People's Republic of China

FY2015 Ex-post Evaluation of Japanese ODA Loan

Harbin City Water Environment Improvement Project

External Evaluator: Shima Hayase, IC Net Limited

0. Summary

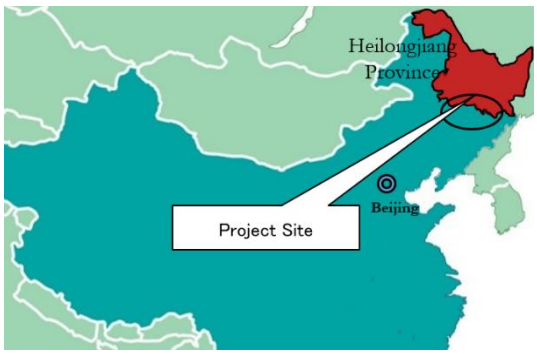
The objective of this project is to improve the sewage treatment capacity in Harbin City by installing sewage facilities, thereby reducing the pollution load of the water discharged into the river within the City, and improving the living environment for the City's residents.

This project was consistent with China's development policies and development needs at the national, provincial, and city levels at the time of the appraisal and the time of the ex-post evaluation, as well as with Japan's policy for assistance to China at the time of the appraisal. Therefore, its relevance is high.

The Pingfang and Songpu sewage treatment plants of the Project were constructed in accordance with the designed capacities in the plan, and meet targets of the Project and the national standards regarding the quality of the water discharged. Conversely, the volume of sewage inflow fell far below the estimates based on which the capacity was designed, and so the operation rate of the treatment plants has remained down below 50%. What is more, facilities to reclaim water were not used at the Songpu sewage treatment plant. This was due to external factors such as the fact that progress was made with autonomous effort to conduct treatment at factories as a result of revisions to drainage water regulations, and the decline in the intake volume into the sewage treatment plants from this project as a result of delays in the construction for the development plan of the City as a whole. Urban development is advancing, with the expectation that the demand levels calculated in the plan will be realized for both the sewage discharge volume and the demand for reclaimed water by 2020. The volume of sewage generated at the time of the ex-post evaluation was to about 90% of the estimates from the time of the appraisal for Harbin City as a whole. However, both the sewage treatment volume and treatment rate exceeded the project's targets. Moreover, the reduction in the total amount of pollutants discharged into the public water within Harbin City is regarded as a contribution from the project when it comes to improving the water quality in the river within the City. Therefore, the claim can be made that its impact is high and it achieved its effectiveness and impact targets on the whole. While the project period was within what was planned, the project costs marginally exceeded what was planned and thus the efficiency is fair. Regarding the sustainability of the effects generated by this project, there is no major problem in the operating agency's operation and maintenance structure, technical level, and financial conditions. Therefore, the sustainability of the project is high.

In light of the above, this project is evaluated to be highly satisfactory.

1. Project Description



Project Location

A reaction tank at the Pingfang sewage treatment plant

1.1. Background

Harbin City, which is the provincial capital of Heilongjiang Province, is seeing rapid progress with industrialization and urbanization in metropolitan areas, as well as surging population growth. As a result, its industrial and domestic sewage has increased. Conversely, its sewage treatment rate remained down at 60%[1] in 2005. As a result, large quantities of untreated sewage water were being discharged into the Songhua River that flows through the City. The water quality[2] in tributaries of the Songhua River had deteriorated to the point that they no longer met the standard for drinkable water (Class III). Given this state of affairs, in its Tenth Five Year Plan for Environmental Protection (2001 - 2005), Harbin City set the targets of boosting its sewage treatment rate in metropolitan areas to 90% by 2010 and maintaining Class III water quality in the Songhua River. It also set forth a policy to improve the water environment.

1.2. Project Outline

This project aims to improve the sewerage treatment capacity in Harbin City, Heilongjiang Province by installing sewerage facilities there, thereby contributing to improving the living environment for the City's residents by reducing the pollution load discharged into the river within the City.

[1] Data provided by JICA

[2] The water quality for rivers, lakes, and other water environments is classified into Class I - V pursuant to the Environmental Quality Standards for Surface Water (GB3838-2002). Class I: Applies primarily to water from water sources and national nature reserves; Class II: Applies primarily to concentrated water sources of potable water for domestic use in Class I preserves, valuable fish protection areas, and fish and shrimp spawning grounds; Class III: Applies primarily to concentrated water sources of potable water for domestic use in Class II preserves, general fish protection areas, and swimming areas; Class IV: Applies primarily to general industrial water areas and water areas for entertainment purposes that do not come into direct contact with humans; Class V: Applies primarily to agricultural water and water areas needed for general scenery.

Loan Approved Amount/ Disbursed Amount	7,398 million yen / 6,883 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	June 2006 / June 2006
Terms and Conditions	Interest Rate: 0.75 % Repayment Period (Grace Period): 40 years (10 years) Conditions for Procurement: General Untied
Borrower / Executing Agency(ies)	Guarantor: Government of the People's Republic of China / Harbin Municipal People's Government
Final Disbursement Date	December 2013
Main Contractor (Over 1 billion yen)	・Beijing Zhonghui United Environmental Engineering Co., Ltd. (China) ・China National Precision Machinery Import & Export Corp. (China)
Main Consultant (Over 100 million yen)	None
Feasibility Studies, etc.	・Environmental Impact Assessment Report (Heilongjiang Province Research Institute for Environmental Protection, Harbin City Research Institute for Environmental Protection August 2002) ・F/S (North China Municipal Engineering Design & Research Institute, Harbin Municipal Engineering Design Institute December 2004)
Related Projects	【ODA Loan】 ・Sanjiang Plain Longtouqiao Reservoir Construction Project (L/A December 1996) ・Heilongjiang Songhua River Basin Environmental Improvement Project (L/A December 1998) 【Other Donors】 ・Xinyigou Sewage Treatment Plant Construction Project (ADB L/A 2008) ・Xinyigou Sewage Intercepting Project (ADB L/A 2008) 【Domestic Finance】 ・Hejiagou Development Project (started in 2010) ・Majiagou Development Project (started in 2010) ・Majiagou Sewage Intercepting Project (started in 2010)

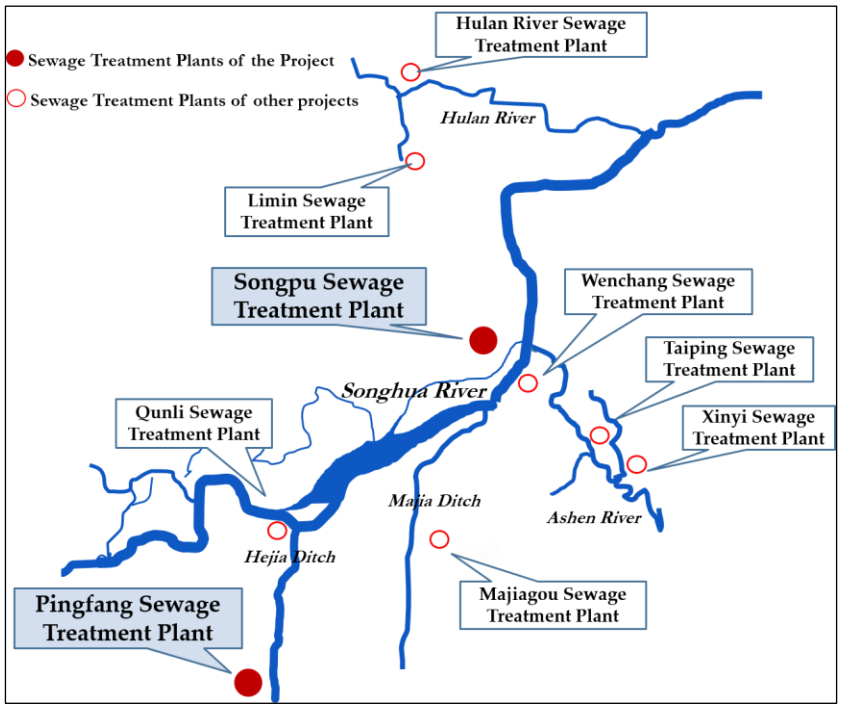


Figure 1: Locations of the river and sewage treatment plants within Harbin City

2. Outline of the Evaluation Study

2.1. External Evaluator

Shima HAYASE, IC Net Limited

2.2. Duration of Evaluation Study

The ex-post evaluation study was carried out as follows:

