Ex-Post Project Evaluation 2012: Package I-6

(Paraguay, Brazil)

November 2013

JAPAN INTERNATIONAL COOPERATION AGENCY

GLOBAL GROUP 21 JAPAN, INC.

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Preface

Ex-post evaluation of ODA projects has been in place since 1975 and since then the coverage of evaluation has expanded. Japan's ODA charter revised in 2003 shows Japan's commitment to ODA evaluation, clearly stating under the section "Enhancement of Evaluation" that in order to measure, analyze and objectively evaluate the outcome of ODA, third-party evaluations conducted by experts will be enhanced.

This volume shows the results of the ex-post evaluation of ODA Loan projects that were mainly completed in fiscal year 2010, and Technical Cooperation projects and Grant Aid projects, most of which project cost exceeds 1 billion JPY, that were mainly completed in fiscal year 2009. The ex-post evaluation was entrusted to external evaluators to ensure objective analysis of the projects' effects and to draw lessons and recommendations to be utilized in similar projects.

The lessons and recommendations drawn from these evaluations will be shared with JICA's stakeholders in order to improve the quality of ODA projects.

Lastly, deep appreciation is given to those who have cooperated and supported the creation of this volume of evaluations.

November 2013
Toshitsugu Uesawa
Vice President
Japan International Cooperation Agency (JICA)

Disclaimer

This volume of evaluations, the English translation of the original Japanese version, shows the result of objective ex-post evaluations made by external evaluators. The views and recommendations herein do not necessarily reflect the official views and opinions of JICA. JICA is not responsible for the accuracy of English translation, and the Japanese version shall prevail in the event of any inconsistency with the English version.

Minor amendments may be made when the contents of this volume is posted on JICA's website.

JICA's comments may be added at the end of each report when the views held by the operations departments do not match those of the external evaluator.

Republic of Paraguay

Ex-Post Evaluation of Japanese ODA Loan

Road Improvement Project (II)

External Evaluator: Takeshi Yoshida
Global Group 21 Japan, Inc.

0. Summary

This Project (hereinafter referred to as "the Project") was implemented for the purpose of developing a road transport network capable of accommodating (i) the strong distribution demand for agricultural and livestock products produced by key industries in Paraguay and (ii) the increased transportation demand with the launch of the MERCOSUR[1], etc. by means of improving national and local roads which are the major arterial roads of the country, and thereby contributing to a sustainable development of national economy. The purpose of the Project was consistent not only with the development policies and needs of Paraguay but also with the ODA policy of Japan. As such, the relevance of the Project is high. The target road sections for improvement under the Project now see a traffic volume which is 1.4 times of that originally anticipated at the time of project planning and the travelling time on all roads has been shortened. In the case of the export of grains as one of Paraguay's major export items, the share of river transportation has increased in recent years and the Project is believed to have contributed to the promotion of river transportation through improved road access to river ports. Meanwhile, the smoother physical distribution and passenger transportation in general as a result of the Project has contributed to local development and improved access to social services. As such, the effectiveness of the Project is judged to be high. The implementation of additional work achieved more improvement of roads and bridges than originally planned. While the project cost was mostly as planned, the project period significantly exceeded the original plan, therefore the efficient of the Project is fair. No major problems are observed in regard to the institutional, technical and financial capacity for road maintenance, and the maintenance conditions of the target roads of the Project are reasonably good. Therefore, the sustainability of the Project is judged to be high. Based on the above findings, the Project is evaluated to be highly satisfactory.

[1] MERCOSUR is a common market created by the Treaty of Asuncion agreed among Argentina, Brazil, Paraguay and Uruguay in March 1991 in order to promote free trade and the fluid movement of capital, goods, services, and labor force in the area.

1. Project Description

Project Locations

Road Section 1 (Paraguari-Tebicuary)

1.1 Background

Agriculture and stock raising are the key industries in Paraguay. On the other hand, land transportation was playing a crucial role in the transportation sector. Around 1990, road transportation accounted for 90% of cargo transportation and 99% of passenger transportation, illustrating the extreme importance of road transportation. The east central area consisting of Asuncion, the capital of Paraguay, and 10 surrounding districts is an important economic area with a heavy concentration of population and is located at the heart of the network for physical distribution by land which was expected to gain development momentum with the launch of the MERCOSUR. Road improvement was considered to be an important means of development. The reality at the time was that the transportation of agricultural and livestock products was severely hampered by the lack of proper road maintenance and by the very low paved road ratio of less than 5% nationwide and 12% for trunk roads.

To improve the situation, the Government of Paraguay implemented the Road Improvement Project (I) (Japanese ODA Loan) in 1990 and the Master Plan Study for Transport System Development and Improvement in 1992 with the assistance of the Government of Japan. In 1997, JICA commissioned the Study for the Planning of Trunk Road Improvement in the East Central Area to determine the feasibility of a road improvement project in the area concerned while the Ministry of Public Works and Communications (MOPC) of Paraguay conducted a Feasibility Study (F/S) on the overlay of trunk roads nationwide. Based on the findings of these studies, a loan agreement for the Road Improvement Project (II) (target project of the present ex-post evaluation) was signed.

1.2 Project Outline

The objective of the Project is to develop a road transportation network capable of meeting the demand for the physical distribution of agricultural and livestock products, which are products of the

key domestic industries, and the increased transportation demand resulting from the launch of the MERCOSUR by means of improving the national as well as local trunk roads, thereby contributing to the sustainable economic development of Paraguay.

Loan Approved Amount/ Loan Disbursed Amount	¥19,428 million/ ¥18,522 million
Exchange of Notes Date/ Loan Agreement Signing Date	December, 1997/ August, 1998
Terms and Conditions	Interest Rate: 2.7% (2.3% for the Consulting Portion) Repayment Period: 25 years (Grace Period: 7 years) Procurement: General untied
Borrower/Executing Agency	Republic of Paraguay/Ministry of Public Works and Communications
Final Disbursement Date	October, 2010
Main Contractors	・Tecnoedil S.A. Constructora(Paraguay)/Compania de Construcciones Civiles S.A.(Paraguay)/Benito Roggio e Hijos S.A.(Paraguay)/Talavera Ortellado Construcciones S.R.L.(Paraguay) ・E.D.B.Construcciones(Paraguay)/EDB Construcciones S.R.L.(Paraguay)/Concretmix S.A.(Paraguay) ・Tecnoedil S.A. Constructora(Paraguay)/Benito Roggio e Hijos S.A.(Paraguay)/Talavera Ortellado Construcciones S.R.L.(Paraguay) ・CDD Construcciones S.A.(Paraguay) ・Konoike Construction Co.Ltd. (Japan)/Tecnoedil S.A. Constructora(Paraguay)/Benito Roggio e Hijos S.A.(Paraguay)/Talavera Ortellado Construcciones S.R.L.(Paraguay) ・Giagui Terraplenagem e Pavimentacao(Brazil)/Emparsanco S.A.(Brazil)/Compania de Construcciones Civiles S.A.(Paraguay)/Ingenieria Isacio Vallejos(Paraguay)/M&T Construcciones S.R.L.(Paraguay) ・Giagui Terraplenagem e Pavimentacao(Brazil)/Emparsanco S.A.(Brazil)/Ingenieria Isacio Vallejos(Paraguay)/M&T Construcciones S.R.L.(Paraguay)
Main Consultant	Central Consultant Inc. (Japan)
Feasibility Studies, etc.	Study for the Project for Trunk Road Improvement in East Central Area
Related Projects	Road Improvement Project (I) (L/A in 1990)

2. Outline of the Evaluation Study

2.1 External Evaluator

Takeshi Yoshida (Global Group 21 Japan, Inc.)

2.2 Duration of Evaluation Study

The ex-post evaluation study for the Project was conducted over the following period.

Study Period : September, 2012 to July, 2013

Field Survey : 31 October to 24 November, 2012; 20 to 22 May, 2013

3. Results of the Evaluation (Overall Rating: A[2])

3.1 Relevance (Rating: ③[3])

3.1.1 Relevance to the Development Plan of Paraguay

In Socioeconomic Development Plan for 1995 through 1998, the Government of Paraguay adopted the development of economic infrastructure as one of its goals for the purpose of promoting agriculture, which is a key industry, and related industries and also promoting exports as it was fully aware of the potential impact of the MERCOSUR and other development prospects. Particular emphasis was placed on the development of the road network as a key component of the economic infrastructure in view of the efficient and reliable transportation of various products.

The Strategic Socioeconomic Plan for 2008 through 2013 sets forth eight development policies, including the promotion of infrastructure development. In accordance with this plan, the MOPC has identified such goals as the implementation of routine road maintenance by small enterprises, improvement of the operational efficiency of the organizations concerned, participation of both the public and private sectors in road management and improvement of road safety in addition to improvement of the road infrastructure.

In this manner, road improvement has always been a priority issue for Paraguay's development policy throughout the period from ex-ante to ex-post evaluation.

3.1.2 Relevance to the Development Needs of Paraguay

As already described in 1.1 – Background, the smooth distribution of primarily agricultural and livestock products through the improvement of trunk roads was an important challenge at the time of appraisal.

In subsequent years, the significantly increased production volume of grains, a major export item, has meant a considerable increase of the demand for physical distribution.[4] On the other hand, the role of rivers as means for the transportation of goods for export as well as imported goods has grown to account for 60% of export-related transportation and 50% of import-related transportation, while the transportation to the river ports almost relies on roads. Accordingly, the comparative shares of land transportation for exports and imports have declined while the domestic transportation volume by

[2] A: Highly satisfactory, B: Satisfactory, C:Partially satisfactory, D: Unsatisfactory
[3] ③: High , ② Fair ,①: Low
[4] The production volume of soybeans and wheat in Paraguay increased by 2.5 times and 6.1 times respectively between 2000 and 2010.

trucks has actually increased because of the massive increase of the production volume of grains. As a result, there is still a strong need for road improvement.

3.1.3 Relevance to Japan's ODA Policy

At the second consultation meeting between Japan and Paraguay in July, 1992, an agreement was reached that the important areas for Japan's ODA were the promotion of agriculture, development of economic infrastructure, development of the social sector and environmental conservation among others. The Project not only fell in the category of the development of economic infrastructure but was also relevant to the promotion of agriculture.

Based on the above observation, the Project has been highly relevant with the country's development plan, development needs, as well as Japan's ODA policy, therefore its relevance is high.

3.2 Effectiveness[5] (Rating: ③)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

At the time of appraisal neither indicators nor their target values to measure effectiveness were specified. In the present ex-post evaluation, effectiveness of the Project is analysed based on i) increase in traffic volume obtained by comparing the projection in F/S and the results of traffic survey for each road section, and ii) increased in travel speed in the road improvement sections.

(1) Increased Traffic Volume

Comparison between the pre-project traffic volume and the forecast based on F/S (in 1997) conducted by the JICA and MOPC and the traffic volume at the time of the ex-post evaluation shows that the current traffic volume exceeds the forecast at five road sections out of seven road sections included in the Project.[6] The average traffic volume for the seven road sections has increased by 3.3 times between 1997 and 2012 which is 1.4 times the forecast[7]. As shown in Table 2, trucks account for some 20% of the overall traffic volume.

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

[6] Improvement, overlay and widening of bridges were implemented at seven road sections by the Project according to the original plan. Moreover, overlay and bridge improvement were made at three additional sections, which are located at the same routes of the original seven sections. As part of the ex-post evaluation, a questionnaire survey on origin-destination, loaded goods, etc. was conducted with 5,849 drivers along with a 12 hour long traffic volume survey at the seven road sections included in the Project at the time of appraisal.

[7] According to MOPC, it is believed that the less-than-projected traffic volume in 2012 at the Section No. 3 was due to a decrease of timber export to Brazil which was using this section.

Truck for Sugar Cane (Road Section 2)

Track for Grains (Road Section 4)

Table 1 Changes of the Actual Daily Traffic Volume in Each Road Section and Comparison with the Forecast

(Vehicles/day)

Road Section		Before the Project (1997)	Actual (2012)	Forecast (2012)	Actual/ Forecast
1	Paraguari-Villarica	412	3,676	3,205	115%
2	La Colmena -Tecuary	60	2,344	737	318%
3	Yby Yau-P.J.Caballero	1,433	2,024	2,735	74%
4	Bell Vista Sur-Km148	1,472	3,599	2,825	127%
5	S.J.Bautista-Encarnacion	1,272	4,603	2,584	178%
6	Cnl.Oviedo-S. Estanislao	2,133	3,916	4,235	92%
7	Rotonda-Km 71	3,340	13,171	7,106	185%
Average		1,446	4,762	3,347	142%

Source: Feasibility study by the JICA and MOPC; traffic survey as part of the ex-post evaluation

Table 2 Traffic Volume Share by Type of Vehicle

Road Section		Passenger Car	Bus	Truck
1	Paraguari-Villarica	86%	3%	11%
2	La Colmena -Tecuary	80%	2%	18%
3	Yby Yau-P.J.Caballero	78%	5%	18%
4	Bell Vista Sur-Km148	68%	4%	27%
5	S.J.Bautista-Encarnacion	72%	2%	26%
6	Cnl.Oviedo-S. Estanislao	76%	2%	22%
7	Rotonda-Km 71	76%	2%	22%
Average		76%	3%	21%

Source: The traffic survey as part of the ex-post evaluation

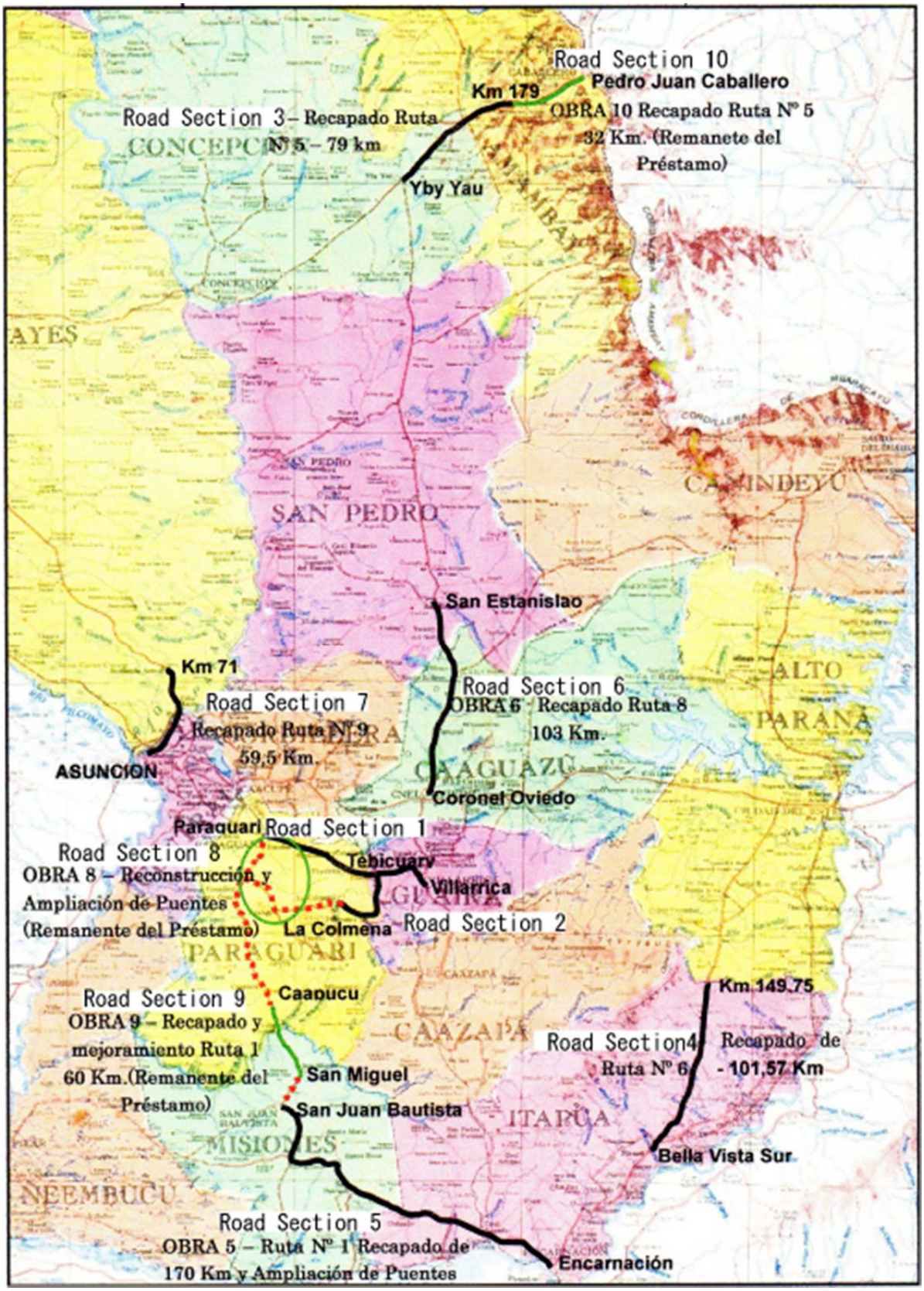

Figure 1 Road Sections of the Road Improvement Project (II)

(2) Shortening of the Travelling Time

According to local people living along the target road sections, the travelling time has become much shorter in Road Sections 1 and 2 where the improvement work was conducted.[8] For example, the travelling time between Paraguari and Caballero (section between Paraguari and Tebicuari) in Road Section 1 has been shortened from one and a half hours prior to the project to 30 minutes. While this section used to be impassable at the time of rain, it is passable in all weather conditions since the implementation of the Project. Meanwhile, the travelling time between La Colmera and Villarrica in Road Section 2 is now only one hour compared to three to four hours before the Project.

3.2.2 Qualitative Effects

The findings of an interview survey and transport survey indicate the following road usage situation by road sections.

Road Section 1: This is a local trunk road connecting Villarrica, the departmental capital, with Route 1 stretching to Asuncion. It is used for the shipment of vegetables to Asuncion and the delivery of soybeans to Port Villeta (the Paraguay River). It provides a detour for Route 2 which is congested and subject to strict weight regulations.

Road Section 2: This is a local trunk road connecting Villarrica, the departmental capital, with La Colmera which is a Japanese settlement area and is popular for the transportation of agricultural products.

