

**Republic of the Philippines
Maynilad Water Services, Inc.**

**Republic of the Philippines
Technical Assistance for Enhancing
Capabilities of Non Revenue Water
Management to Maynilad**

Final Report

January 2019

Japan International Cooperation Agency (JICA)

**Yokohama Water Co., Ltd.
Marubeni Corporation**

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**Republic of the Philippines
Maynilad Water Services, Inc.**

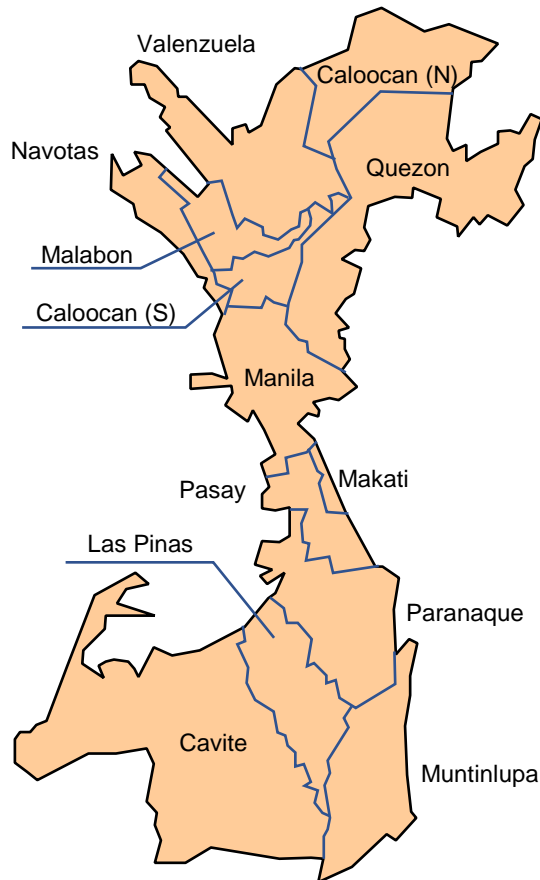
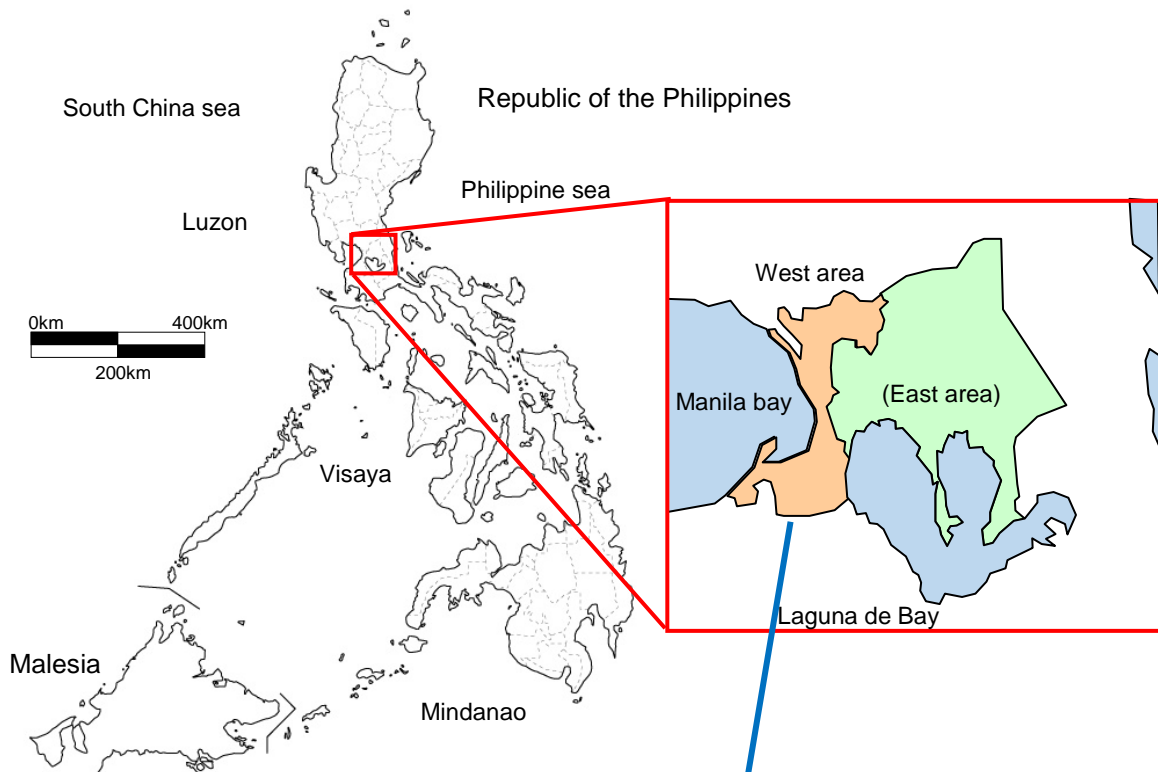
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Project site (Maynilad water supply area)

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Abbreviation

ACP: Asbestos Cement Pipe
BA: Business Area
CAPEX: Capital Expenditure
CEO: Chief Executive Officer
CIP: Cast Iron Pipe
CNRW: Central NRW Management
COO: Chief Operating Officer
CP: Concrete Pipe
DIP: Ductile Iron Pipe
DMA: District Metered Area
DMCI: DMCI Holdings, Inc.
GIP: Galvanized Iron Pipe
GSP: Galvanized Steel Pipe
HDPE: High Density Polyethylene (pipe)
HS: Hydraulic System
JICA: Japan International Cooperation Agency
LMPS: La Messa Pumping Station
LMTP: La Messa Water Treatment Plant
MPIC: Metro Pacific Investments Corporation
MWCI: Manila Water Company, Inc.
MWSI: Maynilad Water Services, Inc.
MWSS: Metropolitan Waterworks and Sewerage System
NRW: Non-Revenue Water
OJT: On the Job Training
OPEX: Operating Expenditure
PE: Polyethylene (pipe)
PI: Performance Indicator
PRV: Pressure Reducing/Regulating Valve
psi: Pound per Square Inch
PVC: Poly-vinyl Chloride (pipe)
PWTP: Putatan Water Treatment Plant
SP: Steel Pipe

Unit conversion table

Pressure	MPa (N/mm ²)	bar (Mdyn/cm ²)	psi (lbf/in ²)	atm (Standard Atmosphere)	Hydraulic head (m)
MPa (N/mm ²)	1	0.1	0.006895	0.101325	0.009806
bar (Mdyn/cm ²)	10	1	0.068947	1.01325	0.098067
psi (lbf/in ²)	145.038	14.5038	1	14.6959	1.42233
atm (Standard Atmosphere)	9.86923	0.986923	0.068046	1	0.096784
Hydraulic head (m)	101.971	10.1972	0.703070	10.3323	1

Foreign exchange rate (December 2018)

1 PHP (Philippine peso)=2.16596 JPY (Japanese Yen)

1 USD (US Dollar)=113.385 JPY (Japanese Yen)

Chapter 1 Project Background and Purpose

1.1. Project background

Metropolitan Waterworks and Sewerage System (MWSS) has been divided into two private companies since 1997. These are Manila Water (MWCI: Manila Water Company, Inc.), which has been implementing water supply and sewerage management in the eastern area of Metro Manila, and Maynilad (MWSI: Maynilad Water Services, Inc.), which has been implementing them in the western area of Metro Manila. The management conditions in the eastern and western areas were different at the start. Maynilad took on much more debt from MWSS than Manila Water did. Manila Water has been smoothly providing the water supply and sewerage management with proper investment, but Maynilad has been reimbursing the debt and had limited investment. Under these conditions, Manila Water has constantly decreased its non-revenue water (hereinafter NRW), but Maynilad has maintained high NRW.

Suez S.A. is a major worldwide water company based in France that signed a contract with Maynilad in 1997, but then terminated it in 2005. Maynilad was temporarily nationalized in 2007. Metro Pacific Investments Corporation (MPIC) and DMCI Holdings have taken over the contract and Maynilad has been privatized again. MPIC and DMCI have provided drastic investment and increased the amount of staff who work on NRW measures. Thus, NRW decreased from 66% in 2007 to 43.3% in 2012.

