Document of
The World Bank

Report No: ICR00003237

# IMPLEMENTATION COMPLETION AND RESULTS REPORT
(IBRD-48640 TF057757)

ON A

LOAN
IN THE AMOUNT OF US$173 MILLION

AND A

GLOBAL ENVIRONMENTAL FACILITY GRANT

IN THE AMOUNT OF US$5 MILLION

TO THE

PEOPLE'S REPUBLIC OF CHINA

FOR A

SECOND LIAONING MEDIUM CITIES INFRASTRUCTURE PROJECT

December 23, 2015

Water Global Practice
China and Mongolia Country Management Unit
East Asia and Pacific Region

CURRENCY EQUIVALENTS

(Exchange Rate Effective November 30, 2015)

Currency Unit = RMB
1.00 = US$ 0.156
US$ 1.00 = 6.40

FISCAL YEAR
January 1 – December 31

ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| AMP | Asset Management Plan |
| APL | Adaptable Program Loan |
| AWSC | Anshan Water Supply Company |
| BOD | Biological Oxygen Demand |
| CDB | China Development Bank |
| CLG | City Leading Group |
| CNAO | China National Auditing Office |
| CMDB | Chinese Model Bidding Documents |
| EA | Environmental Assessment |
| EDZ | Economic Development Zone |
| EMP | Environmental Management Plan |
| EPB | Environmental Protection Bureau |
| FIP | Financial Improvement Plan (for utilities) |
| FIRR | Financial Internal Rate of Return |
| FMS | Financial Management Specialist |
| FWC | Fushun Wastewater Company |
| GEF | Global Environment Facility |
| GEO | Global Environment Objectives |
| GIS | Geographic Information System |
| GPA | Global Program of Action (for the Protection of Marine Environment from Land-Based Activities |
| HWSC | Haicheng Water Supply Company |
| IBRD | International Bank for Reconstruction and Development |
| ICB | International Competitive Bidding |
| ID | Institutional Development |
| ISR | Implementing Status Report |
| IW | International Water |
| LA | Loan Agreement |
| LEP | Liaoning Environmental Project |
| LIEPP | Liaoning Integrated Environmental Protection Program |
| LMC-2 | Second Liaoning Medium Cities Infrastructure Project |
| LME | Large Maritime Ecosystems |

| | |
|---|---|
| LPDRC | Liaoning Provincial Development and Reform Commission |
| LPDF | Liaoning Provincial Finance Department |
| LPDHURC | Liaoning Provincial Department of Housing and Urban-Rural Construction |
| LPLG | Liaoning Provincial Leading Group |
| LRBP | Liao River Basin Project |
| LUCRPO | Liaoning Urban Construction and Renewal Project Office |
| M&E | Monitoring and Evaluation |
| NCB | National Competitive Bidding |
| MTR | Mid-term Review |
| NDRC | National Development and Reform Commission |
| O&M | Operation and Maintenance |
| OP | Operational Program |
| PA | Project Agreement |
| PAD | Project Appraisal Document |
| PDO | Project Development Objectives |
| PEMSEA | Partnerships in Environmental Management for the Seas of East Asia (GEF/UNDP/IMO Regional Program on Building Partnerships) |
| PIU | Project Implementing Unit |
| PMO | Project Management Office |
| PPP | Public Private Partnership |
| RAP | Resettlement Action Plan |
| SO | Strategic Objective |
| SS | Suspended Solids |
| SW | Solid Waste |
| TA | Technical Assistance |
| TN | Total Nitrogen |
| TP | Total Phosphorus |
| WWTP | Wastewater Treatment Plant |

| |
|---|
| Regional Vice President: Axel van Trotsenburg |
| Country Director: Bert Hofman |
| Senior Global Practice Director: Junaid Kamal Ahmad |
| Practice Manager: Ousmane Dione |
| Project Team Leader: Khairy Al-Jamal |
| ICR Team Leader: Khairy Al-Jamal |

**CHINA**
**Second Liaoning Medium Cities Infrastructure Project**

## CONTENTS

## A. Basic Information

| | | | |
|---|---|---|---|
| Country: | China | Project Name: | China-Second Liaoning Medium Cities Infrastructure Project |
| Project ID: | P092618, P090375 | L/C/TF Number(s): | IBRD-48640, TF-57757 |
| ICR Date: | 12/16/2015 | ICR Type: | Core ICR |
| Lending Instrument: | SIL, SIL | Borrower: | PEOPLE'S REPUBLIC OF CHINA |
| Original Total Commitment: | USD 173.00M, USD 5.00M | Disbursed Amount: | USD 161.03M, USD 4.80M |
| | | | |
| **Environmental Category: A, A** | | **Focal Area**: I | |
| **Implementing Agencies:** LUCRPO | | | |
| **Cofinanciers and Other External Partners:** | | | |

## B. Key Dates

**China-Second Liaoning Medium Cities Infrastructure Project - P092618**

| Process | Date | Process | Original Date | Revised / Actual Date(s) |
|---|---|---|---|---|
| Concept Review: | 09/20/2005 | Effectiveness: | 12/04/2007 | 12/04/2007 |
| Appraisal: | 10/27/2006 | Restructuring(s): | | 04/01/2008<br>12/30/2013<br>04/04/2014<br>12/23/2014 |
| Approval: | 06/26/2007 | Mid-term Review: | | 10/18/2010 |
| | | Closing: | 12/31/2013 | 06/30/2015 |

**China-GEF-Liaoning - P090375**

| Process | Date | Process | Original Date | Revised / Actual Date(s) |
|---|---|---|---|---|
| Concept Review: | 09/20/2005 | Effectiveness: | 12/04/2007 | 09/19/2007 |
| Appraisal: | 10/27/2006 | Restructuring(s): | | 05/24/2012<br>04/04/2014<br>12/23/2014 |
| Approval: | 06/26/2007 | Mid-term Review: | | 10/18/2010 |
| | | Closing: | 12/31/2013 | 06/30/2015 |

| C. Ratings Summary | |
|---|---|
| **C.1 Performance Rating by ICR** | |
| Outcomes | Moderately Satisfactory |
| Risk to Development Outcome | Moderate |
| Bank Performance | Moderately Satisfactory |
| Borrower Performance | Moderately Satisfactory |

| C.2 Detailed Ratings of Bank and Borrower Performance (by ICR) | | | |
|---|---|---|---|
| **Bank** | **Ratings** | **Borrower** | **Ratings** |
| Quality at Entry | Moderately Satisfactory | Government: | Moderately Satisfactory |
| Quality of Supervision: | Satisfactory | Implementing Agency/Agencies: | Moderately Satisfactory |
| Overall Bank Performance | Moderately Satisfactory | Overall Borrower Performance | Moderately Satisfactory |

| C.3 Quality at Entry and Implementation Performance Indicators | | | |
|---|---|---|---|
| **China-Second Liaoning Medium Cities Infrastructure Project - P092618** | | | |
| **Implementation Performance** | **Indicators** | **QAG Assessments (if any)** | **Rating:** |
| Potential Problem Project at any time (Yes/No): | No | Quality at Entry (QEA) | None |
| Problem Project at any time (Yes/No): | Yes | Quality of Supervision (QSA) | None |
| DO rating before Closing/Inactive status | Moderately Satisfactory | | |

| China-GEF-Liaoning - P090375 | | | |
|---|---|---|---|
| **Implementation Performance** | **Indicators** | **QAG Assessments (if any)** | **Rating:** |
| Potential Problem Project at any time (Yes/No): | No | Quality at Entry (QEA) | None |
| Problem Project at any time (Yes/No): | No | Quality of Supervision (QSA) | None |
| GEO rating before Closing/Inactive Status | Moderately Satisfactory | | |

| D. Sector and Theme Codes | | |
|---|---|---|
| **China-Second Liaoning Medium Cities Infrastructure Project - P092618** | | |
| | **Original** | **Actual** |
| **Sector Code (as % of total Bank financing)** | | |
| Flood protection | 6 | 4 |
| Solid waste management | 17 | 10 |
| Sub-national government administration | 1 | 1 |
| Wastewater Treatment and Disposal | 34 | 30 |
| Water supply | 42 | 55 |
| | | |
| **Theme Code (as % of total Bank financing)** | | |
| City-wide Infrastructure and Service Delivery | 40 | 53 |
| Pollution management and environmental health | 40 | 29 |
| Water resource management | 20 | 18 |

| **China-GEF-Liaoning - P090375** | | |
|---|---|---|
| | **Original** | **Actual** |
| **Sector Code (as % of total Bank financing)** | | |
| Solid waste management | 29 | 24 |
| Sub-national government administration | 59 | 58 |
| Wastewater Collection and Transportation | 6 | 9 |
| Wastewater Treatment and Disposal | 6 | 9 |
| | | |
| **Theme Code (as % of total Bank financing)** | | |
| Municipal governance and institution building | 40 | 52 |
| Pollution management and environmental health | 40 | 42 |
| Water resource management | 20 | 6 |

| E. Bank Staff | | |
|---|---|---|
| **China-Second Liaoning Medium Cities Infrastructure Project - P092618** | | |
| **Positions** | **At ICR** | **At Approval** |
| Vice President: | Axel van Trotsenburg | James W. Adams |
| Country Director: | Bert Hofman | David R. Dollar |
| Practice Manager/Manager: | Ousmane Dione | Keshav Varma |
| Project Team Leader: | Khairy Al-Jamal | Greg J. Browder |
| ICR Team Leader: | Khairy Al-Jamal | |
| ICR Primary Author: | Heinrich K. Unger | |

| China-GEF-Liaoning - P090375 | | |
|---|---|---|
| **Positions** | **At ICR** | **At Approval** |
| Vice President: | Axel van Trotsenburg | James W. Adams |
| Country Director: | Bert Hofman | David R. Dollar |
| Practice Manager/Manager: | Ousmane Dione | Keshav Varma |
| Project Team Leader: | Khairy Al-Jamal | Greg J. Browder |
| ICR Team Leader: | Khairy Al-Jamal | |
| ICR Primary Author: | Heinrich K. Unger | |

## F. Results Framework Analysis

**Project Development Objectives (from Project Appraisal Document)**
The project development objective is to improve the performance and sustainability of water supply, wastewater, and solid waste services in the Second Liaoning Medium Cities Infrastructure Project (LMC-2) cities.

**Revised Project Development Objectives (as approved by original approving authority)**
The PDO was not revised. However, it was phrased differently in the approved Loan Agreement. The PDO in the Loan Agreement is to assist Liaoning Province in improving the performance and sustainability of the wastewater, water supply, and solid waste services through: (i) construction of infrastructure in the Project Cities; and (ii) improving utility management and regulatory practices in Liaoning Province.

**Global Environment Objectives (from Project Appraisal Document)**
The global environmental objective of the LMC-2 project with the GEF enhancements is the reduction of land-based pollution into the Bohai Sea through investments in wastewater and solid waste infrastructure and improved utility regulation, planning and management in the LMC-2 cities and throughout Liaoning Province.

**Revised Global Environment Objectives (as approved by original approving authority)**

The GEO was not revised. Moreover, the GEO in the Grant Agreement was identical with the PDO in the approved Loan agreement.

**(a) PDO Indicators**

| Indicator | Baseline Value | Original Target Values (from approval documents) | Formally Revised Target Values | Actual Value Achieved at Completion or Target Years |
|---|---|---|---|---|
| **Indicator 1 :** | **Wastewater utility cost recovery ratio in four cities[1]** | | | |
| Value (quantitative or Qualitative) | Yingkou 1.0<br>Panjin 0.6<br>Fushun 0.5<br>Gaizhou 0.0 | Yingkou 1.1<br>Panjin 1.1<br>Fushun 1.1<br>Gaizhou 1.1 | Yingkou 1.0<br>Panjin 1.0<br>Fushun 1.0<br>Gaizhou 1.0 | Yingkou 1.1<br>Panjin 1.0<br>Fushun 1.0<br>Gaizhou 1.0 |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Revised target 100% achieved:** Panjin, Fushun and Gaizhou received subsidy from local government to operate their respective WWTPs. | | | |
| **Indicator 2 :** | **Water supply utility cost recovery ratio for five cities** | | | |
| Value (quantitative or Qualitative) | Yingkou 0.9<br>Panjin 0.8<br>Anshan 1.0<br>Haicheng 0.8<br>Xingcheng 0.9 | Yingkou 1.2<br>Panjin 1.2<br>Anshan 1.2<br>Haicheng 1.2<br>Xingcheng 1.2 | Yingkou 1.0<br>Panjin 1.0<br>Anshan 1.0<br>Haicheng 1.0<br>Xingcheng 1.0<br>Fushun 1.0 | Yingkou 0.80<br>Panjin 0.80<br>Anshan 0.93<br>Haicheng 1.0<br>Xingcheng 1.0<br>Fushun 0.9 |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Partially Achieved:** Haicheng and Xingcheng achieved the revised target. Yingkou has more debt service; Yingkou and Panjin had higher operations costs; Xingcheng received local government subsidy. Fushun was added at restructuring (no subsidy). | | | |
| **Indicator 3 :** | **Solid Waste Disposed in Landfill (tons/day) in three cities** | | | |
| Value (quantitative or Qualitative) | Panjin 0<br>Fushun 0<br>Yingkou 0 | Panjin 450<br>Fushun 360<br>Yingkou 492 | Panjin 450<br>Fushun 360<br>Yingkou 0 | Panjin 630<br>Fushun 1000 |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Target exceeded:** Revised target exceeded to reach 140% for Panjin and 278% for Fushun. However, Yingkou SWM subproject was dropped during restructuring due to land availability related issues. | | | |

[1] According to the PAD, a cost recovery ratio applied to all wastewater and water supply companies for this project was defined as operating and non-operating revenues (including subsidies) divided by total operating expenses and the greater of depreciation or debt service. See Section 3.3 for more details.

| | | | | |
|---|---|---|---|---|
| **Indicator 4 :** | **Comprehensive Cost Accounting System and MIS** | | | |
| Value (quantitative or Qualitative) | No | Yes | Dropped | N/A |
| Date achieved | 06/26/2007 | 12/31/2013 | 04/04/2014 | 06/30/2015 |
| Comments (incl. % achievement) | This indicator was dropped during the 2014 restructuring. However the activity was implemented and utility staff were better equipped to deal with financial aspects, especially cost recovery and tariff collection by project closing (see Section 3.2). | | | |
| **Indicator 5 :** | **Decrease in Non-Revenue Water (NRW)** | | | |
| Value (quantitative or Qualitative) | Yingkou 45%<br>Panjin 46%<br>Anshan 37%<br>Haicheng 47%<br>Xingcheng 55% | Yingkou 36%<br>Panjin 37%<br>Anshan 30%<br>Haicheng 38%<br>Xingcheng 44% | Indicator dropped | N/A |
| Date achieved | 06/26/2007 | 12/31/2013 | 04/04/2014 | 06/30/2015 |
| Comments (incl. % achievement) | This indicator was dropped during the 2014 restructuring but substantial reductions in NRW were achieved (see Section 3.2). | | | |

**(b) GEO Indicators**

| Indicator | Baseline Value | Original Target Values (from approval documents) | Formally Revised Target Values | Actual Value Achieved at Completion or Target Years |
|---|---|---|---|---|
| **Indicator 1 :** | **New wastewater treatment plant BOD removal (tons/year) in four cities (Yingkou, Panjin, Fushun, Gaizhou)** | | | |
| Value (quantitative or Qualitative) | 0 | 5,750 | N/A | 17,629 |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Target exceeded.** 306% achieved. | | | |
| **Indicator 2 :** | **New wastewater treatment plant total nitrogen (TN) removal (ton/year) in four cities (Yingkou, Panjin, Fushun, Gaizhou)** | | | |
| Value (quantitative or Qualitative) | 0 | 1,100 | N/A | 4,978 |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Target exceeded.** 452% achieved | | | |
| **Indicator 3 :** | **New wastewater treatment plant total phosphorus (TP) removal (ton/year) in four cities (Yingkou, Panjin, Fushun, Gaizhou)** | | | |
| Value | 0 | 210 | N/A | 509 |

| | | | | |
|---|---|---|---|---|
| (quantitative or Qualitative) | | | | |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Target exceeded.** 242% achieved. | | | |

## (c) Intermediate Results Indicators

| | | | | |
|---|---|---|---|---|
| **Indicator 1 :** | **Direct project beneficiaries (number)** | | | |
| Value (quantitative or Qualitative) | 0 | 5,100,000 | 3,000,000 | 2,900,000 |
| Date achieved | 06/26/2007 | 12/31/2013 | 12/23/2014 | 06/30/2015 |
| Comments (incl. % achievement) | **Revised target substantially achieved.** 97% achieved. This core indicator was revised during December 2014 restructuring. | | | |
| **Indicator 2 :** | **Percentage of female beneficiaries (number)** | | | |
| Value (quantitative or Qualitative) | 0 | 46.1 | N/A | 50 |
| Date achieved | 06/26/2007 | 12/31/2014 | | 06/30/2015 |
| Comments (incl. % achievement) | **Target exceeded:** 108% achieved. This core indicator was added after April 2014. | | | |
| **Indicator 3 :** | **Wastewater treatment plant (WWTP) capacity ($m^3$/day)** | | | |
| Value (quantitative or Qualitative) | 450,000 | 650,000 | N/A | 700,000 |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Target exceeded.** 107% achieved**.** Additional 50,000 m3/d (above the target) was added to Panjin WWTP. | | | |
| **Indicator 4 :** | **Total new or rehabilitated drainage pipelines (km)** | | | |
| Value (quantitative or Qualitative) | 0 | 145 | N/A | 116 |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Target partially achieved.** 80% achieved because of a dropped subcomponent due to the changes in some city plans. | | | |
| **Indicator 5 :** | **Length of new or rehabilitated pipelines for water supply (km)** | | | |
| Value (quantitative or Qualitative) | 0 | 440 | NA | 495 |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments | **Target exceeded.** 112% achieved**.** | | | |

| | | | | |
|---|---|---|---|---|
| (incl. % achievement) | | | | |
| **Indicator 6 :** | **Number of Water Meters installed** | | | |
| Value (quantitative or Qualitative) | 0 | 185,200 | 145,000 | 184,332 |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Revised target exceeded.** 127% achieved**.** The target was revised because of implementation delays. However, the project implementation caught up and exceeded the revised target by project closing. | | | |
| **Indicator 7 :** | **Industrial and municipal waste disposal capacity created under the project (ton/day)** | | | |
| Value (quantitative or Qualitative) | 0 | 2,170 | 1,050 | 1,800 |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Revised target exceeded.** 171% achieved. The landfill in Panjin has a capacity of 600 ton/day, and Fushun 1,200 ton/day. | | | |
| **Indicator 8 :** | **Training for public utilities program (person-days)** | | | |
| Value (quantitative or Qualitative) | 0 | 100 | NA | 226 |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Target exceeded.** 226% achieved. With the support of GEF activities, the project exceeded the target. | | | |
| **Indicator 9 :** | **Number of solid waste master plans completed** | | | |
| Value (quantitative or Qualitative) | 0 | 3 | 4 | 4 |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Revised target 100% achieved:** The cities of Fushun, Yingkou, Gaizhou, and Panjin completed SW master plans | | | |
| **Indicator 10 :** | **Number of wastewater master plans completed** | | | |
| Value (quantitative or Qualitative) | 0 | 3 | 2 | 2 |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Revised target 100% achieved:** The cities of Panjin and Gaizhou completed WW master plans. WW masterplan for Huludao was dropped from the project. | | | |
| **Indicator 11 :** | **Number of water utilities that the project was supporting** | | | |
| Value | 0 | 6 | N/A | 6 |

| | | | | |
|---|---|---|---|---|
| (quantitative or Qualitative) | | | | |
| Date achieved | 06/26/2007 | 12/31/2013 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | **Target 100% achieved.** The water utilities of Yingkou, Panjin, Anshan, Haicheng, Xingcheng, and Fushun were supported by the project | | | |
| **Indicator 12 :** | **Annual provincial utility benchmarking program** | | | |
| Value (quantitative or Qualitative) | None | 100% of LMC-2 cities<br><br>50% of other cities in Liaoning | 100% of GEF PIUs | 100% of GEF PIUs are presented at the city benchmarking system |
| Date achieved | 06/26/2007 | 06/30/2011 | 06/30/2015 | 06/30/2015 |
| Comments (incl. % achievement) | Revised target 100% achieved and PIUs are focussed in utilizing the benchmarking as driver for the utility performance improvement. Two provincial agencies monitoring services & performance of all WS& WW utilities. Summary data available on web[2]. | | | |

[2] This indicator has not been reported in the previous Implementation Status Reports. However, it is captured in the ICR report.

