THE MANILA WATERWORKS SYSTEM: WATER DISTRIBUTION, ACCESS, AND CONTROL IN THE SECOND HALF OF THE NINETEENTH CENTURY

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Primarily considered a nineteenth-century feat, the Manila waterworks system which was formally inaugurated in 1882 is regarded as one if not the most important sanitary infrastructure achievements of the Spanish colonial government. A centerpiece public works project of the Inspección General de Obras Públicas (IGOP), it intended to provide solutions to the problems of health and sanitation in a rapidly urbanizing Manila. Used as a testament of modern engineering in the colony, the infrastructure was central in cleansing, domesticating, and transforming the urban body of the city. This paper tackles the techno-scientific innovations that characterized the Manila waterworks project to sanitize and domesticate the murky, dirty, sickly and unruly body of the modern city. The paper traces how this sanitary infrastructure project was conceptualized and concretized, how water was located, pumped, stored, and distributed to the colonial capital. Furthermore, it interrogates how water was used both as a tool and symbol to cleanse and modernize the colonial body and colonial city. It discusses how water access, exclusion, and control led to an ideological and spatial transformation of Manila in the last decades of the nineteenth century.

KEYWORDS: *Manila waterworks system, sanitary infrastructures, water distribution, water access, water control, colonial public works.*

EL SISTEMA DE TRAÍDA DE AGUA: DISTRIBUCIÓN DE AGUA, ACCESO Y CONTROL EN LA SEGUNDA MITAD DEL SIGLO XIX

Considerado como toda una hazaña del siglo XIX, el sistema de obras hidráulicas de Manila, que se inauguró formalmente en 1882, se contempla como uno de los logros más importantes en infraestructura sanitaria del gobierno colonial español. Un proyecto central de obras

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públicas llevado a cabo por la Inspección General de Obras Públicas (IGOP), que pretendía brindar soluciones a los problemas de salud y saneamiento en una Manila que vivía un proceso de rápida urbanización. Considerada como un testimonio de la ingeniería moderna en la colonia, aquella infraestructura de aguas fue central en la limpieza, la domesticación y la transformación del cuerpo urbano de la ciudad. Este trabajo aborda las innovaciones tecnológicas que caracterizaron el proyecto de obras hidráulicas de Manila a fin de sanear y domesticar el cuerpo turbio, sucio, enfermizo e ingobernable de la ciudad moderna. El texto analiza cómo se conceptualizó y concretó ese proyecto de infraestructura sanitaria, cómo se ubicó, bombeó, almacenó y distribuyó el agua en la capital colonial. Además, cuestiona cómo se usó el agua como herramienta y símbolo para limpiar y modernizar el cuerpo colonial y la ciudad colonial. Discute también cómo el acceso, la exclusión y el control del agua llevaron a una transformación ideológica y espacial de Manila en las últimas décadas del siglo XIX.

PALABRAS CLAVE: Sistema de obras hidráulicas de Manila, infraestructuras sanitarias, distribución de agua, acceso al agua, control de agua, obras públicas coloniales.

Introduction

The nineteenth century gave rise to the conception of a «bacteriological city», a city «defined by new features and modes of social discipline based upon ideologies of cleanliness».¹ Scholars such as Matthew Gandy argued that this idea eventually directed cities to begin investing in urban sanitary infrastructures. In the Philippines, the Manila potable water works project was one of the most significant colonial sanitary infrastructure projects in terms of magnitude, budget, and period of completion. Primarily considered a nineteenth-century feat, this infrastructure which was formally inaugurated in 1882 is regarded as one if not the most important sanitary infrastructure achievements of the Spanish colonial government. A centerpiece public works project of the *Inspección General de Obras Públicas* (IGOP), it intended to provide solutions to the problems of health and sanitation in a rapidly urbanizing Manila, a capital that was perennially plagued by cholera epidemics throughout the nineteenth century and a city that was in dire need of adequate, clean, and safe water.

Used as a testament of modern engineering in the colony, the infrastructure was central in cleansing, domesticating, and transforming the urban body of the city. In the nineteenth century, organicist views of the city became a characteristic feature of the time. The city as a living body composed of organs, tissues, fluids, vessels, arteries, and complex systems was a recurring analogy in many accounts, especially among hygienists, urban planners, and policymakers.²

1. Gandy, Matthew, «Rethinking urban metabolism: water, space and the modern city», *City: analysis of urban trends, culture, theory, policy, action*, vol. 8, n.º 3, 2004, p. 365.

2. Swyngedouw, Erik, *Social Power and the Urbanization of Water*, New York, Oxford University Press, 2004, pp. 31-35. The British architect Sir Edwin Chadwick and French urban planner Baron von Hausmann

This paper tackles the techno-scientific innovations that characterized the Manila waterworks project to sanitize and domesticate the murky, dirty, sickly and unruly body of the modern city. The first part of the paper traces how this sanitary infrastructure project was conceptualized and concretized, how water was located, pumped, stored, and distributed to the colonial capital. The second part interrogates how water was used both as a tool and symbol to cleanse and modernize the colonial body and colonial city. It discusses how water access, exclusion, and control led to an ideological and spatial transformation of Manila in the last decades of the nineteenth century.

This research primarily utilizes underutilized archival sources from the Archivo Histórico Nacional (AHN) in Madrid and the microfilmed National Archives of the Philippines (NAP) documents housed in the Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (CCHS-CSIC). The AHN provides extensive and well-organized documentation of the decades-long inception and materialization of the Manila waterworks system demonstrating the administrative, economic, and techno-scientific changes and processes that this groundbreaking public works project entailed. Despite the documents' fragmentary and poor state, the NAP offers an incomparable and rich account of the local realities, changes, and experiences when the waterworks system was put in place.

The Manila Waterworks Project: From its Inception to Construction

On the 20th to the 24th of July 1882, newspapers and magazines portrayed Manila and its residents in a festive and jovial mood. Street parades, sports activities, night performances, and fireworks displays were part of a week-long celebration of the opening of the first waterworks system in the capital as symbolized by the inauguration of the Carriedo fountain located in the suburb of Sampaloc.³ This colonial infrastructural innovation reflects the developments in the Peninsula at the time.

Matés Barco's numerous works on the development of water supply in Spain highlight the nineteenth century as a period of administrative, ideological, and techno-scientific transformations that led to the laying out of a modern water supply system in the Peninsula's main urban centers.⁴ In Spain, the period witnessed a bigger role played by the municipal governments in undertaking urban projects such as water supply, public sanitation, and other services for the resident's welfare. This translated to the passage of

widely used the metaphor of circulating waters to instill urban reforms in the mid-nineteenth up to the latter part of the nineteenth century.

