India

FY2015 Ex-Post Evaluation of Japanese ODA Loan

"Bangalore Water Supply and Sewerage Project"

External Evaluator: Hisae Takahashi, Ernst &Young Sustainability Co., Ltd.

0. Summary

This project was conducted with the purpose of increasing the water supply and sewerage treatment in Bangalore city by constructing water supply and sewerage systems. Its relevance is high, since the project purpose is consistent with the national development policy of India and State Water Policy of Karnataka, both of which aimed to increase the water supply and improve hygiene conditions and development needs of Bangalore city amid rapid development, as well as Japan's ODA policy. Because this was the first large-scale donor supported public project for the executing agency, the bidding process was delayed and since longer was required to secure the sites and gain approval from the related authorities, the project period largely exceeded the plan. The project cost also exceeded the plan due to price escalation and the increased cost of acquiring land, hence the project efficiency was low. Because of this project, the coverage rates of water supply and sewage treatment[1] rose as well as the volume of water supply and wastewater treated. The overall quality of the treated water at sewerage treatment plants (STPs) has also met the requirement set by the State Pollution Control Board. Living and hygiene conditions have also improved, while IT and automobile companies set up new business in the area where the water supply and sewerage systems were developed, meaning that this project also helped improve the conditions for the industrial foundation in the city, thus its effectiveness and impact were high. The sustainability of the project effect is also high as no serious issues were confirmed in terms of structural, technical and financial aspects of the Operation and Maintenance (O&M), while the facilities developed under this project have also been properly operated and maintained.

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

[1] The rates indicate the area served by water supply and sewerage treatment against the project area covered. The project area, old Bangalore city, was 245km^2 until 2006. However, it expanded to 575 km^2 in 2007 by intergrating new areas. Refer to the note of table 1 for the detail.

1. Project Description

Project Locations

Water Transmission Line to Bangalore City

1.1 Background

Bangalore, the capital of Karnataka State in India, is known as the "Silicon Valley of Asia" amid continued soaring growth, centering on the key industry of software. As the population of the city was 4.1 million people in 1991, expected to rise to 7 million in 2000, the development inside the old city area was expanded outside it as well[2]. The city also started to increase the water supply by taking in supplies from Cauvery River, located 100 km away, for geographic reasons such as the city location at 840 – 940 m above sea level and its distance from a stable water source[3]. However, the total water supply was insufficient to cover the population increase and a further increase in water supply was demanded. The sewerage system also proved inadequate in the growing suburbs and part of the old city. In fact, at the time of appraisal, the volume of wastewater in the old city alone exceeded the capacity of the three STPs located in the city. This not only hampered efforts to improve the living environment in the old city but further exacerbated it, amid the increased sewage and development of the suburb.

Under those circumstances, the project scope included expanding the existing Cauvery water supply system to alleviate severe water shortage and also expanding as well as building STPs to deal with the expecting sewage increase from further water usage[4].

1.2 Project Outline

The objective of this project is to respond to the increased demand for water supply and sewerage system in Bangalore city by constructing a water supply and sewerage system, thus helping to improve the quality of life and industry growth.

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[2] Source: Document provided by JICA

[3] In Bangalore, "Cauvery Water Supply Scheme (CWSS)" was implemented for water intake from Cauvery River over three stages (stage 1 completed in 1974, stage 2 in 1982 and stage 3 in 1994, respectively). This project will be phase 1 in stage 4.

[4] At the time of appraisal, the demand forecast showed large demand/supply gaps in the water supply and difficulties in meeting all the demand required even after the completion of this project. Therefore, the plan envisaged that phase 2 of this project would be implemented to meet the remaining demands.

<ODA Loan Project>

Loan Approved Amount/ Disbursed Amount	28,452 million yen / 23,047 million yen	
Exchange of Notes Date/ Loan Agreement Signing Date	January, 1996 / January, 1996	
Terms and Conditions	Interest Rate	2.1%
	Repayment Period	30 year
	(Grace Period)	(10 year)
	Conditions for Procurement:	General Untied (other than consulting services), Partial Untied (consulting services)
Borrower / Executing Agency	President of India / Bangalore Water Supply and Sewerage Board (BWSSB)	
Final Disbursement Date	January, 2005	
Main Contractor (Over 1 billion yen)	Steel Authority of India (India), Degremont (France), Dodsal Private Ltd. (India), Petron Civil Engineering Ltd. (India)/Electro Steel Casting Ltd. (India)(JV), Bharat Heavy Electricals Ltd. (India), Nila Bauart Engineering Limited Badoda (India), Larsen & Toubro Ltd. (India) /Ksb Pumps Ltd. (India)(JV), V A Tech Wabag Ltd. (India), Larsen & Toubro Ltd. (India) /Thames Water Asia Pte. Ltd. (Singapore) (JV)	
Main Consultant (Over 100 million yen)	TCE Consulting Engineers Limited (India) / Pacific Consultants International (Japan) / Mott Macdonald Ltd. (Singapore) (JV)	
Feasibility Studies, etc.	"Feasibility report" (1995) (Tata Consulting Engineers Limited)	
Related Projects	・(Bangalore City) "Cauvery Water Supply Scheme" (Stage I : 1974,Stage II: 1982, Stage III: 1994) ・(Yen Loan) "Bangalore Water Supply and Sewerage Project" (II-1)(March, 2005), (II-2)(March, 2006)	

2. Outline of the Evaluation Study

2.1 External Evaluator

Hisae TAKAHASHI, Ernst & Young Sustainability Co., Ltd.

2.2 Duration of Evaluation Study

Duration of the Study: August, 2015-October, 2016

Duration of the Field Study: November 21-December 2, 2015, February 22-February 26, 2016

2.3 Constraints during the Evaluation Study

Although an ex-post evaluation is normally conducted within three years of the project completion, the evaluation for this project was scheduled after the completion of the subsequent project (Bangalore Water Supply and Sewerage Project (II) (Phase 2)), scheduled for completion in 2013 and intended to cover both projects. However, since Phase 2 had not been completed by the end of 2015, the ex-post evaluation of this project was conducted separately before completion of Phase 2. Consequently, a decade elapsed after the project was completed, which hindered efforts to collect project documents and apprehend changes between before and after conducting the project from beneficiary interviews and also led to unclear and inconsistent responses on the part of beneficiaries. Accordingly, this information was treated as a reference.