## G. Ratings of Project Performance in ISRs

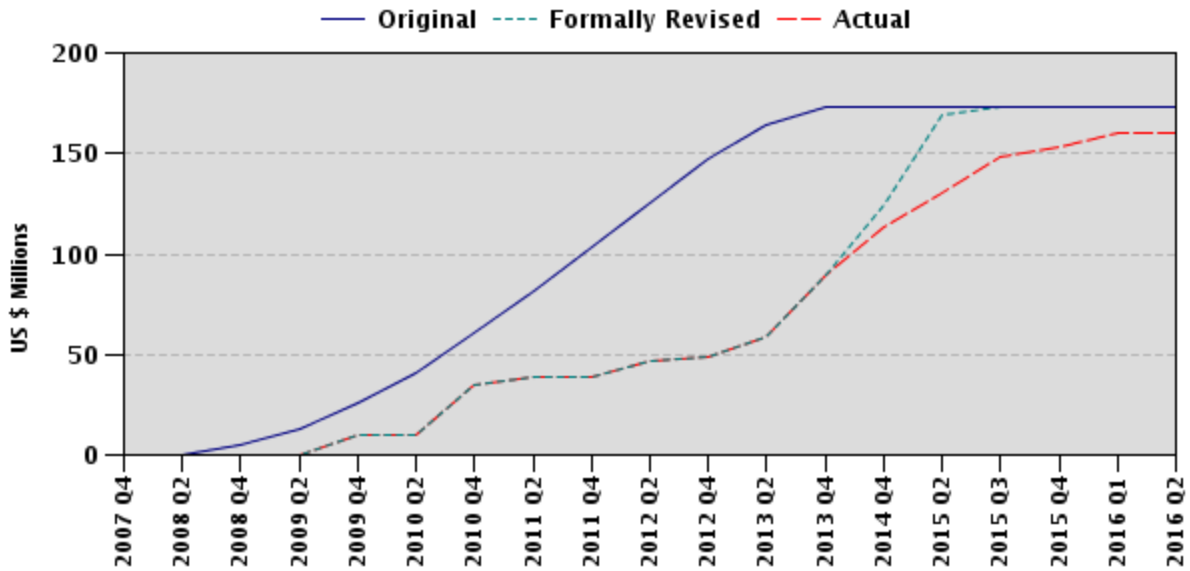
| - | | | | | | |
|---|---|---|---|---|---|---|
| No. | Date ISR Archived | DO | GEO | IP | Actual Disbursements (USD millions) | |
| | | | | | Project 1 | Project 2 |
| 1 | 06/29/2008 | MS | MS | MS | 0.00 | 0.00 |
| 2 | 06/25/2009 | MS | MU | MS | 10.00 | 0.00 |
| 3 | 01/21/2010 | MS | MU | MS | 10.00 | 0.00 |
| 4 | 06/27/2011 | MS | MS | S | 38.65 | 0.00 |
| 5 | 04/08/2012 | MS | MS | MS | 47.10 | 0.00 |
| 6 | 05/16/2013 | MU | U | MU | 78.08 | 0.00 |
| 7 | 03/03/2014 | MU | MU | MU | 94.27 | 1.00 |
| 8 | 06/25/2014 | MS | MS | MS | 113.86 | 2.49 |
| 9 | 12/08/2014 | MS | MS | MU | 130.12 | 3.44 |
| 10 | 06/14/2015 | MS | MS | MS | 153.33 | 5.00 |

## H. Restructuring (if any)

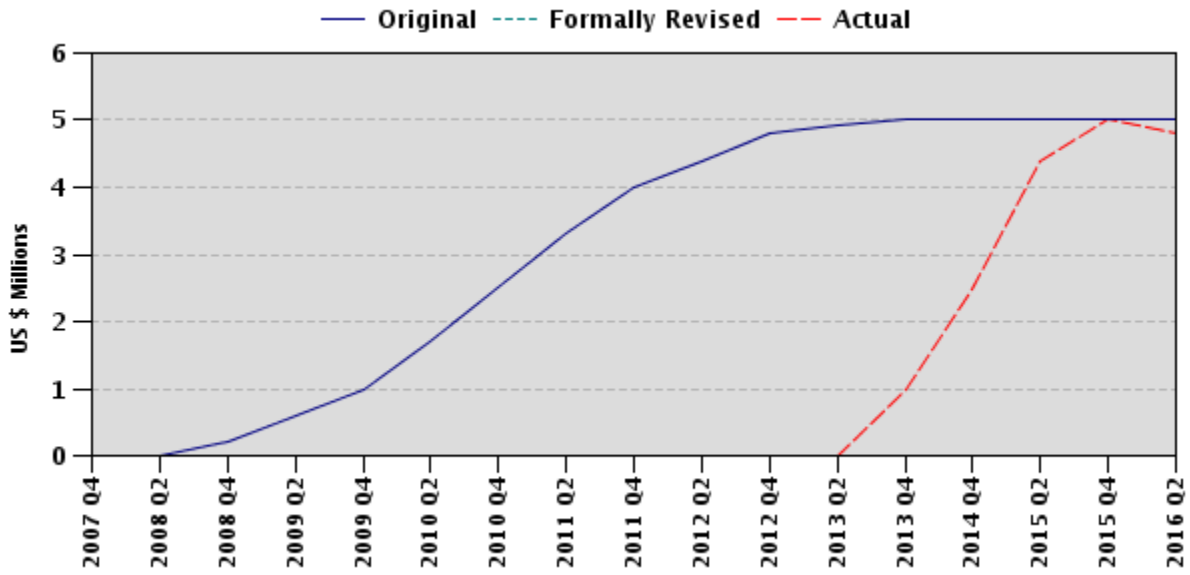
| Restructuring Date(s) | Board Approved | | ISR Ratings at Restructuring | | | Amount Disbursed at Restructuring in USD millions | | Reason for Restructuring & Key Changes Made |
|---|---|---|---|---|---|---|---|---|
| | PDO Change | GEO Change | DO | GEO | IP | Project1 | Project 2 | |
| 04/01/2008 | | | | | | 0.00 | | (i) Reallocation of loan proceeds necessary for capitalization of the front end fee; (ii) reduction of loan allocation for consultant services by $1 million; and (iii) correction of an error in the Project Agreement of the date for submission to the Bank by each utility of their financial improvement plan. |
| 05/24/2012 | | N | | MS | MS | | 0.00 | Amendment of project scope and dissemination |
| 12/30/2013 | N | | MU | | MU | 89.20 | | Extension of closing date. |
| 04/04/2014 | N | | MU | | MU | 97.48 | | (i) Revision of the project scope for some project cities; (ii) project costs and financing plan update; (iii) reallocation of Loan proceeds among categories; (iv) amendment of the Results Framework; and (v) amendment of certain covenants in the Project Agreement. |
| 04/04/2014 | | N | | MU | MU | | 1.00 | Extension of closing date |
| 12/23/2014 | N | | MS | | MU | 130.12 | | Extension of closing date and revision of Intermediate Outcome Indicator 1 |
| 12/23/2014 | | N | | MS | MU | | 4.39 | Extension of closing Date |

## I. Disbursement Profile

P092618




P090375



## 1. Project Context, Development and Global Environment Objectives Design

### 1.1 Context at Appraisal

*Country and Regional Context*

1. Over the past 30 years, China had become an international symbol of economic growth and poverty alleviation but the medium-sized cities in Liaoning Province had benefited to a lesser extent from this prosperity than many other parts of the country. Before the initiation of market oriented reforms of the late 1970s, Liaoning was one of the country's major industrial centers, focusing on heavy industry and mining. The province became one of China's most urbanized provinces with 53 percent of the residents living in urban areas. Much of the urban population settled in a number of medium cities with their economies anchored around a small number of state-owned industrial and mining enterprises. Such enterprises have had mixed success in the transition to a market economy, and many found themselves under severe financial pressure. This weakened the economic base of these cities and, as a result, at a time when many of the cities in China's coastal region – including the two large cities of Shenyang and Dalian in Liaoning – were investing heavily in infrastructure, the medium cities of Liaoning were suffering from systemic underinvestment and deferred infrastructure maintenance despite continued urban growth; this resulted in an accelerated deterioration of the asset base necessary for the provision of urban services.

*Project Context*

2. Much of the existing water supply infrastructure in Liaoning's medium cities was in urgent need of renovation, caused by a severe deterioration of the urban water supply pipelines. Non-revenue water ranged from 37 percent to 55 percent, mainly due to pipeline leakage. This exacerbated the financial difficulties of the water companies since financial sustainability was a major issue with revenues from user fees falling short of meeting the costs of service provision.

3. In addition, Liaoning's medium cities were just starting to develop their wastewater management programs. The collection of wastewater fees from large self-supplied water users, discharging into the municipal drainage system, was a major challenge. Similar to the water supply sector, drainage pipelines were in a state of disrepair and in urgent need of renovation as well as expansion. Wastewater utilities had been established in most cities in Liaoning, but given the limited financial resources in the sector, the utilities were operating rather as government departments and not as commercial enterprises.

4. Many of the medium cities did not have a sanitary landfill and solid waste was disposed of in open dumps that posed hazards to public health and the environment because the collection and transport of municipal solid waste was often incomplete and inefficient. Cost recovery levels for solid waste services were low, and fees were collected in an uncoordinated manner. Moreover, solid waste management functions were provided in a fragmented manner at the district and municipal level; this prevented the adoption of

comprehensive solid waste management and cost recovery strategies.

5. As a consequence, the urban environment of these cities was in serious decline. An investment climate study conducted by the Bank in 2005 found that "livability" concerns had become a significant factor undermining the investment climate in Liaoning's medium cities. The absence of serious efforts to properly maintain and rehabilitate the urban infrastructure had become a significant constraint to the future economic prospects of Liaoning Province. Some cities in Liaoning turned to the private sector to provide urban environmental services but, in the absence of increased sector funding and better utility regulation, these efforts had mixed success and were not financially sustainable. Therefore, it was clear that Liaoning's medium cities and their residents would benefit greatly from investments that supported rehabilitation and upgrading of the urban infrastructure, and in particular urban environmental services.

*The Bohai Sea*

6. The Bohai Sea, located in the northwest corner of the Yellow Sea is one of the most ecologically important, and stressed, bodies of water in the region. Its fishery resources are vital to China, and North and South Korea. More than 40 rivers discharge into the Bohai Sea, of which the Yellow (Huang), Hai, and Liao Rivers are the most significant. The Bohai Sea is a large, shallow embayment of the Yellow Sea which is itself a shallow continental sea of the northwest Pacific Ocean. The open water environment in the Bohai Sea supports diverse marine life including invertebrates, fish, marine mammals and birds. In the past, the Bohai Sea was a major source of larvae and juvenile fish for the East China Sea, but this function has steadily diminished. Therefore, the ecological condition of the Bohai Sea is critically important for maintaining fish stocks and biodiversity in East China coastal waters. It is generally accepted that over-fishing, pollution, reduction of freshwater inflows and habitat loss have contributed to a reduction of these ecosystem functions.

7. The Liao River is the main river in Liaoning Province, discharging into the Bohai Sea which is partly surrounded by Liaoning Province. Before the project, the Liao River had become one of the most polluted river systems in China with more than 68 percent of the river reaches classified as polluted in 2004; 40 percent of these reaches were classified as at or above Class V (worst pollution category). In addition, there were a number of medium and small sized cities along the Bohai Sea coastline in Liaoning Province that discharged wastewater directly into the sea.

**1.2 Original Project Development Objectives (PDO) and Key Indicators (as approved)**

8. According to the loan agreement (LA), the objective of the Project was to assist Liaoning Province in improving the performance and sustainability of the wastewater, water supply, and solid waste services through: (i) construction of infrastructure in the Project Cities; and (ii) improving utility management and regulatory practices in Liaoning Province.

9. On the other hand, the PDO in the Project Appraisal Document (PAD) was to improve the performance and sustainability of water supply, wastewater, and solid waste services in the Second Liaoning Medium Cities Infrastructure (LMC-2) project cities.

10. The two different versions of the PDO are identical in spirit. For the purposes of the ICR report, the legally agreed LA version PDO is used.

11. The key indicators are listed in sub-sections F(a), (b) and (c) of the ICR Datasheet; they are grouped as institutional and environmental indicators as follows:

(a) Institutional: (i) wastewater utility cost recovery ratio in Yingkou, Panjin, Fushun and Gaizhou; and water supply utility cost recovery ratio in Yingkou, Panjin, Anshan, Haicheng and Xingcheng; and (ii) development of comprehensive cost accounting system and MIS for solid waste services.
(b) Environmental: (i) percentage of non-revenue water in Yingkou, Panjin, Anshan, Haicheng and Xingcheng; (ii) tons of annual BOD reduction, and (iii) solid waste disposed in landfill site in tons/day in Yingkou, Panjin and Fushun.

**1.3 Original Global Environment Objectives (GEO) and Key Indicators (as approved)[3]**

12. The GEO in the Grant Agreement is identical to the PDO in the Loan Agreement. In the PAD, the GEO is specified as the LMC-2 project with the Global Environment Facility (GEF) enhancements was the reduction of land-based pollution into the Bohai Sea through investments in wastewater and solid waste infrastructure and improved utility regulation, planning and management in the LMC-2 cities and throughout Liaoning Province. The GEO stated in the PAD were used for this ICR report together with the relevant indicators listed below.

13. The GEO key indicators specified in the PAD were (i) the amount of biological oxygen demand (BOD) removal in tons/year by the new wastewater treatment plants constructed in Yingkou, Panjin, Fushun and Gaizhou; (ii) new wastewater treatment plant total nitrogen (TN) removal (ton/year) in the four cities, and (iii) new wastewater treatment plant total phosphorus (TP) removal (ton/year) in the four cities.

**1.4 Revised PDO (as approved by original approving authority) and Key Indicators, and reasons/justification**

14. The PDO were not revised but, as part of the restructuring finalized in April 2014, the original five key indicators were consolidated into the following three indicators that fully reflect the level of achievement of the PDO: (i) wastewater utility cost recovery ratio

[3] The PDO in the Loan Agreement and the GEO in the Grant Agreement are identical as follows: The objective of the Project is to assist Liaoning Province in improving the performance and sustainability of the wastewater, water supply, and solid waste services through: (i) construction of infrastructure in the Project Cities; and (ii) improving utility management and regulatory practices in Liaoning Province. The project descriptions in the two agreements are also identical.

in Yingkou, Panjin, Fushun and Gaizhou; (ii) water supply utility cost recovery ratio in Yingkou, Panjin, Anshan, Haicheng and Xingcheng; and (iii) solid waste disposed in landfill site in tons/day in Panjin and Fushun. Also, the following two core indicators were added: (i) number of direct project beneficiaries (further amended as part of the April 2014 restructuring), and (ii) percentage of female beneficiaries. Also, target figures for the results indicators were revised primarily to reflect implementation delays and revisions of scope and outputs for certain subcomponents. In several cases, indicators for individual cities were consolidated into one for the whole project area to simplify reporting. Additionally, cost recovery ration indicator targets for water supply and wastewater utilities were revised to more realistic levels in line with updates financial projections.

**1.5 Revised GEO (as approved by original approving authority) and Key Indicators, and reasons/justification**

15. Neither the GEO nor the key indicators for the GEF program were revised.

**1.6 Main Beneficiaries,**

16. The PAD was silent on the main beneficiaries of the project and the GEF program but the PDO and GEO made it clear that the majority of the urban populations of the seven project cities would benefit to varying degrees from improved urban wastewater management, water supply and solid waste services. A core indicator, added as part of project restructuring, set a target of 3 million beneficiaries. In addition, the reduction of pollution into the Bohai Sea and improvements to Bohai Sea water quality would mainly benefit populations involved in fisheries and recreation.

17. Additionally, the project was expected to benefit the staff of the municipal utilities in the project cities through the implementation of the institutional development (ID) component of the Project, mainly by strengthening project management, monitoring safeguards implementation and technical assistance (TA) for the public utility improvement program, solid waste (SW) master planning, and water pollution control planning.

**1.7 Original Components (as approved)**

18. The original components defined in the PAD were as follows:

*Component 1: Wastewater Infrastructure (US$129.9 million).* This component covered four cities (Panjin, Yingkou, Fushun and Gaizhou) and included: (i) the construction of new and rehabilitated wastewater collection systems in four cities; (ii) the construction of new wastewater treatment plants in Yingkou, Panjin, and Gaizhou; and (iii) the construction of river embankment works in Fushun.

*Component 2: Water Supply Infrastructure (US$132.2 million).* This component covered six cities (Panjin, Yingkou EDZ, Fushun, Anshan, Haicheng and Xingcheng) and included: (i) the renovation of water distribution pipelines in all cities; (ii) installing around 185,000 water supply meters; (iii) upgrading treatment plants in Anshan and Haicheng; and (iv) the construction of a new water treatment plant and transmission lines in Yingkou.

*Component 3: Solid Waste Infrastructure (US$55.6 million).* This component included: (i) the construction of new sanitary landfills in three cities (Panjin, Fushun and Yingkou EDZ); (ii) closure of existing open dumps in Fushun and Yingkou; and (iii) solid waste collection vehicles and transfer works and equipment.

*Component 4: Institutional Development (US$7.7 million).* This component covered the following activities: (i) technical assistance (TA) for design and construction; ii) public utility improvement program; iii) solid waste (SW) master planning; and iv) water pollution control planning. The last three activities were to be financed through the GEF grant.

The GEF project components, as set out in the GEF grant agreement, were identical to the above project components but GEF funding was only applied to Component 4 – subcomponents (ii) to (iv).

**1.8 Revised Components**

19. As part of the April 2014 restructuring, the following revisions were made:

1) Due to evolving needs and requirements in the project cities Component 3 was revised as follows to allow the expansion and modification of subcomponents: Component 3: improving the infrastructure and management of solid waste services in the project cities through: (i) constructing and/or expanding solid waste collection and transfer systems, sanitary landfills with leachate control and treatment (newly required by government regulations), closure of open dumps, and other associated works; and (ii) strengthening solid waste management practices, including development of integrated and city-wide solid waste management programs, dedicated cost accounting systems, and management information systems; and improved cost recovery through user fees.
2) The solid waste subproject in Yingkou EDZ was dropped from the project because no suitable location for a new landfill could be secured and the city opted to build a waste incinerator.
3) Subcomponents (ii), (iii) and (iv) of Component 4 were substantially expanded, described in much more specific detail and revised as follows: (ii) Public Utility Management: Providing technical assistance with respect to: (a) a capacity building program for public utility functions in water for Yingkou, Anshan, Panjin, Haicheng and Fushun cities, and wastewater for Panjin and Gaizhou cities; (b) data collection and development of an information management system for Anshan, Yingkou, and Haicheng urban water distribution networks; and (c) studies on ecology service function and basin ecology compensation mechanism of Dahuofang reservoir; (iii) Solid Waste Master Planning: Providing technical assistance to Fushun, Yingkou EDZ, Gaizhou and Panjin for solid waste management planning and its implementation with respect to: (a) development of solid waste master plans; (b) institutional development; (c) landfill site assessment and engineering design; (d) procurement assistance; (e) landfill construction supervision; and (f) training of personnel for effective operation of solid waste management systems; (iv) Water Pollution Control Management: Providing technical assistance to Panjin and Gaizhou for water pollution control management, including: (a) institutional development and financial sustainability; (b)

wastewater master planning; (c) industrial water pollution control; and (d) sludge management.

20. To maintain coherence, compatible revisions were made to the GEF program. These changes include: (i) inclusion of support for geographic information systems (GIS) implementation by water utilities; (ii) increased emphasis on non-revenue water management within the public capacity building program; and (iii) the inclusion of the Dahuofang reservoir ecological study, whilst the public utility capacity building program was downsized by removing the support for the planned private sector participation (PPP) pilot, and the original content on strengthening sector regulation. These changes became necessary because the startup of the GEF component had been delayed and the cities' needs had evolved by the time the GEF program was eventually launched.

### 1.9 Other significant changes

- Restructuring in 2008 to (i) reallocate loan proceeds for the capitalization of the front-end fee; (ii) reduction of loan allocation for consultant services by $1 million and reallocation of loan proceeds to works and goods categories; and (iii) correction of an error in the Project Agreement (in paragraph 15 of Annex A to the Schedule) of the due date for submission to the Bank by each utility of their financial improvement plan.
- Restructuring in April 2014 to : (i) require the provision of resettlement action plans (RAPs) for new and / or expanded subcomponent investments in Gaizhou, Fushun and Panjin, (ii) preparation of environmental assessments (EAs) and implementation of environmental management plans (EMPs) in the same three cities, (iii) preparation of comprehensive solid waste (SW) strategic sector plans plus detailed action plans for implementation, and (iv) require water supply and wastewater utilities to prepare and make public annual water and wastewater utility performance reports. Also, the loan proceeds were reallocated with some cities and sectors being increased and others having their allocations reduced to deal with capacity increases and cost overruns of some subcomponents, self-funding by some cities, and reduced subcomponent scope due inability to complete works.
- Targets of some results indicators were revised to reflect implementation delays and revisions of scope and outputs for some subcomponents. In several cases, indicators for individual cities were consolidated into one for the whole project area. Additionally, cost recovery ratio indicator targets for water and wastewater utilities were revised to more realistic levels in line with updated financial model.
- Two extensions of the project closing date to December 31, 2014 and subsequently to June 30, 2015.

## 2. Key Factors Affecting Implementation and Outcomes

### 2.1 Project Preparation, Design and Quality at Entry

*Rationale for Bank involvement*

21. As part of a program to revitalize the industrial base in the country's northeast, the

Government of China had programmed a series of Bank urban infrastructure investment projects in Liaoning. The provincial government had asked the Bank to support urban transport, environment and energy investments in high-priority medium sized cities. The LMC-2 project, focusing on urban environment, was the second in a series of three projects.[4]

22. The Bank was well positioned to help Liaoning's medium cities address their urban environmental challenges, due to the Bank's competitive advantage in financing and policy advice and its strong, long-term relationship with Liaoning province. The Bank had been Liaoning's development partner for over fifteen years, and could apply its long experience of working in China on urban environment issues. Bank assistance provided the project cities and the provincial government an opportunity to gain from the Bank's extensive China and global experience with institutional development and sector policies.

23. In June 2001, the Liao River Basin Project (LRBP) had been approved and it closed in December 2008. The LRBP had a similar PDO, i.e. to assist with the environmental recovery of the Liao River Basin through investments in wastewater collection and treatment. While the physical investments were completed satisfactorily (according to the June 2009 ICR report), tariff increases and institutional reforms of the wastewater / drainage companies made less progress. In fact, the ICR report had expected the LCM-2 project, as the follow-on project to the LRBP to continue the institutional reforms over time.

*Rationale for GEF grant support*

24. Liaoning province had not only requested Bank support for LMC-2 project but also expressed an interest in additional support from GEF to demonstrate innovative approaches to reducing land-based sources of pollution into the Bohai Sea. With co-financing from GEF the project was able to fund a set of institutional development activities to address the key regulatory, management, and planning issues that would have negatively affected the sustainability of the physical investments in pollution control activities in strategic "hot spots" close to the Bohai Sea. It was expected that the lessons learned from these institutional innovations could then be disseminated locally and nationally.

25. In 2007, the GEF had financing available through the Strategic Partnership Investment Fund for Pollution Reduction in the Large Marine Ecosystems of East Asia ("the Fund") that operated under GEF's Operational Program (OP)10, the contaminant-

[4] The first Liaoning Medium Cities Infrastructure Project dealt with urban transport and was approved in June 2006 and closed in October 2013; and the Third Liaoning Medium Cities Infrastructure Project dealt with urban heating and gas distribution; it was approved in 2008 and is expected to close on June 30, 2016.

based OP. It stressed the removal of barriers to pollution reduction, which LMC-2 targeted by addressing institutional and planning constraints in a holistic way. The GEF activity was also in line with GEF Strategic Objectives (SOs) in the International Waters (IW) Focal Area. It was in conformance with SO1 (catalyze reform and investment) as it aimed to improve utility regulation and management throughout Liaoning Province, and contributed to planning and investment in pollution control infrastructure in the project cities. With respect to SO3 (innovative demonstration), this GEF activity was to demonstrate: (i) provincial level utility benchmarking programs – the first of their kind in China; (ii) new approaches to solid waste management (SWM) which was a significant source of non-point source pollution from uncollected garbage and point source pollution from unsanitary dumps; and (iii) industrial pollution control within the context of overall municipal wastewater management. The GEF activity was expected to generate a mix of local and also regional benefits by reducing pollution (BOD and nutrients) to the East China Sea, in accordance with one of the four new strategies in the IW Agenda for GEF's fourth replenishment period: to address land-based pollution (especially nitrogen) that creates anoxic "dead" zones in coastal waters.

*Incorporation of lessons learned*

26. During preparation a number of important lessons, mainly from the 2007 Bank study on "Improving the Performance of China's Urban Water Utilities", were incorporated in the project design: (i) strengthen financial sustainability through the requirement of financial improvement plans (FIPs) to be updated and reviewed annually; (ii) improve utility regulation and oversight of municipal utility companies through building the capacity of local and provincial governments to do performance benchmarking, initiate PPPs, improve utility regulations and introduce competitive utility management; and (iii) improve the performance of pipeline networks for wastewater collection and water supply distribution through TA for asset management plans to guide pipeline inspection and renovation work.

27. A 2005 Bank study on "Waste Management in China" had highlighted the need to take a comprehensive approach to solid waste management, and the project scope included financing for all aspects of solid waste management (SWM), i.e. collection, transfer, closure of open dumps and construction of new sanitary landfills. Counterpart funding in an earlier urban environment project in Liaoning had been a major problem, and therefore this project was designed with 60% Bank financing of works and 100% for goods.

28. However, lessons from the still ongoing Liao River Basin Project (LRBP) which was being implemented from 2002 to 2008 came too late to influence design. The June 2009 ICR report (Report No. 0000 01101) specifically discourages over-ambitious targets and covenants for institutional and financial reforms of Liaoning's medium cities utilities.

*Design for project sustainability*

29. Past experience in Liaoning province suggested that the investment program was likely to be constructed to high-quality standards and completed on schedule. Long-term

sustainability of the water supply, wastewater and solid waste services would, however, depend on financial sustainability of the utilities providing the services and their ability to operate, maintain, renovate, and expand the infrastructure. Experience over the previous decade with Bank projects had indicated that many cities in Liaoning were still struggling with utility financial sustainability issues. The Project addressed this issue through a variety of measures: (i) requiring each city to have FIPs which would be closely monitored during implementation; (ii) a large, province-wide utility regulatory and management capacity building program; (iii) a provincial benchmarking program to provide competitive pressure on cities and their utilities to improve financial and operational performance; and (iv) comprehensive solid waste strategic sector studies to establish the institutional and financial framework for sustainable services.