3. Mas y Otzet, Francisco de, *Carriedo y sus obras: memoria de las obras pías de los pobres y de las aguas instituidas por Don Francisco Carriedo y Peredo y crónica de los festejos que el Ayuntamiento de la Ciudad de Manila ha celebrado para conmemorar la inauguración de la primera fuente de aguas potables*, Manila, Establecimiento Tipográfico de Ramírez y Giraudier, 1882, pp. 84-88.

4. Matés Barco, Juan Manuel, «El servicio de abastecimiento de agua potable: estado de la cuestión», *Transportes, Servicios y Telecomunicaciones*, n.º 1, 2001, pp. 147-150.

several laws compelling the municipal authorities to provide water service and granting them economic and administrative authority to manage and regulate water access, distribution, and concessions.⁵ In the late eighteenth century up to the nineteenth century, urban policies and infrastructures were put in place as hygienic and sanitary reformers as well as engineers and technological experts played a crucial role in the change of attitude towards public health and sanitation. The Canal Isabel II waterworks project in Madrid which was initiated in 1851 and inaugurated in 1858 is considered as a display of the notable Spanish advances in the field of science and engineering. Considered a modern accomplishment, the water infrastructure involved the construction of aqueducts, canals, and tunnels that channeled water from the Lozoya river to the Spanish metropolis' growing population. This period also coincided with the establishment of the Civil Engineering Corps (*Cuerpo de Ingenieros Civiles*).⁶ This institution later produced a new generation of engineers and specialists that served Spain and its remaining colonies.

The conception and construction of hydraulic infrastructures in the two other remaining colonies of Spain were contemporaneous to the Manila waterworks project. In La Habana, Cuba, a massive project of conducting water through an aqueduct system was started in 1858. However, its construction was extremely slow resulting in its late inauguration in 1893. A few years later, Spanish rule in the Caribbean island would come to an end.⁷ Meanwhile, a project utilizing hydraulic water pump was conceived in San Juan, Puerto Rico almost the same time as the construction of the Canal Isabel II in Madrid. Manila, the Spanish colonial capital was one of the first cities in the Southeast Asian region to establish a piped waterworks system, next to Singapore's formal opening of its first waterworks in 1878.⁸ Throughout the nineteenth century, Batavia (modern-day Jakarta), the Dutch colonial capital's main source of water was artesian wells and it was only in the 1920s that piped water was introduced to the city.⁹ This was also the case of French-ruled Saigon (modern-day Ho Chi Minh) when an old well system was constructed in the capital in 1879. This supplied the capital with water while massive canal-dredging projects characterized the French agricultural-hydraulic ventures until the turn of the century.¹⁰

5. Matés-Barco, Juan Manuel, «El servicio público de abastecimiento de agua en España (siglos XIX y XX): El proceso de acumulación de competencias de los ayuntamientos», *Revista Brasileira de História & Ciências Sociais-RBHCS*, vol. 9, n.º 18, 2017, pp. 45-46. Some of the laws passed include the *Ley Municipal de 1877*, *Ley de Obras Públicas de 1877*, and *Ley de Aguas de 1879*.

6. Merchán Gabaldón, Faustino, «El Canal Isabel II y la contribución de los ingenieros a la modernidad en España», *Revista de Obras Públicas*, n.º 3, 2004, pp. 55-62.

7. García Blanco, Rolando, «Una obra maestra en La Habana: el Acueducto de Albear», *Transportes, Servicios y Telecomunicaciones*, n.º 26, 2014, pp. 282 and 295.

8. Yeoh, Brenda, *Contesting Space in Colonial Singapore: Power Relations and the Urban Built Environment*, Singapore, National University of Singapore Press, 2003, p. 176.

9. Kooy, Michelle and Karen Bakker, «(Post)Colonial Pipes: Urban Water Supply in Colonial and Contemporary Jakarta», in Colombijn, Freek and Joost Coté, *Cars, Conduits, and Kampongs. The Modernization of the Indonesian City, 1920-1960*, Leiden and Boston, Brill, 2015, pp. 66-67.

10. Biggs, David, «Problematic Progress: Reading Environmental and Social Change in Mekong Delta», *Journal of Southeast Asian Studies*, vol. 34:1, 2003, pp. 89-90.

Colonial reports reveal that the colonial government utilized the waterworks project as an attempt to introduce modernity and demonstrate its reform agenda in the colony in the last decades of Spanish rule in the Philippines. Part of this reform agenda was the creation in 1866 of the *Inspección General de Obras Públicas* (IGOP). This colonial institution, composed of engineers, architects, and technological experts, was tasked to plan, carry out, and supervise the construction of public works in the colony such as roads, railways, trams, bridges, ports, lighthouses, schools, prisons, electric and waterworks system.¹¹ While it is true that the project of supplying Manila with clean water was first envisioned since the second half of the 18th century, the arrival of a new breed of civil engineers due to the creation of the IGOP was a pivotal factor that finally transformed this vision into a reality. With the establishment of the IGOP, engineers presented themselves as colonial reformers, and their study and implementation of public works projects in the Philippines became increasingly institutionalized, centralized, and standardized.

Official and non-official correspondences, memoirs, and even literary works paint a very alarming situation of the quality of water supply in Manila beginning in the early decades of the nineteenth century up to the distressing degradation and contamination of the city's water towards the last decades of the era. Xavier Huetz de Lemp's important study portrays a social-environmental history of water in colonial Manila which locates the Pasig River and its estuaries as principal water sources of the capital. He traces the complex and multi-layered factors that led to the city's water pollution such as Manila's very low topography and inadequate drainage, inefficient and insufficient waterways infrastructures undertaken by the colonial government, and the lack of public hygiene among residents.¹² This problem got worse when waves of cholera epidemics wreaked havoc not only in Manila but in the provinces during the nineteenth century.¹³ With the establishment of IGOP, the urgency to establish a water supply system was resuscitated when Genaro Palacios, one of the first engineers to arrive in the colony in 1867, was assigned to study, design, plan, and carry out the waterworks project in Manila. But how was the project first conceived? What were the initial attempts before Palacios took over the project?

Funding an idea: Carriedo and the beginnings of the project

The idea of constructing pipelines to distribute potable water to the residents in Manila was first conceived in 1748 when General Francisco Carriedo y Peredo placed under the

11. Costelo, Ros, «Construyendo la Colonia: La Inspección General de Obras Públicas de Filipinas 1866-1898, Trabajo Final de Máster, Universidad Complutense de Madrid, 2016.