3. Results of the Evaluation (Overall Rating: B[5])

3.1 Relevance (Rating: ③[6])

3.1.1 Relevance to the Development Plan of India

At the time of appraisal, "The 8th Five Year Development Plan (1992 – 1997)", a development policy, showed its objective to improve water supply and sewerage systems. In concrete terms, the objectives included to increase the penetration rate in the city and the water supply volume of individual taps and measures to prevent leakage or theft of the water supply and install hygienic latrines with sewerage, to reuse discharge from STPs in urban cities and increase the number of sewerage users in the city[7]. "The 12th Five Year Development Plan (2012 – 2017)[8]", the development policy at the time of the ex-post evaluation, focuses on health, education, drinking water and sanitation and providing critical infrastructure in rural and urban areas for inclusive and sustainable development. The Plan particularly emphasizes the "provision of drinking water and public hygiene" to access safe drinking water and hygienic facilities with improved health in mind.

The sector plan in India, "National Water Policy (2002) (2012: revised 2002 version)[9]", raised urgent issues such as the development and management of water resources, equal and fair water distribution, improvement of safe drinking water and hygienic environment, management of water quality and quantity through sewerage facilities and the non-revenue water plan. In addition, the "State Water Policy of Karnataka 2002"[10] set the target of increasing the water supply volume and equal water distribution. Furthermore, the Ministry of

[5] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[6] ③: High, ② Fair, ① Low
[7] Source: Document provided by JICA
[8] Source: Web site of Planning Commission Government of India (http://planningcommission.nic.in/plans/planrel/fiveyr/12th/pdf/12fyp_vol1.pdf)
[9] Source: Web site of Ministry of Water Resources (http://wrmin.nic.in/forms/list.aspx?lid=1190)
[10] Source: Web site of Government of Karnataka (http://waterresources.kar.nic.in/state_water_policy-2002.htm)

Urban Development shows 18 standards in the water supply and sanitation category as "service level benchmarks[11]", as well as emphasizing the improved quantity and quality of the water supply and sewerage system.

As stated above, the development policy in India consistently targets an increased water supply and improved hygiene environment by developing water supply and sewerage systems. Accordingly, the project has been relevant to the development plan for India.

3.1.2 Relevance to the Development Needs of India

Bangalore city has been struggling to keep pace with the rapid development in the water supply system and was only able to supply 100 liters (L) per capita per day of water at the time of appraisal (1995), far below the required volume of 150 – 200 L for this size of city. Moreover, the demand/supply gap for the total water supply was 306 million L per day (MLD) at the time of appraisal (1995) and was expected to expand to 460 MLD in 2000. The sewerage system capacity of 376 MLD was also far below the required capacity of 544 MLD, which underlined the urgent need to develop water supply and sewerage systems[12].Although this project helped increase both the water supply and sewerage capacity of Bangalore city by the time of the ex-post evaluation, the population of the city also increased from four million at the time of appraisal to 9.5 million in 2014 and is expected to climb further[13]. The covered area of Bangalore city has also expanded to 2.3 times. As shown in Table 1, a major demand/supply gap remains for both water supply and sewerage capacity. Accordingly, the need to expand both the water supply and sewerage system are still high.

[11] Source: Web site of Ministry of Urban Development（http://moud.gov.in/）
[12] Source: Document provided by JICA
[13] According to the executing agency, the executing agency has submitted a proposal to JICA for Phase 3 following Phase 2 since a further increase in demand is anticipated with the increasing polulation in the city. In addition, executing agency explained that pipes from water source to the city need to be constructed every decade to ensure the water volume provided keeps pace with the population growth.

Table 1 Summary of Capacity of Water Supply and Sewerage System in Bangalore City

	At the time of appraisal (1995)	At the time of the ex-post evaluation (2015)
Population (Million)	4.0	9.5[14]
Area of Bangalore city (km^2)	245	575
Water supply volume per capita (L per day)	100	132
Total water supply volume (MLD)	567	1,430
Demand supply gap (MLD)	306	740
Capacity of STPs (MLD)	376	721
Demand supply gap (MLD)	168	423

Source: Documents provided by executing agency

Note: The area of Bangalore city expanded since eight Urban Local Bodies (ULBs) were integrated in 2007. At the time of ex-post evaluation, the area of the city expanded to 800km^2 as 110 villages were later added. Meanwhile, population data is available only for the old Bangalore city area (Bangalore city area at the time of appraisal) and eight ULBs, and BWSSB's official service area was this area at the time of the ex-post evaluation. Thus, data at the time of the ex-post evaluation in table 1 shows the information for the old city area and eight ULBs (city area : 575km^2).

3.1.3 Relevance to Japan's ODA Policy

At the time of appraisal, Japan's ODA assistance policy toward India (1995) emphasized "Improvement of economic infrastructure", "Poverty reduction" and "Environmental preservation"[15]. The policy focused on the provision of safe drinking water as part of "Poverty reduction" and stressed efforts to improve the water quality and water supply in "Environmental preservation". As the project developed water supply and sewerage systems, its consistency with the policy is confirmed.

The project has been fully relevant to India's development and sector plans, which targeted an expansion of the water supply and sewerage capacity, state water policy of the Government of Karnataka, development needs of the rapidly expanding Bangalore and Japan's ODA policy. Therefore its relevance is high.

3.2 Efficiency (Rating: ①)

3.2.1 Project Outputs

The following Table shows the project outputs (planned and actual), any changes and reasons. While the water supply system (Table 2) was basically implemented as planned, the sewerage system (Table 3) differed considerably from the plans, due to the changes in scope based on the result at the time of detailed design. This is because the extent of the sewerage

[14] Population shows the data in 2014.
[15] Source: Document provided by JICA

capacity was subject to review at the time of detailed design[16] as was set out in the appraisal stage.

Table 2 Major Plan and Actual Outputs (Water Supply)

Item	Plan (at the time of appraisal: 1995)	Actual (2005)
1. Intake Structure	1 structure (From water source to Netkal Balance Reservoir（NRR）) Intake tower	As planned (Concrete wall height of channel between intake facility and transmission facility modified)
2. Raw water gravity Main.	1 main (Pipe Steel 2,000mm dia, Length: 9.7 km) NRR ～ T.K. Halli Water Treatment Plant	As planned (Size of Pipe steel was modified to 1,900 mm dia)
3. Water treatment plant (WTP)	1 plant (Capacity: approx. 270 MLD)	As planned
4. Clear water reservoirs (CWR) Pumping plant	Three T. K. Halli:approx. 13.5 million L Harohalli:approx. 11.25 million L Tataguni: approx. 11.25 million L Approx. 1,250KW x 8 each	As planned (the capacity was modified) T. K. Halli: approx. 24 million L Harohalli: approx. 12 million L Tataguni: approx. 12 million L 1,100KW, 1,200KW, 1,300KWx3
5. Treated water transmission	- Pipe Steel 1,950mm dia Length 75 km - Water Pressure Reduction System (WPRS)	- Pipe Steel: Almost as planned (modified to 1,950mm, 1,600mm, 1,200mm dia, length 94km) - WPRS: as planned
6. Water transmission and distribution -Ground level reservoirs (GLR) -Pumping stations -Distribution pipe -Procurement equipment	 - Seven GLR (217 million L in total) Overhead tanks: 5 - 2 stations - 124.5 km Main pipe: 74.5 km Sub pipe: Newly extended: approx. 50km Rehabilitation: approx.10km -Seepage detection, flowmeter	 -Seven GLR (147million L in total) Overhead tanks: Canceled - As planned - 147.0 km Main pipe: 70 km Sub pipe: New: 77km Rehabilitation: Canceled -As planned
7. Others		Non-revenue water control and water distribution system rehabilitation (pilot project)