Duration of the Study: May 2015 – January 2017

Duration of the Field Study:

November 17, 2015 –November 30, 2015

April 5, 2016 – April 9, 2016

2.3. Constraints during the Evaluation Study

At the time of the appraisal, the results indicators for installing sewage facilities through the project were defined as an improvement in the water quality in the City's river. However, the water quality in the river is affected by numerous factors beyond the installation of sewage facilities, which makes it difficult to directly determine the extent to which the project contributed to improving the water quality of a wide river. Therefore, in this ex-post evaluation, changes in the water quality for the City's river as a whole were considered as part of its impact. For this, the contribution the project has made will be analyzed via the share of the level of pollutant load in the water that were reduced as a result of the sewage treatment versus the pollutants discharged into the water throughout Harbin City as a whole.

The evaluator could not obtain cooperation with the Water Resources Bureau and Environmental Protection Bureau of Harbin City for this ex-post evaluation study in terms of providing information and conducting interviews. Alternative information was collected from the Harbin City Inland River Construction and Development Co., Ltd. and directly from the sewage treatment plants. Because of this, data on the City's policies and the water quality in the river could not be obtained, which placed constraints on analyzing the situation of the City as a whole.

3. Results of the Evaluation (Overall Rating: A[3])

3.1. Relevance (Rating: ③[4])

3.1.1. Relevance to the Development Plan of China

(1) Relevance to Development Policies at the Time of the Appraisal

The Tenth Five Year Plan for National Economic and Social Development of the People's Republic of China (2001 - 2005), which was the national development plan at the time of the appraisal, aimed at harmonious economic and social development. It emphasized improving the environment, which had deteriorated as a consequence of economic development. It also set targets related to sewage treatment and improving water quality. These included achieving a sewage treatment rate of 45% in urban areas (60% in cities with populations of 500,000 people or more); improving the water quality in the upstream areas of the Yangtze River, the midstream areas of the Yellow River, and the river basin of the Songhua River; and reducing the total amount of major pollutants discharged by 10% relative to year 2000 levels. What is more, the Harbin City Tenth Five Year Plan for Environmental Protection (2001 - 2005) set the targets of boosting the sewage treatment rate in urban areas to 90% by 2010, and achieving and maintaining Class III water quality in the Songhua River. It also set forth a policy of working to improve the water environment.

(2) Relevance to Development Policies at the Time of the Ex-post Evaluation

The Twelfth Five Year Plan for National Economic and Social Development of the People's Republic of China (2011 - 2015), which was the national development plan at the time of the ex-post evaluation, set five priority areas. For one of these, "Resource-saving and environment-friendly society," it set the target of boosting the level of its social infrastructure across-the-board, including sewage treatment facilities.

The Harbin City Twelfth Five Year Plan for Environmental Protection (2011 - 2015) was enacted based on the aforementioned national policy. It promoted comprehensive development plans for tributaries of the Songhua River, through which it maintained water quality at about the Class III standard in the Songhua River. As for the water quality in the river's tributaries, the objective was to have no tributaries fail to meet the standards, and the tributes that were already meeting the standards maintain their present status. Through this, it presented targets for achieving a sewage treatment rate of 95% in urban areas.

Based on the Songhua River Basin Pollution Prevention and Control Master Plan (2006 - 2010), which was a development plan for the Songhua River Basin, Harbin City laid out the objective of boosting the sewage treatment capacity to 795,000 m^3/day. This called for strengthening its two existing treatment plants (the Taiping and Wenchang sewage treatment plants), building seven sewage treatment plants, including two through this project, and installing a pipe system.

As this indicates, from the time of the appraisal, the improvement of the water quality of the river and building and enhancing sewage treatment infrastructures continued to be a priority area in the development plans of the national government and Harbin City at the time of the ex-post evaluation, and the relevance of the project was adequately ensured.

3.1.2. Relevance to Development Needs of China

The population of Harbin City at the time of the appraisal reached 3.47 million people, and industrial sewage and domestic sewage had increased as a result of this rapid development. The treatment capacity from the existing sewage treatment plants[5] and small-scale treatment facilities

[3] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

[4] ③ :High, ② :Fair, ① :Low

[5] In addition to the Wenchang sewage treatment plant (325,000 m^3/day) and the Taiping sewage treatment plant

came to a total of 670,000 m^3/day. As such, the treatment rate versus the sewage discharged (490,000 m^3/day of domestic sewage and 620,000 m^3/day of industrial sewage) remained at 60%, and in regions[6] where the population did not have connection to sewage treatment plants, sewage water was being discharged into the river.

Therefore, Harbin City formulated its Sewage Facility Development Master Plan (2005 - 2020) for up till the year 2020. The plan was to boost treatment capacity to 2.05 million m^3/day and the treatment rate to 90% versus the population of 4.15 million people and volume of sewage of 2.29 million m^3/day (of which, there was 920,000 m^3/day of domestic sewage and 1.37 million m^3/day of industrial sewage) projected for 2020.

At the time of the ex-post evaluation,[7] progress had been made with enhancing in-house treatment at companies within the City, and so the volume of industrial sewage generated came to around 10% of what had been predicted, at 143,000 m^3/day. Conversely, the population of Harbin City increased to 4.35 million people, which exceeded the predictions for 2020 of the master plan, and domestic sewage came to 950,000 m^3/day. The sewage treatment rate for the volume of sewage of 1.09 million m^3/day for the City as a whole came to 88%.[8] However, the target of 95% (for urban areas, excluding towns and townships) from the Harbin City Government's Twelfth Five Year Environmental Protection Plan (2011 - 2015) was not achieved. In consideration for future population growth, the quantity of domestic sewage was expected to increase further at the time of the ex-post evaluation, and so the development needs for sewage treatment will remain high.

3.1.3. Relevance to Japan's ODA Policy

In the "Medium-Term Strategy for Overseas Economic Cooperation Operations (2002 – 2005)," by the Japan International Cooperation Agency (hereafter referred to as "JICA") set forth the priority areas of strengthening responses to reduce poverty, the installation of infrastructure for economic growth, and support for environmental conservation and preventing pollution. As part of these, it indicated the necessity of installing sewage treatment facilities to serve as a countermeasure against water pollution designed to avoid and mitigate the negative effects on the environment via the development of infrastructure.

What is more, JICA's "Country Assistance Strategy for China" (2002 – the first half of 2006) set environmental conservation and human resource development, primarily in inland regions, as priority areas. It positioned the installation of sewage systems as economic / social infrastructure that form the base of the private sector activities, and emphasized the fact that their installation would promote sustainable growth.

This project strived to strengthen sewage treatment capacity of the City and to improve the water quality of the river by building sewage treatment facilities, and aimed to promote the sustainable development of the City. It was confirmed that the project's relevance to Japan's ODA policies, which have the objective of improving the environment and performing social development in inland regions as indicated above, has been assured.