Road Sections 3 and 10: These lots have a high ratio of truck transportation involving construction materials and consumer goods, contributing to the border trade with Brazil (Route 5).

Road Section 4: This lot has a high ratio of truck transportation. As a trunk road for the transportation of such agricultural products as soybeans and grains, it is used to transport these products to a port on the Paraná River (Route 6).

Road Sections 5, 8 and 9: These lots also have a high ratio of truck transportation as they are part of Route 1 connecting Asuncion with Encarnacion, the third largest city in Paraguay. As areas along Route 1 are popular stock raising areas, they are used for the transportation of livestock products.

[8] As part of the ex-post evaluation, workshops involving local people living along the target road sections under the Project were held eight times in addition to interview surveys with eight local governments, 10 bus companies and 10 transport agencies.

Road Section 6: This is the only national route (Route 8) running north-south in Paraguay and is used for multiple purposes.

Road Section 7: This lot has a high ratio of truck transportation involving construction materials, consumer goods and livestock products as it is the only trunk road (Route 9) linking western Paraguay (Chaco Region) with Asuncion.

Commercial and industrial facilities such as distribution warehouses, repair workshops, etc. along the service roads (Road Section 10)

Evaluation workshop with the residents along the road (Road Section 2)

3.3 Impacts

3.3.1 Intended Impacts

From 2000 to 2012, both imports and exports have recorded an increasing trend with an increase of the export volume in particular. This is probably because of the increasing international demand for grains which constitute a leading export item for Paraguay. During this period, the trade volume with MERCOSUR countries (Argentina, Brazil, Uruguay and Venezuela) grew by nearly 50% even though its share in Paraguay's global trade volume declined as shown in Table 3.

Table 3 Import and Export Volumes of Paraguay

(Unit: tons)

	2000		2012	
	Global	MERCOSUR	Global	MERCOSUR
Imports	2,633	2,112 (80%)	5,655	3,449 (61%)
Exports	3,413	2,481 (73%)	9,724	3,499 (36%)
Total	6,146	4,596 (75%)	15,379	6,948 (42%)

Source: Central Bank of Paraguay

According to data of the Central Bank of Paraguay, river transportation is used for 95% of exported soybeans as of 2010.[9] The Paraguay River and the Parana River account for 71% and 24% of soybean exports respectively, indicating the dominant position of the Paraguay River for the export of soybeans from Paraguay. In 2004, the corresponding figures were 35% for the Paraguay River and 37% for the Parana River. The growing prominence of the Paraguay River is presumably attributable to the improved road access to export ports on the Paraguay River. The work in Road Sections 1, 2, 4, 5 and 8 under the Project has contributed to improving the access to ports on the Paraguay River.

3.3.2 Other Impacts

An interview survey with local residents, local public authorities and transport companies found the following impacts along the routes of the target roads of the Project.

- In areas near Road Sections 1 and 2, vegetable cultivation has increased due to the improved logistics to reach urban areas. The production of soybeans has also increased. The impacts are particularly strong in Japanese settlements at La Colmena and access to schools and hospitals has much improved in addition to an increase of the processing of agricultural products.

- In Road Section 4, there has been much impact on Japanese settlers in Pirapo, including the increased shipment of agricultural products and better access to schools and hospitals in Encarnacion, the department capital.

- The area around Road Section 7 which was subject to road widening has seen rapid development with the advance of large commercial facilities and distribution facilities, exploiting the area's proximity to Asuncion, the capital. In addition to the three-time increase of the through traffic, the volume of shopping traffic and physical distribution traffic to and from commercial facilities has much increased.

- The areas near Colonel Oviedo in Road Section 6 and Pedro Juan Caballero in Road Section 10 have seen asphalt overlay as well as the introduction of local service roads on both sides of the trunk road, improving the convenience for local traffic. As a result, many new stores and factories are located in these areas, contributing to local development. Moreover, land prices have increased to boost the tax revenue of the relevant municipalities.

As for the Road Sections 1 and 2 that included some widening and new construction, the construction works were conducted after obtaining environmental licence and permission from the Environmental

[9] Based on data quoted in the Preparatory Survey on the Eastern Region Export Corridor Improvement Project in the Republic of Paraguay (JICA, 2011)

Department. Environmental monitoring, river protection works as well as tree plantations were implemented as well. For the two sections, land acquisition was made in line with the provisions of domestic law and some 370 households were compensated[10]. No serious environmental impact has been reported and neither land acquisition nor resettlement were made in other road sections where overlay and/or bridge improvement were made on existing roads.

As a result of the Project, the traffic volume is double the original forecast and the travelling time has been much shortened. Apart from its contribution to the promotion of agriculture, the Project has contributed to local development and improved access to social services by means of making physical distribution and passenger transportation in general much smoother. Based on such observation results confirming the manifestation of positive effects of the Project, the effectiveness of the Project is judged to be high.

3.4 Efficiency (Rating: ②)

3.4.1 Project Outputs

The planned and actual outputs of the Project are shown in Table 4. Following the redesign of the Project based on the findings of the detailed design study, the total length of the subject road sections and numbers of target bridges were revised. At the time of appraisal, the Project involved seven work lots. Three more work lots (Road Sections 8 – 10) were subsequently added, mainly because of the fall of the unit construction cost due to the fluctuation of exchange rate. All of the additional work lots were either on the original list of candidate sections compiled at the time of appraisal or an extension of a selected route (originally selected work lot). They included sections which had been omitted at the time of appraisal (in 1997) but for which overlay became necessary with the passing of time and bridges of which the construction, rehabilitation or improvement was considered to be necessary.[11]

[10] No information was obtained from MOPC on relocation nor concrete number of the households compensated.
[11] The decisions on the additional work lots were taken in 2006 and 2007.

Table 4 Planned and Actual Project Outputs

Road Section (Work Lot)		Route	Road Section	Planned	Actual
Improvement of Unpaved Road	1	Local	Paraguarí-Tebicuary	58.50 km	56.25 km
	2	Local	Tebicuary-Villarrica	24.50 km	25.00 km
		Local	La Colmena-Tebicuary	38.10 km	36.20 km
Overlay	3	Route 5	Yby Yau-P. J. Caballero Km.179	70.00 km	70.00 km
Overlay	4	Route 6	Bella Vista Sur-Km. 148	106.00 km	101.57 km
Overlay	5	Route 1	S J. Bautista Mnes.-Encarnación	170.00 km	170.00 km
Widening of Bridge	5	Route 1 Local	Paraguari-S. J. Bautista-Encarnacion Carapeguá-Acahay-La Colmena	Widening of 83 bridges	Widening of 177 bridges
Overlay	6	Route 8	Cnel. Oviedo-San Estanislao	100.00 km	103.00 km
Overlay	7	Route 9	Rotonda-Km.71	50.00 km	59.50 km
Bridge	8	Route 1 Local	Paraguari-S. J. Bautista Carapeguá- Acahay-La Colmena	(not included in the original plan)	New: 1 Rebuilding: 5 Widening: 3 Repair: 4
Overlay	9	Route 1	Caapucu-S. J. Bautista		55.0 km
Overlay	10	Route 5	Km. 179-P. J. Caballero		32.0 km
Total				617.10 km 83 bridges	708.52 km 190 bridges

Source: Reference materials at the time of appraisal and those provided by the PCR.

3.4.2 Project Inputs

3.4.2.1 Project Cost

The total project cost was ¥26,425 million which was 102% of the originally planned cost of ¥25,904 million. The actual amount of Japanese ODA loan disbursed was ¥18,480 million which was 95% of the planned loan amount of ¥19,428 million. Although the actual project cost slightly exceeded the planned cost, the efficiency of the Project is judged to be high because of the more than planned outputs, in turn resulting from the additional work[12].

Table 5 Project Cost (Original and Actual)

(Unit: ¥ million)

Item	Original			Actual		
	JICA	Paraguay	Total	JICA	Paraguay	Total
Civil Engineering	15,724	3,502	19,226	15,037	5,318	20,355
Consulting Service	2,132	-	2,132	3,466	464	3,930
Contingency	1,572	351	1,932	0	0	0
Land Acquisition Cost	-	268	268	0	82	82
Taxes	-	2,355	2,355	0	2,081	2,081
Services	0	(4,845)	(4,845)	19	0	19
Grand Total	19,428	6,476	25,904	18,522	7,945	26,467

Source: Prepared by the evaluator using the reference materials at the time of appraisal and other reference materials provided by JICA

Foreign exchange rates:

(At the time of appraisal) 1 US$ = 2,128 Gs.= ¥118

(Actual) 1 US$ = 5,398Gs.= ¥112 (weighted average for the project period)

[12] Total cost excluding the additional works was 95% (24,686 million Yen) of the total planned cost.

3.4.2.2 Project Period

The Project was originally planned to be implemented in 64 months from August, 1998 to December, 2003. In reality, 158 months from August, 1998 to October, 2011 were required to complete the Project. The actual project period was 247% of the original plan and the efficiency in terms of the project period is judged to be low even if the increased outputs are taken into consideration.

The main reasons for the initial delay of the Project implementation were the slow progress of land acquisition for the planned road widening sections and the delay of the construction work due to persistent rain caused by El Nino, etc. Additional factors for the delay were the delays of the selection process for the consultancy service provider and contractor, stagnation and confusion surrounding the execution of various procedures due to two changes of the government and subsequent replacement of the minister and difficulty of securing the construction materials.

The slow progress of land acquisition in particular was the largest factor which adversely affected the implementation of the Project. While the land expropriation work was implemented in accordance with the Public Procurement Act in Paraguay, the complexity of the procedure set forth by the Act and the ambiguity surrounding land ownership or absence of a title document in the case of most of the households involved made ascertaining land ownership, determination of the compensation amount and commencement of the work a lengthy process.[13]

3.4.3 Results of Calculations of Internal Rate of Return (IRR)

According to the feasibility study featuring Road Sections 1 and 2 where road improvement work was conducted, the average Economic Internal Rate of Return (EIRR) for these two sections was estimated to be 25.6%. In the ex-post evaluation, the EIRR was recalculated for Road Sections 1, 3, 4, 6 and 7 based on the following assumptions.[14] The recalculation results show generally high EIRR values as shown in Table 6, indicating that the target roads of the Project offer a sufficiently high EIRR in general.

- Project life : 20 years
- Benefit : Reduction of the vehicle operation cost after the completion of the Project
- Cost : Road repair and maintenance cost

[13] Having learned from such experiences, road improvement/construction projects in Paraguay in recent years legislate a specific land acquisition and compensation procedure for each project as a measure to substantially shorten the period required to complete the procedure and period required to reach the stage of work commencement.

[14] Recalculation was not conducted for other road sections because different types of works have been conducted in a same road section and vital information was not obtained for cost-benefit calculation.

Table 6 EIRR Recalculation Results

Road Section	EIRR
1	34%
3	35%
4	30%
6	30%
7	46%

Source: Prepared by the evaluator using the results of the traffic survey conducted as part of the ex-post evaluation and materials provided by the executing agency.

While the total project cost was almost as planned, the project period significantly exceeded the original plan, therefore the overall efficiency of the project is fair.

3.5 Sustainability (Rating:③)

3.5.1 Institutional Aspects of Operation and Maintenance

Road maintenance in Paraguay is the responsibility of the Directorate General of Roads under the Deputy Minister of Public Works and Communication of the MOPC. The maintenance of national routes is mainly conducted through long-term contracts under Gestión y Mantenimiento por Niveles de Servicio (hereinafter referred to as "GMANS"); Operation and Maintenance by Service Levels, and the actual maintenance work is conducted by contractors under the supervision of the Directorate General of Roads. Operation and maintenance by GMANS contract was introduced in 2006 utilizing a loan project by the World Bank[15]. Funding by the Inter-American Development Bank (IDB) is also utilized. Local roads and some national routes which are not included in GMANS contracts are directly maintained by the Road Maintenance Department and local offices of the Directorate General of Roads.

Of the road sections of the project, Road Sections 3, 4, 6, 10 and the national route section of Road Section 8 are maintained by the GMANS contracts while local) road sections, i.e. Road Sections 5, 7 and part of 8, are directly maintained by the MOPC. In the case of Road Sections 1 and 2, as they were still in the defect liability period, they were maintained by the contractor. Even though these sections have not yet been upgraded to national road status, they are scheduled to become targets for the GMANS contract in the future.

[15] National routes totalling some 2,000 km nationwide are covered by seven GMANS contracts. Each contract lasts for five years with the first year focusing on rehabilitation and the remaining years dealing with the repair and maintenance needs. GMANS contracts set forth the standards for the paved road surface conditions and other relevant aspects of roads and the Director General of Roads regularly checks the state of attainment of the required standards. Of the seven contracts, four began with World Bank loans and three with IDB loans. While planning to rely on foreign loans to continue GMANS contracts, the MOPC has begun its search for alternative funding sources to enable road maintenance work with its own funds in the future.

As the overloading of trucks is a major cause of road damage, 13 weigh stations are located nationwide along national routes. These weigh stations are controlled by the Deputy Minister for Finance of the MOPC.

3.5.2 Technical Aspects of Operation and Maintenance

Road maintenance work under GMANS contract is conducted by contractors and the field visit by the present evaluator found no technical problems. As for those roads directly maintained by the MOPC, maintenance works were conducted based on an established standards and procedures, and no major technical issues were found by the field observations.

The MOPC sends its staff members the technical training on road maintenance organized by donors etc. During the project period, some staff members participated in the training organized by JICA on road sector[16].

3.5.3 Financial Aspects of Operation and Maintenance

The annual budget size of the MOPC has been around 1 trillion Gs. to 1.5 trillion Gs. for the last 10 years, of which nearly 90% goes to the Office of the Vice-Minister of Public Works for which road maintenance is one of its important work assignments. The size of the actual budget for road maintenance has increased almost five-fold in the last 10 years and it does not appear that road maintenance is significantly hindered by an insufficient budget.

Table 7 Annual Budget Size of the MOPC

(Unit: million Gs.)

	2001	2004	2007	2010
MOPC	1,026,478	1,503,447	1,190,942	1,586,663
Office of the Public Works Vice-Minister	899,395	1,398,156	1,058,359	1,394,541
Road Maintenance Work	64,778	36,415	136,768	309,158

Source: MOPC

Note: The amounts include the budget for GMANS contracts.

[16] 18 staff members of the MOPC participated in training in Japan (in such fields as road and civil engineering administration, financing system for road construction and maintenance, road and transport planning, environmental and social consideration, construction work management and others) from FY 1998 to FY 2010.

Weigh station (Road Section 7)

Asphalt Plant of MOPC local office

3.5.4 Current Status of Operation and Maintenance

The field observations found no special problems in regard to the road maintenance of the national route sections of Road Sections 3, 4, 6 and 10 which are maintained under the GMANS contracts.

In the case of Road Sections 5, 7, 8 and 9 which are directly maintained by the MOPC, some side ditches and slopes appear to require repair although these defects do not affect the functionality of the relevant sections. While these lots subject to direct maintenance by the MOPC are maintained along with other roads, the available number of road maintenance equipment is insufficient in the face of the total length of the subject roads, resulting in a rather long wait for repair.

Road Sections 1 and 2 were still in the defect liability period at the time of field visit. Although no weigh station is located in Road Section 1, which has the status of a local road, the road acts as a bypass for Route 2 which is under the strict load control. The resulting heavy traffic of over-loaded vehicles that deviate from Route 2 made in necessary to conduct repair work at Road Section 1 within one year of its opening.[17]

No major road problems are observed in regard to the institutional, technical and financial capacity for road maintenance and the maintenance conditions of the target road sections of the Project are reasonably good. Therefore, the sustainability of the project is high.

4. Conclusion, Recommendations and Lessons Learned

4.1 Conclusion

This Project was implemented for the purpose of developing a road transport network capable of accommodating (i) the strong distribution demand for agricultural and livestock products produced by

[17] This repair work was conducted by the contractor because the defect liability period was still effective.

key industries in Paraguay and (ii) the increased transportation demand with the launch of the MERCOSUR, etc. by means of improving national and local roads which are the major arterial roads of the country, and thereby contributing to a sustainable development of national economy. The purpose of the Project was consistent not only with the development policies and needs of Paraguay but also with the ODA policy of Japan. As such, the relevance of the Project is high. The target road sections for improvement under the Project now see a traffic volume which is 1.4 times of that originally anticipated at the time of project planning and the travelling time on all roads has been shortened. In the case of the export of grains as one of Paraguay's major export items, the share of river transportation has increased in recent years and the Project is believed to have contributed to the promotion of river transportation through improved road access to river ports. Meanwhile, the smoother physical distribution and passenger transportation in general as a result of the Project has contributed to local development and improved access to social services. As such, the effectiveness of the Project is judged to be high. The implementation of additional work achieved more improvement of roads and bridges than originally planned. While the project cost was mostly as planned, the project period significantly exceeded the original plan, therefore the efficient of the Project is fair. No major problems are observed in regard to the institutional, technical and financial capacity for road maintenance, and the maintenance conditions of the target roads of the Project are reasonably good. Therefore, the sustainability of the Project is judged to be high. Based on the above findings, the Project is evaluated to be highly satisfactory.

4.2 Recommendations

4.2.1 Recommendations to the MOPC

It is necessary to establish a weigh station in Road Section 1 and 2 to control the traffic of over-loaded vehicles. Particularly in Road Section 1 which appears to be used by over-loaded vehicles as a detour to avoid weight inspection on Route 2, the introduction of a weigh station is urgently required. In view of the necessity for weigh stations to be established along with the opening of improved roads, it is highly desirable for the Directorate General of Roads to review its organizational structure or work procedure so that the feasibility of establishing a weigh station is examined as part of the planning of a road improvement project.

4.2.2 Recommendations to the JICA

None

4.3 Lessons Learned

- For any road improvement or road construction project, it is important to examine in advance (i) the likelihood of traffic involving over-loaded vehicles, including those detouring from other roads, and (ii) the necessity for the introduction of a weight regulation regime so that effective traffic control with a weigh station and other means is in place at the time of the opening of a road if necessary.

- When land acquisition is required as part of public works, the commencement of the work may be greatly hindered not only by the complexity of the procedure involved but also by the emergence of a situation where the unclear land ownership of the subject persons for compensation makes the finalisation of the subject persons for compensation and calculation of the precise compensation amount difficult. When the emergence of such a situation is anticipated, it is important to consider as much simplification of the procedure as appropriate so that the revised procedure allows commencement of the work prior to the completion of the calculation and payment of the compensation as long as the status of the land in question has been finalized as subject land for compensation.

