United Mexican States

Ex-Post Evaluation of Japanese ODA Loan

Baja California Water Supply and Sanitation Project

External Evaluator: Hiromi Suzuki S., IC Net Limited

0. Summary

This project aimed to solve water pollution problems by developing the water supply and sewerage infrastructure of three cities in Baja California, namely Mexicali, Tijuana and Ensenada.

This project was in line with the development plans of the Mexican government and the Baja California state government and their development needs as well as with Japan's ODA policy at the times of the appraisal and the Ex-Post Evaluation. Therefore its relevance is high. All the operation and effect indicators for water supply and sewerage systems have improved greatly in each city. The targets set at the time of the appraisal were achieved or the values are improving steadily. Although the water supply and sewerage project in Tijuana includes the unfinished Tecolote-La Gloria Sewage Treatment Plant, the State Commission for Public Services of Tijuana (Comisión Estatal de Servicios Públicos de Tijuana, hereinafter referred to as CESPT) constructed temporary small-scale sewage treatment plants using its own funds and it is providing a partial service. Therefore, the sewerage development project in Tijuana has been effective despite the delay in the development of the Tecolote-La Gloria Sewage Treatment Plant. The External Evaluator found evidence of project effects including a reduction in river water pollution, an improvement in the residents' living conditions, an improvement in environmental problems concerning Mexico and the US and the reuse of treated sewage by the State Commission for Public Services of Mexicali (Comisión Estatal de Servicios Públicos de Mexicali, hereinafter referred to as CESPM) and CESPT (Tijuana). Therefore the project's effectiveness and impact is high[1]. Although the project cost was within the plan, the project period has significantly exceeded the plan because the Tecolote-La Gloria Sewage Treatment Plant is unfinished. Therefore the efficiency of the project is fair. Some problems have been observed in terms of the financial aspects of the operation and maintenance system administered by the State Commissions for Public Services in all three cities. Some problems have also been observed in terms of the technical aspects of the operation and maintenance system administered by the State Commission for Public Services of Ensenada (hereinafter referred to as CESPE). Therefore sustainability of the project effect is fair.

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

[1] The policy of this Ex-Post Evaluation was that the External Evaluator would check the overall effectiveness while also checking the effectiveness of the project in each city.

1. Project Description

Project Locations

Monte de Los Olivos Sewage Treatment Plant (Tijuana)

1.1 Background[2]

Baja California is situated in Northwestern Mexico and has a border with the US. At the time of the appraisal, the three cities subject to the project (Mexicali, Tijuana and Ensenada) were receiving a large amount of foreign direct investment and were experiencing remarkable economic development as they were part of the Border Industrialization Program. Many people from other parts of Mexico migrated to the cities looking for jobs and the unemployment rate in the area was 2.2% which is lower than the national average of 3.3%[3]. The Mexican government attached importance to Baja California due to the large numbers of people traveling between the state and the US and the important economic role that the state plays.

In Baja California, infrastructural development for daily life lagged behind the rapidly growing population. For the National Water Commission (Comisión Nacional de Agua, hereinafter referred to as CONAGUA), the development of water supply and sewerage systems had a particularly high priority in its national water infrastructure development program. The water pollution problem in the state had become so serious that it was discussed at a bilateral summit with the US, and there was an urgent need to solve the problem. The improvement of living conditions in Baja California was of major importance to Japan because about 40% of the foreign direct investment in the state in the latter half of the 1990s came from Japan (581 million US dollars). Japanese-owned businesses had the largest number of employees among foreign companies operating in the state, accounting for about 40% (14,000 employees) of the total number of foreign company employees. It is with this background that the Mexican government requested the ODA Loan to the Japanese government.

[2] Created based on press releases and JICA's materials given at the time of the appraisal.
[3] JICA's materials given at the time of the appraisal, the National Institute of Statistics and Geography of Mexico (Instituto Nacional de Estadística, Geografía e Informática, hereinafter referred to as INEGI)

1.2 Project Outline

The objective of this project is to resolve river water pollution by developing the water supply and sewerage infrastructure of three cities in Baja California namely Mexicali, Tijuana and Ensenada, thereby contributing to improving the living conditions of residents in the three cities and curbing environmental problems in Mexico and the US.

Source: INEGI

Figure 1: Project Locations

Loan Approved Amount/ Disbursed Amount	22,148 million yen / 22,053 million yen
Exchange of Notes Date/ Loan Agreement Signing Date	March 2000 / March 2000
Terms and Conditions	Interest Rate: 2.5% (1.8% for the development of sewerage systems as part of the project and consulting services) Repayment Period: 25 years (Grace Period: 7 years) Condition for Procurement: General untied
Borrower / Executing Agencies	The National Bank of Public Works and Services (Banco Nacional de Obras y Servicios Públicos S.N.C., BANOBRAS) / Comisión Estatal de Servicios Públicos de Mexicali (CESPM), Comisión Estatal de Servicios Públicos de Tijuana (CESPT), Comisión Estatal de Servicios Públicos de Ensenada (CESPE)
Final Disbursement Date	July 2009
Main Contractors (Over 1 billion yen)	Arca del Pacifico, S. de R.L. de C.V. y Asociados (Mexico), Constructora Cadena, S.A. de C.V. Y Asociados (Mexico), Alepo Construcciones, S.A. de C.V., Asociación en Participación (Mexico), Grupo Construcciones Planificadas, S.A. (Mexico), Degremont, S.A. de C.V. y Asociados

	(Mexico), Earth Tech México, S.A. de C.V. (Mexico), Constructora Makro, S.A. de C.V., A en P. (Mexico), Fypasa, Cotrisa y Construplan, S.A. de C.V. (Mexico)
Main Consultants (Over 100 million yen)	Nippon Jogesuido Sekkei Co., Ltd. (Japan) / Black & Veatch International (the United States) (JV)
Feasibility Studies, etc.	F/S: Conducted by the Baja California state government (1997) Special Assistance for Project Formation for the Baja California Water Supply and Sanitation Project (1998)
Related Projects	[Japanese ODA Loan projects] Monterrey Water Supply and Sewerage Project (L/A signed in 1992) Metropolitan Mexico Sanitation Project (L/A signed in 1997) [Technical cooperation projects] Project on Capacity Enhancement for Establishing Mexican Norms of Water Quality Criteria (implemented in 2008–2010) [Other international organizations and aid organizations] North American Development Bank (NADB): The Sewage Treatment System Improvement Project (1997)

2. Outline of the Evaluation Study

2.1 External Evaluator

Hiromi Suzuki S. (IC Net Limited)

2.2 Duration of Evaluation Study

Duration of the Study: September 2013 - January 2015

Duration of the Field Study: November 30 - December 16, 2013 and April 24 - May 11, 2014

3. Results of the Evaluation (Overall Rating: B[4])

3.1 Relevance (Rating: ③[5])

3.1.1 Relevance to the Development Plan of Mexico

3.1.1.1 The Development Plans at the Time of the Project Appraisal

At the time of the project appraisal, the National Water Use Program (2001–2006) was

[4] A: Highly satisfactory; B: Satisfactory; C: Partially satisfactory; D: Unsatisfactory

[5] ③: High; ②: Fair; ①: Low

formulated for the water supply sector based on the National Development Plan (1995–2000)[6]. The program aimed to promote the deregulation and streamlining of water use and the removal of pollutants from watershed areas which discharge wastewater, in order to enable the sustainable development of water resources and water use[7] [8].

The Baja California state government formulated the Baja California State Development Plan (1996–2001) based on the National Development Plan. In the plan, it set 11 goals in total with the aim of improving residents' living conditions, including social infrastructural development and the improvement of health and hygiene. In particular, water supply and sewerage development were priority areas for the improvement of living conditions. The Baja California Water Supply and Sanitation Project was the core part of the water supply and sewerage development stipulated in the plan.

3.1.1.2 The Development Plans at the Time of the Ex-Post Evaluation[9]

The National Development Plan (2013–2018) at the time of the Ex-Post Evaluation prioritized "the achievement of an equal society" and "productivity improvement," among others. For the water supply sector, it set a policy of improving water supply services and access to basic infrastructure, while promoting sustainable water resource development. The National Water Use Program (2014–2019) aimed at "ensuring the safety and sustainability of water resources" and included "improving water supply and sewerage services and strengthening access to the services" in six priority areas.

The Baja California State Development Plan (2008–2013) states that it would continue to prioritize water supply and sewerage development, water recycling and water resource management. In particular, the plan emphasizes that water resources are common resources of the US and Mexico and that bilateral agreements should be taken into account when using, discharging and managing water resources. The Baja California State Water Use Program (2008–2013) sets detailed plans for achieving the goals of the State Development Plan. The program gives four strategies: (1) expansion of the water supply and sewerage service area and the qualitative improvement of the services as well as the promotion of water recycling; (2) the development of new water resources; (3) participatory water resource management where government, citizens, businesses, etc. participate and the strengthening of cooperation with the

[6] The plan aimed at two goals: the promotion of economic activities by tapping into urban and local characteristics; and the urban development of highly populated areas while maintaining harmony with the environment.
[7] Water used for urban life, industrial and agricultural purposes.
[8] To achieve these goals, ten specific measures were set. In particular, the priority measures included the promotion of investment in infrastructural development and maintenance, and the efficient operation of the water use projects.
[9] As of April 2014, the Baja California State Water Use Program (2014–2019) had not been published. Therefore, in the Ex-Post Evaluation, the relevance between this project and the state-level development plans was checked based on the Baja California State Development Plan (2008–2013) and the Baja California State Water Use Program (2008–2013).

US; and (4) the strengthening of technology, management, finance, etc. for water supply and sewerage businesses. All these are highly relevant to this project.

As explained above, the national and state development plans prioritized the improvement of the water environment and living conditions through the development of water supply and sewerage infrastructure both at the time of the project appraisal and the Ex-Post Evaluation. The Baja California State Water Use Program at the time of the Ex-Post Evaluation set a development goal of strengthening cooperation with the US in the water environment field. The above-mentioned items are relevant to this project.

3.1.2 Relevance to the Development Needs of Mexico

3.1.2.1 The Development Needs at the Time of the Project Appraisal

The three cities subject to this project were experiencing rapid economic growth even when compared to other cities in Mexico (see "1.1 Background") and there was a marked concentration of the population in the area due to people migrating from other states looking for jobs[10]. However, the development of water supply and sewerage systems lagged behind the rapid population increase. At the time of the appraisal, the water supply coverage was 97% in Mexicali, 88% in Tijuana and 89% in Ensenada, and the sewerage system coverage was only 89%, 61% and 71%, respectively. In addition to constructing new facilities, investment in rehabilitation and the extension of existing facilities was considered urgent.

Baja California has an approximately 226km border with the US and shares the Colorado River, the New River and the Tijuana River with the US. At the time of the appraisal, some of the sewage in the state was discharged into the New River without being treated. The polluted water then flew into the Salton Sea in the US and was degrading the environment. This water pollution problem developed into a diplomatic problem between Mexico and the US. Therefore, this project was considered urgent by the Baja California state government, which aimed to improve the living conditions of the residents of the state and to solve the bilateral problem quickly.

3.1.2.2 The Development Needs at the Time of the Ex-Post Evaluation

The annual population growth rate in Baja California has been decreasing in general since it reached 4.3% in 2000. According to the 2010 census, the average annual population growth rate from 2000 to 2005 was 2.7% and the average annual population growth rate from 2006 to 2010 was 2.2%[11]. These figures were lower than the 3.5% which had been projected at the time of the project appraisal. The water supply coverage has significantly increased in all three cities (100%

[10] The population was growing rapidly with an average annual growth rate of 3.5% (the national average in 1980–1990 was 1.9%). This increasing trend was expected to continue.
[11] The national average population growth rate in 2005–2010 was 1.8%.

in Mexicali, 99% in Tijuana and 99% in Ensenada), but the sewerage system coverage remains 95%, 89% and 93%, respectively, and continuous development is needed. Tijuana has less sewerage system coverage than the other cities because the population is rapidly increasing in the area covered by CEPST's sewage treatment service. Therefore, there is still a strong need for sewerage development[12].

On the other hand, the water quality in the Colorado River, the New River and the Tijuana River which developed into a bilateral problem with the US has been greatly improved due to many projects being implemented based on treaties and arrangements that were put in place by the International Boundary and Water Commission (hereinafter referred to as the IBWC). The IBWC is a bilateral commission established by the two countries. At the time of the Ex-Post Evaluation, the quality of the treated water discharged into the rivers met the national standards[13] (NOM-001-SEMARNAT-1996).

As explained above, at the time of the Ex-Post Evaluation, there were still a strong development needs for the expansion of the water supply and sewerage system coverage and the improvement of the water environment in the three cities subject to the project. Curbing the environmental problem in Mexico and the US was one of the expected impacts of the project. The situation has improved greatly due to various bilateral efforts, but further improvements in water quality are hoped for.

3.1.3 Relevance to Japan's ODA Policy[14]

In Japan's Medium-Term Policy on Official Development Assistance (August 1999) which was in use at the time of the project appraisal, Japan's basic ODA policy was to assist with economic and social infrastructure, to assist with intangible projects such as human resource

[12] There are multiple reasons for the low sewerage system coverage in Tijuana. For example, the migrant population from other states is increasing. Also, the border between Tijuana and San Diego in the US has the largest number of people traveling through it in the world, and Tijuana has an increasing floating population from Mexico and elsewhere who aim to enter the US. In addition, Playas de Rosarito (a city covered by CESPT's sewage treatment service) has a high average annual population growth rate (4.5% in 2005–2010). Playas de Rosarito receives the population which spills over from Tijuana.

[13] The national standards for domestic water supply (Mexico's official set of rules) are stipulated in NOM-127-SSA1-1994 issued by the Secretariat of Health. The laws on the water quality standards for sewage discharge are stipulated in NOM-001-SEMARNAT-1996 (the water quality standards for discharging sewage into coastal areas), NOM-002-SEMARNAT-1996 (the water quality standards for discharging sewage into urban sewerage networks) and NOM-003-SEMARNAT-1997 (the water quality standards for reusing the water resulting from sewage treatment for public services) which were issued by the Secretariat of the Environment and Natural Resources. All the standards stipulate the maximum permissible levels for 17 pollutants in total, including suspended solids (SS), biochemical oxygen demand (BOD), total nitrogen (TN) and total phosphorus (TP) (see footnotes 21 and 27 for details of SS and BOD). Sewage treatment plants must at least observe NOM-001-SEMARNAT-1996 strictly. When treated water is to be reused for public services, the stricter NOM-003-SEMARNAT-1997 must be met.

