Effort in reducing unaccountable water and economic consideration

I. Dimaano

Central Non-Revenue Water, Maynilad. 1321 Apolinario St, Makati City, Philippines. E-mail: irineo.dimaano@mayniladwater.com.ph

Abstract

In 2007, Maynilad Water Services, Inc. (Maynilad), the private water and wastewater service provider of the West Zone of Metro-Manila (Philippines), had an enormous challenge ahead: to achieve 100% service coverage in the coming few years with basically no additional water resources; to connect an additional 3 million people still without access to piped water; and to improve the service level to the existing customers. The only way to meet this demand is to reduce water losses from its deteriorated pipe network. Water balance made in that year showed significant total non-revenue water of 1,500 million liters per day which is equivalent to 66% of the total system input volume.

Maynilad recognized that to be financially viable, it needs to address the non-revenue water problem. Thus, the Central NRW team was immediately created in 2008 and was tasked to lead Maynilad’s ambitious NRW reduction and management program, which is considered one of the largest NRW projects in the world in terms of amount of water losses and the scope and magnitude of works involved to bring down the high level of NRW.

Maynilad’s NRW program involves breaking up the whole network into hydraulically isolated and measurable district metered areas (DMA); monitoring and diagnosing each DMA; developing well-trained and fully equipped leak detection teams to find surfacing and non-surfacing leaks; active leakage control; pressure management; selective pipe replacement/rehabilitation; closing of illegal connections and decommissioning of old distribution pipes; integrated meter management; and a sustained capacity building of NRW teams.

By the end of 2013, 6 years after implementing the NRW program, Maynilad was able to recover more than 700 MLD and managed to bring down the NRW level to 39%. The water that was saved in turn was used to supply additional 400,000 new customers in the expansion areas and generally improved the level of service of the existing customers by providing higher water pressure and longer water availability. These translated to an increase in billed volume by 56 and 107% increase in total revenues for the company.

Key words: manila, non-revenue water, NRW management

BACKGROUND OF MAYNILAD

Metropolitan Waterworks and Sewerage System (MWSS), a government owned corporation providing water and sewerage services to the whole of Metro-Manila, was privatized in 1997 and was divided into two concession areas. The 1997 privatization was in response to the then pressing needs which were (1) poor level of service, (2) high non-revenue water and (3) the need to develop other water sources to meet the growing demand. A huge investment was required to answer these needs.

The West Zone concession area which covers western portions of Metro-Manila (17 cities and municipalities) having 9 million plus population was awarded to Maynilad under the joint consortium of Benpres Holdings (Philippines) and Lyonnaise dex Eaux (France).

The East Zone concession area which covers the eastern portions of Metro-Manila (23 cities and municipalities) having 6 million population was given to Manila Water, a consortium of Ayala (Philippines), United Utilities (UK), Bechtel (USA) and Mitsubishi (Japan).
The two concessionaires, who were each granted 25 years to manage each concession network, will act as agents and operators of MWSS responsible for operation and maintenance, service expansions and new investments.

However, the impact brought about by the Asian financial crisis compounded by the effects of El Nino led to the early termination of the concession contract in the West Zone.

From 2004 to 2006, Maynilad was taken aback by the government and placed under MWSS control and also prepared the way for its second privatization.

In 2007, after a successful public bidding, the operation of Maynilad was awarded to the joint consortium of Metro Pacific Investment Corp. (MPCI) and D.M. Consunji Inc. (DMCI), two best Filipino owned companies in the Philippines.

In 2009, MWSS agreed to extend the concession agreement with both Maynilad and Manila Water by 15 more years to 2037 from 2022, the original expiry date.

**PROFILE OF MAYNILAD**

**Service area**

In 2014, Maynilad covers an area of 540 km² with approximately 9.3 million people. Raw water supply comes from Angat Dam in Bulacan, located north of Metro-Manila, which provides 96% of its total supply while the remaining 4% comes from Laguna Lake, located South east of Metro-Manila and from few deepwells supplying the fringe areas in the south portions of the concession. This can be seen in Figure 1.

