ASIAN DEVELOPMENT BANK
Operations Evaluation Department

PROJECT PERFORMANCE EVALUATION REPORT

FOR

THE PEOPLE'S REPUBLIC OF CHINA

In this electronic file, the report is followed by the Management response.

ADB

Performance Evaluation Report

Project Number: PPE: PRC 28241
Loan Numbers: 1490/1491-PRC
December 2005

Anhui Environmental Improvement Project for Municipal Wastewater Treatment/Industrial Pollution Abatement in the People's Republic of China

Operations Evaluation Department

Asian Development Bank

CURRENCY EQUIVALENTS

Currency Unit – yuan (CNY)

At Appraisal (October 1996)		At Project Completion (January 2003)		At Operations Evaluation (June 2005)
CNY1.00	= $0.1200	= $0.1210	=	$0.1208
$1.00	= CNY8.3364	= CNY8.2770	=	CNY8.2765

ABBREVIATIONS

ADB	–	Asian Development Bank
AEPB	–	Anhui Environmental Protection Bureau
APG	–	Anhui Provincial Government
AVP	–	Anhui Vinylon Plant
BOD	–	Biological Oxygen Demand (BOD)
CDCC	–	Chaohu Dongya Cement Company
COD	–	chemical oxygen demand
CWTEC	–	Chaohu Wastewater Treatment Engineering Company
DO	–	dissolved oxygen
EA	–	Executing Agency
EIRR	–	economic internal rate of return
FIRR	–	financial internal rate of return
HCFP	–	Hefei Chemical Fertilizer Plant
HCW	–	Hefei Chemical Works
HISC	–	Hefei Iron and Steel Corporation
HSTC	–	Hefei Sewage Treatment Company
ICB	–	international competitive bidding
IS	–	international shopping
NOx	–	nitrogen oxides
O&M	–	operation and maintenance
OEM	–	Operations Evaluation Mission
PCR	–	project completion report
PIA	–	project implementing agency
PMO	–	Project Management Office
PPER		Project Performance Evaluation Report
PRC	–	People’s Republic of China
RRP	–	Report and Recommendation of the President
SCADA	–	Supervisory Control and Data Acquisition
SOE	–	state-owned enterprise
SS	–	suspended solid
TA	–	technical assistance
TCR	–	technical assistance completion report
TOT	–	Transfer-Operate-Transfer
WACC	–	weighted average cost of capital
WWTP	–	wastewater treatment plants

WEIGHTS AND MEASURES

kg	–	kilogram
km	–	kilometer
l	–	liter
m	–	meter
m^3	–	cubic meter
mg	–	milligram
mm	–	millimeter

NOTE

In this report, "$" refers to US dollars.

Director	:	D. Edwards, Operations Evaluation Division 2, Operations Evaluation Department (OED)
Team Leader	:	C.C. Yu, Senior Evaluation Specialist, Operations Evaluation Division 2, OED
Team Members	:	B. Palacios, Senior Evaluation Officer, Operations Evaluation Division 2, OED R. Perez, Senior Operations Evaluation Assistant, Operations Evaluation Division 2, OED

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CONTENTS

In accordance with the guidelines formally adopted by the Operations Evaluation Department (OED) on avoiding conflict of interest in its independent evaluations, the Director General of OED did not review this report and delegated approval of this evaluation to the Director of Operations Evaluation Division 2. The fieldwork was undertaken by Klaus Schonfeld (International Consultant/Wastewater Treatment Specialist), and Zhaohui Hu Huang (Domestic Consultant/Financial Specialist) under the guidance of the Mission Leader. To the knowledge of the management of OED, there were no conflicts of interest of the persons preparing, reviewing, or approving this report.

BASIC DATA

Project Preparation/Institution Building

TA No.	Technical Assistance Name	Type	Person-Months	Amount ($'000)	Approval Date
2187	Anhui Municipal Wastewater Treatment Project	PPTA	22	325.0	19 Oct 1994
2188	Anhui Industrial Pollution Abatement Project	PPTA	30	485.0	21 Oct 1994
2693	Formulation of an Integrated Environmental Management Plan for the Chao Lake Basin	ADTA	77	800.0	26 Nov 1996
2751	Capacity Building of Wastewater Operations in Anhui Province	ADTA	36	460.0[1]	27 Jan 1997

Key Project Data ($ million)

	Loan 1490-PRC		Loan 1491-PRC	
	As per ADB Loan Documents	Actual	As per ADB Loan Documents	Actual
Total Project Cost	70.0	61.3	266.0	173.3
Foreign Exchange Cost	28.0	26.5	122.4	108.8
ADB Loan Amount/Utilization	28.0	26.5	112.0	108.8
ADB Loan Amount/Cancellation		1.5		3.2

Key Dates	Expected		Actual	
	Loan 1490-PRC	Loan 1491-PRC	Loan 1490-PRC	Loan 1491-PRC
Fact-Finding	5–17 May 1996		5–17 May 1996	
Appraisal	24 Jun–12 Jul 1996		22 Jul–16 Aug 1996	
Loan Negotiations	I Sep 1996		16–18 Oct 1996	
Board Approval	III Oct 1996		26 Nov 1996	
Loan Agreement			16 Jul 1997	
Loan Effectiveness	14 Oct 1997		14 Oct 1997	
First Disbursement			21 May 1998	07 Aug 1998
Project Completion			Apr 2001	Nov 2003
Loan Closing	30 Jun 2002	30 Jun 2001	10 Mar 2003	18 Feb 2004
Months (effectiveness to completion)	70	58	54	85

Borrower People's Republic of China
Executing Agency Anhui Provincial Government

	Loan 1490/1491-PRC		Loan 1490-PRC		Loan 1491-PRC	
Mission Data	No. of Missions	Person-Days	No. of Missions	Person-Days	No. of Missions	Person-Days
Fact-Finding	1	162				
Appraisal	1	260				
Change in Scope					1	16
Inception			1	14		
Project Administration						
Review			7	85	4	30
Project Completion			1	33	1	30
Operations Evaluation	1	22				

ADTA = advisory technical assistance, PPTA = project preparatory technical assistance, PRC = People's Republic of China.

[1] $400,000 financed by the Government of Denmark through the Danish International Development Agency and $60,000 financed by the Government of the People's Republic of China.

EXECUTIVE SUMMARY

Located in the center of Anhui Province, Chao Lake was identified in the early 1990s by the then National Environment Protection Agency as one of three lakes in the People's Republic of China (PRC) prioritized for environmental cleanup. Anhui experienced unprecedented annual economic growth of 20% in the 1990s, and the lake absorbed vast quantities of nutrients, which resulted in seasonal algal blooms affecting the water supply intakes for both Hefei and Chaohu cities and causing the decline of fish stocks. The operational strategy of the Asian Development Bank (ADB) for the PRC in the early 1990s aimed to achieve three objectives: improving economic efficiency, reducing poverty, and improving the environment and conserving natural resources.

The Anhui Environmental Improvement Project (the Project) was the first major initiative of a massive cleanup campaign. It was intended to support the Government's policy and institutional reforms aimed at improving the environment in a sustainable manner and to demonstrate effective and sustainable management techniques and investments for pollution control in Anhui Province, particularly in the Chao Lake Basin. Specifically, the Project aimed to improve the water quality in Chao Lake and reduce wastewater, air, and solid waste pollution in the cities of Hefei and Chaohu. The Project was to have six subprojects: two for constructing central wastewater treatment facilities for Hefei and Chaohu cities, and four for industrial pollution abatement for four top industrial polluters in Anhui Province. In addition, two advisory technical assistance (TA) grants were approved to help the Anhui Provincial Government formulate a least-cost, long-term Integrated Environmental Management Plan (IEMP) for enhancement of water and air quality and solid waste management in the Chao Lake Basin, and for capacity building of wastewater treatment operations in Anhui Province.

Two loans were approved in November 1996 for the Project consisting of $28.0 million for Loan 1490 on wastewater treatment facilities and $112.0 million for Loan 1491 on industrial pollution abatement. The loans became effective in October 1997. The total project cost was estimated at $336.0 million equivalent, including $150.4 million in foreign exchange cost and $185.6 million equivalent in local currency cost. The ADB loan, from its ordinary capital resources, would amount to $140.0 million, or 93% of the estimated foreign exchange costs. The remaining $196.0 million equivalent was to be financed through commercial loans and internal cash generation of the subproject enterprises or the project implementing agencies (PIAs).

The Operations Evaluation Mission (OEM) visited Hefei, Chaohu, and Beijing from 28 June 2004 to 12 July, 2005. It found that, while most project components had been implemented as envisaged at appraisal, the quality of implementation varied, ranging from excellent to less than satisfactory. Despite the complexities of the Project and changes of PIAs in one subproject, Loan 1490 was closed with only a 9-month delay. For Loan 1491, most disbursements were made before the revised loan closing date of 31 December 2002, 18 months behind the original closing date, but the loan was not closed until 18 February 2004, mostly due to delayed liquidation of the imprest account. The actual project cost at completion was $234.53 million equivalent, comprising $135.23 million in foreign exchange cost and $99.30 million equivalent in local currency cost, resulting in a $101.47 million cost underrun, or 30% below the appraisal estimate. The reasons for the substantial cost underrun included the Government's waiving of import duties for ADB (and World Bank) projects, strong competition among suppliers, and possible overbudgeting for some items. ADB loan utilization amounted to $135.23 million to cover the foreign exchange cost; the remaining $4.77 million was cancelled.

Hefei Wastewater Treatment Plant. The 300,000 cubic meters (m^3)/day secondary wastewater treatment facilities (including the ADB-financed Phase II of 150,000 m^3/day) were constructed as envisaged, and the quality of construction and equipment is good by international standards. The plant is well operated and maintained, currently operating at a capacity of 250,000-280,000 m^3/day and servicing 880,000 people (out of 1.5 million residents of Hefei city). Total influent treated has been increasing steadily from 11,100 tons in 1998 to 90,520 tons in 2004 (83% of its design capacity). In 2004, the plant was transferred to a German company under a transfer-operate-transfer (TOT) contract for a 23-year period. The main considerations behind the Government's decision for a TOT arrangement were twofold: (i) to improve service through the introduction of new management expertise, and (ii) to recover past investments so as to rapidly expand the system. The subproject helps Hefei achieve a wastewater treatment ratio of about 50%, one of the highest among large cities in the PRC.

Chaohu Wastewater Treatment Plant. The 60,000 m^3/day primary wastewater treatment plant was built with minor modifications of the original design. However, almost immediately after commissioning in July 2001, the Chaohu Municipal Government decided to invest, financed by a state-issued bond, in adding more facilities to convert it into a secondary treatment plant to meet the discharge standards. While the quality of construction of both phases is generally satisfactory, rust is visible on some equipment despite the plant's anticorrosive efforts. The plant is currently operating at 45,000 m^3/day capacity, which is expected to reach 52,000 m^3/day by the end of 2005 due to ongoing improvements in the sewage collection system in the city. The quality of the effluent, while not as good as that of the Hefei plant, mostly meets applicable discharge standards. The wastewater treatment ratio in Chaohu is about 70%, one of the highest among small to medium cities in the PRC.

Anhui Vinylon Plant (AVP). There was a substantial change of implementation arrangements in this subproject. The original PIA decided to pull out of a joint venture with Chaohu Dongya Cement Company, which was to produce cement using AVP's waste materials. Instead, AVP built a separate cement plant using its own financing to utilize its own waste materials, even though it reportedly implemented the other components of the subproject to clean up its environment through increasing wastewater treatment and recycling. As a result, the ADB-financed facilities were forced to source materials elsewhere, which include approximately 70% freshly mined limestone and 30% waste materials from other industrial sources including coal ash and some mining wastes. The quality of construction of the dry process cement plant financed under the subproject is good by international standards and is currently operating at 100% of its design capacity. Compared with conventional wet process plants, the dry plant is more energy efficient and produces lower air emissions.

Hefei Chemical Works (HCW). The ionic membrane caustic soda facility was built as envisaged. The quality and apparent workmanship of the visible equipment is very good and consistent with the highly corrosive nature of the product. All 12 units are operating well at full capacity and produce high quality caustic soda. In 2004, the total annual turnover of HCW was about Y570 million, including approximately Y170 million generated by the ADB-financed facility. The on-site wastewater treatment plant was in operation, but rust is extensively visible due to the corrosive environment and the choice of materials. On the effectiveness of the treatment, the effluents mostly meet the applicable discharge standards. Water consumption and wastewater discharge have been reduced through increasing wastewater treatment and recycling. There is a significant reduction of asbestos (though not total elimination as intended) as hazardous waste.

Hefei Iron and Steel Corporation (HISC). The wastewater treatment facilities were built as envisaged and are mostly in working condition. However, the equipment suffers from severe corrosion, partly due to the extremely corrosive environment and the poor choice of materials. Monitoring data indicate that the effluents mostly meet the standards with the exception of some parameters that were either not tested or exceeded the standards for some tests. The coking plant was only partly implemented, with the first of the two planned batteries and shared auxiliary facilities commissioned in 2003. However, the work for installing the second battery had not started as of the OEM's visit in June 2005 due to a shortage of local funding. The single battery is operating at its design capacity, producing 300,000 tons of coke per annum. The old, inefficient, and more polluting gasification plant, which was supposed to be replaced by the new facility, is still in operation. As the result of the operation of the first battery, HISC no longer needs to source coke from a large number of smaller inefficient and environmentally unfriendly coking plants.

Hefei Chemical Fertilizer Plant (HCFP). The prilled urea plant was implemented as envisaged, and the quality of construction is generally satisfactory. However, extensive corrosion has developed in the structural components, partly due to the highly corrosive nature of the production process. The plant has been operating at 110% of its design capacity. In 2004, the annual turnover of HCFP was Y730 million, about 30% of which is directly attributable to urea production. Site visits confirmed the completion of all three wastewater treatment facilities. Despite some uncertainties regarding the effectiveness of one of the treatment plants, overall the effluents appear to meet the discharge standards on parameters tested, with a few exceptions. As an encouraging sign of the plant's significant reduction of pollution, prior to the commissioning of the subproject in 2001, the plant paid Y120,000 per month in pollution levies; since then, the amount has been reduced to Y40,000.

Technical Assistance. Four TAs were provided related to the Project. The two project preparatory TAs were useful in providing a comprehensive and systematic assessment of project environmental and economic benefits, but did not seem to affect the actual project design, which had been carried out previously by domestic design institutes. The two advisory TAs, however, appear to have achieved significant results. Under TA 2751, a series of training courses were conducted for operators of municipal and industrial wastewater treatment facilities throughout Anhui Province in environmental monitoring, operation, maintenance, and management of such facilities. A permanent training center has been established using the training manuals and equipment provided under the TA. Under TA 2693, a long-term IEMP was formulated for the enhancement of water and air quality and solid waste management in the Chao Lake Basin. The TA outputs were highly relevant, timely, and instrumental for the formulation of the Chaohu Environmental Improvement Plan, approved by the State Council, and Anhui's 10th Five Year Plan. A series of investment projects aimed at improving environmental quality in the Chao Lake Basin were recommended. More than 80% of them either have been constructed or are being constructed.

The Project was and is relevant through addressing the pollution in Chao Lake, targeted as a top priority for environmental cleanup by both Anhui Province and the State Council. To a varied extent, the six subprojects have achieved some intended and unintended environmental benefits, as well as financial/economic benefits. Overall, the Project is assessed as efficacious. The Project was generally implemented smoothly, with moderate delays for some subprojects. The overall recalculated economic internal rate of return is 16.4% and the overall recalculated financial internal rate of return (FIRR) is 8.4% (higher than the cost of capital). Overall, the Project as a whole is assessed as efficient. With some exceptions, the subprojects are generally well maintained, but the poor financial performance of the subproject enterprises may adversely affect the subprojects' sustainability despite their satisfactory FIRRs. Overall, the Project is

assessed as less likely to be sustainable (without the Government's coverage of debt). The Project has achieved significant impacts on institutional strengthening of Anhui environmental management and on the operation and maintenance of wastewater treatment facilities, particularly through the four related TAs. Overall, the Project is rated as successful. Ratings have also been given to individual subprojects.

The main issue facing the Project, which continues to have relevance for ADB's current operations in the PRC, is whether and how ADB should support state-owned enterprises (SOEs) to achieve environmental improvement and, at the same time, sound financial and economic returns. Public sector lending has shown its limitations due to the high technological and market risks associated with industrial projects. ADB's Private Sector Operations Department, with more experience in credit rating and financial due diligence for industrial enterprises, may play a more appropriate role in addressing issues of environmental improvement among state-owned enterprises, with suitable technical support from ADB's public sector operations departments. Two lessons were identified. At the program (strategic) level, ADB must recognize that achieving synergy between environmental benefits and financial benefits is the best possible scenario as the latter is the basis for sustainable achievement of the former. The subproject enterprises should not be forced to choose between environmental benefits and financial benefits. At the project level, the project preparatory TAs had little impact on the actual design of the Project due to a series of reasons including poor timing of the TAs and cost considerations. ADB needs to reassess its project preparatory TA program in the PRC and, in the case of continuing such TAs, take measures to improve its relevance and usefulness.

The financial covenants were mostly not complied with. While improving the financial performance of the PIAs remains an important goal for the Government through restructuring and reforms of SOEs, this is likely to be a long-term task. ADB currently has only one similar project in the pipeline to support SOEs in industrial pollution abatement and technological upgrade. However, ADB should continue its dialogue with the Government on SOE restructuring and stand ready to provide financial and technical assistance if required.

David Edwards
Director
Operations Evaluation Department
Evaluation Division 2

I. BACKGROUND

A. Rationale

1. Located in the center of Anhui Province, Chao Lake was identified in the early 1990s by the then National Environment Protection Agency as one of three lakes in the People's Republic of China (PRC) prioritized for environmental cleanup. The Chao Lake watershed was then home to some 8 million people, including 1.3 million urban dwellers whose drinking water originated in the lake. Industries numbered about 3,000, and industry and inhabitants together poured 220 million tons of untreated wastewater into the lake every year. Coupled with unprecedented annual economic growth of 20% in Anhui Province in the 1990s, the lake had absorbed vast quantities of nutrients, resulting in seasonal algal blooms, affecting the water supply intakes for both Hefei and Chaohu cities, and depleting dissolved oxygen, thus contributing to the decline of fish stocks.

2. A study by the Anhui Environmental Protection Bureau (AEPB) in 1995,[1] sponsored by the Canadian International Development Agency, indicated that almost $1 billion would need to be invested in various types of environmental protection programs in the basin over a period of 10-15 years to have a significant impact on Chao Lake water quality. The operational strategy of the Asian Development Bank (ADB) in the PRC in the early 1990s aimed to achieve three objectives: improving economic efficiency, reducing poverty, and improving the environment and conserving natural resources. The Anhui Environmental Improvement Project (the Project) was the first major initiative of this massive cleanup campaign. It was intended to demonstrate effective and sustainable management techniques and investments for pollution control in Anhui Province, particularly in the Chao Lake Basin.

B. Formulation

3. In January 1994, during a country programming mission, the PRC Government requested ADB's assistance for financing a project to improve and protect Chao Lake. ADB subsequently provided two project preparatory technical assistance (TA) grants[2] to determine the most economical and sustainable method of (i) providing wastewater treatment in Hefei and Chaohu cities, and (ii) reducing industrial wastewater discharges from the largest factories/polluters identified by AEPB. TA 2187 identified a need to expand the collection and treatment of domestic wastewater for Hefei and Chaohu cities. TA 2188 identified the 18 most polluting industries in the Chao Lake Basin and designed an intervention project that could serve as a model for the other industries in the area. Four subprojects were identified from the list of 18 enterprises as top priority to participate in the industrial pollution component of the proposed Project. In August 1996, the Appraisal Mission confirmed the scope and the financing and implementation arrangements for the Project. In November 1996, the Board approved two loans for the Project.[3]

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[1] AEPB. 1995. *Chao Lake Watershed Management.* Hefei.

[2] ADB. 1994. *Technical Assistance to the People's Republic of China for Anhui Municipal Wastewater Treatment Project* (TA 2187-PRC for $325,000, approved on 19 October 1994). Manila; and ADB. 1994. *Technical Assistance to the People's Republic of China for Anhui Industrial Pollution Abatement Project* (TA 2188-PRC for $485,000, approved on 21 October 1994). Manila.

[3] ADB. 1996. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of China for the Anhui Environmental Improvement Project for Municipal Wastewater Treatment* (Loan 1490-PRC for $28.0 million, approved on 26 November 1996). Manila; and ADB. 1996. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of China for the Anhui Environmental Improvement Project for Industrial Pollution Abatement* (Loan 1491-PRC for $112.0 million, approved on 26 November 1996). Manila.

4. Subprojects were selected to be consistent with the project objective. Since Hefei and Chaohu cities both contributed to the degradation of Chao Lake water quality by unfettered discharge of domestic and industrial wastewater, wastewater treatment plants (WWTPs) in both cities constituted an obvious choice. The four industrial subprojects were selected from a shortlist of 18 (out of a total of 2,500) based on the severity of their potential pollution and their potential for environment-related efficiency improvements.

C. Purpose and Outputs

5. The long-term objective or goal of the Project was to assist Anhui Province in its efforts to abate environmental degradation and pollution in the Chao Lake watershed area. Specifically, it aimed to reduce wastewater discharge to the Chao Lake, and air and solid waste pollution in the cities of Hefei and Chaohu. Table 1 provides a brief description of the scope at appraisal for each subproject.

Table 1: Summary of Subprojects

Loan	Subproject	Brief Scope at Appraisal
Loan 1490: Municipal Wastewater Treatment	Hefei Central Wastewater Treatment Facilities	Construction of (i) a 150,000 m^3/day secondary sewage treatment plant, (ii) 90.8 km of interceptors (300 - 2,000 mm diameter) and gravity sewers, (iii) 3.4 km force main (600 - 1,200 mm diameter), and (iv) four lift stations.
	Chaohu Central Wastewater Treatment Facilities	Construction of (i) a 60,000 m^3/day primary sewage treatment plant, (ii) 32.0 km of interceptor and trunk sewers (500 - 1,600 mm diameter), (iii) 65.5 km of secondary sewers (200 - 500 mm diameter), and (iv) five lift stations.
Loan 1491: Industrial Pollution Abatement	Anhui Vinylon Plant	To reduce solid waste discharges and wastewater discharges into Chao Lake, the subproject was to include (i) installation of new carbide sludge concentration pond to recycle approximately 700,000 tons/year of inorganic wastewater; (ii) installation of a new dry fly ash storage silo for the power plant with a mechanical handling system to eliminate approximately 950,000 tons/year of boiler flushing water; (iii) renovation of the existing biological treatment plant to accommodate an additional 360,000 tons/year of organic wastewater generated by the Anhui Vinylon Plant; the treated wastewater was to be discharged into the Yuxi River; (iv) renovation of the piping network for wastewater collection and treatment; (v) modification of the existing solid waste storage area to prevent rain runoff from being contaminated and discharged into Chao Lake and provision of pretreatment of a smaller quantity of rain runoff; and (vi) replacement of the existing 200 tons/day wet cement plant with a new dry process cement facility with capacity of 2,000 tons/day.
	Hefei Chemical Works	To minimize freshwater consumption; reduce wastewater discharge from 36,000 m^3/day to about 2,000 m^3/day; and eliminate, through process change, asbestos, tar gas, and lead wastes, the subproject was to construct (i) an ionic membrane caustic soda plant with designed capacity of 50,000 tons/year, (ii) a 24,000 m^3/day wastewater treatment plant that includes individual pretreatment facilities for certain workshops, wastewater collection into a main drainage system, and a storm run-off collection system; and (iii) a 500 m^3/day domestic sewage treatment plant for staff quarters.
	Hefei Iron and Steel Corporation	To reduce air pollution and the demand for freshwater intake from the Nanfei River by reducing water usage and increasing water recycling from 63.9% to 93.5%, and water pollutant discharges that exceeded national and provincial standards, the subproject was to achieve (i) the installation of two new coke batteries each with 45 ovens with a capacity of 600,000 tons/year and to include coal preparation, coke making, gas purification, and auxiliary and transport facilities; and (ii) upgrading wastewater/water treatment facilities consisting of a biological wastewater treatment plant[a] for the coking facility, and a water supply system and recalculating water system for the No. 2 plant.

