Ex-Post Project Evaluation 2016
Package I-9 (Brazil)

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ICNET Limited

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Federative Republic of Brazil

FY2016 Ex-Post Evaluation of Japanese ODA Loan Project

"Sanitation Improvement Project for Baixada Santista Metropolitan Region (I) (II)" /

and

Technical Assistance Project related to ODA Loan "Environmental Monitoring Project for Baixada Santista Metropolitan Region"

External Evaluator: Noriaki Suzuki, IC Net Limited

0. Summary

The Baixada Santista Metropolitan Region in Brazil is a region made up of nine cities. Situated between the Greater São Paulo and the Atlantic Ocean, this tourist destination is marked by rapid development, especially in urban areas. The objective of the project is to ameliorate water pollution associated with rapid population growth in the region and provide stable water supply to meet the surging water demand in these urban areas by developing water supply and sewerage facilities in the areas, thereby contributing to the improvement of the local living environment. The project is relevant to the Brazilian government's policies and development needs, as well as the development needs of the region and Japan's ODA policy. Therefore, its relevance is high. The time-consuming bidding process resulted in a four-year delay for starting the construction work. This in turn led both to higher prices of materials and equipment and to revisions to the original design associated with the lapse of time. These consequences greatly pushed up the costs for the work, necessitating additional loan. Even after the additional ODA loan, the budget for the construction was not executed as planned because of three factors: (i) higher costs associated with an extended construction period; (ii) the soaring costs of laying trunk sewer[1] and sewage collection network;[2] and (iii) more funds were allocated to combat the water scarcity that began to take its toll in the metropolitan area around 2014. Thus, the efficiency of the project is low. Although the wastewater treatment plants and the water supply system have been completed, three percent of the planned sewerage connections have remained uncompleted. Thus, the project period and cost are both significantly higher than planned. Despite the unfinished components, this project is highly effective. The wastewater treatment volume, household connections, and sewerage coverage have all exceeded 80 percent of the targets. The project has contributed to improved water quality in the region partly because of its Technical Assistance project called the "Environmental Monitoring Project for Baixada Santista

[1] A trunk sewer is a trunk drainpipe that is laid under a road surface at an appropriate gradient so as to convey wastewater to a wastewater treatment plant.

[2] A sewage collection network is a network of drainpipes that are laid underground along sewer mains to collect wastewater from households.

Metropolitan Region."[3] In addition, a beneficiary survey in the region has shown that many residents feel their living environment has improved because of increased water supply, improved water quality, and better household sanitation, suggesting that they are highly satisfied with the project. Therefore, the effectiveness and impact of the project are high. Following the completion of the work, the facilities are operated and maintained by the Baixada Santista Business Unit (RS) of the Basic Sanitation Company of the State of São Paulo. No problems have been observed in the institutional, technical or financial aspects of the maintenance of the project. Therefore, the sustainability of the project effect is high. In light of the above, this project is evaluated to be satisfactory.

1. Project Description

Project Location

A new wastewater treatment plant in Itanhaém

1.1. Background

The State of São Paulo is the hub of economic activity in Brazil. In 2001, its GDP stood at some 400 billion reais (approximately 15 trillion yen), accounting for 33 percent of Brazil's GDP. In the same year, the state's population amounted to 37 million, representing 22 percent of the country's total population. The Baixada Santista Metropolitan Region[4] in the state is particularly marked by rapid economic development in recent years. Made up of nine cities that are situated between the Greater São Paulo and the Atlantic Ocean, this region is an industrial area that boasts the country's largest trade port of Santos as well as the city of Cubatão, a major industrial center in the state. The region is also a coastal resort area nearest from the Greater São Paulo. Rapid development has been particularly prominent in urban areas. Given such remarkable economic development, the state government anticipated a rapid population growth[5]. It was developing basic living infrastructure such as roads and power grids at a rapid pace.

[3] This original environmental monitoring component of this ODA loan project, has been spun off as a Technical Assistance Project related to ODA Loan. Both projects are subject to an integrated ex-post evaluation. See "1.3 Evaluation Policy" for details.

[4] The Baixada Santista Metropolitan Region refers to the area made up of nine cities in the coastal region of the State of São Paulo, namely, Bertioga, Cubatão, Guarujá, Santos, São Vicente, Praia Grande, Mongaguá, Itanhaém, and PeruíbePeruíbe. It is the target area of this project.

[5] The population, which stood at 1.5 million in 2001, was projected to reach 2.9 million by 2016.

Sewerage development, however, was considerably lagging behind because the region's geographic conditions called for more investment than in other regions. As of 2004, sewerage coverage was 53 percent for the nine cities on average but less than 30 percent for the five cities other than Guarujá, Santos, São Vicente, and Praia Grande, and the five cities had lower level coverage as compared with the national average of 31.3 percent. Untreated sewage flowing into rivers and coast was causing water pollution, aggravating the living environment of local residents. The resultant marine pollution was adversely affecting tourism, a major industry in the region. Although water supply coverage was already as good as 100 percent, the region's installed capacities to take, convey, and purify water had reached their limits. Available water supply was definitely scarce to meet the demands of the ever-growing population and that of a growing number of tourists during the peak season. The Government of the State of São Paulo planned to install new water supply and sewerage facilities in order to improve the living environment in the region that had been seriously deteriorated. As part of the plan, the state government and Companhia de Saneamento Básico do Estado de São Paulo (the Basic Sanitation Company of the State of São Paulo; hereinafter referred to as "SABESP") requested, through the Brazilian government, ODA loan assistance in installing and developing such facilities from the Japanese government, which approved the request.

1.2. Project Outline

The objective of this project is to ameliorate water pollution associated with rapid population growth and provide stable water supply to meet the surging water demand in the Baixada Santista Metropolitan Region, a coastal region of the State of São Paulo, by developing sewerage facilities, an environmental monitoring system, and water supply facilities, thereby contributing to the improvement of the living environment of local residents.

Loan Approved Amount/ Disbursed Amount	40,489 million yen (1) 21,320 million yen (2) 19,169 million yen	/ / /	40,489 million yen (1) 21,320 million yen (2) 19,169 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	(1) August 20, 2003 (2) July 1, 2010	/ /	(1) August 6, 2004 (2) February 15, 2011

Terms and Conditions	Interest Rate	(1) 2.5% (1.8% for wastewater treatment plants and consultation services) (2) 2.5% (1.8% for wastewater treatment plants and consultation services)
	Repayment Period (Grace Period)	25 years (7 years)
	Conditions for Procurement	General Untied
Borrower / Executing Agency	Companhia de Saneamento Básico do Estado de São Paulo (SABESP)	
Project Completion	Uncompleted (as of December 2016. Scheduled for completion by December 2018.)	
Main Contractors	Construbase Engenharia Ltda. (Brazil) / Telar Engenharia e Comercio Ltda (Brazil) / ECL Engenharia e Construcoes Ltda (Brazil), Saenge-Engenharia de Saneamento e Edificacoes Ltda. (Brazil), Jofege Pavimentacao e Construcao Ltda (Brazil) / Enotec Engenharia Obras e Tecnologia (Brazil), Delta Construcoes S.A. (Brazil) / Araguaia Construtora Brasileirade Rodovias S.A. (Brazil), Constructora Andrade Gutierrez S.A.(Brazil), Carioca Christiani-Nielsen Engenharia S.A. (Brazil) / Construtora Norberto Odebrecht (Brazil), Consben Construcoes e Comercio Ltda (Brazil), Cesbe S.A. Engenharia e Empreendimentos (Brazil) / Construtora Elevacao Ltda. (Brazil) / Cobrape Cia Brasileira de Projetos e Empreendimentos (Brazil)	
Main Consultants	Logos Engenharia S.A. (Brazil) / Ductor Implantacao de Projetos S.A. (Brazil) / JNS Engenharia Consultoria e Gerenciamento S.C. Ltda (Brazil) / Chuo Kaihatsu Corporation (Japan)	
Feasibility Studies, etc.	Secretaria De Recursos Hidricos Saneamento E Obras, 2000	
Related Projects	[Technical Cooperation] The Project for Capacity Development on Non Revenue Water Control for Sanitation Company of the State of São Paulo (2006–2010) [Japanese ODA Loan] Non Revenue Water Control Project in São Paulo State (February 2012) [Other bilateral and multilateral donors] Water Sector Project in the State of São Paulo (World Bank) (1989–1993) Guarapiranga River Basin Environmental Sanitation Project (World Bank) (1993–2000) Project of the Tietê River Decontamination (IDB) (1992–2008)	

JICA also conducted a Technical Assistance project Related to ODA Loan “Environmental Monitoring Project for Baixada Santista Metropolitan Region” (hereinafter referred to as “Technical Assistance project”).

Overall Goal		The water quality and sanitation in Baixada Santista of the coastal region in the State of São Paulo is improved, which contributes to the improvement of the living conditions.
Project Purpose		Environmental monitoring for the Target Area is appropriately implemented, enabling to verify and evaluate the water quality conditions.
Outputs	Output 1	Environmental monitoring plan is drawn up based on the environmental characteristics of the Target Area.
	Output 2	Environmental monitoring is appropriately implemented based on the above-mentioned Environmental monitoring plan.
Total cost		180 million yen
Period of cooperation		March 2010–February 2013
Executingagency		Companhia de Saneamento Básico do Estado de São Paulo (SABESP)
Supporting Organization in Japan		Techno Chubu Company, Ltd.

This ex-post evaluation covers the Technical Assistance project and the main ODA Loan project and conducts as an integrated ex-post evaluation.

1.3. Evaluation Policy

The "Environmental Monitoring Project for Baixada Santista Metropolitan Region" was originally designed as an environmental monitoring component of the main project; it has been spun off and approved as a separate technical cooperation project for 2009, as discussed later in 3.2.1 (2). The Project Purpose of this Technical Assistance project is to improve the implementation structure of water quality monitoring in the public waters into which the treated wastewater flows, which is the purpose of the original environmental monitoring component of the main project. The Overall Goal of the Technical Assistance project is to strengthen water quality monitoring on public waters, that contributes to the improvement of the living environment in the region under the main project. For these reasons, the Technical Assistance project is closely related to the main project. Given the background to the formulation of the Technical Assistance project and its close association with the main project, the evaluator has decided to evaluate the two projects integrally in this ex-post evaluation.

2. Outline of the Evaluation Study

2.1. External Evaluator

Noriaki Suzuki, IC Net Limited

2.2. Duration of Evaluation Study

This ex-post evaluation study was conducted with the following schedule.

Duration of the Study: August 2016–February 2018

Duration of the Field Study: November 21–December 8, 2016; May 21–29, 2017

2.3. Constraints during the Evaluation Study

Available information on project planning and implementation phases was limited. For example, no materials from the time of additional ODA loan were available that clearly stated the basis for the redefined targets for the operation and effect indicators. Moreover, officials at the executing agency for this project had little idea about the redefined targets for these indicators. Such lack of available information caused two major constraints in the evaluation. First, it was unclear whether the target for the daily volume of wastewater treated—one of the operation and effect indicators—was for annual average or maximum value, as there was no description of the basis for setting this particular target. It was eventually assumed that the target was for annual maximum value in view of the fact that the estimated average daily volume far exceeded the target. The evaluation had to be made based on this assumption. Second, it was questionable whether the baselines for two of the operation and effect indicators in the water supply services—the non-revenue water rate and the leakage rate—were appropriate. Therefore, the external evaluator checked the relevance of these baselines by comparing them with data from Brazilian National Information System on Sanitation (hereinafter referred to as "SNIS"). The baseline figure that were found irrelevant were replaced by figures from SNIS. For these constraints, this ex-post evaluation examines the relevance of the targets for the operation and effect indicators and assesses the extent to which the executing agency and JICA played a part or contributed, solely based on the results of the analysis of the reliability and adequacy of the information and data that were available at the time of evaluation.

