

Ex-Post Evaluation of Japanese ODA Grant Aid Project  
Project for Vientiane Water Supply Development

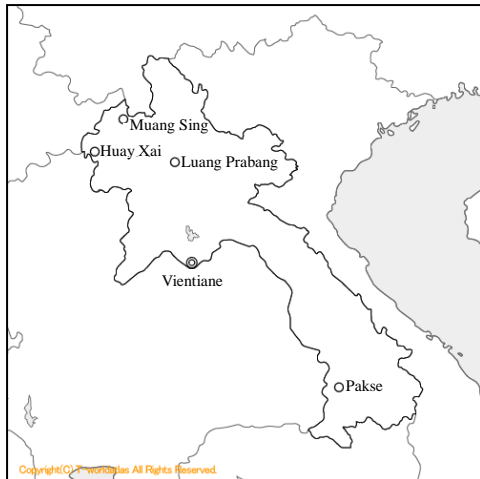
External Evaluator: Noriko Ishibashi, IC Net Limited

**0. Summary**

This project is aimed at expanding and rehabilitating two of the four existing water purification plants in Vientiane<sup>1</sup>, the Kaolieo and Chinaimo Water Purification Plants, for securing a stable water supply and raising the water supply coverage in the service area there. It is relevant to the development plan and development needs of Laos, as well as Japan's ODA policy. Therefore the relevance of the project is high. After the expansion and rehabilitation of the two water purification plants, the amount of water supplied in the city grew as expected, leading to an increased population served and higher water service coverage. However, the actual project period was slightly longer than planned. Therefore the efficiency of the project was fair. In terms of the sustainability of the project, neither of the two water purification plants have any major problem in terms of their daily operation and maintenance, at least at present. However, there is some concern about their sustainability in the future. From the financial point of view, there are challenges to run on a financially self-supporting as an independent organization having self-supporting accounting system. Therefore, the sustainability of this project is fair.

In light of the above, this project is evaluated as (B) satisfactory.

**1. Project Description**



Project Location



Water receiving well at the Kaolieo Water Purification Plant

**1.1 Background**

In its fifth Five-Year National Socio-Economic Development Plan (2001 - 2005), Lao People's Democratic Republic placed great emphasis on the development of the social infrastructure, including water supply and sewerage. In the Development Plan for

<sup>1</sup> At the time of the planning for this Project, in 2003, Vientiane had four water purification plants, Kaolieo, Chinaimo, Thadua, Thagone within the city.

Communication, Transport, Post and Construction, announced earlier than the five-year plan, in 1997, the former Ministry of Communication, Transportation, Post and Construction<sup>2</sup> (currently Ministry of Public Works and Transport: MPWT) set a target of achieving 100 percent water service coverage in large cities as a development objective for the water services sector. Meanwhile, Japan started offering development aid for Vientiane Capital water services as early as 1963. Japan's support for the development of the urban water infrastructure there included the construction and repair of the Kaolieo Water Purification Plant (in 1964 and 1983, respectively) and the upscale and rehabilitation of the Chinaimo Water Purification Plant (between 1992 and 1996) and so forth. Before the implementation of this project, the Study on Vientiane Water Supply Development Project was carried out in 2003 to form a master plan for its water services sector. According to the study, before the implementation of this project, in 2003, Vientiane supplied about 78,000 cubic meters of water per day of its water supply capacity of about 100,000 cubic meters per day, lower than the maximum one-day demand that year of 122,000 cubic meters. Thus supply capacity was insufficient to satisfy the demand. It led to over capacity operation<sup>3</sup> of the existing water purification plants, in case the water demand would be high, whenever required. Expanding and developing its water purification plants to meet the demand for water was an urgent challenge for the city to address.

## 1.2 Project Outline

The objective of this project is to secure a stable water supply and raise the water supply coverage in the service area of Vientiane by upgrading water supply facilities and main water distribution pipeline there.

<b>Grant Limit/ Actual Grant Amount</b>		2,875 million yen / 2,171 million yen	
<b>Exchange of Notes Date</b>		February 2006 (study for the Detailed Design) June 2006 (Construction work)	
<b>Executing Agency:</b>		Ministry of Public Works and Transport, Laos / Vientiane Capital Water Supply Company (NPVC)	<b>Project Completion</b> March 2009
<b>Project contractor</b>	<b>Consultant</b>	Nihon Suido Consultants	
	<b>Constructor</b>	Shimizu Corporation	
	<b>Procurement</b>	Shimizu Corporation	
<b>Feasibility Studies, etc</b>	<b>Basic design study</b>	<b>Detailed design study</b>	
	The Basic Design Study on the project for the Vientiane Water Supply Development 1st: June - September 2004 2nd: April - September 2005	February 2006 - February 2007 (as is in the Completion Report)	

<sup>2</sup> The name of the ministry was changed in 2007 from Ministry of Communication, Transportation, Post and Construction to Ministry of Public Works and Transport (MPWT).

<sup>3</sup> Water supply capability of a facility is in principle determined by its design, however, slightly larger amount can be supplied.

Related Projects	Technical cooperation	Grant aid	Other international and aid agencies, etc.
	<ul style="list-style-type: none"> <li>• Study on Vientiane Water Supply Development Project (March 2003 - February 2004)</li> <li>• Capacity Development of Urban Water Supply Authorities (September 2003 -)</li> <li>• Short-term expert: Water Supply Planning Sector (2000)</li> <li>• Long-term expert: Water Supply Facilities Operations and Maintenance of (2000 - 2002)</li> <li>• Japan Overseas Cooperation Volunteers: Water Purification Plant Water Quality Testing (1998 - 2000)</li> <li>• Senior Volunteers: Water Purification Plant Water Quality Testing (2001 - 2003)</li> <li>• Technical Cooperation Project: Capacity Development of Water Supply System (2002 - 2005)</li> <li>• Senior Volunteers: Non Revenue Water Management (April 2004 - ) (NPVC headquarters)</li> <li>• Senior Volunteers: Water Purification Operation (2004 -) (Chinaimo Water Purification Plant)</li> <li>• Long-term expert: Capacity Development of the Water Supply System (2005 -)</li> </ul>	<ul style="list-style-type: none"> <li>• Kaolieo Water Purification Plant Development Plan (1963)</li> <li>• Vientiane Water Supply Facilities Repair and Expansion Plan (1983)</li> <li>• Vientiane Water Supply Facilities Expansion and Development Plan (1996)</li> <li>• Vientiane National Road 1 Improvement Project</li> </ul>	<ul style="list-style-type: none"> <li>• French Development Agency (AFD) Study on Water Distribution Networks (2003 - 2004)</li> <li>2nd Leakage Prevention Project (2004 - 2005)</li> <li>Training Center Construction Project (Chinaimo Water Purification Plant)</li> <li>• Government of Laos Dongmakhay Water Purification Plant Construction Project</li> </ul>