Loan	Subproject	Brief Scope at Appraisal
	Hefei Chemical Fertilizer Plant	To reduce nitrogen contamination in the irrigation water runoffs and the level of pollutants discharged in HCFP's wastewater, and to improve the financial prospects of plant, the subproject sought (i) installation of a new 110,000 tons/year prilled urea plant utilizing an ammonia stripping process; (ii) construction of a wastewater treatment plant with a treatment capacity of 16,800 m^3/day for the new coal gasification unit to upgrade water recycling and improve the use of treated water for cooling purposes; (iii) construction of a new biological treatment plant with a capacity of about 4,800 m^3/day for the waste streams; (iv) construction of a new wastewater pretreatment plant (432 m^3/day) to treat wastewater from the chloride soda plant and neutralize wastewater from the demineralized water station; and (v) renovation of the wastewater collection and effluent discharging pipeline system.

km = kilometer, m^3 = cubic meter, mm = millimeter

[a] Neither the Summary of the Environmental Impact Assessment nor the project preparatory TA consultant's report indicates the design capacity for the wastewater treatment plant.

Source: Summary of Environmental Impact Assessment.

6. In addition to the two project preparatory TAs (footnote 2), an advisory TA[4] grant was attached to the Project. TA 2693 aimed to help the Anhui Provincial Government (APG) formulate a least-cost, long-term integrated environmental management plan (IEMP) for enhancement of water and air quality and solid waste management in the Chao Lake Basin. In addition, a second stand-alone TA grant was approved in January 1997, two months after the loan's approval, for capacity building of wastewater operations in Anhui Province;[5] TA 2751 was financed by the Government of Denmark and administered by ADB. It aimed to provide training in environmental monitoring, operation, maintenance, and management of municipal and industrial wastewater treatment facilities in Hefei, Chaohu, and other smaller cities in the Chao Lake Basin, and throughout Anhui Province. The TA was also included in this evaluation due to its clear relevance and close relation to the Project.

D. Cost, Financing, and Executing Arrangements at Appraisal

7. Appendix 1 provides a cost breakdown by project component. At appraisal, the Project cost was estimated at $336.0 million equivalent, including $150.4 million in foreign exchange cost and $185.6 million equivalent in local currency. The ADB loans, from its ordinary capital resources, would amount to $140.0 million,[6] or 93% of the estimated foreign exchange costs, including $28.0 million under Loan 1490 for wastewater treatment facilities and $112.0 million under Loan 1491 for industrial pollution abatement. The remaining $196.0 million equivalent, including $10.4 million of foreign exchange cost and $185.6 million equivalent of local currency cost, was to be financed through commercial loans and internal cash generation of the subproject enterprises or the project implementing agencies (PIAs).

8. The Executing Agency was the APG, which was to provide overall project coordination through its Project Management Office (PMO), initially established as the Project Office to implement the project preparatory TA. The two PIAs for the two wastewater treatment subprojects were Hefei Sewage Treatment Company (HSTC) and Chaohu Wastewater Treatment Engineering Company (CWTEC). The four PIAs for the four industrial subprojects were to be Anhui Vinylon Plant (AVP), Hefei Chemical Works (HCW), Hefei Iron and Steel

[4] ADB 2005. *Technical Assistance to the People's Republic of China for Formulation of an Integrated Environmental Management Plan for the Chao Lake Basin* (TA 2693-PRC for $800,000, approved on 26 November 2005). Manila

[5] ADB 1997. *Technical Assistance to the People's Republic of China for Capacity Building of Wastewater Operations in Anhui Province* (TA 2751-PRC for $460,000, approved on 27 January 1997). Manila.

[6] ADB's loan terms to the Government included the pool-based variable lending rate for US dollars with a maturity of 25 years and a grace period of 5 years. The terms of relending (to the executing agencies) and onlending (to the project implementing agencies) were the same, i.e., without additional charges.

Corporation (HISC) and Hefei Chemical Fertilizer Plant (HCFP). However, for the AVP subproject, it was understood at the time of project approval that, while AVP would be the PIA for the subproject, a new limited liability company, Chaohu Dongya Cement Company (CDCC), in which AVP would be one of the main shareholders (40%), would be created to construct and operate the cement plant. The details of the incorporation and the implementation would be developed after loan approval and subject to ADB's approval (para. 76 of the Report and Recommendation of the President).

E. Completion and Self-Evaluation

1. Loan 1490: Municipal Wastewater Treatment

9. The project completion report (PCR) for Loan 1490 was circulated in March 2003.[7] The PCR rates the Project component highly successful based on the following findings: (i) improvement in the water quality of Chao Lake from Class V in 1996 to between class IV and class V in 2001;[8] (ii) socioeconomic benefits such as improvements in living conditions and public health, particularly for the urban poor, and its contribution to the achievement of the Millennium Development Goals; (iii) strengthened capacities of APG, HSTC, and CWTEC; (iv) efficient utilization of project funds and timely release of counterpart funds; and (v) smooth project implementation. However, the PCR does not provide an explicit assessment of the project facilities relative to the appraisal scope and the quality of construction. This is mostly due to the PCR mission not having included engineering expertise in WWTP design and operation.

2. Loan 1491: Industrial Pollution Abatement

10. The PCR for Loan 1491, which was circulated in October 2004,[9] rates the project component successful. However, loan closing was 31 months delayed. The main reasons given for the implementation delays are (i) slow project procurement, (ii) difficulties in obtaining counterpart funds due to the Asian financial crisis, and (iii) partly due to the time taken to settle the imprest account. All subprojects had cost underruns, mostly due to lower prices of domestic goods in the aftermath of the Asian financial crisis and the Government's decision to waive import duties for equipment used for environmental protection purposes. The PCR reports that the objectives of the Project were achieved such that the quality of Chao Lake improved from class V in 1996 to between classes IV and V in 2004. The PCR also states that the emissions of three of the four subproject enterprises had been reduced. The exception was HISC, which had not yet decommissioned its old coke oven at the time of the PCR.

11. The PCR reports that both HCFP and HCW were implemented as planned and were operating in a satisfactory manner. For HISC at the time of the PCR, the installation of the production wastewater treatment had been completed so that the water discharge for the plant had reportedly met the Class I emission standard. One coke oven had been put into production in November 2003, shortly before the PCR, while the second oven was still not yet commissioned. The construction was delayed due to difficulties in raising counterpart funds. The new schedule for the trial production of the second oven had been set for December 2005.

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[7] ADB. 2003. *Project Completion Report on the Anhui Environmental Improvement Project for Municipal Wastewater Treatment in the People's Republic of China* (Loan 1490-PRC, IN.51-03). Manila.

[8] Class I, the highest standard, is for natural reserved and water supply sources with limited treatment. Classes II and III designate water for fishing and recreation, and may be used as water supply sources with full treatment. Class IV is water suitable for industrial uses and noncontact recreational uses. Class V denotes water for agricultural purposes and scenic viewing.

[9] ADB. 2004. *Project Completion Report on the Anhui Environmental Improvement Project for Industrial Pollution Abatement in the People's Republic of China* (Loan 1491-PRC, IN.250-04). Manila.

12. For AVP, changes in implementation arrangements took place during implementation. In July 1997, the Government requested ADB's approval to separate the original scope into two portions.[10] The first portion included tasks (i) through (v) in the original scope (Table 1), i.e., environmental modifications at AVP and the closure of the existing wet cement plant, and AVP continued to be the PIA for this portion using its own resources. The second portion comprised task (vi), or construction of the cement clinker plant using solid wastes from AVP, and was to be implemented by a newly formed company, the Chaohu Dongya Cement Company, in which AVP was to hold 10% of the shares (reduced from 40% as envisaged at appraisal; para. 8), using ADB financing. CDCC would be the PIA for the ADB loan. ADB approved the change and allocated $40 million for the CDCC subproject. The two portions of the subproject were reported to be completed on schedule. The renovation and expansion of AVP's biological treatment plant allowed its wastewater discharge to meet the Class II standard for wastewater treatment. CDCC implemented its subproject with ADB financing on schedule, and started operation. However, impressed by the benefits of the CDCC plant, AVP decided to pull out of the CDCC joint venture completely and construct its own similar clinker plant using its own wastes. CDCC was forced to source solid wastes, mainly fly ash and ferric sulfate, from other industrial plants for its clinker production. Despite this setback, the PCR reported that in 2003 CDCC produced 781,000 tons of cement clinker, higher than the 730,000 tons per year envisioned at appraisal.

3. Technical Assistance

13. TA 2693 for the formulation of the IEMP (footnote 4) was completed in October 1999, and the technical assistance completion report (TCR) was circulated in September 2004,[11] five years after TA completion. The TCR reports that the TA accomplished most of its objectives and was successful. The consultants performed their assigned task well. The TCR reports, however, that the improved water quality for Chao Lake was not sustained as new industrial projects were put into operation in 2001. However, the TCR does not evaluate the quality of the main output, i.e., the IEMP, and how it was used in subsequent environmental management for the Chaohu Lake Basin.

14. TA 2751 for capacity building of wastewater treatment operations in Anhui Province was completed in April 1999 and the TCR was circulated in June 1999.[12] The TCR reports that the objectives were accomplished and rates the TA as generally successful. The performance of the consultant is rated as excellent. The TA produced various management and operations manuals and five training workshops. About 30 staff members from AEPB, HSTC, and CWTEC attended the training sessions. The TCR recommends further assistance from ADB to operationalize the use of the core training group by establishing a wastewater treatment training center in Hefei City.

F. Operations Evaluation

15. This Project Performance Evaluation Report (PPER) assesses various aspects of project formulation, design, implementation, and sustainability, as well as the Project's socioeconomic,

[10] The request by the Government followed almost immediately after loan signing on 16 July 1997. ADB fielded a mission in August 1997 to assess the revised arrangement and to review the feasibility studies and other related documents. The findings and recommendations of the mission were outlined in a memo dated 25 November 1997, which was approved by ADB Management.

[11] ADB. 2004. *Technical Assistance Completion Report on Formulation of an Integrated Environmental Management Plan for the Chao Lake in the People's Republic of China* (TA 2693-PRC, IN.210-04). Manila.

[12] ADB. 1999. *Technical Assistance Completion Report on Capacity Building of Wastewater Treatment Operations in Anhui Province in the People's Republic of China* (TA 2693-PRC, IN.132-99). Manila.

environmental, and institutional impacts. The assessment is based on a review of ADB documents, discussions with ADB staff, and findings of the Operations Evaluation Mission (OEM), which visited Hefei, Chaohu, and Beijing from 28 June to 12 July 2005. The OEM held discussions with the Executing Agency and the six PIAs; the Hefei Sewage Treatment Administration Office, and the Ministry of Finance. The OEM inspected the project facilities and their operation and maintenance (O&M). Copies of the draft PPER were sent to the Government and concerned ADB departments for review; all comments received have been considered in finalizing the PPER.

II. PLANNING AND IMPLEMENTATION PERFORMANCE

A. Formulation and Design

16. The formulation of the Project conformed to the PRC's policy of environmental management as embedded in the 9th Five-Year Plan and formulated in the Trans-Century Green Engineering Plan, which specifically includes the cleanup of Chao Lake. The formulation was also consistent with one of ADB's three strategic objectives for the PRC vis-à-vis the environment, namely to enhance environmental protection and natural resource management. The inclusion of two central WWTPs in Hefei and Chaohu and the selection of four top industrial enterprises/polluters[13] from a list 18 candidate industrial enterprises based on a detailed survey of their pollution intensity were both prudent and cost effective for arresting pollution in the Chao Lake. The Project aimed to achieve environmental cleanup through both source reduction at the industry level by adopting more efficient and environmentally cleaner technologies and "end of pipe" treatment with the two central WWTPs. An additional rationale for financing industrial abatement through adopting cleaner technologies included the potential demonstration effects for other industries.

17. ADB had a policy of not financing industrial projects on the basis that such projects should be financed through the commercial capital market. This may have caused the Appraisal Mission to downplay the technological upgrading nature of the Project and to stress, perhaps overly so, its environmental benefits. As such, the Report and Recommendation of the President (RRP) contains one short paragraph describing the scope of the six subprojects. More detailed description of the project scope was included in a supplementary appendix that was available only upon request. The OEM could not find the supplementary appendix in the files but managed to locate a version of the project scope from the Summary Environmental Impact Assessment, which evidently was not the final version. The practice of not voluntarily presenting the full project scope in the RRP for the Board's approval has been rare in ADB's history, and it may have reflected the particular culture at the time, with heavy emphasis on various policy compliance issues but less on the actual project scope. It is not a prudent and responsible way of presenting project information.[14]

18. For the AVP subproject, the original PIA, AVP, decided to pull out of the Project. The change of PIAs in this case may have affected the achievement of the Project's main objective (para. 23).

[13] According to a key APEB official interviewed and the Report and Recommendation of the President, the four selected enterprises contributed more than half (around 65%) of the total industrial pollution load discharged into the lake at the time of appraisal.

[14] At the Board's meeting, an objection was raised to Loan 1491 on industrial pollution abatement. A question was brought up regarding the wisdom of processing all the components together as one project when they could stand alone individually. The opposing Chair felt that the loan was for more than pollution abatement and that modernization and expansion of productive enterprises should be self-financed or financed with commercial capital.

19. On the specific technical design of the Project, while the overall project design was sound, some design flaws or issues were identified by the OEM. The design of the wastewater treatment facilities at HCW (para. 24) and HCFP (para. 26) appeared to be either unconventional or questionable, and the OEM could not ascertain their treatment effectiveness. The choices of materials for the wastewater treatment facilities at HISC were unsuitable for the extremely corrosive environment, which resulted in extensive corrosion after a few years of operation (para. 25). The Chaohu WWTP was designed as a primary treatment plant but was almost immediately converted to a secondary plant to meet the stringent discharge standards, i.e., a case of underdesign (para. 22). In this context, both project preparatory TAs were very detailed and based on thorough, locally prepared prefeasibility and feasibility studies. Both provided a sound basis for fact finding, appraisal, and finally, loan agreements. However, some detailed proposals were not followed, and had they been, may have improved the outputs and outcomes of the Project. These shortcomings were essentially technical, but also, in the case of the industrial part of the Project, cost related. Industries were reluctant to spend money and time on peripherals like environmental protection that do not immediately add to financial gain. Detailed design essentially followed predesigns prepared by design institutes. Industrial components were designed locally in accordance with locally developed technology or by foreign companies in accordance with proprietary technology, resulting in performances equal to expectations or exceeding them. On balance, detailed design was competently executed by local engineers.

B. Achievement of Outputs

20. Table 2 provides a summary of the main outputs as compared with the outputs envisaged at the appraisal.

Table 2: Main Outputs of Subprojects

Subproject	Output Envisaged	Output Achieved
Hefei WWTP	150,000 m^3/day WWTP	Implemented as envisaged
	96.2 km interceptors & sewers	Implemented as envisaged
	4 pump stations	Implemented as envisaged
Chaohu WWTP	60,000 m^3/day primary WWTP	60,000 m^3/day secondary WWTP
	97.5 km interceptors & sewers	Implemented as envisaged
	5 pump stations	Implemented as envisaged
AVP/CDCC		
• Industrial	2,000 tons/day cement plant	Implemented as envisaged and operating at 100% capacity
• Wastewater, etc.	Various environmental facilities (see tasks (i) to (v) for the AVP subproject in Table 1)	Reportedly implemented as envisaged, not independently verified by OEM
HCW		
• Industrial	50,000 tons/year caustic soda plant	Implemented as envisaged and operating at 100% capacity
• Wastewater	24,000 m^3/day biochemical plant to adjust pH and reduce NH_3-N, P_{tot}, COD, SS	Implemented as envisaged but modified to unconventional process configuration, making performance questionable
HISC		
• Industrial	Two 300,000 tons/year coke ovens	Only one 300,000 tons/year coke oven was installed
• Wastewater	A biochemical plant (unknown capacity) to reduce cyanide and sulfide (see Table 1)	Implemented as envisaged but inadequately maintained, with questionable performance

Subproject	Output Envisaged	Output Achieved
HCFP		
• Industrial	400 tons/day prilled urea plant	Implemented as envisaged and operating at 110% capacity
• Wastewater	(i) 16,800 m^3/day for coal gasification waste, etc.	(i) A building about 100 m long, 30 m wide, and 30 m tall was identified as housing magnetic separator and aeration units and inclined plate settlers
	(ii) 4,800 m^3/day biochemical plant for various waste streams	(ii) Plant design modified (see discussion in para. 26)
	(iii) 432 m^3/day for chloride soda plant waste, etc.	(iii) Equipment identified was in working order

AVP = Anhui Vinylon Plant, CDCC = Chaohu Dongya Cement Company, COD = chemical oxygen demand, HCFP = Hefei Chemical Fertilizer Plant, HCW = Hefei Chemical Works, HISC = Hefei Iron and Steel Corporation, km = kilometer, m = meter, m^3/day = cubic meter per day, NH_3-N = ammonia nitrogen, OEM = Operations Evaluation Mission, P_{tot} = total phosphorus; SS = suspended solids, WWTP = wastewater treatment plant.
Source: Operations Evaluation Mission.

21. The Hefei WWTP subproject was implemented essentially as envisaged and the associated sewer network additions were reportedly implemented also.[15] The only deviation form the design proposed in the feasibility study is that no effluent chlorination was provided.[16] The quality of the equipment, some imported and others fabricated locally, and the choices of materials are good to excellent.

22. For the Chaohu WWTP subproject, the ADB-financed primary treatment facilities and the associated sewer network additions were implemented essentially as envisaged. There is some imported equipment, but most was manufactured locally, and the quality of construction and chosen materials is good. However, the OEM was informed by the Executing Agency and PIA officials that the primary treatment facilities were never independently operated became secondary treatment facilities financed using their own resources were immediately added on to primary treatment facilities. The reason is that that the primary treatment effluent would have not met the applicable discharge standards.[17] It appears that a secondary treatment design essentially identical to Hefei was adopted. Some of those units built under the loan were intended for primary treatment, but all the major equipment for the secondary plant was also purchased under the loan.

23. For the AVP subproject, at the time of appraisal, the APG wanted AVP to form a joint venture, CDCC, with several partners for the proposed cement plant including an existing cement company, Chaohu Cement Company, which had more experience in operating a cement plant (para. 8). CDCC would use the waste materials from AVP. However, due to

[15] The fact that the sewage reaching both plants is of low strength (significantly lower than assumed biological oxygen demand and suspended solids) indicates one or both of the following: the sewers are poorly constructed and admit more than the allowable infiltration, or suitable overflow structures have not been built, which causes the combination of sewage with storm water. The chief engineer from the Hefei Sewage Treatment Administration Office noted that separation to the extent feasible is planned and overflow structures are being built, but that much of the old central district is congested, making the separation of sanitary and storm sewers very difficult and in some cases, practically impossible.

[16] Disinfection of municipal WWTP effluent was not a requirement under the regulation at the time of appraisal. The current standard of 1 x 10^4 coliform bacteria per liter under GB18918-2002 was promulgated in 2002.

[17] A question was raised by the OEM regarding why the noncompliance of primary treatment with the standards was not foreseen at the time of appraisal. The Executing Agency official interviewed indicated that, although they knew the primary treatment would not have been adequate to meet the standards, they adopted a phased approach for the Project's formulation to reduce resistance from Chaohu city, as the prevalent opinion of the city was that wastewater treatment was too expensive for a medium-size city like Chaohu.

business-related considerations, AVP decided to lower its shares in CDCC from 40% to 10% but still agreed to provide the waste materials to the CDCC cement plant. The change of scope was approved by ADB based on the above understanding and the further understanding that AVP would continue to implement other pollution-abatement measures using its own resources. However, after the approval of the change of scope, AVP pulled out of the joint venture completely and built its own cement plant to utilize its waste materials and thereby ceased to supply waste materials to the ADB-financed cement plant. The OEM was not granted access to AVP, as AVP had completely severed its ties with the Project. The Executing Agency officials, however, assured the OEM that AVP had implemented all pollution abatement measures in accordance with AEPB's requirements to clean up Chao Lake. During its field visit to the CDCC, the OEM observed a well-constructed and largely well maintained plant with some major imported equipment. The PIA informed the OEM that the equipment had to be retrofitted in order to use the freshly mined materials rather than wastes from AVP as originally envisaged.

24. At HCW, the 50,000 tons/year ion membrane caustic soda plant was implemented as envisaged, and the equipment was well made of appropriate corrosion-resistant materials. The WWTP appears to be a conventional activated sludge plant. However, activated sludge recycling is not practiced, as is normally done elsewhere, and equipment that may have been pumps intended for this purpose has been removed. This precludes the plant operating as an activated sludge plant as probably intended. Instead, the aeration tanks are fitted with brushes that are reported to be populated by bacteria intended to provide chemical oxygen demand[18] reduction.

25. Under the HISC subproject, only one of the two coke oven batteries was installed together with associated equipment. Equipment for the other battery was reportedly purchased using ADB loan proceeds, but necessary local funds for civil works and installation have not been mobilized. Plant officials informed the OEM that, due to the expected merger of HISC with another steel company, all projects were on hold.[19] The WWTP was implemented as envisaged, but the quality of construction and the choices of materials are poor by international standards. It appears much older than its age, partly because of severe corrosion of a number of the components. Plant operating staff informed the OEM that, during trial operations before official commissioning, they informed the design institute and contractors that some of the materials used would not stand the severe corrosive environment, and more measures, e.g., building a box for some instruments to protect them from corrosion, should have been adopted. However, they felt that their opinions were ignored. The OEM brought up the issue with PIA and Executing Agency officials, who suggested that, at the time of project implementation, strong corrosion-resistant plastic materials were either unavailable or prohibitively expensive in the PRC.

26. At HCFP, the 400 tons/day prilled urea plant was implemented as envisaged and was operating smoothly at the time of the OEM visit. The quality of the equipment and construction is satisfactory, even though some rust was visible, partly due to the highly corrosive operating environment. However, the OEM could not ascertain the implementation of wastewater components of the subproject as envisaged, even though a second site visit was arranged by the PIA during a very rainy day and the plant was said to be under renovation. Plant staff, however, informed the OEM that the components had been constructed and installed as envisaged and were meeting discharge standards; they provided the OEM with some supporting test data (Appendix 2). With respect to the 4,800 m^3/day biochemical plant, the

[18] A measurement of a group of pollutants that will potentially react with dissolved oxygen in water; a lower value is more favorable.

[19] The PCR suggests that the second oven battery and associated equipment would be installed by December 2005. This is unlikely, since the work had not started at the time of the OEM's visit in July 2005.

officials responsible for the plant's operation advised the OEM that the design had been revised to chemical treatment but did not elaborate on the design changes. The officials were unaware of the chemical composition of the patented additive produced by a Hefei-based chemical company.

C. Cost and Scheduling

27. Appendix 1, Table A1.3 provides a detailed breakdown of the costs. The total actual project cost at completion was $234.53 million equivalent (30% below the appraisal estimate), including $61.26 million for Loan 1490 (12% underrun) and $ 173.27 million for Loan 1491 (35% underrun). The total cost comprised $135.23 million in foreign exchange cost (10% underrun) and $99.30 million equivalent in local currency cost (46% underrun). The local currency and the overall cost figures are slightly higher than those presented in the PCRs, as some revisions were made based on new information presented to the OEM (details of the revisions are presented in Appendix 3 on financial reevaluation). The reasons for the relatively large cost underrun, i.e., 30% in terms of total cost and 46% in terms of local currency cost, were several, including the Government's waiving of import duties for ADB (and World Bank) projects; competition, which drove the prices (particularly local prices) down; and possible overbudgeting. ADB loan utilization amounted to $135.23 million to cover the foreign exchange cost; the remaining $4.77 million was cancelled.

28. The PCRs present the implementation schedule as appraised and as implemented for Loans 1490 and 1491 comprising all six subprojects. They are not duplicated here, as there were no revisions. Loan 1490 was implemented relatively smoothly, with about a 9-month delay in closing date, despite an initial delay of 10.5 months in loan effectiveness, due mostly to issues related to local financing. It experienced some initial delays due to the Government's complex procurement approval procedures, but implementation accelerated once the initial hurdles were overcome. Both HSTC and CWTEC completed their project activities before 30 June 2002, the original loan closing date, with the Chaohu WWTP commissioned in August 2001 and the Hefei WWTP commissioned in December 2001.