Source: Documents provided by JICA and Questionnaire responses to executing agency

[16] Source: Document provided by JICA

Table 3 Main Plan and Actual Outputs (Sewerage System)

Item		Plan		Actual (2005)
		Appraisal (1995)	Detailed design survey[Note] (1998)	
1. Sewerage System				
Expansion	K&C Valley	55 MLD	55 MLD	55MLD
	Hebbal Valley	30 MLD	Out of this project scope	Out of this project scope
	Subtotal (Expansion)	**85 MLD**	**55 MLD**	**55 MLD**
New Construction	Geddalahalli	56 MLD	50MLD (Raja Canal)	40 MLD
	Medohalli	49 MLD	20 MLD (KP Puram)	20 MLD
	Bodanhalli	74 MLD	30 MLD (Kadabesinahalli)	50MLD
	Mailasandra	97 MLD	75MLD	75 MLD
	Teggalapariya	49 MLD	20 MLD (Nagasandra)	20 MLD
			20 MLD (Jakkur)	10 MLD
	K&C Valley	-	30 MLD	30MLD
	Subtotal (New onstruction)	**325 MLD**	**245 MLD**	**245 MLD**
Total (Extension & New construction)		**410 MLD**	**300 MLD**	**300 MLD**
2. Pumping Station		11points		8 points
3.Trunk Sewer		Reinforced concrete pipe: Approx. 150 km Cast iron pipe: Approx. 9 km		55 km 16 km
4. Others		Machinery & appliances, Machinery & appliances for laboratory, Cleaning equipment for sewer maintenance		As planned

Source: Documents provided by JICA and responses of Questionnaire to executing agency

Note: STPs in parentheses indicate the location of STP as newly determined at the time of the detailed design stage.

Table 4 Major Plan and Actual Outputs (Others, Consulting Services)

	Plan (at the time of appraisal: 1995)	Actual (2005)
Others	Construction of dormitories and management building, Communication equipment, rehabilitating the service road	As planned
Consulting Services	Contents: Detailed design, Documentation for bidding, Support of bidding, Construction supervision, Trainings for staffs, preparation of reports Total 964MM	As planned 2,281MM

Source: Documents provided by JICA and Questionnaire for ex-post evaluation for JICA-financed project

Changes in output and reasons

(Water supply system)

The output of the water supply systems was basically as planned. As shown in Table 5, some changes were made in the height of the concrete wall of channel between intake and transmission facility, pipe sizes, reservoir capacity, and number of pumps. There were cancelations of constructing an elevated tank, etc., to suit the current situation. None of these changes affected any functions of the intake structure, raw water transmission or water supply and were thus justified as reasonable.

Table 5 Reasons for Changes in Scope of Water Supply System

Item	Reasons for changes
Intake structure	Taking the water level and banks into consideration, the height of the concrete wall of the channel between the intake and transmission facility was changed to protect against overflow.
Raw water gravity Main	The size of the pipes was changed, with cost, safety and effectiveness in mind.
Reservoirs	Detailed survey into the site location and needs exposed the requirement for higher capacity than originally planned and the capacity of the T.K. Halli reservoir in particular was expanded.
Water distribution facility	Based on the water supply volume and capacity in Bangalore city, the total size of GLR was downscaled and adjusted to ensure consistent and equal distribution of water within each area. In addition, the length of the distribution pipes was also changed for newly adopted detours due to the difficulties in using planned distribution routes. Constructing a reservoir at high altitude also eliminated the need to install an elevated tank, hence installation of tanks were canceled.
Others	With the surplus of this project, pilot survey[17] was added (August, 2002) and conducted for non-revenue water in the latter half of the project as one of the key issues to be tackled in Bangalore city. The results of this survey are utilized as a component of non-revenue water during Phase 2.

Source: Questionnaire and interview to executing agency.

(Sewerage system)

The capacities for STPs were re-examined at the time of the detailed design as planned. The sewerage facilities, including the pump station, had to be relocated elsewhere due to the difficulties in securing the original site given the land issues, such as the cooperation provided by those living there. The new site was determined with adequate consideration of the site condition and the capacity of each facility to secure necessary capacities.

[17] This component included research into measures for leakage and non-accounted water (installment of a water meter and introduction of a water payment system, etc.) and rehabilitation of distribution systems.

Accordingly, with no effects impacting on the project result, the changes made were deemed reasonable. Major changes and reasons for them are shown in Table 6.

Table 6 Reasons of Scope Changes for Sewerage System

<table>
<tr><th>Item</th><th>Reasons of changes</th></tr>
<tr><td rowspan="3">Sewerage Facilities</td><td>Habbal Valley STP had to take immediate action to deal with severe water pollution. Conversely, progress of this project was delayed, so the expansion works were performed with State Government funding.</td></tr>
<tr><td>The facility was newly constructed in addition to expanding the existing facility in K&C Valley to correspond to the deficiencies on the existing system.</td></tr>
<tr><td>The STP capacity was to be “re-determined based on population and development predictions as of 2001 during the detailed design survey.” Based on the detailed design survey, the planned capacity was modified and the STP construction sites had to be newly prepared because many planned construction sites had already been encroached by residents due to the delay in commencing the project. Consequently, the amount of wastewater and appropriate location were examined and modified as follows:
<table>
<tr><th>Original</th><th>Modified</th><th>Reasons for changes</th></tr>
<tr><td>Geddalahalli</td><td>Raja Canal</td><td rowspan="3">Construction sites were relocated as the planned sites could not be acquired.</td></tr>
<tr><td>Medohalli</td><td>K R Puram</td></tr>
<tr><td>Bodanhalli</td><td>Kadabesinahalli</td></tr>
<tr><td colspan="2">Mailasandra
Decrease capacity of STP</td><td>As the project was delayed, STP (Vashahabaty) was constructed 0.5km away from the Mailasandra STP with the support of the State government. Accordingly, the capacity of Mailasandra was decreased.</td></tr>
<tr><td>Tegglapariya</td><td>Nagasandra</td><td>Construction sites were changed as the planned sites could not be acquired.</td></tr>
<tr><td></td><td>Jakkur</td><td>In line with the site relocations and STP capacity changes, Jakkur STP was newly constructed to accommodate the total treatment capacity.</td></tr>
</table>
</td></tr>
<tr><td>Pumping Station</td><td>Along with the STP site relocation, the number of pumping stations also has to be changed. Based on the detailed survey for appropriate capacity and location, the location was adequately changed as planned.</td></tr>
<tr><td>Trunk Sewer</td><td>After the project commenced, 95km of sewer was conducted and completed by the Indian side, which resulted in changing the total length of 55km among the planned 150km of trunk sewers under this project. The length of steel pipes was changed from the planned 9km to 16km.</td></tr>
</table>

