

Republic of Peru

FY2018 Ex-post Evaluation of Japanese ODA Loan  
“Iquitos Sewerage Improvement and Expansion Project”

External Evaluator: Nobuyuki Kobayashi, OPMAC Corporation

## **0. Summary**

The objective of this project is to treat sewage properly and to widen the coverage of sewerage service in Iquitos in the Department of Loreto, one of the major cities in the Amazon region, by improving and expanding the sewerage system, thereby contributing to improved sanitary conditions and living environment in the area. This project was highly relevant to the country's development plan and development needs, as well as to Japan's ODA policy. Regarding the project plan and the approach, however, it can be concluded that an assessment should have been made at the time of the appraisal whether the sewage collection method and the sewage treatment method of this project would function adequately considering local circumstances. Therefore, its relevance is fair. Considering the changes in outputs in this project, the cost of this project exceeded the plan. In addition, the project period significantly exceeded the plan. Therefore, efficiency of the project is low. Regarding the indicators for the outcome of this project (the proper treatment of sewage in Iquitos and the expansion of sewerage coverage), out of the seven indicators set at the ex-ante evaluation, five have not been achieved. The sewage treatment plant has stopped its operation since July 2016. Regarding the impacts of this project improvements in hygiene conditions and living environment of the residents in Iquitos, no impacts has been verified as the contribution of this project. This project achieved its objectives at a limited level and, thus, the effectiveness and impacts of the project are low. Regarding the operation and maintenance, major problems have been observed in terms of the institutional/organizational aspect, the technical aspect, the financial aspect and the current status. Therefore, the sustainability of the project effects is low. At the time of the ex-post evaluation, operation and maintenance based on the public-private partnership are progressing, but it is expected to take a certain amount of time until the contractor starts operating the sewerage facilities.

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

## 1. Project Description



Project Location



Sewage Treatment Plant Built by this Project

### 1.1 Background

The sewerage connection rate in Peru was 57% in 2005, and 12.21 million of the population in the country did not use a sewerage service. The sewerage connection rate in Peru was even lower compared to that of 77% for the whole Latin American region. Provinces, districts, or water supply and sewerage public corporations owned by local governments invested in water supply and sewerage services in Peruvian local cities. However, the development of sewage treatment facilities was insufficient because the investment was based in principle on an independent accounting system.

Iquitos, where the project was implemented, is the capital of the Department of Loreto located in the Amazon region of Peru and is a major city in the region. Before the implementation of the project, the sewer network in Iquitos did not have sufficient capacity, and there were difficulties coping with the increase in drainage volume in the rainy season. In addition, no sewage treatment facility had been constructed in Iquitos and, therefore, the sewage flowed into the tributaries of the Amazon River without treatment. As a result, hygiene problems occurred. On the other hand, the improvement of the water supply was progressing in Iquitos. Since an increase of water consumption was expected in the future, the development of the sewerage system was urgently needed.

With this background, in order to cope with the problems of the sewerage system in Iquitos, the Japanese ODA loan financed this project in FY 2008 for the construction of a sewage treatment facility and expansion of sewer network.

### 1.2 Project Outline

The objective of this project is to treat sewage properly and to widen the coverage of sewerage service in Iquitos in the Department of Loreto, one of the major cities in the Amazon region, by

improving and expanding the sewerage system, thereby contributing to improved sanitary conditions and living environment in the area.

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| Loan Approved Amount/<br>Disbursed Amount              | 6,660 million yen / 6,660 million yen   |
| Exchange of Notes Date/<br>Loan Agreement Signing Date | November 2008 / December 2008   |
| Terms and Conditions                                   | Interest Rate      0.01%<br>Repayment Period      15 years<br>(Grace Period      5 years)<br>Conditions for Procurement      General Untied<br>(Consulting Service: General Untied) |
| Borrower/<br>Executing Agency                          | Republic of Peru/Organismo Publico Infraestructura Para La Productividad (OPIPP)  |
| Project Completion                                     | October 2013  |
| Target Area  | Iquitos, Department of Loreto   |
| Main Contractor<br>(Over 1 billion yen)                | China International Water and Electric Corporation (People's Republic of China)   |
| Main Consultant<br>(Over 100 million yen)              | NJS Consultants (former Nippon Jogesuido Sekkei).   |
| Related Studies (Feasibility Studies, etc.)            | JICA (2007) "Special Assistance for Project Formation (SAPROF) for Provincial Cities Water and Sewerage System Improvement and Expansion Project (Iquitos City)"                    |
| Related Projects                                       | Italian government's fund (Fondo Italo Peruano) "Sewer Network Construction" Project  |

## 2. Outline of the Evaluation Study

### 2.1 External Evaluator

Nobuyuki Kobayashi, OPMAC Corporation

### 2.2 Duration of Evaluation Study

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

Duration of the Study: June 2018 – November 2019

Duration of the Field Study: August 15 – August 31, 2018, May 4 – May 15, 2019

### 2.3 Constraints during the Evaluation Study

Project completion was defined as the time of the take-over of the facilities constructed by the project. At that time, however, the executing agency pointed out defects in the constructed facilities. In addition, the water supply and sewerage public corporation in the Department of

Loreto (SEDALORETO), which was responsible for operation and maintenance, did not agree to take over the facilities constructed by the project. Therefore, it could not be determined that the project had been completed. Nevertheless, efficiency was tentatively judged based on the completion date of the takeover certificate issued by the construction supervision consultant, which resulted in the shorter project period. For effectiveness, the judgment was tentatively made by using the 2015 data, in which the project effects were most pronounced after the completion date of the above-mentioned take-over certificate.

This project did not retain documents concerning assessments at the time of the appraisal, the conditions for calculating the economic internal rate of return (EIRR), or the methods to set the operation and effect indicators. Thus, it was impossible to collect relevant information on the above topics. Regarding the impact on the natural environment of this project, the obtained information was limited due to personnel changes caused by the administration changes of the Loreto Department and the short operational period of the sewerage facility.

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

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

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

At the time of the ex-ante evaluation, the *National Sanitation Plan 2006-2015* formulated by the Ministry of Housing, Construction, and Sanitation (MVCS) planned to increase the nationwide sewerage connection rate from 57% (68% for urban areas) in 2005 to 77% (84% for urban areas) in 2015. It was also planned that the sewage treatment rate in urban areas would be increased from 22% in 2005 to 100% in 2015. The water supply and sewerage public corporations needed to be independently profitable, and capital investment had been difficult in small and medium cities. Therefore, the Garcia administration, which was established in 2006, had a poverty reduction policy that focused on the water sector, and the central government supported capital investment in the sector under the “Agua para Todos (Water for All)” program.