3. Results of the Evaluation (Overall Rating: B[6])

3.1. Relevance (Rating: (③)[7])

3.1.1. Consistency with the Development Plan of Brazil

(1) Development plan at the time of appraisal

The Pluriannual Plan (*Plano Plurianual*; hereinafter referred to as "PPA") 2004–2007, the mid-term development investment plan of the federal government of Brazil, defined the water supply and sewerage sector as a top priority to be addressed as it provides basic infrastructure services. PPA 2004–2007 set out the target of raising sewerage coverage from 51 percent to 58 percent on average and water supply coverage from 92 percent to 94 percent, both on average, in urban areas across the country. Based on the federal government's policy, the State of São Paulo set the target of adding 400,000 sewerage household connections and 330,000 water

[6] A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory
[7] ③: High, ②: Fair, ①: Low

household connections in urban areas in its version of PPA 2004–2007. This project is designed to (i) develop sewerage in urban areas in the Baixada Santista Metropolitan Region that are high in population growth but low in sewerage coverage, and (ii) develop water supply facilities that can meet the demand of the growing population and cope with the anticipated growth in number of tourists during the peak season in the region, where water supply coverage is already nearly 100 percent. Therefore, the project is highly consistent with the development plan of Brazil at the time of appraisal.

(2) Development plan at the time of the ex-post evaluation

At the time of the ex-post evaluation, the water supply and sewerage sector was still high on the agenda of PPA 2012–2015 and PPA 2016–2019 of both the federal government of Brazil and the State of São Paulo. The main objectives are to extend water supply services to not only urban areas but also rural area and develop sewerage in urban areas for sanitary improvement. Meanwhile, *the National Plan for Basic Sanitation* (*Plano Nacional de Saneamento Básico*; hereinafter referred to as "PLANSAB"), which was announced in April 2011, states that 95 percent of households will have access to drinking water through water supply services and 81 percent of wastewater will be treated, both by 2023, across the country. This project is located in the Baixada Santista Metropolitan Region, which boasts rich tourism resources among other regions in the State of São Paulo, and is aimed at (i) expanding lower sewerage coverage, especially in urban areas where further economic development is expected as part of efforts to improve sanitation in the region; and (ii) expanding and strengthening water supply services that can cope with the projected increase in water demand associated with the expected growth both in local populations and in the number of tourists in the peak season. This project is thus consistent with the national development plan at the time of evaluation as well as at the time of appraisal. Therefore, the project is highly relevant.

3.1.2. Consistency with the Development Needs of Brazil

(1) Development needs at the time of appraisal

In the Baixada Santista Metropolitan Region, the existing wastewater treatment plants were largely in need of bad repair. They discharged wastewater that had undergone only primary treatment (removing only solid matters) into coastal waters. Water quality tests in the coastal area found extremely high coliform counts. The discharge of inadequately treated wastewater into coastal seas and rivers was causing water pollution, seriously aggravating the living environment of local residents. The 2003 water quality test that covered 242 points along the coast of the Baixada Santista Metropolitan Region found that coliform counts at 202 points were larger than 1,000/100ml, the water quality standard for public waters in the State of São Paulo, suggesting that the associated marine pollution was also affecting tourism, a key industry

in the region. Meanwhile, the existing water supply facilities were being used up to their capacity in terms of taking, conveying, and purifying water. Available water supply was definitely scarce to meet the demand of the rapidly-growing population and that of a growing number of tourists during the peak season. In light of these circumstances, there was a great need to provide stable water and wastewater services in the region at the time of appraisal.

(2) Development needs at the time of the ex-post evaluation

At the time of the ex-post evaluation, water supply and sewerage coverage in the Baixada Santista Metropolitan Region as a whole is above the national average and better than at the time of appraisal. Although sewerage coverage in the region has been improved to 71 percent, six cities have yet to reach the PLANSAB target of achieving 75 percent by 2010: Bertioga (39 percent), Cubatão (51 percent), Guarujá (63 percent), São Vicente (71 percent), Praia Grande (72 percent), and Itanhaém (34 percent). These cities are still in significant need of sewerage services. It is fair to say that the Baixada Santista Metropolitan Region is still in need of water supply services as well. Water supply coverage in the region was 93 percent in 2016 but below the PLANSAB target of achieving 99 percent in the State of São Paulo by 2018.

There remains a need for water supply services because the region has yet to achieve the target for the State of São Paulo for 2018, although this project made it possible to meet the growing water demand associated with the growing number of tourists for the future. In addition, with regard to the need of sewerage services, some cities have yet to achieve the PLANSAB target of raising sewerage coverage to 75 percent in urban areas by 2010. Thus, the region is still in significant need of sewerage services. Therefore, this project is highly relevant.

3.1.3. Consistency with Japan's ODA Policy

JICA's Medium-Term Strategy for Overseas Economic Cooperation Operations (2002–2004) identified "projects for environmental conservation" and "support for economic infrastructure development, social sectors, and poverty measures for the correction of income gaps and regional gaps" as priority areas of assistance, in view of the worsening living environment associated with urbanization as well as marked gaps between the rich and the poor and among regions. The Japanese government's ODA policy for Brazil of 2006 identified the environment as one of the five priority areas. Japan has a strong track record in assistance not for water supply and sewerage. It was hoped that Japan's assistance would address delay in the development of water and wastewater services in metropolitan areas that were undergoing rapid population concentration to help improve the living environment there. This project aims at coping with natural environmental problems and contributing to the improvement of the living environment in the region. Therefore, the project is highly consistent with Japan's ODA policy.

In light of the above, this project has been highly relevant to Brazil's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

3.2. Efficiency (Rating: (①))

3.2.1. Project Outputs

(1) Summary of the water and wastewater systems

This project includes two ODA Loan projects: one that was agreed in 2004 (hereinafter referred to as "Phase I") and the other is the additional ODA loan extended in 2011 (hereinafter referred to as "Phase II"). For this additional loan, the targets for some of the operation and effect indicators, including wastewater treatment volumes and BOD concentrations in treated water were adjusted to reflect the actual figures as of 2009 as well as the projected additional population growth associated with the postponed project completion year. However, no significant component was added that entailed the expansion of the project scope.

Although the installation of the nine wastewater treatment plants was completed by 2011, the laying of trunk sewer and sewage collection network, and the work for sewerage connections were significantly delayed for two major reasons. One was that much time was spent for the procedures for the work to pave municipal roads in relation to municipal authorities. The other was that the work to lay trunk sewer was partly suspended owing to changes in municipal governments. Because of this significant delay, the total lengths of trunk sewer and sewage collection network, and the numbers of sewerage household connections were far below the planned figures as of December 2013 in four cities—Cubatão, Guarujá, Praia Grande, and Itanhaém—leaving many uncompleted sections. After January 2014, the uncompleted sections were redefined as unconstructed portions to be financed by the executing agency (hereinafter referred to as "borrower's unconstructed portions") and construction work for them began as a governmental project. After the first half of 2014, water scarcity began to take its toll in the State of São Paulo as a whole. The state government had to spend much money to address the problem. The budget originally earmarked for the partner's unconstructed portions could not be executed. The work for partner's unconstructed portions was significantly delayed. Largely because of this delay, small portions of the planned facilities remained uncompleted as late as December 2016. Specifically, 1.3 percent of the trunk sewer and sewage collection network (13.39 km), 4.4 percent of the sewerage connections (5,410 households), and 3.5 percent of pumping stations (3 locations) were uncompleted.[8] The water scarcity ended in mid-2016. It is therefore expected that the budget for the partner's unconstructed portions will be executed

[8] As of December 2016, the partner's unconstructed portions in this project existed in three cities: Cubatão (1.203 km of sewage collection network and 1,930 connections uncompleted), Guarujá (8.815 km of sewage collection network, 2,117 connections, and three pumping stations uncompleted), and Itanhaém (3.374 km of sewage collection network and 1,363 connections uncompleted).

without any problems and that all the work for them will be completed by 2018. Given that some portions of the planned trunk sewer and sewage collection network, and pumping stations remained uncompleted in Cubatão, Guarujá, and Itanhaém as of December 2016, the efficiency evaluation excluded these portions in evaluating the project outputs in sewerage. All the water supply work was completed by May 2013.

(2) The environmental monitoring component

Consultations between JICA and SABESP over the additional ODA loan revealed that the division of role in the original environmental monitoring component of this project was not clearly defined between SABESP and Companhia Ambiental do Estado de São Paulo (the Environmental Company of the State of São Paulo; hereinafter referred to as CETESB). It was even suggested that the whole component be outsourced to a professional service provider. Eventually, the JICA and SABESP agreed to exclude this component from the scope of this project. They noted that the component was essentially designed to provide facilities and equipment for monitoring the water quality of public waters and that wastewater treatment plants in the project area as well as the facilities and equipment at SABESP' regional offices were adequate for the implementation of such monitoring. Meanwhile, a water quality monitoring program had not been formulated for the region; the structure for monitoring the water quality of public waters was inadequate. In November 2009, SABESP and JICA agreed to implement the environmental monitoring component as a project that was separate from, but Technical Assistance to, the ODA Loan project. The Technical Assistance project was implemented between 2010 and 2013. The original environmental monitoring component included three subcomponents: (i) the construction of a monitoring center, (ii) the installment of automatic water quality monitoring devices, and (iii) the installment of a pollution source monitoring equipment. Under the new Technical Assistance project, Subcomponent (i) was transformed into capacity building of simple laboratories in wastewater treatment plants as well as the sanitation control section in the Baixada Santista Metropolitan Region[9] (hereinafter referred to as "RSOC"), as these units have similar functions. Subcomponents (ii) and (iii) were transformed into technical cooperation for operators at wastewater treatment plants as well as employees at the Baixada Santista Business Unit, RSOC, as these subcomponents can be replaced with regular monitoring at fixed points.

As originally planned, the Technical Assistance project involved the assignment of an expert (10 M/M) and provision of machinery and equipment as inputs. Project activities such as the implementation of a baseline study, the formulation of an environmental monitoring program,

[9] A division within the Baixada Santista Business Unit, which is in charge of the operation and maintenance of the water supply and sewerage facilities that have been constructed in this project. RSOC is responsible for water quality control and monitoring.

the preparation of an environmental monitoring manual continued to January 2011. After January 2011, activities for Output 2 were launched. In accordance with the environmental monitoring program and manual that had been developed for Output 1, environmental monitoring was conducted nine times in total by 2013. This monitoring focused on fecal coliform counts and eutrophication at 23 locations in the Baixada Santista Metropolitan Region. No major problems were found at the locations where treated wastewater was discharged.[10]

An environmental monitoring report was prepared each time, bringing the total number of such reports to nine. In response to the findings of this environmental monitoring, the environmental monitoring program and manual were reviewed for revisions. Everything was done according to plan. Therefore, the Technical Assistance project is considered to be highly efficient.

3.2.2. Project Inputs

3.2.2.1. Project Cost

(1) Summary of Project Cost

The total project cost for Phase I and Phase II up to December 2016 is 136,687 million yen[11] as compared to the original estimated cost[12] of 38,787 million yen,[13] representing 352 percent of the planned cost.[14] The four factors, which were also partly responsible for the additional ODA loan, are as follows: First, the start of construction work had to be postponed in order to cope with the conditions when the environmental license was granted, resulting in higher costs of materials and equipment. Second, the basic design for wastewater treatment had to be altered. For example, during the foundation work for wastewater treatment plants, an intermediate soil layer was found that prevented the piles from being sunk into the specified depth. This required layer replacement and other work. Since the wastewater treatment plant in Santos is located in a residential area, this plant needed to be designed to prevent adverse environmental impacts such as bad odor and noise from being felt in the neighborhoods. Specifically, it was necessary to install a sedimentation tank, in one building and other facilities responsible for the subsequent

[10] The monitoring found that fecal coliforms were more than 10,000 counts/100 ml in the locations where domestic sewage and wastewater were discharged directly into the sea or rivers but below 2,500 counts/100 ml in the locations where wastewater was discharged after being treated. Nitrogen levels, which indicate the extent of eutrophication, were around 0.2 mg/l in total as compared to the recommended thresholds of 0.1 mg/l for nitrate nitrogen and 0.25 mg/l for Kjeldahl nitrogen at the monitoring locations. Although phosphorus levels were higher than the allowable limit of 0.02 mg/l at a few locations, eutrophication was found to be under control in the locations where wastewater was discharged after being treated.

[11] Calculated at an exchange rate of 1R$=46.61JPY as recorded by the IMF.

[12] Reflecting the reduction in the budget for the environmental monitoring component of the original project from 779 million yen to 264 million yen (250 million yen funded by SABESP plus 14 million yen funded by the Japanese ODA Loan).