After Marubeni Corporation participated in Maynilad's business management from 2012, the management has been facilitated differently, and NRW has decreased from 40% to 30% over the course of 5 years. From 2018 to 2022, Maynilad is aiming to decrease the NRW rate to 20%, which is the reason why they sought investment funding. After Maynilad secured long-term investment funding from JICA, they launched renewals of distribution networks, flow meters and distribution control systems.

In 2017, Maynilad formulated its "Business Plan 2018-2022," which followed "Business Plan 2013-2017." Maynilad set indicators for improving the NRW rate, water supply rate, water supply pressure, and water supply time, and has decided to proceed with its business improvements based on this goal. Maynilad has formulated the investment plan in order to implement efficient NRW countermeasures that aim to improve the NRW rate.

1.2. Project outcome

The expected outcomes of this project are as follows:

- 1) An analysis of the present situation and issues for the actual ability of NRW
- 2) Recommendation of efficient NRW countermeasures that will fit the present situation
- 3) The formulation of the implementation plan, as well as monitoring support

1.3. Project period

1st dispatch – October to November 2017

- 2nd dispatch – February to March 2018
- 3rd dispatch – June to July 2018
- 4th dispatch – September to October 2018

1.4. Organization

Maynilad Water Service Inc.: MWSI

1.5. JICA team member

Name	Position	Organization
Ken Yokoyama	Team Leader / Water Supply Improvement Project (1)	Yokohama Water
Yoshinobu Ono	Sub Team Leader / Water Supply Improvement Project (2)	Yokohama Water
Yusuke Ando	Equipment / Water Distribution Facilities and Water Supply Equipment	Yokohama Water
Daisuke Ikeda	NRW Measures / Water Distribution Facilities and Water Supply Equipment (1)	Marubeni
Pedro Coelho Ramalho	NRW Measures / Water Distribution Facilities and Water Supply Equipment (2)	Marubeni (AGS)
Mio Uematsu	Finance / Asset Management (1)	Marubeni
Miguel Marques Santos Soares	Finance / Asset Management (2)	Marubeni (AGS)

Chapter 2 Maynilad Outline, Organization and Implementation

2.1. Outline of Maynilad

(1) Water Supply System

a) Water Sources

Surface water is the main water source for Maynilad. Currently, it uses water from the Angat and Ipo dams to supply La Messa water treatment plant 1, LMTP1, and La Messa water treatment plant 2, LMTP2, as well as water from Laguna Lake to supply Putatan water treatment plant 1 (PWTP1). Putatan water treatment plant 2 will be operational. LMTP1 and LMTP2 use conventional treatment sequences (coagulation, flocculation, sedimentation, filtration and disinfection), although with different technologies and process sequences. PWTP1 uses a more complex process that includes coagulation, dissolved air flotation, biological aerated filtration, microfiltration, ultrafiltration and reserve osmosis, and finally, disinfection.

Table 2-1 Water Treatment Capacity

WTP	Capacity	Treatment sequences
LMTP1	1,500,000m ³ /d	Coagulation, Sedimentation, Filtration
LMTP2	900,000m ³ /d	Coagulation, Sedimentation, Filtration
PWTP1/2	300,000m ³ /d	Microfiltration, Ultrafiltration and Reserve Osmosis
Total	2,700,000m ³ /d	

b) Water Transmission

After water treatment, the water is distributed to 28 reservoirs with a total capacity of 601,000m³. This is done either by natural gravity or by pumping through the Primary Lines (pipes that range from 350 to 3200mm in diameter). The total length of the Primary Lines in Maynilad is about 546km, and most of them are in steel pipes (66%).

Table 2-2 Network length of Primary Lines

Pipe type	Length (km)	Percentage
SP (Steel Pipe)	358.6	65.6%
DIP (Ductile Iron Pipe)	113.0	20.7%
CIP (Cast Iron Pipe)	49.6	9.1%
ACP (Asbestos Cement Pipe)	16.4	3.0%
CP (Concrete Pipe)	4.1	0.7%
PVC (Polyvinyl Chloride)	2.5	0.5%
HDPE (High Density Polyethylene)	2.3	0.4%
Total	546.5	100.0%

(Data from Maynilad, JICA team edited)

Approximately 56% of the Primary Lines are 350mm to 750mm in diameter. Many pipes have been updated since 1990, but the pipelines that were constructed in the 1980s still remain and they will be updated in the future. The Primary Lines (29%: 156km) have already been updated in the past 10 years.

Water is delivered from the Primary Lines to the existing 12 business areas (BAs), which are a division of Maynilad’s service area and facilitate the management of the service. The BAs are grouped into three business districts (North, Central and South). The length of the Primary Lines passing through the BAs is about 450km.

Table 2-3 Network length by pipe diameter (Primary Lines)

Pipe Diameter (mm)	Length (km)	Percentage
350 or more and less than 500	105.7	19.3%
500 or more and less than 750	200.6	36.7%
750 or more and less than 1100	110.7	20.3%
1100 or more and less than 1600	79.9	14.6%
1600 or more and less than 2600	35.2	6.4%
2600 or more and 3200 or less	14.4	2.6%
Total	546.5	100.0%

(Data from Maynilad, JICA team edited)

Table 2-4 Network length by installation date (Primary Lines)

Installation date	Length (km)	Percentage
Unknown	0.2	0.0%
1950 ~ 1959	2.8	0.5%
1960 ~ 1969	1.3	0.2%
1970 ~ 1979	20.5	3.8%
1980 ~ 1989	205.3	37.5%
1990 ~ 1999	49.2	9.0%
2000 ~ 2009	111.4	20.4%
2010 ~ 2017	156.0	28.5%
Total	546.5	100.0%

(Data from Maynilad, JICA team edited)

c) Water Distribution

Water is supplied to customers mainly through Secondary Lines (200mm to 315mm in diameter) and Tertiary Lines (15mm to 160mm in diameter). The table below presents the main characteristics of the water system in Maynilad per BA. The total length of the Secondary and Tertiary Lines is 6,287km, most of which is PVC pipe (80%).

Table 2-5 Network length of Secondary/Tertiary Lines

Pipe type	Length (km)	Percentage
PVC (Polyvinyl Chloride) pipe	5,034.4	80.2%
HDPE (High Density Polyethylene) pipe	315.8	5.0%
ACP (Asbestos Cement Pipe)	315.5	5.0%
GSP (Galvanized Steel Pipe)	277.5	4.4%
CIP (Cast Iron Pipe)	183.8	2.9%
GIP (Galvanized Iron Pipe)	109.9	1.7%
Other Material	46.7	0.7%
No Information	3.4	0.1%
Total	6,287.0	100.0%

(Data from Maynilad, JICA team edited)

It was observed that the most frequent pipe diameters in the Secondary and Tertiary Lines are 100mm to 150mm. In terms of the installation date, 73% of the Secondary and Tertiary Lines have been installed or renewed during the last 17 years.

Table 2-6 Network length by pipe diameter (Secondary/Tertiary Lines)

Pipe Diameter (mm)	Length (km)	Percentage
Less than 50	5.0	0.1%
50 or more and less than 100	1,805.5	28.7%
100 or more and less than 150	2,041.4	32.5%
150 or more and less than 200	1,422.6	22.6%
200 or more and less than 250	640.7	10.2%
250 or more and less than 300	184.7	2.9%
300 or more and less than 350	187.1	3.0%
Total	6,287.0	100.0%

(Data from Maynilad, JICA team edited)

Table 2-7 Network length by installation date (Secondary/Tertiary Lines)

Installation date	Length (km)	Percentage
1960 ~ 1969	13.0	0.2%
1970 ~ 1979	0.9	0.0%
1980 ~ 1989	1,377.9	21.9%
1990 ~ 1999	309.5	4.9%
2000 ~ 2009	2,269.4	36.1%
2010 ~ 2017	2,316.3	36.8%
Total	6,287.0	100.0%

(Data from Maynilad, JICA team edited)

Table 2-8 Main characteristics of the water system of Maynilad (2016)