At the time of the ex-post evaluation, The *Bicentenary Plan Peru to 2021* (2011) formulated by the National Strategic Planning Center (CEPLAN) is the long-term development plan. Its Specific Objective 3 “To develop integral and efficient management of water and water resources throughout Peru” includes the goal of increasing the sewage treatment rate to 100% in 2021. According to the *National Sanitation Policy 2017-2021* formulated by MVCS, the nationwide sewerage connection rate would be increased from 73.7% (88.3% for urban areas) in 2016 to 93.9% (100% for urban areas) by 2021. A sewage treatment rate of 68% in 2016 will also reach 100% in 2021. At the time of the ex-post evaluation, Technical Organization for the

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

<sup>2</sup> ③: High, ②: Fair, ①: Low

Administration of Water Supply and Sanitation Services (OTASS) under MVCS is supporting local water and sewerage public corporations which can not be independently profitable and is investing in the reconstruction of local water and sewerage public corporations.

At the time of both the ex-ante and the ex-post evaluations, the central government continues to increase the sewerage connection rate and the sewage treatment rate. In addition, the central government's policy to support capital investment in water supply and sewerage public companies in local cities remains unchanged. As this project aims to increase the coverage of the sewerage service and the amount of sewage treatment through the development of sewer networks and the sewage treatment facility in Iquitos, Department of Loreto, this project is consistent with Peru's development policy.

### 3.1.2 Consistency with the Development Needs of Peru

At the time of the ex-ante evaluation, the population of Iquitos in the Department of Loreto was estimated to be approximately 390,000 (2007), and 40% of Loreto's population was concentrated in Iquitos.<sup>3</sup> As of 2007, Iquitos had a sewerage connection rate of 65.1% but there was no sewage treatment facility, and sewage flowed into the tributaries of the Amazon River without treatment. In addition, the Japanese ODA loan project “Provincial Cities Water Supply and Sewerage Improvement and Expansion Project (Iquitos, Cusco, and Sicuani)” was supporting the development of the water supply in Iquitos at the time of the ex-ante evaluation. As water consumption in Iquitos was expected to increase, the development of the sewerage system was an urgent issue.

At the time of the ex-post evaluation, the population of Iquitos was estimated to be approximately 480,000 in 2017, and almost 50% of the population of the Department of Loreto was concentrated there in 2017.<sup>4</sup> The water supplied population in Iquitos reached 370,000 in 2018, increasing by 89,000 from 2013 to 2018.<sup>5</sup> Similarly, the water supply amounted to 31.6 million m<sup>3</sup> in 2017, increasing by 3.0 million m<sup>3</sup> from 2012 to 2017. As of 2017, the sewerage connection rate in Iquitos was 46%. While population growth continued, connection to the sewerage service was sluggish, and the sewerage connection rate declined. At the time of the ex-post evaluation, interviews with local residents revealed that households not connected to the sewerage system were pouring sewage into ditches and rivers without treatment.

Between the times of the ex-ante evaluation and the ex-post evaluation, the population of Iquitos increased, from 390,000 in 2007 to 480,000 in 2017. The water supplied population and the amount of the water supply also increased. Thus, it is concluded that the necessity for

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<sup>3</sup> INEI “Estimaciones y Proyecciones de Poblacion Total por Sexo de las Principales Ciudades, 2000-2015”

<sup>4</sup> Based on population estimate data of INEI in 2017

<sup>5</sup> Data in JICA (2007) SAPROF suggests that the water supplied population was estimated at approximately 230,000 in 2002.

sewage treatment also increased. Due to the population growth and the stagnant growth of the sewerage connection, the sewage connection rate fell, and sewage was being released without being treated. Therefore, there is the necessity to solve sanitation problems by sewage treatment at the time of both the ex-ante and the ex-post evaluations. Since this project aims to expand the sewerage system and introduce proper sewage treatment in Iquitos, it is highly consistent with development needs.

### 3.1.3 Consistency with Japan's ODA Policy

At the time of the ex-post evaluation, the *Country Assistance Program for Peru* (2000) by the Ministry of Foreign Affairs stated that it would promote the development of the water supply and sewage service as a response to a basic human need, and that it would provide support for projects contributing to the improvement of the living environment of poor people. In addition, the program focused on environmental protection and had the policy of supporting countermeasures for global environmental issues including water pollution control. In March 2008, the leaders of Japan and Peru signed a joint statement on further cooperation on environment and climate change issues and promoted an approach focusing on adaptation measures in sectors such as water and sanitation.<sup>6</sup> This project aims at the improvement of the sanitation conditions and living environment of residents by promoting proper sewage treatment and expansion of the sewerage service through the improvement of sewerage facilities. Therefore, the project is considered consistent with the development for basic human needs, with water pollution control, and with greater support for the water and sanitation sectors, which were emphasized in the country assistance program and the joint statement.

### 3.1.4 Appropriateness of the Project Plan and Approach

As the sewage treatment method for this project, the screen and direct discharge method, which minimized necessary expenses (project costs and O&M costs), was proposed first.<sup>7</sup> However, this first proposal had the following problems: (1) the robustness of the discharge pipe was not assessed enough, (2) there was no evaluation of the environmental impact on the discharge destination, and (3) the contribution to water quality improvement was small. Therefore, the facultative pond method, which was the second lowest in cost and carried out the biological treatment, was adopted at the time of the appraisal. However, the removal of surface soil lowered the ground level than anticipated as the geological examination found that the ground was softer than the assumption. As a result, this required the impervious wall surrounding the sewage treatment facility to be higher, from 4.7m to 7m. In order to reduce an

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<sup>6</sup> Ministry of Foreign Affairs "Japan's Official Development Assistance Country Databook 2008"

<sup>7</sup> JICA (2007) SAPROF

increase in project costs, measures were taken to reduce the land area and shorten the length of the impervious wall. As a result, the final method used was a combination of Upflow Anaerobic Sludge Blanket (UASB)<sup>8</sup> and sprinkling filter, which required the second smallest area after the initial plan (screen and direct discharge). For sewage treatment using trickling filter method solely, the area for the sewage treatment plant would be large. In the final plan, UASB, which requires less land area, conducts the primary treatment, and a trickling filter is used for the secondary treatment after reducing the concentration of organic matter. However, UASB is a method suitable for processing sewage with a high Biochemical Oxygen Demand (BOD).<sup>9</sup> While the BOD of influent sewage was assumed to be 286 mg/litre in the appraisal, the UASB method had a few cases for processing that of low BOD (especially below 300 mg/litre). Therefore, in the case of sewage treatment with low BOD, it was necessary that the cost-benefit be determined by comparison with other treatment methods after an appropriate assessment.

This project selected a separate sewage system, which collects wastewater and rainwater by using different pipes, as the sewage collection method. The sewer network to be installed by this project would be used for wastewater, while the existing sewer pipe would be used for rainwater. In the combined system, where wastewater and rainwater are collected by the same sewer pipe, the amount of water increases significantly in the rainy season. If sewage is overflowed, sewage might affect residential areas and cause damages on residents. Thus, it is necessary to increase the pipe diameter. The separate system was therefore presumed to be advantageous over the use of the combined system in the project area from the point of view of investment cost. However, as described later (“3.3.1.1 Quantitative Effects (Operation and Effect Indicators)”), the BOD of the inflowing sewage during the operation period was much lower than expected.