12. Huetz de Lemp, Xavier, «Water in Nineteenth Century Manila», *Philippine Studies*, vol. 49:4, 2001, pp. 497-504.

13. *Ibidem*, p. 489. Huetz de Lemp documented the years 1820-1823, 1842-1844, 1854, 1865, 1863-1865, 1882-1883, 1888-1889 when the epidemic hit the colonial capital.

administration of the *Ayuntamiento* de Manila the amount of 10.000 escudos as initial capital to fund the project. In terms of the type of material and technology, the Carriedo proposal was very much limited to its time. For example, water was designed to be carried by pipes made up of old materials such as tile or Chinese clay.¹⁴ Insufficiency of funds and events such as the British occupation of Manila disrupted this project.¹⁵ It practically took a century before the interest of building water pipes in Manila was revived when in 1842 and 1855, after a series of cholera epidemics, military engineers Tomas Cortes and Felipe de la Corte were appointed to conduct studies on supplying safe and clean water to Manila and its suburbs.¹⁶

Locating and testing the water source

Studies such as those initiated by Cortes and De la Corte that explored, identified, and examined the water sources in Manila and its environs led to the production of new knowledge about the colony. These studies mapped the complex network of water systems in the colonial capital, its sources and flow, and the demographic composition of the urban capital in the second half of the nineteenth century. After surveying and inspecting the different bodies of water, Cortes in 1842 identified the rivers of San Mateo (northeast of Manila) and the stream of Tungtong which is part of the Marikina river as two possible sources of drinking water due to their excellent quality. Thirteen years later, another study was conducted in 1855 by De la Corte, that proposed a project that will carry the water from the stream of Tungtong to the capital¹⁷ and the use of pumping machines and water filtrations composed of sand and carbon to improve the quality of water from the Pasig River.¹⁸ However, these studies also reflect the techno-scientific limitations of the time. For example, the two studies only used the turbidity of the water as the principal indicator for excellent water quality. The two proposals did not materialize primarily due to budget constraints.

In 1868, Genaro Palacios undertook the task of drafting a project proposal to conduct water to Manila and its suburbs. If one will analyze the thousands and thousands of pages of memoirs and blueprints that were authored by Palacios and the technical recommendations made by the Consultative Board of Public Works of the IGOP, techno-scientific

14. Salt, Alexander W. E., «Francisco de Carriedo y Peredo», *The Philippine Journal of Science*, vol. VIII, n.º 3, 1913, p. 172.

15. Palacios, Genaro, «Proyecto de abastecimiento de agua de la ciudad de Manila», *Revista de Obras Públicas*, tomo I, 13, 1878, p. 152.

16. Archivo Histórico Nacional (AHN), Ultramar, 491, Exp. 1. «Aprobación del proyecto de abastecimiento de aguas potables a Manila: Extracto del expediente» (1859-1886).

17. De la Corte, Felipe, «Memoria sobre proveer a Manila de Aguas Potables», *Ilustración Filipina: periódico quincenal*, t. 1, n.º 1-20, 1859.

18. AHN, Ultramar, 491, Exp. 1, «Aprobación del proyecto de abastecimiento de aguas potables a Manila: Extracto del expediente» (1859-1886).

tific knowledge appears to be the cornerstone of the waterworks project under his command. Detailed maps and plans were produced as a result of extensive studies on the geological and topographical terrain of Manila and its environs. Different water sources at this time were not only examined according to their turbidity but were also subjected to chemical analysis and laboratory tests. A commission composed of chemists led by Don Juan Escosura, Manzanique and Guillermo Borries who provided the apparatus and laboratory analyzed the conditions of the water. They furnished Palacios with a report that detailed the presence of organic and inorganic matter in water, such as the presence of salt, lime, calcium chloride, magnesium, lead acetate, etc.¹⁹ The commission after analyzing four water sources came up with this summary report:

TABLE 1. Summary report of the water analysis from different water sources in Manila and its environs

WATER SOURCE	SUMMARY FINDINGS
Water from San Mateo river in Marikina	Contains a little amount of salts; Evaporation of 750 grams resulted to a residue of 0.10 to 2 grams; Salts consist of lime carbonate to a state of carbonate and calcium chloride; Contains some organic matter; Gives a very light precipitate due to lead acetate and dissolves perfectly the soap.
Water from San Mateo river in Santolan	Contains a small amount of salts; Salts consist of lime carbonate to a state of carbonate and calcium chloride and some sulfate; It also contains organic matter; Lead acetate gives a more pronounced precipitate than in the previous one; Soap dissolves in it completely.
Water from the stream of Tungtong	A greater quantity of salts: Evaporation of 500 grams has left a residue of 0.15; It contains lime carbonate to a state of bicarbonate, with indications of magnesia in small quantity, very little organic substance. The soap dissolves but is somewhat cloudy; Gives a more abundant precipitate compared to the previous ones due to the lead acetate.
Water from San Pedro de Macati area of the Pasig River	A greater amount of residue seen in the process of evaporation since 0.18 residue is obtained from 500 grams. Contains lime, carbonate, indications of magnesia; Large quantity of organic substances; Lead acetate precipitates in abundance and completely dissolves soap. This water could be considered as potable concerning the number of salts, but it contains a large amount of organic matter, therefore, water can only be used for drinking if it goes through the process of filtering water through layers of carbon.

19. AHN, Ultramar, 491, Exp. 2, «Aprobación del proyecto de abastecimiento de aguas potables a Manila: Sobre un legado dejado para surtir de agua potable a Manila» (1859-1869).

Comparing the presence of organic matter as well as residue in the different water samples, the sample from Marikina in the upper part of San Mateo river proved to be of the highest quality. It was clear for Palacios that the mere physical appearance and odor of the water were not sufficient basis in distinguishing the best water source for Manila. In the four samples, the very high presence of organic materials in the water sample from the Pasig River led to the specialists' recommendation of carrying out purification processes before it becomes ideal for the public's use. The water sample data was used by Palacios to compare which water source in Manila met the water quality standard in different key cities in the world such as in Paris, Lyon, Toulouse, Geneva, New York, Madrid, and water sources in Valencia and Jerez. Palacios was heavily influenced by the studies and works of engineers who pioneered some of the most essential sanitary infrastructures in Spain and France. For instance, the blueprints of the Manila waterworks system authored by Palacios show some references to the works of engineer Jose Morer, a former professor and colleague of Palacios in the Escuela de Caminos that was behind some of the waterworks projects of Canal Isabela II in Madrid.²⁰

Aside from water quality, the water capacity of the source was also tested through months-long studies. Palacios and his team had to observe and record the meteorological characteristic of the islands to determine the dry and wet seasons. Studies had just started when massive flooding occurred in September 1867 which was followed by drought until May of 1868. Palacios recorded that after the September 1867 flooding that submerged Luzon and Manila, the rain did not come anymore in the capital and its surrounding provinces until May in 1868. It may have rained once, but the severe lack of rainwater drained all the cisterns in the capital and its suburbs. The 6-month drought that occurred in last months of 1867 up to the first few months of 1868 was utilized by Palacios and his team to determine the river's lowest level of water through putting up several gauging stations at its various points.²¹ Frequent typhoons and earthquakes always hampered the smooth implementation of the planning and constructing phase of the project, especially the infamous 1880 earthquake that left the Luzon island with damages to life and infrastructures.²²

The waterworks construction and water distribution

The first plan of the water system that was designed by Palacios in 1869 was a complex system comprised of high Roman aqueducts approximately 27 kilometers in length. Ai-

20. AHN, Ultramar, 491, Exp. 2, Genaro Palacios, «Proyecto de Conducción de Aguas a Manila, Documento n.º 1 Memoria Descriptiva», 30 de noviembre de 1869.