3.1.4. Relevance to Appropriateness of Project Planning and Approach

The sewage treatment plants from this project were completed as planned, and there are no problems with their operation and maintenance status. However, the amount of sewage influent has fallen below the estimates, and their operation rates remain low. What is more, the facility to reclaim water at the Songpu sewage treatment plant are not in operation because the demand for

(325,000 m^3/day), apartment buildings and factories had small-scale sewage treatment facilities (totaling 20,000 m^3/day), which were owned privately.

[6] Harbin City had a total of 1,103.34 km in existing sewer pipes, with a breakdown of this coming to 52.94 km of sewage pipes, 972.60 km of combined pipes, and 77.8 km of storm sewer pipes.

[7] The ex-post evaluation was performed in 2015, but the most recent data provided was for 2014.

[8] The volume of sewage came from the China Statistical Yearbook and the sewage treatment rate came from the Harbin City Statistical Yearbook, with data from 2014 used for both.

the use of reclaimed water envisioned at the time of the appraisal has not yet appeared as of the time of the ex-post evaluation. These changes are primarily due to delays in the urban development plans of Harbin City, with the expectation being that the demand will grow along with the future advances in urban development. At the time of the ex-post evaluation, urban development had already made advances in the region downstream of the Pingfang sewage treatment plant. Countermeasures were examined in response to the capacity shortfall of the Qunli sewage treatment plant that treats sewage in this region. This development was expected to gradually spread to the Pingfang sewage treatment area. Conversely, government-related facilities and the research institutions such as research center of universities began to relocate themselves to the service district of the Songpu sewage treatment plant, and the population trended upward.

In addition, the fact that progress has been made with in-house sewage treatment at large-scale factories that were a source for discharging sewage is a factor that decreased the volume of sewage taken in at the sewage treatment plants. The pollutant reduction was promoted by this self-help effort of the Chinese side in tightening regulations, therefore it yielded positive impact on the Project.

The development of Harbin City continues to make progress as of the time of the ex-post evaluation, and no clear risks or factors that would cause this development trend to fall behind for the foreseeable future have been observed. Given this, it is highly likely that the demand for sewage treatment for the City as a whole will continue to increase over the medium to long-term. Since this project's goal was to improve the water environment in Harbin City, the need for such a project will conceivably remain high over the medium to long-term.

On the other hand, at the time of the ex-post evaluation the relevance between the installation of facilities and their usage methods had not been aligned with the urban plans. Adequate progress has not been made with utilizing excess capacity, for example, by transferring the responsible treatment amounts among treatment plants to optimize the City's capacity as a whole. When it comes to rating the project's relevance, the need for sewage treatment will remain high over the medium to long-term, and so the rating will not be lowered. However, it is recommended that analysis on how to accommodate all the facilities in the City more effectively should have been undertaken at the level of the Harbin City government (see the section on Effectiveness for details).

In light of the above, the implementation of the project is fully relevant to the development policies and needs of China, Harbin City, and the river basin, as well as Japan's ODA policies. Therefore, its relevance is high.

3.2. Efficiency (Rating :②)

3.2.1. Project Outputs

Planned and Actual Outputs

The Pingfang sewage treatment plant and pipeline, as well as the Songpu sewage treatment plant[9] were built as planned. Regarding the construction of the pump station and mainlines (for inlet, outlet, and reclaimed water distribution) [10] for the Songpu sewage treatment plant, the construction schedules for the underground section had to coincide with the construction work to build roads within the City. Because of this, it was cancelled from the scope of this project and carried out via separate domestic financing. An application for the change was submitted from the executing agency to JICA, and officially approved by JICA in August 2008.

For the training for the staff of the executing agency and others, the number of eligible trainees was reduced by one person. However, the courses and facility tours planned at the time of the

[9] The data provided by JICA is for the Songbei sewage treatment plant, but officially this is the Songpu sewage treatment plant. The name of the sewage treatment district for this treatment plant is the Songbei District.

[10] According to the material provided by JICA, it is written as "pipelines" (for drainage sewage water discharge, and reclaimed water) "

appraisal were largely carried out as planned.

Table 1 Comparison of Output of the Plan and the Actual Results

Plan (2006)	Actual (2015)
Pingfang Sewage Treatment Plant CASS Process[11]:Treatment Capacity 150,000 m^3/day Among them: All the amount for Advanced Treatment Intercepting Main Lines[12] 900mm-2,800mm Approx. 64 km	As Planned
Songpu Sewage Treatment Plant CASS Process:Treatment Capacity 100,000 m^3/day Among them: 30,000 m^3/day Recycled as Reclaimed Water	As Planned
Songpu Sewage Treatment District Pump Station 2 locations Drainage Mainlines[13] 300mm-2,000mm approx. 67 km Discharge Main Lines[14] 1,400mm approx. 6 km Reclaimed Water Distribution Pipes[15] 100mm-700mm approx. 25 km	Constructed by other projects using domestic financing
Training October 2006 (14 days) 15 persons September 2007 (14 days) 11 persons October 2007 (14 days) 10 persons Destination: Niigata Prefecture Total 36 persons	Training December 2007 (14 days) 15 persons October 2008 (13 days) 10 persons November 2008 (14 days) 10 persons Destination: Niigata Prefecture Total 35 persons

Source: Material provided by JICA and Harbin City Inland River Construction and Development Co., Ltd

3.2.2. Project Inputs

3.2.2.1. Project Cost

At the time of the appraisal, the total project cost was estimated to be 14,983 million Japanese yen (7,969 million Japanese yen in foreign currency; 6,924 million Japanese yen in domestic currency). After deducting the cancellation of the construction for the pipe system (1,977 million Japanese yen), the total project cost was estimated to be 12,916 million Japanese yen. Compared to the actual total project costs of 13,602 million Japanese yen (6,883 million Japanese yen in foreign currency; 6,719 million Japanese yen in domestic currency), the project costs came in at 105%, exceeding the planned value by 5%.

Regarding each output, the construction costs for the two treatment plants substantially increased, in which the Pingfang sewage treatment plant cost came to 139%, and the Songpu sewage treatment plant cost came to 174% of what had been planned.[16] The budget for the pipe system that was removed from the scope of the project was diverted to this. According to the project implementation the reason for the increase in the construction costs is because of the rise

[11] CASS Process: a biological treatment process (activated sludge technology) for removing nitrogen and phosphorous. This enables space saving for the facility.
[12] According to the material provided by JICA, it is written as “Intercepting Pipelines.”
[13] According to the material provided by JICA, it is written as “Drainage Pipelines.”
[14] According to the material provided by JICA, it is written as “Sewage Discharge Pipelines.”
[15] According to the material provided by JICA, it is written as “Reclaimed Water Pipelines.”
[16] The costs for each facility at the time of the appraisal came to 120% of the planned values when the rate of inflation from the period (2006 - 2011) is multiplied and figured in to this, meaning that the construction costs increased even more than this.

in the costs of the materials and personnel, as well as the increased cost for the adoption of the monitoring control system. This was handled by increasing the budget from domestic currency.

3.2.2.2. Project Period

The project implementation period planned at the time of the appraisal was from July 2006 to April 2011 (58 months), and the project was completed as planned.[17] The construction work to lay the pipe system for the Songpu sewage treatment plant that was removed from the project's scope so that it could be instituted at the same time as road construction work was delayed by roughly one year. But since it was completed before the end of the warranty period for the sewage treatment plant, the project could start operation within the planned period.

