Manila water’s experience in the provision of sewerage service in the east zone of Metro Manila

R. Baffrey and A. Adis

Abstract

In 1997, major improvements were needed in the provision of water and sewerage services in Metro Manila. Only 26% of the population served had 24-hour access to potable water and a mere 3% were connected to adequate wastewater treatment facilities. Coupled with these conditions were issues of high non-revenue water and indiscriminate discharge of untreated wastewater to all major water bodies of the metropolis. As a result, the Metropolitan Waterworks and Sewerage System (MWSS), the government agency mandated to provide water and sewerage services in Metro Manila, privatized its operation via a public-private partnership. Manila Water Company obtained the exclusive right of providing these services for the East Zone of Metro Manila.

This paper identifies the challenges encountered in providing sewerage services during Manila Water’s first 15 years of operation. Poor data availability, lack of available land, fragmented infrastructure planning, and low customer acceptance were among the key challenges that threatened the efficient delivery of service. Consequently, this paper also highlights the resultant strategies employed by Manila Water to address the aforementioned challenges. Implementation of inventive technical solutions, combined with the harnessing of human resources and increased stakeholder awareness, were among the strategies utilized to provide sewerage and sanitation services in the most efficient manner possible.

As of 2012, Manila Water now operates 38 wastewater facilities with a total capacity of 135 million liters per day (MLD) corresponding to 100% septage coverage and 23% sewerage coverage of the East Zone of Metro Manila.

Key words: combined system, drainage, Manila water company, sewerage, septage management

MANILA WATER STORY

In 1997, tremendous improvement was needed in the provision of water and sewerage service for Metro Manila. Only 26% of the population served had 24-hour access to water, with the rest having limited or no access to water at all. Incidents of low pressure and poor water quality were rampant throughout the service area, and non-revenue water attributed to massive leaks and illegal connections was at an all-time high of 63%.

Sewerage service provision was in a bad state, with only 3% of the concession served by what was considered as adequate sewage treatment. Approximately 85% of households utilized individual or communal septic tanks offering only primary treatment, if at all, while the remaining population had access only to rudimentary toilet facilities that discharged directly to the nearest drainage system or water body. Though septic tanks aimed to provide some level of wastewater treatment, it was oftentimes the case that these tanks were improperly designed, constructed, and maintained, thereby drastically decreasing their capability to perform as intended. In addition to this, the absence...
of sewer networks allowed untreated wastewater from septic tanks to overflow into drainage systems that eventually discharged directly into receiving bodies of water.

Studies conducted by the Department of Environment and Natural Resources (DENR) show that all three major river systems of Metro Manila were heavily impacted by these conditions, as well as additional discharges from non-domestic sources such as industries and agriculture. According to a 2003 study published by the World Bank, an estimated 330,000 tons of biochemical oxygen demand (BOD) is discharged annually into the waters of Metro Manila, 58% of which is attributed to domestic wastewater sources and the remaining 42% from other sources [1]. The San Juan River has a reported BOD concentration of 68 mg/l, by far the highest among the three rivers, with the BOD concentration of the Marikina and Pasig Rivers following at 18.2 mg/l and 10.7 mg/l, respectively. All BOD values are greater than 7 mg/l – the standard determined by DENR as appropriate water quality capable of sustaining aquatic life. It is important to note that both San Juan and Marikina Rivers are tributaries of the Pasig River, as illustrated in Figure 1.

As a result, the three major rivers of Metro Manila were declared biologically dead, further elucidating the need for improved sewerage services in Metro Manila [2].

In response to these conditions, the Metropolitan Waterworks and Sewerage System (MWSS), the government agency mandated to provide water and sewerage services in Metro Manila, executed a pioneering program intended to infuse private sector contribution into the capital investments required to aggressively improve water and wastewater services. As such, MWSS privatized its operation in 1997 via a public-private partnership in which Manila Water Company obtained the...
exclusive right of providing the aforementioned water and sewerage services for the East Zone of Metro Manila.

