REPORT

SECOND DRAFT

The Lusaka Water Supply, Sanitation, and Drainage (LWSSD) Project: Evaluation Design Report

February 21, 2019

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ACKNOWLEDGEMENTS

We greatly appreciate the contributions of the many people whose input influenced this report. We especially thank Rabia Chaudhry, our project monitor at the Millennium Challenge Corporation (MCC), and Ryan Moore, the contracting officer's representative, for their support throughout the process of developing the evaluation design. Also at MCC, we thank Marc Tkach for helping us understand the infrastructure investments, Naomi Cassirer for input on elements of the project and evaluation that relate to gender and social inclusion, Stefan Osborne for information about the project's economic analysis, Sarah Drew and Denise Leung for explaining the Livelihood Restoration Program, and Katherine Tan and Tamara Heimur for shedding light on the Sanitation Connection Action Plan.

In Lusaka, we sincerely thank Floyd Mwansa and Patrick Chilumba and their colleagues Claude Kasonka and Samuel Mwanagombe of the Monitoring and Evaluation team at the Millennium Challenge Account–Zambia (MCA-Z) for their incredible support leading up to, during, and following our missions in January and August of 2018. While we were in Lusaka, many other colleagues from MCA-Z were also extremely generous with their time as they helped us understand the details of the activities they oversee and their priorities for the evaluation, including: Chipili Chikamba, Titus Chilongo, Brenda Kapika, Philemon Masangula (seconded from Lusaka Water and Sewerage Company), Matimba Mungule, Mbulwe Mwimba, Mommie Witika. We were honored to have an opportunity to brief MCA-Z CEO Pamela Bwalya and Deputy CEO Israel Banda on our mission and we are very grateful to Steve Marma, Gretchen Goodhart, and Choolwe Haamukwanza of the MCC Resident Country Mission, for sharing their knowledge about the project and for their generous hospitality and support during the mission. We also thank the numerous organizations and individuals who met with us during the mission and participated in the stakeholder workshop for their patient explanations and helpful insights; in particular, MCA-Z's consultants and contractors were wonderfully supportive and we benefitted greatly from all the information they shared with us during and after the mission. The mission was also greatly enhanced by the opportunity to discuss the project and the evaluation with Joe Dalton of MCC's independent engineering team from MWH.

Several other colleagues have made important contributions to this report. Our consultants Rueben Lifuka and Stephen Clamp participated in our January 2018 mission and provided valuable subject matter expertise as we developed the report. Loay Hidmi, our third expert consultant, also provided key input on the report and Chibamba Mwansakilwa, our local consultant for the first mission, helped us to understand the local context. At Mathematica, we thank Randall Blair for reviewing and providing thoughtful comments on the draft report, Maria Myers for editorial review, and Sharon Clark for careful formatting of the report.

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ACRONYMS

AIR	American Institutes for Research
CBE	community based enterprise
CDC	Centers for Disease Control and Prevention
CP	construction package
ERR	economic rate of return
IBNET	International Benchmarking Network for Water and Sanitation Utilities
IEC	Information, Education, and Communication
IGP	Innovation Grant Program
InfrA	Infrastructure Activity
IRB	institutional review board
ISA	Institutional Strengthening Activity
LCC	Lusaka City Council
LRP	Livelihood Restoration Program
LSP	Lusaka Sanitation Programme
LWSC	Lusaka Water and Sewerage Company
LWSSD	Lusaka Water Supply Sanitation and Drainage
MCA-Z	Millennium Challenge Account Zambia
MCC	Millennium Challenge Corporation
MPCA	Millennium Project Completion Agency
NRW	non-revenue water
NWASCO	National Water Supply and Sanitation Council
O&M	operations and maintenance
SCAP	Sanitation Connection Action Plan
SIGM	social inclusion and gender mainstreaming

SM	sanitation marketing
SWM	solid waste management
TA	technical assistance
USAID	United States Agency for International Development
WASH	water, sanitation and hygiene
ZEMA	Zambia Environmental Management Agency

I. INTRODUCTION

Home to 1.7 million residents and 13 percent of the country's population, Lusaka is growing quickly as a result of rapid urbanization (World Bank 2015). The majority of Lusaka residents (70 percent) live in unplanned, peri-urban areas outside the city center (Central Statistics Office 2010). These areas are characterized by insecure land tenure, high population density, low coverage of piped water infrastructure, unsafe sanitation, and poor drainage systems.

Inadequate water, sanitation, and drainage in Lusaka contribute to a myriad of inefficiencies and health problems that constrain opportunities for economic growth. According to the latest census (2010), only 31 percent of urban Lusaka households have access to piped water in their home or plot; the rest spend substantial time collecting water from community stand points, kiosks, wells, or other sources (Central Statistics Office, Ministry of Health, and ICF International 2014). Reliability of the piped water supply can also be problematic, especially in peri-urban areas. The Centers for Disease Control and Prevention (CDC 2015) estimates that such areas can have as little as four hours of supply a day. According to the latest Zambia Demographic and Health Survey, urban Lusaka residents who lack access to water on their premises spend an average of 17.3 minutes per round trip when collecting water and likely take multiple trips per day (Central Statistics Office, Ministry of Health, and ICF International 2014). Further, in urban areas of sub-Saharan Africa, the responsibility for water collection falls mostly on women and children and has been shown to have negative effects on health, school attendance, and performance (Graham et al. 2016).

Lusaka also suffers from inadequate sanitation infrastructure and problems with solid waste disposal. About 90 percent of residents use pit latrines, most of which are unimproved (World Bank 2016). Peri-urban areas are especially vulnerable to fecal contamination because they are located largely in low-lying land prone to floods (Nchito 2010). Rainwater frequently causes pit latrines to overflow, resulting in environmental and health hazards. At the time that this report was written, there had been over 4700 cholera cases and 88 deaths during the 2017-2018 epidemic in Lusaka (World Health Organization 2018). Historically, investments in drainage have been neglected; many residents dispose of their trash in drains rather than pay to have it collected by garbage services approved by the city. Poor sanitation, combined with clogged drainage systems that flood during the rainy season, contributes to annual outbreaks of water-borne diseases, including cholera, dysentery, and typhoid (Future Climate for Africa 2016; MWH Global n.d.), thus placing a heavy burden on the public health system. Floods also damage property, interfere with transportation routes, and force schools and small-scale businesses to close for long periods (Chisola 2012).

The Lusaka Water and Sewerage Company (LWSC) is responsible for the provision of water and sanitation services in Lusaka and for maintaining infrastructure assets associated with water and sanitation. LWSC's service area includes the entirety of Lusaka Province, including the city of Lusaka, Luangwa, Chilanga, Chongwe, Chirundu, Kafue, Rufunsa, and Shibuyunji. It is a privately managed company but is owned by each of the municipalities it services, including Lusaka City Council (LCC), the municipal authority for the city of Lusaka. LWSC provides water to residents through kiosks and piped water and collects revenues for this service according to an increasing block tariff schedule, in which higher rates are charged for increasing

levels of water consumption. The tariff schedule is approved by the National Water Supply and Sanitation Council (NWASCO), a regulatory body under the Zambia Ministry of Water Development, Sanitation and Environmental Protection. NWASCO also issues LWSC's license and ensures that LWSC meets guidelines for service, water quality, and other operational targets. In addition to NWASCO, LWSC is regulated by the Ministry of Health for water quality and by the Zambia Environmental Management Agency (ZEMA) for environmental protection (Japan International Cooperation Agency 2009 and http://www.nwasco.org.zm/index.php/regulated-sector/water-sector-overview).

The poor quality of water, sanitation, and drainage services in Lusaka is attributable largely to inadequate investment in infrastructure and inefficient institutional practices (Ashraf et al. 2017). As of 2013, more than half of LWSC's infrastructure was past its useful lifetime (LWSC 2013). LWSC has historically faced many operational constraints, including challenges with revenue collection (particularly from government facilities) and achieving cost recovery, inadequate monitoring capabilities, shortages of human resources, and insufficient training. Although these issues have been the focus of donor investments (World Bank 2015, 2016), before this project there had been little improvement—and even some deterioration—in such key indicators as the number of hours of water supply, staff costs, and maintenance cost coverage. Together, technical and commercial challenges have caused almost half (47 percent as of 2015) of Lusaka's water to become non-revenue water (NRW) (World Bank 2016) that eventually must be subsidized by paying customers or the government.

There are similar infrastructure and capacity concerns regarding sewers and drainage. Lusaka's sewer network currently covers only 30 percent of the city's area (World Bank 2015). Further, the Millennium Challenge Corporation's (MCC) preliminary scoping exercise of drainage systems in the city revealed several problems, including undersized drains, blockages from solid waste, siltation from lack of maintenance, constrained flow, and low velocities. LCC, which is responsible for the city's drainage network, faces several challenges relating to drainage infrastructure and maintenance. First, it does not have full financial autonomy to raise money through taxes, fees, or external donors (Future Climate for Africa 2016; Mulenga 2013). Moreover, the 2013 National Decentralization Policy has given LCC more responsibility for primary health care and education, thus broadening its workload, and insufficient funding contributes to its inability to recruit and retain highly skilled workers (Mulenga 2013).

To fulfill their mandates, both LWSC and LCC must improve the coverage and quality of the services they provide while simultaneously addressing existing financial and operational shortcomings. To complicate matters further, LWSC's efforts to expand services into new parts of the city are likely to exacerbate the utility's current financial and operational challenges, unless it can add enough high-income customers to cross-subsidize new low-income customers.

To address these challenges, in 2013 MCC invested $354 million in the Lusaka Water Supply Sanitation and Drainage (LWSSD) project. The project aimed to expand access to and improve the quality of water and sanitation service provision, and upgrade drainage services in Lusaka by rehabilitating and extending infrastructure and strengthening the institutional capacity of the LWSC and LCC.

II. OVERVIEW OF THE LWSSD PROJECT

In this chapter, we provide context for the planned evaluation. We begin by providing an overview of the LWSSD project, including 1) a description of the compact Development phase that preceded implementation; 2) summaries of the LWSSD project's two key activities—the Infrastructure Activity (InfrA) and the Institutional Strengthening Activity (ISA); 3) a description of outreach activities to households that were incorporated into the project after the compact Development phase had ended; and 4) an overview of the Innovation Grant Program (IGP), a mechanism for providing grants to local private sector organizations to provide products and services in line with the compact's goals. Next, we discuss the mechanisms through which project activities are expected to affect outcomes, as depicted in the updated project logic and reflected in the estimates of the project's predicted economic rate of return.

A. Overview of the project and implementation plan

1. Compact development

In 2011, as part of the first phase of the compact development process, Millennium Challenge Account–Zambia (MCA-Zambia) implemented a constraints analysis study to identify barriers to economic growth and poverty reduction. It performed the analysis to ensure that MCC investments are directed to produce positive economic growth impacts by addressing the most pressing constraints to growth. The constraints analysis identified three main binding constraints to economic growth: low quality of human capital, poor infrastructure services, and coordination failures. The analysis identified water and sanitation as part of both infrastructure and human capital constraints, but did not discuss drainage.

As the next step in developing a compact between MCC and the Government of Zambia, MCC commissioned the development of master plans for improving water supply, sanitation, and drainage in Lusaka (see Box II.1). These master plans laid the foundation for the LWSSD project and were intended to be used as the principal tools for prioritizing MCC's investments in Zambia.

The objectives of the **Water Supply Master Plan** were to evaluate the water supply in Lusaka Province, comprised of Lusaka, Kafue, Chongwe, and Luangwa Districts, and to identify projects that had the potential to: 1) promote equity of service provision and increase financial sustainability of LWSC in order to decrease the need for the government to subsidize the sector, and 2) support economic growth by ensuring that services are delivered to customers in a reliable and cost effective way. Gauff Ingenieure, subcontracted by the U.S. Army Corps of Engineers on behalf of MCA-Zambia, produced the report based on an assessment that they implemented in the last quarter of 2010. The assessments revealed that

Box II.1. Overview of master plans

Water Supply Master Plan: Recommends extending the distribution networks and storage capacity with the goals of providing 100 percent of the population access to safe water, increasing household connections from 32 percent to 80 percent of the population, and reducing NRW from 48 percent to 15 percent by 2035.

Sanitation Master Plan: Recommends expanding access to 100 percent of the population by 2035 by extending the existing sewer network to serve 50 percent of the population.

Drainage Investment Plan: Suggests decreasing flooding by building wells and pumps to improve drainage and increase capacity for primary outfall systems by upgrading the existing infrastructure and extending the outfall to the basin boundaries in priority areas.

60 percent of Lusaka's water supply came from ground water via 92 boreholes, and the remaining 40 percent came from the Kafue River via the Iolanda treatment plant. Additionally, 20 percent of the boreholes were out of commission at any given time due to disrepair. Various components of the Iolanda treatment plant were in disrepair at the time of the assessment. Only 60 percent of the Lusaka water storage capacity was functional due to disrepair of storage reservoirs. Distribution was challenging due to frequent bursting of pipes and low water pressure, leading to high water losses. Other water losses were attributed to illegal connection, unmetered consumption and leakages; Gauff found that total NRW was at 48 percent. Similar challenges were found in Congwe, Luangwa, and Kafue, which all suffered water shortages, low water pressure, dilapidated storage reservoirs, frequently bursting pipes, and illegal water connections. The authors recommended increasing design capacity, extending the distribution networks, and increasing storage capacity for the network, reducing NRW, and implementing a balance scorecard for LWSC. Gauff recommended reducing NRW by first implementing a consumer survey that would identify registered and unregistered customers and update the billing database and Geographic Information System; implementing bulk and consumer metering to ensure good water management; acquiring leak repair materials, tools, and equipment to improve leak detection; and performing pipeline replacement. Specifically, their recommendations aimed to reduce NRW in Lusaka Province from 48 percent to 25 percent by 2015, and to 15 percent by 2035; to provide 100 percent access to safe water in 2035; and to increase household connections from 32 percent to 80 percent of the population by 2035.

The first goal of the **Sanitation Master Plan**, prepared by Tetra Tech concurrently with the Water Supply Master Plan, was to achieve access to improved sanitation for 100 percent of the population in the Lusaka Province by 2035 by extending the existing sewer network to serve 50 percent of population (the remainder of the population will be served by improved onsite systems). The second goal of the Sanitation Master Plan was to consistently meet Zambia Environmental Management Agency and World Health Organization goals for agricultural reuse of water. This reported identified policies, existing sanitation infrastructure (the wastewater collection system, pump stations, wastewater treatment plants, and wastewater stabilization ponds), and onsite systems as the key constraints related to sanitation in the City of Lusaka. TetraTech proposed five types of projects for investment that aimed to address these constraints and achieve the aforementioned goals: 1) upgrading the collection system, 2) expanding the collection system, 3) upgrading the treatment plant, 4) expanding the treatment plan, and 5) onsite projects to improve the existing system or construct new systems.

