

Country Name	<b>The Capacity Development Project for Non-Revenue Water (NRW) Reduction in Colombo City</b>
The Social Democratic Republic of Sri Lanka	

**I. Project Outline**

Background	For the National Water Supply and Drainage Board (NWSDB), which is responsible for water supply and sanitation in the most part of Sri Lanka, high rate of Non-Revenue Water (NRW) has been a longstanding problem in its operation and management. Especially in Colombo City, where deteriorated pipes still remained in many parts of its distribution system, the NRW rate in 2008 was 54.1%, higher than its nationwide average of 33.0%. To tackle this problem, NWSDB has been working to reduce the rate of NRW in several ways such as leak repair, detection/elimination of illegal connections, removal of public stand posts and converting its users to individual connection, and billing system improvement. However, as these measures had not produced satisfactory outcomes, it was necessary for NWSDB to gainfully utilize external support to improve its capacities of practical implementation in NRW reduction measures.												
Objectives of the Project	<ol style="list-style-type: none"> <li>Overall Goal: The Non-Revenue Water (NRW) rate in Colombo City is reduced.</li> <li>Project Purpose: NWSDB's capacity to implement NRW reduction activities in Colombo City is strengthened.</li> </ol>												
Activities of the project	<ol style="list-style-type: none"> <li>Project site: Kotahena Area and Borella Area in Colombo city</li> <li>Main Activities: (i) training on methods and techniques for NRW reduction activities for NWSDB staff in the pilot sites, (ii) preparation of NRW reduction work plan for the pilot sites, (iii) implementation of pipe rehabilitation works and other NRW reduction activities in pilot sites, and (iv) preparation of an execution plan for dissemination of project outcomes to other areas in Colombo city.</li> <li>Inputs (to carry out above activities) <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">Japanese Side</td> <td style="width: 50%;">Sri Lankan side</td> </tr> <tr> <td>1) Experts: 6 persons</td> <td>1) Counterpart personnel: 30 persons</td> </tr> <tr> <td>2) Trainees received: 10 persons (plus Third Country Training: 6)</td> <td>2) Land and facilities: Project office, electricity, water supply</td> </tr> <tr> <td>3) Equipment: Portable ultrasonic flow meter, correlation leak detector, electronic leak detector, pipe detector, micro excavator, pick-up trucks, etc.</td> <td>3) Local cost: Salaries to counterpart personnel, expenses for isolation work of pilot sites, repairing of pipe networks after the detection of leakage and civil work for road opening/reinstatement, maintenance cost for equipment provided by the project.</td> </tr> </table> </li> </ol>					Japanese Side	Sri Lankan side	1) Experts: 6 persons	1) Counterpart personnel: 30 persons	2) Trainees received: 10 persons (plus Third Country Training: 6)	2) Land and facilities: Project office, electricity, water supply	3) Equipment: Portable ultrasonic flow meter, correlation leak detector, electronic leak detector, pipe detector, micro excavator, pick-up trucks, etc.	3) Local cost: Salaries to counterpart personnel, expenses for isolation work of pilot sites, repairing of pipe networks after the detection of leakage and civil work for road opening/reinstatement, maintenance cost for equipment provided by the project.
Japanese Side	Sri Lankan side												
1) Experts: 6 persons	1) Counterpart personnel: 30 persons												
2) Trainees received: 10 persons (plus Third Country Training: 6)	2) Land and facilities: Project office, electricity, water supply												
3) Equipment: Portable ultrasonic flow meter, correlation leak detector, electronic leak detector, pipe detector, micro excavator, pick-up trucks, etc.	3) Local cost: Salaries to counterpart personnel, expenses for isolation work of pilot sites, repairing of pipe networks after the detection of leakage and civil work for road opening/reinstatement, maintenance cost for equipment provided by the project.												
Ex-Ante Evaluation	April 2009	Project Period	October 2009 - October 2012	Project Cost	(Ex-Ante) 250 million yen (Actual) 305 million yen								
Implementing Agency	National Water Supply and Drainage Board (NWSDB)												
Cooperation Agency in Japan	Nihon Suido Consultants Co., Ltd.												