## 2. Outline of the Evaluation Study

### 2.1 External evaluator

Noriko Ishibashi, IC Net Limited

### 2.2 Duration of Evaluation Study

The duration of this ex-post evaluation study, and that of the field study for it, are as follows:

Duration of the Study: September 2011 - November 2012;

Duration of the Field Study: December 4 - 16, 2011; May 27 - June 1, 2012

### **3. Results of the Evaluation (Overall Rating: B<sup>4</sup>)**

#### **3.1 Relevance (Rating: [3]<sup>5</sup>)**

##### 3.1.1 Relevance with the Development Plan of Laos

In its fifth Five-Year National Socio-Economic Development Plan (2001 - 2005), Laos regarded the spread of waterworks and the expansion of water service coverage as a priority issue in its socio-economic development, placing great emphasis on water supply and sewerage, as well as other social infrastructure. In the seventh Five-Year National Socio-Economic Development Plan (2011 - 2015), announced in 2010, the country set a target of supplying clean water to 80 percent of its total population as one of its objectives in the economic sector. In 1997, the Ministry of Communication, Transport, Post and Construction produced its Development Plan, declaring a target of achieving a water service coverage of 90 percent on a national average basis by 2020, with 100 percent coverage in large cities and 80 percent coverage in small cities, as a development objective in the water services sector. The Ministry of Public Works and Transport, in its National Urban Development Strategy announced in 2010 and to be approved by the government, has set the target for water service coverage in urban areas in 2020 at 80 percent of the population in these areas, or the 1,950,000 people living in urban districts.

In light of the above, this project is evaluated to be highly relevant to the country's development plan and policy.

##### 3.1.2 Relevance with the Development Needs of Laos

At the time of planning for this project, in 2003, it was estimated that the maximum one-day water demand in Vientiane in 2007 would be about 140,000 cubic meters per day. At that time, the two existing water purification plants in the city had a combined purification capacity<sup>6</sup> of 100,000 cubic meters per day<sup>7</sup>, an estimated shortfall of about 40,000 cubic meters water per day. The city saw its demand for water increasing from 2005, with the growing permanent population there, as well as an increasing fluid population, such as workers for private-sector companies and tourists, and the visitors to national sporting events held there. In addition to the two water purification plants for which this project was carried out, the city, having formed a joint venture with a Vietnamese company, was constructing two more plants. It also had a plan to build another plant with capital invested by China.

At the time of planning for this project, the population receiving water supply in Vientiane accounted for only 40 percent of those living in the city, and the remainder depended mainly on wells for water. In such circumstances, this project was conducted as a solution to the forecasted shortfall in the water supply. As Vientiane expected a constantly high level of demand for water, offering the city aid for the development of water supply facilities was highly relevant.

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<sup>4</sup> A: Highly satisfactory, B: Satisfactory, C: Partially satisfactory, D: Unsatisfactory

<sup>5</sup> [3]: High, [2] Fair, [1] Low

<sup>6</sup> Purification capacity of a purification plant, that is designed taking into account the one-day maximum water demand. Therefore it is larger than the 'amount of water supply per day' that is one-day average water supply volume. The actual one-day average water supply volume in 2003 was 78,000 cubic meters.

<sup>7</sup> The existed purification plants were four namely Kaolieo, Chinaimo, Thadue and Thagone, among which NPVC excludes the capacity of Thadue and Thagone because the operation of these two had been for emergency cases etc.

Table 1: Water supply in Vientiane

	2005	2010	2015 Estimate
Population of Vientiane (persons)	698,318	776,261	902,716
Water supply population (persons)	286,935	404,350	466,981
Water supplied (m <sup>3</sup> /day)	120,197	171,807	n.a.
Water service coverage (%)	41	52	52

Source: NPVC data

### 3.1.3 Relevance with Japan's ODA Policy

In its Programme Implementation Plan effective at the time of planning for this project, the Japan International Cooperation Agency (JICA) referred to the stable supply of safe water as one of its five priority “development issues in the infrastructure and energy sectors.” Before the planning for this project, the French Development Agency<sup>8</sup> (L'Agence Française de Développement: AFD; hereinafter referred to as “AFD”) and JICA had agreed to divide the roles between them in the provision of aid for the urban water services sector of Laos, with the former expanding water distribution networks in urban areas and the latter rehabilitating and constructing water purification plants.

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 (Rating: [3])

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

#### 3.2.1.1 Enhancement of the water supply capacity and the facilities utility rate<sup>9</sup>

Table 2 below shows the water supply capacities of the Kaolieo and Chinaimo Water Purification Plants and their facility usage rates.

As of 2010, after their expansion and repair in this project, the Kaolieo and Chinaimo Water Purification Plants had a water supply capacity of 61,000 and 85,000 cubic meters per day, respectively, and their facility usage rate reached 102 and 106 percent, both going above 100 percent.

