing at appraisal.

## **ABBREVIATIONS**

ACWF	–	All China Women's Federation
ADB	–	Asian Development Bank
AIFC	–	average incremental financial cost
AIFR	–	average incremental financial revenue
A/O	–	aerobic/oxic
AP	–	affected person
BOT	–	build-operate-transfer
EIA	–	environmental impact assessment
EIRR	–	economic internal rate of return
EOCC	–	economic opportunity cost of capital
FIRR	–	financial internal rate of return
HRPPCP	–	Hai River Pollution Prevention and Control Plan
JBIC	–	Japan Bank for International Cooperation
LCB	–	local competitive bidding
LRD	–	Luan River Diversion
LRDMB	–	Luan River Diversion Management Bureau
NGWT	–	national guidelines on water tariffs
MBI	–	market based instrument
MWR	–	Ministry of Water Resources
O&M	–	operation and maintenance
PIA	–	project implementation agency
PMO	–	project management office
PPMS	–	project performance management system
PRC	–	People's Republic of China
RP	–	resettlement plan
SDPC	–	State Development Planning Commission
SEPA	–	State Environmental Protection Agency
SERF	–	shadow exchange rate factor
SRP	–	summary resettlement plan

TA	–	technical assistance
TEMC	–	Tianjin Environmental Monitoring Center
TEPB	–	Tianjin Environmental Planning Bureau
TMEB	–	Tianjin Municipal Emergency Bureau
TMG	–	Tianjin Municipal Government
TML	–	Tianjin Luanhe Drinking Water Source Protection Engineering Ltd
TSC	–	Tianjin Sewerage Company
WACC	–	weighted average cost of capital
WRP	–	water resources protection
WWT	–	wastewater treatment

## **WEIGHTS AND MEASURES**

ha	–	hectare
km	–	kilometer
lpcd	–	liter per capita per day
m <sup>3</sup>	–	cubic meters

## **NOTES**

- (i) The fiscal year (FY) of the Government coincides with the calendar year.
- (ii) In this report “\$” refers to US dollars.

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## **LOAN AND PROJECT SUMMARY**

<b>Borrower</b>	The People's Republic of China (PRC)
<b>Project Description</b>	<p>The Project will help to reduce pollution; protect water resources; and improve the environment, living conditions, and public health standards in Tianjin's urban areas. The Project has two parts. Part A consists of wastewater collection and treatment, including construction of sewer mains and pump stations connected to a treatment plant in the Beicang area. Part B consists of protecting Tianjin's sole raw water supply, including the watershed of the Yuqiao Reservoir; a dedicated 34-kilometer closed conduit downstream to avoid the pollution in the passage through the Zhou River; and improvements to the existing open channel further downstream.</p>
<b>Classification</b>	<p>Primary: Environment Secondary: Human Development</p>
<b>Environmental Assessment</b>	<p>Category A. An environmental impact assessment (EIA) was undertaken and the summary EIA was circulated to the Board on 28 February 2000.</p>
<b>Rationale</b>	<p>Tianjin, the PRC's fourth largest city, has 9.6 million people and is a municipality with the status of a province, similar to Beijing, Chongqing, and Shanghai. A high priority in Tianjin's development as a major industrial center has been to improve the urban environment in the densely settled city center, including relocating industry, promoting new industrial developments, and encouraging the development of clean and high-technology industry. More than half of Tianjin's wastewater is discharged untreated into canals, rivers, and Bohai Bay. Increasing pollution in the Hai River Basin threatens the city's sole raw water supply. If left unchecked, the pollution may have catastrophic consequences on economic growth and the health and well-being of Tianjin's populace. Continued sustainable economic growth is required to help alleviate increasing urban poverty. Attention must be given to improved wastewater management and environmental protection of the city's raw water source for such growth to be sustainable. The Project addresses two high-priority components in the wastewater and water resources sectors. (i) The Beicang wastewater treatment (WWT) component will enhance urban environmental and public health conditions, contribute to a comprehensive wastewater management program for the Hai River Basin, and help mitigate the pollution loading in Bohai Bay, a key marine and fisheries resource that increasingly suffers from red tide and other effects of untreated wastewater effluent. (ii) The water resources protection (WRP) component will address the single raw water supply source, the Luan-Tianjin water diversion system, which serves 5 million people who are currently at risk</p>

from increasing pollution. The WRP component will eliminate the sources of pollution to the raw water system that are within Tianjin's control, and lend credibility to Tianjin's demands for pollution control of the upstream pollution sources in Hebei Province. The WRP component also incorporates the best practices for comprehensive watershed management within the Yuqiao Reservoir watershed, and will reduce the future pollution risks to a more manageable level. The Project is an important component of a comprehensive approach to address pollution in the Hai River Basin, which will serve as a model for replication in the PRC.

### Objectives and Scope

The main objectives of the Project are to improve (i) the urban environment by reducing environmental contamination through improved wastewater management, and (ii) the quality of raw water supply in Tianjin. Related objectives include strengthening the capacity of the raw water supply and wastewater operations to be more efficient and managed on commercial principles, introducing comprehensive watershed management approaches, and improving cost recovery from users through an improved tariff structure with gradual increases to achieve full cost recovery.

### Cost Estimates

The total project cost is \$340.7 million equivalent, including a foreign exchange cost of \$169.2 million (49 percent) and a local currency cost of \$171.5 million equivalent (51 percent).

### Financing Plan

Source	(\$ million equivalent)			Percentage
	Foreign Exchange	Local Currency	Total Financing	
A. Long-Term Loans				
ADB	130.0	0.0	130.0	38
China Development Bank	0.0	87.8	87.8	26
B. Tianjin Municipal Government	39.2	83.7	122.9	36
<b>Total</b>	<b>169.2</b>	<b>171.5</b>	<b>340.7</b>	<b>100</b>

### Loan Amount and Terms

The \$130.0 million loan, from the ordinary capital resources of the Asian Development Bank (ADB), will have a 25 year term, including a grace period of 5 years, an interest rate determined in accordance with the ADB's pool-based variable lending system for US dollar loans, a commitment charge of 0.75 percent per annum, and a front-end fee of 1.0 percent. The loan proceeds will be relent by the central Government to the Tianjin Municipal Government (TMG) on the same terms and conditions as the ADB loan. TMG will onlend the loan proceeds to the Tianjin Sewerage Company (TSC) and the Tianjin Municipal Luanhe Drinking Water Source Protection Engineering, Ltd (TML) through onlending terms and agreements on the same terms and conditions as the

ADB loan. The two companies will assume the foreign exchange and interest rate variation risks for the ADB loan while TMG will assume the intermediation and transaction costs.

<b>Period of Utilization</b>	Until 30 June 2006
<b>Executing Agency</b>	Tianjin Municipal Government
<b>Implementation Arrangements</b>	The Tianjin Municipal Development Planning Commission (TMDPC), under the overall direction and guidance of the TMG leading group headed by the deputy executive mayor of Tianjin, will coordinate project implementation work through various design institutes and the Project's Implementation Agencies. TSC and TML will be responsible for day-to-day project management.
<b>Procurement</b>	ADB-financed equipment and materials will be procured in accordance with ADB's <i>Guidelines for Procurement</i> . Major contracts for equipment and materials will be tendered through international competitive bidding or international shopping procedures, depending on the contract amount. In accordance with ADB requirements, foreign contractors may participate in the bidding for local competitive bidding contracts.
<b>Consulting Services</b>	About 65 person-months of international and 130 person-months of domestic consulting will be required, with expertise in international competitive bidding and international shopping procedures, including international specifications, bid evaluation, contracts, quality control, and project performance management systems. The consultants will provide guidance and training for capacity building to ensure that (i) the two Implementing Agencies are able to function as effective project management units; (ii) appropriate institutional, managerial, financial, and operational arrangements are in place to enhance operational effectiveness, management efficiency, and financial sustainability; (iii) the Implementation Agencies are converted from construction into operating companies upon completion of implementation; and (iv) social, resettlement, and environmental impacts are monitored. Consultants will be recruited in accordance with ADB's <i>Guidelines on the Use of Consultants</i> . Detailed design engineering and construction supervision will be carried out by qualified local design institutes recruited by TMDPC; these services will not be financed by ADB.
<b>Estimated Project Completion Date</b>	31 December 2005
<b>Project Benefits and Beneficiaries</b>	The Project will directly benefit 9.6 million urban residents in the Tianjin urban area whose living conditions and public health standards will be improved through the removal of about 100,000

cubic meters per day of untreated sewage from the area, and protection of the city's sole raw water supply from the serious threat of increasing pollution. These environmental improvements will stimulate economic activity, support sustainable economic growth, enhance the image of Tianjin as an international city, and contribute to a comprehensive model program for river basin management and cross-jurisdictional pollution prevention and control. The Project will bring about 40,000 hectares of flood-prone agricultural land into full productive use, and reduce pollution added to Bohai Bay, a critical marine resource.

The Project has been designed to mitigate all construction-related environmental impacts and adequate provision has been made to fully compensate the estimated 10,700 people adversely affected by the Project, primarily due to temporary and permanent loss of land. Physical relocation of 12 households (56 affected people) is expected. Extensive consultation with affected people is being undertaken as outlined in a comprehensive resettlement plan, which will be made publicly available prior to any ground leveling or construction. A summary resettlement plan, made publicly available in the PRC prior to loan negotiations, is available on the ADB website.

The Project will support poverty reduction by (i) preventing increases in the incidence of waterborne diseases, to reduce spending on medical care and sick days taken, thus providing more income to households; (ii) safeguarding the quality of drinking water and improving wastewater services, as poverty goes beyond income levels and includes deprivation of essential assets and opportunities to which every human is entitled such as clean water and a clean environment; and (iii) providing employment opportunities to women through the All China Women's Federation.

In addition to the direct benefits, the Project will help support economic growth. The policy dialogue for tariff reforms and cost recovery undertaken during project processing will help eliminate existing subsidies. Wastewater and water tariffs will be increased to ensure full cost recovery is achieved by 2005, the first year of operation of the new systems. As a result of ongoing policy dialogue, TMG increased wastewater and water tariffs by 62 percent in November 1999. An affordability analysis estimates tariffs under the Project to be an acceptable 4.5 percent of income for the poorest 5 percent of households and 1.5 percent for mean income households by the year 2005.





## **I. THE PROPOSAL**

1. I submit for your approval the following Report and Recommendation on a proposed loan to the People's Republic of China (PRC) for the Tianjin Wastewater Treatment and Water Resources Protection Project.

## **II. INTRODUCTION**

2. The Project is in Tianjin, the PRC's fourth largest city. Tianjin has a population of 9.6 million, is a municipality with the status of a province, similar to Beijing, Chongqing, and Shanghai, and is a major industrial center. Tianjin lies between Beijing and the coast of Bohai Bay, at the mouth of rivers forming the heavily polluted Hai River Basin. Seven of the nine major rivers in the basin flow through Tianjin to Bohai Bay. The Project is one of a number of planned wastewater treatment and water resources protection projects under the Hai River Basin Pollution Prevention and Control Plan (HRPPCP), funded by the Asian Development Bank (ADB). This basinwide program comprises more than 600 potential projects, of which the high-priority projects will be implemented under the PRC Transcentury Green Plan. Tianjin is a priority area under the plan, and the components of the Project have been selected for immediate implementation under the HRPPCP.

3. In 1999, ADB approved a technical assistance (TA) to help TMG formulate the Project.<sup>1</sup> The TA study reviewed the feasibility studies prepared by local design institutes and confirmed the need to improve wastewater collection and treatment and to protect Tianjin's sole raw water supply source from the increasing threat of pollution. The final TA report was presented in February 2000. The results of TA reports, Government feasibility studies, the findings of ADB missions,<sup>2</sup> and extensive discussions with Government officials and project beneficiaries during visits to Tianjin form the basis of this report. The linkages between the goals, objectives, outputs, and inputs for the proposed Project are in the project logical framework (Appendix 1).

## **III. BACKGROUND**

### **A. Sector Description**

4. Concurrent with the relatively high economic growth in the past 20 years, the PRC's urban population in 668 cities has been growing rapidly, increasing from about 190 million in 1980 to 376 million, or 31 percent of the total population in 1999. These estimates exclude the "floating" population,<sup>3</sup> which has grown rapidly during the past 10 years, particularly in larger cities. Rapid rural to urban migration is expected to continue in the foreseeable future and about 700 million people, equivalent to 45 percent of the population, are expected to live in cities by 2010. Growth of the urban economy and populations has placed pressure on an overloaded urban infrastructure while increasing the threat of water pollution.

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<sup>1</sup> TA 3216-PRC: *Tianjin Wastewater Treatment and Water Resources Protection*, for \$800,000, approved on 2 July 1999.

<sup>2</sup> The appraisal mission was fielded from 15-25 May 2000, and comprised M. Westfall, Urban Development Specialist-Mission Leader; Y.L. Feng, Environment Specialist; S. Price, Sr. Social Development Specialist; O. Tiwana, Counsel; M. Varkay, Programs Officer; T. Chien, Environmental Engineer-Staff Consultant; M. Diab, Social Specialist-Staff Consultant; F. Waters, Economic-Financial Analyst-Staff Consultant; W. Yan, Tariff Specialist-Staff Consultant.

<sup>3</sup> The floating population includes transient workers and informal commercial traders who live in the urban center full- or part-time, but who do not have residency permits, and the unskilled workers and farmers who enter the urban area for day labor and the markets. The floating population is estimated to be between 70 million and 100 million people.

5. The growing need for basic urban services resulting from ongoing rapid urban growth is increasingly constraining the physical and financial capacity of most cities to provide adequate water infrastructure for the delivery of clean, safe water supply. This has led to a deterioration of the quality of life for urban residents, degradation of the urban environment, and inefficient economic development. The situation has been exacerbated by the pollution of raw water sources—lakes, rivers, reservoirs, local streams, canals, and groundwater sources—by untreated or partially treated municipal and industrial wastewater. Because of the seriousness of the situation, the Government is paying increasing attention to water resources management and pollution control. Large-scale investments in water supply and water resources protection will be needed in the foreseeable future to improve the living conditions of urban residents and to sustain economic growth.

6. During the era of the centrally planned economy, the provision of water was considered a basic social need and was heavily subsidized by the Government. Water tariffs in many cities remained unchanged for 20-40 years. As a result, water supply companies (WSCs) did not have sufficient financial resources to expand or to operate and maintain existing systems. Also, consumers had no market-oriented incentives to conserve water. Beginning in the mid-1980s, the need for tariff adjustments was recognized because of inflation and demand growth fueled by rapid economic growth. Under the Government's ongoing market-based reforms, all WSCs and new water supply projects, including those dealing with raw water supply delivery, are required to be financially sustainable and capable of full cost recovery. Between 1986 and 1996, there were major increases in water tariffs, averaging 17-20 percent annually. This reflects the Government's commitment to bring commercial principles to the water sector. Despite these increases, water tariffs are still low, and need to be increased in many cities.

7. The Ministry of Water Resources (MWR) is responsible for the planning and administration of water resources. It manages the water intake permit system; coordinates water resource use among the different sectors; formulates interregional and interprovincial water allocation and distribution alternatives; and prepares long-term water demand projections and supply plans at the central, provincial, and municipal levels. The Ministry of Construction (MOC), through the provincial and municipal construction commissions, is responsible for overseeing urban plans for major cities, including plans and investments for urban wastewater treatment (WWT) and water resources protection.

8. The State Environmental Protection Agency (SEPA), through its policies and programs, plays an important role in the development of sound environmental practices in the PRC water sector. The SEPA's major responsibilities include (i) developing national environmental protection policies, strategies, laws, and administrative regulations; (ii) coordinating and providing guidance on major environmental issues; (iii) developing national environmental standards; and (iv) administering the national environmental certification system and the monitoring and information network.

9. Private sector participation in the PRC's water sector is still at a very early stage of development. The major source of financing continues to be Government equity and grants supplemented by domestic loans and official development assistance. Between 1991 and 1997, the local governments spent Y50 billion (\$6.0 billion) on water supply. The investment required for urban water supply is estimated to be Y74 billion (\$8.9 billion) between 1997 and 2000, a 48 percent increase over expenditures in the 1991 to 1997 period. The Government recognizes that greater efforts are required to mobilize private sector funding. In 1991, the Government

adopted a policy to allow foreign investment in the sector. For infrastructure projects, the Government is experimenting with the build-operate-transfer (BOT) model.<sup>4</sup>

10. Water pollution remains a serious problem in most PRC cities. In the early 1990s only a small amount of wastewater generated by cities was treated and an even lower percentage met national discharge standards. This problem is being progressively tackled by the Government within both the eighth and ninth five-year plans. Initial efforts have focused on industrial WWT; by the end of 1997 an estimated 62 percent of industrial discharges met the relevant standard, up from 20 percent reported earlier in the decade. All industrial discharges must comply with the standard by the end of 2000. Investment is also being made in municipal WWT but progress is slower, with only approximately 20 percent of wastewater from an urban population in excess of 400 million receiving adequate treatment. Municipal wastewater is therefore a major cause of pollution in streams, rivers, lakes, and some coastal waters.

11. To improve the quality of life of urban populations and to achieve sustainable growth and development, better environmental quality is necessary. Large investments are required to address these problems along with improved legal, regulatory, and enforcement frameworks, and the provision of market-based incentives designed to encourage environmental-friendly production practices. The Government has recognized that pollution of water resources is a major threat to sustainable development and health of the PRC's large urban population. Environmental issues were accorded high priority during the National People's Congress held in Beijing in March 1998. The congress recognized that the degradation of the PRC's water systems, in particular lakes and rivers, requires urgent attention. The Ninth Five-Year Plan (1996-2000) aims to invest Y12 billion (\$1.4 billion) in the 52 most polluted cities, mostly in the eastern provinces, for the construction of wastewater treatment plants and collection systems.

## **B. Government Policies and Plans**

12. The Government has identified urban wastewater and water resources as priority sectors of the Ninth Five-Year Plan. The Government's strategy focuses on (i) developing water sources; (ii) protecting existing sources by controlling industrial and residential pollution in rivers, lakes, and reservoirs; (iii) controlling overextraction from groundwater resources; and (iv) improving demand management by introducing water-saving technologies and operations and using appropriate pricing mechanisms. Guidelines emphasize (i) proper planning and the inclusion of wastewater and water supply projects in economic development plans; (ii) mobilizing financial resources from users and from various Government sources for the construction of new facilities; (iii) full cost recovery from industrial and commercial users and recovery of operation and maintenance (O&M) costs from residential users by the year 2000; (iv) use of loans and credit to finance projects; and (v) application of new technology where appropriate.

13. The Government has formulated a number of programs to address water shortages and water quality. Many of the programs are supported by ADB and other bilateral and multilateral agencies. Generally, the investments are funded locally or supported by concessional aid, rather than loans on commercial terms. The Government is increasingly concerned about the need for policy reform and capacity building to improve water resource management, and to introduce cost-recovery techniques and enable water delivery programs to be financially self-sustaining.

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<sup>4</sup> A construction agreement on the first urban water infrastructure project for Chengdu City, approved by the Government to investigate the use of foreign funds under the BOT methodology, was signed in July 1998, and was the result of ADB assistance in structuring and partially financing the project. Official construction started in early 1999 with completion expected in September 2001.

14. Environmental policies were initially developed in the 1980s, when a system of environmental management was put in place,<sup>5</sup> including standards for airborne emissions, wastewater effluents, and solid waste disposal.<sup>6</sup> Policies addressing environmental problems were contained in the Eighth Five-Year Plan, which emphasized strict compliance with environmental protection laws and regulations. Major achievements included (i) requiring environmental impact assessments (EIA) for new investment projects;<sup>7</sup> (ii) using fees, fines, and compensation payments to implement the polluter-pays principle; (iii) using the target responsibility system, which involves the establishment of contracts with local governments and agencies setting out environmental targets and goals; and (iv) strengthening environmental management at the national and local levels. In the 1990s, SEPA developed a more comprehensive strategy to address industrial pollution prevention and control. Solutions have been shifted from end-of-pipe treatment toward an emphasis on cleaner production processes, an initiative ADB is supporting.

15. Because of the severity of urban environmental problems, the Government has made cities the focal point of its environmental protection efforts. The Government's program for comprehensive improvement of the urban environment emphasizes (i) reducing air pollution through improved coal-burning methods, more extensive use of natural gas and coal, and the introduction of clean coal technology; (ii) upgrading basic infrastructure including water supply, drainage, and the protection of water resources; (iii) reducing vehicular pollution; and (iv) urban reforestation. ADB has helped the Government improve environmental conditions in selected medium-sized cities by preparing environmental improvement programs and supporting action plans,<sup>8</sup> which are being used to guide development in an environmentally responsible manner.

16. In 1996, the State Council issued guidelines requiring all major cities to give priority to environmental protection and management. SEPA has identified 47 priority cities, including Tianjin, for improved environmental protection, and included the environmental improvement programs for these cities in the Ninth Five-Year Plan. ADB has supported these efforts by helping to upgrade the knowledge and skills of senior local government officials in the priority cities to plan and implement environmental infrastructure, and to develop and enforce local environmental policies, rules, and regulations.<sup>9</sup>

17. Environmental protection is now clearly established as a national priority in the PRC's development strategy, with all medium- and long-term investment plans incorporating environmental sustainability as a fundamental component. The Government's continuing emphasis on price and enterprise reforms, aimed at improving industrial efficiency and providing greater autonomy and accountability at the enterprise level complements the environmental policies and regulations. Price liberalization will promote environment-friendly behavior by encouraging energy efficiency and resource conservation. The Government is increasing the

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<sup>5</sup> ADB supported this process by providing TA 987-PRC: *Institutional Strengthening of the National Environmental Protection Agency*, for \$340,000, approved on 10 June 1988.

<sup>6</sup> This includes the Law on Solid Waste Pollution Prevention and Treatment, covering hazardous and toxic wastes, which was formulated in 1996. Progress on classification of hazardous and toxic wastes is ongoing with assistance from the World Bank.

<sup>7</sup> ADB has made major contributions under TA 987-PRC (footnote 5); TA 1436-PRC: *Environmental Impact Assessment and Training*, for \$600,000, approved on 10 December 1990; TA 1988-PRC: *Environmental Impact Assessment and Training*, for \$900,000, approved on 18 November 1993; and TA 2975-PRC: *Environmental Impact Assessment and Training*, for \$600,000, approved on 31 December 1997.

<sup>8</sup> TA 2456-PRC: *Pilot Environmental Plans for Selected Medium-size Cities*, for \$537,000, approved on 4 December 1995.

<sup>9</sup> TA 2906-PRC: *Leadership Training on Urban Environmental Management in Key Cities*, for \$600,000, approved on 3 November 1997.

pollution levy, while improving the administration of the pollution levy fund, to make more investment funds available for waste minimization technology and industrial WWT facilities. During the 1990s, the prices of most key commodities have been liberalized to reflect market conditions, which provides better market-based incentives to conserve industrial inputs.

18. Under the Ninth Five-Year Plan, the PRC has developed an umbrella environmental program with a target year of 2010. This program, the Transcentury Green Plan, designates three river basins (Hai, Huai, and Liao) and three lakes (Chao, Dianchi, and Tai) for intense planning and project implementation to alleviate serious environmental problems affecting water quality and the contiguous population.

19. In response to the required action for the Hai River Basin, the PRC developed the HRPPCP, which was approved by the State Council in March 1999. The HRPPCP designates Tianjin as one of four major cities, along with Beijing, Shijiazhang, and Qinhuangdao, requiring urgent intervention in pollution control. The plan requires that all main river sections in Tianjin meet their designated standard, and drinking water sources meet class III national standards for drinking water sources.<sup>10</sup> The PRC has recently designated Bohai Bay as a major water body requiring national level intervention for cleanup.<sup>11</sup>

### C. External Assistance to the Sector

20. Addressing urban environmental problems and improving WWT and water resources protection is accorded high priority in ADB's PRC country operational strategy. ADB has provided nine loans, totaling more than \$1 billion, for environmental improvement, wastewater management, and water supply. ADB has provided three loans for water resource management and supply in Dalian City,<sup>12</sup> Zhejiang Province,<sup>13</sup> and Fuzhou City<sup>14</sup> in Fujian Province. ADB has also provided a loan to help reduce pollution and restore the water quality in Suzhou Creek and its tributaries in Shanghai City.<sup>15</sup> Several of ADB's urban environment projects have financed WWT components (e.g., Beijing, Chengde, Hefei, Qingdao, and Tangshan).<sup>16</sup> The municipal WWT component of the Anhui Environmental Improvement Project<sup>17</sup> is proceeding on schedule. Initial concern about cost recovery has been mitigated through policy dialogue on tariff increases and the introduction of commercial management principles. These measures have helped to demonstrate that such projects can be financially viable under the lending terms of

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<sup>10</sup> The class III standard is one of five classes. Class I, the highest standard, is for water supply sources with limited treatment and national natural reserves; II and III are for fishing and recreation, and may be used as water supply sources where full treatment is employed; IV is suitable for industrial uses and recreational uses not involving contact between the water and people's bodies; and V is for agricultural uses and scenic viewing.

<sup>11</sup> ADB has supported environmental improvement in Bohai Bay through TA 2695-PRC: *Coastal Resources Conservation and Environmental Improvement*, for \$810,000, approved on 3 December 1996.

<sup>12</sup> Loan 1313-PRC: *Dalian Water Supply Project*, for \$160 million, approved on 20 September 1994.

<sup>13</sup> Loan 1544-PRC: *Zhejiang-Shanxi Water Supply Project (Phase I)*, for \$100 million, approved on 24 September 1997.

<sup>14</sup> Loan 1636-PRC: *Fuzhou Water Supply and Wastewater Treatment Project*, for \$102 million, approved on 30 September 1998.