In the years that followed privatization, Manila Water initially focused its efforts on the provision of water service, having immense success in reducing NRW from 63 to 11%, and ultimately serving 99% of its entire concession area with clean, potable water that is available 24 hours a day. This paper highlights the corresponding efforts in sewerage, first identifying the considerable challenges encountered prior to discussing the innovative strategies employed to both construct and operate sewerage infrastructure with maximum impact and efficiency. In subsequent sections, inefficiencies caused by poor data availability, lack of available land, fragmented infrastructure planning, and low customer acceptance will be presented with the corresponding specific strategies that mitigate these inefficiencies by harnessing human resources, employing inventive technical solutions, and increasing stakeholder awareness of the need for sewerage and sanitation service.

CHALLENGES

Given the clearly identified urgent need for sewerage service in Manila’s East Zone, it was incumbent that service be provided in the most efficient manner possible. In this section, challenges are discussed in the context of the two main factors identified to impact efficiency: duration and cost. Duration pertains to the time required to implement sewerage infrastructure, whereas cost pertains to both operational expenditures as well as capital investments. It should be noted that cost directly impacts duration due to the customer’s willingness to pay, or to be more accurate, the customers’ ability to pay. Given the current tariff structure and the need to temper rate increases over the entire concession period, initial capital investments can only be made to the extent that customers are able to pay for these services. As such, both capital and operational expenditures have to be at optimum levels in order to implement infrastructure in the shortest possible time. The primary challenges encountered by Manila Water in the provision of sewerage service are discussed as follows:

Insufficient and inaccurate data

Data acquisition was the foremost obstacle that needed to be addressed in the planning for sewerage and sanitation projects. Population and corresponding flow projections, wastewater quality, and as-built data for existing infrastructure were among the key parameters for which data was either limited or non-existent, even from the time of MWSS. Without this data, project planning needed to employ several assumptions which in turn required risk mitigation and contingency costs that ultimately affected the total capital expenditure for proposed projects. Verifying the completeness and accuracy of existing data, or even gathering data for the first time, severely impacts the duration of project implementation. Furthermore, if the data gathered greatly varies from actual conditions in terms of cost estimates and flow projections, additional unwarranted cost may be incorporated during the actual construction phase of proposed projects.

Land availability

Land quality greatly affects both the duration and cost of construction. Treatment plants require large areas of land in low-lying areas preferably close to existing bodies of water, yet far from residential and commercial developments. Unfortunately for Metro Manila, large available open spaces are scarce, and if there is available land, it is commonly inhabited by informal settlers. Furthermore, identified potential sites are often unattainable or too costly due to prioritization of these areas for residential
and commercial use. In some cases, available land is either too small or too far from a main tributary or river, necessitating an overall increase in a project’s capital and operational cost. In Taguig City alone, one of the emerging cities covered by Manila Water, only 37% of land is unoccupied. Attempts made to acquire these available locations often encounter stiff competition with the business sector. Also worth mentioning is that aside from land required for facilities, land for lift stations and sewer networks must also be acquired to provide adequate service.

Although the Clean Water Act of 2004 requires local government units (LGUs) to provide land for sewerage infrastructure, it is oftentimes the case the land is either provided at a cost or located in an area not ideal for wastewater treatment. This requires not only increased capital cost, but also necessitates more intricate and innovative designs that require a longer duration of implementation as well as more complicated operation and maintenance.

Uncontrolled urban development and fragmented infrastructure

Uncontrolled urban development results in poor planning due to the fact that infrastructure is in a sense always ‘catching up’ to a growing population. Road construction is not carefully integrated with utility planning due to the urgency of implementation, as well as the fact that several entities are responsible for different services required by Metro Manila residents. As such, pipe-laying work is vastly difficult in the extremely congested roads of Metro Manila. Given that excessive depths and trench widths required for sewer networks employing gravity flow are certain to impact pedestrian and vehicular traffic, LGUs either require trenchless construction or delay the release of permits. This increases project cost and lengthens project duration. Moreover, infrastructure for other essential services such as power, flood control, and water supply are reasonably given priority over sewerage, and are subsequently implemented with little consideration of the required space for future sewer networks. This also results in challenges in project implementation, oftentimes requiring that sewer networks be laid in unsuitable conditions.