The **Drainage Investment Plan** was produced by CH2M HILL and Rankin Engineering, after a visit to Lusaka in the last quarter of 2010 and focused on proposing interventions to improve solid waste management (SWM) and drainage infrastructure by identifying priority flooding areas, developing a drainage strategy, identifying specific improvements and implementation costs, and estimating investment risks and benefits. The residents of peri-urban areas where pit latrine use is common suffer negative effects on health, education, and productivity due to poor drainage, which leads to frequent flooding during the rainy season. Poor drainage also results in stagnant pools, which is can contribute to higher malaria rates.

To develop the master plan, the authors estimated the population of all of the city's districts and assessed cumulative seasonal rainfall and depth, soil types, and hydrogeology. The team found that flooding is caused by the combination of high groundwater levels and the lack of

surface water drainage infrastructure. In light of their findings, the authors recommended placing wells and pumps to improve drainage in priority areas; increasing capacity of primary outfall system by upgrading the existing infrastructure and extending the outfall to the basin boundaries; and using pumped groundwater as a potable water source for revenue for LWSC. The report recommended further feasibility studies on all of these issues and identified 18 specific projects, grouped into three investment packages based on the priority level of the project.

Out of the recommendations presented by CH2M HILL, the top priorities chosen by the project management committee for the feasibility phase were the improvements of the Bombay drain and the Kanyama/John Laing/Makeni drain, based on the projects' ability to fit within the time and budget constraints of the overall MCC compact with the Government of the Republic of Zambia. The project management committee chose to focus on improving the Bombay drain due to the social importance of this drain to Lusaka, despite the fact that it was identified as priority 15 out of 19 in the Drainage Investment Report. The Kanyama/John Liang/Mareni drain was ranked 1 out of 18 projects and was considered to have the largest potential to relieve flooding, particularly in the Southwest area of Lusaka.

The LWSSD project that came out of the master plans developed prior to the compact was comprised of two main activities: 1) InfrA and 2) ISA. Both activities entail support to LWSC and LCC. We describe both activities in more detail in the following sub-sections.

2. The Infrastructure Activity (InfrA)

InfrA accounted for the majority of MCC's investment ($283.8 million) and aimed to address several of the water, sanitation, and drainage infrastructure recommendations specified in the Water Supply Investment Master Plan, Sanitation Master Plan, and Drainage Investment Plan. The activity included components to rehabilitate the core water network, extend and rehabilitate water and sewer networks in residential areas, rehabilitate the Kaunda Square wastewater stabilization ponds, reduce physical NRW losses, and improve the Bombay and Mazyopa drains. In addition, the activity included the Resettlement Action Plan, which was dedicated to resettlement and livelihood restoration to individuals who were negatively impacted by the project.

The construction components of InfrA were split into nine construction packages (CPs), described below and summarized in Table II.1.

- CP 1 and 2 rehabilitated and upgraded core water network infrastructure, including the Iolanda treatment plant, and distribution centers and core network pipes in Lusaka. As discussed in the Water Supply Investment Master Plan, these investments are necessary to improve the quality of water that reaches all Lusaka residents, including those in neighborhoods targeted by the intervention.
- The primary intention of CP 3 and CP 5 was to improve and increase water and sewerage services for underserved peri-urban neighborhoods by extending and rehabilitating water and sewer networks in these neighborhoods. However, since new connections in these neighborhoods may have operating costs in excess of revenues, CP 5 additionally extended water services in middle-class neighborhoods—such as Kwamwena and Ndeke-Viorna

Valley—to cross-subsidize extensions in poorer neighborhoods so that these CPs remain financially sustainable for LWSC.[1]

- CP4 rehabilitated the Kaunda Square wastewater stabilization ponds in accordance with the recommendations in the Lusaka Sanitation Master Plan.
- CP 6 implemented recommendations in the Water Supply Investment Master Plan to reduce NRW. NRW consists of three components: real losses, apparent losses, and unbilled authorized consumption. Real losses consist of various types of leaks including leaks on transmission and distribution mains, leakage overflow at storage tanks, and leaks at service connection points. Apparent losses consist of losses arising from consumption that is not billed at the intended rate. It includes unauthorized consumption, including theft and illegal connections; customer metering inaccuracies caused by faulty water meters, intentional and unintentional misreporting by meter readers, and unmetered billed customers who are billed a flat rate for unlimited water use; and systematic data handling errors such as customers who are omitted from the billing system. In Lusaka, a key source of unbilled authorized consumption has historically been government employees who consumed water but were not billed for their consumption due to political arrangements and precedent. CP 6 focused on reducing real losses by replacing potentially leaky main pipes and pipes to connect households to the water network. In addition, to address losses through faulty water meters and unmetered consumption, CP 6 included the installation of new water meters and the replacement of water meters in areas where they are likely to be faulty.
- CP 7, 8, 9, and 10 were intended to reduce flooding by improving drainage infrastructure in Lusaka, following the guidance of the Lusaka Drainage Investment Plan. CP 7, 8, and 10 expanded and reinforced the Bombay and Mazyopa drains, including the construction of a trash trap near the end of the Mazyopa drain. CP 9 was canceled early in the compact implementation.

To date, work on InfrA is ongoing. Only CPs 4, 5, and 10 have been completed. Delays on CPs 3 and 6 prompted MCA-Z to terminate those contracts with Elevolution in May of 2018. After a second procurement, in August 2018 MCA-Z contracted with UNIK to complete those two CPs within a year. Funding for the works after the end of the compact in November 2018 comes from the Government of Zambia.[2] The Government of Zambia established the Millennium Project Completion Agency (MPCA) as the successor entity to MCA-Z, responsible for overseeing the completion of the remaining works contracts activities after MCA-Z closes at the end of March 2019.

[1] Lusaka has an increasing block tariff schedule, in which higher rates are charged for increasing levels of water consumption. It is anticipated that the relatively poor residents of peri-urban neighborhoods will consume lower volumes of water that may not cover the costs of water provision, while residents in middle-class neighborhoods will consume higher volumes of water and produce revenues for LWSC in excess of costs.

[2] One of the initial conditions precedents under the compact required the Government of Zambia to set aside funding to ensure the sustainability of the infrastructure.

Table II.1. Summary of infrastructure activity construction packages

Construction package ("CP")	Contractor	Description	Status
CP 1 & 2	Denys	Core water network rehabilitation, including complete overhaul of the Iolanda treatment plant plus refurbishing reservoirs and core network pipes in the city	The works are currently being commissioned. Everything should be handed over to LWSC by April 2019.
CP 3	Elevolution (replaced by UNIK)	Rehabilitation and extension of water and sewer networks, including household connections for extension work, in Mtendere; water connections in Kamanga and other areas of Chelston	Elevolution's contract was terminated in May 2018 due to poor performance, and MCA-Z contracted with UNIK in August 2018 to complete the works within a year.
CP 4	Mota Engil	Rehabilitation of Kaunda square wastewater stabilization ponds	CP 4 was completed and turned over to LWSC at the end of 2017.
CP 5	UNIK	Rehabilitation and extension of water network in Kwamwena, Ndeke-Viorna Valley, Chipata, Ngombe, and SOS Village	CP 5 was completed and turned over to LWSC before the compact ended.
CP 6	Elevolution (replaced by UNIK)	Construction to reduce NRW, including replacement and installation of: • Main pipes and service pipes • Water meters • Pipes to connect households to the water network Establishment of district metering areas	Elevolution's contract was terminated in May 2018 due to poor performance, and MCA-Z contracted with UNIK in August 2018 to complete the works within a year.
CP 7 & 8	CMC	Bombay drain improvements	There is still some work to be done to connect side drains; complete bridges, fences, and plantings; seal gaps. Work is expected to be completed by May 2019.
CP 9			**[CANCELLED]** CP 9 was also intended to improve drainage but was canceled early in the implementation of the compact.
CP 10	Gabriel Couto (firm)	Mazyopa drain improvements, including the Mazyopa trash trap	CP 10 was completed and turned over to LCC before the end of the compact.

Multiple entities were involved in construction oversight:

- MWH was contracted by MCC as the independent engineering firm to help oversee construction as well as the technical assistance activities described in the next section.
- SMEC was contracted by MCA-Z to provide program management services. In this role, SMEC focuses on monitoring construction progress across all CPs and tracking issues that could expose MCA-Z to risks and challenges to completing the planned work by the compact end date.

- UWP was the construction supervising engineering firm for all CPs other than CP 6, contracted by MCA-Z. UWP's team of over 70 staff were physically present at construction sites to ensure safety and compliance.
- Seureca was the construction supervising engineering firm for CP 6, contracted by MCA-Z for a role very similar to UWP's but on a much smaller scale for just the single CP that is related to the NRW TA they provide to LWSC (see next section).

At the completion of the compact, all of the new water and sanitation assets were handed over to LWSC and drainage assets to LCC. The handover process included the provision and maintenance manuals developed by Gauff and training to LWSC and LCC staff on operations by the contractor for each CP.

LWSSD's construction projects cut through areas where Lusaka residents lived and worked, disrupting some people's property and livelihoods. The goal of the **Resettlement Action Plan** was to compensate or resettle project-affected persons (PAPs) who were physically displaced (relocated or lost shelter), economically displaced (lost assets or means of income generation), or lost access to water supply or sanitation facilities as a result of the project. Tetratech was responsible for identifying and categorizing PAPs by need and also coordinating payments. Approximately 4,000 PAPs were identified and $6.7 million USD was awarded in compensation. Those who 1) lost their livelihoods, 2) were perceived to be vulnerable, and 3) relied on agriculture-based income sources were eligible to enroll in the **Livelihood Restoration Program** (LRP), designed to assist them with finding new lines of work by providing self-analysis, financial and business management training, and intensive technical training. LRP was implemented by Cardno, and served 86 individuals affected by the CP 4 and CP 10 project activities in Kaunda Square and Mazyopa. The program accepted two cohorts of enrollees. The first cohort started the program in July 2016 and concluded in October 2017, and the second cohort started in July 2017 and concluded in the fall of 2018.

3. The Institutional Strengthening Activity (ISA)

ISA was the second main activity of LWSSD ($26.7 million), complementing investments in infrastructure by supporting technical assistance (TA) to both LWSC and LCC to improve their financial sustainability, operational management, and responsiveness to poor and disadvantaged customers. Table II.2 summarizes these components of ISA. As implementation evolved, ISA also ended up including outreach to households as an extension of TA activities to LWSC and LCC. Although the IGP was originally conceived as part of ISA, it was not integrated with TA activities so we discuss it separately in Section II.A.4.

Table II.2. Summary of TA components of the institutional strengthening activity

Project component	Consultants	Description
TA to LWSC		
NRW reduction	Seureca-NRW team	Included a census of properties to update the customer database.
Asset management	Seureca-asset management team	Included creation of an asset registry and improvements to software to facilitate more pro-active maintenance. The TA was intended to help ensure compliance with the international standard ISO 55 000.
Environmental management	• LabWare: provide, install, and customize laboratory information management software (LIMS) • Spectro Blue: provide an inductively coupled plasma mass spectrometer, training, and one year of maintenance	Included the purchase of an ICP spectrometer and database software that allows measurements to be shared between labs. It also included related training and handover activities.
SIGM, IEC, and SM	Cowater International and GOPA Infra Consulting	At LWSC, the recipients were: • the gender committee • the IEC/SM technical group • the commercial director • the HR director • the director of planning and development
TA to LCC		
Environmental management (institutional capacity building on drainage maintenance and SWM)	Seureca - drainage and SWM team	• Consisted of 3 tasks: 1. Institutional strengthening and capacity analysis of LCC for drainage and solid waste 2. Implementation of recommendations at LCC 3. Stormwater management master plan Solid waste management functions were moved to a new utility that was created under the compact. LCC continues to be responsible for drainage.
SIGM and IEC [a]	Cowater International and GOPA Infra Consulting	At LCC, intended recipients were: • the gender committee (or "technical working group"), • social economist planners • unspecified directors

[a] In contrast to LWSC, TA to LCC only included SIGM and IEC, and not SM.

a. TA to LWSC

As described in Table II.2, TA to LWSC aimed to improve institutional capacity along four dimensions that were each addressed by distinct consultant teams. The four dimensions are discussed below, and are as follows: 1) NRW reduction; 2) asset management; 3) environmental management; and 4) social inclusion and gender mainstreaming (SIGM); information, education, and communication (IEC); and sanitation marketing (SM).

- Seureca is provided TA to LWSC to improve the utility's institutional capacity for **NRW reduction**. Seureca's main NRW reduction activity was updating LWSC's customer database to decrease commercial losses. To do this, Seureca conducted a census of 160,000 properties throughout Lusaka to update the database with information on: connection status, meter presence and functionality, whether the property is being billed, and location information about the property such as address, account number, plot number and water meter number. This census information was integrated with the LWSC billing database. Seureca also tested the maintenance state of water meters, as many prove to be faulty or in disrepair. Additionally, they trained LWSC staff to conduct these activities in the future—helping to establish maintenance practices—and a separate LWSC team in in leak detection and flow measurement.
- A separate Seureca team provided LWSC with institutional capacity for **asset management** to improve short- and long-term value generation from its assets and to strengthen LWSC asset management practices to international standards. Prior to the compact, LWSC lacked a system for identifying which assets need maintenance and when. As a result, LWSC was only able to react to issues when major failures occur, and was unable to conduct financially sustainable preventative maintenance. This caused greater financial losses to the company and unreliable service provision and inconvenience to the population. Additionally, LWSC was unable to identify priorities for capital expenditures that pose challenges to donor investment, a main source of revenue for the company.

  In order to mitigate these issues, the asset management TA offered a variety of services. Seureca was charged with creating an inventory of assets, which includes asset value and maintenance activity timing, and leveraging the EDAMs system for customer billing. This new system was supported by classroom training, workshops and training manuals for staff who use the system. At least five LWSC staff completed the Institute of Asset Management training. Seureca also provided quality control and access control to improve quality of data in system, as well as adding engineering drawings and testing information to the system. The goal of the asset management TA was to develop LWSC's capacity to implement standards in line with ISO 55,000.[3] To reach this goal, Seureca suggested that LWSC adopt a revised asset management policy, create a new asset management team composed of existing staff, as well as work with NWASCO to help them adopt asset management indicators when regulating utilities – to help induce LWSC to maintain its assets. Seureca anticipated that working with the Ministry of Water Development, Sanitation, and Environment would create accountability at LWSC.

