

People's Republic of China

FY2015 Ex-Post Evaluation of Japanese ODA Loan

“Huhhot Environmental Improvement Project”

External Evaluator: Shima Hayase, IC Net Limited

## **0. Summary**

The objective of this project is to improve the water quality of rivers in Huhhot City in the Inner Mongolia Autonomous Region by increasing the sewage treatment rate through the construction of sewerage facilities.

This project was consistent with China's development policies and development needs at the national, autonomous region, and municipal levels at the time of the appraisal and the ex-post evaluation; Japan's policy for assistance to China at the time of the appraisal. Therefore, its relevance is high. At the time of the ex-post evaluation, expansion and remodeling of the sewage treatment plant were being carried out to keep up with the urban development plan. Because the operation was suspended or reduced during the period, the sewage treatment volume and the treatment rate were lower than the target values. However, it can be judged that effects have arisen because of the following factors: the volume and the rate are likely to recover after the completion of the remodeling construction; indicators for main effects, such as the sewage treatment rate and the quality of the treated water, have almost achieved the targets; and sewerage service has been spreading smoothly. Moreover, at the time of the ex-post evaluation, the effectiveness and impact of this project are high, because this project seems to widely contribute to improvement in the water quality of rivers in Huhhot City, as indicated by a decrease in the total volume of pollutants discharged into water in the City. Although, just after the beginning of this project, the sewerage master plan was revised and cancellation of the construction of the Ruybaita sewage treatment plant and reduction of the tertiary treatment capacity<sup>1</sup> of the Zhanggaiying sewage treatment plant were done. These changes were due to a review of the sewerage construction plan and were in accordance with this project objective of contributing to urban development. While the project cost was lower than planned, a considerable delay was caused in the project period and the efficiency of the project is fair. Regarding the sustainability of the effects that arose by this project, there is no great problem in the maintenance system of operating agency, technology, and finance. Therefore, the sustainability of the project is high.

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

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<sup>1</sup> The process in which organic matters are removed by applying high-level treatment to water discharged from a sewage treatment plant to purify the water for recycling

## 1. Project Description



Project location



Bio-reaction tank in the Gongzhufu sewage treatment plant

### 1.1 Background

Huhhot City, the capital of the Inner Mongolia Autonomous Region, is located in the middle basin of the Yellow River and was developing as an economic, transport, and trade center. In the urban district, industrialization and urbanization rapidly developed and were accompanied by an increase in industrial and domestic sewage. However, the sewage treatment capacity was provided only by an existing sewage treatment plant. As a result, more than half of the sewage discharged from the City flowed into the Xi River and the Xiaohei River, which flow in the City, and the water quality of the rivers<sup>2</sup> worsened below the level usable as agricultural water (inferior class V).

Although Huhhot City set the objective of improving the water quality of rivers in the City to fulfill class V standards and reducing the emissions of Chemical Oxygen Demand (COD) by 10% compared with the emissions in 2000 according to the “10th Five-year Plan (2001 to 2005) for Environmental Protection in Huhhot City,” it was difficult to fulfill these objectives by the deadline, due to a delay in planning and fundraising.

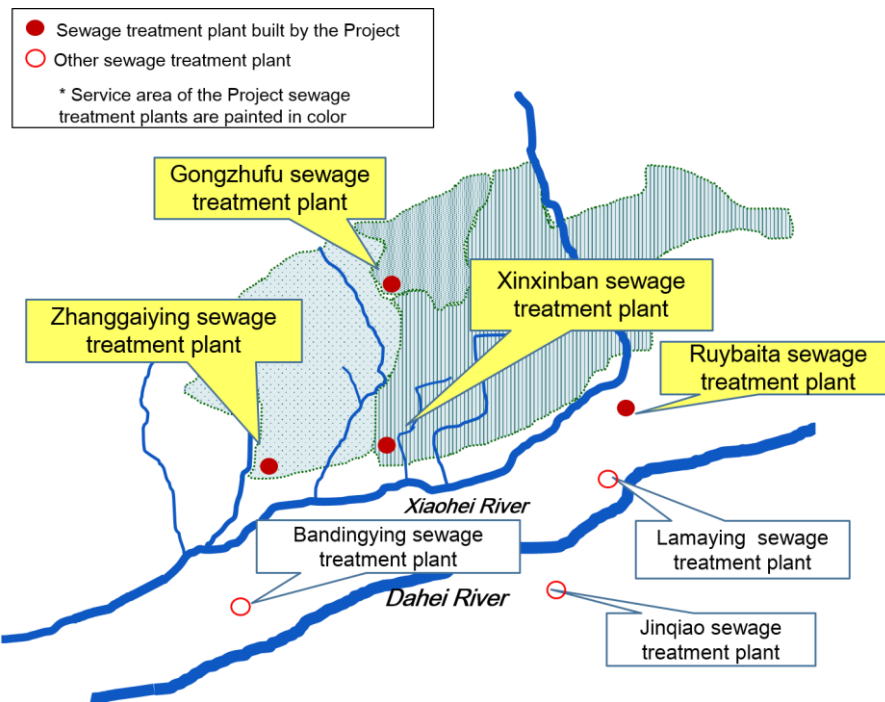
### 1.2 Project Outline

The objective of this project is to improve the water quality of rivers in Huhhot City in the Inner Mongolia Autonomous Region by increasing the sewage treatment rate through the construction of sewerage facilities, thereby contributing to the promotion of sustainable development of the City.

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<sup>2</sup> 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	9,747 million Japanese yen / 8,082 million Japanese yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2004 / March 2004
Terms and Conditions	Interest Rate                      0.75 % Repayment Period                40 years (Grace Period)                    (10 years) Conditions for Procurement:                      General Untied
Borrower / Executing Agency(ies)	The People's Republic of China/ Inner Mongolia Autonomous Region People's Government
Final Disbursement Date	August 2013
Main Contractor (Over 1 billion yen)	None
Main Consultant (Over 100 million Japanese yen)	None
Feasibility Studies, etc.	• F/S (North China Municipal Engineering Design & Research Institute, Inner Mongolia Autonomous Region Water Resource Hydropower Research Institution, Huhhot City Water Bureau (March 2003)
Related Projects	<b>【ODA Loan】</b> • Hohhot Water Supply Project (L/A December 1996) • Hohhot And Baotou Environmental Improvement Project I, II (L/A December 1996, September 1997)



Source: Prepared from materials provided by Huhhot Shouchuang Chunhua Water Development Co., Ltd.  
 Note: The sewage treatment plant at Ruybaita, whose construction had been planned, was not constructed.

Figure 1: Location of rivers and sewage treatment plants in Huhhot 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: August, 2015 – January 2017

Duration of the Field Study:

November 30, 2015 – December 11, 2015

April 9, 2016 – April 14, 2016

### 2.3 Constraints during the Evaluation Study

Although it is said that the construction of sewerage facilities under this project resulted in improvement in the water quality of rivers in the City, it is difficult to directly assess how much this project contributed to improvement in the water quality of rivers in a wide area, for the water quality of the rivers was influenced by many factors other than the construction of the sewerage facilities. Therefore, this ex-post evaluation regards a change in the water quality of all the rivers in the City as impact, and the contribution of this project will be analyzed by qualitatively

confirming the factors for the improvement of the water quality and referring to the reduction in the volume of aquatic pollutants as a result of sewage treatment and its ratio to the pollutants discharged into the water in the whole of Huhhot City.