**II. Result of the Evaluation**

< Special perspectives considered in the ex-post evaluation >

- One of the indicators for overall goal was set as "Decrement of NRW rate per annum in CMC area exceeds one (1) percent point up to 2017" with its target year of 2017. However, this ex-post evaluation has made a judgment for degree of achievement of this indicator based on the available actual figures up to 2015.

<b>1 Relevance</b>
<p>&lt;Consistency with the Development Policy of Sri Lanka at the time of ex-ante evaluation and project completion&gt;</p> <p>This project was consistent with Sri Lankan development policy of "to improve the accessibility of safe water" as set forth in the policy documents of Regaining Sri Lanka including the National Water Supply Plan (2002-2005) and the 10-Years Development Plan (Mahinda Chintana) (2006-2016).</p> <p>&lt;Consistency with the Development Needs of Sri Lanka at the time of ex-ante evaluation and project completion&gt;</p> <p>This project met the development needs of Sri Lanka to reduce the non-revenue water in Colombo city as a high NRW rate has been an critical issue in Colombo.</p> <p>&lt;Consistency with Japan's ODA Policy at the time of ex-ante evaluation&gt;</p> <p>The project was consistent with Japan's Country Assistance Program for Sri Lanka (prepared in April 2004) to prioritize to support assistance plan based on the medium and long term development vision including development of basic and economic infrastructure such as improvement of water supply service.</p> <p>&lt;Evaluation Result&gt;</p> <p>In light of the above, the relevance of the project is high.</p>
<b>2 Effectiveness/Impact</b>
<p>&lt;Status of Achievement for the Project Purpose at the time of Project Completion&gt;</p> <p>The project purpose was achieved by the project completion. As shown in the table below, various NRW reduction activities such as meter installation, meter replacement, leak detection and repair, and detection/elimination of illegal connection were implemented in the pilot sites. As a result, a remarkable NRW reduction was observed in some sub-zones of the pilot sites. For example, the NRW rate in sub-zone K-1 of Kotahena Area reduced from 85.3% to 56% during the project period. As a part of the pilot sites was included in the target area of Japanese ODA loan project "Water Sector Development Project II (2008-2016)", replacement of old pipes through the ODA project has also contributed to reduce NRW in the pilot sites.</p> <p>The experiences in the pilot sites were disseminated to other areas in Colombo city. The Area Engineers (AEs), the Officers in Charge</p>

(OICs) and the Engineer Assistant (EAs) of non-pilot sites were involved in the pilot activities and participated in weekly meetings to share the issues raised in the pilot activities. The AE of Colombo City South and the AE and OIC of Colombo City East learned about the systematic methods of NRW reduction by participating in the workshops/seminars, OJT in the pilot sites, and weekly meetings. Then, they have practiced its method in their responsible areas. As a result, the non-pilot sites also reduced NRW rate (see table below). Also it is considered that NWSDB has allocated a certain amount of budget for NRW reduction activities. An execution plan to achieve reduction of NRW rate by one (1) percentage point per annum, as per the Goal 2.1 of “Corporate Plan 2007-2011”, was prepared and it was incorporated into an action plan of the NWSDB cooperate plan by the project completion.

<Continuation Status of Project Effects at the time of Ex-post Evaluation>

After the project completion, the NRW reduction activities introduced in the pilot sites have been carried out in the entire Colombo City according to the execution plan using available resources focusing on key result areas. The progress has been monitored in the weekly progress review meeting chaired by the General Manager (GM).