Another significant impact of uncontrolled urban development in terms of duration and cost is the relocation programs mandated by law for informal settlers living on land intended for sewerage infrastructure. Negotiations for their relocation may take long periods of time, thus delaying the provision of sewerage service. In addition to this, the presence of informal settlers along waterways greatly undermines the effect of sewerage infrastructure. Even if adequate sewer networks are provided, the settlers would continue the indiscriminate discharge of untreated wastewater to creeks, tributaries, and rivers, severely degrading the quality of these receiving bodies of water. A holistic and inter-agency approach to wastewater management is needed to guarantee that the intended impact of implemented infrastructure is fully realized.

Customer acceptance and stakeholder management

Primary stakeholders include residents, homeowner associations (HOAs), LGUs, and government agencies involved with sewerage services. The support of residents, HOAs and LGUs for a project is oftentimes the defining factor for successful project implementation. Currently, the need for sewerage and sanitation services is not fully comprehended by stakeholders. This is mainly due to the fact that the impact of these services is neither considered tangible, nor clearly convertible improvements in economy and health. As a result, the ‘Not in My Back Yard’ sentiment is still present and community and government support for these projects is hard to obtain. Without this support, every single phase of project implementation is affected: from data collection, to construction, and eventually even operations. Alternatively, when these stakeholders fully support the project, procurement of permits and right-of-ways are faster and resident
complaints are minimized, leading to more efficient implementation and delivery of sewerage service.

**STRATEGIES**

Taking into consideration the aforementioned challenges, Manila Water, in close coordination with MWSS, utilized a comprehensive strategic framework comprised of demand management, technology selection, program execution, and sustainability initiatives. Though the overall framework will not be discussed in detail, several of the key strategies employed through this framework are presented below. These strategies aimed to provide service with optimum impact in the most expedient and cost-effective manner possible, enabling the massive expansion of sewerage and sanitation coverage in the East Zone. Several of the strategies utilized innovative technical solutions, whereas others maximized human resources and customer advocacy, the unifying thread being that in each, efficiency was made a priority.

**Upgrade of communal septic tanks**

In 1997, Communal Septic Tanks (CSTs) were scattered throughout the East Zone. At that time, these CSTs, with dedicated sewer lines, were operating inefficiently and ineffectively. Access manholes were covered or built over by housing structures, causing difficulty in operation and maintenance which in turn rendered these structures useless in performing their intended purpose of performing primary treatment. Over time, sludge and silt accumulated to levels that reduced capacity which, combined with increased influent loads, caused wastewater entering the CSTs to leave without treatment. Upgrade of these existing communal septic tanks was made a priority.

Utilizing communal septic tanks also provided an opportunity for rapid service expansion due to the immediate availability of sewer networks and land for these structures. Given that sewer service expansion was not at the forefront of water utility focus at the time and customers were more intent on the improvement of water service, it was important to build operational wastewater facilities in the quickest time and with minimum impact. Consequently, as these CSTs were upgraded into package sewage treatment plants (STPs) fully compliant with government standards, Manila Water not only expanded coverage but also produced a number of STPs that demonstrated the impact that adequate sewerage service could have on surrounding communities.

While most CSTs were upgraded into package STPs, others were innovatively upgraded into lift stations connected in series to convey wastewater to a larger regional wastewater treatment plant. This was the method employed for the East Avenue Sewage Treatment Plant. East Avenue STP is the largest wastewater facility in Quezon City with a capacity to treat 17 million liters per day (MLD). To ensure the integrity of the collection system, the upgrade of the CSTs into lift stations were done in conjunction with the rehabilitation of existing sewer networks.

As of 2011, 29 out of the 38 wastewater treatment facilities currently operated by Manila Water are from CST upgrades. These 29 facilities have a combined capacity of 57 MLD. Furthermore, this approach circumvented the challenge of insufficient land availability and congested roads.

**Septage management**

The second technical approach applied was septage management, a strategy that uses a more decentralized method of providing wastewater service. This approach caters to all households in the East Zone not served by a sewer network. As mentioned previously, at the onset of privatization only 3% of all residents in Metro Manila were connected to a sewer network while 85% only had
household septic tanks. The effectiveness of these septic tanks was heavily dependent on proper maintenance, and since most residents were not aware of proper maintenance methods or were unwilling to pay for sanitation services, the result was direct overflow of wastewater from these tanks into drainage systems and receiving bodies of water. Consequently, the septage management approach was applied to address this issue.