### **3. Results of the Evaluation (Overall Rating: A<sup>3</sup>)**

#### **3.1 Relevance (Rating:③<sup>4</sup>)**

##### 3.1.1 Relevance to the Development Plan of China

###### (1) Relevance to the Development Plan at the Time of Appraisal

The “10th Five-year Plan of the People’s Republic of China for Economic and Social Development (2001 – 2005),” the national development plan at the time of appraisal, aimed at harmonious economic and social development and placed importance on the improvement of the environment, which had worsened during economic development. The “10th Five-year Environmental Protection Plan (2001 – 2005)” specified the following objectives concerning sewage treatment and water quality improvement: an increase in the sewage treatment rate to 45% in urban areas (60% if the population is 500,000 or more); improvement of water quality in the upper reaches of the Yangzi River, the central reaches of the Yellow River, and the basin of the Songhua River; and a 10% reduction in the total emissions of main pollutants, as compared to 2000.

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

The “12th Five-year Plan of the People’s Republic of China for Economic and Social Development (2011 – 2015),” the development plan at the ex-post evaluation, specified five propriety fields. Regarding “resource-saving and environment-friendly society” among them, the plan set the objective of improving the general level of infrastructures, including sewage treatment facilities. In the “12th Five-year Environmental Protection Plan (2011 – 2015),” which specified national objectives in the environmental field, among the eight environmental protection projects, three projects concerned the improvement of the water environment and the strengthening of construction of sewage treatment infrastructures. The objectives to be achieved included a reduction in the emissions of COD and ammoniacal nitrogen (NH<sub>3</sub>-N), strengthening of construction of sewage pipe networks, division of flow of rainwater and polluted water, an increase in the urban sewage treatment rate, and a reduction in the ratio of water of inferior class V<sup>5</sup> in rivers and lakes.

The “12th Five-year Inner Mongolia Autonomous Region Government Environmental Protection Plan (2011 – 2015),” which was established based on the above-mentioned national

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<sup>3</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>4</sup> ③ High, ② Fair, ① Low

<sup>5</sup> If water does not meet the standards for class V, the water is classified into inferior class V.

policy, specified the following objectives: improvement of the quality of sewage treatment water in basins to improve the water quality of the rivers in the Autonomous Region above inferior class V; and an increase in the sewage treatment rate to 90% and an increase in the purified water use rate to 30% of the sewage volume in the prefecture-level cities<sup>6</sup> including Huhhot City, by 2015.

In this way, the improvement of the water quality of rivers and the strengthening of construction of sewage treatment infrastructures continued to be priority fields for the development plan in the State, the Autonomous Region, and Huhhot City in the period between the appraisal and the ex-post evaluation.

### 3.1.2 Relevance to the Development Needs of China

Although, at the time of the appraisal, the volume of industrial and domestic sewage was increasing due to rapid development in Huhhot City, there was only one sewage treatment plant, and the sewage treatment rate of the City was only 43%.<sup>7</sup> Untreated sewage flowed into rivers in the City, with the result that the water quality of the Xiaohei River, a main river, was not improved from inferior class V. To improve it, Huhhot City drew up the “Sewerage Construction Master Plan (2005 – 2030)” to construct five sewage treatment plants (with a capacity of 600,000 m<sup>3</sup>/day) in the City by 2020. Because it is expected at the time of the ex-post evaluation that the volume of sewage in the City would increase further, the master plan was revised and the construction goal was raised to six sewage treatment plants (with a capacity of 750,000 m<sup>3</sup>/day). In this way, the development needs for strengthening the sewage treatment capacity are still high at the time of the ex-post evaluation, as at the time of the appraisal.

### 3.1.3 Relevance to Japan’s ODA Policy

In the “Medium-Term Strategy for Overseas Economic Cooperation Operations (2002 – 2005),” among the priority fields, such as the strengthening of measures for poverty reduction, infrastructure improvement for economic growth, and support for environmental conservation and pollution prevention, JICA specified the need for constructing sewage treatment facilities as a measure against water pollution for avoiding or reducing the negative environmental impact of infrastructure development.

Moreover, in the “Country Assistance Policy for China” established in 2002, JICA regarded environmental conservation and human resource development mainly in inland areas as priority fields. The construction of sewerage facilities was regarded as the construction of economic and social infrastructures that will serve as a basis for the activities of the private sector. Importance was placed on the construction of sewerage facilities, because they were expected to facilitate

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<sup>6</sup> In China, the administrative districts are divided into the following: province level (province, directly controlled city, autonomous region), prefecture level (prefecture-level cities, autonomous prefectures), county level (county-level cities, city-controlled districts, autonomous county, hoshu), and village level (villages, towns, special districts).

<sup>7</sup> Materials provided by JICA

sustainable development.

This project aims to facilitate the sustainable development of the City by constructing sewage treatment plants and improving the water quality of river branches flowing beyond national borders. It was confirmed that, as described above, this project is relevant to Japan's ODA policy that aims to improve the environment mainly in inland areas and develop infrastructures.

#### 3.1.4 Relevance to Appropriateness of Project Planning and Approach

After this project began, the construction of sewage treatment plants in Bandingying and Lamaying was added to the master plan to strengthen sewage treatment in the southern area of Xiaohei River, where development has been advanced further. This resulted in the cancellation of the construction of the Ruybaita sewage treatment plant and pipe networks, which was planned under this project. As a result, the construction was removed from this project and became China's own project. The service area of the Ruybaita sewage treatment plant was divided into areas under the service of the Jinqiao and Lamaying sewage treatment plants.

Although the executing agency proceeded with the domestic procedure to use the surplus produced due to the cancellation for constructing a new plant, the surplus was not used because the closing date of disbursement for the ODA loan came before completion of the procedure. In addition, regarding the details of the cancellation and the use, there were insufficient liaison and coordination between the project implementation unit<sup>8</sup>/the executing agency and JICA. In materials provided by JICA, it was also pointed out that "coordination by an increase or decrease in funds was not carried out appropriately, and domestic procedures and domestic fundraising were not carried out by the deadline."<sup>9</sup>

Because opportunities for using the surplus more effectively were missed, it can be thought that there was room for improvement. However, because the construction of the Ruybaita sewage treatment plant was cancelled due to a change in the urban planning of Huhhot City, it can be judged that the cancellation is appropriate from the viewpoint of the objective of this project.

In light of the above, this project is fully relevant to the development policies of the Chinese Government, the Inner Mongolia Autonomous Region, and Huhhot City and needs and Japan's ODA policy. Therefore, its relevance is high.

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<sup>8</sup> The agency that manages and maintains the sewage treatment plants constructed by projects under the direction of the Huhhot Municipal People's Government.

<sup>9</sup> To make a change, the executing agency has to file applications with and receive approval from many organizations at multiple levels, such as the City, the autonomous region, the Development and Reform Commission, the Ministry of Finance, and the Ministry of Construction at the national level, and the Export-Import Bank of China. Because official coordination with JICA was not able to be carried out during the approval period, such delay occurred.