One of the reasons for the lower BOD of influent sewage than planned lies in the difficulty in separating rainwater and wastewater in the project area. Issues related to planning and approach are also pointed out as well as those in the quality of construction. According to the data for 2015, a year which the sewage treatment plant was in operation, the inflow to the sewage treatment plant (69,768 m<sup>3</sup>/day) during the rainy season (April to May) was significantly higher than the inflow (17,305 m<sup>3</sup>/day) at other times (January-March, June-December). Also, typical houses in Iquitos are not designed to separate rainwater and sewage. Therefore, the project decided to separate these using connection basins. However, the following issues became evident: 1) as Iquitos had a large amount of rainfall, the basins became full and the two types of water could not be separated, and 2) although frequent cleaning of the connection basins was required, residents did not clean them. In addition, the

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<sup>8</sup> A type of sewage treatment method using anaerobic bacteria

<sup>9</sup> BOD is an indicator of water pollution. The higher BOD is, the worse the water quality is.

feasibility of the connection basins had not been assessed at the appraisal phase, and the construction of the connection basins was based on the feasibility assessment of the basins by the Peruvian government at the time of detailed design. Moreover, the project area included areas where there were no existing sewer pipes, mainly in the San Juan Bautista District, and it was not assumed to separate rainwater and wastewater in these areas. The period of low BOD lasted for a long time. At the time of the ex-post evaluation, MVCS assesses a low-cost treatment method without biological treatment such as the combination of the first sedimentation tank and the chlorine contact tank.

As explained above, it is considered that there was a problem with both the project plan and approach.

It can be concluded that it was necessary to assess whether the sewage collection method and the sewage treatment method of the project would function adequately in consideration of local circumstances at the time of the appraisal. In the implementation of this project, the project plan and approach had some issues. Therefore, its relevance is fair.

### 3.2 Efficiency (Rating: ①)

#### 3.2.1 Project Outputs

This project was to develop a sewerage system in Iquitos, Department of Loreto. The comparison between the planned and the actual outputs is shown in the following table.

Table 1: The Outputs of this Project (Plan and Actual)

| Plan   | Actual   |
|--|--|
| 1) Sewage Treatment Plant: Capacity 0.73 m <sup>3</sup> /s (approximately 63,000 m <sup>3</sup> /day)  | 1) Sewage Treatment Plant: Capacity 0.88 m <sup>3</sup> /s (approximately 76,000 m <sup>3</sup> /day)  |
| 2) Construction of Pumping station: 19 stations  | 2) Construction of Pumping station: 18 stations  |
| 3) Expansion of Sewer Network: Force Main 18.6 km, Discharge Pipe 1.4 km, Principal Collector Line 26 km, Diversion Works, Secondary Network 273.4 km, Connection of 38,599 Households | 3) Expansion of Sewer Network: Force Main 19.11 km, Discharge Pipe 1.4 km, Principal Collector Line 48.26 km, Diversion Works, Secondary Network 349.5 km, Connection of 41,149 Households |
| 4) Consulting Service: Detailed Design, Tender Assistance, Construction Supervision, Capacity Development in Operation & Maintenance, Public Awareness Campaign                        | 4) Consulting Service: Same as the left  |

Source: Documents provided by OPIPP, questionnaire answers from OPIPP





Sludge Blanket of UASB



Trickling Filter



Pumping Station



Inside of Pumping Station

Regarding the differences between the plan and the actual, the expansion of sewage treatment capacity, the length of sewer pipes such as principal collector lines, and an increase in the number of houses connected were seen due to an increase in the beneficiary population at the time of the detailed design. In addition, there was a decrease in the number of pumping stations (19 stations to 18 stations) resulting from a review of sewage pipe routes at the time of detailed design.

Due to these changes, in the outputs of this project, there were defects in sewer pipes, connection basins, and road pavements. In addition, commissioning was not completed for some equipment of the sewage treatment facility. The defects in the sewer pipes and connection basins were a factor behind the inflow of sewage falling below the expected level, and at the time of the ex-post evaluation, they caused trapped water and the backflow of sewage (see “3.4.4 Status of Operation and Maintenance”). Operation of the sludge treatment machine and the SCADA system has not been confirmed at the sewage treatment facility. Moreover, it was not possible to construct the sewer network as planned as defects in the road pavement caused resident protests (see “3.3.2.2 Other Positive and Negative Impacts (3) Effects on Road Transportation).

Moreover, the Ministry of Foreign Affairs of Japan and JICA implemented restrictive measures<sup>10</sup> on the contractor of the project due to "reckless works due to negligence", and on the construction supervision consultant for "false statements", "reckless works due to negligence", and "unjust or dishonest behaviour".

### 3.2.2 Project Inputs

#### 3.2.2.1 Project Cost

The actual amount of the project cost was 21,382 million yen, while the planned amount was 16,105 million yen. The planned amount of the project cost rose to 16,742 million yen after the adjustment (an increase of 637 million yen) due to the increase of output (expansion in the treatment capacity of the sewage treatment plant, extension of the sewer network). In comparison with the planned amount (adjusted) of the project cost, the actual amount was 128% of the planned cost (adjusted) and exceeded the plan. According to the construction supervision consultant, the actual amount of the project cost exceeded the planned amount because an expansion of the sewer network was required to detour underground utilities and thus countermeasure construction was needed for the drainage and sealing of groundwater.

#### 3.2.2.2 Project Period

As mentioned in “2.3 Constraints during the Evaluation Study”, there were disputes at the take-over of the facilities of this project, and completion of the project could not be determined. For this reason, the efficiency was tentatively judged. The planned project period at the appraisal was 37 months (December 2008 to December 2011) while the actual project period was 59 months (December 2008 to October 2013) (see the following table). The actual project period was 159% of the plan and thus was significantly longer than planned. The project period had been almost as planned until the commencement of the civil work, but the extension of the construction period led to the delay of the project. Besides the above-mentioned detour of underground utilities and countermeasure construction for groundwater, other reasons for the delay in the construction were residents’ protests against the civil engineering work, weather conditions, etc.

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<sup>10</sup> The measures did not allow the contractor and the consultant to participate in ODA projects or to be counterparts for the contracts with JICA.