  Strong asset management is particularly important in context of the large influx of new assets from LWSSD, the Lusaka Sanitation Programme (LSP), and the Kafue Bulk project. LSP is a five-year program that aims to improve sanitation infrastructure in Lusaka and is based on the sanitation master plan designed as part of LWSSD. It comprises a total investment of 240M euros from four donors: the European Investment Bank (EIB), the KfW Development Bank (KfW), the African Development Bank (AfDB), and the World Bank (WB). The Kafue Bulk Water Supply project is a $150M investment undertaken by the

[3] The ISO 55000 establishes global asset management standards to help organizations achieve their objectives via efficient asset management. (ISO, 2014)

Government of Zambia using a loan from the EXIM (Export-Import) Bank of China to extract, treat, and pipe to Lusaka an additional 50M cubic meters of water per day from the Kafue river. Water supplied through the project may increase the load of core distribution network assets being rehabilitated under LWSSD's CP 1 and CP 2 investments, and could affect the outcomes of households that are potential beneficiaries of LWSSD. In addition, both LWSSD and the Kafue Bulk Water Supply project will increase the rate of water extraction from the Kafue River, potentially impacting water levels and the sustainability of the river as a source of water.

- **Environmental management** was provided to LWSC by Spectro Blue which purchased an inductively coupled plasma mass spectrometer for testing water quality, effluent levels and sludge for agricultural sale, together with appropriate training and maintenance for the equipment. Additionally, a second TA provider, LabWare, installed a customized laboratory information management software known as LIMS to help manage and link data form spectrometers across three labs located in Iolanda, Manchinchi, and Libala. Spectro Blue also provided training to 10 staff, including 3 administrators, on how to use the equipment and database. The main goal of the environmental TA component was to increase monitoring of toxins in the water and ultimately, to reduce toxicity of water. Additionally, LWSC could potentially use the spectrometer as a revenue source by testing samples for other utilities.
- The final piece of TA to LWSC was on **SIGM, IEC, and SM,** all of which were contracted to Cowater International and GOPA Infra Consulting. Cowater worked on improving the capacity of members of the gender and IEC committees at LWSC to provide customer care and outreach to households and to be responsive to the needs of women and poorer households. Cowater helped to create two appointed permanent positions for IEC and gender and trained two LWSC staff who are on the existing committees. Additionally, Cowater worked with LWSC to create policies and tools related to SIGM and IEC, designing flexible payment options for households connecting to infrastructure, exploring text message reminder systems for bill payment, and discussing with other stakeholders the possibility of providing subsidies to help facilitate access to services for the poor that could be incorporated into the tariff structure. By strengthening LWSC's capacity to develop gender responsive policies and structures to enhance the organization's ability to provide appropriate, affordable, and sustainable water supply and sanitation, the goal was to promote behavior change and uptake of services and care for infrastructure. Although TA was targeted to particular recipients in LWSC, the intention was for SIGM, IEC, and SM to be institutionalized across the whole organization.

Restructuring of LWSC (supported by LSP) was a key risk for this component of the TA to LWSC. The restructuring consultant was provided with Cowater's recommendations, but was not very responsive to them or interactive with Cowater. Additionally, LWSC staff who were trained may leave the company after restructuring, or may be in different roles.

b. TA to LCC

The TA to LCC included an environmental management component, provided by Seureca, as well as SIGM and IEC, provided by Cowater. The environmental management TA entailed institutional capacity building on drainage maintenance and SWM and creation of a master plan

for storm water management. Additionally, MCA procured drainage maintenance equipment for LCC.

One of Seureca's first activities as part of the environmental management TA to LCC was to assess the organization's capacity to manage solid waste and maintain drains. This prompted the creation of a framework for a new SWM utility since the analysis found that LCC did not have sufficient capacity to manage solid waste, nor was it interested in playing a more active role in regulating existing service providers including Community Based Enterprises (CBEs) and franchisees. One consequence of LCC's minimal engagement on SWM was that the former landfill had become a dumpsite, spurring discussions with the Danish International Development Agency to fund the establishment of a new functional landfill and to secure dedicated funding for SWM. At the same time, LCC and other stakeholders agreed that drain maintenance should remain under LCC's purview, so as part of the environmental management TA Seureca supported the creation of a new drain maintenance unit within LCC, since the new drains were a different type of infrastructure than the rest of the drainage system in the city, and required new approaches to maintenance. At the time of writing, the new drain maintenance unit is still in the process of being established, so MPCA will take over from MCA-Z to continue providing support for this process.

Establishment of the new SWM utility required that the National Assembly pass a law, which only happened during the last days of the compact. Leading up to that, existing LCC employees who were expected to be moved to the new utility attended trainings to prepare them for their new roles, including sessions on management of dump sites and safe disposal, health and safety information, epidemiological information about chemicals at the dump sites, and asset management and financial training. In the post-compact period, MPCA will continue to work with Seureca to provide support to the new utility.

Lastly, Cowater International and GOPA Infra Consulting provided SIGM and IEC TA (but not SM) to LCC, including setting up SIGM and IEC technical working groups and working with members of these groups and with directors at LCC to provide training. Cowater tailored the SIGM and IEC TA to focus on SWM and drainage maintenance. IEC training involved messaging on the safety of residents along drains, discouraging the dumping of rubbish in drains, and discouraging vandalism, among other things. As with the TA to LWSC, by strengthening LCC's capacity to develop gender responsive policies and structures to enhance the organization's ability to provide appropriate, affordable, and sustainable drainage services, the goal was to promote behavior change and uptake of services and care for infrastructure. Although TA was targeted to particular recipients in LCC, the intention was for SIGM and IEC, to be institutionalized across the whole organization.

c. Outreach to households

Originally, the TA was intended to enable LWSC and LCC to implement IEC and SM outreach in the neighborhoods where infrastructure projects were underway, with the goal of creating positive behavior change and uptake of new infrastructure. However, because construction progress got ahead of the TA, MCC and MCA-Z decided to engage Cowater on a second contract to lead IEC and SM implementation activities since LWSC and LCC were not yet prepared to do the outreach themselves. The IEC plan was developed by Water and

Sanitation for the Urban Poor, and implemented by the Cowater/Gopa Infra TA team in collaboration with the CP contractors, LWSC, and LCC. Cowater trained a cadre of community mobilizers to educate residents about the benefits of sanitation and water connections; and provide information on toilet maintenance, construction-related safety, and the hazards of disposing of solid waste in drains. These efforts focused on poorer residents, and relied on door-to-door visits, billboards, community meetings, and radio shows. Cowater has also established an office in Mtendere to help encourage connections to the sanitation network in this area.

Box II.2. Entities involved in outreach to households

Cowater: Provided water and sanitation education, including maintenance, safety, and the benefits to connecting. Focus on areas with new water and sanitation connections.

SCAP: An initiative to encourage and assist residents in connecting to sanitation. Focus on areas with new sanitation connections.

InfrA contractors: Provided safety information. Focus on all areas where LWSSD construction occurred.

Cowater's outreach related to sanitation connections fell under an initiative called the Sanitation Connection Action Plan (SCAP). SCAP is a partnership between MCA-Z and the Government of Zambia that aims to make sure that at least 80 percent of the properties in Mtendere are connected to the new sewer system by sensitizing residents to the benefits of sanitation, informing residents of their obligation to connect to nearby sanitation lines under the Public Health Act, providing financial planning knowledge to residents regarding bill payment, training toilet construction teams, providing toilet purchase options to households, and providing financial assistance to households to purchase toilets. These activities were designed and implemented by a consortium of organizations that included Cowater, MCA-Z, and others. SCAP activities were funded through LWSSD and other sources, and are being continued by LWSC since the compact ended. LWSSD's involvement in SCAP implementation includes not only Cowater's IEC and SM activities, but also those of People's Process on Housing and Poverty in Zambia (PPHPZ), an IGP grantee that conducts community sensitization, construction team training, toilet design and provision, and toilet loan provision.

In addition to Cowater's safety messaging, LWSSD construction contractors also provided safety information to residents in the neighborhoods in which they work. For example, Elevolution and UNIK, the contractors implementing network extensions in CP 3 and CP 5 neighborhoods, provide safety information to residents in these neighborhoods, including advice on the locations of new toilet facilities and inspection chambers.[4]

4. The Innovation Grant Program (IGP)

The IGP awarded $5 million USD in grants to local private sector organizations in Lusaka to implement innovative projects on water supply, sanitation, and drainage aimed at improving the quality of life in project communities, which will complement the improved infrastructure. Specifically, organizations were encouraged to propose projects that improve water use, sanitation and hygiene; reduce blockage of sewer and drainage systems; expand opportunities for

[4] Inspection chambers are underground chambers accessed by manholes that are located on each property connected to the sanitation network. They are used to examine the area where sanitary service lines from the street connect to lines within each property.

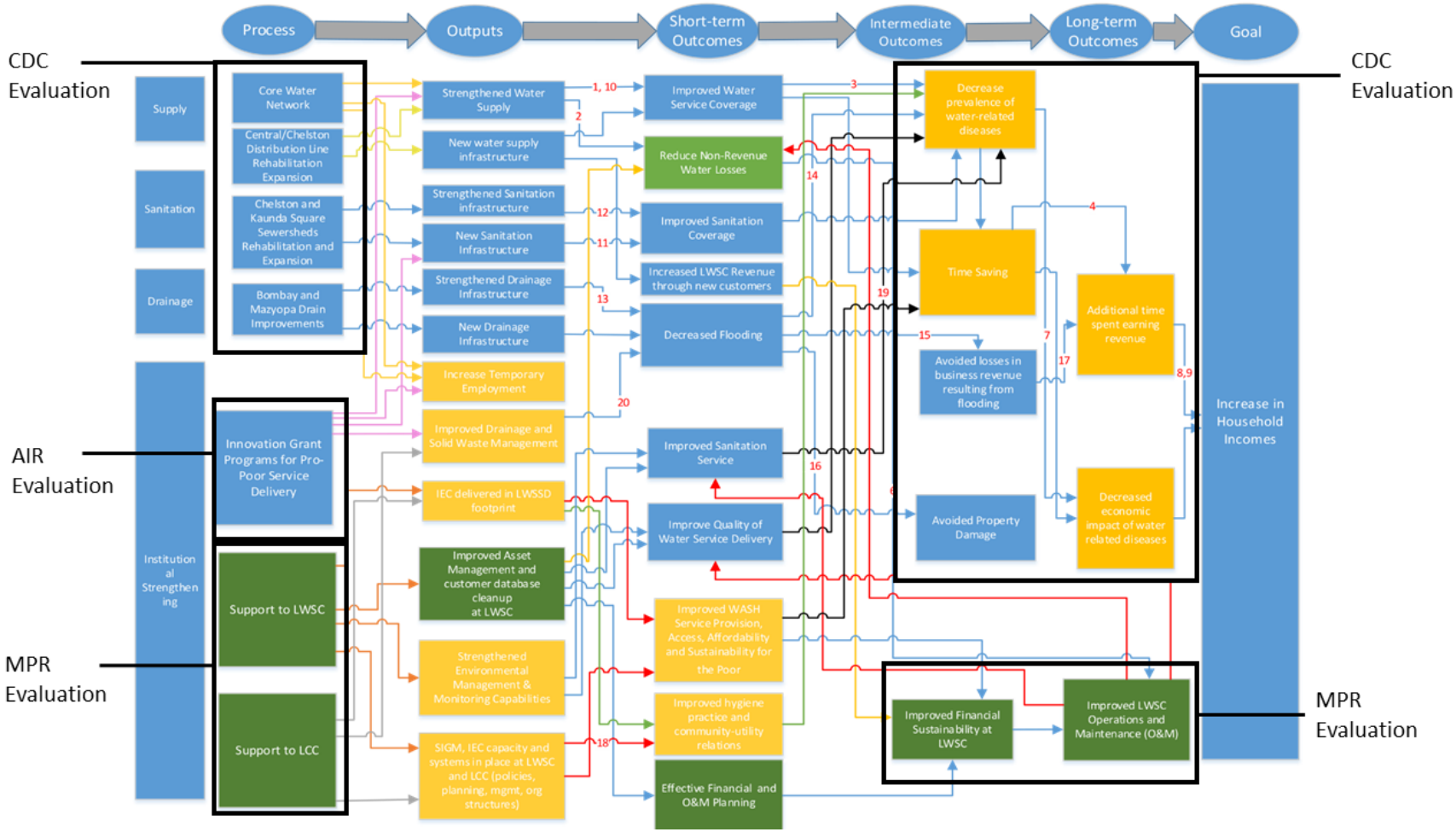
entrepreneurship and income generation activities related to water supply, sanitation, solid waste management and drainage; and ensure access for women and vulnerable groups. Five projects were awarded in October 2015 for the first round of applications; nine additional projects were approved in February 2017 for the second round. The funded programs involved the installation of biolatrines, drilling boreholes, community mobilization and sensitization to sanitation, collection of solid waste, and recycling plastic waste into durable construction materials and furniture, among other activities.

B. Theory of change and LWSSD evaluations

1. MCC's project-wide theory of change

The LWSSD project's objective is to "expand access to, and improve the reliability of, water supply and sanitation, and improve drainage services in select urban and peri-urban areas of the city of Lusaka in order to decrease the incidence of water-borne and water-related diseases, generate time savings for households and businesses and reduce NRW in the water supply network." As shown in Figure II.1, the project's four InfrA sub-activities and the three ISA sub-activities of ISA were designed to be synergistic with a set of changes in institutional practices at LWSC and LCC that would lead to new and strengthened water, sanitation, and drainage infrastructure and service provision. Among the short-term outcomes, the project is expected to lead to improved coverage of, and quality of, water and sanitation services, particularly for the poor; reductions in NRW and increased revenue for LWSC; effective planning by LWSC and LCC related to finances, operations, and maintenance as well as improved community relations; and reduced flooding. Ultimately, households are expected to benefit from decreased prevalence of water-related diseases, time savings, and avoided property damage from floods, while businesses avoid losses in revenue from flooding, and LWSC become financially sustainable. Finally, the health benefits and additional time spent earning revenue contribute to the project's goal of increasing household income.

Figure II.1. LWSSD compact logic and evaluation scopes



Source: MCA-Z 2017

Notes: The numbers on arrows in the diagram are taken from the diagram in MCA-Z's monitoring and evaluation plan, and refer to assumptions underlying the logic model. We refer to these numbers later when discussing the assumptions underlying causal links in the diagram. According to MCC, the colors of boxes and arrows were only meant to improve the readability of this complex diagram.