It has three water treatment plants with a total combined capacity of 2,500 MLD: the La Mesa Treatment Plant-1 (1,500 MLD), one of the biggest in Asia, and La Mesa Treatment Plant-2 (900 MLD) which are both located in Novaliches, Quezon City, and the recently built Putatan Water Treatment Plant (100 MLD), located in Muntinlupa, which uses a micro-filtration and reverse osmosis system.

Maynilad distribution network comprises of 5,575 km of pipes of different materials, 17 pumping stations, and 18 reservoirs. Approximately, 40% of its pipe network is more than 30 years old.

It has 12 business area offices that operate within specific boundaries catering to the needs of over 1,100,000 customers, thus, making it the largest water utility in the Philippines.

Its service coverage stands at 96% with the balance mostly comprising of the still un-served expansion areas in the South which are currently served by private groundwater wells.

![Figure 1](https://iwaponline.com/wpt/article-pdf/10/1/50/89063/wpt0100050.pdf)
THE CHALLENGE IN 2007

In 2007, Maynilad’s customers were experiencing poor level of service. Water supply was unreliable and was available for 24 hours in only 47% of the customers and only 53% were getting more than 7 psi average water pressure at their water meters. There was a commitment to improve the service level in the existing 700,000 customers. The goal is to ensure that all served customers have continuous water supply at a minimum of 7 psi by the end of 2012.

The service coverage at that time was only 81% and Maynilad plans to meet the 92% commitment by the end of 2012. There were more than 300,000 additional customers waiting to be served, mostly in the southern part of the concession area.

However, the existing treatment plants were operating near their maximum capacities and no major additional water sources were being developed to provide water for the improvement in service level and to the new customers.

Maynilad was also losing 1,500 MLD in its deteriorated network at that time for an NRW level of 66%. Most of the losses were incurred in the central part of the concession area – the most congested part of Manila and where the oldest pipes were located. It is also the part of the network that will convey water to the expansion area.

The management recognized that the only way to meet the additional demand is to reduce water losses. Maynilad launched an ambitious NRW reduction and management program, which is considered one of the largest NRW projects in the world in terms of amount of water losses and the scope and magnitude of works involved to bring down the high level of NRW.

MAYNILAD’S NON-REVENUE WATER HISTORY

In the early 1980s, the MWSS under foreign assisted Manila Water Supply Rehabilitation Projects I and II (MWSRP-I and MWSRP-II) had implemented various NRW reduction programs. It applied the concept of zone/district metering which aimed to rehabilitate major portions of its distribution network to reduce high NRW and improve its level of service.

Significant results were attained in the early stages of the program, thru massive replacements of old pipes, meters, appurtenances and others. However, improved level of NRW did not last long enough primarily due to the lack of supporting programs and right organizations to monitor and sustain the improvements made.

At the initial stage of Maynilad operation under private management, zone/sub-zone metering once again implemented in various parts of the system. Similarly, NRW target levels were achieved in areas where NRW reduction programs were carried out, but the eventual gains deteriorated after a period of time due to lack of sustainable programs.

Just after a few years, this concept of NRW reduction was abandoned, and the program shifted to massive system wide leak repairs and meter replacements which eventually were not able to produce significant NRW reduction.

Other NRW related projects were also carried out by various groups in Maynilad; however, most of them were poorly managed and not well coordinated within the organization. Evidently, there was no direct and full time ownership of the program. That is, many were involved but hardly a few were directly responsible. It was very evident that there was a lack of clear direction where the management wanted its NRW program to proceed.

Ten years after privatization, from 1997 until 2006, there were no significant changes in the system wide NRW level of Maynilad, except only in 1998 when it reached 61%. It was, however, mainly caused by very low system input volume due to forced supply reduction brought about by the El Nino phenomenon.
Under the MWSS take-over and operation in 2004–2006, no considerable accomplishment was made during the period in terms of reducing the level of NRW and improving the level of service.