Table 2: Breakdown of the Project Period (Plan and Actual)

|                                     | Plan                       | Actual                       |
|-------------------------------------|----------------------------|------------------------------|
| Commencement of Project             | December 2008              | December 2008                |
| Tender for Consultant               | December 2008 – April 2009 | November 2008 – January 2009 |
| Consulting service                  | May 2009 – February 2012   | January 2009 – March 2015    |
| Tender for Civil Work               | January 2010 – June 2010   | November 2009 – June 2010    |
| Civil Work                          | July 2010 – December 2011  | July 2010 – October 2013     |
| Project Completion (Project Period) | December 2011 (37 months)  | October 2013 (59 months)     |

Source: Documents provided by OPIPP and JICA, questionnaire answers from OPIPP

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

The EIRR was -0.3% in comparison with the planned rate of 11.34% (see the table below for conditions of calculation). The reason for the EIRR being below that forecast is that sewage treatment facilities were not operating, and benefits did not reach the expected levels. The project had a public nature, and the increase in sewerage fees associated with the project was limited and the profitability was low. For these reasons, the financial internal rate of return (FIRR) was not calculated at the time of the ex-ante evaluation.

Table 3: Conditions for Calculation of EIRR

| Item         | Conditions for calculation   |
|--------------|--|
| Costs        | Project cost (excluding tax), O&M cost   |
| Benefits     | Increase in income based on willingness to pay for sewage treatment, decrease in medical expenses brought by reduction of waterborne infectious diseases, incremental gain of tourism income   |
| Project Life | 20 years   |
| Assumptions  | <ul style="list-style-type: none"> <li>For the project cost, the actual amount was used. The ratio of O&amp;M cost over the project cost (1.33%) based on JICA (2007) SAPROF was used because the assumptions for calculation of EIRR at the time of ex-ante evaluation were not available.</li> <li>As for benefits as a whole, there were no assumptions for calculation at the ex-ante evaluation, and the unit of each benefit was not available. Therefore, a unit of benefit per 1 m<sup>3</sup> of treated sewage was estimated, achieving EIRR (11.34%) with the assumptions of the project cost and the sewage treatment amount at the time of the ex-ante evaluation. On the amount of treated sewage, the actual amount was used until the ex-post evaluation. For the forecasted amount in the future, it is assumed that resumption of sewage treatment by a public-private partnership (PPP) will commence from 2023. The demand projection was based on the forecast by JICA expert.<sup>11</sup></li> <li>The costs and the benefits denominated in foreign currency were converted into those based on the price at the ex-post evaluation (2017) with the GDP deflator in Japan. The costs and the benefits denominated in local currency were based on the GDP deflator in Peru.</li> <li>The conversion factor from financial price to economic price was assumed to be 0.9 times, based on the EIRR calculation condition of JICA (2007) SAPROF.</li> </ul> |

Both the project cost and project period significantly exceeded the plan. Therefore, efficiency of the project is low.

<sup>11</sup> JICA dispatched the expert from December 2017 to July 2018 for the cooperation for strengthening SEDALORETO in sewerage system management and financial capacity.

### 3.3 Effectiveness and Impacts<sup>12</sup> (Rating: ①)

#### 3.3.1 Effectiveness

##### 3.3.1.1 Quantitative Effects (Operation and Effect Indicators)

According to the construction supervision consultant, the sewage treatment plant operated 24 hours a day from April 2014 to October 2015, 8 hours from November 2015 to June 2016, and suspended after July 2016. As mentioned in “2.3 Constraints during the Evaluation Study”, there were disputes over the take-over of the facilities of this project. Although the completion of the project could not be determined, effectiveness was tentatively evaluated using the data for 2015, when the project effect was most evident.

The proper treatment of sewage in Iquitos and the expansion of sewerage coverage were regarded as the outcomes of the project. For the above outcomes, effectiveness was evaluated with an emphasis on the indicators set at the time of ex-ante evaluation. Specifically, the proper treatment of sewage was evaluated with the indicators on the operational status of the sewage treatment plant, and the expansion of sewerage coverage was evaluated with the percentage of the connected population and the percentage of served population.

#### (1) Proper Treatment of Sewage

In two years after the project completion, the actual of the population of whom sewage was treated (2015) was 33% of the target of the ex-ante evaluation (2013). The actual amount of the treated sewage (2015) was 46% of the target of the ex-ante evaluation (2013). The served population and the treated amount were both lower than the targets of the ex-ante evaluation due to the lack of wastewater inflow. This problem was caused by factors such as defects in the sewer network, lack of connection and defects in connection basins,<sup>13</sup> and non-operation of the “Sewer Network Construction” Project, which was a sewer network project of the Italian government Fondo Italo Peruano. As a result of insufficient inflow of wastewater into the sewage treatment plant, the actual rate of facility utilization (2015) was 34%. The rate of facility utilization should desirably have been above 40% at the commencement of operation<sup>14</sup>, but the actual rate of facility utilization (2015) did not reach the target (89.54%). The sewage treatment plant stopped operation after July 2016 and sewage treatment was not conducted at the time of ex-post evaluation.

Accurate comparison between the actual and the target could not be made as the concertation of BOD and that of Suspended Solid (SS)<sup>15</sup> were lower than originally expected. This was due to other factors such as rainwater and groundwater being mixed with the

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<sup>12</sup> Sub-rating for Effectiveness is to be put with consideration of Impacts.

<sup>13</sup> Based on the survey by the construction supervision consultant (2015), of the 41,294 connection basins, it was found that more than 30% had defects in construction, 70% were not used, and 30% were not connected.

<sup>14</sup> JICA (2019) “JICA Indicator Reference in Financial Assistance Projects ”

<sup>15</sup> SS is an indicator of water pollution. The higher SS is, the worse the water quality is.

sewage flowing into the sewage treatment plant. It was difficult to judge the achievement level of water quality improvement. The actual of BOD at two years after the project completion (2015) was 46.7 mg/liter against the target of 30 mg/liter (2013). However, the monthly average of BOD in inflowing sewage in 2015 was 129.4 mg/liter, which was lower than the assumption made at the time of the ex-ante evaluation (286 mg/liter). It was difficult to assess the achievement of the indicator as factors other than this project affected this indicator significantly. In addition, the actual of SS concentration at two years after the project completion (2015) was 17.1 mg/liter against the target of 30 mg/liter (2013). The SS concentration of inflowing sewage in 2015 (average of January-September) was 85.0 mg/liter, which was lower than the assumption (480 mg/liter) made at the time of the ex-ante evaluation. For this reason, it was difficult to judge the achievement of the indicator.

Table 4: Indicators for Treatment of Sewage

|  | Baseline | Target                   | Actual          |                         |                                    |
|--|----------|--------------------------|-----------------|-------------------------|------------------------------------|
|  | 2007     | 2013                     | 2013            | 2014                    | 2015                               |
|  |          | 2 Years After Completion | Completion Year | 1 Year After Completion | 2 Years After Completion           |
| Population of whom sewage treated (persons)*   | 0        | 347,113                  | —               | —                       | 113,568<br>(Target was unachieved) |
| Amount of Treated Sewage (m <sup>3</sup> /day) | 0        | 56,581                   | —               | —                       | 25,824<br>(Target was unachieved)  |
| Rate of Facility Utilization (%)               | 0        | 89.54                    | —               | —                       | 33.96<br>(Target was unachieved)   |
| Concentration of BOD (mg/litre, outlet)**      | —        | 30                       | —               | —                       | 46.7<br>(Difficult to judge)       |
| Concentration of SS (mg/litre, outlet)**       | —        | 30                       | —               | —                       | 17.1<br>(Difficult to judge)       |

Source: Documents provided by JICA, SEDALORETO, etc.