30. The project, through GEF funding, included outreach activities to disseminate experience and knowledge learned from the GEF-funded institutional development component to the entire Liaoning province, East Asia, and globally. Key experiences to be replicated included: (i) planning and implementing a utility regulatory and capacity building program, including utility benchmarking; (ii) sustaining solid waste services to reduce non-point source pollution and landfill leachate run-off; and (iii) wastewater management planning for cities with complex industrial and municipal pollution sources and limited financial resources. Dissemination was to take place mainly through involvement in GEF and Partnerships in Environmental Management for the Seas of East Asia (PEMSEA) sponsored workshops and websites. The replication potential in Liaoning and throughout China was considered to be high.

*Risks and their mitigation*

31. Several substantial risks were identified during preparation and appropriate risk mitigation measures – similar to the lessons that were incorporated – were applied: (i) the risk to financial sustainability was mitigated through up-front tariff increases and the requirement for FIPs and annual updates; (ii) the risk to the sustainability of solid waste services was mitigated through the requirement to prepare strategic solid waste studies early during project implementation; (iii) the risk of lower than targeted reductions in non-revenue water was mitigated through TA for asset management plans (to determine the most effective loss reduction actions) and financing of metering programs to improve billing. Lastly, the risk of insufficient provincial leadership in the public utility program was addressed through close Bank interaction with provincial leaders and the establishment of a strong provincial leadership group.

32. While in general, the counterpart fund met the commitment at appraisal, the risk of inadequate counterpart funds for some cities was underestimated during project appraisal; it should have been rated as “substantial” instead of “moderate”. For example, the shortage of counterpart funds had significant impacts on the implementation of the Fushun component, and the Liaoning Finance Department, LUCRPO and the Bank had to intervene several times with the Fushun Mayors to ensure implementation of the Fushun component as appraised earlier. Lack of sufficient counterpart funds for land acquisition and / or resettlement also caused some subprojects to be dropped or reduced in scope. Bank

appraisal had not identified the risk of slow project startup of implementation, and therefore not even preliminary designs had been prepared prior to project approval.

*Project design*

33. Project design considered a number of options, such as an adaptable program loan (APL) and three multi-sector projects (each covering urban environment, urban transport and energy) focusing on a selected number of medium cities. The APL option was dismissed because of the likely difficulty to define appropriate triggers for the second and third projects and the length of time needed for the approval of the follow-on projects. A series of single-sector projects was eventually used as the most suitable packaging because it would complement the sector investments with sector-specific and institutional reforms. The reduced complexity of a single-sector project was another key consideration for the chosen project design; in fact, the water supply, wastewater and solid waste management utilities involved in seven medium cities presented considerable challenges to coordinate and supervise. The design decision to focus on renovation and service improvements in existing urban areas – rather than investing in new satellite cities and industrial parks as had been proposed by the government – was definitely correct since many of the new developments are not fully occupied at this stage.

*PDO and key indicators*

34. The indicators selected for the monitoring the achievement of the GEO were designed to measure the reduction of pollution loads rather than – directly or indirectly – measuring the water quality of the Bohai Sea, the target of the GEF intervention. Few appraised KPI targets were found to be impractical and therefore revised during loan restructuring, and some legal covenants required by the Bank did not adequately take account of the local institutional, financial and policy constraints.

**2.2 Implementation**

*Implementation arrangements*

35. The Liaoning Provincial Leading Group (LPLG), chaired by a Vice Governor of Liaoning, provided high-level guidance to the project, and coordinated all policy and institutional issues related to the project. A well-established office under the Liaoning Provincial Department of Housing and Urban-Rural Construction (LPDHURC), called the Liaoning Urban Construction and Renewal Project Office (LUCRPO), provided continuous day-to-day project management, coordination and liaison. The Liaoning Provincial Department of Finance (LPDF) was responsible for integrated management of the Project on behalf of LPLG, including providing guidance to LUCRPO and the project cities; they managed the designated Project Account. The Liaoning Provincial Development and Reform Commission (LPDRC) is responsible for providing overall infrastructure planning management in Liaoning and developing policies to promote economic reform and development; the LPDRC was closely involved throughout the project implementation. Each participating city established a City Leading Group (CLG) in which local government leaders took part. The CLGs were responsible for providing

high level direction and oversight for project implementation activities in the respective cities. Each city also established a project management office (PMO) to coordinate project implementation activities within its jurisdiction and provide linkages with LUCRPO and the LPLG. The CLG assigned either the existing public utility company or a suitable government department as the project implementing agency (PIA) for each individual sub-component with the responsibility for the implementation of that particular sub-component.

*Implementation problems and delays*

36. After a long preparation period the project got off to a slow start, and six months after Effectiveness some disbursement conditions (signing of subsidiary LAs and some safeguard documents) still had not been met. In fact, there was a year's delay between Effectiveness and start of any significant implementation activities. The construction management consultants were hired at that point but after two years they still had not been paid and threatened to quit. Eleven contracts that had been earmarked for retroactive financing were completed some four years later only due to: difficulties with land acquisition / resettlement, inadequate counterpart funding, procurement delays and slow internal clearances. New requirements for the mandatory installation of leachate treatment facilities at landfill sites caused more problems, and local governments scrambled for funds to finance such facilities. The TA proposed for the GEF grant funding kept being delayed by uncertainty about the scope of GEF activities and the content of the TORs, and there was no real champion to move things along. A special procurement review was carried out by the Bank to finally allow the award of construction contracts that had been held up due to supposed irregularities; these turned out to have been minor in nature.

*Mid-term review and project restructuring*

37. The Bank's on-time mid-term review in October 2010 readily determined that the project needed to be restructured on an urgent basis to drop a few subcomponents, add some new items such as leachate treatment facilities, reallocate funding accordingly, and also re-design the GEF components. However, it took almost three years before the restructuring, formally, took place in April 2014. Earlier in 2013, the Bank had made the restructuring conditional upon satisfactory progress on some key activities and also delivery of some outstanding safeguard actions. This approach worked well, and following the restructuring, the project acquired a new momentum; this applied in particular to the GEF component: newly designed studies and TA, responding to the then current needs, and executed without further delays. This work contributed much to the successful completion of the project – with an 18 months extension – which was concluded with a very productive dissemination workshop in June 2015 (see section 3.6 below and also Annex 6).

38. Despite the late restructuring all contracts were successfully completed. About USD12 million were canceled, mainly due to some significant contract savings. Also, about USD0.2 million of the GEF grant were canceled after satisfactory implementation of all grant-funded TA, training and dissemination activities.

**2.3 Monitoring and Evaluation (M&E) Design, Implementation and Utilization**

*Design*

39. The results framework was logically conceived, with an appropriate balance of indicators to measure institutional and environmental outcomes. The results framework was closely linked to the project supported activities and measures used to assess progress were fairly standard for this type of project. Given that the project worked in a large number of cities, data collection demands were significant, but this was to be expected in a multi-city project. One shortcoming was that the cost recovery targets were ambitious, given the fact that the utilities in the project cities of Liaoning do not have full control of tariff adjustments – they are imposed by the local governments. However, there is a provision for local governments to subsidize wastewater and solid waste services, if cost recovery is not adequate. At appraisal it was expected that wastewater, and even some water supply companies would have a continuing need for subsidies "during a transition period."

*Implementation*

40. M&E reporting was part of the Borrower's semi-annual progress reports, and these comprehensive reports listed the updated indicators. As a result of the slow start-up of the M&E system in May 2008, information was generated either through the LRBP-supported TA program or the Provincial EPB but there was no comprehensive reporting on the status of key legal covenants and monitoring indicators except by Bank staff in the Bank's own implementation status reports (ISRs); it is therefore rated as Modest. The results indicators were modified and simplified as part of the restructuring. The GEF-funded TA was to support setting a utility benchmarking system, eventually to cover 75% of all provincial utilities in Liaoning. Due to delays of the TA, the GEF support was modified to focus the on use of benchmarking as driver of performance improvement at the utility level. In addition, two 2 provincial agencies were set up by government to monitor services & performance of all WS& WW utilities in Liaoning province. Summaries of these monitoring data are available on the web.

*Utilization*

41. M&E was intensively and very effectively used especially in safeguard implementation where independent external agencies were employed to monitor, and report on, the management and mitigation of environmental and social impacts, especially land acquisition. Detailed environmental data and information were gathered and used to monitor and manage ambient conditions, especially during construction to minimize negative impacts on, and resultant complaints from, the local populations. The M&E system is at moderate risk of being abandoned after the completion of the project. This has been mitigated through building the IAs' capacity and the good practice established over the past four years. The provincial system, set up for monitoring utility performance and service, will also contribute to continuing M&E of WS and WW companies.

**2.4 Safeguard and Fiduciary Compliance**

*Environment*

42. LUCRPO was responsible for supervision and review of all environment management activities such as training, coordination, and reporting; it also reviewed

implementation of the EMP. Each Project Implementation Unit (PIU) set up a separate environment management division during the early stages of the project. For each component, environment management organization members addressed environment-related issues, took charge of environmental protection of sites, coordinated with relevant government departments, and ensured that all contractors fulfilled their environmental obligations by implementing all necessary mitigation measures during construction. It was found that when environmental education of the local population was done ahead of implementation, and good communication was maintained throughout the actual implementation stage, there was minimal complaints and resultant delays.

43. During implementation, both internal and external routine environmental monitoring was conducted to ensure that all contractors implemented effective environmental management measures as stipulated in the respective EMPs and contracts. Each PIU hired qualified external local environmental monitoring agencies to conduct regular environment monitoring. All monitoring results met national environmental standards and there were a minimal number of complaints. Based on the EMP, the following key environmental impact mitigation measures were employed: (i) control of air pollution, (ii) control of water contamination, (iii) control of the spreading of solid waste, and (iv) minimizing traffic conflicts. Bank supervision made sure that environmental safeguard requirements were complied with, such as in the case of Gaizhou were the extension of the closing date for the entire project was made conditional on the city submitting a satisfactory EIA.

*Land acquisition*

44. There were problems initially when three landfill site locations had been selected without sufficiently broad public consultation, especially ignoring the concerns and objections of the adjacent population. The local people eventually rejected the initially selected sites with the result that one subcomponent had to be dropped and two others had to find new sites.

45. The main resettlement agencies had local offices and a well-trained full-time workforce. All staff members were proficient in operations and policies on land acquisition (LA) and temporary land occupation; they also had good experience in compensation and resettlement for LA. Consequently, they ensured the smooth implementation of land acquisition and resettlement. All LA was implemented in strict conformity with the applicable policies, compensation rates and resettlement programs. Temporary land occupation for construction activities was also dealt with and appropriate compensation was provided; efforts were made to minimize the length of temporary land occupation. As the implementation proceeded and further to the initial problems with landfill sites, the local resettlement implementing agencies attached great importance to the participation of, and consultation with, project-affected people (AP). Many announcements were released and many mobilization meetings were held to collect comments and opinions from the APs. The grievance redress and appeals mechanisms were established and well publicized.

46. Based on the available records, all APs were properly resettled, and most opted to take monetary compensation; many of those initiated their own livelihood restoration measures, such as exporting labor and job training. Most of APs responded positively to a

sampling “satisfaction survey”. There was regular monitoring and review of all LA by an independent external agency, and detailed reports are available. A good precedent of creative land acquisition was set in Fushun where the local government allocated a former state-owned coal mine waste dump site for the new sanitary landfill, thereby avoiding all resettlement – it would otherwise have required the resettlement of 238 rural HHs.

47. With regard to overall safeguard compliance, project restructuring in 2014 was made conditional upon the Borrower first completing, submitting and disclosing satisfactory EIA and RAP documents for all delayed existing, and one new component (in Panjin). Compliance was achieved very promptly.

*Procurement*

48. All procurement was undertaken in accordance with Bank guidelines and there were no incidents of mis-procurement. However, strict adherence to Bank procurement procedures caused serious delays in some cases, such as the GEF studies where the Bank carried out a special procurement review due to supposed irregularities; these turned out to be minor and the contracts were eventually awarded. There also were long delays with awarding eleven contracts that had been earmarked for retroactive financing, and procurement issues were given as one of the reasons for these delays. In all cases, though, the Bank’s procurement specialists provided advice and assistance to resolve issues and expedite procurement decisions.

*Financial management*

49. Audits consistently received clean opinions, and there were no outstanding audits. The project coordination office had an adequate financial management system (FMS) in place that provided accurate and timely information on implementation progress and Bank loan uses. However, FM capacity varied among different PIUs, and most PIUs required some training in FM and guidance on project accounting and financial reporting from the LUCRPO. Therefore, in the later stages of implementation, the project management consultants were tasked to assist LUCRPO with financial management (FM) aspects; this led to substantial improvements in FM by the local PIUs.

50. During the earlier years of project implementation, disbursement progress was a serious concern until the old paper-based payment requisitioning and disbursement system was upgraded by the PIU to an electronic online system in 2012. This new system enhancement resulted in substantive efficiency improvements to the processing of disbursement requests.

**2.5 Post-completion Operation/Next Phase**

51. All new infrastructure facilities constructed under the project are being well operated and maintained, and each municipal government is providing sufficient budget funds to ensure these operations are fully financed. However, tariffs are not at a level that provide for financial sustainability and in the case of some sub-components low income collection rates are also a threat to financial sustainability. This situation may change in

the future as in late 2013 the PRC national government announced new policies which recognized the need to increase water supply charges as a water conservation measure, however as yet this has not filtered down to the LMC-2 project cities and subsidies have increased significantly over the life of the project.

52. The three municipal WWTPs have made a largely trouble-free transition to regular operations[5]. Panjin has signed an outsourcing contract for the O&M of their WWTP with an experienced contractor to assure high operational and effluent quality standards. The operational procedures developed jointly between the PIUs and the GEF consultants were used for improving operations of two new WWTPs in Panjin and Yingkou, and the GEF-funded TA was instrumental in resolving operational issues with the Ghaizhou WWTP.

53. The only sanitary landfill constructed under LMC-2 was in Fushun whose sanitation department also benefited from GEF-funded technical assistance, and the landfill is being operated to the required standards that could still be improved, especially placing an adequate daily cover. The new Panjin sanitary landfill constructed under BOT arrangements is considered an LMC-2-associated project and, based on local EPB inspections, is also being operated within the set standards. This project financed collection vehicles, transfer stations and sanitary landfill equipment to improve overall sanitary conditions in Panjin.

54. With regard to a follow-on operation, in April 2015 the Liaoning PDRC submitted a proposal to the NDRC to consider an application for funding from the Bank as a follow-on urban water supply project – termed "a safe and sustainable development and demonstration project". Building on the long-standing relationship between Liaoning and the Bank, the province wants to deepen policy reform, move forward with institutional innovation ("mixed ownership"), and achieve modern utility enterprise management objectives. The needs to be addressed by the new project are: (i) low per capita water resources in Liaoning, (ii) aging networks with high losses, excessive energy use, insufficient HR capacity, and (iii) poor management and financial performance. The Bank has received the request officially from the Government in September 2015, and it is under review for possible financing.

## 3. Assessment of Outcomes

### 3.1 Relevance of Objectives, Design and Implementation

*Relevance of Objectives*

[5] There were initial start-up problems at Gaizhou, caused in part by the current low hydraulic loading of the WWTP. However, Gaizhou benefitted from GEF-funded operational support TA, and the WWTP eventually passed EPB inspection that it complied with the set effluent standards.

Rating: High

55. The project's objectives were consistent with the 2006 to 2010 Country Partnership Strategy (approved by the Board in May 2006) which sought, among other objectives, to: (i) improve the competitiveness of the various regions of China and the overall investment climate, and (ii) address the needs of disadvantaged groups and underdeveloped areas through financing infrastructure. Specifically, the project supported the objectives of: (a) reducing poverty, inequality, and social exclusion; (b) financing sustained and efficient growth; and (c) improving public and market institutions.

56. The Project is also consistent with the current Country Partnership Strategy (CPS) for 2013-2016. The CPS highlights the high level of pollution in the water bodies in China that necessitate better management of environmental pollutants from wastewater and solid waste. The CPS also recognizes the need for high-quality public services; need for better water resources management; integration of rural-urban growth; promoting an integrated approach to water and environmental management; expanding safe water supplies to smaller cities; supporting private sector investment in water and sanitation; improving sanitation, solid waste and other basic urban services in selected second-tier cities; addressing environmental management; enhancing opportunities in rural areas and small towns through high quality water and sanitation services; enhancing urban environmental services through improved water supply, wastewater collection treatment and disposal, and solid waste collection and disposal; and enhancing opportunities in rural areas and towns through improved services.

57. The project is also relevant to China's current 12th Five Year Plan (2011-2015)[6] which aims to forcefully address environmental and social imbalances through the development of services measures to set targets for reduction of pollution and increased energy efficiency.

58. GEF assistance was and still consistent with (i) China's strategy for reducing municipal water pollution, and (ii) various international agreements, including the recommendations of the PEMSEA, the Bank's partner in the Fund. The GEF activity further was consistent with the aims and objectives of the World Summit on Sustainable Development to which GEF subscribes. The Project also had direct relevance for the Global Program of Action (GPA) for the Protection of the Marine Environment from Land-based Activities through the proposed improvements of the Bohai Sea coastal and marine environment.

*Relevance of design and implementation*
Rating: Substantial

59. The design of the project built on the lessons learned from past projects and was

[6] The current CPS and the 12th Five Year Plan were informed by the joint study, China 2030, prepared by the Bank and the Development Research Center of the State Council.

based on a solid intervention logic. The link between the objective and the areas of intervention was clear. The subprojects were carefully selected to ensure that their impacts were aligned with the project objectives, and the performance indicators facilitated the measurement of such achievements. The project design could not fully anticipate the dynamic development situation in China in general, and Liaoning Province in particular. The rapidly changing requirements and needs would have benefited from a number of pre-screened stand-by "spare subprojects" (as suggested by one of the PIUs) that could have replaced the dropped subprojects.

60. Project preparation for the institutional development component resulted in a design that responded to the needs of Liaoning. The appraisal decision was confirmed subsequently by more recent research and the sector planning and policy documents issued by national authorities, many of which are aligned with the original program objectives. The relevance of the design of the GEF component was high.

61. The original design also included a management structure for the program that was agreed by all parties at the time of appraisal, and the risks to the program were identified and assessed. However, two shortcomings were identified during implementation: (i) failure to identify and enlist a senior level "champion" within the provincial government with the ability and commitment to implement the program as intended; and (ii) a relatively low level of consultation on the design of the program with the city level agencies. These shortfalls delayed the public utility capacity building program in particular since it was designed as a provincial level initiative.

**3.2 Achievement of Project Development Objectives and Global Environment Objectives**
Rating: Substantial

*(i) Improving Performance and Sustainability of Wastewater Services*
Sub-rating: Substantial

62. The project has greatly improved the performance of the wastewater services by meeting all physical infrastructure targets: (i) construction of 250,000$m^3$/day new wastewater treatment capacity; (ii) installation of ten new and seven upgraded wastewater pumping stations; and (iii) construction of 60 km of new interception and collection sewer pipelines in Fushun, Yingkou, Panjin and Gaizhou. The expanded wastewater collection systems and increased treatment capacities improved the overall performance of the wastewater utilities; they served more people and lowered the annual pollution and nutrients loads to the surrounding environment, including the Liao River and the Bohai Sea, by about 17,629 tons of BOD, 4,978 tons of TN, 509 tons of TP – far exceeding the performance indicators targets. These works also helped to increase coverage of sewage collection and treatment, thereby reducing the risks of local flooding. Below is a summary listing of the beneficial outcomes of improved wastewater services performance:

- in Panjin, wastewater treatment coverage comprises 722 ha with an estimated population of 283,000 and the coverage rate has increased to 85%
- in Yingkou, wastewater treatment coverage increased to 90% and now covers a population of 420,000 and the wastewater treatment rate increased from 45 to 90%

- in Gaizhou, river banks have been stabilized and bank erosion has been halted over a section of 3.3 km
- in Panjin and Yingkou, substantive treated effluent re-use by municipality and industry
- cleaner, less polluted surface water for irrigation, fisheries and recreation
- cleaner urban environment and decrease of unsanitary conditions
- reduction of pollution load entering – directly or indirectly – the Bohai Sea
- conservation of economic activities in the Bohai Sea, i.e. fishing and tourism
- improved investment climate

63. In terms of improved sustainability of wastewater utilities, the cost recovery of the targeted four utilities in Yingkou, Panjin, Fushun and Gaizhou increased significantly from between 0.5 and 1.0 to reach the range of 1.0 to 1.1; and in Yingkou, wastewater tariffs and collection performance are satisfactory. While business plans (identifying financing needs arising from growing service demands) were prepared for four cities, two wastewater master plans were also completed. The master plans update the previous wastewater plans; they include an updated service demand forecasts, the extent and timing of infrastructure improvements needed, and broad financing estimates. They also include a specific strategy for the separation of existing wastewater and storm water collection networks. The master plans are essential for city authorities to update their own planning documents and to guide detailed infrastructure planning.

64. Equally important for sustainability, staff capabilities and skills have increased very significantly and measurably through the following measures:
- operator training, compilation of training material and an operational manual
- domestic study tours to relevant sites and facilities
- optimization and efficiency savings reviews
- completion workshop on innovative approaches to utility planning, design, operation and management
- increased monitoring of utility performance and service and posting of results.

