

Republic of Paraguay

FY 2020 External Ex-Post Evaluation of Japanese Grant Aid Project

“The Project for Improvement of the Drinking Water System for Coronel Oviedo City”

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## 0. Summary

The Project for Improvement of the Drinking Water System for Coronel Oviedo City (hereinafter referred to as “the Project”) was implemented for the purpose of ensuring stable supply of safe water for Coronel Oviedo City by means of constructing such water supply facilities as a water treatment plant (hereinafter referred to as “WTP”), transmission pipeline, etc., thereby contributing to improvement of the living environment for residents. The Project is highly consistent with the national development policies, plans and needs of Paraguay at the time of both planning and ex-post evaluation. As it is highly consistent also with Japan’s ODA policies at the time of planning, the relevance of the Project is high. Although the outputs of the Project were generally as planned with the project cost being within the plan, the project period exceeded the plan, making the efficiency of the Project fair. Through the implementation of the Project, a stable and safe water supply has been achieved in Coronel Oviedo City and the convenience of water use in daily life has improved. The secondary effect in Villarrica City was achieved as planned. While there is a possibility of an increase of the discharge volume of untreated domestic wastewater from households in the post-project period, such expected impacts as improvement of the living environment and improvement of hygiene in the city have been realized. As such, the effectiveness and impacts of the Project are high. As the institutional/organizational, technical and financial aspects of the operation and maintenance of the Project pose no problems, the sustainability of the project effects is high.

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

## 1. Project Description



Project Location



WTP Constructed under the Project

## 1.1 Background

In the Republic of Paraguay (hereinafter referred to as “Paraguay”), 70.4% of the total population (approximately 6.2 million) had access to a water supply system such as piped water supply in 2012, while the remaining some 30% did not have stable access to safe water. The water supply service in cities with a population of 10,000 or more was operated by Sanitary Service Company of Paraguay (ESSAP). At the time, some 1.2 million people in 29 cities nationwide received water supply from 21 water supply systems.

Coronel Oviedo City (population of 62,000 in 2012) was one of the major cities after three major urban areas, including the Asunción metropolitan area, in Paraguay. Water was supplied to this city from the Tebicuarymi WTP which is located some 20 km of Coronel Oviedo City, uses Tebicuarymi River as the water source, which also supplied water to Villarrica (population of 52,000 in 2012), Mbocayaty (population of 2,800 in 2012) and Yataity (population of 2,100 in 2012) cities. However, as this WTP lacked a sufficient water treatment capacity to meet the increased water demand in each city, the water supply coverage in Coronel Oviedo City was only 61% in 2012. Some 2,000 applications for new water supply connection were pending and water supply was restricted to a maximum of 16 hours a day. Meanwhile, Tebicuarymi River flooded every few years and inundation of the WTP caused stoppage of its operation for a long period of time with a severe impact on the citizens’ life. In view of such situations, it was considered essential to construct a new WTP as well as transmission pipeline in order to ensure stable water supply in response to the ever-increasing water demand.

Under these circumstances, the Government of Paraguay made a request to the Government of Japan for grant aid for the construction of a new WTP (hereinafter referred to as “the new WTP”) at the site of the Tebicuarymi WTP (hereinafter referred to as “the existing WTP”) and a new transmission pipeline to Coronel Oviedo City.

## 1.2 Project Outline

To ensure stable supply of safe water to residents of Coronel Oviedo City by means of constructing such water supply facilities as a WTP, transmission pipeline, etc., thereby contributing to improvement of the living environment for residents.

Grant Limit / Actual Grant Amount	1,827 million yen / 1,827 million yen
Exchange of Notes Date Grant Agreement Signing Date	June 2014 / September 2014
Executing Agency	Directorate of Drinking Water and Sanitation (DAPSAN) / Ministry of Public Works and Communications (MOPC)
Project Completion	October 2017

Target Area	Coronel Oviedo City, Caaguazu Department (target area for water supply), Yataity City, Guaira Department, (construction site of the new WTP)
Main Contractor	Hazama Ando Corporation
Consultant	Kyowa Engineering Consultants Co., Ltd.
Basic Design Study/ Preparatory Study	May 2013 to February 2014
Related Projects	None

## 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 the Study: December 2020 to January 2022

Duration of the Field Survey: May 2021 (by local consultants)

### 2.3 Constraints During the Evaluation Study

The external evaluator was unable to travel to Paraguay because of the COVID-19 pandemic. Accordingly, interviews with the Directorate of Drinking Water and Sanitation (hereinafter referred to as “DAPSAN”) of the Ministry of Public Works and Communications (hereinafter referred to as “MOPC”) and ESSAP, physical inspection of the water treatment and transmission facilities newly constructed under the Project and interviews with officials of Coronel Oviedo City and water users were conducted by local consultants with remote supervision by the external evaluator.

## 3. Results of the Evaluation (Overall Rating: A<sup>1</sup>)

### 3.1 Relevance (Rating: ③<sup>2</sup>)

#### 3.1.1 Consistency with the Development Plan of Paraguay

“The Public Policy for Social Development 2010 - 2020” prepared by the Government of Paraguay in 2009 included actions designed to achieve a target water supply coverage of 80.5% in 2015 as a millennium development goal as soon as possible. Moreover, the country’s “Strategic Economic-Social Plan 2008 - 2013” included such targets as “increased social investment to reduce poverty” and “improved access to public services.” In this plan, Coronel Oviedo City was

<sup>1</sup> A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory

<sup>2</sup> ①: Low; ②: Fair; ③: High

considered to be a priority city for the development of water treatment facilities in reference to such indicators as the quality of supplied water, population served and water supply coverage.