Comparison Between the Original Plan and the Actual Results

Item	Components	Original Plan	Actual Results
Outputs	• Road improvement • Overlay • Widening of bridge • Consulting service	121.1km 496.0km 83 sites Consulting service	117.5km 591.1km 190 sites As planned
Project Period		August,1998 to December, 2003 (64months)	August, 1998 to October, 2011 (158 months)
Project Cost	• Japanese ODA Loan Portion • Executing Agency • Total Exchange Rate	¥19,428 million ¥6,476 million ¥25,904 million US$ 1= ¥118 (as of January 1997)	¥18,522 million ¥7,945 million ¥26,467 million US$ 1 = ¥112 (weighted average between 1998 to 2011)

Republic of Paraguay

Ex-Post Evaluation of Japanese ODA Loan

Asuncion Power Transmission and Distribution Network Improvement Project

External Evaluator: Hajime Sonoda
Global Group 21 Japan, Inc.

0. Summary

This project was implemented for the purpose of achieving a stable power supply by means of improving the transformation, transmission, distribution facilities, distribution control system and telecommunication facility for power supply maintenance in the Asuncion Metropolitan Area which was experiencing a rapid increase of the power demand. As this purpose was consistent not only with the development policies and needs of Paraguay but also with the ODA policy of Japan, the relevance of the project is high. With the implementation of this project, a stable power supply to the Metropolitan Area was secured as the capacity to receive power from the trunk transmission line and the capacity for transforming were increased. Moreover, the insulation of the distribution network and introduction of a distribution control system had a positive effect on the reduction of interruptions. In the Metropolitan Area, the increase of the power consumption per household in recent years is believed to have contributed to improvements in standard of living and the project is contributed to such improvement. As such, the effectiveness / impact of the project is judged to be high. Meanwhile, although the final project cost was within the planned cost, the project period was two times of the originally planned period, therefore efficiency of the project is judged to be fair. Some substation sites experienced strong opposition from local residents who feared damage to their health by electromagnetic field. In the face of such opposition, Administracion Nacional de Electrididad (ANDE) now places more emphasis on the aspect of social consideration in its work involving transmission and transformation. The sustainability of the project is judged to be fair as there are minor problems with the institutional and technical aspects of the maintenance of the distribution control system. Based on the above, this project is evaluated to be satisfactory.

1. Project Description

Project Location

Republicano Substation

1.1 Background

The long-term power generating capacity in Paraguay was secured from the late 1980's when the Itaipu Power Station, one of the world's largest hydropower stations, was commissioned with joint operation with Brazil. However, the transmission and distribution capacity in the Metropolitan Area which accounted for 60% of the country's power demand was predicted to suffer from a significant

shortage by 2000 when the power demand was forecasted to grow to 2,141 GWh with a rapid population increase. To make matters worse, the Metropolitan Area was experiencing frequent interruptions caused by damage to uninsulated power lines by fallen trees, etc. The long wait for the restoration of power supply due to the weak maintenance regime had a considerable negative impact on industrial activities and civic life. In 1988, the Government of Paraguay made a request to the Government of Japan for the provision of technical cooperation to achieve a stable power supply in the Metropolitan Area. In 1990, a master plan was formulated based on the findings of the Feasibility Study on Power Distribution System Improvement Project in the Metropolitan Area of the Republic of Paraguay. To implement this master plan, the Government of Paraguay made a request for Japanese ODA Loan to the Government of Japan which subsequently decided in 1994 to implement the Asuncion Power Transmission and Distribution Network Improvement Project (target project of the present ex-post evaluation; hereinafter referred to as "the Project"). The ODA Loan for the Project was disbursed from 1994 to 2005 and the work continued thereafter until 2007 with funding by the Paraguay side.

1.2 Project Outline

The project aimed at achieving a stable power supply in the Metropolitan Area, which was experiencing a rapid increase of the power demand, by means of improving the transmission lines, substations, distribution network, distribution control system and telecommunication equipment for power supply maintenance, thereby contributing to the improvement of the basic living environment for residents of Asuncion.

Loan Approved Amount/ Disbursed Amount	¥8,100 million yen / ¥5,636 million yen
Exchange of Notes Date / Loan Agreement Signing Date	November, 1994 / November, 1994
Terms and Conditions	Interest Rate: 3.0% Repayment Period: 30 years(Grace Period: 10 years) Procurement type: General untied
Borrower/Executing Agency	Administracion Nacional de Electricidad (ANDE: National Electricity Administration), Republic of Paraguay
Final Disbursement Date	November, 2005
Main Contractors	Schneider Electric SA France (France) / Alstom T & D SA (France) / SAINCO (Spain)
Main Consultant	Electric Power Development Co., Ltd. (Japan)
Feasibility Studies, etc.	Feasibility Study on Power Distribution System Improvement Project in the Metropolitan Area of the Republic of Paraguay
Related Projects	・Transmission and Distribution Network Improvement Project (L/A in 1985) ・Yguazu Hydropower Station Construction Project (L/A in 2008)

2. Outline of the Evaluation Study

2.1 External Evaluator

Hajime Sonoda (Global Group 21 Japan, Inc.)

2.2 Duration of Evaluation Study

The ex-post evaluation study for the Project was conducted over the following period.

Duration of Study : September, 2012 - July, 2013
Duration of Field Study : November 3 - December 9, 2012
March 24 - March 31, 2013

3. Results of the Evaluation (Overall Rating: B[1])

3.1 Relevance (Rating: ③[2])

3.1.1 Relevance to the Development Plan of Paraguay

Around the time of appraisal, the Office of the President of Paraguay published a white paper on the power sector in 1993, stressing the importance of this sector in view of the correlation between economic development and the power demand. Following this white paper, the Power Development Plan (to 2000) of ANDE adopted such goals as power supply to all, sufficient power supply to industries and socioeconomic development as well as improvement of the living standard through power supply.

At the time of ex-post evaluation, the Strategic Socioeconomic Plan (2008 – 2013) of the Government of Paraguay stipulates eight development policies, including the promotion of infrastructure development. The power sector heads the priority order for infrastructure development. As the problem was Paraguay's inability to undertake sufficient power supply for the power demand due to an insufficient transmission and distribution capacity despite a sufficient generating capacity, the priority issues were extension of the high voltage transmission network, reduction of the power loss of the existing transmission network and extension of the distribution networks in rural areas.

As outlined above, the electricity sector has always been a priority sector of Paraguay's development policy since the time of appraisal to the time of ex-post evaluation.

3.1.2 Relevance to the Development Needs of Paraguay

As described in 1.1 Background, the improvement/development of the transmission and distribution networks was urgently required to provide a stable power supply for the Metropolitan Area.

As the improvement of the transmission and distribution networks in the Metropolitan Area was largely achieved by a series of projects, including the present project, the current priority is said to be the improvement of the high voltage transmission network linking the power generating area to consumption areas. As the existing transmission network does not meet the N-1 standard[3], it is important to construct a highly reliable transmission network. In addition, given the 6.2% annual increase of the power consumption in the Metropolitan Area (2006 – 2011), the continual expansion of the transmission and distribution facilities is required. Meanwhile, the needs for insulation of distribution network is high, due to the fact that frequent interruptions still occur in areas without insulated distribution lines as only 10% of the distribution network is currently insulated.

In short, even though the project has helped the Metropolitan Area to avoid a significant capacity shortage in terms of transmission and distribution, there is still a strong need for the further improvement of the transmission and distribution networks in view of the likely rapid increase of the power demand.

3.1.3 Relevance to Japan's ODA Policy

At the second consultation meeting between Japan and Paraguay in July, 1992, an agreement was reached that the important areas for Japan's ODA were the promotion of agriculture, development of

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1 A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

2 ③: High , ② Fair ,①: Low

3 The N-1 standard means that a transmission network has reserve capacity to continue to supply power in a stable manner even if an incident such as a failure on one transmission line occurs with the power system.

economic infrastructure, development of the social sector and environmental conservation among others. The project fell in the category of the development of economic infrastructure.

Based on the above observation, this project has been highly relevant with the country's development plan, development needs, as well as Japan's ODA policy, therefore its relevance is high.

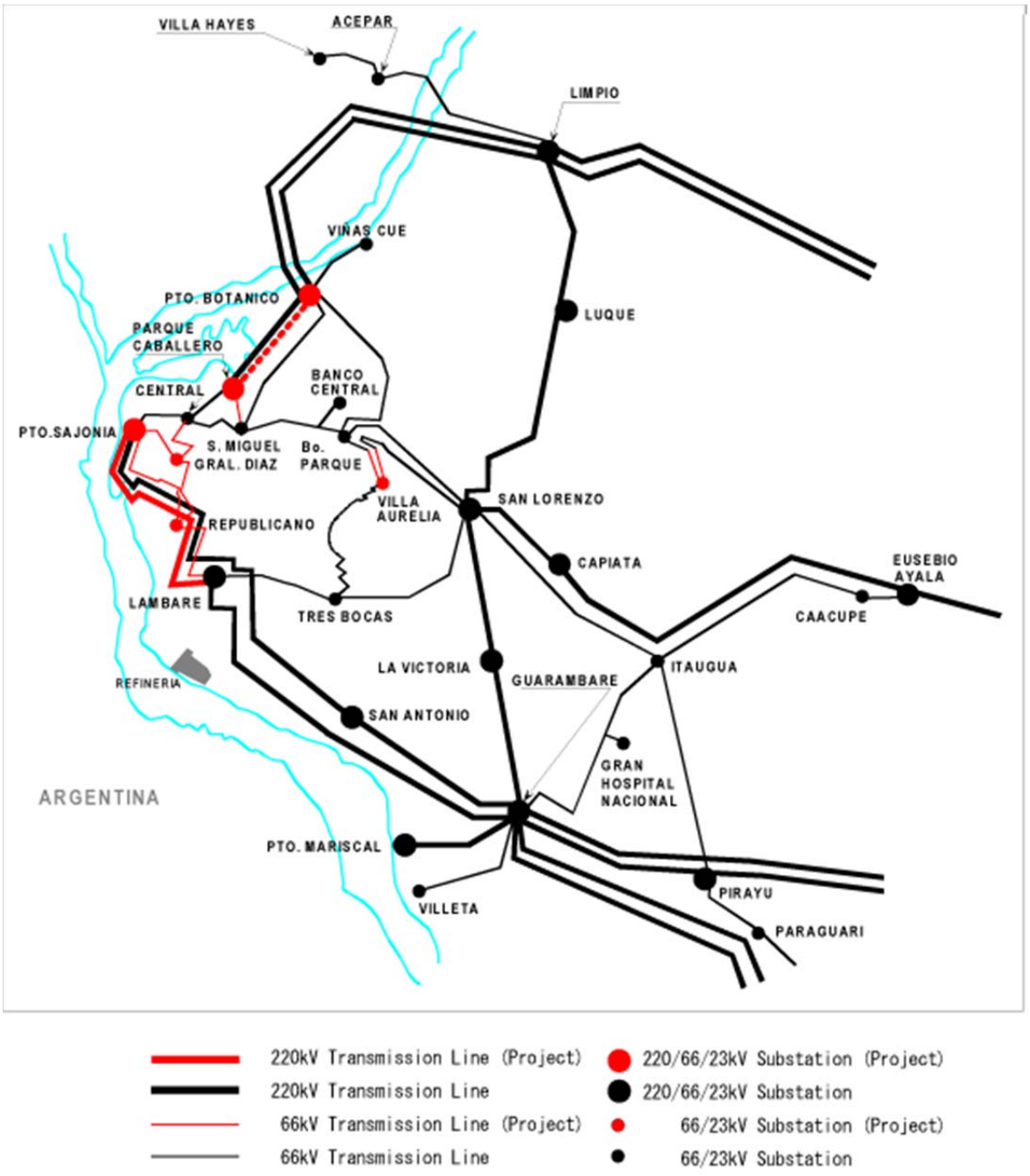

Figure 1 Power transmission facilities constructed by the Project (in red)

3.2 Effectiveness[4] (Rating: ③)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

The project aimed at achieving a stable power supply in the Metropolitan Area by means of constructing transmission lines and substations, extending and insulating distribution lines and introducing a distribution control system. The degree of achievement and the contribution of the project are quantitatively analysed next from several viewpoints[5].

(1) Increase of the Capacity to Receive Electricity from the Trunk Transmission Lines

The trunk transmission lines from the Itaipu Power Station and other power sources to the Metropolitan Area consist of four 220 kV lines and one 500 kV line with a second 500 kV line under construction as of March, 2013. The three substations included in the project receive power from these trunk transmission lines (Substations Puerto Botanico, Puerto Sajonia, Parque Caballero). The increased capacity to transform 220 kV in the Metropolitan Area as a result of the project is 360MVA and accounts for 20% of the capacity of the power system in the Metropolitan Area (1,800 MVA in 2011). However, at the Parque Caballero Substation, an overhead 220 kV transmission line has not been constructed nor connected at the time of ex-post evaluation because of an opposition among local residents who worry over health damage by magnetic field and a disagreement by the land owner (local authority) on its use. Therefore, even though the additional transformation facility of 120 MVA installed is in operation, the additional capacity is not fully utilized as the substation has sufficient capacity[6]. Similarly, the 220 kV switchgear installed at the Puerto Botanico Substation is not in operation as it has not yet been connected to the transmission line.

(2) Increased Substation Capacity in the Metropolitan Area

Under the Project, 23 kV transforming facilities with a total capacity of 380 MVA (against the planned capacity of 360 MVA) were installed at five substations and were connected to the distribution networks (Substations Parque Caballero, Puerto Sajonia, Republicano, Villa Aurelia, and General Diaz).[7] This capacity was equivalent to 21% of the entire capacity of the power system in the Metropolitan Area (1,824 MVA in 2011).[8]

The power consumption in the Metropolitan Area increased by 2.5 times from 1994 to 2011 and the annual peak power demand reached 1,146 MW in 2011. In January, 2006 (peak power demand month due to the use of electricity for heating), before the commencement of the operation of the substations constructed or expanded under the Project, the utilisation ratio (maximum load / [installed capacity x power factor]) of the 26 substations in the Metropolitan Area was an average of 77% with the ratio exceeding 90% at 14 substations (more than 100% at seven substations), indicating that the transforming capacity limit was exceeded in some areas.

The increased transforming capacity as a result of the Project reduced the average utilization ratio of the substations to 65% in 2008 with only four out of 29 substations recording the utilization ratio of more than 90% and no substations recording the utilization ratio of more than 100%.

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4 Sub-rating for the Effectiveness is to be put with consideration of Impact.

5 Although target values were shown as for electrification rate of the Metropolitan Area at the time of appraisal, no indicators or target values were specified as for an attainment of reliable power supply. In the ex-post evaluation, analyses were made based on such indicators as transmission and transformation capacity, utilization ratio of substations, frequency and duration of interruptions, while no analysis was made on electrification rate as the Project did not affect it (refer to the section of "Efficiency").

6 The additional facility was used as a back-up facility for the existing substation at the time of field visit.

7 Excluding the Puerto Botanic Substation where only switchgear was installed.

8 In addition to the project, ANDE has continually expanded the transmission and transforming facilities in the Metropolitan Area. From 2005 to 2012, it added capacity of some 300 MVA outside the scope of the Project.

In January, 2012, the utilization of the five substations newly constructed or expanded under the Project was between 36% and 90%. Meanwhile, the utilization ratio of the Villa Aurelia Substation distributing power to an area with a rapid power demand increase exceeded 90%.[9] Without the Project, it is reasonable to assume that the power demand in some parts of the Metropolitan Area would have significantly exceeded the transforming capacity, causing severe disruption to the power supply, including a series of planned outages. In other words, the Project made it possible to avoid the emergence of a serious problem in power supply.[10]

Table 1 Transitions of Utilization Rate of Substations in the Metropolitan Area

	January, 2006	January, 2008	January, 2012
Average utilization ratio (%)	77%	65%	75%
Number of substations with a utilization ratio of 90% or lower	15	25	23
Number of substations with the utilization ratio of between 90 % and 100%	14	4	10
Number of substations with the utilization ratio of 100% or higher	7	0	0

Source: Prepared by the evaluator using ANDE data

Puerto Sajonia Substation (left; switch yard, right; control room)

Parque Caballero Substation (the facility not yet connected)

66kV transmission line

[9] As the power demand in the area is very high, this substation is scheduled for upgrading to a 220 kV substation by 2019.

[10] The delayed implementation of the Project temporarily caused a situation where the transforming capacity fell short of the increasing power demand in some areas, including Villa Aurelia.

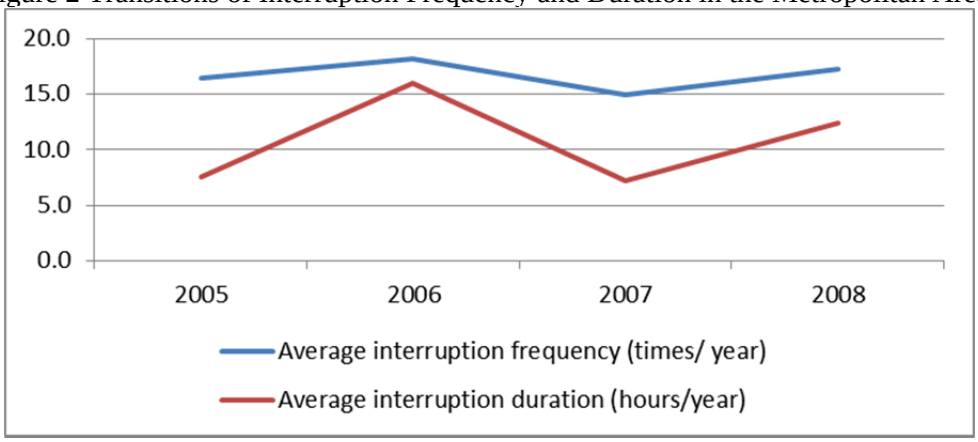
(3) Decrease of Interruption due to Newly Insulated Distribution Network

Under the Project, 23 kV distribution lines and 380 V distribution lines were constructed for 256 km and 351 km respectively. These figures correspond to 4.4% and 6.9% of the total length of 23 kV distribution lines and 380 V distribution lines respectively in the Metropolitan Area in 2012. The beneficiaries of the distribution network improved by the Project are estimated to be some 38,000 households and 4,500 commercial or industrial facilities. As the improvement of the distribution network under the Project entirely consisted of the renewal or upgrading (insulation) of the existing distribution network without extension, the Project made no contribution to the improvement of the electrification rate.[11]

Insulation of distribution lines is known to be effective for reducing interruptions due to contacts with trees in severe weather conditions and small animals. Using insulted distribution lines, trimming of trees will be unnecessary and more flexibility in routes of installation can be acquired. (Figure 2) According to ANDE, the number of interruptions was dropped by one-third to a quarter after the insulation of the distribution network.[12]

According to Figure 1, the frequency and duration of interruptions with the 23 kV distribution network in the Metropolitan Area did not show any tangible decrease in the period from 2005 to 2008.[13] Because the insulation work under the Project covered less than 10% of the distribution network in the Metropolitan Area, its effects are not visible in the results those indicators. However, ANDE has been implementing further insulation work with its own funds for the purpose of enhancing the reliability of power supply and increasing the degree of freedom of the work to install new distribution lines.