21. AHN, Ultramar, 491, Exp. 2, Genaro Palacios, «Proyecto de Conducción de Aguas a Manila, Documento n.º 1 Memoria Descriptiva», 30 de noviembre de 1869.

22. AHN, Ultramar, 471, Exp. 1, «Daños causados en construcciones de Luzón por los terremotos de julio de 1880» (1880-1881).

ded by gravity and water pipes situated in high and mountainous areas of Marikina and Montalban, clean water was directed from the San Mateo River to San Juan del Monte. This original design was not approved because of the costs involved and the engineers also worried about the structural integrity of the system, considering the frequency of calamities such as earthquakes and typhoons.²³

Palacios presented a lesser expensive alternative plan which identified the lower part of San Mateo River (Marikina River today, particularly in Libis), considered to be the most superior quality and the most abundant water source to the capital. This alternative plan as shown in Map 1 became the final blueprint for the Manila water supply system. Water was taken from the area of Santolan where steam engines were put in place. According to Palacios, these machines should be able to pump 103 liters of water per second for the consumption of the capital's inhabitants which was then estimated at around 220.000.²⁴ Palacios used the following population data to estimate the number of inhabitants of Intramuros and the suburbs as well as the Chinese and temporary residents of the capital.

TABLE 2. Number of inhabitants of Manila (Intramuros) and its suburbs as used by Genaro Palacios in estimating the capital's water consumption

SUBURB/PUEBLO	NUMBER OF INHABITANTS
Intramuros (Plaza de Manila)	13.288
Tondo	37.588
Binondo	57.048
Sta Cruz	19.768
Quiapo	9.960
Sampaloc	11.456
San Miguel	4.432
San Fernando de Dilao/Paco	11.212
Ermita	17.680
Malate	19.292
Chinese and temporary residents	16.000
Total	217.724

Then from the pumping station, water was drawn by the five-kilometer cast-iron pipes towards «El Depósito», a water reservoir located on the hill of San Juan del Monte. This underground reservoir designed by Palacios had a total capacity of 56,000 cubic meters of water daily. According to Palacios, the water reservoir's unique location and it's

23. AHN, Ultramar, 491, Exp. 2, «Aprobación del proyecto de abastecimiento de aguas potables a Manila: Sobre un legado dejado para surtir de agua potable a Manila» (1859-1869).

24. Palacios, Genaro, «Proyecto de Abastecimiento de aguas de la ciudad de Manila», *Revista de Obras Públicas*, tomo 1, n.º 13, 1878, p. 154.

sufficient elevation is necessary to be able to pump and supply water to the capital. From El Depósito, water was forcefully conducted to the city through cast-iron pipes of varied measurements and diameters. Aqueducts and bridges had to be constructed to be able to conduct water from the water reservoir to the distribution pipes towards the capital, such as those that were constructed in the estuary of San Juan del Monte and one along Mariquina.²⁵

MAP 1. The final waterworks system plan designed by Genaro Palacios. The map shows where water will be sourced and stored leading to the distribution pipelines in Sampaloc.

SOURCE: AHN, ULTRAMAR, MPD, 4537.

The second part of the waterworks system is the water distribution. The primary distribution lines begin in Sampaloc, where the iconic Carriedo fountain was put in place, and in Quiapo. From this suburb, water lines with smaller water pipes ran through the other suburbs such as San Miguel, Santa Cruz, Tondo and Binondo crossing the Pasig river to allow water to flow to the different parts of Intramuros and the Manila suburbs to the left of the river which included San Fernando de Dilao/Paco, Hermita and Malate.

25. Palacios, Genaro, «Proyecto de abastecimiento de aguas de la ciudad de Manila», *Revista de Obras Públicas*, 26, tomo I, 14, 1878, p. 165.

Palacios in his memoir attempted to create a systematic distribution of water in Manila and its suburbs through the construction of water fountains in the capital. Two types of hydrants were put in place; first, water fountains where potable water flowed and the other were fire hydrants allocated for fires and street cleaning. The water hydrants were to be built of smelted iron and not in stone. There were three types of potable water fountains. In some areas of the capital, the public fountain had only one faucet. Some, however, had two or four valves.²⁶ On paper, the water fountains were planned to be constructed within the municipal radio at intervals of 100 meters and in greater distances in some parts of the Manila suburbs. Ideally, the number of water fountains and the type to be placed inside Intramuros and in each and every suburb should depend on the number of inhabitants. Official reports, such as the one written by Mas y Otzet, indicated that there were around 390 fountains for potable water and 280 fire hydrants that were put in place.²⁷ However, the blueprint authored by Palacios in 1879 reveal only half of this number which was at around 200 public water fountains.²⁸ According to Palacios, the laying down of pipe waters in the capital proved to be challenging due to the very low elevation of some of the streets and points of the different suburbs and the numerous estuaries that had to be crossed by the pipes.²⁹ Eventually, the insufficiency of public water fountains caused the inadequate and unequal water distribution for the capital's increasing number of residents and resulted to the inhabitant's vulnerability in times of epidemics.

Due to the project's magnitude in terms of scale and budget which amounted to 480.000 pesetas, the colonial government through the *Inspección General de Obras Públicas* had to open public biddings for the acquisition and operation of more up-to-date materials as well new machines and equipment necessary for the waterworks system project. Spanish and non-Spanish construction houses and companies that were based in the Philippines and Europe could participate in these biddings. The biddings in the public works projects supervised by the *Inspección General de Obras Públicas* demonstrated open participation of different players in the field of science and technology. Generally, the plans and blueprints of the waterworks project authored by Palacios expose a heavy reliance on Western most especially British, French and Belgian science and technology complemented with local knowledge, materials, and workforce.

One of the biggest and most expensive biddings in the waterworks project was the acquisition of the pumping machines in 1881. The engines would drive water from the river source to the pipes leading to the water reservoir and the distribution lines towards

26. AHN, Ultramar, 492, Exp. 2, «Aprobación del proyecto de abastecimiento de aguas potables a Manila: Presupuestos de gastos. Modificaciones del trazado de las tuberías» (1881-1886).

27. Mas y Otzet, Francisco *Carriedo y sus obras...*, cit., p. 76.

28. AHN, Ultramar, MPD. 4634, «Proyecto de conducción de aguas a Manila: Variación de algunos diámetros de tuberías de la distribución: Plano de las líneas de tuberías de la distribución de aguas potables en Manila y sus arrabales, según el trazado aprobado por R. O. de 10 de junio de 1875, indicando las longitudes y diámetros de las tuberías, la situación de fuentes y llaves de comunicación y de desagüe», Manila, 20 agosto 1879.