3.2.3. Results of Calculations of Internal Rates of Return (Reference only)

Only the Financial Internal Rate of Return (FIRR) for the project was calculated at the time of the appraisal. At the time of the ex-post evaluation, the evaluator recalculated the FIRR[18]with the maintenance fees and other costs and the revenue submitted by the executing agency. The FIRR that was envisioned at the time of the appraisal was 5.67%. In contrast, the FIRR at the time of the evaluation turned out to be in at a negative value. This is because the sewage treatment volume at the time of the ex-post evaluation was less relative to what had been planned at the time of the appraisal, and the corresponding revenue from the sewage treatment was calculated to be less than what was planned.

In light of the above, the project period was within the plan, but the project costs exceeded the plan. Therefore, its efficiency is fair.

3.3. Effectiveness[19] (Rating: ③)

3.3.1. Quantitative Effects (Operation and Effect Indicators)

At the time of the planning, this project was expected to produce the following effects: "improvement in the sewage treatment capacity" in Harbin City; and "improvement in the quality of discharged water" from the sewage treatment plants. In response to improving the sewage treatment capacity, target value was set for Harbin City's sewage treatment rate and sewered population. Of these, there is statistical data for the sewage treatment rate, but statistical data regarding the sewered population has not been published, or the data has not been submitted from the executing agency. Therefore, estimated values for the sewered population were calculated from the sewage treatment volume as an alternative method. Targets for each of the treatment plants had not been set at the time of the appraisal, but the achievement status for the effects was confirmed by the sewage treatment volume.

As for improving the water quality of the discharged water, which serves as an effect indicator, this was confirmed by the concentration of pollutants contained in the water discharged from each treatment plant.

(1) Operation Indicators

1) The Sewage Treatment Volume and the Rate, the Sewered Population, and the Percentage of Sewered Population in Harbin City

The plan at the time of the appraisal envisioned sewage discharge of 1.35 million m^3/day across Harbin City as a whole by one year after the completion of the project (2012[20]), and the target of

[17] Project completion is defined as the point "When the warranty period ends." This corresponds to the period guaranteed by the construction company, and is equivalent to the trial run period following the completion of the construction.

[18] Prerequisites include costs (construction costs, maintenance costs), benefits (sewer usage fees), and a project life of 30 years.

[19] The rating is performed by factoring the impact into the decision on effectiveness.

[20] The data provided by JICA listed this as 2010, but going by "when the warranty period concludes," which is the definition for completion, one year after project completion would be 2012.

treating 68% of this, or 920,000 m^3/day, was set. Following the completion of the project, both the sewage treatment volume and treatment rate exceeded their target values at the time of the ex-post evaluation, and so the effects could largely be said to have been achieved. Conversely, the volume of sewage discharge for the City as a whole one year after project completion (2012) came to 1.2 million m^3/day, falling below what had been envisioned at the time of the plan. This is due to the fact that the volume of sewage water discharged remained around 90% of what had been projected as a result of the substantial decrease in the volume of industrial sewage owing to the start of in-house treatment at companies, as well as delays in urban development.

Moreover, the target values for the sewered population and the percentage of sewered population at one year after project completion were estimated from the sewage water volume and the sewage treatment volume to be 3.17 million people and the percentage of sewered population to be 59%. Compared with this, the actual values for 2012 came to a sewered population of 3.98 million people and a sewered population rate of 83%, which exceeded the targets.

Table 2: Harbin city's Sewage Treatment Volume and Rate, Population in the Sewage Service, and the Sewered Population

	Baseline	Target	Actual			
		1 year after completion	completion	1 year after completion	2 years after completion	3years after completion
	2004	2012	2011	2012	2013	2014
Volume of Sewage Water (10,000m^3/day)	111	135	115	120	104	109
Domestic Sewage Water (10,000 m^3/day)	49	N/A	N/A	N/A	92	95
Industrial Sewage Water (10,000 m^3/day)	62	N/A	N/A	N/A	12	14
Volume of Sewage Water Treated(10,000 m^3/day)	65	90	93	100	90	96
Sewage Treatment Rate	60%	67%	81%	83%	87%	88%
Population (10,000 persons)	444	540	459	479	418	435
Sewered Population (10,000 persons)	260	317	372	398	361	383
Percentage of Sewered Population (%)	59%	59%	81%	83%	86%	88%

Source: The standard values and target values came from data provide by JICA. The actual values for the sewage discharge volume and treatment volume, as well as the treatment rates, came from the Harbin City Statistical Yearbook, while the City's population and sewered population were estimated values calculated from the treatment volume.[21]

[21] The treatment volume for the standard values divided by the population, and for the volume of sewage generated per person estimated values for the sewered population were calculated.

2) Treatment Volumes and Treatment Rates for the Sewage Treatment Plants and the Plant Operation Rate

The Pingfang and Songpu sewage treatment plants were constructed as designed, and they had been furnished with the planned treatment capacity at the time of the appraisal. As such, this has contributed to "improvement in the sewage treatment capacity" of Harbin City, which was an aim of the project. However, no numerical targets were set at the time of the appraisal, but the actual treatment volumes[22] and the operation rates are around 20 to 30% of the design capacity. Therefore, they are not being used to their utmost capacity. According to the interviews during the field study at the sewage treatment plants, the operation rate for Pingfang sewage treatment plant was around 67% during the summer peak and about 30% in the winter. For Songpu sewage treatment plant the annual average is around 50%, with this coming to up to about 70% during peak time.

Moreover, the plan at the time of the appraisal called for a design capacity for the two sewage treatment plants to cover 26% of the total treatment volume for the City one year after the project's completion. The treatment volume by the two sewage treatment plants from the project was 68,000 m^3/day in 2012, which is around 6.8% of the treatment volume for the City, with the share from their contribution falling substantially below what had been envisioned.

This is due to the fact that urban development was delayed, and because the demand for sewage treatment in the areas eligible for sewage treatment by the two plants fell below what had been envisioned. Conversely, the number of companies building in-house waste water treatment plants has increased as a result of discharge regulations that were strengthened in 2010.[23] The volume of sewage discharged by the industrial sector within Harbin City decreased, which is a factor that had a positive effect on the project's impact.

A drainage design institute that analyze the demand for urban infrastructure in the City confirmed that the construction of new sewage treatment plants would be unnecessary, because the total capacity of the current sewage facilities with some additional work would be enough to handle the demand for sewage treatment in Harbin City predicted up through 2040. Regarding the delay in urban development, the plan was to complete the construction of an industrial park that had been initially planned by the year 2020, thus the capacity of the two sewage treatment plants built by this project will be utilized. Conversely, at the time of the ex-post evaluation, the sewage treatment rate for Harbin City as a whole remained 90%, therefore, the surplus capacity from the two treatment plants from this project may be utilized through measures like extending sewage pipeline network and broadening the treatment areas, or promoting transfers between the sewage treatment plants.

[22] Regarding the achievement of the treatment volume to the target, due to the reason that no target volume was set at the appraisal, this evaluation compared the achievement to the designed capacity and the actual treatment volume.

[23] In 2010 the Water Quality Standards for Town Sewage Systems that Discharge Sewage (CZ3082-1999) were revised, and progress has been made with the dissemination of in-house sewage treatment facilities at large factories and the reuse of reclaimed water.