Figure 2 Transitions of Interruption Frequency and Duration in the Metropolitan Area



Source: ANDE

[11] The Project initially planned to improve the electrification rate by means of extending the distribution network. Refer to the section on "Efficiency" for the reasons for the non-extension of the distribution network. The electrification rate in the Metropolitan Area reached 99.7% in 2011.

[12] In one distribution section, for example, the number of interruptions fell from some 40 times a year in 2004 and 2005 to less than 10 times a year from 2010 onwards.

[13] The work under the Project was completed in September, 2007. The data calculation method was refined in 2009 to make new data reflect the occurrences of interruptions more accurately. Accordingly, the data for 2009 onwards cannot be compared with the data shown in Fig. 1.

Fig.3 Relationship between a tree and distribution line
(left; un-insulated lines, right; insulated lines) (provided by ANDE)

23kV distribution lines

On-pole switch

(4) Power Distribution Control System and Communication Equipment

With the introduction of a distribution control system and telecommunication facilities, it became possible to remotely monitor and operate more than 200 switches for the 23 kV distribution network in the Metropolitan Area and to make the response to interruptions much faster. Prior to the Project, a repair team was only dispatched after a visual or other confirmation of an incident of interruption at the site concerned upon reporting by a user(s). With the new system, a repair team is dispatched almost immediately after the occurrence of an interruption.

In short, the Project increased the capacity to receive power from the trunk transmission lines as well as the transforming capacity in the Metropolitan Area. The actual increase of these capacities exceeded the planned increase. The new facilities have been fully utilized, contributing to a stable power supply in the Metropolitan Area. Moreover, the improvement (insulation and introduction of the distribution control system) of the distribution network under the Project has reduced the frequency of interruptions to some extent, thereby contributing to a stable power supply. The Project has, therefore, made an important contribution to achieving a stable power supply in the Metropolitan Area and its effectiveness is high.

3.2.2 Qualitative Effects

Improvement of the living environment in the Metropolitan Area is considered to constitute a qualitative effect of the Project and is analysed in this report as part of the Impact.

3.3 Impact

3.3.1 Intended Impacts

The project was expected to contribute to the improvement of the basic living conditions of local residents by means of achieving a stable power supply to match the power demand in the Metropolitan Area.

The power consumption in the Metropolitan Area increased by 52% in the seven years from 2005 to 2011 (Figure 4). In the same period, the total number of users increased by 17% (Table 3). General users (residential) account for 45% of the total power consumption in the Metropolitan Area while commercial users and industrial users account for 21% each in 2011 (Figure 5).

It was considered that the living standard improved in this period of a substantial increase of the power consumption per residential user. The power consumption by commercial users also increased, suggesting a possible improvement of their services. In the case of industrial users, the level of power consumption did not increase as much as the number of such users, suggesting a possible increase of the ratio of small business users among industrial users. The project is judged to have made these changes possible through preventing destabilization of power supply due to an increase of demand.

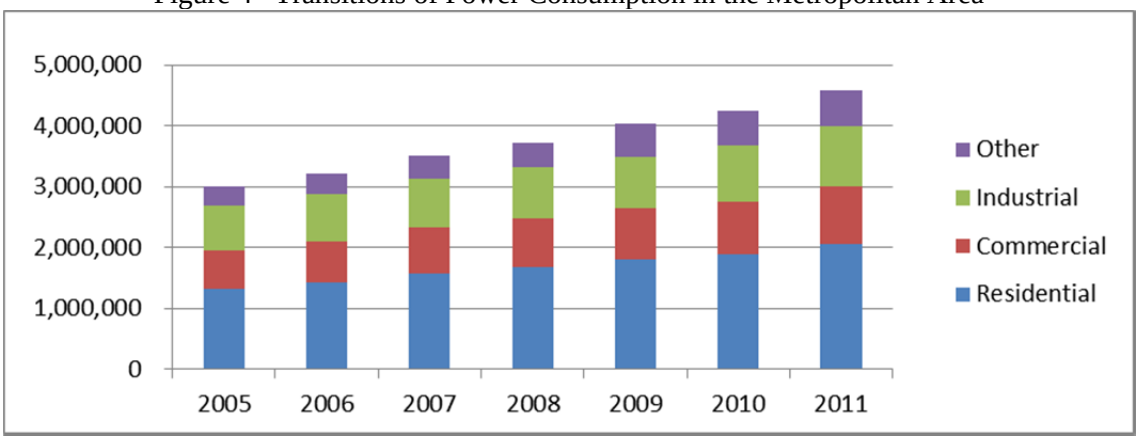
On the other hand, the findings from the interviews with business operators and ordinary households in the Metropolitan Area appear to suggest a decline of the number of interruptions in areas where the distribution network was improved under the Project. However, interruptions have not been completely eradicated and many business operators possess their own generator in case of an interruption.

Table 3 Transitions of Power Consumption in the Metropolitan Area (2005-2011)

	Increase of the Number of Users	Increase of Power Consumption	Increase of Power Consumption per User
Residential	17%	57%	34%
Commercial	12%	48%	32%
Industrial	51%	34%	-11%
Other	29%	81%	41%

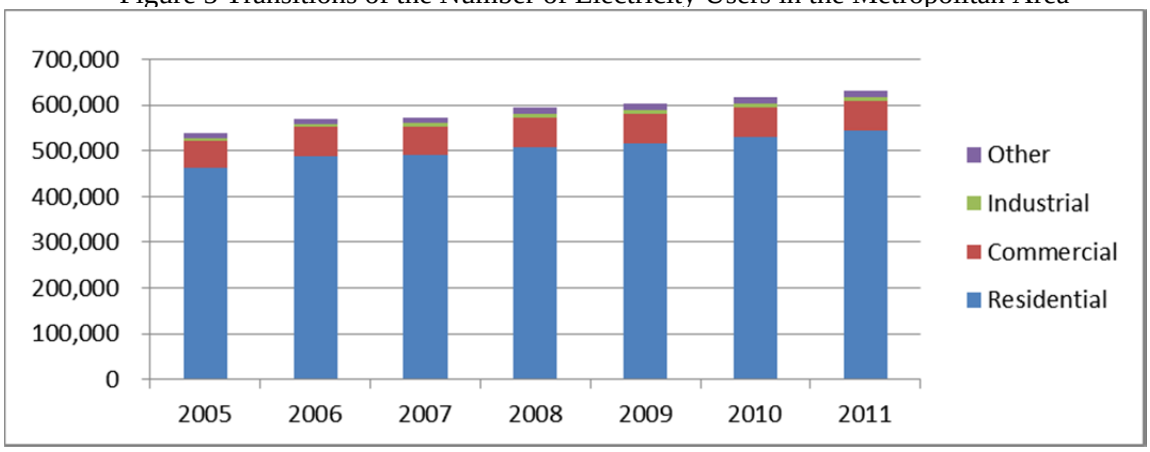
Source: ANDE

Figure 4 Transitions of Power Consumption in the Metropolitan Area



Source: ANDE

Figure 5 Transitions of the Number of Electricity Users in the Metropolitan Area



Source: ANDE

3.3.2 Other Impacts

(1) Environmental and Social Impacts

At the time of appraisal, it was possible to obtain an environmental permit for the transmission and transformation facilities included in the Project by means of simply submitting an environmental management plan. However, revision of an environment-related law after the commencement of the Project made an environmental impact assessment (EIA) a compulsory requirement for transmission and transforming facilities with a capacity of less than 100 kV. Following this revision, an EIA was conducted for the Project. The environmental permit requires renewal every two years after its original issue. ANDE is regularly reporting on the maintenance work, training and impacts on the surrounding environment (in terms of noise, odor and electromagnetic field) regarding each of the new substations, and the environmental authority monitors the measures taken by ANDE.

The necessary environmental permit for the Project was obtained prior to the signing of the construction contract. However, strong opposition by local residents concerned about possible health damage due to electromagnetic field emerged at three substation sites at the time of the renewal of the said permit after signing of the construction contract for Substations of Republicano, General Diaz and Pinoza. As politicians became involved in this dispute, the issue acquired political and social dimensions. ANDE patiently negotiated with the opposing local residents at a forum involving residents' groups, municipal offices, competent environmental office and environmental experts. In the case of two substations, an agreement to allow the construction of a substation was reached with conditions which included the construction of a high perimeter wall around the substation and the construction of neighbourhood parks, and such facilities were constructed as agreed. In the case of Pinoza Substation, however, the construction work had to be abandoned because of the failure to reach agreement with the residents and find an alternative site. The construction of part of the planned 220 kV transmission line (overhead) was also abandoned because of opposition by local residents or the difficulty of using the earmarked land (the use of the municipal land in question for another purpose was prioritised by the municipal authority).

(2) Other Impacts

As ANDE had never experienced opposition by local residents on the grounds of electromagnetic field, it implemented several measures as listed below to build up the understanding of local residents[14]. As a result, similar incidents have become rare.

[14] In those days there were no environmental standards on electromagnetic field, and there was no awareness on

- An international conference was held to which experts from the World Health Organization, Pan American Health Organization and others were invited to share an international understanding of and information on health damage by electromagnetic field.

- Based on the achievements of the above conference, the competent environmental office set forth electromagnetic field protection standards in 2007 and every EIA today must reflect these standards.

- A consultation meeting with local residents is now held prior to construction work. All relevant government offices, etc. participate in this meeting.

- The environmental management section of ANDE has been upgraded.

The experience of opposition by local residents to the construction of some of the facilities planned under the Project had the effect of making ANDE focus on the social consideration aspect of its transmission and transformation projects. As it was difficult to predict such opposition by local residents in advance, and ANDE's construction plan for the project followed the administrative procedures required at the time, its preparations for the project cannot be said to have been inappropriate.

Based on such observation results confirming the achievement of certain positive effects of the project, the effectiveness/impacts of the Project is high.

3.4 Efficiency (Rating:②)

3.4.1 Project Outputs

The planned and actual outputs of the Project are shown below.

Table 4 Planned and Actual Project Outputs

	Planned	Actual
Substation 220/66/23kV 66/23kV	3 locations 3 locations	3 locations 3 locations
Transmission line 220kV 66kV	2 sections, 15.5 km 7 sections, 19.2 km	1 section, 9.1 km 8 sections, 10.7 km
Distribution line 23kV extension 23kV insulation 380/220V extension 380/220V insulation	790 km 57 km 1,087 km 83 km	0 km 256 km 0 km 351 km
• Distribution control system • Telecommunication system for distribution maintenance	• Substation monitoring system	• Independently controlled automatic distribution system
Road lighting	(Not planned)	Street lights: Approx.14,000

Source: ANDE

The locations of some substations and transmission lines were changed or their construction was cancelled because of the reasons described below. In addition, some of the planned overhead transmission lines were buried underground instead. As a result, the increase of the transformation capacity by the new substations was 360 MVA (100% of the planned capacity) for 220 kV facility and 380 MVA (112% of the planned capacity) instead of the planned 340 MVA for 23 kV facility.

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its possible health damage neither in ANDE nor in general public.

- After the feasibility study in 1990, the master plan of ANDE was revised to take the rapid increase of the power demand and the ageing nature of the original master plan into consideration. With the subsequent planning of multiple high voltage transmission lines, the routes of the planned high voltage transmission lines under the Project were altered.

- Apart from the cancellation of the construction of some transmission and transforming facilities due to the difficulty of land acquisition or opposition by local residents who were concerned in regard to possible health damage by electromagnetic field, it was necessary to make some changes to the plan, including the change of location and the laying of the transmission lines underground (refer to the section for "Impact".)

While the procurement of the consultant for this Project was delayed due to the delay in approval of loan agreement by the parliament as mentioned below, ANDE extended the distribution network using its own funds (partly paid by local residents) under a "self-implementation scheme" against the background of a rapidly increasing power demand.[15] The enforcement of a new municipal regulation (restriction on the felling of trees) in 1994 made it impossible to install un-insulated power cables while felling lines of trees. This new situation increased the necessity for insulation work and the focus of the Project was placed on the renewal and insulation of existing distribution lines instead of extending them. In the end, the total length of the distribution network construction of the Project was reduced to approximately one-third of the planned length at the time of appraisal.

In the case of the distribution control system, the originally planned "substation monitoring system" was changed to an "independently controlled automatic distribution system" capable of reducing interrupted sections as well as the duration of each interruption with a smaller manpower requirement for system maintenance as requested by ANDE against the background of falling system prices due to technological innovation. However, the specifications of the system introduced under the Project were determined in 2000 and have already become obsolete. All of the above changes are judged to be appropriate as they correspond to changing needs and technologies.

As part of the environmental as well as social consideration, the procurement and installation of street lights was added as a crime prevention measure. This change was approved as a better social and environmental consideration measure to meet the request by local residents living in the vicinity of some substations and was made possible because of the leeway for Japanese ODA Loan. The completion of this additional work was delayed until 2013 as the necessary coordination with the related administrative organizations proved to be a lengthy process at some sites.

3.4.2 Project Inputs

3.4.2.1 Project Cost

Under the Project, Japanese ODA Loan was used to procure material for the transmission, transforming and distribution facilities while the counterpart fund was used to carry out the civil engineering work. The final construction cost of these facilities fell significantly below the planned cost because of the reduced length of the transmission and distribution lines caused by changes of the plan, the reduced yen equivalent local currency amount to cover the cost of the construction work conducted by the Paraguayan side due to changes of the exchange rate and the reduction of the cost due to a competitive tender.[16] The resulting total project cost of ¥6,848 million was 64% of the

[15] From 1994 to 1997, ANDE constructed 1,577 km of 23 kV distribution lines and 1,902 km of 380/220 V distribution lines.

[16] In regard to the construction of distribution lines, the cost per unit length was higher than planned as the total length of the insulation work (including the laying of power cables underground) increased with the extension of the existing distribution lines being removed from the scope of the Project.

planned cost (¥10,801 million) and the disbursed loan amount of ¥5,636 million was 70% of the planned amount. [17]

Although simple comparison is difficult because of the much changed outputs, the Project cost was within the planned cost, therefore the efficiency of the project is evaluated to be high.

Table 5 Planned and Actual Project Costs

(Unit: ¥ million)

	ODA Loan	Plan Paraguay	Total	ODA Loan	Actual Paraguay	Total
Construction of transmission lines	923	488	1,411	2,572	377	2,949
Construction of substations	2,615	696	3,311			
Construction of distribution lines	2,587	376	2,963	1,238	506	1,743
Distribution control system	333	0	333	990	329	1,319
Telecommunication equipment	347	0	347			
Consulting services	547	0	547	831	0	831
Land expropriation	0	154	154	Unknown	Unknown	Unknown
Taxes	0	898	898	Included in the construction cost		
Contingency	680	157	837	0	6	6
Total	8,100	2,701	10,801	5,636	1,211	6,848

Source: Prepared by the present evaluator using ANDE data

(Exchange rate) At the time of appraisal: 1 US$=1,797 Gs = 113.5 Yen

Actual: 1 US$ = 113.0 Yen (average for 2005-07)

1 Yen = 49.7 Gs (average for 2002-07)

3.4.2.2 Project Period

The Project was originally planned to take 74 months to complete from November, 1994 to December, 2000. In reality, it took 155 months from November, 1994 to September, 2007 when the work for the distribution lines was completed. Therefore, the actual project period was 209% of the plan, massively over-running the originally planned period.[18]

The expiring date for loan disbursement was also extended for three years from November, 2002 to November, 2005. A lump sum advanced disbursement was made so that the necessary equipment and materials could be procured before this extended expiring date. Meanwhile, construction work using Paraguay's own funds continued beyond the time limit for loan disbursement.

There are several reasons for the prolonged implementation of the Project as described below.

- Approval of the loan agreement by the parliament of Paraguay was delayed for approximately one year.

- More than three years were required to review the feasibility study to reflect the revised master plan of ANDE and to modify the plan as necessitated by the problem with local residents regarding land acquisition and other problems. [19]

[17] Land acquisition cost is not included in the actual total project cost as no information is available.

[18] Street lighting work is still taking place in some sections as of March, 2013 following the relevant field survey as the necessary agreement with the local public bodies involved could not be reached by the project completion date of September, 2007. However, as street lighting is not directly related to the purpose of the project, the work is not considered to be part of the Project.

[19] As land acquisition was difficult for the Substations in the down town of Bario Obrero and Catedral, the Substations of Republicano and General Diaz were constructed in other locations.

- It took almost four years to conclude the contract because of unsuccessful bidding, restructuring of the work package, rebidding and re-rebidding[20].

- It took almost eight years from the procurement of materials, etc. to the completion of the transmission and transforming facilities because of modification of the plan and suspension of the work necessitated by the opposition among local residents, the difficulty of land acquisition and other reasons.

- In the case of the distribution control system, it took a long time to modify the scope to reflect technological advancement, to answer technical questions posed by the bidding companies (as ANDE had no previous experience of the type of system to be procured) and to evaluate the actual bids. Consequently, the procurement of equipment and materials was considerably delayed and it took six years since the bidding preparation (including examination of specification) by consultant to contract agreement.