*(ii) Improving Performance and Sustainability of Water Supply Services*
Sub-rating: Substantial

65. The project financed construction of (i) installation of 260,000 $m^3$/d new water treatment capacity; (ii) construction of 540 km of new transmission and distribution pipelines; and (iii) the purchase and installation of more than 180,000 new household water meters. The increased drinking water supply and treatment, the installation of more than 180,000 household water meters and the replacement / rehabilitation of water distribution pipelines improved the water supply utility performance to a great extent. Some specific benefits of the physical investments are:
- in Anshan, 250,000 households benefited directly from improved water service as a result of pipe replacements
- in Yingkou the service area was increased by about 2,000 ha with an estimated population of 105,000

- reliable 24-hour water supply covering the entire urban areas in all project cities at adequate pressure

66. While water supply tariffs are not yet at adequate levels for full financial sustainability[7], local governments have been consistent in their budgetary support for water supply operations and debt service. Despite a general reluctance to increase tariffs (due to social and political reasons), Government policy is expected to catch with tariff increases; this will assure the financial sustainability of the water supply utilities in the future. At this stage, the water supply companies are considered to be operationally sustainable only. Moreover, the capacity building provided by the project and GEF-funded TA, has developed and grown staff skills considerably resulting in:

- development of network mapping by a computer-based geographic information system (GIS) in Yingkou, Anshan and Haicheng
- improved operations, leakage control and systems optimization through well-trained and highly competent operators and users of GIS mapping
- three cities now have and utilize a state-of-the-art GIS for more effective monitoring, upgrading, expanding and repairing their water supply networks
- resulting in considerable revenue increases and efficiency gains
- optimal decisions for priority repairs, upgrading or new construction of pipes
- higher quality of treated water through operator training and operational manuals
- more accurate billing of customers, increased tariff collection and higher revenues for the water utilities

67. Moreover, non-revenue water (NRW) was reduced significantly in most of the project cities, which resulted in having more water available for sale, although it was formally dropped from the PDO indicator. Under the GEF TA activity, pilot NRW programs were implemented in five cities: Anshan, Yingkou, Panjin, Haicheng, and Xingcheng. Although scope and size of the pilot activities varied among the cities, all the participating cities benefited from the program by reducing water production loss, lower operating costs, reduced leakage and NRW, sold more water and increased revenues. Moreover, the intervention had positive influences over the utilities' capabilities for system operation and management, gained from better data collection and analysis through installed GIS systems. Some cities, such as Xingcheng, established a dedicated team for leakage detection to further continue NRW reduction efforts. Overall, all the five cities gained NRW reduction experience and motivated to continue the efforts. The table below summarizes the scope and the results in NRW reduction.

| City Name | Condition | Intervention | NRW | |
|---|---|---|---|---|
| | | | 2012 | 2015 |
| Anshan | 18 communities | Replace 91 km of pipes | 53% | 19.5% |

[7] Despite improvement in cost recovery, the utility companies in Yingkou, Panjin, Anshan and Fushun are still lagging slightly in cost recovery and will need to increase their revenue base through tariff increases and / or the local government support

| | | | | |
|---|---|---|---|---|
| | High losses | Install 65,000 new meters | | |
| Yingkou | Average 50% losses<br>2 pilot communities | Network rehabilitation<br>Meter replacement | 54%<br>39% | 13%<br>12% |
| Panjin | Old network from 1950s | Reconstructed ~50% of network<br>Replaced 45,000 meters | 51% | 41% |
| Haicheng | 78 communities<br>Worked in 2 pilot areas | Demand monitoring & measurement<br>Data analysis<br>Leakage detection & repair | 26% | Not known yet |
| Xingcheng | One pilot district | Rehabilitated pipes<br>Relocated many meters | 55%<br>(35%) | 35%<br>(25%) |

*(iii) Improving Performance and Sustainability of Solid Waste Services*
Sub-rating: Substantial

68. The project achieved the physical targets for SWM infrastructure: (i) the construction of two new sanitary landfills in Fushun and Panjin with a combined capacity of 2,000 t/d including the associated landfilling equipment; (ii) installation of one leachate treatment plant; (iii) closure of one old dump site; (iv) supply of 50 compactor-type solid waste collection vehicles; (v) installation of one solid waste transfer station; and (vi) the establishment of a large number of local refuse pick-up points in three cities. These investments created a cleaner environment and provided new solid waste disposal capacity of some 2,000 tons/day, including the treatment of highly contaminating leachate at the landfill sites[8].

- reduced odor and visual nuisance of open dump sites, especially in Fushun where several scattered uncontrolled dump sites were closed
- less potential for groundwater contamination through landfills
- cleaner urban environment and decrease of unsanitary conditions for both cities
- reduction of pollution load entering – directly or indirectly – the Bohai Sea
- conservation of economic activities in the Bohai Sea, i.e. fishing & tourism.

69. The GEF-funded TA contributed importantly to achieving the completion of the targeted SWM master plans which addressed institutional, financial, cost recovery, technical and infrastructure planning issues in the solid waste sector in three cities. Key positive outcomes for sustaining fully adequate SWM services in the future are as follows:

- Gaizhou and Panjin have better designed landfill sites and associated facilities with minimal negative environmental impacts

[8] Leachate collection and treatment below solid waste landfill sites is especially important for the protection of ground water resources

- these two landfill sites have proper groundwater monitoring wells to prevent the spreading pollution into important water resources
- new operational manuals assist with safe and efficient operation of sanitary landfills
- utility staff are better informed on collection, transfer, disposal and management options thus contributing to a cleaner & healthier urban environment
- utility staff are better equipped to deal with financial aspects, especially cost recovery and tariff collection
- SWM utility staff are better equipped to plan for future expansion
- Gaizhou, Fushun & Panjin have separate SWM master plans to guide future development
- Panjin was enabled to operate a well-designed pilot project of integrated urban-rural solid waste management.

70. The GEO were largely achieved (rated moderately satisfactory) because important investments in wastewater and solid waste management infrastructure were put into operation that are reducing the pollution loads into the Bohai Sea through (i) effective city-wide wastewater collection and treatment, and (ii) solid waste collection and disposal in fully engineered sanitary landfill sites (including leachate treatment plants) that minimize groundwater and surface water pollution to reach rivers and eventually the sea. The positive outcomes of the GEF component were demonstrated by the fact that the GEO indicators of reduced BOD, TN and TP – all indicating a decrease in pollution loads – were all exceeded by a factor of at least 2.5.

71. The GEF-funded activities, modified after initial delays, responded well to the key sector issues that arose. The grant financed several highly relevant studies, technical assistance and training activities that contributed greatly to the development and strengthening of the utility companies in planning, monitoring, water supply system network mapping investment projects management, metering and NRW management. All the above-mentioned activities contributed to the improved performance of the targeted urban services. Moreover, the achievement of wastewater and solid waste utilities' cost recovery is expected to ensure the sustainability of these services. Lastly, the dissemination activities held in 2015 assure that study findings will be used widely (see Annex 6 for details).

**3.3 Efficiency**

Rating: Modest

72. Detailed financial projections were carried out at appraisal for the project water supply and wastewater companies, focusing on (i) utility tariffs, their adequacy and affordability; (ii) the financial performance of the utility companies, especially cost recovery ratio and debt service coverage ratio; and (iii) the fiscal sustainability of the local governments for supporting the water supply and wastewater companies' budgets as needed. Annex 3 provides details of the financial analysis done at the time of project completion. Tables 3.2 and 3.3 in Annex 3 demonstrate that the affordability of utility tariffs has increased significantly since appraisal as a result of rapid economic growth whilst over the same time period there have only been very limited, if any, increases in the

tariffs charged for these services. The financial performance of the utility companies is summarized in Table 3.5, also in Annex 3. It shows that varying levels of tariff increases are needed to achieve full financial sustainability, i.e. no operating subsidy from the local government. In China, it is a common practice that the local government provide subsidies to wastewater and water supply companies that are meeting performance targets imposed by the government. These subsidies are counted as non-operating revenues, and they are incorporated in the calculation of a cost recovery ratio. In this context, the situation of the wastewater companies is more complex because low collection rates and inadequate tariffs often impair the prospects for financial sustainability except in Yingkou where tariff collection performance is satisfactory. With regard to the fiscal sustainability of the local governments, there has been significant growth in municipal revenues since appraisal as shown in Table 3.4. In view of these impressive growth rates and also in consideration of the fact there has been no major cost escalation during the LMC-2 implementation, it is apparent that the local governments' fiscal sustainability is now stronger than what it was at appraisal when it was considered to be adequate.

73. At appraisal, subproject-level economic cost-benefit analysis was not considered to be appropriate but all subprojects had used a standard least-cost / cost effectiveness methodology that incorporated technical, environmental, financial and social criteria into the design and decision-making process and an open, competitive bidding process that was used throughout. It is evident that the project investments provided good value for money and can be considered to be substantially efficient. As an example from the city of Panjin, the specific unit price to construct a large WWTP has remained almost the same – it increased only slightly from RMB 2751.9 /t to 2899.5/t over a time span of ten years, i.e. less than 5% which is considerably much less than inflation (28% over 10 years from 2005 to 2014). This means that in real terms the costs actually decreased while the plant developed under this project meets higher treatment standards (Class A) compared to the plant built ten years with financing from the LRBP treated sewage to Class B standards only.

74. Although not readily quantifiable, the project generated economic benefits through improved utility service delivery, higher water use efficiency, reduction of non-revenue water, and better sanitation. The latter improvements contributed important health, environmental and aesthetic benefits. Although there are no data to measure the direct economic impacts of the project, it is interesting to note – as shown in Annex 3 – that the project implementation period witnessed significant economic growth in the benefiting cities: per capita Gross Domestic Product (GDP) increased by factors ranging from 1.6 to 3.6 between 2007 and 2015. The project generated large increases in service areas and benefiting populations, such as in Fushun where 250,000 HHs have benefited directly from water supply services improvements, and in Panjin where the added wastewater treatment capacity covers an area of 722 ha with an estimated population of 283,000; the overall wastewater treatment rate in Panjin increased from 45 to 85%. The urban environmental infrastructure improvements also improved – in a significant way – the local investment climate, thus contributing further non-quantifiable economic benefits.

75. The non-revenue water (NRW) projects supported by the GEF grant generated important efficiency gains. For example, in one pilot community of Xingcheng city, NRW volume was reduced from 55 to 35%, and water revenue increased almost five-fold. In addition, power consumption was reduced and there were fewer customer complaints. As a result, Xingcheng has set up a NRW team to continue getting further efficiency gains system-wide. In Anshan city, similar results were achieved, i.e. a NRW reduction by about one third and a three-fold revenue increase.

### 3.4 Justification of Overall Outcome Rating
**Rating: Moderately Satisfactory**

76. As discussed above, the project was and still is highly relevant to the Bank-China Country Partnership Strategy and also to China's strategy as described in section 3.1. The PDO and GEO were substantially achieved as described above, and the efficiency of the investments was assured through the least-cost approach for selecting and design the priority improvements.

### 3.5 Overarching Themes, Other Outcomes and Impacts
**(a) Poverty Impacts, Gender Aspects, and Social Development**

77. The urban poor have definitely benefited to a greater extent from the project interventions since – before the project – they would have had less access to municipal services, such as reliable clean water supply and garbage pick-up, and would have been more negatively affected by discharges of untreated wastewater. Table 3.3 in Annex shows that the current utility charges are readily affordable by the poorer households, too. The project benefited both genders equally although women usually appreciate the improved sanitary conditions more highly. Regarding social development, the participating local government agencies gained valuable practical experience in the implementation of fair land acquisition with adequate compensation and restoration of livelihoods (in case of resettlement) that were supported by grievance redress and appeals mechanisms.

**(b) Institutional Change/Strengthening**

78. The capacity of provincial, local government and utilities staff was strengthened significantly, not only through well-targeted capacity building TA, but also by acquiring practical on-the-job experience in project and financial management, strict and fair procurement procedures, and innovative technical solutions. Staff capacity also was increased – through training and study tours – for operations and management of the newly built facilities. The project also pushed local governments towards increasing commercialization, especially the wastewater, drainage and solid waste departments.

**(c) Other Unintended Outcomes and Impacts (positive or negative)**

79. The revisions of the GEF grant subcomponents as part of the 2013 project restructuring provided an opportunity to conceive new TA, based on actual needs at that stage. These changes produced an ecological study of the Dahuofang Reservoir, installation of advanced GIS for the three water supply companies, and master plans for urban

wastewater and SWM. The dissemination workshop in June 2015 not only demonstrated the value of this revised TA but also served as a – previously unplanned – stakeholders' project closing workshop.

### 3.6 Summary of Findings of Beneficiary Survey and/or Stakeholder Workshops

80. A GEF dissemination workshop was held on June 12, 2015 in Shenyang. The principal objective of the workshop was to disseminate the lessons learned and information on specific GEF outputs to some 80 public utility managers and relevant government officials across Liaoning Province. The gathering also took the place of a stakeholder workshop. It dealt with the two main components of the project: i) urban water supply and wastewater management and ii) municipal solid waste management, for which the GEF program had provided the TA for the associated ID.

81. The GEF component had been successfully implemented in the later years of LMC-2 implementation in accordance with a revised design. The goals of the GEF program were largely achieved: (i) better public utility management and operations; (ii) up-to-date wastewater sector plans, (iii) some public- private sector partnerships were initiated; (iv) municipal solid waste management was greatly improved, including sector planning and financing, optimization of garbage collection and transportation, landfill operations and training, dump closure plans, and integration of urban and rural waste collection and disposal services; and (v) good asset management was introduced, with particular emphasis on the management of non-revenue water, water leakage reduction, and the implementation of GIS.

82. As well as benefiting the cities and utilities that directly participated in the different GEF initiatives, a very important additional objective of the GEF component was to disseminate best practices and lessons learned from the GEF work to other cities of Liaoning and potentially beyond. The workshop was an important part of that process and achieved the additional objective very well. See Annex 6 for a detailed report. There was no beneficiary survey.

## 4. Assessment of Risk to Development Outcome and Global Environment Outcome

**Rating: Moderate**

83. The table below summarizes risks identified at project closing to the sustainability of the achievements / results of the PDO and how they are expected to be mitigated after project completion.

| Risk factors | Mitigation |
|---|---|
| Operation & maintenance of facilities is poorly executed | O&M Staff are well trained, and seem to be competent and highly motivated |
| Equipment fails to perform as expected and designed | Superior equipment and construction quality were employed to prevent failure |

| | |
|---|---|
| Tariff collection rate is too low and utilities lack revenues | Improved municipal service delivery will motivate customer to pay tariffs. Water supply tariff collection rates are improving but WW and SW charges and collection systems remain inefficient. GEF work suggested reforms for SW charges which are now under consideration by LGs |
| Tariffs are not increased sufficiently to cover operations and debt service | National policies are supportive of tariff reforms but policy implementation is lagging. LGs recognize need for tariff increases but most are awaiting direction from higher levels of government. |
| Local governments fail to provide enough subsidy to make up revenue shortfalls | Some local governments are committed & national policies are expected to change |
| Institutional reform and commercialization stalls | Institutional and commercialization reforms progressing well at national level but absence of enabling regulations to date have impeded policy implementation at local level |
| Momentum for reform and further improvements slows down or is lost | Liaoning Province has already applied to the Bank for a follow-on project |

84. On the basis of the brief analysis above, the risk to development outcome has been assessed as Moderate because despite several significant risk factors, there are a number of positive mitigation factors that reduce the overall risk to a moderate level. The analysis applies equally to Development and GE outcomes.

## 5. Assessment of Bank and Borrower Performance

### 5.1 Bank Performance

**(a) Bank Performance in Ensuring Quality at Entry**

**Rating: Moderately Satisfactory**

85. PDO and GEO were well formulated and focused foremost on improvements in service and sustainability and on reducing environmental pollution, mainly of surface water and the marine environment, although it would have been impossible to devise a suitable indicator to monitor Bohai Sea water quality directly. Strategically, the project was highly relevant and the approach to implementation was well thought out. The indicators used could be measured, but their number could have been reduced.

86. Project preparation took more than two years from concept to Effectiveness and caused some of the proposed investments to be outdated by the time implementation eventually started. Project design was too ambitious in terms of expecting local wastewater utilities to become managerially and financially independent – even though at the time of preparation the ongoing LRBP had experienced difficulties in this regard. On the positive

side, the original investment plan was substantially implemented by project closing. While the technical and financial aspects of the project design were well prepared, the economic analysis was lacking. Safeguard and fiduciary aspects were appropriately covered during preparation, and adequate monitoring processes were included in the design.

87. As mentioned in section 3.1, project preparation for the institutional development component resulted in a design that responded to the needs of Liaoning. However, it was not implementable in its intended form due to a number of factors: (i) a lack of "buy-in" from the project cities, (ii) a minimum of consultations, and (iii) the rapidly changing infrastructure needs and priorities of the cities. This problem was addressed by the original design of the GEF component which responded to the more relevant key issues in the management of the water, wastewater and solid waste sectors in Liaoning, and indeed, in many other parts of China.

88. While local governments succeeded in adjusting their investment priorities, the project design had not anticipated the dynamic development situation in China in general, and Liaoning Province in particular. The rapidly changing requirements and needs would have benefited from a number of pre-screened stand-by "spare subprojects" (as suggested by one of the PIUs) that could have replaced the few dropped subprojects.

**(b) Quality of Supervision**

**Rating: Satisfactory**

89. Although not very effective in the early stages of project implementation to assist the Borrower to overcome initial problems and substantial delays, following the mid-term review, Bank supervision fully supported the Borrower's request for a project restructuring and cooperated with Government to complete the project by the extended closing date. Also, Bank supervision paid particular attention to fiduciary, environmental and resettlement safeguard aspects. Bank completed a Special Procurement Review in May 2011 and found only minor deviations of from Bank guidelines; this was done to allow the implementing agencies to proceed with some badly delayed contract awards. They contributed helpful technical advice and innovative solutions for the infrastructure investments. The Bank was also very supportive in assisting with project restructuring and the re-design of the GEF grant funded sub-components. Bank staff also allowed a fine-tuning of their content in 2014 to utilize grant savings and satisfy emerging needs in relation to sector planning and policies, the commercialization of public utility services, and urban-rural service integration. Bank staff made restructuring and loan closing date extension conditional upon (i) delivery of outstanding safeguard documents for revised / additional subcomponents, and (ii) achievement of important progress actions, which proved to be effective incentives. Lastly, Bank supervision helped to ensure that adequate transition arrangements to regular operation were in place and also stressed the importance of good asset management. Overall, Bank supervision had focused on development impact and was fully adequate in terms of frequency and filed regular and candid reports on project performance.

**(c) Justification of Rating for Overall Bank Performance**

**Rating: Moderately Satisfactory**

90. Based on the above assessments, Bank performance is rated a solid Moderately Satisfactory despite the above mentioned issues with project preparation and problems during the early part of implementation. Bank staff made persistent efforts to get project implementation back on track through a successful restructuring, and with an adequate closing date extension, see it through to completion.

**5.2 Borrower Performance**
**(a) Government Performance**
**Rating: Moderately Satisfactory**

91. Both the central government and LPG showed great commitment to the project and worked hard to secure the necessary counterpart funds, process the PAs and SLAs, and maintain good project records. They also complied with the loan re-payment schedule, met the legal covenants, and fully cooperated with the Bank.

92. In the early stages of implementation there was poor coordination and cooperation between LUCRPO and LFD. This poor working relationship had impeded the progress of implementation and also seriously delayed the request for a badly needed project restructuring which the MTR mission had agreed upon in October 2010. However, the LPG is to be commended for their decision in 2012 to make radical changes in the management team of the PDRC and LFD; they also changed the staffing of LUCRPO. These changes led to a greatly improved implementation performance from 2012 onwards.

93. Some government actions actually interfered with a smooth implementation: a Liaoning provincial requirement to have full wastewater treatment capacity by 2010, and national requirements – introduced in 2008 – for leachate treatment at all sanitary landfills led to changes in project scope as local governments scrambled to meet the new requirements.

94. Lastly, LPG's slow progress with implementing national utility tariff policies discouraged local governments from enacting the covenanted tariff increases in a timely manner.

**(b) Implementing Agencies Performance**
**Rating: Moderately Satisfactory**

95. In general, the IAs embraced the project and aspired to its outcomes. They procured a total of 84 goods and works contracts, of which 79 were completed as planned, four were

completed with reduced scope[9], and one dropped[10]. The pace of implementation was varied; some cities managed to complete the construction of their subprojects in 2013, but others implemented very slowly, especially during the first few years so that after two years of implementation the project was 12 months late.

96. In general, there was a stubborn disbursement lag throughout implementation (due to slow processing of withdrawal applications at the IA and the provincial levels) although physical progress was much better, especially during the later years. By 2010 the key construction management consultants had not been paid (due to an unreasonable payment procedure) and threatened to leave the project – three years after Effectiveness. Bank management called the project "at a critical stage". Just prior to the project restructuring in 2013, DO and IP ratings were downgraded to Moderately Unsatisfactory, and the GEO rating was Unsatisfactory.

97. In view of the impressive recovery of implementation progress after the restructuring, and the efforts made to expedite the processing of all pending payments, the IAs performance overall is rated as Moderately Satisfactory.

**(c) Justification of Rating for Overall Borrower Performance**
**Rating: Moderately Satisfactory**

98. Since both Borrower and IAs were rated Moderately Satisfactory, the overall rating is also Moderately Satisfactory; this rating reflects a slow start with many problems and delays but good efforts on the part of the Borrower to overcome the difficulties, complete the project successfully and achieve the PDO and GEO as well as the full counterpart fund disbursement.

## 6. Lessons Learned

**(a) Partnership engagement and ownership**

99. ***Build strong partnership between all stakeholders including the Bank, the Borrower and the implementing agencies while recognizing their cultural diversity.*** The Bank team's emphasis on strong partnership increased the trust between the parties. The simple act of sitting with the Borrower's team on their side of the table helped greatly to build trust. This was reported by LUCRPO to the top management of LFD and LDRC, and Liaoning shared the concept for a follow up project with the Bank team; that concept was later submitted to the Bank for possible future financing.

[9] Two works and goods contracts were reduced due to a land availability issue for the Dawa solid waste transfer station (which is now proposed for construction with funding from the local budget) and the other two are related to Haicheng water distribution pipelines.

[10] This is related to the cancellation of water supply pipelines in Haicheng that were not needed anymore due to changes in the city's masterplan.

100. ***Ensure the availability of counterpart funds before project Effectiveness.*** This would expedite the pace of implementation and avoid unnecessary delays.

101. ***Build strong local commitment and buy-in early on during project preparation and the early part of the implementation period.*** Implementation proceeded smoothly in Xingcheng where local buy-in was secured early on but there were delays and setbacks with the GEF component due to a lack of sufficient local commitment and buy-in.

**(b) Institutional and financial**

102. ***Identify institutional weaknesses that may impede the pace of implementation.*** This should be carried out at a very early stage in close cooperation with the government and the implementing agencies involved. Thanks to the LPG's intervention, the serious delays at the beginning of the project that were caused by the unworkable implementation arrangements and procedures were compensated for by the fast progress after the radical changes in the management teams of LFD, LDRC and LUCRPO in 2012.

103. ***During project preparation and start-up focus the institutional and capacity-building efforts on those cities with no prior Bank experience.*** The cities that were new to Bank financing had considerable start-up problems and delays, but cities with experience from earlier Bank projects performed much better during the early implementation period.

104. ***Do not set targets that are unlikely to be achieved in view of the prevailing policy environment and precedents.*** The cost recovery indicators for the project cities were not well selected since the utilities in the project cities of Liaoning do not have control of tariff adjustments – tariffs are usually imposed by the local governments.

**(c) Operational**

105. ***Aim for a simple project and proper packaging of the investments to expedite implementation.*** The project financed 84 works and goods contracts. Given their similar nature, the contracts could have been packaged differently to reduce their number and thus the management efforts. However, the complexity of contracting was exacerbated by the wide project scope: eleven IAs covering three distinct infrastructure sectors, and seven widely separated cities.

106. ***Once the need for project restructuring has been identified and agreed upon, proceed expeditiously to actually restructure the project.*** The very much delayed restructuring of this project caused serious disbursement lags due to category allocation limits.

107. ***Expect changes and therefore build flexibility into a project that supports local government investments.*** Fast-growing local governments insisted on their autonomy to make decisions when faced with changing needs and new regulatory and policy requirements. Such situations led to a number of scope changes, some subcomponents were dropped but no substitutes were ready, and a major restructuring became necessary.

108. ***Make sure to actually implement the risk mitigation measures that were proposed for all risks identified during the appraisal process.*** Mitigation measures for risks related to design, fiduciary aspects and institutional capacities were not fully implemented and this caused a number of problems and delays.

109. ***Have some detailed designs for subprojects ready by the start of implementation and also develop some pre-screened standby spare subprojects.*** The lack of completed detailed designs at start-up caused serious implementation delays. Moreover, the project design should have anticipated for the dynamic development situation and develop some pre-screened standby "spare subprojects" that could have replaced the dropped subprojects.

**(d) Capacity building and technical assistance**

110. ***Maximize the benefits of the TA and expedite TA implementation during the early stages of the project.*** All studies and TA activities under the loan and GEF have been completed, albeit late, but it would have been preferable to start these activities during the early stages of the project. This would have given the IAs the opportunity to fully practice, apply and use the acquired skills and adapt or scale them up to respond to specific needs.

111. ***Whenever available, seek grant assistance to finance additional TA for complex technical / institutional projects.*** The GEF grant funds – after restructuring – provided an opportunity to mobilize additional, special TA to address the complex institutional, financial and technical challenges faced by the IAs. The GEF grant also allowed the Borrower to reduce loan funding for TA by USD 1 million.