[13] Excluding a budget of 434 million yen for the environmental monitoring component because this particular component was not implemented as part of this project. The total project cost was originally estimated at 39,221 million yen.

[14] Or 163% of the planned cost when compared to a total project budget of 83,829 million yen that reflects the additional loan.

processes in other buildings. Third, within Brazil's three-tiered environmental license,[15] although the first environmental license was readily obtained at the project planning phase, the second environmental license at the pre-work phase entailed collateral conditions that called for more stringent control of odor and noise at wastewater treatment plants and pumping stations. This necessitated a more powerful deodorizing system and pumping motors that generate less noise. Forth, the redesigning of the project associated with the lapse of time entailed higher costs. The four factors that raised the actual project cost after the appraisal of additional ODA loan are as follows: First, the extension of work meant higher costs of consulting services. Second, the adoption of a construction method that does not entail road-cutting (pipe jacking method) in laying trunk sewer and sewage collection network along heavy-traffic roads pushed up the cost of installing sewerage connections[16] Third, the extension of trunk sewer and sewage collection network entailed higher costs of sewerage-related construction work. Fourth, the laying of sewerage connections for some buildings involved extra work, including the cutting of adjacent roads, the laying of connections, and the rehabilitation and pavement of these roads.

(2) Additional ODA loan

In this project, an additional loan was provided to finance (i) the additional cost of 233 million reais resulting from soaring prices of materials and equipment in the global market triggered by the growing demand in China since 2004; (ii) the additional cost of 109 million reais to meet the collateral conditions of the environmental license; and (iii) the additional cost of 140 million reais arising from the redesigning of the project and the adjustment of the implementation structure that were associated with the lapse of time.[17] Although these additional costs should be more or less funded by the physical contingency for the project, it is deemed impossible to anticipate such a huge increase in costs; the additional costs were relatively small in August 2003, when the exchange of note (E/N) was signed. SABESP tried in vain to obtain loan from international donors other than JICA. It approached multilateral donors for possible loan, but they were reluctant, noting that they were not involved in the project formulation process and that they could not finance in the middle of the process, only the additional costs incurred from the ongoing project of JICA. Therefore, the additional ODA loan that was extended to complete the project and generate project impacts as planned is judged to be relevant.[18]

[15] In Brazil, the environmental license must be obtained at three phases: planning, work commencement, and work completion.

[16] In this report, a sewerage connection refers to a drainpipe that is installed at each household for conveying domestic sewage into a sewage collection network.

[17] According to the document entitled "August 2009_reasons for additional loan" from JICA, it took four years after 2003 for the construction work to begin. This was the main reason for the lapse of time.

[18] In evaluating the project efficiency, the additional ODA loan was interpreted to mean no increase or decrease in the outputs but an increase in the project cost; they did not involve expanding the project scope or directly affect the project impacts.

(3) Inputs for the Technical Assistance project of ODA Loan

The table below shows the planned and actual inputs:

Inputs	**Plan**	**Actual** (at completion)
Dispatch of experts	1 expert (10M/M)	1 expert (10M/M)
Trainees received	Unspecified number of participants	3 participants
Third-country training	None	None
Equipment	Provided (No detailed specification)	Provided (bottom samplers, water samplers, etc.)
Total cost	180 million yen	180 million yen
Inputs from the recipient government	Allocation of counterparts Project office, utility expenses, office equipment (purchased), expenses on the counterparts' side associated with project activities (traveling expenses, pay, etc.)	Allocation of counterparts Project office, utility expenses, office equipment, expenses on the counterparts' side associated with project activities (traveling expenses, pay, etc.)

3.2.2.2. Project Period

Phase I was significantly longer than planned. It lasted 150 months until December 2016 as compared to the planned period from July 2004 to February 2009 (56 months). This represents 268 percent of the planned period; the project period largely exceeded the plan. It will represent 311 percent of the planned period if the whole project is completed by December 2018 (174 months), including the partner's unconstructed portions: sewage collection network, pumping stations, and sewerage connections in Cubatão, Guarujá, and Itanhaém. All the wastewater treatment plants were completed. They were all put into operation by 2011. Water supply facilities were completed by May 2013. They were put into full operation from 2014. Meanwhile, trunk sewer and sewage collection network, and sewerage connections lagged far behind. Some of them remained uncompleted at the time of evaluation.

Table 1: Time of Completion for Trunk sewer and Sewage collection network, and Sewerage Connections

City	**Trunk Sewer**	**Sewage collection network**	**Sewerage Connections**	**Pumping stations**	**Time of completion (scheduled)**	**% of planned period**
Bertioga	Completed	Completed	Completed	Completed	December 2013	204%
Cubatão	Completed	Uncompleted	Uncompleted	Completed	December 2017	289%
Guarujá	Completed	Uncompleted	Uncompleted	Uncompleted	December 2018	311%
Santos / São Vicente	Completed	---	---	Completed	May 2011	148%
Praia Grande	Completed	Completed	Ongoing	Completed	December 2016	268%
Mongaguá	Completed	Completed	Completed	Completed	December 2013	204%
Itanhaém	Completed	Uncompleted	Uncompleted	Completed	October 2017	286%
Peruíbe	Completed	Completed	Completed	Completed	December 2013	204%

Source: documents provided by JICA, and by implementing agencies, etc.

The reasons of the delay are the same as those for the higher project cost as described earlier. There are major reasons why the project period was significantly longer than planned. First, the bidding process lasted more than four years.[19] Second, stricter environmental standards were put in place. Third, changes in municipal governments resulted in the suspension of the construction. Fourth, trunk sewer and sewage collection network were extended.[20] Fifth, a budgetary priority was placed on measures to combat the water scarcity that hit the State of São Paulo in implementing borrower's unconstructed portions. For this reason, the budget originally earmarked for the partner's unconstructed portions were not executed as planned.

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

Financial internal rate of return (FIRR[21])

Factors	Project life: 25 years, Expenses: construction cost and maintenance cost on this project, Benefits: revenue from sewage charge		
At the time of appraisal	0.27% (sewerage project component)	At the time of ex-post evaluation	-5.18% (sewerage project component)

As the calculation methods and grounds of the time for the FIRR cannot be identified, recalculation was implemented in accordance with the factors in the above-mentioned table, making use of the calculation methods of the FIRR that SABESP owns in order to monitor its own financial sustainability. Although precise variance cannot be analyzed without identifying the calculation methods and grounds,[22] the FIRR is considered to be under 0.27% that was estimated at the time of the appraisal on the ground that (i) the project cost has become more than three times bigger, (ii) as SABESP simulated 40 years of project life and set the sewage charge according to that, it is considered that the sewage charge was set lower than the time of appraisal. According to SABESP, since the Baixada Santista area, which is a tourist site, especially has higher environmental standards compared to other areas and has a number of regulations on pavements along with sewerage work, where the construction cost becomes extremely high, its FIRR becomes lower compared to other areas. Meanwhile, as the water

[19] The main causes include the following: the implementation of the price bidding after the decision of the court on a lawsuit filed by a disqualified contractor during the bidding time; the expenditure of over two years for the price negotiation with the lowest bidder of which bidding price largely exceeded the estimated price; and after contract agreement the delay in the contract renegotiation with the second price bid due to the corruption allegation of the bid-winning consortium in another project.

[20] The trunk sewer and sewage collection network were extended because there was no choice but to take detour routes instead of those of the trunk sewer and sewage collection network networks scheduled in the plan because of the extension of housing sites and the direction of municipalities. Moreover, the trunk sewer and sewage collection network were further extended in order to carry sewage water to a sewage treatment plant in the upper stream after carrying it to a pumping station along the coast in flat lands like Praia Grande and Itanhaém, where it is impossible to have gravity flow to a sewage treatment plant making use of the inclination of the land.

[21] Since the FIRR of the waterworks project was not calculated at the time of the appraisal, the FIRR of the sewerage project alone is calculated for the ex-post evaluation.

[22] For example, the calculation methods for the maintenance cost of the project are not clarified in the provided appraisal documents. In the ex-post evaluation, the maintenance cost per 1 m^3 sewage treatment in Santos is calculated by multiplying the estimated amount of sewage treatment in the targeted area of the project. This fact makes it impossible to have precise variation analysis.

supply project of SABESP has a high rate of return, and the FIRR is 8 to 9% on average, which makes enough profit to cover the deficits of the sewerage project, the rate of return of the both waterworks and sewerage projects turns always positive.

Economic internal rate of return (EIRR)

Because the EIRR was not set at the time of the appraisal, the EIRR is not calculated for the ex-post evaluation.

In consideration of the above, the efficiency of the project is low because both the project cost and project period largely exceeded the plan.

3.3. Effectiveness[23] (Rating: (③))

3.3.1. Quantitative Effects (Operation and Effect Indicators)

3.3.1.1. Sewerage project

To evaluate effectiveness, the amount of sewage treatment (m^3/day),[24] the number of households connecting with sewerage, the rate of sewerage connection and the BOD concentration of treated water (mg/l) have been set as the indicators to be handled. The amount of sewage treatment, the number of households connecting with sewerage and the rate of sewerage connection covered for the whole city, and the BOD concentration of treated water covered effluent after sewage treatment at nine sewage treatment plants established in the project. When additional funding was provided, the targets of the Phase I of operation and effect indicators (set on the basis of the baseline in 2000) were respectively reset as the targets of the Phase II on the basis of the actual values in 2009. As it was determined that the targets were based on the latest actual values, which took account of the increase of the residential and tourist population in the area and thus suited the present conditions better, could measure the effect of the project more properly, the targets in the Phase II are compared to the actual values at the time of the evaluation in December 2016 for the ex-post evaluation.

As the years of construction completion vary by city, the achievement rate[25] was calculated by comparing the actual value of two years after completion in each city. After understanding the achievement rates of these indicators, the achievement rates of the operation and effect indicators of the whole sewerage project are evaluated, giving weightage to each indicator as follows. The amount of sewage treatment: 1, the number of households connecting with

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

[24] Since the method of sewage draining is a separate system, and the amount of sewage inflow into the sewage treatment plant is measured as the amount of sewage treatment in the project. In addition, it could not be confirmed that the influence of rainwater is nothing to the amount.

[25] For Praia Grande, where the project was completed in 2016, the achievement rate was calculated using the actual value in 2016, the completion year. For Cubatão, Guarujá, Itanhaém, which still have uncompleted parts, the achievement rate was calculated using the actual value in December 2016.

sewerage: 0.5, the rate of sewerage connection: 0.5, and the BOD concentration of treated water: 1.[26]

(1) Daily amount of sewage treatment (operation indicator)

The target of the Phase II for the daily amount of sewage treatment is 710,420 m^3/day, and considering the regional population as 2.9 million (estimated in 2016) and the daily amount of sewage treatment per person as 200 to 250 liters, it was determined that the target would be the largest amount of the daily sewage treatment through the year.[27] As the actual value, the amount of the daily sewage treatment that would become the largest through the year was calculated in each city to compare with the target.

Table 2: Daily amount of sewage treatment (m^3/day)

City (year of project completion)	Baseline 2000	Revised Target 2013	Actual[28]			Achieve-ment rate
	Appraisal Year	2 Years After Completion	Completion Year	1 Year After Completion	2 Years After Completion	
Bertioga (2013)	1,178	27,799	16,089	12,862	18,287 (2015)	66%
Cubatão (2016)	3,769	22,222	19,731 (2016)	---	---	89%
Guarujá (2016)	0	117,048	76,837 (2016)	---	---	66%
Santos (2011)	91,483	209,434	201,434	196,239	180,454 (2013)	86%
São Visente (2011)	20,846	81,043	68,876	75,383	82,903 (2013)	102%
Praia Grande (2016)	26,044	127,864	157,916 (2016)	---	---	124%
Mongaguá (2013)	3,184	36,473	26,621	25,472	28,383 (2015)	78%
Itanhaém (2016)	0	49,592	26,328 (2016)	---	---	53%
Peruíbe (2013)	10,304	38,945	29,067	39,941	47,376 (2015)	122%
Total	**156,808**	**710,420**	**638,215**			**89.8%**

Source: documents provided by JICA, and by implementing agencies, etc.