At the time of this ex-post evaluation, “poverty reduction and social development” as one of three strategic pillars of “National Development Plan: Paraguay 2030” of Paraguay aims at improving both the water supply coverage (64% in 2014) and sewerage coverage (11% in 2014) to 100% by 2030. The National Poverty Reduction Plan prepared on the basis of the National Development Plan includes improvement of the water supply as part of improvement of the living and sanitary environment for the poor. Meanwhile, “National Development Plan for Water and Sanitation” prepared by DAPSAN in August 2018 lists projects/programs to achieve the target of the national development plan along with three axes, i.e. i) organizational development and capacity building in the water supply and sewerage sector, ii) improvement of the financial and water charge systems and iii) expansion and sustainability of the water supply and sewerage systems.

Based on the above, the Project which aimed at achieving stable water supply in Coronel Oviedo City is highly consistent with the national development policies of Paraguay at the time of both planning (2014) and ex-post evaluation.

### **3.1.2 Consistency with the Development Needs of Paraguay**

As already described in “1.1 Background”, expansion of the water supply service and operating hours were restricted in Coronel Oviedo City in addition to the occasional suspension of the water supply for a long period of time due to flooding of the existing WTP.

At the time of ex-post evaluation, the new WTP constructed under the Project is performing stable water treatment and playing an important role not only in water supply for Coronel Oviedo City but also in improved water supply service for Villarrica City as a secondary effect (refer to “3.3 Effectiveness and Impacts”). This means that the needs for the Project was maintained at the time of ex-post evaluation.

Based on the above, the Project is highly consistent with the development needs of Paraguay at the time of both planning and ex-post evaluation.

### **3.1.3 Consistency with Japan’s ODA Policy**

In the Japanese ODA Policy for Paraguay, Japan considers “sustainable economic development” to be a priority area. The Project is classified under the development theme of “consolidation of economic and social infrastructure” under “sustainable economic development”. JICA’s country analysis paper also considered the water resources sector to be a priority issue. As such, the Project was consistent with Japan’s ODA policy at the time of planning.

Based on the above, the Project is highly relevant to Paraguay's development plan and development needs, as well as Japan's ODA policy. Therefore, its relevance is high.

### 3.2 Efficiency (Rating: ②)

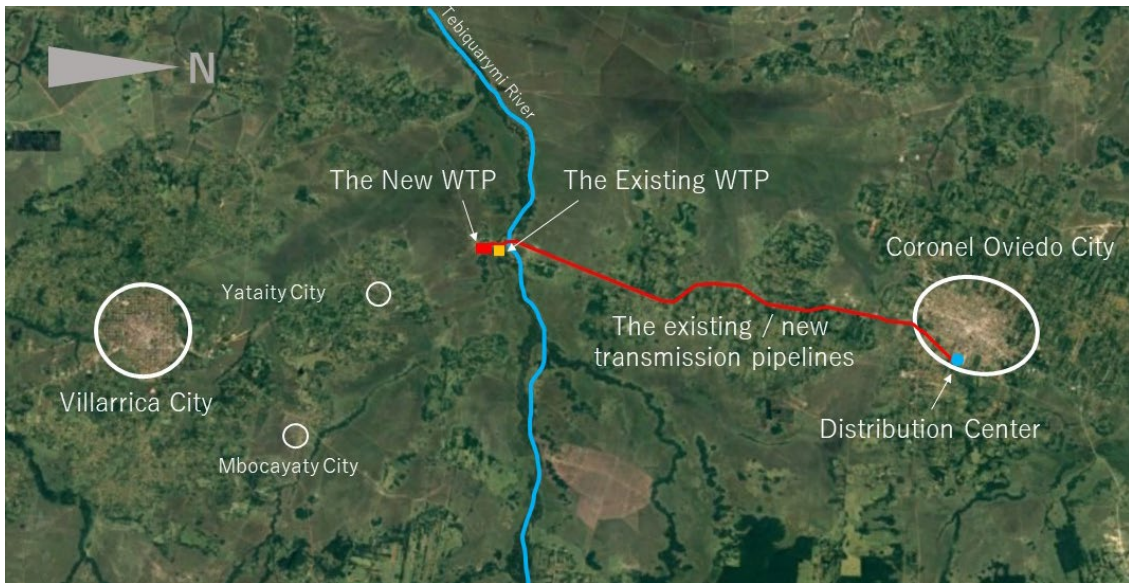
#### 3.2.1 Project Outputs

Under the Project, the new WTP was constructed on the site of the existing WTP and a new transmission pipeline was also constructed from the new WTP to the water distribution center in Coronel Oviedo City. New water intake facilities for existing and new WTPs were also constructed. The Paraguayan side also rehabilitated the existing transmission pipeline from the existing WTP to Coronel Oviedo City and constructed an additional distribution reservoir at the site of the distribution center in Coronel Oviedo City. As shown in Table 1, the outputs of the Project were generally realized as planned.

Table 1 Planned and Actual Outputs

	Planned	Actual
<u>Japanese Side</u>		
Intake Facilities	Planned intake volume: 28,900 m <sup>3</sup> /day Intake, sedimentation basin, intake pump, conduit, etc.	Generally as planned
New WTP	Planned water treatment volume: 13,500 m <sup>3</sup> /day Receiving well, flocculation basin, rapid filtration tank, distribution reservoir (at the site of the WTP), transmission pump, etc.	
New Transmission Pipeline	Planned transmission volume: 12,300 m <sup>3</sup> /day Total length: 22.7 km	
Consulting Service	Detail design, bidding support, construction supervision, training on the operation and maintenance of the WTP (soft component)	
<u>Paraguay Side</u>	<ul style="list-style-type: none"> <li>• Embankment at the new WTP site</li> <li>• Construction of an access road at the new WTP site</li> <li>• Fencing and other exterior work</li> <li>• Power supply extension work to the site</li> <li>• Construction of an additional distribution reservoir at the distribution center in Coronel Oviedo City</li> <li>• Repair/rehabilitation of the existing transmission pipeline to Coronel Oviedo</li> </ul>	Generally as planned

Source: Materials provided by JICA, DAPSAN/MOPC and ESSAP.