## **3.2 Efficiency (Rating: ②)**

### 3.2.1 Project Outputs

#### (1) Planning and Results of Project Outputs

Although the Gongzhufu sewage treatment plant was constructed and the Xinxinban sewage treatment plant was expanded as planned, a revision of the “Sewerage Construction Master Plan” in Huhhot City resulted in the cancellation of the construction of Ruybaita sewage treatment plant and a reduction in the treatment capacity of the tertiary treatment facilities in Zhanggaiying sewage treatment plant.<sup>10</sup>

A network of rainwater pipes was constructed as planned, while the extension of a network of drainage pipes was reduced. This was because the diameter of the pipes was doubled during designing. The sewage treatment capacity has not been changed.

Although training for the actual project executor was provided less frequently than before, the number of participants was almost as planned. Training on environmental monitoring for the staff of the Environment Protection Bureau of Huhhot City was cancelled because the rules on travel for public servant became stricter. However, because substitutive training was held domestically, the purpose of training under this project was achieved.

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<sup>10</sup> Sewage in the Ruybaita treatment region will be treated by the Jinqiao sewage treatment plant (with a capacity of 40,000 m<sup>3</sup>/day), which will be constructed with domestic funds, and the Lamaying sewage treatment plant (with a capacity of 150,000 m<sup>3</sup>/day), which will be constructed by 2020.



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

Plan	Actual
A-1) Gongzhufu sewage treatment plant CAST process <sup>11</sup> Secondary treatment <sup>12</sup> 50,000 m <sup>3</sup> /day Tertiary treatment 30,000 m <sup>3</sup> /day	A-1), A-2) As Planned
A-2) Sewage pipe network Φ300~Φ800 mm approximately 30 km	
B-1) Xinxinban sewage treatment plant Activated Sludge process Secondary Treatment 50,000 m <sup>3</sup> /day	B-1), B-2), B-3) As planned
B-2) Sewage pipe network Φ300~Φ900 mm approximately 86km	
B-3) Sewage pipe network Φ300~Φ700 mm approximately 36 km	
C-1) Ruybaita sewage treatment plant CAST process Secondary treatment 40,000 m <sup>3</sup> /day	C-1) C-2) Canceled
C-2) Sewage pipe network Φ300~Φ900 mm approximately 40 km	
D-1) Zhanggaiying sewage treatment plant. Activated Sludge process Secondary treatment 60,000 m <sup>3</sup> /day Tertiary treatment 50,000 m <sup>3</sup> /day	D-1) Secondary treatment as planned Tertiary treatment changed to 30,000 m <sup>3</sup> /day
D-2) Sewage pipe network Φ300~Φ1600 mm approximately 85 km, Pump station 1 location	D-2) As planned.
E-1) Storm water pipeline (water drainage) approximately 128 km	E-1) Reduced to approximately 80 km
E-2) Storm water pipeline (water distribution) approximately 24 km	E-2) As planned
F-1) Training for the staff of Project Implementation Unit 1) October 2004 (8 days) 8 persons 2) January 2005 (6 days) 6 persons 3) September 2005 (6 days) 6 persons Total 20 persons	F-1) 1) January 2007 (12 days) 10 persons 2) April 2007 (10 days) 9 persons  Total 19 persons
F-2) Training for the staff of the Environment Protection Bureau 1) October 2004 (8 days) 8 persons 2) January 2005 (6 days) 6 persons 3) September 2005 (6 days) 6 persons Total 20 persons	F-2) 1), 2), 3) All canceled

Source: Huhhot Shouchuang Chunhua Water Development Co., Ltd.

<sup>11</sup> Cyclic Activated Sludge Technology: an activated sludge process whereby butch treatment is applied; generally, space-saving.

<sup>12</sup> Among the processes at a sewage treatment plant, the process of removing refuse and other solid matters through filters around the water inlet, or remove solid matters by precipitation in the precipitation ponds prior to biological treatment is called "primary treatment (physical treatment)." The process of removing organic matters by the use of microbes is "secondary treatment (biological treatment)." The process of removing the pollutants that cannot be removed by the former processes after the secondary treatment is called "tertiary treatment (high-level treatment)." The water processed by the tertiary treatment is reused as recycled water.

### 3.2.2 Project Inputs

#### 3.2.2.1 Project Cost

At the time of the appraisal, the project cost was estimated to be 13,081 million Japanese yen (9,747 million Japanese yen in foreign currency; 3,334 million Japanese yen in domestic currency). After the cancellation of the Ruybaita sewage treatment plant<sup>13</sup> (1,611 million Japanese yen) and the training for the staff of the Environment Protection Bureau (15 million Japanese yen), the project cost was estimated to be 11,455 million Japanese yen. The actual cost was 11,105 million Japanese yen (8,074 million Japanese yen in foreign currency; 3,031 million Japanese yen in domestic currency), 97% of the planned cost.

#### 3.2.2.2 Project Period

At the time of the appraisal, the project implementation period was scheduled from April 2004 to December 2008 (57 months). Actually, it was from April 2004 to December 2011 (93 months), 163% of the planned period, thus the project period was significantly longer than planned. The main reason was a delay in the establishment of a network of rainwater pipes. Because the City reviewed the development plan around the time of the bidding, it was necessary to change the construction schedule. In addition, because, during the construction, there was a delay in road works in the area where the network of rainwater pipes was planned to be established, a delay was inevitable.

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

The financial internal rate of return (FIRR) was recalculated with the actual costs and benefits by the executing agency.<sup>14</sup> Although it was 3.80% at the time of the appraisal, it was -3.48% at the time of ex-post evaluation. This was because, compared with the plan at the time of the appraisal, the volume of treated sewage was smaller at the time of the ex-post evaluation, and the sewage treatment revenue gained according to the volume was estimated to be lower than planned.

Table 2: Comparison of FIRR at Appraisal and the Actual Results

Plan at Appraisal (2004)	Actual (2015)
Prerequisite	Prerequisite
<ul style="list-style-type: none"> <li>• Cost : Construction, Operation and Maintenance , Business Tax</li> <li>• Benefit: Sewage Treatment fee revenue, Sales of recycled water (power plant)</li> <li>• Project Life :35 years</li> </ul>	<ul style="list-style-type: none"> <li>• Cost : Construction, Operation and Maintenance , Business Tax</li> <li>• Benefit: Sewage Treatment fee revenue, Sales of recycled water (power plant)</li> <li>• Project Life :35 years</li> </ul>

Source: the evaluator calculated according to the data provided by Huhhot Shouchuang Chunhua Water Development Co., Ltd.

<sup>13</sup> At the time of the appraisal, the cost of constructing Ruybaita sewage treatment plant was estimated to be 1,729 million Japanese yen. Because 118 million Japanese yen was used for designing, the cost remaining due to the cancellation was 1,611 million Japanese yen.

<sup>14</sup> Although each sewage treatment plant's FIRR was estimated at the time of appraisal, each plant's actual FIRR cannot be calculated because the parent company is collectively managing all the plants. The estimated FIRR will be revised as the three plants' FIRR, which then will be compared with the result.

In light of the above, although the project cost is lower than planned, the efficiency is fair because the project period is far longer than planned.