Note 1: \* Population of whom sewage was treated (persons) was calculated without April-May data, the months when rainwater and groundwater were mixed in sewage.

Note 2: \*\* The actual data of BOD and SS were for January to September 2015.

Table 5: Monthly Amount of Sewage Treated (2015)

| Unit: m <sup>3</sup> /day |          |           |         |          |          |
|---------------------------|----------|-----------|---------|----------|----------|
| January                   | February | March     | April   | May      | June     |
| 16,502                    | 16,330   | 28,512    | 71,712  | 67,824   | 37,930   |
| July                      | August   | September | October | November | December |
| 16,589                    | 13,910   | 15,120    | 15,984  | 4,925    | 4,550    |

Source: documents provided by JICA, etc.

Note: The monthly amount of sewage treated was calculated by using the amount of the inflow to the sewage treatment plant and operation hours.

## (2) Coverage of Sewage Service

In a comparison of before and after the project, as of two years after the project completion, it was seen that the percentage of the connected population had dropped. While the target of the ex-ante evaluation (2013) expected an increase by 12.4% from the baseline at the time of

ex-post evaluation, it was assumed that the population of the project area would be 480,000 in four years after the project completion (2015).<sup>16</sup> The population of Iquitos actually reached approximately 480,000 after 4 years (2017) of the project completion.<sup>17</sup> While population growth continued in Iquitos as expected, the operation of the sewerage system had problems and ,therefore, the increase of connection expected at the ex-ante evaluation did not occur. At the time of the ex-ante evaluation, it was planned that sewage treatment would be used by the whole target population (377,062).<sup>18</sup> The comparison of the above mentioned population (2015: 113,568 people) and the aforementioned target population showed that the percentage of served population for the target year, two years after the project completion (2015), was 30%.

Table 6: Indicators for Coverage of Sewage Service

|  | Baseline | Target                   | Actual          |                         |                                  |
|--|----------|--------------------------|-----------------|-------------------------|----------------------------------|
|  | 2007     | 2013                     | 2013            | 2014                    | 2015                             |
|  |          | 2 Years After Completion | Completion Year | 1 Year After Completion | 2 Years After Completion         |
| Percentage of Connected Population (%) | 65.1%    | 77.5%                    | 43.8%           | 45.9%                   | 45.4%<br>(Target was unachieved) |
| Percentage of Served Population (%)    | 0%       | 100%                     | —               | —                       | 30.1%<br>(Target was unachieved) |

Source: documents provided by JICA, SEDALORETO, etc.

### 3.3.1.2 Qualitative Effects (Other Effects)

In this ex-post evaluation, a qualitative survey with local residents in the four districts of Iquitos urban area (Punchana District, Iquitos District, Belen District, San Juan Bautista District) was conducted<sup>19</sup> in order to understand the qualitative effects of this project. Interviews on the project effects were carried out. The results of the qualitative survey were as follows:

#### (1) Usage of Service

Of the 13 households interviewed, 8 households were connected to the sewerage system constructed by this project at the time of the ex-post evaluation. The following reasons were given by households not being connected: it was not clear how to connect, and the house was located on the lower land and thus sewage did not flow even if connected to the sewage system. Furthermore, in San Juan Bautista District, there were households which

<sup>16</sup> JICA (2007) SAPROF

<sup>17</sup> Based on INEI's population estimation in 2017

<sup>18</sup> The target population was smaller than the population in Iquitos because there are some areas where the sewage network cannot be implemented or where sewage does not flow due to low altitude.

<sup>19</sup> On August 24, 2018 and May 10, 2019, three households (1 male, 4 females) in Puncana District, 3 households (2 males, 3 females) in Iquitos District, 3 households (4 females) in Belen District, and 4 households (4 females) in San Juan Bautista District, a total of 13 households (3 males and 15 females) were interviewed.

discontinued their connection to the sewerage system because of backflow. Among the households with a connection to the sewerage system, there were no households that clearly recognized changes in the sewerage service with a comparison of the period of pumping station operation (April 2014-June 2016) and other periods.

## (2) Backflow of Sewage

Regarding the backflow of sewage, differences were found across the districts, and no obvious project effect was confirmed. The northern part of Iquitos (Punchana District) was close to the sewage treatment plant constructed by the project, and sewage flowed naturally. From interviews with local residents in the district, it was confirmed that there was no backflow of sewage at the time of the ex-post evaluation. In the central part of Iquitos (Iquitos District and Belen District) and the south of the town (San Juan Bautista District), however, a backflow of sewage occurred mainly in the rainy season.

## (3) Bad Odour

A similar situation was found with offensive odours. Like the backflow of sewage, differences were found across the districts, and no obvious project effect could be confirmed. In some parts of Punchana District, there were opinions that odour was reduced after the project because a sewage system had not been installed before the project and latrines had been used. In the districts of Iquitos, Belen and San Juan Bautista, there were opinions that the backflow of sewage caused odours both outside and inside of houses.

### 3.3.2 Impacts

#### 3.3.2.1 Intended Impacts

This project regarded improvements in the hygiene conditions and living environment of the residents of Iquitos as its impacts. For the contribution of the project to hygiene conditions, the number of cases of diarrhoea, which was affected by sewage treatment, was assessed. For improvement in the living environment, an assessment of water quality at the discharge destination was made to show the influence on the natural environment while the qualitative survey was made to clarify improvements in living conditions.

#### (1) Change in Hygiene Conditions

No data were obtained to indicate comparable changes in hygiene conditions (such as the number of diarrhoea cases) between before and after the project. Regarding the number of outbreaks of diarrhoea (by age) after 2014 in the 4 district of the Iquitos urban area (Punchana District, Iquitos District, Belen District, and San Juan Bautista District), where the project was implemented, it was not possible to verify a significant relationship between the number

of diarrhoea cases and the operation of the sewage treatment plant (see the following table). In the aforementioned qualitative survey, residents were asked about the frequency of diarrhoea. Based on the interview results, there was an opinion that the frequency of diarrhoea was decreased after the project in Puncana District, where a sewerage system had not been installed before the project. In Iquitos and Belen Districts, residents replied that there was no change in hygiene conditions. In the San Juan Bautista District, some residents said that diarrhoea was increased after the project while others said it was decreased. From the qualitative survey, no clear tendency could be identified for the impact of the project on hygiene conditions.