<sup>8</sup> As stated before, Japan started in 1963 to provide aid to Vientiane for its water services sector. The city was supported in, among others, the construction and repair of the Kaolieo Water Purification Plant, and the expansion and repair of the Chinaimo Water Purification Plant. When JICA conducted the Study on Vientiane Water Supply Development Project (2003 - 2004), the agency held discussions with AFD, agreeing to divide the roles between them; for the former to repair and construct water purification plants for urban districts and for the latter to help expand the water distribution pipe networks. Based on this agreement, this Project was carried out as a grant aid project for the repair and expansion of the water purification plants.

<sup>9</sup> This is calculated by comparing a facility's planned maximum capacity with the actual amount of water supplied, indicating how efficiently it operates compared to its designed capacity.

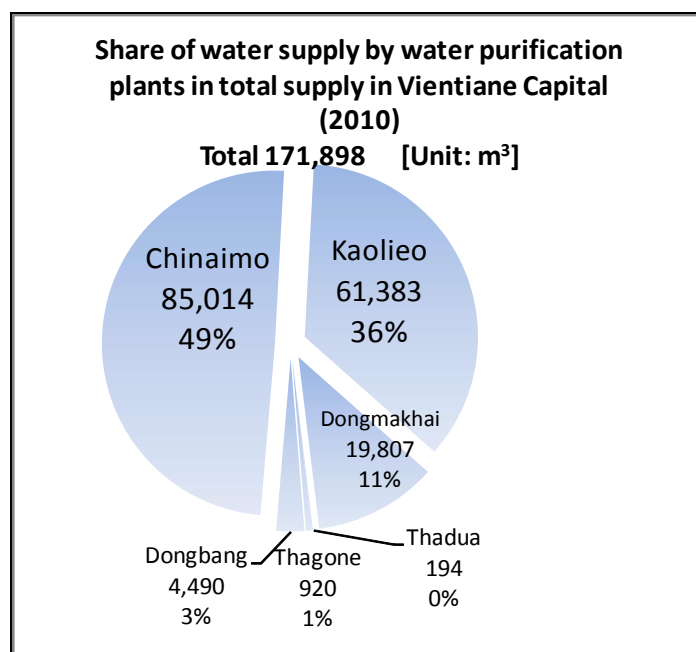
Table 2: Shares of the two water purification plants in the total amount of water supplied in Vientiane

	2010	Design capacity 2009	Facility usage (%)
Water supplied by Kaolieo plant (m <sup>3</sup> /day)	61,383	60,000	102
Water supplied by Chinaimo plant (m <sup>3</sup> /day)	85,014	80,000	106
Total water supplied by the two plants (m <sup>3</sup> /day)	146,397	140,000	105

Source: Basic Design Study Report and NPVC data

### 3.2.1.2 Water supply in Vientiane

The figure below shows the amount of water supplied by the two water purification plants and their proportional share of Vientiane’s total water supply.



Source: NPVC data

Figure 1: Proportional share of the water purification plants in Vientiane of the total water supply

In 2010, when this project had been completed, the city supplied 172,000 cubic meters of water per day on average, against the 2009 target of 105,000 cubic meters, achieving 164% of the plan (See Table 3). The background of this high level of the achievement is due to the contribution from the other new water purification plants shown above in Figure 1 (Dongmakhai and Dongbang Water Purification Plants<sup>10</sup>) had started supplying water. Simultaneously the two plants upgraded by this project are responsible for about 85% of the

<sup>10</sup> Dongmakhai was constructed by the Government of Laos, and Dongbang by a joint venture of a Vietnamese company and NPVC are subscribing.

total water supplied (146,000 cubic meters per day as in Figure 1)<sup>11</sup>. This project also raised the city's water service coverage<sup>12</sup> to 52 percent (114 percent of the plan as in Table 3), which is an excellent achievement compared to the plan (45.6% for 2009).

Table 3: Water supply of the entire Vientiane Water Supply Network<sup>13</sup>, including the two plants for which this project was carried out

	<b>Baseline 2003</b>	<b>2010</b>	<b>Plan 2009</b>	Result/Plan (%)
Population of Vientiane (persons)	651,850	776,261	<b>767,949</b>	101
Water supply population (persons)	251,549	404,350	<b>351,329</b>	115
Water service coverage (%)	39	52	45.6	114
Water supply coverage (%)	47	59	<b>46</b>	128
Water supplied (m <sup>3</sup> /day)	78,251	171,807	<b>105,001</b>	164
Water supplied per capita (liters/person/day)	n.a.	164	<b>n.a.</b>	n.a.
Water supply time (hours/person/day)	24	24	<b>n.a.</b>	n.a.

Source: Basic Design Study Report and NPVC data

### 3.2.1.3 Water supply time, pressure, and quality

According to Vientiane Capital Water Supply Company (commonly known as Nampapa Vientiane Capital hereinafter referred to as “NPVC”), the city's public water service corporation, it supplies water around the clock. At a beneficiary survey<sup>14</sup> conducted among users in the water supply areas of the two water purification plants for which this project was carried out (see also “3.2.2 Qualitative Effects”), the users answered that water was supplied around the clock. Therefore, it is considered that there is not any difficulty in supplying water around the clock. However, there seems to remain something to be improved as the water pressure falls to a low level or water is in short supply in the dry season and during peak times for water use, early in the morning and in the evening, for instance.

The two plants annually examine the quality of the water they supply with regard to the test items specified by the Laos national water quality standards<sup>15</sup>, and these examinations have

<sup>11</sup> Precisely, the total of Dongmakhai and Dongbang supply 24,300 cubic meters per day (approx. 14%), and the existing Thadue and Thagone for 1,200 cubic meters (approx 2%).

<sup>12</sup> The water service coverage is the ratio of the population served in an administrative district to its total population. The water supply coverage is the ratio of the population served with water in a planned water service area to its total population. For this Project, the former is the ratio of the water supply population in Vientiane to its total population, and the latter is the ratio of population who are supplied with water in the Vientiane Water Supply Network (seven of the city's nine districts) to its population.

<sup>13</sup> The Vientiane Water Supply Network is composed of the seven counties of the city. The remaining two counties are part of the other two small-scale water supply networks, but they have been in service only for one year, and are not covered by the NPVC for its statistics.