<sup>15</sup> Loan 1692-PRC: *Suzhou Creek Rehabilitation Project*, for \$300 million, approved on 29 June 1999.

<sup>16</sup> Loan 1205-PRC: *Qingdao Environmental Improvement Project*, for \$103 million, approved on 10 December 1992; Loan 1270-PRC: *Tangshan and Chengde Environmental Improvement Project*, for \$140 million, approved on 2 November 1993; Loan 1336-PRC: *Beijing Environmental Improvement Project*, for \$157 million, approved on 29 November 1993; and Loan 1543-PRC: *Xian-Xianyang-Tongchuan Environmental Improvement Project*, for \$156 million, approved on 24 September 1997.

<sup>17</sup> Loans 1490 and 1491-PRC: *Anhui Environmental Improvement Project for Municipal Wastewater Treatment and Industrial Pollution Abatement*, for \$140 million, approved on 26 November 1996.

ADB's ordinary capital resources. As a result, ADB's future PRC program includes an increasing number of projects in the wastewater and water resources sectors.

21. Since 1989, ADB has financed 52 TA studies for \$27 million to address issues relating to water resource management, environment, and water supply. ADB has helped to strengthen the PRC's policies and strategies for water resources, including a TA that assessed the strategic options for the water sector.<sup>18</sup> This study focused on the management of water resources from an entire river basin perspective, with emphasis on development of basic data, and identification of pollution and erosion control measures, as well as methods for allocation of scarce water resources. ADB has also supported specific water resource management and planning activities in the Beijing-Tianjin area, Dalian, Hainan Island, and the Hai River Basin; and water quality management planning in Shanghai.<sup>19</sup>

22. ADB has supported the water supply tariff reform process through a recently completed study, and a follow-on study currently underway, with the Ministry of Construction.<sup>20</sup> The completed study found that the average cost of urban water production has increased more than six-fold during the past decade due to increasingly poor raw water quality, higher production standards, and increases in the price of inputs. The study assisted the Government in developing the National Guidelines on Water Tariffs (NGWT), focusing on improving the cost recovery performance of the WSCs and promoting water conservation. The follow-on study is assisting the Government in developing the institutional and methodological capacities to implement the NGWT at the local level, and to promote public consultations through public hearings. Recent affordability studies indicate that the proposed higher water tariffs remain affordable, particularly as real average incomes in the PRC have risen by 19 percent annually during the 1990s. While affordability is generally not a problem in major cities and for the more prosperous east coast residents, it remains a concern in some of the poorer interior regions.

23. ADB's assistance to the PRC's wastewater, water supply, and water resources management sectors has resulted in more rational pricing of water, major increases in water tariffs, introduction of wastewater tariffs, implementation of commercial principles, improved environmental management and related fees, formulation of effluent standards and development of regulatory aspects, and introduction of private sector participation. ADB is also assisting the Government to design and implement market-based instruments for water quality management and establish dynamic water quality monitoring capabilities.<sup>21</sup> These are fundamental improvements that will help make the water and wastewater sectors financially and operationally sustainable.

24. In addition to ADB, the World Bank and a number of bilateral agencies have supported the urban wastewater and water resources sectors in the PRC. The World Bank has participated in 19 urban, environmental, and water supply projects. The \$700 million of World Bank assistance has generally been from International Development Association resources, and has been combined with urban development and environmental improvement programs. The

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<sup>18</sup> TA 2817-PRC: *Strategic Options for the Water Sector*, for \$1.18 million, approved on 26 June 1997.

<sup>19</sup> Under TA 1145-PRC: *Beijing-Tianjin Water Resources Study*, for \$550,000, approved on 17 April 1989; TA 1165-PRC: *North Hainan Water Resources Development*, for \$2.3 million, approved on 15 June 1989; TA 1506-PRC: *Dalian Multipurpose Water Resources Development*, for \$600,000, approved on 15 April 1991; TA 1681-PRC: *Beijing Region Water Resources Management*, for \$256,000, approved on 30 March 1992. TA 1835-PRC: *Haihe Basin Environmental Management and Planning Study*, for \$1,200,000, approved on 31 December 1992; TA 2726-PRC: *Water Quality Management Planning for Suzhou Creek*, for \$600,000 approved on 23 December 1996; and supplementary TA of \$400,000 approved on 13 February 1998.

<sup>20</sup> TA 2773-PRC: *Water Supply Tariff Study*, for \$600,000, approved on 24 March 1997, and TA. 3250-PRC: *Water Supply Tariff Study II*, for \$950,000, approved on 3 September 1999.

<sup>21</sup> TA 3211-PRC: *Improving Environmental Management in Suzhou Creek*, for \$840,000, approved on 29 June 1999.

projects include Liaoning Urban Infrastructure, Zhejiang Multicities Development, Rural Water Supply and Sanitation, Shanghai Environment, and Liaoning Environment. The World Bank's water resources projects have been concentrated in the Yellow River Basin.

25. Japan, through its Japan Bank for International Cooperation (JBIC), is the largest bilateral source of aid to the PRC and is mainly involved in physical infrastructure, water resources development, and environmental improvement projects. Since 1989, JBIC has provided loans on concessional terms for 11 urban water supply projects totaling \$900 million, and WWT projects on the Huao and Xiang rivers and in Mudanjiang. In March 1999, JBIC approved the concept for preparation of an urban sewerage treatment project in five cities in Zhejiang Province.

26. Bilateral aid agencies, including from Australia, Canada, Finland, France, Germany, Italy, Norway, Sweden, and United Kingdom, are also involved in the wastewater and water resources sectors, although on a smaller scale. Most bilateral assistance has been designed to address urban environmental problems with an emphasis on wastewater and sewerage treatment, and energy conservation.

27. In Tianjin, the World Bank has been involved in the water supply and sewerage sector. In 1992, the World Bank financed an urban development and environment project, which was efficiently implemented, and is planning a related second project in 2001. The second project includes (i) urban transportation, (ii) wastewater collection and treatment, and (iii) river rehabilitation. A World Bank loan for sewerage and drainage improvements in the middle portion of the Beicang district in urban Tianjin is also under consideration. Facilities include storm drains, sewers, and pump stations. The total investment cost is estimated at Y650 million.

28. In Tianjin, JBIC financed a water supply expansion project in 1990 and is planning to finance sewage treatment projects under a fourth batch of loans to the PRC (1999-2000). The JBIC Tianjin Wastewater Treatment Project has tentative JBIC financing of Y7.2 billion. Loan negotiations for the project were completed in October 2000. The components include (i) expansion and rehabilitation of the Jizhuangzi WWT plant, (ii) construction of the new Xianyang Road WWT plant, and (iii) drainage and sewage collection in the southeast suburbs.

29. These projects are fully complementary and supportive to the proposed Project. There was close coordination between ADB, JBIC, and World Bank during project processing to ensure that their assistance in the water sector in Tianjin is complementary and that duplication and overlap are avoided.

#### **D. Lessons Learned**

30. Projects in ADB's PRC portfolio have generally been implemented on or ahead of schedule, and have performed well. This reflects a rigorous internal screening process, strong project ownership, and good technical capabilities of executing agencies. For some projects, delays have occurred in loan signing and effectiveness as well as in procurement. The Government is streamlining the multiple approval process to address these problems, which tend to occur with weaker executing agencies.

31. Experience in wastewater and water resources management in the PRC, although limited, indicates that projects are well implemented and that water and wastewater tariffs are increased as required. Willingness-to-pay analysis has indicated that consumers are willing to pay substantially higher prices for water, and to a certain extent, are willing to pay for WWT. Issues related to tariff levels, cost recovery, and commercial orientation of the water utilities need to be carefully addressed during project processing. Under the WWT component of the Anhui Environmental Improvement Project, tariffs were increased to levels commensurate with



full cost recovery of O&M costs. Capital costs are also being partially recovered through connection fees. Under the Fuzhou Water Supply and Wastewater Treatment Project, covenants require wastewater tariffs to be increased to cover all O&M and financial costs associated with treating wastewater by 2003.

32. Lessons learned from ADB's postevaluation experience in wastewater, water supply, and water resources management in the Asian and Pacific Region indicate that both supply- and demand-side concerns must be integrated into project designs. Encouraging broad reforms such as commercial management and introducing competition will promote efficient and responsive delivery of water supply and wastewater services. Appropriate pricing policies for water and sanitation services are also required. The policy agenda for water supply and wastewater projects in the PRC has centered around cost recovery, tariff reform, and water resource and wastewater management.

33. During project processing, lessons of experience have been addressed by (i) thoroughly evaluating the technical designs and technologies; (ii) ensuring an adequate debt-equity ratio for Tianjin Sewerage Company (TSC) and the Tianjin Municipal Luanhe Drinking Water Source Protection Engineering Ltd (TML); (iii) undertaking rigorous sensitivity analysis of cash flows, and financial and economic analysis; (iv) incorporating institutional strengthening measures to improve the level of corporate governance; and (v) securing autonomy in operations and for procurement decisions by TSC and TML.

#### **E. ADB's Country and Sectoral Strategy**

34. ADB's three strategic objectives for the PRC are to (i) improve economic efficiency, (ii) promote growth to reduce poverty in poor interior provinces, and (iii) enhance environmental protection and natural resource management. Improving water supply and sanitation facilities is important to enhance the living standards and productivity of urban populations, arrest environmental degradation, and sustain levels of economic growth. Developing efficient water supply systems, including the treatment and distribution of raw water and the treatment and disposal of wastewater, will require substantial investments in both physical infrastructure and human resource development. ADB is pursuing priority projects for urban wastewater, sewage treatment, water supply, and water resources management. Because of the need to achieve cost recovery, the country operational strategy provides for ADB's involvement in highly urbanized areas in the eastern coastal areas where urban environmental problems are acute and income levels are high enough to make the related tariffs affordable. Project preparatory TA is used to prepare, formulate, and process urban infrastructure projects in cities with the most urgent requirements. Policy-support TA is provided to strengthen the management and financial capabilities of the agencies involved in the lending program, to develop reforms for improving cost recovery and financial management of water supply and wastewater, and to help prioritize investments in water supply.

35. In the water sector, ADB is focusing on (i) improving the efficiency of water supply and distribution systems through investment in physical infrastructure, (ii) promoting improved corporate governance and commercial management to enhance the potential for future private sector involvement, (iii) improving cost recovery by strengthening tariff systems and structures for raw and treated water, and (iv) ensuring water resources conservation and environmental protection through the continuing support of legislative and regulatory provisions.

36. One of ADB's strategic objectives in its PRC operations is to help improve environmental and natural resource management. During the 1998 ADB Country Programming Mission, the PRC requested advisory TA to prepare a strategic plan for wastewater management and

pollution control for the Hai River Basin.<sup>22</sup> The TA was completed in January 2000. In 1999, during the midterm review of the ADB country assistance plan, the PRC reconfirmed an earlier request for TA for a Tianjin WWT and water resources protection project. Subsequently, ADB approved a project preparatory TA. The proposed Project is one of the first initiatives being supported by ADB within the context of the Hai River Basin program of environmental improvement, and is consistent with the ADB strategy.

## **F. Policy Dialogue**

37. ADB's agenda for policy dialogue in the wastewater and water resources sectors is being pursued in the following areas: (i) cost recovery and tariff reform; (ii) watershed management; (iii) upstream pollution prevention and control; (iv) market-based instruments for wastewater management, including tradable permits and the pollution levy system; (v) clean production technologies; (vi) regulatory enforcement and monitoring; (vii) water conservation; (viii) corporate governance and enterprise reform; (ix) wastewater management; and (x) private sector participation.

### **1. Cost Recovery and Tariff Reform**

38. The Project will support the Government's ongoing economic and enterprise reform programs that require that all wastewater and water supply projects be financially sustainable and capable of cost recovery. The Government's policy guidance on setting of wastewater tariffs has recently been amended by Circular No. 1192, issued jointly in September 1999 by State Development Planning Commission (SDPC), MOC, and SEPA. The circular provides that wastewater tariffs be set on the basis of full cost recovery principles and requests urgent action by the end of 1999 to implement the circular in priority areas of "the three lakes and three rivers." Tianjin is in one of those priority areas, being part of the Hai River Basin.

39. ADB's Water Tariff Study<sup>23</sup> supported the Government's initiatives by assisting with the development of national guidelines for appropriate water tariff mechanisms at the national level, including the NGWT. The NGWT were promulgated by the SDPC and MOC in September 1999, and will become fully operational over the next two years. In accordance with these regulations, and as a result of ADB's policy dialogue, Tianjin City has increased its water and wastewater tariffs effective 1 November 1999 by 62 percent. The average retail water tariff in the city is now Y1.40/cubic meter (m<sup>3</sup>) compared with the Y1.1/m<sup>3</sup> average in 1998, and the average wastewater tariff is now Y0.35/m<sup>3</sup> compared with the Y0.27/m<sup>3</sup> average in 1998. The retail water tariffs include a raw water fee. The WWT fee is included on water supply bills as a separate and additional item, or is billed separately by TSC where municipal water supply is not provided. The proceeds from these fees are administered by Tianjin Water Supply Company and TSC, and used solely for providing water and wastewater services and infrastructure.

40. Based on a financial assessment of the WWT component, the domestic wastewater tariff rates required by TSC will need to increase from the current rate of Y0.2/m<sup>3</sup> to Y0.6/m<sup>3</sup> in by 2003 and to Y1.20/m<sup>3</sup> by 2005, and remain constant in real terms thereafter. Industrial and other tariff user rates will need to increase from the current rate of Y0.4/m<sup>3</sup> to Y0.8/m<sup>3</sup> in 2003 and to Y1.2/m<sup>3</sup> in 2005 and stay constant in real terms thereafter. These prices will ensure full cost recovery for TSC including its operating and investment costs and provide a reasonable profit.

41. Tianjin Municipal Government (TMG) plans to continue to subsidize stormwater operations at Y34 million per annum, remaining constant in real terms. This subsidy recognizes

<sup>22</sup> TA 3095-PRC: *Hai River Basin Wastewater Management and Pollution Control Project*, for \$570,000, approved on 10 November 1998.

<sup>23</sup> TA3250-PRC: *Water Tariff Study II*, for \$950,000, approved on 3 September 1999.

the natural public good this service provides, and is consistent with ADB policy. TMG will cease the sewerage subsidy, currently at Y5.6 million. TMG will reduce the sewage treatment subsidy, currently at Y75 million, by 50 percent, and by 2003 eliminate the subsidy altogether. The phasing out of these subsidies is consistent with both Government and ADB policy.

42. Based on a financial assessment of the WRP component, the required wholesale prices for raw water to be sold by TML to the Tianjin WSCs need to increase from the current rate of Y0.40/m<sup>3</sup> to Y0.65/m<sup>3</sup> in 2003 and Y0.85/m<sup>3</sup> in 2005, and remain constant in real terms thereafter. Raw water tariffs to industries that recycle water will need to increase from the current rate of Y0.13/m<sup>3</sup> to Y0.22/m<sup>3</sup> in 2003 and Y0.28/m<sup>3</sup> in 2005, and remain constant in real terms thereafter. These prices will ensure full cost recovery for TML including its operating and investment costs and provide a reasonable profit. In addition, TMG will fund the estimated Y47m cash shortfall in 2001.

43. An affordability analysis for 2005 estimates that the combined retail water bill for raw water, wastewater, and an incremental tap water charge will be affordable. For the mean income household, the monthly combined bill is Y32, around 1.5 percent of income. For the poorest 5 percent of households, the monthly combined water bill is Y35, around 4.5 percent of income. The affordability analysis is given as Appendix 2.

## **2. Comprehensive Watershed Management**

44. Water quality in the Luan River to the Tianjin diversion channel has deteriorated in recent years and needs to be restored to ensure that drinking water quality in Tianjin consistently meets national standards. The flood control, river flow augmentation, and agricultural irrigation roles of the diversion compete with the drinking water supply needs. Discussions have been undertaken with the Tianjin Water Conservancy Bureau, and the bureau's unit that is to become the new TML, on watershed management practices based on the best-known international practices. TML expressed strong interest in strengthening comprehensive watershed management. Training in watershed management is included in the implementation package of the proposed loan.

## **3. Upstream Pollution Prevention and Control**

45. The policy dialogue on environmental policy and upstream pollution issues is directly related to watershed management. During project processing, discussions were focused on the effect of total pollution loads, particularly total phosphorus from upstream sources not under the control of Tianjin. Following completion of the ADB-funded HRPPCP, TMG completed a study in August 1999 entitled the "Integrated Pollution Control Program for Yuqiao Reservoir." The report addresses existing pollution loading and estimates the likely results of corrective and preventive actions. Specifically, the report points out that 53.5 percent of total phosphorus, the critical nutrient in reservoir eutrophication, comes from the upstream flows from the Zunhua City area of Hebei Province and two major fertilizer plants.

46. Implementation of the relevant HRPPCP pollution abatement measures, as reinforced in the final report of ADB-funded TA 3095 (footnote 22), the Hai River Basin study, are seen as a high priority by the Government. TMG interagency cooperation and cross-jurisdictional programs are vital elements, and several mechanisms are in place. TMG and Hebei provincial government have held a number of meetings to address cooperation, and the dialogue is expected to be advanced by the Hai River Basin Commission. TMG and Zunhua City are exploring the idea of setting up a jointly-financed environmental fund for industrial WWT in Zunhua City. The 2000 country assistance plan includes assistance from ADB to address trans-

jurisdictional pollution at a policy level.<sup>24</sup> In support of the comprehensive Hai River Basin program, the country assistance plan includes a \$100 million Hebei Hai and Luan wastewater project in its 2002 pipeline. Together with the proposed Project, these interventions can ensure an integrated, coordinated response to pollution prevention and control. In addition, further studies recommended under Hai River Basin study would strengthen regulatory and legal frameworks guiding environmental standards development, penalty and incentive mechanisms, cross-border dispute settlement, and harmonize institutional inspection mechanisms.

#### **4. Wastewater Management**

47. ADB has supported the Government's policies for wastewater management by providing a number of related environmental loans that included WWT components in Beijing, Chaohu, Chengde, Fuzhou, Hefei, Qingdao, Shanghai, and Tangshan. The importance of WWT was also addressed under the Urban Environmental Improvement Planning TA<sup>25</sup> that strengthened institutions responsible for environmental improvement in a number of cities, and identified future infrastructure requirements.

48. The urban area of Tianjin is very densely developed, with a typical density of 600 people per hectare in residential areas. Urban housing has been carefully controlled and planned, including the provision of septic tanks in large apartment buildings and separation of sewage from storm water. Total wastewater flows are 1.4 million m<sup>3</sup>/day, with industrial wastewater accounting for more than half of the total. The existing wastewater collection and transfer system in the project area is inadequate. There are no WWT plants in the Beicang area. The existing Jizhuangzi WWT plant is overloaded and slated for extension, and a new plant is to be built at Xian Yang Road by the end of 2003. Only 47 percent of wastewater flows are treated, and downstream sections of the rivers, waterways, and canals are heavily polluted mainly due to untreated wastewater discharge. Accordingly, wastewater management was a key aspect of policy dialogue during project processing.

49. TMG has prepared wastewater master plans, including sewers, interceptors, and WWT plants. The six urban sewerage districts of Tianjin already contain sewers serving a substantial portion of existing development. The primary focus of the current wastewater programs is on providing adequate treatment capacity and the trunk mains necessary to convey flows to the plants from the present points of discharge. The current plans for wastewater collection and treatment facilities provide for extensive coverage by 2010.

50. To promote the reuse of treated sewage, TMG has approved two pilot programs to reuse treated wastewater from WWT plants in Dagang and Ziezhuangzi. Wastewater will be treated to meet standards for household uses, such as sanitation and gardening. A separate pipeline system will be constructed for each system. A preliminary estimate shows that the retail water tariff in the two towns will be lower than in other areas, which could provide an incentive for wider acceptance at the wastewater reuse concept.

#### **5. Market-Based instruments**

51. Government policies have shifted out of command and control approaches and the introduction of market-based instruments (MBIs). ADB is taking a lead role in helping to design a water pollution trading system by actively supporting pilot projects in Fuzhou and Shanghai.

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<sup>24</sup> PRC: *TA Cluster for Trans-Jurisdiction Environmental Management*, for \$2.2 million, comprising of TAs for (i) legislation and institutions, (ii) planning tools and methodologies, (iii) transcency green program, and (iv) Yellow River pollution control. The cluster will be phased in a period of three years (2001-2003).

<sup>25</sup> TA 2015-PRC: *Urban Environmental Improvement Planning*, for \$480,000, approved on 14 December 1993.

Use of MBIs can improve economic efficiency of wastewater management, and lower the costs of pollution reduction. During project processing, TMG's plans and programs to address the pollution in the existing canals and inland waterways (the Hai River system) were assessed, and the potential for use of MBI technologies for better environmental management was reviewed. A prerequisite for the use of MBIs is administrative control over an entire river basin and its total pollution load, which is not the case for the Hai River in TMG.

52. During project processing, considerable scope was found for the development of a pollution levy system as a charge related to marginal abatement and damage costs. Such a development could achieve least-cost benefits equal to or higher than the use of tradable permits, in this project-specific instance and without the need for large-scale legal or institutional changes and probable high transaction costs associated with tradeable permits. TMG and the Tianjin Environmental Protection Bureau (TEPB) are focusing on creating an enabling environment for MBIs by establishing total maximum allowable pollution loads to reach the desired ambient water quality and strengthening monitoring and enforcement. During project implementation, knowledge gained about MBIs in other ADB TAs will be shared with Tianjin.<sup>26</sup>

53. In the project area, MBIs are increasingly being used for industrial water conservation. The Tianjin Water Savings Office coordinates water conservation efforts. The water consumption plan identifies the optimal consumption of industries. Industrial water use is regularly surveyed to determine whether firms exceed this optimal use. The office has a publicity campaign targeted to domestic water users to promote conservation. As a result of policy dialogue during project processing, water tariffs were revised to promote water conservation and effective demand-side management. Setting water tariffs at rates that encourage water conservation is an effective market-based environmental management tool that can cover domestic and industrial discharges at low administrative cost.

## 6. Clean Production Technologies

54. Policies for the introduction of clean technology are closely related to the broader reform of industry and the program of industrial restructuring and modernization currently being implemented by the Government. ADB is supporting the promotion of clean technology through a TA cluster of six subprojects.<sup>27</sup> TMG is giving high priority to cleaning up the polluted inland waterways by providing assistance to increase the efficiencies of industrial WWT through implementing process audits, adopting recommendations on clean technology, providing advice on pretreatment systems, and making funds available from the pollution levy fund. TMG, through TEPB, has made substantial progress in implementing measures to ensure full compliance with industrial discharge standards. Ambitious targets that exceed government guidelines that are being met by TMG. Industrial pollution control projects under way in TMG use clean technology as well as traditional "end-of-pipe" solutions. In addition, a specific industrial pollution control revolving fund has been established under the World Bank-supported Tianjin Environmental Project (Phase I).

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<sup>26</sup> TA 2951-PRC: *Promotion of Market-Based Instruments in Environmental Management*, for \$697,000, approved on 16 December 1997; TA 3013-THA: *Promotion of Market-Based Instruments in Environmental Management*, for \$605,000, approved on 5 May 1998; and TA 3211-PRC (footnote 21).

<sup>27</sup> TA 3079-PRC: *Promotion of Clean Technology*, for \$3,500,000, approved on 29 September 1998. The TA cluster consists of (i) policies for promotion of clean technology; (ii) national network for clean technology transfer; (iii) legislative support for clean technology; (iv) clean technology development; (v) environmental management for clean technologies in TVEs; and (vi) financing mechanisms for clean technologies in TVEs.

## 7. Regulatory Enforcement and Monitoring for Environmental Management

55. Attention to sound environmental management, including natural resources and water conservation, is a comparatively recent concern in the PRC. To help build the necessary capacity to strengthen the legal framework, ADB supported the training of staff of the Environment Protection Commission of the National People's Congress and the drafting and revising some of the PRC's environmental laws.<sup>28</sup> ADB is also helping to upgrade the knowledge and skills of provincial legislative drafters in the review, amendment, and formulation of local legislation related to the protection and conservation of the environment and natural resources.<sup>29</sup> ADB is supporting improved environmental management through (i) an analysis of the most suitable market-based instruments; and (ii) the formulation of a program for their adoption, specifically in the water and energy sectors.<sup>30</sup> In addition, ADB provided assistance in environmental management by improving the institutional capacity of SEPA, and the local and provincial environmental protection bureaus to strengthen environmental standards and to enforce environmental laws and policies.<sup>31</sup> The PRC's environmental standards are not similar to international practice. The major issue is now compliance and enforcement.

56. In May 1996, the National People's Congress amended the 1984 Water Pollution Law to address many of the weaknesses of the old law, and reflect the revisions to the Water Pollution Prevention and Control Law recommended under TA 2090-PRC (footnote 28). Also in 1996, the State Council approved the Ninth Five-Year Plan for Environmental Protection for 2010 with two supplemental documents: the "Total Emission Quantity Control Plan for Major Pollutants." and the "Transcentury Green Plan."

## 8. Water Conservation

57. The issue of water conservation has been an important part of the Government's and ADB's agenda in the PRC water sector. The water conservation policies that have been pursued in conjunction with the Project include ensuring that system losses are minimized through efficient commercial operations, improved lining of water delivery channels, leakage detection, and repair;<sup>32</sup> and providing market-based incentives to reduce water use through adequate pricing of water and wastewater tariffs. Water conservation policies have been addressed by the Project through the adoption of adequate pricing of water and promoting commercial operations.