Table 3: Waste Water Treatment Volume, Plant Operation Rate of the Treatment Plants
(Annual average volume)

	Treatment Capacity	Completion	1 year after completion	2 years after completion	3 years after completion	4 years after completion
		2011	2012	2013	2014	2015
Pingfang Sewage Treatment Plant						
Waste Water Treatment Volume ($10,000m^3$/day)	150,000 m^3/day	4.6	4.7	4.7	4.8	4.8
Plant Operation Rate (%)		30%	31%	31%	32%	32%
Songpu Sewage Treatment Plant						
Waste Water Treatment Volume ($10,000m^3$/day)	100,000 m^3/day	0.9	2.1	2.2	2.6	2.8
Plant Operation Rate (%)		9%	21%	22%	26%	28%

Source: data provided by Harbin City Inland River Construction and Development Co., Ltd

(2) Effect Indicators

At the time of the appraisal, target values for the concentration of biological oxygen demand (BOD) in the discharged water were set as effect indicators for improvements in the water quality by the enhanced sewage treatment. The actual results from one year after the project completion for this satisfied the target values at both sewage treatment plants, and since then these effects have been maintained.

Table 4: Water Quality in Pingfang Sewage Treatment Plant

		Target	Completion Year	1 year after completion	2 years after completion	3 years after completion	4 years after completion
		1 year after completion	2011	2012	2013	2014	2015
BOD (mg/l)	Inlet	200	146.0	136.5	145.0	130.5	129.5
	Outlet	20	6.2	5.7	6.1	6.7	5.9
	Reduction Rate	90%	96%	96%	96%	95%	95%
	Standard	≦20	≦20	≦20	≦20	≦20	≦20

Source: data provided by Harbin City Inland River Construction and Development Co., Ltd

Table 5 Water Quality in Songpu Sewage Treatment Plant

		Target	Completion Year	1 year after completion	2 years after completion	3 years after completion	4 years after completion
		1 year after completion	2011	2012	2013	2014	2015
BOD (mg/l)	Inlet	200	127.0	105.0	112.0	129.0	122.0
	Outlet	20	12.6	12.0	13.3	13.4	14.0
	Reduction Rate	90%	90%	89%	88%	90%	89%
	Standard	≦20	≦20	≦20	≦20	≦20	≦20

Source: data provided by Harbin City Inland River Construction and Development Co., Ltd

Although no target values were set at the time of the appraisal, in addition to the above, Pingfang sewage treatment plant was required to meet the standards for Class I B and Songpu sewage treatment plant was required to meet the standards for Class II with regard to the chemical oxygen demand (COD) concentration, suspended solids (SS), NH_3-N total nitrogen (T-N) concentration, total phosphorous (T-P) concentration, and the hydrogen ion concentration index (pH) for the discharged water. According to data provided by JICA, the Pingfang sewage treatment plant has set an objective for itself of performing even more advanced treatment, and so Class I B standards were set as its target.[24] For both sewage treatment plants, the target values and the national standard were met regarding all the pollutants for the water quality of the discharged water.

For the facilities to reclaim water at the Songpu sewage treatment plant, facilities equipped with the capacity planned through this project were constructed. However, no progress was made with the construction of the industrial park that was expected to reuse the reclaimed water, and so at the time of evaluation the facilities were unused. Therefore, there is no time-lapse data on the water quality for the reclaimed water. According to an engineer at the Songpu sewage treatment plant, at the time of the inspection, the quality of the reclaimed water discharged technically met the national standards (Class I A). The plan to build the industrial park was delayed, but it is expected that a power plant which will be the primary user of the reclaimed water will be built by 2020. As such, the expectation is that the demand for reclaimed water planned at the time of the appraisal will be met.

3.3.2. Qualitative Effects (Other Effects)

No qualitative effects were set at the time of the appraisal.

Effects from Training

The participants in the training in Japan, which targeted operation and maintenance personnel at the sewage treatment plants, mentioned acquiring understanding of and learning about a number of subjects as effects of the training. These included daily operation and maintenance of treatment plants in Japan, deodorizing systems, sludge treatment techniques, consideration for issues like the environment and noise for residents, and the diligent approach to work of the Japanese people. Operation and maintenance methods and deodorizing techniques have been adopted at both of the sewage treatment plants built by this project. On the other hand, because the sewage treatment plants visited in Japan were old style, some participants answered that that the plants were not very informative for this particular project which built sewage treatment facilities at a water quality level of Class I B for the discharged water through advanced CASS process.

As the above indicates, the improvements in the sewage treatment capacity and percentage of sewered population in Harbin City through this project were largely achieved. The volume of

[24] The Discharge Standard of Pollutants for Municipal Wastewater Treatment Plants (GB18918-2002).

sewage taken in at the two sewage treatment plants built by this project declined, and their operation rates were 50% or less of the design. As such, their contributions to the treated volume for the City as a whole were limited. This was caused by factors such as the delay in urban development and alterations to policies related to industrial sewage treatment. Conversely, both the project's target values and the national standards have been met regarding the water quality of the water discharged by the two sewage treatment plants. At the time of the ex-post evaluation, the project had achieved its goal of "improvement in the sewage treatment capacity" in Harbin City, and "improvement in the quality of discharged water" were achieved. However, the treatment volumes and operation rates for the two treatment plants fell significantly below what had been envisioned as a result of external factors. Given the advancing urban development and increase in future demand in Harbin City, the operation rates for the two sewage treatment facilities from this project are expected to improve. With these points taken into consideration, the achievement status for the effects could be described as favorable on the whole.

3.4. Impacts

3.4.1. Intended Impacts

For this ex-post evaluation, "Reducing pollutants discharged into the rivers in Harbin City" and "Improving the living environment for the residents" were envisioned as impacts of the project. Regarding them, changes in the water quality of the rivers in the City and the contribution of this project were analyzed. In addition, a beneficiary survey was conducted concerning changes in the river environment and the living environment in the City as a result of the new sewage treatment service to analyze the project impacts.

(1) Improvement in the Water Quality of the Rivers in the City and the Contribution of the Project

1) Improvement in the Water Quality of the Rivers in the City

According to data published by the Harbin City Environmental Protection Bureau, the water quality of the Songhua River, which was Class IV at the time of the appraisal (2004), improved to Class III in 2009. The water quality at the downstream observation point repeatedly alternates between Class III and Class IV. However, there are numerous other factors beyond this project that alter the water quality in the river, and so it is difficult to directly detect the causal relationship with this project.

2) Monitoring Data at Points of Observation

At the time of the appraisal, observation points were designated to monitor the water discharged from the sewage treatment plants from this project and the data was provided. However, because data on results since the beginning of the project to time of the ex-post evaluation was not available,[25] it is impossible to analyze the water quality of the rivers quantitatively at each section. Instead, a field survey was conducted to observe the state of each discharge point of each sewage treatment plant.

No foul odors, turbidity, or suspended solids such as waste were observed with the water discharged from either the Pingfang or the Songpu sewage treatment plants, and no factors that would have a negative environmental impact were seen. The water discharged from the Songpu sewage treatment plant has a higher water temperature than the river water, and the water gathered aquatic organisms. On account of this, the residents enjoyed casting nets and fishing in the vicinity around the discharge outlet.

[25] The Harbin City Environmental Protection Bureau has established observation points in order to monitor the water quality and other data of the river, at which it collects cross-sectional data on the river every day. In order to perform this ex-post evaluation, a request was made to the Environmental Protection Bureau to provide this data. However, for political reasons it was reluctant to publicly release data related to the environment, and it refused to provide this data.

Water discharged from the Pingfang sewage treatment plant

Water discharged from the Songpu sewage treatment plant

3) State of Reduction in Pollutants by the Project

By comparing the total volume of pollutants (COD, NH_3-N) discharged into the public water with the level of pollutant load reduced by this project analyze how much this project contributes to improvement in the water quality of the rivers in Harbin City. The ratio of pollutants reduced by this project to the annual total volume is 0.9 - 4.2% in the case of COD, and 2.3 - 4.8% in the case of NH_3-N, thus certain contribution can be admitted.