Source: Questionnaires and interview with executing agency

Water Treatment Facility (T.K. Halli)

STP (Nagasandra)

3.2.2 Project Inputs

3.2.2.1 Project Cost

The planned total project cost was 33,474 million yen (28,452 million yen from Japanese ODA loan) while the actual cost was 36,253 million yen (23,047 million yen from Japanese ODA loan), meaning the total project was higher than planned (108% of the original plan)[18]. The major reasons for the budget excess were the increase in equipment cost along with price escalation, increased construction cost along with the delay in the project period (see 3.2.2.2 project period), the increased cost of land acquisition along with changes of scope for STPs and the higher-than-expected bid price.

3.2.2.2 Project Period

The scheduled project period[19] was 72 months, January 1996 through December 2001 and the actual period was 113 months, January 1996 through May 2005, longer than planned (157% of the planned period). The major factors behind this delay were the "bidding process" and "land acquisition" as explained as follows:

1) The delay in bidding

This project was the first large public project supported by donors for the executing agency. Under such circumstances, more time was required, particularly for preparing the bidding documents, resulting in a two-year delay from the planned period. This

[18] In this project, the extension of Hebbal Valley STP and construction of 63% of the trunk sewer were outside the project scope. Because some classifications of project items differed at the time of appraisal and project completion in the collected documents during the ex-post evaluation, a comparison of the project cost following consideration of the changes could not be simply made. Accordingly, the classifications were reorganized under such restrictions with the potential range and it emerged that the actual cost for STPs was 266%, while that for trunk sewers was 52% of the planned cost. The largely exceeded cost for STPs was explained as changes in the K&C Valley STP of new construction in addition to extension, delays in relocating the construction site and price escalation, but no further analysis was possible, since the cost of STPs was not collected. Conversely, the total trunk sewer length declined and the pipe size also decreased after due consideration of safety and efficiency, which means the modification can be considered appropriate.

[19] The project period is defined from the time of Loan Agreement (project commencement) to completion of construction works (project completion).

delayed the initial construction and caused many STPs to relocate.

2) Issues on land expropriation

As described above, along with the delay in starting construction, residents encroached the planned site locations of transmission water pipes from T.K. Halli CWR to Harohalli CWR and STPs. The completion of the works was delayed for a year as longer time was required for solving the issues.

In addition, it also required time to obtain construction approval from the Bangalore Development Authority to lay the sewer line, and some problems emerged, including a land dispute on the part of Mailasandra STP and difficulties in implementing ground surveys, while issues affecting the pumping supply process[20] and coordination of effluent standard changes by the Karnataka State pollution control board further delayed the project. Furthermore, relocating water and sewerage facility sites usually involves changes to the sewer line, which takes more time than the other facilities, since the design as well as the routes have to be changed, also taking vertical intervals into consideration[21].

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

Financial Internal Rate of Return (FIRR) was recalculated based on the assumption[22] at the time of appraisal. FIRR was calculated as 5.46% from the preliminary calculation of 7.29% at the time of appraisal. The differences were due to the extended project period and water charges which were lower than assumed at the time of appraisal, which resulted in a lower benefit.

In the light of the above, both the project cost and project period significantly exceeded the plan. Therefore, efficiency of the project is low.

3.3 Effectiveness[23] (Rating: ③)

3.3.1 Quantitative Effects (Operation and Effect Indicators)

(1) Water supply: coverage rate of water supply, amount of water supplied

Table 7 shows the coverage rate of water supply and amount of water supply in the

[20] This project used a latest model of main pump made by Japan and a motor made in India to install the pumping systems. This means a motor had to be sent from India to Japan first and tested there, which caused a year or so of delay. According to the executing agency, both the main pumping and motors were procured in India to avoid similar delay issues for Phase 2.

[21] For example, the design for the sewerage line needs to have a proper slope (pitch) to send sewerage to STP for smooth flowing.

[22] Cost: Initial investment cost, maintenance cost, Benefit: Revenue from water supply, Project life: 30 years after the project completion

[23] Sub-rating for Effectiveness is to be put with consideration of Impact.

project area. Though the project aimed to increase the population served with water at the time of appraisal, the relevant data could not be confirmed from the executing agency. Therefore, this evaluation confirmed the coverage rate of water supply as an alternative indicator and also set a target water supply amount based on capacities of both existing and newly built water treatment facilities in this project and analyzed the effectiveness.

Thanks to the project, the coverage rate of water supply in the project area increased to 100% at the time of project completion from 70% at the time of appraisal. The rate decreased to 70% for a certain period since eight ULBs were added to Bangalore city in 2007 (see note on table 1), yet it increased back to 95% at the time of ex-post evaluation with also the contribution of Phase 2. Meanwhile, capacity of water supply at the year of project completion was originally expected as becoming 950 MLD by expanding the water supply facility from Cauvery River and constructing a water treatment plant capable of handling 270MLD[24]. It ultimately achieved 890 MLD, 94% of original target value as the supply capacity sourced from Arkavati River, a different source from this project, has been decreasing since 2005 due to changes in weather conditions or precipitation[25]. Subsequently, water supply facilities were completed at Phase 2 and the water supply amount in the city increased to 1,430 MLD at the time of the ex-post evaluation. The facility utilization has also been maintained at 100% since the project completion. Accordingly, it can be said that the project effectiveness of developing water supply facilities contributed to improve the coverage rate of water supply and the water supply amount in the Bangalore city.

[24] Amount of water supply, 270 MLD, comprises 30% of the total water supply in Bangalore city at the time of project completion and 20% at the time of ex-post evaluation.