**(e) Other Lessons for specific aspects of implementation**

112. ***Carry out full geotechnical investigations before finalizing bidding documents to ensure good engineering design of foundations and structures.*** Lack of complete technical, especially geotechnical, information for the construction of WWTPs necessitated later design changes and variations that caused cost increases and delays in contract completion.

113. ***Do broad and intensive public consultations early in the landfill site selection process and consider all objections and concerns, especially from adjacent populations.*** Three landfill site locations that had been selected early in the land acquisition process were later rejected by the local population; this caused project delays, and the cancellation of one of the SWM components.

114. ***Include sub-metering of electric power consumption within WWTPs.*** The absence of detailed data made the monitoring and control, and subsequent reduction, of power usage difficult to achieve.

115. ***Conduct targeted environmental training of project participants early during project implementation; later, during construction, communicate effectively with the local population with regard to potential environmental and social impacts.*** Timely and

appropriate environmental training helped project participants to better understand the importance, requirements and implementation approach of the EMPs. Also, where good communication with directly affected populations was done, it contributed considerably to smooth project implementation and avoided complaints and construction delays.

## 7. Comments on Issues Raised by Borrower/Implementing Agencies/Partners

### (a) Borrower/implementing agencies

116. Liaoning Province, in its project completion report (PCR) which was prepared by LUCRPO and is summarized in Annex 7, expressed great satisfaction and pride with the project's outcomes. The entire implementation process has been a valuable experience for all agencies involved, and much capacity building of the PIUs has been achieved that will help them with their ongoing operations, planning and implementation of future projects.

117. LUCRPO is also very satisfied with the level of support they received from the Bank during project identification, preparation and implementation; the facilitation of procurement and timely reviews and approval for contract re-packaging and the project restructuring following the MTR discussions; and the re-design at MTR of the GEF grant funded sub-components, and in fine tuning of their content in 2014 to satisfy the needs of emerging sector policies in relation to marketization of public utility services and urban-rural service integration.

118. LUCRPO emphasized that the Bank loan and GEF grant have not just simply helped to finance the Project, but have also introduced advanced management practices for project implementation, strategic sector planning and enterprise operation. Bank project implementation rules and procedures for procurement, contracts management and construction supervision have been broadly accepted as being fair and giving greater assurance of a satisfactory outcome. Good experience has been gained by applying these rules and procedures, which have been replicated on similar projects not financed by the Bank.

119. LUCRPO acknowledged that the GEF-funded capacity building activities have laid a good foundation for improved performance of Liaoning public utilities, in strategic sector level planning and the use of public private partnerships (PPP). In addition; (i) greater knowledge has been obtained of the ecology of the Dahuofang reservoir watershed, which is the key water resource of the Province, and draft mechanisms were developed for its preservation; and (ii) a pilot system of urban-rural integration of solid waste collection and disposal has been designed for implementation in Panjin, which it is hoped can become a model for future integration of public utility services across the urban-rural divide.

120. The Bank concurs with LUCRPO's assessment regarding (i) the importance of the counterpart funding for smooth implementation; (ii) the importance of comprehensive project design that takes into account the site conditions and the local land use plans to avoid variations and delays; (iii) the need for proper arrangements for electricity consumption audits in all water and wastewater installations to be able to develop better energy management plans; (iv) the recognition that cost recovery covenants cannot be viable without considering institutional reforms, as in case of Panjin and Yingkou; (v) the

importance of leadership to facilitate timely implementation of the capacity building activities under GEF; (vi) the great need to do more capacity building in PPP (a PPP pilot was dropped from the GEF component); and (vii) the need for proper asset management, sustainability of the project outcomes and the scaling up of the project activities to further improve the water and wastewater services in Liaoning.

**(b) Cofinanciers**
N/A

**(c) Other partners and stakeholders**
N/A

## Annex 1. Project Costs and Financing

**(a) Project Cost by Component (in USD Million equivalent)**

| China-Second Liaoning Medium Cities Infrastructure Project - P092618 | | | |
|---|---|---|---|
| **Components** | **Appraisal Estimate (USD millions)** | **Actual/Latest Estimate (USD millions)** | **Percentage of Appraisal** |
| Wastewater infrastructure | 129.90 | 124.36 | 95.7 |
| Water supply infrastructure | 132.20 | 145.63 | 110.2 |
| Solid waste infrastructure | 55.60 | 36.35 | 65.4 |
| Institutional Development | 2.70 | 2.78 | 102.9 |
| **Total Baseline Cost** | **320.40** | **309.12** | **96.5** |
| Physical Contingencies | 0.00 | 0.00 | - |
| Price Contingencies | 0.00 | 0.00 | - |
| **Total Project Costs** | | | |
| PPF | 0.00 | 0.00 | - |
| Front-end fee IBRD | 0.43 | 0.43 | 100 |
| **Total Financing Required** | **320.83** | **309.55** | **96.5** |
| | | | |
| **China-GEF-Liaoning - P090375** | | | |
| **Components** | **Appraisal Estimate (USD millions)** | **Actual/Latest Estimate (USD millions)** | **Percentage of Appraisal** |
| Public utility program | 2.35 | 0.00 | N/A |
| Solid waste master planning | 1.50 | 0.00 | N/A |
| Water pollution control planning | 1.00 | 0.00 | N/A |
| Dissemination & training | 0.15 | 0.05 | 33.3 |
| Public utility capacity building | N/A | 0.78 | - |
| Water networks GIS systems | N/A | 1.59 | - |
| Study of ecology of Dahoufang Reservoir | N/A | 0.30 | - |
| Urban solid waste management | N/A | 1.14 | - |
| Strategic planning for urban wastewater management | N/A | 0.92 | - |
| **Total Baseline Cost** | **5.00** | **4.78** | **96.0** |
| Physical Contingencies | 0.00 | 0.00 | - |
| Price Contingencies | 0.00 | 0.00 | - |
| **Total Project Costs** | **5.00** | **4.78** | **96.0** |
| PPF | 0.00 | 0.00 | |
| Front-end fee IBRD | 0.00 | 0.00 | |
| **Total Financing Required** | **5.00** | **4.78** | **96.0** |

Note: Due to the delayed start-up of the GEF-financed studies, the first three components were completely revised and replaced by five new components. Total GEF expenditures do not add up to total amount disbursed due to rounding errors.

**(b) Financing**

| P092618 - China-Second Liaoning Medium Cities Infrastructure Project | | | | |
|---|---|---|---|---|
| **Source of Funds** | **Type of Financing** | **Appraisal Estimate (USD millions)** | **Actual/Latest Estimate (USD millions)** | **Percentage of Appraisal** |
| Borrower | | 147.83 | 148.52 | 100.5 |
| GLOBAL ENVIRONMENT - Associated IBRD Fund (Grant) | | 5.00 | 4.80 | 96.0 |
| International Bank for Reconstruction and Development | | 173.00 | 161.03 | 93.1 |
| **Totals** | | **325.83** | **309.55** | **96.5** |
| | | | | |

| P090375 - China-GEF-Liaoning | | | | |
|---|---|---|---|---|
| **Source of Funds** | **Type of Financing** | **Appraisal Estimate (USD millions)** | **Actual/Latest Estimate (USD millions)** | **Percentage of Appraisal** |
| Borrower | | 0.00 | 0.00 | - |
| Global Environment Facility (GEF) | | 5.00 | 4.80 | 96 |

Note: Local funds were converted at the exchange rate of RMB1.00 = USD0.157

## Annex 2. Outputs by Component

Components 1, 2 and 3 of the project generated a large number and range of physical outputs with many general and some city- or site-specific outcomes. The main outputs and their clear linkages to outcomes are shown in matrix format below.

| CITY | OUTPUTS | OUTCOMES |
|---|---|---|
| ***Component 1 – Wastewater infrastructure*** | | |
| **Fushun** | - 10.8 km of new sewers in Liushan & Zhang Dan districts | - cleaner urban environment<br>- decrease of unsanitary conditions<br>- no more wastewater discharges or over-flows into rivers & lakes<br>- cleaner, less polluted surface water for irrigation, fisheries & recreation<br>- in Panjin & Yingkou, substantive treated effluent re-use by municipality & industry, respectively<br>- reduction of pollution load entering – directly or indirectly – the Bohai Sea<br>- conservation of economic activities in the Bohai Sea, i.e. fishing & tourism<br>- reduction of pollution load entering – directly or indirectly – the Bohai Sea<br>- improved investment climate<br>- in Gaizhou, river banks have been stabilized & bank erosion has been halted over 3.3 km<br>- in Panjin wastewater treatment coverage comprises 722ha with an estimated population of 283,000 and coverage rate has increased to 85%<br>- in Yingkou wastewater treatment coverage increased to 90% and an covers a population of 420,000 and the wastewater treatment rate increased from 45 to 90% |
| **Yingkou** | - new 100,000 $m^3$/d WWTP<br>- drainage & interceptor sewers<br>- 7 new sewage pump stations<br>- 1 sewage pump station was upgraded | |
| **Panjin** | - new 100,000 $m^3$/d WWTP<br>In two districts of Panjin:<br>- 18.8 km sewer lines rehab'd<br>- 2 new sewage pump stations<br>- 6 sewage pump stations were rehabilitated | |
| **Gaizhou** | - new 50,000 $m^3$/d WWTP (using extended aeration A/O process)<br>- new 7 km sewage interceptor<br>- 3.4 km of new main sewers<br>- 1 new sewage pump station<br>- 3.3 km new riverbanks improvement works | |
| ***Component 2 – Water supply infrastructure*** | | |
| **Anshan** | - new 120,000 $m^3$/day water treatment plant (WTP)<br>- 120 km distribution lines either upgraded or newly constructed<br>- 65,250 water meters purchased | - non-revenue water was reduced significantly in all project cities & more water is available for sale, resulting in better service for customers & revenue increases for the utilities<br>- more accurate billing of customers |
| **Haicheng** | - 10,000 $m^3$/d capacity expansion of existing WTP<br>- 60,000 $m^3$/d capacity expansion of existing water distribution plant<br>- 74 km of water distribution pipes newly constructed or upgraded | |

| CITY | OUTPUTS | OUTCOMES |
|---|---|---|
| | - plan to purchase 25,000 water meters later (using non-Bank funds) | - increased tariff collection & higher revenues for the water utilities<br>- due to GIS, more efficient management of distribution system<br>- optimal decisions for priority repairs, upgrading or new construction<br>- higher quality of treated water<br>- better investment climate because of availability of reliable and good quality water supply<br>- in Anshan 250,000 HHs benefited directly from improved water service as a result of pipe replacement<br>- in Yingkou the service area increased by about 2,000ha with an estimated population of 105,000 |
| **Yingkou** | - new raw water intake and 31.3 km transmission line<br>- 70,000 $m^3$/d capacity WTP<br>- construction or upgrading of 125.9 km water distribution lines | |
| **Panjin** | - construction of 33 km of water distribution pipelines<br>- water loss monitoring and water metering equipment:<br>- 205 bulk meters<br>- 92,262 water meters<br>- 6,212 u/g meter chambers | |
| **Fushun** | - construction of large diam. 15 km raw water transmission main line<br>- construction & upgrading of 125.9km water distribution lines<br>- purchase of water loss monitoring equipment | |
| **Xingcheng** | - construction of 17.5 km of distribution network<br>- purchase of water loss monitoring equipment<br>- purchase of 2,200 water meters | - availability of 24-hour adequate pressure throughout the distribution system while before the project there was low pressure & intermittent water rationing |
| ***Component 3 – Solid waste infrastructure*** | | |
| **Fushun** | - sanitary landfill with capacity of 1,400 t/d (NBF)<br>- one leachate treatment plant.<br>- landfill operating equipment<br>- closure of old open dump<br>- 30 rear compaction vehicles | - cleaner urban environment<br>- decrease of unsanitary conditions<br>- reduced odor & visual nuisance of open dump sites<br>- reduced potential of groundwater contamination<br>- reduction of pollution load entering – directly or indirectly – the Bohai Sea<br>- conservation of economic activities in the Bohai Sea, i.e. fishing & tourism<br>- improved investment climate<br>- in Fushun, closure of several scattered uncontrolled dump sites |
| **Panjin** | - sanitary landfill with capacity of 600 t/d (by BOT – not using Bank financing)<br>- 20 rear compaction vehicles<br>- One transfer station w/associated vehicles | |
| ***Component 4 (i) – TA for design and construction*** | | |
| | - review bidding documents<br>- assist with project management<br>- review of payment applications<br>- site inspections and training for supervision activities<br>- assistance with financial management, accounting, and safeguards monitoring | - a well-managed project<br>- timely and informative reports<br>- project was able to get back on track after serious problems & delays<br>- effective construction supervision<br>- good documentation & dissemination of studies and TA outputs<br>- an effective FMS<br>- good safeguards monitoring with |

| CITY | OUTPUTS | OUTCOMES |
|---|---|---|
| | | minimal problems & complaints<br>- significantly increased inst. capacities |

Component 4 (i) was implemented between 2008 and 2015. The TA consultant provided advisory services to the PIUs and LUCRPO for bidding documents review, project management, payment review and asset management. All bidding documents were reviewed by the consultant before submission to the Bank for 'no objection' (prior review) or to LUCRPO for approval (post-review). All payment applications (including VOs) were also reviewed by the consultant and submitted to LUCRPO, with appropriate comments. The consultant did site inspections to construction sites during the construction period. The consultant also provided advice and training to LUCRPO and PIUs, relating to management of contracts, safety issues, and quality and cost control.

In 2013, due to progress and financial reporting problems, additional tasks were added to the package A1 work scope in relation to financial management, accounting, environmental and resettlement safeguards monitoring.

The consultant also provided TA support for implementation of 11 retro-actively financed contract packages scheduled for implementation between September 2007 and March 2008. The TA consultant provided services to the relevant PIUs and LUCRPO for bidding documents review, and project management for these 11 packages. However, due to the delay in implementing some of the packages, the services were not actually completed until December 2012.

*Outcomes: Increased project management capacity of project agencies*

Through the support of the consulting team all 12 project implementing entities developed as effective project implementation agencies and the procurement and the construction phase of all project components were generally well managed. Most construction contracts were completed ahead of schedule, although some delays occurred, notably in Gaizhou, Haicheng and Panjin. All PIUs acquired solid experience in project management and in the particular requirements of implementing a Bank-funded project, such as open and transparent procurement, and effective controls over contract variations and procedures for the handling of contractors' claims. The fact that the project was generally implemented successfully, with performance improving as time went on, demonstrates this capacity building was successful.

In view of the large number of studies, initiatives and reports generated by the GEF component, a summary of objectives, outputs and related outcomes is presented below.

| ***Component 4 (ii) to (iv) – GEF-financed Studies and their dissemination*** | | | |
|---|---|---|---|
| **Ref.** | **Objectives** | **Outputs** | **Outcomes** |
| **B1** | **Public Utility Capacity Building** | | |
| B1-2 | | Leakage Control and Management Report | Water balances prepared for each participating utility. Strategies for reducing leakage levels developed and implementation commenced. |

| *Component 4 (ii) to (iv) – GEF-financed Studies and their dissemination* | | | |
|---|---|---|---|
| **Ref.** | **Objectives** | **Outputs** | **Outcomes** |
| B1-3 | - Provide leadership in the design and supervision of the start-up of the Liaoning Public Utility Improvement Program | Operational Management and Optimization Report | Potential optimization and efficiency savings identified for each utility and managers briefed on potential follow-up actions. |
| B1-4 | | Final Benchmarking Report | Improved awareness of staff of potential benefits from benchmarking, relevant methodologies and implementation issues. Utility managers now better understand the importance of proactive performance management and the techniques involved. All participating utilities are to publish annual performance reports in future. |
| B1-5 | | Capacity Building Design Report and Training Material | Comprehensive compilation of all training material available in hard and electronic format. Several participating utilities started to incorporate this material into their internal training programs. |
| | | 7 utilities benefited from this program: Anshan City WS General Co; Fushun City WS Co; Haicheng City Water Supply Co; Panjin City WS Gen. Co.; Panjin Urban Drainage Mgt Co Ltd; Yingkou Water Affairs Co. Ltd; and Gaizhou Drainage Co. (GDC). | |
| **B2** | **GIS Systems for Water Supply Networks** | | |
| B2-1 | - Provide leadership in design & supervision of the start-up of Information Management Systems (IMS) of Urban Water Supply for scientific management & optimize water distribution. | Data Base of Water Network Assets | Three cities – Yingkou, Anshan and Haicheng – now have and utilize a state-of-the-art GIS for more effective monitoring, up-grading, expanding & repairing their water supply networks. GIS facilitates improved operations, leakage control and systems optimization. Operators & users are well trained & highly competent. |
| B2-2 | | Mapping Database | |
| B2-3 | | Inception Report | |
| B2-4 | | Pipe network hydraulic model | |
| B2-5 | | Training Materials | |
| B2-6 | | Final Completion Report | |
| **B3** | **Study of Ecology of Dahuofang Reservoir** | | |
| B3-1 | - Quantify the ecological service values in the Dahuofang watershed<br>- Promote the improvement of the ecological environment and water quality of | Report on values of ecological services of Dahuofang Reservoir | - availability of more accurate values of ecological service functions value generated by forests, reservoirs, farms and other types of ecosystems in the surrounding areas<br>- ecological compensation policies can be developed |
| B3-2 | | Report on proposals for ecological compensation | |

| *Component 4 (ii) to (iv) – GEF-financed Studies and their dissemination* | | | |
|---|---|---|---|
| **Ref.** | **Objectives** | **Outputs** | **Outcomes** |
| | Dahuofang Reservoir<br><br>- Clarify overall goals, basic principles, then design ecological compensation mechanism | mechanisms for the Dahuofang Reservoir watershed | based on eco-compensation index<br>- based on above, a system for ecological governance can be developed & implemented<br>- case study available for use by other regions |
| **C** | **Urban Solid Waste Management** | | |
| C-1 | - Assist the selected cities to prepare strategic solid waste plans that address institutional, financial, cost-recovery and infrastructure planning issues | Inception Report | - Gaizhou & Panjin have better designed landfill sites & facilities with minimal negative environmental impacts<br>- the 2 landfill sites have proper groundwater monitoring wells to prevent spreading pollution<br>- SW utility staff are better equipped to plan for future expansion<br>- Gaizhou, Fushun & Panjin have separate SW master plans to guide future development<br>- utility staff are better informed on SW collection, transfer, disposal & management options thus contributing to a cleaner & healthier urban environment<br>- utility staff are better equipped to deal with financial aspects, especially cost recovery & tariff collection<br>- new operational manuals assist with safe & efficient operation of sanitary landfills<br>- Panjin is enabled to operate a well-designed pilot project of integrated urban-rural solid waste management |
| C-2 | | Design of Gaizhou proposed solid waste | |
| C-3 | | Panjin priority projects and plan for the expansion of waste collection systems | |
| C-4 | | Report on the design of the new landfill of Yingkou EDZ | |
| C-5 | | Financial Management, Cost Recovery, and Management Model Report | |
| C-6 | | Planning consultation report on Fushun urban waste collection and transportation system | |
| C-7 | | Report on the proposals for integrated urban-rural mgt. of solid waste in Panjin | |
| C-8 | | Final SW Master Plans | |
| C-9 | | Final Operational Manuals | |
| C-10 | | Final Report (includes capacity building activities) | |
| **D** | **Strategic Planning for Urban Wastewater Management** | | |
| D-1 | - Assist Panjin and Gaizhou to develop sustainable wastewater management systems | Inception Report | - staff have updated practices & procedures for plant<br>- wastewater utility staff in Gaizhou & Panjin are better informed about future inst'l & ownership options<br>- specific recommendations are available to guide planning & design for future needs & |
| D-2 | | Gaizhou Operational Manual | |
| D-3 | | Panjin Operational Manual | |
| D-4 | | Gaizhou General Business Plan | |
| D-5 | | Panjin General Business Plan | |
| D-6 | | Gaizhou Wastewater and Drainage Master Plan | |
| D-7 | | Panjin Wastewater and Drainage Master Plan | |

| *Component 4 (ii) to (iv) – GEF-financed Studies and their dissemination* | | | |
|---|---|---|---|
| **Ref.** | **Objectives** | **Outputs** | **Outcomes** |
| D-8 | | Report on potential for market-oriented (commercial) operation of urban infrastructure | expansion of plants<br>- staff have knowledge of options for technical facilities & wastewater treatment systems<br>- staff are better trained & equipped to operate & manage existing facilities |
| D-9 | | Final Report (includes capacity building activities) | |
| **E** | **Dissemination and Training Activities** | | |
| | - Facilitate learning & replication<br>- Import relevant best practices | Dissemination workshop for 80 staff in June 2015 in Shenyang | - all utility staff in Liaoning Province are better informed on innovative approaches to utility<br>planning, design, operation and management. Staff are better informed on best practices, esp. national practices |
| | | Publication of detailed proceedings of workshop | |

To supplement the above matrix of the GEF component outputs and outcomes a summary of outputs, outcomes and benefits by sub-component is presented below.

***Sub-component – Public utility capacity building***

The two main pillars of the technical assistance were: (i) improved operational performance, focusing on reducing the NRW of water supply utilities and the opportunities for operational efficiency and effectiveness improvements (especially via systems optimization) of water and wastewater utilities, and (ii) improved public utility management, with a particular focus on performance measurement, including performance benchmarking.

*Reduction of Non-revenue Water (NRW)*

- A water balance was prepared for each participating water supply utility in close conjunction with water supply operations managers. Each utility should now be able to repeat this exercise and update their water balance.
- Strategies for reducing water leakage levels and other aspects of NRW were developed and their implementation was commenced.
- A pilot exercise to assess the effectiveness of meter replacement in Panjin demonstrated that such replacement programs can achieve increased water sales of up to 40%.

*Operational Efficiency and Systems Optimization Improvements*

- Potential optimization and efficiency savings were identified for each utility and managers briefed on potential follow-up actions.
- Specific applications in the use of supervisory control and data acquisition (SCADA) were introduced and explained, and how these could be utilized in conjunction with the new GIS implemented under sub-component B2.

- Opportunities for pressure optimization both as a means of leakage reduction and service level improvement were identified and explained, and are being actively followed up by the concerned utilities.
- Pumping optimization and potential energy efficiency improvements were identified and explained; and
- For each participating WWTP, a detailed study of treatment efficiency and effectiveness was conducted and specific opportunities explained to local operational managers for their follow-up action.

*Improved Performance Management of Public Utilities*

- Through capacity building sessions and discussions with each participating utility managers now better understand the importance of proactive performance management and the techniques involved.
- All participating utilities have been enabled to publish annual performance reports in future – this will improve transparency in the required service standards and the actual performance of the utilities concerned which is likely to lead to a more informed and supportive customer base.
- The use of performance benchmarking and its potential benefits and shortcomings, alternative approaches and benchmarking systems, and a history of its use in China was provided to the participating utilities, and the IBnet system supported by the World Bank was identified as being most suitable for use in Liaoning.

***Sub-component – Implementation of water network GIS***

This sub-component has resulted in fully operational GIS for the water networks of Anshan, Haicheng and Yingkou water supply companies. Specific benefits obtained or anticipated are as follows:

- Provision of mapping databases for the water supply areas of each of the participating water utilities, training in database use and maintenance and handover to the utilities,
- Provision of operational water network asset databases for each utility, training in database use and maintenance, and handover to the utilities for future updating
- Provision of a hydraulic model of each utilities' water network, and training in its use.
- The systems and tools provided will lead to undoubted improvements in asset management and in the operation of water distribution systems, including leakage reduction;
- Use of hydraulic modelling will allow plans for future investments to strengthen existing networks or their extension to be optimized,

The GIS, although currently operating as stand-alone systems, can later be readily integrated with other IT systems, such as SCADA, work scheduling, financial and inventory systems, to enhance operational efficiency and service levels.