Table 6 COD Emission in Harbin City (unit: 10,000 t/year)

	2011	2012	2013	2014
Emission in Harbin City	33.1	31.5	9.3	9.1
Among Industrial Emission	N/A	N/A	0.7	0.8
Among Domestic Emission	N/A	N/A	8.6	8.3
Reduction by the Project	0.58	0.29	0.29	0.38
Ratio of the Project	1.8%	0.9%	3.2%	4.2%

Source: data on emission in Harbin city came from the National Statistical Year Book, the project's actual data came from Harbin City Inland River Construction and Development Co., Ltd

Table 7 NH_3-N Emission in Harbin City (unit: 10,000 t/year)

	2011	2012	2013	2014
Emission in Harbin City	2.4	2.3	1.5	1.4
Among Industrial Emission	N/A	N/A	0.11	0.11
Among Domestic Emission	N/A	N/A	1.4	1.3
Reduction by the Project	0.056	0.054	0.057	0.068
Ratio of the Project	2.3%	2.3%	3.8%	4.8%

Source: data on emission in Harbin city came from the National Statistical Year Book, the project's actual data came from Harbin City Inland River Construction and Development Co., Ltd

In Harbin City, a number of efforts are being promoted as comprehensive initiatives to improve the water environment. These include promotions of rigorous environmental monitoring by the Environmental Protection Bureau, in-house sewage treatment at large factories, and operation suspension at factories that are regarded as sources of river pollution. This project is one of the core comprehensive water environment improvement efforts in Harbin City, and has been recognized for the contributions to improving the water environment across the City.

(2) Beneficiary Survey

Regarding "improvement in the water quality of the rivers" and "improvement of living / business environment," beneficiary survey[26] with residents (60 samples) and company survey[27] (20 samples) were conducted to study the changes in the river environment, the environments for living and business activities before the project (2005) and at the time of the ex-post evaluation (2015), and the degree of satisfaction with sewage treatment service.

A scene from the beneficiary survey carried out at the Songpu sewage treatment plant

1) Beneficiary Survey

According to the results of the beneficiary surveys, more than 75% of the respondents[28] recognized[29] the improvements in the water quality and environment around the rivers, and the living environment, thus the contributions from the sewage treatment were recognized. On the other hand, 83% were satisfied with the sewage treatment services, but responses of "Somewhat dissatisfied" and "Dissatisfied" accounted for 17%. The primary reasons of dissatisfaction were due to lack of information on sewage treatment services, inefficient and unhelpful responses at customer service and telephone, which are mainly on 'soft' aspects. However, some responses were citing the delay in dissemination of sewage systems and improvements in the water quality.

2) Corporate Survey

From the results of the company surveys, 85% of the respondents replied that drainage flow and pipe blockages have improved and 80% replied that the sanitary environment has improved with respect to the environment for business activities as a result of the start of the sewage treatment service. When they were asked about effects on business activities from the start of the sewage treatment, 80% of the companies responded that productivity had "Improved significantly" or "Improved somewhat," while 55% said the same for efficiency, 55% said the same for business scale, and 50% said the same for the investment environment. As such, there was a particularly strong recognition of its contributions to improving productivity.

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[26] The beneficiary surveys were carried out by gathering together 60 local residents (30 people for each treatment plant) living near the river in the vicinity around the two sewage treatment plants that began offering sewage treatment services as a result of this project. The district resident committees were asked to select the people eligible for the surveys, so these did not constitute a random sample. The surveys were carried out on households that consented to the survey and which agreed to visit their sewage treatment plant and fill out questionnaires. Therefore, it is possible that only cooperative residents took part in the survey, leading to overestimations of the project effects. Moreover, the number of samples is small compared with the total number of beneficiaries (sewered population in the districts). Therefore, it cannot be said to be a representative sample of all the beneficiaries from this project, but considered only as an indication of some of the impressions of the beneficiaries regarding the changes in the surrounding environment.

[27] These were performed on 20 companies eligible for sewage treatment in the area around the Pinsgfang and Songpu sewage treatment plants (ten companies for each treatment plant). As for the type of industries, three companies were in the agriculture/forestry/fishery industry, six were in the manufacturing industry, five were in the service industry, three were in the construction industry, and three were in the public agency or other category.

[28] Those people who did not recognize the improvements made comments like "There was no change," "There was no problem previously," and "No response." When this was cross-referenced against the responses from the interviews with the beneficiaries, their awareness level was low or they thought there was no problem on the issue, and so they selected such response.

[29] 55% of the respondents said that there had been improvements in the growth of harmful plants or plankton and 63% saw improvements in flooding during heavy rains. There was little recognition of the fact that there had been improvements with the other items surveyed, such as improvements with foul odors.

3.4.2. Other impacts

(1) Impact on the Natural Environment[30]

1) Monitoring during Project Execution

At the time of the appraisal, no negative impacts on the natural environment were envisioned. During the construction and remodeling work for the sewage treatment plants through this project, monitoring was carried out on the construction sites and treatment plants by the Harbin City Environmental Protection Bureau and observation units as planned at the time of the appraisal. Ventilation, dust particles, noise and vibration, waste, and drainage were all subject to monitoring. The daily monitoring results were reported to the City's Environmental Protection Bureau each quarter. According to interviews with the project implementation unit, the construction and remodeling work was carried out in conformance with the predetermined environmental protection standards, and no particular problems were seen during the construction work.

Water quality monitoring equipment at the Songpu sewage treatment plant

Sludge treatment facilities at the Pingfang sewage treatment plant

2) Monitoring after Project Completion

Monitoring devises were installed at the inlets and outlets of the sewage treatment plants, and according to the interview with the sewage treatment plant engineers of the project implementation unit, the values for the level of pollutant load in the water (COD, BOD, SS, T-N, T-P, pH, etc.) were monitored around the clock. And these monitoring devises were managed by a third-party agency that specializes in environmental monitoring, and the monitoring data is directly sent online to the State Environmental Protection Bureau. In addition, to check the precision of the observation equipment, the staff of the laboratory in each of the sewage treatment plants inspects the quality of water flowing into and out from the plant every day. According to the interview to the sewage treatment plant engineers of the project implementation unit, the City's Waterworks Bureau performs monthly water sample inspections, the City's Environmental Observation Center performs onsite examinations once each quarter, and the Environmental Protection Bureau performs onsite examinations at a frequency of once a month.

According to the interview to the sewage treatment plant engineers of the project implementation unit, a regulated distance is kept between the plant and the residential area according to "the outdoor drainage design regulation" so as to provide consideration to prevent any negative environmental influence to the residents' sphere of daily life.

At the time of designing, countermeasures were taken by installing equipment that produces noise underground, such as pumps. During the plant operation, foul odors were removed by installing sedimentation basins indoors, and using showers and mineral absorption. As for the sludge generated as a result of the sewage treatment, its moisture content was dried off to 80%,

[30] The environmental impact assessment report for the project was approved by the Harbin City Environmental Protection Bureau in November 2002.

and shipped to an outside sludge treatment center where it was disposed in a landfill. At the time of the ex-post evaluation, the new sludge treatment center built by Harbin City was operating on a trial basis. After the completion, the center is to start treating the sludge from the sewage treatment plants, and reuse it by processing it to soil for greening and other purposes.

3) Monitoring of the Rivers in the City

The Environmental Protection Bureau in Harbin City performs water quality monitoring on the rivers within the City. However, the methods of monitoring or the specific water quality data is not disclosed, and unavailable for the study.