In 2007, when the MPIC-DMCI started its operation the NRW level was at 66% and recognized the magnitude of the problem and realized the golden opportunity in recovering this huge volume of water being lost in the system which was a staggering 1,500 MLD. They set an ambitious target of 40% NRW level at end of 2012. Maynilad recognized that the integration of NRW management in the Investment Plan is needed to ensure the company’s viability. Without NRW Management, development of new water sources will need to be accelerated and larger distribution lines will be constructed as an allowance for the large water loss in the network. To avoid this situation, water loss in the system would have to be constantly managed and monitored.

Over the remaining 30 years of the concession (2008–2037), Maynilad commits to invest 2,572 million USD to improve water services to its customers. A significant component, almost 40% of the total budget, of this investment is dedicated toward managing NRW in the system.

NEW MAYNILAD’S NRW REDUCTION STRATEGY

Creation of NRW team

To make sure that whatever NRW gains achieved are sustained, a specific group has to take the lead and responsibility for the implementation of the entire NRW management program, from conceptualization, execution to maintenance and sustenance. For this purpose, a dedicated Central NRW team was created in 2008 giving them the full management support and leadership to lead the way in reducing Maynilad’s high NRW level.

The NRW teams were placed across Maynilad’s business area offices to manage day to day NRW operations and programs. To oversee and manage the whole program, there is the Central NRW core group that is based in the new office environment away from the old Maynilad headquarter. New and young engineers mostly coming from top universities across the Philippines were hired.

Central NRW also has its own Engineering and Construction Department to design and implement projects related to NRW reduction.

The organizational chart of Central NRW can be seen in Figure 2.

![Figure 2](https://iwaponline.com/wpt/article-pdf/10/1/50/89063/wpt0100050.pdf)

Breaking-up the network into smaller systems

A large distribution network like Maynilad, with poor pipeline conditions, cannot be managed efficiently without breaking them into smaller areas. Thus, the entire Maynilad network was divided into more manageable hydraulic systems (HS) and further down to smaller and more discrete district metered areas (DMA). Subdividing the network into HS and DMA enabled Maynilad to efficiently carry out measurements and diagnose the specific sources of NRW.
DMA diagnostic and assessment

Diagnostic activities are carried out on each established DMA, concurrently with water audit of the primary lines. The baseline flow and pressure measurements were established; the physical and commercial components of the NRW were identified; proper actions were done to address the specific source of NRW; and pressure management were done to protect the network from sudden pressure fluctuations.

Active leakage control

Active leakage control (ALC) is the pro-active leakage reduction procedure to identify water loss in the DMA. It involves detection and repair of both detected and reported leaks. It aims to reduce the components of leak runtime: awareness time, location time and repair time. ALC is vital to cost-effective and efficient leakage management.

Maynilad’s leak detection management, composed of highly trained and well-equipped engineers and technicians capable of locating leaks both at primary and distribution mains, was formed to pinpoint underground leaks, running leaks, illegal connections and unknown laterals in the network using sophisticated equipment.

The Leak Repair Control Center was also created to manage Maynilad’s entire leak repair program. They are on 24/7 availability to ensure that contractor teams are deployed on-time to repair the issued job orders.

Selective pipe replacement

Selective replacement of identified segments of the network is another important aspect in Maynilad’s strategy. Primary lines and distribution lines inside DMAs that have been diagnosed are prioritized based on the potential water recovery, frequency of bursts, age of pipes, maintenance cost and pipe materials (asbestos cement pipes and galvanized iron pipe).

Rehabilitation may be total or partial depending on the diagnosis and cost-benefit analysis. It includes replacement of mainlines, customer service pipes and water meters. It is only implemented when all diagnostic efforts have been exhausted. Properly executed selective pipe replacement projects address both physical and commercial NRW.

Integrated meter management

Being the cash register of the company, it is also important to manage the customer water meters to improve accuracy and reliability of water meters, reduce commercial losses and increase revenue. Meter management in Maynilad is handled by the Integrated Mater Management under Central NRW. The department is responsible for implementing the replacement and maintenance of small and large water meters, testing of meters, and selection of the proper meter technology and correct sizing of meters.