Individual septic tanks are maintained by emptying or ‘desludging’ every 3–5 years in order to retain adequate capacities to perform primary treatment. Manila Water guarantees that this maintenance is performed properly through the deployment of 78 vacuum tankers that cater to all customers in the East Zone. This service is provided at no additional cost to the customer so long as only one septic tank desludging is performed within a 3–5 year period. After collecting the septage from septic tanks, septage is transported to either one of two septage treatment facilities that are ISO certified of Quality, Environmental and Occupational Health and Safety, for appropriate treatment. The two septage treatment facilities are located strategically in the concession area and have a combined capacity to treat 1,400 cubic meters per day of septage; effectively the largest septage treatment capacity in the Philippines.

Septage management is Manila Water’s interim solution in lowering BOD loading into rivers until the entire East Zone is served by dedicated sewage treatment facilities. Through integration with a decentralized territory management structure that produced tremendous success in NRW reduction, efficiencies were also obtained in customer coordination that allowed for easy access to septic tanks and adherence to optimum truck routes and schedules. By 2011, a total of 1 million households in the entire East Zone had been serviced by septage management. For 2010 and 2011 alone, the removed BOD from the treated septage amounted to 67 metric tons. Through this approach, BOD loading into rivers caused by highly organic septage is decreased.

Septage management also offers other key advantages. The decrease in frequency of overflowing septic tanks into drainage systems reduces pollution of the environment, but in addition reduces the health risk involved due to contact with septage at the household level. Furthermore, the presence of the two ISO certified septage treatment facilities that adhere to DENR standards eliminate the indiscriminate dumping of raw septage by private contractors. Proper information dissemination regarding these septage treatment facilities encourages customers to avail of such service of Manila Water to ensure that proper treatment is done before disposal. This technical approach is also the
most flexible and efficient, since it is neither affected by issues of congested roads and no network is needed, nor by issues of land availability because only two sites are needed for the septage treatment facilities.

**Combined sewer-drainage systems**

Apart from the two aforementioned strategies, Manila Water also utilizes combined sewer-drainage collection systems. The main advantage of which is the rapid and efficient provision of coverage while directly addressing issues on land availability, congested roads, stakeholder management, and customer willingness to pay. By integrating with existing drainage infrastructure in which wastewater is currently discharged, these systems require a less extensive sewer network than that required for separate sewer systems. In a rapidly urbanized city such as Metro Manila, it was essential that future systems be implemented in a phased approach. This minimizes the impact to residents and existing transportation infrastructure. Due to these efficiencies in implementation, combined systems can be constructed more rapidly and with less cost, ultimately resulting in higher environmental impact than separate systems. Although the main goal of Manila Water is to cover the whole East Zone via separate systems, the combined system is chosen because it is by far the most rapid solution to address water pollution in Metro Manila.

As of 2012, Manila Water has three operational facilities employing this strategy, namely the Pineda, Olandes and Makati Poblacion STPs. Pineda STP was the first facility constructed among the three. It is located along the banks of the Pasig River and has been operational since 2009. Olandes STP, located along the river easement of the Marikina River, is the 2nd facility to employ this type of collection system. It is also the first facility of Manila Water that has all its process tanks constructed underground while the support facilities containing the electromechanical equipment were elevated on stilts. This design was put to the test during the Super Typhoon ‘Ondoy’ (*International Name: Ketsana*) in September 2009. The facility stood strong against vast amounts
of floodwater and incurred no structural damage. Because of its innovative design, Olandes STP won an Honour Award from the International Water Association in 2010. Another highlight is the use of the facility grounds as a public park.

Lastly, Makati Poblacion STP is the most recent facility to become operational. It is constructed above a flood control pond; also the first of its kind in Metro Manila.