[26] The amount of sewage treatment and the BOD concentration of treated water are major operation indicators to measure a sewerage project, and equal weight was set because they represent a quantitative indicator and a qualitative indicator respectively. The number of households connecting with sewerage and the rate of sewerage connection are effect indicator of the sewerage project, and weight equal to the operation indicator was set after combining both indicators. Where the entire weight was 3, the quantitative indicator and the qualitative indicator of the operation indicator were allocated a weightage of 1 respectively, and the effect indicator was allocated a weightage of 1; and the weight of the effect indicator was separated by the two indicators, which made the weightage of 0.5 respectively.

[27] The increase and decrease of the amount of sewage treatment mainly depend on those of the tourist population. Since the total amount would be 580,000 to 725,000 m^3/day if the whole population in the area including the tourist population has sewage treatment, it is reasonable to regard 710,420 m^3/day as the largest value in the project, which covers up t95% of the population in the area.

[28] For Praia Grande, where 2016 was the completion year, and Cubatão, Guarujá, Itanhaém, where the project was not completed as of 2016, the actual value at the time of the ex-post evaluation in December 2016 was assumed the value of the completion year to compare. The columns for 1 Year and 2 Years After Completion indicate "---" because they were not available at the ex-post evaluation.

In the entire city, there exist both this project and development areas of SABESP's original project, which is out of the scope of this project. The fact that Cubatão and Guarujá have not achieved the target stems from the incompletion of part of the scope of the project, and in other cities, especially Bertioga, Mongaguá, and Itanhaém, it is caused by the delay of the progress of SABESP's original project. The achievement rate of the target level (710,420 m^3/day) of this indicator in the whole area is 89.8% (638,215 m^3/day).

(2) Number of households connecting with sewerage / rate of sewerage connection (operation and effect indicator)

The target value for the number of households connecting with sewerage was revised by multiplying the total number of households in each city in 2013 given as the target year of the Phase II by the target value of the rate of sewerage connection in each city, after analyzing further changes in population based on the total number of households in the service areas of SABESP sewerage connection in each city in 2000. For the evaluation of the project, this revised target in each city was compared with the actual value of the number of households connecting with sewerage.

Table 3: Number of households connecting with sewerage (thousand households)

City (year of project completion)	Baseline[29] 2000	Revised Target 2013	Actual			Achieve-ment rate
	Appraisal Year	2 Years After Completion	Completion Year	1 Year After Completion	2 Years After Completion	
Bertioga (2013)	2.2	18.0	10.5	12.7	14.1 (2015)	78%
Cubatão (2016)	6.3	26.8	21.7 (2016)	---	---	81%
Guarujá (2016)	72.3	127.9	95.5 (2016)	---	---	75%
Santos (2011)	152.4	167.4	171.4	174.8	177.4 (2013)	106%
São Vicente (2011)	49.3	104.0	85.0	87.6	90.2 (2013)	87%
Praia Grande (2016)	62.5	177.6	164.3 (2016)	---	---	93%
Mongaguá (2013)	7.5	36.6	33.8	34.5	36.0 (2015)	98%
Itanhaém (2016)	2.6	50.2	28.3 (2016)	---	---	56%
Peruíbe (2013)	13.2	29.5	29.5	30.7	31.7 (2015)	107%
Total	**368.3**	**738.0**	**659.2**			**89.3%**

Source: documents provided by JICA, and by implementing agencies, etc.

To see the rate of sewerage connection, the target value of the Phase II is compared with the actual value. As population differs from city to city, the rate of sewerage connection in the whole area is calculated using the weighted average by giving added weight based on the population.

[29] The baseline here has been set by multiplying the number of households in the sewerage connection service area of SABESP in 2000 by the penetration rate of the sewerage connection of the time.

Table 4: Operation and effect indicators (rate of sewerage connection) (%)

City (year of project completion)	Baseline 2000	Revised Target 2013	Actual			Achievement rate		
	Appraisal Year	2 Years After Completion	Completion Year	1 Year After Completion	2 Years After Completion	Not weighted by population	Weighted by population	Achieve-ment rate after weighted average
Bertioga (2013)	15	95	33	36	39 (2015)	41%	2.1%	0.9%
Cubatão (2016)	30	95	56 (2016)	---	---	59%	3.3%	1.9%
Guarujá (2016)	66	95	66 (2016)	---	---	69%	14.5%	10.1%
Santos (2011)	95	98	97	97	97 (2013)	99%	26.9%	26.6%
São Vicente (2011)	50	95	68	68	69 (2013)	73%	13.7%	9.9%
Praia Grande (2016)	45	95	83 (2016)	---	---	87%	24.9%	21.8%
Mongaguá (2013)	25	95	74	77	79 (2015)	83%	5.5%	4.5%
Itanhaém (2016)	8	95	72 (2016)	---	---	76%	4.3%	3.3%
Peruíbe (2013)	50	95	71	75	76 (2015)	80%	4.8%	3.8%
Total								**82.9%**

Source: documents provided by JICA, and by implementing agencies, etc.

In Table 3 on the number of households connecting with sewerage and Table 4 on the rate of sewerage connection, the tendencies of the target achievement of both indicators are similar. The target has not been achieved in Cubatão and Guarujá owing to the incompletion of the scope of the project, and in Bertioga and Itanhaém owing to the delay of SABESP's original project, both of which have been influenced especially by the delay of the development of sewage collection network and the connection of sewerage. As the connection of sewerage is delayed in the whole city in São Vicente, it is desirable to develop a project plan in order to promote the connection.[30] The achievement rate of the target level of the number of households connecting with sewerage (738.0 thousand households) is 89.3% (659.2 thousand households), while the achievement rate of the target level of the rate of sewerage connection is 82.9%.

(3) BOD concentration of treated water (effect indicator)

The BOD concentration of treated water of the sewage treatment plants developed in the project[31] is compared with the target in the Phase II. The target in the Phase II for such indicator

[30] Currently, the project plan of "Onda Limpa Phase 2," an original program of the Brazilian government, which is an follow-upprogram of this project, is under development.

[31] The actual value is the annual average of the BOD concentration of treated water sampled in each sewage treatment plant. The measurement basis of the baseline and target was not identified in the available documents.

has been set more strict than the regulations on effluent of treated sewage prescribed by the State of São Paulo (60 mg/l)[32].

Table 5: Operation and effect indicators (BOD concentration of treated water) (mg/l)

City (year of project completion)	Baseline	Revised Target	Actual			Achievement rate
	2000	2013				
	Appraisal Year	2 Years After Completion	Completion Year	1 Year After Completion	2 Years After Completion	
Bertioga (2013)	30.0	21.0	8.0	9.8	9.0	100%
Cubatão (2016)	30.0	16.0	59.9	---	---	0%
Guarujá (2016)	---	9.0	7.1	---	---	100%
Santos / São Vicente (2011)	---	200.0	198	201	194	100%
Praia Grande (2016)	---	110.0	64.8	---	---	100%
Mongaguá (2013)	30.0	8.9	18.0	27.0	16.4	64%
Itanhaém (2016)	---	7.6	7.2	---	---	100%
Peruíbe 1 (2013)	30.0	8.0	5.6	10.0	7.8	100%
Peruíbe 2 (2013)	30.0	8.0	4.8	8.3	7.5	100%

Source: documents provided by JICA, and by implementing agencies, etc.

Urban areas (Bertioga, Guarujá, Santos and São Vicente, Peruíbe)

All the sewage treatment plants established in the cities, which include a number of urban areas, have achieved the target, where the BOD concentration of treated water was within the target values. Although the BOD concentration of treated water became temporarily high one year after the project completion in Peruíbe 1 and 2, it became within the target value after subsequent adjustment. As SABESP gives consideration to make the BOD concentration of treated water within the target value by continuously monitoring water quality as seen above, this can be regarded as an example of an effect of technology transfer through the Technical Assistance project related to ODA loan for environmental monitoring.

Tourist sites (Praia Grande, Mongaguá, Itanhaém)

These cities are also tourist sites, where the target values of the BOD concentration of treated water have been set a little more strictly than other cities. The BOD concentration of treated water at sewage treatment plants in Praia Grande is within the target value. On the other hand, Mongaguá has not achieved the target, where the actual value (16.4 mg/l) exceeded the target value (8.9 mg/l). The achievement rate was 64% (13.6/21.1), comparing the value actually improved (13.6 mg/l) from the baseline (30 mg/l) with the improved value of the target (21.1 mg/l). This stems from the fact that sewage water runs into the sewage treatment plant in Mongaguá more than expected, which makes its operation rate almost 100% at all times.

[32] According to *Decree No. 8468 of the Government of the State of São Paulo*, in terms of the treated water discharged into rivers located in the State of São Paulo, it is established that the maximum of the BOD concentration does not go over 60mg/l under the environmental conditions, with test period for 5 days, at 20° C. In addition, since the treated water is discharged from the both sewage treatment plants Santos / São Vicente and Praia Grande into ocean about 2 km away from the shore, the Decree is not applied for these sewage treatment plants. They have only primary treatment alone and have no secondary treatment (biological removal), which makes the revised target of the BOD concentration of treated water high.

Industrial area (Cubatão)

Cubatão is an industrial area as well as an area of high population density. The BOD influent concentration is extremely high compared to other sewage treatment plants, where the BOD influent concentration is always around 250 mg/l (around 100 mg/l at other sewage treatment plants). Because the BOD influent concentration is high, the BOD concentration of treated water is also higher than other sewage treatment plants, which is always around 50 mg/l. On the other hand, it is within the effluent regulations of the State of São Paulo (60 mg/l). As the city is an industrial area, there is no bathing activity in rivers and the sea, and no issue of affect on the human body exists.[33]

For the effectiveness evaluation of the project, the achievement rate of the BOD concentration of treated water has been determined as 80.6% after taking the average of the sewage treatment plants.

3.3.1.2. Water Supply Project

The indicators used to evaluate the effectiveness of the water supply project are the volume of water supplied (m^3/day), population served, water supply penetration rate, non-revenue water rate, and leakage rate. The reference and target values for these indicators cover the five cities of São Vicente (30% of the city), Praia Grande, Mongaguá, Itanhaém, and Peruíbe served by the Mambu-Branco water purification plant with results also calculated for the same areas, and the degree of achievement is computed for each indicator by comparing with the target values.

After the degree of achievement for each indicator is obtained, the overall degree of achievement for the water supply project's operation and effect indicators is evaluated by weighting each indicator with 1 for the water supply volume, 0.5 for the population served, 0.5 for the water supply penetration rate, 0.5 for the non-revenue water rate, and 0.5 for the leakage rate.[34]

(1) Maximum daily volume of water supplied (operation indicator)

The reference and target values for the volume of water supplied use the maximum daily volume of water supplied throughout the year. Therefore, they are compared with results for the maximum daily volume of water supplied, which were confirmed throughout the year.

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[33] BOD concentrations are periodically confirmed at upstream and downstream from release points, but while the maximum value for samples in 2016 was 40mg/l, the downstream BOD concentration for the same day was 54mg/l, and that for downstream from the release point remained within São Paulo State's reference value of 60mg/l.

[34] The volume of water supplied, non-revenue water rate, and leakage rate are typical indicators to measure a water supply project's operation indicator. While they fall into quantitative or qualitative indicators, the population served and the water supply penetration rate fall into effect indicators for a water supply project. The overall indicators are weighted by 3 with 1 each for the quantitative and qualitative operation indicators and 1 for the effect indicator; the water supply volume, a quantitative indicator, is weighted by 1 while the non-revenue water rate and the leakage rate, both a qualitative indicator, are each weighted by 0.5 to make a total of 1. The population served and the water supply penetration rate, both an effect indicator, is each weighted by 0.5 to make a total of 1.

Table 6: Operation and effect indictors (Maximum daily volume of water supplied) (1,000 m^3/day)

Indicator	Reference value	Revised Target	Results			Achievement rate
	2000	2013	2013	2014	2015	
	Appraisal year	Two years after the completion of the project	Year of completion of the project	One year after the completion of the project	Two years after the completion of the project	
Maximum daily volume of water supplied	17.0	209.7	135.0	159.0	142.0	68%
Average daily volume of water supplied	---	---	117.0	121.0	113.0	---

Source: Materials provided by organizations such as JICA and the implementation agency

The maximum daily volume of water supplied in 2015 was 142,000 m^3/day, and the degree of achievement was 68%, falling short of the target. However, the volume of water taken from the Branco River, which provides water to the Mambu-Branco water purification plant, is 1,600 L/second or 138,200 m^3/day. In fact, according to SABESP, a little more than the prescribed volume of water can be taken, but it is impossible to reach the target value of 209,700 m^3/day, and the basis for the target value could not be confirmed. SABESP's opinion is that this target value may be the volume of water to be supplied, which was decided with the next phase[35] of the present water supply project in mind.