29. Palacios, Genaro, «Proyecto de abastecimiento de agua...», cit., 26, tomo I, 14, 1878, p. 166.

the colonial capital.³⁰ José Echeverría, a Paris-based engineer, authorized by the Ministry of Ultramar to serve as a commissioned agent for the procurement of machines, materials, and services through public biddings accepted proposals from French and Belgian construction houses and companies that wanted to participate in the bidding process. The proposals that these construction houses offered consist of supplying pumping machines of 25 feet in height and that can pump 160 liters per second. Echeverría, because of his formation as an engineer, not only served as a facilitator in the bidding process but also provided some technical assessment on the proposals. The table below, for example, lists the French-dominated and Belgian manufacturers that expressed their interest in supplying the pumping machines for the Manila waterworks project. It also shows the concerns raised by the engineers of the IGOP concerning the technical specifications of the pumping machines according to its steam engine, the primary pump of the machine, the auxiliary pump, the steam generator, the machine's weight, and its bulk weight once transported by sea.

TABLE 3. Summary of different proposals for the acquisition of pumping machines for the waterworks system.

NAME AND LOCATION OF CONSTRUCTION HOUSE/ MANUFACTURER	SEVERAL TECHNICAL OBSERVATIONS MADE BY THE ENGINEERS OF IGOP
Carels Brothers (Ghent, Belgium)	The engines and pumps seem complicated, and their mechanisms are too fragile for the conditions of Manila. The number of machines and their mechanical designs is too risky; there is a high risk of dislocation of several important machine parts especially in times of earth tremors because the mounting frames of the machines are overly stretched and there is too much rigidity in the entire machine system.
Crozet and Company (Le Chambon-Feugerolles, France)	The proposal offers a complete but with less sophisticated machines. Its large dimensions and the heavyweight and overly stretched mounting of the machine's frames can produce dislocations and breaks in times of movements of the ground.
Limited Company of Mechanic Constructions of Anzin (Anzin, France)	The principal defect of the proposed machine consists of the oversized and bulky frames of the motors and the pumps. Withstanding Manila's condition and the constant fear of earthquakes as well as the very high suction height, this proposal would be without a doubt one of the best.
Henri Satre and Company (Lyon, France)	The general design and layout of the proposal is simple, good, and less costly. It, however, has no auxiliary pumps.

30. AHN, Ultramar, 491, Exp. 3, «Aprobación del proyecto de abastecimiento de aguas potables a Manila: Proyecto de conducción y distribución de aguas empleando máquinas» (1871-1874).

Jose Fazcot and Company (Saint-Ouen, France)	Apart from the excessive rigidity of the entire system and the complex configuration of the system, the proposal is good but of a very high cost.
Cail and Company (Paris, France)	The proposal has good qualities and advantages. The machine parts are well configured, the pumps are of simple and robust construction, and fulfill all conditions of safety and proper functioning.
Crozet and Company and Prumier (Le Chambon-Feugerolles, France)	The proposal differs from all the rest of the designs and offers the best way to pump water especially in the distinct case of Manila. The machines are easy to install, the manufacturers provide time to test run the machines, and the type and weight of the devices are ideal.
Locoge and Company (Lille, France)	The type of pump that the proposal offers is not appropriate.

Moreover, the public bidding for the pumping machine was opened for other manufacturers. Manila-based agents played an important role for other players to participate in this process. It is in this context that Frederick Sawyer, agent, and representative of the English manufacturer Mirlees Fait and Walon in Glasgow, could present a proposal of supplying pumping machines for the waterworks project that are capable of elevating 103 liters of water per second.³¹ The presence of agents in the archipelago that facilitated the acquisition of new machines and emerging technologies in Europe, in this case, proved advantageous. Although the French and Belgian proposals offer machines with a capacity of pumping 160 liters per second, in the end, the colonial government opted for the English proposal for the following reasons: first, the English machine and its installation was examined to be way cheaper than the rest of the designs; second, the quality of the pumps have passed the inspection; third, the mode of payment fits the limitations of the waterworks projects; fourth, tests can be done in Manila to verify the machine's performance and durability, and lastly, the manufacturer offered the replacement of damaged parts of the machines.

The carbon that was used to run the machines of the waterworks system was also imported through contractors. Chinese middlemen served as contractors in the waterworks project, mostly involving the supply of construction materials, such as carbon. An example was the Chinese named Co-Fimco, a resident of Binondo who won a public bid wherein he was approved in 1 of June 1887 by the Spanish colonial government to supply 200 tons of carbon from Australia for the operation of the machines used to pump water from the river to the water pipes.³² The purchasing of fire hydrants to be installed in the water lines was also through private contractors. Manila-based contractors Enrique

31. AHN, Ultramar, 492, Exp. 2, Carta del Gobernador General, Manila, 29 April 1881.

32. «Concesión a la contratista chino Co-Finco», Manila, 1 junio 1887, Rollo 1767, Archivo de Filipinas, Biblioteca Tomás Navarro Tomás Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (AF-BTNT-CCHS-CSIC).

Wilks and Herrman Schwenger, for example, were approved to supply 100 and 117 fire hydrants respectively.³³

Natives and Chinese provided the hard manpower for the waterworks project. They served as the foremen (*capataces*), the clerks (*escribientes*), stone cutters or quarrymen (*pedreros*), laborers (*peones*), carpenters (*carpinteros*) and stonemasons (*canteros*). During the construction phase of the waterworks project, long lists of workers that were employed in the waterworks project were reported monthly. The records reveal the names of thousands of laborers, their age (if they are under-age or already of age), the number of days and the amount that was paid them in exchange for their service.³⁴ Local and indigenous materials were utilized in the waterworks project such as lime and limestone from Binangonan and San Mateo, stone and gravel from Bulacan, brick from Manila, *molave* wood from Pampanga and other nearby provinces.³⁵

Cleansing the Body and the City

The Pasig river has always been the principal source of water for the inhabitants of Manila and its environs. However, its poor state was summarized by Palacios when he described that «The water of the Pasig river is always murky most especially in the dry season when it carries a large portion of organic matter that makes it inappropriate for drinking. Among the different water sources, the water from the Pasig River contains the worst chemical composition».³⁶ This body of water that initially served to nourish the body of the city then became the fitting representation of a sickly and polluted body of the colonized inhabitants of Manila.

The introduction of the waterworks project gave birth to the changing notions of water, such as the concept of its potability and usage. Clean, safe, and drinkable water was water conducted through tubes and pipes. Its sufficient supply and easy access was integral for the metabolism and growth of the modern body and the modern city. In terms of urban layout, infrastructures such as waterworks and sewage systems represented the features of a modern city.

When the waterworks project was implemented, two important types of structures were constructed throughout the city and its suburbs. First were the public water foun-

33. «Concesión a los contratistas Enrique Wilks y Herrman Schwenger», Manila, 24 marzo de 1887, Rollo 1764, Archivo de Filipinas, Biblioteca Tomás Navarro Tomás Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (AF-BTNT-CCHS-CSIC).