58. TMG promulgated the Tianjin City Water Conservation Rules in 1986, which were amended in 1997. The Tianjin Water Savings Office implemented the rules, and is responsible for policy, planning, training, and public awareness. The office develops a water savings plan each year, which includes indicators to evaluate performance. Nonresidential water use exceeding the assigned quota is surcharged up to 10 times the regular tariff. To avoid water losses, the Tianjin Engineering and Construction Bureau has undertaken leakage detection. A

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<sup>28</sup> TA 2090-PRC: *Legislative Planning and Procedures for the Protection of the Environment*, for \$393,000, approved on 26 April 1994; and TA 2735-PRC: *Capacity Building for National Resources Legislation*, for \$800,000, approved on 24 December 1996.

<sup>29</sup> TA 3123-PRC: *Provincial Legislation on Environmental Protection and Natural Resources Conservation*, for \$300,000, approved on 15 December 1998.

<sup>30</sup> TA 2951-PRC: *Promotion of Market-Based Instruments for Environmental Management*, for \$697,000, approved on 16 December 1997.

<sup>31</sup> TA 2505-PRC: *Strengthening the Environmental Standards and Enforcement Policies*, for \$600,000, approved on 22 December 1995.

<sup>32</sup> ADB supported this policy on a regional basis, covering PRC as well as other countries, through TA 5725-REG: *Regional Training Course on Reducing Distribution System Water Losses in Developing Member Countries*, for \$75,000, approved on 17 February 1997. The TA scope covers the PRC.

leakage detection workforce examines all water supply mains in the city, which has reduced the overall level of water losses from about 18 percent in 1998 to 13 percent in March 2000.

## 9. Corporate Governance and Enterprise Reform

59. Policy dialogue during project processing addressed four aspects of corporate governance and enterprise reform: (i) structuring TSC and the TML along commercial lines, (ii) preparing a business plan, (iii) strengthening the operations of the boards of directors for the companies, and (iv) implementing external and internal audit arrangements. The Project's component for WWT will be constructed, owned, and managed by TSC, a registered, limited liability company. This is in accordance with State Government Circular No. 1192, which identified the establishment of enterprise companies as the preferred institutional model for managing wastewater services. For the Project's water resources protection components, the facilities will be constructed, owned, and managed by TML, a newly registered, limited liability company. Both companies will be responsible for their financial management and performance, and governed by a board of directors representing the shareholders. The board of directors will be responsible for overseeing financial and operational matters including (i) hiring and firing senior management, (ii) reviewing staffing and remuneration plans, (iii) reviewing the progress of construction and approving annual construction plans, (iv) reviewing and approving annual budgets, and (v) approving procurement of major equipment and civil works contracts. Under the loan, consulting assistance will be provided to develop the capacity of the companies in the areas of accounting, financial management, environmental and social monitoring capability, and operations and management.

## 10. Private Sector Participation

60. ADB has played a leading role in introducing BOT in the PRC's water supply sector by sponsoring a conference<sup>33</sup> and structuring transparent, competitive bidding for the Chengdu BOT project,<sup>34</sup> the first such project in the PRC. During project processing, the main features of the Chengdu BOT<sup>35</sup> project were discussed with TMG, which expressed interest in this modality of private sector involvement for future investments. Other modalities for private sector participation include leasing contracts and joint ventures.<sup>36</sup> While private sector involvement for the raw water supply and WWT components will not take place at this time, the Project will create the environment necessary for future participation by the private sector by pursuing a reform agenda on tariffs, the principle of full cost recovery, and corporatization (restructuring the government entities as corporations), the necessary prerequisites for such private sector involvement.<sup>37</sup> As the WWT component is part of a comprehensive wastewater system composed of multiple treatment plants in six sewerage districts, the opportunity for private sector involvement is limited at this time. Nevertheless, TMG expressed interest in inviting private sponsors using other private sector participation modalities for future projects.

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<sup>33</sup> TA 2504-PRC: *Seminar on BOT in the Water Supply Sector*, for \$100,000, approved on 22 December 1995.

<sup>34</sup> TA 2804-PRC: *Build-Operate-Transfer (BOT) Chengdu Water Supply*, for \$600,000, approved on 2 June 1997.

<sup>35</sup> Loan 1669-PRC: *The Chengdu Generale des Eaux-Marubeni Project*, for \$26.5 million, approved on 11 February 1999.

<sup>36</sup> The positive financial performance of joint venture water bottling enterprises in Indonesia was cited as an example of successful private sector participation.

<sup>37</sup> ADB has supported private sector participation in the PRC water supply sector through TA 2504-PRC and 2804-PRC (footnotes 33 and 34).

## IV. THE PROPOSED PROJECT

### A. Rationale

61. The vision of Tianjin is to advance toward becoming a modern, flourishing, prosperous, and beautiful industrial metropolis. A major thrust of urban planning and development in Tianjin has been to improve the densely-settled urban environment in the city center. This has included relocating industry, promoting new industrial developments, and encouraging the development of clean and high-technology industry. The city has been successful in managing rapid development, with a doubling and tripling of various economic and industrial sectors during 1993-1997. Continued economic growth is crucial to poverty alleviation within the city. Improved wastewater management and environmental protection of the city's sole raw water source are essential for rapid economic growth to continue and to be sustainable. The Project comprises two components that support these goals—wastewater collection and treatment in the Beicang area of Tianjin and water resources protection (WRP) for the Luan-Tianjin water diversion system. Both components are identified as high priority interventions within the HRPPCP and will facilitate the sustainable economic development of urban Tianjin.

62. Wastewater collection and treatment projects in general, and the Beicang WWT component in particular, are important to Tianjin for three reasons: (i) within the local wastewater service areas, improved wastewater services will enhance urban environmental and public health conditions; (ii) the Hai River Basin is highly polluted by upstream sources and drains through Tianjin; the city must shoulder its responsibilities in wastewater management to encourage and demand improved wastewater management by the upstream polluters, located primarily in Hebei Province and in Beijing; and (iii) in coordination with other externally-funded wastewater projects, the WWT component will contribute to a comprehensive wastewater management program and achievement of environmental benefits to the densely developed city center area. Implementation of the wastewater management program will also help mitigate the pollution loading in Bohai Bay, a key marine and fisheries resource that increasingly suffers from red tide and other detrimental effects of untreated wastewater effluent.

63. All of the major urban areas of Tianjin are served almost exclusively by a single raw water supply source, the Luan-Tianjin water diversion system. The 5 million people served by this system are currently at risk from pollution arising at various locations: within the Luan and Li river basins in Hebei Province, and within the Zhou River watershed downstream from Yuqiao Reservoir. The existing problems have highlighted the risk to Tianjin's image as a modern thriving metropolis that can effectively manage its water supply system and provide a safe, clean water supply. The WRP component will eliminate the sources of pollution to the raw water system that are within Tianjin's control, and lend credibility to Tianjin's demands for pollution control of the upstream pollution sources in Hebei Province.

### B. Objectives and Scope

64. The main objectives of the Project are to improve the urban environment, by reducing environmental contamination through improved wastewater management, and the quality of raw water supply in Tianjin City. Related objectives include (i) strengthening the capacity of the wastewater and raw water supply operations to be more efficient and managed on commercial principles; (ii) introducing comprehensive approaches to watershed management; and (iii) improving cost recovery from users through an improved tariff structure, with gradual increases to achieve full cost recovery.

65. The Project has two parts. Part A (WWT) consists of wastewater collection and treatment, and Part B (WRP) consists of protecting the raw water supply for the Tianjin City



center suburbs and coastal districts. The objectives of the WWT component are to (i) provide for WWT in a service area that currently discharges raw sewage to surface waters (over 50,000 cubic meters [m<sup>3</sup>]/day), and for future customers who will be connected to existing and new sewers; (ii) adhere to the HRPPCP, which requires implementation of WWT construction projects by 31 December 2000; and (iii) help improve the Yongdingxin River water quality to meet a minimum class V (footnote 10) standard required by government regulation. The objectives of the WRP component are to (i) provide increased protection from pollution for the raw water supply for approximately 5 million people in urban and coastal Tianjin; and (ii) provide means for the raw water quality to meet class III standard, as required by government regulation. Resettlement impacts addressed under the Project include physical relocation of 12 households, permanent land acquisition affecting 900 households, and temporary land acquisition affecting 1,591 households.

## **1. Part A: Wastewater Collection and Treatment Component**

66. The WWT component will provide wastewater facilities within the Beicang service area of urban Tianjin. The component will provide trunk sewers and four sewage pump stations to serve the newly-developing portion of Beicang, and a WWT plant to serve the eastern portion and the existing sewered area in the central portion of Beicang. The facilities include (i) 15.2 kilometers (km) of sewer mains, 300 millimeters (mm) to 1500 mm in diameter; (ii) 0.8 km of effluent mains, 1800 mm diameter; (iii) four pump stations, ranging in capacity from 6,000 to 15,000 m<sup>3</sup>/d, and pumping heads ranging from 6 to 12 meters (m); and (iv) the Phase I Beicang WWT plant of 100,000 m<sup>3</sup>/day capacity to handle the projected flows in 2010, expandable in the future to 250,000 m<sup>3</sup>/day, and using an "A/O" biological treatment process. The "A/O" process uses a combination of anaerobic and oxic conditions to reduce pollutants and phosphorous in the wastewater.

## **2. Part B: Water Resources Protection Component**

67. The existing Luan-Tianjin water diversion system is the source of potable water for the Tianjin central urban area containing 4 million people. It also provides raw water to six coastal and suburban water supply systems and to industries along the Hai River near the city center. The existing system stretches 234 km from the Panda reservoirs on the Luan River in Hebei Province to the Xiankai River Waterworks, one of the three large water treatment plants within urban Tianjin. The existing raw water system was developed in response to severe water shortages and deteriorated water quality in the Tianjin urban water supply system.

68. The WRP component encompasses three major elements of the Luan-Tianjin water diversion project: (i) improvements to reduce water pollution within the Yuqiao Reservoir; (ii) a new closed pressurized box culvert to carry raw water from Yuqiao Reservoir to the Jiuwangzhuang Gate to avoid pollution of the water from the Zhou River and reduce water losses; and (iii) improvements to the existing open channel from the Jiuwangzhuang Gate to the Dazhangzhuang Pump Station.

69. Water quality in the Yuqiao Reservoir will be protected and improved by (i) planting of appropriate vegetation within various ranges of ground elevation; (ii) improvements or restrictions in land use within a strip of land along the edge of the reservoir, extending 51 km along the lakeside with an area of 36 square kilometers (km<sup>2</sup>); (iii) construction of low dams on small tributaries to retard soil erosion and reduce flow velocities that can carry polluting substances into the reservoir; (iv) wastewater conveyance and treatment systems (by open channels and stabilization ponds) for rural villages, coupled with improvements in wastewater pretreatment in hospitals and enterprises, and improvements in the handling and treatment of nightsoil, manure, and solid wastes; (v) elimination of 730 hectares (ha) of fishponds in the

reservoir and below a ground elevation of 22 m; and (vi) improvement of fish ponds behind a protective dike within the reservoir.

70. The new Zhou River channel sections will consist of pressurized, reinforced concrete culverts. Additional siphons and channels will be required to divert drainage and flood flows above or under the box culvert. A diversion gate will be installed at Yuqiao Reservoir, to divert flows to the new closed culvert, and a siphon will be installed under the spillway channel.

71. Improvements to the existing open channel will consist primarily of installing a lining on the side slopes and bottom of the channel, and will involve repair of existing sections having mortared stone lining, or installation of precast concrete panels. Other measures include removal of sediment from the channel bottom; repair of leaking siphons; rebuilding of leaking gates at two locations; and provision of a patrol road, buffer strip, and fences to isolate the channel from adjacent towns and highways.

72. The WRP component also addresses comprehensive watershed management within the Tianjin portion of the Yuqiao Reservoir watershed. The Luan-Tianjin diversion channels extend about 100 km from the Yuqiao Reservoir to Tianjin's urban areas, a distance that is too long to adequately police and control to prevent pollution and water theft. Further, Jixian County, which covers both the Yuqiao and Zhou River watersheds, continues to develop its agricultural and industrial base, yet lags far behind in terms of industrial and municipal wastewater management. The improvements, including watershed protection within Yuqiao Reservoir and a closed box culvert for the 34 km section downstream of the reservoir, will reduce the future pollution risks to a more manageable level.

### **C. Technical Justification**

73. Under Part A of the Project, the Beicang WWT plant, pumping stations, and sewers fit into an overall wastewater system improvement and expansion program to be partially funded by external assistance agencies. The component is the first of many WWT plants and related projects to be carried out under the HRPPCP. It will provide for the treatment of wastewater discharges that are presently dumped untreated into ditches and a raw sewage canal, and it will provide for the collection and treatment of new connections as growth occurs.

74. The service area for the Beicang WWT plant was confirmed during project processing and was approved at the Government level. Some of the factors involved in confirming the decision were: (i) networks in the city were implemented in the early years of development and expanded along growth patterns; (ii) the siting of the six existing service areas was influenced by topographical constraints such as the Hai River; (iii) the flat terrain in the city requires pumping stations for conveyance, and a reasonable balance between sewer depths and pumping facilities is achieved by dividing the city into multiple service areas; and (iv) multiple WWT plants (a) avoid major cross-city conveyance systems and related pumping costs; (b) allow flexibility to better match plant size with growth; and (c) allow for an areal distribution of effluent discharges, thereby spreading the residual pollutant load to the receiving waters in Tianjin. The basis for the Beicang WWT plant is considered sound.

75. In the feasibility study and the TA work, alternatives were evaluated in deciding upon the WWT components, the WWT plant process, and sewer routings and sizes. The WWT component is technically justified because it will provide for a high level of WWT of existing and future domestic and industrial wastewater from a major area in urban Tianjin. The estimated least-cost option for the WWT plant process and the sewer system were selected for the component.

76. Part B, the WRP component, addresses the challenge of providing clean water in adequate quantities and of acceptable quality. The area does not possess adequate water resources to sustain needs, and the import of water from outside Tianjin is necessary. The situation will worsen as demands increase with economic growth. While additional sources of interbasin transfers, desalination, and wastewater reuse are available, the incremental cost of these is much greater than maximizing use of presently available surface water sources. Hence, protection of this source is extremely important and leads to broader environmental benefits not found in alternative approaches.

77. The existing system, developed as a result of decreasing groundwater availability because of salinity and subsidence problems and growth demands from urban development, requires corrective measures if the system is to continue to be viable. The Yuqiao Reservoir, originally designed for flood control and irrigation and not water supply, needs to be physically improved and operationally controlled as a water supply source. Present pollution loads entering the water body and in-reservoir activities are not acceptable. In the Zhou River section, natural drainage, with attendant domestic sewerage, industrial waste flows, and agricultural run-off, was gated to prevent contamination of the water supply flowing down the river section. This is not effective, especially during flood season. The unlined water supply open channel has experienced problems with erosion, infiltration of pollution, and some exfiltration, as the water levels in the open channel are below the prevailing groundwater levels. The groundwater has a high concentration of chlorides, since there is no drainage system for irrigation return flows. The proposed component addresses these problems and provides reasonable solutions.

78. The WRP component is technically justified because it provides basic protection of Tianjin's sole public water supply against existing and increasing pollution. The WRP component is the least-cost option to achieve the desired level of pollution risk reduction in the Zhou River section. A box culvert was selected rather than an open channels. While costing more, it provides the minimum acceptable level of risk of pollution of the raw water in that section. The least-cost closed conduit option has been selected. The component addresses the problems of (i) nutrient loads fostering algae growth with its attendant impact on water treatment operations; (ii) exposure to biological pollution from domestic sources and chemical pollution from industrial sources in Tianjin-controlled areas; (iii) water losses from the conveyance system because there will be no need to flush sections of the Zhou River, and there will be less leakage from the existing open channel section; and (iv) the need for continued isolation of drainage sections along the Zhou River section. This last aspect of the component will allow normal drainage conditions for about 40,000 of agricultural land, adding significantly to the amount of agriculturally-productive land in the Tianjin area. Under the TA study, a revised forecast of raw water supply from the Luan-Tianjin diversion system was prepared, indicating full use of the system by 2010.

79. TML obtains water from the Luan River in Hebei Province through allocations determined by MWR and formalized under the terms of an administration circular issued by the State Council on 12 June 1983. This circular determines the water allocation from the Panda reservoirs that has to be shared between Tianjin and Hebei Province. It provides for 1.0 billion m<sup>3</sup> of water to be available to Tianjin on an annual basis. This compares to Tianjin's average current requirements from the Luan river source of 500 million m<sup>3</sup> per annum and indicates the source of water is relatively well assured. The price of this water is fixed by the Government-level pricing authorities under the auspices of SDPC and in consultation with MWR. TMG has accepted that any change in this purchase price would also need to be reflected in the price TML sells raw water in order to maintain full cost recovery for its services. As TML is the sole provider of raw water to TWSC and other bulk users of water in Tianjin, formalized water purchase agreements are not considered necessary. The sale price of water will be reviewed

and adjusted periodically by SDPC and MWR in accordance with price regulations contained within State Circular 1985 (44), which governs the pricing of water conservancy projects. These regulations provide for raw water prices to be fixed on the basis of full cost recovery together with an allowable profit of 4-6 percent of capital employed.

#### D. Cost Estimates

80. The project cost is estimated at \$340.7 million equivalent, comprising \$169.2 million in foreign exchange costs (49 percent) and \$171.5 million equivalent in local currency costs. A summary of cost estimates is given in Table 1. Cost tables are included in Appendix 3.

**Table 1: Cost Estimates**  
(\$ million)

Component	Foreign Exchange	Local Currency	Total Cost
<b>A. Base Cost</b>			
1. Wastewater Treatment	18.0	16.8	34.8
2. Water Resources Protection	103.7	116.0	219.7
<b>Subtotal (A)</b>	<b>121.7</b>	<b>132.8</b>	<b>254.5</b>
<b>B. Contingencies</b>			
1. Physical <sup>a</sup>	12.2	13.3	25.5
2. Price <sup>b</sup>	11.7	10.9	22.6
<b>Subtotal (B)</b>	<b>23.9</b>	<b>24.2</b>	<b>48.1</b>
<b>C. Front End Fee</b>	<b>1.3</b>	<b>0.0</b>	<b>1.3</b>
<b>D. Interest and Other Charges During Construction</b>	<b>22.3</b>	<b>14.5</b>	<b>36.8</b>
<b>Total</b>	<b>169.2</b>	<b>171.5</b>	<b>340.7</b>

<sup>a</sup> Includes 10 percent on all costs.

<sup>b</sup> 1.8 percent per annum in 2000, 2.0 percent per annum in 2001, and 3.0 percent per annum thereafter on local costs; and 2.4 percent per annum on foreign exchange.

#### E. Financing Plan

81. It is proposed that ADB provide a loan of \$130.0 million, about 38 percent of the total project costs. The loan will finance 77 percent of the foreign exchange cost of the Project. The balance of the required foreign exchange and local currency requirements will be provided by TMG as equity, and through cofinancing by a loan from the China Development Bank. The financing plan for the Project is in Table 2. The loan will be from ADB's ordinary capital resources at ADB's pool-based variable lending rate for loans from the US dollar facility, with a commitment charge of 0.75 percent per annum and a front-end fee of 1.0 percent. The loan will have a maturity of 25 years, including a grace period of 5 years. The Borrower will be the PRC.

82. The Borrower will relend the proceeds of the ADB loan to TMG on the same terms and conditions as the ADB loan. TMG will onlend the loan proceeds to TSC and TML through onlending agreements on the same terms and conditions as the ADB loan. These two companies will assume the foreign exchange and interest rate variation risks for ADB's loan and reimburse TMG for any intermediation and transaction costs. A flow of funds chart is provided in Appendix 4.

**Table 2: Financing Plan**  
(\$ million)

Source	Foreign Exchange	Local Currency	Total Cost	Total Percentage
<b>Wastewater Treatment Component (Part A)</b>				<b>100</b>
ADB Loan	26.2	0.0	26.2	57
Tianjin Municipal Government Equity	0.0	19.7	19.7	43
<b>Water Resources Protection Component (Part B)</b>				<b>100</b>
ADB Loan	103.8	0.0	103.8	35
Tianjin Municipal Government Equity	39.2	64.0	103.2	35
China Development Bank Loan <sup>a</sup>	0.0	87.8	87.8	30
<b>Subtotal Financed by ADB</b>	<b>130.0</b>	<b>0.0</b>	<b>0.0</b>	<b>38</b>
<b>Subtotal Financed by Counterparts</b>	<b>39.2</b>	<b>171.5</b>	<b>340.7</b>	<b>62</b>

<sup>a</sup> The loan is at 6.21 percent over 15 years with a grace period of 5 years in line with the construction schedule.

## **F. The Executing Agency**

83. Tianjin Municipal Government will be the Executing Agency for the Project. The project management office (PMO), under the direction of a project leading group, will be responsible for administering all matters related to the Project. TMG has established a leading group and an administrative office to coordinate all activities related to the Project. The Leading Group, headed by the Deputy Executive Mayor of Tianjin City, will provide guidance to the Project.

## **G. Implementation Arrangements**

### **1. The Implementing Agencies**

84. The day-to-day implementation of Parts A and B of the Project will be carried out by TSC and TML. During project implementation, TSC and TML will be supported by experienced domestic and international consultants. The PMO and the project implementing agencies (PIAs) will retain the services of procurement agencies for the civil works contracts, mechanical and electrical equipment, and materials. The PIAs will have a number of their staff trained in project implementation. TSC and TML staff need to strengthen their expertise in (i) efficient operating procedures; (ii) preventive maintenance; (iii) administration, accounting, financial planning, and management; (iv) social and environmental monitoring; (v) business planning; (vi) human resources development; and (vii) cost recovery aspects, including cost control measures and tariff review and methodologies to determine adjustments reflecting the impact of inflation and currency fluctuations. Capacity building for the PIAs will be achieved through consultant inputs, hands-on training on project facilities, training in the PRC, and possible international training financed from the loan.

#### **a. Legal Status and Corporate Structure of Project Implementing Agencies**

85. TSC was registered as a state-owned enterprise in May 1996, and is a registered company with a total of 3,500 staff, 2,500 of which work on sewerage operations. TSC was established through a transfer of assets and staffing from the former Sewerage Management Department of the Tianjin Engineering Management Bureau and its formation was initially a condition of a World Bank loan agreement. The new Beicang WWT plant and associated sewerage system extension will require TSC to hire about 200 more staff, although some of the needed staff are expected to be made available through redeployment.

86. TML was registered as a state-owned enterprise on 13 January 2000, with initial registered capital of Y200 million (\$24 million). The company is wholly owned by TMG under the direction of Tianjin Water Conservancy Bureau.

87. During implementation, the management of TSC and TML will be held accountable for setting and managing an annual budget and meeting construction and other implementation deadlines. Once implementation has been completed, the companies will be responsible for all aspects related to operations.

### **b. Financial Performance and Projections**

88. TSC and TML were established to construct<sup>38</sup> and operate facilities for WWT and WRP. All costs associated with the current operations of the companies will be capitalized as preoperating and capital expenditures. Financial projections from 1 January 2006 for TSC and for the first full year of operations for TML, and the critical assumptions, are given in Appendix 5. The financial projections, based on water and wastewater demand projections and incorporating the projected tariff increases for raw water and wastewater tariffs required under the Project, indicate sound levels of financial performance. Cash flows are sufficient to meet all operating costs and debt and equity servicing requirements. Targeted ratios have been estimated and have been covenanted in the loan agreement. The financial indicators for the two companies are summarized in Table 3.

**Table 3: Projected Financial Indicators (2006-2010)**

Item	2006	2007	2008	2009	2010
<b>A. TSC</b>					
1. Debt-Service Ratio	9.4	9.9	10.3	10.9	11.4
2. Current Ratio	9.9	11.3	12.6	13.8	15.0
3. Return on Capital Employed (%)	6.2	6.4	6.6	6.8	6.9
4. Debt Equity Ratio	0.06	0.05	0.05	0.05	0.04
<b>B. TML</b>					
1. Debt-Service Ratio	1.8	1.9	1.9	2.0	2.0
2. Current Ratio	5.0	5.4	5.7	5.9	6.2
3. Return on Capital Employed (%)	5.2	5.9	6.7	7.5	8.2
4. Debt Equity Ratio	0.83	0.72	0.62	0.52	0.43

89. Purchase of the water from the Panda reservoirs by the Tianjin and Hebei governments is governed by terms and conditions stipulated in State Council Circular 44 of 12 June 1983. Details of the existing agreement include (i) a price set at Y0.108/m<sup>3</sup>; (ii) average purchase volume of 553 million m<sup>3</sup>/year; (iii) water guarantee based on 1 billion m<sup>3</sup> being available to Tianjin (excluding water committed to Hebei Province) with good reliability; (iv) there is no minimum purchase amount, and water is taken as needed.

90. Water is sold by Tianjin Luan River Diversion Bureau to TML under a water supply agreement. The intention is for this agreement to remain unchanged and to be taken over by TML, except that the price of raw water sold by TML will need to increase to finance Luan River Diversion improvements. Details of the existing agreement include (i) price set at Y0.40/m<sup>3</sup> for urban water supplies and industrial supply with no return to the Hai River; and Y0.13/m<sup>3</sup> for supplies with discharge return to the Hai River (cooling water); (ii) Tianjin Water Supply Company to take an average of 550 million m<sup>3</sup>/year; and (iii) no minimum purchase amount. These tariffs became effective on 1 November 1999, raised from Y.025/m<sup>3</sup> and Y0.10/m<sup>3</sup>, respectively, an increase of about 62 percent. The water tariff will have to be reviewed regularly

<sup>38</sup> Under PRC requirements, all projects financed from external sources must be implemented by a company specifically established for this purpose so as to foster commercial principles and accountability.

to ensure regularly that adequate provision is made to reflect increases that may occur in the operating costs, including increases in water resources fees and other charges.