Business Area (BA)	System Input Volume (m ³ /year)	Primary Lines (km)	Secondary Lines (km)	Tertiary Lines (km)
North Caloocan	52,326,080	26.2	65.7	542.9
Novaliches - Valenzuela	74,415,123	38.5	79.2	468.9
Fairview - Commonwealth	59,752,912	36.3	74.8	529.7
Quirino - Roosevelt	63,375,224	35.8	84.1	501.6
Malabon - Navotas	38,665,754	15.5	30.2	229.1
South Caloocan	41,145,706	19.5	32.5	285.1
Sampaloc	47,026,495	22.8	40.7	229.3
Tondo	61,306,714	19.4	64.6	230.1
South Manila - Pasay - Makati	80,885,443	57.5	87.1	418.3
Paranaque	67,364,360	57.1	86.7	621.7
Muntinlupa - Las Piñas	77,867,895	49.4	138.7	760.7
Cavite	48,492,326	71.7	134.8	550.5
Total	712,624,032	449.7	919.1	5,367.9

(Data from Maynilad, JICA team edited)

d) Distribution System

At BA level, the network is broken down into hydraulic systems (HSs) and District Metering Areas (DMAs). At the end of 2016, the Maynilad system comprised a total of 141 HSs and 1,599 DMAs. The table below presents the number of HSs and DMAs per BA. The DMA length in Maynilad ranges from an average of 3km/DMA in Tondo to 5km/DMA.

Table 2-9 Distribution of HSs, DMAs and customer meters per BA

Business Area (BA)	HS (Number)	DMA (Number)	Pipe length (km/DMA)	Customer meter (Number)
North Caloocan	11	164	3.7	138,613
Novaliches - Valenzuela	12	184	3.0	135,479
Fairview - Commonwealth	7	136	4.5	155,866
Quirino - Roosevelt	14	159	3.7	118,499
Malabon - Navotas	10	76	3.4	79,598
South Caloocan	9	75	4.3	82,163
Sampaloc	7	66	4.2	68,207
Tondo	20	99	3.0	78,864
South Manila - Pasay - Makati	18	108	5.0	89,422
Paranaque	13	167	4.4	114,218
Muntinlupa - Las Piñas	10	179	5.0	158,837
Cavite	10	186	3.9	126,975
Total	141	1,599	4.0	1,346,741

(Data from Maynilad, JICA team edited)

e) Water Supply

Maynilad formulated its “Business Plan 2018-2022,” which followed “Business Plan 2013-2017.” Several major indicators, such as the following, are specified in this plan, and the values are listed, from the year that the plan started to the final year.

The aim is to achieve a “Water Service Rate” of 100% in a water supply area by 2022. In 2016, the rate of the whole water supply area was 95.1%. By 2017, major cities in the water supply area (Manila City, Quezon City, Makati City, Pasay City, etc.) had achieved 100%, but the situation in the southern area of Maynilad was about 90%.

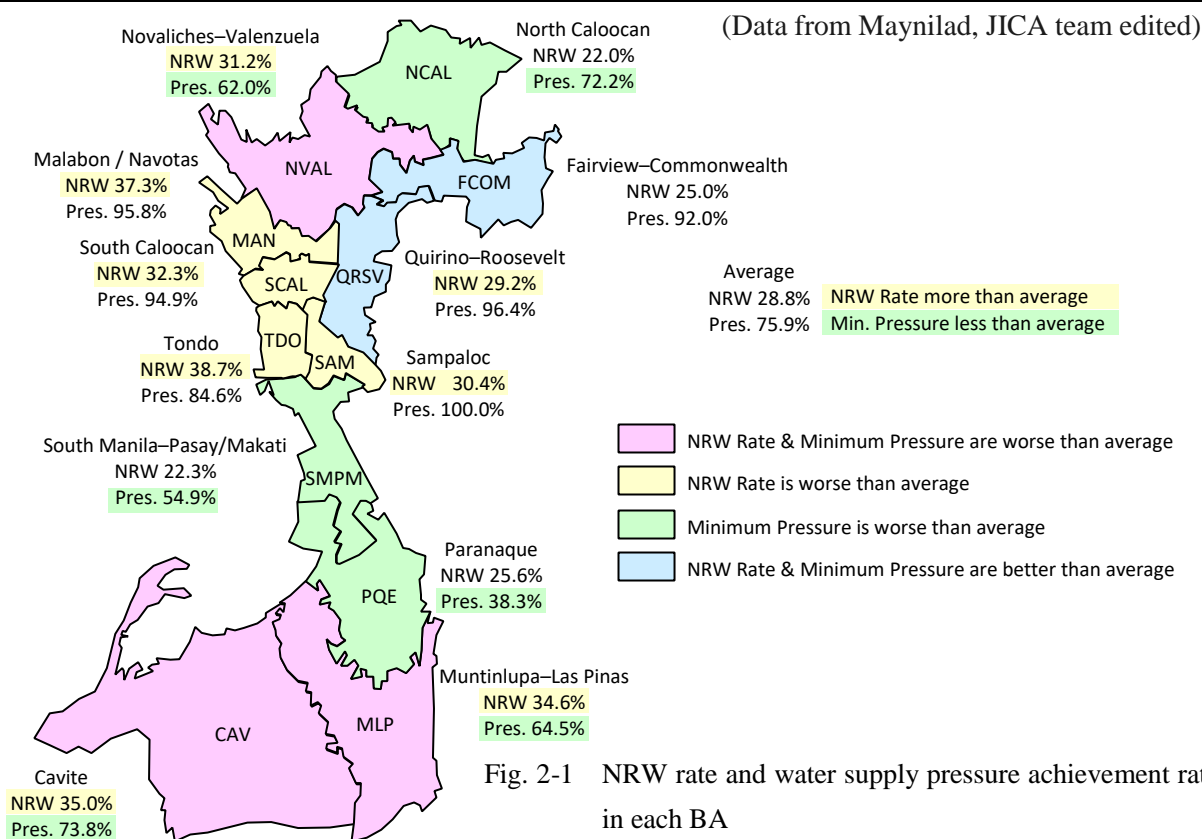
The “Water Supply Pressure” standard was revised in 2016. In 2015, the achievement rate of the minimum water pressure (7psi = 4.9m water head) under the old standard was 94.9%. However, as the minimum water pressure of the new standard changed to 16psi, the achievement rate fell to 75.8% in 2016. Maynilad is trying 100% to achieve the earliest time.

It is necessary to achieve a minimum water pressure (16psi) with a continuous water supply. The aim is to achieve a 100% “24-hour water supply” at the minimum water pressure or more by 2022. Currently, only the Sampaloc BA has been able to achieve 100% water supply for 24 hours at the minimum water pressure (16psi). The achievement rate in the southern part of the Maynilad water supply area is about 40 to 70%.

These indicators are shown in the following table and chart.

Table 2-10 Water supply index achievement rate in each Business Area
 (Refer to the notes in the figure below for color coding)

Business Area	Connection (No.)	Service Coverage (%)	System Input Volume (m ³ /d)	Daily Consumption (m ³ /d/conn.)	Revenue Volume (m ³ /d)	DMA NRW Volume (m ³ /d)	DMA NRW rate (%)	Supply Hour (24hour %)	Achieved Minimum Pressure (16psi %)
North Caloocan [NCAL]	138,613	99-100	142,967	0.80	111,515	31,453	22.0	100.0	72.2
Novaliches – Valenzuela [NVAL]	135,479	99-100	203,320	1.03	139,884	63,436	31.2	100.0	62.0
Fairview – Commonwealth [FCOM]	155,866	100	163,259	0.79	122,444	40,815	25.0	100.0	92.0
Quirino – Roosevelt [QRSV]	118,499	98-100	173,156	1.03	122,595	50,562	29.2	100.0	96.4
Malabon/Navotas [MAN]	79,598	97-99	105,644	0.83	66,239	39,405	37.3	100.0	95.8
South Caloocan [SCAL]	82,163	97-100	112,420	0.93	76,108	36,312	32.3	100.0	94.9
Tondo [TDO]	68,207	100	128,488	1.15	78,763	49,725	38.7	100.0	84.6
Sampaloc [SAM]	78,864	100	167,505	1.48	116,583	50,921	30.4	100.0	100.0
South Manila – Pasay/Makati [SMPM]	89,422	100	220,998	1.92	171,716	49,283	22.3	100.0	54.9
Paranaque [PQE]	114,218	100	184,056	1.20	136,937	47,118	25.6	96.7	38.3
Muntinlupa – Las Pinas [MLP]	158,837	98	212,754	0.88	139,141	73,613	34.6	88.4	64.5
Cavite [CAV]	126,975	74	132,493	0.68	86,120	46,372	35.0	98.7	73.8
Total / Average	1,346,741	95.1	1,947,060	1.03	1,386,307	560,753	29.9	98.2	75.9



In order to reduce the NRW rate and secure the minimum water supply pressure in each BA, the pipe network is reinforced by updating any leaking or fragile pipelines. As a result, there has been a reduction in the occurrence of water leakage due to pipe replacement, and so it is possible to withstand the rise in water supply pressure. Maynilad has plans to replace the PVC pipes as soon as possible, with the first priority being the pipe replacement of vulnerable ACPs and GIPs in the Secondary and Tertiary Lines. Other old PVC pipes and PVC pipes where leakage frequently occurs are to be updated and replaced by new pipes made out of the same kind of PVC.