Source: Prepared by the evaluator

Fig. 1 Locations of Facilities Constructed under the Project and Target Cities for Water Supply

Regarding some of the planned works of the Japanese side, minor modifications were made to the routes of the conduit, transmission pipeline, etc. and the construction methods to reflect the actual geological features. These modifications were needed in order to adjust to the plan for the access road by the Paraguayan side, to improve operability, convenience and safety of operation and maintenance, and to improve workability of construction, all of which were made upon technical reviews and are judged to be appropriate.

The works planned for the Paraguayan side was completed with some additions, including the installation of fire extinguishing equipment at the distribution facility and the replacement of valves for the existing transmission pipeline. Moreover, the Paraguayan side newly constructed a transmission pipeline to Villarrica from the existing WTP and a distribution reservoir (1,500 m<sup>3</sup>) in Villarrica in 2017. Although these facilities are outside the scope of the Project, they are believed to have further boost the effects of the Project in Villarrica (refer to Effectiveness).

While the executing agency for the Project was DAPSAN, ESSAP is responsible for the operation and maintenance of the water supply facilities constructed under the Project.



Water Treatment Facility (left) and Pumping Facility (right) of the New WTP

### **3.2.2 Project Inputs**

#### **3.2.2.1 Project Cost**

The planned total project cost at the time of planning was 2,114 million yen (Japanese portion of 1,822 million yen and Paraguayan portion of 292 million yen). The actual outputs were almost as planned and the actual total project cost was 1,962 million yen (Japanese portion of 1,827 million yen and Paraguayan portion of 135 million yen) which was 93% of the planned cost. As mentioned earlier, some additions were made to the work by the Paraguayan side. However, the overall project cost was within the plan as the embankment at the WTP site and construction of the access road to the construction site were conducted as part of the road maintenance works of the MOPC. Therefore, the efficiency in terms of the project cost is high.

#### **3.2.2.2 Project Period**

The project period, including the detailed design and tender periods, was assumed to be 27 months from June 2014 to August 2016.

For the works by the Japanese side, the consultancy contract and civil engineering contract were signed in October 2014 and May 2015 respectively. Prior to the commencement of the works, the embankment by the Paraguayan side was delayed by persistent rain and flooding. On the other hand, the handing over of the temporary yard for materials was delayed by more than two months as some time was required for the relevant ministries to reach an agreement. Moreover, the overturning of a crane during the construction work by the Japanese side resulted in this crane being unrepairable. The subsequent decision to import an alternative crane from Japan as one could not be procured in Paraguay lengthened the construction period by approximately eight months. Following such incidents, the works by the Japanese side was finally completed in October 2017.

In regard to the works by the Paraguayan side, the new distribution reservoir in Coronel Oviedo City began operation in October 2019. Although its construction had already started at the time of the planning of the Project, the relevant contract was cancelled twice because of problems involving the contractors. The work was completed under the third contract. The rehabilitation work of the existing transmission pipeline started in October 2017, after the commencement of the new transmission pipeline (constructed by the Japanese side), and was completed in December 2018. In order not to interrupt the transmission to Coronel Oviedo City, this work could not have been started before the commencement of operation of the new transmission pipeline.

The formal completion date for the Project was October 2019 when the construction of the new distribution reservoir was completed by the Paraguayan side. However, the principal project effects were already apparent in Coronel Oviedo City when 24 hour water supply using the existing distribution reservoir and new transmission pipeline began after completion of the construction of the new WTP by the Japanese side.<sup>3</sup> Accordingly, for the purpose of evaluating the efficiency of the Project, the project period is set at 37 months (137% of the planned period) from the signing of the consultancy contract in October 2014 to the completion of the construction of the new WTP in October 2017. As this project period exceeded the planned period, the efficiency in relation to the project period is judged to be fair.

In summary, although the project cost was within the plan, the project period exceeded the plan. Therefore, efficiency of the Project is fair.

### **3.3 Effectiveness and Impacts<sup>4</sup> (Rating: ③)**

#### **3.3.1 Effectiveness**

The purpose of the Project was to ensure safe and stable water supply for residents of Coronel Oviedo City by means of constructing water supply facilities, including a WTP and transmission pipeline. In this section, achievement of the project purpose is analyzed based on the indicators set at the time of planning, following the analysis of the operating situation of the WTPs. Further analysis is conducted regarding other effects of the Project, including the secondary effects of the Project.

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<sup>3</sup> After the completed rehabilitation of the existing transmission pipeline, water from the new WTP is supplied to the distribution centre in Coronel Oviedo City via the new and existing transmission pipelines. The rehabilitated existing transmission pipeline and new distribution reservoir not only contribute to a stable water supply for the city but have also created extra capacity to accommodate a demand increase in the future.

<sup>4</sup> Sub-rating for effectiveness is to be put with consideration of Impacts.