## **2. Project Management**

91. A project management office (PMO) has been established under the Tianjin Municipal Development Planning Commission through official notification. The PMO will be the secretariat of the steering committee and will liaise with the administrative office of TMG. The PMO will include a project director, a full-time deputy director, five full-time professional staff, and support staff. The PMO will manage and coordinate the work of the two PIAs (TSC and TML) through their respective project implementation units. Each PIA will set up project implementation units, headed by general managers, to coordinate with the PMO and facilitate timely implementation of project activities. PIAs will be responsible for the day-to-day implementation activities. An organization chart is provided in Appendix 6.

## **3. Performance Contracts**

92. Formal performance contracts between TMG and the PIAs will define the relationships between each party and detail the strategic requirements placed on the PIAs. The performance contracts include business plans and institutional and management development action plans, and address service levels, strategic targets, and other operational aspects. The performance framework contracts are given as a supplementary appendix.

## **4. Project Implementation Schedule**

93. The Project will be implemented over a period of five years (Appendix 7). This schedule is considered realistic because the project implementation structure is already in place, and preparatory works are under way. ADB's successful experience in similar projects in the PRC and the TMG's in-depth knowledge and experience in wastewater pollution control, raw water protection, and supply projects indicates that this schedule is realistic and achievable.

## **5. Consulting Services**

94. The PIAs will retain the services of competent and experienced design institutes to complete the feasibility studies, preliminary design, detailed designs, and specifications. These consultants will be recruited through standard PRC procedures acceptable to ADB. In addition, the PIAs will retain the services of tendering agencies, following standard PRC procedures acceptable to ADB, to help prepare tendering, contract documents, and local competitive bidding procedures for (i) the prequalification of contractors; (ii) tendering and bid evaluation for the procurement of various equipment, materials, and civil works contract packages; and (iii) provision of qualified construction supervision companies for each part of the Project. The selection of the consultants for design, tendering, and construction supervision will be subject to ADB approval with respect to their competence and experience for each assignment and will be funded the counterpart funds.

95. In addition, provision has been made for 65 person-months of international and 130 person-months of domestic consulting services to support the PMO and the PIAs in project implementation and capacity building to be funded under the loan. These consultants will provide assistance to the PMO in the areas of ADB procedures and reporting, international specifications, design and construction, tendering procedures, evaluation of bids, standard contracts, quality control, and the project performance management system (PPMS). The consultants will provide advice, guidance, and training for capacity building necessary to convert the PIAs from construction into operating companies upon completion of implementation. International consulting will be provided for (i) the development of a corporate management structure; (ii) training in the

development of standardized financial and accounting statements; (iii) midterm and final review of retail water and wastewater tariffs; (iv) monitoring of social, resettlement, and environmental impacts; and (v) advice on the method and procedures for benefit monitoring and resettlement. The consultants will be recruited in accordance with ADB's *Guidelines on the Use of Consultants* and other arrangements satisfactory to the ADB on the engagement of domestic consultants. Outline terms of reference for the consulting services are in Appendix 8. In addition to training provided by consultants, the PIAs will use loan funds to finance broader training-related expenses. The PIAs will submit detailed training programs and budgets for ADB approval prior to proceeding with such training activities. Disbursements for approved training expenditures will be through the imprest account (para. 97).

## 6. Procurement

96. ADB-financed goods and services will be procured in accordance with ADB's *Guidelines for Procurement*. Major contracts for equipment will be undertaken through ADB's international competitive bidding procedures, and equipment packages valued under \$500,000 will be procured following ADB's procedures for international shopping. Civil works estimated to cost below \$8 million per package will be carried out under local competitive bidding (LCB) procedures acceptable to ADB, and in accordance with the PRC's Tendering and Bidding Law and procurement regulations.<sup>39</sup> Local contractors have the expertise and capacity to undertake such works. Since such civil works will involve mainly labor costs, international contractors are not likely to be interested in the work and the use of LCB is considered acceptable. In accordance with ADB requirements, foreign contractors may participate in the bidding for LCB contracts. The major construction materials will be purchased through international competitive bidding procedures and financed by the ADB loan. Indicative procurement packages are provided in Appendix 9. The mode of procurement will be decided by TMG in consultation with ADB. The internationally tendered equipment packages will include the technical support necessary for ensuring proper installation, testing, commissioning, and training of operational staff as part of the related contracts. This approach is the most efficient way to ensure quality control during installation and proper operational training in the use of the equipment as the manufacturers' and suppliers' technical experts will be the people most familiar with all aspects of the equipment.

## 7. Disbursement

97. To facilitate disbursements for numerous small expenditures, an imprest account will be established after loan effectiveness in accordance with ADB's *Loan Disbursement Handbook* (June 1996). Disbursements from the imprest account will be supported by an appropriate withdrawal application and related documentation. Such documentation will demonstrate, among other things, that the goods and/or services were (i) produced in and procured from ADB's members, and (ii) eligible for ADB financing. The initial amount to be deposited into the imprest account will not exceed \$300,000. The statement of expenditure procedure may be used for reimbursement of eligible expenditures; any individual contract to be reimbursed or liquidated under the procedure will not exceed \$50,000.

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<sup>39</sup> ADB assisted in the establishment of national procurement regulations for the public sector under TA 2845-PRC: *Establishment of National Procurement Regulation for the Public Sector*, for \$565,000, approved on 20 August 1997, including the drafting of six regulations and three sample bidding documents.



## **8. Advance Procurement and Recruitment Action**

98. Advance action was approved on 5 June 2000 to expedite project implementation. Advance action, which may take place prior to loan effectiveness, includes (i) prequalification of contractors, tendering and bid evaluation for civil work contract packages; (ii) preparation of tender documents for the procurement of materials, plant, equipment, and vehicles; and (iii) recruitment of domestic and international consultants for construction supervision and training. TML and TSC were advised that issuance of invitations to bid or to prequalify under advance procurement action was subject to approval by the ADB. All advance procurement actions will be undertaken in accordance with the ADB's *Guidelines on Procurement*, and advance recruitment of consultants will be carried out in conformity with the ADB's *Guidelines on the Use of Consultants*. The Government, TML and TSC were advised that approval of advance action does not commit the ADB to finance the Project. This action was reported in the June issue of ADB Business Opportunities.

## **9. Operation and Maintenance**

99. All permanent works constructed under the Project will be owned by TSC and TML for their respective components, and each company will each be responsible for the O&M of its component. Prior to commissioning of the works, both companies will recruit any necessary additional personnel. Appropriate training will be provided to any new personnel.

## **10. Project Reviews**

100. In addition to the normal periodic reviews, a midterm review will be undertaken by ADB and the Government two years after project implementation begins. This review will include a detailed evaluation of the scope, implementation arrangements, resettlement, achievement of scheduled targets, and progress on the agenda for policy reform and capacity building measures. A detailed review of the wholesale water prices for the Project, as well as retail level tariffs, will be undertaken. Feedback from the PPMS activities will be analyzed.

## **11. Anticorruption**

101. During project processing, ADB's anticorruption policy was explained to central and local government officials. Attention was drawn to the section on fraud and corruption in ADB's *Guidelines on Procurement*, particularly the need for bidders, suppliers, and contractors to observe the highest standards of ethics in the procurement and execution of ADB-financed contracts, and the sanctions if fraud and corruption are discovered. Similarly, the anticorruption provisions in ADB's *Guidelines on the Use of Consultants* were discussed.

102. The PRC country assistance plan includes assistance that will improve governance and provide incentives to reduce the incidence of corruption in the longer term. The TA for the PRC's procurement regulations (footnote 39) provided assistance to draft procurement and standard bidding documents. In 1998 ADB provided TA<sup>40</sup> to help strengthen the Government's auditing standards. The goal of that TA is to strengthen the Government's auditing system to conform with the requirements of the audit law, and as far as practicable, international auditing standards. The TA helped (i) formulate Government auditing standards and procedures, and (ii) design and implement an audit-training program to promote adherence to such auditing standards and procedures by Government auditors.

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<sup>40</sup> TA 3103-PRC: *Strengthening the Government Auditing System*, for \$700,000, approved on 26 November 1998.

## **12. Reports and Auditing**

103. The PMO and the PIAs will maintain separate accounts for Parts A and B of the Project. The PIAs will maintain records of all project expenditures and forward these regularly to the PMO, and the PMO will prepare consolidated project accounts. The consolidated project accounts will be audited annually by the Tianjin Municipal Audit Bureau and by independent auditors acceptable to ADB. Certified copies of such audited accounts in English will be submitted to ADB not later than six months after the end of the financial year to which they relate. As the ADB loan will be onlent to the PIAs, audited financial statements of the two PIAs will be submitted to ADB annually also no later than six months after the end of the relevant financial year. The PMO will submit to ADB reports and information concerning the use of the loan proceeds, the Project, and the administration and financial information of the PIAs. The reports will include (i) quarterly progress reports on project implementation; (ii) annual reports; and (iii) a project completion report, not later than three months after completion of the Project. Progress reports will emphasize progress made in the areas of policy dialogue, including (i) water and wastewater tariff changes, (ii) environmental and water quality monitoring, (iii) resettlement, and (iv) capacity building and financial management of TSC and TML.

104. As a result of policy dialogue during project processing, audit committees of the board of directors of the PIAs will be established. The committees will review internal and external audit reports and consider other issues of corporate governance. Each audit committee will meet at least once every six months.

## **13. Project Performance Management System**

105. The PPMS will be integrated into the project management information system of the PMO and linked to the two PIAs. Indicators that have been agreed on include service levels, treated water quality, incidence of water-related diseases, water consumption, user satisfaction, and other economic data to monitor project impacts on improved living conditions and economic opportunities related to (i) improved water supply and sewage treatment facilities and services, (ii) improved quality of life, (iii) resettlement, (iv) physical completion, (v) institutional strengthening, and (vi) policy reforms. At the beginning of the Project, the PMO and PIAs, with the assistance of consultants, will develop comprehensive PPMS procedures to systematically generate data on inputs and outputs of the two project components and socioeconomic and environmental indicators to measure project impacts. The PMO and PIAs will refine the PPMS framework, confirm achievable goals, firm up monitoring and recording arrangements, and establish systems and procedures no later than six months after loan effectiveness.

106. Under the PPMS framework, baseline and annual data will be reported at regular intervals by each PIA. Each PIA will be responsible for analyzing and consolidating the data through its management information system. The PPMS will be designed to permit adequate flexibility to adopt remedial action regarding project design, schedules, activities, and development impacts. The PMO, with the assistance of the consultants, will monitor and assess activities, and report to ADB quarterly on the physical implementation and financial aspects of the Project to ensure that impacts are monitored and reported in line with ADB requirements.

## **H. Environmental and Social Measures**

### **1. Environment**

107. As the Project is classified as a Category A environmental project, an environmental impact assessment (EIA) is required. In accordance with the PRC environmental laws and guidelines, EIA outlines and reports have been prepared for each project component. The EIA

reports for the WWT and WRP components have been approved by SEPA. The summary EIA was prepared and circulated to the ADB Board on 28 February 2000.

108. The EIAs conclude that the Project will have substantial positive environmental benefits for the environmental quality and the quality of drinking water in Tianjin City, and, with the planned mitigation measures in place, will have an insignificant adverse impact on the physical and natural environment. The Project will improve the living environment of residents in areas it serves and make appreciable contributions to the water pollution control program of the Hai River Basin. The Project will safeguard the drinking water quality of Tianjin's sole water supply source, help to create conditions to raise living standards, and improve public health conditions for residents. The WWT component is an important link in the implementation of the overall sewerage development plan for urban Tianjin.

109. The WWT component includes a secondary WWT plant that will serve the Beichen district, an urban district with rapid industrial and commercial development without WWT facilities. The biological treatment process selected (para. 66) is highly efficient at removing phosphorus. Bohai Bay has experienced increasingly serious occurrences of red tide due to excessive nutrient (especially phosphorus) loading.

110. Sludge disposal is one of the most significant aspects of WWT operations. Dewatered sludge from TSC's Dongjiao WWT plant is presently given to farmers for agricultural uses since its quality meets the relevant standard. Two options will be provided for sludge disposal: (i) for agricultural use, if the quality meets the standard; and (ii) shipping the dewatered sludge to a landfill at the Xianyang Road WWT plant when, in exceptional cases, the quality does not meet the standard.

111. SEPA has issued a deadline of 31 December 2000 for all industrial wastewater dischargers in the PRC to meet the relevant standards, including pretreatment requirements. Those that fail to do this will face factory closure or production reduction. TMG set its own deadline as 31 December 1999. So far, over 800 industries in Tianjin have complied, while 24 factories have been closed and 24 other factories have had their production levels reduced. Throughout the Luan River diversion project area, which includes upstream areas in Hebei Province, more than 40 factories have complied. Intensive pollution monitoring is undertaken in the Yuquiao Reservoir area. Tianjin's efforts and achievements on industrial pollution control have been commended by SEPA. To address transjurisdictional pollution, TMG is coordinating with the Hai River Basin Commission and the Hebei government on the control of phosphorus emission from two major fertilizer plants in Zunhua municipality, Hebei Province.

112. Industrial wastewater discharging into municipal sewer systems is monitored four times a year, twice by TEPB and twice by local environmental quality monitoring stations. Industrial establishments, however, monitor their discharges sometimes as frequently as several times a day depending on their size. In accordance with international practice, TSC plans to undertake a comprehensive monitoring program of its own with a higher frequency, especially for larger dischargers and those with highly polluting wastewater. This will ensure compliance, resulting in better quality of sludge and plant effluent, greatly enhancing their reuse potential.

113. The effluent from the proposed Beicang WWT plant will be discharged into the Yongdingxin River. To avoid pollution from raw sewage being pumped from the Beicang sewerage catchment area into the river at the present time, a small portion of the river channel was separated from the main channel, which preserves the water quality in the main channel for irrigation. With the operation of the Beicang WWT plant, its effluent quality will also meet the requirement for irrigation use. The addition of the effluent to the storage system behind the channel's weir, for use during the dry season, represents a potential increase of irrigated area by 5,500 ha. This arrangement will reduce pollution discharge to Bohai Bay.

114. With the construction of the new closed conduit channel, the Zhou River stretch will revert to its original function to carry away storm runoff and wastewater from neighboring communities as well as its base flow. At present, because this stretch is used for water supply diversion, these communities suffer from the accumulation of wastewater in ponds and ditches, resulting in an undesirable living environment, increased incidence of waterborne diseases, and threats to public health. The new closed conduit will appreciably improve the environment of the affected area.

115. The potentially adverse environmental impacts are mainly associated with the construction phase. These impacts are shortterm and relate to noise, vibration, air pollution, runoff, safety hazards, disposal of construction debris, and localized traffic congestion. Appropriate mitigation measures will be incorporated into the detailed engineering designs and construction contracts. The PIAs, in cooperation with TEPB, will monitor construction contracts and enforce compliance with environmental regulations and standards.

116. The Tianjin Environmental Monitoring Center (TEMC) of TEPB is well equipped to undertake environmental quality monitoring for the Project. TEMC, with 200 staff, has offices for integrated planning, technical development, water environment, atmospheric environment, instrumentation, physics (noise and vibration), soil ecology (including solid waste), and traffic pollution monitoring. TEMC is certified by the State Technical Standards Bureau for analytical quality assurance and control and the certification is renewed every five years to ensure the maintenance of good practice. The certification ensures the accuracy of analytical results and gives legal standing to the results. The main task in the Project for TEMC will be to (i) carry out the monitoring programs for the construction, start-up, and operations phases; and (ii) prepare reports on relevant monitoring work by the local environmental quality monitoring stations.

## **2. Public Participation**

117. Direct public involvement has been ongoing throughout the development and design of the Project. During preparation of the EIA, public participation occurred during (i) site investigations for facilities, (ii) the preparation of social impact assessments, (iii) the evaluation of priorities and estimation of the value of benefits, and (iv) community surveys undertaken to gauge public reactions to the Project. One hundred questionnaires were distributed to people living near the WWT plant site. The response rate was 89 percent and 94 percent of the respondents expressed support for the component. Questionnaires (828) were distributed to people living within the WRP component area. The response rate was 88 percent, with 99 percent of the respondents from the urban area of TMG stating that the component is important.

## **3. Land Acquisition and Resettlement**

118. Tianjin Municipal Development Planning Commission, in collaboration with consultants, prepared the project resettlement plan (RP). Both components involve land acquisition and resettlement effects, and a comprehensive RP has been prepared for the Project on the basis of the feasibility studies. The RP will comply with the 1998 Land Administration Law, which was drafted with ADB assistance, for the WWT component, and the 1991 MWR Regulations for Medium and Large Water Hydropower Project Construction, for the WRP component. The RP provides compensation and other assistance to people affected including both legal and illegal land users. The summary resettlement plan (SRP), given in Appendix 10, provides detailed information for each project component. The RP will be reviewed, revised, and appropriately modified after the preliminary technical design for each component has been finalized. Copies of the revised RP will be submitted to ADB prior to commencement of land clearing. This will include livelihood restoration plans. Affected people (APs) have been consulted, and a detailed consultation plan is included in the RP. The PIAs released the Chinese version of the SRP to

the districts and counties for release to the affected township offices and review by APs before loan negotiations. TMG agreed to post the SRP on the ADB website and to make the SRP publicly available through affected township offices, for review by APs prior to loan negotiations.

119. The 45 villages around the Yuqiao Reservoir will be affected, 80 villages will be affected by the upgrade of the existing channel and the Zhou River diversion channel, and one township will be affected to accommodate the Beicang WWT plant. Permanent land acquisition of 430 ha will be required affecting over 3,000 APs in 900 households. Temporary land acquisition will impact 550 ha (with 6,367 APs in 1,591 households). Physical relocation of 12 households (56 APs) is expected. The Project will eliminate 960 ha of fishponds (with 1,280 APs in 430 households). No community structures or public institutions will be affected by the Project. Restrictions in the Yuqiao Reservoir buffer zone are not expected to have any adverse impact on land use or yields and therefore no loss of livelihood is anticipated for people in this area.

120. The organization and management structure of the PIAs are adequate to implement the RP. The key agencies involved in the preparation of the RP are represented in the relevant departments within each PIA, which should ensure effective coordination and implementation. The PIAs will ensure that all implementing personnel are briefed fully on the RP. In addition to the internal monitoring carried out by TSC and TML, a qualified institute will be selected to undertake independent monitoring and evaluation of resettlement impacts. Entitlements will be provided to the APs in full before demolition and ground leveling commence, and before any loss of land takes place. The county and township resettlement offices will play an important role in briefing the township and village personnel on RP provisions; making the RP public; ensuring that APs are aware of compensation entitlements, job creation schemes, training activities, and relocation sites; and reflecting the APs' comments and concerns in the revised RP and during its implementation. These offices will ensure that all compensation payments and other specified assistance will be paid directly to the collectives, enterprises, and individuals affected, and there will not be any deductions in the rates.

#### **4. Social Analysis**

121. During the project design, 500 project beneficiary households were surveyed to determine the patterns of water use, the attitudes of the local population toward water, wastewater, and sanitation cost; satisfaction with current water quality; willingness to pay; and affordability. About 79 percent of those surveyed stated that a clean environment was either important or very important to them. Half of the respondents identified improvement in water supply as the highest priority, with 56-64 percent of this subgroup, in various districts, willing to pay for improvements. The most requested improvement was for better water quality.

122. The survey data indicated that interviewees in the middle income bracket (earning Y500-Y1,500/month) were willing to pay for clean water and wastewater services. Based on income data collected and assuming that people spend Y10/month on water, at present people spend 1 percent of their income on water. Health data collected and analyzed indicates that benefits that can be derived from improvements in drainage and sanitation throughout the project areas and in reducing the risk to the safety of the public water supply.

### **V. PROJECT JUSTIFICATION**

#### **A. Financial and Economic Analyses**

##### **1. Financial Analysis**

123. The financial evaluation of the Project was undertaken in real terms using constant 2000 prices. Financial internal rate of return (FIRR) analysis was undertaken for each component.

The FIRR, 10.7 percent for the WWT component and 14.5 percent for the WRP component, compare favorably with the weighted average cost of capital of 4.9 percent for the WWT component and 4.4 percent for the WRP component. Component FIRRs are high since current tariffs are low and the components are only part of current operations. Tariff increases are required to ensure the financial sustainability of the companies. A sensitivity analysis is given in Table 4 and the financial evaluation is shown in Appendix 11.

**Table 4: Sensitivity Analysis**

Scenario	Wastewater Treatment			Water Resources Protection		
	WACC (percent)	FIRR (percent)	Minimum DSCR	WACC (percent)	FIRR (percent)	Minimum DSCR
Base Case	4.9	10.7	9.4	4.4	14.5	1.8
Costs increase by 10 percent		8.7			13.2	
Revenues decrease by 10 percent		8.5			13.0	
One-year delay in revenues		7.5			12.6	
Exchange rate devaluation by 30 percent		8.5			12.7	

DSCR = debt service coverage ratio; FIRR = financial internal rate of return; WACC= weighted average cost of capital

## 2. Economic Analysis

124. The economic analysis was conducted over a 25-year period inclusive of the project construction period, in accordance with ADB's *Guidelines for the Economic Analysis of Projects*. Economic benefits and costs were denominated in terms of the domestic price numeraire and expressed in constant 2000 prices. Project benefits and costs were estimated on a without and with-project basis apportioned on the basis of being tradable or nontradable. Tradable components were adjusted to economic prices using a shadow exchange rate factor of 1.11, and nontraded components were valued at domestic market prices. A shadow wage rate factor of 0.8 was applied to the unskilled labor costs. For the WWT component, benefits were valued on the basis of incremental financial tariffs and net additional agricultural output. For the WRP component, benefits were valued on the basis of resource cost savings and net additional agricultural output. The base case economic internal rate of return (EIRR) is 15.2 percent for the WWT component, 14.7 percent for the WRP component, and 14.8 percent overall. For both components, the EIRR is expected to understate the full economic benefits since all indirect economic growth and risk aversion benefits are not encapsulated in the calculation. A sensitivity analysis (Appendix 12) indicates that both components remain economically viable under adverse benefit and cost assumption testing.

## 3. Fiscal Impact

125. The financial sustainability of the Project was verified through the financial analysis of TSC and TML, and through a review of the urban water demand. The financial projections for TSC and TML indicate that the Project will achieve the minimum debt service coverage ratios and acceptable rates of return on equity. Financial affordability analysis based on the proposed combined retail water supply and wastewater tariff was undertaken and show estimated monthly bills would be around 2 percent of average household income and around 5 percent of the income of households considered to be poor. To ensure that the Project does not have an adverse fiscal impact on either TML or the Tianjin Water Supply Company, wholesale and retail tariffs were structured on the basis of achieving full cost recovery. The annual return on equity from the Project is about 6 percent in real terms.

## **B. Environment**

126. The Project will have substantial positive environmental benefits by improving water quality and the living environment (paras. 108 and 114). Adverse project impacts on the environment will be minimal and will be mitigated. A comprehensive monitoring program for the preconstruction, construction, and operation phases will be undertaken to ensure that all mitigation requirements are met. The Project also addresses the problem that farmland close to the Zhou River is periodically flooded with contaminated water that cannot be released into the river system. Approximately 40,000 ha of land is affected, although waterlogged land is still farmed. With the Project, this land will be brought back into agricultural production by eliminating the flooding problem.

## **C. Social Dimensions**

127. The Project will improve the living environment of the residents in areas it will serve (paras. 108 and 114), the Hai River Basin, and the lower reaches of the Yongdingxin River, enabling the expansion of the irrigated area at the same time.

128. Women play an important role as income earners and are well represented in the workforce in Tianjin. Most women are involved in the cash economy in some way. Many provide additional household income through either wage labor or small-scale trading and businesses such as restaurants or laundry shops. Women work at home as much as outside the home and are responsible for household duties and looking after children, the elderly, and the sick. A number of project impacts will directly benefit women. First, with the improved water supply and availability, women will require less time and resources in managing day-to-day domestic duties. Second, improved water quality will reduce the incidence of water-related illnesses, potentially saving time and money spent on medical care. Hygiene standards and health will improve as a result of the Project. Other measures included will also ensure that women benefit from the Project, such as equal employment opportunities in TSC and TML, and during construction of facilities.

## **D. Poverty Impact**

129. Historically, poverty has been concentrated in rural areas in the PRC. However, in the 1990s, urban poverty began to emerge. Rapid rural-urban migration, the floating populations and the laying off of redundant workers has contributed to rapidly growing urban poverty. Urban poverty is now a major concern of the Government. There is little consolidated information available on urban poverty in the PRC. ADB has provided TA<sup>41</sup> to help fill this gap. Tianjin is one of the cities that might be included in an urban poverty study financed by ADB.

130. The Tianjin urban area has a per capita average urban annual income of Y7,110, higher than the national average. If the international standard of \$1/day is used to define rural poverty, and \$3/day to define urban poverty in east coast cities, both adjusted for purchasing power parities,<sup>42</sup> about 5 percent of Tianjin's urban population, or 210,000 of the Project's beneficiaries, live in poverty. The Project will help reduce poverty by (i) preventing increases in the incidence of waterborne diseases, which will reduce spending on medical care and sick days taken, thus providing more income to households; (ii) safeguarding the quality of drinking water and improvements in wastewater services (poverty goes beyond income levels and includes deprivation of essential assets and opportunities to which every human is entitled); and

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<sup>41</sup> TA 3377-PRC: *Urban Poverty Study*, for \$410,000, approved on 22 December 1999.

<sup>42</sup> Using this methodology, the rural and urban poverty lines for Tianjin would be Y962 and Y2,286, respectively.

(iii) providing equal opportunity to women, as women are typically more at risk of falling into poverty than men.