[14] At the time of the project appraisal, Japan did not have ODA policies specifically for Mexico (such as a "Country Assistance Program for Mexico" or a "Country Assistance Strategy for Mexico." Therefore, in this Ex-Post Evaluation, the relevance between this project and Japan's ODA policy was checked by looking at the following documents: the Medium-Term Policy on Official Development Assistance (August 1999) which is Japan's basic ODA policy; JICA's Medium-Term Strategy for Overseas Economic Cooperation Operations (December 1999) which was established based on the Medium-Term Policy; and the Japan-Mexico Economic Cooperation Policy Dialogue (November 2001). JICA is the abbreviation of the Japan International Cooperation Agency.

development, the development of systems and policies, as well as to tackle global problems. In particular, assistance for Latin America focused on the conservation of the natural environment, responding to the increasing environmental impacts accompanied by economic growth, and the development of basic infrastructure for reducing regional economic disparities. In the Medium-Term Strategy for Overseas Economic Cooperation Operations, "support for economic and social development" was included in priority cooperation areas. In the Japan-Mexico Economic Cooperation Policy Dialogue, it was agreed that the two countries would cooperate on the priority areas of "reducing the disparities between regions and between the rich and the poor," "industrial development and the promotion of local development" and "environmental measures and the conservation of the natural environment."

Therefore, this project was relevant to Japan's ODA policy at the time of the appraisal because the project aimed at water supply and sewerage development and conservation of the water environment.

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

3.2 Effectiveness[15] (Rating: ③)

3.2.1 Quantitative Effects (Operation and Effect Indicators)[16]

Clear operation indicators, effect indicators or target values had not been set for water supply or sewerage projects before the Ex-Post Evaluation. Therefore, at the Ex-Post Evaluation, indicators were set as shown below based on the materials for internal use given at the time of the appraisal. The Ex-Post Evaluation was then conducted using the indicators.

3.2.1.1 Operation Indicators

a. Water supply projects: According to the materials for internal use, the population supplied with water (the additional population supplied with water[17]) and the percentage of non-revenue water were to be used as operation indicators. Therefore, the evaluation was conducted using

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

[16] This project was implemented by three executing agencies and was comprised of many sub-projects. Therefore the basic evaluation policy was to conduct an overall evaluation while also checking the project's effects in each city using the operation and effect indicators. The year of completion was different for the different cities. Therefore, the year in which water supply projects were completed in all three cities was considered the "year of completion" for the water supply projects, and the year in which sewerage projects were completed in all three cities was consider the "year of completion" for the sewerage projects. Therefore, the year of completion for the water supply projects was 2008 and the year of completion for the sewerage projects was 2010, and the evaluation was conducted for 2010 and 2012, respectively, which were two years after the year of completion.

[17] The materials state that the additional population supplied with water should be "200,000 people in Mexicali and 160,000 people in Tijuana," but they were not clearly defined as indicators. Therefore, in the Ex-Post Evaluation, the benchmark year was set to be 1999 and the target value at the time of the project completion was set to be the sum of the population supplied with water in 1999 and the additional population supplied with water mentioned above, for each city.

these items as operation indicators. The amount of water supplied, the facility utilization rate (average)[18] and the water quality (turbidity) were added as reference indicators (see Annex I, Table A). At the Ex-Post Evaluation, it was confirmed that the amount of water supplied increased from the amount at the time of the project appraisal. It was also confirmed that the facility utilization rate (average) exceeded the rate in 2007 (before the start of the project), and that the rate continued to increase in general after the development of facilities started their operations. The water quality was checked against the national standards.

Regarding the population supplied with water, the target achievement rate in 2010 (two years after the project's completion) was 96% in Mexicali and 133% in Tijuana. Therefore the project's effectiveness was confirmed. Regarding the percentage of non-revenue water, the targets were achieved both in Mexicali and in Tijuana. The evaluation results for the reference indicators are as follows. (1) The facility utilization rate: The rate increased from 23% in 2008 to 44% in 2013 at the newly built Xochimilco Water Treatment Plant. The rate increased from 65% in 2008 to 72% in 2013 at the improved Second Water Treatment Plant. The amount of water supplied and the facility utilization rate at both water treatment plants were increasing in general after the projects were completed. The figures declined temporarily after an earthquake measuring 7.2 on the Richter scale hit Baja California on April 4, 2010 which caused damage to water supply infrastructure and the stoppage of operations, but the figures started to increase in general afterwards. The facility utilization rates for the above two water treatment plants were expected to be 60-70% after the project was completed based on the forecast that the average annual population growth rate in 2000-2010 would be more than 3%[19]. However, in reality, the average annual population growth rate during this period was only 2%. Considering this fact, it was reasonable that the facility utilization rate at the Xochimilco Water Treatment Plant was below 50% and the facility utilization rate at the Second Water Treatment Plant was below 70%. Three water treatment plants in Mexicali including the ones developed by the project are connected to each other and a system is in place to enable the saving of electricity charges and other operational costs in accordance with fluctuations at different times of the day and in different seasons. This is enabling them to operate efficiently. (2) The amount of water supplied: Since 2007 the amount of water supplied in Mexicali has been lower than the amount in the benchmark year (1999). This is because citizens and businesses became more aware of the importance of water saving and factories in the maquiladora in Mexicali mainly started to use production processes in which they do not use water and this reduced total water consumption. This was not expected at the time of the appraisal. In addition, in light of the fact that the population growth rate forecast was higher than reality as mentioned above and that the amount of water supplied is only a reference indicator, the External Evaluator determined that the lower

[18] The facility utilization rate (average) = (the average daily water supply) ÷ (the capacity of the facility) × 100.
[19] A forecast made by INEGI at the design stage.

water supply level when compared to the benchmark year's level in Mexicali should not negatively affect the evaluation results of the project. (3) Water quality: The water quality in the two cities met the water quality standards (NOM-127-SSA1-1994) issued by the Secretariat of Health.

b. Sewerage projects: The amount of sewage treated and the population receiving sewage treatment service (whose data has been collected as reference information) have increased steadily (see Annex I, Table B). Regarding the facility utilization rate (see Annex II), nine out of a total of 10 sewage treatment plants which were developed by the project achieved a facility utilization rate of 40% which is considered the guideline value for efficient operation[20]. Only the El Sauzal Sewage Treatment Plant run by CESPE (Ensenada) did not achieve a facility utilization rate of 40%. This is because development in the El Sauzal area which was expected to take place at the time of the project appraisal was never implemented and the population did not increase. Therefore, the amount of sewage did not increase as expected. At the Monte de Los Olivos Sewage Treatment Plant in Tijuana which is run by CESPT (Tijuana), the facility utilization rate declined slightly from the end of 2011 due to lower generation of wastewater in the area covered by the said plant. In addition, at the moment of the Ex-Post Evaluation, the plant was having its annual preventive maintenance, and also fans were being repaired. However, the facility utilization rate is still above 40%.

Regarding the reduction rate for suspended solids (SS[21], see Annex II) which was another item to be used as an indicator at the time of the appraisal, the project targeted "a 70% reduction from the value at the time of the appraisal," but four sewage treatment plants in Mexicali did not achieve the target. In the discussion held with CESPM (Mexicali) on this target value, it was discovered that the four sewage treatment plants are situated in rural areas although they are categorized as urban areas by the National Population Council of Mexico (Consejo Nacional de Población, CONAPO), and the plants emitted only a small amount of SS in the first place. Therefore, CESPM considered that a 70% reduction was an excessive target. Since CONAGUA had the same view on the matter, it was decided that, in the Ex-Post Evaluation, the achievement of the SS reduction rate should be evaluated by looking at whether or not the SS values meet the national standards, as a more realistic alternative indicator. When checking the SS values against the national standards NOM-001-SEMARNAT-1996, all the sewage treatment plants met the standards.

As explained above, both the water supply and sewerage projects have achieved the target

[20] Based on JICA, "The Reference for Operation and Effect Indicators."
[21] SS (suspended solids) refer to insoluble particulate matter with the diameter of 2 mm or less which is suspended in water. They cause turbidity in water and prevent the sun's rays from penetrating the water. In a worst case scenario, they can block the gills of fish which causes death from suffocation (source: the website of the Ministry of the Environment of Japan).

values set for the operation indicators or the values are improving in general. The national standards for water quality have also been achieved. Therefore there are no major operational problems.

3.2.1.2 Effect Indicators

a. Water supply projects: According to the materials for internal use, water supply coverage was to be used as the effect indicator at the time of the appraisal. Therefore, the Ex-Post Evaluation was conducted using water supply coverage as the effect indicator (see Annex I, Table A). The majority of the water supply infrastructure was developed by 2008 and the water supply coverage increased greatly in all three cities by 2010 which is two years after the project's completion. The water supply coverage was 99.4% of the planned value in Mexicali and 102% of the planned value in Tijuana, i.e. it exceeded the planned value.

b. Sewerage projects: According to the materials for internal use, the sewerage system coverage was to be used as the effect indicator at the time of the appraisal. Therefore, the Ex-Post Evaluation was conducted using sewerage system coverage as the effect indicator (see Annex I, Table B). In Mexicali, the sewerage system coverage was 95.2% in 2012 which is two years after the project's completion (a six percentage point increase from the benchmark value). Sewerage system coverage also increased greatly in Tijuana and Ensenada and exceeded the target values. As a result, the sewerage project as a whole achieved the target value. The amount of reused water resulting from sewage treatment[22] increased greatly particularly in Mexicali after 2010. It is also increasing in general in Tijuana. The amount of reused water resulting from sewage treatment was around 0.2 million m^3/year in Ensenada, which is a lower level than the amounts in the other two cities. As explained at a later section, this is because CESPE (Ensenada) has not been able to engage itself in the promotion of sewage recycling due to technical and financial problems. The population receiving sewage treatment services and the amount of sewage being treated are steadily increasing in all three cities, and therefore the effectiveness of the project is high.

With regard to the quality of water discharged from sewage treatment plants which were constructed, improved or extended by the project[23], it was confirmed that the water quality from all the facilities met the national standards (NOM-001-SEMARNAT-1996) (see Annex III). The Tecolote-La Gloria Sewage Treatment Plant administered by CESPT (Tijuana) was unfinished at the time of the Ex-Post Evaluation. The sewage which was to be treated at the plant was

[22] This indicator is used by the executing agencies on a daily basis. During the Ex-Post Evaluation Study, this indicator was added after consulting with the executing agencies because it could be used as a quantitative effect indicator.

[23] Although the water quality had not been designated as an effect indicator at the time of the appraisal, it was added to the effect indicators after consulting with the executing agencies, because it is essential to check the quality of discharged water in order to understand the effect of the sewage treatment plants quantitatively.

treated at five sewage treatment plants constructed and run by CESPT (Tijuana) and a private real estate developer[24]. The quality of water discharged from all these plants meets the national standards[25]. According to CESPT (Tijuana), these sewage treatment plants cover about 30% of the population planned to benefit from the Tecolote-La Gloria Sewage Treatment Plant and covers about 50% of the amount of sewage to be treated at the plant. The remaining 50% of sewage is discharged into rivers without being treated. Therefore, the fact that the Tecolote-La Gloria Sewage Treatment Plant is unfinished is having negative effects on the living conditions of local residents and the natural environment. However, the treatment capacity of the Tecolote-La Gloria Sewage Treatment Plant accounts for only 4% of the total treatment capacity of the nine treatment plants developed by the project (3,004 L/s). When the plant is completed, further improvements to water quality and the living conditions of local residents can be expected (Please see Table 5 for details of the current status of Tecolote-La Gloria Sewage Treatment Plant).

Therefore, the water supply and sewerage projects have been effective in general in Mexicali and Tijuana. Although the Tecolote-La Gloria Sewage Treatment Plant in Tijuana is unfinished, the treatment capacity of the plant accounts for only a small percentage of the total capacity developed by the project. CESPT (Tijuana) is taking all possible alternative measures and they have been effective. The sewage projects in Ensenada have also been effective. Therefore, in light of the analysis results for each city, the External Evaluator determined that the project has been highly effective.

3.2.2 Qualitative Effects

Regarding the qualitative effects expected at the time of the appraisal, these can be considered as effects at the impact level. Therefore they were evaluated in “3.3 Impact” below together with the other impacts.

3.3 Impact

3.3.1 Intended Impacts

3.3.1.1 The Reduction of Pollutants by the Sewerage Projects

At the time of the appraisal, the implementation of the project was expected to improve the quality of water flowing into the New River and the Gulf of California in Mexicali, and the quality of water flowing into the Tijuana River and the Pacific in Tijuana. The improvement in

[24] The sewage treatment plants administered by CESPT are the Porticos de San Antonio plant, the Santa Fe plant, Valle Sur plant I and Valle Sur plant II. The sewage treatment plant run by a private real estate developer is the Villa de Cedro plant. The said treatment plants administered by CESPT were developed by CESPT in the period between 2007 and 2009 as a temporary measure to be taken until the Tecolote-La Gloria plant was completed. Therefore they are not included in the project.

[25] The water analysis report published in April 2014 by an external agency accredited by the state.

water quality in this case is the reduction in BOD and SS. According to the water quality data at the monitoring points in the New River and the Tijuana River[26] obtained from CONAGUA at the time of the Ex-Post Evaluation, the targets for the BOD[27] pollution load at the discharge point were met at both monitoring points in 2012, which is two years after the project's completion[28]. With regard to the SS pollution load at the discharge point, the target for the Tijuana River was met, but the target for the New River was not met. As mentioned above, this is because the SS pollution load was already low at the discharge point in the New River at the beginning of the project (1,724 kg/day) when compared to the SS pollution load at the discharge point in the Tijuana River (24,886 kg/day). Therefore, the target for the New River was excessive. The BOD and SS pollution loads at the discharge points in both rivers have met the national standards since 2010. The treatment capacity developed by the project accounts for 8% of the total sewage treatment capacity in Mexicali and 3% in Tijuana, which are not low participation rates, therefore the project had an impact on river water quality.

Table 1: Water Quality of the New River and the Tijuana River

Year	BOD pollution load at the discharge point (kg/day)		SS pollution load at the discharge point (kg/day)	
	New River	Tijuana River	New River	Tijuana River
2000	9,712	1,459	1,724	24,886
2010 The year of completion	3,971	2,276	2,094	26,827
2011 One year after the project's completion	5,329	1,815	1,930	11,218
2012 Two years after the project's completion	2,188	1,092	1,542	5,500
Target value at the time of the appraisal	8,284	2,047	1,096	7,012
Achievement of the target two years after the project's completion	Target achieved	Target achieved	Target not achieved	Target achieved
National standards	NOM001 achieved	NOM001 achieved	NOM001 achieved	NOM001 achieved

Source: The target values are from JICA's materials given at the time of the appraisal. The actual values are all from CONAGUA.

[26] There is only one monitoring point in each river. For the both rivers, measurements are taken at the discharge points of the relay pumps which are located on the Mexican side of the border.

[27] BOD (Biochemical Oxygen Demand) is the amount of oxygen required by microbes in order to decompose organic pollutants in water. A larger value means more polluted water (source: the website of Ministry of Environment of Japan).

[28] 2010, when all the projects except for the Tecolote-La Gloria Sewage Treatment Plant were completed, was considered the year of completion.