Table 7: Number cases of Diarrhoea

|  | 2014   | 2015   | 2016   | 2017   |
|--|--------|--------|--------|--------|
| Under 1 year old                       | 3,739  | 3,379  | 3,180  | 2,641  |
| 1 year old or older, under 5 years old | 8,996  | 9,093  | 8,534  | 7,066  |
| 5 years old or older                   | 10,265 | 10,844 | 10,883 | 11,553 |
| Total                                  | 23,000 | 23,316 | 22,597 | 21,260 |

Source: Direccion Regional de Salud, Department of LORETO

## (2) Water Quality at Discharge Destination

The sewage treatment plant discharged treated water to the Nanai River during its operation. According to the data obtained from the National Authority of Water (ANA), Ministry of Agriculture and Irrigation for downstream of the discharge point from the sewage treatment plant (the confluence of the Nanai River and the Amazon River), seasonal fluctuations were found but no significant change was seen between before and after of the project completion. There was no clear relationship between the operation of the sewage treatment plant and the water quality at the discharge destination (see the following table). In the data for May 2014, E. coli exceeded the environmental standard. According to ANA, however, the data surpassed the environmental standard due to seasonal fluctuations, and this surpassing of the environmental standard was not consistent.

Table 8: Water Quality at Discharge Destination

|                          | Unit      | Environmental Standards | 12/2012     | 5/2014       | 10/2015 | 7/2017      |
|--------------------------|-----------|-------------------------|-------------|--------------|---------|-------------|
| BOD                      | mg/litre  | Less than 10            | Less than 6 | Less than 2  | 5       | Less than 2 |
| COD                      | mg/litre  | —                       | Less than 9 | Less than 10 | NA      | NA          |
| Thermotolerant Coliforms | NMP/100ml | 2,000                   | 49          | 4,900        | 490     | 790         |

Source: ANA, Ministerio de Agricultura y Riego



### (3) Life Improvements

In the aforementioned qualitative survey, information on the impacts of life improvement among beneficiaries was also collected on the project. Regarding the reduction in the time spent on housework, sewage had been discharged outdoors by some means even before the project was implemented and therefore the introduction of the sewage system did not result in time reduction such as in the elimination of drainage work. In Iquitos and Belen Districts, several households experienced backflow of sewage to their houses when it was raining. The residents also explained that drainage and cleaning required more time than before implementation of the project. Regarding the frequency of washing and dishwashing, there was no opinion that the introduction of the sewerage system affected the frequency in any of the districts. It is considered that lifestyle habits strongly influenced the frequency of washing and dishwashing.

#### 3.3.2.2 Other Positive and Negative Impacts

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

*The Japan Bank For International Cooperation Guidelines for Confirmation of Environmental and Social Considerations* (2002) were applied to this project. According to the guidelines, this project was not under the sector with significant impact or in an environmentally sensitive area. For this reason, the project was classified as a Category B, which shows little negative impact on the natural environment. Peruvian domestic law required the preparation of an environmental impact assessment (EIA) before the commencement of the civil work of this project. In fact, the EIA was prepared before the commencement of the construction. Based on some parts of the EIA and monitoring reports, which were obtained from the construction supervision consultant, and through interviews with them, the monitoring of water quality, air quality and noise was carried out in accordance with the regulations. It was not confirmed that the environmental standards were exceeded on water quality and air quality. Although noise sometimes exceeded the environmental standard due to automobile traffic, this was not attributable to this project. As floating particles increased during the transportation of concrete aggregate, the contractor introduced a countermeasure (covering the aggregate during transportation).

##### (2) Resettlement and Land Acquisition

According to answers of the questionnaire for OPIPP and the interviews with the OPIPP officers, land acquisition and resettlement for this project and these for squatters did not occur during the project period. The monitoring of land acquisition and resettlement was not included in the scope of work for the construction supervision consultant, and land

acquisition had already been completed at the commencement of the civil work. For these reasons, the relevant information could not be obtained from the consultant.

### (3) Effects on Road Transportation

As mentioned in “3.2.1 Project Outputs,” defects in the construction of road pavement during project implementation were pointed out. According to the interviews with OPIPP officers and the construction supervision consultant, long sections of the roads were cut for burying sewer pipes and these sections remained open for a long time. As a result, the road pavements were damaged, and roads were blocked for a long period. At the time of construction, roads have been cut for shorter sections for a reduction in the impact on road traffic. In addition, sheet piles were not used in some sections and the failure to hold the soil also led to the damage of the road pavement. In the interview with the JICA officers, it was reported that JICA officers visited the project site and made a claim to the contractor. However, the contractor's response was inadequate, and the problems remained unresolved during the construction phase. As a significant impact of the construction caused residents' protests, there was an area where the secondary network was not implemented (San Juan Bautista 25th District).

This project has achieved its objectives at a limited level. Therefore, the effectiveness and impacts of the project are low. Regarding the indicators for the outcomes of this project (the proper treatment of sewage in Iquitos and the expansion of sewage coverage), out of the seven indicators set at the ex-ante evaluation, five were not achieved even during the period when the project facilities were operated the most. The achievement level of the other two indicators were not being able to be judged. At the time of the ex-post evaluation, the sewage treatment plant is not in operation, and all indicators were not achieved. Regarding the impacts of this project (improvements in the hygiene conditions and the living environment of residents in Iquitos), the contribution of this project was not verified.

## 3.4 Sustainability (Rating: ①)

### 3.4.1 Institutional/Organizational Aspect of Operation and Maintenance

At both times of the ex-ante evaluation and the ex-post evaluation, OPIPP is responsible for the implementation of this project and SEDALORETO is responsible for the operation and maintenance after the project completion. At the time of the ex-post evaluation, OPIPP was a division implementing public works in the departmental government while SEDALORETO provided water supply and sewerage services in the provinces of Maynas, Alto Amazonas, and Requena. At the time of the ex-post evaluation, SEDALORETO had not taken on the sewerage facilities. For this reason, OPIPP was responsible for the maintenance of the sewage

treatment plant and the pumping stations, but OPIPP did not have the personnel required for the maintenance. In 2019, SEDALORETO has 365 employees, of which 265 are in Iquitos, and 16 engineers. However, at the time of the ex-post evaluation, no personnel were assigned to the operation of the sewage treatment plant constructed by this project.

A presidential decree was issued in May 2019 for the introduction of a PPP scheme for the operation and maintenance of the sewerage facilities in Iquitos. The selection of companies for operation is ongoing. According to MVCS, it is expected that the concessionaire through the stipulated selection process requires four years or more before the sewerage facilities restarts, even if the PPP scheme is introduced.

The institutional arrangements for operation and maintenance remained the same from the time of the ex-ante evaluation to that of the ex-post evaluation, but the completed facilities were not handed over to SEDALORETO at the time of the ex-post evaluation. OPIPP does not have the personnel required for operation and maintenance. Although operation and maintenance through PPP is being planned, it will take several years to select the contractor. However, at the time of ex-post evaluation, it is not possible to conclude that the PPP scheme will definitely be introduced as it is immediately after the commencement of the contractor selection process. Therefore, it is concluded that there is a problem in the institutional/organizational aspect of operation and maintenance.