29. Like Loan 1490, Loan 1491 experienced an initial delay of 10.5 months in loan effectiveness. Project implementation was further delayed by the Government's lengthy procurement approval procedures and the 1997 Asian financial crisis, which resulted in the Government tightening credit. This made it more difficult for individual PIAs to obtain local funding. Despite these difficulties, the AVP-CDCC and the HCFP subprojects were commissioned with approximately a 1 year delay, while the HCW and HISC subprojects were commissioned more than 2 years after the scheduled time. Most of the disbursements were made before the revised loan closing date of 31 December 2002, an 18-month delay compared with the original closing date, but the loan was not closed until 18 February 2004, due mostly to delayed liquidation of the imprest account.

D. Procurement and Construction

30. The Executing Agency and the PIA officials indicated that procurement was conducted in accordance with ADB's *Guidelines for Procurement*, mostly using international competitive bidding (ICB) and international shopping (IS) procedures. However, the OEM noted at least on one occasion under the HCFP subproject, the 60-day mandatory advertisement period was reduced to 30 days, which could have disadvantaged foreign bidders.

31. Like other projects in the PRC, contracts were split into many parts, reducing the overall amount for each contract. This may potentially have two effects: (i) reducing the total cost of the projects for PIAs, as the PIAs have more control over project implementation; and (ii) the reduced contract amounts could have made the contracts less appealing to foreign bidders. A potential anomaly is inherent in the contract prices for the ICB and IS procurement for the cement plant. Of the 28 items listed, only 15 disbursed amounts match the contract amounts. Eight are exactly 10% lower, one is exactly 40% lower, another exactly 85% lower, and another three are between 10.7 and 11.5% lower. The total disbursement amount is 12.7% lower than the contract amount.[20] By comparison, all items for the other three industrial subprojects match.

32. PMO and PIA officials are generally satisfied with the performance of the contractors and consultants, and no references to contractual differences were made during any of the meetings. Bid evaluations were reviewed by ADB prior to procurement contracts being finalized, and it appears that bids were evaluated adequately by local engineers. However, the OEM is of the view that the specification/bid evaluation process may not have achieved the very best design and equipment choices on a life cycle basis. Specifically, in some cases, e.g., HISC WWTP (para. 25), the overall cost could have been lower if better but more expensive materials (in terms of initial investment) had been chosen, due to savings in long-term O&M.

E. Organization and Management

33. As envisaged at appraisal, APG, the Executing Agency, through its PMO, provided strong leadership and coordination in implementing this complex project. PMO staff members were mostly from AEPB, and the PMO was headed by a director of AEPB. This helped the environmental focus of the Project, as AEPB has the necessary mandate to enforce compliance with environmental regulations by all enterprises. The steering committee was headed by a vice-governor of Anhui Province and comprised senior officials from APG, the provincial and local finance bureaus, senior officials of Hefei and Chaohu cities, and APEB. Available documents indicate that the steering committee provided strong leadership throughout the project implantation period.

34. Construction supervision was provided by local companies, the PMO, and staff of the PIAs, without the assistance of international consultants.[21] While the quality of the construction is generally satisfactory, some subprojects could have benefited from more international expertise in both design and construction supervision. Overall, the model of having a PMO in the Government and separate PIAs to implement individual subprojects appears to have worked well, given the strong commitment and ownership at all levels.

III. ACHIEVEMENT OF PROJECT PURPOSE

A. Operational Performance

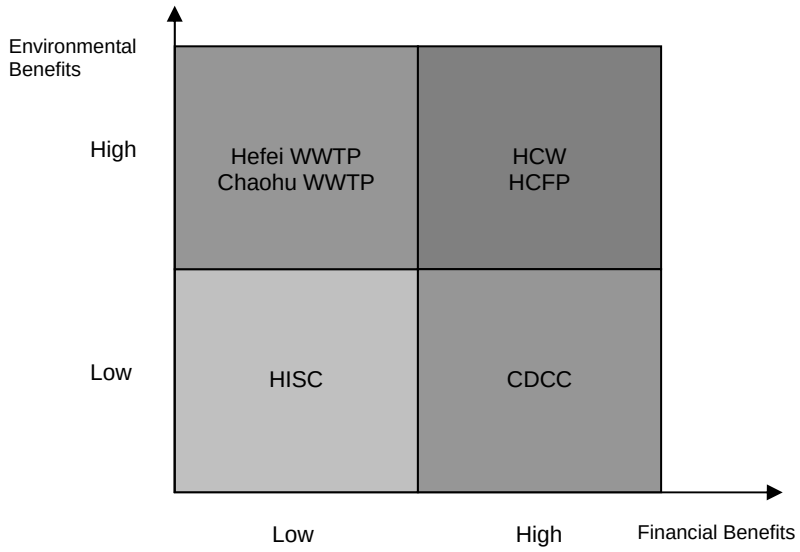
35. The four industrial pollution abatement subprojects have incurred financial and economic benefits to the subproject enterprises and society, through improvement in capacity and the quality of their products, and environmental benefits through reduced pollution discharge and

[20] The PIA officials could not explain, to the satisfaction of the OEM, the exact reasons for the discrepancies. Although this does not necessarily indicate corruption, it is possible that the PIA may have negotiated with the suppliers after the supplying contracts were signed for a fixed percent discount for some items, or lowered the amount of procurement with the agreement of the suppliers. No complaint was received from either side.

[21] The decision of not using international consultants for project supervision and construction appears to be partly for cost saving reasons. For example, for Loan 1490, $6.5 million was allocated for consulting services and training but only $0.3 million equivalent in local currency was utilized (for hiring local consultants).

lower consumption of resources. The two WWTPs have primarily improved the environment. The achievement of the six subprojects in achieving their respective environmental objectives and financial-economic benefits is discussed in greater detail in Section A of Appendix 2. Figure 1 summarizes the analysis by providing a schematic illustration of such achievement. The HCW and HCFP subprojects achieved high environmental benefits (i.e., reduction of wastewater discharge through treatment and increased water recycling, reduction of energy consumption and resultant air emissions) and high financial benefits (i.e., preservation of employment and increased income). The two wastewater treatment subprojects achieved high environmental benefits (i.e., improved water quality) but relatively low direct financial benefits for APG, while the CDCC subproject achieved high financial benefits (i.e., increased supply of high quality cement) but low environmental benefits (i.e., low air emissions and limited use of waste materials such as coal ash). The HISC achieved modest to low environmental benefits (i.e., reduction of wastewater discharge but limited reduction of air emissions) and financial benefits (i.e., half of the coke supplying capacity realized).[22]

Figure 1: Environmental Benefits versus Financial Benefits of the Subprojects



CDCC = Chaohu Dongya Cement Company, HCFP = Hefei Chemical Fertilizer Plant , HCW = Hefei Chemical Works, HISC = Hefei Iron and Steel Corporation, WWTP = wastewater treatment plant.
Source: Operations Evaluation Mission.

B. Performance of the Operating Entities

36. Appendix 4 provides the financial statements for the six PIAs, and Table 3 provides a summary thereof. For the four industrial PIAs, two of them, CDCC and HCFP, had positive net income after tax in 2004, viz., Y18.5 million and Y1.0 million, respectively, while HISC and HCW incurred losses with negative net income after tax, i.e., -Y89.9 million and -Y14.1 million, respectively. To a varied degree, the subprojects have probably helped enhance the PIAs' operational and financial performance, compared with the without-project scenario, even though some of them are still running a loss and their financial performance has been deteriorating. The positive impact of the subprojects appears to be inversely related to the size and diversity (in terms of types of products) of the subproject enterprises. CDCC, comprised entirely of the

[22] The qualitative assessment of "high" or "low" achievement is relative to the potential of each subproject and not relative to each other. In other words, the assessment is not meant to be used for cross-subproject comparisons.

subproject-financed facilities, was the most profitable of the four industrial enterprises. In contrast, HISC runs the biggest loss; like many other poorly managed state-owned enterprises (SOEs) in the PRC, it had more than 10,000 employees, and the subproject-financed coking plant is but a small part of its total assets. HCW, with 3,000 employees, is another example. The subproject-financed facilities, which employ about 100 staff to operate, produce about Y170 million or nearly one third of HCW's total turnover of $567 million in 2004. The loss was due largely to low competitiveness and inefficiencies elsewhere at HCW. In the case of HCFP, the commissioning of the new fertilizer production lines in 2001 has steadily increased its total annual turnover. However, in July 2003, a new holding company was formed, in which HCFP is a major shareholder, to take over the new fertilizer production facilities financed under the subproject. The financial figures for 2004 were only for the new holding company. According to the PIA officials interviewed, the turnover of the HCFP Group for 2004 was approximately Y730 million, and Y192 million was generated by the newly formed holding company using the ADB-financed production line.

Table 3: Summary of Financial Performance of Subproject Enterprises for 2004

Enterprise	Sales (Y million)	Net Income After Tax (Y million)	Debt Service Coverage Ratio (times)	Debt/Debt Plus Equity (%)
CDCC	148.35	18.51	(0.18)	17.2
HCW	567.16	(14.11)	0.67	42.8
HISC	2,399.87	(89.94)	(0.07)	18.7
HCFP	192.33	1.03	0.06	7.5
HSTC[a]	18.62	3.04	7.02	60.4
CWTEC	14.56	2.98	2.78	70.6

CDCC = Chaohu Dongya Cement Company, CWTEC = Chaohu Wastewater Treatment Engineering Company, HCFP = Hefei Chemical Fertilizer Plant, HCW = Hefei Chemical Works, HISC = Hefei Iron and Steel Corporation, HSTC = Hefei Sewerage Treatment Company.

[a] For the period between January to June of 2003.

Source: Project Implementation Agencies.

37. The Project had two financial covenants for the six PIAs: (i) a debt service coverage ratio of not less than 1.3:1, and (ii) a debt-equity ratio of not higher than 70:30. The second covenant was complied with by most industrial PIAs during recent years. However, despite the positive net income after tax for some of them, none of the four industrial PIAs complied with the first covenant on debt service ratio, meaning they are not in a position to service their debt, including ADB debt, due to poor cost control or/and high borrowings. This was confirmed by the provincial finance bureau official interviewed, who indicated that none of the four industrial enterprises is currently capable of repaying its debts, and that the APG is covering the debt payment from its budget.

38. The two WWTPs appear to be in a better financial position than the four industrial enterprises. HSTC had a positive net income after tax as of June 2003 and complied with both ADB's financial covenants on debt service coverage ratio and debt-equity ratio. In December 2003, Wang Xiao Ying WWTP was transferred to a German company via a 23-year transfer-operate-transfer (TOT) concession agreement. With the proceeds from the transfer, the APG prepaid the ADB loan and used the balance to further expand other wastewater treatment facilities. CWTEC's financial performance is also satisfactory, with a positive net income after tax in 2004, and a debt service coverage ratio of 2.8 (higher than the required 1.3) and about 70:30 debt-equity ratio, complying with both financial covenants.

C. Financial and Economic Reevaluation

39. Appendixes 3 and 5 provide the details of the recalculation of the financial internal rates of return (FIRRs) and the economic internal rates of return (EIRRs) for the subprojects and for the Project as a whole. All financial costs and benefits are denominated in the local currency at 2004 constant prices, while the economic costs and benefits are valued at economic prices at the border using the world price numeraire. As summarized in Table 4, with some exceptions, the recalculated FIRRs and EIRRs are broadly in line with the RRP and PCR estimates for most subprojects. The recalculated FIRRs for the subprojects range from 5.5% to 13%, all higher than the respective weighted average cost of capital, and the recalculated overall FIRR for the Project is 8.4%. The recalculated EIRRs for the subprojects range from 12% to 20%, and the recalculated overall EIRR for the Project is 16.4%. It should be noted that, although the four industrial subprojects all had environmental benefits of reducing wastewater discharges or air emissions, these were not quantified and included in the EIRR recalculation due to inadequacy in the methodologies and data related to the economic valuation of pollution reduction. Had they been included, the resulting EIRRs would be higher. In comparison, both the RRP and the PCRs include such environmental benefits in their EIRR recalculation. For the two WWTP subprojects, the willingness to pay for wastewater treatment services in Hefei and Chaohu was assumed to be Y1 per ton of wastewater, consistent with the RRP and PCR figures. In view of the fact that current actual tariffs for the two cities are Y0.68 per ton and Y0.80 per ton, respectively, the estimate of Y1/ton is likely to be a conservative (lower) estimate. Overall, the EIRR estimates for the subprojects and the Project as a whole may be considered as lower-bound estimates.

Table 4: Summary of Financial and Economic Reevaluation (%)

	RRP		PCR		PPER	
Subproject	**FIRR**	**EIRR**	**FIRR**	**EIRR**	**FIRR**	**EIRR**
Hefei WWTP	9.4	15.6	9.9	17.4	5.5	12.8
Chaohu WWTP	7.8	14.8	8.5	14.8	7.9	14.5
Loan 1490	n.e.	n.e.	n.e.	n.e.	6.2	13.2
CDCC	14.8	14.3	11.3	18.1	7.3	16.7
HCW	12.3	21.2	12.4	16.3	13.0	19.9
HISC	13.4	23.2	7.9	13.2	10.1	18.8
HCFP	10.3	13.6	8.3	19.5	7.3	14.5
Loan 1491	n.e.	n.e.	9.3	16.2	9.5	17.8
Project Overall	n.e.	n.e.	n.e.	n.e.	8.4	16.4

CDCC = Chaohu Dongya Cement Company, EIRR = economic internal rate of return, FIRR = financial internal rate of return, HCFP = Hefei Chemical Fertilizer Plant, HCW = Hefei Chemical Works, HISC = Hefei Iron and Steel Corporation, n.e. = not estimated, PCR = project completion report, PPER= project performance evaluation report, WWTP = wastewater treatment plant.
Source: Operations Evaluation Mission.

D. Sustainability

40. Proper and efficient maintenance is essential for the subprojects' operation and long-term sustainability. Of all the subprojects visited by the OEM, while most demonstrated adequate capability for O&M, Hefei WWTP appears to be the best maintained and operated. The transfer to a German operator under a 23-year TOT agreement is likely to strengthen the sustainability of the subproject. The Chaohu WWTP and the CDCC plant are also adequately maintained by dedicated staff. In the cases of HCW and HCFP, although the equipment is properly operated and the maintenance is carried out in accordance with industry regulations, the highly corrosive operating environment has caused visible corrosion in the equipment that

may shorten its operational life. The WWTP of the HISC appears to be the least sustainable from O&M's point of view. The highly corrosive environment is a key factor, but the poor design and particularly the choice of improper materials also contribute to the faster-than-usual deterioration of the equipment.

41. The financial performance of the operating entities or PIAs will also affect the subprojects' sustainability. In this regard, the two WWTPs are in good financial position. Of the four industrial PIAs, with the exception of CDCC, the less-than-satisfactory or poor financial performance for the other three will adversely affect the sustainability of the subprojects. This is despite the fact that there is likely a continuing strong demand for their products and Project-financed facilities form the primary profit-generating source for their respective PIAs. In particular, for the HISC subproject, while the coking plant produces a high quality product that is highly demanded by the domestic and world markets, HISC's uncertain future, whether as an independent or a part of another iron and steel company, casts some doubt on the plant's long-term sustainability. Furthermore, the sustainability of the WWTP at HISC may be questionable, since it may reach a point that further O&M would become prohibitively expensive, and either a complete overhaul or rebuilding would be necessary.

IV. ACHIEVEMENT OF OTHER DEVELOPMENT IMPACTS

A. Socioeconomic Impact

42. The positive socioeconomic impact of the Project comes mainly from two sources: (i) preservation of the employment of the PIAs, and (ii) improved quality of life and health for Anhui residents due to the improved environmental quality. On the first category of impact, several PIAs informed the OEM that without the Project the SOEs would have probably gone bankrupt and many thousands of workers would have lost their jobs. Concerning the second impact, a negative externality from this positive impact stems from the fact that none of the four industrial subproject enterprises is currently capable of servicing its ADB debt, and the APG has to cover the debt payment from its regular budget. This takes away limited resources that could have been spent on other more needed areas such as education and health.[23] Another potentially negative social impact may have been caused by the HISC subproject, which supported a modern coking plant. As a result, HISC no longer needs to source coke from many small, inefficient, and polluting plants located mostly in Shanxi Province. This may have resulted in job loss for those who were employed by these small coking plants.[24] No documented information is available on the health impact.

B. Environmental Impact

43. The primary objective of the Project was to improve the quality of the Chao Lake through industrial pollution abatement and establishing central WWTPs. Section B of Appendix 2 examines the water quality monitoring data for the Chao Lake provided by AEPB. The analysis indicates that the Project has probably helped achieve modest improvement in the water quality, particularly in the western section near Hefei, through reducing industrial wastewater discharge and increasing municipal wastewater treatment. Nonetheless, much more remains to be

[23] A theoretical argument could be made that had ADB not supported the Project, some of these SOEs could have been bankrupt. Although this would result in short-term pain for the people who lose their jobs, the society may gain long-term benefits through more optimal allocation of limited resources.

[24] Detailed information is not available. It is possible that some of these small and polluting plants are still in operation due to the strong demand for coke.

achieved in industrial pollution reduction, particularly in arresting the agricultural runoff associated with fertilizer application.

C. Impact on Institutions and Policy

44. The Executing Agency officials highly complimented ADB's strong endeavor to provide a series of four TAs related to the Project, which together have provided much appreciated exposure to international best practices in environmental management and wastewater treatment. On the effectiveness of the two project-preparatory TAs, most project implementation enterprises informed the OEM that the TAs were useful in providing a comprehensive and systematic assessment of project environmental and economic benefits. However, judging by the results on the ground, the TAs appeared to have had little impact on project design which was carried out by domestic design institutes. One of the reasons is that the timing of the project preparatory TAs may have been too late to have a significant impact. The TAs mostly aimed to ensure that the subprojects as designed fulfilled ADB's requirements with respect to technical and economic evaluations and various compliance issues (para. 56).

45. Under TA 2751, a series of training courses was conducted for operators of municipal and industrial wastewater treatment facilities throughout Anhui Province in environmental monitoring, operation, maintenance, and management of such facilities. Officials at CWTEC indicated that they benefited greatly from the training provided under the TA. Approximately 60 people from Chaohu were trained, and the majority of them are still at the plant. The Hefei Sewage Treatment Administrative Office confirmed that a permanent training center has been established at the Wang Xiao Ying Sewage Treatment Plant, and the training manuals prepared under the TA have been revised and used, together with the training equipment, for continuous training of the operators of wastewater treatment facilities in Anhui.[25] Overall, the TA was and is clearly relevant to the APG's key objective of improving the environmental quality of the Chao Lake, and was effective in training the personnel; and the results have been sustained through establishing the permanent training center. The TA is rated successful.

46. Under TA 2693, a long-term IEMP was formulated for enhancing water and air quality and solid waste management in the Chao Lake Basin. Officials at the Anhui PMO indicated that the TA outputs were highly relevant, timely, and instrumental in the formulation of Chaohu Environmental Improvement Plan, approved by the State Council, and Anhui's 10th Five Year Plan. Timeliness was a key reason emphasized by the officials for its high relevance and usefulness. A series of investment projects aimed at improving environmental quality in the Chao Lake Basin, covering measures for combating lake eutrophication, water conservation, industrial wastewater treatment, water quality monitoring, air pollution abatement, and solid waste and hazardous waste management, were recommended. According to the officials, more than 80% of these recommended projects either have been or are in the process of being constructed. The Executing Agency pointed out that, partly as a result of a recommendation made by the TA's final report, the Anhui Provincial People's Congress passed a provincial regulation that bans the production and use of phosphorus-based detergent. The TA was and continues to be relevant. It has provided a comprehensive framework for improving the environmental quality of the Chao Lake and Anhui Province, and concrete measures have been taken to implement the plan. It is therefore effective, and the results from the TA are likely to be sustainable. Overall, the TA is rated successful.

[25] The Technical Completion Report for the TA recommended ADB's further assistance in establishing such a training center, which did not materialize. APG has taken its own initiative in establishing the center using outputs from the TA.

V. OVERALL ASSESSMENT

A. Relevance

47. The Project as a whole was relevant at the time of appraisal in that it aimed to address severe pollution in the Chao Lake, targeted as a top priority for environmental cleanup by both the APG and the State Council. It was also consistent with ADB's operational strategy in the PRC, in which environmental improvement has been one of the main pillars. Despite the modest improvement in environmental quality in the Chao Lake and in Anhui Province, the relevance has not abated, as much remains to be done to further improve the environment. The Government continues to place high priority on and to commit increasing amounts of resources for this purpose. However, some subprojects, e.g., AVP, turned out to be less relevant for achieving the environmental goals due to changing circumstances during project implementation. Overall, the Project is assessed as relevant.

B. Efficacy

48. The Project has a primary objective of environmental improvement and an underlying objective of financial improvement for the concerned PIAs as a necessary condition for the sustainable achievement of the environmental improvement. Figure 1 summarizes the extent to which the six subprojects have achieved the environmental objectives and financial benefits. The Project as a whole has achieved a modest improvement in the water quality of the Chao Lake, but much more remains to be accomplished. Hefei WWTP is assessed as highly efficacious; Chaohu WWTP, HCW, and HCFP as efficacious; and CDCC and HISC as less efficacious. Overall, the Project is assessed as efficacious.

C. Efficiency

49. The Project was generally implemented smoothly, with moderate delays in some subprojects. The overall recalculated EIRR is 16.4%, with EIRRs for individual subprojects ranging from 12% to 18%. The overall recalculated FIRR for the Project is 8.4%, with FIRRs for individual subprojects ranging from 5.5% to 13.0%, all higher than their respective cost of capital. Overall, all subprojects and the Project as a whole are assessed as efficient.

D. Sustainability

50. The two WWTPs and the CDCC plant are well maintained. For HCW and HCFP, maintenance is carried out in accordance with industry regulations and standards, but the highly corrosive environment may require better maintenance in order to achieve the expected operational life of the equipment. The WWTP of the HISC appears to be least sustainable, from O&M's point of view, of the six subprojects due to the highly corrosive environment and the choice of improper materials for the equipment. Hefei WWTP is assessed as most likely sustainable; Chaohu WWTP and CDCC as likely; and HCW, HCFP, and HISC as less likely. Overall, the Project is less likely to be sustainable.

E. Institutional Development and Other Impacts

51. The Project, including its four related TAs, appears to have had a significant positive impact on the institutional development of the APG and the PIAs. Such impact was particularly evident in the case of the two advisory TAs, which have helped train a large number of professionals in the field of wastewater treatment O&M, as well as developing and implementing

a long-term master plan for environmental improvement for the Chao Lake. The Project as a whole has played a pioneering role in raising the levels of environmental regulations and management in Anhui Province, bringing it to the forefront of integrated environmental management in the PRC. Other social and development impacts include the potential positive health impact of water quality improvement, and the impacts on preserving employment for several key SOEs in Anhui. One of the underlying rationales for ADB's support for this Project is its potential effects as a technology demonstrator for other enterprises. According to Executing Agency officials, there was at least one case in southern Anhui wherein an SOE adopted similar technology to HCW in producing caustic soda. AVP, which was originally included as part of the Project, decided to adopt a similar technology as CDCC but used it own financing. In terms of aggregate institutional and other impacts, the Project as a whole is assessed as moderate.

F. Overall Rating

52. Because of the diverse and relatively independent nature of the six subprojects, ratings are given to individual subprojects as well as to the overall Project (Table 5).

Table 5: Subproject and Overall Project Ratings

Subproject/Project	Rating
Hefei WWTP	Highly Successful
Chaohu WWTP	Successful
AVP/CDCC	Partly Successful
HCW	Successful
HISC	Partly Successful
HCFP	Successful
Project Overall	Successful

AVP = Anhui Vinylon Plant, CDCC = Chaohu Dongya Cement Company, HCFP = Hefei Chemical Fertilizer Plant, HCW = Hefei Chemical Works, HISC = Hefei Iron and Steel Corporation, WWTP = wastewater treatment plant.
Source: Operations Evaluation Mission.