3.3.1.2 The Improvement of the Living Conditions of the Residents in the Three Cities

At the time of the appraisal, the implementation of the project was expected to improve the hygiene and the living conditions of the local residents. To examine the impact of the project, a beneficiary survey was conducted as part of the Ex-Post Evaluation[29]. As shown in Table 2, it was confirmed that the project contributed to the improvement of residents' hygiene to a certain extent in Mexicali and Tijuana, although there were slight differences between the two cities. In Ensenada, water supply projects were excluded from the project because of the delay in the signing of the loan agreement for the project. The survey revealed that there are numerous residents in Ensenada who are dissatisfied with the water supply and that urgent measures are needed. Regarding the sewerage system in Ensenada which was subject to the project, improvements in access and services were observed. Concerning the quality of river water in the three cities, the beneficiary survey results showed no major changes in any of the cities when comparing before and after the project. Improvements in the numerical values of pollutants are not obvious by just looking the river water and therefore it is perhaps difficult for residents to recognize the change.

Table 2: Results of the Beneficiary Survey

Water supply	[Access to water supply services] In all three cities, all respondents answered that they already had taps within their homes or within their residential plots, and had access to water supply services before the project started (15 years ago on average in the three cities).

[29] The details of the beneficiary survey are as follows. The survey period: January 21-31, April 27, May 1 and 4, 2014. The number of beneficiaries surveyed: 50 local residents from each city, 150 residents in total (59% were females and 41% were males. 25% were residents in their 30s, 22% were in their 40s, 21% were in their 50s, 21% were in their 60s and 11% were others). The sampling method: For all the three cities, the beneficiaries surveyed were selected through random sampling from the project's beneficiary areas. The project covers an extended area of each city and it contains many projects. Therefore, some areas were selected through consulting with the executing agencies and then the beneficiaries to be surveyed were selected through random sampling from the selected areas, in some cases. The content of the questions: Changes in the quality of drinking water and domestic water (the smell and taste); the involvement in the project; the satisfaction levels for the project; changes in health conditions; positive and negative changes caused by the project (a reduction in the burdens of tap water charges on family finances, etc.); changes in awareness about hygienic improvements and environmental conservation; whether or not there was pollution during the project's construction work (exhaust gases, waste treatment, dust, turbid water, noise or vibration); and others. Although the project did not conduct water supply development in Ensenada, the questions on water supply were also asked in Ensenada in the same way as in the other two cities, in order to obtain general opinions about water supply.

	[Consumption of tap water and water-saving awareness] Residents in Mexicali (which is closest to water sources and has the lowest water charges) consumed water the most. 38% of the respondents answered that they consume 21-40 m^3 per month on average and 34% answered that they consume 11-20 m^3 per month on average. In Tijuana, where residents have high water-saving awareness, 48% of the respondents answered that they consume 11-20 m^3 and 36% answered that they consume 10 m^3 or less. Although water supply development in Ensenada was excluded from this project, residents in Ensenada also answered that they consumed less water. The reasons were checked at the time of the Ex-Post Evaluation and the main reason was the serious water shortages. CESPE (Ensenada) was making efforts to resolve water shortage problems by conducting the suspension of water supply in a planned manner, while asking residents to save water further, and taking water from the Emilio López Zamora Dam for water supply. The average monthly water charges (which include sewerage service charges) paid by each household was 128 pesos in Mexicali, 110 pesos in Tijuana and 218 pesos in Ensenada.
	[Water supply services] (1) Quality and safety of tap water: When comparing the situation before the project was implemented and the situation at the time of the beneficiary survey (January and May 2014), 92% of the respondents in Mexicali and 90% of the respondents in Tijuana answered that the quality and safety of tap water had "improved" or "greatly improved." Therefore, a major improvement in the quality and safety of tap water was observed in both cities. Only 8% of respondents in Mexicali and 10% of respondents in Tijuana answered that the quality and safety of tap water "did not improve greatly" or "worsened." The main reasons were that "the water pipes are not properly maintained" and "the water smells due to high chloride concentration." On the other hand, in Ensenada which was excluded from the water supply projects, 60% of the respondents answered that the quality and safety of tap water had "improved" or "greatly improved," and 40% of the respondents answered that the quality and safety of tap water "did not improve greatly" or "worsened." Therefore, there are clear differences between Ensenada and the other two cities. The reasons for the negative answers were because "the tap water is turbid because the water pipes and water tanks are not sufficiently maintained" and "the water smells due to high chloride concentration."
	(2) Opinions about the water supply service in general provided by the State Commissions for Public Services before and after the project: 91% of respondents in Mexicali and 96% of respondents in Tijuana answered that they are currently "highly satisfied" or "satisfied" with the service provided by the State Commissions for Public Services when comparing before and after the project. The reasons for the satisfaction were improved water quality, water pressure and fewer suspensions of water supply, as well as improved maintenance. In Tijuana, 33% of respondents answered that they were "able to save time thanks to the elimination of the time required to fetch water." 9% of respondents in Mexicali and 4% of respondents in Tijuana answered that they "hope to see further water quality improvement." On the other hand, in Ensenada which was excluded from the water supply projects, 60% of respondents answered that they were "satisfied" with the water supply service provided by CESPE (Ensenada) and 40% of respondents answered that they were "dissatisfied" with CESPE's service. The reasons for dissatisfaction were that there are problems with the water quality, the water pressure and the maintenance of facilities in general.
	(3) Effects on health: At the time of the project appraisal, people were mainly using Garrafons (purified water in 18-20 liter jugs) or bottled water for drinking, and therefore there was only a small incidence of water-derived diseases. Therefore, both in Mexicali and Tijuana, most respondents answered that there were no major changes concerning health when comparing before and after the project (96% and 91%, respectively). In Ensenada, 76% of respondents answered that there were no major changes, but 11% of respondents answered that "there had been problems of diarrhea and skin diseases, but no such problems exist now."

Sewerage projects	[Access to sewerage services] 100% of the respondents in Mexicali, 74% in Tijuana and 92% in Ensenada answered that the connection to public sewerage networks had improved when comparing before and after the project (they were able to connect to the networks, or they were able to have the existing deteriorated connection equipment replaced). In both Mexicali and Ensenada, all respondents answered that they have been connected to the public sewerage networks since an average of 16 to 17 years ago. On the other hand, 74% of respondents in Tijuana answered that they were able to connect to the networks gradually starting six years ago on average. Tijuana is lagging behind the other two cities regarding provision of the service, because it includes Playas de Rosarito, therefore the population growth rate was higher than in the other two cities.
	[Sewerage services] (1) Opinions about the sewerage service in general provided by the State Commissions for Public Services before and after the project: 44% of respondents in Mexicali, 72% in Tijuana and 66% in Ensenada answered that they are currently "satisfied" with the service provided by the State Commissions for Public Services when comparing before and after the project. The reasons for the low satisfaction level in Mexicali in particular, were "there is a serious inundation problem in the rainy season due to an insufficient drainage system for rainwater (a note from the External Evaluator: rainwater drainage systems are outside the responsibility of the State Commissions for Public Services), "the sewerage networks need to be expanded," and "the commission should put more effort into environmental measures such as improving the quality of river water." In Tijuana and Ensenada, the reasons for the relative high level of satisfaction were "the sewerage projects greatly improved hygiene," and "the commissions are putting effort into water recycling."
	(2) Opinions about the maintenance of the sewerage networks: 76% of respondents in Mexicali, 50% in Tijuana and 73% in Ensenada answered that "the maintenance of the sewerage networks is insufficient and the inspection frequency should be increased." Respondents in the three cities thought that one of the highest priorities for the State Commissions for Public Services in the future should be "the maintenance of sewerage networks (increasing the frequency of patrols and conducting thorough maintenance including regular maintenance checkups and repairs)."
	(3) Changes in the water quality in rivers and other water resources: Respondents were asked to compare the turbidity, smell, floating matter and impact on the natural environment at the time of the project appraisal and at the time of the beneficiary survey. In Mexicali and Tijuana, a large percentage (70%) of the respondents answered that "there was no major improvement, but conditions had not worsened." In Ensenada, some respondents answered that conditions had "worsened" regarding floating matter such as litter, but the respondents themselves pointed out that this is an issue of awareness among the citizens.
	(4) Awareness about the appropriate use of sewerage systems: Respondents were asked about the appropriate use of sewerage systems by beneficiaries, for example "do not drain oil and other combustibles directly into the sewerage system," "minimize the use of detergents," and "reuse water within the household wherever possible." A large percentage of respondents answered that they have started taking the said measures within the past five years (87% in Mexicali, 93% in Tijuana and 91% in Ensenada). There was also an answer that symbolizes the fact that the area neighbors the US: a respondent who had worked in the US said, "I learned that it is important to treat water resources appropriately in the US and I have continued to take appropriate measures since returning to Mexico."

3.3.1.3 The Improvement in the Environmental Problems concerning Mexico and the US

By the time of the project appraisal, the water pollution problem had developed into a diplomatic problem which was even discussed at a bilateral summit with the US. However, as

mentioned earlier, the water quality in the New River and the Tijuana River which run through the two countries has improved thanks to efforts made by various agencies including the IBWC. At the time of the Ex-Post Evaluation, the water quality problem was no longer a diplomatic problem for Mexico and the US.

23% of the water treated at the sewage treatment plants in Mexicali is discharged into the New River. The water quality at the monitoring point in the New River meets the national standards NOM-001-SEMARNAT-1996. With regard to the Tijuana River, by the time of the Ex-Post Evaluation, sewage which had been discharged without being treated at the time of the project appraisal was being treated at sewage treatment plants and collected at the IBWC pumping station before it was discharged into the Pacific. These sewage treatment plants included the La Morita Sewage Treatment Plant and the Monte de Los Olivos Sewage Treatment Plant which were developed by the project. The treated water met NOM-001-SEMARNAT-1996 and the quality of the Tijuana River has greatly improved. The contribution of CESPT (Tijuana) to the environmental improvement of the Tijuana River basin was recognized and it was given an official commendation by the Water Management Committee of California, the US in December 2013. Therefore, it was confirmed that the implementation of the project had a positive impact which was the improvement of the bilateral problem.

3.3.2 Other Impacts

3.3.2.1 Impacts on the Natural Environment

Environmental impact mitigation measures were taken and monitoring was conducted during the implementation of the project by strictly observing the Baja California State Law concerning the Public Procurement of Public Works, Equipment, Materials and Services (July 7, 1998). Table 3 shows the results of the measures and the monitoring[30].

[30] At the time of the appraisal, the sewerage projects in Tijuana included the construction of the Rosarito Sewage Treatment Plant, for which impacts on neighboring residents such as noise and offensive odors were a particular concern. However, CESPT conducted the construction of the plant as a separate project, and therefore it was excluded from the Baja California Water Supply and Sanitation Project. In Mexicali and Ensenada, no environmental problems (noise, vibration, offensive odors, sludge treatment problems, etc.) have been caused by the operation of the sewage treatment plants. In Tijuana, no problems have been caused by the two treatment plants constructed by the project. However, since the Tecolote-La Gloria Sewage Treatment Plant is unfinished, the sewage that was to be treated at the plant is being temporarily treated at five other sewage treatment plants, of which three plants are located in residential districts and offensive odor problems were observed during the visits. CESPT is obtaining residents' cooperation by explaining that this is a temporary measure.

Table 3: Description of the Environmental Impact Mitigation Measures during the Project's Implementation and the Monitoring Results

	Mitigation measures and items monitored
Exhaust gases	The project made sure that all the contractors conducted regular maintenance on construction vehicles to prevent petrol and oil leaks as well as excessive exhaust gas emissions. With the cooperation of the road traffic bureau in each city, the project also minimized indirect exhaust gas emissions by preventing congestion caused by construction work by conducting the necessary traffic controls and providing citizens with information about detours.
Waste treatment	The project conducted training on waste treatment for workers prior to the project's implementation. Waste was collected at the waste collection sites designated by each city municipal government and treated appropriately by type. Recycling was promoted for recyclable waste by outsourcing it to specific private businesses. Sludge was treated by sun-drying in areas designated by each city municipal government.
Dust	Water was sprinkled at least twice a day using water trucks to control dust.
Turbid water	To minimize the amount of wastewater emitted during the construction work, one temporary bio-toilet per 20 workers were introduced. Cleaning and washing the construction vehicles and equipment was outsourced.
Noise	The number of hours that heavy machinery which causes noise problems could be used was limited to six hours a day. The use of engine mufflers was recommended and workers were instructed to use earplugs on construction sites. There was no health damage to neighboring residents or workers, or complaints from them, according to the interviews with the executing agencies and consultants as well as the beneficiary survey.
Vibration	Engine mufflers were used for heavy machinery and construction work was arranged so that it would be conducted at times of the day which would minimize the impacts on neighboring residents. Similarly to "noise" above, there was no health damage to neighboring residents or workers, or complaints from them, according to the interviews with the executing agencies and consultants as well as the beneficiary survey.

The most important positive impact on the natural environment was the recycling of water. All the State Commissions for Public Services are putting effort into the recycling of sewage. In particular, the Las Arenitas Sewage Treatment Plant (see the column for details) run by CESPM (Mexicali) and the Purple Project run by CESPT (Tijuana) are worthy of special mention. In the

Purple Project, the pipes for reusable treated water are colored in purple and the treated water is used for watering public green spaces such as parks[31]. Within the Monte de Los Olivos Sewage Treatment Plant in Tijuana which was constructed by the project, a research center for water resource recycling was established and, although small-scale, it is conducting joint studies on water recycling with the Autonomous University of Baja California[32]. At the La Morita Sewage Treatment Plant in Tijuana, water recycling is used for afforestation activities, by growing 750,000 trees for afforestation per year. At this plant, efforts are also being made to explore other possibilities for water recycling, by establishing a vineyard as part of joint research with a private business, with a view to utilizing treated water for the winery industry which is a local industry of Baja California. As shown above, each State Commission for Public Services used their own funds to add educational and research functions or facilities for promoting water recycling at the sewage treatment plants developed by the project, and succeeded in increasing the positive impacts on the environment.

Figure 2: The "Purple Project" by CESPT (Tijuana): tree nursery greenhouse at La Morita Sewage Treatment Plant

[31] CESPT has launched a website dedicated to the Purple Project in order to let people know about the project (in Spanish only: http://www.cuidoelagua.org/empapate/usoeficiente/lineamorada1.html)

[32] CESPT won the 2014 National Prize of Innovative Processes on Clean Water Supply and Sanitation (PISAPyS), an award given by the National Association of Water and Sanitation Companies of Mexico (ANEAS), for its contribution to water recycling and reuse at La Morita Sewage Treatment Plant.

Column: The Las Arenitas Sewage Treatment Plant Run by CESPM (Mexicali)

The Las Arenitas Sewage Treatment Plant in Mexicali was developed by the project, and is now run and maintained by CESPM (Mexicali). Some positive impacts of CESPM's activities on the natural environment have been observed in areas around the plant, and it is attracting international attention as an example of best practice.

The sewage treatment plant is situated about 23 km to the south of Mexicali. The plant started operating in March 2007. It treats about 50% of the sewage from Mexicali (the sewage treatment capacity is 840 L/s), and the beneficiary population is estimated to be about 400,000.