***Sub-component – Study on ecology of Dahuofang Reservoir***

The study is utilized by the Liaoning Province Dahuofang Water Resource Management Office for developing ecological compensation policies, and the development of a "Dahuofang Reservoir basin ecological compensation system". The research associated report provided a theoretical and value basis for the development of related ecological and environmental governance systems, and is of reference and promotion value to other PRC regions on how to carry out basin ecological service value assessments. Specific benefits arising from the study included:

- a current situation assessment of ecological environment protection, and economic and social development in the Dahuofang Reservoir catchment,
- a proposed methodology, together with a specific quantification of the ecological service values in the Dahuofang watershed
- identified problems, clarified overall goals and basic principles, and made specific proposals for building and perfecting an ecological compensation system for the watershed, and.

The study also advocated for the improvement of the ecological environment and water quality of Dahuofang Reservoir.

***Sub-component – Strategic planning of solid waste disposal***

*Construction Plan for monitoring wells at the new SW sanitary landfill in Gaizhou.*
The plan was established taking account of related standards, engineering, geological and hydrogeological surveys, and has been adopted by Gaizhou city.
*Priority projects and plan for the expansion of waste collection systems in Panjin*
Based on the current situation and taking account of future service needs, a well-designed SW collection and transfer expansion plan was prepared for Panjin and has been adopted by the local government.

*Report on the design of the new landfill of Yingkou EDZ*
A comprehensive design report was prepared covering: (i) engineering, geological, and hydrogeological survey of the landfill site; (ii) the liner system; (iii) leachate collection and treatment; (iv) gas collection; (v) final cover and closure arrangements; (vi) control of leachate level; (vii) monitoring of leachate leakage, and (viii) requirements for underground water monitoring wells.

*Financial management, cost recovery, and management model report*
Provides a guide for the project cities to develop and realize a highly efficient and sustainable solid waste management system capable of delivering the service according to agreed targets in a planned, cost effective and transparent way using most appropriate technology.

*Planning consultation report on Fushun waste collection and transportation system*
Based on the current situation and taking into account the future service needs, a well-designed SW collection and transfer system was prepared for Fushun.
*Proposals for integrated urban-rural (URI) management of solid waste in Panjin*
Three reports prepared under the TA contract deal respectively with (i) a specific plan for URI; (ii) financial management of the system; and (iv) URI administrative management.

The overall outcome is that a URI pilot system has been instituted and so far is operating satisfactorily.

*Final MSW Master Plans*
Separate master plans and supporting reports provided for each of Gaizhou, Fushun, and Panjin cities and the Yingkou EDZ. Each master plan (i) confirmed and evaluated the current situation; (ii) provided a development forecast (iii) set strategic targets, (iv) developed master plans for MSW collection, transportation and treatment; (v) identified required investments needed; and (vi) safeguard actions needed for system sustainability. These plans are being used by city authorities to update their own planning documents and to guide detailed infrastructure planning. Where applicable these master plan reports are compatible with the recommendations of other relevant TA outputs.

*Final Operational Manuals*
These manuals provide for the safety and efficient operation of landfills. They provide standard guidelines and quantitative regulations for operation, facilities, quantification information, environment and safety of solid waste sanitary operations in two parts: (i) MSW landfills and (ii) SW transfer stations.

*Report on SW Institutional Framework and management information system.*
Provides the analysis, a framework and specific recommendations to MSW management authorities to enable them to better manage all aspects of the MSW .service; this includes suggestions on how PPP outsourcing might be used.

*Construction Plan for monitoring wells at the new LMC-2 funded landfill in Fushun*
This plan was established taking account of related standards, engineering, geological and hydrogeological surveys.

*Closure plan for the Taiyangsheng MSW dumping site in Gaizhou.*
Provides detailed closure design plans, including shaping and treatment of the dumps, cover system, leachate collection system, landfill gas collection system, surface water control system, and underground water monitoring, taking account of the specific local situation. The plan facilitates a safe, environmentally sound means of dump closure.

***Sub-component – Strategic planning of urban wastewater management***

*Gaizhou and Panjin Operational Manuals*
The scope of the manuals was restricted to the operations and maintenance requirements of the WWTP in Gaizhou and Panjin constructed under the LMC-2 project and took account of the actual treatment process and the inventory of installed treatment equipment. These manuals, together with the detailed content of manuals supplied by equipment manufacturers, provide comprehensive guidance for use by local WWTP managers to revise and update their practices and procedures.

*Gaizhou General Business Plan*

Provides a development path and identifies the financing needs for the Gaizhou Drainage company assuming service demands are as forecast in the revised city master plan prepared under this same TA (see below).

*Panjin General Business Plan*
Provides a development path and identifies the financing needs for the management of wastewater services in Panjin, assuming service demands and associated infrastructure improvements take place as forecast in the revised city master plan prepared under this same TA.

*Gaizhou and Panjin Wastewater and Drainage Master Plans*
These plans update the previous city wastewater master plans and integrate the planning of wastewater management with the prevention of water-logging in the cities. The plans include an updated forecast of service demand, the extent and timing of infrastructure improvements needed, and broad financing estimates. These plans also include a specific strategy for the separation of existing wastewater and storm pipes, where this is necessary to ensure effective drainage of an area. The plans are being used by city authorities to update their own planning documents and to guide detailed infrastructure planning.

*Report on potential for market-oriented operation of urban infrastructure*
Provides an analysis of the legal and regulatory environment for the marketization of wastewater services in the PRC and lessons from past marketization experience. Identifies actions needed, and suggests a delineation of responsibilities, to facilitate the more effective use of marketization in the wastewater sector.

## Annex 3. Economic and Financial Analysis

### *Economic analysis*

In accordance with the PAD, all project components utilized the standard least-cost which incorporated technical, environmental, financial, and social criteria into the decision-making process. At subproject level economic cost-benefit analysis was not considered to be appropriate because: i) the water supply, wastewater and solid waste treatment investments were driven by the Chinese national standards; and, ii) a significant portion of the investments consisted of renovation of existing pipeline assets. A major innovation under the project was the use of an asset management planning approach for network rehabilitation, which generated the most economic approach for these types of investments by allowing for strategic assessment of the highest priority investments on an ongoing basis.

Although not quantifiable – due to the inherent difficulty in quantifying precisely and meaningfully the benefits in environmental projects, particularly those relating to public health and environmental improvements – the project generated substantial economic benefits through:

- greater urban coverage with water supply, wastewater and solid waste services
- increased treatment capacities for water supply, wastewater and solid waste, facilitating future urban and industrial investments and growth
- improved utility service delivery providing safe and reliable 24-hour water supply, benefiting businesses in particular
- higher quality of treated water
- higher water use efficiency achieved through metering and NRW reduction initiatives
- increased revenue for water companies resulting from metering and lower NRW, strengthening the utility companies
- expanded wastewater collection, treatment and disposal, including some economic re-use of effluent
- higher quality wastewater effluent
- better sanitation through improved wastewater and solid waste collection and disposal.

The beneficial improvements listed above also provided important health, environmental and aesthetic benefits.

*Highlights of environmental benefits:*

- Additional 250,000 $m^3$/d of WWTP treatment capacity has been added in the project cities, with an approximate reduction in total COD discharge of 12,000 tons per annum (2013).
- In Panjin, 30,000 $m^3$/d of treated wastewater effluent is now being re-used for municipal management purposes (irrigating green space and street cleaning).
- In Yingkou, effluent from the wastewater treatment plant is supplied to Zhongyejingcheng (Yingkou) Equipment and Technology Co. Ltd. for use as production water.

- Sanitary municipal solid waste landfills in Panjin and Fushun provide for the daily disposal of 2,000 t/d of solid waste disposal, with full leachate treatment provided in accordance with national standards.
- The new SW facilities have allowed the closure of the old waste dump sites resulting in environmental benefits at those locations. (Professional support on the closure of these existing facilities was provided as part of the GEF component).
- Water quality in the Bohai Sea in the coastal areas of Yingkou and Panjin (the two municipalities where WWTP were constructed) showed a decline in the period up to 2011, but has since improved.
- No significant environmental management issues arose during project implementation and all WWTP and Sanitary landfills constructed under the project at being operated in accordance with the EMP and are in compliance with relevant national operating standards.

The participating local governments also reported that the urban environmental infrastructure improvements improved – in a significant way – the local investment climate, thus contributing further non-quantifiable economic benefits. Lastly, the project investments – by reducing seawater pollution – also contributed to the preservation of economic activities, i.e. fisheries and tourism, in the Bohai Sea.

***Financial analysis***

*Introduction*
This section of the annex reviews the financial performance of the project entities in relation to the following:

- Utility tariffs levied in the project cities
- Tariff affordability
- Financial performance of the water and wastewater companies, including compliance with financial covenants
- Fiscal sustainability of local government guarantees and subsidies

Each of these aspects is considered in turn using the data recorded in the project appraisal document PAD as a baseline and comparing the current situation with the appraisal forecasts.

*Utility Tariff Analysis*
Information on the current tariffs levied by the LMC-2 PIUs is set out in Table 3.1 below and is compared with the tariffs at appraisal and projections made in the PAD for the level of tariff needed to result in financial sustainability. **There was little change in the tariffs charged for the utility services provided by the utilities during the implementation period and therefore, given the increased costs resulting from the LMC-2 project and ongoing price inflation, there is now increased rather than decreased reliance on government subsidies.** The financial position of each company is discussed further below under the heading *Financial performance*.

**Table 3.1: Tariff Comparisons for Water, Wastewater and Solid Waste services**

| Sub-Component | 2006 actual | 2010 projected | 2010actual | 2015 proj | 2015 actual | Notes |
|---|---|---|---|---|---|---|
| ***Water Supply Sub-components*** | | | | | | |
| Anshan, (yuan/$m^3$) | 1.6 | 2.0 | 2.0 | 2.3 | 2.0 | |
| Fushun, (yuan/$m^3$) | 1.1 | n/a | 1.35 | n/a | 1.65 | 2, 5 |
| Haicheng, (yuan/$m^3$) | 1.6 | 1.9 | 1.7 | 2.1 | 1.7 | |
| Panjin, (yuan/$m^3$) | 1.6 | 1.9 | 1.85 | 2.3 | 1.85 | |
| Xingcheng, (yuan/$m^3$) | 1.5 | 1.7 | 1.73 | 2.3 | 1.8 | 4 |
| Yingkou, (yuan/$m^3$) | 2.0 | 2.6 | 2.13 | 2.6 | 2.56 | |
| ***Wastewater Sub-components*** | | | | | | |
| Fushun Wastewater, yuan/$m^3$ | 0.5 | 0.8 | 0.6 | 1.05 | 0.6 | |
| Gaizhou Wastewater, yuan/$m^3$ | 0.35 | n/a | 0.35 | n/a | 0.35 | 2 |
| Panjin Wastewater, yuan/$m^3$ | 0.6 | 0.8 | 0.6 | 1.1 | 0.6 | |
| Yingkou Wastewater, yuan/$m^3$ | 0.5 | 1.2 | 0.5 | 1.3 | 0.6 | |
| ***Solid waste sub-components*** | | | | | | |
| Fushun Solid Waste, yuan/hh/mth. | 4.0 | n/a | 4.0 | n/a | 4.0 | 3 |
| Panjin Solid Waste, yuan/hh/mth. | 0.0 | n/a | 3.0 | n/a | 3.0 | 3 |

**Notes:**

1. All water supply tariffs include the water resource fee (where separately charged).
2. No financial projections to estimate future tariff requirements were made at the time of appraisal.
3. At appraisal, financial analysis was undertaken in respect of service costs but no assumptions on service financing were made at that time. Instead, sector financing was to be studied under the GEF.
4. Tariff increased in Oct 2010, so tariff shown for 2010 is pro-rata.
5. In Fushun a rising block water tariff applies. The blocks were in the range 1.1 to 3.0 yuan/$m^3$ at appraisal and have subsequently risen to a range of 1.65 to 3.3 yuan/$m^3$. Only the tariff for the basic block, which accounts for the majority of domestic consumption, is included in this table.

*Tariff Affordability*

The general affordability of water and wastewater tariffs has improved very significantly during the period of project implementation, as shown in Table 3.2 below. This is a result of rapid economic growth (a general proxy for overall earnings growth) whilst over the same time period there have only been very limited, if any, increases in the tariffs charged for these services.

**Table 3.2: Comparison of Tariff Increases with GDP growth**

| City | 2006 Domestic Tariffs | | | 2014 Domestic Tariffs | | | % Total tariff Increase | % GDP per Capita increase |
|---|---|---|---|---|---|---|---|---|
| | Water | Waste water | Total | Water | Waste water | Total | | |
| Anshan | 1.6 | 0.5 | 2.1 | 2.0 | 0.6 | 2.6 | 23.8 | 158.01 |
| Fushun | 1.5 | 0.5 | 2.0 | 1.65 | 0.6 | 2.25 | 12.5 | 268.77 |
| Gaizhou | 1.6 | 0.35 | 1.95 | 1.65 | 0.35 | 1.95 | 0.0 | 364.09 |
| Haicheng | 1.6 | 0.5 | 2.1 | 1.7 | 0.6 | 2.3 | 9.5 | 158.01 |
| Panjin | 1.6 | 0.6 | 2.2 | 1.85 | 0.6 | 2.45 | 11.4 | 254.22 |
| Xingcheng | 1.5 | none | 1.5 | 1.8 | 0.6 | 2.4 | 60.0 | 219.88 |
| Yingkou | 2.0 | 0.5 | 2.5 | 2.56 | 0.6 | 3.16 | 26.4 | 364.09 |

**Notes:**

1. In Fushun the domestic water tariff operates on a rising block basis – the tariff above is the charge applied to the first block. So the minimum tariff increase is 12.5%, with high water consumers facing larger increases dependent on the amount they consume.
2. Haicheng and Gaizhou are assumed to have the same GDP as their parent city (i.e. Anshan and Yingkou) as this was the assumption made during the project preparations, to avoid double counting.

Where sufficient data was readily available the affordability of water and wastewater charges has been computed as a percentage of earnings for both the average and low income households. **The results as presented in Table 3.3 show that the current charges are readily affordable by even the poorer members of society** when compared to the international yardstick, as referred to in the PAD, that affordability concerns start to arise if charges exceed 5% of disposable earnings.

**Table 3.3: Results of City Affordability Computations**

| City | Average household costs as percentage of disposable earnings | Low income household costs as percentage of disposable earnings |
|---|---|---|
| Anshan | 0.6% | 0.9% |
| Fushun | 0.3% | 0.5% |
| Gaizhou | 1.0% | 1.2% |
| Haicheng | 0.6% | 0.9% |
| Panjin | 0.5% | 0.9% |
| Xingcheng (see note) | 0.2% | 0.4% |
| Yingkou | 0.7% | 1.1% |

**Note:** Xingcheng has yet to introduce a wastewater fee for domestic users and therefore the calculation is based on water usage only, and reflects relatively low per capita usage.

*Fiscal Sustainability*

At appraisal the participating local governments had adequate fiscal capacity for both, debt service and incremental recurrent costs needed for the sustainable operations and maintenance of the project facilities. The fiscal capacity assessment assumed all LMC-2 costs would fall on the local government even where the PIU was a corporate entity with access to its own funds and intended to be financially autonomous; this assessment was very conservative. There has been significant growth in municipal revenues since appraisal as shown in Table 3.4 below. In view of these impressive growth rates and also in consideration of the fact there has been no major cost escalation during the LMC-2 implementation, **it is apparent that fiscal sustainability is now stronger than when it was assessed and considered adequate at appraisal.**

**Table 3.4: Growth in Municipal Revenues over past 10 years**

| **City** | **2005 Revenues** *(RMB billion)* | **2013 Revenues** *(RMB billion)* | **Percentage Increase** *(%)* | **Annual Revenue Growth** *(%)* |
|---|---|---|---|---|
| Anshan | 6.303 | 37.965 | 502% | 55.82% |
| Fushun | 4.719 | 14.887 | 215% | 35.05% |
| Gaizhou | 0.682 | 6.246 | 813% | 90.64% |
| Haicheng | 1.411 | 9.364 | 564% | 62.61% |
| Panjin | 3.401 | n/a | n/a | n/a |
| Xingcheng | 0.355 | 4.744 | 1236% | 137.36% |
| Yingkou | 4.782 | 8.920 | 73.4% | 8.15% |

*Financial Performance of Covenanted PIUs*

Financial projections have been prepared based on the terms of the LMC-2 project agreement (PA) signed between Liaoning Province and the Bank. The projections use the available financial data to the end of 2013 (there was no time to update all projections using the end of 2014 financial data). These projections assess the medium term financial sustainability of the PIUs, and therefore, the use of 2013 data is considered to be acceptable as no major unforeseen changes in the financial situation of the utilities occurred during 2014. The main provisions of the PA were that, commencing in 2008 and each year thereafter, the Anshan, Fushun, Haicheng, Panjin, Xingcheng and Yingkou water supply companies, together with the Panjin and Yingkou wastewater companies need to achieve a simple cost recovery ratio of 1.0 and a debt servicing ratio of 1.3.

It is worth noting that the wording of the PA requirements does not exclude government subsidies within the definitions provided and hence government subsidies are included rather than excluded when calculating whether or not covenants have been complied with.

The LMC-2 solid waste PIUs were not required to prepare annual financial projections. In addition Gaizhou Drainage Company was excluded from the definition of "Project Company" as it was not an operational entity at that time, and Fushun Wastewater Company also was not included in that definition. Thus there is no requirement for either Gaizhou or Fushun wastewater companies to meet the stated financial targets, although

they were required to prepare Financial Improvement Plans (FIPs) and update these annually – which was done.

Although at the time of the PAD it was stated that the Fushun Wastewater Company would be the project owner for the Fushun wastewater component, in reality the Fushun Urban Construction Bureau through the Fushun PMO managed the implementation of this sub-component and Fushun Finance Bureau is providing the resources to service the debt.

*Summary of Results*

The results of the financial projections exercise are summarized in Table 3.5 below. The last column in the table gives an indication of the tariff increases, relative to the 2014 tariff rate, that is needed to achieve full financial sustainability, i.e. no operating subsidy from the local government. In this context, the situation of the wastewater companies is more complex because low collection rates and inadequate tariffs often impair the prospects for financial sustainability. This is the case in Gaizhou and Panjin, but is not a problem in Yingkou where tariff collection performance is reported as being satisfactory.

**Table 3.5: Summary Results of Financial Projections**

| Company | Cost Recovery Ratio | | | Debt Service Ratio | | | Approximate tariff Increase needed |
|---|---|---|---|---|---|---|---|
| | **2013** | **2014** | **2015** | **2013** | **2014** | **2015** | |
| **Anshan Water Supply** | 0.93 | 0.93 | 0.96 | 0.51 | 0.03 | 1.55 | 30% |
| **Fushun Water Supply** | 0.88 | 0.90 | 0.88 | | | | 15% |
| **Haicheng Water Supply** | 0.95 | 1.00 | 1.05 | 0.53 | 0.96 | 1.73 | 55% |
| **Panjin Water Supply** | 0.75 | 0.80 | 0.99 | 1.00 | 1.02 | 1.01 | 120% |
| **Panjin Drainage Company** | See note 2 below. | | | | | | 140% |
| **Xingcheng Water Supply** | 0.79 | 1.00 | 0.51 | | | | 100% |
| **Yingkou Water Supply** | 0.82 | 0.80 | 0.72 | 0.65 | 0.44 | 0.51 | 35% |
| **Yingkou Wastewater** | 1.15 | 1.1 | 1.05 | 0.88 | 0.90 | 1.06 | 0% |

**Notes:**

1. As stated above there was no requirement for Fushun or Gaizhou wastewater companies to meet specific financial targets.
2. No financial projections for Panjin Drainage Company were prepared as that company no longer has any responsibility for wastewater operations, and simply operates as a project office. Using a sector approach the future financing needs for wastewater management in the city estimated that tariff increases of approximately 140% are needed to achieve full cost recovery.
3. 2014 and 2015 figures are based on assumptions made in the 2013 projections.
4. The 2015 estimate for Xincheng excludes any subsidy from the local government, as no decision on subsidy had been made at the time the financial projections were

prepared. However, based on past experience the local government will provide subsidies necessary to ensure the company's financial viability.

*Conclusions*

Each municipal government is providing sufficient budget or operating subsidy to ensure all operations are fully financed. However, tariffs are not at a level that provide for full financial sustainability and in the case of some sub-components low tariff collection rates are also a threat to future financial sustainability. This situation may change as the national government has announced new policies that recognize the need to increase water supply charges as a water conservation measure, however this has not yet filtered down to the LMC-2 project cities[11]. Moreover, local government subsidies have increased significantly over the life of the project as there is a marked reluctance to increase tariffs.

The financial analysis undertaken during the last year of project implementation has revealed that most of the entities face some financial challenges at present, and in several cases receive operating subsidies from the local government; this means the financial indicators in table 3.5 above look better than their underlying financial performance and sustainability. Therefore, the financial autonomy of the water supply companies is compromised by the continuing reliance on government subsidy due a widespread failure on the part of the project city governments to increase the water and wastewater tariffs.

[11] In China it is typical that utility tariffs are increased infrequently but when they do increase, the amount of increase is often substantial. This is largely due to the long and complex application and approval processes for tariff adjustments, and also because of the understandable reluctance on the part of local politicians to impose unpopular measures. However, given that in most cases the tariffs have increased very little over the past 10 years whilst affordability has improved significantly, there is clearly scope for most PIUs to achieve a position of financial sustainability with just one sizable increase. Specifically, with regard to water supply, central government policy is for water utilities to operate on a commercial basis and, generally, subsidies should not be provided. Increasing water tariffs to economic levels is seen as an important water conservation measure, and the introduction of rising block tariffs as already implemented in Fushun is being actively encouraged. Such reforms take time to plan and implement successfully, but they also present opportunities to enhance financial sustainability.