### **3.3 Effectiveness<sup>15</sup> (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 rate in Huhhot City; and improvement in the quality of treated water. To improve the sewage treatment rate, targets were set for the rate, the sewerage population, and the percentage of sewerage population.<sup>16</sup> According to the project implementation unit, however, because the sewage treatment regions are not in accordance with the local government's demarcation, and the region covered by the treatment plants are frequently changed, it is impossible to collect accurate data about the population covered by the treatment plants and the sewerage population.<sup>17</sup> Alternatively, for Huhhot City, the sewerage population is estimated from the volume of treated sewage, while the percentage of sewerage population is estimated by comparison with the population estimated from the volume of discharged water. Regarding each of the sewage treatment plants, because, due to the above-described reason, it is impossible to acquire accurate data on the volume of discharged sewage in the treatment regions, which serves as the denominator for the calculation of the sewage treatment rate, the operation rate to the designed capacity, the area covered by sewage treatment service, and the total length of the network of pipes are used for checking the state of spread of sewerage. Improvement in the quality of treated water is checked by the concentration of pollutants included in water discharged from each of the treatment plants.

#### **(1) Operation Indicators**

1) The Sewage Treatment Volume and the Rate, the Sewerage Population, and the Percentage of Sewerage Population in Huhhot City.

According to the plan at the time of the appraisal, it was estimated that volume of sewage would be discharged at 334,000 m<sup>3</sup>/day in the whole of Huhhot City. The project target was set to treat 294,000 m<sup>3</sup>/day, which is equal to 88% of the volume one year after project completion (2010<sup>18</sup>.) In reality, the volume of discharged sewage in the whole city one year after project completion (2012<sup>19</sup>) was 267,000 m<sup>3</sup>/day, about 80% of the expected volume. The volume of sewage flowing

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<sup>15</sup> Sub-rating for Effectiveness is to be put with consideration of Impact.

<sup>16</sup> The percentage of sewerage population is calculated by dividing the population connected with sewerage pipes in the treatment region by the total population in the treatment region.

<sup>17</sup> The revised Sewerage Master Plan (2010 – 2020) forecasted the population in the whole City. Regarding forecasts for each treatment plant, demand for water supply and demand for sewage treatment were calculated from areas of houses, companies, and public facilities.

<sup>18</sup> The target year set at the time of the appraisal was 2010, one year after project completion in December 2008.

<sup>19</sup> The project completion year was 2012, which is one year after the completion of the rainwater pipes in December 2011.

into the sewage treatment plants was lower than expected. However, the actual treatment volume was 82% of the target, and the ratio of treated sewage was 90% to the sewage volume, which was higher than the target. Therefore, it can be said that effects generally arose. When the ex-post evaluation was conducted in 2015, the volume of sewage treatment decreased and the treatment rate was 73%. This was because the three treatment plants covered by this project were remodeled to add facilities or strengthen for treatment capacity in 2015 and the plants suspended the operations and reduced the treatment volume during the remodeling. Both the treatment volume and the treatment rate are expected to recover to the target levels when the remodeling is completed in 2016.

Table 3: Target and the Actual Results of the Sewage Treatment Volume and the Rate

Year	Baseline	Target	Actual						
		1 year after Completion	Implementation		Completion	1year	2years	3years	4years
	2002	2010	2009	2010	2011	2012	2013	2014	2015
Volume of Sewage Water in Huhhot City (10,000 m <sup>3</sup> /day)	23.0	33.4	23.9	24.7	25.4	26.7	27.9	29.7	30.6
Sewage Treatment Volume in Huhhot City (10,000 m <sup>3</sup> /day)	10.0	29.4*	15.1	19.0	22.6	24.0	24.0	25.8	22.4
Sewage Treatment Rate of Huhhot City	43.5%	88%	63%	77%	89%	90%	86%	87%	73%

Source: Baseline data and target value on materials submitted by JICA, actual data in Huhhot City Statistical Yearbook.

\* The target volume of sewage treatment in Huhhot City is the total volume in the four treatment plants, including the cancelled Ruybaita plant.

Note: The values enclosed by bold lines are the actual values one year after the completion.

According to the plan at the time of the appraisal, the population in the sewage treatment region in Huhhot City one year after project completion was estimated to be 1.4 million and the target percentage of the sewered population was set at 100%. According to estimation,<sup>20</sup> the population in the sewage treatment region exceeded the target population of 1.4 million in 2011. One year after project completion (2012) the sewered population reached to 1.5 million, and exceeded the target. However, the percentage of sewered population was 90% due to an increase in the population in the region.

<sup>20</sup> Because the Gongzhufu and Zhanggaiying sewage treatment plants were completed in October 2009 and the Xinxinban plant was completed in December 2010, the sewered population and the percentage of sewered population may be overestimated compared with the target values set at the time of the appraisal.

Table 4: Population in Sewage Treatment Region: Sewered Population and the Percentage of Sewered Population<sup>21</sup>

(unit: 10,000)

Year	baseline	target	Actual						
		1 year after Completion	Implementation		Completion	1year	2years	3years	4years
	2002	2010	2009	2010	2011	2012	2013	2014	2015
Population in the Sewered Region in Huhhot City	115	140	166	171	159	167	174	185	191
Sewered Population in Huhhot City	52	140	105	132	141	150	150	161	140
Percentage of Sewered Population* (%)	45%	100%	63%	77%	89%	90%	86%	87%	73%

Sources: baseline and target values are based on materials submitted by JICA. The population of Huhhot City is based on data in Huhhot City Statistical Yearbook. The sewered population was estimated from the volume of treated sewage.

\* The percentage of sewered population is the ratio of population connected with sewage pipes in the sewage treatment system to the total population in the treatment region.

2) The Treatment Volume and the Rate of the Sewage Treatment, and the Plant Operation Rate<sup>22</sup> of the Plants Constructed under the Project,

#### Gongzhufu Sewage Treatment Plant

According to the plan at the time of the appraisal, volume of waste water in the service region was estimated as 44,000 m<sup>3</sup>/day, 88% of the designed volume of 50,000 m<sup>3</sup>/day. The target was set to treat 100% of the volume. In 2010, one year after the completion, both the volume of waste water<sup>23</sup> and the volume of treatment were 35,000 m<sup>3</sup>/day, 80% of the target, and the operation rate was 69%. This was because companies in the service areas began treatment of sewage to recycle water in their factories and, as a result, the volume of waste water flowing into the treatment plants was lower than estimated. This was a favorable change for the impact of this project.

<sup>21</sup> The population in the sewage treatment region and the sewered population were estimated by the use of 144 liters/day from 2006 to 2010 and 160 liters/day from 2011 to 2020 (the volume of water used per person in the Sewerage Master Plan at the time of the planning (180 liters/day from 2006 to 2010; 200 liters/day in 2020) multiplied by the polluted water conversion coefficient).

<sup>22</sup> Because the plant operation rate (how much each plant is used in comparison with capacity) was not used as an operation and effect indicator at the time of the appraisal, it is calculated as a reference for this ex-post evaluation.

<sup>23</sup> At the time of the appraisal, the volume of sewage was defined as the volume of sewage generated within the treatment area of each treatment plant. However, because the network of sewage collection pipes in Huhhot City can switch the points of connection to the treatment plants to change the treatment plant into which sewage flows, it is impossible to limit treatment region. Therefore, the volume of sewage generated within a treatment area cannot be assessed and the actual volume of sewage is the volume of sewage flowing into each treatment plant.