G. Assessment of Asian Development Bank and Executing Agency Performance

53. A total of 11 missions were fielded by ADB related to project preparation, implementation, and completion. The Executing Agency and the PIAs are highly appreciative of successive ADB officers' assistance at all stages crediting their dedication as a key factor in the relatively smooth implementation of the Project despite difficulties encountered. During implementation, ADB was generally responsive in explaining its guidelines on procurement and in approving changes in scope. Overall, ADB's performance is assessed as satisfactory. The performance of the Executing Agency and the PIAs was highly satisfactory. As in many other PRC projects, the Executing Agency and the PIAs showed strong ownership of the Project. The APG, through the Steering Committee and the PMO, showed strong leadership in coordinating the execution of the Project.

VI. ISSUES, LESSONS, AND FOLLOW-UP ACTIONS

A. Key Issue for the Future – Continued Support for SOEs?

54. This issue remains relevant to ADB's present operations, particularly in the PRC. All six PIAs were either public utilities or industrial SOEs at the time of appraisal, though some of them, e.g., HSTC, and HCFP, have since been privatized or partly privatized. An objection was raised

by a Board member to Loan 1491 for industrial pollution abatement on the grounds that the loan was for more than pollution abatement and that modernization and expansion of productive enterprises should be self-financed or financed with commercial capital. The experience of this particular Project, i.e., all six subprojects have to a varied degree achieved financial and environmental benefits and attained satisfactory FIRRs and EIRRs, suggests that ADB financing may still have a role in the PRC's drive for SOE technological upgrade, environmental cleanup, and restructuring. However, the financial and market risks are also high, as demonstrated by the reality that the four industrial subprojects appeared to be less successful than the two municipal wastewater treatment subprojects; and most of the four industrial SOEs are not repaying their ADB debt, and APG was forced to use its budget for debt repayment. This has caused burden on APG's limited financial resources and took away resources that could have been spent on essential social services. Another reality that is different from a decade ago, when the Project was appraised, is that there currently exists a large amount of liquidity in PRC domestic banks and a large foreign currency reserve. Domestic banks' faster processing time and less complicated disbursement procedures, as opposed to ADB's reimbursement-based disbursement, make domestic funding more appealing for sound industrial projects. However, ADB's assistance continues to enjoy certain advantages over domestic financing, such as longer grace and repayment periods, lower interest, and exposure to best international practices and technologies. These added values are appreciated by the Executing Agency and the PIAs. ADB should adopt a more client-oriented and demand-driven approach, perhaps through its Private Sector Operations Department (which has more experience in financial due diligence for industrial enterprises) but supported by its public sector operations departments, to complement rather than compete with domestic financing. The question that should be asked is whether there is a demand for ADB support, and if so, how ADB's various departments can work together to meet such a demand.

B. Lessons Identified

1. Program Level: Financial Benefits or Environmental Benefits?

55. At the program (strategic) level, ADB should recognize that achieving the synergy between environmental benefits and financial benefits is the best possible scenario, as the latter is the basis for sustainable achievement of the former. The PIAs should not be forced to choose between environmental benefits or financial benefits. Improvement of technologies or processes is often more economical than adopting end-of-pipe treatment in pollution abatement. ADB's policy of not supporting industrial efficiency improvement projects at the time of appraisal imposed a great deal of pressure on the appraisal team to justify the Project on its environmental merits (para. 17). Most of the costs of the four industrial subprojects were allocated for procuring industrial improvement equipment. In some cases, e.g., HCW and HCFP, this has resulted in dramatic environmental improvement as well as significant financial returns. In the case of CDCC, the environmental benefits have been less significant. Although better quantification and benchmarking of environmental benefits relative to financial and economic benefits are warranted in the future for similar projects, it needs to be recognized that deficiencies in the methodologies and data would impose practical limits on the accuracy of the breakdown of such benefits. A more client-oriented approach would place less emphasis on the relative breakdown of financial versus environmental benefits and focus more on meeting the clients' overall demand.

2. Project Preparation and Design

56. Like most other PRC projects, the Project was designed by domestic design institutes. ADB provided two project preparatory TAs based on detailed designs provided by design institutes. While the project preparatory TAs produced very detailed and good quality reports, e.g., 819 pages for one of them, they seemed to have had little impact on the final design of the Project. One reason is that the TA implementation was well after the design was completed by the local design institutes and the TAs served mostly as a validation of the design. In the case of the WWTP at HISC, had the design specified or adopted more corrosion-resistant, albeit more expensive, materials, it could have helped prolong the operating lives of these facilities and reduce O&M costs. However, this issue was not explicitly discussed in the TA consultant's report. The OEM noted that several other subprojects were constructed differently from the way described in the TA reports, indicating that the recommendations were not followed due to economic and other reasons. Despite the overall successful rating for the Project, specific subprojects could have benefit from sound suggestions made by the international consultants. ADB needs to reassess its project preparatory TA program in the PRC and, in the case of continuing such TAs, should take measures to improve their relevance and usefulness. The experience of this Project also suggests that, despite the PRC's growing capacities, it may still benefit from international assistance and technology transfer, particularly in the areas of project supervision and quality control.

C. Follow-Up Actions and Recommendations

1. Government and Project Implementation Agencies

57. Most loan covenants were complied with except the financial covenants and one regarding submission to ADB of annual project benefit monitoring and evaluation reports for the first 5 years after commissioning.[26] As the PPER has been conducted, such benefit monitoring reports would not serve much additional value and should no longer be requested. On the financial covenants, while improving the financial performance of the PIAs remains an important goal for the Government through SOE restructuring and reforms, this is likely to be a long-term task, e.g., one that will take a decade.

58. HISC should complete the installation of the second coking battery as soon as possible, as most of the equipment has been procured and there is a strong market demand for high-quality coke. HISC, HCW, and HCFP should, as soon as possible, take more preventive maintenance measures to control extensive corrosion and thus prolong the operational life of the equipment.

2. Asian Development Bank

59. ADB currently has only one similar project in the pipeline to support SOEs in industrial pollution abatement and technological upgrading. ADB should continue its dialogue with the Government on SOE restructuring.

[26] Hefei WWTP was an exception. The OEM noted two such reports that contained some useful operational and impact data.

PROJECT COST
Table A1.1: Cost Breakdown by Project Component
Loan 1490: Anhui Environmental Imrpovement Project for Municipal Wastewater Treatment
($ million)

Component	Appraisal Estimate			Actual		
	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost
Subproject 1: Chaohu Wastewater Treatment Plant						
Preliminary Expenses			-			-
Land Acquisition	-	0.70	0.70	-	2.10	2.10
Site Preparation			-			-
Engineering and Design			-			-
Equipment and Material (Major Process)	1.90	0.50	2.40	1.60	0.50	2.10
Auxiliary Equipment			-			-
Import Duties	-	0.80	0.80			-
Domestic Transport			-			-
Construction and Erection	3.00	6.10	9.10	4.50	6.70	11.20
Consulting Service and Training	0.40	1.60	2.00	-	0.10	0.10
Others			-	-	0.80	0.80
Base Cost	**5.30**	**9.70**	**15.00**	**6.10**	**10.20**	**16.30**
Contingencies						
Physical Contingency	0.40	0.70	1.10	-	-	-
Price Contingency	0.60	0.80	1.40	-	-	-
Subtotal	1.00	1.50	2.50	-	-	-
Interest During Construction	0.90	0.60	1.50	0.60	0.40	1.00
Total	**7.20**	**11.80**	**19.00**	**6.70**	**10.60**	**17.30**

- = not available.

Component	Appraisal Estimate			Actual		
	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost
Subporject 2: Hefei Wastewater Treatment Plant						
Preliminary Expenses			-			-
Land Acquisition		1.20	1.20	-	4.30	4.30
Site Preparation			-			-
Engineering and Design			-			-
Equipment and Material (Major Process)	7.50	1.50	9.00	7.20	-	7.20
Auxiliary Equipment			-			-
Import Duties	-	1.80	1.80	-	-	-
Domestic Transport			-			-
Construction and Erection	7.30	16.20	23.50	10.50	15.60	26.10
Consulting Service and Training	0.50	4.00	4.50	-	0.20	0.20
Others			-	-	2.60	2.60
	15.30	**24.70**	**40.00**	**17.70**	**22.70**	**40.40**
Contingencies						
Physical Contingency	1.20	1.80	3.00	-	-	-
Price Contingency	1.50	2.10	3.60			-
	2.70	3.90	6.60	-	-	-
Interest During Construction	2.80	1.60	4.40	2.10	1.50	3.60
Total	**20.80**	**30.20**	**51.00**	**19.80**	**24.20**	**44.00**

- = not available.

Table A1.2: Cost Breakdown by Project Component
Loan 1491: Anhui Environmental Imrpovement Project for Industrial Pollution Abatement
($ million)

Component	Appraisal Estimate			Actual		
	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost
Subproject 1: Anhui Vinylon/Chaohu Dongya Cement Company						
Preliminary Expenses	0.00	0.00	0.00	0.00	0.00	0.00
Land Acquisition	0.00	1.80	1.80	0.00	2.33	2.33
Site Preparation	0.00	0.60	0.60	0.00	0.31	0.31
Engineering and Design	0.00	2.40	2.40	0.00	1.29	1.29
Equipment and Material (Major Process)	28.00	1.70	29.70	27.13	0.00	27.13
Auxiliary Equipment	1.60	0.40	2.00	0.00	0.00	0.00
Import Duties	0.00	12.40	12.40	0.00	0.00	0.00
Domestic Transport	0.00	0.70	0.70	0.00	0.00	0.00
Construction and Erection	5.30	26.00	31.30	0.00	8.30	8.30
Consulting Service	0.50	0.00	0.50	0.00	0.00	0.00
Training	0.00	0.30	0.30	0.00	0.11	0.11
Commissioning and Startup	0.00	0.50	0.50	0.00	0.00	0.00
Energy and Environmental Management	0.00	0.10	0.10	0.00	0.00	0.00
Project Management	0.00	0.30	0.30	0.00	0.63	0.63
Base Cost	35.40	47.20	82.60	27.13	12.97	40.10
Physical Contingency	3.00	4.20	7.20	0.00	0.00	0.00
Subtotal	**38.40**	**51.40**	**89.80**	**27.13**	**12.97**	**40.10**
Price Contingency	2.50	3.40	5.90	0.00	0.00	0.00
Interest During Construction	3.90	5.40	9.30	2.74	2.20	4.94
Total	**44.80**	**60.20**	**105.00**	**29.87**	**15.17**	**45.04**
Subproject 2: Hefei Sifang Chemical Industrial Group Co., Ltd.						
Preliminary Expenses	0.00	0.00	0.00	0.00	0.00	0.00
Land Acquisition	0.00	0.30	0.30	0.00	0.63	0.63
Site Preparation	0.00	0.40	0.40	0.00	0.41	0.41
Engineering and Design	0.70	0.60	1.30	0.00	0.24	0.24
Equipment and Material (Major Process)	9.90	0.20	10.10	16.87	0.24	17.11
Auxiliary Equipment	0.00	2.50	2.50	0.00	0.00	0.00
Import Duties	0.00	4.20	4.20	0.00	0.00	0.00
Domestic Transport	0.00	0.50	0.50	0.00	0.00	0.00
Construction and Erection	0.60	2.40	3.00	0.00	6.35	6.35
Consulting Service	0.10	0.00	0.10	0.00	0.00	0.00
Training	0.00	0.10	0.10	0.00	0.12	0.12
Commissioning and Startup	0.00	0.10	0.10	0.00	0.11	0.11
Energy and Environmental Management	0.00	0.20	0.20	0.00	0.46	0.46
Project Management	0.00	0.50	0.50	0.00	0.19	0.19
Base Cost	11.30	12.00	23.30	16.87	8.75	25.62
Physical Contingency	1.10	1.10	2.20	0.00	0.00	0.00
Subtotal	**12.40**	**13.10**	**25.50**	**16.87**	**8.75**	**25.62**
Price Contingency	0.80	0.80	1.60	0.00	0.00	0.00
Interest During Construction	1.40	1.50	2.90	0.00	2.26	2.26
Total	**14.60**	**15.40**	**30.00**	**16.87**	**11.01**	**27.88**

Component	Appraisal Estimate			Actual		
	Foreign Exchange	Local Currency	Total Cost	Foreign Exchange	Local Currency	Total Cost
Subproject 3: Anhui Chlor-Alkali Chemical Group Co., Ltd.						
Preliminary Expenses	0.00	0.00	0.00	0.00	0.00	0.00
Land Acquisition	0.00	0.50	0.50	0.00	0.76	0.76
Site Preparation	0.00	0.10	0.10	0.00	0.05	0.05
Engineering and Design	0.30	0.20	0.50	0.00	0.31	0.31
Equipment and Material (Major Process)	9.90	1.20	11.10	12.48	0.70	13.18
Auxiliary Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Import Duties	0.00	3.70	3.70	0.00	0.00	0.00
Domestic Transport	0.00	0.20	0.20	0.00	0.21	0.21
Construction and Erection	0.70	2.80	3.50	0.00	4.10	4.10
Consulting Service	0.20	0.00	0.20	0.00	0.00	0.00
Training	0.20	0.10	0.30	0.00	0.05	0.05
Commissioning and Startup	0.10	0.10	0.20	0.00	0.98	0.98
Energy and Environmental Management	0.00	0.10	0.10	0.00	0.21	0.21
Project Management	0.00	0.20	0.20	0.00	0.17	0.17
Base Cost	11.40	9.20	20.60	12.48	7.54	20.02
Physical Contingency	1.10	0.90	2.00	0.00	0.00	0.00
Subtotal	**12.50**	**10.10**	**22.60**	**12.48**	**7.54**	**20.02**
Price Contingency	0.80	0.70	1.50	0.00	0.00	0.00
Interest During Construction	1.40	0.40	1.80	1.40	1.33	2.73
Total	**14.70**	**11.20**	**25.90**	**13.88**	**8.87**	**22.75**
Subproject 4: Hefei Iron and Steel Company						
Preliminary Expenses	0.00	0.00	0.00	0.00	2.60	2.60
Land Acquisition	0.00	0.00	0.00	0.00	0.00	0.00
Site Preparation	0.00	0.20	0.20	0.00	0.00	0.00
Engineering and Design	0.50	2.00	2.50	0.00	1.85	1.85
Equipment and Material (Major Process)	31.20	8.80	40.00	43.19	0.00	43.19
Auxiliary Equipment	1.80	0.70	2.50	0.00	1.06	1.06
Import Duties	0.00	13.90	13.90	0.00	0.00	0.00
Domestic Transport	0.00	0.50	0.50	0.00	0.00	0.00
Construction and Erection	3.80	15.30	19.10	0.00	23.12	23.12
Consulting Service	0.30	0.00	0.30	0.00	0.00	0.00
Training	0.30	0.40	0.70	0.00	0.00	0.00
Commissioning and Startup	0.00	0.40	0.40	0.00	0.00	0.00
Energy and Environmental Management	0.00	0.20	0.20	0.00	0.00	0.00
Project Management	0.00	0.20	0.20	0.00	0.81	0.81
Base Cost	37.90	42.60	80.50	43.19	29.00	72.63
Physical Contingency	3.40	4.00	7.40	0.00	0.00	0.00
Subtotal	**41.30**	**46.60**	**87.90**	**43.19**	**29.00**	**72.63**
Price Contingency	2.90	3.40	6.30	0.00	0.00	0.00
Interest During Construction	4.10	6.70	10.80	4.96	0.00	4.96
Total	**48.30**	**56.70**	**105.00**	**48.15**	**29.00**	**77.59**

Table A1.3: Summary of Project Cost at Appraisal and Completion
($ million)

Loan and Project	Type of Currency	Appraisal Estimate	Actual at Completion	% Below Estimate
Loan 1490: Waste Water Treatment	Foreign exchange cost	28.00	26.46	5.50
	Local currency cost	42.00	34.80	17.10
Subtotal		**70.00**	**61.26**	**12.50**
Loan 1491: Industrial Pollution Abatement	Foreign exchange cost	122.40	108.77	11.10
	Local currency cost	143.60	64.50	55.10
Subtotal		**266.00**	**173.27**	**34.90**
Project		**336.00**	**234.53**	**30.20**

Source: Asian Development Bank.

ACHIEVEMENT OF OUTCOME AND ENVIRONMENTAL IMPACT

A. Operational Performance

1. Improvement in Capacity and Quality of Production

1. Since its commissioning in April 2001, the Chaohu Dongya Cement Company (CDCC) cement plant has been operating satisfactorily and is currently operating at 100% of its design capacity at 2,000 tons per day. The withdrawal of the Anhui Vinylon Plant (AVP) has forced CDCC to source materials elsewhere, including approximately 70% freshly mined limestone and 30% waste materials from other industrial sources including coal ash and mining wastes. The demand for its cement has been strong due to the high quality and the booming construction industry. More recently, the cement market has become more competitive as the supplies have increased[1] and the price of the cement has also declined somewhat. According to project implementing agency (PIA) officials, the subproject-financed plant does not have a price advantage due to its more expensive albeit better quality imported equipment, but it has still managed to compete on a quality basis.

2. At Hefei Chemical Works (HCW), all 12 units built under the subproject are operating well at full capacity and produce high-quality caustic soda. There are no standby units, but plant staff advised that the supply contract included major spare parts that could be installed within 24 hours. Nevertheless, a leak was observed that appeared to have been due for a repair for some time. HCW produces four types of chemical products including caustic soda. In 2004, the total annual turnover was about Y570 million, including approximately Y170 million generated by the subproject-financed facility. In 2005, the facility has reached 100% of its design capacity, and the product enjoys high demand and prices. The PIA officials informed the Operations Evaluation Mission (OEM) that the subproject has improved HCW's operational and financial performance significantly and helped in preserving the employment of its approximately 3,000 staff.[2] However, one of its older production lines using conventional diaphragm cell technology is still in operation due to the high demand for its products.

3. Since its commissioning in 2003, the single coking battery installed under the Hefei Iron and Steel Corporation (HISC) subproject has been operating at 110% of its design capacity of 300,000 tons/year, producing Grade I quality coke. However, due to the unavailability of the second battery, the old inefficient gasification plant, which was supposed to be replaced by the new facility, is still in operation, producing 120,000 tons of coke per year. However, as envisaged at appraisal, HISC no longer needs to source coke from a large number of smaller inefficient and environmentally unfriendly coking plants located mostly in other provinces, e.g., Shanxi.

4. Since its commissioning in February 2001, the facilities built under the Hefei Chemical Fertilizer Plant (HCFP) subproject have been operating smoothly, with an average daily output of 440 tons of urea, 10% higher than the design capacity. In 2004, the annual turnover of the HCFP Group was Y730 million, and that of 2005 is expected to reach Y930 million. About 30% of the turnover is directly attributed to urea production. Together with other products

[1] CDCC officials informed the Operations Evaluation Mission that AVP has become a main competitor for the CDCC plant with its recently built two 1,000 tons/day plants and one 6,000 tons/day plant.

[2] The subproject-financed production line employs approximately 100 employees, while the vast majority of the 3,000 employees work in other parts of the plant.

manufactured using byproducts from the facility, the ADB-financed facility helps achieve up to 50% of the total turnover of the HCFP Group.

2. Reduced Pollution and Resource Use

5. The primary objective of the Project was to abate environmental pollution in the Chao Lake watershed. To a varied extent, all six subprojects have achieved some intended or unintended environmental benefits.

a. Hefei Wang Xiao Ying WWTP (Phase 2)

6. The subproject-financed facilities form Phase 2 of the existing Hefei Wang Xiao Ying Wastewater Treatment Plant (WWTP), which is essentially a duplicate of Phase 1 except for the main control building and some common use of disinfection facilities. The WWTP, with a combined capacity of 300,000 cubic meters (m^3)/day of secondary treatment, employs a staff of 76 and is currently servicing 880,000 people (out of 1.5 million in Hefei City). It is generally well maintained, and the housekeeping is in accordance with international best practice.[3] However, the OEM noted that a number of process-related signals and indicating bulbs were defective. The plant can be accessed and controlled through a supervisory control and data acquisition (SCADA) system, although the OEM derived the impression that the system may not have been fully utilized, since pilot lights and/or signals were found faulty.

7. Table A2.1 shows the yearly average of the test data for several key indicators produced by the WWTP's own laboratory[4] and compares them with the applicable national discharge standard of water pollutants for municipal WWTPs. The standard has 18 indicators including those for arsenic and heavy metals, but most of these indicators are not routinely tested for. The PIA officials suggested that they were assumed to meet the standards, and the laboratory does not have the capability to test most of them anyway. Of the six indicators tested for, the total nitrogen (N_{tot}) limit was exceeded in 2003; the total phosphorus (P_{tot}) limit was exceeded in 2003 and 2004; and the suspended solids (SS) limit was exceeded in 2001, 2002, and 2003. The treatment processes were selected with an emphasis on nutrient removal. Nitrogen and phosphorus removal requires stricter adherence to operating principles than are apparently practiced at the WWTP.[5] It is likely that operations were deficient during the first few years of operations. The 2005 data (for the first 5 months) indicate that the deficiency appears to have been addressed.

[3] The site inspection by the OEM included the maintenance and repair workshop. It appears that the workshop is capable of handling most routine maintenance including periodically scheduled preventive maintenance. However, major repairs are sourced to outside companies.

[4] The subproject included a laboratory and necessary testing equipment. The OEM was informed that, in addition to testing for the plant, the laboratory also markets its services outside of the plant.

[5] In particular, phosphorus removal falls short of required reduction, even with the significantly relaxed standard for phosphorus removal introduced in 2002.

Table A2.1: Hefei Wastewater Treatment Plant Yearly Effluent Test Data
(mg/l or as noted)

Item	1999	2000	2001	2002	2003	2004	2005[a]	Standard[b]
Average Inflow '000 tons/day	136	142	195	199	244	248	247	300
BOD_5	—	—	3.43	2.65	4.26	4.2	4.5	20
COD_{Cr}	—	—	23.35	24.1	26.0	29.1	26.9	60
NH_3-N	—	—	0.27	2.21	0.41	0.76	3.27	8
N_{tot}	—	—	—	—	***22.6***	16.0	8.73	20
P_{tot}	—	—	1.33	0.85	***1.93***	***1.85***	0.39	1.5
SS	—	—	***22.9***	***26.0***	***23.5***	12.0	7.40	20

— = no test data available.
BOD_5 = biochemical oxygen demand, COD_{cr} = chemical oxygen demand, mg/l = milligram per liter, NH_3-N = ammonia nitrogen, N_{tot} = total nitrogen; P_{tot} = total phosphorus; SS = suspended solids.
Note: Figures in bold italic refer to testing results exceeding standards.
[a] First 5 months.
[b] GB 18918-2002 "Class 1B Discharge standard of water pollutants for municipal wastewater treatment plant.
Source: Hefei Sewage Treatment Administrative Office.

8. A possible reason for the operational deficiency is the combined sewers, resulting in weaker than expected sewage strength. Table A2.2 shows the average monthly concentrations for three pollutants in the influent and the effluent for 2004. It shows biochemical oxygen demand (BOD)[6] reduction from 92% to 98%, chemical oxygen demand (COD) reduction from 82% to 89%, and SS reduction from 77% to 93%. These are in the appropriate ranges for secondary WWTPs even though the strengths are lower than assumed in the design brief. The 4 months of the rainy season (June to September) had the effect of lowering the incoming BOD by 17% as compared with the yearly average, making the achievement of phosphorus reduction more difficult.[7] The low BOD also adversely affects the nitrification/denitrification process, as evidenced by the relatively poor nitrogen removal rates. Again, better 2005 data indicate that the transfer-operate-transfer (TOT) concessionaire has reacted to the situation.

[6] A measurement of a group of pollutants that will potentially react to deplete oxygen in the water; a lower value is more favorable.
[7] This is because the incoming BOD is utilized as a carbon source for conversion of polyphosphates to orthophosphates in the anaerobic pretreatment process.