### 3.3.1.1 Operating Status of the WTPs

The construction work of the new WTP under the Project was completed on October 31, 2017 and this new WTP has maintained a high operating rate of around 98% since 2018. According to the ESSAP, most operational stoppages are caused by power outages.<sup>5</sup> In regard to the existing WTP, replacement of the broken-down power generating facility by the ESSAP in 2013 and replacement of the transmission pump in 2019 and the transmission pipeline in 2020 (all outside the scope of the Project) have led to a slightly better operating rate than the new WTP since 2019. In 2020, the operating rate of the existing WTP recorded 100%.

The annual water treatment volume of the new WTP in 2020 was 4,875,675 m<sup>3</sup> with an average daily treatment volume of 13,056 m<sup>3</sup> which was 97% of the planned volume. Some 10% of the treatment volume is consumed on site for back wash, etc. and the remaining water is conveyed to Coronel Oviedo. The treated water by the existing WTP is conveyed to Villarrica and two other cities. The total annual water treatment volume of these two WTPs was 9,557,423 m<sup>3</sup> in 2020 which was 181% of the annual treatment volume of the existing WTP in 2016.

Table 2 Operating Situation of the New and Existing WTPs

	2016	2017	2018	2019	2020
Annual operating rate: annual operating hours ÷ (24 hours x 365 days or 366 days)					
Existing WTP	93.2%	95.7%	95.1%	99.3%	100.0%
New WTP	(Under construction)	(Completed on October 31)	97.3%	98.7%	98.6%
Annual water treatment volume (m <sup>3</sup> )					
Existing WTP	5,292,500	4,422,500	3,650,000	4,423,419	4,681,748
New WTP	-	738,000	4,489,500	4,826,990	4,875,675
Total	5,292,500	5,160,500	8,139,500	9,250,409	9,557,423

Source: Materials provided by DAPSAN and ESSAP

### 3.3.1.2 Degree of Achievement of Project Goals (Coronel Oviedo)

Table 3 shows the indicators set at the planning stage in relation to the project purpose and their baseline, target and actual values at the time of ex-post evaluation. The degree of achievement is high for all the indicators.

<sup>5</sup> At the time of the preparatory study, the installation of a generator at the new WTP was not planned because of the decreasing trend of power outages. According to ESSAP, while power outages have been decreasing and power supply is restored within 15 minutes in most cases, power generating equipment would be necessary for the operating rate of the WTP to be increased further.

Table 3 Target and Actual Indicator Values

Indicator	Baseline Value (2012)	Target Value (2020) (4 years after completion)	Actual Value (2020)
Population served	37,620	52,000	48,210
Number of connections (Reference)	7,524	10,400	9,642
Average distribution volume	6,600 m <sup>3</sup> /day	12,300 m <sup>3</sup> /day	12,343 m <sup>3</sup> /day
Water supply hours	16 hours/day	24 hours/day	24 hours/day

Note: Data is for Coronel Oviedo City.

Source: Materials provided by JICA for the reference values and target values and materials provided by DAPSAN and ESSAP for actual values.

#### Population Served

The estimated population served by piped water in Coronel Oviedo in 2020 was 48,210 which was 128% of the 37,620 in 2012 and 93% of the target population of 52,000. As actual data on the population served was unavailable, estimation for the purpose of ex-post evaluation is made based on the number of household connections, assuming that the number of persons served per connection has remained unchanged since the time of planning (5.0 persons per household).

#### Average Distribution Volume

The average daily distribution volume to the distribution area by ESSAP in Coronel Oviedo City in 2020 was 12,303 m<sup>3</sup> which was almost as planned and was 186% of the baseline value of 6,600 m<sup>3</sup>/day in 2012. The distribution volume per person (water usage volume + leakage volume) increased from 175 liters/day in 2012 to 255 liters/day in 2020 (146% of the 2012 level), suggesting the increased use of piped water by residents.

#### Water Supply Hours

The average water supply hours per day in Coronel Oviedo City used to be 16 hours or less. 24 hour water supply operation started as planned immediately after the completion of the new WTP in October 2017.

In this ex-post evaluation, the “annual days of water supply cut-off” and “water quality after treatment” before and after the Project were compared as additional indicators. As described below, both indicators have recorded a high level of improvement.

### Annual Days of Water Supply Cut-Off

In Coronel Oviedo City, water supply cut-off totaling 2 - 3 weeks a year used to occur up to 2016 due to flooding of the existing WTP. Since 2017, no suspension of operation due to flooding has been recorded with both the new and existing WTPs. The reasons for this are that the new WTP is constructed on the site banked by the Paraguayan side to avoid flooding and that an increase of the discharge capacity of Tebicuarymi River after bridge replacement work by the MOPC (a project planned in parallel with the Project) has prevented the occurrence of severe flooding. There have been no incidents of the simultaneous suspension of operation of both the new and existing WTPs due to reasons other than flooding. Consequently, there have been no widespread or long water supply cut-off incidents in Coronel Oviedo.

### Water Quality After Treatment

The water quality after treatment at the new WTP in 2020 (sampled at the said plant) showed a pH value of 7.0 (Paraguayan standard: 6.0 ~ 8.0), turbidity of 0.6 NTU (Paraguayan standard:  $\leq 1.0$ )<sup>6</sup> and chromaticity of 3 (Paraguayan standard:  $\leq 5$ ), indicating generally good quality of the treated water. No coliforms were detected. The water quality test by the Regulatory Body for Sanitation Services (ERSSAN) did not point out any problems<sup>7</sup>, suggesting that the water quality of both plants is suitable for drinking. In the case of turbidity which was an issue prior to the commencement of the Project, even though the turbidity of the raw water significantly fluctuates from one season to another (11 to 290 NTU), the turbidity after treatment is generally constant (0.5 to 0.8 NTU), suggesting that appropriate treatment is conducted in response to the quality of the raw water. Meanwhile, although the average post-treatment turbidity at the deteriorated existing WTP improved from 2.4 NTU at the time of planning (June 2012 to May 2013) to 2.0 NTU in 2020, the post-treatment turbidity can reach a maximum of 2.8 NTU, failing to meet the Paraguayan standard. In short, the quality of the water supply to Coronel Oviedo City has improved due to the distribution of water from the new WTP constructed under the Project.