### Xinxinban Sewage Treatment Plant

At the time of the appraisal, the target volume of treatment one year after project completion was 180,000 m<sup>3</sup>/day and the target volume of treatment was 150,000 m<sup>3</sup>/day, 83.3% of the waste water. In reality, the volume of treatment was almost as planned and the operation rate was 99% of the designed capacity (150,000 m<sup>3</sup>/day).

### Zhanggaiying Sewage Treatment Plant

At the time of the appraisal, the target volume of treatment one year after the project completion was 90% of the waste water flow of 66,900 m<sup>3</sup>/day. The actual volume of treatment was 57,000 m<sup>3</sup>/day, 95% of the plan. The plant operation rate was 95% of the designed capacity (60,000 m<sup>3</sup>/day).

Table 5: Waste Water Treatment Volume, Facility Utilization Rate of the 3 Treatment Plants

Year	Baseline	Target	Actual						
		1 year after completion	2009	2010	2011	2012	2013	2014	2015
	2002	2010							
Gongzhufu Sewage Treatment Plant (one year after completion:2010)									
Waste Water Treatment Volume (10,000 m <sup>3</sup> /day)	0	4.4	2.3	3.5	3.3	3.4	3.4	3.2	1.3
Facility utilization rate	—	88%	46%	69%	67%	68%	67%	63%	25%
Xinxinban Sewage Treatment Plant (one year after completion:2012)									
Waste Water Treatment (10,000 m <sup>3</sup> /day)	10.0	15.0	9.2	9.9	13.5	14.8	14.8	13.8	12.3
Facility Utilization Rate	—	100%	62%	66%	90%	99%	98%	92%	90%
Zhanggaiying Sewage Treatment Plant (one year after completion:2010)									
Waste Water Treatment (10,000 m <sup>3</sup> /day)	0	6	3.6	5.7	5.8	5.8	5.8	5.3	5.0
Facility Utilization Rate	—	100%	60%	95%	97%	97%	97%	88%	84%

Source: material provided by Huhhot Shouchuang Chunhua Water Development Co., Ltd.

### 2) State of Spread of Sewage Treatment Service

Regarding the area of development in the sewage treatment regions and the length of the network of pipes as substitutes for the indicator on percentage of sewered population, both the target area and the target length were achieved 100% one year after the completion in the service areas of the Gongzhufu and Zhanggaiying sewage treatment plants. They almost achieved 100% one year after the completion in the service area of the Xinxinban plant. Because the Xinxinban plant undertook the treatment of sewage generated in the service areas of other plants in 2012 and

2013, the length of the network of pipes has become 108% of the planned length in the service area of the Xinxinban plant.<sup>24</sup>



Inlet filter of the Zhanggaiying



Settling pond in the Xinxinban

## (2) Effect Indicators

At the time of the appraisal, as an indicator for sewage treatment's effect of water quality improvement, target values were set for the biochemical oxygen demand (BOD), suspended solids (SS), and  $\text{NH}_3\text{-N}$  concentration of discharged water. One year after the completion, the three sewage treatment plants achieved the target values. Since then, the Xinxinban and Zhanggaiying plants have maintained this effect. Although the Gongzhufu plant (Table 6) achieved the target value of  $\text{NH}_3\text{-N}$  in 2010, the effects were not maintained after that. According to the project implementation unit, the value of  $\text{NH}_3\text{-N}$  at the inlet was 20% to 50% higher than estimated because untreated wastewater flowed from neighboring factories.<sup>25</sup> Because the reduction rate exceeded the target and met the secondary-class national standards, the effect indicators are judged to be almost fulfilled.

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<sup>24</sup> In 2014, because the Jinqiao sewage treatment plant began to operate, the Xinxinban plant ceased to undertake the treatment of sewage generated in service areas of other plants and, as a result, the length of the network of pipes returned to 100% of the total length in its own service area.

<sup>25</sup> Large companies and factories designated as important pollutant sources are required to remove pollutants at their own sewage treatment plants under strict emission control. According to the actual project executor, however, it cannot be said that all companies are under the strict emission control, and some companies elude monitoring and discharge pollutants into sewage or rivers.

Table 6: NH<sub>3</sub>-N Treatment in Gongzhufu Sewage Treatment Plant

Year		Target <sup>26</sup>	Actual					
		(2010)	2009	2010	2011	2012	2013	2014
NH <sub>3</sub> -N (mg/l)	Inlet	30	38.5	36.8	46.3	41.7	36.6	39.8
	Outlet	15 (30)*	14.2	13.3	20.2	15.4	17.2	17.4
	Reduct Ion Rate	50%	63%	64%	56%	63%	53%	56%

Source: material provided by Huhhot Shouchuang Chunhua Water Development Co., Ltd.

\* Because target values are different from the national government's discharge standards, both target values and national standards are written in the table. National standards are written in parentheses.

Although target values were not set at the time of the appraisal, sewage treatment is required to meet the secondary-class national standards<sup>27</sup> concerning not only the above-mentioned three substances but also discharged water's COD concentration, total nitrogen (T-N) concentration, total phosphorous (T-P) concentration, and hydrogen ion concentration (pH). The three treatment plants were able to meet the national standards for the concentration of any substance. In addition, as a result of this project, the quality of water treated at the Gongzhufu and Zhanggaiying sewage treatment plants, where tertiary treatment facilities were constructed, meet the target values of all the substances designated at the time of the appraisal and the national standards for other substances.

In light of the above, Huhhot City has almost fulfilled the targets for the sewage treatment volume and the sewage treatment rate. The treatment volume in the target year (one year after the completion) was 80% at the Gongzhufu plant, which had been influenced by a decrease in the inflow volume, 99% at the Xinxinban plant, and 95% at the Zhanggaiying plant. Additionally, due to the reason that sewage treatment service has been spreading and the effect indicators have been almost fulfilled, it can be judged that quantitative effects have arisen in the project as a whole.

### 3.3.2 Qualitative Effects (Other Effects)

At the time of the appraisal, it was assumed that qualitative effects were "improvement of water pollution in the Xi River, the Xiaohei River, and other rivers by the establishment of a network of sewage pipes" and "reuse of water after sewage treatment." Regarding the improvement of water pollution, "improvement of the water quality of the rivers in the City," the impact level of this project is applied and integrated into "3.4 Impact" below.

<sup>26</sup> According to the actual project executor, although the Gongzhufu sewage treatment plant was under the regulation of the national standard of the secondary class, however the target values were set higher than the standards at the time of the appraisal because the plant adopted the latest CASS method.

<sup>27</sup> Discharge Standards of Pollutants for Municipal Waste Water Treatment Plants (GB18918-2002)



### (1) Reuse of Water after Sewage Treatment

At the time of the appraisal, at the Gongzhufu and Zhanggaiying sewage treatment plants, where tertiary treatment facilities were planned to be constructed under this project, reclaimed water was planned to be used as cooling water at power plants (30,000 m<sup>3</sup>/day) and as scenic water<sup>28</sup> in parks and the like (50,000 m<sup>3</sup>/day).