With the aim of complying with NOM-003-SEMARNAT-1997 and improving the natural environment in the surrounding areas, CESPM (Mexicali) started to plant aquatic plants that have water purification abilities such as Scirpus juncoides var. hotarui in 2008 and developed about 100 ha of man-made wetlands. The wetlands are not only improving water quality but also contributing to biodiversity improvement. Before the project was implemented, it was a wasteland due to the high sulfur content, but at the time of the Ex-Post Evaluation, about 130 wild bird species lived in the area including an endangered species the clapper rail (Rallus longirostris), as well as coyotes and iguanas. CESPM (Mexicali) is aiming to further develop the area into a Las Arenitas Complex which includes a nature reserve (including 120 ha of afforestation) and natural environment education facilities.

Figure 3: The Aerial View of the Las Arenitas Sewage Treatment Plant and Wetlands (provided by CESPM)

Figure 4: *Scirpus juncoides* var. *hotarui* and Wild Birds in the Wetlands (The photograph of the wild birds was provided by CESPM.)

As shown in Figure 3, the area used for the Las Arenitas Sewage Treatment Plant is wasteland, but the implementation of the project made it possible to utilize the discharged water and create wetlands. The Las Arenitas Wetlands could not have been established without the project. In addition, there is no doubt that the efforts and cooperation of CESPM (Mexicali) and other organizations after the project's completion further increased the positive impacts of the project on the natural environment. These organizations include the Border Environment Cooperation Commission (Comisión de Cooperación Ecológica Fronteriza, hereinafter referred to as COCEF), the U.S. Fish and Wildlife Service, the Secretariat of the Environment and Natural Resources, CONAGUA, NGOs such as the Sonoran Institute and Pronatura. The Las Arenitas Wetlands have been highly praised and many documentaries on the wetlands have been made[33].

[33] For example, the documentaries include Hooper Cynthia (2012) Humedales Artificiales: Three Transnational Wetlands, ARID: A Journal of Desert Art, Design and Ecology, and Redford Center "Watersheds: Exploring a New Water Ethic for the New West."

3.3.2.2 Land Acquisition and Resettlement

Table 4 shows the land acquired for the project implementation. The land to be acquired was in undeveloped areas with no residents, and therefore no resident relocation was required in any of the three cities. The law of the Baja California state government allows land acquisition for projects which are deemed to be of a public nature with high public benefits. The land for the projects was acquired appropriately.

Table 4: Details of the Land Acquisition by the Project

	Details
Mexicali	[Plan] The area: 377.5 ha, the cost: 30,621 million pesos
	[Actual] The area: 654.18 ha (the number of plots: 15), the cost: as planned. • The owners: Individuals, the Mexicali county government and farming communities ("ejido"). All the land plots were wasteland, which were not used for production activities or as residential sites. • The acquisition process: The acquisition processes for all the land plots were completed without major problems, based on the civil law of the Baja California state. The process was as follows: (1) the Baja California state land assessment committee conducted a survey and decided on the maximum price of the land to be acquired; (2) consultations were held with the landowners in the presence of notaries and the final price was decided (the price must not exceed the maximum price); and (3) the acquired land was registered as a public asset and at the commercial registry.
Tijuana	[The plan] The area: about 16 ha, the cost: 30,624 million pesos
	[Actual] The area: 1,227.5 ha (the number of plots: 23), the cost: 51,439 million pesos • The owners: The land was owned by individuals or jointly owned by ejudos, a total of 216 owners. • The acquisition process: The same process as in Mexicali was used. The land plots to be acquired were wasteland, which were not used for production activities. • The process for acquiring land use permission: The land use permission for laying sewer pipes in inhabited residential plots was acquired based on the Baja California state law on water services. Explanatory meetings were held for the relevant residents on the effects of the project, etc. and consultations were held on compensation. The compensation given was as follows: (1) the payment of cash, (2) the restoration of the land to its original state after the construction has been completed; (3) and permission to connect the drainpipe of the relevant household to the sewer pipe to be installed within the residential plot. Consultations with one household were prolonged, but it was agreed eventually that their drainpipe would be reallocated and the problem was solved.

3.3.2.3 Unintended Positive/Negative Impacts

All three State Commissions for Public Services are conducting awareness raising activities explaining how the sewerage system works, its role and water recycling. For example, at the Monte de Los Olivos Sewage Treatment Plant (Tijuana) which was constructed by the project, CESPT (Tijuana) used its own funds to establish a facility next to the plant for children to experience the sewage treatment process. Visits by elementary and junior high school students

to the facility are organized regularly. Regarding awareness raising activities for businesses, promoters from CESPT (Tijuana) visit restaurants and markets and conduct awareness raising activities on the maintenance of sewer pipes in what is called the Catch Oil Program[34]. CESPM (Mexicali) introduced a joint program called the Industrial and Commercial Wastewater Monitoring Program with the state's environmental conservation bureau in 2010. The program gives businesses advice on wastewater treatment systems and treatment methods. These programs were only made possible or strengthened through the development of the sewerage infrastructure carried out by the project.

As has been seen above, this project has largely achieved its objectives. Therefore its effectiveness and impact is high.

3.4 Efficiency (Rating: ②)

3.4.1 Project Outputs

The main changes to the outputs in each city are as follows (for details, see the annex "Comparison of the Original and Actual Scope of the Project"): In Mexicali, water treatment plants and sewage treatment plants were consolidated in order to increase the efficiency of the project, which reduced the number of water treatment plants and sewage treatment plants that need to be improved by the project. In Tijuana, the length of water pipes and the number of water meters installed slightly exceeded the plan, because the population growth rate in Playas de Rosarito covered by CESPT (Tijuana) was revised upwards., As for construction of the Tecolote- La Gloria Sewage Treatment Plant, a lawsuit between CESPT and a contractor started in 2012 and is continuing as shown in Table 5. The plant was still unfinished at the time of the Ex-Post Evaluation. In Ensenada, the biggest change was that all the projects in Ensenada were reallocated to sewerage projects because CESPE (Ensenada) decided to conduct water supply projects that were planned at the time of the project appraisal early using its own funds. All the changes explained above except for the Tecolote-La Gloria Sewage Treatment Plant were appropriate because they were made in order to respond to changes in each city's needs.

[34] The program explains how to use grease traps which prevent oil draining from the sink.

Table 5: Main Changes to the Outputs in Each City and the Reasons for the Changes

Mexicali (CESPM)	
Water supply	• The improvement of the First Water Treatment Plant and the Ejido Nuevo León Water Treatment Plant: The improvement of the plants was excluded from the project because they were improved or expanded using CESPM's own funds before the project started, due to strong demands from residents. • The improvement of the Colonia Progreso Water Treatment Plant and the Colonia Nacionalista Water Treatment Plant: In order to increase the efficiency of the project, the functions of the two plants were merged into the newly built Colonia Xochimilco Water Treatment Plant. The treatment capacity of the Colonia Xochimilco Water Treatment Plant was increased to 1,100 L/s (110% of the planned capacity). • The construction of a reservoir: At the time of the appraisal, the planned capacity of the reservoir (for storing untreated water to be sent to the First and Second Water Treatment Plants) was 150,000 m^3, of which 80,000 m^3 was to be constructed by the project. However, the capacity was increased to 160,000 m^3 in total in case of emergencies, and it was decided that the entire reservoir would be constructed by the project. The reservoir was designed so that floating matter in the untreated water can be settled in the reservoir and the load on the water treatment plants can be reduced. • With regard to the number of water meters installed, the number of meters required increased because the meters which were originally to be installed by another project were added to the project. The number therefore increased to 227% of the planned number. CESPM (Mexicali) paid for the installation of the additional meters.
Sewerage	• The treatment capacity of the project's sewage treatment plants was revised when INEGI revised its population growth forecast downwards in 2000. The revised treatment capacity was much lower than the planned capacity: 41% of the planned capacity for the Guadalupe Victoria Sewage Treatment Plant, 14% for the Estación Coahuila Sewage Treatment Plant, 18% for the Los Algodones Sewage Treatment Plant and 36% for the Ciudad Morelos Sewage Treatment Plant. The revised treatment capacity should enable stable sewage treatment at least until 2025 (2030 for the Ciudad Morelos Sewage Treatment Plant)35. • The construction and modification of pumping stations: Some of the sewage treatment plants were to be constructed in suburbs and the treated water was to be pumped up to the water level of the New River where the treated water was to be discharged. For this purpose, six pumping stations were included in the project at the time of the appraisal, but the number was later increased to 10 (167% of the planned number. One of them was added because the Santa Isabel Sewage Treatment Plant was canceled and a pumping station was built instead).
Ensenada (CESPE)	
Water supply	• At the time of the appraisal, the water supply projects needed to be implemented urgently due to the strong needs. For this reason, when the launch of the project was delayed, CESPE (Ensenada) decided to conduct all the planned water supply projects using its own funds separately from the project. Therefore only sewerage projects were included in the project in Ensenada.
Sewerage	• At the time of the appraisal, the sewerage component of the project only included the construction of sewer mains, but the following projects were later added: the improvement of the El Sauzal Sewage Treatment Plant, and the development of sewer mains, sewer laterals and pumping stations in the northeastern part of Ensenada, where sewerage infrastructure development was delayed.

[35] CESPM (Mexicali) is already considering an additional treatment capacity increase (40 L/s) of the sewage treatment plants as a response measure to a possible future increase in the amount of sewage that needs to be treated, and it has already acquired the land needed for the capacity increase.

Tijuana (CESPT)	
Water supply	• The construction of water pipes: Because INEGI revised the population growth rate upwards for Playas de Rosarito which is covered by CESPT (Tijuana), more water pipes than planned were constructed and the length of the water pipes constructed ended up at 103% of the planned length. • The construction of pumping stations: The Lázaro Cárdenas District has much steep terrain with many rocks and water has to be pumped up before it can be delivered to the beneficiaries. Therefore one more pumping station was later added to the nine pumping stations planned at the time of the appraisal. • The construction of distribution reservoirs: The distribution reservoir that was planned to be constructed in the Lázaro Cárdenas District was replaced by the pumping station mentioned above. In the Ejido Matamoros District, it was determined that the existing infrastructure was sufficient and the construction of a reservoir was excluded from the project. Regarding the Maclovio Rojas Third Distribution Reservoir and two distribution reservoirs in the Tecolote District III, the landowners withdrew their decisions to sell the land before the project started. CESPT (Tijuana), which reckoned that negotiations would take some time, excluded the construction of the distribution reservoirs from the project. CESPT later constructed the Maclovio Rojas Third Distribution Reservoir using its own funds. As for the Tecolote District III, the demand for water in the area is covered by two Pan-American Distribution Reservoirs. • The installation of water meters: As mentioned above, the population growth rate for Playas de Rosarito was revised upwards and therefore the number of water meters required increased. Although the cost increased to 250% of the planned cost, CESPT (Tijuana) paid for the installation of the additional meters.
Sewerage	• The construction of sewer mains: Due to the population increases in the areas subject to the project, more sewer mains were installed than planned. The length of sewer mains installed slightly exceeded the planned length (110% of the planned length). • The construction of sewage treatment plants: Because the population growth rate was revised upwards, the treatment capacity at the La Morita Sewage Treatment Plant was slightly increased from what was planned at the time of the appraisal. The La Morita Sewage Treatment Plant and the Monte de Olivos Sewage Treatment Plant were designed so that the treatment capacity can be increased later for possible future demand increases. The Lomas de Rosarito Sewage Treatment Plant was excluded from the project due to local residents' strong demands for the early construction of the plant. The construction of the plant was launched before the project started, using CESPT's own funds and a loan from the central government.

	• The Tecolote-La Gloria Sewage Treatment Plant: [Status at the time of the Ex-Post Evaluation] The contractor suspended construction work on May 18, 2010. The contractor said that the main reason for the suspension was a shortage of funds. This problem developed into a lawsuit and had not been resolved at the time of the Ex-Post Evaluation. About 21% of the construction work has been completed. While the structures of the grid chamber and the final settling tank as well as the building for the sterilization process had been completed, the oxidation ditch had not been finished. In the on-site survey, part of the reinforcing steel was exposed and corrosion was observed. Some pieces of equipment installed on site were left as they were, and four pumps were left on site with simple plastic covers on them. All the facilities and equipment were exposed to the weather. Although two guards from CESPT (Tijuana) were permanently stationed on site to prevent the equipment from being stolen, they were prohibited from modifying the construction site during the lawsuit. It is not clear to what extent the equipment would be usable even if the construction work is resumed in the future. CESPT (Tijuana) said that part of the oxidation ditch would need to be dismantled.  Figure 5: The Unfinished Tecolote-La Gloria Sewage Treatment Plant (at the time of the Ex-Post Evaluation)
	[Future measures] A future population increase is expected in the areas which were to benefit from the Tecolote-La Gloria Sewage Treatment Plant. It is clear that the existing five sewage treatment plants will not be sufficient to cover the increasing population. The Baja California state government gave clear instructions that CESPT (Tijuana) must take measures immediately. COCEF and CONAGUA support this policy. Regarding the future of the Tecolote-La Gloria Sewage Treatment Plant, CESPT (Tijuana) is considering two scenarios: (1) to complete the current plant (provided that the lawsuit is resolved); and (2) to build a new sewage treatment plant with a treatment capacity of 80 L/s. It has already submitted the basic design specifications for scenario (2) to CONAGUA. In either case, it has already been decided that the central government will lend 50% of the project cost via the Drinking Water, Sewage and Sanitation in Urban Areas Program (APAZU). The other 50% will be paid by the state government or covered by a loan. At the time of the Ex-Post Evaluation, CESPT had secured a loan from the NADB, COCEF and the Environmental Protection Agency (EPA) available until mid-2016, and the construction of Tecolote-La Gloria Sewage Treatment Plant had been included in the Construction Investment Program for Fiscal Year 2015, under which the plant is planned to conclude by latest 2016.

3.4.2 Project Inputs

3.4.2.1 Project Cost

The total planned project cost was 36,914 million yen (the foreign currency part was 11,180 million yen and the local currency part equaled 109 million US dollars), of which the cost subject to the Yen Loan was 22,148 million yen. The actual cost at the time of the Ex-Post

Evaluation[36] was 34,862 million yen (the foreign currency part was 21,792 million yen and the local currency part equaled 117 million US dollars), which was 94% of the planned cost.