<sup>14</sup> The survey was conducted in the water supply area for two of the water purification plants of the city. Business establishments were surveyed with person-to-person interviews, and villages were surveyed with group interviews of user representatives chosen by village chiefs. Samples were selected from among ordinary residents in six villages (n=65, 10 to 13 from each village), and among the managers of nine business establishments, whose businesses are hotels or factories (n=10) (75 samples in total).

<sup>15</sup> The standards include 34 test items which comprise: five physical items (color, turbidity, smell, taste, etc.), 20 chemical items (pH, hardness, calcium, etc.), three bacteria-related items (coliform bacilli, etc.), and six harmful substances (arsenic, mercury, lead, etc.).

proved that the standards are satisfied. Their test laboratories in those plants also examine turbidity, color, pH, and other major test items on a daily basis to confirm that the water satisfies the standards before it is distributed. However, a beneficiary survey (see “3.2.2 Qualitative Effects”) revealed that the water became turbid<sup>16</sup> in some areas in the rainy season. As a result, it is understood that safe water is unavailable for some users in the rainy season.

According to the Technical Department of NPVC, the volume of water and/or water pressure fluctuates between time zones not so much because of the amount of water supplied than because in the water supply and distribution facilities, among other issues, some of the branches coming out of the main distribution pipes are too narrow to maintain the water pressure and the water feed pumps installed in some houses prevent the water from going and spreading to the areas around them.

### 3.2.2 Qualitative Effects

#### 3.2.2.1 Amount of water, and water quality

To capture the effects that this project had produced in terms of its qualitative aspects, a beneficiary survey was conducted among the residents in the districts for which the project was carried out. Table 4 below outlines the findings of the survey. As stated above in Chapter 3.2.1.3, the water pressure falls to a low level or the water is in short supply in the dry season and during peak times for water use, early in the morning and in the evening. Nonetheless, all the respondents said that with the completion of the project, housekeeping, hand-washing, and other tasks in daily life had gotten easier.

Table 4: Findings of a beneficiary survey (summary)

Those surveyed	User awareness
Hotels and factories (Nine establishments)	<ul style="list-style-type: none"> <li>• Eight of the nine establishments responded that the amount of water supplied and water pressure improved, so that these two factors can be said to be generally in good condition.</li> <li>• Two establishments answered that from 2007 water was supplied for a longer period in the day.</li> <li>• In terms of water quality, seven establishments said they saw no turbid running water, while two had recognized turbidity in the water.</li> <li>• All the nine establishments said the water charges were at an affordable level. Seven of them also answered that the water bill was at an appropriate level, while two responded that it was too high.</li> <li>• As one of the conditions they would consider in buying a site, five of the nine establishments pointed out access to water.</li> </ul>

<sup>16</sup> In the beneficiary survey, some respondents from two of the nine business establishments surveyed and three of the six villages reported that the water supplied was sometimes turbid.



Village residents (Six villages)	<ul style="list-style-type: none"> <li>• Residents in five villages said the amount of water supplied fluctuated according to the season and period of the day, with water short supply in the dry season and in the morning and evening. Those in only one village said there was no problem with the amount of water supplied.</li> <li>• Residents in two villages said the water pressure was sufficient, while those in four responded that the water did not run smoothly, especially in the morning.</li> <li>• In terms of water quality, respondents in three villages mentioned turbidity, mainly in the rainy season, as a problem. Those in five of the six villages pointed out the strong smell of chemicals that they sometimes recognized.</li> <li>• All the respondents in the six villages said that after their houses were connected to water pipes in 2006 and tap water was available, housekeeping and hand-washing became easier. Almost 30 percent of the 65 participants from the six villages said the water charges were too high, but other respondents from all the villages answered that it was affordable.</li> </ul>
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Source: Beneficiary Survey

### 3.3 Impact

#### 3.3.1 Intended Impacts

This evaluation study has found no clear relationship between the project and improvements in public hygiene in Vientiane or the growth of its economy. In terms of the economy, despite an increased number of factories located in the city, concerned officers of the NPVC were of the opinion that there was no clear relationship between the economic development of Vientiane and this project. However, interviews with those working for hotels and factories in the city revealed almost 60 percent of the companies had produced a construction plan only after examining the availability of city water and the water supply conditions, a fact which suggests that improved water supply conditions have made an indirect contribution to Vientiane's economy.

#### 3.3.2 Other Impacts

##### 3.3.2.1 Impacts on the natural environment

An Environmental Impact Assessment and an Initial Environmental Examination were conducted as part of the Study on Vientiane Water Supply Development project (2003 - 2004), and it was concluded that the construction of the facilities for this project and operation of the facilities afterwards have no negative impact on the environment. The Ministry of Public Works and Transport says that with no major problem found in the project, no mitigation measure has been taken. Neither is any monitoring carried out. However no negative impact observed at the time of the evaluation.

##### 3.3.2.2 Land Acquisition and Resettlement

The site of the Km6 Booster Pump Station was expanded to upgrade the station, and one household was asked to resettle to acquire its land. The land originally belonged to the NPVC,

but had been used by the family<sup>17</sup>. They, together with the village chief and some other third parties, talked, and agreed that NPVC would pay the necessary relocation cost as a solution. The land acquisition caused no problem as no complaint came from the original land user after they had moved.

Though water pressure falls low in some parts of Vientiane and/or in a specific season of the year, this project has produced greater achievements than planned in terms of amount of water supplied, the population served, and water supply coverage, for which it should be evaluated highly. In particular, the population served by water supply of Vientiane increased by 150,000 thanks largely to two water purification plants for which this project was carried out, and the increase led to a higher water supply coverage, another target of this project.

In light of the above, this project has produced the effects almost as planned, and therefore, its effectiveness is high.