## **E. Risks**

131. Potential financial and policy risks related to the Project include failure (i) of TMG to meet the cash/equity transfers required to construct the Project; (ii) of TMG to generate adequate political support to increase water tariffs to meet cost recovery targets; (iii) of TMG to effectively enforce its discharge monitoring program; (iv) of upstream pollution management under the HRPPCP for the water resources component; (v) of TMG to construct sufficient sewer connections for the WWT component; and (vi) to implement, in parallel with project implementation, the dam safety program for the WRP component.

132. The potential financial and policy risks have been mitigated by assurances related to the financial and managerial autonomy for TSC and TML. ADB review missions will monitor TSC and TML compliance with the financial and operational covenants to ensure their financial sustainability. With a commitment letter provided by the Tianjin Finance Bureau ensuring the local equity contribution for the two components, local funding is not expected to be a constraint. The companies' assurance to (i) establish an account to cover four months of operating expenditures; and (ii) set up a debt service account with sufficient funds to cover four months of debt service payments under the ADB loan are also measures to mitigate financial risks. The Project does not have any unusual technical risks. The raw water and transmission mains and WWT plant included in the Project will use standard technology common throughout the PRC that conforms to international standards. Specific construction risks will be mitigated by the use of experienced domestic and international consultants to prepare detailed designs and monitor implementation. The risk of delay in construction has been addressed through ongoing synchronization efforts and TMG's confirmation of the appointment of the deputy mayor as chair of the Project. Upstream pollution management of the WRP component will be addressed under the Hai River Basin Management Plan. TMG has agreed to commit to the dam safety program and related enhancements.

## **VI. ASSURANCES**

### **A. Specific Assurances**

133. In addition to the standard assurances, the Government has given the following assurances, which will be incorporated into the legal documents:

#### **1. Land Acquisition and Resettlement**

134. **Compliance with Laws and Regulations.** TMG will ensure that all land and rights of way required for the Project are made available in timely manner. TMG and each PIA will ensure that the provisions of the RP agreed with ADB, including compensation and other entitlements for affected persons (APs), are in accordance with all applicable government laws and regulations and ADB's policy on involuntary resettlement. Within three months after loan effectiveness, the RP will be amplified to reflect details of preliminary technical design and will include a livelihood restoration program satisfactory to ADB.

135. **Implementation.** TMG and each PIA will ensure that (i) all necessary measures have been taken to ensure timely implementation of the RP, including public consultations with APs; and (ii) every AP is fully compensated and assisted prior to displacement from housing, land, livelihood sources, and/or assets, in accordance with the RP so that such APs are at least as well off as they would have been in the absence of the Project.



136. **Budget.** TMG and each PIA will ensure timely provision of counterpart funds for land acquisition and resettlement activities specified under the RP. TMG and each PIA will ensure that counterpart funds for compensation entitlements under the RP are fully provided directly to APs and the relevant village organizations.

137. **Monitoring and Reporting.** TMG and each PIA will ensure that (i) adequate staff and resources are committed for internal monitoring of the implementation of the RP and appropriate measures, including internal monitoring reviews, will be undertaken during RP implementation; (ii) an independent domestic monitoring agency will be selected in accordance with procedures acceptable to the ADB to carry out monitoring, evaluation, and bi-annual reviews during RP implementation; and (iii) a resettlement monitoring and evaluation system and a methodology for socioeconomic assessments of the impacts of resettlement under the Project, acceptable to ADB, will be established.

138. Each PIA will coordinate with and oversee authorities involved in resettlement activities under the Project, to ensure effective RP implementation, and will provide periodic reports to ADB on the progress of land acquisition and resettlement.

## 2. Environment

139. **General.** TMG and the PIAs will ensure that the project facilities are constructed, operated, maintained, and monitored in strict conformity with (i) all applicable government laws and regulations, including national and local environmental protection, health, labor, and occupational safety regulations and standards; (ii) the environmental mitigation and monitoring measures detailed in the EIA and summary EIA for the Project approved by SEPA; and (iii) applicable ADB requirements.

140. **Monitoring.** Each PIA will ensure, among others, that its respective environmental monitoring offices will include an adequate number of full-time personnel, and sufficient resources to monitor the implementation of the environmental monitoring program, under guidance of TEPB through TEMC and that annual environmental reports will be submitted to ADB until commencement of commercial operation of the project facilities.

141. **Water Resources Safety and Protection.** TMG and TML will ensure that (i) the detailed design of Part B of the Project adequately addresses Yuqiao Reservoir safety concerns and incorporates a program for completion of pressurized grouting of the Reservoir Dam, including regular monitoring; (ii) sufficient funds are made available for timely completion of the pressurized grouting program of the Reservoir Dam; (iii) a comprehensive study and evaluation of the modification of fish ponds within the relevant protective dike at the inlet of the Yuqiao Reservoir will be submitted to ADB for review before any biological treatment basin or other environmental improvement activities are started that could affect the fish ponds remaining around the Yuqiao Reservoir.

142. **Wastewater Treatment Plant and Related.** TMG and TSC will ensure that (i) the detailed design of the Beicang WWT plant adequately addresses potential irrigation reuse issues; (ii) prior Beicang WWT plant operations start, (a) construction of pipes necessary for raw sewage collection will have been completed; and (b) a landfill facility within the Xianyang Road WWT plant will be operating; (iii) remedial measures are undertaken to minimize odor from the Beicang WWT plant, including source control; and (iv) internationally acceptable practices are used during construction of the Beicang WWT plant and related project facilities to minimize negative environmental impacts, including measures for dust reduction, provision of storm runoff detention ponds, and controlled disposal of waste soil and, wherever possible, use of trenchless methods for necessary pipe-laying.

143. TMG will ensure the timely implementation of the industrial pollution sources management program requiring industries to improve pretreatment of wastewater to satisfy national wastewater discharge standards.

### **3. Counterpart Funding**

144. The Government, through TMG, will ensure that (i) all local and foreign currency counterpart financing necessary for the Project, including equity contributions and cash advances, is provided in time to enable completion of project activities; and (ii) additional counterpart funding will be provided for any shortfall of funds or cost overruns.

### **4. Performance Framework Contracts**

145. The PIAs will implement in a timely manner their performance framework contracts, particularly with regard to agreed strategic business and action plans relating to improvements in institutional, managerial, operational, personnel, financial, and technological systems, and marketing and customer relations.

### **5. Cost Recovery**

146. TMG, TML, and TSC will review the tariff regimes, including for water and wastewater, prior to the midterm review of project implementation. The review will include (i) recalculation of minimum cost recovery tariffs based on actual project costs, the proposed capital investment program, and ongoing Government requirements; (ii) affordability and willingness-to-pay surveys; (iii) financial and economic benefits analysis; and (iv) extension of the price escalation mechanism to household and commercial users and other potential fees, charges, or market-based instruments to encourage water conservation and sound environmental behavior. The findings will be submitted to ADB for review and discussion during the midterm review of project implementation.

147. TMG will ensure that by the end of 2005 the wastewater tariffs charged by TSC to all wastewater consumers are increased from the present levels to ensure full recovery of O&M, depreciation, and financial costs, i.e., debt service obligations, and a reasonable profit margin for TSC. Thus, TSC will prepare and submit the necessary applications for tariff increases to Government authorities concerned.

148. TMG will ensure that by the end of 2005 the raw water tariffs charged to its consumers are increased to ensure full recovery of O&M, depreciation, and financial costs, i.e. debt service obligations, and a reasonable profit margin for TML. Thus, TML will prepare and submit the necessary applications for tariff increases to Government authorities concerned.

149. TMG will ensure that no entity will be exempted from the tariff established, granted a preferential rate, or excused for delays in payments without penalties.

### **6. Training**

150. The PIAs will prepare and submit their training plans to be implemented under the Project to ADB for review and concurrence, and will ensure that training institutes for such purpose will be selected in accordance with procedures acceptable to ADB.

### **7. Implementation arrangements**

151. TMG will ensure that TSC and TML will have full financial, operational, and managerial autonomy, including with respect to staffing decisions and determination of annual business plans and financial and capital expenditure budgets.

152. TSC and TML will appoint commercial auditors that are qualified to undertake company audits in the PRC and are acceptable to ADB and an audit committee of each board of directors will be established to review internal and external audit reports and to consider other issues of corporate governance.

#### **8. Financial Performance**

153. TSC and TML companies will maintain (i) minimum debt service coverage ratio of 1.4:1, (ii) maximum debt equity ratio of 65:35, and (iii) minimum current ratio of 2:1.

#### **9. Financial Matters**

154. TSC and TML will each establish separate bank accounts and ensure that each account maintains a minimum balance to cover one month of estimated O&M expenditure and, beginning no later than 1 January 2004, a minimum balance sufficient to cover four months of estimated O&M expenditures for its operations.

155. TSC and TML will each establish an account by 1 March 2005 or within 60 days of incurring any long-term debt obligations and will ensure that the minimum balances in such an account will be sufficient to cover four months of debt service obligations.

156. TSC and TML, among others, will ensure that interest and principal payments on shareholders advances, if any, will be made from general cash reserves, excluding cash maintained in the retention account and debt service accounts.

#### **B. Condition to Loan Effectiveness**

157. As a condition to loan effectiveness, the Government agrees that onlending agreements, in form and substance satisfactory to ADB, will have been entered into between (a) TMG and TSC, for Part A of the Project; and (b) TMG and TML, for Part B of the Project.

#### **C. Condition of Disbursement**

158. No disbursements of the ADB loan for financing the Water Resources Protection component of the Project will be made until TML and China Development Bank have entered into a cofinancing agreement for such purpose on terms and conditions acceptable to ADB.

### **VII. RECOMMENDATION**

159. I am satisfied that the proposed loan would comply with the Articles of Agreement of ADB and recommend that the Board approve the loan of \$130,000,000 to the People's Republic of China for the Tianjin Wastewater Treatment and Water Resources Protection Project from ADB's ordinary capital resources, with interest to be determined in accordance with ADB's pool-based variable lending rate system for US dollar loans and with a term of 25 years, including a grace period of 5 years, and other such terms and conditions as are substantially in accordance with those set forth in the draft Loan and Project Agreements presented to the Board.

TADAO CHINO  
President

16 November 2000

## APPENDIXES

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## SUPPLEMENTARY APPENDIXES

(available on request)

A	ADB's Assistance to the People's Republic of China for the Urban, Environment, and Water Supply Sectors
B	Summary Environmental Impact Assessment
C	Public Participation Activities
D	Detailed Cost Estimates and Financing Plan
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F	Resettlement Plan
G	Land Impacts and Land Allocation Before and After the Project
H	Detailed Economic Analysis
I	Details of Financial Projections / Historical Statements

## PROJECT LOGICAL FRAMEWORK

[illegible]

Design Summary	Indicators & Targets	Project Monitoring Mechanisms	Risks/ Assumptions
	<ul style="list-style-type: none"> <li>Incidents of illegal effluent use reduced</li> <li>Increase in public perception of satisfaction with the urban environment by 2006</li> <li>1 billion m<sup>3</sup>/year of raw water supply protected from pollution and water losses by Dec 2005</li> <li>Reduction in water losses from 4% to 2% by Dec 2005</li> <li>Increase in transfer scheme availability from 10 to 12 months per annum by Jan 2006</li> </ul>	<ul style="list-style-type: none"> <li>Number of prosecutions</li> <li>Socioeconomic survey, visual perception survey</li> <li>Flow monitoring, including Xia waterworks</li> <li>Records of operational use</li> <li>Records of operational use</li> </ul>	<ul style="list-style-type: none"> <li>Upstream pollution prevention and control is adequately addressed</li> <li>Public awareness and education programs are implemented successfully</li> <li>Continued unauthorized usage is addressed</li> </ul>
<b>C. Outputs</b> 3. Wastewater Treatment Component	<ul style="list-style-type: none"> <li>Beicang Wastewater Treatment Plant completed with 100,000 m<sup>3</sup>/day added by Dec 2005</li> <li>Sewerage collection and conveyance capacity of 100,000 m<sup>3</sup>/day by Dec 2005</li> <li>Effective operating regime introduced               <ul style="list-style-type: none"> <li>(i) Compliance with sewer discharge standards by Jan 2006</li> <li>(ii) Wastewater treatment plant effluent discharge compliance by Jan 2006</li> <li>(iii) Sludge disposed of in accordance with legal requirements by Jan 2006</li> </ul> </li> <li>TSC enterprise reform completed by Jan 2006               <ul style="list-style-type: none"> <li>(i) Full management and financial autonomy by Dec 2002</li> <li>(ii) Self-financed wastewater services by Jan 2006</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Project implementation plan and reviews</li> <li>Discharge monitoring program</li> <li>Discharge monitoring program</li> <li>Sludge disposal monitoring program</li> <li>Performance contracts</li> <li>Audited financial statements</li> </ul>	<ul style="list-style-type: none"> <li>Adequate source water volume</li> <li>Input water quality is maintained</li> <li>Industries implement adequate pretreatment</li> <li>Effective enforcement powers and procedures</li> <li>Changes in disposal regulations</li> <li>Government support for institutional reform</li> <li>Government and public acceptance and support for tariff increases</li> <li>Tariff increases are affordable in a positive economic context</li> </ul>

Design Summary	Indicators & Targets	Project Monitoring Mechanisms	Risks/ Assumptions
<p>2. Water Resources Protection Component</p>	<ul style="list-style-type: none"> <li>• New Zhou water diversion channel completed by end 2005, with Zhou River section water losses less than 1%</li> <li>• Yuqiao Reservoir works completed by 2004, with sustained class III water quality</li> <li>• Lower reaches lining and renovation completed by 2005, with lower section water losses less than 1%</li> <li>• Environmental management program implemented by Jan 2006 with               <ul style="list-style-type: none"> <li>(i) Sustained class III water quality at inlet to Tianjin Wastewater Treatment Plant</li> <li>(ii) Less than 12 pollution incidents per annum</li> </ul> </li> <li>• Enterprise reform of Tianjin Luanhe Drinking Water Source Protection Engineering Ltd (TML)               <ul style="list-style-type: none"> <li>(i) Full operational responsibilities assumed by Jun 2000</li> <li>(ii) Full management and financial autonomy by Dec 2002</li> <li>(iii) Tianjin Luanhe Drinking Water Source Protection Engineering Ltd (TML) operating on a self-financed basis by Jan 2006</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>• Project implementation plan and reviews</li> <li>• Flow monitoring</li> <li>• Water quality monitoring program</li> <li>• Project implementation plan and reviews</li> <li>• Flow monitoring</li> <li>• Water quality monitoring program</li> <li>• Pollution incident reporting records</li> <li>• Number of prosecutions</li> <li>• Project progress reviews</li> <li>• Legal status, review missions</li> <li>• Audited financial statements</li> </ul>	<ul style="list-style-type: none"> <li>• Resettlement package acceptable to those affected</li> <li>• Effective enforcement powers and procedures</li> <li>• Completion of related dam safety program</li> <li>• TMG authorizes reforms in the manner and time required</li> <li>• Government support for institutional reform</li> <li>• Tariff increases are affordable in a positive economic context</li> </ul>
<p><b>D. Activities</b></p> <p>1. Wastewater treatment component</p> <ul style="list-style-type: none"> <li>• Beneficiary participation</li> <li>• Land acquisition and resettlement</li> <li>• Project design</li> <li>• Project construction</li> </ul>	<p>Start: Oct 1999 Complete: Ongoing Responsibility: TSC</p> <p>Start: Complete: Responsibility: Start: Jun 2000 Complete: Dec 2003 Responsibility: TSC Start: Apr 2002 Complete: Sep 2005 Responsibility: TSC</p>	<ul style="list-style-type: none"> <li>• Project progress reports</li> <li>• Review missions</li> </ul>	

Design Summary	Indicators & Targets	Project Monitoring Mechanisms	Risks/ Assumptions
<ul style="list-style-type: none"> <li>• Development of operational procedures and staff training (including monitoring and control procedures)</li> <li>• O&amp;M budget and staff development</li> <li>• TSC institutional reforms</li> </ul> <p>2. Water resources protection component</p> <ul style="list-style-type: none"> <li>• Sewerage tariff reviews and increases</li> <li>• Beneficiary participation</li> <li>• Land acquisition and resettlement</li> <li>• Project design</li> <li>• Project construction</li> <li>• Establish O&amp;M budget and staff development</li> <li>• TML institutional reforms</li> <li>• Water tariff reviews and increases</li> </ul>	<p>Start: Dec 2000 Complete: Aug 2003 Responsibility: TSC, consultants</p> <p>Start: Dec 2000 Complete: Jun 2003 Responsibility: TSC, consultants</p> <p>Start: Nov 1999 Complete: Mar 2004 Responsibility: TSC</p> <p>Start: Nov 1999 Complete: Ongoing Responsibility: TSC, TPB</p> <p>Start: Nov 1999 Complete: Ongoing Responsibility: TWCB,TML</p> <p>Start: Jan 2001 Complete: Jun 2004 Responsibility: TML</p> <p>Start: Oct 2000 Complete: Sep 2003 Responsibility: TML</p> <p>Start: Sep 2001 Complete: Sep 2005 Responsibility: TML</p> <p>Start: Jun 2000 Complete: Dec 2005 Responsibility: TML, consultants</p> <p>Start: Nov 1999 Complete: Jan 2005 Responsibility: TML, consultants</p> <p>Start: Nov 1999 Complete: Ongoing Responsibility: TML,TPB</p>	<ul style="list-style-type: none"> <li>• Project progress reports</li> <li>• Review missions</li> </ul>	
<p><b>E. Inputs</b></p> <p>1. Consultants</p> <p>2. Civil Works</p> <p>3. Equipment and Materials</p> <p>4. Project Management, Design, Supervision, and Incremental Administration</p>	<ul style="list-style-type: none"> <li>• 65 person-months international consultants</li> <li>• 130 person-months domestic consultants</li> </ul> <p>\$144.1 million</p> <p>\$61.5 million</p> <p>\$20.9 million</p>	<ul style="list-style-type: none"> <li>• Project progress reports</li> </ul>	<ul style="list-style-type: none"> <li>• Availability of counterpart funds and domestic cofinancing</li> <li>• Selection of competent consultants who perform well</li> </ul>



<b>Design Summary</b>	<b>Indicators &amp; Targets</b>	<b>Project Monitoring Mechanisms</b>	<b>Risks/ Assumptions</b>
5. Training 6. Land and Resettlement           7. Others: Physical contingency Price contingency Front end fee Interest during construction and commitment charges	\$0.2 million \$27.8 million           \$25.5 million \$22.6 million \$1.3 million \$36.8 million	<ul style="list-style-type: none"> <li>• Country and township governments and village committee; project implementation agencies; international specialist</li> </ul>	<ul style="list-style-type: none"> <li>• National regulations on resettlement are observed</li> <li>• Adequate funds provided for resettlement</li> </ul>
<b>Total Project Cost</b> <b>TMG Equity</b> <b>Cofinancing (China Development Bank)</b> <b>Asian Development Bank</b>	\$340.7 million \$122.9 million \$87.8 million \$130.0 million		

## AFFORDABILITY ANALYSIS

1. Affordability analysis was undertaken for the year 2005, comparing a range of household incomes with estimated retail water bills. The analysis was undertaken at current 2005 prices.
2. Estimated retail bills include raw water, wastewater, and an incremental tap water charge. Estimates assume: (i) no change in current household size, (ii) an increase in water consumption per capita from 107 to 117 liters per day, (iii) implementation of recommended tariff increases for wastewater and raw water; and (iv) no real increase in the incremental charge made by the water distribution companies. Detailed assumptions are shown in Table A2.
3. The total combined retail charge is estimated to be Y2.61/m<sup>3</sup> (2000 prices) equivalent to Y2.96/m<sup>3</sup> (2005 prices). Based on estimated average water consumption per capita and household size, the average monthly retail water bill in 2005 is estimated to be Y28 (2000 prices), equivalent to Y32 (2005 prices). This represents a doubling of the current average household bill in real terms.
4. For the analysis, household incomes are assumed to remain constant over the period. This is a conservative estimate given recent growth of around 4 percent per annum. However, by assuming static real incomes, the analysis allows for differential income growth across household income categories and helps to ensure that the affordability assessment is realistic for the very low income categories.
5. For the mean income household, the monthly combined water bill is Y32, around 1.5 percent of income. For the poorest 5 percent of households, the monthly combined water bill is Y35, around 4.5 percent of income.
6. Charges are considered to be affordable for all income levels. Even for the poorest 5 percent of households, bills represent less than 5 percent of monthly income, within the accepted affordability range.

Table A2. Tianjin, Urban Income (Yuan) and Affordability

Percentile	Mean per Capita Income/Year	Household Size	Monthly Household Income 1999	Monthly Household Income 2005	Household Water Consumption (m <sup>3</sup> )	Combined Household Charge	Combined Charge, as a Proportion of Income
<b>Mean</b>	<b>7,111</b>	<b>3.06</b>	<b>1,813</b>	<b>2,057.3</b>	<b>10.7</b>	<b>31.8</b>	<b>1.54%</b>
5	2,504	3.32	693	785.9	11.7	34.5	4.39%
10	2,914	3.33	809	917.6	11.7	34.6	3.77%
20	4,061	3.25	1,100	1,247.9	11.4	33.7	2.70%
40	5,150	3.35	1,438	1,631.3	11.8	34.8	2.13%
60	6,667	3.07	1,706	1,935.2	10.8	31.9	1.65%
80	8,400	2.88	2,016	2,287.4	10.1	29.9	1.31%
90	10,370	2.69	2,325	2,637.5	9.4	27.9	1.06%
100	15,625	2.76	3,594	4,077.5	9.7	28.7	0.70%
<b>Summary Year 2000</b>			<b>Summary Year 2005</b>		<b>2000 Prices</b>		<b>2005 Prices</b>
Average bill		13.75	Average bill		28.02		31.80
lpcd		107.00	lpcd		117.0		117.00
Wastewater		0.20	Wastewater		1.06		1.20
Raw water		0.40	Raw water		0.75		0.85
Tap water		1.2	Tap water		1.55		1.76
Combined charge		1.4	Combined charge		2.61		2.96
HH consumption		9.82	HH consumption		10.70		10.7
			Inflation index		1.00		1.13
			Real income index				1.00
<b>Growth rates per annum</b>							
Average monthly bill		15.3%					
Average real bill		13.3%					
Consumption		1.8%					
Inflation		2.6%					
Real income		0%					

HH = household; lpcd = liter per capita per day; m<sup>3</sup> = cubic meter

Sources: Tianjin Statistical Yearbook; Consultant's estimates.

**COST ESTIMATES**  
(\$ million)

Component	Foreign Exchange	Local Currency <sup>a</sup>	Total Cost
<b>A. Wastewater Treatment Component (Part A)</b>			
1. Civil Works	3.9	5.9	9.8
2. Equipment and Materials	13.4	0.0	13.4
3. Land	0.0	6.1	6.1
4. Resettlement	0.0	1.3	1.3
5. Project Management, Design, and Training	0.7	3.5	4.2
<b>Subtotal (A)</b>	<b>18.0</b>	<b>16.8</b>	<b>34.8</b>
<b>B. Water Resources Protection Component (Part B)</b>			
1. Civil Works	53.7	80.6	134.3
2. Equipment and Materials	48.1	0.0	48.1
3. Land	0.0	2.2	2.2
4. Resettlement	0.0	18.2	18.2
5. Project Management, Design, supervision and Training	1.9	15.0	16.9
<b>Subtotal (B)</b>	<b>103.7</b>	<b>116.0</b>	<b>219.7</b>
<b>C. Contingencies</b>			
1. Physical <sup>b</sup>	12.2	13.3	25.5
2. Price <sup>c</sup>	11.7	10.9	22.6
<b>Subtotal (C)</b>	<b>23.9</b>	<b>24.2</b>	<b>48.1</b>
<b>D. Other Charges</b>			
1. Front End Fee	1.3	0.0	1.3
2. Interest and Other Charges During Construction <sup>d</sup>	22.3	14.5	36.8
<b>Subtotal (D)</b>	<b>23.6</b>	<b>14.5</b>	<b>38.1</b>
<b>Total</b>	<b>169.2</b>	<b>171.5</b>	<b>340.7</b>

<sup>a</sup> Inclusive of taxes at a 3.41 percent for local costs excluding land and resettlement.