34. «Lista de los trabajadores de la traída de aguas de Manila», Rollo 1770, Archivo de Filipinas, Biblioteca Tomás Navarro Tomás Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (AF-BTNT-CCHS-CSIC).

35. AHN, Ultramar, 491, Exp. 1, «Aprobación del proyecto de abastecimiento de aguas potables a Manila: Extracto del expediente» (1859-1886).

36. AHN, Ultramar, 491, Exp. 2, Genaro Palacios, «Proyecto de Conducción de Aguas a Manila, Documento n.º 1 Memoria Descriptiva», 30 de noviembre de 1869.

ins that provided clean drinking water and second were the fire hydrants that not only served as anti-fire structures but also maintained the cleanliness of the city's arteries, the streets. The *Ayuntamiento* de Manila in several proclamations emphasized that aside from providing safe drinking water, street washing and cleaning should be regularly carried out to ensure the city's sanitation. As a result, it ordered the installation of water hoses to be installed in the fire hydrants to be able to wash the streets of the capital. The city opened this service for public bidding. For example, on 3 February 1894, Don Abelino Mierco got the approval of his bid to undertake the washing and cleaning of the streets of San Jacinto, Nueva, San Vicente, Dasmariñas, Norzagaray and Santa Cristo in Binondo. However, the use of water hose was strictly regulated by the colonial government due to fears that natives utilized this in the unregulated and limitless extraction of water. It was even stipulated that the water hose would be under the safekeeping of the municipal's architect and the Fire Brigade (*Cuerpo de Bomberos*).³⁷

Controlling the water supply and distribution

Controlling the flow of water implies controlling the city and its inhabitants. Water access and distribution became a form of social control in the colony. In the case of Manila, new modes of social regulation and discipline were put in place based on the evolving idea of clean, safe, and modern drinkable water. The colonial government implemented laws and rules that exacted control among the water activities of Manila residents most especially of the natives. The Guardia Civil Veterana was assigned to patrol along water sources to monitor and restrict the movement of the natives. The colonial authorities determined activities related to water that were criminalized such as washing of dirty clothes of sick people and bathing near the water source. Individuals caught throwing things from sick or dead people and excreting human waste in the river were severely penalized.³⁸ To further implement this control, the colonial government adopted a more rigorous surveillance system. In July 1888, it issued a decree employing the necessary force of the Guardia Civil to perform household surveillance with reported cases of illnesses and their habits related to water. It also stated the assigning of four more leaders (*cuadrilleros*) per barrio that were specifically tasked to monitor the water activities of the inhabitants such as where and how they get water and how they throw their waste.³⁹

State control was not only limited to activities near the water source but, more importantly, was extended to the water lines and water distribution. In public spaces, the

37. «Informe de José Irastra al Corregimiento de Manila», Manila, 3 febrero 1894, Rollo 1769, Archivo de Filipinas, Biblioteca Tomás Navarro Tomás Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (AF-BTNT-CCHS-CSIC).

38. «Informe de Manuel Ramírez Bazán al Ayuntamiento de Manila», Manila, 20 April 1886, NAP Rollo 1767, Archivo de Filipinas, Biblioteca Tomás Navarro Tomás Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (AF-BTNT-CCHS-CSIC).

39. *Ibidem*.

colonial government imposed closer vigilance and stricter protection on the pipelines. In the case of Manila and its suburbs, the colonial government employed the services of plumbers (*fontaneros*) and overseers for the sole purpose of guarding and monitoring the state of the water lines, water pipes, and public water fountains. Their original duty was to manage and maintain the excellent condition of the water lines and pipes, and if needed, repair them also. The repeated incidents of prohibited extraction of water from the public fountains and the destruction of some water lines prompted *Inspector General* Ramirez Bazan of the IGOP to ask the *Ayuntamiento* de Manila to employ more plumbers and overseers. Their tasks included the surveillance of the public water fountains, the inspection of water lines and pipes leading to private houses and buildings, and monitor the resident's activities surrounding the water fountains and water sources.⁴⁰ Most of the time, these plumbers and overseers ended up fighting with the residents while they tried to implement the rules of the colonial government to control water use. Usually, these rules contrasted with the residents' views and habits regarding water and its use. On 31 May 1894, the captain of the Fire Brigade of Manila reported that a day earlier while he was inspecting the flooded streets at around 7:30 and 8:00 in the morning, a serious altercation occurred between a Chinese man and a plumber named Ramon de Leon in Paseo de Magallanes. According to the official report, the Chinese was illegally extracting water, and when asked to pay the dues for water service, he violently refused to oblige. It became a severe fight that it disrupted public order and produced commotion in the thoroughfares.⁴¹

According to the rules set by the colonial government, water that comes out of the public water fountains is free of charge. The colonial government, because of the belief that a large amount of water is illegally extracted or put to waste by the natives or the Chinese, imposed several regulations regarding water use. An example of unauthorized extraction of water from public fountains was reported to the municipal authorities of Manila, when residents of Pandacan, a town northeast of the capital, were taking water from the public fountains in the nearby suburb of San Miguel and Uli-uli. The plan for the water pipe lines indicates that Pandacan had no access to piped water. Until the late nineteenth century, the pueblo was a frontier of the colonial capital so it did not belong to the priority areas where the tubes and water lines passed through. The several incidents of unauthorized extraction of water from public water fountains led to the urgent acquisition of mechanical water meters that were installed to the fountains.⁴²

In terms of distribution, peripheral areas had no sufficient access or had no access at all to new technology services like potable water because naturally the more lucrative

40. *Ibidem*.

41. «Informe de Jose Iraistro al Corregimiento of Manila», 31 March 1894, Manila. NAP Rollo 1769, Archivo de Filipinas, Biblioteca Tomás Navarro Tomás Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (AF-BTNT-CCHS-CSIC).

42. «Informe de Manuel Ramírez Bazán al Ayuntamiento de Manila», 20 April 1886 Manila, NAP Rollo 1767, Archivo de Filipinas, Biblioteca Tomás Navarro Tomás Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (AF-BTNT-CCHS-CSIC).

MAP 2. Map showing the water lines that ran through Manila and its suburbs

spaces at the center were the privileged spaces.⁴³ Graham and Marvin argue that in colonial cities the waterworks network was largely concentrated to meet the needs of metropolitan and local elites.⁴⁴ In the Manila waterworks system, access to water supply may be measured through the number of public fountains that were put in place in Intramuros and its suburbs. Map 2 shows the water pipe lines that ran through the entire capital, while Map 3 highlights the public water fountains that were put in place from Sampaloc to Intramuros and the suburbs. To the right of the Pasig River are the suburbs of Binondo, Santa Cruz, Quiapo, San Miguel, Sampaloc and Tondo while to the left of the riverbank are San Fernando de Dilao or Paco, Hermita, and Malate. Using this map to determine the location and position of the public fountains, it is evident that Intramuros and the suburbs to the right of the river, especially the areas of Binondo and Sta Cruz, had

43. Graham, Stephen and Simon Marvin, *Splintering Urbanism Networked Infrastructures, Technological Mobilities and the Urban Condition*, London and New York, Routledge, 2001, p. 59.