At the time of the ex-post evaluation, the volume of water used and the recycling rate were lower than the target values, except for the Gongzhufu plant, which achieved the target recycling volume in 2012. At the Zhanggaiying plant, the annual recycling rate was 7% to 12%, considerably lower than the target, and tertiary treatment was not carried out in 2014 and 2015.

The water recycling rate was lower than planned because the tertiary treatment facilities are operated according to the volume of demand for reclaimed water. Demand for reclaimed water was lower than expected because of the following reasons: there was a delay in the construction of power plants to which water was to be supplied; large factories planning to use reclaimed water constructed sewage treatment plants within them to recycle water themselves; and scenic water was used only in the winter season.

The revised “Huhhot City Sewerage Master Plan (2010 – 2020)” specified the policy to increase the volume of use of reclaimed water to 390,000 m<sup>3</sup>/day by 2020 through the expansion of use of reclaimed water to industrial purposes, road cleaning, and car washing. In addition, demand for reclaimed water is expected to increase at the Gongzhufu and Zhanggaiying plants. Therefore, it is judged that effects will arise.

### (2) Effect of Training

According to the participants for the training in Japan for the officers in charge of the operation and maintenance of the sewage treatment plants, as an effect of the training, the method of operating and maintaining treatment plants in Japan, odor control, and tidying-up in the plants were added to the design and the operation. In addition, for the purpose of environmental education, preparations have been made to adopt what is carried out in treatment plants in Japan, such as the acceptance of field trips and the cultivation of flowers. On the other hand, two engineers working at the treatment plants answered that because sewage treatment systems in Japan were old-fashioned, they did not serve as a reference concerning the new type of treatment technology adopted in this project.

In light of the above, the targets for the following were almost achieved: the sewage treatment rate, the sewered population, and the percentage of sewered population in Huhhot City; the operation indicators, such as the operation rate, of each treatment plant area of facilities, and length

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<sup>28</sup> Collective name for water used for watering plants in parks and maintaining landscapes by pouring water into rivers in the dry season in China.

of the network of pipes; and the quality of discharged water as an effect indicator. Therefore, it can be said that the effects of this project have arisen. Although the target recycling rate of water, which was set as a qualitative effect, has not been achieved due to a decrease in demand, demand for reclaimed water is likely to increase. Therefore, good effects have arisen as a whole.

### **3.4 Impacts**

#### **3.4.1 Intended Impacts**

The impacts of this project are “improvement in the water quality of the rivers in the City” and “sustainable development of the City.” 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 beginning of sewage treatment service, and the state of emergence of project effects was checked.

#### **(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 information published by the Inner Mongolia Autonomous Region Environmental Protection Bureau, the water quality of the Xiaohei River improved from inferior class V at the time of appraisal to class V in 2011. The water quality of the Dahei River (the main river of the Xiaohei River) was also improved from inferior class V at the time of appraisal to class V in 2010 and has maintained that level. However, because the change was caused by many other factors in addition to this project, it is difficult to find a direct causal relationship with this project. The factors contributing to the improvement include not only sewage treatment but also the installation of sewage pipes and rainwater pipes. This project installed 35% of the sewage pipes and 20% of the rainwater pipes in the whole Huhhot City. According to the project implementation unit, the promotion of construction of rainwater pipes has produced the effect of reducing flood damage in the rainy season. The “12th Five-year Environmental Protection Plan in Huhhot City (2010 – 2015)” focused on dye factories and other companies to reduce pollutant discharge, obliged factories to treat sewage within themselves, and imposed the objective of reducing pollutants. The degree of achievement is monitored by the Environmental Protection Bureau. If a company fails to achieve the objective, penalty or shutdown will be imposed on the company. Such strict management of discharged water is also one of the factors contributing to the improvement of the water quality of the rivers.

## 2) Monitoring Data at Points of Observation

At the time of the appraisal, observation points were designated to monitor water discharge from the sewage treatment plants constructed by this project. However, because data on results were not available,<sup>29</sup> 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.



Water treated at the Gongzhufu sewage treatment plant and discharged to a branch of the Xiaohei River

The wastewater discharge points of the Gongzhufu and Xinxinban sewage treatment plants were located in residential areas where shores were protected by concrete and the networks of sewage pipes were established. The rivers did not emit an odor and water appeared to be transparent. On the other hand, the wastewater discharge point of the Zhanggaiying sewage treatment plant was located in a rural area. The river emitted an odor and the water appeared to be muddy. In this area, because a network of sewage pipes were under construction, domestic wastewater seems to be discharged without treatment. According to the project implementation unit, the effects of discharge of treated water include reducing muddiness and odor through the dilution of river pollutants and easing the problem of river water shortage in the dry season.



Treated water discharged from the Xinxinban sewage treatment plant into the Xiaohei River



Treated water discharged from the Zhanggaiying sewage treatment plant into a branch of the Xiaohei River

## 3) State of Reduction in Pollutants by the Project

By comparing the total volume of pollutants (COD, NH<sub>3</sub>-N) discharged into sewage in the whole of Huhhot City with the volume of pollutants reduced by this project, it is possible to analyze how much this project contributes to improvement in the water quality of the rivers in

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<sup>29</sup> The Environmental Protection Bureau of Huhhot City has established observation points to monitor the water quality of the rivers. Although data on the sections of the rivers are collected at the points every day, no data were disclosed.

Huhhot City. The ratio of pollutants reduced by this project to the annual total volume is 1.6 to 8% in the case of COD and 2.7 to 3.6% in the case of NH<sub>3</sub>-N. Given the size of inputs into Huhhot City, where various projects are carried out to improve the water environment, this project has considerably contributed to the reduction of pollutants in the whole city.

## (2) Beneficiary Survey

Regarding “improvement in the water quality of the rivers” and “sustainable development of the City,” a beneficiary survey on residents<sup>30</sup> (60 samples) and a corporate survey<sup>31</sup> (20 samples) were conducted to study changes in the river environment, the environments for living and corporate activities before the project (2005) and at the time of the ex-post evaluation, and the degree of satisfaction with sewage treatment service.

### 1) Beneficiary Survey

According to the results of the beneficiary survey, more than 85% of the respondents recognized improvement in the water quality of the rivers, the river environment, and the living environment, which indicates that sewage treatment made some contribution. On the other hand, although more than 60% are satisfied with sewage treatment service, about 40% answered “If anything, unsatisfactory.” This is mainly because of provision of information on services, customer service, and phone response. However, more than 10% of the respondents pointed out a delay in the spread of sewage facilities. It can be said that beneficiaries are expecting wider sewage treatment services.

### 2) Corporate Survey

According to the results of the corporate survey, more than 80% of the companies answered that improvement was shown in drainage, clogged pipes, odor, and the hygiene environment. However, 35% of the respondents thought that there is no change in flooding around the companies because of heavy rain in the rainy season. This seems because the installation of rainwater pipes in the City is incomplete and drainage ditches are clogged due to refuse dumping and insufficient maintenance.

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<sup>30</sup> The beneficiary survey was conducted door-to-door and covered 60 local residents (20 for each sewage treatment plant) who have houses near rivers and around the three plants that began to provide sewage treatment service under this project. Of the respondents, 58% were men and 42% were women. By age group, 25% were between 20 and 29, 27% were between 30 and 39, 18% were between 40 and 49, 13% were between 50 and 59, 13% were between 60 and 69, and 4% were 70 years old and over.