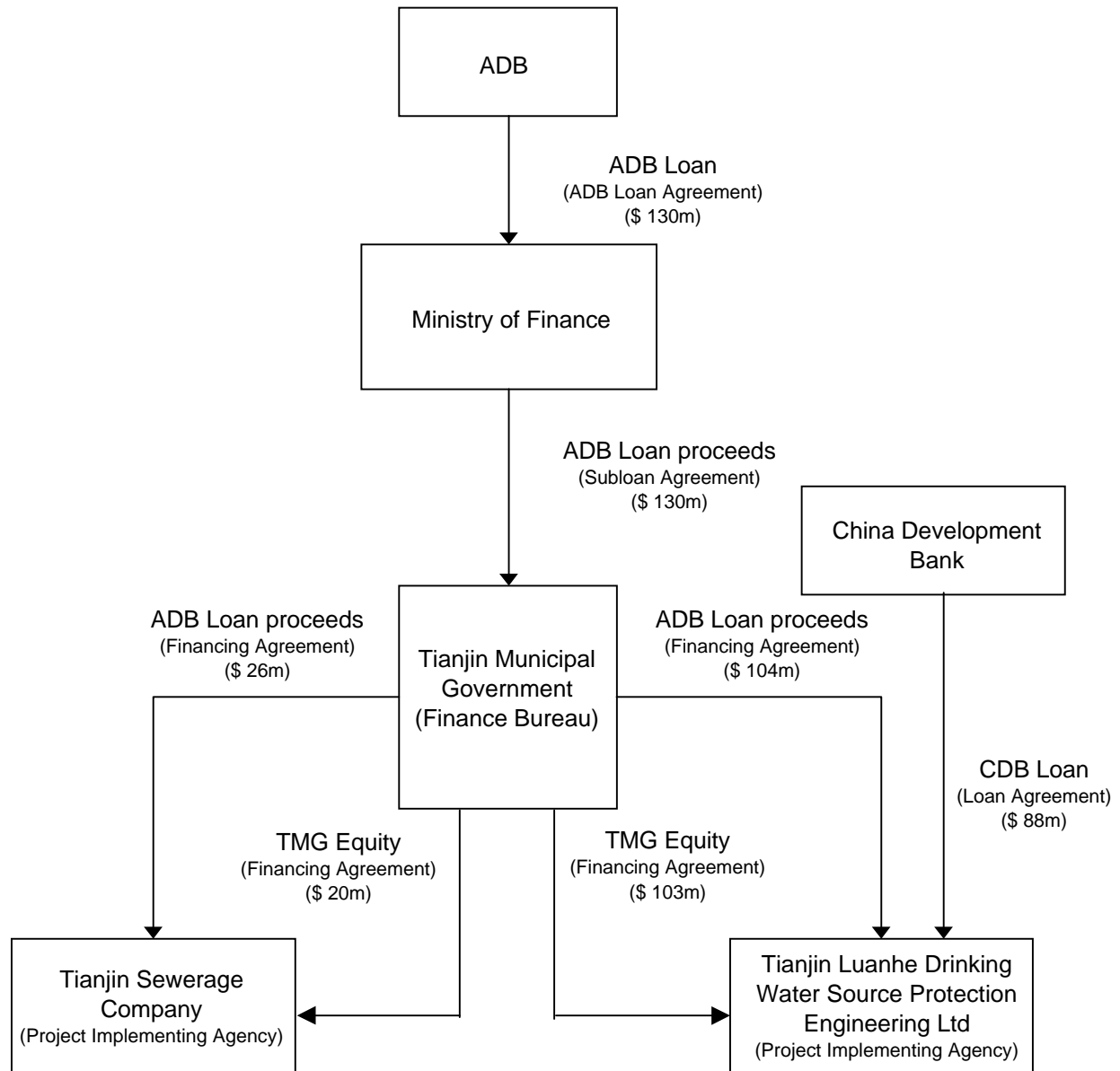
<sup>b</sup> Includes 10 percent on all costs.

<sup>c</sup> 1.8 percent per annum in 2000, 2 percent per annum in 2001 and 3 percent per annum thereafter on local costs; and 2.4 percent per annum on foreign exchange.

<sup>d</sup> Includes commitment fee of 0.75 percent.

Source: Staff estimates.

### FLOW OF FUNDS



ADB = Asian Development Bank; CDB = China Development Bank; TMG = Tianjin Municipal Government

## **FINANCIAL PROJECTIONS**

### **A. Overview and Basis of Estimation Used**

1. Tianjin Sewage Company (TSC) is responsible for wastewater collection, treatment, and disposal and stormwater drainage for six service areas within urban Tianjin. TSC was registered as a state-owned enterprise in May 1996, through a transfer of assets and staffing from the former Sewerage Management department of the Tianjin Engineering Management Bureau.
2. Tianjin Luanhe Drinking Water Source Protection Engineering Ltd (TML) is responsible for the supply of raw water for urban Tianjin and for flood control services. TML was registered, as a state-owned enterprise in January 2000, through the transfer of assets and staffing from the Luan River Diversion Management Bureau (LRDMB).
3. TSC and TML operate and maintain existing assets required for the provision of wastewater and raw water supply services. Financial projections for TSC and TML are based on full cost recovery for all operations of the company including existing operations, additional facilities provided under the Project, and known investment plans.
4. Financial projections are undertaken in current prices. International inflation is assumed to be 2.4 percent per annum. Domestic inflation is assumed to be 1.8 percent for 2000, 2.0 percent for 2001, and 3.0 percent thereafter.

### **B. Wastewater Treatment Component**

#### **1. Operating Costs**

5. Current annual operating costs of TSC are Y138 million (\$16.7 million) including two existing wastewater treatment plants, facilities, equipment, and the sewer network. Additional operating costs incurred by the Project are estimated by TSC at Y25 million (\$3.0 million) annual, including labor, power, maintenance, chemicals, inspection fees and other costs to cover the new wastewater treatment plant, and the additional network and pumping stations. Additional operating costs of Y96 million (\$11.6 million) will be incurred in 2004, to cover additional facilities not covered under the Project, including one new treatment plant (Xing Yang Road due for completion in 2003), expansion of the existing treatment plant at Jizhuangxi (due for completion in 2003), and associated sewer networks. Operating costs are assumed to increase in line with inflation.

#### **2. Capital Expenditure**

6. Project capital expenditure is estimated at Y343 million (\$41.4 million). This includes physical contingencies of 10 percent for all items, and price contingencies in line with expected inflation. Replacement costs for mechanical equipment are included in 2014.

#### **3. Revenues**

7. Revenues will come from direct user charges and subsidies. Proposed direct charges for all user types are Y1.06 (\$0.13) by 2005 (2000 prices) equivalent to Y1.2 (\$0.15) by 2005, (2005 prices). For industries where wastewater is monitored, TSC will collect revenues. For all other industries, domestic and other use, revenues will be collected by the water distribution company, which will charge 2 percent commission. Charges will be based on 100 percent of water supplied and no industry or activity will be exempt from charges. Annual wastewater volumes, at 417 million m<sup>3</sup>, are expected to rise at an average of 2 percent per annum.

8. The storm water subsidy of Y34 million (\$4.1 million) will continue as a storm water drainage charge to TMG, reflecting the “public good” that the service provides. The charge will remain constant in real terms. The sewerage subsidy of Y5 million (\$0.6 million) will cease in 2000. The sewage treatment subsidy will be phased out. The subsidy is assumed to halve in 2000 and cease in 2003, allowing tariffs to increase at a politically acceptable rate, which is necessary for successful project implementation.

#### **4. Balance Sheet Assumptions**

9. The opening balance is based on TSC balance sheet for 1998. Total current assets are Y103 million (\$12.4 million). Gross fixed assets are Y1,361 million (\$164.4 million), accumulated depreciation Y50 million (\$6.0 million), and net fixed assets in operation Y1,311 million (\$158.3 million).

10. Opening balance of the capital account was assumed to be the same as the value of net fixed assets in operation.

11. Project fixed assets are depreciated at 4 percent per annum on a declining balance. Existing assets are depreciated at a composite index of 3.1 percent per annum, on the basis of a detailed analysis of specific items in the asset register. Assets to be transferred to the TSC in the future are depreciated at 2.5 percent per annum.

12. Accounts receivable represent 15 percent of current period debit.

13. Accounts payable represent 10 percent of operating expenses. Seventy percent of additions to accounts payable are paid in the following year.

14. The allowance for doubtful debts represents 5 percent of current period debit.

15. Long term debt includes the Asian Development Bank (ADB) loan, of Y217 million (\$26.2 million) from ADB's ordinary capital reserves, which carries an interest rate of 6.42 percent per annum, a commitment charge of 0.75 percent, and a 1 percent front end fee. The loan is repaid over 25 years with a grace period of 5 years.

16. Provision for foreign exchange and interest risk is included as part of debt service at an additional 5 percentage points over the prevailing interest rate of 6.42 percent.

17. Nonoperational revenue is based on the 1999 TSC profit and loss statement, at Y10 million (\$1.2 million) representing profits on construction. It is assumed to remain constant in real terms.

18. Interest on cash balance is 4 percent per annum.

19. TSC will be exempt from business income tax until 2005. From 2006, income tax is assumed at 33 percent of net revenue.

20. TSC will review financial performance on a yearly basis and assess appropriate tariff levels to achieve full cost recovery, considering items including revenue collection performance, actual costs, and investment plans.

#### **5. Projected Financial Statements**

21. Detailed financial projections up to the year 2015 have been prepared for TSC. Projections cover the wastewater management operations as proposed under the Project, existing operations, and the new facilities under construction. The projected financial statements are presented in current prices that include inflation in each year.

22. Total assets are seen to increase from Y1.4 billion (\$0.17 billion) in 2000 to Y6.2 billion (\$0.75 billion) in 2015 as a result of growth in retained earnings from operations and the transfer of assets. Sufficient cash is generated to be able to pay all debt service requirements.

23. On the basis of the proposed charges, and subsidies in the first two years, TSC will run at a small profit over the projection period. Profits (measured by return on capital employed) in the early years are low, rise to reach 8 percent in 2003, as tariff increases take place. Profit levels fall to 2 percent in 2004. This is the result of the additional expenditure required to cover the operations and maintenance of additional facilities from 2004. Profit levels slowly increase to reach 8 percent by 2015. These profit levels are considered to be reasonable, in conjunction with PRC guidelines.<sup>1</sup>

## **C. Water Resources Protection Component**

### **1. Operating Costs**

24. Current operating costs of facilities and raw water delivery is estimated at Y218 million (\$26.3 million). This includes raw water purchase, operation and maintenance of reservoirs, tunnel, administration of the bureau and monitoring and covers all labor, power, equipment and other costs. Additional operating costs associated with the Project are Y25 million (\$3.0 million).

### **2. Capital Costs**

25. Capital expenditure under the Project is estimated at Y2.2 billion (\$0.27 billion). TML does not have any specific long-term investment plans, thus no specific investments or additional costs are included in the financial projections.

### **3. Revenues**

26. Revenues will come from direct charges. Proposed direct charges for raw water consumed are Y0.75 (\$0.09) by 2005 (2000 prices) equivalent to Y0.85 (\$0.10)/cubic meter (m<sup>3</sup>) by 2005, (2005 prices), and Y0.25 (\$0.03) by 2005 (2000 prices) equivalent to Y0.28 (\$0.03)/m<sup>3</sup> by 2005 (2005 prices), for industries that recycle water. TML will collect charges from the water distribution companies for consumed water and will charge users directly for recycled water. Annual consumption of water is projected to rise from 537 million m<sup>3</sup> in 2000 to 748 million m<sup>3</sup> by 2020, an average growth rate of about 1.7 percent per annum. Demand for recycled water used primarily by the power plants, steel works, and paper mill is expected to remain constant at 415 million m<sup>3</sup> per annum.

27. No specific subsidies are included for flood control services provided by TML. No information regarding the costs of flood control as an operation is available and it has not been possible to determine an appropriate charge for the activity. Rather, flood control is an integral part of raw water provision, and as such is a positive economic externality of the operation.

### **4. Balance Sheet Assumptions**

28. All assets of LRDMB are transferred to TML in the year 2000.

29. The opening balance, at the end of 1999, is based on asset valuations provided by LRDMB, adjusted for inflation and assuming 60 percent accumulated depreciation. Net fixed assets in operation are Y717 million (\$86.6 million).

30. The opening balance of the capital account was assumed to be the same as the value of net fixed assets in operation.

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<sup>1</sup> State Circular 1192, issued by SPDC, MOF, and SEPA in September 1999.



31. Project fixed assets and existing assets are depreciated at 2.5 percent per annum on a declining balance. The rate is low since the assets are primarily civil works with a long economic life. The diversion management department assets are depreciated at 5 percent, since these assets include noncivil works items, including vehicles.
32. Accounts receivable represent 15 percent of current period debit.
33. Accounts payable represent 10 percent of operating expenses. Seventy percent of additions to accounts payable are paid in the following year.
34. The allowance for doubtful debts represents 5 percent of current period debit.
35. Long-term debt includes the ADB loan, of Y859 million (\$103.7 million) from ADB's ordinary capital reserves, and a loan from China Development Bank of Y727 million (\$87.8 million). The ADB loan carries an interest rate of 6.42 percent per annum, a commitment charge of 0.75 percent and a 1 percent front end fee. The loan is repaid over 25 years with a grace period of 5 years. The China Development Bank loan carries an interest rate of 6.21 percent per annum. The loan is repaid over 15 years, with a grace period of 5 years.
36. Provision for foreign exchange and interest risk is included as part of debt service at an additional 5 percentage points over the prevailing interest rate of 6.42 percent.
37. Nonoperational income is 3 percent of operating revenues.
38. Interest on cash balance is 4 percent per annum.
39. TML will be exempt from business income tax until 2005. From 2006, income tax is assumed at 33 percent of net revenue.
40. TML will review financial performance on a yearly basis and assess appropriate tariff levels to achieve full cost recovery, considering items including revenue collection performance, actual costs, and investment plans.

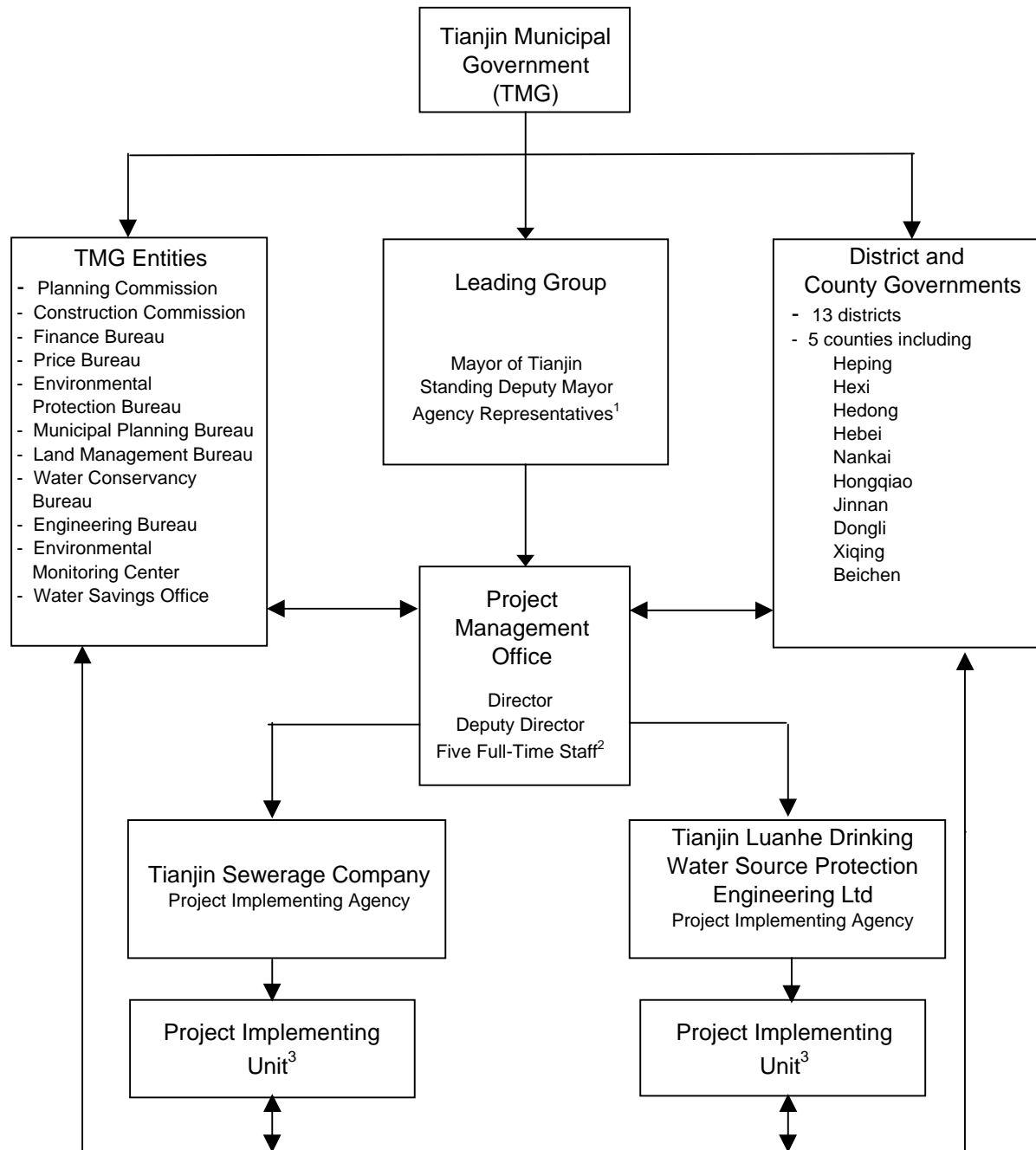
## **5. Projected Financial Statements**

41. Detailed financial projections up to the year 2015 have been prepared for TML. Projections cover existing raw water supply operations and additional facilities proposed under the Project. The projected financial statements are presented in current prices that include inflation in each year.
42. Total assets are seen to increase from Y0.8 billion (\$0.10 billion) in 2000 to Y4.8 billion (\$0.58 billion) in 2015. Sufficient cash is generated to be able to pay all debt service requirements.
43. On the basis of the proposed charges, TML will run at a small profit over the projection period. Profits increase gradually over the period. In the years of implementation and up to 2010, average profit levels measured by return on capital employed are less than 6 percent, in line with People's Republic of China guidelines.<sup>2</sup> After this period, profits rise gradually.

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<sup>2</sup> Reasonable profit for raw water provision is designated to 4-6 percent. Source: State Council. 1985. Circular (94): Calculation, Collection and Management of Water Tariff for Water Conservancy Projects. Beijing: State Council.

## PROJECT ORGANIZATION CHART



<sup>1</sup> Staff from Tianjin Environmental Planning Bureau (TEPB), Tianjin Finance Bureau (TFB), Tianjin Municipal Development Planning Commission (TMDPC), Tianjin Luanhe Drinking Water Source Protection Engineering Ltd (TML), Tianjin Municipal Engineering Bureau (TMEB), Tianjin Sewerage Company (TSC), Tianjin Urban and Rural Construction Commission (TURCC), and Tianjin Water Conservancy Bureau (TWCB).

<sup>2</sup> Five full-time staff from TFB, TMDPC, TMEB, TURCC, and TWCB.

<sup>3</sup> To be composed of core working groups responsible for project management and operations, finance, engineering, resettlement and environmental monitoring and public awareness.

## Implementation Schedule

Activity	2000		2001				2002				2003				2004				2005			
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
<b>ADB Loan Period</b>		▲																				▲
<b>Part A: Wastewater Treatment Plant</b>																						
1. Land Acquisition																						
2. Resettlement																						
3. Preliminary and Final Design																						
4. Tendering																						
5. Construction and Commissioning																						
Wastewater Treatment Plant																						
Pumping Stations																						
Sewers																						
<b>Part B: Water Resource Protection</b>																						
Zhou Section Covered Channel																						
1. Land Acquisition																						
2. Resettlement																						
3. Preliminary and Final Design																						
4. Tendering																						
5. Construction																						
6. Commissioning																						
Open Canal Lining and Repair																						
1. Land Acquisition																						
2. Resettlement																						
3. Preliminary and Final Design																						
4. Tendering																						
5. Construction																						
6. Commissioning																						
Reservoir Protection																						
1. Land Acquisition																						
2. Resettlement																						
3. Preliminary and Final Design																						
4. Tendering																						
5. Construction																						
Village Waste Controls																						
Buffer Arbor and Aquatic Works																						
Fishpond Restruction																						
6. Commissioning																						

## OUTLINE TERMS OF REFERENCE FOR CONSULTING SERVICES AND TRAINING

### A. Scope of Work

1. The consultants will work with the Executing Agency, project management office (PMO), project implementation agencies (the Tianjin Sewerage Company and the Tianjin Luanhe Drinking Water Source Protection Engineering Ltd [TML]), and other relevant officials of Tianjin Municipal Government (TMG) to provide assistance and advice on the items in this sector.

2. **Project Planning, Design, and Implementation Procedures.** Tasks include (i) the development of comprehensive project implementation plans and procedures for monitoring and control; (ii) the introduction of document control and contract management systems; (iii) the review of designs, drawings, and bidding documents; (iv) the review of manufacturer's proposals and drawings for adequacy and compliance with tender and contract specification; (v) review of the project components for potential problems and adverse mitigation measures; (vi) inspection of the manufacturing facilities of suppliers of equipment under international and local competitive bidding procedures, in cooperation with the PMO and the project implementation units; (vii) advice on construction methods; (viii) assistance with construction inspection to determine that the work is undertaken in accordance with the intent of the contract drawings and specifications and monitoring progress relative to cost and time constraints; (ix) help with construction safety inspection, reporting, and the monitoring system establishment; (x) advice on the needed training program and the review of construction progress; (xi) assistance with preparing reports for contract payment approval; (xii) recommendations for a practical and effective design supervision system; (xiii) advice on international competitive bidding and international shopping contract procedures; (xiv) advice on reporting procedures, including those covering construction progress, withdrawal, and payment; (xv) supervision and management of construction; (xvi) training and on-the-job guidance on the above items; (xvii) establishment of a framework for a project performance monitoring system; and (xviii) development and implementation of an environmental monitoring program and reporting procedures.

3. **Institutional and Managerial Improvements.** Tasks include (i) review of the overall management organization of the company to identify where changes in organizational structures (the management model) might lead to improvements in the business performance of the organization; (ii) review of human resource planning procedures and the assessment of staffing requirements; (iii) development of a set of strategic performance indicators and targets with which to measure and assess the overall performance of the companies; (iv) assistance to TMG to develop procedures for the effective regulation of the companies based on agreed business plans; (v) assistance to the companies to develop a procedure for identifying and prioritizing capital projects; (vi) identification of requirements and appropriate recommendations for the development of human resources policy to improve the skills and performance of the workforce; and (vii) preparation, agreement to and implementation of a program of management training.

4. **Strengthening of Financial Management.** Tasks include (i) a review of financial information systems and procedures in each of the companies and proposal for modifications thereto; (ii) preparation of and gaining agreement to a financial management development plan to modernize the financial management arrangements of each company to be as close as possible to international accounting standards; (iii) assistance in the selection of software for computer based systems for financial and management accounting and other financial systems; (iv) assistance in the preparation of implementation plans for computerized systems; (v) assistance in the preparation of a program of financial training seminars and courses for different levels of accountants, economists, and financial managers, including training in international accounting standards; and (vi) assistance in the preparation and delivery of a series of training courses in financial management, including accrual accounting, for nonfinancial managers.

5. **Utility Tariff Setting, Billing and Income Collection.** Tasks include (i) development of a methodology for the periodic review of raw water supply and wastewater tariffs; (ii) a design, for implementation by TMG authorities, of a socioeconomic survey to regularly measure customer satisfaction with utility services and willingness to pay; (iii) a review of tariff structures; and (iv) review of company billing and income collection arrangements and development of an action plan for the improvement of income collection.

6. **Improvements in Operational Management.** The consultants will (i) review operational practices and procedures and recommend improvements that will create cost savings; (ii) provide guidance in operational standard setting and in the preparation of operational procedures to improve reliability and consistency in service provision; and (iii) undertake a general review of the maintenance program. For Tianjin Sewerage Corporation (TSC), tasks will include review of procedures for the control of discharges of industrial wastewater and recommend improvements; review of and recommendations for improvements to sewer inspections and maintenance programs and available equipment, including activities to reduce infiltration and unauthorized connections; and review of policies and procedures for sewer connections programs, use of septic tanks and arrangements for protecting the structural integrity of buried assets. For TML, tasks will include assistance in the application of a reservoir operations plan to reconcile the different interests of urban water resources, flood control, and irrigation needs and optimize beneficial use; and review of existing operational control systems and recommend improvements.

7. **Environmental Management, Monitoring and Water Quality Improvement.** Tasks include assistance in (i) preparing of raw water quality monitoring and improvement plan; (ii) reviewing and updating the Integrated Pollution Control Program for Yuqiao Reservoir, to control and monitor the upstream and reservoir area pollution sources; (iii) establishing comprehensive watershed management practices for the Luan River and Yuqiao Reservoir catchment within Tianjin City and policy dialogue with cross-jurisdictional province and agencies; (iv) implementing relevant measures and policies; and (v) reviewing water environment protection measures and alternatives. To minimize the potential adverse environmental impacts during the construction phase, an environmental monitoring program and reporting system will be implemented, including an environmental work program for ensuring mitigation measures are undertaken during construction and operation of the project facilities. Effectiveness of water quality monitoring and reporting including proper environmental mitigation measures, monitoring requirements, and reporting procedures will be incorporated in the detailed design and tender document.

8. **External Training.** In addition to providing on-the-job training through interaction between the PMO, TSC, and TML counterpart staff, the consultant will help prepare the external training program, including (i) study tours for project implementation, management and operation of the wastewater treatment plant, sewerage company, and raw water supply company; (ii) site visits to successful water pollution control, water shed management, raw water protection projects; (iii) introduction to engineering planning and design tools to assist in project implementation; (iv) a training program and instruction on design, software systems for document control, accounting system, financial management, quality management, scheduling, reporting and construction contract management; and (v) a seminar-workshop on disbursement and project implementation requirements from the Asian Development Bank. The consultants will provide training in watershed management, to include public awareness and education for the residents of the Yuqiao watershed, especially the fisherfolk who will manage fishponds in the reservoir. Such training will be extended to the Tianjin Environmental Protection Bureau and related TMG agencies.

9. **Benefit Monitoring.** The consultants will develop methods and procedures for benefit monitoring of the Project in general and for implementation of the resettlement plan in particular, as a supplement to the work by the independent monitoring and evaluation agency; and will advise on the method and procedures for environmental monitoring and reporting. The resettlement monitoring and evaluation will pay particular attention to livelihood restoration.

## B. Reports

10. The consultants will assist TSC and TML to prepare quarterly progress reports, annual reports, and a project completion report.

## C. Indicative Schedule and Budget

11. Table A8.1 provides an indicative schedule based on the needs of individual companies as assessed during project preparation. Table A8.2 provides an indicative budget to the consulting services.