(2) Population served and the water supply penetration rate (operation and effect indicators)

The population served has increased steadily since 2000, and the degree of achievement was 88% compared to the target value. On the other hand, the water supply penetration rate is not constantly maintained at 100%, but partly because of the effects of this project, the rate was kept at 98% in 2013 and 2014. However, despite the population increase from 2014 to 2015 (The rate is estimated to have risen by 7.4%) and the decline in the growth rate for the population served due to the effects of factors such as serious water shortages in the capital area of São Paulo State, which had surfaced since around 2014, the rate remains at 92% in 2015.

Table 7: Operation and effect indicators (Population served and the water supply penetration rate)

Indicators	Reference value	Revised Target	Results			Achievement rate
	2000	2013	2013	2014	2015	
	Appraisal year	Two years after project completion	Year of project completion	One year after project completion	Two years after project completion	
Population served (1,000 persons)	917	1,605	1,324	1,398	1,410	88%

[35] Currently, two pumps are installed to take water at a rate of 800 L/second. Plans call for a new pump to be added to increase the volume of water to be taken in the next phase.

Water supply penetration rate (%)	100[36]	100	98	98	92	93%
Changes in estimated population[37] (1,000 persons) (reference information)			*1,351*	*1,427*	*1,533*	

Source: Materials provided by organizations such as JICA and the implementation agency

(3) Non-revenue water rate and the leakage rate (effect indicators)

Table 8: Operation/effect indicators (Non-revenue water rate and the leakage rate[38]) (%)

Indicators	Indicators	Revised Target	Results			Achievement rate
	2000	2013	2013	2014	2015	
	Appraisal year	Two years after project completion	Year of project completion	One year after project completion	Two years after project completion	
Non-revenue water rate	--	45.0	32.1	32.4	31.1	100%
Leakage rate	37.9[39 †]	20.0	34.6	33.5	33.3	26%

Source: Materials provided by organizations such as JICA and the implementation agency

†) The rate of achievement was calculated by comparing with the rate of actual improvement (4.6%) from the reference value (37.9%) and the rate (17.9%) required for keeping the leakage rate within the target value (20%).

The non-revenue water rate was kept within the target value, achieving the target, but the leakage rate exceeded the target value, failing to achieve the target with the rate of achievement at 26%. It is difficult to determine whether the target value is appropriate because its basis is not clearly defined, but according to 2015 SNIS data, the average leakage rate for SABESP was 33.5%, and it can be said that the leakage rate (33.3%) for the water supply system under this project in 2015 was average. On the other hand, this project aimed at producing effects in its water supply project as it responded to increases in the residential and tourist populations caused by remarkable economic and tourism development. Its direct aim was not to make water supply service efficient and improve its quality, and the water supply system covered by this project included existing water distribution pipelines, and therefore, the contribution of intervention through the project to improvement of non-revenue water and leakage rates is limited. Under these circumstances, it can be determined that this project brought about certain

[36] The reference value for the water supply penetration rate is 100%, and the reason the penetration rate continued to fall as indicated in the table is a sharp rise in the population of the Baixada Santista area, which started to become conspicuous in 2004.

[37] It is the estimated population in the Baixada Santista region provided by the executing agency, which includes both resident and tourist population.

[38] While the non-revenue water volume is calculated based on the revenue water volume ([the water volume delivered into the water distribution system] – [the revenue water volume]), the volume of water on which charging is based, the leakage rate is computed based on the actual loss volume. The non-revenue water volume includes water used for social purposes, and the non-revenue water volume is usually larger than the leakage volume, but if the basic fee is set, and the revenue water volume is larger than the volume of water actually supplied, there are cases in which the volume of water used for social purposes and part of the leakage volume are offset, statistically causing the non-revenue water volume to be smaller than leakage volume.

[39] In the materials provided by JICA, the reference value is defined as 10.8%, lower than the target value. This is too low if the leakage rate defined in the footnote is taken into consideration, and it is estimated that a figure that does not include the loss water volume is defined as such. For this reason, the evaluator reset the average leakage rate for SABESP in 2000 at 37.9% (calculated from SNIS).

effects because the results of these indicators improved to a level similar to that for other areas though they did not reach the target value.

A calculation of the rate of achievement for each project taking into consideration the rate of achievement for the sewerage project's four indicators and their weightage as well as the rate of achievement for the water service project's five indicators and their weightage shows that the achievement rate for the sewerage project was **85.5%** and that for the water supply project was **73.7%**. Then, the percentage of each project to the total project cost is 79% (¥91,841 million) and 21% (¥24,455 million), and the overall achievement rate for the project is calculated at **83.0%** by multiplying the achievement rate for each project by this rate. Since this exceeds the target of 80%, it can be determined that the project almost reached the effect target value.

3.3.2. Qualitative Effects (Other Effects)

As a qualitative effect, the living environment of local residents was expected to improve. This will be analyzed later in Section "Impacts" because such an effect falls into the impacts of this project.

3.3.3. Technical Assistance Project

The Technical Assistance project was implemented from 2010 to 2013 with the aim of ensuring that environmental monitoring was conducted appropriately in the area covered by the Project to Improve Sanitation in the Coastal Area of São Paulo State so that the quality of water was confirmed and assessed. It was carried out in three phases with the first dedicated to the analysis of CETESB's existing environment-related data, and the second and third to the verification and improvement of environmental monitoring methods. In order to quarterly confirm the effects of environmental improvement by this project, particularly water quality in coastal areas, was monitored. All activities ended without any trouble, and environmental monitoring plans were formulated and revised, and documents such as reports on baseline studies and the results of environmental monitoring were created. In addition, an effective and efficient water quality monitoring method (sampling points, conditions, items and collection methods) was proposed, and all intended results were achieved. Partly because of the contribution of these achieved results, both the project purpose and the overall goal were attained, contributing greatly to the improvement of the living environment in the area. The table below summarizes the degree of achievement for each goal's indicators.

Project Purpose	Indicator	Situation and evaluation at the time of ex-post evaluation
Environmental monitoring for the Target Area is appropriately implemented, enabling to verify and evaluate the water quality conditions.	Situation of the improvement of the logistics	The monitoring method developed through the Technical Assistance project was applied to actual operations, too. This helped improve the water quality monitoring system in the area, and therefore, the achievement rate is high.

Overall Goal	Indicator	Situation and evaluation at the time of ex-post evaluation
The water quality and sanitation in Baixada Santista of the coastal region in the State of Sao Paulo is improved, which contributes to the improvement of the living conditions.	Operational and effect indicators of ODA Loan Project	After the completion of the Technical Assistance project, based on the proposals from the project, a medium- to long-term water quality monitoring program for rivers and the coast in the Baixada Santista area was developed to step up efforts to improve sanitation under this project, and its implementation began. Therefore, it is highly likely that initiatives to improve sanitation under this project will be stepped up, and it can be said that the achievement rate is high.

In addition, following the proposals from the Technical Assistance project, whether chlorination was really needed at the sewage treatment plants (Estações de Pré-Condicionamento de Esgoto, hereinafter referred to as “EPC”) in Santos and Praia Grande, which conduct only primary treatment, after the primary treatment of sewage was considered. After the project ended, at the EPC in Santos, sewage was released on an experimental basis at 2 km off the coast without chlorination, and the quality of water at the release point was monitored periodically. As a result, it was concluded that chlorination was not necessary, and it was decided that not only the Santos sewage treatment plant but also three in Praia Grande could release sewage into the ocean without chlorination. This is an example in which proposals from the Technical Assistance project led to reduction in sewage treatment costs, and it can be said that this example contributed to the effective and efficient operation of the sewage treatment plants.

Based on this, it can be determined that the Technical Assistance project is highly effective.

3.4. Impacts

3.4.1. Intended Impacts

(1) Confirmation of intended impacts based on beneficiary survey results

The anticipated impact of this project at the time of appraisal was to "improve the living environment of residents in the Baixada Santista region." To assess whether this objective had

been achieved, a beneficiary survey[40] was conducted in Praia Grande, Mongaguá, and Itanhaém. The results of this survey covering the sewerage and water supply project are shown below.

Table 9: Sewerage project survey results

Satisfaction with the sewerage project		Impact of launching the sewerage project	
Satisfied	97%	Felt a positive impact	90%
Not satisfied	3%	No change or negative	10%
Water quality improvement of rivers/ocean		Improvement of living environment by launching sewerage project	
Improved	50%	Improved by making sewage treatment easier	88%
Not improved	50%	No substantial improvement	12%
Living environment improved through better water quality		Health situation improved through better water quality	
Living environment improved	87%	Health improved	40%
No substantial improvement	13%	No substantial change	60%

Source: Compiled by evaluator based on results of the beneficiary survey

Although sewerage connection progress differed by selected cities, Mongaguá was completed as planned in 2013. As for Praia Grande, sewerage connections under the scope of the project were completed in December 2016, as it was immediately after the project completion, there are still some places where the sewerage work has not even started. In Itanhaém, there are still areas where houses have not been connected to the sewage treatment system. The percentage of project beneficiaries in each city that had a positive impression of the sewerage project was 94% in Mongaguá, 90% in Praia Grande, and 86% in Itanhaém. The percentage of beneficiaries who had a positive impression of sewerage service connection was proportional to progress of the sewerage project. From this it is fair to say that the survey results make it clear that the sewerage project achieved its intended effect.

The satisfaction level with this project was high in all cities at 97%. Meaningful benefits of the sewerage project to the beneficiary group survey respondents included elimination of the need to treat sewage in residential septic tanks; elimination of time and labor to regularly clean septic tanks and have sludge collected by septic trucks; and elimination of smell and filth on residential premises. Thus, 88% of households reported that the living environment had improved, demonstrating that the project has greatly contributed to improving the living environment of beneficiaries.

[40] The beneficiary survey's aim was to "assess whether the living environment of local residents was improved by providing water supply and sewerage services able to withstand the rapid economic growth and sudden population increases during tourism season in the Baixada Santista region." The beneficiary survey was administered to a total of 150 households comprising 50 households in each of Praia Grande, Mongaguá, and Itanhaém, which were the target cities for the water supply and sewerage projects, and are also the cities most impacted by rapid economic growth and sudden population increases during tourism season. On the map, groups of 400–500 households were divided into survey partitions, from which one sample household location was selected for each. Sample households were distributed evenly on the map, ensuring that they were separated from each other. If the selected household was not willing to participate in the survey, the neighboring household was selected to ensure that one representative household was surveyed in each survey partition.

As for rivers, beaches, community roads, etc., despite a half of respondents sensed some improvement, the other respondents felt that not enough was done. This sentiment appears to be influenced by the incomplete state of local storm sewer pipes that impact the natural environment and people's daily lives (especially roadways), as well as residential waste management which is not covered by this project. As is common in all areas of Baixada Santista, residential waste is often discarded in rivers, drainage ditches etc. around areas where the beneficiary survey was administered, and this trash overflows into the city each time rainwater levels increase. For 13% (20 of the 150 households) of the beneficiary group survey respondents, seeing residential trash filled wastewater overflowing into the city each time it floods left them with the impression that the constructed sewage treatment facilities were not necessarily contributing to a better environment. Accordingly, it seems that about half of the beneficiary group survey respondents could not fully feel a sense of improvement in the natural environment of rivers, sea and community roads. Comments (from 9 out of 150 households, or 6% of the total) showed that some people even felt that wastewater from residential waste is overflowing precisely because of the sewer pipe construction work.