Based on the above, as the degree of achievement in Coronel Oviedo City is high for such indicators as the population served, water supply hours, annual days of water supply cut-off and

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<sup>6</sup> NTU (Nephelometric Turbidity Unit) indicates the degree of turbidity and a larger value indicates a higher level of turbidity.

<sup>7</sup> The ERSSAN was established as an independent administrative body aimed at supervising and guiding water supply and sewerage services under Article 8 of Law No. 1614/2000 concerning the regulations and framework to determine charges for water supply and sewerage services. The authority and obligations of the ERSSAN as set forth in Article 10 include the evaluation of water service providers, ensuring of technical levels, confirmation of the set scope of water supply, setting of the water charge, punishment of offenders of the relevant laws and regulations, approval of tender documents, management of service quality and supervision of the general activities of water service providers and others. Water quality testing by the ERSSAN is conducted by means of sampling water at the WTPs, distribution reservoirs and taps of water users.

water quality, the purpose of the Project is judged to have been achieved. According to the officials of Coronel Oviedo City, many complaints regarding water supply were made to the municipal office before the Project and the local radio station often talked about problems relating to water supply, but such situations greatly improved after the Project. According to the Coronel Oviedo Office of the ESSAP, the city did not experience any problems in the dry season of 2020 when many other cities suffered water shortages.

Construction of the new distribution reservoir by the Paraguayan side under the Project meant the construction of a new reservoir (tower type: 1,500 m<sup>3</sup>) near the existing distribution reservoirs (1,400 m<sup>3</sup> semi-underground type and 500 m<sup>3</sup> elevated type). Before the Project, the elevated distribution reservoir which could be used during power outages was too small to prevent cutting off of the water supply. The capacity of the distribution reservoir has been substantially increased under the Project to maintain water distribution for several hours when a power outage occurs, meaning that no water supply cut-off takes place as long as the power outage is short. At present, ESSAP is considering the installation of a generator at the pumping station of the new WTP to prevent cutting-off of the water supply due to a long power outage.

Since 2016, ESSAP has been proceeding with expansion (two areas with some 110 households) and renewal (some 350 households) of the water distribution network in Coronel Oviedo City. The positive effect of the Project mentioned earlier is in fact the synergy effect of such work and the Project. At the time of the preparatory study, improvement of the distribution network was proposed to improve the water pressure based on the results of water pressure measurement at various locations in the city and its implementation by the Paraguayan side was expected, but the relevant work was not included in the work of the Paraguayan side for the Project. According to ESSAP, this proposal has not been implemented as such but the identification of concrete problems of the distribution network was found to be useful. ESSAP prepared a plan to ensure an appropriate water pressure throughout the city by means of dividing the distribution network in the city into multiple areas and supplying water to areas with a high elevation from an elevated distribution reservoir. The draft improvement plan proposed by the preparatory study was incorporated in this later plan which was the result of the capacity building of ESSAP under JICA's technical cooperation project titled "Project for Capacity Development of Distribution Network Management of the ESSAP (2011 - 2014)". However, there is no concrete schedule for the implementation of this plan.

At the time of planning, 15 water and sanitation cooperatives using wells as water sources were operating in some areas of Coronel Oviedo City and supplying water to some 2,200 households at a lower charge than ESSAP. The interview survey at the time of the preparatory study found that some of these cooperatives were willing to receive water supply from ESSAP if its water supply service improves after the Project. However, no cooperative has actually switched to water supplied by ESSAP at the time of ex-post evaluation. In fact, some cooperatives use

water supplied by ESSAP through illegal connection to ESSAP's distribution network. The joint efforts of ESSAP and ERSSAN to solve this problem have been made but not yet been successful.

### **3.3.1.3 Other Effects**

#### **(1) Improved Water Supply Service in Villarrica City**

Prior to the Project, the existing WTP supplied water not only to Coronel Oviedo City (population of 61,600 in 2012) but also to Villarrica City (population of 51,500 in 2012), Mbocayaty City (population of 2,800 in 2012) and Yataity City (population of 2,100 in 2012). Water supply in Villarrica City was restricted to 12 - 16 hours a day. The combined water supply capacity of the existing and new WTPs substantially increased after the construction of the latter under the Project. In particular, improved water supply service for Villarrica City among the other three cities mentioned above was expected as a secondary effect of the Project with an expected increase of the water supply volume to Villarrica City.

The total water supply volume to these three cities increased from 7,400 m<sup>3</sup>/day in 2012 to 10,963 m<sup>3</sup>/day in 2020. The number of connected households in Villarrica City increased from 8,598 in 2016 to 10,200 in 2020.<sup>8</sup> The water supply coverage in Villarrica City increased from 72% in 2012 to 98% in 2020, and 24 hour water supply was achieved in 2018.<sup>9</sup> Based on the above, it is judged that the improved water supply service expected in Villarrica was realized and the planned secondary effect of the Project was achieved. The executing agency constructed a new transmission pipeline (21.3 km) to and a distribution reservoir (1,500 m<sup>3</sup>) in Villarrica City in parallel with the Project. The above-mentioned secondary effect was in fact the effect of synergy between these works and the Project.