Table 6: The Total Project Cost: Planned and Actual[*1]

Items		Planned costs			Actual costs			Percentage compared to the plan
		Yen Loan (million yen)	Local currency (million US dollars)	Total (million yen)	Yen Loan (million yen)	Local currency (million US dollars)	Total (million yen)	
1. Civil engineering work total		18,654	68	27,860	17,960	84	27,353	98%
a. The local currency part subject to the Yen Loan subtotal[*2]		9,135	-	-	-	-	-	-
b. The foreign currency part subject to the Yen Loan subtotal		9,519	-	-	17,960	-	-	-
Breakdown	Mexicali subtotal	5,921		15,990	10,015	48	15,222	95%
	Out of the above, water supply	*3,912*	-	*10,112*	*5,946*	*28*	*8,987*	*89%*
	sewerage	*2,008*		*5,878*	*4,069*	*20*	*6,235*	*106%*
	Tijuana subtotal	2,989		10,850	6,755	32	10,307	95%
	Out of the above, water supply	*1,170*	-	*2,389*	*2,134*	*10*	*3,226*	*135%*
	sewerage	*1,820*		*8,461*	*4,621*	*22*	*7,081*	*84%*
	Ensenada subtotal	608		1,020	1,190	6	1,824	179%
	Out of the above, water supply	*529*	-	*869*	*0*	*0*	*0*	*0*
	sewerage	*80*		*151*	*1,190*	*6*	*1,824*	*1,208%*
2. Contingencies		1,037	3	1,393	0	0	0	-
3. Consulting services		2,457	0	2,457	3,832	0	3,832	156%
4. Land acquisition costs		0	7	961	0	5	569	59%
5. Tax		0	31	4,243	0	28	3,108	73%
Total		22,148	109	36,914	21,792	117	34,862	94%

Source: The planned cost data is from JICA's materials given at the time of the appraisal. The actual cost data is from the Baja California State Water Commission (Comision Estatal del Agua de Baja California, hereinafter referred to as CEA).

Exchange rate for the planned costs: 1 peso to 15.7 yen; the exchange rate at the time of the appraisal: 1 US dollar to 8.6 pesos (the Bank of Mexico); the price contingencies: 2.0% for the foreign currency part and 10.0% for the local currency part; the material contingencies: 5.0% for both the foreign currency part and the local currency part; the cost estimation base period: May 1998.

Exchange rate for the actual costs: 1 US dollar to 110 yen (it was decided through consultation with the executing agencies that the average value of OANDA's data on foreign exchange rates from March 2003 to January 2010 would be used.)

*1: For the planned costs, the data included a breakdown of the foreign currency part subject to the Yen Loan and the local currency part subject to the Yen Loan, but for the actual costs, the data prepared by the executing agencies only included a breakdown of the costs subject to the Yen Loan and the local currency part (unit: million dollars), therefore the above table used the latter breakdown categories for both the planned costs and the actual costs.

*2: For the planned costs, there is no data on the costs of the civil engineering work subject to the Yen Loan for each city.

[36] As mentioned above, CESPT is considering two scenarios concerning the unfinished Tecolote-La Gloria Sewage Treatment Plant (see Table 5 for details). The project cost is 1,068 million yen for scenario (1) and 180 million yen for scenario (2). Even if the cost of scenario (1) (which is higher) is included in the total project cost, the total project cost is still within the plan (97% of the planned cost).

The project cost for each city changed from the time of the appraisal due to the changes in "outputs" explained above. The main reason for the total project cost being within the plan was that all the signed contracts were in US dollars and the US dollar weakened against the yen. When looking at the project cost for each city, the project cost for Tijuana was within the plan. In Mexicali, the plan at the time of the appraisal was revised into a more cost-effective plan by consolidating water treatment plants and changing the size of each sewage treatment plant in accordance with the population growth rate, as explained above. This resulted in a much lower project cost than in the plan. In Ensenada, the project cost was 179% of the planned cost, because the improvement of the El Sauzal Sewage Treatment Plant and the development of pumping stations were added to the project, among others. The project costs were determined to be appropriate considering the changes in the "outputs" and the effects of the exchange rates.

3.4.2.2 Project Period

The planned project period at the time of the appraisal was from March 2000 to December 2004 (57 months). The actual project period was from March 2000 to May 2014, which is when the Ex-Post Evaluation was conducted (171 months, 300% of the planned period), because the Tecolote-La Gloria Sewage Treatment Plant is unfinished.

Table 7: Project Period: Planned and Actual

Process	Planned (at the time of the appraisal)	Actual	Percentage compared to plan
L/A signing date	March 2000	March 2000	-
Consulting services	March 2000 - December 2004 57 months	June 2001 - January 2010 104 months	182%
The project period	March 2000 - December 2004 57 months	March 2000 - May 2014* 171 months	300%
Mexicali			
Bidding procedures	June 2000 - March 2001 9 months	November 2000 - March 2003 29 months	322%
The development of water supply networks	January 2001 - September 2003 33 months	September 2002 - March 2006 43 months	130%
The development of sewerage networks	January 2001 - December 2004 48 months	October 2002 - December 2006 57 months	119%
Water treatment plants	April 2001 - December 2003 21 months	December 2003 - September 2007 46 months	219%
Sewage treatment plants	April 2001 - December 2003 21 months	April 2004 - February 2008 47 months	224%
Tijuana			
Bidding procedures	June 2000 - March 2001 9 months	November 2000 - October 2004 48 months	533%
The development of water supply networks	January 2001 - September 2003 33 months	November 2002 - May 2008 67 months	203%
The development of sewerage networks	January 2001 - September 2003 33 months	September 2003 - October 2010 70 months	212%
Sewage treatment plants*	April 2001 - December 2002 21 months	November 2005 - Unfinished as of May 2014 (Plants other than the Tecolote-La Gloria Sewage Treatment Plant were completed in October, 2010.) 103 months	490%
Ensenada			
Bidding procedures	June 2000 - December 2000 6 months	November 2000 - December 2003 38 months	633%
The development of sewerage networks, etc.	January 2001 - December 2002 24 months	July 2004 - March 2008 45 months	188%

* The actual project period was considered to be up to May 2014 which is when the Ex-Post Evaluation was conducted, because the Tecolote-La Gloria Sewage Treatment Plant is unfinished.

The main reasons for the delay are as follows.

a. The launch of the project was delayed because it took time to select a consultant[37]. As the launch of the project was postponed, residents' demands for the prompt development of many components increased and each executing agency developed these components using their own funds, as explained above. Therefore, the project developed other components.

b. The implementation of the "Tijuana Bid Package 7" was greatly delayed. The package included the Tecolote-La Gloria Sewage Treatment Plant, the La Morita Sewage Treatment Plant and the Monte de Los Olivos Sewage Treatment Plant. The contractor for the package extended the completion date of the work for the package three times for various reasons

[37] The companies which came second and third in the bidding filed complaints because the company which conducted the Special Assistance for Project Formation (SAPROF) for the project was selected as a consultant and this infringed state law. The state government then invalidated the selection process. However, the state government's legal affairs bureau issued a ruling in April 2001 that the selection process and results were valid because the yen loan project procurement guidelines override state law for yen loan contracts.

including a significant delay in the launch of the detailed designing process, changes to the designs which occurred after the detailed designing was launched, and difficulties in securing labor. Then, in May 2010, it pulled out its workers and heavy machinery and abandoned the construction work, saying that the main reason for the suspension was a shortage of funds. CESPT (Tijuana) repeatedly requested that the contractor resume the construction work, but due to lack of developments, CESPT canceled the contract with the company in April 2012. This problem later developed into lawsuits in the district court and the federal financial and administrative court of law. The lawsuit was still ongoing at the time of the Ex-Post Evaluation. For the projects in Mexicali and Tijuana (including Playas de Rosarito), detailed designs had to be revised because INEGI revised the population forecast downwards for Mexicali and upwards for Tijuana.

c. The bid price for the development of sewerage networks in Tijuana greatly exceeded the expected price, and therefore the bidding had to be conducted again.

d. Hurricane Katrina, which occurred in 2005, delayed the delivery of materials that were to be imported from the US, and the development work for water supply and sewerage networks in Mexicali and Tijuana was delayed.

As mentioned above, the main reason why the project period was 300% compared to plan is specifically due to the fact that the Tecolote-La Gloria Sewage Treatment Plant is unfinished, which resulted in a decrease in the efficiency of the project. The fact that the said sewage treatment plant is unfinished because of a lawsuit (developed into a lawsuit in April 2012) is a matter that has to be solved urgently between the Executing Agency and the contractor.

This project consists of a series of subprojects conducted in several cities. In reference to the bid package in which the Tecolote-La Gloria Sewage Treatment Plant was included, as a result of the site visit conducted by JICA's representative office in 2007, especially the said plant was considered as requiring a close attention of its progress speed after starting construction, and that the construction progress rate was low. In Japanese ODA loan projects, it is true that primarily Executing Agency is the main entity responsible for the implementation of a project, and that a Consultant assists with the management of the project's progress. However, when it is clear that a subproject is experiencing a delay, before it develops into a lawsuit, a detailed monitoring of the factors that could affect the progress of the subproject could have been conducted. Project monitoring plans indicating specific actions towards correcting the course of the project could have been discussed and agreed upon between JICA, BANOBRAS (the borrower) and related entities of the subprojects, that is, CEA and CESPT (Tijuana) which was the executing agency in this case. Such actions could have been effective.

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

At the time of the appraisal, the financial internal rate of return (FIRR) was only calculated for Mexicali and Tijuana (18.9% and 23.68%, respectively)[38]. At the time of the Ex-Post Evaluation, calculation of the FIRR was not possible because accurate data on the operation and maintenance costs, investment costs, etc. for the facilities developed by the project was not available.

As has been seen above, although the project cost was within the plan, the project period exceeded the plan. Therefore efficiency of the project is fair.

3.5 Sustainability (Rating: ②)

3.5.1 Institutional Aspects of Operation and Maintenance

Each State Commission for Public Services is responsible for the operation and maintenance of infrastructure after the completion of the project[39]. Both CESPM (Mexicali) and CESPT (Tijuana) are led by Directorate Generals and each commission is comprised of four sub-directorates: the Water Supply and Sewerage Sub-directorate, the Service Sub-directorate, the Project and Construction Sub-directorate and the Administrative Sub-directorate. The Water Supply and Sewerage Sub-directorate is responsible for the operation and maintenance of water treatment plants and sewage treatment plants, and the Service Sub-directorate is responsible for the operation and maintenance of the water mains network and the sewer pipe network. The institutional structure for the operation and maintenance is clear and there is no problem of personnel shortages. CESPE (Ensenada) is comprised of the Administrative and Financial Sub-directorate, the Service Sub-directorate and the Technical Sub-directorate, and the Technical Sub-directorate has the water supply department and the sewerage department. As shown in Table 8, the percentage of personnel directly engaged in the operation and maintenance of water supply and sewerage infrastructure is 47% at CESPM (Mexicali), 52% at CESPT (Tijuana) and 36% at CESPE (Ensenada). In the interviews with workers on site, many workers said that, at CESPE (Ensenada), “there are personnel shortages and maintenance work cannot catch up with the needs,” while there is no shortage in the institutional structure for the operation and maintenance of infrastructure at CESPM (Mexicali) and CESPT (Tijuana).

[38] The costs used for the calculation at the time of the appraisal were the project investment costs and the operation and maintenance costs (expenditures for water and sewage treatment, maintenance costs, expected uncollected charges, wages and general administrative expenses). The income sources used for calculation were the income from service charges (a 10% revision of service charges per year was expected) and other income sources (1% of the income from service charges was expected). A project life of 26 years was used.

[39] The Baja California State Water Commission (CEA) coordinated between the executing agencies and served as a contact point with JICA during the project implementation. At the time of the Ex-Post Evaluation, CEA was also responsible for the creation of the water supply and sewerage infrastructure plan for the entire Baja California area and the coordination between State Commissions for Public Services. CEA was understood to be a “supervisor” at the time of the appraisal, but in reality it was a “coordinator” which did not have any decision making authority concerning the content, postponement, etc. of the project.

Table 8: Institutional Structure for the Operation and Management of Facilities at Each State Commission for Public Services (2013)

Department	CESPM (Mexicali)	CESPT (Tijuana)	CESPE (Ensenada)
Operation of water treatment plants	84 people	440 people	27 people
Operation of sewage treatment plants	85 people		43 people
General maintenance	47 people		13 people
Operation and maintenance of water mains	174 people	449 people	67 people
Operation and maintenance of sewer pipes	157 people		40 people
Total	547 people	889 people	190 people
Total number of employees	1,165 people	1,692 people	525 people

Source: CESPM (Mexicali), CESPT (Tijuana) and CESPE (Ensenada)

The water treatment plants of CESPM (Mexicali) are controlled at the headquarters via the remote control system[40]. CESPT (Tijuana) has been outsourcing the operation and maintenance of the La Morita Treatment Plant and the Monte de Olivos Treatment Plant constructed by the project to a French-owned private company since 2012. Regarding the maintenance of water mains and sewer pipe networks in Mexicali and Tijuana, cities are divided into districts and each district has a dedicated maintenance team. In Ensenada, although there are 11 teams that maintain the water mains for the entire city, during the on-site survey, many workers on site said that the personnel shortages are preventing appropriate maintenance. The water research center was established within CEA and a technical assessment team made up of personnel from each State Commission for Public Services was formed. The team conducts detailed assessment of several water treatment plants and sewage treatment plants every year and gives recommendations on what should be improved and how. The team then conducts monitoring on the improvement progress one year later, in order to strengthen the monitoring of and the institutional structure for the operation and maintenance of infrastructure in the entire water supply and sewerage sector of Baja California.

As has been seen above, there are personnel shortages at CESPE (Ensenada), while both CESPM (Mexicali) and CESPT (Tijuana) have appropriate institutional structures for the operation and maintenance of water supply and sewerage facilities. Therefore there are some problems with the institutional aspects of the operation and maintenance system.

3.5.2 Technical Aspects of Operation and Maintenance

With regard to the technical aspects of the operation and maintenance of infrastructure, the Ex-Ante Evaluation results reported that the number of staff members who are experienced in

[40] The remote control system for sewage treatment plants will be introduced in 2014.

maintenance was particularly small in CESPM (Mexicali), but it was discovered in the Ex-Post Evaluation that the staff members in the water supply and sewerage sector have been employed for long enough when looking at the average number of years of employment.

Table 9: Technical Levels of the Staff Members Involved in the Operation and Maintenance of Infrastructure (December 2013)

	University graduates or higher education Average years of experience	Clerical staff Average years of experience	Engineers Average years of experience	Non-engineers Average years of experience	Subtotal	Total number of employees
CESPM (Mexicali)	72 people 15 years	28 people 17 years	160 people 16 years	287 people 13 years	547 people	1,165 people
CESPE (Ensenada)	18 people 9 years	3 people 25 years	46 people 9 years	123 people 15 years	190 people	525 people
CESPT (Tijuana)	89 people 11 years	43 people 6 years	725 people 14 years	32 people 4 years	889 people	1,692 people

Source: CESPM (Mexicali), CESPT (Tijuana) and CESPE (Ensenada)

CESPM (Mexicali) has the most advanced maintenance system. It has a database for the procedures and check sheets for daily inspections and preventive maintenance[41] for each type of equipment. The database is updated constantly. A detailed maintenance program is created every fiscal year and a budget is allocated to the program. Corrective maintenance is often conducted for deteriorating water mains. CESPM (Mexicali) is also putting effort into quality control: it has introduced an internal evaluation system for the operation teams to evaluate the maintenance teams. All three State Commissions for Public Services keep the maintenance manuals of each equipment manufacturer. CESPM (Mexicali) and CESPT (Tijuana) were conducting periodic maintenance and preventive maintenance in accordance with the manuals. The on-site survey revealed that CESPE (Ensenada) was not necessarily able to follow the manuals for maintenance and also the maintenance in general was delayed, resulting in more corrective maintenance than preventive maintenance. This is because CESPE has not been able to improve its technical levels for maintenance due to personnel shortages and the financial situation explained later.