Table 10: Water supply project survey results

Satisfaction with water supply project		Water shortages eliminated by improving water supply	
Satisfied	97%	Water shortages were eliminated by improving water supply	86%
Not satisfied	3%	Water shortage has not been resolved	14%

Water quality improvement	
Improved	75%
No substantial change	6%
There was no particular problem before the project	19%

Source: Compiled by evaluator based on results of the beneficiary survey

In all cities, the satisfaction level towards the water supply project was extremely high, exceeding 95%.[41] Before the Mambu Branco water treatment plant was installed, water supply was insufficient—especially during tourist season. After the water treatment plant was installed there was a dramatic increase of water supply, providing a year-round, reliable supply of water,[42] which was highly appreciated by residents. Regarding water quality, there was little sense of improvement in the Praia Grande and Itanhaém areas.[43] The reason behind this was that the water sources of these two cities was relatively good in quality compared to Mongaguá[44] even before construction of the water facility in this project. As there were no serious issues with water quality to begin with, there was also little sense of improvement. In

[41] Breakdown of satisfaction with water supply project: Praia Grande (98%), Mongaguá (92%), Itanhaém (92%).
[42] Breakdown of cities where water shortages were eliminated: Praia Grande (80%), Mongaguá (66%), Itanhaém (64%).
[43] Breakdown of cities that felt water quality was improved: Praia Grande (67%), Mongaguá (91%), Itanhaém (67%).
[44] Aguapeú River, the main source of water in Mongaguá, flooded frequently during rainy season, which caused declines in water quality.

contrast, Mongaguá, which had problems with the water quality of its water source, improved the water quality for up to 91% of project beneficiaries by supplying water from the Mambu Branco water treatment plant, which sources water from the Mambu and Branco rivers. It is clear from this that this project was successful in dramatically improving both water quantity and quality in this city. As seen from the above, the increasing water supply and improvement in water quality was successful in improving the living environment by providing adequate water for showers and cooking.

(2) Suitability for bathing

The suitability of water for bathing[45] has consistently hovered around 70% on average since 2009 and continued environmental monitoring is needed because of the target of 100% not being achieved. On the other hand, BOD concentration, one of the effectiveness indicators, has cleared wastewater regulations (60 mg/l) in all areas. Given the fact that treated discharge wastewater has cleared wastewater regulations, we can consider this project to have tangibly contributed to improving the environment in this region. Here are two possible reasons that bathing suitability has not been improved:

- ✓ With each passing year more people are swimming because of constantly increasing population of residents and tourists in the area, resulting in the corresponding increase of illegal trash dumping in the swimming waters. To illustrate this, cities with particularly low bathing suitability indexes—specifically Santos, São Vicente, Praia Grande, and Mongaguá—have all experienced notable increases in both residential and tourist populations. We can infer from this that population increase greatly affect the indicators.
- ✓ Normally, rainwater flows to the ocean through the municipal drainage ditches, but because of the increase of residents and tourists, trash discarded on roads now flows along with rainwater to rivers and the ocean along ditches. This is the main cause of water quality degradation in rivers, estuaries and beaches.

In addition to wastewater discharge, other causes of water pollution in suburban rivers and the ocean include population increases; changes in discharge rates; the introduction of nearby industrial factories; and environmental policies. Thus, it would not be appropriate to use the same indicators to measure this project's direct impact and it should only be treated as a reference.

(3) Impact of the Technical Assistance Project

[45] Suitability for bathing in Brazil evaluates whether or not sea bathing near the coast and estuary is suitable for the human body based on the number of coliform bacteria per 100 ml of water. Water bathing ratings have four levels (excellent; good; not harmful to humans; unsuitable). Sampling is conducted weekly at 88 locations (as of 2016) in the Baixada Santista region.

SABESP regularly monitors treated water. When the BOD concentration of inlet waste water is too high, it responds by increasing the amount of oxygen injected or increasing primary treatment time at the sewage treatment plant to ensure that the BOD concentration of treated water can pass wastewater regulations. SABESP also cooperates with CETESB to perform fixed-point monitoring of water quality at 300 locations around the region. The technology and implementation system enhancements achieved through the Technical Assistance project, have made significant contributions for implementing monitoring activities appropriately and smoothly, and the implementation of this project as well as the Technical Assistance project have been instrumental in contributing to improving living conditions in the region.

3.4.2. Other Positive and Negative Impacts

(1) Impacts on the natural environment

No negative impacts with regard to the natural environment were found according to interviews with the project executing agency and results of the beneficiary survey. Environmental mitigation measures are required to acquire an environmental license in Brazil. Thus, in this project, reforestation and other measures were taken to plant vegetation in other sites to reduce overall environmental impact to Baixada Santista when establishing infrastructure in the region. Environmental impact mitigation measures went according to plan and no significant issues occurred as a result. Sludge disposal at sewage treatment plants has also been going smoothly as no neglected sludge was found in the plant during site visits. Disposed sludge is outsourced to a contractor and eventually disposed of in a landfill; thus, it is not used effectively.

(2) Land acquisition and resettlement

Resettlement progressed smoothly with no particular problems and compensation was awarded to all six households that requiring resettlement (1 in Bertioga, 4 in Cubatão, 1 in Mongaguá) to cover costs associated with moving and securing residences at their new address. With regard to land acquisition, since five of the six designated households (the ones in Cubatão and Mongaguá) were not the landowners to begin with, no compensation was dispensed for land acquisition. Compensation was paid to the one household[46] in Bertioga and the matter was settled without issue. According to an interview with the executing agency, negative impacts on people's livelihood, etc., were avoided by paying moving expenses and compensation as well as by introducing the families to public assistance programs provided by the city. There was also no after-the-fact opposition to the compensation.

Operational and effectiveness indicators set for the sewerage project also passed their targets of 80%, demonstrating the high effectiveness of the project. Water supply volume and leakage rate in the water

[46] Compensation content is generally decided through discussions between the two parties, and the compensation amount assessed by experts. If agreement cannot be reached through mutual discussion between the two parties, it is settled in court. In this project, both parties agreed on the compensation content and amount. Compensation was paid to only one household in Bertioga (375,688 BRL).

supply project did not achieve their target indicators. However, these are not currently objects for evaluation because questions remain regarding the appropriateness of the revised target of the operational effectiveness indicators that were set. On the other hand, the project delivered an achievement rate of over 80% in other operational effectiveness indicators—specifically, the indicators measuring population served, water supply coverage rate, and the non-revenue water rate. As a result, the achievement rate for effectiveness indicators in this project as a whole was high at 83%. With regard to impact, nearly 90% of beneficiary survey respondents reported that their living environment had improved, demonstrating that the project has in fact greatly contributed to improving the living environment of beneficiaries. In addition, this project did not generate any negative impact, and the implementation of this project as well as Japanese ODA loan related project have been instrumental in strengthening environmental monitoring systems of the project and contributing to improving living conditions in the region.

The above illustrates that this project has largely achieved its planned effectiveness. Therefore, effectiveness and impact of the project are high.

3.5. Sustainability (Rating: 3)

3.5.1. Institutional Aspects of Operation and Maintenance

(1) Structure of the project implementation body

In implementing this project, the “Executive Management of the Sanitation Improvement Project for Baixada Santista” (hereinafter referred to as "TB") was established within the 'Technology, Enterprises and Environment Executive Office' (hereinafter referred to as "T Main Office") and became the entity responsible for the project. Meanwhile, the “Baixada Santista Business Unit” (hereinafter referred to as "RS") became responsible for operation and maintenance of water supply and sewerage facilities constructed in this project.

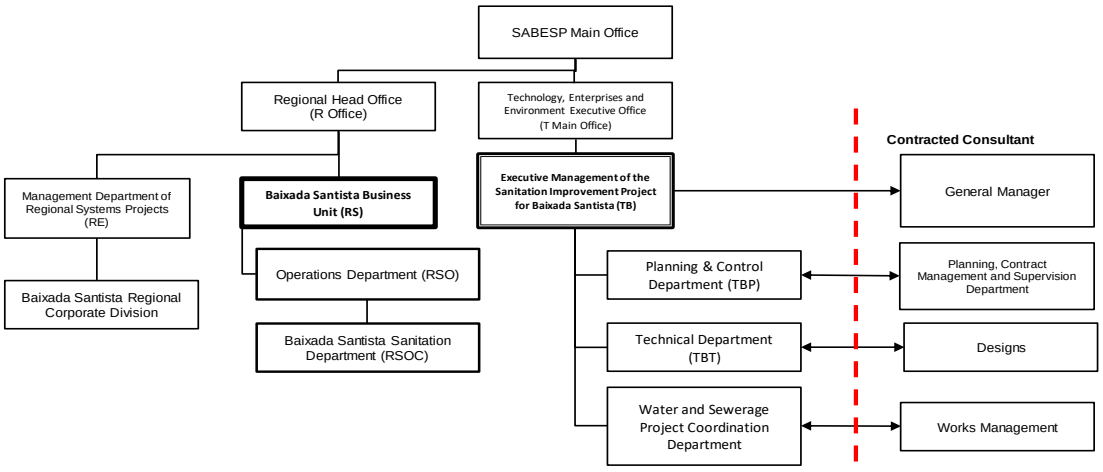

Figure 1: Overview of the project implementation system1

TB employs 35 personnel (as of December 2016). It is responsible for overseeing and inspecting construction work on the trunk sewer and sewage collection network in this project, which is yet to be completed. In addition to addressing the incomplete sections, TB is currently formulating an implementation plan for the successor program of this project. In an interview with TB, it confirmed that, continuing even after 2017, it is allocating a budget covered by them to complete the construction work they were responsible for which was started in 2014 but not completed. These will be being given priority over other SABESP projects in the region and handled with sufficient manpower and implementation structure. TB also confirmed that it will begin by strengthening the construction progress management and inspection process to ensure these sections are completed. There are no particular problems seen in TB's implementation structure for completing the unfinished construction work for which it is responsible.

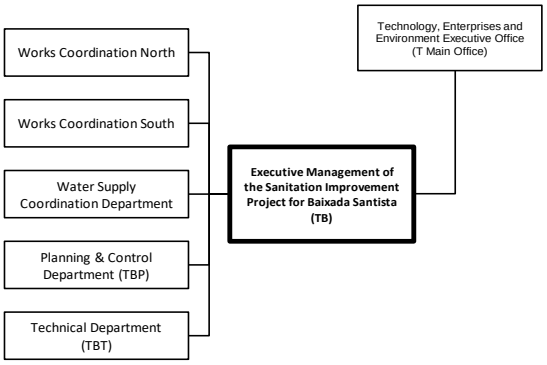

Figure 2: TB implementation structure2

(2) Institutional aspects of operation and maintenance of water supply and sewerage services

RS is responsible for the operation and maintenance of water supply and sewerage facilities developed in this project. As envisioned at the time of appraisal, RS, which is the business unit for the Baixada Santista region, is responsible for operation and maintenance (O&M). To that end, it has deployed personnel with senior management experience in water treatment and sewage treatment plants, and assigned about a dozen dedicated staff members under them. There is no particular variance from the O&M system envisioned at the time of appraisal and maintenance is being carried out as expected.

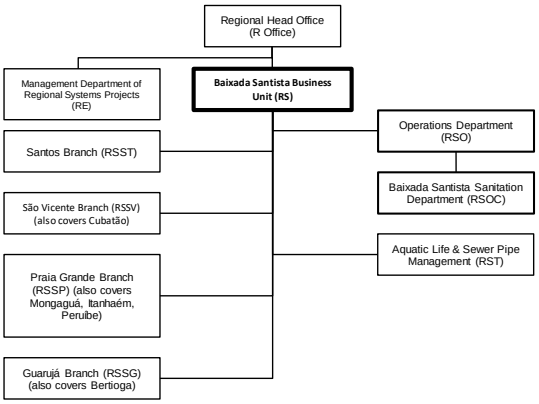

Figure 3: RS implementation structure3

The sewage treatment plant has a robust maintenance and inspection team. The O&M structure consists of 5 to 12 personnel (except Santos sewage treatment plant with 27 personnel) who work 3-shift/day rotations of 3 to 6 workers (except Santos with 11 workers) who work 8-hour shifts to operate the plants 24 hours-a-day 365 days-a-year. The water treatment plant

established in this project is operated and maintained by a team of 21 personnel. As with the sewage treatment plant, they work in a 3-shift/day rotation (10 people are always stationed) to operate the plant 24 hours-a-day 365 days-a-year.

Individual branch offices assign sufficient personnel to periodically inspect sewage pumping stations, distribution pumping stations, and water supply tanks that are within their jurisdiction. They inspect all facilities under their charge on a cycle ranging from 3 days to 1 week. Although inspection frequency varies by facility, personnel make rounds to facilities every 2 hours (about 3 times a day) and spend approximately 30 minutes per facility for the inspection.