### **3.4 Efficiency (Rating: [2])**

#### 3.4.1 project Outputs

As described later in more detail, the total length of water distribution pipes, one of the project outputs for which Japan was responsible in this project, was shortened by almost 30 percent as some sections of the construction work for the water pipes turned out to overlap with those of an aid project carried out by AFD. Meanwhile, the length of embankment work was extended at the implementation stage, though it had no impact on the effects of the project. In addition, some changes were made in the design as the need for correcting the tender documents arose to add items and specifications that had been omitted in them, among others (described later). Lao side was responsible for the leasing of land for storing machinery and equipment, the relocation of existing facilities, the acquisition of land, construction work for installing the power lines and putting up fences, which were completed as originally planned.

Despite some of the specifications that had been omitted at the tender, almost the same outputs as required in the Basic Design were delivered in the end with changes made in the design during the construction work and supplementary work carried out during the defects liability period. Those construction and supplementary work were done at the expense of the construction consultant. Regarding the main distribution pipe, sections of the pipe construction work that had been removed from this project scope were completed in an aid project carried out by AFD. As a result, it should be concluded that there was no change in the outputs that had an impact on the effects of this project.

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<sup>17</sup> According to the NPVC, there are cases where the court recognizes the right of a third party to use land it has been using customary. In this case, the NPVC did not consider that the land had been illegally occupied.

Table 5: Comparison of the outputs (Plan/Results)

Output	Plan	Result
<b>1. Expansion of Kaolieo Plant (Current capacity of 20,000 m<sup>3</sup>/day is expanded to 60,000 m<sup>3</sup>/day)</b>		
1) Water intake and penstock facilities:	One set of water intake structures (44,000 m <sup>3</sup> /day) Water intake pump, embankment construction (66 m)	As planned, except embankment construction (90 m, 24 m added)
2) Water purification facilities:	Facility capacity (40,000 m <sup>3</sup> /day) • Water receiving well; • Mixing basin; • Flocculation basin; • Sedimentation basin and sludge removal equipment; • Rapid filter, Total filtration flow basin and chloride mixing basin	As planned, except handrails and roofs added
3) Water distribution facilities:	Water distribution facilities (10,600 m <sup>3</sup> ) • Distribution reservoir, pump well, distribution pump; • Chemicals injection equipment	Almost as planned, except buoyancy prevention measures for distribution reservoir
4) Electrical and instrumentation facilities:	Electrical and instrumentation facilities	As planned
5) Development of the main administrative building and others in the premises:	Development of the main administrative building and others in the premises	As planned
<b>2. Repair of Kaolieo plant (Existing capacity: 20,000 m<sup>3</sup>/day)</b>		
1) Water intake and penstock facilities:	Repair of the water intake tower, replacement of water intake pumps and the painting of penstocks	As planned
2) Water purification facilities:	• Improvement of the water receiving well (mixing basin); • Flocculation basin; • Improvement and repair of the sedimentation basin facilities; • Change of the filtration method for the filtration basin; • Improvement of the filtration rate • Installation of new backwash flow meters;	As planned
3) Water distribution facilities:	• Embankment raising of the opening of the distribution reservoir, installation of additional distribution pipes, replacement of distribution pumps, and the installation of new submersible pumps; • Chemicals injection equipment	As planned
4) Electrical and instrumentation facilities:	• Replacement and installation of power and control boards; • Replacement and installation of raw water flow meters and other instrumentation equipment	As planned
5) Main administrative building, etc.	Main administrative building; • Water quality test laboratory: Removal of existing facilities	As planned
6) Water distribution pipes:	Improvement (replacement) of distribution pipes	As planned
<b>3. Improvement of Chinaimo Water Purification Plant (Existing capacity: 80,000 m<sup>3</sup>/day)</b>		
1) Water distribution facilities:	Distribution reservoir and distribution pumps	As planned, except embankment thickness of distribution reservoirs added
2) Electrical and instrumentation facilities:	• Replacement of power receiving and transformation equipment; • Instrumentation equipment	As planned, except oil-filled circuit breaker As planned for instrumentation equipment
3) Development of premises	Development of the premises	As planned
4) Supply and distribution pipes:	Separation of the water supplied and distributed, replacement of the supply and distribution pipes, and facilities to cope with water hammer	As planned

Output	Plan	Result
4. Repair of the Km6 Booster Pump Station		
1) Distribution facilities:	Replacement of water distribution pumps and improvement of distribution pipes	As planned
2) Electrical and instrumentation equipment:	Construction of power receiving and transformation equipment, and improvement of instrumentation equipment and the premises	As planned
5. Extension of the water supply and distribution pipes		
Supply and distribution pipes	• Supply pipes: 720 m • Distribution pipes: about 11,915 m	As planned 8,615 m (3,300 m reduction)
6. Non-physical components		
Training and instruction	For: employees of the two plants 1) Operation and maintenance 2) Water supply and distribution operation and control	As planned
Deliverables	1) Non-physical component completion report and implementation report • Non-physical component completion report • Non-physical component implementation report 2) Manuals, handbooks, etc. • Water purification plant operation manual • Operation and control manual	Almost as planned

Source: Basic Design Study Report and JICA's data

Table 6: Major outputs removed or added

Items changed	Removed from the scope	Additions to the scope
1. Kaolieo Water Purification Plant		
Embankment work	–	• Extension of the embankment work (24 km)
Distribution reservoir	–	• Buoyancy prevention
Filter bed	–	• Replacement of the existing filter sand
Flocculation basin, sedimentation basin, and others	–	• Installation of handrails, roofs, etc.
2. Chinaimo Water Purification Plant		
Power facilities	–	• Replacement of parts of the power receiving and transformation equipment
Distribution reservoir	–	• Thicker embankment
3. Extension of the water supply and distribution main pipes		
Length of the water supply and distribution pipes to be extended	Parts that overlapped with an AFD aid project were removed (3,300 m).	–

Source: Project Completion Report, JICA's data

Changes in the plan stated above were made in two stages, at the time of detailed planning and during the construction work, for the reasons given below:

Changes made at the time of the detailed planning

- As stated before, sections of the construction work for laying water distribution pipes that would overlap with a project to be carried out with the aid of AFD, which had remained

unclear at the time of the Basic Design study<sup>18</sup>, were canceled. Because AFD's plan was made clear at the time of the Detailed Designing of this project, based on this information the total length of the water distribution pipes was reduced.