DMA sustenance

Continuous monitoring of DMAs with acceptable NRW levels was implemented to ensure that the good NRW levels are sustained. Maynilad also started to automate DMA data gathering and monitoring to help the NRW teams monitor the DMAs that need attention.
Capacity building

Maynilad believes that the foundation of having a strong organization lies in having competent and competitive work force. Central NRW invested in training its employees to increase their productivity and to ensure a continuous transfer of knowledge and skills to new employees. CNRW personnel were able to attend continuous technical, safety and management trainings from world class experts.

CAPEX COST

Two hundred and eighty million US dollars were allocated for NRW reduction for 2008–2013. This is equivalent to 28% of the total Maynilad CAPEX budget for the said period. Among the biggest components of Maynilad’s CAPEX for that period were DMA establishment, isolation, measurement and diagnostic; leak repair; selective pipe replacement; purchase of modern leak detection equipment; and replacement of customer water meters.

ACCOMPLISHMENTS

The following activities essential to NRW reduction were accomplished by Maynilad from 2008 to 2013:

- Maynilad was able to establish 138 HSs and 1372 DMAs – 980 of which were automated by the end of 2013.
- Thirty thousand underground leaks were detected, with more than 6,000 km of pipe network, including overlaps, investigated.
- Leak repair output was increased from 17,000 repairs per year in 2009 to 40,000 leaks per year in 2010–2013. During the 6-year period, the total leaks repaired were 200,000.
- One thousand and ninety kilometers of pipes, equivalent to 24% of the old network, were replaced. Majority of the rehabilitated lines is found in Central Manila.
- Almost 700,000 small customer meters and more than 3,000 large meters were replaced and almost 800 electromagnetic meters were installed in DMAs and selected large accounts for more accurate measurement of supply and billed volume.

BENEFITS

Reduction of NRW

Rapid reduction of non-revenue water was achieved during the last 6 years. Maynilad’s NRW average NRW volume in 2013 is 768 MLD for an NRW level of 38.7%. This is equivalent to a reduction of 738 MLD from the 2007 NRW volume of 1,506 MLD and a 27% point reduction in NRW level.

The annual average NRW levels from 1997 to 2013 can be seen in Figure 3.

Improved service level

Improvement in water pressure and extended water availability were experienced as a result of recovering such a huge volume of physical losses. In 2013, 100% of Maynilad’s customers were experiencing a minimum of 7 psi water pressure while 98% were getting uninterrupted water supply for 24 hours/day. Figures 4 and 5 show Maynilad’s water availability and pressure maps in 2007 and 2013.
Figure 3 | Maynilad’s NRW average NRW level (1997–2013).

Figure 4 | Maynilad’s water availability map (2007 vs 2013).

Figure 5 | Maynilad’s water pressure map (2007 vs 2013).
Increase in service coverage and billed services

Aside from improving the service levels of the existing customers, recovering water also gave Maynilad an opportunity to expand its services. Having a reliable network allowed an efficient conveyance of water from the source up in the north to the new areas far down south. From just 700,000 customers in 2007, an additional 430,000 households were tapped to increase the number of total customers to 1.1 million.

Increase in billed volume

Increase in billed volume resulted from the efficient redistribution of recovered water, better service level on existing customers, aggressive marketing strategy to get more customers and improved accuracy and reliability of water meters. Billed volume increased from just 778 MLD in 2007 to 1,215 MLD in 2013 – an increase of more than 400 MLD or 56%.

Increase in revenue

Consequently, there was a 127% growth in revenue from 2007 to 2013 – equivalent to an increment of more than 200 million US$.

Savings in operational costs

Another benefit of reducing the physical losses is the reduction in operational expenses. Because less water is needed to be produced to satisfy the demand, water treatment cost was reduced. Since there was a significant improvement in water pressures in the distribution network, booster pump operation was minimized, if not totally eliminated. This led to lower cost to distribute water.

The comparative performance indicators between 2007 and 2013 can be found in Table 1.