**Table A8.1: Indicative Schedule**

<b>Area of Expertise</b>	<b>International (Person-Months)</b>	<b>Domestic (Person-Months)</b>
Technical and Engineering Management (incl. Tendering and Procurement)	30	60
Institutional and Managerial Development	9	12
Financial management	12	25
Operations management	6	15
PPMS framework and resettlement monitoring	4	9
Environmental monitoring and reporting	4	9
<b>Total</b>	<b>65</b>	<b>130</b>

**Table A8.2: Indicative Budget**

<b>Item</b>	<b>Budget</b>
International Consultancy (65 person-months@\$22,000/month)	1,430
National Consultancy (130 person-months@\$3,000/month)	390
Travel, Accommodation and Communication	200
Local Transport	80
Local Administrative Support and Office Rental	250
Overseas training	150
Local training	50
Equipment	50
<b>Total</b>	<b>2,600</b>

### INDICATIVE PROCUREMENT PACKAGES

Item	Procurement Mode	Number of Packages	Percentage Financed by ADB
<b>Wastewater Treatment</b>			
1. Civil Works			
Wastewater Treatment Plant	LCB	1	40
Pump Stations	LCB	1	40
Sewers	LCB	1	40
2. Equipment and Materials			
Wastewater Treatment Plant	ICB	1	100
Materials (cement, steel, cables)	ICB	1	100
<b>Water Resources Protection</b>			
1. Civil Works			
Reservoir Village Waste Controls	LCB	2	16
Reservoir Buffer Arbor/Aquatic	LCB	2	16
Reservoir Fishponds Reconstruction	LCB	1	16
Zhou Section Covered Channel	LCB	12	16
Existing Channel Improvements	LCB	16	16
2. Equipment and Materials			
Material (Cement)	ICB	4	100
Material (steel)	ICB	4	100
Reservoir Buffer Arbor/Aquatic	ICB	1	100
Equipment (Gates, Locks)	ICB	1	100

ICB = international competitive bidding; LCB = local competitive bidding

## SUMMARY RESETTLEMENT PLAN

### A. Introduction

1. This summary resettlement plan (RP) draws upon the comprehensive resettlement plan prepared for the Project, which involves land acquisition and resettlement effects. It also incorporates the discussion on resettlement with the relevant agencies carried out during appraisal. The RP was prepared on the basis of the feasibility designs. As a condition for loan effectiveness, the RP will be revised and updated when the preliminary technical design is finalized. The revised RP will be submitted to the Asian Development Bank (ADB) prior to land clearing, and will include livelihood restoration plans. A detailed socioeconomic survey has been completed.

2. The Tianjin Municipal Development Planning Commission, in collaboration with Tianjin Sewerage Company, the Tianjin Luanhe Drinking Water Source Protection Engineering Ltd, other relevant agencies, and the project preparatory technical assistance consultants, was responsible for preparing the RP, and ensuring that the requirements of the Asian Development Bank (policy on involuntary resettlement, *Handbook on Resettlement: A Guide to Good Practice*) are met.

### B. Land Acquisition, Land Use, and Resettlement

3. Project impacts have been identified by a preliminary survey that was undertaken during October 1999 to January 2000. Thus, resettlement impacts and budget are estimates and will be revised in light of the preliminary technical design. As a result of permanent land acquisition of 4.29 million square meters (m<sup>2</sup>), over 3,360 people or 940 households will be affected in 125 villages and one district (45 around the reservoir and 80 for the upgrade of the upgrade of the channel and the Zhou River diversion channel, and Beichang District). Temporary land acquisition of 5.51 million m<sup>2</sup> will affect over 6,370 persons or 1,591 households. Physical relocation of 12 households, with 56 affected persons (APs) is expected. No community structures or public institutions will be affected by the Project.

4. Table A10.1 gives details of land impacts resulting from the project.

**Table A10.1: Land Impacts**  
(‘000 m<sup>2</sup>)

Project Structure/Component	Permanent Land Impact	Temporary Land Impact	Total
<b>A. Wastewater Treatment</b>			
1. Wastewater treatment plant	220.1		220.1
2. Pumping stations	4.0		4.0
3. Sewer network		53.0 <sup>b</sup>	53.0
<b>Subtotal (A)</b>	<b>224.1</b>	<b>53.0</b>	<b>277.1</b>
<b>B. Water Resources Protection</b>			
1. Reservoir (22 m water)	2,927.0		2,927.0
2. Reservoir (buffer zone)	3,517.7 <sup>a</sup>		3,517.7
3. Existing channel	444.4		444.4
4. Zhou River Diversion Channel		693.7	693.7
5. Reservoir and channel		5,509.4	5,509.4
<b>Subtotal (B)</b>	<b>6,889.1</b>	<b>6,203.1</b>	<b>13,092.2</b>
<b>Total</b>	<b>7,113.2</b>	<b>6,256.1</b>	<b>13,369.3</b>

<sup>a</sup> Land use restrictions only, no land acquisition of use required. Therefore this figure is not included in land impact and budget calculations.

<sup>b</sup> Calculations based on sewer pipes with 15.17 length and width 3.5 m



### **C. Project Impacts on Livelihood**

5. In most affected villages, APs engage in agricultural activities. Economic activities are generally restricted by environmental regulations. Some villages have lost most of their land already to the reservoir, and are provided with a subsidy for food and fuel. Incomes are supplemented by other occupations, such as service-related activities and transportation, and industrial enterprises. Several villages subsist mainly on fishing in the reservoir. Due to the relatively small parcels of land being acquired in each village, most households will not experience a major impact from land acquisition. Land impacts (permanent and temporary) and land allocation per capita before and after the Project are given as a supplementary appendix. A livelihood restoration program will review options and develop viable employment activities that are permitted by environmental regulations, particularly in villages that have low land per capita ratios. The options will include

- (i) land development;
- (ii) agricultural intensification;
- (iii) enterprise development; and
- (iv) self-employment by APs, with provision for start-up capital.

### **D. Compensation and Entitlements**

6. The compensation fees and entitlements are based on laws and regulations of the People's Republic of China and the ADB guidelines and policies relating to resettlement. The wastewater treatment component is governed by the 1998 Land Administration Law. The water resource component is governed by the 1991 Ministry of Water Resources (MWR) Regulations on Medium and Large Hydropower Project Construction. Since MWR is revising these regulations, any changes will be incorporated, as necessary, in the revised RP. All APs, legal and illegal land users, will be eligible for compensation. Compensation for nonland assets will be made at full replacement rates.

### **E. Public Information, Consultation, Grievance, and Appeal**

7. During the impact survey and planning of resettlement, consultations were undertaken with town and township leaders. Interviews and informal discussions have been held in the affected towns and villages. The revised RP will include plans for livelihood restoration, developed in close consultation with APs, and fully disclosed to them. The revised RP will be fully translated into Chinese and provided to APs at least two months before ground leveling and construction commence. The project implementation agencies (PIAs) will address any concerns raised by APs. Consultation sessions will be held with APs to fully explain resettlement entitlements, including the compensation rates. The final RP will be available at the office of the village committee in all project-affected areas, and the revised RP will take into consideration all comments received. The PIAs placed the SRP in the affected township offices for review by the APs prior to loan negotiations. A comments register, both verbal and written, will be kept by township resettlement offices. The RP consultation plan is shown in Table A10.2. Grievances may be expressed verbally to the local village committee or more formally by letter to higher authorities at county and municipal level land management bureau. APs if dissatisfied with the administrative resolution of their dispute may also appeal to the people's court. A full description of the grievance procedure and timescales involved are contained in the RP.

**Table A10.2: Public Participation Plan**

<b>Purpose of Event</b>	<b>Form of Event</b>	<b>Timing</b>	<b>Implementing Agencies</b>	<b>Target Participants</b>	<b>Remarks</b>
Information briefing on the project and resettlement issues to elicit comments on project from affected persons (APs).	Display of resettlement plan (RP) at township level	15 June July 2000	County resettlement office, village committee	All project APs	<ul style="list-style-type: none"> <li>meetings to be held in each county</li> </ul>
Display summary RP on website	Global	15 June 2000	Asian Development Bank	Global	
Inform project beneficiaries of project progress, final design, and project timing, consult with APs on livelihood activities for inclusion in the revised RP.	Community meetings and focus group discussions	During preliminary technical design and prior to loan effectiveness (Oct-Nov 2000)	Project implementation agencies, county resettlement office, and village committee	APs	<ul style="list-style-type: none"> <li>AP input into livelihood activities</li> <li>Identify training requirements for Aps</li> </ul>
Present and elicit comments on the revised RP	Community meetings and focus group discussions	Jan 2001	Village committee	All project APs	<ul style="list-style-type: none"> <li>Distribution of the draft RP before event</li> <li>Discuss concerns relating to RP</li> <li>Identify "gaps" in RP</li> <li>Undertake focus group discussions with various occupations, age groups, and women to elicit specific concerns</li> </ul>
Final inventory and census	Individual interviews, household interviews	Dec 2000-Jan 2001	County resettlement office, village committee	All project APs	<ul style="list-style-type: none"> <li>Inventory all assets and land holdings</li> <li>Collect additional socioeconomic data</li> </ul>
Advise APs of entitlements and disbursement of compensation	Public meetings	Jan-Feb 2001	County resettlement office, village committee	All project APs	<ul style="list-style-type: none"> <li>Household meetings to outline entitlements</li> </ul>
Monitoring of APs, project beneficiaries, and health impacts.	Household meetings	June 2001-June 2005	County resettlement office, village committee, and independent external monitor	Random sample	<ul style="list-style-type: none"> <li>Identify where additional support is required particularly for vulnerable and disadvantaged groups</li> <li>Provide recommendations and update RP monitoring plan</li> <li>Identify health improvements</li> <li>Assess project beneficiaries' ability to pay tariff and satisfaction with water and wastewater service.</li> </ul>

**F. Organization, Implementation, and Monitoring and Evaluation**

8. The PIAs and the county resettlement office will be responsible for implementing the RP. Implementation at the local level is the responsibility of county and township governments and village committees of the affected areas. Implementation of the RP will be monitored by the PIAs. The PIAs will brief all resettlement staff fully on the contents of the RP prior to implementation. During RP implementation, internal monitoring will be undertaken every six weeks. Post resettlement monitoring will be undertaken internally by the PIAs every three months. External monitoring will be undertaken annually for two years after resettlement and will include a socioeconomic survey of at least 15 percent of affected families in villages affected by land acquisition and those affected by house relocation. Data will be disaggregated by gender, and attention will be given to vulnerable groups. The aim is to ascertain whether the Project has met the resettlement objectives of providing equal or better livelihoods and living standards. An international specialist in monitoring and evaluation will be engaged to help develop a resettlement monitoring and evaluation system and a methodology for the socioeconomic assessments. The resettlement monitoring and evaluation will pay particular attention to livelihood restoration. At the end of each monitoring exercise, a report will be submitted to the PIAs, who will forward a copy to ADB.

**G. Cost Estimates and Flow of Resettlement Funds**

9. The cost of land acquisition and resettlement, including monitoring and evaluation, is part of the project cost and has been included in the project cost estimates. The PIA will be responsible for arranging the resettlement financing and for negotiating with the APs. Tianjin Municipal Government will guarantee to meet any budget shortfall required to meet the RP objectives, including any changes approved to the 1991 MWR Regulations on Medium and Large Hydropower Project Construction. PIA will ensure the compensation and other specified assistance is provided in full, on time, and directly to the APs and their collectives. The resettlement funds will be provided to village committees, enterprises offering job opportunities, the APs to be resettled, and other agencies involved in resettlement management and administration. Entitlements will be provided to the APs before demolition and ground leveling commence.

## **FINANCIAL EVALUATION**

### **A. Introduction**

1. Financial viability was assessed for each of the project components by comparing (i) the financial internal rate of return (FIRR), based on incremental revenue generation, with the weighted average cost of capital (WACC); and (ii) the average incremental financial revenue (AIFR) with the average incremental financial cost (AIFC). A series of sensitivity tests were also undertaken. All figures shown are in constant 2000 prices, unless otherwise stated.
2. Cost recovery is based on tariffs required for financial sustainability of the project agencies, Tianjin Sewerage Company (TSC) and Tianjin Luanhe Drinking Water Source Protection Engineering Ltd (TML).
3. Affordability analysis was undertaken for combined wastewater and water tariffs, by comparing monthly bills with household income levels, including the 5 percent of residents estimated to be poor.

### **B. Wastewater Treatment Component**

#### **1. Costs**

4. Costs include capital expenditures related to the Project in the year they are incurred, including physical contingencies but excluding price contingencies. Operations and maintenance costs include labor, equipment, power, and other costs, based on estimates from TSC. Replacement costs for mechanical and electrical equipment are included every 10 years. All components are assumed to have a life of 20 years except for civil works, which are assumed to have a life of 40 years.

#### **2. Incremental Revenue**

5. Incremental revenues were calculated for the Project, using proposed incremental tariff increases in constant 2000 prices and wastewater flow projections for the Beicang service area. Since the capacity of the treatment plant is 100,000m<sup>3</sup>/day, this volume is taken as the maximum for incremental revenue calculations. It is assumed that revenues will be realized in line with the proposed schedule for introducing charges.

#### **3. Financial Viability**

6. The WACC is calculated at 4.9 percent, discounting at international inflation rates for the Asian Development Bank (ADB) loan portion, and assuming a 6 percent real return on equity for Tianjin Municipal Government (TMG). The FIRR is calculated at 10.7 percent, based on a 5 year implementation period and a 20 year operating period.
7. Table A11.1 summarizes the results of the analysis and sensitivity tests. The base-case FIRR exceeds the WACC by around 5 percentage points, indicating that the Project is financially viable. This margin is necessary, since tariff revenues are also required to pay for other operations of TSC. Sensitivity tests show that the Project remains viable under adverse cost, revenue and exchange rate assumptions.

**Table A11.1: Wastewater Treatment Component, Summary Results of FIRR Analysis**

	<b>FIRR</b>	<b>Sensitivity Indicator</b>
Base Case	10.7	
Costs Increase by 10%	8.7	1.8
Revenues Reduce by 10%	8.5	2.0
Costs Increase by 10% and Revenues Reduce by 10%	6.6	
Exchange Rate Devaluation of 30 %	7.5	
Revenues delayed by one year	8.5	

Note: The sensitivity indicator measures the proportionate decrease in the FIRR as costs increase or revenues decrease.

8. AIFC and AIFR were calculated by discounting annual capital investment and operation costs, and incremental revenues, at the WACC. The AIFR of 1.27 exceeds the AIFC of 0.72. This indicates that the Project will realize positive returns. Since the FIRR exceeds the WACC, and the AIFR exceeds the AIFC, the Project is demonstrated to be financially viable.

## **5. Cost Recovery**

9. Tariff estimates are based on (i) full cost recovery; (ii) financial sustainability of TSC, including non-Project operations; (iii) two tariff increases, the first in 2003 and the second in 2005, thereafter tariffs to remain constant in real terms; (iv) phasing out of the differential charging structure by 2005; (v) phasing out of the TMG wastewater treatment subsidy; (vi) immediate cessation of the sewerage subsidy; (vii) continuation of the stormwater subsidy, in recognition of the service as a public good, consistent with ADB policies. Current and estimated tariffs are shown in Table A11.2.

**Table A11.2: Wastewater Treatment Component, Tariff Schedule**

	(Y/cubic meter)		
	<b>2000</b>	<b>2003</b>	<b>2005</b>
Domestic customers			
Constant 2000 prices	0.20	0.56	1.06
Current prices	0.20	0.60	1.20
Other customers			
Constant 2000 prices	0.40	0.75	1.06
Current prices	0.40	0.80	1.20

Note: Current prices reflect the price base of the year quoted 2003, 2005.

10. Regular reviews of tariffs will ensure that the full cost recovery tariff rate is set at appropriate levels, particularly with regard to future investment plans for additional wastewater treatment facilities.

## C. Water Resources Protection Component

### 1. Costs

11. Costs include capital expenditures related to the project in the year they are incurred, including physical contingencies but excluding price contingencies. Operations and maintenance costs include labor, equipment, power, and other costs, based on estimates from TML. All components are assumed to have a life of 20 years except for civil works, which are assumed to have a life of 40 years.

### 2. Incremental Revenues

12. Incremental revenues were calculated for the component at constant 2000 prices using proposed incremental tariff increases and water demand projections, including consumed water and recycled water. It is assumed that revenues are realized in line with the proposed schedule for introducing charges.

### 3. Financial Viability

13. The WACC is calculated at 4.4 percent discounting at international inflation rates for the ADB loan portion and domestic inflation rates for the China Development Bank portion, and assuming a 6 percent real return on equity for TMG. The FIRR is calculated at 14.5 percent, based on a 5 year implementation period and a 20 year operating period.

14. Table A11.3 summarizes the results of the analysis and sensitivity tests. The base-case FIRR exceeds the WACC by around 10 percentage points, indicating that the Project is financially viable. This margin is necessary, since tariff revenues are also required to pay for other operations of TML. Sensitivity tests show that the Project remains viable under adverse cost, revenue, and exchange rate assumptions.

**Table A11.3: Water Resources Protection Component, Summary Results of FIRR Analysis**

	FIRR	Sensitivity Indicator
Base Case	14.5	
Costs Increase by 10%	13.2	0.91
Revenues Reduce by 10%	13.0	1.00
Costs Increase by 10% and Revenues Reduce by 10%	11.8	
Currency Devaluation of 30%	12.7	
Revenues delayed by one year	12.6	

Note: The sensitivity indicator measures the proportionate decrease in the FIRR as costs increase or revenues decrease.

15. AIFC and AIFR were calculated by discounting annual capital investment and operation costs, and incremental revenues, at the WACC. The AIFR of 0.48 exceeds the AIFC of 0.20. This indicates that the Project will realize positive returns. Since the FIRR exceeds the WACC, and the AIFR exceeds the AIFC, the Project is demonstrated to be financially viable.

## 5. Cost Recovery

16. Tariff estimates are based on (i) full cost recovery; (ii) financial sustainability of TML, including non-Project operations; (iii) two tariff increases, the first in 2003 and the second in 2005, thereafter tariffs to remain constant in real terms; (iv) continuation of the differential pricing of consumed water and recycled water, based on their production costs; and (v) TMG subsidy of the estimated cash shortfall until increased tariff revenues are realized. Current and estimated tariffs are shown in Table A11.4.

**Table A11.4: Water Resources Protection Component, Tariff Schedule**  
(Y/cubic meter)

	2000	2003	2005
Consumed water			
Constant 2000 prices	0.40	0.61	0.75
Current prices	0.40	0.65	0.85
Recycled water			
Constant 2000 prices	0.13	0.20	0.25
Current prices	0.13	0.22	0.28

Note: Current prices reflect the price base of the year quoted 2003, 2005.

17. Regular reviews of tariffs will ensure that the full cost recovery tariff rate is set at appropriate levels, particularly with regard to future investment plans for additional facilities.

## D. Affordability

18. Affordability for domestic consumers was considered for the year 2005, comparing a range of household incomes with estimated retail water bills. Average monthly retail water bills in 2005 are estimated to be Y28, double the estimated current bill of Y14. Estimated retail bills include raw water, wastewater, and an incremental tap water charge.

19. Charges are considered to be affordable for all income levels including the 5 percent of the population considered to be poor. For an average income household, estimated combined water bills represent around 1.5 percent of income. Even for the poorest 5 percent of households, estimated bills represent less than 5 percent of monthly income, within the accepted affordability range.

20. Tables A11.5 and A11.6 present the FIRR of the two components.

**Table A11.5: Wastewater Treatment Subproject, Financial Internal Rates of Return**

Net Revenue											Average Incremental Cost and Revenue			
Year	Capital Costs	O&M Costs	Total Costs	Incremental Revenue	Base Case	Costs Plus 10%	Revenue Less 10%	Revenue Delayed by one Year	Costs plus 10%		Year	Flow (million cubic meters)	Total Costs	Incremental Revenue
									Revenue Less 10%	Devaluation of 30 %				
Sensitivity Indicators														
2000	12	0	12	0	-12	-13	-12	-12	-13	-14	2000	56	12	0
2001	85	0	85	0	-85	-94	-85	-85	-94	-100	2001	59	85	0
2002	88	0	88	-1	-88	-97	-88	-88	-97	-103	2002	63	88	-1
2003	82	0	82	23	-60	-68	-62	-83	-70	-74	2003	66	82	23
2004	27	0	27	23	-4	-7	-7	-4	-9	-9	2004	70	27	23
2005	24	13	37	54	18	14	12	-14	9	12	2005	75	37	54
2006	0	25	25	58	33	30	27	29	24	28	2006	79	25	58
2007	0	25	25	61	36	33	29	33	27	31	2007	82	25	61
2008	0	25	25	64	39	36	32	36	30	34	2008	86	25	64
2009	0	25	25	67	42	40	35	39	33	38	2009	90	25	67
2010	0	25	25	74	49	46	41	42	39	45	2010	99	25	74
2011	0	25	25	74	49	46	41	49	39	45	2011	99	25	74
2012	0	25	25	74	49	46	41	49	39	45	2012	99	25	74
2013	0	25	25	74	49	46	41	49	39	45	2013	99	25	74
2014	46	25	71	74	3	-4	-5	3	-12	-9	2014	99	71	74
2015	0	25	25	74	49	46	41	49	39	45	2015	99	25	74
2016	0	25	25	74	49	46	41	49	39	45	2016	99	25	74
2017	0	25	25	74	49	46	41	49	39	45	2017	99	25	74
2018	0	25	25	74	49	46	41	49	39	45	2018	99	25	74
2019	0	25	25	74	49	46	41	49	39	45	2019	99	25	74
2020	0	25	25	74	49	46	41	49	39	45	2020	99	25	74
2021	0	25	25	74	49	46	41	49	39	45	2021	99	25	74
2022	0	25	25	74	49	46	41	49	39	45	2022	99	25	74
2023	0	25	25	74	49	46	41	49	39	45	2023	99	25	74
2024	-41	25	-16	71	86	88	79	89	81	89	2024	99	-16	71
Net Present Values:											Net Present Values:			
10%			368	380	12	-24	-26	-29	-62	-49	4.91%	694	500	665
4.91%			525	697	172	120	103	117	50	84	Average Incremental Cost			
FIRR					10.7%	8.7%	8.5%	8.5%	6.6%	7.5%	per m <sup>3</sup>			
Sensitivity Indicator						1.81	2.00						0.72	0.96
Weighted Average Cost of Capital														
Source	Amount	Percent	Interest Rate		Discount Rate	Discounted Interest								
Bank	180	52.5%	6.42%		2.40%	3.9%								
Equity	163	47.5%	6.00%			6.0%								
Total	343	100%	6.22%											
Real WACC						4.9%								



Table A11.6: Water Resources Protection Subproject, Financial Internal Rates of Return

Net Revenue											Average Incremental Cost and Revenue			
								Revenue Delayed by one Year	Costs plus 10% Revenue Less 10%	Currency Depreciation of 30 %		Volume Produced (cubic meters)	Total Costs	Revenue
Year	Capital Costs	O&M Costs	Total Costs	Incremental Revenue	Base Case	Costs Plus 10%	Revenue Less 10%				Year			
Sensitivity Indicators						10%	10%		10%					
2000	55	0	55	0	-55	-60	-55	-55	-60	-62	2000	952	55	0
2001	443	0	443	2	-441	-486	-441	-443	-486	-504	2001	957	443	2
2002	663	0	663	3	-660	-727	-661	-661	-727	-754	2002	968	663	3
2003	574	0	574	163	-411	-468	-427	-571	-484	-492	2003	979	574	163
2004	219	0	219	131	-88	-109	-101	-55	-122	-118	2004	990	219	131
2005	47	13	60	286	226	220	197	71	192	218	2005	1,002	60	286
2006	0	26	26	300	274	272	244	260	242	271	2006	1,014	26	300
2007	0	26	26	315	289	286	257	274	255	285	2007	1,025	26	315
2008	0	26	26	329	303	300	270	289	268	299	2008	1,036	26	329
2009	0	26	26	344	318	315	283	303	281	314	2009	1,047	26	344
2010	0	26	26	358	332	330	297	318	294	329	2010	1,059	26	358
2011	0	26	26	372	346	344	309	332	306	343	2011	1,069	26	372
2012	0	26	26	385	359	357	321	346	318	356	2012	1,077	26	385
2013	0	26	26	398	372	370	333	359	330	369	2013	1,086	26	398
2014	0	26	26	412	385	383	344	372	342	382	2014	1,095	26	412
2015	0	26	26	425	399	396	356	385	354	395	2015	1,104	26	425
2016	0	26	26	438	412	410	368	399	366	408	2016	1,114	26	438
2017	0	26	26	452	426	424	381	412	378	422	2017	1,124	26	452
2018	0	26	26	466	440	438	394	426	391	437	2018	1,135	26	466
2019	0	26	26	481	454	452	406	440	404	451	2019	1,146	26	481
2020	0	26	26	495	469	466	419	454	417	465	2020	1,158	26	495
2021	0	26	26	509	483	481	432	469	430	480	2021	1,169	26	509
2022	0	26	26	524	498	495	446	483	443	494	2022	1,181	26	524
2023	0	26	26	539	513	510	459	498	456	509	2023	1,193	26	539
2024	-556	26	-530	554	1,084	1,137	1,029	1,069	1,082	1159	2024	1,205	-530	554
Net Present Values:											Net Present Values:			
10%			1,547	2,192	645	490	426	399	271	-1154	4.44%	9,328	1,811	4,446
4.44%			1,811	4,446	2,635	2,454	2,190	2,267	2,009	1258	Average Incremental Cost			
FIRR					14.5%	13.2%	13.0%	12.6%	11.8%	12.7%	per m <sup>3</sup> 0.19 0.48			
Sensitivity Indicator							0.91	1.00						
Weighted Average Cost of Capital														
				Interest	Discount	Discounted								
Source	Amount	Percent	Rate	Rate	Rate									
Bank	701	32.4%	6.42%	2.4%	3.9%									
CDB Loan	760	35.2%	6.21%	2.6%	3.5%									
Other	701	32.4%	6.00%		6.0%									
Total	2,161	100.0%												
Real WACC						4.4%								

## **ECONOMIC ANALYSIS**

### **A. Economic Context**

1. Tianjin has serious environmental problems due to a lack of adequate wastewater and water resources management, which constrains the development potential of the city. Tianjin is part of the heavily polluted Hai River Basin, one of three river basins designated for intense planning and project implementation to address environmental damage, under the national Transcentury Green Plan. The Hai River Pollution Prevention and Control Plan (HRPPCP) identifies Tianjin as one of four priority cities requiring urgent attention, and requires that water in rivers meets class V standards<sup>1</sup> and that drinking water sources meet designated national quality standards.