<Status of Achievement for Overall Goal at the time of Ex-post Evaluation>

The overall goal was achieved. The NRW reduction activities have been expanded to 22 zones of the CMC in accordance with the execution plan. Pipe replacement, installation of water meters etc. have been undertaken with assistance of JICA and ADB projects, while NWSDB has allocated funds for leak repairs. In 2015 alone over 12,000 leaks repaired, 10,400 defective meters were replaced. As a result, NRW rate in CMC area reduced from 49.5% in 2012 to 45.9% in 2015. Based on this good performance in NRW reduction rate in 2012-2014, it is expected that the decrement of NRW rate per annum in CMC area will exceed one percent point by 2017 as planned.

<Other Impacts at the time of Ex-post Evaluation>

The project has brought about several positive impacts such as saving of production cost, improvement in performance of distribution system, and increase in number of connections/subscribers, which has contributed to improvement of quality of service and increase of NWSDB’s revenue (see Table 1). No negative impact on natural environment was observed and no land acquisition and resettlement of people was implemented.

Table 1: Incremental Water Revenue of NWSDB

	2012	2013	2014	2015
Incremental Water Revenue (Million LKR)	344	407	472	507

Source: NWSDB

<Evaluation Result>

In light of the above, through the project, the project purpose was achieved, the project effects have been continued, the overall goal was achieved, and no negative impact was observed. Therefore, the effectiveness/impact of the project is high.

Achievement of project purpose and overall goal

Aim	Indicators	Results		
(Project Purpose) NWSDB’s capacity to implement NRW reduction activities in Colombo City is strengthened	(Indicator 1) Number of NRW reduction activities records will increase compared to what was before the Project	<u>Status of the achievement: achieved</u> (Project Completion)		
		a) Kotahena Area (Pilot site)		
			Sub-zone	
			K1   K2   K3&4   K5   K6   K7   K8   K9   K10	
		<b>NRW rate (%)</b>		
		Before	85.3   78.5   -   -   -   -   -   -   -	
		After activities	56   72   71   -   -   -   -   -   -	
		<b>Activities for NRW reduction (cases)</b>		
		Meter installation to stand post	14   33   19   4   -   3   -   3   -	
		Meter installation	45   20   8   0   -   4   -   0   -	
		Meter replacement	19   10   14   3   -   4   -   1   -	
		Leak detection and repair	90   93   36   9   -   28   70   12   11	
		Detection/elimination of illegal connection	53   23   5   1   -   0   -   1   -	
		<Source> Project completion report (JN) p22		
				b) Borella Area (Pilot site)
				Sub-zone
				B1   B2   B3   B4-1   B4-2   B5   B6   B7   B8   B9   B10
		<b>NRW rate (%)</b>		
		Before	40.3   -   84.3   -   -   -   -   -   -   -	
		After activities	18   -   29   27   52   -   28   -   -   -	
		<b>Activities for NRW reduction (cases)</b>		
		Meter installation to stand post	2   6   0   2   25   11   7   1   2   1   0	
		Meter installation	12   25   14   0   17   11   9   0   0   76   0	
Meter replacement	7   7   20   3   12   12   17   6   0   274   1			
Leak detection and repair	47   31   19   5   29   36   31   9   9   65   1			
Detection/elimination of illegal connection	8   15   19   0   13   9   21   0   2   -   1			
		c) Non-pilot sites		
		Kirulapana sub-zone in Colombo City South   Kent road sub-zone in Colombo City East   Handala Ferry road sub-zone in Colombo City North		
<b>NRW Rate (%)</b>				