44. *Ibidem*, p. 82.

focal concentration of water fountains. The presence of more hydrants in this area might indicate easier water access. Naturally, Intramuros, being the seat of the political, military, and religious power of colonial Manila, is expected to have more water fountains. On the other hand, Binondo, which served as the city's commercial center with a very cosmopolitan character⁴⁵ had more control of the city's water distribution alongside the commercial district of Santa Cruz and Quiapo. Business establishments and varied economic activities were actually concentrated in these areas during the time.⁴⁶ In contrast, one may find fewer hydrants in the areas to the left of the river and in the peripheral suburbs of Sampaloc and Tondo.

MAP 3. Map showing the water fountains distributed in the different suburbs.

Furthermore, Map 4 measures the ratio of water fountains to the number of inhabitants per suburb. Census data of the time identified the suburbs of Binondo and Tondo with the highest population, with 57,048 and 37,588 inhabitants respectively. The map

45. Chu, Richard, *Chinese and Chinese Mestizos of Manila: Family, Identity, and Culture, 1860s-1930s*, Leiden and Boston, Brill, 2010, p. 180.

46. Stefan Lagman, Marco and Ma. Simeona Martinez, «Assessing the Characteristics of Late Nineteenth Century Manila-Based Business Establishments: A Review of the *Contribución Industrial*», *Journal of Asian Network for GIS-based Historical Studies*, vol. 2, 2014, p. 68.

clearly shows that the commercial district composed of the suburbs to the right of the river had better water access and distribution in terms of the ratio of the number of fountains to the number of inhabitants. Meanwhile, the poor ratio of water fountains to the number of inhabitants is very much evident in Tondo which was home to poor native urban workers and in the peripheral areas of Sampaloc and the less-commercial suburbs to the left of the Pasig. In the end, the poorer classes still relied on water from the rivers and estuaries, rainwater, and wells as their principal source of water. This proved to be very risky as they expose themselves to the dangers of cholera that swept the city in the 1880s.⁴⁷

MAP 4. Map showing the ratio of water fountain to the number of inhabitants per suburb.

Domesticating the water

The elaboration of extensive sewer and water systems and the changing conception of «clean water» paved the way to an increase in the domestication of water. Piped water began to enter the households of the capital and water «became part of an invented tra-

47. Doeppers, Daniel, «Manila's Imperial Makeover: Security, Health, and Symbolism», in McCoy, Alfred and Francisco Scarano (eds.), *Colonial Crucible Empire in the Making of the American Modern State*, Wisconsin, The University of Wisconsin Press, 2009, p. 494.

dition of domesticity».⁴⁸ With this, water, became urbanized and commodified through standardized infrastructure services.⁴⁹ Generally, water in the public water fountains is free. However, the *Ayuntamiento* de Manila offered the privilege of directly servicing water to households by paying four centavos per cubic meter of water. Aside from direct potable water service, households and building owners may also opt to install fire hydrants at 12,50 pesos per year.⁵⁰

To control private water consumption, houses were surveyed before permits were granted. Then, water meters and taps were attached to the households that were approved for direct water servicing. A typical receipt of payment reflects the level of control that the Manila colonial government imposed to individuals to be able to get private access to water. The receipt indicates the name of the household owner, the complete address which includes the street number, street name, and name of the district.⁵¹ It also shows also the quantification and commodification of water. Every day, water use of a household is measured through water taps and meters and is documented to produce a monthly consumption history reflecting the amount of water per cubic meters used and the corresponding fee.⁵²

In the case of Manila, permits for water service in private houses reveal the unequal and racialized nature of water access. The following table, as extracted from one of the permits of a Manila household to get direct water access, documents the amount of water intended for different water-users in a domicile.⁵³

TABLE 4. Intended water use in a domicile in Manila.

USER/INTENDED WATER USE	AMOUNT OF WATER ALLOTTED DAILY
A member of a European family or a European servant (<i>Persona de la familia de los amos o sirviente europeo</i>)	50 liters
A native servant (<i>sirviente indígena</i>)	25 litres
A horse	30 litres
A carriage with 2 to 4 wheels	40 litres
A garden	2 litres per square meter

48. Gandy, Matthew, «Rethinking urban metabolism...», *cit.*, p. 367.

49. Graham Stephen and Simon Marvin, *Splintering Urbanism...*, *cit.*, p. 56.

50. *Reglamento para el uso público, gratuito y a domicilio privado mediante retribución de las aguas potables del canal de Carriedo*, Manila, Imprenta de la R. Mercantil de Díaz Puertas y C. Cervantes, 1885, pp. 9-10.

51. «Recibo del pago de Mariano Limjap», NAP Rollo 1766, Archivo de Filipinas, Biblioteca Tomás Navarro Tomás Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (AF-BT-NT-CCHS-CSIC).

52. «Recibo del pago de Abraham Garcia», NAP Rollo 1765, Archivo de Filipinas, Biblioteca Tomás Navarro Tomás Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (AF-BTNT-CCHS-CSIC).

53. «Solicitud del abastecimiento de agua», NAP Rollo 1764, Archivo de Filipinas, Biblioteca Tomás Navarro Tomás Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (AF-BTNT-CCHS-CSIC).

The data reflects the divide even to the access of water in the context of a domicile in the colonial setting. It shows that a native servant was only allowed to spend half the amount of water that his or her European or Spanish master could consume. In fact, a horse was even entitled to more water supply than a native. To maintain the colonial government's control on water access, the contract for direct water access among households was limited to two years. This direct access was also regulated within one domiciliary. The government applied punitive measure to private homes that redistribute, transfer or sell the water illegally.⁵⁴

By examining the list of paying households for the years 1886 and 1887,⁵⁵ it is quite expected that Binondo would record the highest number of private water access given the economic capacity of its residents as shown in Table 4. Again, the suburbs to the left of the river as well as the peripheral and poorer suburbs of Sampaloc and Tondo had lesser number of private households with direct water access. Meanwhile, the bustling districts of Quiapo, Santa Cruz, and San Miguel had more households with pipelines as well as Intramuros which was home to the affluent families of colonial Manila.

TABLE 5. Number of households in Intramuros and Manila suburbs with direct private water access through open water pipes.

54. *Reglamento para el uso público, gratuito y a domicilio privado mediante retribución de las aguas potables del canal de Carriedo*, p. 12.

55. «Relación de los recibos de aguas de Carriedo por los meses de enero a diciembre de 1886 a 1887», NAP Rollo 1771, Archivo de Filipinas, Biblioteca Tomás Navarro Tomás Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (AF-BTNT-CCHS-CSIC).