3.4.3 Results of Calculations of Internal Rates of Return (IRR)

The economic internal rate of return was not calculated at the time of appraisal. No calculation is made in the ex-post evaluation because of the lack of sufficient data from ANDE.

Although the project cost was within the plan, the project period was exceeded the plan, therefore efficiency of the project is fair.

3.5 Sustainability (Rating:②)

3.5.1 Institutional Aspect of Operation and Maintenance

ANDE is a public body which is responsible for the operation of the power system in general, ranging from generation to distribution, in Paraguay and operates all of the facilities introduced under the Project. At the end of 1992, ANDE had 2,533 employees. This increased to 3,755 in 2011. While the manpower strength increased by 50% in this period, the number of users and the power consumption in Paraguay per ANDE employee increased by 1.7 times and 2.2 times respectively. As the standard of service was maintained through the period without a significant increase in interruptions, these figures indicate an improvement of the labor productivity.

At the time of ex-post evaluation, the operation and maintenance of the transmission and transforming facilities are conducted by the Operation Division and the Transmission Maintenance Division of the Technical Department while the operation and maintenance of the distribution network and distribution control system are conducted by the Metropolitan Area Distribution Operation Division and the Distribution Maintenance Division of the Distribution Department. The maintenance of the distribution network in the Metropolitan Area is conducted by six teams with five members each for the 23 kV network and six teams with five members each for the low voltage distribution lines. Those on the front line believe that an additional three teams or so are necessary for each of the 23 kV network and the low voltage distribution lines to achieve their proper maintenance.

The personnel affairs of ANDE are prone to political influence and the frequent reorganization, personnel reshuffles and large numbers of non-technical employees are believed to have damaged the organizational efficiency of ANDE.[21] In addition, there appears to be room for improvement in regard to the administrative capacity of ANDE in view of problems associated with the operation and

[20] The first bidding for material of distribution line was not successful due to non-existence of qualified bidder. Rebidding was carried out after dividing into four lots, among which two lots needed re-rebidding as there were no bidders technically qualified.

[21] In the last seven years, ANDE has seen the successive appointment of 10 presidents.

maintenance of the distribution control system and also its failure to provide sufficient internal information for the ex-post evaluation.

3.5.2 Technical Aspect of Operation and Maintenance

In 2012, ANDE received an international quality award as a result of a consumer satisfaction survey conducted by the CIER with 1,300 power distribution companies in Central America, South America and the Caribbean Region.[22] The Human Resources Training Division of ANDE implemented some 200 training courses in 2011 and 1,795 staff members attended these courses for a total of 55,000 hours or some 15 hours per staff member.

The general technical capability in regard to transmission, transforming and distribution on the part of the staff members of ANDE is believed to be sufficient. For the operation and maintenance of the distribution control system, training was provided by the manufacturer to transfer the necessary skills and technical knowledge to some staff members of ANDE. However, some of these staff members have since been transferred to other positions. As such, there appears to be no firm build-up of skills to operate and maintenance the distribution control system in the competent division of ANDE.

3.5.3 Financial Aspect of Operation and Maintenance

In recent years, ANDE has maintained a high level of profitability and sound financial health as outlined below.

- From 1997 to 2002, ANDE recorded a deficit in such accounting items as the ordinary profit and profit before tax. These went into the black in 2003 and thereafter. The contributory factors for its positive performance are an increase of the power tariff by some 30% in 2003, beneficial changes of the purchase contract for power from the Itaipu Hydropower Station and changes of the exchange rate for the purchase of power.

- The rate of return (ordinary profit/working capital) went into positive in 2003 and has since been in the range of 4–8%. Although not entirely sufficient, it has maintained a generally adequate level (the government criteria for public entity is 8%).

- The EBITDA margin (EBITDA/turnover) has been in the range of 25–33% for the last five years, maintaining a high level of profitability.[23]

- The current ratio has exceeded 200% in the last five years and is, therefore, sufficiently high. The equity to liability rate of 48.3% in 2007 was fairly adequate and has since improved to 30.2% (2011).

Interviews with those responsible for the operation and maintenance of the facilities provided under the Project found no incidence of an insufficient budget significantly hindering maintenance except in the case of the distribution control system as described next.

[22] Regional Electric Integration Commission (La Comisión de Integración Eléctrica Regional：CIER) is NGO established in 1964 aiming at a regional integration of power systems, having its headquarter in Uruguay and participation of more than 200 electric companies, regulating bodies and relevant ministries from 16 countries in Latin America and Caribbean Region.

[23] EBITDA margin is an indicator of corporate profitability. It is given by dividing EBITDA (Earnings Before Interest, Tax, Depreciatiion and Amotization) by sales.

Table 6 Financial Results of ANDE

(Unit: million Grs.)

	2009	2010	2011
Current assets	2,406	2,529	2,508
Fixed assets	6,677	7,321	7,760
Total assets	9,083	9,849	10,268
Current liabilities	967	1,106	926
Fixed liabilities	1,531	1,628	1,454
Net assets	6,585	7,115	7,888
Operating income	315	283	387
Income before income taxes	477	357	595
Current net income	451	330	540

Source: ANDE

The delay of the official handing over of the distribution control system by its supplier until November, 2012 meant that ANDE did not allocate a maintenance budget for the system until then, causing some operational problems. Trial operation of the system began in February, 2007 and the provisional handing over took place in March, 2008 to continue operation. The delay in question was caused by slow procedural progress within ANDE, in turn caused by the lack of a proper succession of the work whenever the person in charge was replaced.

3.5.4 Current Status of Operation and Maintenance

(1) Transmission and Transforming Facilities

The substations and transmission lines constructed under the Project have been maintained based on the relevant ANDE standards. Because of the adoption of preventive maintenance, the adequate conditions and functions of the facilities have been maintained, suggesting no problems in regard to operation and maintenance.

(2) Distribution Facilities

The 23 kV distribution lines are subject to annual preventive maintenance which includes thermographic inspection. Any disconnection is promptly repaired. ANDE possess the technical capability to repair live lines. The insulated distribution lines appear to have undergone frequent repairs as the original insulation work was less than satisfactory because of the unfamiliar nature of the work for the local contractor. In regard to the low voltage distribution lines, preventive maintenance is not practiced and repair work is conducted on receipt of a report of disconnection or interruption.

(3) Distribution Control System

Of the 350 pole switches procured under the Project, 325 were installed. However, some of the installed switches were later removed due to changes of the distribution routes, reducing the number of operating switches to 289 at present. These switches are linked to the distribution control room by radio. The actual number of switches linked to the control room stands at 220 at present (overall availability ratio of 76%) as some have lost their link due to tilting of the highly directional antenna or have broken down because of the incursion of rainwater to the transmitter. As for some of the operating switches which register less reliable information on the state of opening/closing, on-site checking is essential. The person responsible for the system believes that it is necessary to recruit a full-time telecommunications engineer(s). However, according to an ANDE engineer involved in the installation of the distribution control system (the same person who was responsible for the installation work under the Project), the positional adjustment of the antenna of the pole switches and protection of the transmitter from rainwater are not difficult and are within the present capability of ANDE.

The control room has three large display units. However, these units are not used because of their broken-down lamps and an old manual display unit is used. The front view of this manual display unit is hindered by the new large display units which cannot be removed until their final handing over. These new units have been out of action because of the high cost of replacement lamps.[24] It must be mentioned that large display units with older specifications were procured. ANDE side believed that a series of problems starting from the lamp out did not be posed if liquid crystal displays were procured. While the procurement of the distribution control system was experiencing substantial delays, JICA side did not accept the proposal to change the specification of the display in the course of procurement procedures, considering the possibility of further delay.

ANDE is currently examining a development of an information system that allows integrated management of operation, quality and loss of power, investment, maintenance, protection and planning of transmission and distribution system. It is not yet clear how the distribution control system of the Project will be considered in this system.

Distribution Control Room (left; large display units not in use, right; manual display unit)

3.5.5 Sustainability Summary

Based on the above observations, some problems have been observed in terms of technical and financial aspects, therefore sustainability of the project effect is fair.

4. Conclusion, Recommendations and Lessons Learned

4.1 Conclusion

This project was implemented for the purpose of achieving a stable power supply by means of improving the transformation, transmission, distribution facilities, distribution control system and telecommunication facility for power supply maintenance in the Asuncion Metropolitan Area which was experiencing a rapid increase of the power demand. As this purpose was consistent not only with the development policies and needs of Paraguay but also with the ODA policy of Japan, the overall relevance of the project is high. With the implementation of the project, a stable power supply to the Metropolitan Area was secured as the capacity to receive power from the trunk transmission line and the capacity for transforming were increased. Moreover, the insulation of the distribution network and

[24] After the provisional handing over of the SCADA system in 2008, the official handing over took place in November, 2012. During this period, ANDE did not allocate the necessary budget and manpower to maintain the system on the grounds that the system had not been officially handed over. ANDE took the stance that it could not touch the system until the official handing over. As the guarantee period in the contract was two years from the provisional handing over, any necessary repair or adjustment during this period was the responsibility of the supplier.

introduction of a distribution control system had a positive effect on the reduction of interruptions. In the Metropolitan Area, the increase of the power consumption per household in recent years is believed to have contributed to an improved standard of living and the Project is partly responsible for such improvement. As such, the effectiveness / impact of the Project is judged to be high. Meanwhile, although the final project cost was within the planned cost, the project period was two times of the originally planned period, therefore efficiency of the Project is judged to be fair. Some substation sites experienced strong opposition from local residents who feared damage to their health by electromagnetic field. In the face of such opposition, ANDE now places more emphasis on the aspect of social consideration in its work involving transmission and transformation. The sustainability of the Project is judged to be fair as there are minor problems with the institutional and technical aspects of the maintenance of the distribution control system. Based on the above, this project is evaluated to be satisfactory.

4.2 Recommendations

4.2.1 Recommendations for ANDE

- Utilization of the distribution control system: It is necessary to examine a range of required work to improve the availability ratio of pole switches and the use or renewal of the large display units. ANDE should then implement such work with appropriate funding so that the distribution control system can be better utilized. For this purpose, the existing internal technical resources of ANDE must be effectively utilized and the necessary engineers should be deployed. In connection with new technologies, ANDE must be aware of the need to avoid the excessive transfer of engineers once trained with such technologies. The work recommended here should conform to an integrated information management system for transmission and distribution which is currently being examined by ANDE.

- Continual expansion of the transmission and transforming facilities in the Metropolitan Area: It is necessary to continually expand the transmission and transforming facilities to ensure a sufficient and stable power supply to meet the ever increasing power demand in the Metropolitan Area. Possible solutions, including the laying of power cables underground for the entire section, should be sought to re-start the suspended construction of a 220 kV transmission line between the Parque Caballero Substation and the Puerto Botanico Substation. It is hoped that this section will be completed at an appropriate time utilising the facilities constructed under the Project.

- Information management of the completed project: It is desirable for ANDE to sort and store various types of information relating to the operation of the completed facilities under every completed project so that the follow-up and ex-post evaluation activities for the projects can be efficiently conducted.

4.2.2 Recommendations for the JICA

None

4.3 Lessons Learned

- Importance of social consideration for a project to construct transmission and transforming facilities in an urban area: When a project to construct transmission and/or transforming facilities in a densely population area is planned, careful consideration should be given to the following matters with a view to preventing misunderstanding and anxiety among local residents to the project and to reduce possibility of unnecessary opposition by them.

    - Explanations on the influence of magnetic field based on scientific knowledge.

- Information sharing and consensus building with local residents as well as other stakeholders through continual dialogue.

- A highly professional expertise in the above regards of the project implementing body.

➢ Important points for the introduction of new technologies in the field of rapid technological innovation: When technologies in the field of rapid technological innovation are newly introduced, careful consideration should be given to the following matters with a view to preventing (i) inadequate operation and maintenance due to insufficient technical capability and (ii) the current new technologies soon becoming obsolete.

- The time from the decision on equipment specifications to the commissioning of equipment should be made as short as possible.

- In relation to the above, the aid organization should ensure its own flexibility to accommodate the modification of the specifications.

- Careful considerations to personnel transfer so that technical expertise can be firmly built up, such as avoiding excessive transfer of personnel with high technical expertise.

- Follow-up should be provided by means of technical cooperation, etc.

Comparison Between the Original Plan and the Actual Results

Item	Components	Original Plan	Actual Results
Outputs	• Substation • Transmission line • Distribution line • Substation monitoring system • Telecommunication system for distribution maintenance • Consulting service	220/66/23kV 3 stations 66/23kV 3 stations 22 kV 2 sections 15.5km 66kV 7 sections 19.2km Extension of 23kV line 790km Insulation of 23kV line 57km Extension of 380/220V line 1,087km Insulation of 380/220V line 83km	220/66/23kV 3 stations 66/23kV 3 stations 22 kV 2 sections 9.1km 66kV 8 sections 10.7km Extension of 23kV line 0km Insulation of 23kV line 256km Extension of 380/220V line 0km Insulation of 380/220V line 351km • SCADA(Supervisory Control And Data Acquisition) • Telecommunication system for distribution maintenance • Consulting service
Project Period		November,1994 to December, 2000 (74 months)	November, 1994 to September, 2007 (155 months)
Project Cost	• Japanese ODA Loan Portion • Executing Agency • Total Exchange Rate	¥8,100 million ¥2,701 million ¥10,801 million US$ 1= ¥113.5 (as of January, 1994)	¥5,636 million ¥1,211 million ¥6,848 million US$ 1 = ¥113.0 (weighted average between 2005 to 2007)

Federative Republic of Brazil

Ex-Post Evaluation of Japanese ODA Loan

Guanabara Bay Basin Sewerage System Construction Project

External Evaluator: Hajime Sonoda
Global Group 21 Japan, Inc.

0. Summary

The Guanabara Bay Basin Sewerage System Construction Project (hereinafter referred to as "the Project") was implemented to improve the hygiene environment for residents and to reduce the inflow volume of pollutants to the said bay by means of constructing sewerage facilities in the western part of the Guanabara Bay Basin in the State of Rio de Janeiro. As the purpose of the Project was consistent with not only the development policies and needs of the aforementioned state but also with the ODA policy of Japan, the overall relevance of the Project is high. While highly efficient secondary treatment facilities were constructed, the actual sewage treatment volume remained as low as some 30% of the planned volume due to the incompletion of some of the planned sewage collection facilities. As a result, the pollutant reduction volume was some 70% of the planned level. Some areas where the sewerage system was completed have seen an improvement of the hygiene environment. Flow of pollutant to the Guanabara Bay has been reduced, while no significant improvement of the water quality has been observed in the bay. Given the limited impact, the effectiveness of the Project is judged to be fair. While the project cost remained within the planned budget, the project period substantially exceeded the planned period. Given the fact that not all of the sewage collection facilities had been completed at the time of the ex-post evaluation, the efficiency of the Project is evaluated to be low. Meanwhile, the insufficient budget for equipment maintenance at the wastewater treatment plants (WWTPs) and its delayed execution, the insufficient deployment of manpower coupled with the lack of a preventive maintenance system is responsible for the inadequate maintenance of some equipment. In Meriti which is included in the project area and where the municipal authority has taken the responsibility to operate and maintain the sewerage system, neither the organizational set-up nor the organizational capacity to properly execute the work has yet been firmly established. Accordingly, the sustainability of the Project is judged to be low.

Based on the above, this Project is evaluated to be unsatisfactory.

1. Project Description

Project Location

Alegria Waste Water Treatment Plant

1.1 Background

Guanabara Bay facing the city of Rio de Janeiro has gained much popularity as a symbol of Brazil due to its beautiful scenery, boosting the value of Rio de Janeiro as an international tourist city. In the early 1990's, however, the water quality of the bay seriously deteriorated due to the massive inflow of raw sewage and the illegal dumping of waste, adversely affecting local fisheries and tourism. As the city's population exceeded nine million with the absence of a properly constructed sewerage system, especially in low income areas, some 120 tons of raw sewage were discharged to the bay every day, constituting one factor for the deterioration of the water quality. This situation made the development of an extensive sewerage system in the Guanabara Bay Basin an urgent task.

To rectify the situation, the State Government of Rio de Janeiro prepared the Rio Environment Program and began to improve the environment of the Guanabara Bay Basin through the development of a sewerage system by *Companhia Estadual de Aguas e Esgotos do Rio de Janeiro* (Rio de Janeiro State Water and Sewerage Corporation, hereinafter referred to as "CEDAE"). Based on the latest census in 1991, the CEDAE reviewed the Water and Sewerage Master Plan and conducted a feasibility study for the project in the Phase 1. This project (Phase 1) was put into implementation in 1993 with a joint loan by the Inter-American Development Bank (hereinafter referred to as "IDB") and the Japan International Cooperation Agency (hereinafter referred to as "JICA" (the former Overseas Economic Cooperation Fund). The Guanabara Bay Basin Sewerage System Construction Project (the target project of the ex-post evaluation) was part of the project in the Phase 1.[1]

1.2 Project Outline

The objective of this Project is to improve living conditions for residents and also to reduce the volume of pollutant inflow to the bay by constructing sewerage facilities in the western part of Guanabara Bay Basin in the State of Rio de Janeiro, thereby contributing to an improvement of residents' life as well as conserving fishery and tourism resources at the Guanabara Bay.

Loan Approved Amount/ Disbursed Amount	31,475 million Yen / 31,467million Yen
Exchange of Notes Date / Loan Agreement Date	March, 1993 / March, 1994
Terms and Conditions	Interest Rate: 5.0% (Consulting Service: 3.25%) Repayment Period: 25 years (Grace Period: 7 years) Procurement type: General untied
Borrower/Executing Agency	Rio de Janeiro State / Rio de Janeiro State Water and Sewer Company (CEDAE: *Companhia Estadual de Águas e Esgoto*)
Final Disbursement Date	December, 2006
Main Contractors	・ Camargo Correa(Brazil)・Sergen(Brazil)・Engeform(Brazil)（JV） ・ Via Engenharia S.A.(Brazil)・Ecal – Engenheiros Construtores Associados(Brazil)・Hans Brochier Gmbh & Co.(Germany) ・ Construtora Queiroz Galvao S.A.(Brazil)・Etesco - Construcoes e Comercio Ltda.(Brazil)（JV） ・ Encalso Construcoes Ltda.(Brazil)・Stemag Engenharia e Construcoes Ltda.(Brazil)・Coneng Engenharia Ltda.(Brazil)

[1] In the State of Rio de Janeiro, this project in the Phase 1 was called the Guanabara Bay Depollution Program with three components featuring water supply, sewerage and solid-waste disposal. The Japanese ODA Loan project being evaluated here formed part of the sewerage component. The other parts were financed by the IDB. In 1994, JICA conducted the Study on Recuperation of the Guanabara Bay Ecosystem (a master plan study). This study took place after the commencement of the Project.