[25] This project water supply system has Cauvery River as a water basin. However, the water supply decreased from 150 MLD to 50 MLD in the water supply system which has Arkavati river as a water basin due to changes in the rainfall amount and natural conditions.

Table 7 Coverage Rate of Water Supply and Amount of Water Supply in Bangalore City

	Baseline	Target	Actual				
	1995	2001	2005	2011	2012	2013	2014
	Baseline Year	2 Years After Completion	Completion Year	6 Years After Completion	7 Years After Completion	8 Years After Completion	9 Years After Completion
Coverage rate of water supply (%)[Note1]	70	N.A	100[Note2]	70	85	90	95
Amount of Water Supply (MLD)	680	950	890	930	950	1,230[Note3]	1,430
Facility Utilization (%)	100	N.A.	100	100	100	100	100
Unaccounted Water Rate (%) [Note4]	30	N.A.	35	38	45	45	40
Leakage Rate (%)[Note4]	20	N.A.	25	28	35	35	30

Source: Prepared based on documents provided by JICA and executing agency

Note 1: The project area for 1995-2005 was old Bangalore City, 245km^2. The area was later expanded, and at the point of 2011, it was 575 km^2.

Note 2: Data of 2006 which was available in executing agency.

Note 3: Water supply increased in 2013 with implementing Phase 2.

Note 4: Although the baseline and target value for the rate of unaccounted water and leakages were not set as markers to determine the effectiveness of this project, the information was obtained as a reference to understand the situation of Bangalore city[26].

(2) Sewerage: coverage rate of sewerage treatement, amount of treated wastewater, effluent quality

Table 8 shows the coverage rate of sewerage treatment, amount of treated wastewater and effluent quality[27] of the project area. The appraisal of this project was before the ex-ante evaluation scheme was introduced. Thus, no target of operation indicator for the sewerage facility was set at the time of appraisal. Accordingly, in this evaluation, the target value was set and the achievement level analyzed based on the capacity of the STPs, planned sewerage quantity at the time of appraisal and the quality level defined by the State Pollution Control Board.

The coverage rate of sewerage treatment improved to 70% at the time of project completion from 60% at the time of appraisal. As stated above, the rate decreased to 60% in 2011 due to the expansion of Banagalore city. However, it increased to 80% at the time of ex-post evaluation alongside the extension of sewer connections to the STPs and improvements in the rate of STP utilization (utilization rate of STPs shown in Table 9). The coverage rate would be far lower, if the project had not constructed new STPs. Therefore,

[26] There is significant leakage from dilapidated distribution pipes, unlike the pipes installed in this project and the rates of leakage and water unaccounted for at the time of the ex-post evaluation worsened from figures at the time of appraisal. Given the purpose of this project, the unaccounted water issue was only measured in the pilot project (survey) within a limited area, so conducting this project had no impact on the unaccounted water rate. However, a survey with added scope was included in the component for unaccounted water during Phase 2, which led to the full-scale implementation of countermeasures against unaccounted water and is expected to have an effect in the future.

[27] Effluent water quality shows that of the targeted STPs extended and constructed for this project.

this project can be said to have contributed to increase in the coverage rate of sewerage treatment. The amount of treated wastewater at the time of project completion was 23% of the planned amount estimated at the time of appraisal. The planned amount of sewerage was estimated by 80% of the water supply amount and the sewerage facility of this project was designed and developed based on that number. In fact, a certain period of time was generally required until the sewerage facility went into full operation, by gradually connecting to the sewer lines following construction of the sewerage facility[28]. The STPs constructed in this project are also expected to go into full operation by 2020, development of sewer lines by this project is limited and the amount of treated sewerage at the time of the ex-post evaluation was significantly increased to 75% of the planned amount. Accordingly, the effectiveness of increasing sewerage treatment as planned under this project was confirmed.

Table 8 Coevrage Rate of Sewerage Treatment, Amount of Treated Wastewater, Effluent Quality of Bangalore City

	Baseline	Target	Actual				
	1995	2001	2005	2011	2012	2013	2014
	Baseline Year	2 Years After Completion	Completion Year	6 Years After Completion	7 Years After Completion	8 Years After Completion	9 Years After Completion
Coverage rate of sewerage treatment (%)	60	N.A	70 Note1	60	65	75	80
Amount of Treated Wastewater (MLD)	150	796 Note2	180	319	479	525	600
BOD Concentration Note3 Outflow (mg/ℓ)	60 Note4	20	11.8	11.7	11.7	12.1	11.5
SS Concentration Note3 Outflow (mg/ℓ)	150 Note4	30	13.4	14.1	15.0	15.1	14.1

Source: Documents provided by JICA and executing agency
Note 1: Data as of 2006 which was available in executing agency.
Note 2: In the documents prepared at the time of appraisal, the planned amount of wastewater treated was calculated as 80% of the water supply.
Note 3: Data is the average of STP constructed under this project.
Note 4: Data for BOD and SS concentrations as of the baseline were for K&C Valley alone.

Biochemical Oxygen Demand (BOD)[29] and Suspended Solids (SS)[30] concentrations of treated wastewater at STPs constructed under this project meet the standards (target) set by the Karnataka State Pollution Control Board. Both the BOD and SS effluent concentrations

[28] Based on the interviews with the executing agency.
[29] It is also called "biological oxygen needed" and is one of the key indicators of water quality. It is the amount of dissolved oxygen needed (i.e. demanded) by aerobic biological organisms to break down organic material present in a given water sample at a certain temperature over a specific period. Generally, the larger the BOD, the worse the water quality.
[30] It is a collective terms for small solid particles (less than 2mm) which remain in suspension in water as a colloid.

of K&C Valley improved significantly compared with that before the project[31], hence the improvement in water quality was also confirmed.

Table 9 Utilization Rate of STPs

(Unit: %)

	2011	2012	2013	2014	2015
K&C Valley	104.1	86.2	98.3	92.3	96.5
Kadabesinahalli	55.4	52.7	58.0	68.5	64.8
Mailasandra	45.4	49.8	57.3	61.0	78.3
Nagasandra	37.4	33.7	42.0	48.9	64.4
Jakkur	40.6	39.4	58.7	73.1	86.9
K R Puram	26.4	37.3	76.8	104.2	107.9
Raja Canal	44.8	46.5	88.2	90.86	65.3[Note]

Source：Documents provide by executing agency

Note: In late 2015, part of the sewer line connected to Raja Canal STP was affected by work to widen the road, which decreased 10MLD of capacity and the operation rate of Raja Canal STP in 2015. This situation will be resolved after December 2016, when the road construction will be completed.