In the list of paying households, one can find the names of important Spanish, European and American residents and business owners in Manila such as the Ynchausti's, Barreto's, Fressel, Bell, as well as mestizos, Chinese-mestizos and local elites such as the Legarda's, Roxas', Paterno's, Lim-jap's, etc. In a way, the presence of canalized water became an indicator of a modern household. Only families of political and economic importance were able to avail of this privilege which was limited only to almost 5 % subscription of the entire households in the capital by 1902.⁵⁶

Delineation and laying out the urban space of the city

The waterworks project, the biggest integrated and inter-suburb public works project in the second half of the nineteenth century, led to a spatial reconfiguration of the city. The water canals and pipes literally served as connecting lines of a rapidly growing city. Lands had to be surveyed and classified to administer the water distribution in the city which then led to more extensive delineation and laying out of urban space in the capital. *Inspector General* Manuel Ramírez Bazán wrote on 17 August 1886 to the *Ayuntamiento* de Manila with regard the urgent need of mapping out the city and its suburbs that would show a clear and complete delineation of the suburbs' jurisdiction with respect to the waterworks network.⁵⁷ The colonial government through its engineers and land surveyors conducted surveys that produced land appraisals to produce a more complete record of the lands of the city and its suburbs. The first type of information that was gathered was the land's geometric form, its type, dimensions, and boundaries with a detailed description of the street name and number as well as the name of the property owner. Then land measurement was undertaken after which a land declaration is made that classified lands as cleared lands, lands prone to flooding, grassy lands, and lands used for rice cultivation. Finally, the land is appraised with the price of expropriated lands. By 26 of August 1886, the total amount of expropriated lands for the waterworks project reached to 9.624 pesos.⁵⁸

Memoirs of these surveys reveal a new appreciation and valuation of land locations and property. This was specifically observed when the colonial government had to acquire lands where the water pipelines had to cross. Naturally, properties that were near public fountains and water lines became prime locations such as when alterations were done in Tanduay and Arlegui streets in Quiapo. Based on the memoirs and blueprint of the

56. Doeppers, Daniel, *Feeding Manila in Peace and War, 1850-1945*, Quezon City, Ateneo de Manila University Press, 2016, p. 256.

57. «Expropiación de Terrenos», NAP Rollo 1764, Archivo de Filipinas, Biblioteca Tomás Navarro Tomás Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (AF-BTNT-CCHS-CSIC).

58. «Informe de la Inspección General de Obras Públicas», Manila, 26 de agosto de 1886, NAP Rollo 1767, Archivo de Filipinas, Biblioteca Tomás Navarro Tomás Centro de Ciencias Humanas y Sociales-Consejo Superior de Investigaciones Científicas (AF-BTNT-CCHS-CSIC).

waterworks project, the colonial government identified priority areas for water access. For example, there were explicit directions that pipes should reach other public works projects of the city such as the slaughterhouses and markets in the suburbs. The colonial authorities wanted to lay out pipelines on streets and lands of public domain to be able to monitor their state. This was the reason why there were changes in the pipelines route so that pipes would pass along the *Real Fábrica de Tabacos* in Meisic and the Carenero warehouse to have water access.⁵⁹

It was also clear to the colonial government that the streets with houses made up of strong materials and areas with large population were the priority areas where pipelines would pass through. This was the case when *Inspector General* Ramírez Bazán reported the modification of the route of the pipes that distribute the water in the suburb of San Fernando de Dilao or Paco. The alteration in the blueprint consists in laying out an extension of 1.280 meter-pipeline to Real Street towards the direction of the town of Santa Ana. According to the *Inspector General*, «the advantages of the new pipeline route is unquestionable since the Real Street is the main street of the suburb where the best types of houses are located and the largest population of the area reside».⁶⁰

Conclusion

After the end of the Spanish rule in the Philippines, water hydrants were available for free in the different public spaces in Manila.⁶¹ In 1904, Mr. Desmond Fitzgerald, consulting engineer of the proposed new water supply of the city of Manila of the American colonial government in the Philippines reported that the capacity of the Manila waterworks system drawn from the Marikina river had already been nearly reached. His proposal was to either expand the existing system or find a new source that would supply Manila's exponential need for clean drinking water. Despite the limitations of the Manila waterworks, Fitzgerald however recognized the system as «an admirable structure for an earthquake country».⁶²

The Manila waterworks system as a public works project symbolized the triumph of engineering in the last decades of Spanish colonial rule in the Philippines. It represented an optimistic view of how technological solutions could be devised to respond to the public health and sanitation problems of the colony. The creation of a specialized institu-

59. AHN, Ultramar, 492, Exp. 2, «Informe del Inspector General Manuel Ramírez Bazán», Manila, 29 May 1884.

60. AHN, Ultramar, 492, Exp. 2, «Informe del Inspector General Manuel Ramírez Bazán» Manila, 12 mayo 1884.

61. Doeppers, Daniel, «Manila's Imperial Makeover: Security, Health, and Symbolism», in McCoy, Alfred and Francisco Scarano, *Colonial Crucible Empire in the Making of the American Modern State*, Wisconsin, The University of Wisconsin Press, 2009, p. 494.

62. *Annual Report of the Municipal Board*, «Report of Mr. Desmond Fitzgerald upon the proposed new water supply», Manila, 28 April 1904.

tion dedicated to the construction of public works projects, the presence of engineers with a broader technological know-how, the open participation of different players in the field of science and technology, the evident political will of the municipal authorities of Manila and the central colonial government, and the changing attitudes towards sanitation, public health, and urban space in a rapidly urbanizing city were all vital factors for the realization of one of the biggest sanitary infrastructure projects in Manila. Indeed providing safe and clean water was the colonial government's direct response to the cholera epidemics in the nineteenth century⁶³ and the growing pressure of providing a basic service to a growing colonial capital.

However, the waterworks inaugurated in 1882 did not directly mean the eradication of water-borne diseases and illnesses. This present study exposes that the laying out of the waterworks system did not guarantee equal access and full distribution of clean, safe, and affordable water for the entire inhabitants of the colonial capital. In Manila, while it is important to recognize the construction of a revolutionizing public work which was the waterworks system, it is also equally important to ask: What was the reach of the water supply in Manila? Who had access to it? These questions once answered would paint a picture, such as in the case of Manila, of an incomplete modernity because there were «citizens who could lay claim to potable water and they were 'subjects' who were left to make do as best as they could».⁶⁴ This study presents the complex intersections between technological innovations and the many layers of the politics of sanitation and water access and exclusion in a colonial context. As with other goods and urban services, the circulation of water and its mechanisms of access and exclusion reveal relations of economic and political power.

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63. Huetz de Lempis, Xavier, «Water in Nineteenth Century Manila...», *cit.*, p. 490.

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