2. LWSSD evaluation portfolio

As shown in Figure II.1, this evaluation will complement an impact evaluation of the time savings and health benefits generated by the LWSSD project. The impact evaluation is being conducted by the CDC and focuses on the combined effects of CPs 1, 2, 3, and 5 in the neighborhoods served by CPs 3 and 5. Our evaluation is primarily a mixed-methods performance evaluation to measure the effectiveness of the LWSSD as a whole, with an emphasis on ISA's effects on the physical sustainability of the infrastructure and the financial sustainability of LWSC, LCC's new drain maintenance unit, and the new SWM as outcomes of the TA. Our proposed performance evaluation will address outcomes that are not suitable for impact evaluation and will add context to the impact evaluation by helping MCC understand what was implemented, how and why these results occurred, and whether they are likely to be sustained.

MCC has also commissioned a performance evaluation of the IGP which is being conducted by the American Institutes for Research (AIR) and a study monitoring water quality in LWSC's distribution system which is being done by CDC. In addition, MCA-Z contracted with IDInsight to conduct a formative evaluation of SCAP. Whenever possible, we will use data from the other LWSSD evaluations as discussed below. Due to the synergies between project activities, it is not possible to attribute outputs and short-term outcomes to specific activities, even though the scopes of the evaluations are well defined in terms of which activities each evaluator focuses on, and which intermediate and long-term outcomes fall under the impact evaluation and the performance evaluation.

CDC evaluation of household outcomes and water quality. The CDC is conducting a multi-component impact evaluation that focuses on health outcomes and improved water quality. Table II.3 lists the high-level research questions the CDC evaluation will address.[5]

To evaluate the impact of interventions to extend water supply and sanitation networks to residential areas, they will compare pre and post outcome measures in both intervention and comparison areas using household survey data collected in 2015-2016 and a second round planned for 2019-2020. Comparison areas are peri-urban areas that are similar to intervention areas with respect to water and sanitation characteristics, but that are not receiving any interventions.

The CDC's baseline survey also included testing household water for free chlorine residual, pH, turbidity, conductivity, temperature, pressure, total coliforms, E. coli, and nitrates. After the baseline, the CDC set up routine water quality monitoring at multiple points purposively sampled throughout LWSC's distribution network. Water quality measures provide indicators of results upstream in the program logic from the health indicators measured in the household survey.

[5] CDC's evaluation was initially expected to also estimate impact of the drainage intervention on households and businesses in central Lusaka, using data from a traffic observation study and surveys of households and businesses in the areas served by the new drains. The CDC team initially planned to use pre-post comparisons with no comparison group, as they were unable to identify a suitable comparison group. However, MCC reassessed evaluation priorities for the Zambia compact and determined that a re-scoping was necessary to put resources towards assessing key results of the interventions rather than conducting a follow-up round of the drainage evaluation.

Table II.3. CDC impact evaluation research questions

Research Questions	Key Indicators
Health	
What are the health benefits attributable to each type of compact activity?	• Incidence of waterborne disease • Access to improved sanitation • Household garbage disposal • Percent of people practicing safe hygiene
Safe water supply/consumption	
What are the current consumption rates of safe versus un-safe water consumption and usage? Do compact activities lead to an increase in safe water consumption?	• Access to improved water supply • Residential water consumption • Continuity of service
Economic and Social	
Do households experience an increase in income due to compact activities? Are households able to afford household connections, toilets, and water bills? Were subsidy provisions adequate for sanitation connections? What is the probability of finding work for beneficiaries? What are the time and cost savings/use attributable to each compact activity?	• Average household income • Time spent gathering water

Note: Research questions and indicators are based on the CDC's Evaluation Design Report. Some aspects of their research plan may evolve over time.

AIR evaluation of the IGP. AIR conducted a performance evaluation of the IGP that focused on the grant facility's implementation, stakeholder perceptions of the program, and relation to other components of the compact. The evaluation covered two grant cycles: the first ran from summer 2015 through fall 2016 and the second launched in early 2017 and finished in the fall of 2018. AIR described the five phases of IGP implementation for each of the two grant cycles: start-up, selection, implementing the award, completing the award, and revising the process. The evaluation used a mixed methods approach, relying on qualitative data from in-depth interviews and small focus group discussions with stakeholders and quantitative data from a survey of proposal workshop participants as well as monitoring data and cost information collected by the IGP manager.

IDinsight evaluation of the SCAP. The primary objective of IDinsight's evaluation was to refine the sanitation interventions in Mtendere to help MCA achieve its SCAP objective. IDinsight's evaluation included:

- Describing socio-economic and demographic characteristics of property owners connecting to the system
- Informing sanitation marketing and IEC plans
- Exploring the potential for financing mechanisms to motivate property owners to invest in toilets, and the potential for targeting the poorest of the poor for cost-sharing schemes

- Determining the potential effectiveness of enforcement of the Public Health Act[6]

IDinsight used both quantitative and qualitative data. Between August-October 2017, IDinsight conducted a survey of 744 households (340 tenants and 404 property owners/landlords), including observation of property location and characteristics, as well as 84 semi-structured interviews and 20 key informant interviews with community mobilizers, loan recipients, and households that ended up declining a loan. They also used SCAP connection monitoring data and 2016 Census data collected by MCA-Zambia for details on household income.

C. Economic rate of return and beneficiary analysis

1. Review of the ERR model

MCC uses the economic rate of return (ERR) to assess whether its projects are sound investments. The ERR is the discount rate at which the benefits of a project are exactly equal to its costs; a higher ERR implies relatively higher benefits and lower costs. Prior to the compact, MCC developed an ERR model for the LWSSD project based on five benefit streams: (1) time savings from water supply and drainage improvements, (2) health benefits, including reduced incidence of disease and stunting, (3) LWSC revenue benefits from a reduction in NRW, (4) avoided property damages due to reduced flooding, and (5) avoided loss in value added due to reduced flooding.

Time savings account for the vast majority (88 percent) of the benefits in the ERR, and 92 percent of the time savings benefits are due to the water supply project. Health benefits account for only 6 percent of total benefits, with water supply and drainage each accounting for approximately 40 percent of the health benefits and sanitation playing a smaller role. NRW reduction benefits are fairly small, accounting for just 4 percent of the total, and benefits from avoided property damages and loss in value added are even smaller. In table II.4 we summarize the key assumptions underlying each benefit stream and note the risks to the ERR that stem from these assumptions.

[6] IDinsight's evaluation was originally intended to include more testing of different options for SM, IEC, and financing mechanisms, but construction delays did not leave enough time for these activities prior to the end of the compact (and thus IDinsight's contract from MCA).

Table II.4. Assumptions and risks underlying ERR benefit stream estimates

Benefit stream components	Assumptions underlying estimates	Risks to assumption validity
All streams		
Number of beneficiaries served	• Project components each serve the number of beneficiaries originally anticipated.	• If the project fails to reach the expected number of beneficiaries, benefits would be smaller than estimated in the ERR.
Timing of costs and benefits	• Benefits and costs are assumed to occur within a certain timeframe, which affects their present value.	• Benefits and costs could occur on a different timeframe, particularly if there are delays in implementation.
Value of time savings from water supply and drainage improvements		
Time saved by increasing access to kiosks and the piped water network	• The ERR assumed 16,790 households who formerly had no service would get connected to the piped network. • New household connections will require no time waiting for water. Improvements in the kiosk will reduce waiting time by approximately 9 percent. • "No access" households are walking an average of 51 minutes to gather water, based on survey data that found this to be the average distance to a clean source. The ERR assumed that households spend over 3.5 hours per day collecting water.	• The ERR's assumption about the number of households who will get connected to the piped water network is far above the number of non-connected households who live in Mtendere and the poor neighborhoods in CP5 areas. Moreover, almost all of the relatively affluent households who get connected to the piped network in CP5 previously had their own borehole and pump, so were not spending time collecting water. • No evidence has been cited for the waiting time assumptions. If in-home connections are not perfectly reliable and households do have to wait for water sometimes, the ERR would over-estimate the benefits of the project. • If "no access" households were instead accessing dirty water closer to their homes, the ERR would over-estimate the time savings for these households (but these households would experience health benefits by switching to cleaner water).
Travel time saved from reduced flooding	• The city will experience less flooding due to improvements in drainage, which will reduce time lost in traffic (assumed to be twice as long during a flood) • Calculations are based on probabilities of floods of different intensities and assumptions about how much time is lost in traffic for different levels of flooding.	• No evidence has been cited for the assumptions about time spent in traffic due to flooding. According to CDC's baseline survey data, the benefits of drainage might have been grossly overestimated at baseline. That said, it is worth noting that it is also possible that CDC's data collection methods were not able to capture the full range of benefits attributable to reduced flooding.

TABLE II.4 (*continued*)

Benefit stream components	Assumptions underlying estimates	Risks to assumption validity
Value of time (also included in health benefits below)	• Time saved will be diverted into wage earning. • The value of time is based on wages for working women in Lusaka.	• In fact, people may divert the time saved into leisure or school work. • The value of time should reflect who in the household is collecting water / stuck in traffic due to flooding, since the value of time would vary by age and employment status (the value of time for people stuck in traffic is likely much higher than the value of time for those collecting water but the ERR assumes the same value for both types of people).
Health benefits		
Reductions in disease incidence (infectious diarrhea, intestinal nematodes, malaria, lymphatic filariasis, and schistosomiasis) and stunting	• There will be reductions in the disability-adjusted life years lost to infectious diarrhea, intestinal nematodes, malaria, lymphatic filariasis, and schistosomiasis. • The reduction in diarrhea is also expected to reduce stunting (based on an assumption that 47 percent of diarrhea cases result in stunting). The reduction in stunting creates returns to education and earnings.	• It is not clear whether the LWSSD project or the local context resembles that of the projects used as the basis for estimated health benefits. • The relationship between diarrhea and stunting is not well understood since there are multiple confounding factors. Assuming that 47 percent of diarrhea cases result in stunting is likely too high, and would overstate this benefit stream in the ERR. • Disability-adjusted life years are valued according to the same value of time, with the same risks to validity described above.
LWSC revenue benefits from a reduction in NRW		
Reduced NRW	• Commercial NRW losses are a social transfer from the utility to the non-paying water user – and are therefore not a source of returns.	• This implies that the value of water is equal for LWSC and nonpaying water users, which may not be the case. • Assigning value to the reduction in commercial NRW losses could increase the estimated benefit of the project substantially.

In addition to assessing whether the ERR's assumptions are substantiated, it is also worth considering whether the ERR includes all relevant benefit streams, since ideally the evaluation would incorporate data collection to allow the addition of any benefit streams that were not foreseen when the ERR was created. Through close review of the ERR model and initial conversations with MCA-Z staff who were involved in the development of the compact, we have identified three potential benefit streams that are not included in the ERR but which influenced the design of the LWSSD project and therefore might be worth including in a post-compact ERR:

- **Prevention of catastrophic failure at Kafue river intake and/or distribution system** (CP1 and 2). The main motivation for CP1 and 2 was to prevent catastrophic failure of the Kafue river intake (which supplies 40 percent of the city's water) and distribution system, since much of this infrastructure was well past its expected lifetime. That sort of catastrophic failure could have major economic costs and the benefit of averting these costs is not included in the ERR. In this case, it is not clear what the appropriate counterfactual for the LWSSD project is. It would be relatively straightforward to augment the ERR to include a probability of system failure, but there is still a question of whether another donor would have stepped in to replace broken parts and end a catastrophe. In the absence of the compact, it is very likely that some other donor would have intervened, in which case it could be assumed that CP1 and 2 did not generate any economic return by preventing a catastrophe (since someone else would have done the same thing the project did). On the other hand, CP1 and 2 turned out to be extremely ambitious and relatively lengthy projects, so it seems reasonable to assume that in the case of some sort of catastrophic failure, the city would have been without the water from Kafue for an extended period (perhaps not as long as it has taken to complete CP1 and 2, since temporary solutions to specific issues might have been possible, but such an approach would not prevent other elements from failing in a similar fashion, causing other outages). To the extent that a catastrophic failure at the Kafue intake or somewhere else in the distribution system could have left a large share of Lusaka's households and businesses without water temporarily (even if another donor stepped in to fund an emergency fix), for the post-compact ERR we might want to consider the benefits of preventing hypothetical outages ranging from several months to 1-2 years.
- **Health benefits outside of the neighborhood provided with new sewers** (CP3). Mtendere was chosen to receive a new sewer network not only to benefit the families who live there, but perhaps more importantly, to protect the underground aquifer. Fecal contamination of the aquifer could have much wider health consequences than just the people who live in Mtendere, since that water is distributed throughout LWSC's network. The ERR assumes that 214,701 people will benefit from the new sewers, but we could not find any source for this assumption. It is possible that this number includes households not residing in Mtendere but who drink the water that comes from that aquifer, but CDC's evaluation of health impacts was not designed to measure health impacts beyond the neighborhoods where the infrastructure was constructed so it is not going to be possible to assess whether there are more widespread health benefits due to the sewers protecting the aquifer and thereby improving water quality. To the extent that pit latrines in Mtendere are not likely to be decommissioned, it is unlikely that there will be any health benefits from the sewers, so we might not need to make any changes to the ERR, despite having a better understanding for the original rationale for CP3.

- **Reduced infrastructure depreciation thanks to ISA.** The ERR did not include either the benefits of ISA (in terms of reduced depreciation thanks to better operations and maintenance practices supported by the compact) or the costs of the TA. This is worth reconsidering for the post-compact ERR, particularly since we expect the evaluation to determine the extent to which the TA enables LWSC and LCC to maintain the new infrastructure.

2. Beneficiary analysis

A major assumption underlying all benefit calculations is the number of beneficiaries served by the project. The ERR assumes that the different project components will be successfully completed on time, and does not discount to account for risk of de-scoping. It also assumes that all benefits begin to accrue in the second year of the project; however, if the project is delayed, benefits may begin to accrue later or may not reach as many households if the works are not completed as envisioned or if households do not connect to the new water and sewer infrastructure.

Our evaluation will include questions about LWSC and LCC's outreach and community engagement efforts, allowing us to learn about the potential effects of the project on beneficiary households. We will learn about uptake from CDC's survey, allowing us to evaluate whether households have been able to connect to water and sanitation. We will examine which types of households—for example poor households and women-headed households—are connecting to water and sanitation services to learn who benefits from the project. As we describe further in Section IV.H, we will work closely with CDC to ensure that the content of their survey would be able to answer our research questions. From our performance evaluation, we will learn about the types of messages that are effective in reaching households. We will also evaluate households' bill-paying behavior for water and trash collection services so we can understand the extent to which households are able to pay their bills.