Table A2.2: Hefei Wastewater Treatment Plant Monthly Test Data, 2004
(mg/l or as noted)

Month	Average Effluent '000 tons/day	BOD_5 Influent	BOD_5 Effluent	BOD_5 % Removal	COD_{Cr} Influent	COD_{Cr} Effluent	COD_{Cr} % Removal	SS Influent	SS Effluent	SS % Removal
Jan	250	117	4	97	230	25.1	89	180	24.5	86
Feb	245	65.3	5.2	92	169	30.4	82	100	23.5	77
Mar	207	109	4.2	96	211	34.9	83	169	21.5	87
Apr	177	124.5	3	98	237	31.4	87	163	24	85
May	210	107.5	3.2	97	220	27.9	87	181	26	86
Jun	268	75	3.2	96	188.5	27.8	85	140.5	22	84
Jul	219	84.5	5.8	93	214	34.9	84	112.5	20.5	82
Aug	157	82.6	5.8	93	205	34.2	83	144.5	22.5	84
Sep	182	84	4.6	95	244.5	33	87	210	24.5	88
Oct	286	105	3.6	97	205	32	84	146	21	86
Nov	245	110	4.2	96	211	29	86	191	12	94
Dec	228	107.2	4.6	96	189.5	27.8	85	114.5	8	93

BOD_5 = biochemical oxygen demand; COD_{cr} = chemical oxygen demand; mg/l – milligram per liter, SS = suspended solids.
Source: Hefei Sewage Treatment Administrative Office.

b. Chaohu WWTP

9. The operational performance of Chaohu WWTP has been generally satisfactory, and the housekeeping is generally adequate but with some evidence of neglect. The plant is currently operating at 45,000 m^3/day capacity, which is expected to reach 52,000 m^3/day by the end of 2005, compared with the 60,000 m^3/day design capacity, due to the ongoing improvement of the sewage collection system in the city. The subproject-financed primary treatment facilities were never independently operated, as secondary treatment facilities were immediately added on to them by the PIA. As in the Hefei WWTP, the Chaohu WWTP also has automatic and remote process control and data collection and recording via a SCADA system, even though the system may have not been fully utilized.[8] The plant is being operated by a staff of 20, in line with international practices for a plant of this capacity. The WWTP includes a spacious laboratory that is capable of performing various routine tests including BOD_5, although heavy metal concentrations are not tested on-site.[9] The effluent was not nearly as clear (or well treated) as in the Hefei WWTP, possibly as a result of the sludge return/wasting procedure[10] and possibly because of reportedly experimental operation of aerators.

10. Table A2.3 provides some test data for the Chaohu WWTP. While the nature and the time of the tests are unclear,[11] the table nonetheless indicates that the effluent meets the

[8] Several pilot lights on the mimic boards were in fault state, indicative of faulty lights and/or signal generators, which will adversely affect automatic and remote operation and data collection

[9] On the day of the OEM visit, there was essentially no laboratory work being performed, which plant staff explained was due to a recent power failure. The predesign brief contained no references to standby power or multiple power feeds, as was provided for in the Hefei WWTP.

[10] The plant recycles 100% of its secondary sludge, resulting in much higher than normal mixed liquor SS and wastes, for several hours at a time twice a week. While this is unusual, it appears to give acceptable results.

[11] The data were provided by CWTEC on a handwritten note, without indicating the time of measurement or whether it was a snapshot measurement or yearly average. The OEM is in the process of confirming these.

applicable discharge standards for all six pollutants measured. A comparison of Tables A2.2 and A2.3 indicates that the Chaohu influent is of much lower strength on the basis of BOD, COD, and SS that the Hefei influent, and the percentage of removal is also lower than that of Hefei. The PIA explained that the lower strength may be caused by the fact that many industrial plants in Chaohu have installed on-site wastewater treatment facilities driven by more stringent enforcement of environmental regulations by the Anhui Environmental Protection Bureau (AEPB). The lower removal rates suggest that the Chaohu WWTP is probably not being operated as effectively as the Hefei WWTP.

Table A2.3: Chaohu Wastewater Treatment Plant Test Data
(mg/l or as noted)

Pollutant	Influent	Effluent	Standard[a]	% Removal
BOD_5	70	10	20	86
COD_{Cr}	130	35	60	73
NH_3-N	16	6	8	63
SS	100	16	20	84
N_{tot}	25	15	20	40
P_{tot}	1.8	1.3	1.5	28

BOD_5 = biochemical oxygen demand, COD_{cr} = chemical oxygen demand, mg/l = milligram per liter, NH_3-N = ammonia nitrogen, N_{tot} = total nitrogen; P_{tot} = total phosphorus; SS = suspended solids.
[a] GB 18918-2002 Class 1B discharge standard of water pollutants for municipal wastewater treatment plant.
Source: Chaohu Wastewater Treatment Engineer Company.

c. Anhui Vinylon Plant/Chaohu Dongya Cement Company

11. The original PIA, Anhui Vinylon Plant (AVP), decided to finance pollution abatement components aimed at reducing solid waste and wastewater discharge through increasing wastewater recycling and reuse of waste materials to produce cement. This means that, even though the subproject did not contribute to AVP's pollution abatement directly, the initial inclusion of AVP in the Project may have facilitated AVP's initiative for environmental cleanup. In particular, through the subproject, AVP confirmed the technical feasibility of employing modern clean technology to produce cement using its wastes even though it eventually decided to build its own plant.

12. For CDCC, the new cement plant has been operating at full capacity, but it utilizes much less waste material than initially envisaged due to AVP's withdrawal. An "unexpected" environmental benefit of the subproject was achieved. Anhui Cement Company, which owns and operates several plants including the CDCC plant, decided to close down (at least temporally) one of its older plants employing the "wet process" and more polluting technology due to the recent increasing supplying capacity in the market and the heavy pollution levy charged by AEPB.[12] Table A2.4 provides air emission data for the ADB-financed CDCC plant for two pollutants, which are both compliant with the recently promulgated emission standards. No test data were provided on nitrogen oxides (NO_x), but it may be inferred from the fact that the dry process technology produces 25% of the NO_x that the emission would probably meet the standard. Table A2.4 also indicates that the total pollution levy paid by CDCC has been

[12] Compared with the old wet process cement plant, the new dry plant is more energy efficient and produces fewer air emissions. For example, on a per ton of cement basis, the dry process uses approximately 150 kilogram (kg) coal, compared with 290 kg for the wet process. The dry process emits about 25% of the nitrogen oxides of that for the wet process. Since the commissioning of the new plant and the decommissioning of the older plant, the Chao Dong Cement Company, which is the holding company of CDCC and owns several other cement plants, has reduced its total payment of pollution levy from Y1.2 million to about Y1.0 million per annum.

increasing. This is because in the PRC the pollution levy, which is different from a pollution fine due to violation of standards, has to do with total emissions, which means that, even if an enterprise meets the emission standards, it still has to pay a certain amount of pollution levy. Concerning water pollution, the OEM observed that the plant has a wastewater treatment (primary treatment) and recycling system. The plant officials informed the OEM that the plant recycles virtually all process wastewater with near zero discharge.

Table A2.4: Chaohu Dongya Cement Company: Air Emission Data

Item	2001	2002	2003	2004	2005[a]	Standard[b]
TSP (ton/year)	162.56	177.62	169.41	187.46	75.43	
TSP (kg/ton of product)	0.49	0.23	0.22	0.22	—	0.30
SO_2 (mg/m^3)	19.05	15.89	26.00	23.08	13.72	400.00
Pollution Levy (Y)	0.00	240,000	330,000	330,000	—	

— = no test data available.
kg/ton = kilogram per ton, mg/m^3 = milligram per cubic meter, SO_2 = sulfur dioxide, TSP = total suspended solids.
[a] First 5 months.
[b] GB 4915 2004. Emission Standard of Air Pollutants for Cement Industry.
Source: Chaohu Dongya Cement Company.

d. Hefei Chemical Works

13. Table A2.5 presents the effluent testing data provided by HCW.[13] The test parameters all met the standards with the exception of COD for the 2005 test. However, no test data were provided to indicate that the effluent meets standards pertaining to asbestos and chlorides, which were also regulated by the environmental standard.

Table A2.5: Hefei Chemical Works: Wastewater Treatment Plant Effluent Test Data
(mg/l or as noted)

Item	4 Jul 2002	27 Feb 2004	10 Jan 2005	Standard[a]
BOD_5	—	15.32	—	30.00
COD_{Cr}	90.30	57.20	***113.00***	100.00
Cyanide	—	0.01	—	0.50
NH_3-N	—	12.52	—	NS
Mercury (µg/l)	0.50	0.16	0.32	5.00
Oil	—	1.40	—	8.00
pH	6.21	8.33	7.84	6~9
Phenol	—	—	0.10	0.50
Sulfide	—	—	0.40	NS
SS	31.40	—	36.00	70.00

— = no test data available.
BOD_5 = biochemical oxygen demand; COD_{cr} = chemical oxygen demand; mg/l = milligram per liter; NH_3-N = ammonia nitrogen; NS = no applicable standard; pH = the symbol of a scale, numbered from 0 to 14, that rates water solutions according to their acidity or alkalinity; SS = suspended solids; µg/l = microgram per liter.
Note: Figures in bold italic refer to testing results exceeding standards.
[a] GB 15581-1995 Discharge standard of water pollutants for caustic alkali and PVC industry for Class 1 plants asbestos-based and ion membrane-based and utilizing acetylene process.
Source: Hefei Chemical Works.

[13] The tests were performed by Hefei Environmental Monitoring Center using the samples collected from HCW.

14. Water consumption and wastewater discharge have been drastically reduced through increasing wastewater treatment, more efficient caustic soda production, and increased water recycling (about 28% of treated effluent is reportedly recycled). In addition, there has been a significant reduction of asbestos generated on site, although total elimination of asbestos has not been achieved since one of the two old caustic soda production lines that uses asbestos is still in operation. Total energy consumption and resultant air pollution are due to the more efficient production technology employed, although no specific data were made available in this regard.

e. Hefei Iron and Steel Company

15. The WWTP at HISC, though appearing much older than its age, seems to generate satisfactory results. Table A2.6 provides the yearly aggregate test data for several indicators (number of tests unknown). Plant operators informed the OEM that virtually all the effluent is being recycled, but PIA officials later suggested that, plant-wise, the recycling rate is above 70%, slightly higher than 69% at the time of appraisal but lower than the 94% as targeted. Table A2.6 indicates that all parameters except COD met the emission standards. The noncompliance with the COD standard may reflect the poor quality and fast corrosion of some of the components. Furthermore, no test data were provided to indicate if the effluent met standards pertaining to NH_3-N and chlorides.

Table A2.6: Hefei Iron and Steel Plant: Wastewater Treatment Plant Effluent Test Data
(mg/l or as noted)

Item	2004	2005 (first 6 months)	Standard[a]
COD_{Cr}	***131.00***	***133.00***	100.00
Cyanide	0.42	0.14	0.50
Oil-petroleum	7.50	5.40	8.00
pH	7.20	7.10	6~9
Phenol	0.34	0.39	0.50
SS	135.00	143.00	70.00

COD_{cr} = chemical oxygen demand; NS = no applicable standard; pH = the symbol of a scale, numbered from 0 to 14, that rates water solutions according to their acidity or alkalinity; SS = suspended solids.
Note: Figures in bold italic refer to testing results exceeding standards.
[a] GB 13456-1992. Discharge standard of water pollutants for iron and steel industry for large plants.
Source: Hefei Iron and Steel Corporation.

16. In terms of air pollution reduction, as the old inefficient gasification plant that was supposed to be replaced by the new facility is still in operation, the OEM observed that the air quality of the plant area is poor, and the old plant probably exceeds the applicable emission standards. No emission data were made available.

f. Hefei Chemical Fertilizer Plant

17. Two main types of environmental benefits were envisaged for the subproject. First, compared with ammonium bicarbonate, the main fertilizer produced by HCFP prior to the subproject, urea has much higher nitrogen content (about 46% vs. 17%) and is also less volatile. With proper techniques, there is generally less runoff of nitrogen associated with urea application and thus less pollution of rivers and lakes. However, no data were available on the relative runoff of the urea and ammonium bicarbonate in Anhui, where most of HCFP's products

were sold and used. Plant officials noted that HCFP is conducting training on effective fertilizer application for farmers who purchase their products.

18. The other main environmental benefit of the subproject was achieved through constructing three in-situ WWTPs. The first one is a 16,800 m^3/day WWTP to recycle coal gasification, carbon recovery, and other wastewater streams. The OEM inquired about cyanide and sulfide removal in this WWTP based on the concern expressed in the project preparatory TA report that the wastewater system described in the feasibility report may not be capable of removing cyanides and sulfides. The OEM was informed that cyanide concentration is "very low" and within standards and that, in any event, it is recycled. Sludge from this WWTP is mixed with coal ash and sold to brick-making factories. The plant officials informed the OEM that part of the treated effluent is being recycled, but it is not clear what portion of the effluent is being discharged into the Shiwuli River.

19. For the second WWTP, viz.., 4,800 m^3/day biological treatment plant to treat waste streams from the copper acetate washing section, urea plant, ammonia plant, ammonia synthesis unit, floor washing area, sodium tripolyphosphate, and living quarters, the OEM observed the plant in operation, but it was unclear if it had been built as envisaged. The OEM was advised that the biological WWTP had been converted into a chemical WWTP and that one feature of that revised plant was the addition of a proprietary chemical produced by another Hefei-based chemical factory, but the plant officials could not identify the name or composition of the chemical. Table A2.7 presents the effluent testing data provided by the plant. The data are results of yearly tests conducted by AEPB. Since commissioning in 2000, most pollutants have met the discharge standards except that the NH_3-N limit of 60 mg/l is usually exceeded, despite the high removal efficiencies (79% ~ 83%).

Table A2.7: Hefei Fertilizer Plant: Wastewater Treatment Plant Effluent Test Data
(mg/l or as noted)

		1999	2000	2001		2002		2003		2004		
		Plant	Plant	Plant	AEPB	Plant	AEPB	Plant	AEPB	Plant	AEPB	Standard[a]
Wastewater ('000 tons/yr)		495	675	885		944		921		751		
COD_{cr}	in	431	275	241	—	239	—	236	—	221	—	
	out	431	131	132	143	136	138	133	149	125	127	150
SS	in	—	—	—	—	—	—	—	—	—	—	
	out	—	—	—	34	—	38	—	28	—	19	70
NH_3-N	in	914	550	516	—	491	—	499	—	426	—	
	out	914	***92***	***90***	***88***	***93***	***92***	***92***	***95***	***88***	***92***	60
N_{tot}	in	—	—	—	—	—	—	—	—	—	—	
	out	—	—	—	—	—	—	—	—	—	96	NS
P_{tot}	in	22.6	16.5	12.6		11.9	—	12.3	—	10.8	—	
	out	22.6	0.6	0.5	0.5	0.5	0.4	0.5	0.5	0.4	0.9	NS
Phenol	in	—	—	—	—	—	—	—	—	—	—	
	out	—	—	—	0.2	—	0.2	—	—	—	0.1	0.2
Copper	in	—	—	—	—	—	—	—	—	—	—	
	out	—	—	—	0.6	—	0.9	—	—	—	—	NS

— = no test data available, COD_{cr} = chemical oxygen demand, mg/l = milligram per liter, NH_3-N = ammonia nitrogen, NS = no applicable standard, N_{tot} = total nitrogen, P_{tot} = total phosphorus, SS = suspended solids.
Note: Figures in bold italic refer to testing results exceeding standards.
[a] GB 13458-2001. Discharge standard of water pollutants for ammonia industry for large plants.
Source: Hefei Chemical Fertilizer Plant

20. The third WWTP facility financed under the subproject, viz., 432 tons/day WWTP to pretreat chloride soda and wastewater from the demineralized water system before discharge to the municipal sewers, appeared to be well made of appropriate, corrosion-resistant materials. The OEM was informed, and observed, that its operation had been satisfactory. As an encouraging sign for the plant's reduction of pollution, prior to 2001, the plant paid Y120,000 per month in pollution levies to AEPB, mainly for excessive NH_3-N discharges. Since then, the amount has been reduced to Y40,000. The significant reduction of HCFP's pollution discharge was also confirmed by the Project Management Office/AEPB director.

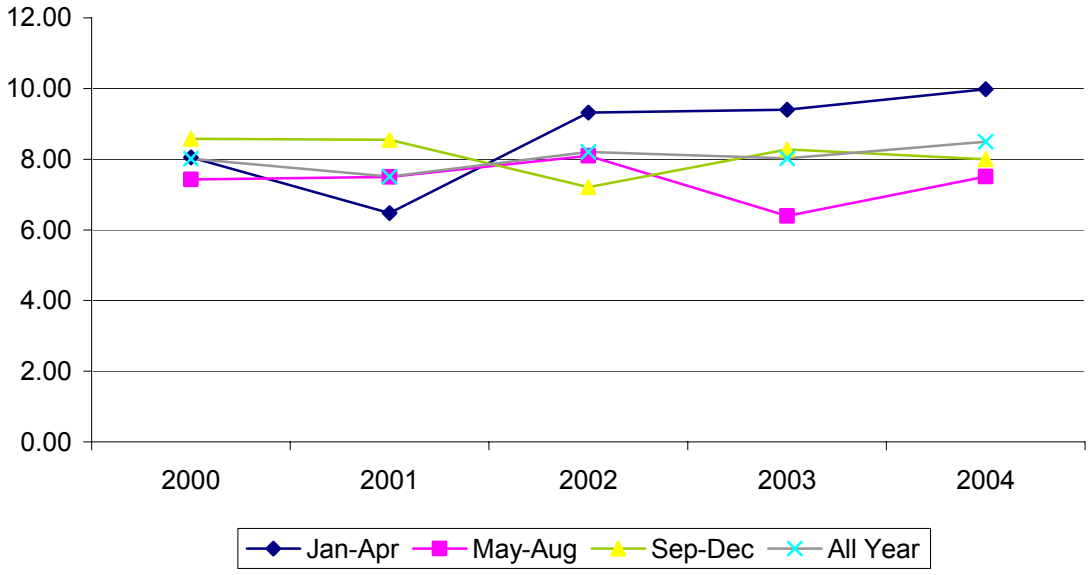
B. Environmental Impact

21. The primary objective of the Project was to improve the quality of the Chao Lake through industrial pollution abatement and establishing central WWTPs. In particular, the two wastewater treatment subprojects, operating at about 75%–83% of their design capacities, have achieved the expected environmental benefits by contributing to the relatively high proportion of wastewater treatment in the respective cities—50% for Hefei and 70% for Chaohu. However, the water quality of the Chao Lake depends on a variety of other factors including new industrial development in the watershed, rainfall and seasonal changes, and water inflows allocated from the Yangzi River. AEPB provided monthly test data on four parameters—dissolved oxygen (DO), COD, N_{tot}, and P_{tot}, for the western and eastern sections of the Chao Lake between 2000 and 2004.[14]

22. Figures A2.1 through A2.4 indicate the trends, or lack thereof, for two representative indicators, DO and COD. The figures appear to show both location and seasonal changes. In terms of location, for both DO and COD, the western section of the Chao Lake, near Hefei, appears to have improved more significantly than the eastern section, as would be expected, since Hefei is a much larger pollution source, and reduction of the pollution load would have had more impact on the water quality. The improvement is particularly significant with COD loads (Figures A2.3 and A2.4). For the eastern section near Chaohu, no significant improvement is observed for either parameter, although both parameters were generally more favorable (than the eastern section) at the beginning of the period. In terms of seasonal changes, the DO level between January and April for the western section increased more steadily and rapidly compared with other seasons and annual averages. This is possibly because the effect of pollution abatement on the DO level is greater during this relatively dry season. The DO levels during other seasons, and COD, show little seasonal changes.

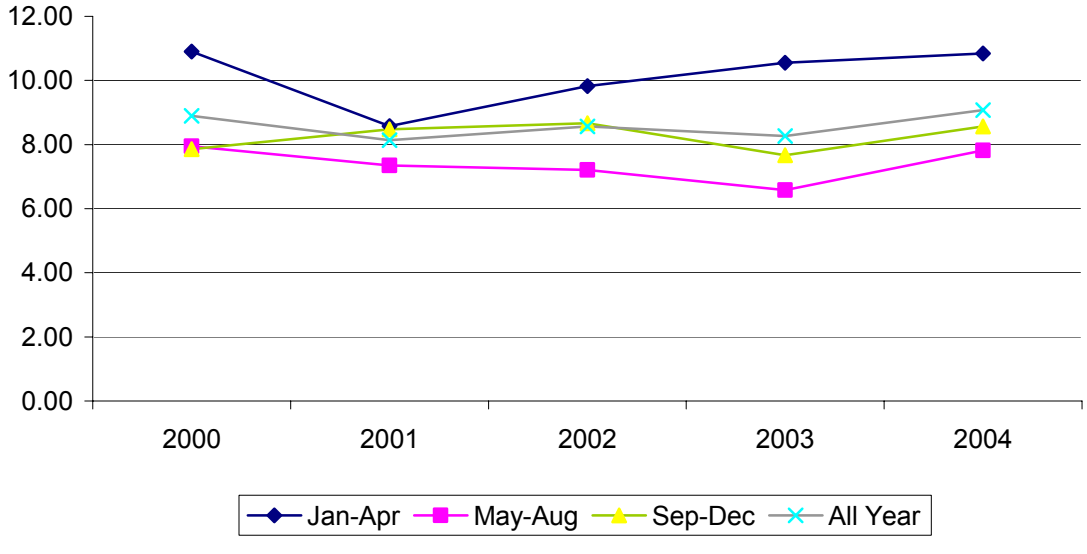
[14] Samples were collected from the central points of the eastern and western sections of the Chao Lake.

Figure A2.1: Yearly and Seasonal Changes in Dissolved Oxygen (mg/l) (West Lake, Near Hefei)



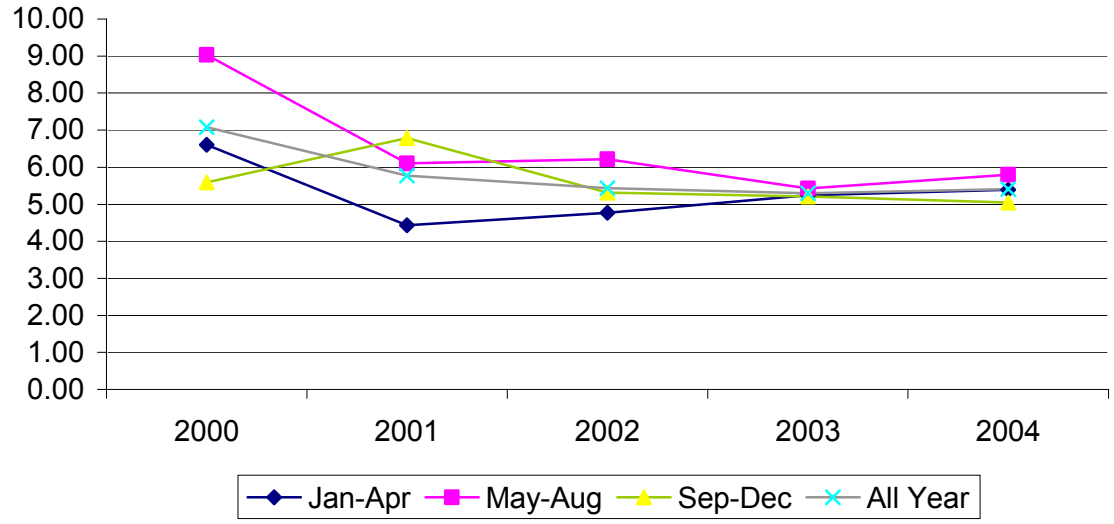
mg/l = milligram per liter.
Source: Anhui Environmental Protection Bureau.

Figure A2.2: Yearly and Seasonal Changes in Dissolved Oxygen (mg/l) (East Lake, Near Chaohu)



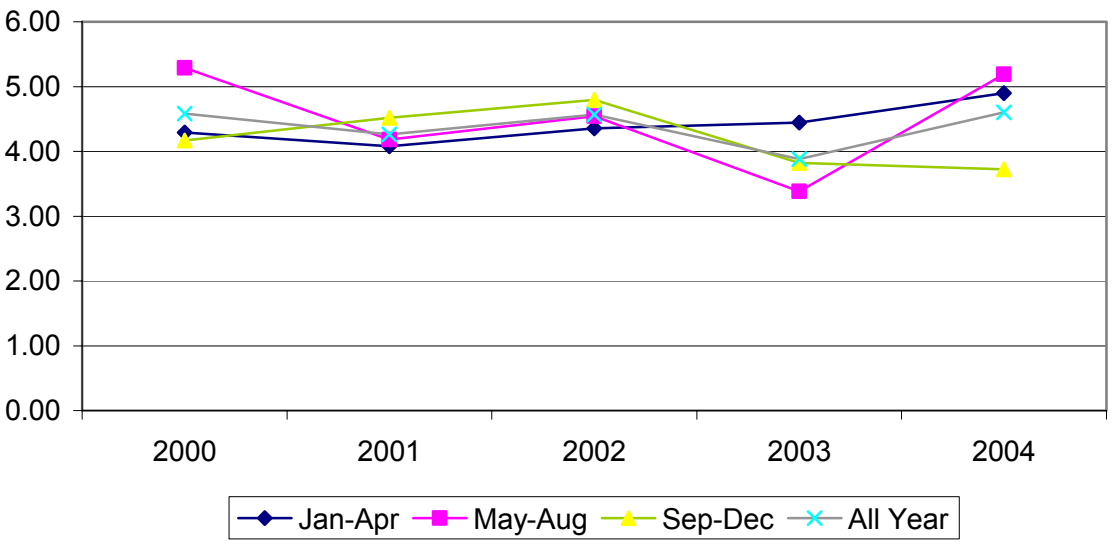
mg/l = milligram per liter.
Source: Anhui Environmental Protection Bureau.