#### **1. Wastewater Treatment**

2. Tianjin lacks a comprehensive wastewater management system. The existing sewage network is overloaded and less than 50 percent of wastewater is treated. Currently, most sewage is discharged into the nearest watercourse, polluting the environment, causing environmental damage, and threatening public health. Most of the rivers currently fail to reach class V water quality standards, well below the national objective set out in the HRPPCP. In addition, the water quality in Bohai Bay is deteriorating with consequent damage to the marine environment and the incidence of red tide has increased, causing damage to the marine industry and aquaculture.

3. The wastewater treatment (WWT) component forms part of the wastewater management plan for the city drawn up to address these problems and to enable Tianjin to meet the quality standards set out in the HRPPCP. Other wastewater projects financed by agencies such as the World Bank and Japan Bank for International Cooperation (JBIC), are also planned in the city. The component fits well in the plan, is prioritized and well sequenced vis-à-vis the other related projects.

#### **2. Water Resources Protection**

4. Tianjin is heavily reliant for water supply on raw water transferred from the Luan River using the Luan River Diversion (LRD) system via the Yuqiao Reservoir. The quality of water delivered to water treatment works consistently fails to meet the minimum class III (footnote 1) water quality standard required under the national guidelines. Investment is urgently required for Tianjin's water source to meet the standards required by law and to ensure that the raw water supply consistently continues to meet these standards in the future. The water resources protection component will improve the water quality in the Yuqiao Reservoir and in the downstream water courses and restore the quality of the water supplied to the treatment works, to meet national guidelines. In addition the component will help guard against future risks to water contamination and enable the water authority to guarantee the delivery of water at the required quality standards.

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<sup>1</sup> The Class III standard is one of five classes. Class I, the highest standard, is for water supply sources with limited treatment and national natural reserves. Class II and III are for fishing and recreation, and may be used as water supply sources where full treatment is employed. Class IV is suitable for industrial uses and non-contact recreational uses. The Class V standard is designated for agricultural uses and scenic viewing.

### **3. Methodology and Approach**

5. The analysis establishes the economic rationale, describes beneficiaries, sets out the “without Project situation,” assesses the need and demand for each component, and undertakes an analysis of alternatives. The analysis compares the calculated economic internal rate of return (EIRR) for the Project and each component to the economic opportunity cost of capital (EOCC), which is assumed to be 12 percent. The analysis also includes an assessment of nonvalued factors, which are particularly important for environmental projects, given the difficulties of valuing benefits. The analysis uses the domestic price numeraire, since benefits are nontradeable in nature. The analysis was done in constant 2000 prices. Detailed economic analysis is available as Supplementary Appendix F.

#### **B. Wastewater Treatment Component**

##### **1. Component Beneficiaries**

6. Direct component beneficiaries include the 60 existing industries and 200,000 residents of the Beicang service area, and the new industries and an estimated 800,000 future residents that choose to locate there. Indirect beneficiaries include users of drainage water and the Yongdingxin River for irrigation and all residents of Tianjin who experience environmental benefits from a reduction in pollution. Most importantly, since the Beicang area is a planned area for economic growth and expansion, the component will remove what would otherwise be a constraint to economic growth. Therefore residents are also indirect beneficiaries through improved wealth and employment effects resulting from economic growth.

##### **2. The “Without Project” Situation**

7. Under the “Without Project” scenario (i) the Beicang east area will suffer from the public health risks, odor, and amenity problems associated with the lack of a sewer system; and (ii) development in the Beicang area will not happen at the planned pace and the economic growth in the component area will be constrained, leading to a lower overall growth rate for Tianjin than would occur if the Project went ahead.

##### **3. Demand for Wastewater Services**

8. Demand assessment is based on previous work conducted under the project preparatory technical assistance (TA). This work established the need and demand for the component, from existing and potential residents and industries. The social survey found that residents ranked environmental improvements as a top priority to improve their quality of life.

##### **4. Analysis of Alternatives for Wastewater Services**

9. Project alternatives were considered at the feasibility stage. For the WWT plant this included the type of treatment process used and location. Two alternative processes were considered. The aerobic/oxic (A/O) dephosphorization process was chosen as the preferred option since (i) operation and maintenance costs were lower, (ii) Tianjin Municipal Government (TMG) staff have experience with the A/O process, and (iii) the plant requires less land.

10. For the sewerage system, alternative layouts and main diameters were considered. The larger diameter pipe system was chosen over the smaller pipe system since it was marginally cheaper. In addition, local expertise is knowledgeable about the use of large pipe systems and the larger pipe diameter offers more flexibility for future capacity.

## 5. Economic Rate of Return Analysis

### a. Costs

11. Taxes are excluded for all costs except land at a rate of 3.41 percent for local costs. Since the analysis is undertaken using the domestic price numeraire, tradable items were multiplied by the shadow exchange rate factor (SERF), which is assumed to be 1.11.<sup>2</sup> The economic opportunity cost of land was considered. The next best alternative use of the land for the WWT plant is assumed to be industrial, given surrounding uses. The cost of the land on the industrial Tianjin Economic Development Area, which lies outside the city, is about Y119.94 per square meter (m<sup>2</sup>) which is 51 percent of the estimated cost per m<sup>2</sup> for the wastewater treatment plant site, and 80 percent of the cost estimated for pumping stations. The conversion factors for land are assumed to be 0.51 and 0.8 respectively.

12. A conversion rate of 0.8 is applied to unskilled labor since there is considerable surplus labor in many state industries. No conversion factor is applied to skilled labor. Economic costs are phased over the planning period of the Project, which is assumed to be 25 years.

### b. Benefits

13. The component will provide direct benefits to users and reduce the health risks, odor, and environmental damage that would otherwise occur. The approximate reduction of biochemical oxygen demand (BOD) suspended solids in the component area is 23 tons per day, equivalent to 8,395 tons per year. It will also provide indirect benefits to the central Beicang subarea through alleviating the overloading of the sewerage system that currently occurs.

14. The health and environmental benefits of the component are difficult to value. Willingness to pay for wastewater tends to be undervalued, since the benefits are largely unseen. The social survey showed a relatively low willingness to pay for the service, about an additional Y2.2 per month than is currently being paid. This value is considered to considerably understate the true willingness to pay, and is not used in the valuation of benefits. Health data does not provide reliable estimates of illness or disease associated with the lack of wastewater management. The environmental benefits are valued using the incremental tariff revenue for the service area of Beicang, which acts as a proxy for the value of environmental improvements.

15. The irrigation potential of effluent from the WWT plant provides an additional economic benefit. The effluent would provide irrigation water to the nearby farms, during the dry period when the rivers run dry and there is little water available for irrigation. What water could be used will therefore be in demand and can thus be considered as an additional economic benefit. The potential land area that could be irrigated is estimated at 3.67 million m<sup>2</sup>. The net additional output is valued at Y22 million per year, when the wastewater treatment plant is running at full capacity.

### d. Nonvalued Benefits

16. The component offers economic growth benefits that are not encapsulated in the EIRR calculation. The Project facilitates the development of a new growth area of the city, where industry and housing will be located. Without the Project, some of this new development will locate elsewhere in Tianjin, but some of the investment and growth will either happen later or not occur. Thus this incremental economic growth effect should be considered an economic benefit providing employment, wealth generation, and poverty reduction effects.

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<sup>2</sup> The SERF is the reciprocal of the standard conversion factor SCF, which is estimated to be 0.1. Therefore the SERF is estimated at 1.11. See Supplementary Appendix E for a more detailed discussion.

17. The component provides wastewater facilities for all residents of the Beicang service area regardless of income. In fact, since the poor and lower income household are (i) less able to afford health services, and (ii) more likely to live in poorly maintained housing close to open sewers, they are more at risk from the negative impacts under the current situation and will benefit more than the average person under the Project. Sewer connections are provided and included in costs of the component, thus low-income residents are not excluded. Including sewer connections also helps to reduce the risk of benefits not being realized.

#### **e. Results**

18. Sensitivity assumptions are taken to be 10 percent. Table A12.1 summarizes the results of the EIRR analysis and the sensitivity tests and Table A12.2 (page 72) shows the calculation. The base case EIRR is 15.2, percent exceeding the EOCC of 12 percent. Sensitivity tests show that costs would have to increase by 19 percent and benefits would have to fall by 16 percent for the EIRR only falls below the EOCC. The EIRR falls below the EOCC under the sensitivity tests where costs increase by 10 percent and benefits decrease by 10 percent. However, these events are considered unlikely. The component is economically viable since the EIRR exceeds the EOCC and the component also demonstrates other additional nonvalued benefits.

**Table A12.1: Economic Internal Rate of Return and Sensitivity Tests**

	<b>EIRR</b>	<b>Sensitivity Indicator</b>	<b>Switching Value</b>
Base Case	15.2%		
Costs Increase by 10%	13.4%	0.89	19%
Benefits Reduce by 10%	13.3%	0.96	16%
Costs Increase by 10% and benefits Reduce by 10%	11.5%		
Benefits Delayed by 1 Year	12.5%		

### **C. Water Resources Protection Component**

#### **1. Component Beneficiaries**

19. Beneficiaries are the water users or end customers of the LRD system. This includes a population of approximately 5 million people, institutions, industries, and commercial establishments. Water is also a necessity for many of the industries along the Hai River, particularly the power plants, which use the water for cooling and recycle it. Water supply companies will benefit from an improvement in the quality of their raw material, which is likely to result in cost savings in traditional treatment, and a reduction in water losses from flushing and backwashing. In addition farmers living near the Zhou River will benefit through land being brought back into agricultural production.

#### **2. The “Without Project” Situation**

20. “Without the Project,” the raw water supply for Tianjin will not meet the current required national standards for water supply. Nor is it likely to meet these standards in the future. Due to the recent increase in pollution, the water quality is likely to deteriorate further. Since there is no alternative water supply, the “without Project situation” implies a situation in which there is no drinking water supply for Tianjin, resulting in very severe economic consequences. The economic analysis assumes that the “without Project situation” is less severe and that the LRD

water is an acceptable source for the city. However, it does assume that the current problems of pollution continue and that there is a real risk from contamination of the drinking water in the future, which is required by Government to be mitigated. The project addresses the issue of upstream pollution since control of pollution outside the scope of this project is critical for this Project to achieve expected benefits. The Asian Development Bank (ADB) is involved in pollution control activity through (i) a recently completed TA, (ii) a second TA under way in the Hai River basin, and (iii) another proposed loan. As part of an integrated strategy and in close coordination with other funding agencies, the risk of upstream pollution mitigating the positive benefits of this Project is considered to be acceptable.

### **3. Need and Demand for Raw Water**

21. The demand for raw water from the Luan-Tianjin diversion comes from industries along the Hai River; Tianjin Water Supply Company, which is the major water supply company for urban Tianjin; and six other small water supply companies in the coastal and suburban areas. Given the potential demand for Tianjin Municipality and supply of water from all sources (not just the Luan-Tianjin diversion) as estimated by the TMDPC, for the municipality demand will outstrip supply by 2010. This emphasizes the requirement for new water sources, primarily other river diversions.

22. Domestic demand projections are based on population and households and assume an increase in per capita water consumption from around 100 to 147 liters per day by 2020, which is consistent with assumed income growth and behavioral patterns, and brings average water consumption more in line with other Asian cities.

23. Since current water consumption is low compared to other countries there is less need or scope for demand management measures through water pricing. Tariff levels are currently very low and planned increases to establish full cost recovery pricing will help to establish demand management principles. However, estimated forecasts of demand indicate that the income effect will outweigh the price effect over the project period.

### **4. Analysis of Alternatives for the Supply of Raw Water**

24. Three options were considered for the Zhou River diversion channel carrying water from Yuqiao Reservoir to Juiwangzhuang Gate: an open water channel, a box culvert, and a pipeline. However, the three options do not give the same output since an open water channel does not offer the degree of protection of the water supply that the underground options do. The open channel is considered as an alternative because it would not guard against the future risk of contamination is a critical objective of the Project. The underground options have better safety and aesthetic values for the local residents and avoid the dis-benefits associated with permanent division of agricultural land plots, in particular access to land which makes implementation easier. There are also technical engineering and environmental advantages.

25. The pipeline and the boxed culvert were costed in detail by the Water Conservancy Survey and Design Institute. The boxed culvert option has been preferred since it has all the advantages of an underground option and the lower cost.

### **5. Economic Rate of Return Analysis**

#### **a. Costs**

26. Financial costs were converted to economic costs using the same SERF, tax rate, and conversion rates for labor as for the wastewater component. The main costs for resettlement are for the reservoir component, where farmers and fish-farmers will be compensated for their

loss of income and livelihood. No conversion factors were applied since the payments are meant to reflect reasonable losses.

#### **b. Economic Benefits**

27. Raw water quality will be improved so that it consistently meets the national standard, and the future quality of the water will be ensured through the adequate protection of the water source and the conveyance system.

28. The improvement in current raw water quality and the reduced risk of future contamination will not be fully appreciated or experienced by the end-users. These sorts of benefits are largely “invisible” to the end user and under these circumstances, the revealed willingness to pay tends to understate the true willingness to pay. The social survey showed a reasonably low willingness to pay for improved water quality at just under Y3 per month. This value is not considered to be a true reflection, which would require a full understanding of the potential risks that would be averted under the Project.

29. The valuation of benefits uses a resource cost savings approach assuming that, at the very least, the standards of drinking water quality must be met, if not through Government investment, then by the water distribution companies themselves. Under this situation, the water distribution companies would be required to invest in some sort of advanced water treatment to try to mitigate the failure of the raw water to meet the required standard.

30. There are also benefits from the Project to farmland close to the Zhou River, which currently is periodically flooded with contaminated water that cannot be released into the river system. Approximately 400.2 million m<sup>2</sup> is affected. Thus under the Project, this land will be brought back into agricultural production, and the annual net additional output is conservatively valued at Y158 million.

#### **c. Nonvalued Benefits**

31. The Project offers other benefits, which are not encapsulated in the EIRR calculation. There is some very marginal increase in water supply capacity, since less water is needed for flushing, as well as shorter period when the system is shut down. This water, however, is not needed to meet demand until well after the year 2010. There is also a flood control benefit to the Project since the additional water conveyance downstream from the reservoir increases the capacity of water than can be released from the reservoir during times of flood. Most importantly, the Project provides and protects the water supply of the city, without which economic activity would be threatened. When considered against the alternative scenario, the economic gains are significant.

32. As with the wastewater component, the component does not differentiate between income levels of beneficiaries: all Tianjin residents will have access to the improved water supply system. However, the poor are likely to suffer more without the project situation, where for example the cost of diverting water from other sources will be higher or residents may be required to buy bottled water. The poor are more vulnerable and will be above average beneficiaries of the Project.

#### **d. Results of the EIRR Analysis**

33. Sensitivity assumptions are taken to be 10 percent. Table A12.3 summarizes the results of the EIRR analysis and the sensitivity tests and Table A12.4 (page 73) shows the calculation. The base case EIRR is 14.7 percent, which exceeds the EOCC of 12 percent. Costs would have to increase by 24 percent and benefits would have to fall by 20 percent for the EIRR to fall below the EOCC. Even under the worst case sensitivity test, where costs increase by 10

percent and benefits decrease by 10 percent, the EIRR does not fall below the EOCC. The EIRR calculation demonstrates that the component is economically viable. However, the margin by which the EIRR exceeds the EOCC fails to reflect the true economic worth of the Project, which is considered to be much higher, since the potential impact of not undertaking the component has severe economic consequences.

**Table A12.3: Water Resources Component  
Economic Internal Rates of Return and Sensitivity Tests**

	EIRR	Sensitivity Indicator	Switching Value
Base Case	14.7%		
Costs Increase by 10%	13.4%	0.62	24%
Benefits Reduce by 10%	13.3%	0.69	20%
Costs Increase by 10% and Benefits Reduce by 10%	12.1%		
Benefits Delayed by 1 Year	13.0%		

## **D. Overall Project Analysis and Conclusions**

### **1. Project EIRR Analysis**

34. The above analysis indicates that both the components are economically viable and that they stand up to sensitivity tests where costs increase and revenues decrease. The EIRR for the total Project has also been calculated. Since components are mutually exclusive, the sum of the costs and benefits for individual components has been used for the overall Project. The relative size of the component in terms of costs and benefits means that the results of the project analysis are reasonably similar to those for the other component. Table A12.5 summarizes the results and Table A12.6 shows the calculation. The base case EIRRs is 14.8 percent, which exceeds the EOCC of 12 percent. The economic analysis demonstrates the economic viability of the two components and the overall Project. Especially since significant benefits have not been valued in the EIRR analysis, the Project is economically worthwhile.

**Table A12.5: Project Economic Internal Rate of Return and Sensitivity Test**

	EIRR	Sensitivity Indicator	Switching Value
Base Case	14.8		
Costs Increase by 10%	13.4%	0.66	23%
Benefits Reduce by 10%	13.3%	0.74	19%
Costs Increase by 10% and Benefits Reduce by 10%	12.1%		
Benefits Delayed by 1 Year	12.9%		



**Table A12.2: Economic Analysis, Wastewater Treatment Component**  
(Y million)

Year	Base Financial Costs			Economic Costs			Economic Benefits				Sensitivity Tests			
	Capital Cost	O&M Cost	Total Cost	Capital Cost	O&M Cost	Total Cost	Incremental Revenue	Irrigated Land	Total Benefits	Net Benefits	Costs Plus 10%	Benefits Less 10%	Costs plus & benefits less 10%	Benefits delayed by one year
2000	16		16	16		16	0		0	-16	-18	-16	-18	-16
2001	87		87	90		90	0		0	-91	-100	-91	-100	-90
2002	79		79	82		82	-1		-1	-83	-91	-83	-91	-83
2003	60		60	63		63	23		23	-40	-47	-43	-49	-64
2004	26		26	27		27	23		23	5	8	7	10	5
2005	21	13	34	22	13	35	54	8	62	28	24	21	18	12
2006		25	25		26	26	58	17	75	49	46	41	39	37
2007		25	25		26	26	61	18	78	52	50	45	42	49
2008		25	25		26	26	64	19	82	56	54	48	46	52
2009		25	25		26	26	67	20	87	61	58	52	50	56
2010	220	25	245	230	26	256	74	22	95	- 160	- 186	- 170	- 195	- 169
2011		25	25		26	26	79	22	100	74	72	64	62	69
2012		25	25		26	26	84	22	105	79	77	69	66	74
2013		25	25		26	26	89	22	111	85	82	74	71	79
2014	39	25	64	41	26	67	95	22	117	50	43	38	31	44
2015		25	25		26	26	101	22	123	97	95	85	82	91
2016		25	25		26	26	108	22	130	104	101	91	88	97
2017		25	25		26	26	115	22	137	111	109	97	95	104
2018		25	25		26	26	123	22	145	119	116	105	102	111
2019		25	25		26	26	132	22	154	128	125	112	110	119
2020		25	25		26	26	141	22	163	137	134	121	118	128
2021		25	25		26	26	151	22	173	147	144	130	127	137
2022		25	25		26	26	162	22	184	158	155	139	137	147
2023		25	25		26	26	174	22	195	169	167	150	147	137
2024	- 40.62	25	- 16	- 39	26	- 13	180	22	201	214	216	194	195	208
Initial Capital	241.47			252.18										
NPV at 12%										73	34	27	- 12	12
EIRR										15.2%	13.4%	13.2%	11.5%	12.5%
Sensitivity Indicator											0.89	0.99		
Switching Value											19.0%	16.0%		

**Table A12.4: Economic Analysis, Water Resources Protection Component**  
(Y million)

Year	Base Financial Costs			Economic Costs			Economic Benefits				Sensitivity Tests			
	Capital Cost	O&M Cost	Total Cost	Capital Cost	O&M Cost	Total Cost	Resource Cost Savings	Agricultural Output	Total Benefits	Net Benefits	Costs plus 10%	Benefits Less 10%	Costs plus & benefits less 10%	Benefits delayed by one year
2000	89		89	96		96			0	-96	-106	-96	-106	-96
2001	524		524	564		564			0	-564	-620	-564	-620	-564
2002	531		531	572		572			0	-572	-629	-572	-629	-572
2003	432		432	466		466			0	-466	-512	-466	-512	-466
2004	181		181	195		195			0	195	214	195	- 214	195
2005	68	11	79	73	10	83	145	79	224	141	132	118	110	83
2006		23	23		21	21	290	158	448	427	425	382	380	203
2007		23	23		21	21	290	158	448	427	425	382	380	427
2008		23	23		21	21	290	158	448	427	425	382	380	427
2009		23	23		21	21	290	158	448	427	425	382	380	427
2010		23	23		21	21	290	158	448	427	425	382	380	427
2011		23	23		21	21	290	158	448	427	425	382	380	427
2012		23	23		21	21	290	158	448	427	425	382	380	427
2013		23	23		21	21	290	158	448	427	425	382	380	427
2014		23	23		21	21	290	158	448	427	425	382	380	427
2015		23	23		21	21	290	158	448	427	425	382	380	427
2016		23	23		21	21	290	158	448	427	425	382	380	427
2017		23	23		21	21	290	158	448	427	425	382	380	427
2018		23	23		21	21	290	158	448	427	425	382	380	427
2019		23	23		21	21	290	158	448	427	425	382	380	427
2020		23	23		21	21	290	158	448	427	425	382	380	427
2021		23	23		21	21	290	158	448	427	425	382	380	427
2022		23	23		21	21	290	158	448	427	425	382	380	427
2023		23	23		21	21	290	158	448	427	425	382	380	427
2024	- 556.12	23	- 534	- 599	21	- 578	290	158	448	1,026	1,084	981	1,039	1,026
Total	1,824.51			1,964.70										
<b>NPV at 12%</b>										351	208	172	29	136
<b>EIRR</b>										<b>14.7%</b>	<b>13.5%</b>	<b>13.4%</b>	<b>12.2%</b>	<b>13.0%</b>
<b>Sensitivity Indicator</b>											0.61	0.68		
<b>Switching Value</b>											<b>24%</b>	<b>20%</b>		

**Table 12.6: Project Economic Analysis**  
(Y million)

Year	Base Financial Costs			Economic Costs			Economic Benefits				Sensitivity Tests			
	Capital Cost	O&M Cost	Total Cost	Capital Cost	O&M Cost	Total Cost	Water Resources Protection Benefits	Wastewater Treatment Benefits	Total Benefit	Net Benefits	Costs plus 21%	Benefits Less 17%	Costs plus & benefits less 10%	Benefits delayed by one year
2000	105	-	105	113	-	113		0	0	-113	-136	-113	-136	-113
2001	610	-	610	654	-	654		0	0	-655	-791	-655	-791	-654
2002	610	-	610	654	-	654		-1	-1	-655	-791	-655	-791	-654
2003	493	-	493	529	-	529		23	23	-506	-616	-510	-620	-530
2004	207	-	207	222	-	222		23	23	199	- 246	- 203	- 249	- 199
2005	89	24	112	95	23	118	224	62	286	168	144	119	94	- 95
2006	-	48	48	-	47	47	448	75	522	476	466	386	376	240
2007	-	48	48	-	47	47	448	78	526	479	470	389	379	476
2008	-	48	48	-	47	47	448	82	530	483	474	392	382	479
2009	-	48	48	-	47	47	448	87	534	488	478	395	386	483
2010	220	48	268	230	47	276	448	95	543	267	209	172	115	258
2011	-	48	48	-	47	47	448	100	548	501	491	407	397	496
2012	-	48	48	-	47	47	448	105	553	506	496	411	401	501
2013	-	48	48	-	47	47	448	111	558	512	502	415	406	506
2014	39	48	87	41	47	88	448	117	564	477	458	379	361	471
2015	-	48	48	-	47	47	448	123	571	524	514	426	416	518
2016	-	48	48	-	47	47	448	130	577	531	521	431	421	524
2017	-	48	48	-	47	47	448	137	585	538	528	437	427	531
2018	-	48	48	-	47	47	448	145	593	546	536	444	434	538
2019	-	48	48	-	47	47	448	154	601	554	545	451	441	546
2020	-	48	48	-	47	47	448	163	610	564	554	458	449	554
2021	-	48	48	-	47	47	448	173	620	574	574	467	457	564
2022	-	48	48	-	47	47	448	184	631	584	584	476	466	574
2023	-	48	48	-	47	47	448	195	643	596	596	485	475	564
2024	- 597	48	- 549	- 638	47	- 591	448	201	649	1,240	1,240	1,128	1,251	1,234
Total	2,113.2			2,266.2										
NPV at 12%										423	423	37	343	148
EIRR										14.8%	14.8%	12.3%	9.9%	12.9%
Sensitivity Indicator											1.41	1.41		
Switching Value											26%	21%		