In terms of the distribution of customer meters, it has been observed that about 91.0% are residential customers, 4.1% commercial customers, 3.8% semi-business customers and 0.8% industrial customers. When analyzing the revenue volume per service type, it has been shown that about 78.0% of the consumption is due to residential customers, 10.6% to commercial customers, 7.7% to semi-business customers and 3.7% to industrial customers. The number of contracts for commercial and industrial use is small, since a large amount of tap water is consumed, but the ratio of the amount of water revenue is high.

Table 2-11 Customer meters distribution and revenue water distribution per service type

Service type	Customer meters	Revenue water
Residential customers	91.3%	78.0%
Commercial customers	4.1%	10.6%
Semi-business customers	3.8%	7.7%
Industrial customers	0.8%	3.7%

(Data from Maynilad)

f) NRW Rate/Volume

Based on the present situation, Maynilad has formulated a plan to reduce the NRW rate from the current figures of 28.8% (2016) to 20% in 2022. The definition for this NRW rate is the NRW rate tabulated by the total DMA. This NRW rate is different from the general definition of the amount of NRW, since the amount of water in the water supply transmission pipe that is sent to each DMA from the outlet of the water treatment plant is omitted. Maynilad changed the evaluation, based on the NRW rate of all the DMAs, and decided to change to the NRW rate, including all the water supply pipelines.

However, since this change is different from the definition of the NRW rate that has been used so far, the NRW rate in the conventional total DMA is defined as “DMA NRW Rate.” The NRW rate includes all the water supply pipelines as the “Total NRW Rate.” The evaluation used to evaluate the NRW rate is described. In this document, the DMA NRW rate is mainly used. The current DMA NRW rate of 28.8% will be approximately 38% when it is replaced with the Total NRW rate. It is assumed that the Total NRW rate in 2022 will be 27%, and there is supposed to be an achievement of 20% of the Total NRW rate in 2027. These indicators are shown in the following figures.

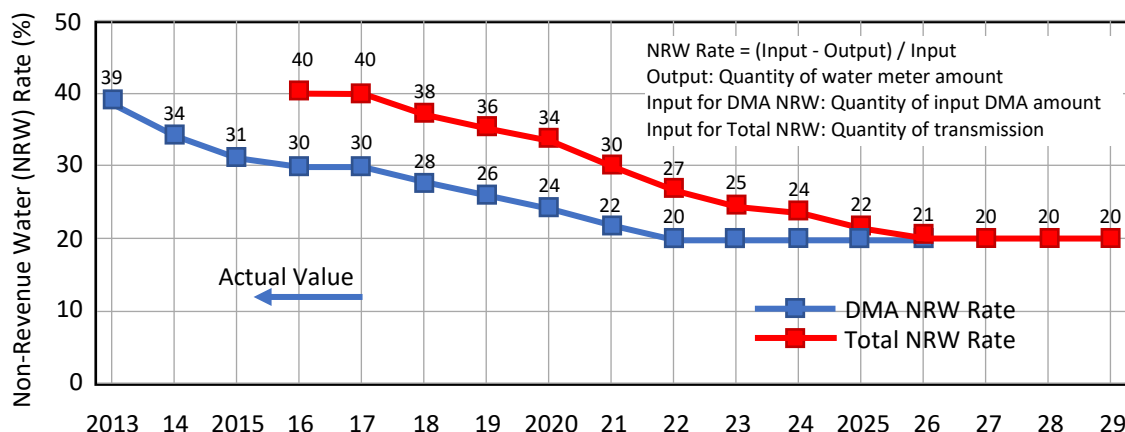


Fig. 2-2 Target value of NRW rate (From Business Plan 2018-2022)

At the end of 2016, the percentage of the Revenue rate / NRW rate was 71.2% / 28.8% (Apparent Losses: 7.9%, Leakage and Others: 20.8%).

Table 2-12 Maynilad's water balance sheet (DAM NRW Rate)(2016)

System Input Volume 100%	Revenue Volume	Water Charge	71.2%
	NRW Volume 28.8%	Authorized Unbilled Consumption	0.1%
		Apparent Losses	
		Water Meter Error	3.4%
		Illegal Connection	4.5%
		Real Losses	
		Leakage and others	20.8%

(Data from Maynilad, JICA team edited)

(2) Organizational structure

There was a restructuring of Maynilad in 2016 to implement the works, following the Board of Directors and each department. The management and administration divisions are managed by the CEO, and the Engineering and O&M divisions by the COO. The organization, the divisions in charge, and the number of staff are shown in the table below.

Table 2-13 Maynilad Organization (December, 2017)

[Management]
Board of Directors: 9
Executive Committee: 7
Management Committee: 5
Audit Committee: 4
[Administration] 2,191 on December 2017
Office of President (CEO): 1
Internal Audit and Risk Management: 6 Internal Audit: 5
Finance Department: 57 Performs fundraising financial plan & implementation, treasury management Treasury Division: 9 Corporate and Financial Planning Division: 9 Controllership Division: 37
Corporate QESH (Quality, Environment, Safety and Health) Department: 58 Enhances the effective management (customer satisfaction, organizational efficiency) of quality, environment, safety, health as a judgment of corporate value, and carries out related standards and regulations Central Laboratory: 27 Integrated Management System Division: 6 Environmental Management Division: 5 Quality Assurance Division: 5 Safety Division: 12
Human Resource Department: 39 Performs personnel management, job recruitment, salary based on evaluation, work conditions. Talent Management Division: 9 Health Management Division: 6 HR Operations Division: 11 HR Business Partner Division: 8 Organization Development Division: 4
Logistics Department: 97 Performs procurements of equipment, materials and constructions. Administration Division: 13 Inventory and Warehouse Management Division: 50 Procurement of Infra Division: 13 Procurement of Goods and Services Division: 12 Vendor Management Division: 7
Information Technology Service Department: 27 Performs the whole of Maynilad's IT services. Automation and Instrumentation Division: 15 Information Systems Division: 1 IT Projects Division: 6 Information Security Division: 1 IT Operations Division: 1 Information Technology Division: 1

<p>Commercial and Marketing Department: 34 Performs comprehensive activities of the water supply and sewerage service development, planning, research and analysis, advertisement publicity/public relations, sales activities, customer information management Business Solutions and Sales Division: 10 Corporate Communications Division: 6 Government Relations Division: 3 Advocacy and Marketing Division: 8 Maynilad Water Academy: 4</p>
<p>Legal and Regulatory Affairs Department: 11 Performs Contract/Legal affairs, Legal checks, Institutional legal affairs, In-house legal counseling Legal Division: 5 Regulatory Affairs Division: 4</p>
<p>Office of COO (chief operating officer): 1</p>
<p>Customer Experience and Retail Operations Department: 880 Performs DMA management, customer service, meter reading, fee collection in the BA Business Operations Central Services Division: 24 Key Accounts Relations Division: 20 North District Division: 428 Central District Division: 167 South District Division: 239</p>
<p>Water Supply Operations Department: 338 Performs operation management of water purification plant, management of distribution reservoir and pumping station Technical Planning Division: 9 Solutions Design Group: 4 Water Production Division: 113 Water Network Division: 187 Water Source Division: 23</p>
<p>Central NRW Management Department: 214 Executes all the tasks related to reducing non-revenue water Planning and Support Division: 22 Analysis Division: 5 Services Division: 25 Engineering and Construction Division: 38 Integrated Meter Management Division: 36 Leak Detection Management Division: 86</p>
<p>Program Management Department: 132 Performs planning, designing and management of the construction of plants and related works Construction Division: 36 Engineering Division: 56 Planning and Support Division: 30 Project Management Division: 8</p>
<p>Wastewater Management Department: 178 Performs sewer service in the water supply area Catchment Management Division: 46 Planning and Management Services Division: 14 Sewer Network Management Division: 39 Septage Management Division: 37 Facilities Integrity and Reliability Management Division: 40</p>
<p>Technical Services Department: 100 Performs information management based on GIS Planning and Support Division: 2</p>