#### **(2) Improved WTP Operation and Maintenance Skills**

Technical assistance in the form of training (the Soft Component) was provided under the Project as part of the consulting services to enhance the operation and maintenance capacity at the new WTP. 16 persons underwent this training and all were assigned to the new WTP.

According to the executing agency, the contents, duration, method, etc. of this training were appropriate and the manuals and document formats used for the training have continued to be used up to the time of ex-post evaluation. The executing agency highly values the fact that the learning of various treatment methods (adjusted quantity of coagulant, etc.) in response to the quality of the raw water during the training has led to appropriate water treatment.

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<sup>8</sup> The actual number of households in Villarrica receiving piped water supply is larger than 10,200 because of bulk supply to housing estates. However, the exact number of such households is unclear.

<sup>9</sup> In the other two smaller cities, the water supply coverage ratio was 100% with 24 hour supply prior to the implementation of the Project.

### 3.3.2 Impacts

#### 3.3.2.1 Intended Impacts

The improved water supply service in Coronel Oviedo City due to the implementation of the Project was expected to contribute to an improved living environment for the residents. To find out the achievement situation of such impact, 20 household water users and five commercial water users in the city were interviewed as part of the ex-post evaluation.<sup>10</sup>

In regard to any changes of the water supply service after the Project, 40% and 30% of residents interviewed said that “much improved” and “improved” respectively. None of those interviewees said that “worsened”. In regard to any changes of the water supply hours, water pressure and water quality, more than 60% said either that “much improved” or “improved” for each of these aspects. Meanwhile, some residents pointed out sudden cutting-off of water supply and/or deterioration of the water quality, both of which were presumably the result of construction works of water supply facility. The degree of satisfaction with the current water supply service is high as two-thirds of the residents replied that they are very satisfied. Some reported that “there has been no long cutting-off of the water supply since three years ago” and “while the water supply volume was low with poor water quality in the past, there are currently no problems”.

Many residents reported that “there is no longer a need to use a well” or “the use of a well has declined”. Nearly half of the residents replied that the volume of water use has increased and some people purchased a washing machine. It was reported that the frequency of washing or taking a bath has increased and the COVID-19 pandemic was pointed out as a reason for this along with the improved water supply service. Most people obtain information on sanitation from television or the Internet. Some residents said that they consciously control their water consumption to keep the water bill low. Many residents welcome the facts that they can take a bath whenever they want or whenever necessary and that they can maintain good hygiene habits, both of which are the result of the around the clock supply of water. Half of the residents believe that the number of cases of diarrhea has fallen due to improved hygiene habits and improved water quality. On the other hand, there is a fixed concept wide-spread among the residents that “the water supplied by ESSAP is undrinkable” because of the frequent clouding of the water before the Project and many people still buy and use bottled water for drinking and cooking even after the completion of the Project.

Some residents pointed out that there had been frequent incidents of street flooding caused by leaking water and cutting off of the water supply as well as deterioration of the water quality because of the work to repair water leaks. Many requested that the ESSAP should promptly deal

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<sup>10</sup> The target persons to be interviewed were randomly selected from the ESSAP’s list of water users. As this ex-post evaluation study was restricted by the COVID-19 pandemic, these interviews were conducted by telephone by a local consultant. The 20 household water users consisted of 14 males and 6 females. 15 of them received water supply even before the Project and 5 were new users. The 5 business users included an everyday dishes and sweet shop, a supermarket and a general store. Efforts to interview a medical institution in Coronel Oviedo were unsuccessful as medical staff were too busy to respond due to the COVID-19 pandemic.

with leakage from the old distribution network. It was also pointed out that the sewerage system properly functioned in only certain areas of the city center.

In the case of the interviews with the commercial water users, three out of the five reported improvement of the water quality and four reported improvement of the water supply hours and water pressure. Four replied that they were very much satisfied with the current water supply service and the remaining one also described the service as being satisfactory. It was mentioned that accessibility to water supply had not only improved the hygiene situation at a store but also contributed to longer business hours. On the other hand, some critical comments were made that the level of the water charge for commercial use is too high and that it is unreasonable for a house to be included in the commercial category simply because a small store with little water usage is attached to the house.

Based on the above, it is verified that the expected impact of the Project to contribute to improvement of the living environment of residents of Coronel Oviedo City has been achieved.

### **3.3.2.2 Other Positive and Negative Impacts**

#### **(1) Impacts on Natural Environment**

At the time of planning, the Project was classified in Category B as any adverse impacts on the environment would not be severe in the light of the JICA Guidelines for Environmental and Social Considerations (published in April 2010). Following approval of the environmental impact assessment and environmental management plan, and promulgation of the Environmental Impact Declaration by the Ministry of Environment of Paraguay, the Project obtained an environmental license in August 2014. During the construction period and after commissioning of the new facilities, environmental monitoring was conducted in line with the environmental management plan. Alleviation measures were implemented in relation to soil, water, atmosphere, noise, vibration and landscape and the implementation situation of these measures has been regularly reported to the Ministry of Environment. The latest approval by the Ministry of Environment was obtained in January 2021. According to DAPSAN and ESSAP, no serious impacts on the environment have occurred in relation to the Project.

Although Coronel Oviedo City has a sewerage system with a sewage treatment plant using oxidation ponds, the number of sewer connections in 2020 was approximately 6,000 which was 60% of the number of water supply connections. In view of the fact that the water supply volume to Coronel Oviedo City substantially increased with the completion of the Project and a lack of the proper functioning of the sewerage system in some areas as pointed out by the residents, there is a possibility that the volume of untreated domestic wastewater from households has increased since the implementation of the Project.

## (2) Resettlement and Land Acquisition

As the project sites were premises of the existing WTP and land owned by the ESSAP, the acquisition of land for the Project was unnecessary. During the project period, the Project did not produce any notable negative impacts on the social environment.