		<table border="1"> <tr> <td>Before</td> <td>18.9</td> <td>52.8</td> <td>18.3</td> </tr> <tr> <td>After activities</td> <td>7.0</td> <td>38.0</td> <td>-</td> </tr> <tr> <td colspan="4"><b>Activities for NRW reduction (cases)</b></td> </tr> <tr> <td>Mete installation to stand posts</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>Detection/elimination of illegal connection</td> <td>4</td> <td>-</td> <td>2</td> </tr> <tr> <td>Meter accuracy test and meter replacement</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>Leak detection and repair</td> <td>11</td> <td>29</td> <td>14</td> </tr> </table> <p>(Ex-post Evaluation) continued</p> <ul style="list-style-type: none"> <li>The learning from the pilot project was carried out for the whole of Colombo City using available resources focusing on key result areas of level attending leaks, leaks detected by night surveys, compliant handled, defective meter replacement, application received, connection speed, inspection on disconnection, checking of lower consumption places, metering of unmetered places, flushing of lines and detection of illegal connection The progress has been monitoring in the weekly progress review meeting chaired General Manager (GM).</li> </ul>	Before	18.9	52.8	18.3	After activities	7.0	38.0	-	<b>Activities for NRW reduction (cases)</b>				Mete installation to stand posts	-	-	-	Detection/elimination of illegal connection	4	-	2	Meter accuracy test and meter replacement	-	-	-	Leak detection and repair	11	29	14
Before	18.9	52.8	18.3																											
After activities	7.0	38.0	-																											
<b>Activities for NRW reduction (cases)</b>																														
Mete installation to stand posts	-	-	-																											
Detection/elimination of illegal connection	4	-	2																											
Meter accuracy test and meter replacement	-	-	-																											
Leak detection and repair	11	29	14																											
	(Indicator 2) The budget to be allocated for NRW reduction will increase compared to what was before the Project	<p><u>Status of the achievement: achieved</u> (Terminal Evaluation)</p> <ul style="list-style-type: none"> <li>Although it is rather difficult to extract the budget allocated for NRW reduction activities from the regular budget of NWSDB since O&amp;M section and NRW section carry out the NRW related activities as a part of their routine works, NWSDB has managed to allocate the budget necessary for the project activities from its own regular budget.</li> <li>Therefore, it can be concluded that NWSDB has allocated a certain amount of budget for NRW reduction activities.</li> </ul> <p>(Ex-post Evaluation) continued</p> <ul style="list-style-type: none"> <li>Allocated amount for NRW reduction activities from NWSDB O&amp;M budget is limited due to NWSDB financial situation. However NRW activities are being implemented utilizing project financing.</li> </ul>																												
	(Indicator 3) An execution plan to achieve reduction of NRW rate by one (1) percentage point per annum, as per the Goal 2.1 of “Corporate Plan 2007-2011”, is prepared and incorporated into relevant plans/programs of NWSDB	<p><u>Status of the achievement: achieved</u> (Terminal Evaluation)</p> <ul style="list-style-type: none"> <li>NRW execution plan was prepared and incorporated into action plan of the cooperate plan.</li> </ul> <p>(Ex-post Evaluation) continued</p> <ul style="list-style-type: none"> <li>The NWR program in the action plan has been implemented in the whole Colombo City including the pilot sites and being updated.</li> </ul>																												
(Overall goal) The NRW rate in Colombo City is reduced	(Indicator 1) NRW reduction activities are comprehensively conducted by 22 zone officers in Colombo Metropolitan City (CMC) area in accordance with the execution plan	<p><u>Status of the achievement: achieved</u> (Ex-post Evaluation)</p> <ul style="list-style-type: none"> <li>NRW reduction activities have been expanded to 22 zones of the CMC in accordance with the NRW execution plan. Pipe replacement, installation of water meters etc. have been undertaken with assistance of JICA and ADB projects, while NWSDB has allocated funds for leak repairs.</li> </ul>																												
	(Indicator 2) Decrement of NRW rate per annum in CMC area exceeds one (1) percent point up to 2017	<p><u>Status of the achievement: achieved</u> (Ex-post Evaluation)</p> <ul style="list-style-type: none"> <li>The actual decrement of NRW rate per annum in CMC area during 2012-2015 was 1.2 percent point/year, which met the target value of 1.0 percent point/year.</li> </ul> <table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="4">Actual</th> <th>Target</th> <th></th> </tr> <tr> <th>2012</th> <th>2013</th> <th>2014</th> <th>2015</th> <th>2016</th> <th>2017</th> </tr> </thead> <tbody> <tr> <td>NRW rate in CMC area (%)</td> <td>49.5</td> <td>47.7</td> <td>46.3</td> <td>45.9</td> <td>45.0</td> <td>44.0</td> </tr> </tbody> </table>		Actual				Target		2012	2013	2014	2015	2016	2017	NRW rate in CMC area (%)	49.5	47.7	46.3	45.9	45.0	44.0								
	Actual				Target																									
	2012	2013	2014	2015	2016	2017																								
NRW rate in CMC area (%)	49.5	47.7	46.3	45.9	45.0	44.0																								