III. LITERATURE REVIEW

Water utilities around the world struggle to provide reliable, equitable, and financially sustainable services. In many cases, utilities are forced to subsidize all customers when they do not have the ability to identify and target the poor, resulting in insufficient financial resources for maintenance of the existing network and expansions into underserved areas. Decisions about leadership and priorities are often influenced by political considerations rather than optimizing investments for the sake of the utility or consumers.

While best practices exist for technical challenges such as reducing NRW, there is still much debate about which financial models could allow utilities to achieve their competing objectives of a broad service mandate and financial sustainability. To strengthen utilities, governments and donors sometimes provide technical assistance or implement reforms intended to build capacity and accountability. These approaches are difficult to rigorously evaluate since there is no way to know what would have happened had the status quo persisted, as the effects of these approaches can take years to materialize and in the meantime many other factors that influence the utility's performance are also likely to evolve. Moreover, the design and results of technical assistance and reforms are highly idiosyncratic, dependent on the particular people involved and the unique institutional context in which they are implemented. In this chapter we review the existing evidence on strategies to improve utilities' financial condition by reducing NRW, expanding access to networked water and sanitation services, and improving accountability of utilities. We end the chapter by identifying gaps in the literature and discussing the potential contributions of this evaluation.

A. Summary of existing evidence

NRW reductions. The first step toward achieving financial sustainability is usually to reduce NRW. The many existing manuals on strategies to reduce NRW cover topics such as measurement of NRW, conduct of water balances, and use of district metered areas; leak management and control; and resolution of customer meter inaccuracy, meter reading errors, and unauthorized consumption, including ensuring that all customers have a meter or that the utility is able to accurately estimate consumption for households without meters (Development Alternatives International 2010, Baghirathan and Parker 2017, Frauendorfer and Liemberger 2010, Farley et al. 2008, Farley and Liemberger 2005). For example, Nakuru Water, Sewerage and Sanitation Company in Kenya reduced NRW from 50 to 20 percent in just six months by applying these strategies (Ndirangu et al. 2013). The water utility JIRAMA in Madagascar also used two district meter areas to demonstrate that major water (and thus financial) revenues could be saved by implementing NRW reduction strategies such as a pressure management system and non-visible leak location (Ramanantsoa et al. 2011).

We did not find a similar plethora of manuals related to improving utilities' collection ratios, nor did we identify any studies reporting the results of utilities' efforts to increase the collection ratio although this is likely also a major challenge for many utilities, even if they do not like to admit it. Among more than 50 utilities included in a World Bank review of water and sanitation infrastructure in Africa, the majority reported collection ratios of over 90 percent. However, alternative measures of revenue such as those based on household survey data or a comparison of reported revenue, volume produced, and the tariff schedule, suggest that no more than half of the

utilities that report such high collection ratios are actually so efficient, while the rest are likely forfeiting payments from up to a third of their customers (Banerjee and Morella 2011).

Expanding coverage. In some cases, the financial health of the utility might be improved by increasing the number of paying customers, making better use of existing infrastructure such as the water treatment plant, possibly even by building new infrastructure to supply underserved areas. Consumer access to the water network can be expanded by providing subsidies to consumers for connecting, simplifying the legal and administrative procedures for new connections, and providing education and support to poor households for managing their water resources and budget can increase the utility's savings. Although the literature on subsidies for new connections is sparse, one study (Debomy et al. 2005) has shown that a connection subsidy program in Abidjan, in Côte d'Ivoire helped increase connections to the piped water network for the poor. The Provincial and Peri-urban Water Supply and Sanitation Project offered subsidies for new connections to poor households in Cambodia and initial results have shown success in effectively increasing connections among poor communities (United Nations 2007).

Price is not the only barrier to connecting to the piped network that households' face—the paperwork required to apply for a connection can be confusing and time consuming. A Moroccan utility in Tangiers offered information about buying a connection on credit (at full cost) and provided guidance about the application process (Devoto et al. 2012). Simplifying the legal and administrative procedures for connecting to the network drastically increased the number of households signing up for new connections. This program decreased significant barriers that prevented many households from connecting to the piped water network such as lack of awareness of the availability of the credit option and/or the complexity of the application process were significant barriers.

For households that are accustomed to physically transporting all of the water they use, the luxury of being able to turn on a tap and have access to an unlimited supply of water can be difficult to manage. Without training on how water bills are calculated, poor households with low numeracy skills may have difficulty planning how much they can afford to consume. Szabó and Ujhelyi (2015) conducted a randomized evaluation of a water education campaign in low income, peri-urban townships in South Africa. Using administrative billing data, the study found that households that received visits from education officers who explained water meters, bills, and the approximate amount of water used during various activities paid bills by approximately 30 percent more than household that did not receive these visits (Szabo and Ujhelyi 2015).

Corporatization and accountability. Separating operations and oversight of utilities is widely recognized as necessary to create sufficient incentives to identify challenges and proactively solve them (Berg 2013 and Baietti et al. 2006). For example, since the 1990s privatization (in which a private company owns and manages the utility) has been promoted as a means of improving the financial sustainability and performance of utilities by bringing in external sources of finance and motivating utilities to provide better services (more satisfied customers are hypothesized to lead to more revenue which translates into more profit) (Araral 2009). In recent years, however, privatized utilities in many cities (for example, Accra in Ghana and Maputo in Mozambique) have reverted to government management (Lobina et al. 2014) as privatization has rarely succeeded in addressing the complex web of fundamental challenges that previously constrained public utilities (Baietti et al. 2006).

In contrast to privatization, under the corporatization model the utility becomes a corporation that is still owned by the government (either national or municipal), but it has a distinct legal identity, transparent financial accounts that are segregated from other government operations, and the ability to make operational decisions independent of the government (United States Agency for International Development (USAID), 2006). Corporatized utilities have the potential to exhibit the six characteristics of well-performing public water utilities identified by Baietti et al. (2006) through extensive case study research: (1) autonomy to prevent political interference by the government from undermining performance; (2) external accountability through performance standards, benchmarking, and monitoring by civil society[7]; (3) internal accountability to motivate and reward management and staff for achieving targets; (4) use of market-oriented approaches such as outsourcing and market-testing to reduce costs; (5) customer orientation to promote satisfaction and ultimately bill-paying; and (6) a corporate culture that inspires staff and managers to excel. Baeitti et al. (2006) emphasize that although a ring-fenced government department *can* establish the recommended governance processes and operate like a corporation, and while a corporation *might not* exhibit all six of the desirable characteristics, the most promising approach for creating a well-operating utility is to create a corporation.

Although corporatization can be an important step to becoming a successful utility company, it is not always enough. For example, NRW in Lusaka remained high at 50 percent due to poor infrastructure, illegal connections, and low billing and low collection rates even after LWSC was corporatized, due to a lack of accountability (McDonald and Ruiters 2005). Additional tools such as performance-based contracts can strengthen corporatized utilities by holding managers accountable for poor performance and incentivizing efficiency and better service provision. The National Water and Sewerage Corporation in Uganda has successfully achieved financial sustainability and efficient service provision by introducing performance-based contracts that compensate local managers on achievement of minimum targets. These strategies which were implemented starting in 1998, have transformed the previously grossly inefficient utility in 10 years: service coverage increased by 50 percent, the total number of metered connections increased five-fold, the number of staff per 100 connections fell by 80 percent, collection rates increased by 50 percent and the NRW share was halved (Baietti et al. 2006). Similarly, SABESP in Sao Paolo successfully uses performance based-contracts to focus on commercial efficiency such as improving metering, billing and collection (Marin et al. 2012).

B. Gaps in the literature and contribution of the LWSSD evaluation

Overall, the literature on strategies to improve the financial position of water utilities, the quality of service they provide, and their ability to serve increasing numbers of poor customers is nascent. Very few utilities have publicly shared their experiences with strategies to reduce NRW, improve their bill collection rates, or expand service to underserved areas and there is very little evidence on the sustainability of subsidizing poor households' connections to the network.

[7] Berg (2013) also emphasizes the role of citizen participation in regulating state-owned water utilities. For an extensive review on the topic, see Muller, Simpson, and van Ginneken (2008), which considers over a dozen tools to make utilities more accountable to their customers, but ultimately concludes that "despite the substantial theoretical and advocacy work that has been done on tools for accountability, we found little data on their practical benefits and performance and therefore cost-effectiveness."

Our evaluation of the LWSSD project will contribute to addressing some of these gaps. In particular, our performance evaluation will provide useful evidence on the effects of technical assistance to reduce NRW, strengthen asset management, and better serve poor customers.Our evaluation will combine quantitative evidence on the changes associated with the project with a comprehensive qualitative analysis to understand how and why these changes are observed. Our evaluation will not only add to the overall evidence base, but will be particularly useful in guiding LWSC and LCC management, Zambian policymakers, and donors, all of whom want to ensure the sustainability of the infrastructure and improved management practices after the end of the compact. In addition, this evaluation will hopefully identify learnings for MCC about the challenges implementing entities face when trying to balance the competing demands of continuing status quo operations, overseeing major infrastructure investments, and simultaneously engage in institutional strengthening activities to facilitate improvements in operations, and particularly maintenance of the new infrastructure.

IV. EVALUATION DESIGN

In this chapter, we describe our proposed design for the evaluation of the LWSSD project. We begin by listing the questions the evaluation seeks to address and providing a brief overview of the proposed evaluation design, which includes an implementation study and a mixed-methods outcomes evaluation with five components. We then describe each element of the design in further detail, including the data they will rely on and how we will draw on these data to answer the evaluation questions.

A. Evaluation questions

The evaluation of the LWSSD project seeks to answer the following questions proposed by MCC:

1. Were the activities/sub-activities implemented as designed? What were the implementation challenges and successes?
2. Is there evidence that the interventions have resulted in the outcomes outlined in the program logic?
3. Did the LWSSD project result in a reduction in the implicit subsidies to the water and sanitation sectors by the government? Was the LWSSD project as a whole effective at increasing the operational efficiency and sustainability of LWSC as measured by NRW, collection ratio, and tariff adequacy?
4. How did the use of the Sustainability Agreement, and the Lusaka Water Supply and Sanitation Master Investment Plans by LWSC, MCC, MCA-Zambia, other donors, and the government contribute to additional investments and the overall sustainability of water and sanitation sectors?
5. How successful is LWSC in implementing and maintaining a life-cycle centric approach to asset management?
6. Did the TA to LCC catalyze improved waste management and collection, improved capacity, or long-term sustainability of waste management and drainage operations?
7. To what extent does the IGP as a whole contribute to the project level outcomes and economic benefits regarding water supply, SWM, and sanitation?
8. How were environmental and social considerations incorporated into the LCC's TA contributions to long-term SWM improvements, including sustainability and functionality of drains? How did environmental and social considerations impact effectiveness of LWSC monitoring of water and sanitation services?
9. How effective were Information, Education, and Communication and Sanitation Marketing (IEC/SM) activities during implementation of the infrastructure works in achieving their goals (e.g., connection uptake, maintenance, understanding the water bill and payment management, drainage maintenance, reduction of theft and vandalism, hygiene, health and safety, and local employment)?
10. How did the SIGM and IEC TA contribute to changes in LWSC and LCC policies, structures, planning, staffing, capacities and budgets to 1) provide gender-responsive,

appropriate, affordable and sustainable services for the poor and 2) to plan, develop, and manage IEC and SM campaigns that promote behavior change, uptake of services and care of physical assets in low-income peri-urban areas? Do the achieved outputs contribute to project level outcomes and compact objectives?

B. Augmented ISA theory of change for the evaluation

The compact logic illustrates how the activities support each other and translate into the short- and long-run outcomes that the project aims to affect. In our evaluation, we focus on ISA sub-activities and any other activities that lead to outcomes related to sustainability of the infrastructure and the management practices and financial position of LWSC, LCC's drainage unit, and the new SWM utility.[8] For example, while new water supply infrastructure does not fall under ISA, it is expected to bring in new revenues through new bill-paying customers, in turn improving the financial stability of the utility. As such, these relevant InfrA sub-activities are included in the logic model extracts we use as a basis for our evaluation (Figures IV.1 and IV.3, for LWSC- and LCC-related activities, respectively). By measuring indicators along different points in the program logic, we can understand whether and how the various program objectives are being met, and if not, where the program logic breaks down.

After a thorough review of the project's original logic as described in the Monitoring and Evaluation Plan, the evaluation team worked with MCC to revise the project logic to provide more clarity on the causal pathways between the activities and the outcomes and update the activities to align with how the project was actually implemented. The new version of the project logic serves as the framework for the evaluation design. Table IV.1 lays out the assumptions implicit in the causal chains for both LWSC and LCC outcomes.

All of the assumptions in Table IV.1 will be addressed, at least in part, by our evaluation, with one exception: Assumption 13* addresses infrastructure quality and falls outside of the institutional strengthening focus of our evaluation.

[8] The ERR is driven by outcomes which are measured by CDC's evaluation. The only link between our evaluation and the ERR is provided by the outcome on reductions in NRW losses.