	（JV） ・ Construtora Passarelli S.A.(Brazil)・Construbase Engenharia Ltda.(Brazil)（JV）
Main Consultant	・ Iesa-Internacional de Engenharia S.A.(Brazil)/Logos Engenharia S/A(Brazil)・Pacific Consultants International (Japan)・Kaiser Engineers & Constructors, Inc.(USA)（JV） ・ Earth Tech Brasil Ltda.(Brazil) ・ Aquacon Consortium(Brazil) ・ Hidroservice Consortium (Brazil)
Feasibility Studies, etc.	- The Study on Recuperation of the Guanabara Bay Ecosystem (JICA, 1994） - The Study on Management and Improvement of the Environmental Conditions of Guanabara Bay in Rio de Janeiro (JICA, 2003）
Related Projects	Basic Sanitation Program for the Guanabara Bay Basin (Phase I) (IDB, BR-072、1993～）

2. Outline of the Evaluation Study

2.1 External Evaluator

Hajime Sonoda (Global Group 21 Japan, Inc.)

2.2 Study Period

The ex-post evaluation study for the Project was conducted over the following period.

Study Period: September, 2012 - July, 2013
Field Survey : 18 November - 7 December, 2012
27 - 30 May, 2013

3. Results of the Evaluation (Overall Rating: D[2])

3.1 Relevance (Rating: ③[3])

3.1.1 Relevance to Development Plan of Brazil

In 1991, the State Government of Rio de Janeiro prepared the Rio Environment Program and the CEDAE implemented a water supply and sewerage facilities construction project to improve the environment of the Guanabara Bay Basin.

The State Government of Rio de Janeiro has been stepping up its efforts to improve the environment, including the expansion of the sewage collection and treatment facilities and the dredging and cleaning of lagoons, beaches, rivers and canals following the United Nations Conference on Sustainable Development (Rio +20) in 2012 and in anticipation of the World Cup in 2014 and the Olympics in 2016. The Pacto Pelo Saneamento (Pact for Sanitation) adopted by the State Government in April, 2011 aims at improving both collection and treatment rates to 80% by 2018.

As such, improvement of the local sewerage system has been a priority issue since the time of the ex-ante to the ex-post evaluation.[4]

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

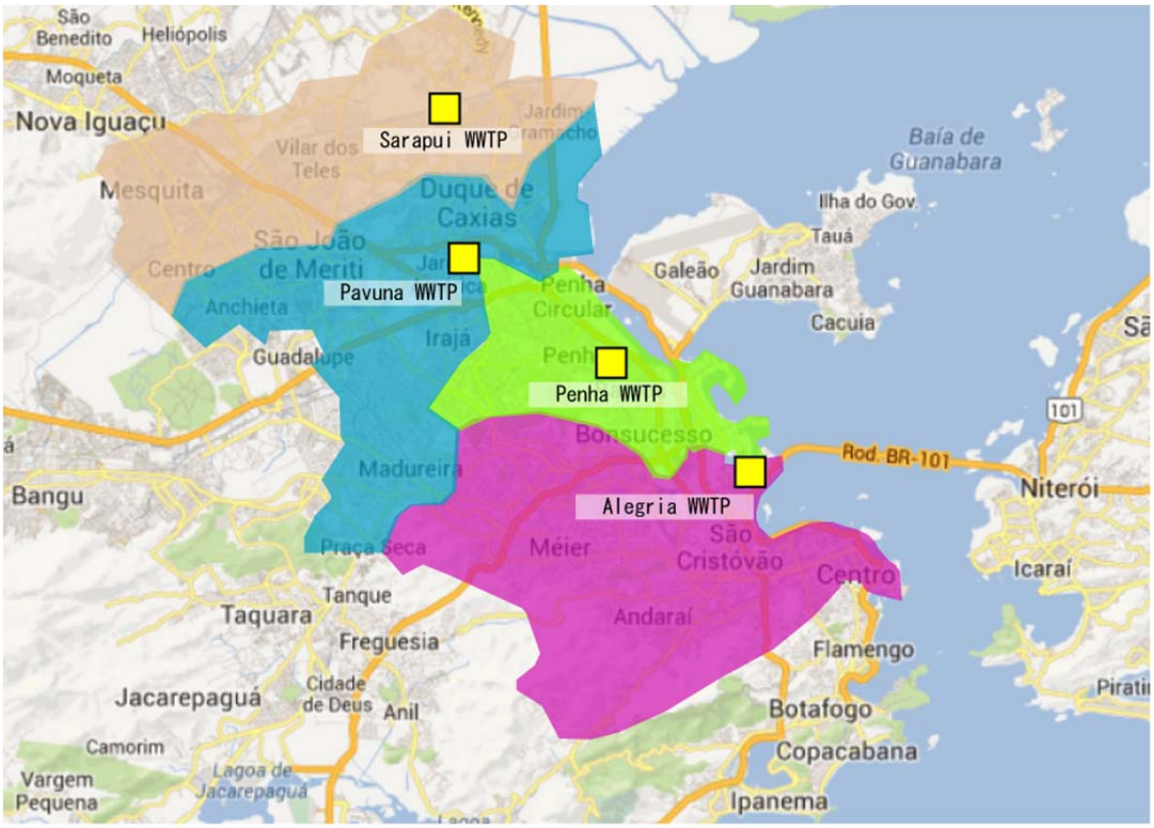

Figure 1. Waste Water Treatment Plants included in the Project and Their Serving Areas

3.1.2 Relevance to Development Needs of the State Rio de Janeiro

As described in 1.1 Background, improvement of the sewerage system in the Guanabara Bay Basin was an urgent priority at the time of appraisal.

The sewage collection rate and sewage treatment rate in the Guanabara Bay Basin were 40% and 44% respectively in 2006.[5] As of 2012, only 14% of the total Biochemical Oxygen Demand (BOD) load in the said basin is removed by sewage treatment plants.[6] According to the Department of Environment of the State Government of Rio de Janeiro, the water quality in Guanabara Bay has little improved in the last 10 years. Therefore, there is still a strong need for improvement of the sewerage facilities at the time of the ex-post evaluation.

3.1.3 Relevance to Japan's ODA Policy

In 1992, Japan sent the Comprehensive Study Mission for Economic Cooperation to Brazil and agreed with the Brazilian side that the environment, industry and agriculture were three priority sectors for

[4] In 2007, the Federal Government of Brazil adopted the Basic Sanitation Act and the National Plan for Environmental Sanitation proposed in April, 2011 aimed at achieving an urban sewage collection rate of 91% and a sewage treatment rate of 88% by 2030.

[5] At the national level, only 47% of the total population of Brazil enjoy adequate sewage treatment as of 2008, leaving the remaining 53% in need of proper sanitation facilities. National Department of Environmental Sanitation data indicate a nationwide sewage collection rate and sewage treatment rate of 46% (54% for urban areas) and 40% respectively as of 2010.

[6] The BOD is the amount of dissolved oxygen to be consumed by aerobic biological organisms in a body of water to oxidise and breakdown organic materials present in the water. A higher BOD value indicates a higher level of water pollution. The BOD is used as a general indicator of water pollution.

Japan's ODA. In the environment sector, the main focus has been placed on the protection of the natural environment, including the preservation of tropical rain forests in the Amazon and the mitigation and prevention of urban as well as industrial pollution. The target project of the present evaluation is in the category of the environment sector.

Based on the above observation, the Project has been highly relevant with the development plan, development needs of the State of Rio de Janeiro as well as Japan's ODA policy, therefore its relevance is high.

3.2 Effectiveness[7] (Rating: ②)

3.2.1 Quantitative Effects (Operation and Effect Indicators)

The primary objective of the Project was to reduce the pollutants such as BOD load discharged to Guanabara Bay in sewage from the Guanabara Bay Basin by means of constructing sewage collection and treatment facilities. At the time of appraisal, BOD concentration and Suspended Solids (SS) concentration of treated sewage were selected as indicators[8]. For the purpose of the present evaluation, considering the above objective of the Project, sewage treatment volume, utilization rate and treatment efficiency (rate of pollutant removal) at each WWTP are analysed with special emphasis on removal of the BOD load.

The installed treatment capacity, volume of treated sewage and utilization rate (volume of treated sewage divided by installed treatment capacity) are shown in Table 1 for three newly constructed WWTPs (Alegria, Pavuna and Sarapui WWTPs) and the Penha WWTP where a sludge centrifugal dewatering units were newly installed. Of the three new WWTPs, the Alegria WWTP receives a sewage volume of slightly more than 50% of the respective treatment capacity while the utilization rate of the other two WWTPs is very low. The main reason is that some parts of the sewage collection facilities are either incomplete or unconnected (refer to 3.4. Efficiency for further details) at these WWTPs. In the case of the Penha WWTP, while the new sludge centrifugal dewatering unit is the only one newly installed under the Project, the deterioration of other equipment necessitates restriction of the volume of sewage to be received in order to ensure appropriate treatment.

Table 1 Volume of Treated Sewage and Utilisation Rate of WWTPs
(January through October, 2012 average)

WWTP	Installed Treatment Capacity (litres/second)	Volume of Treated Sewage (litres/second)	Utilization Rate (%)
Alegria*	2,500	1,365	55%
Pavuna	1,500	127	8%
Sarapui	1,500	220	15%
Penha	1,600	600	38%
Total	7,100	2,312	33%

Source: Prepared by the external evaluator based on the relevant CEDAE data and findings of a series of interviews at WWTPs.

Note: Although the treatment capacity of the primary treatment at the Alegria WWTP is 5,000 litres/second, the treatment capacity of the secondary treatment is 2,500 litres/second, forcing the actual operation of the primary treatment to run at 2,500 litres/second.

The BOD and SS treatment efficiency (pollutant removal rate) at each WWTP is shown in Table 2. As secondary treatment by conventional activated sludge process is conducted at all of these WWTPs, the

[7] Sub-rating for Effectiveness is to be put with consideration.

[8] Suspended solids refers to small solid particles in suspension in water as colloids or because of the motion of water. SS is used as an indicator of the water quality.

overall treatment efficiency is sufficiently high.[9] At the time of appraisal, a post-secondary treatment concentration and pollutant removal rate of 20 mg/litre and 90% respectively were planned for both the BOD and SS.

Table 2 BOD and SS Treatment Efficiency (January through October, 2012 average)

BOD Treatment Efficiency	Pre-Treatment BOD Concentration (mg/litre)	Post-Treatment BOD Concentration (mg/litre)	BOD Removal Rate (%)
Alegria	240	4.7	98%
Pavuna	140	6.1	96%
Sarapui	120	17.0	86%
Penha	240	24.0	90%
SS Treatment Efficiency	**Pre-Treatment SS Concentration (mg/litre)**	**Post-Treatment SS Concentration (mg/litre)**	**SS Removal Rate (%)**
Alegria	240	4.7	98%
Pavuna	120	7.8	96%
Sarapui	120	35.0	86%

Source: Prepared by the external evaluator based on the relevant CEDAE data and findings of a series of interviews at WTPs.
Note: No SS data was obtained for the Penha WWTP.

Primary Treatment Facility (Sarapui WWTP)

Secondary Treatment Facility (Alegria WWTP)

Treated Water Before Discharge (Alegria WWTP)

Sludge Centrifugal Dewatering Units (Penha WWTP)

[9] Although the treatment efficiency at the Sarapui WWTP is less than 90%, the low BOD concentration of the incoming sewage remains the post-treatment BOD sufficiently low.

Based on the above data, the removed BOD load at each WWTP was estimated. The estimated values are compared to the planned values in Table 3. At the Penha WWTP, sludge produced by the sewage treatment process used to be discharged to a river without any further processing. Due to the abolition of sludge discharge after the installation of a sludge centrifugal dewatering units under the Project, the BOD load removed at this WWTP is considered as an effect of the Project.

Table 3 Comparison of Planned and Actual BOD Load Removal
(January through October, 2012)

WWTP	Planned BOD Load Removal (tons/day)	Actual BOD Load Removal (tons/day)	Achievement Rate Actual/Planned (%)
Alegria	20.7	27.7	130%
Pavuna	5.2	1.4	27%
Sarapui	5.2	2.1	40%
Penha	29.9	11.2	37%
Total	61.0	42.5	70%

Source: Prepared by the present evaluator based on the relevant CEDAE data and findings of a series of interviews at WTPs.

Note: BOD removal volume = volume of treated sewage x pre-treatment BOD concentration x BOD removal rate.
As the planned values were set at the time of appraisal (1994), they did not reflect subsequent changes, including the addition of secondary facilities.

The total BOD load removal is estimated to be 42.5 tons/day. This is equivalent to 70% of the planned value and more than a half has been achieved by the Alegria WWTP. It must be noted that the planned value used for comparison were set at the time of appraisal and, therefore, did not include subsequent planning changes, such as expansion of the treatment capacity at the Pavuna and Sarapui WWTPs and the additional installation of a secondary treatment facility at the three new WWTPs (refer to 3.4 for details of the planning changes). After these changes, the target BOD load removal was 145.5 tons/day and the actual achievement rate compared to this is as low as 29%. The better performance of the Alegria WWTP than the planned performance is due to the higher BOD removal rate with the addition of a secondary treatment facility. The operating status of each WWTP is outlined below.

Alegria WWTP

98% of the BOD load is removed by secondary treatment. However, only half of the trunk lines connecting the existing sewer network to the WWTP have been completed, resulting in an actual sewage treatment volume of 1.3 m^3/sec compared to the planned 2.5 m^3/sec. The BOD load removal is approximately 28 tons/day.

Pavuna WWTP

Although the BOD load removal rate by secondary treatment is as high as 96%, the partially incomplete as well as unconnected sewer network means a low sewage treatment volume of 0.13 m^3/sec compared to the planned 1.5 m^3/sec. The low BOD concentration of the incoming sewage can likely be attributed to the intrusion of river water. The BOD load removal is approximately 1.4 tons/day.

Sarapui WWTP

The BOD removal rate by secondary treatment of 86% is slightly below the planned rate. The partially incomplete as well as unconnected sewer network is responsible for the low sewage treatment volume of 0.22 m^3/sec compared to the planned 1.5 m^3/sec. The low BOD concentration of the incoming sewage can likely be attributed to the intrusion of river water. The BOD load removal is approximately 2.0 tons/day.

Penha WWTP

The complete removal of sludge which was formerly discharged with hardly any treatment (some 30 tons/day in terms of the BOD load) through a dewatering process was planned. As the sewage treatment volume has fallen to the some 40% level of the volume at the time of planning due to the general deterioration of the WWTP, the current BOD load removal is approximately 11 tons/day (At this WWTP, only the sludge centrifugal dewatering units were installed with Japanese ODA Loan).

In short, the actual BOD load removal is estimated to be approximately 43 tons/day (for January through October, 2012 average) compared to the planned 61 tons/day at the time of appraisal (achievement rate of 70%). The reason for the achievement of 70% of the planned BOD load removal despite the substantially lower sewage treatment volume than planned is the addition of secondary treatment facilities (refer to 3.4 for further details). Because of the delayed completion of the WWTPs, however, the realization of the positive effects of the Project was also delayed by 3–5 years compared to the original plan. During this period, untreated sewage continued to be discharged to Guanabara Bay.

The low BOD load removal can be directly attributed to the partially incomplete as well as unconnected sewer networks for sewer collection at the three new WWTPs and the restriction on the volume of incoming sewage at the Penha WWTP due to the deterioration of the plant. Because of this, the target BOD load removal has not been achieved despite a higher BOD removal rate due to the addition of a secondary treatment. If the sewage collection facilities had been completed as planned, the actual BOD load removal would be three times higher than the current volume.

3.2.2 Qualitative Effects

The qualitative effects assumed at the time of appraisal included improved public hygiene, improved river water and bay water quality, recovery of fisheries in the bay and conservation of tourism resources in the Guanabara Bay Basin. These issues are analyzed in the next section as impacts (3.3 Impacts).

3.3 Impact

3.3.1 Intended Impacts

(1) Impact on Improvement of Public Hygiene

Some parts of the service areas of the Pavuna and Sarapui WWTPs were newly connected to the sewerage system as a result of the Project. According to the CEDAE, some 26,000 households had been newly connected to the sewerage system by May, 2013. This figure represents some 70% of the planned 35,000 households (refer to 3.4 Efficiency for further details).

As part of the ex-post evaluation, a questionnaire survey was conducted featuring 105 households newly connected to the sewerage system in 2000 onwards[10]. 41% of these households are found to be satisfied with the service while the remaining households point out such problems as the leakage and odour of sewage. 46% of the newly connected households believe that the hygiene environment of their homes and in the neighbouring area has improved. Meanwhile, 15% of the respondents said that water-borne infectious diseases are still occurring after connection to the sewerage system.[11]

[10] The questionnaire survey was carried out at those areas where sewer was constructed after 2000. Totally 105 households (53 for Pavuna WWTP and 52 for Penha WWTP) were interviewed. 64% of the interviewee were female, 70% were over 46 years old, and 55% have received secondary education or higher.

[11] No data on water-borne infectious diseases was obtained to make it possible to compare the pre-project and post-project status of such diseases.

In short, the Project had a positive impact on the improvement of public hygiene for some 26,000 households by May, 2013. The sewage collection rate and sewage treatment rate in the Guanabara Bay Basin in the State of Rio de Janeiro have improved to 40% and 44% respectively from the 25% and 15% respectively at the time of appraisal. The main contributory factor has been the Guanabara Bay Depollution Program which includes the Project.