#### 3.4.2 Technical Aspect of Operation and Maintenance

As mentioned above, SEDALORETO is the institution responsible for the operation and maintenance of the completed facilities. From 2014 to 2016, SEDALORETO was engaged in the operation and maintenance of the sewage treatment plant and the pumping stations, and acquired the skills required to operate the facilities constructed by this project. However, at the time of the ex-post evaluation, the staff who operated the sewage facilities resigned and this made it difficult to reactivate the facilities.

According to SEDALORETO officers, instructions are mainly given as on-the-job-training within the organization because the training budget was small. Since the law requires a workplace safety and health program which includes safety procedures in operation, training in that field is continued. The construction management consultant prepared manuals for the operation and maintenance of the sewage treatment plant and the pumping stations in Spanish. The site survey confirmed that the manuals were distributed to the sewage treatment plant. In the interviews with SEDALORETO officers, it is mentioned that an employee candidate needs to have qualifications (electricity, machinery, etc.), employment history, and educational degrees in relevant fields .

It is expected that a company with the technical capability for operation and maintenance will be in charge of operation based on a PPP scheme. However, the selection process of a

contractor is ongoing at the time of the ex-post evaluation. A certain period is required until the contractor can start operation, even if the PPP scheme is introduced.

As the SEDALORETO employees engaged in the operation and maintenance of the facilities constructed by the project resigned, SEDALORETO faces technical difficulties in operation and maintenance at the time of the ex-post evaluation at the time of the ex-post evaluation. It was expected that a certain period of time would be needed for the operation of a concessionaire with technical capabilities even if the PPP scheme was introduced. Therefore, it was concluded that there was a problem in the technical aspect of operation and maintenance.

### 3.4.3 Financial Aspect of Operation and Maintenance

The sewerage facilities constructed by this project are under dispute over the completion of construction, and the SEDALORETO sewerage fee does not reflect the investment costs and operation and maintenance costs associated with the project. According to the supervision agency (Superintendencia Nacional de Servicios de Saneamiento: SUNASS), which authorized water tariffs, a revision of the sewerage fees of SEDALORETO requires the following: 1) the dispute between OPIPP and the contractor is resolved, and SEDALORETO accepts the sewage treatment facilities, 2) SEDALORETO determines whether the facilities have no problem in operation and, 3) that SEDALORETO applies an assessment of tariff to SUNASS.

SEDALORETO operated the sewage treatment plant until July 2016. However, since tariff collection was not foreseeable, operation of the sewage treatment plant and the pumping stations ceased from that month. As there is the possibility that the sewage treatment plant may be submerged, the pumping station in the sewage treatment plant still maintains minimal operation even at the time of the ex-post evaluation. According to relevant organizations, OPIPP has paid the electricity for the operation of the pumping station and cleaning costs (since 2019) and SEDALORETO paid for security guards and cleaning costs at the sewage treatment plant (up to 2018).

Regarding the financial conditions of SEDALORETO, a deficit of operating income continued, and net income also became negative after 2015 (see the table below). In addition, the non-revenue water rate of SEDALORETO continuously exceeds 60% and has remained at a very high level since 2017. Moreover, the current assets of SEDALORETO are only less than 20% of its current liabilities. Thus, the low current ratio has also been an issue, and the high non-revenue water ratio has led to the problem of short-term liquidity. The low profitability and the liquidity problem have made it difficult to reinvest equipment by using their own funds or by borrowing. At the time of the ex-post evaluation, SEDALORETO is in

the process of restructuring with the support of OTASS as the company faced difficulties in achieving independent profitability.

Table 9: SEDALORETO Income

Unit: soles

|                    | 2014        | 2015        | 2016       |
|--------------------|-------------|-------------|------------|
| Revenue            | 27,539,633  | 29,034,854  | 31,224,159 |
| Operational Income | -10,926,812 | -4,546,749  | -5,398,695 |
| Net Income         | 5,102,422   | -13,865,903 | -6,765,694 |

Source: SEDALORETO

Table 10: SEDALORETO Financial Indicators

|                        | 2014  | 2015   | 2016   |
|------------------------|-------|--------|--------|
| Return on Equity       | 5.8%  | -20.0% | -10.6% |
| Current Ratio          | 39.3% | 26.5%  | 15.9%  |
| Debt to Equity Ratio   | 67.3% | 73.7%  | 74.7%  |
| Non-revenue Water Rate | 64.0% | 64.5%  | 62.6%  |

Source: SEDALORETO

At the time of the ex-post evaluation, OTASS under MVCS is providing management and financial support to SEDALORETO. However, since OTASS cannot support recurrent expenditure including operation and maintenance costs due to the institutional constraint, it is difficult for them to directly provide financial support for the operation and maintenance of SEDALORETO.

The tariff for the sewerage facilities constructed by this project has not been collected. The setting of the sewerage fee requires the resolution of disputes and countermeasures for defects, but it has been difficult to foresee a timing for this. In addition, the operating income of SEDALORETO remained negative, and the non-revenue water rate has been high. Therefore, it is concluded that there is a problem in the technical aspect of operation and maintenance.

#### 3.4.4 Status of Operation and Maintenance

On the present status of the facilities built by this project, interviews with relevant organizations and the site survey revealed the following:

Sewage treatment plant: The operation of the sewage treatment plant has been suspended since July 2016, and no test run has been conducted to check operating capacity. At the time of the field visit, it was confirmed that the sewage treatment plant was cleaned when necessary. At the time of the field visit, it was confirmed that SEDALORETO had not decided the transportation and disposal methods of the sludge. Nevertheless, the amount of sludge was not enough to be disposed immediately as the operational period of the sewage treatment plant was short and the organic matter concentration of the inflowed sewage was low.

Pumping stations: One pumping station (EBD 7) is under operation, but operation and maintenance were not conducted at other pumping stations. At the pumping stations where the site survey was conducted, some of the transformers, meters and cables were stolen. As of May 2019, OPIPP removed and stored equipment at the pumping stations for the prevention of theft.

Sewer Network: OPIPP conducts cleaning since SEDALORETO has not taken on the sewer network and can not clean it. In May 2019, OPIPP rented high-pressure washing vehicles and cleaned sewer pipes. Due to defects in construction, there are reverse slopes in several sewer pipes where sewage does not flow.<sup>20</sup> At the time of the site survey, there were scattered spots where sewage was trapped and backflowing. According to the SEDALORETO officers, the road surface and manholes are depressed because the the sewage pipes in the installed area were been constructed improperly.

Connection Basins: It was reported that among 41,294 connection basins, 29,416 units (71%) were unused, 13,852 units (34%) had defects, and 12,963 (31%) were not connected.<sup>21</sup> In order to make the separate sewage system function, the connection basins are required to separate rainwater and sewage. However, many connection basins have problems.