To summarize the Project's effectiveness and impacts, the Project achieved its purpose of realizing a safe and stable water supply service in Coronel Oviedo City. The positive secondary effect on Villarrica City was also realized as planned. In Coronel Oviedo City where the water supply service has improved, the convenience of water use for daily life has increased. Even though there is a possibility that the volume of untreated domestic wastewater has increased, the expected impacts of the Project, such as an improved living environment and hygiene habits in the city, were duly realized. As the expected results of the Project were realized as planned, the effectiveness and impacts of the Project are high.

## **3.4 Sustainability (Rating: ③)**

### **3.4.1 Institutional/Organizational Aspects of Operation and Maintenance**

The operation and maintenance of the facilities constructed under the Project are conducted by ESSAP. To be more precise, Coronel Oviedo office of ESSAP conducts meter readings, collection of the water charge and operation and maintenance of the distribution reservoirs and distribution network in the city. The operation and maintenance of the new WTP, the existing WTP and the transmission lines are conducted by staff members of these WTPs as a separate body from the said local office of ESSAP. The head office of ESSAP is responsible for the control of the procurement of goods by the WTPs and its local offices and external subcontracting which is conducted as required. It also provides technical guidance and proposals to improve the water supply and sewerage services.

The new WTP and the existing WTP have 13 and 15 operators respectively. The total number of staff members is 35, including the manager of the WTPs, electrical and mechanical engineers, water quality testers and cleaners. This means the employment of an additional 12 persons from a manpower strength of 23 at the time of the preparatory study. Given the fact that both WTPs have been smoothly operating without any serious problems and have supplied the planned volumes of treated water in the last three years, there appear to be no institutional/organizational constraints relating to the operation and maintenance of the WTPs. According to ESSAP, its Coronel Oviedo office has sufficient manpower to perform its duties described above. As such, there are no problems with the institutional/organizational aspects of the operation and maintenance of the Project.



Table 4 Personnel Deployment at the Tebicuarymi WTP

Position	At the Time of Preparatory Study	At the Time of Ex-Post Evaluation	Remarks
Manager	1	1	Manages both the new and existing WTPs
Operators	12	28	New WTP: 13 Existing WTP: 15
Electrical and mechanical engineers	2	2	One each for the new WTP and existing WTP
Water quality testers	2	2	Working for both the new WTP and existing WTP
Storage workers	4	0	Storage is directly managed by the manager
Cleaners	2	2	One each for the new WTP and existing WTP
Total	23	35	

Source: Materials provided by the ESSAP

### 3.4.2 Technical Aspects of Operation and Maintenance

According to the report of defect inspection in November 2018, daily operation and maintenance at the new WTP was conducted in accordance with the manuals and did not pose any problems as it fully reflected the outcomes of the technical training conducted by the consultant as the Soft Component of the Project. All the completion drawings, list of equipment and operation and maintenance manuals were properly stored and used when needed.

The site visit as part of the ex-post evaluation confirmed similar situations. All the staff members who underwent training (the Soft Component) are still working at the new WTP. No special technical problems have been reported regarding the operation and maintenance of the new WTP. The new and existing WTPs use rapid filtration systems as in the case of many other WTPs run by ESSAP and no particularly advanced technologies are required for the operation and maintenance of these WTPs. As described in “3.3.1 Effectiveness”, the operating rate of the new WTP has been high and appropriate treatment is conducted in response to the varying quality of the raw water. Therefore, no special technical issues are found regarding the operation and maintenance of the Project.

It should be noted that ESSAP head office is conducting the training of the staff members of WTPs mainly on the safety management of WTPs, i.e. handling of chlorine gas and fire extinguishing equipment.

### 3.4.3 Financial Aspects of Operation and Maintenance

Table 5 shows the revenue and expenditure of ESSAP for FY 2017 through FY 2019. During this period, the revenue mostly consisting of the collected water charge exceeded the expenditure, producing an average annual operating profit of 60,000 million G. (approximately 1 billion yen).

The operating profit ratio was between 5% and 20% (average: 14%), showing a sufficient level of profitability. The debt ratio of 105% to 119% indicates a sound financial condition in general. The current ratio improved from 95% in FY 2017 to 119% in FY 2019, indicating increasing financial stability. During the site visit, no special financial constraints were reported in relation to the operation and maintenance of the Project. Therefore, there are no problems regarding the financial aspects of the operation and maintenance of the Project.

Table 5 Financial Results of ESSAP

(Unit: Million Guarani)

	2019	2018	2017
Revenue	525,956	396,752	387,979
Public sector sales	75,226	51,723	43,803
Private sector sales	428,078	330,832	296,677
Other revenue	22,651	14,197	47,499
Expenditure	359,439	310,219	276,756
Operating cost	219,795	200,414	176,528
Sales cost	14,837	9,974	9,659
Administration cost	124,807	99,831	90,570
Profit before interest payment and tax exemption	166,517	86,533	111,223
Financial expenses	66,096	46,546	38,268
Provisions	13,051	10,287	-7,940
Depreciation cost	5,142	8,282	4,664
Operating profit	82,228	21,418	76,231
Other adjustments	-1,958	-164	-603
Income tax	11,229	3,587	8,862
Net profit	72,957	17,996	67,972
Operating profit ratio (operating profit ÷ revenue)	16%	5%	20%
Debt ratio (debt ÷ capital)	105%	119%	111%
Current ratio (current assets ÷ current debt)	119%	96%	95%

Source: Materials provided by ESSAP

#### 3.4.4 Status of Operation and Maintenance

The average annual operating hours of the new and existing WTPs for 2019 - 2020 were 8,604 hours with an operating rate of as high as 98.2%. As described in “3.3.1 Effectiveness”, stoppages of these WTPs were mainly caused by power outages.