Geographic Information System Division: 50 Telemetry Division: 46
Integrated Asset Management Department: 10 Performs the management of assets and promotes company-wide integration Asset Health Care Division: 2 Asset Information and Knowledge Division: 2 Asset Management Strategy, Planning and Performance Division: 2 Asset Risk, Reliability and Assurance Division: 2
Business Development Department: 4 Performs business outside the concession area Business Development Division: 4

(Data from Maynilad, JICA team edited)

The CEO office is mainly responsible for the core operations of the administrative work that is related to the business management of Maynilad. The COO is in charge of managing and arranging the following 8 technical divisions. CNRW is a counterpart that performs the NRW implementation program, the monitoring and evaluation of NRW PI, the priority of CAPEX works and monitoring of leakage detection and water meter management. Additionally, CNRW is the responsibility of the NRW management procedure and NRW program guidelines.

2.2. Implementations

Major evaluation items of Maynilad’s performance indicators, from 2012 to 2016, are shown in the table and figures below. Maynilad publishes an Annual Report every year and publicizes the evaluation of its water supply and sewer service.

Table 2-14 Major evaluation items

KPI	2012	2013	2014	2015	2016
Billed Volume [Million PHP/m ³ /year]	428.42	443.85	463.24	481.53	498.60
Billed Water Services [Number]	1,073,508	1,129,497	1,190,062	1,265,625	1,312,223
Water Service Coverage [%]	87.6	89.5	91.6	93.6	94.3
Pipes Laid to Date [km]	7,085	7,306	7,458	7,575	7,637
NRW rate [%]	43.4	38.7	33.9	31.0	29.9
NRW Recovered Volume [1,000m ³ /d]	120	138	117	58	10
24-Hour Water Service Rate [%]	96.0	97.8	99.9	99.8	98.2
Water Pressure Rate (Ave. > 7psi) [%]	99.8	99.9	100	100	100
Water Pressure Rate (Min. > 16psi) [%]	40.0	58.0	67.0	70.7	75.8

(Maynilad Annual Report 2016)

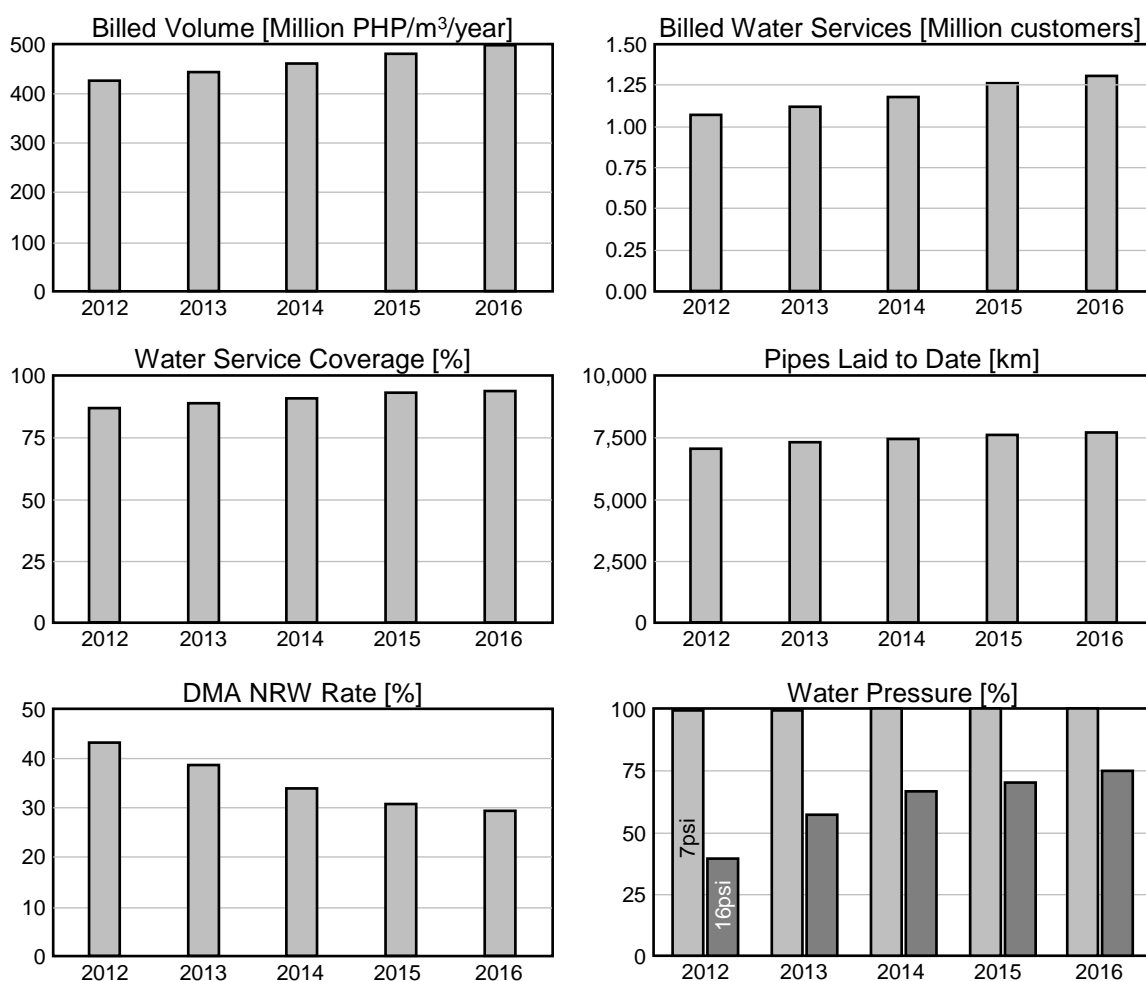


Fig. 2-3 Trend of KPIs (Data from Maynilad, JICA team edited)

The amount of water revenue has also increased and the paired NRW amount/rate has been decreasing due to there being an increase in the water service population in the water supply area, as well as the number of contracted customers and the pipeline length.

Maynilad increased the minimum water supply pressure from 7psi (hydraulic head: 4.9m) to 16psi (hydraulic head: 11.2m) in 2016, which was achieved at a rate of 75.8%. According to this measurement of water pressure, the 24-hour water supply rate fell from 100% in 2015 to 98.2%. Customers who could use the water supply more even for households who could not use tap water due to low water pressure, and the amount of revenue water increased. At the same time, the amount of water leaking from water leakage holes also increased. The water usage of customers decreased at night. The reason was high water pressure occurred at the water leakage points. Maynilad has adjusted the output of the distribution water pump. This measure was taken in order to adjust the water supply pressure at night.

2.3. Finances

Maynilad's balance sheet, income statement, cash flow statement over the past 4 years and the investment project for reducing non-revenue water are shown below.

(1) Balance sheet

Maynilad's balance sheet is shown in the table below. The Flow ratio (= Current assets/Current liabilities × 100) is one of indicators that showed its short-term payment ability exceeded 100% in 2015 and 2016. The Flow ratio in 2017 dropped slightly to 73%, but Maynilad's water charge collection rate was almost 100%. The D/E ratio (Debt Equity Ratio) has been in the 1% range, with sufficient borrowing capacity to develop the facility.