<sup>31</sup> The corporate survey covered 20 companies around the sewage treatment plants (8 companies around the Zhanggaiying plant; 4 companies around the Xinxinban plant; 4 companies around the Gongzhufu plant). The 20 companies consisted of 10 service providers, 5 manufacturers, 3 constructors, 1 company engaged in agriculture, forestry, or fisheries, and 1 company engaged in medical care.

### 3.4.2 Other impacts

#### (1) Impacts on the Natural Environment<sup>32</sup>

##### 1) Monitoring during Project Execution

At the time of the appraisal, no negative impact on the natural environment was assumed. During the construction of the sewage treatment plants under this project, as planned at the time of the appraisal, the observation unit of the Environmental Protection Bureau' conducted unannounced inspections in construction sites to check the state of exhaust, fine particles, noise, vibration, waste, and drainage and reported the results to the Environmental Monitoring Center. The record was reported quarterly to the Environmental Protection Bureau of Huhhot City. According to the results of interviews with the project implementation unit, the construction was in accordance with the environmental protection standards and there was no special problem during the construction.

According to the beneficiary survey conducted to the residents mentioned above, 70 to 80% answered "did not mind at all / did not mind much" to the environmental impacts under monitoring during the project implementation, such as exhaust, waste, drainage, vibration and noise. Regarding the fine particles, 63% answered "did not mind at all / did not mind much." To all the categories a few answered "mind very much/ mind a little", however Inner Mongolia Autonomous Region is the area, where is influenced by yellow sand storms, also the City was developing rapidly with construction of residences and the number of cars was increasing, it is difficult to extract the environmental impact purely by the project and evaluate its impact separately from other causes.

##### 2) Monitoring after Project Completion

The completed three sewage treatment plants monitor the concentration of pollutants (COD, BOD, SS, T-N, T-P, pH, etc.) in the water for 24 hours by monitors installed at the sewage inlets and outlets. The monitors are managed by a third-party organization specialized in environmental monitoring. The monitoring data are 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.

In order to remove odor, the Gongzhufu sewage treatment plant carries out ion deodorization, while the Xinxinban plant carries out bio-deodorization. The Zhanggaiying plant does not apply these deodorization devices as the other plants did, because it is located in an industrial zone apart from residential zones.

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<sup>32</sup> The survey report on the environmental impacts of this project was approved by the Environmental Protection Bureau of the Inner Mongolia Autonomous Region in July 2003.

Sludge generated in each of the sewage treatment plants is dehydrated to a moisture content of about 80%, is conveyed to suburban waste treatment facilities by trucks, is further dehydrated by heat to a moisture content of 30 to 40%, and is burnt by a refuse incinerator together with household refuse. After being burnt, refuse is buried. At the time of the ex-post evaluation, sludge recycling facilities are under construction in Huhhot City. From 2017 onwards, when the facilities are completed, the sludge disposal method in each sewage treatment plant is likely to change from burying to recycling.

### 3) Monitoring of the Rivers in the City

Although the Environmental Protection Bureau of Huhhot City is monitoring the water quality of the rivers in the City, data are unavailable because concrete data on the method and the water quality are not open to the public.

### (2) Land Acquisition and Resettlement

At the time of the appraisal, it was planned that sites with a total area of 56 ha would be acquired for the four sewage treatment plants. In reality, sites with a total area of 23 ha were acquired, due to the cancellation of the construction of the Ruybaita plant and fine adjustment of a site for additional construction of the Xinxinban plant. Because sites are vacant lots where it used to be factories or undeveloped wasteland, there was no resettlement.

### (3) Other Impacts

None in particular.

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

## **3.5 Sustainability (Rating:③)**

### 3.5.1 Institutional Aspects of Operation and Maintenance

As planned at the time of the appraisal, the ODA Loan Office was established in the Office of Foreign Affairs, the Department of Finance, Inner Mongolia Autonomous Region. The ODA Loan Office took charge of liaison and coordination with related agencies, domestic fundraising, and repayment of loans.

At the time of the ex-post evaluation, such offices at the autonomous region level has changed its name to public investment offices, and has expanded the jurisdiction over projects with domestic and foreign loans. Because main officers in charge of this project have not been replaced since the appraisal and have continued to be in charge of liaison and coordination and supervise subordinate organizations, such as the project implementation unit, there is no significant change

in the substantial operation of this project.

At the time of the appraisal, it was planned that the Huhhot Chunhua Water Development Co., Ltd.<sup>33</sup>(hereinafter referred to as “Chunhua Co.”) would take charge of the construction and remodeling of the sewage treatment plants and their operation and management. However, the Huhhot Shouchuang Chunhua Water Development Co., Ltd. (hereinafter referred to as “Shouchuang Chunhua Co.”) was established as its subsidiary, and these duties were transferred to the subsidiary in December 2008. The staff members for the operation and maintenance were transferred from Chunhua Co. to the subsidiary.

The sewage treatment plants are actually operated by the Production Management Department of Shouchuang Chunhua Co. Table 7 shows the number of staff in each plant. According to Shouchuang Chunhua Co., staff in charge of clerical work and management are stationed in each plant, and the sufficient number of the staff necessary for the operation of the plant is placed, including the engineers engaged in the operation and maintenance of the plant, the manager of the monitoring room, the patrol staff, and the engineers engaged in water quality inspection.

Table 7: Headcount of Each Sewage Treatment Plants Production Management Department

(unit:person)

	<b>Total</b>	Operation	Management	Administration
Gongzhufu Sewage Treatment Plant	<b>31</b>	26	2	3
Xinxinban Sewage Treatment Plant	<b>41</b>	36	2	3
Zhanggaiying Sewage Treatment Plant	<b>27</b>	21	2	4

Source: data provided by Huhhot Shouchuang Chunhua Water Development Co., Ltd.

To sum up, no problem has been observed in the operating and maintaining institutional systems during and after the project execution.

### 3.5.2 Technical Aspects of Operation and Maintenance

#### Technical Level of Operation and Maintenance

The engineers transfer techniques to each other within Shouchuang Chunhua Co., which is in charge of operation and maintenance. Every year, seven to eight types of training are held for engineers and other employees. The company also holds training to respond to emergencies. It appropriately prepares manuals, records management logs, and keeps inventory of parts, etc. and, in each fiscal year, draws up and implements a business plan. The electric and laboratory engineers need to acquire qualifications as technicians. Because there is a term of validity for the licenses and renewal requires undergoing training and examination, the technical level has been maintained. In light of the above, no problem has been observed in the technical aspects of

<sup>33</sup> Chunhua Co. is a company totally owned by Huhhot City Government and constructs, operates, and maintains waterworks, sewer, river improvement works, etc. Because it has several subsidiaries engaged in the development of the water environment, the name was changed to the Huhhot Chunhua Water Development Co., Ltd. There is no change in the type of business and the state of investments.

operation and maintenance.

### 3.5.3 Financial Aspects of Operation and Maintenance

Because 2009 was a year of trial run, the revenue from sewage treatment charges was lower than the operation and maintenance cost. Since 2010, however, the revenue has been higher than the cost.