(2) Impact on Qualitative Improvement of River Water and Bay Water

Table 4 compares the BOD load generated by sewage in the Guanabara Bay Basin with the BOD load removal at the four WWTPs included in the Project. In 2010, the BOD load removal by the four WWTPs was 10.5% of the total BOD load generated, quadrupling the volume before the Project in 2000. Based on CEDAE data, it is estimated that some 29 tons of BOD load are removed daily by other WWTPs in the basin (2012). The total BOD load removal in the basin is, therefore, some 72 tons/day or approximately 15% of the total BOD load generated. The decline of the BOD load removal between 2010 and 2012 was caused by the decline of the sewage treatment volume at the Penha WWTP because of the deterioration of the plant.

Table 4 Comparison of BOD Load and Removal Volume by the Project in the Guanabara Bay Basin

	BOD Load Generation in Guanabara Bay Basin (tons/day)	BOD Load Removal by the Project (tons/day)	Removal Rate (%)
2000	448.2	11.3	2.5%
2005	469.8	12.8	2.7%
2010	486.0	50.8	10.5%
2012	494.6	42.5	8.6%

Source: Prepared by the external evaluator based on the relevant CEDAE data and findings of a series of interviews at WTPs.

Note: The BOD load is based on the estimated load in "The Study on Management and Improvement of the Environmental Conditions of Guanabara Bay in Rio de Janeiro, the Federative Republic of Brazil" (2004) by JICA with adjustment made to take the actual population increase into consideration. For 2012, the figure is an estimate based on the actual performance from January through October.

According to the Department of Environment of the State Government of Rio de Janeiro, the water quality is worse in the western part of Guanabara Bay because of a concentration of pollution sources there. While the area benefiting from the Project is this very western part, improvement in terms of the BOD concentration in the period from 2000 to 2010 to the level of two-thirds that recorded in the pre-project period is not far from satisfactory.[12] No tangible improvement of the water quality has been observed at Sarapui River to which treated sewage is discharged by the Pavuna and Sarapui WWTPs.

Table 5 Transitions of BOD Concentration in Sarapui River and Western Part of Guanabara Bay

(Unit: mg/litre)

	1990	2000	2010
Sarapui River	33.6	27.0	36.4
Guanabara Bay ①	14.6	15.2	10.7
Guanabara Bay ②	na	18.2	11.7

Source: Department of Environment, State Government of Rio de Janeiro

Note: Refer Figure 3. For the locations of Guanabara Bay ① and ②

[12] Cunha Canal in the eastern part of the bay where accumulated sludge hampered water circulation underwent dredging in 2009. This may have been a contributory factor for the improved water quality at the sampling points. The JICA's Study on Recuperation of the Guanabara Bay Ecosystem in 1994 set the target BOD concentration in 2004 at 10 mg/litre.

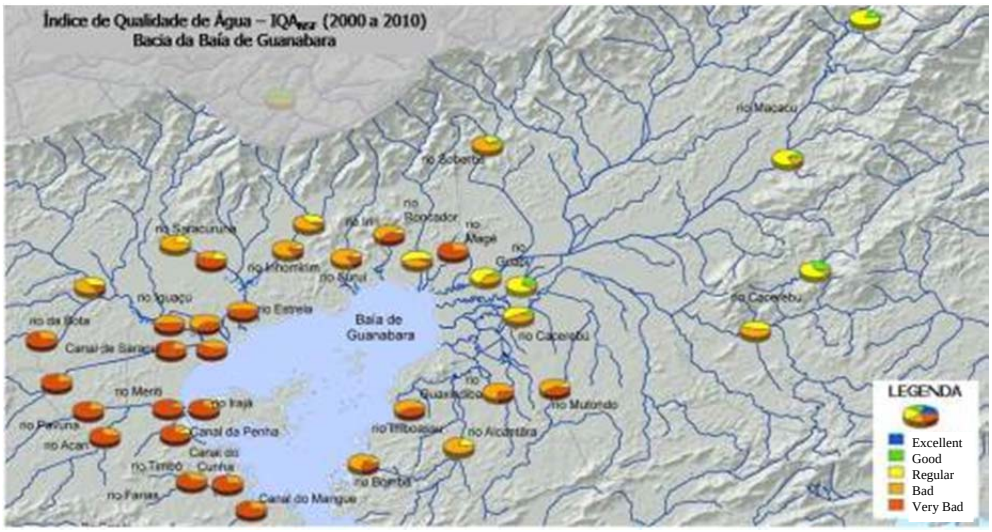

Figure 2. Water Quality of the Rivers in Guanabara Bay Basin
(Distribution of the measured values during 2000 – 2010)
Source: Department of Environment, State Government of Rio de Janeiro

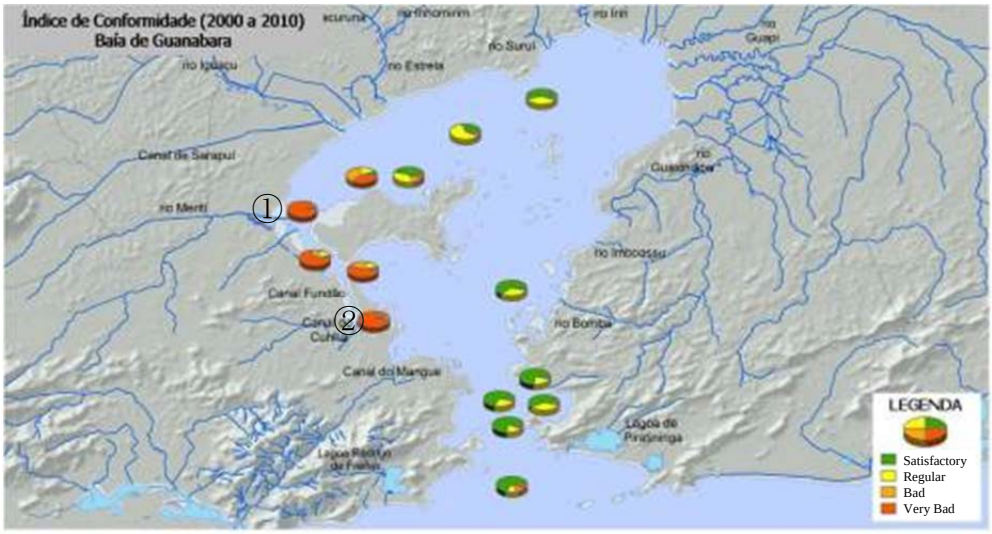

Figure 3. Water Quality of the Guanabara Bay
(Distribution of the measured values during 2000 – 2010)
Source: Department of Environment, State Government of Rio de Janeiro

Beach at the Guanabara Bay (Right: Western Part, Left: Eastern Part)

Fisherman in the Bay (Western Part)

View of Guanabara Bay from a Pleasure Boat

A series of interviews with various stakeholders in the water quality of Guanabara Bay has discovered the following facts.[13]

- The pollution in the bay is caused by not only discharged raw sewage but also by a massive inflow of rubbish from rivers after rain. A large-scale oil spill in 2000 appears to have affected the opinion of pollution on the part of fishermen and visitors to the beach. [14]

- In 2001, some 10,000 local fishermen were engaged in artisanal fisheries in the bay, most of whom pointed out a decline of the fish varieties and the catch due to the pollution of the bay by sediment sludge and rubbish. These same fishermen believe that the situation of water pollution in the bay has worsened in the last 10 years. Prawn fishing which used to record a catch of some 200 to 300 tons a year in the 1980's is no longer practiced in the bay.

- Nearly half of those representing commercial facilities and yacht clubs in the bay believe that the water quality has somewhat improved in recent years. However, they also say that the pollution of the bay continues to adversely affect their businesses, pointing out a decline of tourists, decrease of marine leisure activities and damage to ships by rubbish.

- More than half of local residents visiting the beach in the bay believe that the water quality has worsened in the last 10 years. Almost no local residents dare to swim in the bay.

To summarise, the impact of the Project on water quality improvement is judged to be limited as the BOD load removal by the Project is as low as some 10% of the total BOD load discharged to the bay in sewage. The water quality in the western part where pollution sources are concentrated is still poor and pollution by rubbish is also serious in this part. Water pollution in the bay is still badly affecting local fisheries and the operation of commercial and recreational facilities along the coast. In short, no visible positive impacts have been produced by the Project in relation to the conservation of fishing as well as tourism resources.

[13] As part of the ex-post evaluation, a series of interviews was conducted with 56 persons representing fishermen's cooperatives, restaurants, NGOs and tourist facilities as well as researchers and visitors to the beach.

[14] An oil spill involving some 13 billion litres of petroleum oil occurred in the Duque de Caxias refinery area in January, 2000.

3.3.2 Other Impacts

The sludge produced at the WWTPs amounts approximately 13 ton / m^3 in 2011 and is currently transported by truck to the Gerinchino landfill site located some 30 – 40 km from the WWTPs for sanitary landfill. The field observation confirmed that the sludge treatment at this site is appropriate as suitable soil cover and planting are practiced.

The Project did not involve the resettlement of residents or encountered any major problems in terms of land acquisition. One exception is the lengthy negotiations with a municipality to obtain consent for the shaving of a cliff located next to the site for the secondary treatment facility at the Alegria WWTP.

No other special positive or negative impacts of the Project are observed.

In summary, the Project achieved around 70% of BOD load removal targeted at the time of appraisal[15], and improved public hygiene of some 26 thousand households by May 2013. Inflow of BOD load to the Guanabara Bay was reduced by 10% and no visible impact has been realized in the western part of the Bay. Therefore, this Project has somewhat achieved its objectives, and its effectiveness is fair.

3.4 Efficiency (Rating: ①)

3.4.1 Project Outputs

The construction of three new WWPTs began in 1997.[16] In 2001 when the construction of the primary treatment facilities was almost completed, the original plan was revised to expand the capacity of each primary facility and to add secondary treatment facilities. These changes were approved by JICA as a means of further enhancing the outcomes of the Project in view of the facts that the required funding for these changes could be secure within the original loan limit and that the land required to accommodate the additional facilities had been already prepared.
In December, 2006 when the extended expiry date for loan disbursement arrived, the construction of the sewage collection facilities had still not been completed. Because of this, the subsequent construction work continued thereafter with funding by the Federal Government of Brazil and the State Government of Rio de Janeiro. Table 6 shows the planned project outputs at the time of appraisal, actual outputs up to 2006 and subsequent works completed between 2007 and May, 2013.

The planned sewage collection facilities (trunk lines and sewer networks) are incomplete and their construction work is still in progress (refer to 3.4.2.2 Project Period for the reasons of delay). The facilities completed by the expiry date for loan disbursement in December, 2006 included 42.7 km of trunk lines (59% of the planned total) and 240.9 km of sewer networks (36% of the planned total). Through the contracts made under the Project, 77% (55.4km) of trunk lines and 51% (334.2km) of sewer networks were constructed by October, 2013. Under new contracts, the CEDAE has been continuing the remaining works. A total of 70% of the trunk lines in the Alegria WWTP service area, 82% of the trunk lines and 90% of the sewer network in the Pavuna WWTP service area and 95% of the trunk lines and 93% of the sewer network in the Sarapui WWTP service area were completed by March, 2013.[17]

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[15] In judging the level of effectiveness / impact of the Project, the plans and targets set at the time of appraisal, not the plans and targets modified in 2001 to expand primary treatment capacity and add secondary treatment, were considered as "the original plan" for comparison, as they were the basis for an international agreement through the Exchange of Notes.

[16] At the three new WWTPs, the construction of only primary treatment facilities had begun as planned at the time of appraisal. At the Alegria WWTP, the construction of an additional primary treatment facility with a capacity of 1,000 litres/sec to be funded by the State Government of Rio de Janeiro was suspended because of funding difficulties. As a result, the original plan was scaled up to include the construction of a primary treatment facility with a capacity of 5,000 litres/sec under the Project instead of 4,000 litres/sec.

[17] The CEDAE's plan as of March, 2013 consists of the following components.

Table 6 Planned and Actual Project Outputs

WWTP	Planned (1994)	Actual		
		1994 to 2006	2007 to May, 2013	Total to Oct, 2013
Alegria WWTP*				
Primary Treatment	4000 (l/s)	5,000 (l/s)		5,000 (l/s)
Secondary Treatment	None	2,500 (l/s)		2,500 (l/s)
Trunk Lines	23.1km	14.0 km	2.9 km	16.9 km
Pavuna WWTP				
Primary Treatment	1,000 (l/s)	1,500 (l/s)		1,500 (l/s)
Secondary Treatment	None	1,500 (l/s)		1,500 (l/s)
Trunk Lines	30.7 km	11.7 km	3.7 km	16.1 km
Sewer Network	373.8 km	90.1 km	62.0 km	153.0 km
Pumping Station	9 locations	0 locations		0 locations
New Connections	26,500	811	8,894	9,705
Sarapui WWTP				
Primary Treatment	1,000 (l/s)	1,500 (l/s)		1,500 (l/s)
Secondary Treatment	None	1,500 (l/s)		1,500 (l/s)
Trunk Lines	18.2 km	17.0 km	4.4 km	22.4 km
Sewer Network	284 km	150.8 km	25.8 km	181.2 km
Pumping Station	8	0		0
New Connections	8,500	2,122	13,708	15,830
Penha WWTP				
Sludge Centrifugal Dewatering Units	4 units	4 units	4 units	4 units

Source: The planned values are based on material compiled at the time of appraisal. The actual values are based on CEDAE data.

Note: The work for the secondary treatment facility at the Alegria WPT included civil engineering work to allow treatment at a rate of 5,000 litres/sec and the construction of a secondary treatment facility with suitable equipment for treatment at a rate of 2,500 litres/sec. The actual performance since 2007 is the performance under the construction agreement concluded for the Project.

- Secondary treatment facility (2,500 litres/sec) at the Alegria WWTP: preparations in progress by the IDB to conduct the work in a succeeding project
- Manguinhos e Caleria de Cintura da Maré trunk line and Faria Timbó trunk line in the Alegria WWPT service area: preparations in progress by the IDB to conduct the work in a succeeding project
- Trunk lines and sewer network in the Sarapui WWTP service area (scheduled for completion in March, 2014):
  - Construction of the remaining works included in the Project: in progress with funding by the State Government
  - Expansion of the sewer network to connect 6,000 households: agreement concluded to fund the work by the State Government
  - Expansion of the sewer network to connect 4,130 households: agreement concluded to fund the work by the State Government
  - Expansion of the sewer network to connect 10,000 households and cleaning of the existing secondary sewer lines
- Trunk lines and sewer network in the Pavuna WWTP service area (scheduled for completion in March, 2014):
  - Construction of the remaining lines agreed under the Project: in progress with funding by the State Government
  - Expansion of the sewer network to connect 1,500 households: agreement concluded to fund the work by the State Government
  - Expansion of the sewer network to connect 38,000 households: preparations in progress by the IDB to conduct the work in a succeeding project
  - Cleaning of the sewer network constructed under the Project: examination in progress of the possible implementation of the work in the IDB's succeeding project

The original plan included new connection to the sewer network of 35,000 households in the Sarapui and Pavuna WWTP service areas. By 2006, only 2,933 households (8% of the planned target) were connected. This figure had improved to 25,535 households (73%) by October, 2013. Some of the sewer lines planned under the Project have been buried underground in the Sarapui and Pavuna WWTP service areas but not all of these lines have been connected to the WWTP or targeted households.[18] This is because of the piece-meal construction work. This is a factor for the low sewage treatment volume despite the overall progress of the construction work. No new connections have been made in the Alegria and Penha WWTP service areas because sewer networks had existed.

Several pumping stations were originally planned along the trunk lines but these have not been constructed because of the perceived difficulty of their maintenance. Instead, all of the lines now rely on gravity to carry sewage to WWTPs.

3.4.2 Project Inputs

3.4.2.1 Project Cost

The planned and actual project costs are shown in Table 9. Although the trunk line and sewer network construction work is still in progress, the project cost of the work implemented by the expiry date for loan disbursement (December, 2006) is analyzed here.

The construction cost of the primary treatment facilities specified in the project scope at the time of appraisal drastically dropped to some 40% (approximately ¥6,100 million) of the original level because of the huge depreciation of the local currency against the yen during the construction period from 1998 to 2001. With the addition of the secondary treatment facilities, however, the total construction cost of the WWTPs (primary and secondary treatment facilities) ended up at 138% of the planned cost. In the case of the sewer construction cost, the final cost was 54% of the planned cost due to the low completion rate of 59% for the trunk lines and 36% for the sewer network. The substantial extension of the project implementation period pushed up the consultant cost.

Because of the reasons described above, the total project cost (excluding the land acquisition cost) was ¥49,650 million, 83% of the planned project cost of ¥60,121 million. Meanwhile, the amount of loan disbursement was almost 100% of the planned amount. The project cost is, therefore, judged to be within the planned cost even when the increases and decreases of some of the outputs are taken into consideration. If it is assumed that all of the planned sewer lines were constructed as planned, the total cost of sewer construction would have been approximately double the actual cost. Meanwhile, based on the assumption that no additional work was conducted, the construction cost of the WWTPs would have been approximately ¥6,100 million. Based on these assumptions, the total project cost would have been some ¥50,000 million which is within the originally planned project cost.

The efficiency of the project cost cannot, however, be said to be high because of the low quality of the overall outputs as a sewage system, in turn caused by (i) the need for the cleaning of the new sewers which were constructed in a piece-meal manner and which were simply left buried underground without connection and (ii) the lengthy period of the low utilization rate of the new WWTPs after their completion.

[18] According to the CEDAE, there has been an increase of the inoperable secondary sewer lines due to their blockage by muddy rainwater while laying unused underground or by sewage discharged via drainage pipes illegally connected to them by owners of nearby houses. It is currently planned to clean and properly connect them in a succeeding project using an IDB loan.

Table 7 Planned and Actual Project Costs

(unit: ¥ million)

	Planned			Actual (December, 2006)		
	JBIC	RdJ* State	Total	JBIC	RdJ State	Total
WWTP	15,653	0	15,653	21,662	0	21,662
Sewer Lines / Network	10,324	19,172	29,496	4,036	12,008	16,044
Consulting Service	3,104	0	3,104	5,739	0	5,739
Taxes	0	7,355	7,355	0	6,205	6,205
Land Acquisition	0	1,253	1,253	Unknown	Unknown	Unknown
Physical Contingencies	2,396	2,117	4,513	-	-	-
Total	31,475	29,899	61,374	31,436	18,213	49,650

Source: The planned figures are based on materials compiled at the time of appraisal. The actual figures are prepared by the evaluator using the relevant data provided by JICA and CEDAE.