- Some parts of the existing power receiving and transformation equipment that had been believed to work at the time of the Basic Design study turned out to have some trouble, and they were replaced.

#### Changes made during the construction work

- There are two reasons; firstly tender documents produced and approved for the detailed design had some items and specifications omitted from them (installation of handrails and replacement of the filter sand and so on) and some inconsistencies with the basic design. Secondly, as the estimated amount of rainfall and groundwater in the detailed design turned out to be different from the actual conditions at the implementation stage, an embankment had to be added for the Chinaimo distribution reservoir and additional work had to be done for the extension of the embankment of the Kaolieo Water Purification Plant to enable the project to produce the effects as originally planned. These changes were put on the table at a later half of the implementation stage, and as a result a part of the works on embankment of Chinaimo and other minor additions must have been carried out after the project period.

### 3.4.2 Project Inputs

#### 3.4.2.1 Project Costs

The loan approved amount for this project was 2,875 million Japanese Yen, and Japanese side actually spent the project cost of 2,171 million yen as ODA funds (75 percent of the plan). However, some of the original construction work for this project was carried out by a construction consultant as additional work after the project period, and with the cost for the additional work, or about 21 million yen, included, the actual cost spent to carry out the original plan as was in the Basic Design was 2,192 million yen (76 percent of the plan). The final project cost was even lower than the cost in the revised plan, which was mainly because competitive bidding led to lower price proposals from tenderers.

Lao side was asked to bear 39 million yen of the project costs at the time of planning. The actual project cost that the country expensed was 15 million yen.

#### 3.4.2.2 Project Period

The project period was set at 32 months in the Basic Design study. The actual project period was 34 months, from the conclusion of the Exchange of Notes to the completion of the construction work in March 2009 (two months longer than the plan, or about 105 percent of the planned period) so that it is slightly longer than planned. Some of the construction work sections with some changes made in the design after the work had gotten started went on into

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<sup>18</sup> As described before, this Project was implemented with the roles divided between JICA and AFD for their aid projects. However, as of 2004, AFD was still conducting a study of the water distribution pipe network in Vientiane for its project, and planned to choose the target sections after completing the study. This Project was designed in a manner that the minimum necessary length of water distribution pipes would be laid to enable the Project to produce the effects without the AFD aid project. The overlapping sections were canceled at the time of Detailed Design study of the Project.

the defects liability period. The extra work was carried out by a construction consultant with its own expenses and was completed in May 2009.

The reasons why project period was longer than planned were; because delays arose in the construction work for National Road 1, another grant aid project, that overlapped with work for this project in some sections, which required adjustment of the work schedule; and because it took time to coordinate with Laos for the work required to make up for omissions found in the detailed design and for adjustments caused by differing conditions such as amount of rainfall and underground water and changes of the length of the embankment construction work and so on.

In light of the above, the project cost was lower than planned, while the project period was slightly longer than planned, and therefore the efficiency of this project was fair.

### **3.5 Sustainability (Rating: [2])**

#### **3.5.1 Structural Aspects of the Operation and Maintenance**

The NPVC, the executing agency of this project, operated and maintained water purification plants and distribution facilities at the time of this ex-post evaluation study as before, and no change was found in its operation and maintenance structure. Neither was there any major organizational change from the time of planning in NPVC structure, including that of the targeted water purification plants, or in its implementation scheme, except that some departments were added and the workforce increased. It was pointed out that the Chinaimo Water Purification Plant needed one more person for operation and maintenance, but NPVC's Administration concluded that the plant could be operated with the current workforce. Actually no major problem in the operation of the plant had been reported. According to NPVC's Human Resource Department, after the Basic Design study had proposed that more meter readers be deployed, it increased the number of readers posted at each branch office from five to eight by the time of this evaluation study. No major problem had been reported in meter reading. The size of its staff is generally appropriate.

Table 8: Operation and maintenance scheme for the water purification plants  
(Unit: in persons)

Department	Plan	Result (2011)
NPVC total	Some 320	467
NPVC headquarters total		211
(of which) Administrative (headquarters)		91
Technical (headquarters)		120
7 branch offices total	n.a.	148
Kaolieo Plant total	n.a.	37
(of which) Administrative		5
Technical		32
Chinaimo Plant total	n.a.	35
(of which) Administrative		6
Technical		29
Dongmakhai Plant	-	26
Km6 Booster Pump Station	n.a.	3
Others	n.a.	7

Source: NPVC's data and an interview survey

Note: The number of employees in the table above does not include those working on limited-term contracts.

### 3.5.2 Technical Aspects of the Operation and Maintenance

This project included non-physical components for training in two subjects: the operation and maintenance of the facilities, and the operation control for water supply and distribution. The field study conducted as part to this ex-post evaluation found that the basic operational data were recorded on a daily basis. Therefore their operation and maintenance was generally good.

Records kept by the plants and station were regularly sent to NPVC's headquarters to compile the necessary data. Records of the facilities operation, such as the amount of water, were kept in specific forms, demonstrating that a system had been established for recording. Their ability to keep records and perform the operation and maintenance were enhanced thanks not only to this project, but also to manuals produced by, and/or with the support of, JICA's senior volunteers and its experts in human resources development for water service corporations. However, though there had been no major trouble found in the operation and maintenance of the water purification plants, there were some problems in preventive maintenance as, for instance, the failure to carry out three-month, six-month, or other regular inspections and the lack of a plan produced for regular inspections in the first place. The fact that the two water purification plants saw their utilization rate staying above 100 percent also indicates that there is a great need for preventive maintenance.

They seem to have sufficient basic skills for the daily work, if not in the nighttime or in an emergency, at least at present, as there is a technical advisor available for repairing pumps who support all the water purification plants in Vientiane for the maintenance of their pumps, and the power company also comes to help them and repair electrical systems whenever necessary.