Although most of the revenue is from sewage treatment charges, they are insufficient for operation and maintenance because they have been set at a low level. To cope with this, the City has given subsidies from the financial budget.<sup>34</sup> Because the sewage treatment plants are regarded as important infrastructures for the City, its subsidies are guaranteed and shutdown is unlikely to occur due to financial shortage. In the development plan at the national level also, improvement of water quality is an important issue and receives priority in budget allocation. Because this situation is unlikely to change, it is hard to foresee any problem in securing the operation and maintenance cost. Although sewerage charges are insufficient for financing the operation and maintenance cost, because the City government is expected to continue to give subsidies, there is no problem in the sustainability of the operation and maintenance cost.

### 3.5.4 Current Status of Operation and Maintenance

According to the results of interviews and a field survey concerning the status of the operation and maintenance of the three treatment plants, the plants constructed by this project have continued to treat sewage, keeping the volume and the water quality in accordance with the project plan and the national standards respectively.

Main machinery, such as pumps and dehydrators were regularly inspected, maintained, and cleaned. Although repairing and expansion were carried out at the time of the field survey, the main machinery was kept sufficient to display the functions planned by this project. Although construction materials were put on the ground, those were put in order, and manuals and maintenance, inspection, and patrol records were kept completely. No problem has observed. In addition, each sewage treatment plant has a private electric generator in case of a power failure.

According to the project implementation unit, the network of rainwater pipes installed in the City is functioning normally. In the whole of China, however, some problems have occurred. Rainwater pipes installed under roads are clogged with refuse and soil. Water for domestic use and oil used for cooking are dumped into drainage ditches. These problems have occurred also in Huhhot City.

The project implementation unit has established mid- and long-term maintenance plans in accordance with the sewage treatment master plan of the City and has renewed and repaired

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<sup>34</sup> Data on the ratio of the City's subsidies are not available, because the total expenses, including the expenses for using sewerage, are collectively paid from the Finance Agency to Chunhua Co., the parent company.



equipment. Although some foreign parts have been introduced, there is no problem in acquiring them because they can be secured through domestic agencies.

In light of the above, no major problems have been observed in the institutional, technical, and financial aspects of the operation and maintenance system. 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 water quality of rivers in Huhhot City in the Inner Mongolia Autonomous Region by increasing the sewage treatment rate through the construction of sewerage facilities.

This project was consistent with China's development policies and development needs at the national, autonomous region, and municipal levels at the time of the appraisal and the ex-post evaluation; Japan's policy for assistance to China at the time of the appraisal. Therefore, its relevance is high. At the time of the ex-post evaluation, addition and remodeling were carried out to keep up with the urban development plan. Because the operation was suspended or reduced during the period, the sewage treatment volume and the treatment rate were lower than the target values. However, it can be judged that effects have arisen because of the following factors: the volume and the rate are likely to recover after the completion of the remodeling construction; indicators for main effects, such as the sewage treatment rate and the quality of the treated water, have almost achieved the targets; and sewerage service has been spreading smoothly. Moreover, at the time of the ex-post evaluation, the effectiveness and impact of this project are high, because this project seems to widely contribute to improvement in the water quality of rivers in Huhhot City, as indicated by a decrease in the total volume of pollutants discharged into water in the City. Although, just after the beginning of this project, the sewerage master plan was revised to cancel the construction of the Ruybaita sewage treatment plant and reduce the tertiary treatment capacity of the Zhanggaiying sewage treatment plant, these changes were due to a review of the sewerage construction plan and were in accordance with this project's objective of contributing to urban development. While the project cost was lower than planned, a considerable delay was caused in the project period and the efficiency of the project is fair. Regarding the sustainability of the effects that arose by this project, there is no great problem in the maintenance system of operating agency, technology, and finance. Therefore, the sustainability of the project is high.

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

### **4.2 Recommendations**

None

### **4.3 Lessons Learned**

#### Need for Monitoring and Support during Changes in this Project

Just after the beginning of this project, the urban plan was changed and the construction of the Ruybaita sewage treatment plant and the network of pipes were cancelled. To cancel the construction, the executing agency and the project implementation unit had to file an application with the City, the autonomous region, and the state as well as several agencies at multiple levels, such as the Development Reform Committee, the Finance Agency, and the Construction Agency. Because it was impossible to give any report to JICA or coordinate with it until receiving an official approval, some delay occurred in communication and information sharing with JICA. Although the project executor had an intention to use the surplus resulting from the cancellation for constructing another treatment plant, this could not be materialized until the end of the term of the ODA loan, resulting in loss of opportunity. In JICA's loan projects for developing countries, because many organizations are unfamiliar with making changes in a project plan, it frequently takes a lot of time to proceed with intergovernmental procedures or give approval. In such cases, JICA should monitor the situation even during the procedures up to approval and, on occasions such as dispatch of a midterm supervision mission, consider coordinating with superior organizations and giving support in carrying out the procedures.

#### Need for Consultation about the Preparation of a Training Plan according to Local Needs

Although the training in Japan for the staff in charge of the operation and maintenance of the sewage treatment plants under this project accomplished some achievements, some participating engineers working at sewage treatment plants answered in interviews that because Japan's sewage treatment systems were old-fashioned, they did not serve as a reference for the new-type treatment facilities constructed by this project.

On the course of designing a detailed training plan, if the project is to implement new technology or specification, JICA should explain the executing agency that the agency should select the contents and visitation destination which fit to the technology and the specification. Moreover to say, if the training plan is to function an important role in the project, the detailed contents should be made a request item by the agency, subject to JICA's concurrence, so to avoid mismatching to the actual conduct of the project.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
(1) Project Outputs Gongzhufu Sewage Treatment Plant	CAST Process Secondary Treatment 50,000 m <sup>3</sup> /day Tertiary Treatment 30,000 m <sup>3</sup> /day Sewage Pipe Network approx.30 km	As planned
Xinxinban Sewage Treatment Plant	Activated Sludge Process Secondary Treatment 50,000 m <sup>3</sup> /day Sewage Pipe Network approx.120 km	As planned  Cancelled
Ruybaita Sewage Treatment Plant	CAST process Secondary Treatment 40,000 m <sup>3</sup> /day Sewage Pipe Network approx.40 km	As planned Reduced to 30,000 m <sup>3</sup> /day
Zhanggaiying Sewage Treatment Plant.	Activated Sludge Process Secondary Treatment 60,000 m <sup>3</sup> /day Tertiary Treatment 50,000 m <sup>3</sup> /day	Reduced to approx. 80 km
Storm water pipeline	Drainage Network approx.128 km Distribution Network approx.24 km	As planned
Training	Project Implementation Unit 3 times total 20 staff Environmental Protection Bureaus 3 times total 20 staff	2 times total 19 staff  Cancelled
(2) Project Period	April 2000 – December 2008 (57 months)	April 2004 – December 2011 (93 months)
(3) Project Cost Foreign Currency Local Currency  Total ODA loan portion Exchange Rate	9,747 million Japanese yen 3,334 million Japanese yen (233 million Chinese yuan) 13,081 million Japanese yen 9,747 million Japanese yen  1 Chinese yuan = 14.3 yen (as of September 2003)	8,074 million Japanese yen 3,031 million Japanese yen (218 million Chinese yuan) 11,105 million Japanese yen 8,082 million Japanese yen  1 Chinese yuan = 13.89 Japanese yen (average rate of IMF2004 - 2013)