The large success of these three facilities is rooted on the strong relationship established with various stakeholders and their innovative design. Through the planning stage of Olandes STP, the local government unit was directly involved. Open communication was established to make sure both parties achieved their goals, a sewage treatment facility and a public park. Though located in a flood-prone area, the innovative design of the facility allowed for the project to be completed. For Pineda STP, key partners in the community paved the way for allowing Manila Water to ‘borrow’ existing land being used as a basketball court to convert it to a treatment facility, and then returning the court in better condition and at a higher elevation atop the facility. For Poblacion STP, the area of the flood control pond was used since Makati City is highly urbanized and available land is both scarce and costly – this facility was built without any impact to the flood impounding structure beneath.
As of 2012, Manila Water operates a total of 38 facilities with a total capacity of 135 MLD, increasing service coverage from 3% in 1997 to 23% in 2012.

To fulfill its commitment of providing 100% sewerage coverage, Manila Water is now embarking the implementation of a Master Plan largely utilizing the combined sewer-drainage system approach. This is through the construction of wastewater facilities strategically located to capture and rehabilitate the waters of Marikina, San Juan and Pasig Rivers. In this aggressive Master Plan, a more centralized collection system compared to the current collection system will be employed in which larger regional facilities will be built having treatment capacities ranging from 40–200 MLD. The intent of this approach is to obtain better efficiencies in implementation, due to the lesser number of land parcels to be obtained, and efficiencies in operation, due to the inherent robustness and flexibility provided by treating large quantities of wastewater. The construction of these regional facilities takes into consideration the balance between feasibility of construction and efficiency of treatment. One of the factors considered is the strategic location of the facility. The location must be in low areas, to maximize conveyance via gravity, and the potential effluent outfalls should be near water bodies, for easier discharge.

Currently, there are 2 projects in the construction stage, the Libingan ng mga Bayani (LNMB) Sewage Treatment Plant and Marikina North Sewage Treatment Plant. Libingan ng mga Bayani literally translates as Heroes’ Cemetery. The location of the LNMB STP was set forth through an agreement between Manila Water and the Department of National Defense. The agreement has two main objectives – construction of an underground wastewater facility and landscaping of the area to convert it into an aboveground open air museum and park. It will be Manila Water’s pilot facility to employ the sequencing batch reactor (SBR) technology with a capacity of 75 MLD. Likewise, the Marikina North STP will also employ the SBR technology. To date, it will be the largest wastewater facility to be constructed in the Philippines with a treatment capacity of 100 MLD.

Wastewater advocacy

Probably the greatest challenges and, conversely, the keys to successful provision of sewerage service are customer acceptance and stakeholder management. Admittedly, wastewater management, especially with regards to protecting Metro Manila’s major waterways, is not something that...
Manila Water can handle alone. It is a challenge that must be undertaken together with key stakeholders, especially local government units. Consequently, Manila Water has put-up a strong wastewater advocacy program to address this challenge. In this advocacy, Manila Water aims to partner and raise social awareness amongst stakeholders on wastewater management. For LGUs located in nearby facilities, two flagship programs were implemented regarding solid waste management. These programs were ‘Linis Estero’ and ‘Linis Ilog’. ‘Linis Estero’ literally translates to ‘Cleaning Creeks’. This program was implemented near the area of Pineda STP, its aim was to educate proper waste disposal to the people living near the creek. During the program, the creek itself was cleaned of all solid waste by members of the community, local government units and Manila Water employees. The other program is the ‘Linis Ilog’ program, which translates to ‘Cleaning Rivers’. This program was implemented near Olandes STP, located beside Marikina River. These programs proactively engage stakeholders in the shared responsibility of cleaning waterways and also provide a venue to discuss required dependencies and potential synergies that may be explored. From an operational efficiency perspective, this also improved solid waste management which in turn improved the collection efficiency of the combined-sewer drainage systems served by the two facilities.

For the rest of the stakeholders located in the East Zone, Manila Water employs the Water Trail Program or ‘Lakbayan’, meaning journey in Filipino. The Water Trail Program tours members of the public around facilities of Manila Water and discusses topics on water and wastewater treatment as well as environmental sustainability activities. The success of the Lakbayan program earned it an Anvil Award from the Public Relations Society of the Philippines. The award highlights the programs innovative way of making different stakeholder group realize the importance of responsible water use and the need for wastewater management.