Note: RdJ State…Rio de Janeiro State

Exchange rates: At the planning stage: US$1 = Cr$2,395 = ¥133

Actual: R$1 = ¥46.25 (average for the project implementation period)

3.4.2.2 Project Period

It was originally planned that the Project would be implemented in a 60 month period (five years) from 1994 to 1998. In reality, even though it took 17 years and 9 months (213 months: 355% of the planned duration) to reach the expiry date for loan disbursement in December, 2006 from the time of the loan agreement which was signed in March, 1994, some of the planned sewage collection facilities (trunk and secondary) are not completed, and construction works are still in progress by the time of ex-post evaluation.

The consulting services and main construction work were originally scheduled to start in 1995 and 1996 respectively. Because of the delay of procurement preparations and actual procurement, however, the consulting services (four contracts in total) and the main construction work (four contracts in total) only started during 1996 to 1997 and 1997 to 2001 respectively. In the case of the sewage collection facilities in the Pavuna and Sarapui WWTP service areas where the construction work delay was the longest, the initial delay of consultant selection led to delayed procurement preparation work, including the detailed design. Together with the change of the procurement method, partly because of a change of the government, it took more than two years from public announcement to signing of the contract which finally took place in March, 2001.

In June, 2001 changes were made to the original contracts as the increased capacity of the primary treatment facilities and installation of secondary treatment facilities were added. At this time, the additional work was expected to be completed by the original expiry date for loan disbursement in July, 2003.[19]

Subsequently, the expiry date for loan disbursement was extended to December, 2006 for the following reasons.

- As the ground at the Alegria WWTP was much softer than anticipated, it was necessary to change the materials and construction method, delaying the actual construction work for more than a year.

- The state governor changed four times after signing of the loan agreement. Each time a new governor took office, many staff members of the CEDAE were replaced, causing confusion in the

[19] At this time, the construction of the primary treatment facilities was almost completed. In the Pavuna and Sarapui WWTP service areas, the construction contracts for the sewage collection facilities had just been concluded and any delays of the work execution were unforeseen.

project implementation. The audit conducted by the new governor regarding the administrative affairs of the previous governor resulted in an additional delay of procedural matters.

- In May, 2000, the Brazilian Fiscal Responsibility Law was promulgated for the purpose of ensuring fiscal discipline in the public sector, establishing legal restrictions designed to achieve balanced finance at the state level. Because of this, payment by the project implementing body to the contractors for the trunk line and sewer network construction work for which the funding by the State Government of Rio de Janeiro was fairly large was delayed. Because of this, the construction work itself was delayed.[20]

When the disbursement of Japanese ODA Loan ended in December, 2006 as the extended expiry date expired, some parts of the planned work had not been completed. This work then continued with funding by the State and Federal Governments.

Although the planned time of completion for the three new WWTPs was sometime in the first half of 1998, their primary treatment facilities were only completed in 2000 and 2001. The completion of the secondary treatment facilities had to wait until 2005 through 2009. At the Alegria WWTP site, the construction work of the secondary treatment facility was considerably delayed due to (i) changes of the construction materials and method to take the soft ground into consideration and (ii) delay of the rock excavation work caused by the delayed acquisition of the neighbouring land. As a result, this facility was not completed by the expiry date for loan disbursement. In the case of the Pavuna WWPT, only the work of installing a sludge centrifugal dewatering unit was completed by August, 2001.

The construction of sewage collection facilities in the post-project years has been slow due to insufficient funding by the State Government of Rio de Janeiro. The work is not completed as of March, 2013 as described in 3.4.1 Project Outputs.

3.4.3 Results of Calculations of Internal Rates of Return (IRR)

At the time of appraisal, the Financial Internal Rate of Return (FIRR) was estimated to be 1.1% to 9.0% based on various combinations of preconditions. In the present ex-post evaluation, recalculation of the FIRR is not conducted because of (i) the slow progress of connection to the sewer network and (ii) lack of sufficient CEDAE data on the WWTP operation and maintenance cost.

In regard to the Economic Internal Rate of Return (EIRR), the estimate of the IDB was referred to at the time of appraisal, but recalculation to produce an estimate directly comparable to the earlier the estimation by the IDB has not been conducted.[21]

Based on the above, efficiency of the project cost was not high, while the project period was significantly exceeded the plan, therefore efficiency of the Project is low.

3.5 Sustainability (Rating:①)

3.5.1 Institutional Aspects of Operation and Maintenance

The Office of Production and Large Operation of the CEDAE is responsible for the operation and maintenance of WWTPs. In the case of the Pavuna and Sarapui WWTPs, a joint maintenance section is located at the Pavuna WWTP. The staff strength at the time of ex-post evaluation is shown in Table

[20] The loan accounted for 100% of the funding for the WWTPs while only accounting for 35% of the funding for the trunk and secondary sewer lines.

[21] The IDB estimate makes it possible to compare only trunk lines in the Alegria WWTP service area. At the time of appraisal, the EIRR for these trunk lines was estimated to be 32.5% and the post-project recalculation puts it at 19%.

8. The staffing level is less than half of the assumed level at the time of appraisal. Even though the WWTPs are not fully operating because of an insufficient incoming sewage volume, the CEDAE admits that there is a shortage of staff.

Table 7 Staff Deployment at WWTP

(Unit: persons)

WWTP	Alegria	Pavuna	Sarapui
Operation			
Engineer/Operator	26	15	15
Office Servant	5	4	5
Other	5	2	2
Maintenance			
Engineer	2	2	
Mechanic	3	5	
Electrical Engineer	4	4	
Other	3	1	
Total	48	27	28

Source: CEDAE

Note: Totals for Pavuna and Sarapui were given considering half of the persons who work both for Pavuna and Sarapui WWTPs.

Each WWTP has its own workshop and conducts equipment repair as well as the processing of simple parts. A maintenance contract with an external company covers the repair of some special pumps and sludge centrifugal dewatering units in the case of the breakdown of such equipment.

The Office of Major Repair of the CEDAE is responsible for the operation and maintenance of the trunk lines (pipe diameter of 500 mm or more). Sewer networks other than those in Meriti are operated and maintained by local offices of the CEDAE. Several sewer line teams in possession of appropriate equipment and tools are deployed at each local office. According to these local offices, while the number of teams is insufficient, their response is adequate except during the rainy season when many sewer lines are flooded by rain.

The municipality of Meriti located in the Pavuna and Sarapui WWTP service areas has decided to proceed with its own sewerage service by not renewing the sewerage concession with the CEDAE in view of the slow progress of the sewerage system development by the CEDAE. The city administration has been examining the feasibility of outsourcing the maintenance work but no concrete plan or organizational arrangements for such outsourcing have been decided as of December, 2012.

3.5.2 Technical Aspects of Operation and Maintenance

Field visits to and interviews at WWTPs found that the CEDAE has the technical capability to conduct the simple repair of pumps, etc. and to process certain parts in-house. Manuals for electromechanical equipment and systems are stored at each WWTP and are regularly referred to. Each WWPT has its own laboratory to conduct water quality inspection and microbiological testing. The high level of treatment efficiency indicates an in-house capacity to adequately manage secondary treatment using microbes. In 2009, the CEDAE introduced an in-house university system with which training are provided in an organized manner for the capacity building of its staff members.

The results of interviews with those working at the CEDAE and observation of the maintenance conditions of various facilities, however, suggest that the CEDAE is less capable of adequately planning and managing maintenance work at sewage treatment facilities. No plans are prepared to regularly appraise the need for the maintenance, inspection and repair of equipment and the management of such works. There is no maintenance plan for individual equipment and operation records for individual equipment are not prepared except in the case of some equipment subject to a maintenance contract.

In short, although the CEDAE possesses the skill to conduct the basic operation of electromechanical equipment and simple repair, it lacks the know-how and system to implement preventive maintenance. In regard to preventive maintenance at WWPTs, JICA is planning to implement a technical cooperation "The Project of Training in Operation and Maintenance of Sewerage System".

3.5.3 Financial Aspects of Operation and Maintenance

The water and sewerage charge is the main source of income for the CEDAE. As shown in Table 9, both the operating income and EBITDA margin increased between 2010 and 2011, improving the overall profitability. As the net D/E ratio (debt ratio) is less than 1, financial stability of the CEDAE is strong.

Table 9 Financial Status of the CEDAE

(Unit: R$ million)

	2010	2011
Gross Operating Income	3,231	3,516
Net Operating Income	2,884	3,167
EBITDA	880	842
EBITDA Margin	30.5%	31.3%
Net D/E Ratio	0.40	0.49

Source: Annual Report of the CEDAE

Note: EBITDA = Earnings Before Interest, Taxes, Depreciation and Amortization

According to the CEDAE, there are sufficient financial resources to operate the WWPTs and no operational problems have so far arisen. However, the same cannot be said in regard to maintenance given the fact that many equipment and systems are awaiting repair. The results of interviews with front-line workers also support this view. The procurement of materials and services is a lengthy process as the arrangement of a tender by the Department of Engineering, Construction and Project is required for any procurement needs which exceed R$ 16,000 (approximately ¥800,000). Along with the lack of any preventive maintenance, this lengthy process is believed to be one of the principal factors for the present inoperable state of some equipment at the WWPTs due to the lack of swift repair.

Table 10 shows the expenditure for the operation and maintenance of the WWPTs from 2009 to 2011 (excluding the personnel cost, electricity cost, chemical cost and expenditure for maintenance which is procured through a tender).

Table 10 Operation and Maintenance Expenditures of WWTPs

(Unit:R$ thousand)

	Alegria WWTP	Pavuna and Sarapui WWTPs
2009	167	126
2010	273	198
2011	257	195

Source: CEDAE


Primary treatment facility not available for operation (Alegria WWTP)

Sludge Centrifugal Dewatering Units waiting for repair (Alegria WWTP)

Secondary treatment facility not available for operation (Pavuna WWTP)

Workshop (Pavuna WWTP)

Maintenance works of sewer

3.5.4 Current Status of Operation and Maintenance

(1) WWTPs

All of the WWTPs have so far been in continual operation without any lengthy stoppage. Although there is subsidence at the Alegria WWPT due to it being located on reclaimed land, the civil engineering facilities supported by piles have been adequately functioning. The civil engineering facilities at the other WWTPs have not posed any maintenance problems.

There is no preventive maintenance regime for electromechanical equipment and the necessary parts must be procured for equipment repair whenever equipment breakdown occurs. Operation and maintenance records are not kept for individual equipment except for some pumps and sludge centrifugal dewatering units for which a maintenance contract has been concluded. Simple equipment can be repaired at the in-house workshop at each WWPT. Because of a lack of funds, general parts may be procured for processing in-house instead of the procurement of genuine parts.

According to information provided by the CEDAE, some 30% of the electromechanical equipment at the Alegria, Pavuna and Sarapui WWPTs require repair as of December, 2012 and are currently not functional. Some equipment, including those of the primary treatment facility at the Alegria WWPT, require renewal as they are beyond repair. The equipment and system maintenance conditions are generally poor. Much rust is visible and hardly any repainting has been conducted. Because the incoming sewage volume is substantially below the treatment capacity, treatment has continued with little disruption by means of mobilising reserve equipment in place of the broken-down equipment. The situation where it is not urgently necessary to repair broken-down equipment has actually worsened the overall operational status of the WWPTs. At the Penha WWPT, deteriorated equipment is simply left unused instead of being renewed, and as a result, it has been necessary to restrict the volume of sewage accepted by the WWPT.

(2) Trunk Lines and Sewer Network

Trunk lines are cleaned before a carnival and other major events and when a decline of the flow rate is reported by a WWPT provided that any blockage or hampered flow can be visually confirmed through manholes. No repair has so far been necessary for the trunk lines constructed under the Project. In the case of the sewer networks, these are cleaned by the local CEDAE office in response to a notification by residents.

In the Pavuna and Sarapui WWPT service areas, there has been an increase of the number of areas where underground sewer pipes unused for a long time have become blocked by muddy rainwater or sewage discharged via drain pipes illegally connected to them by owners of nearby houses.[22]

As described above, the operation and maintenance system of the CEDAE is generally adequate as far as the sewage collection facilities are concerned. However, some of the equipment and systems at the WWTPs do not operate properly, partly because of the manpower shortage and partly because of the lack of proper funding for equipment maintenance. The lack of any preventive maintenance has exacerbated this inadequate maintenance situation. In Meriti where the municipal authority has opted for an independent sewerage maintenance system, the system has not yet been fully established. Based on the above observations, the sustainability of the Project is judged to be low.

4. Conclusion, Recommendations and Lessons Learned

4.1 Conclusion

The Project was implemented to improve the hygiene environment for residents and to reduce the inflow volume of pollutants to the said bay by means of constructing sewerage facilities in the western part of the Guanabara Bay Basin in the State of Rio de Janeiro. As the purpose of the Project was consistent with not only the development policies and needs of the aforementioned state but also with the ODA policy of Japan, the overall relevance of the Project is high. While highly efficient secondary treatment facilities were constructed, the actual sewage treatment volume remained as low as some 30% of the planned volume due to the incompletion of some of the planned sewage collection facilities. As a result, the pollutant reduction volume was approximately 70% of the planned level.

[22] Refer to footnote 17 for the relevant projects funded by IDB loan.

Some areas where the sewerage system was completed have seen an improvement of the hygiene environment. Flow of pollutant to the Guanabara Bay has been reduced, while no significant improvement of the water quality has been observed in the bay. Given the limited impact, the effectiveness of the Project is judged to be fair. While the project cost remained within the planned budget, the project period substantially exceeded the planned period. Given the fact that not all of the sewage collection facilities had been completed at the time of the ex-post evaluation, the efficiency of the Project is evaluated to be low. Meanwhile, the insufficient budget for equipment maintenance at the wastewater treatment plants (WWTPs) and its delayed execution, the insufficient deployment of manpower coupled with the lack of a preventive maintenance system is responsible for the inadequate maintenance of some equipment. In Meriti which is included in the project area and where the municipal authority has taken the responsibility to operate and maintain the sewerage system, neither the organizational set-up nor the organizational capacity to properly execute the work has yet been firmly established. Accordingly, the sustainability of the Project is judged to be low.

4.2 Recommendations

4.2.1 Recommendations to the CEDAE and Meriti Municipality

- The CEDAE should urgently complete the construction of the trunk lines and sewer network so that the treatment capacity of the three new WWPTs constructed under the Project is fully utilized. In addition, the construction of an additional secondary treatment facility at the Alegria WWTP should be urgently realised. At the Penha WWTP, given the ongoing process of deterioration, investment in new equipment should be realised to restore the plant's treatment capacity.

- Using the technical cooperation schedule of JICA, the CEDAE should proceed with technical analysis and system development to achieve an appropriate operation and maintenance system, including preventive maintenance, at all of the WWTPs. For this purpose, the CEDAE should prepare a facility rehabilitation plan as well as an operation and maintenance plan for each WWTP and should make the appropriate budgetary arrangements.

- The Municipality of Meriti should urgently establish the sewerage operation and maintenance system. The CEDAE should coordinate with the Municipality of Meriti fully and provide necessary information to the municipality.

4.2.2 Recommendations to JICA

None

4.3 Lessons Learned

- In the case of a sewerage project which includes the construction of a WWTP(s), it is essential to construct appropriate sewage collection facilities at the same time. In the present Project, significant delays in construction of sewage collection facilities compared to the early completion of the WWTPs hampered realization of project benefit. In this regard, the following issues must be carefully considered in planning and implementation of such projects.

    - Even when the project implementing body has expressed its commitment to funding, the feasibility of such funding should be carefully analysed without prejudice. In order to minimize risks associated with funding limitations, planning should take into consideration such measures as appropriate share of funding by the implementing body, phased implementation, etc. If a change of government is foreseen during the implementation period, more cautious preparation is required.

    - If the implementing body is judged to have sufficient financial capacity compared to the size of the contract, it is desirable to include a part or the entire sewage collection facility in the same

package with the WWTP(s). By including sewage collection and treatment facilities together in one package would increase the probability of realization of project benefit.

- When the contract for the sewer collection facility is independent from the contract for the WWTP(s), it should be divided into lots of a suitable size to match the feasible funding. In deciding the way of division and the order of implementation of collection facilities, dates of completion and commissioning of the WWTP(s) should be well considered, so that the probability of realization of project benefit could be maximized by synchronizing the completion of WWTP(s) and the completion of collection facilities close to the WWTP(s).
- The construction plan for the sewage collection facility must ensure that sewers closer to the WWTP(s) are completed earlier so that the risk of unconnected and buried sewer due to unforeseen suspension of construction works can be minimized.

Comparison Between the Original Plan and the Actual Results

Item	Original Plan	Actual Results (As of December, 2006)
Outputs	1) Alegria WWTP Primary treatment: 4m^3/s Trunk lines: 23.1km 2) Penha Sludge centrifugal dewatering units: 4 units 3) Sarapui WWTP Primary treatment: 1m^3/s Trunk lines: 18.2km Sewer network: 289.4km Pumping stations: 7 locations 4) Pabuna WWTP Primary treatment: 1m^3/s Trunk lines: 30.7km Sewer network: 373.8km Pumping stations: 10 locations 5) Consulting Services	1) Alegria WWTP Primary treatment: 5m^3/s Secondary treatment: 2.5m^3/s Trunk lines: 14.0km 2) Penha Sludge centrifugal dewatering units: 4 units 3) Sarapui WWTP Primary treatment: 1.5m^3/s Secondary treatment: 1.5m^3/s Trunk lines: 17.0km Sewer network: 150.8km Pumping stations: 0 locations 4) Pabuna WWTP Primary treatment: 1.5m^3/s Secondary treatment: 1.5m^3/s Trunk lines: 9.3km Sewer network: 83.8km Pumping stations: 0 locations 5) Consulting Services
Project Period	January,1994 to December, 1998 (60 months)	March, 1994 to December, 2006 (213 months)
Project Cost - Japanese ODA Loan Portion - Executing Agency - Total - Exchange Rate	 ¥31,475 million ¥29,899 million ¥61,374 million US$ 1= ¥133	 ¥31,436 million ¥18,213 million ¥49,650 million 1Real= ¥46.25 (Average: 1994 – 2006)