To help the water supply corporations maintain and enhance their technical expertise, lecturers were trained by AFD as part of its aid program and/or by JICA in its technical cooperation project, so that they would in turn give training to the plant workers. They provided two types of training courses, introductory and refresher classes. Classes to teach basic maintenance techniques are held regularly, which enables new technicians to be trained. Since the water purification plants each have different types of purification systems, thus, the training courses offered after the beginner-level course are aimed mainly at veteran workers so that techniques will be transferred to them through on-the-job based practical training. In general, however, the two plants have only weak schemes for updating manuals and helping their employees to further develop technical expertise in a systematic manner. For instance the aeration valve for water hammer effect in Chinaimo purification plant was unable to restart, and partly due to the transfer of the staff in charge, thus unoperational since a blackout in around 2010.

The NPVC's Technical Department is responsible for measures against non revenue water. With the support of AFD in its project, the department, together with the employees of NPVC's branch offices, work to prevent leakage, examine whether the meters work properly, and repair broken ones. The department has also installed pressure and flow meters at around 25 points on the water distribution pipe network in the city to monitor the flow rate and pressure for detecting any leakage. Despite such efforts, NPVC has not yet succeeded in reducing non revenue water.

### 3.5.3 Financial Aspects of the Operation and Maintenance

NPVC is operated on a self-supporting accounting system basis. The table below shows the NPVC's financial condition.

Table 9: NPVC's financial condition (last 3 years)  
(in million kip; in million yen)

Item	2009	2010	2011	In yen
<b>Revenues</b>				
Water sales	74,701	55,134	61,516	
Other revenues	30,588	14,938	22,992	
Total revenues	105,289	70,072	84,508	857
<b>Expenditures</b>				
Personnel expenses	7,969	9,526	8,971	
Maintenance expenses	64,991	61,840	65,939	
Other expenses	25,832	12,292	19,023	
Total expenditures	98,792	△ 83,658	△ 93,934	△ 952
Balance	6,497	13,586	9,426	96

Source: Answers from NPVC's Financial Department to a questionnaire

Note: The exchange rate was 1 yen = 0.010138 kip (as of November 2011).



The NPVC operated at a deficit in the last two years. In 2011, it made a loss of 96 million yen<sup>19,20</sup>. Deficits continued mainly because of low water tariff. (For more details, see the next heading.)

In interviews with us, members of the Financial Department said that revenues other than water sales were unlikely to grow fast in the future as they came mainly from connection fees<sup>21</sup>, and that, in terms of expenditures, electricity accounted for a large portion of the maintenance costs, about 25 percent in 2011, leaving no prospect of the NPVC improving its financial position with its own revenue sources, at least in the short term.

The NPVC makes up its deficit every year with borrowings it obtains with government guarantees. As of the end of 2011, the NPVC had outstanding debt of 581 million yen on its balance sheet, while its assets were worth 3,815 million yen, enough to avoid its liabilities exceeding its assets. The Department of Improvement of State Enterprises, Ministry of Finance says the government intends to continue giving NPVC financial support as long as it works hard to improve its performance and efficiency. It is unlikely that NPVC will go bankrupt at least in the short or medium term.

#### 3.5.3.1 Water rates

The NPVC is operated on a self-supporting accounting system. It is authorized by law to set a water rate at cost with a five percent markup on this. However, based on the public nature of water services, the Prime Minister's Decree 37 of 1999 requires that the water rate be set within a range that allows low-income families to pay not more than three percent<sup>22</sup> of their income for water and that the water rate be raised only after consultations with the government and obtaining the Parliament's approval. Any actual increase in the water rate is influenced by political factors, and it is difficult for the NPVC to set a water rate exactly in the manner it is authorized to do so by law. The present average water rate is 1,350 kip per cubic meters (2011), less than 70 percent of the actual cost of 1,999 kip, which is the cause of the NPVC's chronic deficit. According to the Financial Department of the NPVC, the water rate was raised in 2009 after two years of work negotiating with the Government and obtaining the Parliament's approval. During the process fuel prices and other production costs rose again, and the NPVC is faced with the need to raise the water rate once more.

Based on these water tariff setting criteria given by law, the water rate could only be raised by 80 kip per cubic meter to 1,470 kip, which is too low to cover the costs. There is no practical way to avoid setting a water rate that is too low, the cause of the deficit-ridden finances.

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<sup>19</sup> The exchange rate was 1 yen = 0.010138 kip (as of November 2011).

<sup>20</sup> Water sales increased in 2009 because water rates were raised only during six months of the year.

<sup>21</sup> After applying for the city water service, a household pays the construction work expenses for installing the water distribution pipes and a meter (about 400 yen, or 35,000 kip, as of 2011) and a connection fee of about 2,200 yen or 200,000 kip.

<sup>22</sup> In accordance with the Prime Minister's Decree 37 of 1999, issued in September that year, water rates in Vientiane were set in a manner that the water fees would amount to no more than three percent of the income of low-income families and no more than five percent of the income of medium to high-income families.

Table 10: Water rate per cubic meter from 2009 (householder and industrial use)

Volume of water used (m <sup>3</sup> )	Rate (kip)
<6	500
6 to <21	1,000
21 to <51	1,350
≥51	2,700

Source: NPVC's data

Note: Charged by the cubic meter

### 3.5.3.2 Non revenue water

In interviews with members of the NPVC's Financial Department, they said non-revenue water also had a great impact on its financial condition. After this project was completed in 2009, the amount of water supplied increased, while the ratio of non revenue water also rose from about 30 percent, the estimate as of 2003, to 34 percent in 2010. Efforts to lower the high non revenue water rate from its level of above 30 percent have been made since the time of planning for this project. For instance, adjustments are made to prevent the water pressure from going too high. The high rate of non revenue water is due mainly to leakage from old water supply pipes. Although the NPVC recognizes that as a fundamental solution to leakage is replacing them, there is no financial resource available for this work.