Figure IV.1. Augmented theory of change for evaluation of LWSC institutional strengthening

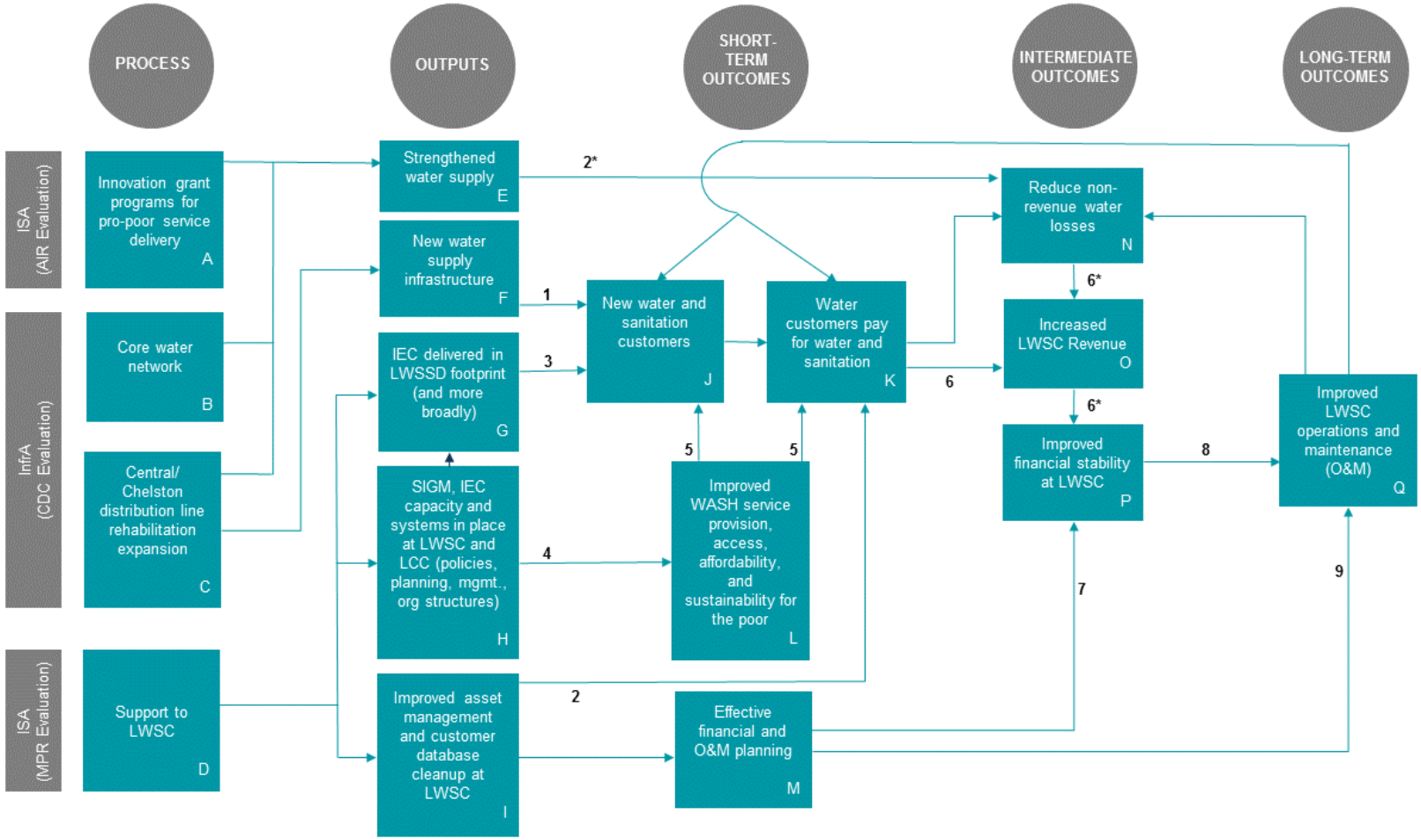


Figure IV.2. Augmented theory of change for evaluation of LCC institutional strengthening

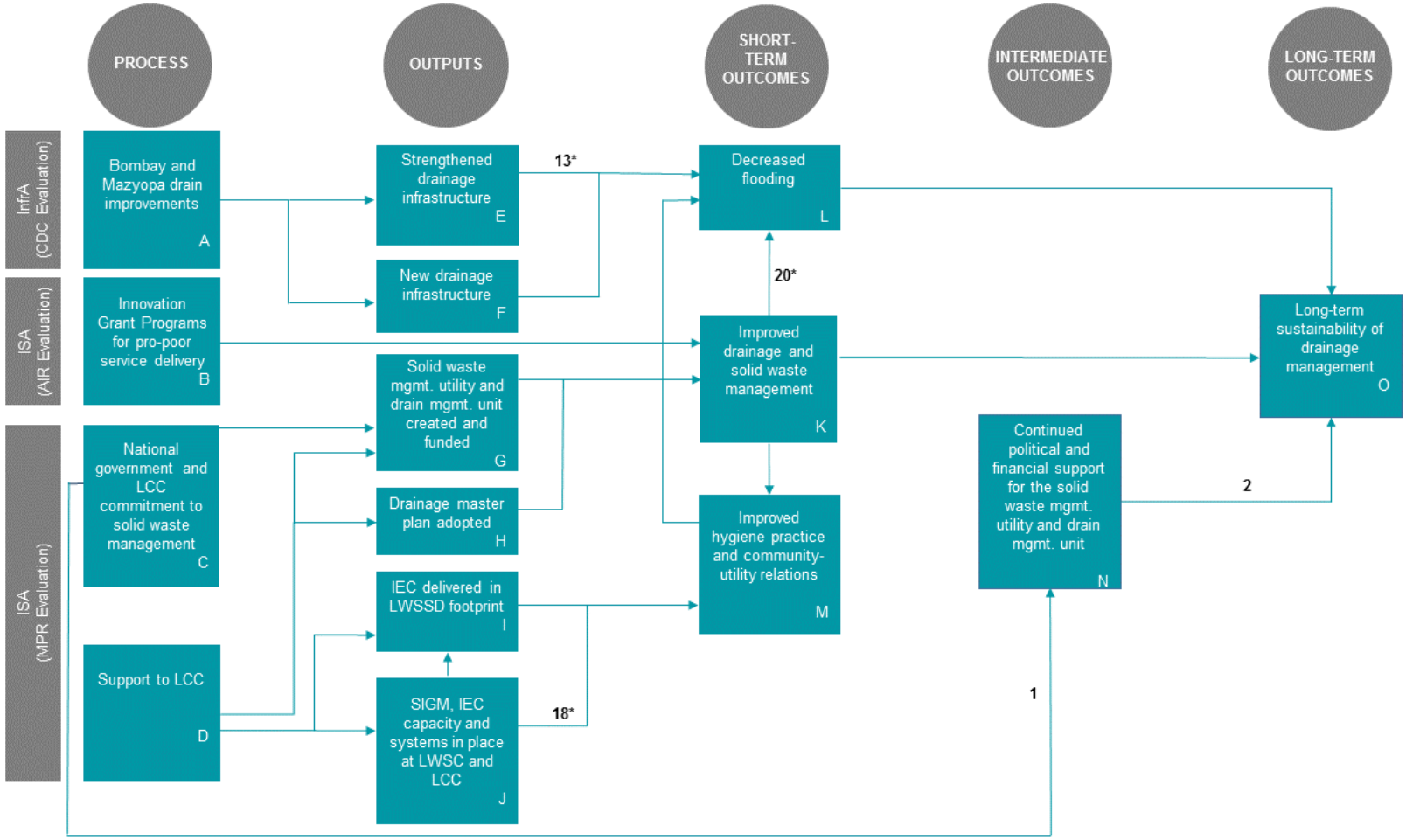


Table IV.1. Assumptions underlying the project logic

Causal link in the project logic	Assumption
LWSC financial stability	
1, 3	New water supply infrastructure leads to new customers. The water network is expanded in areas where potential customers live, and households in new connection areas are willing and able to sign up for water and sanitation services once connected to the network
2*	Strengthened water supply reduces physical losses, and expanded opportunities for theft are mitigated effectively by LWSC.
2	Improved asset management and customer database cleanup at LWSC allows LWSC to bill customers who previously were not paying for their water. These customers, including residential, business, and government customers, subsequently pay their bills.
4	LWSC develops sufficient SIGM and IEC capacity and systems to improve water, sanitation, and hygiene (WASH) service provision, access, affordability, and sustainability (SAAS) for the poor. LWSC develops policies that effectively include women and poor households in its services, and continues to have the capacity to implement gender and social inclusion programs.
5	Improved WASH SAAS makes it easier for the poor to pay for water services, so they are more likely to sign up for and pay for services.
6*	Reduced NRW improves the financial stability of LWSC.
6	Paying customers increase LWSC revenue. The revenue new customersbring in more than compensates for the additional cost of providing them with water services. This includes new customers from low income neighborhoods as well as from medium/high income communities (such as Kwamwena and Ndeke) who subsidize service provision to low income water users.
7	Effective financial and operations and maintenance (O&M) planning improve financial stability at LWSC. Improved management—along with the increased revenues discussed above—compensate for the increase in expenses that come with the addition of new infrastructure and new household connections.
8	LWSC uses increased funds to invest in long-term O&M.
9	Better financial and O&M planning improves LWSC's capacity for improved long-term O&M. TA effectively helps LWSC establish an institutional framework and develop the necessary leadership and technical expertise to manage O&M in the long run.
LCC drainage financial stability	
13*	New and strengthened drainage infrastructure has the capacity to handle rainfall so that flooding is prevented. Infrastructure activities are adequately planned for—expected rain and appropriate capacity is built into the system.
18*	IEC effectively changes individuals' hygiene behavior and is institutionalized so that activities continue in the future. Households have trash-collection options available to them so that they are able to keep trash out of the drains.
20*	Improved drain maintenance ensures the drainage system's continued capacity to handle rainfall, thus decreasing flooding.

Note: * denotes assumptions in the original logic model. All other assumptions were added by the MPR research team.

C. Evaluation design overview

1. Evaluation questions and components of the design

Guided by the evaluation questions posed by MCC and the augmented theories of change we developed in collaboration with the project team, we propose a performance evaluation of the LWSSD project that consists of a qualitative implementation study and an outcome evaluation comprising five mixed-methods studies focused on infrastructure sustainability; financial sustainability; SIGM, IEC, and SM; the combined effects of project activities on beneficiaries; and other investments in the sector (Table IV.2). Our main goal for the **implementation study** is to help contextualize the findings of the outcomes evaluation, so we will concentrate on project activities that were expected to lead to better service provision and improved financial sustainability at LWSC, LCC, and the new SWM utility. The LWSSD project has already been well documented by MCA-Z, the independent engineer, and the entities that provided the TA to LWSC and LCC, so we will focus our implementation study on elements of the project that were not implemented as envisioned—in particular, those that are not completed by the time the compact ends. To do this, we will use interviews, project documents, and administrative records to document how key sub-activities under both InfrA and ISA were implemented, how implementation was influenced by the context (including the incentives different actors faced and the characteristics of the individuals and institutions involved in the project), how the activities reinforced each other, and the potential for the project's effects to be sustainable.

The second component of the evaluation is an **outcome evaluation** leveraging household survey data from CDC's impact evaluation, primary qualitative data (including observations of infrastructure and maintenance practices), and secondary administrative data sources (including key documents) to explore the effects of project activities on LWSC, LCC, the new SWM utility, and ultimately the households these entities serve. Our outcomes evaluation comprises studies on institutional capacities related to infrastructure sustainability; financial sustainability; and SIGM, IEC, and SM plus a beneficiary study at the household level and an investment study of how the LWSSD project influenced priorities and other sources of funding for the sector. The institutional capacity studies will consider whether LWSC, LCC, and the new SWM utility adhere to the best practices recommended and supported through the TA, as well as exploring the ultimate outcomes of interest, including functionality of the infrastructure; the financial position of LWSC, LCC's drainage unit, and the new SWM utility; and these three organizations' relationship with their low-income customers. At the household level, the beneficiary study will track attitudes and practices related to use of water, sanitation, drainage, and SWM services, but we will not be able to attribute changes to particular aspects of the LWSSD project, since households could be affected by multiple influences (for example, the expansion of the network, improvements in the core network distribution system, and—thanks to the SIGM TA—a better appreciation on LWSC's part of the challenges low-income consumers face). Finally, the investment study will consider how the funding ecosystem for water, sanitation, and drainage in Lusaka has been affected by the LWSSD project—and the creation of the master plans, in particular—and how other sources of funding affect the financial sustainability of the sector.

Table IV.2. Evaluation questions and proposed evaluation design

		Mixed methods outcome evaluation (data collection 2018-19 and 2021)				
		Institutional capacity				
Evaluation Question	Implementation study (2018-19)	Infrastructure sustainability study	Financial sustainability study	SIGM, IEC, and SM[a] study	Beneficiary study	Investment study
1. Were the activities/sub-activities implemented as designed? What were implementation challenges and successes?	X					
2. Is there evidence that the interventions have resulted in the outcomes outlined in the program logic?		X	X	X	X	X
3. Did the LWSSD project result in a reduction in the implicit subsidies to the water and sanitation sectors by the government? Was the LWSSD project as a whole effective at increasing the operational efficiency and sustainability of LWSC as measured by NRW, collection ratio, and tariff adequacy?			X			
4. How did the use of the Sustainability Agreement, and the Lusaka Water Supply and Sanitation Master Investment Plans by LWSC, MCC, MCA-Zambia, other donors, and the government contribute to additional investments and the overall sustainability of water and sanitation sectors?						X
5. How successful is LWSC in implementing and maintaining a life-cycle centric approach to asset management?		X				
6. Did the TA to LCC catalyze improved waste management and collection, improved capacity, or long-term sustainability of waste management and drainage operations?		X	X	X	X	
7. To what extent does the IGP as a whole contribute to the project level outcomes and economic benefits regarding water supply, SWM, and sanitation?	X				X	

Table IV.2 (*continued*)

Evaluation Question	Implementation study (2018-19)	Mixed methods outcome evaluation (data collection 2018-19 and 2021)				
		Institutional capacity				
		Infrastructure sustainability study	Financial sustainability study	SIGM, IEC, and SM[a] study	Beneficiary study	Investment study
8. How were environmental and social considerations incorporated into the LCC's TA contributions to long-term SWM improvements, including sustainability and functionality of drains? How did environmental and social considerations impact effectiveness of LWSC monitoring of water and sanitation services?	X	X		X		
9. How effective were IEC/SM activities during implementation of the infrastructure works in achieving their goals (e.g., connection uptake, maintenance, understanding the water bill and payment management, drainage maintenance, reduction of theft and vandalism, hygiene, health and safety, and local employment)?				X	X	
10. How did the SIGM and IEC TA contribute to changes in LWSC and LCC policies, structures, planning, staffing, capacities and budgets to 1) provide gender-responsive, appropriate, affordable, and sustainable services for the poor and 2) to plan, develop, and manage IEC and SM campaigns that promote behavior change, uptake of services and care of physical assets in low-income peri-urban areas? Do the achieved outputs contribute to project level outcomes and compact objectives?				X	X	

[a] Social inclusion and gender mainstreaming (SIGM); information, education, and communications (IEC); sanitation marketing (SM).

In addition to the evaluation questions discussed above, at the request of MCC's Environmental and Social Performance staff, our beneficiary study will also assess the success of the Livelihood Restoration Program implemented as part of the Resettlement Action Plan. Our assessment will make use of primary qualitative data (focus group discussions) conducted in 2018-2019 to explore longer-term effects of the program, leveraging an evaluation conducted by Cardno that uses a difference-in-differences design to examine changes in the short-term outcomes of program recipients enrolled in the first cohort relative to a comparison group of PAPs who also lost gardening land but were excluded from the program.