Figure A2.3: Yearly and Seasonal Changes in Chemical Oxygen Demand (mg/l) (West Lake, Near Hefei)



mg/l = milligram per liter.
Source: Anhui Environmental Protection Bureau.

Figure A2.4: Yearly and Seasonal Changes in Chemical Oxygen Demand (mg/l) (East Lake, Near Chaohu)



mg/l = milligram per liter.
Source: Anhui Environmental Protection Bureau.

23. Table A2.8 provides the annual average of the four parameters as compared with the applicable environmental quality standards for surface water. The indicators present a "muddy" picture of the water quality. Both DO and COD levels are highly satisfactory, meeting Class I standards for all years and both sections of the lake, while the N_{tot} and P_{tot} were much less favorable, in the range of Class III to Class V standards. In particular, N_{tot} in the western part of lake exceeded the Class V (the most relaxed) standard for 4 out of 5 years, while that for that eastern part exceeded the standard in 1 out of 5 years. The high concentrations of nitrogen and phosphorus are an indication that agricultural runoff of fertilizer applications continues to threaten the Chao Lake's water quality, and the long-term risk of eutrophication remains significant.

Table A2.8: Water Quality Indicators of the Chao Lake

Location	Item	2000	2001	2002	2003	2004	Standard (Class #)[a]
West Lake	DO	8.02	7.51	8.21	8.02	8.49	≥7.5 (Class I)
	COD	7.08	5.78	5.44	5.30	5.41	≤15 (Class I)
	P_{tot}	0.21	0.21	0.17	0.26	0.30	≤0.3 (Class IV)
	N_{tot}	***2.60***	1.97	***2.81***	***3.62***	***3.10***	≤2.0 (Class V)
East Lake	DO	8.90	8.13	8.57	8.27	9.07	≥7.5 (Class I)
	COD	4.58	4.26	4.57	3.88	4.60	≤15 (Class I)
	P_{tot}	0.13	0.13	0.11	0.10	0.19	≤0.2 (Class III)
	N_{tot}	1.38	***2.11***	1.27	1.35	1.12	≤2.0 (Class V)

DO = dissolved oxygen, COD = chemical oxygen demand, N_{tot} = total nitrogen; P_{tot} = total phosphorus.
Note: Figures in bold italic refer to testing results exceeding standards.
[a] GB 3838-2002. Environmental quality standards for surface water.
Source: Anhui Environmental Protection Bureau.

24. On the whole, the Project has probably helped to achieve modest improvement in the water quality of the Chao Lake, particularly in the western section near Hefei, through reducing industrial wastewater discharge and increasing municipal wastewater treatment. Nonetheless, much more remains to be achieved in industrial pollution reduction, particularly in arresting agricultural runoff associated with fertilizer application. The Project, with the HCFP subproject, made a limited contribution by helping HCFP producing urea instead of a more volatile ammonium bicarbonate in this area, but the ever increasing use of fertilizer has more than offset any impact that this subproject might have had. Another related point is the deficiency of the two WWTPs in phosphorus and nitrogen removal, which calls for greater adherence to operations procedures.

FINANCIAL REEVALUATION

A. Assumptions for Financial Reevaluation

1. General

1. Financial reevaluation of the subprojects was carried out on an incremental and after-tax basis. All investment costs and benefits in recalculating the financial internal rate of return (FIRR) were expressed in real terms at 2004 constant prices. The economic life of project facilities is 15 years for the industrial subproject, and 30 years for the wastewater treatment subprojects with the replacement of wastewater treatment facilities occurring in year 15, as assumed in the Report and Recommendation of the President and the Project Completion Report (PCR).

2. The exchange rate used for recalculating the FIRR is Y8.27 per US dollar, due to the fact that capital investments for the Project were made during 1998-2004, before the yuan appreciated in July 2005.

2. Capital Costs

3. Capital costs were based on actual capital expenditures. Based on the final record of project costing, the actual capital cost for the wastewater treatment component was confirmed at $61.3 million, the same as in the PCR. However, the actual capital cost of the industrial pollution abatement component was revised to $173.27 million, slightly higher than the $170.37 quoted in the PCR. The difference is caused by two revisions. The first revision was made for the Hefei Chemical Fertilizer Plant subproject, wherein the interest during construction of $2.26 million was not included in the PCR calculation. The actual project cost for the subproject was then revised to $27.88 million instead of the $25.62 million quoted in the PCR. The second revision was made for the Hefei Iron and Steel Corporation (HISC) subproject based on actual capital investments in 2004 following PCR completion, as well as the additional capital investment to be made in 2007 for the second new oven to be installed and commissioned. The total project cost for the HISC subproject is thus revised to be $77.69 million, instead of the $76.96 million quoted in the PCR. The detailed project cost breakdowns for all subprojects are provided in Appendix 1.

4. Future additional capital costs for major equipment replacement have been taken into account in the FIRR recalculation wherever applicable. For wastewater treatment subprojects, additional capital costs for major equipment replacement are assumed to take place in the 15th year of operation. As for the industrial pollution abatement subprojects, all project facilities were assumed to have a 15-year economic life, with no residual value and no major equipment replacement during their respective service lives. However, for the HISC subproject, as the second new oven's commissioning is assumed to lag behind the first oven's by 4 years, it is then assumed that there would be an additional capital cost of Y16 million in the 15th year of operation of the first oven, and that both the first and second ovens would be scrapped at the end of the service life of the second oven, with zero residual value.

3. Incremental Cash Flow

5. Incremental benefits and costs were derived by comparing both the with and without-project scenarios. Project benefits are based on sales of products and services associated with project facilities at market prices. The benefits associated with energy efficiency improvement are reflected in the reduction of production costs and the enhancement of production volume.

Benefits from technology upgrading are reflected in product quality improvement and/or product mix change. Financial benefits from environmental improvements are implicitly included in the analysis through reduced pollution levies as part of production costs.

6. In the without-project scenario, benefits and costs of those subprojects classified as new establishments are zero. These subprojects are the Chaohu Wastewater Treatment subproject, Hefei Wastewater Treatment subproject, and Chaohu Dongya Cement subproject. Benefits and costs associated with old facilities at the Hefei Chemical Fertilizer Plant and the Hefei Chemical Works are also treated as zero due to two considerations: First, the old facilities at the two plants had served far beyond their economic lives at the time when the new facilities were commissioned. Products from these old facilities either had little market demand or had negative profit margins. Operating these facilities would cause heavy losses. Second, the operation of those old facilities had caused severe environmental pollution and violated environmental regulations. Thus, it was inevitable for the concerned subproject enterprises to cease the operation of the old facilities regardless of whether the Asian Development Bank (ADB)-financed subprojects were established or not.

7. As for the HISC subproject, its old facilities were not demolished and were still operating at 70% of capacity in 2004 due to the delayed commissioning of the second new oven. The old facilities are planned to be demolished in 2007 so that the site can be cleared for the second new oven, to be installed and commissioned in 2008. As thus, the old facilities are assumed to operate at 50% capacity in 2005, 30% capacity in 2006, and zero percent capacity in 2007 in the without-project scenario.

4. Projections

8. Projections on production volumes, sales volumes, and production costs for each subproject are based mainly on forecasts provided by subproject enterprises, with market trends and input price increases taken into consideration.

5. Weighted Average Cost of Capital (WACC)

9. The WACC was recalculated in real terms, based on revisions with respect to actual capital costs, average nominal costs of both the ADB loan and domestic loans, and the inflation rate. The revised average nominal cost of the ADB loan is 6.3%, and the revised local inflation rate is 2%.

B. Financial Performance of Subprojects

10. Table A3.1 provides the recalculated FIRRs for all subprojects and the Project as a whole. The financial performance of individual subprojects and of the Project as a whole are generally satisfactory. The recalculated FIRR for the overall project (including both the industrial pollution abatement component and the wastewater treatment component) is 8.4%, higher than the overall WACC of 5.3%. The industrial pollution abatement component performed better than the wastewater treatment component, with a recalculated FIRR of 9.5% compared with 6.2% for the wastewater treatment component. The recalculated FIRRs for individual subproject ranged from 5.5% to 13.0%, all exceeding their respective WACCs.

1. Industrial Pollution Abatement Component

11. Compared with projections in the PCR, all industrial subprojects except the Hefei Chemical Works subproject have lower-than-expected financial performance. The main cause is the soaring raw materials prices, especially that of coal. Other reasons include low capacity utilization and poor byproduct sales. Since 2004, coal prices have gone up by at least 50%, and they are forecast to increase by an additional 10% in the coming years. The profitability of the cement, fertilizer, and coking plants was particularly adversely affected. As to the HISC subproject, in addition to the coal price increase, the delayed commissioning of the second oven was another major factor. Low capacity utilization resulted in high operating costs on one hand, and delayed processing of a project to produce byproducts such as benzol and sulfur.

12. The Hefei Chemical Works subproject is the best performing industrial subproject, with its recalculated FIRR at 13.0%, slightly higher than the 12.4% projected in the PCR and the 12.3% estimated at appraisal. This was attributable to the smooth project implementation and operation, and most importantly to the growing demands for caustic soda from downstream industries such as the paper pulp, textile, and chemical fiber industries. While this subproject is also under pressure from increases in raw materials, electricity, and transportation costs, the corresponding increases in caustic soda price are passed on to the customers due to the strong demands from downstream industries.

2. Wastewater Treatment Component

13. The recalculated FIRR for the Chaohu Wastewater Treatment subproject is 7.9%, in line with the 8.5% projected in the PCR and the 7.8% estimated at appraisal. The FIRR for the Hefei Wastewater Treatment subproject is recalculated as 5.5%, lower than the 9.9% projected in the PCR and the 9.4% estimated at appraisal. The lower FIRR recalculated by this analysis is attributable to two factors: First, increases in wastewater treatment tariff were lower than estimated at appraisal. The wastewater treatment tariff in Hefei in 2004 was Y0.74/m^3, which will increase to Y0.8/m^3 in 2006, still lower than the RMB1.0/m^3 estimated at appraisal for the 2005 tariff. Sensitivity analysis shows that the FIRR for this subproject would improve to 7.37% if the tariff were raised to Y1.1/m^3 in 2006. Second, this analysis may have underestimated the financial return on this subproject due to insufficient information. The Hefei Wastewater Treatment subproject (Phase II of the Wang Xiao Ying Wastewater Treatment Plant) was transferred together with Phase I to a German company under a transfer-operate-transfer contract for a 23-year period. Available data that could be used for analysis were only up to 2003. In this case, operation costs from 2004 onward were all projected on the basis of 2003 data by taking into account increases in certain operation cost items; at the same time tariff incomes were estimated based on projected wastewater treatment volumes. It is possible that the operating costs under the German concessionaire's operations are lower than those projected by this analysis due to more efficient and effective management, whereby the financial return would be enhanced.

C. Debt Service Capability of Subproject Enterprises

14. The reconstructed and consolidated financial statements for each subproject enterprise are provided in Appendix 4. It should be mentioned that the Hefei Wastewater Treatment Company has prepaid its debt to ADB after using the proceeds from the transfer. Among other subproject enterprises, the Chaohu Wastewater Treatment Company has the strongest ability to repay its debts. Its debt service ratios were kept above 2% for the past 2 years, and its debt-equity ratio went down from 72.3% in 2003 to 70.1% in 2004. As for the rest of the industrial

subproject enterprises, while they were able to keep their respective ratios of debt to debt plus equity below 70%, their respective operating cash flows for the past few years were either insufficient or negative, and these subproject enterprises thus had to rely on additional borrowings to meet their interest and debt repayment obligations. These industrial subproject enterprises have to streamline their operations and cut down their overall operational costs so as to improve their cash flow position and enhance their capacity for debt servicing.

FINANCIAL INTERNAL RATE OF RETURN

Table A3.1: Chaohu Dongya Cement Company
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Revenue	Incremental Operating Cost	Net Cash After Tax
1998	3.24			(3.24)
1999	84.42			(84.42)
2000	101.62			(101.62)
2001	81.67	56.30	38.24	(63.61)
2002	57.98	116.94	75.67	(23.09)
2003		126.46	84.48	35.36
2004		148.35	103.03	37.60
2005		150.61	104.60	38.06
2006		150.61	104.60	38.06
2007		150.61	104.60	38.06
2008		150.61	104.60	38.06
2009		150.61	104.60	38.06
2010		165.67	115.97	40.53
2011		165.67	115.97	40.53
2012		165.67	115.97	40.53
2013		165.67	115.97	40.53
2014		165.67	115.97	40.53
2015		165.67	115.97	40.53
			FIRR	**7.30%**
			WACC	**5.13%**

Table A3.1a: Sensitivity Analysis

Item	FIRR	Test
Base case	**7.30%**	
Clinker price + 10%	9.54%	1.00
Raw material cost +10%	7.13%	1.00
Electricity cost + 10%	6.88%	1.00
Coal cost + 10%	6.52%	1.00
Total operation cost + 10%	5.44%	1.00
Combination of:		
Clinker price + 10%, while total operation cost + 10%	8.03%	

FIRR = financial internal rate of return, WACC = weighted average cost of capital.

Table A3.2: Hefei Chemical Fertilizer Plant
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Revenue	Incremental Operating Cost	Net Cash After Tax
1998	25.53			(25.53)
1999	11.38			(11.38)
2000	109.45			(109.45)
2001	45.25	80.72	55.04	(23.42)
2002	15.60	115.68	89.40	6.63
2003	2.81	134.24	117.86	12.78
2004		182.93	153.01	24.67
2005		228.75	195.93	26.61
2006		220.95	188.23	26.54
2007		220.95	188.23	26.54
2008		220.95	188.23	26.54
2009		220.95	188.23	26.54
2010		232.00	205.48	22.39
2011		232.00	205.48	22.39
2012		232.00	205.48	22.39
2013		232.00	205.48	22.39
2014		232.00	205.48	22.39
2015		232.00	205.48	22.39
			FIRR	**7.26%**
			WACC	**5.65%**

Table A3.2a: Sensitivity Analysis

Item	FIRR	Test
Base case	**7.26%**	
Urea price + 10%	11.81%	1.00
Raw material cost + 10%	4.75%	1.00
Electricity cost + 10%	5.79%	1.00
Total operation cost + 10%	-4.37%	1.00
Combination of:		
Urea price + 10%, while total operation cost + 10%	5.23%	

FIRR = financial internal rate of return, WACC = weighted average cost of capital.

Table A3.3: Hefei Chemical Works
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Revenue	Incremental Operating Cost	Net Cash After Tax
1998	10.70			(10.70)
1999	26.86			(26.86)
2000	79.70			(79.70)
2001	23.05	94.45	78.86	(8.99)
2002	24.01	102.97	82.16	(6.46)
2003		106.90	79.23	22.15
2004		129.01	99.51	23.38
2005		147.15	109.20	29.04
2006		166.07	123.22	32.32
2007		175.29	130.53	33.60
2008		184.52	137.84	34.89
2009		184.52	137.84	34.89
2010		184.52	149.02	27.40
2011		184.52	149.02	27.40
2012		184.52	149.02	27.40
2013		184.52	149.02	27.40
2014		184.52	149.02	27.40
2015		184.52	149.02	27.40
			FIRR	**12.97%**
			WACC	**5.02%**

Table A3.3a: Sensitivity Analysis

Item	FIRR	Test
Base case	**12.97%**	
Caustic soda price + 10%	18.72%	1.00
Chlorine price + 10%	19.66%	1.00
Raw material cost + 10%	12.55%	1.00
Electricity cost + 10%	11.83%	1.00
Total operation cost + 10%	9.60%	1.00
Combination of:		
Caustic soda price +10%, while total operation cost +10%	16.89%	

FIRR = financial internal rate of return, WACC = weighted average cost of capital.

Table A3.4: Hefei Iron and Steel Corporation
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Revenue	Incremental Operating Cost	Net Cash After Tax
1998	16.55			(16.55)
1999	46.09			(46.09)
2000	53.27			(53.27)
2001	141.59			(141.59)
2002	158.88			(158.88)
2003	63.36			(63.36)
2004	55.52	105.80	142.36	(92.08)
2005		290.09	232.97	50.04
2006		344.60	284.03	52.36
2007	60.00	426.37	360.40	(4.02)
2008		736.03	599.36	104.66
2009		865.92	702.99	122.26
2010		865.92	706.02	120.23
2011		865.92	706.67	119.79
2012		865.92	707.35	119.33
2013		865.92	708.07	118.85
2014		865.92	709.77	117.72
2015		865.92	713.33	115.33
2016		865.92	714.16	114.77
2017		865.92	715.04	114.19
2018	16.00	865.92	715.95	97.57
2019		865.92	717.95	100.46
2020		865.92	722.15	97.64
2021		865.92	723.21	96.93
2022		865.92	724.33	96.19
			FIRR	**10.10%**
			WACC	**5.60%**

Table A3.4a: Sensitivity Analysis

Item	FIRR	Test
Base case	**10.10%**	
Commissioning of Oven #2 delayed by 1 year	9.58%	
Commisioning of Oven #2 delayed by 2 years	9.10%	
Commisioning of Oven #2 delayed by 3 years	8.65%	
Coke price + 10%	13.18%	1.00
Coal gas price + 10%	11.08%	1.00
Raw material cost (coal) + 10%	5.20%	1.00
Utilities cost + 10%	10.02%	1.00
Total operation cost + 10%	4.74%	1.00
Combination of:		
Coke price + 10%, while total operation cost + 10%	9.40%	
Coal gas price + 10%, while total operation cost + 10%	6.33%	

FIRR = financial internal rate of return, WACC = weighted average cost of capital.

Table A3.5: Chaohu Wastewater Treatment Plant
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Revenue	Incremental Operating Cost	Net Cash After Tax
1998	43.74	18.24		(25.50)
1999	50.46	9.61		(40.85)
2000	7.11	9.88		2.76
2001	24.87	10.76	1.26	(17.04)
2002	35.42	11.19	3.08	(28.20)
2003		13.16	3.61	8.18
2004		16.91	3.94	10.47
2005		20.66	4.36	12.69
2006		20.64	5.14	12.16
2007		18.49	5.41	10.54
2008		18.49	5.41	10.54
2009		18.49	5.41	10.54
2010		20.34	5.86	11.48
2011		20.34	5.86	11.48
2012		20.34	5.86	11.48
2013		20.34	5.86	11.48
2014		20.34	5.86	11.48
2015		22.38	6.37	12.50
2016		22.38	6.37	12.50
2017	8.00	22.38	6.37	4.50
2018		22.38	6.37	12.50
2019		22.38	6.37	12.50
2020		24.61	6.95	13.61
2021		24.61	6.95	13.61
2022		24.61	6.95	13.61
2023		24.61	6.95	13.61
2024		24.61	6.95	13.61
2025		27.07	7.61	14.82
2026		27.07	7.61	14.82
2027		27.07	7.61	14.82
2028		27.07	7.61	14.82
2029		27.07	7.61	14.82
2030		29.78	8.36	16.13
2031		29.78	8.36	16.13
			FIRR	**7.95%**
			WACC	**5.35%**

Table A3.5a: Sensitivity Analysis

Item	FIRR	Test
Base case	**7.95%**	
Wastewater treatment tarrif + 10%	8.70%	1.00
Electricity cost + 10%	7.85%	1.00
Total operation cost + 10%	7.72%	1.00
Combination of:		
Tariff + 10%, while total operation cost + 10%	8.49%	

FIRR = financial internal rate of return, WACC = weighted average cost of capital.

Table A3.6: Hefei Wastewater Treatment Plant
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Revenue	Incremental Operating Cost	Net Cash After Tax
1998	66.40			(66.40)
1999	105.40			(105.40)
2000	61.14			(61.14)
2001	46.27			(46.27)
2002	46.20	36.08	12.65	(26.92)
2003		35.83	12.32	19.33
2004		37.23	13.60	19.41
2005		37.23	13.83	19.26
2006		43.80	17.48	22.28
2007		43.80	17.66	22.17
2008		43.80	17.84	22.06
2009		43.80	18.03	21.95
2010		43.80	18.23	21.82
2011		43.80	20.24	20.60
2012		50.37	20.46	24.86
2013		50.37	20.69	24.72
2014		50.37	20.93	24.58
2015		50.37	21.19	24.42
2016		50.37	23.51	23.01
2017		57.93	23.79	27.90
2018		57.93	24.08	27.72
2019		57.93	24.39	27.53
2020		57.93	24.72	27.33
2021		57.93	27.40	25.70
2022		66.61	27.76	31.31
2023		66.61	28.13	31.08
2024		66.61	28.52	30.84
2025		66.61	28.94	30.59
2026		66.61	32.04	28.70
2027		76.61	32.49	35.12
2028		76.61	32.97	34.82
2029		76.61	33.47	34.52
2030		76.61	34.00	34.20
2031		76.61	37.59	32.01
			FIRR	**5.54%**
			WACC	**4.85%**

Table A3.6a: Sensitivity Analysis

Item		FIRR	Test
Base case		**5.54%**	
	Wastewater treatment tarrif + 10%	6.33%	1.00
	Electricity cost + 10%	5.38%	1.00
	Total operation cost + 10%	5.22%	1.00
Combination of:			
	Tariff + 10%, while total operation cost + 10%	6.03%	

FIRR = financial internal rate of return, WACC = weighted average cost of capital.

Table A3.7: Overall FIRR for Municipal Wastewater Treatment Component
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Revenue	Incremental Operating Cost	Net Cash After Tax
1998	110.15	18.24	0.00	(91.91)
1999	155.86	9.61	0.00	(146.25)
2000	68.25	9.88	0.00	(58.37)
2001	71.13	10.76	1.26	(63.30)
2002	81.62	47.27	15.72	(55.13)
2003	0.00	48.99	15.93	27.51
2004	0.00	54.14	17.54	29.88
2005	0.00	57.89	18.19	31.95
2006	0.00	64.44	22.63	34.44
2007	0.00	62.29	23.07	32.71
2008	0.00	62.29	23.25	32.60
2009	0.00	62.29	23.44	32.49
2010	0.00	64.14	24.09	33.30
2011	0.00	64.14	26.10	32.08
2012	0.00	70.71	26.32	36.34
2013	0.00	70.71	26.55	36.20
2014	0.00	70.71	26.79	36.06
2015	0.00	72.75	27.56	36.92
2016	0.00	72.75	29.88	35.51
2017	8.00	80.30	30.16	32.40
2018	0.00	80.30	30.46	40.22
2019	0.00	80.30	30.76	40.03
2020	0.00	82.54	31.67	40.94
2021	0.00	82.54	34.35	39.31
2022	0.00	91.23	34.71	44.92
2023	0.00	91.23	35.08	44.69
2024	0.00	91.23	35.48	44.45
2025	0.00	93.69	36.55	45.40
2026	0.00	93.69	39.65	43.52
2027	0.00	103.68	40.10	49.93
2028	0.00	103.68	40.58	49.64
2029	0.00	103.68	41.09	49.33
2030	0.00	106.39	42.36	50.32
2031	0.00	106.39	45.95	48.14
			Overall FIRR	**6.19%**
			Overall WACC	**4.99%**

FIRR = financial internal rate of return, WACC = weighted average cost of capital.