3.3.2 Qualitative Effects (Other Effect)

A beneficiary survey[32] and interviews with residents living next to water and sewerage systems were conducted to complement the quantitative effect of the project during the site survey. The surveys were summarized as follows[33]:

When confirming the water supply volume, around 60% of respondents cited that the water supply volume increased. However, an average increase of 26 liters per family was confirmed after project completion when the actual volume of water supply was queried (See Table 10). Duration for water supply[34] per time also slightly improved (See Figure 1) and 70% of respondents answered that the adequacy of frequency and timing for the water supply was reliable or fair (See Table 11). Meanwhile, only 28% answered that the water quality had improved compared to before the project implementation (See Table 12). As water is normally supplied once every two days, water is stored in the tank installed at houses. According to water users, the stored water is utilized, which may have declined the water quality due to the condition of storage[35]. Conversely, 70% of respondents had no complaints over water quality. There are even many opinions confirmed in the interviews with residents

[31] The BOD (effluent) concentration at K&C Valley improved from 60mg/ℓ to 9.5mg/ℓ, from 150mg/ℓ to 11.1mg/ℓfor SS (effluent) concentration, when the situation before and after the project was compared (see Table 8).

[32] Beneficiary surveys were conducted in the five residential areas (Indranagar, J. P. Nagar, Rajaji Nagar, R.B.I. Colony and Nandini Layout) near the project sites, where water and sewerage facilities were developed, with 100 beneficiaries in total; 41 of which male and 59 female. The age breakdown was: 18-30 years old for nine samples, 31-40 for 18 samples, 41-50 for 29 samples, 51-60 for 18 samples and over 60 for 26 samples.

[33] As mentioned in “Constraints during the Evaluation Study”, this ex-post evaluation was conducted ten years after project completion, which meant most beneficiaries had difficulties in properly comparing the situation before and after the project and in some cases, responses were not consistent with the result of interview surveys with neighbors.

[34] Water is supplied for three hours every other day in Bangalore city.

[35] Interviews with executing agency and residents.

at service stations for customers of BWSSB in Rajaji Nagar and other area during the site survey, " no more cases of mud in water is confirmed during rainy seasons, color of water is getting clear and no more smell is confirmed".

Table 10 Increase in Water Supply Volume
(per family per day, average four members per family)

Largely increased	Increased	Not increased	Not increased at all
1%	60%	31%	8%
Change in water supply volume confirmed with respondents About 26ℓ increased (Before project: About 335ℓ, After the project: about 361ℓ) on average			

Source: Result of beneficiary survey

Table 11 Frequency/Timing of Water Supply

Reliable	Fair	Not reliable
34%	35%	31%

Source: Result of beneficiary survey

Table 12 Improvement of Water Quality

Improved	Same	Worse	Largely Worse
28%	52%	17%	3%

Source: Result of beneficiary survey

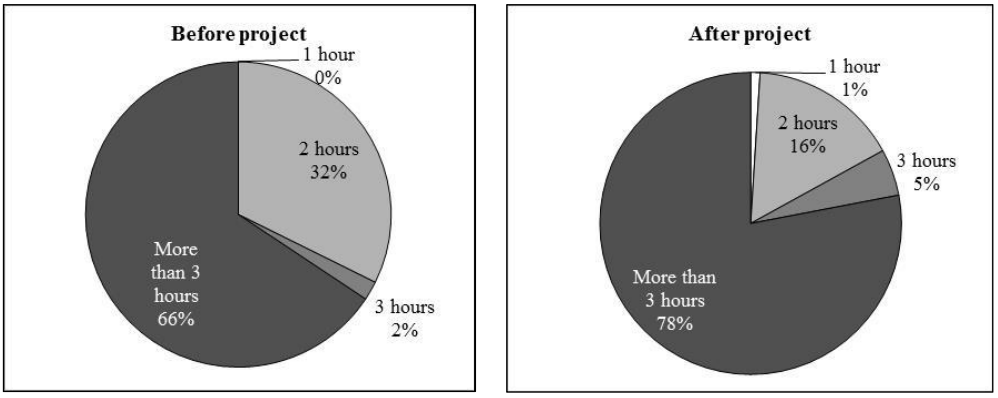

Figure 1 Change in Water Supply Volume before and after the Project

Source: Result of the beneficiary survey

When confirming the effects on aspects such as odor, insect infestation and visual appearance by developing sewerage facilities, respondents answered that the improvement was about 30% (See Table 13). As for insect infestation, 20% of respondents answered that it had worsened. As a reason, the effects generated by developing sewerage facilities were not easily visible and the fact that an ex-post evaluation was conducted a decade after project completion made it more difficult for people to apprehend the changes before and after the project properly, as mentioned in "2.3 Constraints during the Evaluation Study". On the other hand, in interview surveys with residents conducted at J. P. Nagar and R. B. I Colony, many answered that odor and insect infestations had improved, indicating a certain level of effectiveness was confirmed.

Table 13 Effects of Developing Sewerage Facilities
(Odor, Visual Appearance, Insect Infestations)

	Largely improved	Improved	No change	Worse	Much worse
Odor	0%	27%	66%	4%	3%
Vector attraction	0%	28%	52%	14%	6%
Aesthetics	0%	26%	68%	0%	2%

Source: Result of the beneficiary survey

3.4 Impacts

3.4.1 Intended Impacts

3.4.1.1 Improvement of Living Life and Foundation of Industry in Bangalore City

In Bangalore city, no statistical data to show the improvement in living life and foundation of industry in Bangalore city was available. However, the executing agency explained some impact, based on the fact that the “neighboring area where the CWR was developed through this project had developed as a software hub”, “many automobile companies had moved into the Bidadi area where the STP was developed under this project by the time of the ex-post evaluation”. Expanding the capacity of the water supply system and constructing sewerage facilities boosted the water supply, improved the hygiene environment and then contributed to IT and automobile companies setting up and expanding in Bangalore city.

3.4.1.2 Decrease in the Workload (Fetching Water) of Women

In the beneficiary survey, 18% of respondents answered that the time spent on fetching water had decreased and 73% cited no changes, as a certain volume of water was already supplied in some areas, even before the project. Meanwhile, neighbors of CWR in the Mailasandra area, 3km from water point, explained in the interview survey during the site surveys that water needed to be fetched several times a day previously. However, the regular water supply under the project helps eliminate the time formerly spent on fetching water, which can then be used to care for family, educate children and on leisure. As such, a reduced workload for women in some areas was confirmed.