With regard to personnel development for the operation and maintenance of infrastructure, all three State Commissions for Public Services conduct training programs, but their levels differ. CESPM (Mexicali) has the most advanced programs. In order to improve quality control, it has a corporate target of increasing the number of qualified workers engaged in water supply and sewerage services who are certified by the US California Department of Public Health and the California Water Environment Association. For that, CESPM supports its workers by both

[41] Preventive maintenance refers to systematic maintenance conducted before equipment, machinery, etc. malfunctions or deteriorates. Corrective maintenance mentioned later refers to the repair of equipment and machinery after malfunction has occurred.

providing in-house training and by sending them to external training organizations. As for CESPT (Tijuana), it provided training programs in and out of the institution during 2013 on "water leakage investigation and repair of water mains," "on-site workers' safety management," etc. in-house and at other organizations. It plans to conduct 68 training programs in total in 2014, including "5S in maintenance," "water analysis" and "hydraulics." Similarly, CESPE (Ensenada) conducted 10 training programs in-house and at other organizations in 2013, including "operation indicators for water supply and sewerage systems," "the maintenance of water mains networks" and "the reuse of water resulting from sewage treatment." However, the number of programs and the content are insufficient for improving maintenance technical levels. As a future measure, CESPT (Ensenada) said that it wants to support non-engineers who have 10 years or more of experience in obtaining qualifications[42].

As has been seen above, it was confirmed that all three State Commissions for Public Services kept maintenance manuals, and it was also confirmed from maintenance records that CESPM (Mexicali) and CESPT (Tijuana) conducted maintenance appropriately by following the manuals. However, CESPE (Ensenada) has not been able to engage in the technical improvement of maintenance and its maintenance work is being delayed due to personnel shortages and its financial situation as explained later. Its technical levels for maintenance are clearly lagging behind when compared to the facilities and equipment of CESPM (Mexicali) and CESPT (Tijuana), and there is room for improvement.

3.5.3 Financial Aspects of Operation and Maintenance

When looking at the financial information for the past four years obtained at the time of the Ex-Post Evaluation, revenues from water charges collected by CESPT (Tijuana) and CESPE (Ensenada) are increasing in general, but they are not enough to cover the operational and maintenance costs. The fee collection rate is increasing in general at CESPT (Tijuana), but the rate fluctuates in a range between 70% and less than 90% at CESPM (Mexicali) and CESPT (Tijuana) and there is no significant improvement. The government has a compensation system for sewage treatment plants which comply with national water quality standards[43], but it is not

[42] During the implementation of the project, as part of the consulting services, training was conducted by the National Hydraulic Engineering Institute of Mexico for all three State Commissions for Public Services. However, it was reported that the training did not lead to technical improvements because its content was general and did not take into account the water environment in Baja California. Furthermore, a total of six people participated in the training "The FY 2009 Project for Supporting Capacity Building for Improving the Sustainability of Development Effects concerning Yen-loan Projects in the Water Supply and Sewerage Sectors in Latin America" which was conducted in Japan from January 12 to February 5, 2010. However, only three ex-participants are still working at the executing agencies (two at CESPM (Mexicali) and one at CESPT (Tijuana)). At CESPM (Mexicali), the training content is being utilized by the ex-participants putting what they learned in Japan into practice. At CESPT (Tijuana) and CESPE (Ensenada), it was reported that "knowledge did not accumulate within the organizations." Concerning how to select the participants for the training in Japan, many people said that "JICA's opinions should be more influential in order to ensure that personnel who have the potential to be useful in the future will be selected, because participants are not selected objectively within the executing agencies in many cases."

[43] CONAGUA pays a subsidy of 0.5 pesos per m^3 of treated water.

enough to cover interest on loans or depreciation costs, and the State Commissions for Public Services continue to operate at a loss. In Mexico, there is a fundamental idea that "access to water is the right of all citizens" and the suspension of water supply due to unpaid bills is prohibited by law. Therefore, the future challenge is how citizens' ideas can be changed and paying for services can be made the norm[44].

[44] Each State Commission for Public Services is conducting awareness raising activities and taking measures to resolve the problem of non-payment (such as offering discounts for those who pay in advance), in order to increase the fee collection rate. CESPM (Mexicali) and others are making efforts to improve business management, for example to earn income by offering a water quality analysis service and training service to private businesses and State Commissions for Public Services in other states. The new governor who took office in November 2013 implemented a "cancellation program" for unpaid water supply and sewerage charges from January to April 2014. The program cancels all the unpaid water charges for the period from 2007 to 2012 and allows people to pay unpaid water charges for 2013 in installments. In exchange, all the residents in the state should be committed to paying future water charges by the deadlines. However, similar programs have been implemented by past administrations and the effectiveness of the program as an economic incentive is not clear.

Table 10: Financial Situation at Each State Commission for Public Services

(Unit: million pesos)

	2010	2011	2012	2013	Financial status
CESPM (Mexicali)					
[Income]					• Until 2012, CESPM was the only executing agency in the project that was able to cover maintenance costs including labor costs with the income from water charges. However, it is operating at a loss mainly due to the payment of interest and depreciation costs. The fee collection rate has been decreasing in general since 2011. • Because of the above-explained financial situation, the rating company Fitch Ratings revised the rating for CESPM downwards from A to A- (in the system used in Mexico) in August 2013. It still considers that the default risk is low.
Water charges	845	870	956	873	
Others	83	112	103	47	
Subtotal (A)	928	982	1,059	920	
[Expenditure]					
Operation and maintenance costs*1	716	755	877	927	
Others	372	374	358	350	
Subtotal (B)	1,088	1,129	1,235	1,277	
(A) - (B)	-160	-147	-176	-375	
Fee collection rate*2	83%	88%	83%	74%	
CESPT (Tijuana)					
[Income]					• At CESPT, the operation and maintenance costs have been larger than the income from water charges for the three years from 2010 to 2012. Therefore, CESPT has been operating at a loss. However, income from water charges is increasing every year and the deficits are decreasing in general. • Fitch Ratings continued to rate CESPT as A in the Mexican system in October 2013.
Water charges	1,633	1,746	1,895	2,023	
Others	295	276	413	313	
Subtotal (A)	1,928	2,022	2,308	2,336	
[Expenditure]					
Operation and maintenance costs*1	1,694	2,088	2,028	2,058	
Others	172	144	434	395	
Subtotal (B)	1,866	2,232	2,462	2,453	
(A) - (B)	62	-210	-154	-117	
Fee collection rate*2	71%	67%	70%	72%	
CESPE (Ensenada)					
[Income]					• CESPE has been operating at a loss for the past four years. In 2012, the income from water charges increased to the point where it can just about cover the operation and maintenance costs. • Fitch Ratings continued to rate CESPE as BB in the Mexican system in October 2013.
Water charges	302	329	368	391	
Others	29	28	3	4	
Subtotal (A)	331	357	371	395	
[Expenditure]					
Operation and maintenance costs*1	331	343	365	388	
Others	63	73	78	57	
Subtotal (B)	394	416	443	445	
(A) - (B)	-63	-59	-72	-50	
Fee collection rate*	81%	78%	81%	77%	

Source: The financial statements are from CESPM (Mexicali), CESPT (Tijuana) and CESPE (Ensenada). The data on fee collection rates is from CEA.

*1: Including the labor costs

*2: The fee collection rate = (the amount collected in the relevant fiscal year ÷ the amount billed in the relevant fiscal year) × 100.

Water charges are categorized into domestic[45], commercial, industrial and public. The sewerage charges are categorized into charges for households and others. The charges are calculated based on the investment costs for water supply and sewerage development and the maintenance costs for the developed infrastructure. They are then announced in an official gazette. The state ordinance stipulates that the charges can be revised upwards only within the inflation rate announced by the Bank of Mexico every year. As an exception, the state ordinance also allows a special increase in charges (including an increase exceeding the inflation rate) where necessary, such as for recovering investment. However, according to interviews with the State Commissions for Public Services, the charges to be applied from January 2014 only increased by 5%, while in reality a 25% increase was needed. Therefore the level of charges continues to put pressure on their operations.

As explained above, all three State Commissions for Public Services have been operating at a loss, and therefore concern remains about the financial sustainability of their operation and maintenance systems.

3.5.4 Current Status of Operation and Maintenance

The following explains the situation for the operation and maintenance of the facilities and equipment in each city at the time of the Ex-Post Evaluation. Equipment and machinery other than the ones which are pointed out to be malfunctioning and unrepaired below are all working and being run properly.

CESPM (Mexicali)

- Water treatment plants: Regarding the Second Water Treatment Plant, there were leaks in the water pipes connecting to two distribution reservoirs. At the time of the on-site survey, the repair work was in progress and was expected to be completed by the end of 2014.
- Sewage treatment plants: The amount of water flowing into the treatment plants decreased due to an increase in citizens' water-saving awareness, and this increased BOD in the sewage at the treatment plants. As a measure to treat the increased load, more anaerobic chambers and aerators will be installed at the Zaragoza Sewage Treatment Plant using the FY 2015 budget.

CESPT (Tijuana)

- The La Morita Sewage Treatment Plant and the Monte de Los Olivos Sewage Treatment Plant: Because the sand separators are getting worn away, the maintenance manual will be altered and preventive maintenance will be conducted more frequently. At the time of the Ex-Post Evaluation, the fans were being replaced.

[45] Tap water charges and sewerage charges are not separated in the bills. The sewerage charges account for about 40% of the total charges.

CESPE (Ensenada)

- The El Sauzal Sewage Treatment Plant: The sludge collector in the settling tank was unbalanced and the accumulated sludge that has settled in the tank cannot be removed properly. The settling tank was planned to be emptied in March 2014 in order to replace the collector, but a budget could not be secured and it has not been replaced.
- Pumping stations: The emergency generator at the relay pumping station in the northeastern part of Ensenada had broken down and has not been repaired. At the IMSS Pumping Station, the sand separator control system and the vortex pump need to be replaced and the flowmeter needs to be repaired, but they have not been done due to delays in obtaining spare parts. At the majority of pumping stations, the salt tolerance coating maintenance is being delayed and sea breezes are corroding the outer surface of the water pipes. The maintenance of coarse screens is also being delayed. The obtainment of spare parts is being delayed at CESPE (Ensenada) due to various problems, for example parts have not been purchased for over one year due to a lack of funds although purchase requests have been submitted, and parts have not been delivered due to the manufacturers' circumstances.

At the time of the Ex-Post Evaluation, there were no major problems in the operation and maintenance at CESPM (Mexicali) and CESPT (Tijuana). The necessary repairs and the obtainment and replacement of spare parts have already been done or are included in the maintenance plan for the next fiscal year. With regard to CESPE (Ensenada), there were problems concerning the obtainment of spare parts and maintenance was not being conducted as planned, due to budget shortages and insufficient human resources (both in terms of institutional structure and technical levels) as explained above. Unrepaired equipment and machinery were seen in various places at CESPE's facilities.

As has been seen above, some minor problems have been observed in terms of the institutional, technical and financial aspects of the maintenance system for the project as well as the current status of the operation and maintenance of the project. Therefore sustainability of the project effect is fair.

4. Conclusion, Lessons Learned and Recommendations

4.1 Conclusion

This project aimed to solve water pollution problems by developing the water supply and sewerage infrastructure of three cities in Baja California, namely Mexicali, Tijuana and Ensenada.

This project was in line with the development plans of the Mexican government and the Baja California state government and their development needs as well as with Japan's ODA

policy at the times of the appraisal and the Ex-Post Evaluation. Therefore its relevance is high. All the operation and effect indicators for water supply and sewerage systems have improved greatly in each city. The targets set at the time of the appraisal were achieved or the values are improving steadily. Although the water supply and sewerage project in Tijuana includes the unfinished Tecolote-La Gloria Sewage Treatment Plant, CESPT (Tijuana) constructed temporary small-scale sewage treatment plants using its own funds and it is providing a partial service. Therefore, the sewerage development project in Tijuana has been effective despite the delay in the development of the Tecolote-La Gloria Sewage Treatment Plant. The External Evaluator found evidence of project effects including a reduction in river water pollution, an improvement in the residents' living conditions, an improvement in environmental problems concerning Mexico and the US and the reuse of treated sewage by CESPM (Mexicali) and CESPT (Tijuana). Therefore the project's effectiveness and impact is high. Although the project cost was within the plan, the project period has significantly exceeded the plan because the Tecolote-La Gloria Sewage Treatment Plant is unfinished. Therefore the efficiency of the project is fair. Some problems have been observed in terms of the financial aspects of the operation and maintenance system administered by the State Commissions for Public Services in all three cities. Some problems have also been observed in terms of the technical aspects of the operation and maintenance system administered by CESPE (Ensenada). Therefore sustainability of the project effect is fair.

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

4.2 Recommendations

4.2.1 Recommendations to the Executing Agencies

- CESPT (Tijuana): Because the Tecolote-La Gloria Sewage Treatment Plant is unfinished, there is a delay in the improvement of the relevant residents' living conditions and there are also negative impacts on the natural environment such as the fact that about 50% of the sewage from the relevant area is discharged into a river without being treated. CESPT (Tijuana) has already formulated two detailed plans for the measures to be taken, however, it is desirable that it takes urgent decisions and develops the necessary sewage treatment facility.
- CESPE (Ensenada): It is desirable that CESPE improves its management policy, institutional structure for maintenance, and its technical level to similar levels such as CESPM (Mexicali) and CESPT (Tijuana), and provides a more stable water supply and sewerage services to the citizens. Regarding the water supply system which was excluded from the project due to the delay in the launch of the project, there are problems such as the interruption of water supply, as well as water quality problems. CESPE needs to formulate

and implement specific plans on the measures to be taken and state when they will be put into action in order to solve these problems in the future.

- All the three State Commissions for Public Services: Regarding the problems stated in "3.5.4 Current Status of Operation and Maintenance," it is desirable that the three commissions make sure that countermeasures to these problems will be included in future budgets and maintenance programs, and take urgent measures. In addition, in light of the results of the beneficiary survey, it is necessary to conduct the water treatment process thoroughly and also to improve the maintenance and implementation systems for the water mains and sewer pipe networks.

4.2.2 Recommendations to JICA

- Regarding CESPT (Tijuana) Tecolote-La Gloria Sewage Treatment Plant, after consulting and agreeing with CESPT (Tijuana), JICA should continuously check the progress of Plant. For that, the following future measures must be taken: JICA should indicate that both CESPT (Tijuana) and JICA are both accountable, and request CESPT (Tijuana) to submit a progress report, as well as the "Monitoring Sheet" which will be provided to CESPT (Tijuana) together with this Ex-Post Evaluation Report, once every two months for instance.
- The discharge of water from sewage treatment plants in desert areas is an important issue for many countries. Therefore, it is desirable to introduce the efforts made at the Las Arenitas Wetlands to a wider population as an example of best practice.