### Table 1 | Performance indicators (2007 vs. 2013)

<table>
<thead>
<tr>
<th>Performance indicator</th>
<th>Unit</th>
<th>2007</th>
<th>2013</th>
<th>Var</th>
<th>% Var</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average system input volume</td>
<td>MLD</td>
<td>2,284</td>
<td>1,983</td>
<td>−301</td>
<td>−13%</td>
</tr>
<tr>
<td>Average billed volume</td>
<td>MLD</td>
<td>778</td>
<td>1,215</td>
<td>+437</td>
<td>+56%</td>
</tr>
<tr>
<td>Average NRW volume</td>
<td>MLD</td>
<td>1,506</td>
<td>768</td>
<td>−738</td>
<td>−49%</td>
</tr>
<tr>
<td>Average NRW level</td>
<td>%</td>
<td>66</td>
<td>39</td>
<td>−27</td>
<td>−41%</td>
</tr>
<tr>
<td>Service coverage</td>
<td>%</td>
<td>81</td>
<td>96</td>
<td>+15</td>
<td>+19%</td>
</tr>
<tr>
<td>Billed services</td>
<td>(×1,000)</td>
<td>700</td>
<td>1,129</td>
<td>+429</td>
<td>+61%</td>
</tr>
<tr>
<td>Revenue</td>
<td>M USD</td>
<td>164</td>
<td>373</td>
<td>+209</td>
<td>+127%</td>
</tr>
</tbody>
</table>

KEY LEARNINGS

After working for more than 6 years reducing and managing Maynilad’s non-revenue water, the following notions were learned:

- ‘NRW management is not a one-time activity’. Several attempts to reduce NRW in the past failed due to the discontinuity of the program. Focus is often diverted to other activities once the target NRW levels were achieved. It is important to keep NRW management as part of the regular operations in order to sustain the low NRW level. It is also worth noting that an even greater effort is
needed when working in such low NRW systems. The diagnostic methods must be more systematic and the staffs must be well-equipped and highly skilled to be able to immediately resolve the problems in case increase in NRW in DMAs will be observed. This will ensure that the NRW of the utility will be kept at low level.

- ‘Quality data management system must be in place.’ NRW management is data hungry and different field data must be continuously monitored and utilized to be able to efficiently manage all the DMAs at the same time. Since an appropriate strategy must be applied for different NRW problems, it is important to have reliable and good quality data as wrong data will lead to wrong decision. This will also help the NRW staff to properly prioritize issuance of job orders.
- ‘Quality workmanship is essential.’ Quality workmanship in laying the pipes and installing the appurtenances is vital to the effectiveness of NRW reduction and to the long-term sustenance of the low level of NRW. All pipe replacement projects and leak repair activities must follow the highest quality standards to ensure that the leaks will not recur and the economic life of the network will be maximized.
- ‘Local Government Units (LGUs) are very important partners.’ Majority of the works relevant to NRW reduction involve excavation in major roadways. That is why establishing good working relations with LGUs (city engineering, public works, traffic bureau, public officials) is also a priority. They must be assured that minimal disturbance will be made during the projects and the pavements will be restored properly for them to have immediately grant permits. This helps in the timely completion of the projects and in the faster realization of water recovery.
- ‘Continuous staff development’. The foundation of having a strong organization that manages NRW lies in having competent and highly skilled personnel. Maynilad Central NRW is investing in training its employees to keep in step with the latest development in water loss management, to ensure a continuous transfer of knowledge and skills to employees and to increase their productivity. Incentives are also given to top performing employees to motivate them to maintain their performance and to encourage them to keep on developing their skills.

**CONCLUSION**

Making NRW reduction and management among a water company's top priorities indeed has a lot of benefits. It helps the company to become more financially viable.

The costs invested to improve the network and recover water can be justified by the increase in revenue that will result from having a more efficient water distribution and from the additional volume of water that can be sold to new customers. Savings can also be made from the deferment of projects to develop new water sources and from the reduced operational costs. These additional funds can be used to finance other projects that will ultimately make the company more stable and profitable.