## Annex 4. Bank Lending and Implementation Support/Supervision Processes

**(a) Task Team members**

| Names | Title | Unit | Responsibility/ Specialty |
|---|---|---|---|
| **Lending** | | | |
| Greg Browder | Task Team Leader | EASUR | TTL |
| Hao Zhang | Sanitary Engineer | EASUR | Wastewater Mgt |
| Axel E. Baeumler | Senior Economist | EASUR | Economic aspects |
| Hardy Wong | Solid Waste Specialist | Consult. | SWM |
| Eddie Hum | Environmental Engineer | Consult. | Env't & Urban |
| Patrick McCarthy | Financial Specialist | Consult. | Fin. Mgt. & FIRR |
| Terrence Driscoll | Environmental Engineer | Consult. | Environment |
| Yue Ma | Environmental Engineer | Consult. | Environment |
| Chaogang Wang | Sr. Social Scientist | EASSD | Land acquisition |
| Chongwu Sun | Sr. Environmental Specialist | EASEN | Environment |
| Zhentu Liu | Sr. Procurement Specialist | EAPCO | Procurement |
| Haixi Li | Financial Management Specialist | EAPCO | FM |
| Mei Wang | Senior Counsel | LEGEA | Legal matters |
| Anne Harrison | Program Assistant | EASUR | Team support |
| Raja Iyer | LMC Program Advisor | EASUR | Review & advice |
| | | | |
| **Supervision/ICR** | | | |
| Chongwu Sun | Senior Environmental Specialist | GENDR | Environment |
| Greg J. Browder | Lead Water Resource Management | GWADR | TTL (early) |
| Suhail Jme'an | Sr Financial Specialist | EASWE | TTL (later) |
| Guangming Yan | Urban Specialist | GSURR | Urban issues |
| Guoping Yu | Senior Procurement Specialist | GGODR | Procurement |
| Hiromi Yamaguchi | Consultant | GFADR | |
| Jiang Ru | Senior Environmental Specialist | GENDR | Environment |
| Eddie Hum | Environmental Engineer | Consult. | Env't & urban |
| Mingyuan Fan | Sr Sanitary Engineer | GWADR | Wastewater &SWM |
| Vellet E. Fernandes | Temporary | GWADR | Team support |
| Xuemei Guo | Country Program Assistant | EACPQ | Team support |
| Xujun Liu | Consultant | GSURR | |
| Zhefu Liu | Senior Social Development Spec. | GSURR | Social Safeguards |
| Khairy Al-Jamal | Sr. Infrastructure Specialist | GWADR | TTL (most recent) |
| Toyoko Kodama | Urban Specialist | GWADR | Indicators & ISR |
| Haixia Li | Sr Financial Management Spec. | GGODR | FM Specialist |
| Aimin Guo | Social Development Specialist | GSURR | Social Safeguards |
| Yan Li | Economist | Consult. | Economist |
| Heinz Unger | Municipal Engineer | Consult. | ICR Prim. Author |

**(b) Staff Time and Cost**

| Stage of Project Cycle | Staff Time and Cost (Bank Budget Only) | |
|---|---|---|
| | No. of staff weeks | USD Thousands (including travel and consultant costs) |
| **Lending** | | |
| 2005 | 23.53 | 144.55 |
| 2006 | 63.88 | 321.19 |
| 2007 | 42.36 | 190.58 |
| **Total:** | **129.77** | **656.32** |
| **Supervision/ICR** | | |
| 2008 | 12.67 | 86.83 |
| 2009 | 13.06 | 77.74 |
| 2010 | 17.15 | 66.51 |
| 2011 | 13.91 | 74.21 |
| 2012 | 14.65 | 86.18 |
| 2013 | 7.77 | 43.96 |
| 2014 | 23.59 | 132.13 |
| 2015 | 26.45 | 166.82 |
| **Total:** | **129.25** | **734.38** |

## Annex 5. Beneficiary Survey Results

No beneficiary survey was done.

## Annex 6. Stakeholder Workshop Report and Results

### GEF Stakeholder Dissemination Workshop[12] – June 12, 2015 in Shenyang

**1. Summary of proceedings from urban water supply and wastewater management**
***Session 1: Public Utility Management and the Use of Benchmarking***
This presentation included (i) distinguishing attributes of high performing public utilities globally, (ii) the process of performance management, (iii) use and benefits of business planning where utilities operated on a fully or quasi-commercial basis, and the use of performance benchmarking to improve utility performance (with the World Bank IBNET system described in detail, and key cost drivers for water and wastewater utilities.
Points and best practices identified from the GEF work for broader dissemination were:

- The performance issues faced by Liaoning water sector utilities are broadly the same as anywhere else in the world, thus best practices from elsewhere are often highly relevant;
- Customers should be viewed as the key stakeholder group and consultative efforts should be re-directed accordingly;
- Water sector utilities were rarely in direct competition with each other and it was often mutually beneficial to exchange views, compare and analyze performance, and cooperate in making improvements;
- As fixed assets represented a very high percentage of total capital investment in water and wastewater systems, greater attention needed to be given to improving asset performance, and optimizing asset life. More attention than hitherto should be given to asset maintenance systems, and asset rehabilitation as an alternative to asset replacement;
- Commercially- orientated integrated business planning was difficult to implement in utilities that were necessarily locked in to a government planning system that was functionally compartmentalized, as in Liaoning, although it made sense where water supply companies (in particular) were given commercial freedom and could benefit, in the right circumstances, both a utility and its government regulators;
- There was little sense in Liaoning developing its own bespoke benchmarking system but local adjustments and enhancements to an established system were likely to make sense
- Earlier work in Shandong and pilot testing in several Liaoning utilities suggested the IBNET set of indicators would be a practical set for use in Liaoning;
- Fragmented institutional arrangements for wastewater management made the introduction of a sector wide system of performance indicators and establishing benchmarking partnerships difficult to achieve at the utility level.

[12] The dissemination workshop was held in lieu of a stakeholder workshop; it achieved comparable outcomes.

- To avoid benchmarking being viewed as a threat, participation should be voluntary rather than compulsory; and
- Energy consumption is a key cost driver for both water supply and wastewater operations and therefore improved energy management needs to be a key priority in any cost reduction/efficiency improvement strategy.

***Session 2: The Use of Public Private Partnerships for Public Utilities***

This presentation included (i) the definition and features of a PPP and some of the different structures (models) used; (ii) existing PPP policies of central PRC government, including recent 2015 guidelines and regulations of relevance to PPP implementation; (iii) case studies of PPP both in China and overseas, that identify good and bad practices; and (iv) details of the PPP work undertaken by the LMC2 GEF component and the conclusions drawn.

Points and best practices identified from the GEF work for broader dissemination were:

- Better ways of mobilizing private financing are needed and this is very much the situation in China as emerging government policies recognize. Performance-based approaches that push service providers to innovate and to deliver higher quality services at lower cost are therefore called for in order to meet these challenges;
- PPP is strongly supported by central government and being increasingly promoted and supported by government guidelines and regulations;
- A PPP center has been created within the Ministry of Finance and Liaoning has also established a PPP center to promote PPP and provide guidance to public sector organizations;
- PPP should not be viewed as just an alternative financing vehicle but also as a driver of improvements in service levels and the efficiency of service provision;
- To be sustainable over a long contract period of up to 30 years, a PPP contract has to create a win-win situation for both parties and trust between the parties needs to be established with each understanding their role in the arrangement.
- The governments with the most developed PPP markets focus on using the market to enable the public sector to achieve value-for-money, which is driven primarily by:
  - ***Risk transfer:*** relieving government of the cost of asset-based risks—that is, risk directly associated with build or operating assets
  - ***Whole-of-life costing:*** through whole-of-life costing the government can achieve optimization between capital costs and operating and maintenance costs.
  - ***Innovation:*** providing wider opportunity and incentive for innovative solutions as to how service requirements can be delivered
  - ***Asset utilization:*** developing opportunities to generate revenue from use of the asset by third parties.
- Key success factors to establishing a conducive environment and facilitating a successful arrangement include:
  - strong government support;
  - meaningful stakeholder consultation;
  - a stable legal and regulatory framework, that ensure both public and private interests are met;
  - a contractual framework that reflects the economics of the project,

- the rational allocation of risk among parties; and.
- well-understood and fair exit mechanisms.

- Currently, the principles of PPPs are not well understood in China and a significant number of PPP contracts of different types have failed to meet their objectives or run into other problems due to:
  - inadequate due diligence by one or both parties;
  - a lack of transparency and competition in the procurement process;
  - insufficient attention given to risk allocation;
  - contracts that are biased in favor of one party; and
  - contracts are not sufficiently detailed to allow changes in circumstances to be readily managed or to protect the interests of both parties.

***Session 3: The use of Geographic Information Systems (GIS)***

This presentation included (i) an overview of GIS and its application to improving the management water supply networks, (ii) details of the GIS system development work undertaken for Anshan, Haicheng and Yingkou Water Supply Companies, (iii) an explanation of the systems installed, (iv) the functionality of the software package (v) potential applications that will improves standards or efficiency of water supply provision, and (vi) the key success factors in a successful water network GIS implementation.

Points and best practices identified from the GEF work for broader dissemination were:

- Water and wastewater utilities are best advised to engage specialist support to help them with the design and implementation of a network GIS system.
- Under the GEF, separate contracts were let for (i) system design, software acquisition, implementation and initial training and support; and (ii) data gathering, verification and system input. This split in contractual responsibilities worked well being aligned with the expertise and experience of the different contractors.
- Data verification is a crucial process in ensuring the output from the implemented system has user confidence.
- Ongoing data management is equally important and utility procedures and record – keeping systems often need to be re-engineered to ensure GIS data update is fully integrated with day-to-day procedures.
- It is envisaged GIS systems in each of the 3 client companies will continue to evolve and integrating GIS with other utility business systems will be explored to give expanded benefits in the medium term (e.g. links with planned preventative maintenance, customer billing, operations SCADA, and financial management systems, as well as network modeling software).

***Session 4: The Management of Non-Revenue Water (NRW)***

This presentation included (i) the benefits to be obtained from NRW reduction (ii) the composition of NRW; (iii) developing a systematic approach to NRW reduction via 5 key questions (iv) establishing a water balance and other best practices to answer the key questions below; (v) the four pillars of leakage management; (vi) use of performance indicators to evaluate progress in NRW reduction; and (vii) using asset management and GIS to support NRW reduction efforts.

Points and best practices identified from the GEF work for broader dissemination were:

- Liaoning suffers from extremes and rapid changes in climate placing great stress on water networks, and many cities have areas of old and poorly installed pipe networks;
- Under such a situation Liaoning is very unlikely to ever achieve best practice results and the inherent situation dictates that active NRW management will need to be a continuing priority;
- Assessments made during the GEF work confirmed that the participating LMC2 water utilities were indeed very poorly performing and all need (and are) treating NRW reduction as a high priority; and
- The five key questions to answer in addressing NRW management problems, in the correct sequence are:
    1) How much water is being lost?
    2) Where is it being lost from?
    3) Why is it being lost?
    4) What actions can we take to reduce losses?
    5) How can we evaluate our progress?
- Priority based replacement of water meters in older apartment buildings in Panjin had been assessed as leading to a 40% improvement in water sales.
- Improved pressure management within water distributions systems is often a key contributor to reduced leakage;
- Specialist leakage control technology and equipment requires skilled trained operators to make best use of it. This in turn suggest the creation of specialist leakage detection teams within each water utility;
- Link NRW reduction with other programs like Asset Management and GIS.

***Session 5: Technology utilization and Case Studies in NRW Management.***

This presentation included (i) a snapshot of the NRW and water leakage challenges faced by Chinese water utilities, (ii) an introduction to some modern technology that could assist water utilities in their NRW management; and (iii) some specific case studies in China where such technology had brought good results.

Points and best practices identified for broader dissemination were:

- China has 20% of the World population but only 7% of the usable water resources;
- Even this statistic understates the water management challenge as water resources are unevenly distributed across China with some of the more densely populated areas having the least per capita resources. Liaoning was in this situation and makes water conservation a priority;
- Modern technology can greatly support a systematic management strategy to reduce levels of non-revenue water; and
- Specialist suppliers are available to advise and support local water utilities and will provide necessary user training

***Session 6: General Discussions and Questions Session***

The main areas of delegate interest, exchanges of view and questioning were as follows:

(i) Recent announcements on PPP policy, regulations and guidelines by central government, and how to select a suitable PPP models for specific cases;

(ii) Specific questions on NRW technology and systems;

(iii) Concerns that use of performance indicator systems meant more work for ordinary staff without any obvious reward for them – this made gaining their cooperation difficult. It was suggested that systems first be piloted on a small scale and then built into enhanced MIS designs, thus largely automating the process – this potentially had the benefit of enriching job content rather than increasing workloads; and

(iv) An exchange of views on GIS implementation and the key factors in getting it right, especially the importance of the data verification process to ensure systems output could be trusted and used with confidence.

**2. Summary of proceedings from municipal solid waste management**

***Session 1: Project Summary of Strategic Planning of Urban Solid Waste Disposal***

This presentation gave an overview of the LMC-2 – "Strategic Planning of Urban Solid Waste Disposal: Fushun, Panjin, Yingkou EDZ and Gaizhou City", introducing project background, objectives, project activities implementation process and outputs and outcomes. Also, the results and best practices internationally and domestically were disseminated and the technical and administrative staff from local waste management departments in Liaoning provincially trained.

***Session 2: Urban-Rural Integrated Solid Waste Management***

(i) Sophisticated solid waste management and waste separation

(ii) Urban-rural solid waste collection and transportation system

- National policies and standards for rural waste treatment;
- Solid waste collection and transportation principles and methods;
- Urban-rural integrated (URI) waste management in Switzerland.

(iii) URI Solid Waste Management Plan for Panjin City.

- Present situation and evaluation of solid waste management system;
- Development Forecast;
- URI solid waste management mode;
- Plan of solid waste sorted collection;
- Plan of URI solid waste collection, transportation and treatment;
- Investment plan of solid waste treatment;
- Safeguards and benefit analysis.

***Session 3: Current Status and Outlook of Waste to Energy in China***

(i) Solid waste management and utilization in China

- Social problems caused by municipal solid waste;
- Current status of waste generation in China;
- Solid waste treatment method in China;
- Waste management hierarchy;

Recycling or waste-to-energy (WTE) – Principles of efficiency.

(ii) Current status of WTE in China

- Advantages of WTE;

- Traditional WTE methods: landfill gas utilization and heat or power from incineration & landfill gas, incl. introduction to this technology in China;

(iii) New WTE methods based on waste separation
- Organic waste: biogas and fertilizer;
- High heat value waste: incineration/gasification/RDF.

***Session 4: Current Status and Trend of Solid Waste Incineration***
- Environmental policy system and waste incineration in Europe;
- Waste incineration in North America;
- Waste incineration in Japan and South Korea;
- Waste treatment and incineration in developing countries;
- General condition of waste treatment in China;
- Construction of waste incineration plants in China;
- Waste incineration standards in China;
- New features of waste incineration industry in China;
- Outlook of waste incineration industry.

***Session 5: Leachate Treatment Technologies and Typical Cases in China***
- Characteristics of leachate;
- Standard and regulations on leachate treatment;
- Current technologies and case studies of leachate treatment;
- Main issues existing in current technologies;
- New process for leachate treatment;
- Concentrated leachate treatment technologies;
- Operational management and construction modes.

***Session 6: Rural Solid Waste Management in China***
- Current status of rural SWM: almost no management or simple disposal;
- Where does the rural waste come from and where does it go?
- Serious problems of rural waste in China;
- How do the developed countries cope with rural solid waste?
- Waste recycling: a way out?

**3. Other Observations**

The workshop – although fairly brief – also provided a useful opportunity for representatives of the different city utilities to network amongst themselves, and to discuss issues of mutual concern and interest. A comprehensive set of documentation was issued to all delegates, and a name list and contact details of all delegates is being made available by LUCRPO to support further networking in the future.

*Report prepared by LUCRPO – June 2015*

## Annex 7. Summary of Borrower's ICR and/or Comments on Draft ICR

*The following summary is the main text of the Borrower's ICR dated October 2015*

## 1. ASSESSMENT OF PROJECT OBJECTIVE AND QUALITY AT ENTRY

**Original Project Objectives**

As defined in the Project Appraisal Document (PAD) Report No. 38278-CN, dated May 15, 2007, the project development objective was to improve the performance and sustainability of water supply, wastewater, and solid waste services in the LMC-2 cities. Enhanced wastewater and solid waste services will also help reduce pollution into the Bohai Sea and contribute to improving Bohai Sea water quality.

The Global Environment Objective of the LMC-2 project with the GEF enhancements is the reduction of land-based pollution into the Bohai Sea through investments in wastewater and solid waste infrastructure and improved utility regulation, planning and management in the LMC-2 cities and throughout Liaoning Province.

### 1.1 Revised Objectives

Although there have been changes in project content and in detailed design of some components during implementation, there has been no change in the project objectives during implementation, which have remained as stated in the appraisal document.

### 1.2 Original Components

The project was structured as four separate components with the project scope of each described in Schedule 1 of the loan agreement: (A) wastewater management; (B) water supply management; (C) solid waste management; and (D) institutional development.

The cities participating in the different components were expected to be:

a) Wastewater interception & treatment sub-components in 4 cities of Panjin, Yingkou, Fushun and Gaizhou;
b) Water treatment and distribution sub-components in 5 cities of Anshan, Haicheng, Panjin, Yingkou and Xingcheng;
c) Solid waste management sub-components in 3 cities of Panjin, Fushun and Yingkou EDZ;
d) Institutional development, comprising institutional capacity building, technical assistance and training was intended to benefit all cites with dissemination and replication within Liaoning and across China as appropriate. This component was to be financed in part by the loan (package A) and in part by GEF grant (packages B, C, D & E).

### 1.3 Project Changes

Significant changes that occurred within the scope of infrastructure components included: (1) Fushun wastewater sub-component was reduced in size and scope at the MTR; (2) the Yingkou EDZ solid waste sub-component was dropped; and (3) Panjin added a new project of Comprehensive Urban and Rural Area Solid Waste Collecting System.

Changes were also made to the institutional development component of the project, especially to the GEF funded packages, with the most significant of these affecting the proposed public utility capacity building program.

### 1.4 Project Delays

The original closing date of the loan was December 31, 2013. However, implementation of Gaizhou wastewater, Haicheng and Fushun water supply were slower than expected, and the Panjin solid waste sub-component was extended in scope, meaning that additional time was required to complete the physical works. In addition there were design issues and serious procurement delays in respect of the GEF funded technical assistance packages forming a large portion of institutional development component of the project. In order to maximize loan utilization and ensure the achievement of development objectives, the loan closing date was therefore extended to June 30, 2015 with the agreement of the PRC Ministry of Finance, and the Bank

In addition not all contracts earmarked for early completion under retro-active financing arrangements were implemented early as envisaged in the project implementation program, with extensive delays in implementing package HWS/1.3. This was due to late domestic approval of the preliminary design for Haicheng water supply, which was not obtained until October 2011.

### 1.5 Quality at Entry

Project preparation of the physical investments at appraisal has been proved largely satisfactory. The feasibility studies and engineering design for each project component (as well as for the overall project) proved to be appropriate. Most of the technical designs employed advanced yet commercially available technologies that proved to be fit for purpose. The procurement plan, as appraised, proved to be executable, but some of the contracts earmarked for retro-active financing were delayed indicating preparations and /or the need for these were not as advanced as claimed by the relevant PIUs at Appraisal. However, some of the appraised KPI targets were found to be impractical and therefore revised during loan restructuring, and some legal covenants required by the Bank did not adequately take account of the local situation.

Project preparation for the Institutional Development resulted in a design that can be considered to have responded to the needs of Liaoning. However, unfortunately, it did not prove to be implementable in its intended form due in part to a lack of “buy-in” from the project cities and their rapidly changing needs.

## 2. ACHIEVEMENT OF OBJECTIVE AND OUTPUTS

### 2.1 Outcome / Achievement of Objective

#### 1) Wastewater Component

The municipal wastewater sub-components in Panjin and Yingkou are already in operation achieving their design capacity (100,000 $m^3$/d in each case) and producing effluent that

meets the required quality standards. A wastewater sub-component in Gaizhou is in operation and producing effluent that meets the required quality standards, but is not yet achieving its design capacity (50,000 $m^3$/d), due to the city's wastewater collection network being incomplete. All the three new WWTP have passed examination and acceptance testing by Liaoning EPB.

The Project has constructed wastewater treatment facilities with design capacity of 250,000 $m^3$/d, and made BOD discharge reduction of 3,500 t/a in year 2014. Total BOD discharge reductions contributed by 6 WWTPs in 4 project cities with Bank loan financing is about 17,629 t in year 2014. This will contribute significantly to protecting water quality in the Bohai Sea and the component can be considered to have fully achieved its objectives. Indeed, since the new WWTP in Panjin and Yingkou were commissioned there is evidence of some quality improvements in those receiving coastal waters.

**2) Water Supply Components**

The Anshan and Yingkou WTPs are already in operation achieving their design capacity (120,000 and 70,000 $m^3$/d) and producing water that meets the PRC urban water supply quality standards.

The extensions to the Haicheng WTPs are capable of meeting their increased design capacity (100,000 and 30,000 $m^3$/d respectively and are producing water that meets the PRC urban water supply quality standards. Average demand is currently only 65,000 $m^3$/d but can rise to between 85,000 to 90,000 $m^3$/d during winter peak time. The most significant reason for this shortfall in demand is that Haicheng is no longer required to export water to Anshan due to the extensive development and increased utilization of the Dahuofang surface water resource and conveyance system.

The Project has constructed water treatment capacity of 260,000 $m^3$/d in total, installed 184,330 water meters, and constructed 495 km of pipelines, with a benefiting population of 1.85 million in the service area. The component can be considered to have substantially achieved its objectives.

**3) Solid Waste Components**

The solid waste sub-component in Fushun is already in operation with a design capacity of 1,400 t/d. Currently it is receiving on average some 1,000 t/d.

The solid waste landfill in Panjin was taken out of the project, but was successfully implemented under the BOT mode of implementation, rather than with Bank funds; LMC2 Loan funds provided associated equipment and vehicles to improve solid waste collection and conveyance. This has contributed significantly to improving urban sanitation in the two districts. Construction of Panshan transfer station and procurement of vehicles has been substantially completed, but 3 types of trucks were identified as technical deviation and could not be accepted. Dawa transfer station has been cancelled from contract PSW/21.2 (after receiving 'no objection' from the Bank) because the proposed proved to be unsuitable. It will now be constructed later by local funding once a suitable site has been identified.

## 2.2 Output by Components

(a) **Fushun Wastewater (**RMB 219.3 million PAD; RMB 73.7 million after MTR, RMB 42.4 million by completion)

This sub-component was implemented between 2009 and 2013, in accordance with the reduced scope agreed by the Bank during the MTR.

(b) **Yingkou Wastewater (**RMB 376.7 million PAD; RMB 331.3 million by completion)

This sub-component has been satisfactorily implemented as appraised between 2008 and 2013. It is now providing 100,000 $m^3$/d of secondary treatment capacity, and about 90% of total municipal wastewater flow from the city is now being treated in compliance with the relevant national discharge standard (class 1A).

(c) **Panjin Wastewater (**RMB 319.3 million PAD; RMB 292.5 million by completion)

This sub-component has been satisfactorily implemented between 2008 and 2015 in accordance with the revised FSR agreed by the Bank. It is now providing 100,000 $m^3$/d of secondary treatment capacity, and about 90% of total municipal wastewater flow is now treated in compliance with the relevant national discharge standard (Class 1A).

(d) **Gaizhou Wastewater (**RMB 123.7 million PAD; RMB 119.3 million by completion)

This sub-component was implemented as appraised between 2008 and 2015. It is now providing 50,000 $m^3$/d of secondary treatment capacity, and about 70% of total municipal wastewater flow from the city is now being treated in compliance with the relevant national discharge standard (Class 1B).

**(e) Anshan Water Supply** (RMB 240.6 million PAD; RMB 186.8 million by completion)

This sub-component was satisfactorily implemented between 2009 and 2013, in accordance with the revised FSR agreed by the Bank. It is now providing 120,000 $m^3$/d of potable water to the local residents.

(f) **Haicheng Water Supply** (RMB 117.1 million PAD; RMB 76.1 million by completion)

This sub-component was implemented between 2012 and 2015, with reduced scope for pipeline as agreed with the Bank during implementation. It is now capable of providing an additional 70,000 $m^3$/d of potable water to the local residents, bringing the total capacity to 30,000 $m^3$/d.

(g) **Yingkou Water Supply** (RMB 289.9 million PAD; RMB 310.1 million by completion)

This sub-component was satisfactorily implemented between 2009 and 2013, in accordance with the PAD. It is now capable of providing an additional 70,000 $m^3$/d of potable water to the local residents.

(h) **Panjin Water Supply** (RMB 160.4 million PAD; RMB 74.5 million by completion)

This sub-component was implemented between 2010 and 2014, with reduced scope as agreed with the Bank during implementation. This was because the remaining residential area where it was planned to install new pipelines and water meters (as per the PAD), was replaced by new buildings and water meters by property developers.