Table 2-15 Balance sheet (Million PHP)

Assets	2014	2015	2016	2017
Current Assets	11,935	14,718	13,972	11,731
Cash and cash equivalents	7,078	9,164	8,034	4,993
Accounts receivable – net	2,205	2,371	2,502	2,753
Prepayments and other current assets	2,652	3,183	3,436	3,986
Non-current Assets	60,302	66,852	71,978	80,541
Deferred tax assets / (Deferred tax liability)	2,171	2,156	1,032	463
Service concession assets – net	56,471	61,996	68,719	77,801
Property, plant and equipment – net	573	646	1,065	1,230
Other non-current Assets	1,087	1,054	1,162	1,048
Total Assets	72,237	80,570	85,950	92,272
Liabilities and Capital	2014	2015	2016	2017
Current Liabilities	12,890	14,283	13,910	15,964
Accounts payable	1,653	2,411	1,923	2,588
Income tax payable	247	233	660	662
Accounted expenses	8,204	8,539	8,206	9,705
Other current liabilities	2,787	3,100	3,121	3,009
Service concession payable to MWSS – current portion	1,094	1,358	1,329	1,217
Notes payables – current portion	1,692	1,742	1,792	1,792
Non-current Liabilities	31,554	30,854	31,856	32,586
Service concession payable to MWSS – non-current	7,041	6,737	6,500	6,242
Notes payables – non-current	22,509	23,083	24,642	25,067
Deferred credits	1,153	305	-132	-90
Pension cost and other employee benefits	281	416	317	594
Customers' deposits and other non-current liabilities	569	313	529	773
Total liabilities	44,443	45,136	45,766	48,550
Total shareholder's equity	27,794	35,433	40,184	43,722
Paid-in capital – common	4,547	4,547	4,547	4,547
Additional capital stock – common shares	9,980	9,980	10,021	10,021
Treasury stock	-408	-268	-342	-298
Other comprehensive income				-304
Retained earnings	13,675	21,174	25,958	29,755
Total liabilities and shareholders' equity	72,237	80,570	85,950	92,272

(Data from Maynilad, JICA team edited)

(2) Profit and loss statement

Maynilad's profit and loss statements are shown in the table below. The sales in 2017 were 20.6 billion PHP (a 2.6% rise from the previous year) and the cash charge was 6.5 billion PHP (a 14.5% rise from the previous year), which was mainly due to rising labor costs and electricity costs. The increase in personnel expenses was due to a change of the composition of its employees in 2017, mainly the expenses (retirement payments) related to the early retirement program, as well as the salary of new employees hired (182 new employees). The cost of electricity also increased by 16.5% caused by high rate of operation of the Putatan water treatment plant and the commencement of operation of new pump stations there. Non-cash charges rose by 11.4%, which was due to an increase in the intangible fixed book value. This was down to Capex investment and an increase in the depreciation rate by the production proportional method, based on the amount of revenue water. Net income is 6.83 billion PHP (a rise of 0.8% from the previous year). Maynilad has recorded an operating income of 54% and a recurring profit of 45% against the water services revenue.

Table 2-16 Statement of profit and loss (Million PHP)

	2014	2015	2016	2017
Revenue	18,228	18,924	20,029	20,550
Water services	14,509	15,162	16,117	16,585
Sewer services	3,294	3,367	3,508	3,601
Other contracts and services	424	395	404	364
Operating income	10,946	11,795	11,825	11,231
Salaries, wages and benefits	-2,018	-1,838	-1,993	-2,820
Light and Power	-762	-754	-776	-904
Chemicals	-156	-188	-245	-246
Repairs and maintenance	-491	-385	-511	-446
Regulatory costs (MOE)	-71	-94	-101	-110
Contracted services	-807	-906	-934	-913
Rental	-162	-141	-136	-153
Collection charges	-122	-137	-136	-145
Taxes and licenses	-166	-186	-205	-219
Transportation and travel	-174	-103	-95	-114
Business meetings and representations	-81	-91	-113	-117
Insurance	-43	-43	-51	-52
Advertising and promotion	-41	-52	-58	-59
Utilities	-52	-52	-57	-59
Others	-92	-114	-287	-165
Provision for doubtful accounts	---	232	77	-57
Depreciation and amortization	-252	-254	-281	-352
Amortization of service concession assets	-1,779	-2,024	-2,302	-2,387
Provision for inventory obsolescence	-12	-0	0	-1
Income before income taxes	8,233	9,574	10,008	9,298
Other income (expenses)	2,713	2,221	1,817	1,934
Income tax	40	-56	-3,232	-2,465
Net Income	8,273	9,519	6,776	6,832

(Data from Maynilad, JICA team edited)

An annual inflation rate of 3.7% (assumptions in business plan, 2018) is expected to continue for the time being. Increased revenue is expected as a result of an increase in the water supply volume (4%) that is above the inflation rate. There will be an increase in the amount of revenue water and a reduction of OPEX in the future, as a result of the NRW rate improving. A further sales increase is expected. There will be an increase in sales of about 500 PHP in the replacement of customer meters, according to estimates based on Maynilad's water balance and NRW reduction results. (There are about 1.4 million customer water meters in total. In the business plan, Maynilad is planning to replace approximately 830,000 water meters in 5 years.) Sales are projected to increase by about 100,000 PHP/km replacement. (Pipe network is the total length of 7,656 km, and the business plan states that about 1,574 km is to be exchanged over the next 5 years.)

(3) Cash flow statement

Maynilad's cash flow statement is shown in the table below. There is cash flow from investment activities every year, and both the establishment and renewal of facilities have been carried out as planned. In the future, the formulation of medium- and long-term financing plans that utilize long-term loans will be indispensable in the implementation of maintenance and the systematic renewal of further facilities. Maynilad has formulated the plan after grasping both the current working capital and its future forecast, and the business operation has been appropriately carried out.

Table 2-17 Cash flow statement (Million PHP)

	2014	2015	2016	2017
Net cash provided by operating activities	6,637	2,754	5,900	4,412
Cash flows from investing activities	-632	-313	-777	-514
Cash flows from financing activities	-4,681	-3,537	-3,205	-5,400
Net increase (decrease) in cash and equivalents	1,324	-1,096	-1,918	-1,502

(Data from Maynilad, JICA team edited)

(4) Reduction target and basic policy for reducing non-revenue water

The Business Plan 2018-2022 has been prepared by Maynilad ahead of the water tariff revision negotiations, which take place once every 5 years. The final goal of this business plan, which was created to determine the new water tariff from 2018, is to achieve a 20% DMA-NRW rate in 2022 (28% in 2018).

The business plan describes the basic efforts that will be made to reduce non-revenue. It follows procedures that have been practiced in successful cases around the world. The JICA team consulted with Maynilad, and determined that the following basic policy was appropriate:

- ◆ Water distribution analysis (Water balance analysis of the water treatment volume and inlet flow into each DMA), a water leakage survey and the repair of leak points found in Primary Lines (350mm or more in diameter)
- ◆ Water distribution analysis in DMA, a water leakage survey of Secondary and Tertiary Lines (less than 350mm in diameter), repair of water leakage points and pipe replacement
- ◆ Checking the accuracy of existing customer water meters

- ◆ Time series analysis of customer water consumption volume and a survey of illegal connections
- ◆ The repair of elevated tanks and distribution reservoirs with leakage
- ◆ Water pressure management in the distribution network
- ◆ Other works related to reducing NRW

(5) Scheduled investment business

In the business plan, there are 9 sub-programs planned in the NRW management program. The amount of planned investment into each of these sub-programs is shown in the table below. The figure below compares the planned investment for countermeasures against NRW in the current business plan with those in the previous Business Plan 2013-2017. The cumulative investment up to the final year of the concession period (2037) will increase by 45%.