(2) Land Acquisition and Resettlement

Since the construction site had already been secured the land acquired for this project remained small including 0.15 km^2 for the Pingfang sewage treatment plant and 0.11 km^2 for the Songpu sewage treatment plant, and was acquired as planned. Since the area was undeveloped wasteland, no resettlement occurred.

(3) Other Impacts

None in particular

In light of the above, this project has largely achieved its objectives as planned from the implementation of the project. Therefore, its effectiveness and impact are high.

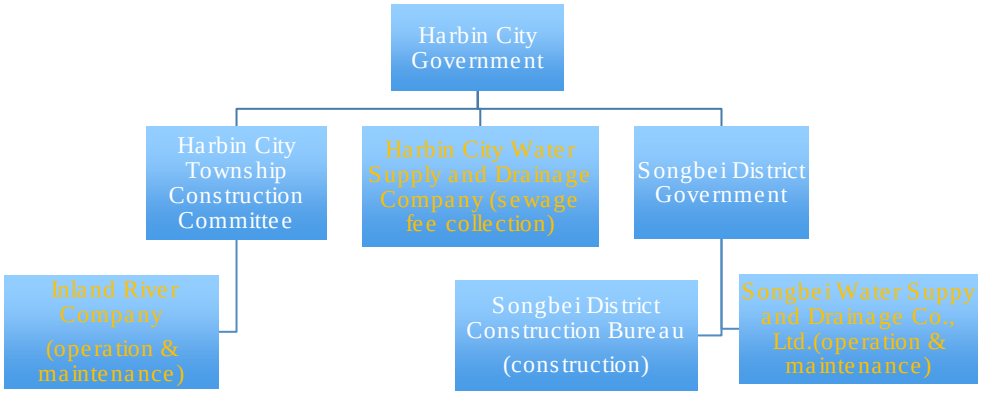
3.5. Sustainability (Rating: ③)

3.5.1. Institutional Aspects of Operation and Maintenance

At the time of the appraisal, with the commission by the city government, the Harbin City Inland River Construction and Development Co., Ltd.[31] (hereafter referred to as the "Inland River Company") was to manage construction of the sewage facilities, construction of the sewage treatment facilities, and maintenance of the sewage pipelines, and was to continue operating and managing the facilities after the completion of the project.

This went in accordance to the plan for the Pingfang sewage treatment plant. For the Songpu sewage treatment plant, since districts were established, the Construction Bureau of the Songbei District became in charge of construction of the Songpu sewage treatment facilities, and operation and maintenance at the time of the test-drive. Thereafter, at the formal operation stage, the responsibilities were transferred to the Songbei Water Supply and Drainage Co., Ltd., which is a state-owned company that was established to handle the operation and maintenance work for the sewage treatment plants.

[31] A state-owned company that handles sewage system projects and public projects related to the water environment (wholly owned by the Harbin City People's Government).



Source: material provided by Harbin City Inland River Construction and Development Co., Ltd
Note) The government agency is white letters, state-owned enterprises by the government is shown in yellow

Figure 2. Operation and maintenance structure at the time of the ex-post evaluation

Both the Inland River Company and the Songbei Water Supply and Drainage Co., Ltd. have defined chains of command and divisions of roles within their organizations. They have stationed the personnel necessary to perform the operation and maintenance of the sewage treatment plants, including administrative and management, engineers for operation and management of the plant facilities, monitoring room operators, patrol, and laboratory technicians. As such, no problems were seen with their operation and management structures. Both the Pingfang and Songpu sewage treatment plants have extremely small numbers of personnel involved in operation and maintenance compared with the numbers at the time of the planning. This is because progress has been made with automation that concentrates control in a central control room by means of installing surveillance cameras and water quality and volume monitoring devices within the plants. A reasonable number of people to carry out operations has been deployed. Thus no problem was found in the institutional aspects of the Project's operation and maintenance.

Table 8 Headcount of Pingfang Sewage Treatment Plant (unit:person)

	Plan (2006)			Actual (2015)				
	Total	Sewage Treatment Plant	Pipes and Pump Stations	Total	Engineers	Management	Administration	Accounting
Pingfang Sewage Treatment Plant	146	83	63	37	25	7	4	1

Source: data provided by Harbin City Inland River Construction and Development Co., Ltd

Table 9 Headcount of Songbei Water Supply and Drainage Co., Ltd. (unit:person)

	Plan (2006)			Actual (2015)				
	Total	Sewage Treatment Plant	Pipes and Pump Stations	Total	Engineers	Management	Administration	Accounting
Songpu Sewage Treatment Plant	100	88	12	35	25	4	5	1

Source: data provided by Harbin City Inland River Construction and Development Co., Ltd

3.5.2. Technical Aspects of Operation and Maintenance

Technical Level for Operation and Maintenance

During the planning, there were concerns about a lack of experience since a newly established company was going to be the project implementation unit. However, this was supplemented for by hiring engineers from university programs with a high level of expertise as well as seasoned engineers who had amassed experience at other treatment plants, and no problems have occurred.

At both the Inland River Company and the Songbei Water Supply and Drainage Co., Ltd. new hires undergo training, and after their hiring all of the employees undergo training several times each year, thus their technical level is maintained.

It was confirmed that both treatment plants carry out their operations, inspect their water quality measurement devices daily, and periodically inspect and overhaul their pumps and other equipment. According to the observation at the field study, manuals and log books for patrols, inspection, and water quality monitoring were equipped at each section. A liaison structure was set in place for when emergencies occur, and response training is carried out. Moreover, training for responding to heavy rains and flooding has been carried out at the Pingfang sewage treatment plant.[32]

Given the above, no problem was found with the technical aspects of operation and maintenance.

3.5.3. Financial Aspects of Operation and Maintenance

The operation and maintenance costs for the sewage treatment plants were paid to them from the Financial Affairs Bureau of the Harbin city as sewer usage fees through the Inland River Company and the Songbei Water Supply and Drainage Co., Ltd. The amount was the actual cost of operation and maintenance that had been established by an audit.

A breakdown of their revenue shows that this primarily comes from sewer usage fees. Since the fee level has been set on the low side[33] the level is not sufficient for operation and maintenance, thus, subsides from the city government is covering the deficit.[34] However the sewage treatment plants are recognized as important infrastructural facilities for the City, and they are operated and maintained by a state-owned company, which is a municipal governmental agency. As such, subsidies from the City have been firmly committed for the operation and maintenance costs.[35] Therefore, situations like the cessation of operations as a result of a lack of funds will not arise. Moreover, improving water quality is a priority in the national development plan, thus budgetary allocations towards sewage treatment have been prioritized. It is expected that the priority will not be changed in the future, thus it is foreseen that any problem will not arise when it comes to securing operation and maintenance costs. The sewer usage fees are inadequate as operation and maintenance costs, but the expectation is that the subsidies from the government will continue. As such, no problems were seen with sustainability in terms of the operation and maintenance costs.

3.5.4. Current Status of Operation and Maintenance

From the field study, it was confirmed that the current status of operation and maintenance at both the Pingfang and Songpu sewage treatment plants is in good shape. Periodic inspections of the sludge treatment facilities have been carried out at Pingfang, and repairs on the underground pipe system have been carried out at the Songpu sewage treatment plant and the pipeline network outside, however both plants were in a condition where they can perform the functions planned through this project. The insides of the plants were meticulously cleaned and kept in order, and they have been fully furnished with manuals and maintenance, inspection, and patrol records. According to the records, responses are promptly carried out when malfunctions with the facilities were discovered, with these including reporting the problems, performing repairs, and replacing parts. Both sewage treatment plants were equipped with generators (that can operate for eight hours) which can operate their intake and drainage pumps in case of blackouts.