4.3 Lessons Learned

Appropriate Monitoring of Projects that are Experiencing Delays

The "Tijuana Bid Package 7" which included the unfinished Tecolote-La Gloria Sewage Treatment Plant (see 3.4.2.2 Project Period for details) was identified for having problems already since 2007. In ODA loan projects that are large in size and take longer time, it is important to also conduct periodical site visits of subprojects, and also to have agreements on detailed project monitoring procedures, not only with the executing agency but also with the entities in charge of subprojects.

Especially, when it is possible to see that a particular subproject might be delayed for a long period, it is desirable that JICA conducts discussions not only with the executing agency, but also with the entities in charge of the subproject and the consultants, in order to agree on specific project monitoring plans including possible scenarios that can be foreseen in the future and what actions will be taken by when. In projects that have particular problems, such as the case of the unfinished construction site of this project, it is desirable to collect information not only from the executing agency, but also directly from the entities that are overseeing the construction and managing that particular subproject. In addition, sharing knowledge on

measures that were taken in similar problems (regarding project and contract management etc.) of other JICA projects in other countries[46], so that operation departments and overseas representative offices can use these to analyze and solve project management problems, is also an idea worth considering.

End

[46] In similar ODA loan projects that resulted in delayed project periods due to unfinished construction works, there have been cases where the contract was completely canceled when the contractor suspended construction works, or as a way of avoiding the cancellation of the contract, supplementary clauses were added to the contract so that part of the implementation of the project would be transferred to the executing agency. These measures have minimized impacts on the whole project as a result.

[Annex I] Operation and Effect Indicators

A. Water Supply Projects: Operation and Effect Indicators[*1]

	Benchmark value 1999	Target value at completion	2007	2008 Completion Year[*2]	2009 One year after project completion	2010 Two years after project completion[*2]	2011	2012	2013	Target achievement rate two years after project completion
Operation indicators										
Population supplied with water (10,000 people)[*3]										
• Mexicali	59.8	79.8	68.8	70.6	75.2	76.7	78.5	80.4	82.3	96%
• Tijuana	115.2	131.2	147.9	163.2	168.4	174.2	172.5	181.4	187.8	133%
• Ensenada	-	-	27.6	28.8	28.2	28.8	29.9	29.9	31.7	-
Amount of water supplied (million m^3/year)										
• Mexicali	101.7	Not set	84.4	85.7	86.7	80.1	82.6	85.9	85.9	Stagnating
• Tijuana	100.3		110.5	111.3	109.7	105.8	110.1	117.8	114.2	Slightly decreased
• Ensenada	-		21.8	21.6	21.6	21.7	22.3	22.7	21.9	-
Percentage of non-revenue water[*4] (%)										
• Mexicali	28%	25% or less	14%	17%	17%	13%	14%	16%	16%	Achieved
• Tijuana	27%	20% or less	19%	20%	20%	19%	21%	19%	19%	Achieved
• Ensenada	27%	20% or less	20%	19%	19%	21%	21%	21%	17%	-
Water quality (turbidity/NTU)										
• Mexicali	-	National	0.53	0.40	0.41	0.49	0.47	0.49	0.43	Achieved
• Tijuana	1.5	standards:	0.47	0.53	0.54	0.63	0.57	0.51	0.38	Achieved
• Ensenada	1.0	<1.0	0.96	0.97	0.97	0.97	0.97	0.96	0.98	-
Effect indicators										
Water supply coverage (%)										
• Mexicali	97%	100%	99.2%	99.3%	99.3%	99.4%	99.5%	99.6%	99.7%	99.4% (at least 80% achieved)
• Tijuana	88%	97% or more	93.4%	97.5%	98.7%	98.9%	98.0%	99.1%	98.7%	102%
• Ensenada	94.2%	Not set	97.4%	97.8%	98.5%	98.6%	98.6%	98.6%	99.4%	-

B. Sewerage Projects: Operation and Effect Indicators[*5]

	Benchmark value 1999	Target value at completion	2007	2008	2009	2010[*6] Completion year	2011 One year after project completion	2012 Two years after project completion	2013	Target achievement rate two years after project completion
Operation indicators										
Population receiving sewage treatment service (10,000 people)										
• Mexicali	51.0	Not set	65.5	67.5	71.9	73.3	75.0	76.8	78.6	Increasing steadily
• Tijuana	71.0		156.3	145.7	151.3	157.0	155.2	163.9	169.3	
• Ensenada	NA		24.2	26.9	26.5	27.1	27.8	29.0	29.7	
Amount of sewage treated (million m^3)/year										
• Mexicali	37.5	Not set	50.2	55.5	57.0	55.9	56.3	57.7	57.8	Increasing steadily
• Tijuana	NA		75.6	64.6	75.8	76.3	82.1	81.3	82.5	
• Ensenada	NA		14.5	15.7	16.6	16.9	17.6	17.8	17.9	
Effect indicators										
Sewerage system coverage (%)										
• Mexicali	89%	97%	94.4%	95.0%	94.9%	95.0%	95.1%	95.2%	95.3%	98% (at least 80% achieved)
• Tijuana	61%	85%	80.5%	87.1%	88.7%	89.1%	88.2%	89.6%	89.3%	105%
• Ensenada	71%	80%	85.6%	91.3%	92.5%	92.7%	91.7%	93.2%	93.4%	116%
Amount of reused water resulting from sewage treatment (million m^3/year)		Not set								
• Mexicali	0		13.4	14.3	43.0	40.4	41.8	45.5	45.4	Increasing in general
• Tijuana	0		2.3	2.5	3.7	3.2	3.8	4.1	4.5	Increasing in general
• Ensenada	0		0.6	0.6	0.5	0.2	0.1	0.2	0.2	Mostly unchanged

Source: The planned values are from JICA's materials given at the time of the appraisal. The actual values are from each State Commission for Public Services and CEA.

*1: Water supply projects were not conducted in Ensenada. Therefore the indicators shown above are for reference only.

*2: "The year of completion" for the water supply projects is 2008 which is when all the projects in Mexicali and Tijuana were completed. The evaluation was conducted for 2010 (two years after the project's completion) onwards.

*3: The materials for internal use state that the target value for the additional population supplied with water should be 200,000 people in Mexicali and 160,000 people in Tijuana, but they were not clearly defined as indicators nor was the benchmark fiscal year. Therefore, in the Ex-Post Evaluation, the benchmark year was set to be 1999 and the target value at the time of the project completion was set to be the sum of the population supplied with water in 1999 and the additional population supplied with water mentioned above.

*4: The percentage of non-revenue water = (The amount of water which did not become subject to the collection of charges) ÷ (the amount of water supplied) × 100

*5: For the income from water charges and the fee collection rate, please see "3.5.3 Financial Aspects of Operation and Maintenance" in "3.5 Sustainability."

*6: The year of completion for the sewerage projects was considered to be 2010 which is when all the sewerage infrastructure developments in the three cities were completed except for the Tecolote-La Gloria Sewage Treatment Plant. The evaluation was conducted for 2012 (two years after the project's completion).

[Annex II] Operation Indicators for Each Water Treatment Plant and Sewage Treatment Plant

	Actual								
	2005	2006	2007	2008 Year of completion of water supply projects	2009	2010 Year of completion of sewerage projects	2011	2012	2013
CESPM (Mexicali)									
Water Supply Projects									
Xochimilco Water Treatment Plant (Treatment Capacity: 1,100 l/s)									
Population Served (1000 persons)	—	—	96,886	150,671	154,069	157,543	161,096	164,736	168,448
Amount of Water Supply (m^3/day)	—	—	31,043	54,049	53,373	47,249	43,388	47,807	50,092
Facility Utilization Rate (%)	—	—	27%	23%	47%	40%	40%	40%	44%
Water Treatment Plant No. 2 (Treatment Capacity: Approx. 2,750 l/s)									
Population Served (1000 persons)	388,518	397,280	406,239	481,255	492,108	503,206	514,554	526,180	538,037
Amount of Water Supply (m^3/day)	125,307	119,071	130,163	153,942	144,183	135,449	148,349	152,002	156,743
Facility Utilization Rate (%)	73%	69%	55%	65%	60%	56%	62%	63%	72%
Sewerage Projects									
Las Arenitas Sewage Treatment Plant (Treatment Capacity: Approx. 840 l/s)									
Amount of waste water treated (m^3/day)	—	—	55,717	61,281	59,233	64,207	66,111	68,392	72,032
Facility Utilization Rate (%)	—	—	77%	84%	82%	86%	91%	94%	99%
BOD Reduction Rate (%)	—	—	75%	77%	73%	78%	81%	80%	78%
SS Reduction Rate (%)	—	—	75%	74%	60%	94%	82%	81%	70%
Guadalupe Victoria Sewage Treatment Plant (Treatment Capacity: Approx. 70 l/s)									
Amount of waste water treated (m^3/day)	—	—	1,963	2,301	2,275	1,501	2,523	2,904	2,878
Facility Utilization Rate (%)	—	—	3%	38%	38%	37%	42%	48%	47%
BOD Reduction Rate (%)	—	—	—	85%	87%	96%	90%	92%	92%
SS Reduction Rate (%)	—	—	—	58%	78%	75%	77%	65%	76%
Estacion Coahuila Sewage Treatment Plant (Treatment Capacity: Approx. 20 l/s)									
Amount of waste water treated (m^3/day)	—	—	—	295	798	768	730	763	832
Facility Utilization Rate (%)	—	—	—	17%	46%	48%	42%	44%	48%
BOD Reduction Rate (%)	—	—	—	—	82%	89%	93%	95%	95%
SS Reduction Rate (%)	—	—	—	—	44%	97%	44%	31%	40%
Los Algodones Sewage Treatment Plant (Treatment Capacity: Approx. 20 l/s)									
Amount of waste water treated (m^3/day)	—	—	523	513	558	623	468	750	1,278
Facility Utilization Rate (%)	—	—	30%	19%	32%	39%	27%	43%	74%
BOD Reduction Rate (%)	—	—	—	87%	78%	95%	88%	90%	88%
SS Reduction Rate (%)	—	—	31%	47%	51%	98%	68%	64%	31%
Ciudad Morelos Sewage Treatment Plant (Treatment Capacity: Approx. 30 l/s)									
Amount of waste water treated (m^3/day)	—	615	1,113	1,040	1,230	1,302	1,352	1,418	1,547
Facility Utilization Rate (%)	—	24%	43%	40%	47%	50%	52%	55%	60%
BOD Reduction Rate (%)	—	32%	55%	91%	87%	82%	83%	89%	84%
SS Reduction Rate (%)	—	13%	63%	71%	76%	68%	73%	73%	27%
Colonia Zaragoza Sewage Treatment Plant (Treatment Capacity: 1,300 l/s)									
Amount of waste water treated (m^3/day)	68,447	67,040	68,661	66,856	71,758	69,750	69,789	68,449	65,726
Facility Utilization Rate (%)	61%	59%	61%	59%	64%	62%	62%	61%	59%
BOD Reduction Rate (%)	—	38%	25%	17%	80%	16%	23%	26%	31%
SS Reduction Rate (%)	—	54%	44%	23%	75%	25%	29%	40%	32%
CESPT (Tijuana)									
Sewerage Projects									
Monte de Olivos Sewage Treatment Plant (Treatment Capacity: Approx. 340 l/s)									
Amount of waste water treated (m^3/day)	—	—	—	—	11,698	17,589	18,774	15,965	16,735
Facility Utilization Rate (%)	—	—	—	—	29%	44%	47%	43%	42%
BOD Reduction Rate (%)	—	—	—	—	98%	99%	99%	98%	97%
SS Reduction Rate (%)	—	—	—	—	99%	99%	99%	99%	97%
La Morita Sewage Treatment Plant (Treatment Capacity: 254 l/s)									
Amount of waste water treated (m^3/day)	—	—	—	—	—	2,814	6,769	10,839	14,636
Facility Utilization Rate (%)	—	—	—	—	—	13%	31%	50%	67%
BOD Reduction Rate (%)	—	—	—	—	—	98%	99%	97%	96%
SS Reduction Rate (%)	—	—	—	—	—	98%	99%	99%	98%
Tecolote la Gloria Sewage Treatment Plant: Not completed thus no data is available									
CESPE (Ensenada)									
Sewerage Project									
El Sauzal Sewage Treatment Plant (Treatment Capacity: 120 l/s)									
Amount of waste water treated (m^3/day)	3,024	2,791	3,370	2,851	2,877	2,419	2,765	2,903	2,889
Facility Utilization Rate (%)	29%	27%	33%	28%	28%	23%	27%	28%	27%
BOD Reduction Rate (%)	95%	95%	94%	96%	94%	97%	98%	97%	97%
SS Reduction Rate (%)	94%	94%	94%	96%	95%	95%	97%	94%	95%

Source: CESPM (Mexicali), CESPT (Tijuana), CESPE (Ensenada).