2. Data sources

The evaluation will rely on several data sources for the interim analysis in 2018-2019 and the final analysis in 2021. More details are provided later in this chapter when we discuss each component of the evaluation in detail. At a high level, however, the data sources can be categorized as:

- **Project documents** which we will review in 2018-2019
- **Primary qualitative data** collected by Mathematica in 2018-2019 and 2021
- **Household survey data from the CDC's 2016 baseline and 2019 endline –** a representative household survey in both implementation neighborhoods and comparison areas
- **Water quality data from the CDC's distribution system monitoring sub-study** collected in 2018-2019
- **Secondary administrative data** compiled quarterly for LWSC's shareholders

The implementation study will mainly rely on the project documents and primary qualitative data whereas the outcome evaluation will use the CDC's household survey and water quality data, the primary qualitative data, and the secondary data from administrative sources.

3. Timing of data collection and duration of exposure

It appears that the majority of both InfrA and ISA will still be in process in 2018 when we do our first data collection due to construction delays, uncertainty stemming from the reorganization of LWSC that is funded by the LSP, and the relatively late decision to include the creation of a SWM utility as part of the compact. Given this timeline, the interim round will actually be more like a baseline, as it would be premature to expect LWSC to have been able to make major changes while the TA is still in process. Rather, changes in service coverage and quality—and the financial sustainability of LWSC, LCC's new drainage unit, and the new SWM utility—are more likely to become apparent between the interim and final evaluation rounds.

4. Outcomes included in the evaluation

Our proposed evaluation will include all outcomes in the augmented project logics we developed for the evaluation. Table IV.3 includes details on the outcomes that correspond to each evaluation question, the indicators we will use for each outcome, and the data sources we will rely on. Lettering and numbering in the outcome column of the table refers to specific elements of Figures IV.1 (LWSC) and IV.2 (LCC).

Table IV.3. Evaluation questions, outcomes, indicators, and data sources

Evaluation question	Outcomes[a]	Indicators	Data sources
1. Were the activities/sub-activities implemented as designed? What were the implementation challenges and successes?	1E/1F/2E/2F. New and strengthened water supply and drainage infrastructure	• Progress of construction packages • Number of households connected to water and/or sanitation	Key informant interviews (MCC / MCA-Z staff, construction implementers), document review (compact documents, construction monitoring reports), household survey data and focus group discussions
	1G/2I. IEC delivered in LWSSD footprint (and more broadly)	• IEC operation manual developed and training of trainers conducted • Household respondents reporting receiving IEC messaging	Key informant interviews (MCC / MCA-Z staff, Cowater, LCC, LWSC), document review (Cowater TORs and progress reports), household survey data and focus group discussions
	1H/2J. SIGM, IEC capacity and systems in place at LWSC and the new SWM utility (policies, planning, management, organizational structures)	• SIGM and IEC TA provided to LWSC and the new SWM utility • Policies and staffing for SIGM and IEC activities are in place • Payment options meet the needs of poor customers • Targeting criteria for tariff subsidies developed • Tariff set by NWASCO	Key informant interviews (MCC / MCA-Z staff, Cowater, NWASCO, LWSC, SWM utility), document review (Cowater TORs and progress reports, LWSC documentation submitted to NWASCO, NWASCO verdict on LWSC tariff)
	1I. Improved asset management and customer database cleanup at LWSC	• Asset management and customer database management TA provided to LWSC • Policies and staffing for asset management and customer database maintenance are in place • Preventative maintenance occurs • LWSC customer database reflects all information gathered through the completed customer census • LWSC carries on with regular updates to the customer database	Key informant interviews (MCC / MCA-Z staff, Seureca NRW and asset management teams, LWSC managers), document review (Seureca reports)

Table IV.3 (*continued*)

Evaluation question	Outcomes[a]	Indicators	Data sources
1. Were the activities/sub-activities implemented as designed? What were the implementation challenges and successes? (*continued)*	2G. SWM utility and drain maintenance unit created and funded	• SWM utility created • Drain management unit created • Funding sources identified for both entities • Staff assigned to both entities	Key informant interviews (MCC / MCA-Z staff, staff of new SWM utility, Seureca implementers, staff of LCC and new drain maintenance unit), document review (Seureca reports, documentation of funding availability for both units)
	2H. Drainage master plan adopted	• Master plan written • LCC, new drain maintenance unit, and other relevant bodies agree to adopt the master plan	Key informant interviews (MCC / MCA-Z staff, government ministries, Seureca implementers, LCC staff, staff of new drain maintenance unit), document review (drainage master plan, Seureca reports)
2. Is there evidence that the interventions have resulted in the outcomes outlined in the program logic?	All outcomes	All indicators	All data sources
3. Did the LWSSD project result in a reduction in the implicit subsidies to the water and sanitation sectors by the government? Was the LWSSD project as a whole effective at increasing the operational efficiency and sustainability of LWSC as measured by NRW, collection ratio, and tariff adequacy?	1K. Customers pay for water and sanitation 1N. Reduced NRW 1O. Increased LWSC revenue 1P. Improved financial stability at LWSC 1Q. Improved LWSC operations and maintenance (O&M)	LWSC-level indicators: • Volume of non-revenue water • Collection ratio • Number of connections to network (disaggregated by residential and commercial) • Ratio of staff to volume of water supplied • Operating costs (including average labor cost of production), revenues, and operating cost coverage ratio • Value of implicit subsidy	Document review (LWSC quarterly reports, Antonopoulos technical audits of LWSC performance) and key informant interviews (MCC / MCA-Z staff, Seureca implementers, LWSC staff, NWASCO)

Table IV.3 (*continued*)

Evaluation question	Outcomes[a]	Indicators	Data sources
4. How did the use of the Sustainability Agreement, and the Lusaka Water Supply and Sanitation Master Investment Plans by LWSC, MCC, MCA-Zambia, other donors, and the government contribute to additional investments and the overall sustainability of water and sanitation sectors?	1P. Improved financial stability at LWSC 1Q. Improved LWSC operations and maintenance (O&M) 2K. Improved drainage and SWM2N. Continued political and financial support for the SWM utility and drain maintenance unit	• Dollars committed to the WASH sector by government, private sector, and donors • Share of new projects (number and share of value of new investments) that are listed as priorities in the Master Investment Plans	Key informant interviews (MCC / MCA-Z staff; LCC/LWSC leadership; Ministry of Water Development, Sanitation and Environmental Protection), document review (documentation from other projects such as LSP and the Kafue Bulk Project, Sustainability Agreement, Lusaka Water Supply and Sanitation Master Investment Plans)
5. How successful is LWSC in implementing and maintaining a life-cycle centric approach to asset management?	1I. Improved asset management and customer database cleanup at LWSC	• LWSC staffing is adequate for maintenance, inspection, record-keeping, and valuation of infrastructure assets; staff positions are filled; staff has adequate time and training • LWSC staff have the resources to do their jobs, including testing and maintenance equipment, electronic devices and software for record keeping, transport, and dedicated budgets • Staff have the agency and authority to do their jobs effectively; there is internal accountability for and verification of the performance of their duties • LWSC has adopted thorough and accurate maintenance, inspection, and asset management record-keeping processes • Regular maintenance and inspection activities are carried out on schedule • Reduction in catastrophic failures and emergencies	LWSC operational records, LWSC billing data, Antonopoulos technical audits of LWSC performance, key informant interviews (LWSC senior management; LWSC inspection, maintenance, repair, and call center staff; asset record-keeping staff)

Table IV.3 (*continued*)

Evaluation question	Outcomes[a]	Indicators	Data sources
6. Did the technical assistance (TA) to LCC catalyze improved waste management and collection, improved capacity, or long-term sustainability of waste management and drainage operations?	2K. Improved drainage and SWM 2N. Continued political and financial support for the SWM utility and drain maintenance unit 2O. Long-term sustainability of drainage management	• LCC drain maintenance unit and SWM utility staff have the resources to do their jobs, including testing and maintenance equipment, electronic devices and software for record keeping, transport, and dedicated budgets • LCC drain maintenance unit and SWM utility staff have the agency and authority to do their jobs effectively; there is internal accountability for and verification of the performance of their duties • LCC drain maintenance unit and the SWM utility have adopted thorough and accurate maintenance and inspection processes • Maintenance activities and physical condition of drainage infrastructure	Key informant interviews (LCC senior management; LCC inspection, maintenance, repair, and call center staff; staff of the new SWM utility), document review (Seureca reports on environmental TA to LCC)
7. To what extent does the IGP as a whole contribute to the project level outcomes and economic benefits regarding water supply, SWM, and sanitation?	1J. New water and sanitation customers 1L. Improved WASH service provision, access, affordability, and sustainability for the poor 2K. Improved drainage and SWM 2M. Improved hygiene practice and community-utility relations	• Number of households who benefit from water, sanitation, and SWM services provided by IGP grantees • Number of households in Mtendere who receive financing from Peoples Progress (IGP grantee)	IGP project documentation, household survey (questions regarding coverage of IGP grantees' programs)
8. How were environmental and social considerations incorporated into the LCC's TA contributions to long-term SWM improvements, including sustainability and functionality of drains? How did environmental and social considerations impact effectiveness of LWSC monitoring of water and sanitation services?	1H/2J. SIGM, IEC capacity and systems in place at LWSC and LCC (policies, planning, mgmt., org structures) 1L. Improved WASH service provision, access, affordability, and sustainability for the poor 2L. Decreased flooding	• LCC/LWSC trained in IEC/SIGM • Household respondents reporting receiving IEC messaging • LCC, LWSC, and SWM utility include environmental and social considerations in their work • Drains are not clogged • Reduced incidence, duration, and severity of flooding	Key informant interviews (MCC / MCA-Z staff; LCC/LWSC staff; SWM utility staff), document review (Cowater reports, Seureca reports, LWSC monitoring documentation), household survey data and focus group discussions

Table IV.3 (*continued*)

Evaluation question	Outcomes[a]	Indicators	Data sources
9. How effective were IEC and SM activities during implementation of the infrastructure works in achieving their goals (e.g., connection uptake, maintenance, understanding the water bill and payment management, drainage maintenance, reduction of theft and vandalism, hygiene, health and safety, and local employment)?	1G/2I. IEC delivered in LWSSD footprint (and more broadly) 1H/2J. SIGM, IEC capacity and systems in place at LWSC and LCC (policies, planning, mgmt., org structures) 2M. Improved hygiene practice and community-utility relations	• Number of households who connect to water and sewer networks • Households understand water bills and payment • Reduction of theft and vandalism • Households practice improved hygiene • Households use and pay for SWM services • Volume of trash in drains	Key informant interviews (MCC / MCA-Z staff; LCC/LWSC staff; SWM utility staff), document review (Cowater reports, Seureca reports, LWSC monitoring documentation), household survey data and focus group discussions
10. How did the SIGM and IEC TA contribute to changes in LWSC and LCC policies, structures, planning, staffing, capacities and budgets to 1i) provide gender-responsive, appropriate, affordable and sustainable services for the poor and 2ii) to plan, develop, and manage IEC and SM campaigns that promote behavior change, uptake of services and care of physical assets in low-income peri-urban areas? Do the achieved outputs contribute to project level outcomes and compact objectives?	1H/2J. SIGM, IEC capacity and systems in place at LWSC and LCC (policies, planning, mgmt., org structures) 1L. Improve WASH service provision, access, affordability, and sustainability for the poor 2M. Improved hygiene practice and community-utility relations	• Number of households who connect to water and sewer networks • Households understand water bills and payment • Households are able to pay their water bills • Households practice improved hygiene and SWM	Key informant interviews (MCC / MCA-Z staff; LCC/LWSC staff; SWM utility staff), document review (Cowater reports, Seureca reports, LWSC monitoring documentation), household survey and focus group discussions

[a] Letters and numbers link to the project logic (Figures IV.1 and IV.2), with the number referring to the figure number and the letter referring to the output or outcome in that figure.

In the subsequent sections of this chapter, we describe each evaluation component in further detail, including the methodologies, data sources, and analysis plans.

D. Implementation study

1. Methodology

The first component of our evaluation design will rely on qualitative methods to document implementation challenges and lessons learned, with a particular focus on the ISA TA activities and the InfrA CPs that are not completed by the end of the compact.[9] By documenting and reflecting on what actually happened and the timeline for activities, the implementation study will complement the outcomes evaluation and CDC's impact evaluation by providing important context on *how*, *why*, *where*, and for *whom* the estimated changes in outcomes did or did not occur. As noted in Table IV. 2 above, the implementation study will address evaluation questions #1 (implementation fidelity to design, successes and challenges), #7 (contribution of IGP to project level outcomes and economic benefits)[10], and #8 (incorporation of environmental and social considerations in the TA programs for LCC and LWSC). Expanding a bit on the evaluation questions posed by MCC, the implementation study will answer questions such as:

- Were project activities implemented as designed? If there were changes, what were the reasons for these changes, and what are the implications?
- What were implementation challenges and successes? What lessons can be learned from the LWSSD implementation experience?
- What can we infer about the relative contributions of the various elements of InfrA and ISA to the outcomes envisioned in the project logic? To what extent did the activities complement each other to generate these outcomes?
- How were competing objectives of financial sustainability, improvements to service quality, and expansion of services to underserved neighborhoods balanced in the TA programs developed by MCA-Z and its consultants?

Based on the status of progress made in project activities at the time this report is being written, we anticipate that delays in infrastructure construction, consequent delays in activities to help households connect—including SIGM, IEC, SM, and SCAP activities—and slow progress in other ISA activities may limit what is implemented by the end of the compact. Therefore, understanding challenges, the decisions made about what work to prioritize as the compact draws to a close, the implications of any activities that were not completed, and lessons learned from the implementation experience will likely be a particular focus of the implementation study.

[9] SMEC will have documented all CP activity that is completed by the end of the compact so there is no need to duplicate that effort. Because the environmental TA to LWSC, the IGP, and the LRP are not very tightly linked to the key outcomes of improved service delivery and financial sustainability of LWSC, LCC, and the new SWM utility, the implementation study will not delve deeply into these elements of the LWSSD project.

[10] AIR is conducting a performance evaluation of the IGP which will not cover impacts on household level outcomes. Instead, AIR's evaluation will report on implementation, stakeholder response to the program, and cost. We will leverage AIR's findings in our implementation study but we will also explore potential impacts on households.

2. Data sources

Document review. Table IV.4 lists the documents we plan to review for the implementation study. To understand whether activities were implemented as designed, we will first review compact documents, master plans, terms of references (TORs), and inception reports from ISA implementers to understand what was initially intended. Then, to understand how initial plans may differ from what was finally implemented, we will compare these with progress reports, final reports, and other project monitoring data from implementers and project oversight bodies such as MWH and SMEC. We also anticipate that MCA-Z's end term evaluation report will be a key document for synthesizing the implementation experience. Project monitoring data from implementers and project oversight bodies will also serve as a source of information for learning about implementation challenges and successes, along with the technical audits of LWSC's performance toward targets in the Sustainability Agreement provided by Antonaropoulos & Associates.