Table 11: Number of personnel at RS (2016)

RS Dept./Branch	Target City	Number of Staff
Sewage treatment plant	All areas	142
Sewer trunk line/sewage collection network/connections	Bertioga	11
	Cubatão	10
	Guarujá	19
	Santos	27
	São Vicente	17
	Praia Grande	16
	Mongaguá	15
	Itanhaém	15
	Peruíbe	12
Water treatment plant (Mambu-Branco)	Itanhaém	21
Water supply pipe network/pumping station/water supply tank	São Vicente	2
	Praia Grande	6
	Mongaguá	21
	Itanhaém	4
	Peruíbe	4
Total		342

If a failure occurs in the water treatment or sewage treatment plants, or if an abnormality in the water supply / sewage treatment facilities is detected on one of the monitoring screens in each of the plants, staff members of the branch office covering the water supply / sewage treatment facilities were informed of the abnormality, and they check the abnormality, take emergency measures, assess the problem, and identify the most appropriate corrective measure. If parts need to be repaired or replaced, this fact is immediately notified to RS's Aquatic Life & Sewer Pipe Management Department (RST) and the part is generally repaired or replaced within the same day. For both normal and abnormal operating situations, an adequate staff structure and distribution has been established to handle emergencies or carry out repair and replacement tasks.

(3) Implementation structure for monitoring water quality

RS monitors water quality at water treatment and sewage treatment plants, measures odor concentration at sewage pumping stations, and inspects the quality of water discharged into rivers. It also performs regular water quality inspections at a location about 2 km away from the shore, which is the discharge area of treated water from treatment plants where only primary treatment is carried out. The following table summarizes RS's implementation system for monitoring water quality.

Table 12: Overview of RS's implementation system for monitoring water quality

Inspection target	Major inspection items	Implementer	Frequency
Water treatment plant	Turbidity, chromaticity, pH, residual chlorine	Water treatment plant staff	Sample every 2-4 hrs. every day
Sewage treatment plant	BOD concentrations of inlet waste water, BOD concentrations of treated water, pH, coliform bacteria, suspended solids	Treatment plant staff	Sample every 2-4 hrs. every day
Measure odor concentration at sewage pumping station	Measure odor concentration, check for solid matter (remove as necessary)	Staff of responsible RS branch office	Facility in charge inspects on 3-day to 1-week cycle
Inspect water quality of river discharged into	At the discharge point: Upstream/downstream BOD concentration, pH, coliform bacteria, suspended solids	Staff of responsible RS branch office	About twice a month
At the discharge area of sewage treatment plant that only conducts primary treatment (2 km from the shore)	Dissolved oxygen, pH, salinity	Staff of responsible RS branch office	Every 2-3 months

Source: documents provided by implementing agencies, etc.

RS's system for conducting water quality inspections of treated discharged wastewater is well established and water quality monitoring duties are being carried out smoothly. Water quality inspections are performed at a point 2 km from shore under the technical guidance of CETESB. Each month, these water quality test values are sent RSOC in Santos City where they are analyzed. These analysis results are then shared across SABESP and reported to CETESB.

CETESB is the environmental certification body of the São Paulo state government. It provides certification and authorization on matters related to the environment in response to requests from various organizations for infrastructure development (including private enterprises) in São Paulo. CETESB also conducts environmental monitoring in coastal areas and rivers. In connection with this project, Cubatão branch office (31 workers) and Santos branch office (24 workers), which have jurisdiction over Baixada Santista, inspects the coliform and enterococcus bacteria count per milliliter of water at several monitoring points (62 points in 2015) in the coastal areas and rivers of Baixada Santista.

Through the water supply / sewage treatment facilities as core facilities, the system for operation, maintenance and inspection both in and outside of related facilities has been firmly established and emergency response is also being carried out quickly. Also, (a) RS is properly monitoring the water quality of public water bodies where treated wastewater is discharged and (b) CETESB, as a third-party organization, is conducting audits to determine whether proper water quality monitoring of these public water bodies is being conducted. Thus, it is fair to say that the operation and maintenance of this project and the system to measure its impact are functioning properly.

3.5.2. Technical Aspects of Operation and Maintenance

Independent contractors responsible for installing facilities prepare and distribute manuals for all facilities during the test operation phase of water supply and sewerage facilities. These manuals, including daily operational improvements, are regularly reviewed. Operational improvements are pursued for each water treatment and sewage treatment plant. Technical service notes (Nota Técnica de Serviços; hereinafter referred to as "NTS") which contain standardized operating procedures and know-how have been prepared and O&M is being implemented in accordance with them. Some processes described in NTS conform to ISO 9000 and ISO 14000 standards. In fact, all water treatment and sewage treatment plants are currently working towards acquiring ISO 14000 certification; thus, the systematization and formalization of operating procedures is progressing in the course of certification acquisition. Various efforts are also being made at RS to strengthen the technical skills of personnel. For example, training is regularly held to improve the skills of RS staff and case-by-case measures are implemented to boost the capacity of personnel in charge of O&M that had been identified as requiring skill upgrades to competently carry out their work. Training measures take into account O&M of the facility to ensure that disruptions do not occur.

Likewise, SABESP has unique career plans for personnel across the entire group. It offers technical skill improvement programs harmonized with the ability and needs of individuals, and provides technical training in cooperation with universities that have expert knowledge or are researching in the areas of water supply and sewerage related technology, especially seepage inspection and distribution network analysis for the installation, upgrading, and maintenance of water systems. Further, to provide incentive to improve technologies, since around 2012 SABESP has endeavored to boost personnel motivation by adopting a performance-based salary system for managers and general staff, and by paying bonuses in a profit-sharing system that rewards departments that raise profitability by achieving objectives.

The Non-revenue Water Management Technology Project (2007–2010) contributed to improving the efficiency of operation maintenance, especially in the water supply work in this project. Of particular note, many training opportunities were provided in the project to improve the skills of SABESP staff responsible for managing non-revenue water. This has greatly contributed to improving the technical skills of many SABESP staff members. These technical skill improvements were further reinforced through OJT, and capacity and skill development systems have also been introduced through the technical project in the Baixada Santista region. Teaching materials and training plans were reorganized in partnership with Serviço Nacional de Aprendizagem Industrial (SENAI), a national service for industrial training, and training has been provided to contractors and SABESP inspectors with the goal of improving SABESP's water supply and sewerage services. These efforts have contributed to improving the operation and maintenance skills of not only SABESP personnel, but also those of independent contractors that handle water supply and sewerage services.

SABESP has been introducing various approaches as part of a system to improve technology and capacity, including routine training of staff in charge of O&M, responding to situations, and improving capabilities by offering incentives. There are no problems present regarding technical aspects.

3.5.3. Financial Aspects of Operation and Maintenance

(1) SABESP-wide revenue and O&M expenses

Based on financial statements[47] published by SABESP, we can confirm that it has maintained a sound revenue structure for many years. Trends in revenue and O&M from 2009 to 2015 are summarized in the table below. In 2011, net income temporarily declined because of a temporary increase in debt payments. In 2014 and 2015, O&M expenses were higher than other years causing a decline in net profit. This was the result of a serious water shortage that became apparent in metropolitan São Paulo from 2014 and required extensive spending to address. The water shortage was resolved by the end of 2015, and it was estimated that O&M costs would return to normal year levels after 2016. Regardless, there are basically no problems in management practices as evidenced by the operating margin which—except for 2014—exceeds 25%.

[47] SABESP is listed on the New York stock exchange. This financial statement reflects figures from the *FORM 20F* submitted to the same stock market. The evaluator analyzed years 2009–2015 and summarized them into the table.

Table 13: SABESP changes in income and expenditures (2009–2015) (Unit: Million BRL)

Income/Expenditure	2009	2010	2011	2012	2013	2014	2015
Total income	8,580 †	9,231	9,927	10,738	11,316	11,213 †	11,712
Water supply system	4,104	4,427	4,607	4,944	5,276	4,897	5,046
Sewerage system	3,132	3,399	3,698	3,983	4,264	4,009	3,901
Other	1,343	1,405	1,622	1,811	1,776	2,308	2,765
Operation and maintenance costs	- 5,087	- 5,195	- 6,019	- 6,450	- 6,816	- 7,636	- 8,261
Gross profit	3,492	4,036	3,909 ‡	4,288	4,499 ‡	3,578	3,451
Selling costs	- 655	- 711	- 684	- 727	- 631	- 924	45
Personnel & overhead costs	- 717	- 653	- 713	- 717	- 729	- 743	- 452
Operating profit	2,120	2,672	2,512	2,843 ‡ †	3,139	1,911	3,044
Operating margin	24.7%	28.9%	25.3%	26.5%	27.7%	17.0%	26.0%
Financial return	- 10	- 379	- 633	- 296	- 483	- 636	- 2,457
Tax & public contributions	- 603	- 662	- 498	- 636	- 732	- 372	- 51
Net profit	1,508 ‡ ‡	1,630 ‡ ‡	1,381	1,912 ‡ ‡	1,924	903	536
Net profit increase/decrease	---	8.1%	- 15.3%	38.5%	0.6%	- 53.1%	- 40.6%

† : Total income (=Water supply system + Sewerage system + Other), is slightly different from sum of the factors due to rounding of the respective factor.
‡ : Gross Profit (=Total income + (- Operation and maintenance costs)), is slightly different from sum of the factors due to rounding of the respective factor.
‡ † : Operating profit (=Gross profit + (- Selling costs - Personnel is overhead costs)), is slightly different from sum of the factors due to rounding of the respective factor.
‡ ‡ : Net profit (=Operating profit + (- Financial return - Tax & public)), is slightly different from sum of the factors due to rounding of the respective factor.

In addition, revenues from water supply and sewerage projects are increasing by the year and profitability of the water supply business is especially high. In 2015, the gross margin extended to 3,451 million BRL, making it possible to afford future investment plans.

Every year O&M expenses increase RS-wide in step with the increase of households using water supply and sewerage services[48]. In 2015, 6.9% of the 5,191 million BRL (360 million BRL) in O&M expenses, which was paid by SABESP, was allocated to RS's O&M costs[49]. According to an interview with SABESP, because sufficient O&M expenses are being allocated at present and similar O&M expenses are expected to continue, it was confirmed that there are no problems regarding RS's O&M expenses, including for this project.

[48] O&M expenses of water supply and sewerage facilities managed by RS cannot be divided into RS-wide and this project. Thus, RS-wide O&M expenses were evaluated in including expenses of this project.
[49] As a percentage, RS-wide O&M expenses comprise 6.9% of SABESP-wide expenses, which is higher than the percentage of served population that RS makes up in the total expenses of SABESP-wide (water supply service 6.4%, sewerage service 4.7%). This shows that RS receives sufficient O&M expenses on a served population per capita basis.

Table 14: O&M expense trends for SABESP and RS (2009–2015) (Units: Million BRL)

Year	SABESP-wide O&M expenses	RS O&M expenses	RS O&M expenses as % of total
2009	3,275	202.8	6.2%
2010	3,442	212.8	6.2%
2011	4,063	234.5	5.8%
2012	4,338	259.8	6.0%
2013	4,656	297.3	6.4%
2014	5,057	313.8	6.2%
2015	5,191	360.0	6.9%

Source: documents provided by implementing agencies, etc.

(2) Water supply and sewerage fee income for this project

Although the fee structure varies from region to region, the same unit price applies to both water supply and sewerage fees that are charged in the Baixada Santista area. Water consumption is read from meters installed at each household. As for sewage drainage, an amount equal to water consumed is charged to users. Unit prices for water supply and sewerage are submitted to Agencia Reguladora de Saneamento e Energia do Estado de São Paulo (ARSESP), São Paulo's sanitation regulatory agency, in accordance with São Paulo water and sewerage legislation, upon which a third-party agency reviews the submission to ensure there are no questionable calculation methods. It also analyzes submissions from the perspective whether fee setting is fair considering the state's economic situation and evaluates the validity of water supply and sewerage rates. São Paulo state owns 51% of SABESP's stock and has influence on every decision it makes, including fee setting. In water supply and sewerage projects with public impact, the state presents the pricing necessary to maintain SABESP water supply and sewerage business while also considering the economic situation and living standards of residents. In terms of the setting of water supply and sewerage rates, the state is capable of setting fees that not only maintain water supply and sewerage projects, but also consider the economic situation and living standards of residents, which demonstrates that water supply and sewerage business have extremely high financial sustainability.