[32] The area eligible for treatment by the Songpu sewage treatment plant is not at risk from flooding from heavy rains because it has completely finished with branching its storm sewer pipes.

[33] Since the fee for sewage systems are determined by local governments via public hearings, fees have been kept on the low side. From the beneficiary surveys it was found that this accounts for a share of 0.9% of household budgets on average.

[34] No response was received from the project implementation unit regarding the share of subsidiaries from the City.

[35] Information on the financial resources of the Harbin City government was not provided by the City.

Both treatment plants have developed maintenance plans, and according to the plan upgrading and renovation of the facilities have been conducted. For the equipment that was manufactured in overseas countries such as sludge dewatering centrifuges and the switchboards in the plants, the parts are available at agents nearby, thus no problems have arisen.

At the time of the ex-post evaluation, both treatment plants were at less than 50% of their operation rates. The facilities to reclaim water for the Songpu sewage treatment plant was built in accordance to the plan, but since the construction plan of the industrial park that was slated to reuse the reclaimed water delayed, the facilities were not used at the time of the evaluation. According to the project implementation unit, regardless of the low plant operation rates, maintenance has been carried out at an adequate level to ensure that the treatment plant facilities can immediately accommodate to the demand. According to the City's development plans, the plant operation rates and reused volume for reclaimed water will both rise to the levels expected at the time of the appraisal by 2020.

In light of the above, there are no problems with the project's institutional aspects, technical aspects, financial aspects, or current status of operation and maintenance. Therefore, the sustainability of the project effects is high.

4. Conclusion, Lessons Learned, and Recommendations

4.1. Conclusion

The objective of this project is to improve the sewage treatment capacity in Harbin City by installing sewage facilities there, thereby reducing the pollution load of the water discharged into the river within the City, and improving the living environment for the City's residents.

This project was consistent with China's development policies and development needs at the national, provincial, and city levels at the time of the appraisal and the time of the ex-post evaluation, as well as with Japan's policy for assistance to China at the time of the appraisal. Therefore, its relevance is high.

The Pingfang and Songpu sewage treatment plants of the Project were constructed in accordance with the designed capacities in the plan, and meet targets of the Project and the national standards regarding the quality of the water discharged. Conversely, the volume of sewage inflow fell far below the estimates based on which the capacity was designed, and so the operation rate of the treatment plants has remained down below 50%. What is more, facilities to reclaim water were not used at the Songpu sewage treatment plant. This was due to external factors such as the fact that progress was made with autonomous effort to conduct treatment at factories as a result of revisions to drainage water regulations, and the decline in the intake volume into the sewage treatment plants from this project as a result of delays in the construction for the development plan of the City as a whole. Urban development is advancing, with the expectation that the demand levels calculated in the plan will be realized for both the sewage discharge volume and the demand for reclaimed water by 2020. The volume of sewage generated at the time of the ex-post evaluation was to about 90% of the estimates from the time of the appraisal for Harbin City as a whole. However, both the sewage treatment volume and treatment rate exceeded the project's targets. Moreover, the reduction in the total amount of pollutants discharged into the public water within Harbin City is regarded as a contribution from the project when it comes to improving the water quality in the river within the City. Therefore, the claim can be made that its impact is high and it achieved its effectiveness and impact targets on the whole. While the project period was within what was planned, the project costs marginally exceeded what was planned and thus the efficiency is fair. Regarding the sustainability of the effects generated by this project, there is no major problem in the operating agency's operation and maintenance structure, technical level, and financial conditions. Therefore, the sustainability of the project is high.

In light of the above, this project is evaluated to be highly satisfactory.

4.2. Recommendations for the executing agency

Promote the use of excess sewage treatment capacity

The two sewage treatment plants built through this project were built as planned. However, the operating rates at the time of the ex-post evaluation were significantly below their design capacity. This was primarily caused by the fact that the sewage water taken into the sewage treatment plants had decreased because of the delays in the urban development, and as a result of strengthening regulations, in-house treatment promoted at the plants that served as a major source of sewage.

For the future, sewage volume will increase in conjunction with the advances in urban development, and the facility capacities will be expected to be fully used. On the other hand, the sewage treatment rate at the time of the ex-post evaluation was 90% in the Harbin City as a whole, with some sewage that remains untreated. As a countermeasure for this, the executing agency may take examples from other cities, such as planning the expansion and extensions of the pipeline network as well as optimizing sewage volume between treatment plants in view of the development of the city as a whole. Through such measures the remaining capacity from the two treatment plants from this project may be used.

4.3. Lessons Learned

1) Necessity of appropriate planning and monitoring during the project implementation to take full advantage of the facilities' designed capacity

The sewage treatment volumes and operation rates of the two sewage treatment plants of the project have fallen substantially below the designed capacity. The expectation is that their treatment capacities will be used effectively over the medium to long-term. But on the other hand, there was sewage that was going untreated for the City as a whole at the time of the ex-post evaluation. There could be some leeway to use the underutilized capacity for Harbin City as a whole by promoting the installation of a pipeline network to such sewage treatment plants, or transferring sewage between treatment plants, and so forth.

In Harbin City's case, since it has several state-owned companies that carry out operation and maintenance for sewage treatment plants, the city government must take the lead in coordination for the optimization between plants, and the possibilities can be considered at the time of the project designing, so as to prepare for such situation, as well as any future inspection or repair work for the sewage treatment plants.

JICA must consider ways to use facilities more effectively together with the executing agency when project plans are formulated. In addition, while projects are being implemented, the relevance of the plan must be considered in response to changes in the actual needs through monitoring or mid-term supervision, so as to consider the modification needs such as additional pipelines or adjustment of sewage treatment service districts in accordance to the needs.

2) Consideration on comprehensive approaches in order to boost the project's effects

Progress has been made with regulating the large-scale factories that were a source of pollutants in Harbin City. As a result, the number of companies built in-house waste water treatment facilities, which has facilitated a reduction in the pollutants discharged into the river. These regulations have brought about positive effects regarding the intended Project's impact in improving the water quality of the river and the living environment for the residents. When formulating similar environmental and hygiene improvement projects in other countries, JICA may be suggested to consider comprehensive approaches in parallel on policy recommendations or policy-making; for instance, combining human resource development training for government and environmental division staff within the ODA loan or by technical cooperation, and so to aim higher effects from the projects.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
(1) Project Outputs Pingfaeng Sewage Treatment Plant	CASS Process: 150,000 m^3/day Intercepting Main Lines Approx.64 km	As Planned
Songpu Sewage Treatment Plant	CASS Process: 100,000m^3/day Reclaimed Water 30,000 m^3/day	As planned Cancelled
Sewage Pipeline Network	Pump Station 2 locations Drainage Approx. 67 km Discharge Conduit Approx.6 km Reclaimed Water Network Approx. 25 km	(Constructed by other projects via domestic financing)
Training	3 times total 36 persons	3 times total 35 persons
(2) Project Period	July 2006 – April 2011 (58 months)	As planned
(3) Project Cost Amount paid in Foreign Currency	9,747 million Japanese yen	6,883 million Japanese yen
Amount Paid in Local Currency	3,334 million Japanese yen (139 million Chinese yuan)	6,719 million Japanese yen (460 million Chinese yuan)
Total	14,893 million Japanese yen	13,602 million Japanese yen
ODA loan portion	7,398 million Japanese yen	6,883 million Japanese yen
Exchange Rate	1 Chinese yuan ＝ 13.7 yen (as of September 2005)	1 Chinese yuan ＝14.6yen (actual amount 2006 - 2011)