(i) **Fushun Water Supply** (RMB 213.6 million PAD; RMB 251.5 million by completion)

This sub-component was implemented between 2011 and 2014, in accordance with a revised plan as agreed with the Bank during implementation.

(j) **Xingcheng Water Supply** (RMB 36.0 million PAD; RMB 29.9 million by completion)

This sub-component was satisfactorily implemented between 2008 and 2010, with minor change to that in the PAD.

(k) **Fushun Solid Waste** (RMB 87.8 million PAD; RMB 118.0 million by completion)

This sub-component was satisfactorily implemented between 2010 and 2015, in accordance with a revised plan as agreed with the Bank.

(l) **Panjin Solid Waste** (RMB 264.9 million PAD; RMB 302.7 million after MTR; RMB 113.2 million by completion)

This sub-component was implemented between 2010 and 2015, except for the Dawa transfer station which – due to site complications – is still to be completed by local funding (NBF), once an alternative site is found.

(m) **Institutional Development** (RMB 21.6 million PAD; RMB 14.48 million by completion). This component was fully implemented between 2008 and 2015, but with changes to the GEF subcomponent made as agreed at the MTR. The reduced cost of this component is largely due to changes in the RMB: USD exchange rate and procurement savings and not any significant downsizing of component scope.

***Project Management & Asset Management (Package A)***

Based on the PAD this sub-component was to be implemented between 2007 and 2013, and involved four TA packages (A1, A2, A3 and A4). Package A2 and A4 subsequently became non-banked financed (NBF). Packages A1 (as revised in agreement with the Bank) and A3 were satisfactorily implemented between 2007 and 2015.

***GEF Funded Technical Assistance to support the Global Environmental Objective***

The appraised design of this technical assistance comprised 6 contracts and was to be implemented from 2008 to 2013. This part of the component was restructured following the MTR and was satisfactorily implemented in 10 contract packages between June 2013 and December 2014.

## 2.3 Economic Benefits

The nature of the works and benefits created methodological challenges and benefit quantification difficulties during project preparations. Therefore, taking account of the clear objectives of the project, the original economic analysis used for appraisal of the project comprised of: i) a qualitative description of benefits; and ii) least cost analysis.

All the physical project outputs have been important as facilitating environmentally sustainable growth in the project cities and Liaoning Province. Economic growth in Liaoning has increased from 221.43 billion RMB in 2006 to 695.6 billion RMB in 2013, an average increase of 229%. Specific economic benefits include substantial benefits in terms of service quality, water use efficiency and improved sanitation; resulting in

important health, environmental and aesthetic benefits, and the preservation of economic activities in the Bohai Sea, such as fisheries, that are water quality dependent.

## 2.4 Financial Performance

The financial viability of the Project water and wastewater components was assessed based on the ability of the water and wastewater tariff to generate sufficient revenues for the project companies to meet their principal financial targets. These targets were a cost recovery ratio of at least 1.0 and debt service coverage of at least 1.3, set on the assumption that all water and wastewater charges revenues are retained by, or transferred to the project companies.

This reform has yet to take place for wastewater companies, and therefore both wastewater project companies (Panjin and Yingkou) are technically non-compliant with the related loan covenants. However, in all four cities with wastewater sub-components, the municipal government is providing adequate financial resources to ensure the full operation of the new WWTPs, as well as other wastewater infrastructure.

## 2.5 Institutional Development

The project implementation units (PIUs) for all the LMC-2 water and wastewater sub-components are legally autonomous state-owned enterprises established under PRC company law, although the wastewater companies, especially, have negligible financial or managerial autonomy. Solid waste services in the project cities continue to be directly provided by government agencies. Institutional development initiatives focused primarily on: (i) project management support and capacity building; (ii) strategic sector planning; and (iii) public utility capacity building, with specific attention paid to the management of non-revenue water, asset management, and operational efficiency and systems optimization.

## 2.6 Procurement

All procurement was undertaken in accordance with WB guidelines and there were no incidents of mis-procurement during LMC-2 implementation. All bidding documents were subject to review by TA consultants and approval by LUCRCPO, or the WB "prior review" procedure. These arrangements operated successfully. Some relatively minor procurement issues arose from time to time during the implementation which were dealt with in an open and transparent manner and by involving the Bank's procurement specialists as needed.

## 2.7 Poverty Alleviation and Social Impacts

Whilst poverty alleviation and social impact were not primes objectives of the project, the water, wastewater and solid waste components have directly provided significant local temporary job opportunities during construction and over 300 permanent jobs on the water and waste treatment plants and disposal facilities.

The water supply improvements in Xingcheng have provided for 24-hour supplies to all parts of the urban area, and also increased service reliability during the peak tourist season, with tourism critical to the local economy and the livelihoods of many residents.

The significant reduction in the discharge of untreated wastewater and improved solid waste collection and disposal have improved the urban environment and living conditions in the cities, reduced the risk of health concerns due to groundwater contamination and helped preserve the viability of the Bohai Sea fishery resource. As a facilitator of sustainable economic development, the Project will have continuing beneficial poverty alleviation and social impacts, because economic growth has been shown to be the most influential factor in reducing poverty and improving livelihoods.

## 2.8 Environmental Impact

No significant environmental management issues arose during project construction and the environmental management plans prepared to mitigate potential adverse environmental impacts resulting from the Project activity were implemented in full. The Project is set to fully achieve the beneficial impacts that were identified in the PAD Environmental Assessment, and although it will only be possible to assess the full environmental impact some years after project completion, specific benefits are already apparent.

## 2.9 Land Acquisition and Resettlement

All land acquisition and resettlement of affected persons was successfully dealt with in accordance with the resettlement plans approved by the Bank. Some construction delays did arise as a result of land acquisition and resettlement issues, most notably in Gaizhou and Panjin.

## 2.10 GEF Activities

GEF funded capacity building activities have laid a foundation for improved performance of Liaoning public utilities, in strategic sector level planning and the use of public private partnerships (PPP). In addition; (i) greater knowledge has been obtained of the ecology of the Dahuofang reservoir watershed, which is the key water resource of the Province, and draft mechanisms developed for its preservation; and (ii) a pilot system of urban-rural integration of solid waste collection and disposal has been designed for implementation in Panjin, which it is hoped can be a model for future integration of public utility services across the urban-rural divide.

## 2.11 Monitoring and Evaluation Systems

LUCRPO, supported by the project management consulting team, established and subsequently operated a comprehensive monitoring, and reporting system for the project.

The system included (i) the monitoring of key implementation progress milestones; (ii) Land acquisition and resettlement; (iii) procurement (planning, bidding and contract awards); (iv) construction progress and contract completions; (v) environmental compliance; and (vi) key output performance indicators.

Customized templates were prepared and issued to individual PIUs to collect information and the updated progress status on a half-yearly basis, and the completed templates were then used to prepare half-yearly progress reports to the Bank.

## 2.12 Financial Management

Financial record-keeping and project accounting has been conducted in accordance with relevant guidelines of the PRC Ministry of Finance as apply to all sovereign foreign loans, including those of the Bank. At project commencement project management manuals were prepared and issued by the Liaoning Provincial Department of Finance (LPDF), and included procurement, payment and disbursement procedures.

Aggregated project accounting statements were prepared on a six monthly basis. The annual project accounts were audited (by Liaoning Provincial Audit Office on behalf of the China National Audit Office) as required in the loan agreement and submitted to the Bank, together with the audit report. No significant audit issues arose during project implementation.

During the course of project implementation the old paper-based payment requisitioning and disbursement system was upgraded to an electronic online system. This new system enhancement resulted in big efficiency improvements to the processing of loan disbursement claims.

# 3. MAJOR FACTORS AFFECTING IMPLEMENTATION AND OUTCOME

## 3.1 Factors Outside the Control of Local Government or the Implementing Agency

(a) The exchange rate of US$ with RMB was 1:6.8 at the time of appraisal (2007), by January 2010 the rate had fallen to 1:6.3 and by June 2014 stood at 1:6.15. This significantly reduced the real value of WB loan and increased the level of counterpart funding required as most contracts were denominated in Chinese RMB. The need for unanticipated supplementary financing created difficulties for some of the project companies, exacerbated by budgetary constraints, and caused some payment delays to contractors. The Fushun and Xingcheng water supply sub-components were delayed and/or downsized at least in part due to failures in providing counterpart funding as needed.

(b) Revised eligibility criteria established by the national government meant it was not feasible to implement many of the overseas training programs that had originally been designed into the project.

## 3.2 Factors Generally Subject to Local Government Control

(a) Approval of the preliminary design for Haicheng water supply was delayed by some 3 years as the original FSR endorsed expanded use of groundwater sources, as the preferred option. This conflicted with a new provincial water resources policy to restrict groundwater use and required special investigation and justification, before the proposals were allowed to proceed.

(b) In 2010, Panjin city decided to utilize a BOT contract in place Bank funding for construction of the sanitary landfill, this was disappointing, given the efforts made by both Liaoning and the Bank to prepare and appraise this sub-component for inclusion in LMC2.

However, there has been no detriment to the intended outcome and the BOT contract is operating satisfactorily. At the same time Panjin proposed a new project of "Comprehensive Urban and Rural Area Solid Waste Collecting System" in 2011, to achieve integration of solid waste management in urban and surrounding rural areas. This innovative proposal received strong support from Liaoning and the Bank, but changed the original scope of the sub-component and resulted in an extended project period being required.

(c) Yingkou EDZ proposed a change of the project scope by introducing an incineration facility in 2009. This proposal could not be supported by Liaoning Province nor the Bank and the sub-component was therefore deleted during the MTR.

(d) Counterpart funding issues, and a decision to change the site for the new solid waste landfill, caused initial delays for the Fushun solid waste sub-component.

(e) The redesign of the GEF funded capacity-building sub-components and changing needs of the project cities delayed the implementation by a total of 5 years.

(f) Policy decisions by LPG to (i) develop and actively promote the Dahuofang water resource and transfer scheme; and (ii) impose stringent controls on groundwater abstraction for urban water supplies resulted in major changes in design and in some cases delays and impacts on outcomes in respect of the Anshan, Haicheng and Panjin water supply sub-components and the urban water supply strategies of those cities.

(g) Other political decisions, often resulting from changes in personnel, led to some delays and changes of scope in several other sub-components, especially Gaizhou and Fushun wastewater sub-components.

(h) The complexity of the disbursement procedure for consulting services package A1 impaired the efficiency of the services, and therefore contributed to procurement and construction delays.

(i) Despite the agreements reached with the Bank at the time of appraisal, local government has not complied with financial covenants due to a failure to increase user charges.

### 3.3 Factors Generally Subject to local Project Company Control

Most of the engineering design had been based on sound engineering information and proved satisfactory. However, upon the request of some project companies for the purpose of speeding up project implementation, some of the engineering designs were prepared without detailed site and geotechnical information resulting in unnecessary and preventable variations, and delays during construction.

Land acquisition and resettlement of LMC2 were generally satisfactory, however, in a few cases, such as Gaizhou River Rehabilitation Project (GWW/1.4), Panjin pumping station (PWW/1.3), and Dawa transfer station (PSW/1.3), the land acquisition and resettlement process resulted in a delay in project implementation.

Poor knowledge of Bank-financed contract conditions by contractors, construction supervisory staff, and some PIUs led to some difficulties in processing contract

variations and it was a principal cause of disbursement delays due to submission of poorly documented claims.

Changes to the scope or detailed design during implementation, or poor coordination with local planning created problems leading to delays and/or higher costs. This was a particular problem in Gaizhou and Haicheng.

Poor cost estimation in the original preparation for the Gaizhou wastewater component led to major cost escalation, requiring significant parts of the planned sewage interception facilities to be shelved and removed from the project. As a consequence, the new Gaizhou WWTP constructed under the project, remains only about 50% utilized.

In contrast, the Panjin wastewater company, following a review of wastewater demand, argued successfully to increase the capacity of the proposed new Shuangtaizi WWTP from 50,000 $m^3$/d to 100,000 $m^3$/d and this has resulted in a significantly increased rate of wastewater treatment in that district of the city, than would otherwise have been the case.

## 3.4 Costs and Financing

### (a) Costs

A breakdown of project cost by component is provided in Annex 1 where final expected costs are contrasted with those at Appraisal. Total project cost at the appraisal was RMB 2562.90 million, to be partly financed by US$173.00 million of WB loan.

The completion cost of LMC2 is currently estimated at RMB 1954 million which is 76.3% of the estimated project cost at appraisal. There were three major reasons for this cost variation:

- Water supply sub-components: The Anshan sub-component was re-designed, whilst the sub-components in Panjin and Haicheng were downsized.
- Wastewater sub-components: The main variation relates to the very significant downsizing of the Fushun sub-component.
- Solid waste sub-components: The cost variation arises from the cancellation of the Yingkou EDZ sub-component and the implementation of the Panjin landfill facility using BOT financing rather than WB loan.

### (b) Financing

The necessary counterpart funds were provided through a mixture of state bonds, commercial borrowing, the resources of the municipal governments and implementing agencies self-financing. The final financing split is expected to be 51.9 % (Bank Loan funds) to 48.1 % local funding (assuming the exchange rate of USD1.00 to RMB6.3), compared to the 57.1% Loan to 42.9% local funding estimate at the Appraisal (with exchange rate of 1:7.7).

# 4. SUSTAINABILITY

## 4.1 Prospects for Sustainability

We recognise sustainability of the Project needs to be viewed in terms of (a) whether an appropriate institutional arrangement has been set up to provide for managerial autonomy and sustainability; (b) the ability to operate and maintain the facilities; and (c) financial sustainability. In our view the overall Project can be considered partly sustainable against these criteria. The new infrastructure constructed under the project is all being well operated and maintained, and each municipal government is providing sufficient budget to ensure these operations are fully financed. However, tariffs are not at a level that provide for financial sustainability and in the case of some sub-components low income collection rates are also a threat to financial sustainability.

This situation may be set to change as in late 2013 the PRC national government announced new policies which recognized the need to increase water supply charges as a water conservation measure. However as yet this has not filtered down to the LMC2 project cities and it is not unusual in China for some detailed policy announcements to take an extended period before detailed regulations are formulated at provincial level and implementation proceeds. In the meanwhile, subsidies have increased significantly over the life of the project.

## 4.2 Transition Arrangements to Regular Operation

***Wastewater***

All three of the municipal wastewater treatment plants have made a largely trouble-free transition to normal operations, although there were initial teething problems at Gaizhou, caused in part by the current low hydraulic loading of the WWTP. However, Gaizhou benefitted from GEF funded operational support TA (packages B1 and D), and the WWTP has now passed EPB inspection and demonstrated it can meet required standards.

As it did for No.1 WWTP constructed under LRBP, Panjin has signed an outsourcing contract for the operation and maintenance of the WWTP with an experienced contractor to give assurance over operational standards. In all three cities, use has been made of operational procedures developed jointly between the PIUs and the GEF consultants.

***Water Supply***

All new treatment facilities were constructed by well-established water supply companies, no significant issues were encountered, and all are operating well.

***Solid Waste***

The only sanitary landfill constructed under LMC2 was in Fushun, whose Sanitation Department also benefited from GEF funded technical assistance (package C). The landfill is being operated to required standards, although following concerns expressed by the Bank

during their ICR mission, LUCRPO has asked the PIU that detailed procedures for providing daily cover were reinforced.

The new Panjin sanitary landfill constructed under the BOT mode is considered an LMC2 associated project and based on local EPB inspections it is also being operated to required standards.

## 5. BANK AND BORROWER PERFORMANCE

### 5.1 Bank

The Bank's performance is considered to be satisfactory both during the design and implementation phases. The support of WB staff during their missions to Liaoning, was appreciated by LPG, LURPCO and all the PIUs involved. During the phase of identification, preparation and appraisal for the project, Bank staff provided helpful guidance to assist LUCRPO and the PIUs in project preparation. During the implementation phase, the Bank deployed supervision missions (on average twice a year) to help Liaoning to achieve project objectives. Generally, the bidding documents & bid evaluation reports (subject to prior Bank review) were reviewed and approved by the Bank in a timely manner with no delays. The Bank has also done its best to provide guidance in dealing with (i) changing circumstances, such as timely approval for contract re-packaging and the project restructuring following the MTR discussions; and (ii) implementation issues that arose from time to time.

The Bank was also very supportive in assisting with the re-design of the GEF grant funded sub-components at MTR, and in fine tuning of their content in 2014 to satisfy the needs of emerging sector policies in relation to marketization of public utility services and urban-rural service integration.

### 5.2 Borrower

The national and provincial government's commitment to the project remained strong and supportive during all phases of the Project. The provincial government supported the Project by directing and coordinating the implementation efforts, with the LPDF as the lead agency.

The LUCRPO, the project cities and the PIUs all performed active project management functions throughout the implementation with the municipalities making great efforts to designate necessary resources for component execution. As a result, most of the main physical components were completed in good time, well in advance of the original loan closure deadline. The Project has been implemented in accordance with WB procedures on procurement and contract management, although there have been some procurement and implementation delays and issues, and disbursement progress was a serious concern for large parts of the implementation period.

Despite the extensions to the loan closure date, some investments in Haicheng and Panjin remained incomplete at loan closure. In Haicheng the principal cause was urban planning issues, including the forecasting of future water demand that resulted in some works not

being proceeded with. In Panjin, the site for the Dawa transfer station was belatedly found to be unsuitable due to the presence of a nearby natural gas pipeline.

It must be acknowledged that the project cities' failure to increase tariffs means they have performed less well in the implementation of the institutional and financial reforms that had been agreed with the Bank at the time of Appraisal.

## 6. LESSONS LEARNED

The LMC2 project has been very successful and achieved most of its original objectives, especially in respect of the physical interventions. The entire implementation process has been a valuable experience for all the agencies involved, and much capacity building of the PIUs has been achieved that will help them with their ongoing operations, with planning and in implementing future projects.

The WB loan and GEF grant have not just simply helped financing the Project, but have also introduced advanced management practices for project implementation, strategic sector planning and enterprise operation. WB project implementation rules and procedures on procurement, contracts management and construction supervision have been broadly accepted as being fair and giving greater assurance of a satisfactory outcome. Good experience has been gained by practicing these rules and procedures, which have been replicated on similar projects not financed by WB. Specific lessons learned include:

1）Government support, such as fulfilment of covenants, cooperation and timely approval from domestic authorities of various levels, and a strong and stable project management organization are crucial for success in project implementation.

2）Major changes after appraisal and loan effectiveness should be avoided. Such changes need review and evaluation by domestic procedures and the Bank, and will inevitably result in delays in implementation and additional cost, with the worst case scenario being under-utilization of the loan. Under LMC2 most major changes resulted from local political decisions or changes to city master plans, rather than component design failings.

3）Before engineering design, designers should have adequate site inspection for local planning and geotechnical data, and incorporate that information into drawings and bill of quantities, to reduce unnecessary and preventable variations, and to avoid delay and cost over-run during construction.

4）The absence of sub-metering of electricity within the WWTP makes the monitoring and control of power consumption difficult to achieve and is something that should be rectified in future projects.

5）The readiness of contract packages to proceed under retro-active financing needs to be carefully appraised. The inclusion of Gaizhou contract GWW/1.1 seems to have been particularly ill-advised, due to the state of preparations and readiness for the whole of that sub-component at the time of appraisal.

6）The inclusion of the cost-recovery covenants for the Panjin and Yingkou wastewater companies without any matching commitment to institutional reform was a major

mistake. These seem to have been included because the WB Board would have expected them to be included, rather than there being a real prospect of them being complied with. Under existing institutional arrangements for wastewater service provision, a cost recovery covenant needs to apply at the city sector level and not at the utility level.

7）The GEF capacity building program lost its impetus in the early stages of implementation due to: (i) the lack of a program "champion" within provincial government (ii) the absence of project city "buy-in"; and (iii) changes in local circumstances.

8）Unintended beneficial outcomes have included the opportunity to explore urban –rural systems of MSW service integration in Panjin as a result of the change in financing of the proposed landfill to BOT modality, the upsizing of Shuangtaizi WWTP, and also the implementation of successful water network GIS as a result of GEF component restructuring.

9）Unintended adverse outcomes have been over-capacity created in the Gaizhou wastewater and Haicheng water supply sub-components.

10） The dropping of the full PPP pilot from the GEF component resulted in a lost opportunity for Liaoning to gain experience in PPP implementation with expert consulting support and under Bank guidance. Given the current emergence of PPP this could have given very useful experience, indeed, if it had gone ahead.

## Annex 8. Comments of Co-financiers and Other Partners/Stakeholders

N/A

## Annex 9. List of Supporting Documents


The World Bank. *Project Appraisal Document, Report No. 38378-CN.* May 15, 2007.

*Loan Agreement and Project Agreements (and Amendments).* September 19, 2007.

*GEF Grant Agreement (and Amendment). September 9, 2007.*

The World Bank. *Aide Memoires, ISR Reports and Management Letters.* May 2008 to June 2015.

The World Bank. *Project Restructuring Paper, Report No. RES12485.* March 20, 2014.

Liaoning Urban Construction & Renewal Project Office (LUCRPO). *Borrower's Implementation Completion Report – 2nd Draft.* June 2015.

Note: The following seven studies were financed by the GEF Grant.

AECOM Asia Limited Company. *Capacity Building of Public Utilities – Project Finish Report.* December 2014.

Shenyang Jinjian Digital City Software Ltd. *Consulting Service of Network Geographic Information System (GIS) for Yingkou Water Supply – Project Completion Report.* December 2014.

Shenyang Jinjian Digital City Software Ltd. *Consulting Service of Network Geographic Information System (GIS) for Anshan and Haicheng Water Supply – Project completion Report.* December 2014.

Liaoning Province Finance Society. *Research on the Value of Dahuofang Reservoir Ecosystem Service and Data Collection.* November 2014.

Liaoning Province Finance Society. *Research of Ecological Compensation Mechanisms for Dahuofang Reservoir Basin – Final Report.* November 2014.

China Urban Construction Design & Research Institute Co., Ltd. *Strategic Planning for Urban Solid Waste Disposal: Fushun, Panjin, Yingkou EDZ and Gaizhou City – Project Finish Report.* December 2014.

HJI Group Corporation. *Strategic Planning of Urban Wastewater Management of Panjin and Gaizhou Cities – Project Completion Report (Volume 1).* December 2014.

## Annex 10: Project Pictures

Anshan Water Supply: Water Treatment Plant – Treated Water Pump house

Fushun Water Supply: Water Treatment Plant – Transmission Pipe


Yingkou Water Supply – Water Treatment Plant

Yingkou Water Supply – Water Treatment Plant

Panjin Water Supply – Water Meter Box


Ghaizhou Wastewater: Rehabilitated Urban Drainage

Yingkou Wastewater Treatment Plant


Ghaizhou Wastewater Treatment Plant

Panjin Wastewater Treatment Plant


Panjin Wastewater Treatment Plant

Panjin Solid Waste – Garbage Collection Vehicles

Panjin Solid Waste – Waste Transfer Station


Fushun Solid Waste – Waste Compactor

Fushun Solid Waste – Leachate Treatment Plant

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CHINA

# LIAONING MEDIUM CITIES INFRASTRUCTURE PROJECT II

- Water Supply — WATER SUPPLY COMPONENT
- Solid Waste — SOLID WASTE COMPONENT
- Waste Water — WASTEWATER COMPONENT
- GEF — GEF-FUNDED ACTIVITIES
- PROJECT CITIES
- MAIN CITIES AND TOWNS
- PROVINCE CAPITALS
- PROVINCE BOUNDARIES
- INTERNATIONAL BOUNDARIES

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