In this way, SABESP has established a stable financial structure. Given that there are no problems in budget of water supply and sewerage services that RS provides, including this project, there are no problems present regarding financial aspects.

3.5.4. Current Status of Operation and Maintenance

This ex-post evaluation ascertained the status concerning the operation and maintenance of water supply and sewerage facilities in this project through quarterly progress reports from SABESP, questionnaire responses, and field surveys. Generally speaking, all facilities are being operated and maintained without problems. By contrast, although there are no problems significant enough to prevent the operation, management or maintenance of water supply and

sewerage facilities, some minor faults were discovered. These included inoperable sensors for detecting sewage intake; inoperable sensors for detecting oxygen concentration during secondary sewage treatment; and overdue maintenance for equipment required to treat activated sludge separated in the biological process or equipment for chlorine treatment before discharge. However, as these were all quickly dealt with via alternative means, there are no problems present with respect to operation and maintenance.

In Mongaguá, some difficulties are being experienced in facility expansion to respond to the rising population (sewage treatment plants' operating rate exceeds 100% at times). Plans to expand Mongaguá city's sewage treatment plant are currently underway in this project to deal with this. Aside from the Mongaguá expansion plan, plans are also being made to newly establish four sewage treatment plants and expand the sewer trunk line and sewage collection network.

Based on the above, there are no particular problems in the institutional, technical or financial aspects as well as the current status of the operation and maintenance system. Therefore, the sustainability of the effects produced by this project is high.

4. Conclusion, Lessons Learned and Recommendations

4.1. Conclusion

The Baixada Santista Metropolitan Region in Brazil is a region made up of nine cities. Situated between the Greater São Paulo and the Atlantic Ocean, this tourist destination is marked by rapid development, especially in urban areas. The objective of the project is to ameliorate water pollution associated with rapid population growth in the region and provide stable water supply to meet the surging water demand in these urban areas by developing water supply and sewerage facilities in the areas, thereby contributing to the improvement of the local living environment. The project is relevant to the Brazilian government's policies and development needs, as well as the development needs of the region and Japan's ODA policy. Therefore, its relevance is high. The efficiency of the project is low. The time-consuming bidding process resulted in a four-year delay for starting the construction work. This in turn led both to higher prices of materials and equipment and to revisions to the original design associated with the lapse of time. These consequences greatly pushed up the costs for the work, necessitating additional loan. Even after the additional ODA loan, the budget for the construction was not executed as planned because of three factors: (i) higher costs associated with an extended construction period; (ii) the soaring costs of laying trunk sewer and sewage collection network; and (iii) more funds were allocated to combat the water scarcity that began to take its toll in the metropolitan area around 2014. Although the wastewater treatment plants and the water supply system have been completed, three percent of the planned sewerage connections have remained uncompleted. Thus, the project period and cost are both significantly higher than planned.

Despite the unfinished components, this project is highly effective. The wastewater treatment volume, household connections, and sewerage coverage have all exceeded 80 percent of the targets. The project has contributed to improved water quality in the region partly because of its Technical Assistance project called the “Environmental Monitoring Project for Baixada Santista Metropolitan Region”. In addition, a beneficiary survey in the region has shown that many residents feel their living environment has improved because of increased water supply, improved water quality, and better household sanitation, suggesting that they are highly satisfied with the project. Therefore, the effectiveness and impact of the project are high. Following the completion of the work, the facilities are operated and maintained by the Baixada Santista Business Unit (RS) of the Basic Sanitation Company of the State of São Paulo. No problems have been observed in the institutional, technical or financial aspects of the maintenance of the project. Therefore, the sustainability of the project effect is high. In light of the above, this project is evaluated to be satisfactory.

4.2. Recommendations

4.2.1. Recommendations to the Executing Agency

As construction work undertaken by the executing agency in this project has not been completed in Cubatão, Guarujá, and Itanhaém, appropriate management of the work must continue. Sufficient funds must be invested to complete construction by the project completion date newly defined in each city, and construction work needs to proceed with the highest priority. For uncompleted work the counterpart is responsible for, regardless of the work being funded by the counterpart, it is desirable for quarterly progress reports to be prepared and submitted to JICA because this work falls under the scope of the original project.

Being a tourist destination, the project target for the BOD concentration of treated water in Mongaguá (8.9mg/l) has been set in the Phase II much more strictly than the regulations on effluent of treated sewage prescribed by the State of São Paulo to ensure the water quality of public water bodies. Despite this, the BOD concentration of treated water greatly exceeds the target. This appears to be because the volume of sewage to be treated by Mongaguá sewage treatment plant has almost reached the limit of its treatment capacity. Some ingenuity in the operation and maintenance of the sewage treatment plant is needed as a stopgap countermeasure. For example, it is necessary to increase the amount of oxygen injected to reduce treated water BOD concentration, and sewage treatment capacity must be augmented in order to withstand future demand.

4.2.2. Recommendations to JICA

As for the remaining three cities with unfinished work that the counterpart is responsible for, including Cubatão, construction on unfinished work will continue in order to fulfill the scope of

the project, funded by SABESP own finance. This is scheduled to complete in December 2018 and it will be necessary to monitor this project to ensure that construction is completed as planned. With regard to operational and effectiveness indicators for this project's ex post evaluation—specifically, sewer treatment volume, number of households connecting with sewerage connection rate to the sewage treatment system, and BOD concentration levels of treated water from newly constructed or upgraded sewage treatment plants—it is desirable to conduct monitoring two years after completion of the project, which is the timeframe set in target indicators, in order to determine whether the project achieves its effect indicators. If a risk is anticipated or problem is discovered, it is also desirable to receive information from SABESP and provide necessary advice.

4.3. Lessons Learned

(1) Thorough information management

This project has spanned 10 years since the time of the appraisal and has a complicated background, as is apparent from the long timespan. It was difficult to assess the appropriateness of set indicators in this ex-post evaluation as it was impossible to confirm conditions at the time of the appraisal and implementation plan. The same is true for material that formed the basis of the anticipated operational and effectiveness indicators, which are important in order to clearly understand all the facts. It goes without saying that information management is essential for proper implementation, monitoring and evaluation of projects. At the time of formulating a project implementation plan, aside from the plan itself, it is vital that project executing agencies and JICA local office fully discuss and agree on the basic framework to manage information and ensure information is properly managed.

(2) Strengthening project monitoring

This project required more time and cost than anticipated, resulting in the actual project costs that were 3.5 times the projected amount and the actual time that was 2.5 times the planned one. In particular, substantial time and cost was poured into the sewer trunk line and sewage collection network after 2010 when the sewage treatment plant construction was complete, and sewer pipe construction work in Cubatão, Guarujá, Praia Grande, and Itanhaém was still unfinished at the time of contract completion. Contractors were newly recruited and contracted to completed the unfinished construction work allocated to the counterpart in this project; however, there is no mention of this in progress reports submitted after 2012. The report also contained no progress updates for the above four cities. There have been no particular progress reports provided to JICA local office after the 2013 year-end project completion report, and even at the time of the ex-post evaluation incomplete work remains in Cubatão, Guarujá, and Itanhaém. Satisfactory project effectiveness has still not been achieved at the time of the ex-post

evaluation because of the impact of unfinished work in these cities. It is believed that the lack of adequate project monitoring through the course of the project is one of the reasons that some work was left unfinished. In addition to periodic confirmation onthe project progress through project progress reports, it is important for the executing agency and JICA local office to maintain close communication so as to be aware at all times of risks such as increased project expenses caused by project delays and unfinished work by contractors, and to deal with these risks appropriately in order to achieve the project's intended effect. The Japanese ODA loan projects currently underway in São Paulo, Brazil are the “Non Revenue Water Control Project in São Paulo State” and “Environmental Improvement Project in the Basin Lake Billings.” Rather than simply receiving progress reports from these projects, it is preferable that the executing agency and the JICA local office maintain close communication to manage risks and respond quickly to problems when they occur.

(3) Applying a regionally focused "program approach" to improving the living environment

A program approach is effective because related sub-sectors become involved in regional waste management and regional environmental improvement/conservation projects. This project aimed to improve the living environment of local communities. However, rainwater and wastewater measures controlled by the city were insufficient when the amount of rainwater increased, causing water to overflow from drain ditches and manholes, and residential waste discarded in drainage ditches flooded the streets, adversely affecting the living environment of local residents. The problem was that there is a limit to how much the local residents' living environment can be improved with only a SABESP standalone project. Rather than standalone projects, we can expect a more comprehensive improvement to the living environment of local residents by implementing a regionally-focused "program approach" to improving it, involving multiple regional actors. For example, projects involving infrastructure, such as water supply and sewerage improvement or wastewater management projects would be implemented as Japanese ODA loan projects, whereas coordination with multiple regional actors and technical support for improving regional living conditions would be implemented as JICA technical cooperation projects. By cooperating with the city as well as public water supply and sewerage corporations to form and implement a comprehensive program-based project for improving the area's living environment, it would be possible to not only contribute to improving the area's living environment, but to fully realize it. In the state of Ceará in eastern Brazil, the state government and public water corporation assumed the primary role in constructing waterways carrying water to all parts of the arid region. This realized a water supply to support daily life, livestock, and agriculture while also achieving comprehensive water and environmental measures that involve inhabitants and relevant local authorities and incorporate water management, etc. Depending on the recipient country's needs, it may be more effective to

implement a project in combination with such comprehensive environmental measures than to simply carry out a Japanese ODA loan project for developing just a part of the country's infrastructure.

Comparison of the Original and Actual Scope of the Project

Item	Plan	Actual
(1) Project Outputs	Sewerage project (whole area) Sewage treatment plants: **9 plants in 8 cities in Phase I** (no update in Phase II) Total sewage treatment capacity: **8,321 L/s** Sewer trunk line: **100 km in Phase I** (updated to 122 km in Phase II) Pumping stations: **78 in Phase I** (updated to 101 in Phase II) Sewage collection network: **992 km in Phase I** (updated to 1,059 km in Phase II) Sewage service connections: **118,000 homes in Phase I** (updated to 123,000 in Phase II) Sea outfalls: **4.3 km in Phase I** (updated to 4.4 km in Phase II) Water Supply Project (Mambu Branco Water Supply System) Water treatment plants: **1 plant** Water treatment capacity: **1,600 L/s** Raw water pipeline: **2 km** Water distribution pipelines: **66 km** Pumping stations: **3** Water supply tank: **20,000 m³**	Sewerage project (whole area) Sewage treatment plants: **9 facilities in 8 cities** Total sewage treatment capacity: **8,321 L/s** Sewer trunk line: **132 km** Pumping stations: **101** Sewage collection network: **1,035 km** Sewage service connections: **100,000 homes** Sea outfalls: **4.5 km** Water Supply Project (Mambu Branco Water Supply System) Water treatment plants: **1 plant** Water treatment capacity: **1,600 L/s** Raw water pipeline: **2 km** Water distribution pipelines: **64 km** Pumping stations: **3** Water supply tank: **20,000 m³**
(2) Project Period	July 2004–Feb. 2009 (56 months)	May 2007–Dec. 2016 (150 months (incomplete))
(3)Project Cost Foreign currency Local currency Total Japanese ODA loan portion Exchange rate (reference) Foreign currency Local currency Total Japanese ODA loan portion Exchange rate	Phase I: 4,985 million JPY 34,236 million JPY (561 million BRL) 39,221 million JPY 21,320 million JPY 1 BRL=61.02 JPY (at Jan. 2001) (Reference) Updated portion for Phase II (additional financing) 0 million JPY (Phases I+II: 4,985 million JPY) 45,393 million JPY (Phases I+II: 79,629 million JPY) (1,064 million BRL (Phases I+II: 1,625 million BRL)) 45,393 million JPY (Phases I+II: 84,614 million JPY) 19,169 million JPY (Phases I+II: 40,489 million JPY) 1 BRL=42.65 JPY (at Dec. 2008)	Foreign currency 707 million JPY Local currency 135,980 million JPY (2,917 million BRL) Total 136,687 million JPY Japanese ODA loan portion 40,489 million JPY Exchange rate 1 BRL = 46.61 JPY (Jan. 2005–Dec. 2016 average)
4) Final Disbursement	March 2011	

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