[Annex III] Effect Indicators: Quality of the Water Discharged from Sewage Treatment Plants

Name of Sewage Treatment Plant	National Standard NOM-001-SEMARNAT-1996	Actual					2010 Completion Year	2011 One year after completion	2012 Two years after completion	2013 Three years after completion
		2005	2006	2007	2008	2009				
CESPM (Mexicali)										
Las Arenitas Sewage Treatment Plant										
BOD Emission Volume (Ton/year)	—	—	—	1,607	1,178	886	934	1,238	1,100	1,228.90
BOD Concentration (mg/l)	75	—	—	79	52	41	39	51	43	42.8
	Achieved									
COD Emission Volume (Ton/year)	—	—	—	7	4	3	3	3	3	731.8
COD Concentration (mg/l)	250	—	—	253	213	169	192	184	171	161.1
	Achieved									
SS Emission Volume (Ton/year)	—	—	—	6	5	4	5	4	4	311.1
SS Concentration (mg/l)	75	—	—	61	57	63	67	55	64	65.7
	Achieved									
NH_3-N (Ammoniac Nitrogen) mg/l	—	—	—	31	22	22	25	21	26	27.3
Total Nitrogen (T-N) mg/l	40	—	—	40	31	32	31	31	36	36.2
	Achieved									
Total Phosphorus (T-P) mg/l	30	—	—	9	7.53	5.21	2.96	5.44	5.76	5.7
	Achieved									
pH (Range)	10-5	—	—	8	8.31	8.38	8.43	8.22	8.12	8.29
	Achieved									
Number of Coliform Bacteria (MPN/100ml)\	2000	—	—	5,722	3,895	102	240	756	971	239.9
	Achieved									
Guadalupe Victoria Sewage Treatment Plant										
BOD Emission Volume (Ton/year)	—	—	—	120	23	21	14	15	15	21.9
BOD Concentration (mg/l)	75	—	—	167	27	25	24	16	14	13.7
	Achieved									
COD Emission Volume (Ton/year)	—	—	—	24	2	1	2	1	1	35.8
COD Concentration (mg/l)	250	—	—	398	165	159	193	165	123	178
	Achieved									
SS Emission Volume (Ton/year)	—	—	—	29	3	3	4	2	2	7.5
SS Concentration (mg/l)	75	—	—	200	56	44	51	39	39	37
	Achieved									
NH_3-N (Ammoniac Nitrogen) mg/l	—	—	—	35	27	33	36	39	36	40
Total Nitrogen (T-N) mg/l	40	—	—	44	36	40	46	46	43	45.6
	Achieved									
Total Phosphorus (T-P) mg/l	30	—	—	7.82	7.81	6.53	7.23	6.55	6.45	7.02
	Achieved									
pH (Range)	10-5	—	—	7.4	8.26	8.13	7.97	8.08	7.94	8.14
	Achieved									
Number of Coliform Bacteria (MPN/100ml)\	2000	—	—	20,920,000	44	132	91	17	12	5.3
	Achieved									
Estacion Coahuila Sewage Treatment Plant										
BOD Emission Volume (Ton/year)	—	—	—	—	0.49	8	7	3	2	3.2
BOD Concentration (mg/l)	75	—	—	—	4.51	26	25.3	11.46	6.9	5.4
	Achieved									
COD Emission Volume (Ton/year)	—	—	—	—	0.14	2	2	1	0.43	7.1
COD Concentration (mg/l)	250	—	—	—	87	206	198	203	171	144.3
	Achieved									
SS Emission Volume (Ton/year)	—	—	—	—	1	5	5	6	6	5.8
SS Concentration (mg/l)	75	—	—	—	16	69	63	76	99	60.7
	Achieved									
NH_3-N (Ammoniac Nitrogen) mg/l	—	—	—	—	31	22	16	22	22	24.9
Total Nitrogen (T-N) mg/l	40	—	—	—	35	28	23	31	32	31.4
	Achieved									
Total Phosphorus (T-P) mg/l	30	—	—	—	10	6.34	4.8	5.41	6.15	5.2
	Achieved									
pH (Range)	6-10	—	—	—	7.88	8.41	8.47	8.25	8.13	8.1
	Achieved									
Number of Coliform Bacteria (MPN/100ml)\	2000	—	—	—	3	16	61	88	3.38	102.7
	Achieved									
Los Algodones Sewage Treatment Plant										
BOD Emission Volume (Ton/year)	—	—	—	10	4	8	4	3	4	10.7
BOD Concentration (mg/l)	75	—	—	53	19	37	19	19	15	12.8
	Achieved									
COD Emission Volume (Ton/year)	—	—	—	2	1	3	1	1	1	13.3
COD Concentration (mg/l)	250	—	—	120	134	189	151	162	140	165.7
	Achieved									
SS Emission Volume (Ton/year)	—	—	—	2	3	4	3	4	2	116
SS Concentration (mg/l)	75	—	—	57	59	58	60	59	45	57.3
	Achieved									
NH_3-N (Ammoniac Nitrogen) mg/l	—	—	—	10	16	18	16	22	24	30
Total Nitrogen (T-N) mg/l	40	—	—	15	22	25	23	29	31	39.8
	Achieved									
Total Phosphorus (T-P) mg/l	30	—	—	2.99	4.5	3.92	2.96	4.15	5.09	5.3
	Achieved									
pH (Range)	6-10	—	—	8	8.23	8.23	8.19	8	7.74	7.83
	Achieved									
Number of Coliform Bacteria (MPN/100ml)\	2000	—	—	410,000	12	5	318	36	70	26.7
	Achieved									
Ciudad Morelos Sewage Treatment Plant										
BOD Emission Volume (Ton/year)	—	—	33	65	7	14	12	11	8	12
BOD Concentration (mg/l)	75	—	149	160	18	30	24	22	14	20
	Achieved									
COD Emission Volume (Ton/year)	—	—	19	25	1	2	1	1	1	0.8
COD Concentration (mg/l)	250	—	347	434	165	143	143	143	103	115
	Achieved									
SS Emission Volume (Ton/year)	—	—	15	21	3	2	2	2	1	0.4
SS Concentration (mg/l)	75	—	115	132	56	47	44	37	34	60
	Achieved									
NH_3-N (Ammoniac Nitrogen) mg/l	—	—	36	33	26	22	28	36	34	36
Total Nitrogen (T-N) mg/l	40	—	7	40	35	29	34	43	40	42
	Achieved except 2011 and 2013									
Total Phosphorus (T-P) mg/l	30	—	9.85	7.66	7.53	5.52	5.32	4.15	5.56	6
	Achieved									
pH (Range)	6-10	—	7.8	7.4	8.45	7.99	8.01	7.97	8.01	7.95
	Achieved									
Number of Coliform Bacteria (MPN/100ml)\	2000	—	12,750,000	19,380,000	47	82	67	14	9	31
	Achieved									

Name of Sewage Treatment Plant	National Standard NOM-001-SEMARNAT-1996	Actual								
		2005	2006	2007	2008	2009	2010 Completion Year	2011 One year after completion	2012 Two years after completion	2013 Three years after completion
CESPM (Mexicali)										
Colonia Zaragoza Sewage Treatment Plant										
BOD Emission Volume (Ton/year)	—	—	2,104	1,353	1,001	1,231	917	1,070	350	336
BOD Concentration (mg/l)	75	—	86	54	41	47	36	4	14	14
	Achieved									
COD Emission Volume (Ton/year)	—	—	5,407	4,135	4,490	5,133	5,091	5,094	2,573	2,758
COD Concentration (mg/l)	250	—	221	165	184	196	200	200	103	115
	Achieved									
SS Emission Volume (Ton/year)	—	—	1,908	1,578	1,122	1,440	1,145	1,171	849	983
SS Concentration (mg/l)	75	—	78	63	46	55	45	46	34	41
	Achieved									
NH_3-N (Ammoniac Nitrogen) mg/l	—	—	26	27	24	28	27	30	34	36
Total Nitrogen (T-N) mg/l	40	—	37	35	40	37	36	39	40	42
	Achieved except 2013									
Total Phosphorus (T-P) mg/l	30	—	8.91	8	6.86	6.97	5.85	6.25	5.56	6.01
	Achieved									
pH (Range)	6-10	—	8.3	8.2	8.19	8.08	8.19	8.1	8.01	7.9
	Achieved									
Number of Coliform Bacteria (MPN/100ml)\	2000	—	550,000	30,000	62	9	55	325	10	31
	Achieved									
CESPT (Tijuana)										
Monte de Olivos Sewage Treatment Plant										
BOD Emission Volume (Ton/year)	—	—	—	—	—	29.9	32.7	37.7	43.6	35.4
BOD Concentration (mg/l)	75	—	—	—	—	7	5.1	5.5	7.49	5.8
	Achieved									
COD Emission Volume (Ton/year)	—	—	—	—	—	175.1	242	223.4	190.6	185.7
COD Concentration (mg/l)	250	—	—	—	—	41	37.7	32.6	32.72	30.4
	Achieved									
SS Emission Volume (Ton/year)	—	—	—	—	—	29.9	39.8	36.3	30.7	30.7
SS Concentration (mg/l)	75	—	—	—	—	7	6.2	5.3	5.28	5.02
	Achieved									
NH3-N (Ammoniac Nitrogen) mg/l	40	—	—	—	—	5	13.8	29.4	18.9	28.9
	Achieved									
PO4-P (phosphate-phosphorus) mg/l	30	—	—	—	—	5	14.8	6.5	4.9	8.84
	Achieved									
pH (Range)	6-10	—	—	—	—	7.4	7.4	7.4	7.32	7.08
	Achieved									
Number of Coliform Bacteria (MPN/100ml)\	2000	—	—	—	—	223	175	697	890	239
	Achieved									
La Morita Sewage Treatment Plant										
BOD Emission Volume (Ton/year)	—	—	—	—	—	—	9	13.3	49.5	40.8
BOD Concentration (mg/l)	75	—	—	—	—	—	8.8	5.38	12.5	7.64
	Achieved									
COD Emission Volume (Ton/year)	—	—	—	—	—	—	67.6	96.6	165	228.9
COD Concentration (mg/l)	250	—	—	—	—	—	65.8	39	41.7	42.85
	Achieved									
SS Emission Volume (Ton/year)	—	—	—	—	—	—	8.3	13	21.6	31.19
SS Concentration (mg/l)	75	—	—	—	—	—	8	5.28	5.46	5.84
	Achieved									
NH3-N (Ammoniac Nitrogen) mg/l	40	—	—	—	—	—	27.2	31.2	27.6	24.25
	Achieved									
PO4-P (phosphate-phosphorus) mg/l	30	—	—	—	—	—	4.9	6.7	7	7.3
	Achieved									
pH (Range)	6-10	—	—	—	—	—	7.65	7.43	7.33	7.24
	Achieved									
Number of Coliform Bacteria (MPN/100ml)\	2000	—	—	—	—	—	910	436	329	132.5
	Achieved									
Tecolote la Gloria Sewage Treatment Plant										
CESPE (Ensenada)										
El Sauzal Sewage Treatment Plant										
BOD Emission Volume (Ton/year)	—	18	14	21	11	14	8	10	10	10.75
BOD Concentration (mg/l)	75	16	14	17	11	13	9	10	9	10.4
	Achieved									
COD Emission Volume (Ton/year)	—	56	58	76	47	41	37	46	55	77.47
COD Concentration (mg/l)	250	51	57	62	45	39	42	46	52	74.9
	Achieved									
SS Emission Volume (Ton/year)	—	14	13	17	11	14	12	10	16	14.9
SS Concentration (mg/l)	75	13	13	14	11	13	14	10	15	14.41
	Achieved									
Total Nitrogen (T-N) mg/l	40	5.83	—	—	16	14.41	15.65	14.69	10.6	12.95
	Achieved									
Total Phosphorus (T-P) mg/l	30	7.64	—	—	4.4	6.51	6.22	7.03	5.09	5.93
	Achieved									
pH (Range)	6-10	7	6.9	7.2	7.1	7.2	7.2	7.2	7.3	7
	Achieved									
Number of Coliform Bacteria (MPN/100ml)\	2000	776	—	—	278	<3	<3	<34	36	<3
	Achieved									

Source: CESPM (Mexicali), CESPT (Tijuana), CESPE (Ensenada).

Comparison of the Original and Actual Scope of the Project

Item	Original	Actual
(1) Project Outputs		
[Mexicali]		
I. Water supply projects		
a. Newly built Water Treatment Plants (WTP)		
• Colonia Xochimilco WTP	Treatment capacity: 1,000 L/s	Treatment capacity: 1,100 L/s
b. Improved or extended		
• Colonia Progreso WTP	Treatment capacity: approx. 67 L/s	Merged into Colonia Xochimilco WTP
• The First WTP	Treatment capacity: approx. 1,250 L/s	Excluded
• The Second WTP	Treatment capacity: approx. 2,200 L/s	Treatment capacity: approx. 2,750 L/s
• Ejido Nuevo León WTP	Treatment capacity: approx. 35 L/s	Excluded
• Colonia Nacionalista WTP	Treatment capacity: approx. 60 L/s	Merged into Colonia Xochimilco WTP
• Construction of a reservoir for untreated water	1 reservoir Capacity: approx. 80,000 m^3	1 reservoir Capacity: approx. 160,000 m^3
• Construction of water mains	82 km	99 km
• Installation of water meters	Approx. 22,000 units	50,000 units
II. Sewerage projects		
a. Newly built Sewage Treatment Plants(STP)		
• Las Arenitas STP	Treatment capacity: approx. 840 L/s	As planned
• Guadalupe Victoria STP	Treatment capacity: approx. 170 L/s	Treatment capacity: approx. 70 L/s
• Estación Coahuila STP	Treatment capacity: approx. 140 L/s	Treatment capacity: approx. 20 L/s
• Los Algodones STP	Treatment capacity: approx. 110 L/s	Treatment capacity: approx. 20 L/s
• Santa Isabel STP	Treatment capacity: approx. 195 L/s	Canceled
• Ciudad Morelos STP	Treatment capacity: approx. 110 L/s	Treatment capacity: approx. 30 L/s
b. Improved or extended		
• Colonia Zaragoza STP	Treatment capacity: approx. 1,300 L/s	As planned
• Construction and improvement of arterial sewer mains	Approx. 31 km	As planned
• Construction and improvement of branch sewer mains networks	Approx. 183 km	As planned
• Construction and improvement of pumping stations	6 stations	10 stations
[Tijuana]		
I. Water supply projects		
(All newly built)		
• Construction of water mains	Approx. 353 km	362 km
• Construction of pumping stations	9 stations	10 stations
• Construction of distribution reservoirs	15 reservoirs	11 reservoirs (The one in Lázaro Cárdenas was replaced by a pumping station)
• Installation of water meters	23,372 units	58,513 units
• Installation of taps for individual households	31,000 units	167 units
II. Sewage projects		
(All newly built)		
• Monte de Olivos STP	Treatment capacity: approx. 340 L/s	As planned (can be increased to 460 L/s)
• Lomas de Rosarito STP	Treatment capacity: approx. 75 L/s	Excluded
• Tecolote-La Gloria STP	Treatment capacity: approx. 100 L/s	Unfinished (Planned treatment capacity: 120 L/s,

• La Morita STP	Treatment capacity: approx. 150 L/s	construction progress rate: 20.92%) 254 L/s (can be increased to 380 L/s)
• Construction of pumping stations	2 stations	As planned
• Construction of public sewer laterals	76 km	41 km
• Construction of sewer mains	Approx. 627 km	692 km
[Ensenada] I. <u>Water supply projects</u> • Construction of pumping stations	3 stations	-
• Construction of water pipes from water treatment plants to distribution facilities	Approx. 4.4 km	-
• Construction of distribution tanks	3 tanks	-
• Installation of arterial water mains	Approx. 24 km	-
• Construction of water mains networks	Approx. 21 km	
II. <u>Sewerage projects</u> a. Newly built • Construction of arterial sewer mains	6.5 km	6.11 km
• Construction of public sewer laterals	-	13.11 km
• Construction of branch sewer mains networks	-	33.77 km
• Construction of pumping stations	-	3 stations
b. Improved or extended • Improvement of El Sauzal STP	-	Treatment capacity was increased from 60 L/s to 120 L/s
• Construction and improvement of pumping stations	-	1 station
(2) Project Period	March 2000 - December 2004 (57 months)	March 2000 - May 2013 (171 months) Note: The time when the Ex-Post Evaluation was conducted was used because part the project is unfinished.
(3) Project Cost Amount paid in Foreign currency Amount paid in Local currency	11,180 million yen 25,734 million yen (190 million US dollars)	21,792 million yen 13,070 million yen (117 million US dollars)
Total Japanese ODA loan portion Exchange rate	36,914 million yen 22,148 million yen 1 peso = 15.7 yen (As of May 1998)	34,862 million yen 21,792 million yen 1 US dollar = 110 yen (Average between March 2003 and January 2010) Source: OANDA