Table 2-18 Investment plan for reducing NRW in business plan (Million PHP)

	2018	2019	2020	2021	2022	2018 -22	2023 -27	2028 -32	2033 -37	2018 -37
1. DMA Establishment/Splitting, Leak Repair	484	514	429	429	437	2,294	1,330	1,160	928	5,712
2. Procurement of Equipment	595	617	552	628	873	3,264	3,951	3,169	3,297	13,681
Procurement of Water Meter	535	617	527	628	873	3,179	3,866	3,109	3,237	13,392
Procurement of Leak Survey Equipment	60	0	25	0	0	85	85	60	60	290
3. Selective Pipe Replacement	1,394	1,732	1,507	1,520	1,265	7,417	1,378	0	0	8,796
ACP Line Replacement	152	0	44	154	373	723	249	0	0	972
GIP/ Temfacil Line Replacement	0	0	29	325	394	748	948	0	0	1,696
Full and Partial Pipe Replacement	1,242	1,732	1,434	1,041	498	5,946	181	0	0	6,128
4. Primary Line Assessment and Repair	70	70	117	117	117	490	467	388	310	1,656
5. Primary Line Replacement	1,285	282	309	342	342	2,560	1,709	1,709	1,025	7,002
ACP Primary Line Replacement	0	282	309	0	0	591	0	0	0	591
Selective Primary Pipe Replacement	1,285	0	0	342	342	1,969	1,709	1,709	1,025	6,411
[1] Total (1+2+3+4+5)	3,828	3,215	2,914	3,036	3,034	16,026	8,835	6,426	5,561	36,847
[2] Expansion of piping	651	428	523	508	687	2,798	1,459	600	480	5,337
[3] Grand Total ([1]+[2])	4,479	3,643	3,437	3,544	3,721	18,823	10,294	7,026	6,040	42,183
[4] Loans from JICA		7,800				7,800				
[5] Shortage ([3]-[4])		6,879		3,544	3,721	11,023				

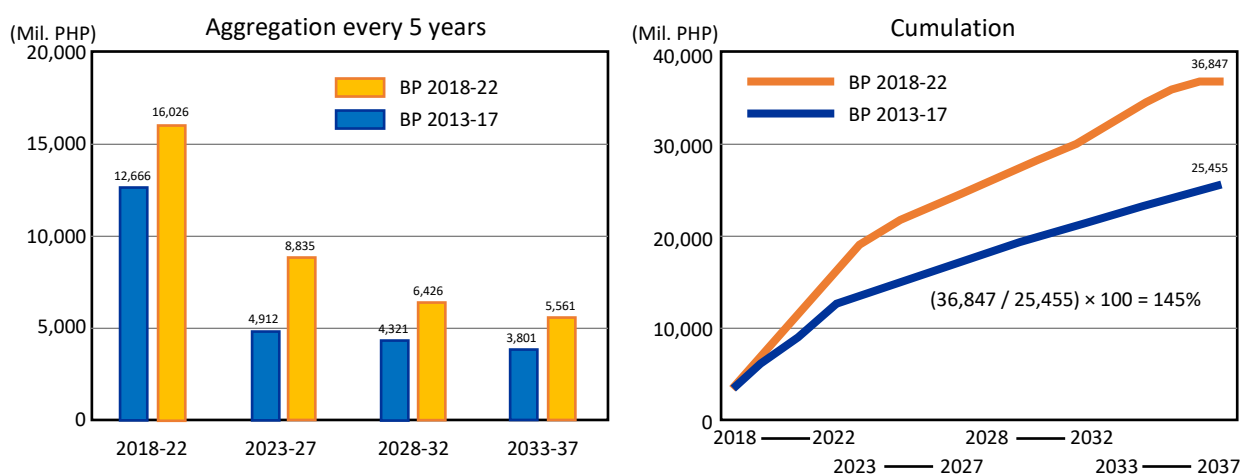


Fig. 2-4 Comparison of the investment schedule for reducing NRW in the old and new business plan

Maynilad has budgeted 26.3 billion PHP in 2018-2022 for building a water treatment plant (capacity: 300,000m³/day), the installation of flow meter for Primary Lines, the maintenance of shared infrastructure and water rights that are related as capital expenditure (CAPEX). In addition, Maynilad has budgeted 15.2 billion PHP in 2018-2022 for a 24-hour water supply at a minimum water pressure of 16psi (hydraulic head: 11.2m), the expansion of the water supply service rate and climate change that is related as operational expenditure (OPEX).

In the Business Plan's NRW management and revenue expansion project, which is based on the achievement of 20% of the DMA NRW rate by 2022 and 20% of the Total NRW rate by 2027, Maynilad plans to build DMA, discover and repair water leaks, enrich the leak detector, and prioritize pipeline replacement. In addition, it has budgeted 18.8 billion PHP for installing a flowmeter of the water supply system and achieving a water supply service rate of 100% in 2018-2022. This 18.8 billion PHP will cost about 4 billion PHP annually. Maynilad will preferentially use the JICA's loan amount (7.8 billion PHP), but the shortfall (11.0 billion PHP) will be withdrawn from Maynilad's own funds (revenues from water tariff increase and borrowing from financial institutions). Each year's estimated expenditure amount is shown in [3], [4], [5] in the table above.

2.4. Future plan

Based on the results of the previous business plan, Maynilad has summarized the following plan of the water supply system, which is used as indicators in the business plan.

Table 2-19 Actual value of the water service index in the previous business plan

Water Service Index		Actual Value					Target
		2012	2013	2014	2015	2016	2016
Water Supply							
New Connection	Single year	93,566	70,962	39,672	30,472	48,559	
	Cumulative					283,231	267,019
Water Coverage		97.1%	101.4%	105.4%	108.3%	112.9%	95.1%
Continuity of Supply							
Water Availability (24-hour supply)		96.1%	97.8%	99.9%	99.8%	98.2%	100%
Water Pressure 7psi (average)		86.0%	89.0%	96.0%	94.9%	---	100%
Water Pressure 16psi (minimum)		---	---	---	---	75.8%	100%
New Connection to Water Main							
Response for New Connections		99.1%	98.8%	99.3%	99.6%	99.6%	90%
Installation of New Service Connection		98.9%	98.4%	97.8%	97.6%	98.9%	90%
Drinking Water Quality Standards		100%	100%	100%	100%	100%	100%
Other Customer Service Standards							
Response to Customer Service Complaints		98.7%	99.2%	96.7%	96.4%	98.3%	95%
Response to Customer Billing Complaints		96.9%	98.9%	90.2%	92.0%	98.6%	90%

(Maynilad Business Plan 2018-2022)

As the actual population is less than anticipated, the actual water connections are 113%, which is more than 100%. In addition, the demand for connections from new customers has been met almost 100%, except for places where it has proved difficult to make a connection.

The minimum pressure has changed from 7psi (hydraulic head: 4.9m) to 16psi (hydraulic head: 11.2m) in 2016. Thus, the minimum pressure condition went from 95% to 76%, which is a drastic decrease, but with a 24-hour water supply rate, this did not cause a significant decline in the water supply operation.

The water quality standard adaptation is always 100%, which is an important indicator, as it is required for the water supply.

Responding to complaints is a major issue in customer service, in both developed and developing countries, generally. Maynilad is making an effort with the resolution rate of complaints is almost 100%.

After referring to the PIs for 2012 to 2015, Maynilad determined the target for PIs for 2018 to 2022 in the Business plan. The target PIs are shown in the table below.

Table 2-20 Future target value of water service index

Water Service Index	2017	2018	2019	2020	2021	Total
Water Supply						
New Connection	25.241	35.577	37.586	26.884	22.135	147.422
Water Service Coverage	95.8%	97.0%	98.3%	98.9%	99.5%	
Continuity of Supply						
Water Availability at 16psi	77.4%	83.3%	88.6%	92.4%	96.3%	
New Connection to Water Main						
Response for New Connections	5 days	5 days	5 days	2 days	2 days	
Installation of New Service Connection	7 days	7 days	7 days	3 days	3 days	
Drinking Water Quality Standards	Conform	Conform	Conform	Conform	Conform	
Other Customer Service Standards						
Response to Customer Service Complaints	95% (in 10 d)	95% (in 10 d)	95% (in 10 d)	95% (in 10 d)	95% (in 10 d)	
Response to Customer Billing Complaints	90% (in 10 d)	90% (in 10 d)	90% (in 10 d)	90% (in 10 d)	90% (in 10 d)	
Response to Request for New Connection	95% (in 5 d)	95% (in 5 d)	95% (in 5 d)	95% (in 5 d)	95% (in 5 d)	
Installation of New Service Connection	95% (in 7d)	95% (in 7d)	95% (in 7d)	95% (in 7d)	95% (in 7d)	
Response to Disruptive Mains <300mm	100% (in 1d)	100% (in 1d)	100% (in 1d)	100% (in 1d)	100% (in 1d)	

(Maynilad Business Plan 2018-2022)

The closer the ‘water service coverage’ rate is to 100%, the lower the annual growth rate will be. It is expected that “new connection” will grow steadily if there are some migrants in the water supply area. In calculating the water coverage rate, the denominator and numerator both increase by the same number (with the out-migrants, the denominator and numerator are both decreased by the same number). Maynilad must activate activities in order to oblige illegal connectors that have not been customers before to become contractors (a new amount of water consumption is recorded only in the numerator of the formula).