The intent of these advocacy programs is not only to raise awareness on the dependencies required for sewerage service implementation and operation, but also educate customers on the overall impact of these services on their daily lives. It is the hope that through the education of key stakeholders, an overall culture of wastewater acceptance will be spread in communities, which in turn will result in increased demand and improved efficiency for sewerage service implementation.

**Operational efficiency**

Currently, Manila Water operates 38 wastewater facilities in the East Zone of Metro Manila. Alongside this increase in number of facilities, is the increase in the operational expenditures which in turn increase tariff pressure for customers. As a result, it was identified that efficiency must be constantly improved. Likewise, these efficiency practices need to be utilized across all wastewater facilities and also integrated into the design and construction of future facilities.

Manila Water initially focused on power efficiency improvements. Part of the reason for these initiatives is that the Philippines has one of the most expensive power cost in the world, which in turn drastically affects cost of treatment. A comparison of the power efficiency of all sewage treatment facilities between 2010 and 2011 shows an increasing trend in improvement: an 18% improvement was accomplished in 2010, increasing to 30% in 2011. Both values were reckoned against the power efficiency data for 2009. This power efficiency improvement was largely due to equipment optimization practices.

Aside from equipment optimization, continuous process optimization is also done. These practices aim to improve operation efficiency in terms of chemical and power consumption. These include process train selection, process parameter optimization and design improvements. All practices were accomplished without sacrificing compliance to effluent water quality. This is validated by consistent results of 100% compliance of all effluent parameters with the DENR standards in 2011.
Moving forward, Manila Water aims to achieve a more holistic plan on operational efficiency. This will involve the development of a cost-neutral facility through optimized operation and resource management. Also, opportunities for potential services and innovative technologies aimed at improving compliance, reliability and efficiency of both existing and future wastewater facilities are being explored.

Harnessing human capital

Manila Water’s success in the efficient delivery of sewerage service is a result of the evolution of its people. Retained government employees from MWSS in 1997 were integrated with fresh talents produced through a customized cadetship program to create a multi-faceted workforce equipped to address a multitude of functions. In project implementation, strategic asset management and program management units were created to carefully plan and execute projects with a detailed approach to risk management. Feedback from lessons learned was immediately incorporated into planned projects and issues with insufficient data availability were mitigated through acquired experience in project planning. In operations, a rigorous training for plant managers and plant operators was put in place. This training program assures personnel are equipped with basic operation and maintenance techniques adhering to international standards and safety procedures. Process engineers were also hired to infuse externally generated knowledge on areas initially unfamiliar to the organization. Knowledge from these experts was quickly disseminated to provide continuous learning and improvements in operation techniques and technologies. Major thrusts of the operations team include strict compliance and adherence to regulatory standards and policies, meeting operational expenditure targets and involvement in the planning stage of future wastewater treatment facilities. All these facets of involvement allow the team to have a more rounded expertise on sewerage services, both in planning for future facilities and actual operation of current facilities.

The expertise and passion of Manila Water’s employees was further confirmed by the recently won Asian Human Capital Award, given by the Singaporean Ministry of Manpower. Manila Water is the first Philippine company to receive this award, given to companies for their innovative and impactful human resource practices. It recognized Manila Water’s transformation from a struggling, underperforming water utility, into a world-class water and wastewater services provider. In winning the award, Manila Water joins a select group of companies including Procter and Gamble, Ritz Carlton Singapore and Accenture Services India.

SUMMARY

The efficient provision of sewerage service in a heavily urbanized and developing metropolis such as Metro Manila is extremely difficult. The prioritization of other services such as water, power, flood control and transportation have led to low stakeholder awareness of the need for sewerage and sanitation service, which in turn have resulted in technical, economic, and social challenges in both implementation and operation. To deliver services at rates acceptable to customers, Manila Water and MWSS employed several strategies that optimized resources and the use of existing infrastructure, solidly supported by an aggressive advocacy campaign to educate and promote stakeholders on the benefits of implemented projects. Through the integration of innovative technical applications and the evolution of skills and personnel, sewerage and sanitation service was greatly improved in Metro Manila’s East Zone. Although this experience has allowed for a unique approach to aggressive environmental protection and service provision in Metro Manila and other similar regions, a holistic and inter-stakeholder program is essential to delivering a comprehensive solution to water pollution in Metro Manila.