Table A3.8: Overall FIRR for Industrial Pollution Abatement Component
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Revenue	Incremental Operating Cost	Net Cash After Tax
1998	56.02	-	-	(56.02)
1999	168.75	-	-	(168.75)
2000	344.04	-	-	(344.04)
2001	291.56	231.47	172.14	(237.61)
2002	256.47	335.59	247.22	(181.79)
2003	66.17	367.59	281.57	6.93
2004	55.52	566.09	497.91	(6.43)
2005	-	816.60	642.70	143.76
2006	-	882.23	700.08	149.29
2007	60.00	973.22	783.76	94.19
2008	-	1,292.11	1,030.04	204.16
2009	-	1,422.00	1,133.66	221.75
2010	-	1,448.11	1,176.49	210.55
2011	-	1,448.11	1,177.14	210.11
2012	-	1,448.11	1,177.83	209.66
2013	-	1,448.11	1,178.54	209.17
2014	-	1,448.11	1,180.24	208.04
2015	-	1,448.11	1,183.80	205.65
2016	-	865.92	714.16	114.77
2017	-	865.92	715.04	114.19
2018	16.00	865.92	715.95	97.57
2019	-	865.92	717.95	100.46
2020	-	865.92	722.15	97.64
2021	-	865.92	723.21	96.93
2022	-	865.92	724.33	96.19
			Overall FIRR	**9.51%**
			Overall WACC	**5.41%**

FIRR = financial internal rate of return, WACC = weighted average cost of capital.

Table A3.9: Overall FIRR for Anhui Environment Improvement Project
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Revenue	Incremental Operating Cost	Net Cash After Tax
1998	166.17	18.24	-	(147.93)
1999	324.61	9.61	-	(315.01)
2000	412.29	9.88	-	(402.41)
2001	362.69	242.23	173.40	(300.91)
2002	338.09	382.86	262.95	(236.92)
2003	66.17	416.58	297.50	34.44
2004	55.52	620.23	515.44	23.45
2005	-	874.49	660.89	175.71
2006	-	946.67	722.70	183.73
2007	60.00	1,035.52	806.83	126.90
2008	-	1,354.40	1,053.29	236.76
2009	-	1,484.29	1,157.10	254.24
2010	-	1,512.25	1,200.58	243.85
2011	-	1,512.25	1,203.24	242.19
2012	-	1,518.82	1,204.15	246.00
2013	-	1,518.82	1,205.10	245.38
2014	-	1,518.82	1,207.03	244.09
2015	-	1,520.85	1,211.36	242.57
2016	-	938.66	744.05	150.28
2017	8.00	946.22	745.20	146.59
2018	16.00	946.22	746.41	137.79
2019	-	946.22	748.72	140.49
2020	-	948.46	753.82	138.59
2021	-	948.46	757.56	136.24
2022	-	957.15	759.04	141.10
2023	-	91.23	35.08	44.69
2024	-	91.23	35.48	44.45
2025	-	93.69	36.55	45.40
2026	-	93.69	39.65	43.52
2027	-	103.68	40.10	49.93
2028	-	103.68	40.58	49.64
2029	-	103.68	41.09	49.33
2030	-	106.39	42.36	50.32
2031	-	106.39	45.95	48.14
		Overall FIRR		**8.42%**
		Overall WACC		**5.30%**

FIRR = financial internal rate of return, WACC = weighted average cost of capital.

FINANCIAL PERFORMANCE OF SUBPROJECT ENTERPRISES

Table A4.1: Financial Performance of Chaohu Dongya Cement Company, 2002-2004
(CNY million)

Year Ending December 31	2001	2002	2003	2004
Income Statements				
Sales	57.04	118.48	128.99	148.35
Less: Cost of Sales	46.43	89.31	97.16	112.01
Gross Profit	10.61	29.16	31.83	36.33
Less: Total Operating Expenses	4.23	7.24	7.86	6.45
Other Operating Income	(0.00)	0.01	0.09	0.25
Operating Income/Expense	6.37	21.93	24.05	30.13
Non-operating Income/Expense	(0.35)	(0.35)	(0.20)	0.02
Interest Expenses	7.08	17.19	5.23	4.81
Net Income Before Tax	(1.05)	4.40	18.62	25.33
Income Tax		2.20	6.16	6.82
Minority Shareholder's Loss/Profit				
Net Income After Tax	**(1.05)**	**2.20**	**12.46**	**18.51**
Cash Flow Statements				
Net Income After Tax		2.20	12.46	18.51
Add: Noncash Charges		111.74	19.72	(31.62)
Interest Expense		17.19	6.00	4.79
Internal Cash Generation		131.13	38.18	(8.32)
Borrowings		60.00	40.00	40.00
Equity Contributions and Grants Received			0.57	-
Proceeds from Investments		0.41	-	
Other Local Sources		5.52	3.55	0.15
Total Sources of Funds		**197.07**	**82.30**	**31.84**
Capital Expenditures		23.86	10.57	
Debt Service		226.53	65.49	45.04
Other Payments		0.08		
Changes in Working Capital			-	
Total Application of Funds		**250.46**	**76.06**	**45.04**
Changes in Cash		**(53.40)**	**6.24**	**(13.21)**
Cash Balance, Beginning of Year		60.49	7.09	13.32
Cash Balance, End of Year		7.09	13.32	0.11
Balance Sheets				
Current Assets	164.83	35.18	53.39	72.20
Cash and Deposits	60.49	7.09	13.32	0.11
Accounts Receivable, net	5.42	10.00	16.57	59.37
Inventories, net	6.54	6.49	5.62	8.68
Other Current Assets	92.37	11.60	17.88	4.04
Fixed Assets	326.89	343.19	343.05	342.38
Less: Accumulated Depreciation	9.39	27.09	44.77	62.17
Provision for Decline in Value	0.34		-	
Fixed Assets, net	317.16	316.10	298.28	280.21
Construction in Progress		-	-	-
Other Noncurrent Assets	73.95	34.64	30.70	26.81
Total Assets	**555.93**	**385.92**	**382.36**	**379.22**
Current Liabilities	127.96	93.42	110.23	89.97
Accounts Payable	1.86	3.22	10.88	2.81
Short-Term Loans	70.00	60.00	40.00	40.00
Other Payables	56.10	30.20	59.35	47.15
Long-Term Debt	218.02	82.77	49.66	49.66
Other Long-Term Liabilities		0.07	0.35	0.41
Equity	209.95	209.66	222.12	239.18
Paid-In Capital	80.00	80.00	80.00	80.00
Surplus, Reserves, and Retained Earnings	129.95	129.66	142.12	159.18
Total Liabilities and Equity	**555.93**	**385.92**	**382.36**	**379.22**
Financial Indicators				
Return on Net Fixed Assets (%)[a]	2.01%	6.94%	8.06%	10.75%
Debt Service Coverage Ratio (times)[b]	n.a	0.58	0.58	(0.18)
Debt/Debt Plus Equity (% of debt)[c]	50.94%	28.30%	18.27%	17.19%

[a] Net operating income after taxes as a percentage of average net fixed assets in operation.

[b] Ratio of internal cash generation to annual debt service.

[c] Ratio of long-term debt to long-term debt plus equity.

Source: Chaohu Dongya Cement Company. Some accounts were estimated based on the available information.

Table A4.2: Financial Performance of Hefei Chemical Fertilizer Works, 1998–2004
(CNY million)

Year Ending December 31	1998	1999	2000	2001	2002	2003	2004[d]
Income Statements							
Sales	278.44	290.01	318.60	369.66	455.05	391.89	192.33
Less: Cost of Sales	243.78	261.95	283.17	338.79	407.26	357.20	169.25
Gross Profit	34.67	28.06	35.42	30.87	47.79	34.69	23.07
Less: Total Operating Expenses	30.41	26.48	32.39	31.04	36.32	35.25	18.48
Other Operating Income/Expense	0.78	0.58	(0.79)	1.31	1.21	1.36	0.49
Operating Income	5.03	2.15	2.24	1.14	12.68	0.79	5.08
Non-operating Income/Expense	4.70	7.98	8.28	11.34	(0.37)	8.77	0.57
Interest Expenses	6.83	7.11	7.45	11.76	11.06	7.48	4.12
Net Income Before Tax	2.89	3.02	3.07	0.73	1.25	2.08	1.54
Income Tax	0.96	1.00	1.01	0.20	0.47	0.69	0.51
Minority Shareholder's loss/Profit							
Net Income After Tax	**1.94**	**2.02**	**2.06**	**0.52**	**0.77**	**1.39**	**1.03**
Cash Flow Statements							
Net Income After Tax		2.02	2.06	0.52	0.77	1.39	1.03
Add: Noncash Charges		12.01	21.36	(29.21)	(12.38)	78.02	1.57
Interest Expense		7.11	7.45	11.76	11.06	7.48	3.24
Internal Cash Generation		21.14	30.87	(16.94)	(0.55)	86.90	5.85
Borrowings		21.60	88.78	188.42	19.45	35.08	89.80
Equity Contributions and Grants Received		(2.06)	(6.66)	3.32	0.06	19.42	
Proceeds from Investments							2.73
Other Local Sources							
Total Sources of Funds		**40.68**	**112.99**	**174.81**	**18.96**	**141.40**	**98.38**
Capital Expenditures		9.62	84.95	1.00	(12.24)	(82.89)	1.45
Debt Service		12.66	88.85	167.80	28.71	156.27	94.70
Other Payments		18.58	(61.23)	4.77	5.39	61.71	6.89
Total Application of Funds		**40.86**	**112.57**	**173.56**	**21.86**	**135.10**	**103.04**
Changes in Cash		**(0.18)**	**0.42**	**1.25**	**(2.90)**	**6.30**	**(4.66)**
Cash Balance, Beginning of Year		3.98	3.79	4.21	5.46	2.56	8.86
Cash Balance, End of Year		3.79	4.21	5.46	2.56	8.86	4.20
Balance Sheets							
Current Assets	209.16	214.72	180.31	204.48	206.89	132.36	158.11
Cash and Deposits	3.98	3.79	4.21	5.46	2.56	8.86	4.20
Accounts Receivable, net	16.14	42.20	41.13	6.05	1.56	5.02	80.66
Inventories, net	85.58	68.03	70.71	65.06	55.52	41.12	46.26
Other Current Assets	103.47	100.69	64.26	127.91	147.25	77.36	26.99
Fixed Assets	140.33	149.95	234.90	235.89	223.65	52.89	54.15
Less: Accumulated Depreciation	65.83	73.72	89.46	100.44	108.66	27.49	28.62
Provision for Losses in Fixed Asset Disposal							
Fixed Assets, net	74.49	76.23	145.44	135.45	115.00	25.40	25.53
Construction in Progress	34.86	52.64	2.81	7.08	15.00	13.23	17.03
Other Noncurrent Assets	15.42	15.78	12.62	13.13	13.12	71.76	70.92
Total Assets	**333.93**	**359.37**	**341.19**	**360.14**	**350.00**	**242.75**	**271.59**
Current Liabilities	200.56	204.87	171.04	190.58	157.94	89.33	117.32
Accounts Payable	75.72	91.80	80.12	66.01	52.50	20.74	1.59
Short-Term Loans	89.55	84.00	79.38	116.20	98.85	39.75	86.60
Other Payables	35.29	29.07	11.54	8.37	6.59	28.84	29.13
Long-Term Debt	17.58	39.18	51.18	46.74	65.89	11.28	11.13
Other Long-Term Liabilities	0.72	0.28	8.55	8.55	11.07	6.23	5.60
Equity	115.08	115.04	110.42	114.26	115.10	135.91	137.54
Paid-In Capital	65.56	69.38	70.03	70.03	70.03	70.03	70.03
Surplus, Reserves, and Retained Earnings	49.52	45.66	40.40	44.24	45.07	65.88	67.51
Total Liabilities and Equity	**333.93**	**359.37**	**341.19**	**360.14**	**350.00**	**242.75**	**271.59**
Financial Indicators							
Return on Net Fixed Assets (%)[a]	6.75%	2.83%	1.54%	0.84%	11.03%	3.13%	19.89%
Debt Service Coverage Ratio (times)[b]	n.a	1.67	0.35	(0.10)	(0.02)	0.56	0.06
Debt/Debt Plus Equity (% of debt)[c]	13.25%	25.41%	31.67%	29.03%	36.41%	7.66%	7.49%

[a] Net operating income after taxes as a percentage of average net fixed assets in operation.

[b] Ratio of internal cash generation to annual debt service.

[c] Ratio of long-term debt to long-term debt plus equity.

[d] Hefei Fertilizer Chemical Works used the subproject's assets to set up a new share holding company, Sifang Chemical and Industrial Corp. Ltd. (SCIC) in July 2003. The above financial statements for 2004 are for SCIC.

Source: Hefei Sifang Chemical Fertilizer Works. Some accounts were estimated based on the available information.

Table A4.3: Financial Performance of Hefei Iron and Steel Corporation, 1998–2004
(CNY million)

Year Ending December 31	1998	1999	2000	2001	2002	2003	2004
Income Statements							
Sales	1,177.65	1,210.03	1,483.99	1,400.68	1,850.55	2,063.70	2,399.87
Less: Cost of Sales	1,197.39	1,124.77	1,359.39	1,282.69	1,670.18	1,765.26	2,381.54
Gross Profit	(19.74)	85.26	124.60	117.99	180.37	298.44	18.33
Less: Total Operating Expenses	137.42	125.20	109.33	121.67	161.03	270.79	210.18
Other Operating Income	26.39	23.21	4.22	11.00	5.36	4.82	3.87
Operating Income/Expense	(130.78)	(16.72)	19.49	7.32	24.69	32.47	(187.98)
Non-operating Income/Expense	(80.19)	(3.52)	(4.04)	5.82	(4.50)	0.16	(2.12)
Interest Expenses	52.20	30.99	24.58	12.50	11.89	12.39	10.72
Other Adjustments							
Net Income Before Tax	(263.16)	(51.23)	(9.13)	0.63	8.30	20.25	(200.82)
Income Tax			0.09	(0.04)	6.79	40.29	(4.00)
Minority Shareholder's Loss/Profit							(106.87)
Net Income After Tax	**(263.16)**	**(51.23)**	**(9.22)**	**0.68**	**1.51**	**(20.04)**	**(89.94)**
Cash Flow Statements							
Net Income After Tax		(51.23)	(9.22)	0.68	1.51	(20.04)	(89.94)
Add: Noncash Charges		(68.71)	(71.05)	116.52	67.20	178.42	69.85
Interest Expense		30.99	24.58	12.50	11.89	12.39	10.72
Internal Cash Generation		(88.95)	(55.69)	129.70	80.60	170.76	(9.37)
Borrowings		76.26	(248.64)	196.01	231.57	794.76	106.90
Equity Contributions and Grants Received		4.65	2.58	(16.26)	16.78	95.27	
Proceeds from Investments							129.00
Other Local Sources							39.22
Total Sources of Funds		**(8.05)**	**(301.75)**	**309.45**	**328.94**	**1,060.79**	**265.75**
Capital Expenditures		(94.79)	26.34	482.07	(43.34)	113.70	75.94
Debt Service		204.07	160.84	82.14	120.28	804.83	137.97
Other Payments		(106.78)	(487.92)	(296.71)	237.49	107.71	268.84
Changes in Working Capital							(324.31)
Total Application of Funds		**2.49**	**(300.74)**	**267.51**	**314.42**	**1,026.24**	**158.44**
Changes in Cash		**(10.54)**	**(1.01)**	**41.94**	**14.53**	**34.55**	**107.31**
Cash Balance, Beginning of Year		38.89	28.35	27.34	69.28	83.81	118.36
Cash Balance, End of Year		28.35	27.34	69.28	83.81	118.36	225.67
Balance Sheets							
Current Assets	795.67	1,016.82	759.45	866.66	1,359.50	1,242.56	1,099.48
Cash and Deposits	38.89	28.35	27.34	69.28	83.81	118.36	225.67
Accounts Receivable, net	90.93	91.79	85.00	118.25	104.96	74.96	215.54
Inventories, net	510.58	583.58	339.05	400.33	389.78	318.06	311.31
Other Current Assets	155.28	313.10	308.06	278.79	780.96	731.19	346.95
Fixed Assets	2,407.47	2,312.68	2,339.01	2,821.09	2,676.07	2,789.78	2,974.48
Less: Accumulated Depreciation	766.54	762.72	819.44	886.60	855.45	935.99	1,005.84
Fixed Assets, net	1,640.93	1,549.96	1,519.58	1,934.49	1,820.62	1,853.79	1,968.64
Construction in Progress	297.82	485.99	794.78	575.56	752.26	879.10	700.36
Other Noncurrent Assets	115.06	136.16	43.05	15.48	58.16	11.03	19.84
Total Assets	**2,849.49**	**3,188.92**	**3,116.85**	**3,392.18**	**3,990.54**	**3,986.48**	**3,788.31**
Current Liabilities	1,237.53	1,480.59	847.82	949.34	1,442.82	1,378.82	1,461.16
Accounts Payable	253.22	288.21	258.40	240.17	363.84	174.51	287.76
Short-Term Loans	295.26	371.52	122.88	109.77	128.26	117.87	113.12
Other Payables	689.05	820.86	466.54	599.40	950.72	1,086.44	1,060.28
Long-Term Debt	528.40	355.32	219.06	358.53	463.23	475.94	382.46
Other Long-Term Liabilities	65.37	381.42	1,085.04	1,134.97	1,116.86	1,088.87	281.30
Equity	1,018.19	971.60	964.93	949.34	967.63	1,042.86	1,663.39
Paid-In Capital	1,117.75	1,117.84	1,117.84	1,117.84	1,117.84	1,233.80	1,224.85
Surplus, Reserves, and Retained Earnings	(99.56)	(146.24)	(152.92)	(168.50)	(150.21)	(190.94)	438.54
Total Liabilities and Equity	**2,849.49**	**3,188.92**	**3,116.85**	**3,392.18**	**3,990.54**	**3,986.48**	**3,788.31**
Financial Indicators							
Return on Net Fixed Assets (%)[a]	-7.97%	-1.08%	1.28%	0.38%	1.36%	1.75%	-9.55%
Debt Service Coverage Ratio (times)[b]	n.a	(0.44)	(0.35)	1.58	0.67	0.21	(0.07)
Debt/Debt Plus Equity (% of debt)[c]	34.17%	26.78%	18.50%	27.41%	32.37%	31.34%	18.69%

[a] Net operating income after taxes as a percentage of average net fixed assets in operation.

[b] Ratio of internal cash generation to annual debt service.

[c] Ratio of long-term debt to long-term debt plus equity.

Source: Hefei Iron and Steel Corp. Some accounts were estimated based on the available information.

Table A4.4: Financial Performance of Hefei Chemical Work, 1998–2004

(CNY million)

Year Ending December 31	1998	1999	2000	2001	2002	2003	2004
Income Statements							
Sales	267.81	278.71	350.75	304.06	374.29	494.04	567.16
Less: Cost of Sales	268.82	238.37	283.05	264.14	319.31	428.07	492.22
Gross Profit	(1.01)	40.35	67.71	39.93	54.98	65.97	74.93
Less: Total Operating Expenses	30.76	29.93	39.36	30.98	38.55	54.06	71.29
Other Operating Income		(0.31)	0.51	1.08	0.54	0.74	0.65
Operating Income/Expense	(31.77)	10.11	28.86	10.02	16.98	12.65	4.29
Non-operating Income/Expense	(1.51)	(0.03)	(1.61)	(1.61)	(2.66)	(1.05)	(1.20)
Other Adjustments							
Interest Expenses	10.80	10.04	25.68	6.84	7.26	8.51	16.79
Other Adjustments							
Net Income Before Tax	(44.07)	0.04	1.56	1.57	7.06	3.09	(13.69)
Minority Shareholder's Loss/Profit						0.44	0.33
Net Income After Tax	**(44.07)**	**0.04**	**1.18**	**1.39**	**6.87**	**0.69**	**(14.11)**
Cash Flow Statements							
Net Income After Tax		0.04	1.18	1.39	6.87	0.69	(14.11)
Add: Noncash Charges		(20.31)	(58.85)	62.48	17.22	31.12	34.32
Interest Expense		10.04	25.68	6.84	7.26	8.51	16.98
Internal Cash Generation		(10.23)	(31.98)	70.72	31.35	40.32	37.19
Borrowings		47.81	(11.43)	48.72	82.50	85.56	56.16
Equity Contributions and Grants Received		7.88	407.80	(20.58)	(3.47)		
Proceeds from Investments						8.03	
Other Local Sources						0.76	1.07
Total Sources of Funds		**45.46**	**364.39**	**98.85**	**110.38**	**134.67**	**94.43**
Capital Expenditures		3.33	17.27	(99.69)	18.01	23.37	37.32
Debt Service		53.94	233.65	63.99	58.90	94.68	55.39
Other Payments		(2.44)	106.09	141.27	17.67	7.69	7.44
Total Application of Funds		**54.84**	**357.01**	**105.57**	**94.58**	**125.74**	**100.16**
Changes in Cash		**(9.38)**	**7.38**	**(6.72)**	**15.80**	**8.93**	**(5.73)**
Cash Balance, Beginning of Year		11.48	2.11	9.49	2.77	18.57	27.50
Cash Balance, End of Year		2.11	9.49	2.77	18.57	27.50	21.77
Balance Sheets							
Current Assets	148.82	178.54	210.47	180.20	206.60	221.10	320.48
Cash and Deposits	11.48	2.11	9.49	2.77	18.57	27.50	21.77
Accounts Receivable, net	72.49	77.12	63.56	71.38	51.98	103.37	212.29
Inventories, net	43.97	56.85	85.10	63.58	65.47	52.34	61.19
Other Current Assets	20.88	42.47	52.32	42.46	70.58	37.89	25.23
Fixed Assets	622.77	626.10	643.37	543.68	561.69	672.02	656.65
Less: Accumulated Depreciation	155.76	171.40	189.80	217.60	245.37	202.07	221.18
Fixed Assets, net	467.01	454.70	453.57	326.09	316.32	469.95	435.47
Construction in Progress	1.87	3.58	1.18	12.83	19.20	35.21	50.88
Other Noncurrent Assets	1.82	0.66	109.71	228.83	239.12	276.48	242.10
Total Assets	**619.52**	**637.48**	**774.93**	**747.94**	**781.24**	**1,002.74**	**1,048.93**
Current Liabilities	327.46	329.81	265.87	268.80	268.43	314.85	474.45
Accounts Payable	120.99	118.36	128.55	128.52	120.56	144.11	158.08
Short-Term Loans	72.43	71.63	60.20	52.00	51.58	50.98	50.55
Other Payables	134.05	139.82	77.12	88.27	96.29	119.75	265.82
Long-Term Debt	235.79	240.50	32.53	32.30	63.58	218.37	246.02
Other Long-Term Liabilities	9.96	12.95	13.33	2.83	1.82	0.10	0.10
Equity	46.30	54.22	463.19	444.01	447.41	469.43	328.37
Paid-In Capital	50.00	51.00	459.55	368.31	375.32	401.34	401.97
Surplus, Reserves, and Retained Earnings	(3.70)	3.22	3.64	75.70	72.08	68.09	(73.60)
Total Liabilities and Equity	**619.52**	**637.48**	**774.93**	**747.94**	**781.24**	**1,002.74**	**1,048.93**
Financial Indicators							
Return on Net Fixed Assets (%)[a]	-6.80%	2.22%	6.36%	3.07%	5.37%	2.69%	0.98%
Debt Service Coverage Ratio (times)[b]	n.a	(0.19)	(0.14)	1.11	0.53	0.43	0.67
Debt/Debt Plus Equity (% of debt)[c]	83.59%	81.60%	6.56%	6.78%	12.44%	31.75%	42.83%

[a] Net operating income after taxes as a percentage of average net fixed assets in operation.

[b] Ratio of internal cash generation to annual debt service.

[c] Ratio of long-term debt to long-term debt plus equity.

Source: Hefei Chemical Works Company. Some accounts were estimated based on the available information.