3.4.2 Other Impacts

3.4.2.1 Impacts on the Natural Environment

During the project implementation, monitoring was conducted in line with the environment and safety plan set by the Public Health Department of the state government. No complaints concerning noises and odors were generated during and after the project, according to interviews with the executing agency and residents as well as the site survey. Sewerage discharged from STPs were regularly collected by farmers and used in fertilizers

and the quality of water discharged from STPs also met the water quality standard[36], thus no negative impact on the natural environment was confirmed.

3.4.2.2 Land Acquisition and Resettlement

120 hectare (ha) for laying the transmission line, 7 ha for the ground level reservoir and 11 ha as land for the STP were acquired under this project. The land was acquired in line with regulations set by the state government[37]. No resettlement took place as a result of implementing the project.

3.4.2.3 Increase in land value

According to interviews during the site survey with neighbors of the facilities developed under this project, the land price around the site at the time of the ex-post evaluation increased three times on average compared to before the STP construction. This increase can be considered largely attributable to economic development of the city, since land price also increased in Bangalore city as a whole. However, residents explained that this increase was because more people and companies had moved into the area thanks to the improved living environment and hygiene, e.g. odors after the development of facilities. Thus, this project is also considered to boost land prices to a certain level by improving the living and hygiene environment.

This project has largely achieved its objectives. Therefore effectiveness and impact of the project are high.

3.5 Sustainability (Rating: ③)

3.5.1 Institutional Aspects of Operation and Maintenance (O&M)

The O&M of water supply and sewerage facilities were commissioned to private contractors; supervised and managed by BWSSB. For three years after the project completion, the contractor which constructed the facilities took charge of the O&M of facilities. Contract periods changed to seven years in 2013 and tendering was repeated, whereupon private contractors were reselected and continued O&M activities. After the termination of the seven-year contract, tendering will be re-conducted and contractors selected. Under this project, since O&M after the project completion was conducted by the project contractors, the experiences and knowledge obtained during the project are considered to have been utilized effectively. This also contributed to satisfactory O&M activities.

[36] State water pollution board obliges BWSSB to draw up a daily report.
[37] Based on the responses of Questionnaire to executing agency.

Furthermore, a system for monitoring the contractor's work was also organized, with engineers of BWSSB stationed in each facility to monitor the contractor's O&M performance and to report to BWSSB head office regularly. Approximately 50 O&M staff at each water and sewerage treatment plants and 10 O&M staff at the CWR from contractors were dispatched on average, with one to two BWSSB staff members also assigned at each facility. Considering the O&M condition during the site survey at the time of the ex-post evaluation, the number of staff assigned is considered appropriate. Regarding the total number of BWSSB staff (2,580 staff members in total and 256 technical staff), a lack of staff was one of the concerns since appraisal. However, the O&M works of each facility were outsourced, reducing the number of staff needed for O&M. This resolved the problem of insufficient staff at the time of the ex-post evaluation and no major problems were seen in the O&M system[38].

3.5.2 Technical Aspects of Operation and Maintenance

According to BWSSB, their staff members have the necessary technical capacity and experience, gained through seminars, workshops and training programs. The turnover is very low, without any transfer to other cities, meaning knowledge obtained etc. through training can be accumulated within the organization. Contractors, which were commissioned to perform actual O&M activities, also received training in line with manuals for O&M of developed facilities during the project. The contractor has required technical knowledge of O&M activities because they oversaw construction and laying of facilities for this project. At the time of the ex-post evaluation, manuals for O&M were properly kept and utilized at each facility. Furthermore, taking into account the actual O&M situation during the site survey, no major problems were seen regarding technical capacity for O&M.

3.5.3 Financial Aspects of Operation and Maintenance

The balance of current transactions of BWSSB has recorded deficits in recent years (See Table 14)[39], given the increasing burden of power charges, which comprises 30-40% of the expenditure, interest payments on loans for investment projects[40] and water supply at public taps. However, its revenue from sales water secures most of the required O&M cost and proper O&M activities are conducted[41]. The rate of water charge collection is as high as 99% or so because of efforts made by BWSSB to apply new payment methods such as installing a kiosk allowing payment via ATM and introducing payment via website as well as the original payment method at the service stations. Furthermore, the site survey also showed that all

[38] Based on the responses of Questionnaire to executing agency.
[39] Although BWSSB is basically an autonomous entity, funding is invested by the state government based on the regulation, since water service is considered a public service.
[40] Project cost for the capital investment was allocated by the Government of Karnataka.
[41] Source: Interviews with financial department of BWSSB.

facilities were properly operated and maintained, thus there are no major issues in terms of securing the O&M cost at the time of the ex-post evaluation.

Table 14 BWSSB's Income and Expenditure

(Unit: Million Indian Rupees (INR))

	2012/2013	2013/2014	2014/2015
Income	**5,835**	**7,411**	**8,782**
Sales of Water	5,123	5,920	8,110
Other Income	713	1,491	671
Expenditure	**7,799**	**11,552**	**12,182**
Establishment	1,296	1,528	1,630
Power Charges	3,247	3,565	3,950
Repair and Maintenance	775	954	1,051
Cost of General Administration	510	865	793
Depreciation	882	1,633	1,661
Interest Payment on Loans	1,081	2,999	3,089
Provision	8	8	7
Surplus/Deficit	**▲1,963**	**▲4,141**	**▲3,400**

Source: Documents provided by BWSSB

Note: Some figures do not match in total because of the rounding.

BWSSB revised the water tariff during 2014/2015 to improve revenue, expecting to boost revenue in water sales from the next fiscal year and also continuously strove to save expenditure on power charges and other administration costs[42]. In addition, BWSSB is negotiating a water tariff setting plan which will be adjusted in proportion to the increased power tariff, since the power charge accounts for a large portion of expenditure. Regarding interest payments, BWSSB is working to reduce the burden by considering refinancing from institutions with lower interest rates[43] as well as approaching the state government to consider reducing interest on project loans.

3.5.4 Current Status of Operation and Maintenance

Facilities developed under this project are largely utilized properly at the time of the ex-post evaluation[44]. Though the utilization rate of some sewerage treatment plants was low as of the ex-post evaluation, those rates have been increasing yearly as shown in Table 9 and plan to be fully operational by 2020. Furthermore, steady progress was also confirmed by the time of the ex-post evaluation, though works to connect sewer lines remained relatively slow for a few years after project completion. Thus, BWSSB is expected to plan and make progress

[42] Interview with financial department of BWSSB.

[43] According to the financial department of BWSSB, by refinancing existing loans borrowed from the Life Insurance Cooperation (LIC) at a higher rate of interest to institutions like the Karnataka Urban Infrastructure Development and Financial Corporation (KUIDFC) which lend at lower rates, the burden of the interest payment would be reduced by 5%.