Source: NWSDB

### 3 Efficiency

The project period was within the plan (ratio against the plan: 100%), the project cost was higher than the plan (ratio against the plan: 120%). It was identified the necessity of creating detailed GIS maps which include the locations of valves, water meters, pipe trace, washouts, air valves etc. of the distribution systems. These maps were to be used for monitoring of the distribution systems on NRW reduction activities, asset management etc. Therefore additional costs were spent for GIS restructuring activities and public relations activities in response to the recommendations by the mid-term evaluation in 2011. Therefore, efficiency of the project is fair.

### 4 Sustainability

#### <Policy Aspect>

Corrective actions for the NRW reduction are key areas in all policy documents of Sri Lankan government as well as NWSDB's corporate plan such as the 10-Years Development Plan (Mahinda Chintana) (2006-2016), Master Plan update: Institutional Development and Non-Revenue Water Engineering Study, NWSDB's 10 Year Development Plan (2016-2025) and NWSDB's Corporate Plan (2012-2016).

#### <Institutional Aspect>

NWSDB is responsible for the NRW reduction activities in Colombo city. In particular, four (4) NRW Reduction Teams (two teams for each pilot site) and the NRW Reduction Management Team established by the project play a leading role for continuation of NRW reduction activities in the pilot sites as well as dissemination of the NRW reduction activities to entire area of Colombo city. The NRW Reduction Management Teams are composed of officers and staff of Western-Central Regional Support Center<sup>1</sup> of NWSDB, while the NRW Reduction Team is composed of responsible officers of the Regional Support Center. All members of the teams (7 in NRW management Team, 14 in two NRW Reduction teams in Borella, 20 in two NRW Reduction Teams in Kotahena) have been working continuously. As mentioned earlier, NWSDB staff (e.g. AEs, OICs and EAs) of non-pilot sites who participated in the project activities in the pilot sites and trained by the project have been engaged in practicing the methods of the NRW reduction in their respective zones. However, in order to practice a full scale of NRW reduction activities in 22 zones in Colombo city, the current trained manpower is limited, particularly there is a shortage of trained staff for conducting close monitoring on a zonal basis. NWSDB has taken actions to trained more staff under ongoing projects as well as utilizing budget for annual training. NWSDB has constructed demonstrated Yard under Greater Kandy Water Supply Project (2001-2010) funded by JICA and will start trainings on pipe laying practices, detection of leaks etc. soon.

#### <Technical Aspect>

NWSDB staffs have a basic knowledge and methodology of NRW reduction introduced by the project. NWSDB has organized training programs on “Strategies of NRW Reduction” and “NRW Reduction for Pipe Fitters/Work Supervisors” for respective engineers every year. The manuals developed by the project have been extensively utilized and further developed by the Master Plan Study assisted by JICA. The on-going ADB assisted projects such as Institutional Development of National Water Supply and Drainage Board (2016-2018) and Greater Colombo Water and Wastewater Management Improvement Investment Program (2015-2020) are expected to further strengthen the technical capacity of NWSDB and physical improvement of distribution systems such as old pipes and fitting replacement and creation of DMAs (District Metering Areas<sup>2</sup>) for fighting for NRW. When they need repairs of equipment which is used for NRW reduction activities such as leak detectors, it is carried out through reliable local service providers.