Table A4.5: Financial Performance of Hefei Sewage Treatment Company 2002-2004
(CNY million)

Year Ending December 31	2002	2003 (Jan-Jun)[d]
Income Statements		
Sales	24.89	18.62
Less: Cost of Sales	27.87	13.15
Gross Profit	(2.99)	5.47
Less: Total Operating Expenses	0.67	0.17
Other Operating Income	0.07	
Operating Income/Expense	(3.59)	5.29
Non-operating Income/Expense	-	-
Interest Expenses	3.31	1.66
Net Income Before Tax	(6.90)	3.64
Income Tax	-	0.60
Net Income After Tax	**(6.90)**	**3.04**
Cash Flow Statements		
Net Income After Tax		3.04
Add: Noncash Charges		6.92
Interest Expense		1.66
Internal Cash Generation		11.62
Borrowings		
Equity Contributions and Grants Received		
Proceeds from Investments		
Other Local Sources		
Total Sources of Funds		**11.62**
Capital Expenditures		
Debt Service		1.66
Other Payments		2.29
Changes in Working Capital		
Total Application of Funds		**3.95**
Changes in Cash	**-**	**7.67**
Cash Balance, Beginning of Year		0.34
Cash Balance, End of Year		8.01
Balance Sheets		
Current Assets	5.67	13.70
Cash and Deposits	0.34	8.01
Accounts Receivable, net	2.78	2.29
Inventories, net	2.54	3.12
Other Current Assets	0.01	0.29
Fixed Assets	364.48	364.48
Less: Accumulated Depreciation	13.85	20.78
Fixed Assets, net	350.63	343.71
Construction in Progress	-	-
Other Noncurrent Assets	-	
Total Assets	**356.30**	**357.40**
Current Liabilities	2.37	1.64
Accounts Payable	2.07	1.23
Short-Term Loans	-	-
Other Payables	0.30	0.41
Long-Term Debt	216.03	214.82
Other Long-Term Liabilities	-	
Equity	137.90	140.94
Paid-In Capital	144.80	144.80
Surplus, Reserves, and Retained Earnings	(6.90)	(3.86)
Total Liabilities and Equity	**356.30**	**357.40**
Financial Indicators		
Return on Net Fixed Assets (%)[a]	-1.02%	1.54%
Debt Service Coverage Ratio (times)[b]		7.02
Debt/Debt Plus Equity (% of debt)[c]	61.04%	60.38%

[a] Net operating income after taxes as a percentage of average net fixed assets in operation.

[b] Ratio of internal cash generation to annual debt service.

[c] Ratio of long-term debt to long-term debt plus equity.

[d] Hefei Sewage Treatment Company was sold to a German in early December 2003. Balance Sheet Information for Hefei Sewage Treatment Company is only available as of the 30th of June 2003.

Source: Hefei Sewage Treatment Company. Some accounts were estimated based on the available information.

Table A4.6: Financial Performance of Chaohu Sewage Treatment Company, 2002-2004
(CNY million)

Year Ending December 31	2002	2003	2004
Income Statements			
Sales	9.56	11.44	14.56
Less: Cost of Sales	5.12	6.33	6.87
Gross Profit	4.44	5.11	7.69
Less: Total Operating Expenses	0.56	0.52	0.50
Other Operating Income	-	-	-
Operating Income/Expense	3.88	4.59	7.19
Non-operating Income/Expense	-	-	-
Interest Expenses	2.03	3.70	3.60
Net Income Before Tax	1.86	0.89	3.59
Income Tax	0.37	0.18	0.61
Minority Shareholder's Loss/Profit			
Net Income After Tax	**1.48**	**0.71**	**2.98**
Cash Flow Statements			
Net Income After Tax		0.71	2.98
Add: Noncash Charges		3.17	3.44
Interest Expense		3.70	3.60
Internal Cash Generation		7.58	10.02
Borrowings			
Equity Contributions and Grants Received			-
Proceeds from Investments			
Other Local Sources			
Total Sources of Funds		**7.58**	**10.02**
Capital Expenditures			
Debt Service		3.70	3.60
Other Payments			
Changes in Working Capital		3.76	6.33
Total Application of Funds		**7.47**	**9.93**
Changes in Cash	**-**	**0.12**	**0.08**
Cash Balance, Beginning of Year		0.17	0.28
Cash Balance, End of Year		0.28	0.37
Balance Sheets			
Current Assets	3.20	6.68	13.03
Cash and Deposits	0.17	0.28	0.36
Accounts Receivable, net	2.94	6.34	12.50
Inventories, net	0.05	0.03	0.15
Other Current Assets	0.04	0.02	0.01
Fixed Assets	124.92	124.92	124.92
Less: Accumulated Depreciation	2.56	5.73	9.16
Provision for Decline in Value		-	
Fixed Assets, net	122.36	119.19	115.76
Construction in Progress	-	-	-
Other Noncurrent Assets	5.07	5.07	5.07
Total Assets	**130.63**	**130.94**	**133.86**
Current Liabilities	6.34	5.94	5.88
Accounts Payable			-
Short-Term Loans	-	-	-
Other Payables	6.34	5.94	5.88
Long-Term Debt	90.33	90.33	90.33
Other Long-Term Liabilities	-	-	-
Equity	33.95	34.66	37.64
Paid-In Capital	32.46	32.46	32.46
Surplus, Reserves, and Retained Earnings	1.48	2.20	5.18
Total Liabilities and Equity	**130.63**	**130.94**	**133.86**
Financial Indicators			
Return on Net Fixed Assets (%)[a]	3.17%	3.86%	6.21%
Debt Service Coverage Ratio (times)[b]		2.05	2.78
Debt/Debt Plus Equity (% of debt)[c]	72.68%	72.27%	70.59%

[a] Net operating income after taxes as a percentage of average net fixed assets in operation.

[b] Ratio of internal cash generation to annual debt service.

[c] Ratio of long-term debt to long-term debt plus equity.

Source: Chaohu Sewage Treatment Company. Some accounts were estimated based on the available information.

ECONOMIC REEVALUATION

A. Assumptions for Economic Reevaluation

1. General

1. Recalculation of the economic internal rate of return (EIRR) was carried out on an incremental basis. Incremental costs and benefits are determined by comparing situations with and without a project for each subproject. The economic life of the project facilities remained the same as those in the Report and Recommendation of the President and the Project Completion Report, that is, 30 years for wastewater treatment subprojects and 15 years for the industrial pollution abatement subproject, with no salvage value. All prices of tradable commodities were expressed in 2004 world prices in domestic currency.

2. Economic Capital Cost

2. Economic values of capital costs were derived from converting actual financial capital cost components with certain conversion factors. Taxes, duties, and interests during construction were excluded. Imported equipment was valued at international prices, while local equipment was valued by applying a conversion factor of 1.1 to the respective financial costs. The conversion factor for civil works was 1.1, while the conversion factor for the rest of capital cost components was 0.926.

3. Input and Output Prices

3. Economic costs for inputs to all subprojects were derived by converting their financial costs with the respective conversion factors. A standard conversion factor of 0.926 was applied to all inputs except for coal and salt. As coal was an exportable input, its economic price was valued at its free-on-board price minus local transport and handling costs adjusted to the source of supply.

4. As to the economic prices for project outputs, the economic values of the wastewater treatment tariff were valued on the basis of customers' willingness to pay for wastewater treatment, conservatively assumed at Y1 per ton for both Hefei and Chaohu. The economic value of coal gas was valued on the basis of the border price of liquefied petroleum gas that would have been otherwise used in the absence of the subproject, with adjustments for local transportation and handling costs. Other project outputs such as fertilizer, cement, caustic soda, and coke, and project byproducts such as coal tar, sulfur, benzol, carbolineum, and haphthalene, were all valued at their border prices with adjustments for local transportation and handling costs depending on whether they are exportable outputs or import substitutes or both.

4. Economic Benefits and Costs

5. Economic benefits from wastewater treatment subprojects were valued mainly at customers' willingness to pay for wastewater treatment in Hefei and Chaohu cities. Main economic benefits from industrial pollution abatement subprojects were derived from incremental economic benefits of project outputs that were sold. Potential environmental benefits from the reduction in wastewater discharge volumes for industrial subprojects were identified but not quantified in this analysis, partly because the volume of wastewater discharge from an industrial subproject depends on capacity utilization, which that is in turn affected by factors such as market demands for project outputs and working capital positions at subproject

enterprises. Economic benefits from energy efficiency improvement were reflected in the reduced production cost and the enhanced production volumes.

6. The economic costs were derived from converting the financial incremental operating costs with certain conversion factors.

5. Projections

7. Projections for each subproject were made for a period of either 30 or 15 years wherever applicable. Projections on production volume, sales volume, sales price, and production cost were based on forecasts provided by each subproject enterprise, with the market trend being taken into consideration.

B. Economic Analysis

8. Table A5.1 provides the recalculated EIRRs for all subprojects and the Project as a whole. The EIRR for the overall project was recalculated as 16.4%. The recalculated EIRR is 17.8% for the industrial pollution abatement component, and 16.7% for the wastewater treatment component. EIRRs for individual subprojects ranged from 13.0% to 20.0%.

ECONOMIC INTERNAL RATE OF RETURN

Table A5.1: Chaohu Dongya Cement Company
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Benefits	Incremental Cost	Net Benefit
1998	3.22			(3.22)
1999	83.88			(83.88)
2000	100.97			(100.97)
2001	81.15	62.21	37.77	(56.70)
2002	57.61	129.23	74.73	(3.11)
2003		139.74	83.43	56.31
2004		166.98	103.65	63.33
2005		169.53	105.23	64.30
2006		169.53	105.23	64.30
2007		169.53	105.23	64.30
2008		169.53	105.23	64.30
2009		169.53	105.23	64.30
2010		186.48	116.67	69.81
2011		186.48	116.67	69.81
2012		186.48	116.67	69.81
2013		186.48	116.67	69.81
2014		186.48	116.67	69.81
2015		186.48	116.67	69.81
			EIRR	**16.07%**

Table A5.1a: Sensitivity Analysis

Item		EIRR	Test
Base case		**16.07%**	
	Clinker price + 10%	18.34%	1.00
	Raw material cost + 10%	15.91%	1.00
	Electricity cost + 10%	15.70%	1.00
	Coal cost + 10%	15.37%	1.00
	Total operation cost + 10%	14.42%	1.00
Combination of:			
	Clinker price +10%, while total operation cost + 10%	16.98%	

EIRR = economic internal rate of return.

Table A5.2: Hefei Chemical Fertilizer Plant
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Benefits	Incremental Cost	Net Benefit
1998	25.55			(25.55)
1999	11.39			(11.39)
2000	109.54			(109.54)
2001	45.28	117.87	90.98	(18.40)
2002	15.61	146.82	117.90	13.32
2003	2.82	159.41	138.94	17.66
2004		202.21	163.64	38.57
2005		243.24	199.39	43.85
2006		228.14	185.31	42.83
2007		228.14	185.31	42.83
2008		228.14	185.31	42.83
2009		228.14	185.31	42.83
2010		239.54	202.29	37.25
2011		239.54	202.29	37.25
2012		239.54	202.29	37.25
2013		239.54	202.29	37.25
2014		239.54	202.29	37.25
2015		239.54	202.29	37.25
			EIRR	**14.46%**

Table A5.2a: Sensitivity Analysis

Item	EIRR	Test
Base case	**14.46%**	
Urea price + 10%	18.91%	1.00
Raw material cost + 10%	12.23%	1.00
Electricity cost + 10%	13.15%	1.00
Total operation cost + 10%	4.56%	1.00
Combination of:		
Urea price + 10%, while total operation cost + 10%	11.92%	

EIRR = economic internal rate of return.

Table A5.3: Hefei Chemical Works
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Benefits	Incremental Cost	Net Benefit
1998	10.65			(10.65)
1999	26.73			(26.73)
2000	79.32			(79.32)
2001	22.95	92.43	72.98	(3.50)
2002	23.90	100.07	76.02	0.15
2003		103.95	73.24	30.70
2004		127.32	93.63	33.69
2005		144.32	102.74	41.58
2006		162.91	115.93	46.98
2007		171.96	122.81	49.15
2008		181.01	129.69	51.32
2009		181.01	129.69	51.32
2010		181.01	140.21	40.80
2011		181.01	140.21	40.80
2012		181.01	140.21	40.80
2013		181.01	140.21	40.80
2014		181.01	140.21	40.80
2015		181.01	140.21	40.80
			EIRR	**19.85%**

Table A5.3a: Sensitivity Analysis

Item		EIRR	Test
Base case		**19.85%**	
	Caustic soda price + 10%	25.00%	1.00
	Chlorine price + 10%	26.26%	1.00
	Raw material cost + 10%	19.45%	1.00
	Electricity cost + 10%	18.78%	1.00
	Total operation cost + 10%	16.71%	1.00
Combination of:			
	Caustic soda price + 10%, while total operation cost +10%	23.12	

EIRR = economic internal rate of return.

Table A5.4: Hefei Iron and Steel Corporation
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Benefits	Incremental Cost	Net Benefit
1998	16.70			(16.70)
1999	46.51			(46.51)
2000	53.76			(53.76)
2001	142.88			(142.88)
2002	160.33			(160.33)
2003	63.94			(63.94)
2004	57.07	136.04	152.95	(73.98)
2005		333.90	247.82	86.07
2006		397.33	300.96	96.37
2007	61.68	492.49	380.43	50.39
2008		847.53	632.67	214.86
2009		997.09	742.05	255.04
2010		997.09	745.25	251.84
2011		997.09	745.94	251.15
2012		997.09	746.66	250.43
2013		997.09	747.42	249.67
2014		997.09	749.21	247.88
2015		997.09	752.97	244.12
2016		997.09	753.85	243.24
2017		997.09	754.77	242.32
2018	17.60	997.09	755.74	223.75
2019		997.09	757.85	239.24
2020		997.09	762.28	234.81
2021		997.09	763.40	233.69
2022		997.09	764.58	232.51
			EIRR	**18.81%**

Table A5.4a: Sensitivity Analysis

Item	EIRR	Test
Base case	**18.81%**	
Commissioning of Oven #2 delayed by 1 year	18.40%	
Commissioning of Oven # 2 delayed by 2 years	17.16%	
Commissioning of Oven # 2 delayed by 3 years	16.19%	
Coke price + 10%	21.80%	1.00
Coal gas price + 10%	19.57%	1.00
Raw material cost (coal) + 10%	14.93%	1.00
Utilities cost + 10%	18.76%	1.00
Total operation cost + 10%	14.62%	1.00
Combination of:		
Coke price + 10%, while total operation cost + 10%	18.54%	
Coal gas price + 10%, while total operation cost + 10%	15.64%	

EIRR = economic internal rate of return.

Table A5.5: Chaohu Wastewater Treatment Plant
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Benefits	Incremental Cost	Net Benefit
1998	43.49	22.00		(21.49)
1999	50.17	11.39		(38.78)
2000	7.07	11.71		4.63
2001	24.72	12.78	1.15	(13.09)
2002	34.10	13.30	2.80	(23.59)
2003		15.67	3.29	12.38
2004		20.55	3.65	16.90
2005		25.30	4.05	21.25
2006		25.27	4.77	20.49
2007		23.12	5.02	18.09
2008		23.12	5.02	18.09
2009		23.12	5.02	18.09
2010		25.43	5.44	19.99
2011		25.43	5.44	19.99
2012		25.43	5.44	19.99
2013		25.43	5.44	19.99
2014		25.43	5.44	19.99
2015		27.97	5.91	22.06
2016		27.97	5.91	22.06
2017	8.80	27.97	5.91	13.26
2018		27.97	5.91	22.06
2019		27.97	5.91	22.06
2020		30.77	6.45	24.32
2021		30.77	6.45	24.32
2022		30.77	6.45	24.32
2023		30.77	6.45	24.32
2024		30.77	6.45	24.32
2025		33.84	7.06	26.78
2026		33.84	7.06	26.78
2027		33.84	7.06	26.78
2028		33.84	7.06	26.78
2029		33.84	7.06	26.78
2030		37.23	7.76	29.47
2031		37.23	7.76	29.47
			EIRR	**14.53%**

Table A5.5a: Sensitivity Analysis

Item	EIRR	Test
Base case	**14.53%**	
		1.00
Electricity cost + 10%	14.44%	1.00
Total operation cost + 10%	14.32%	1.00

EIRR = economic internal rate of return.

Table A5.6: Hefei Wastewater Treatment Plant
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Benefits	Incremental Cost	Net Benefit
1998	65.87			(65.87)
1999	104.56			(104.56)
2000	60.65			(60.65)
2001	45.90			(45.90)
2002	45.83	53.05	11.74	(4.51)
2003		52.69	11.43	41.26
2004		54.75	12.62	42.13
2005		54.75	12.84	41.91
2006		64.41	14.75	49.66
2007		64.41	14.89	49.52
2008		64.41	15.05	49.36
2009		64.41	15.21	49.20
2010		64.41	15.38	49.04
2011		64.41	17.08	47.34
2012		74.07	17.26	56.81
2013		74.07	17.46	56.62
2014		74.07	17.66	56.41
2015		74.07	17.87	56.20
2016		74.07	19.83	54.24
2017		85.18	20.07	65.11
2018		85.18	20.32	64.87
2019		85.18	20.58	64.61
2020		85.18	20.85	64.33
2021		85.18	23.11	62.07
2022		97.96	23.41	74.55
2023		97.96	23.73	74.23
2024		97.96	24.06	73.90
2025		97.96	24.41	73.55
2026		97.96	27.03	70.94
2027		112.66	27.41	85.25
2028		112.66	27.81	84.84
2029		112.66	28.24	84.42
2030		112.66	28.68	83.97
2031		112.66	31.71	80.95
			EIRR	**12.77%**

Table A5.6a: Sensitivity Analysis

Item	EIRR	Test
Base case	**12.77%**	
		1.00
Electricity cost + 10%	12.65%	1.00
Total operation cost + 10%	12.54%	1.00

EIRR = economic internal rate of return.

Table A5.7: Overall EIRR for Municipal Wastewater Treatment Plant
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Benefits	Incremental Cost	Net Cash
1998	109.36	22.00	-	(87.37)
1999	154.73	11.39	-	(143.34)
2000	67.72	11.71	-	(56.01)
2001	70.62	12.78	1.15	(58.99)
2002	79.93	66.36	14.54	(28.11)
2003	-	68.37	14.72	53.65
2004	-	75.30	16.27	59.03
2005	-	80.05	16.88	63.16
2006	-	89.68	19.52	70.16
2007	-	87.53	19.92	67.61
2008	-	87.53	20.07	67.46
2009	-	87.53	20.23	67.30
2010	-	89.84	20.81	69.03
2011	-	89.84	22.51	67.32
2012	-	99.50	22.70	76.80
2013	-	99.50	22.89	76.61
2014	-	99.50	23.10	76.40
2015	-	102.04	23.79	78.26
2016	-	102.04	25.75	76.30
2017	8.80	113.15	25.98	78.37
2018	-	113.15	26.23	86.92
2019	-	113.15	26.49	86.66
2020	-	115.95	27.30	88.65
2021	-	115.95	29.56	86.39
2022	-	128.73	29.86	98.86
2023	-	128.73	30.18	98.55
2024	-	128.73	30.51	98.21
2025	-	131.80	31.47	100.33
2026	-	131.80	34.09	97.72
2027	-	146.50	34.47	112.03
2028	-	146.50	34.88	111.62
2029	-	146.50	35.30	111.20
2030	-	149.88	36.44	113.44
2031	-	149.88	39.47	110.41
			Overall EIRR	**13.19%**

EIRR = economic internal rate of return.

Table A5.8: Overall EIRR for Industrial Pollution Abatement Component
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Benefits	Incremental Cost	Net Benefit
1998	56.12	-	-	(56.12)
1999	168.51	-	-	(168.51)
2000	343.59	-	-	(343.59)
2001	292.26	272.52	201.73	(221.48)
2002	257.45	376.12	268.64	(149.98)
2003	66.75	403.09	295.61	40.73
2004	57.07	632.56	513.87	61.62
2005	-	890.99	655.18	235.81
2006	-	957.91	707.43	250.48
2007	61.68	1,062.11	793.77	206.67
2008	-	1,426.20	1,052.90	373.30
2009	-	1,575.77	1,162.28	413.49
2010	-	1,604.13	1,204.42	399.71
2011	-	1,604.13	1,205.11	399.02
2012	-	1,604.13	1,205.83	398.30
2013	-	1,604.13	1,206.59	397.54
2014	-	1,604.13	1,208.38	395.75
2015	-	1,604.13	1,212.14	391.98
2016	-	997.09	753.85	243.24
2017	-	997.09	754.77	242.32
2018	17.60	997.09	755.74	223.75
2019	-	997.09	757.85	239.24
2020	-	997.09	762.28	234.81
2021	-	997.09	763.40	233.69
2022	-	997.09	764.58	232.51
			Overall EIRR	**17.76%**

EIRR = economic internal rate of return.

Table A5.9: Overall EIRR for Anhui Environment Improvement Project
(CNY million)

Year Ending 31 Dec	Capital Cost	Incremental Benefits	Incremental Cost	Net Benefit
1998	165.49	22.00	-	(143.49)
1999	323.24	11.39	-	(311.85)
2000	411.31	11.71	-	(399.60)
2001	362.87	285.30	202.89	(280.46)
2002	337.38	442.47	283.18	(178.09)
2003	66.75	471.46	310.33	94.38
2004	57.07	707.86	530.14	120.65
2005	-	971.03	672.06	298.97
2006	-	1,047.58	726.95	320.64
2007	61.68	1,149.64	813.69	274.28
2008	-	1,513.73	1,072.97	440.76
2009	-	1,663.29	1,182.51	480.79
2010	-	1,693.97	1,225.23	468.73
2011	-	1,693.97	1,227.62	466.34
2012	-	1,703.63	1,228.53	475.10
2013	-	1,703.63	1,229.48	474.14
2014	-	1,703.63	1,231.48	472.15
2015	-	1,706.17	1,235.93	470.24
2016	-	1,099.14	779.60	319.54
2017	8.80	1,110.25	780.76	320.69
2018	17.60	1,110.25	781.97	310.68
2019	-	1,110.25	784.34	325.91
2020	-	1,113.04	789.59	323.46
2021	-	1,113.04	792.97	320.08
2022	-	1,125.82	794.45	331.38
2023	-	128.73	30.18	98.55
2024	-	128.73	30.51	98.21
2025	-	131.80	31.47	100.33
2026	-	131.80	34.09	97.72
2027	-	146.50	34.47	112.03
2028	-	146.50	34.88	111.62
2029	-	146.50	35.30	111.20
2030	-	149.88	36.44	113.44
2031	-	149.88	39.47	110.41
			Overall EIRR	**16.39%**

EIRR = economic internal rate of return.

MANAGEMENT RESPONSE TO THE PROJECT PERFORMANCE EVALUATION REPORT FOR THE ANHUI ENVIRONMENTAL IMPROVEMENT PROJECT FOR MUNICIPAL WASTEWATER TREATMENT AND INDUSTRIAL POLLUTION ABATEMENT IN THE PEOPLE'S REPUBLIC OF CHINA (Loan 1490/1491-PRC)

On 9 February 2006, the Director General, Operations Evaluation Department, received the following response from the Managing Director General on behalf of Management:

1. Management has reviewed the Project Performance Evaluation Report (PPER) and finds the overall project rating of successful consistent with the ratings in the respective project completion reports.

2. We appreciate the report's comments on the need for ADB to review how to support state-owned enterprise (SOEs) to achieve environmental improvement as well as sound financial and economic returns. It is important to note that the projects being reviewed were appraised in 1996 and implemented in 1997–2003. More recently, with the adoption of the Innovation and Efficiency Initiative (IEI), ADB's regional departments (RDs) are strengthening the skills in financial analysis to partner with ADB's Private Sector Operations Department (PSOD) for undertaking non-sovereign lending to SOEs. Consequently, the RDs should continue to prepare SOE projects, taking PSOD's support in risk analysis. It is also important to recognize that public sector lending provides a vehicle for ADB to undertake broad sector and environmental analysis and related policy dialogues, which are essential to provide the sector and policy context for successful support to SOEs.

3. We welcome the report's recommendation for ADB to adopt a more client-oriented and demand-driven approach to its financing of projects, particularly in the area of environmental improvement, through its private sector operations. Private sector enterprises should be encouraged to adopt environmentally friendly practices, including technological upgrade. Since a large number of industrial SOEs also continue to operate, it will be equally important that these upgrade the technologies to reduce emissions and improve energy efficiency. We will endeavor to bring together suitable in-house resources and use external consulting services to prepare robust proposals to help the People's Republic of China (PRC) address environmental issues in industry. Other recommendations made by the report will also be followed up through ADB's future operations.

4. Those lessons identified by the report are duly noted and will be considered in the preparation of future projects.