At the WTPs, electrical and mechanical engineers check the pumps, control panel and chemical injection system every day. Operators conduct the back washing of the filtration tank every 48 hours or more frequently if required. The settling basin of the intake, coagulation basin, sedimentation basin and filtration basin of the WTPs are cleaned once a month.

Up to the time of the ex-post evaluation, no facilities or equipment at the new WTP have experienced any major problems. With the highly deteriorated existing WTP, renewal of the transmission pumps, replacement of the filtering materials and replacement of the porous blocks

(baseplates supporting the filtering materials) as well as wooden gates of the sedimentation basin has been conducted in stages. However, staff members of the existing WTP believe that full-scale rehabilitation is necessary in view of the substantial cost and labor involved in operation and maintenance and occasional exceeding of the post-treatment turbidity above the relevant standard.

According to the officials of Coronel Oviedo City, there have been frequent leakage incidents in the city from water pipes deteriorated due to road paving work by MOPC. Insufficient checking of the state of water pipes when planning paving work is the background for such damage and a need for inter-organizational coordination can be pointed out.

Based on the above, no major problems have been observed regarding the institutional/organizational, technical and financial aspects and current status of the operation and maintenance system. Therefore, the sustainability of the emerged effects of the Project is high.

## **4. Conclusion, Lessons Learned and Recommendations**

### **4.1 Conclusion**

The Project was implemented for the purpose of ensuring stable supply of safe water for Coronel Oviedo City by means of constructing such water supply facilities as a WTP, transmission pipeline, etc., thereby contributing to improvement of the living environment for residents. The Project is highly consistent with the national development policies, plans and needs of Paraguay at the time of both planning and ex-post evaluation. As it is highly consistent also with Japan's ODA policies at the time of planning, the relevance of the Project is high. Although the outputs of the Project were generally as planned with the project cost being within the plan, the project period exceeded the plan, making the efficiency of the Project fair. Through the implementation of the Project, a stable and safe water supply has been achieved in Coronel Oviedo City and the convenience of water use in daily life has improved. The secondary effect in Villarrica City was achieved as planned. While there is a possibility of an increase of the discharge volume of untreated domestic wastewater from households in the post-project period, such expected impacts as improvement of the living environment and improvement of hygiene in the city have been realized. As such, the effectiveness and impacts of the Project are high. As the institutional/organizational, technical and financial aspects of the operation and maintenance of the Project pose no problems, the sustainability of the project effects is high.

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

## **4.2 Recommendations**

### **4.2.1 Recommendations to the Executing Agency**

- It is desirable for ESSAP together with ERSSAN to conduct awareness raising activities designed to inform the residents that the quality of supplied water in Coronel Oviedo City is suitable for drinking with a view to facilitating the use of the city's water supply service.
- It is necessary for ESSAP together with ERSSAN and the municipal government of Coronel Oviedo City to consult with the water and sanitation cooperatives in the city to eliminate illegal connection to the distribution network of ESSAP by some cooperatives. At the same time, it is desirable to facilitate the lawful use of water supplied by ESSAP by the water and sanitation cooperatives.
- It is desirable for DAPSAN and ESSAP to implement the water distribution network improvement plan in Coronel Oviedo City as soon as possible.
- It is essential for ESSAP to sufficiently coordinate with the Directorate of Roads of MOPC so that road repair work by the said directorate can avoid damaging the water distribution network.
- It is necessary for DAPSAN and ESSAP to evaluate the current situation of the sewerage service in Coronel Oviedo City and to plan and implement an investment scheme necessary to contain the discharge of untreated sewage into the environment.

### **4.2.2 Recommendations to JICA**

JICA should encourage the DAPSAN and ESSAP to implement the recommendations listed above and monitor their implementation situation.

## **4.3 Lessons Learned**

### Meeting the preconditions to realize expected impacts of a project in the water supply and sewerage sector

The construction of the WTP and the transmission pipeline under the Project has substantially increased the volume of water supply to Coronel Oviedo City and the water quality has also improved. Following such improvement, the number of connections has increased with 24 hour water supply of safe drinking water. However, many residents have maintained their pre-Project habit of using purchased bottled water for drinking and cooking. DAPSAN/ESSAP have prepared a distribution network improvement plan for Coronel Oviedo City as its necessity was pointed out at the timing of the planning of the Project, but it has not yet been implemented. There are many water and sanitation cooperatives in the city which use wells as water sources and some of them still have illegal connections to the water supply system of ESSAP, indicating the

existence of the inappropriate use of the ESSAP's water supply by some cooperatives. Meanwhile, the Project is appraised as having positively contributed to improvement of the living environment of residents. In the meantime, there is concern regarding the slow development of the sewerage system and an increase in the discharge of untreated domestic wastewater which could possibly lead to environmental contamination.

In the light of the above, it is desirable to analyze the conditions to achieve the expected impacts in the case of a project to improve a part of water supply and sewerage systems so that the necessary conditions are internalized by means of including such works in the scope of the project as much as possible. When some important conditions are left as external conditions, it is desirable to prepare concrete recommendations or a plan to achieve such conditions, while considering the possibility of collaboration with other organizations if necessary, and to monitor the implementation of such recommendations or plan by both the executing agency and JICA. In this context, it is desirable to broadly analyze the relevant conditions relating not only to the water and sewerage infrastructure but also to the operating and maintenance bodies of these services, their users and other stakeholders.

**END**