#### <Financial Aspect>

Allocated amount for NRW reduction activities from NWSDB’s O&M budget is limited due to NWSDB financial situation, which is affected by the several factors such as tariff structure which is not cost reflective, high energy cost, high personal cost, and high NRW rate, etc. Therefore, the current NRW reduction activities have been implemented utilizing savings from Water Sector Development Project II (ODA loan project) and ADB funded projects.

#### <Evaluation Result>

In light of the above, slight problems have been observed in terms of the institutional and financial aspects of the implementing agency. Therefore, the sustainability of the effectiveness through the project is fair.

### 5 Summary of the Evaluation

The project has achieved the project purpose and the overall goal. NRW reduction activities were implemented in the pilot sites, which resulted in a remarkable NRW reduction in some sub-zone of the pilot sites. The NRW reduction activities were further introduced to the other area in Colombo city through NWSDB staff of non-pilot sites who participated in the project activities in the pilot sites and trained by the project. As a result, NRW rate in Colombo city area reduced from 49.5 in 2012 to 46.3 in 2014 and it is expected that the decrement of NRW rate per annum in CMC area will exceed one percent point by 2017 as planned. The project has brought about several positive impacts such as saving of production cost, improvement in performance of distribution system, and increase in number of connections/subscribers, which has contributed to improvement of quality of service and increase of NWSDB’s revenue. Regarding sustainability, slight problems have been observed in terms of the institutional and financial aspects of the implementing agency due to shortage of staff for monitoring of NRW and limited budget for implementing a full scale of NRW activities in Colombo city. As for efficiency, the project cost was higher than the plan because the additional costs were spent for GIS restructuring activities and public relations activities.

Considering all of the above points, this project is evaluated to be satisfactory.

### III. Recommendations & Lessons Learned

#### Recommendations for Implementing agency:

##### Strengthening of NWSDB’s monitoring capacity for NRW

- At the moment, monitoring of NRW is conducted in order to evaluate the number of the NRW reduction activities in a certain period. Currently, creation of District Metering Areas (DMAs) in a way which several DMAs in one zone are in progress under ongoing Greater Colombo Water and Wastewater Management Improvement Investment Program (2015-2020) by ADB. In the future, DMA will be mandated to conduct the water audit for monitoring of water inflow into distribution system and amount of water sales level, which will enable DMA to calculate revenue gain and level of NRW with water savings and reward the staff.
- Therefore, it is recommended that NWSDB will develop the database and the necessary monitoring formats and guideline for DMA referring to the existing monitoring system on a zonal basis. Also NWSDB could be ready with guideline and procedures for conducting of water audit.

#### Lessons learned for JICA:

- One out of two pilot sites which had been selected in the same area where JICA Loan project was in progress had given room for NRW reduction project to measure effectiveness of different NRW reduction techniques (e.g. with project funding pipe replacement and with limited O&M budget other actions) in two pilot sites so that menu of priority actions for reduction of NRW in Colombo city is established. JICA assisted Master Plan “Update, Institutional Development, and Non-Revenue Water Engineering Study” was conducted in parallel with this project which gives synergy effect. Both projects were instrumental in implementing NRW reduction activities utilizing saving of the JICA WSDPII and ADB funded Project. In this case, good scheduling of the relevant projects gives synergy effect and plough effect.

<sup>1</sup> There are eleven (11) Regional Support Center in NWSDB.

<sup>2</sup> DMA refers to water distribution areas divided off to measure and manage water supply volume using a water service meter. It is considered that the water distribution management based on DMA is an effective distribution management system for NRW reduction.



Checking the flow measurement in DMA 3 of Colombo City



Old pipe replacement with new pipes in DMA9 in Colombo City



Old pipe replacement with new pipes in DMA9 in Colombo City