A “continuous water supply” at the minimum water supply pressure (16psi) is mainly achieved by increasing both the pump pressure and the pipe diameter of the replacement pipes; however, leakage from

the existing leakage point can increase, or a fragile part of the pipeline can rupture, causing the leakage to increase. Since the water supply pressure rises at night with low water consumption, Maynilad must continue the measures that have been implemented so far (output adjustment by the night pump).

Maynilad's "response to new connection request" target is set at 5 days (this will change to 2 days from 2020), and the "installation of new service connection" is set at 7 days (3 days from 2020). In the case of the Yokohama Waterworks Bureau (YWWB), the "response to a new connection request" is the same day. When it comes to the seizure of the Building Standard Law violation, "installation of new service connection" will be approved after it has been applied for and 5 days of the examination period have passed. Permission to excavate and use police roads will also proceed. After that, the completion of the construction of the water supply equipment, notification, submission, examination, and the completion of the inspection require a minimum of 9 business days. Maynilad has room for improvement when it comes to its "response to new connection request." Although there are differences in the laws that are applicable, an improvement in customer service can be expected if there is deregulation and a reduction in the number of days of the "new water supply connection."

2.5. Capacity building plan

Maynilad has enhanced the abilities of its staff and strengthened their capacity to raise the company’s corporate value by meeting its obligation to provide the water supply and its sewerage service to customers.

Maynilad has also invested in staff training, in addition to the restructuring it has done. The total training time in 2017 was 81,681 hours, which was up from 52,162 hours in 2015, an increase of 56.6%. The staff’s participation ratio rose from 69% in 2015 to 85% in 2017, an increase of 16 points. The evaluation showed these training programs had a positive result.

Maynilad’s major innovative project was “Think Maynilad Innofest.” A total of 114 staff members participated in this and made 71 suggestions. Two excellent ones proved useful in improving the company’s work. As a result, Maynilad uses revolutionary working lists.

In addition, two teams from Maynilad attended the “Idea Space Start-up Competition,” which aims to improve work throughout the Philippines. They ranked among the top 10 teams by solving their work issues. They came up with a feasible solution by themselves. Maynilad institutionalized its “Think Maynilad Innofest,” which boosted the culture of improving the company’s work and increased the motivation of its staff.

Maynilad started a three-year growth strategy with three pillars: “Works efficiency,” “Business growth,” and “Organization & Staff capacity building.” Maynilad has been making substantial improvements and structural reforms in the past decade through this growth strategy, while also trying to achieve further transformation by setting new goals. Maynilad has judged that both training and human resources are necessary in organizations in order to achieve the growth strategy under the three pillars described above. As a result, Maynilad is continuously investing in staff training.

Maynilad has introduced a Balanced Scorecard Management System to evaluate its personnel. This uses the weighting and numeral evaluations method with a number of initiatives. It measures “work objectives, viewings of finances, customers, working processes, study and growth.” The performance of staff is evaluated by the system, which is based on the rank of the calculated numerical value.

Table 2-21 Participation in employee training

	2015	2016	2017	Comparison 2015→2017
Total employees (person)	2,147	2,229	2,191	+2.0%
Total training hours (hour)	52,162	72,715	81,681	+56.6%
Training hour per person (hour/person)	24.3	32.6	37.3	+13.0
Training participation	69%	87%	85%	+16 point

(An excerpt from Maynilad’s data, and JICA Team added indicators)

2.6. Organization, Abilities and Issues in CNRW

Central NRW Management (CNRW), which has been established by Maynilad to reduce NRW, has 214 staff members. The organization, divisions in charge and number of staff are shown in the table below.

Table 2-22 Role of CNRW Organization

Role and Personnel of each Division
Planning & Support Division [22] <ul style="list-style-type: none"> ✓ CNRW plans and programs, Business Plan, pipe replacement prioritization, scheduling and monitoring of deliverables. It prepares CAPEX planning requirements ✓ Handles program management, plans, organizes, leads, and controls all CAPEX projects. Works cross-functionally with other stakeholders (internal and external) ✓ Admin support, process management and documentation, budget management (CAPEX/OPEX), commitment and disbursement, materials management, billing
Analysis Division [5] <ul style="list-style-type: none"> ✓ Leak Detection, Management Report, Web Portal ✓ Automation, Netbase Management ✓ NRW Programs
Service Division [25] <ul style="list-style-type: none"> ✓ Oversees the Implementation of Maynilad’s NRW Program, Monitors and evaluates NRW performance indicators, generates periodic NRW reports, prioritizes NRW CAPEX Projects, conducts NRW Trainings, ensures adherence to NRW Operational Procedures (Ops) and NRW Programs Guidelines, coordinates and collaborates with other units ✓ Manages the provision of NRW services outside of Maynilad (NRW Rapid Assessment, NRW Feasibility Study, NRW Trainings, Network Rehabilitation/Maintenance Services, Leak Detection and Pipe Inspection Services, Metering Services, NRW Data Management System) ✓ Defines the NRW project requirements in the pre-development stage of potential clients (strategy, costing, timeline and deliverables)
Engineering & Construction Division [38] <ul style="list-style-type: none"> ✓ Designs and costs estimates, Quality Assurance and Safety ✓ Oversees the implementation of CAPEX projects of the CNRW Division (Regular CAPEX, Affected Utility Projects, Service Level Improvement projects, South Accelerated projects)
Integrated Meter Management Division [36] <ul style="list-style-type: none"> ✓ Procures water meters and confirms the accuracy of new and existing ones ✓ Installs DMA flow meters, intake, transmission and distribution of the pumps’ flow meters, confirms their accuracy and adjustment
Leak Detection Management Division [86] <ul style="list-style-type: none"> ✓ Detects leaks and repairs them ✓ Provides training for leakage technicians and engineers

(Made by JICA Team)

CNRW is organized very well by the Division Director, while its management is performed by the Section Head Manager.

Leak detection management has 80 staff members and a training center. Maynilad has a training yard for leak detection at its Tondo branch where basic training is performed. Staff require a lot of experience to

carry out the techniques used for leakage detection, which they mostly learn from OJT. The supervision of the pipework is performed by young engineers in the field. Our impression is that a small amount of equipment is used, but it is used properly to find leakages and the results are good. They contact other related divisions, who help to solve any leakage issues. Maynilad has equipment that measures and confirms water meter accuracy, which is of a higher specification than Yokohama's. The leakage detection techniques in the country are at a higher level than in other developing countries.

The JICA team members delivered two short, technical seminars to CNRW. They have studied the technology (Analysis method: DMA analysis, monitoring analysis, meter error test, others) used in the headquarters and in the field and discussed it with us. The JICA team explained their conclusions in detail and the organization has been developing and expanding. The JICA team recognized CNRW's capacity to build through OJT, after having discussions and examining data with them.



Picture Meeting with division responsible for NRW reduction



Picture Technical seminar

Chapter 3 Present situations and issues analysis for NRW

Not open to the public

Chapter 4 Summary

Not open to the public

Chapter 5 Conclusion

Maynilad is faithfully implementing its water supply business operations as private enterprises under the strong leadership of its CEO, COO and department heads. The staff has enough ability to create the business plans and knowledge that is necessary for business execution. In addition to this, management improvement by Marubeni Corporation, a capital participant from Japan, has been successful, as it has achieved a significant reduction in non-revenue water over the past five years.

For this work, the JICA team has discussed countermeasures with its counterparts, as well as the staff of NRW-related departments. Maynilad staff took serious note of the current issues and held discussions with the JICA team in order to improve them.

As a result of the Business Plan, which was verified this time, and the improvement proposal of the project that is being implemented, the NRW rate of Maynilad will steadily be reduced.

Chapter 6 Annex

Not open to the public