Trapped Sewage



Backflow of Sewage

The facilities constructed by this project are in a situation where deterioration is likely to occur. Regarding the operation and maintenance of the sewage treatment plant and the pumping stations, periodic test runs are necessary to keep the equipment in working condition, but the operation has not been implemented except for EBD 7. In addition, theft of equipment

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<sup>20</sup> Sewer pipes slope in the direction of flow, but in this project there were several sections which sloped in the opposite direction due to construction defects.

<sup>21</sup> Based on the assessment made by the construction supervision consultant in 2015. “Unused” refers to the cases that the outlet was blocked for the prevention of backflow, and garbage was clogged due to the lack of cleaning. “Defect” refers to the cases that the basin was not constructed in accordance with the drawing, and the basin had cracks or chips.

occurred at the pumping stations. Therefore, it is concluded that there are issues in the status of operation and maintenance.

Major problems have been observed in terms of the institutional/organizational aspect, technical aspect, financial aspect, and current status. Therefore, sustainability of the project effects is low.

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

##### **4.1 Conclusion**

The objective of this project is to treat sewage properly and to widen the coverage of sewerage service in Iquitos in the Department of Loreto, one of the major cities in the Amazon region, by improving and expanding the sewerage system, thereby contributing to improved sanitary conditions and living environment in the area. This project was highly relevant to the country's development plan and development needs, as well as to Japan's ODA policy. Regarding the project plan and the approach, however, it can be concluded that an assessment should have been made at the time of the appraisal whether the sewage collection method and the sewage treatment method of this project would function adequately considering local circumstances. Therefore, its relevance is fair. Considering the changes in outputs in this project, the cost of this project exceeded the plan. In addition, the project period significantly exceeded the plan. Therefore, efficiency of the project is low. Regarding the indicators for the outcome of this project (the proper treatment of sewage in Iquitos and the expansion of sewerage coverage), out of the seven indicators set at the ex-ante evaluation, five have not been achieved. The sewage treatment plant has stopped its operation since July 2016. Regarding the impacts of this project improvements in hygiene conditions and living environment of the residents in Iquitos, no impacts has been verified as the contribution of this project. This project achieved its objectives at a limited level and, thus, the effectiveness and impacts of the project are low. Regarding the operation and maintenance, major problems have been observed in terms of the institutional/organizational aspect, the technical aspect, the financial aspect and the current status. Therefore, the sustainability of the project effects is low. At the time of the ex-post evaluation, operation and maintenance based on the public-private partnership are progressing, but it is expected to take a certain amount of time until the contractor starts operating the sewerage facilities.

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

## 4.2 Recommendations

### 4.2.1 Recommendations to the Executing Agency

#### Early Hand-over of the Facilities and Minimal Operation

OPIPP is responsible for the implementation of infrastructure but it is not the department in charge of operation and maintenance. Therefore, it should be a precondition for appropriate maintenance that OPIPP hands over the completed facilities to the O&M agency SEDALORETO. As construction quality caused a dispute over the completion of construction works, and because arbitration between OPIPP and the contractor is ongoing, the facilities have not been handed over yet at the time of the ex-post evaluation. Early completion of arbitration between the executing agency and the contractor is desirable for the appropriate maintenance of the facilities. Moreover, if the Peruvian side (SEDALORETO) is the owner of the sewerage facilities in the introduction of the PPP scheme, an early take-over of the facilities by SEDALORETO is required. Finally, for the prevention of the deterioration of the facilities, it is desirable that OPIPP and SEDALORETO should cooperate in the improvement of the connection basins, cleaning and campaigns and aim at minimal operation (periodic test runs, operation of the sewage treatment plant at natural inflow, etc.).

### 4.2.2 Recommendations to JICA

#### Monitoring for the Restart of the Facilities and Working with Relevant Organizations

As described above, since minimal operation (periodic test runs, operation of the sewage treatment plant at natural inflow) is desirable for the prevention of deterioration of the facilities, it is desirable to continue to monitor the operational status of the facilities as well as to work with OPIPP, SEDALORETO, OTASS, and MVCS for the restart..

## 4.3 Lessons Learned

### Careful Assessment of Sewage Collection Method

This project selected a separate sewage system, but rainwater and sewage are easily mixed due to the structure of local houses, and the project area has more rainfall than other areas of Peru. For these reasons, separation using a connection basin does not work sufficiently. As a result, the BOD of inflowing sewage was significantly lower than expected at the time of appraisal, when the sewage treatment plant was in operation. Consequently, sewage with unexpectedly low concentration of organic matter flew into the UASB and sprinkle filter system. In the case that the separate sewage system is selected, it is desirable to take local situation into consideration when assessing whether the method to separate sewage system functions well or not at the time of the appraisal.



#### Sludge Disposal of Sewage Treatment Plant

For the sustainable operation of a sewage treatment plant, proper disposal of discharged sludge is necessary. At the time of the ex-post evaluation, however, no disposal method for the sludge discharged from the sewage treatment plant constructed by this project have not been determined. At the time of appraisal, the decision on the sludge disposal method was not an issue to be monitored by JICA. At the time of ex-post evaluation, the sewage treatment plant of this project was not in operation and, thus, sludge treatment is not an urgent issue. However, monitoring of this issue is desirable as the method of sludge disposal should be decided at the time of appraisal or at latest by the completion of the project.

### Comparison of the Original and Actual Scope of the Project

| Item                            | Plan   | Actual   |
|---------------------------------|--|--|
| 1. Project Outputs              | 1) Sewage Treatment Plant: Capacity 0.73 m <sup>3</sup> /s<br>2) Construction of Pumping station: 19 stations<br>3) Expansion of Sewer Network: Force Main 18.6 km, Discharge Pipe 1.4 km, Principal Collector Line 26 km, Diversion Works, Secondary Network 273.4 km, Connection of 38,599 Households<br>4) Consulting Service: Detailed Design, Tender Assistance, Construction Supervision, Capacity Development in Operation & Maintenance, and Public Awareness Campaign | 1) Sewage Treatment Plant: Capacity 0.88 m <sup>3</sup> /s<br>2) Construction of Pumping station: 18 stations<br>3) Expansion of Sewer Network: Force Main 19.11 km, Discharge Pipe 1.4 km, Principal Collector Line 48.26 km, Diversion Works, Secondary Network 349.5 km, Connection of 41,149 Households<br>4) Consulting Service: Same as the Left |
| 2. Project Period               | December 2008 – December 2011 (37 months)  | December 2008– October 2013 (59 months)  |
| 3. Project Cost                 |  |  |
| Amount Paid in Foreign Currency | 962 million yen  | 159 million yen  |
| Amount Paid in Local Currency   | 15,143 million yen (430 million soles)   | 21,223 million yen (685 million soles)   |
| Total                           | 16,105 million yen   | 21,382 million yen   |
| ODA Loan Portion                | 6,660 million yen  | 6,660 million yen  |
| Exchange Rate                   | 1 Sol = 35.2 yen (As of January 2008)  | 1 Sol = 31.0 yen (Weighted average between January 2008 and December 2014)   |
| 4. Final Disbursement           | December 2013  |  |