### 3.5.3.3 Prospects for a water rate revision and financial support from the government

According to the Department of Improvement of State Enterprises of the Ministry of Finance, a member of the Water Services Regulatory Committee<sup>23</sup>, the water rate was discussed at talks on an increase in the water charges<sup>24</sup>. However, the agreement was made that the NPVC is required to develop a long-term business plan and a system for internal business audits as a prerequisite for any water rate increase. The department also says the government will continue to make up the deficits of the NPVC only when it works hard to improve its own efficiency and business performance. The NPVC is required to improve its own management as the first step to making itself financially independent.

In this respect, JICA will start a "Capacity Development Project for Improvement of Management Ability of Water Supply Authorities,"<sup>25</sup> a technical support project, in August 2012 to help the NPVC to be capable of preparing a long-term business plan and strengthen its business audit system. These activities are expected to make NPVC's management more efficient, and help it satisfy the prerequisites for government financial support and a water rate increase in the medium and long-term.

As described above, the NPVC has been in a state of chronic deficit due mainly to a water rate that is set too low and to rising costs. Further pressure on its finances is expected with the

<sup>23</sup> An institution set up to help make public water service corporations and private-sector businesses more efficient through audits of their business.

<sup>24</sup> Discussions in Water Services Regulatory Committee meeting with the presence of NPVC Board of Directors and Water Services Regulatory Committee members

<sup>25</sup> Under one of the project objectives of helping the NPVC, as a pilot water service corporation for this Project, and for water corporations in two other provinces, systems will be developed to enhance their business administrative capacity from the medium to long-term viewpoint, thus the project is aimed at supporting them in preparing a business plan and improving their business indicators. The project period is for five years from August 2012 to July 2017.

investments it is intending to make to construct new water purification plants. Despite the financial support it is likely to receive from the Lao government for the time being, the NPVC has challenges to resolve in its financial sustainability.

#### 3.5.4 Current Status of the Operation and Maintenance

The use and maintenance of the existing facilities and equipment is generally good. They have got through major problems using ad-hoc maintenance measures, for instance when a pump breaks down, they use an outdated spare pump. However without preventive maintenance plans, such as a maintenance plan prepared to cope with old and deteriorating machinery and equipment, and spare parts procured in advance according to a plan, there might be further problems in the medium and long term.

As described above, maintenance for this project has some problems in terms of its structural and technical aspects. In terms of its financial aspects, there is no major difficulty for the time being as its sustainability is guaranteed by the government. However, there is concern about its long-term financial independence. Therefore, the sustainability of the project effect is fair.

## 4. Conclusion, Lessons Learned and Recommendations

### 4.1 Conclusion

This project is aimed at expanding and rehabilitating two of the four existing water purification plants in Vientiane, the Kaolieo and Chinaimo Water Purification Plants, for securing a stable water supply and raising the water supply coverage in the service area there. It is relevant to the development plan and development needs of Laos, as well as Japan's ODA policy. Therefore the relevance of the project is high. After the expansion and rehabilitation of the two water purification plants, the amount of water supplied in the city grew as expected, leading to an increased population served and higher water service coverage. However, the actual project period was slightly longer than planned. Therefore the efficiency of the project was fair. In terms of the sustainability of the project, neither of the two water purification plants have any major problem in terms of their daily operation and maintenance, at least at present. However, there is some concern about their sustainability in the future. From the financial point of view, there are challenges to run on a financially self-supporting as an independent organization having self-supporting accounting system. Therefore, the sustainability of this project is fair.

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

### 4.2 Recommendations

#### 4.2.1 Recommendations to the Executing Agency

##### 4.2.1.1 Measures for improvement of the financial aspects

While the NPVC has no discretionary authority to set a water rate despite its status as a state enterprise run on a self-supporting accounting system, it needs to carry out all possible measures to improve its financial condition. As short or medium-term solutions, it is required that

government compensation for the NPVC's deficits due to a water rate that is set low for political reasons, and government financial support to the NPVC for capital investment.

#### 4.2.1.2 Improvement of the water distribution pipe network infrastructure

While this project improved the amount of water supplied and the water supply coverage in Vientiane, it is observed that some branch pipes used to supply the water to households from a major distribution pipe, and some water supply pipe networks still have problems that make it difficult to keep water pressure at the appropriate level in some areas. Water distribution and supply pipes are being replaced with the support of AFD in its project only in places that have a greater need to stop water leaks. Additional work should be carried out so that narrow pipes will also be replaced in sections that are critical for maintaining the appropriate water pressure, as water pressure maintained at an appropriate level will make AFD's aid more effective.

#### 4.2.1.3 Capacity enhancement of the plant employees

Employees working for the two water purification plants have sufficient expertise for daily operation and maintenance work. There were some cases where technical expertise was not handed over between employees, e.g. an air chamber in the Chinaimo Water Purification Plant, when they were transferred. To enable workers to deal with such new types of machinery, the executing agency should have an internal system within the plants in place to raise the level of the skills of the workers. Currently the plants do not carry out preventive maintenance or regular inspection of the equipment regardless of whether there is any trouble. A maintenance plan should be prepared in order to carry out such preventive kind of maintenance work.

### 4.2.2 Recommendations to JICA

#### 4.2.2.1 Improvement of the NPVC's business

JICA plans to help the NPVC ensure that its management is more efficient through the technical cooperation project that it is providing called "The Project for Management Capacity Enhancement of Water Service Corporations," which is due to start in August 2012. To persuade the Lao government to grant the financial support that NPVC needs to restore its finances, it must develop an internal business audit system and prepare a long-term business plan. With the support of JICA in the program, the NPVC must develop a management system to enable it to set a water rate at the appropriate level, and prepare a business plan including a capital investment plan in order to establish the foundation of any sound business operation.

## 4.3 Lessons Learned

Regular maintenance is essential to ensure the continuity of any water service. It is crucial to assist the executing agencies to fully understand, using non-physical components, among others, how important preventive maintenance is even when there is no obvious problem.