[44] Based on the interview survey to BWSSB and the site survey.

continuously to achieve the plan for full operation of sewerage treatment plants.

O&M works are commissioned to contractors. During the site survey, the evaluator observed that items and inspection frequency were recorded daily and preventive maintenance management sheets were utilized. Annual overhauls were also regularly conducted. All the necessary spare parts were procurable and each facility was properly operated. Sludge discharged from STPs was collected and used as fertilizer by farmers after being dried at a drying bed in the plants. Furthermore, taking into account the actual O&M situation during the site survey, no major problems emerged regarding the current O&M status.

No major problems have been observed in the institutional, technical and financial aspects of the operation and maintenance system. Therefore sustainability of the project effects is high.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project was conducted with the purpose of increasing the water supply and sewerage treatment in Bangalore city by constructing water supply and sewerage systems. Its relevance is high, since the project purpose is consistent with the national development policy of India and State Water Policy of Karnataka, both of which aimed to increase the water supply and improve hygiene conditions and development needs of Bangalore city, amid rapid development as well as Japan's ODA policy. Because this was the first large-scale donor supported public project for the executing agency, the bidding process was delayed and since longer was required to secure the sites and gain approval from the related authorities, the project period largely exceeded the plan. The project cost also exceeded the plan due to price escalation and the increased cost of acquiring land, hence the project efficiency was low. Beacause of this project, the coverage rates of water supply and sewage treatment rose as well as the volume of water supply and wastewater treated. The overall quality of the treated water at STPs has also met the requirement set by the State Pollution Control Board. Living and hygiene conditions have also improved, while IT and automobile companies set up new business in the area where the water supply and sewerage systems were developed, meaning that this project also helped improve the conditions for the industrial foundation in the city, thus its effectiveness and impact were high. The sustainability of the project effect is also high as no serious issues were confirmed in terms of structural, technical and financial aspects of the O&M, while the facilities developed under this project have also been properly operated and maintained.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agency

As the area of Bangalore city has continued to expand even after the project completion, there is a need to develop a sewer line to cover the sewerage services for the population. Accordingly, construction works to connect sewer lines continue as of now. BWSSB needs to carefully re-examine the feasible plan and make steady progress as planned toward full utilization of facilities in the future since the connection works showed slow progress after project completion.

4.2.2 Recommendations to JICA and Executing Agency

JICA has supported efforts to respond to the increased demand for water supply and sewerage system in Bangalore city by implementing this project and Phase 2. In terms of the predicted demand at the time of appraisal, since both projects need to be completed in order to meet the demand, delaying Phase 2 may affect to generate effects from those projects. Accordingly, to avoid any delay, the executing agency must make steady progress with Phase 2, which has been delayed. JICA also needs to monitor progress and support the smooth implementation of Phase 2.

4.3 Lessons Learned

・Support for the executing agency which lacked experience in conducting large-scale projects

This project was the first large-scale public works project for the executing agency, which delayed the project and made land acquisition problematic due to a lack of experience in tendering works. In future, if the executing agency lacks experience of conducting large-scale projects, the consultants and JICA must provide support with attention after the project starts, such as preparation of tendering documents, etc., through consulting services. In addition, to prevent any project delay, proposing a more careful monitoring plan in detail at the appraisal and including it in the project activities would be effective.

・Setting of the project period which allowed spare time for the sewerage sector project

In this project, the need to change the route of the sewer arose with the relocation of STPs, led to a longer time to obtain approval for these changes from related authorities (Bangalore Development Authority and Municipality of Bangalore) and became a cause for the project delay. When changing the output of sewers, a longer period would be needed, since changes to the route, as well as the design considering vertical interval and etc., is also required due to their function. In addition, there are also challenges, such as the fact that time frame required for new approval for a modified scope differs by authorities. Therefore, to support the sewerage sector project which includes laying the sewer, the related party making the project plans needs to set a project period which carefully considers the features of the sewerage sector at the time of appraisal.

・Efficient and effective selection method for O&M activities

Under this project, a contract for O&M activities was concluded for seven years after project completion with contractors having constructed the facilities of this project. The contracted contractors are familiar with project facilities as they were involved in O&M training for each facility and equipment during the project. As such, applying contract methods which assign contractors with sufficient knowledge of facilities for O&M activities for a certain period after the project completion helps facilitate proper daily O&M activities by utilizing sufficient technical experience. It also helps to maintain the project facilities in good condition.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
1.Project Outputs	Water Supply: Intake Structure 1 Raw water gravity Main. 1 Water Treatment Plant 1 CWR 3 approx. 36 million L in total Pumping Plants approx. 1,250KW x 8 Treated water transmission Pipe Steel approx. 75km WPRS Water transmission & distribution Reservoirs 7, approx. 217 million L in total Overhead tanks 5 Pumping stations 2 Distributing pipe 125km Procurement of equipment (seepage detection, flowmeter) Sewerage System: Expansion 2 (85MLD in total) New Construction 5(325 MLD in total) Pumping station 11 Trunk sewer Reinforced concrete approx.150km Cast iron pipe approx. 9km Others (Machinery & appliances for laboratory, cleaning equipment for sewer maintenance)	Water Supply: Intake Structure As planned Raw water gravity Main. As planned Water Treatment Plant As planned CWR As planned approx. 48 million L in total Pumping Plants approx. 1,100KW, 1,200KW, 1,300KW x 3 Treated water transmission Pipe Steel approx. 94km WPRS Water transmission & distribution Reservoirs7, approx.147 million L in total Overhead tanks Canceled Pumping stations As planned Distribution pipe 147km Procurement of equipment As planned Pilot project for non-revenue water Sewerage System: Expansion 1 (55 MLD in total) New Construction 7(245 MLD in total) Pumping station 8 Trunk sewer Reinforced concrete approx. 55km Cast iron pipe approx. 16km Others As planned
2.Project Period	January 1996– December 2001 (72 months)	January 1996 – May 2005 (113 months)
3.Project Cost Amount Paid in Foreign Currency	11,884million yen	Unknown[Note]
Amount Paid in Local currency	21,591million yen (7,471 million Indian rupee)	Unknown[Note]
Total	33,474million yen	36,253million yen
Japanese ODA Loan Portion	28,452million yen	23,047million yen
Exchange Rate	1 Indian rupee= 2.89 yen (As of April 1995)	1 Indian rupee = 2.76 yen (Average between January 1996 and May 2005)

Note: This ex-post evaluation was conducted more than ten years after the project completion. Although attempts were made to confirm the project cost written in the document provided by JICA during the surveys, no document including detailed information on foreign and local currencies was available, because the executing agency imposed a ten-year retention rule for project documents.