Table IV.4. Data sources for the implementation study document review

Project component	Data source(s)
All components	• Compact documents • Water, sanitation, and drainage master investment plans • MCA-Z end term evaluation report • Trip reports from MWH missions to check on project implementation
InfrA construction packages	• Construction oversight monitoring and final reports from SMEC
Outreach to households – IEC and SM	• Cowater base and option period TORs • Cowater LWSC and LCC progress reports • Cowater final report
TA to LWSC	
NRW	• Seureca-NRW kickoff and progress reports including census and database integration progress tables • MWH's NRW baseline and targets summary • Seureca-NRW technical notes on LWSC customer database • Seureca-NRW baseline district metering area (DMA) reports • Seureca-NRW final report • Antonopoulos technical audits of LWSC performance
Asset management	• Seureca-Asset Management's task level reports • Seureca-Asset Management's quarterly progress reports • Asset management audit reports • Seureca-Asset Management's final report
Environmental management	• SMEC progress and final reports
SIGM, IEC, and SM	• Cowater base and option period TORs • Cowater LWSC progress reports • Cowater final report • Gender and per-urban policy documents

Project component	Data source(s)
TA to LCC	
Drainage and SWM	• TOR for Seureca-Drainage and SWM • Solid waste improvement plan • Storm water master plan • Seureca-Drainage and SWM inception, interim, and final reports for Tasks 1, 2, and 3
SIGM and IEC	• Cowater base and option period TORs • Cowater LCC progress reports • Cowater final report • Gender and per-urban policy documents

Primary qualitative data. Key informant interviews and focus group discussions with staff at MCC, MCA-Z, and MPCA; implementers; and the staff at LWSC, LCC, and the new SWM utility with whom they worked will help fill in gaps in in our understanding of challenges and successes, and will provide a better understanding of the reasons why they occurred. We anticipate that a political economy framework will be a key lens through which to understand the underlying reasons for challenges, and that we may need to interview staff at different levels of seniority at LWSC, LCC, and the new SWM utility to gain a full understanding of the relationships and incentives faced by individuals involved in implementing the project's activities. For example, if we find that ISA activities could not be completely implemented because of a lack of engagement at LWSC, we will seek to understand the incentives, agency, and authority of staff at LWSC who were targeted by these activities and may conduct interviews not only with targeted staff, but those to whom they report and senior officials required to approve any new policies or staff activities proposed by ISA implementers. More broadly, we will seek to understand the underlying organizational incentives at the utilities that may explain implementation challenges by gaining a better understanding of their relationships with regulators and government ministries that provide oversight. A number of bodies play an oversight role for LWSC and LCC, and these roles may include funding, regulation, and potentially deciding how senior management and board members at LWSC and LCC are chosen and rewarded. In addition, as discussed in the Introduction, several changes in government ministries have occurred during the past several years, and these may have led to both conflicting oversight roles and gaps in oversight. We will explore these dynamics through interviews with leaders in oversight and regulatory entities and a review of any policy documentation describing their intended relationships with LWSC, LCC, and the new SWM utility. In particular, we will seek to learn how these entities perceive their roles with respect to LWSC and LCC, what policies or mandates they are intended to follow, and whether these are followed in practice.

Table IV.5 summarizes the proposed respondents, number of interviews or focus group discussions, and the project activities and illustrative interview topics to be addressed with each respondent for the primary qualitative data collection for the implementation study. We will develop a qualitative data collection protocol for each respondent; although the protocols will be tailored for each respondent type, they will all cover similar topics related to the evaluation questions. We propose interviews with stakeholders who have specific content knowledge about the project activities and/or when there may be power differentials that could inhibit some people from participating in a group interview or focus group discussion, whereas we propose focus

group discussions when we are seeking a diversity of perspectives from a larger group of people (such as households that benefitted from the network extensions). At each organization we will begin by identifying the person or people who were most directly involved in implementing the project activities. We will then consult with MCC and MCA-Z to ensure that our proposed sample does not omit individuals who might have a good perspective on the program. We plan to conduct up to 48 semi-structured interviews during our 2018-2019 round of data collection.

Table IV.5. Respondents for the implementation study primary qualitative data collection (2018-2019 only)

Respondent	Number of focus group discussions or interviews	Project activities	Illustrative topics
MCC and MCA-Z	8 interviews	All	• Project design, implementation, mainstreaming of gender and social issues • Successes and challenges • Influence of other programs (such as LSP) on how LWSSD project activities were implemented or will be sustained • How master plans related to project implementation plans
MPCA	3 interviews	Ongoing CPs, especially 3 and 6 Establishment of drain maintenance unit at LCC and SWM utility	• Post-compact oversight of CP3 and 6
National government ministries[a]	4 interviews	TA to LWSC TA to LCC	• Whether roles and responsibilities regarding utilities are clear • Changes in roles and responsibilities due to project activities • Perceptions of institutional changes at utilities • Factors that facilitated or inhibited institutional changes at utilities • New developments that could influence the same outcomes that the LWSSD project is targeting • Changes in government spending (particularly investments in LWSC, LCC, the new SWM utility) • Creation of new SWM utility
NWASCO	1-2 interviews	TA to LWSC	• How tariffs are set (water and sanitation services) • NWASCO's relationship with LWSC and the utilities NWASCO regulates

Table IV.5 (*continued*)

Respondent	Number of focus group discussions or interviews	Project activities	Illustrative topics
LWSC (head of corporate planning office, IT manager, commercial director, branch managers, asset manager, asset management auditor, director of finance, SCAP focal point person, SCAP implementing unit)	7-12 interviews	TA to LWSC Outreach to households	• Experience of infrastructure construction and takeover, including success and challenges • Experience of TA, including successes and challenges implementing recommendations related to NRW and asset management • Successes and challenges of integrating social inclusion and gender mainstreaming into organization • NRW • Influence of new developments and other projects (such as LSP) on the organizational structure and LWSSD-related outcomes • The extent to which the organization can carry out its role in the absence of the project • Financial and political sustainability of LWSC
LCC (engineering services director, director of finance)	2-3 interviews	TA to LCC Outreach to households	• Experience of infrastructure construction and takeover, including success and challenges • Experience of TA, including successes and challenges implementing recommendations • Successes and challenges of integrating social inclusion and gender mainstreaming into organization • Organizational changes as a result of the project and the new SWM utility • Influence of new developments and other projects on organizational activities and LWSSD-related outcomes • The extent to which the organization can carry out its role in the absence of the project • Financial and political sustainability of LCC • Thoughts on the decision to construct new lined drains versus drainage maintenance to reduce flooding
New SWM utility (general manager of the utility; board of directors; SIGM, IEC, and SM focal point person)	2-4 interviews	TA to LCC	• Experience of creation and assumption of responsibilities, including successes and challenges • Financial and political sustainability of new utility • Relationships with LCC, ministries, and regulators
TA implementers (Cowater, Seureca-NRW, Seureca-Asset Management, Seureca-Drainage and SWM)	4-8 interviews[b]	TA to LWSC TA to LCC Outreach to households	• Experience and process of providing technical assistance • Beneficiary institution's preparation to operate without TA • Facilitators and drivers of change

Table IV.5 (*continued*)

Respondent	Number of focus group discussions or interviews	Project activities	Illustrative topics
Cowater community mobilizers	1 FGD	Outreach to households	• Experience and process of conducting outreach to households in Mtendere • Initial level and change in knowledge of households about water and sewer connections • Successes and challenges of outreach
Project oversight (MWH and SMEC)	2-4 interviews[b]	All	• Experience of infrastructure construction and takeover, including success and challenges • Experience of TA, including successes and challenges implementing recommendations related to NRW and asset management • Successes and challenges of integrating social inclusion and gender mainstreaming into organization • NRW • Influence of new developments and other projects (such as LSP) on the organizational structure and LWSSD-related outcomes • The extent to which the organization can carry out its role in the absence of the project • Financial and political sustainability of LWSC / LCC

[a] These Ministries include the Ministry of Water Development, Sanitation, and Environmental Protection; the Ministry of Housing and Infrastructure Development; the Ministry of Local Government; and the Ministry of Health.

[b] Depending on the information available in reports produced by these entities, we might determine that some of these interviews are not needed. We do not plan to interview UWP or Seureca because their information should be available in documents we will review and would also be included in SMEC's perspective (since SMEC is the aggregator of information from the contractors and consultants).

Data collection timeline. Interviews for the implementation study will take place during the 2018-2019 data collection round. In 2018, we will focus on understanding the current status of implementation and learning about any decisions about how to prioritize remaining activities before the end of the compact, taking advantage of the fact that the compact is still active to interview consultants, contractors, and MCA-Z staff in addition to staff at LWSC and LCC. In 2019, we will focus on talking to those who oversee the continuation of LWSSD activities in the post-compact period. This would include interviewing representatives at MPCA, the new drain maintenance unit at LCC, and the new SWM utility.

3. Analysis plan

The implementation study will rely on information extracted through systematic document review and coding of primary qualitative data. We will follow best practices for collecting and organizing these data, including setting up structured formats for extracting text from documents and working with verbatim transcriptions of recordings from interviews and focus group discussions. We will use the following analytic methods.

Thematic framing for qualitative data. As an initial step, we will read through the transcripts and obtain a holistic sense of the data. We will then develop a detailed initial coding scheme which we will apply as we systematically review data from the different respondents and documents. The coding scheme will allow us to categorize respondents' comments and document excerpts under key topics and subtopics aligned with the evaluation questions and project logic (for example, codes might include "implementation challenges," "non-revenue water," and "cost of water"). Based on the coded data we will identify key themes across all respondents and among subgroups according to respondent characteristics (including gender, whether or not the household has a connection to the piped water network, etc.) in order to take into account similarities as well as differences in perspectives across different respondent groups. We will use qualitative data analysis software such as NVivo to manage the raw data, codes, and respondent characteristics.

Triangulation. Triangulation involves testing for consistency in results or findings across several data sources and methods of inquiry (Patton 2002). It facilitates confirmation of themes or findings and the identification of important discrepancies across qualitative data, documents, program monitoring data, and secondary data sources. It also reduces the potential for inaccuracies that arise from a largely retrospective review.

Contribution analysis. Building on the triangulation process and using the framework of the project logic, contribution analysis aims to determine the strength of the evidence on the contribution of various elements of the LWSSD project on outcomes anticipated in the project logic. The first step in contribution analysis involves compiling evidence on activities implemented, outputs, and outcomes and on assumptions underlying the results chain shown in the logic model. The next step focuses on critically examining the strength of the evidence supporting the achievement of outputs and outcomes and linkages, giving considerable weight to stakeholder perspectives on the program's contribution or influence, as well as evidence of the influence of other factors on outcomes (Mayne 2008). Contribution analysis complements triangulation by looking at activities and results in a broader context to identify where attribution is appropriate and robust, as well as any major shortcomings in initiative design, implementation, and achieved outcomes.

Political economy analysis. To understand implementation challenges and successes, examine how institutions are changing as a result of the TA activities and other simultaneous factors external to the LWSSD project, and assess the sustainability of policies and practices adopted as a result of the TA, we will use frameworks from political economy analysis as a guide for instrument development and as a lens when reviewing the qualitative data. Broadly, our political economy analysis will examine (1) how power and resources were distributed and contested during implementation of the LWSSD project and (2) the implications of these dynamics for (a) the evolution of management practices LWSC, LCC, and the new SWM utility, and (b) the benefits and obligations of being connected to the piped network among households that benefit from CP3 and CP5 (Poole 2011). Our interview guides will include questions for each type of respondent about the "rules of the game" (both formal regulations and cultural norms) that govern how they interact with other actors engaged in or affected by the LWSSD project. Such interactions could include official communications between LWSC and NWASCO, LWSC's response to a household that is delinquent on its bill, or a household's strategies to hide the fact that it is stealing water from LWSC's network. A key step in political economy analysis is mapping the relationships between actors, which in the case of the LWSSD project would include leaders and staff at various government entities at the national and city levels, utility managers and staff, and consumers. As we facilitate the interviews and analyze the qualitative data, we will be looking for indications of who has power in each of these relationships and what mechanisms each actor uses to exert influence.

E. Infrastructure sustainability study

1. Methodology

Our infrastructure sustainability study will consider whether there is evidence that the interventions (particularly InfrA, the NRW and asset management TA to LWSC, and the TA to LCC) have resulted in strengthened and protected water supply, sewer, and drainage networks (evaluation question #2) that are sustainable (i.e., continues to function as designed, thanks to proper operation and maintenance). More specifically, the infrastructure sustainability study will explore LWSC's success in implementing and maintaining a life-cycle centric approach to asset management (evaluation question #5) and long-term sustainability of drainage (evaluation questions #6 and 8). It will also explore the sustainability of LWSC's NRW activities as these pertain to operations and maintenance, although NRW reduction will be evaluated to a greater extent in our financial sustainability study (evaluation question #3).

We will provide an assessment of the sustainability of the infrastructure assets that were constructed or rehabilitated by LWSSD through a combination of an **institutional capacity sub-study**—an examination of whether organizational structure and resources, maintenance and inspection processes, and asset management practices at LWSC and LCC have changed in a manner consistent with the sustainable management of infrastructure—and **a physical infrastructure sub-study**—a comparison of the maintenance activities and physical condition of the assets in 2021 to their condition at the time of delivery.

2. Data sources

Institutional capacity sub-study. ISA activities that target institutional changes at LWSC and LCC have already begun. Therefore, to understand the baseline condition for institutions, we

will rely on reports from consultants who assessed baseline institutions at each organization and on retrospective questions during our interviews and focus group discussions that ask respondents to compare institutions before and after the project. Reports that describe the baseline include:

- Progress reports by Seureca's NRW team on their TA activities, including the consumer census and database updates, which describe LWSC's maintenance practices related to NRW reduction.
- The Task 4 report produced by Seureca's Asset Management team, which assesses LWSC's asset management practices at baseline
- Early technical audits of LWSC's performance toward targets in the Sustainability Agreement provided by Antonaropoulos & Associates
- The Task 1 assessment report produced by Seureca's Drainage and SWM team, which provides an assessment of LCC's baseline capacity for drainage and SWM

To learn about how institutional outcomes are evolving, we will conduct interviews with staff at LWSC and LCC in both data collection rounds (2018-2019 and 2021). Table IV.6 describes the respondents we anticipate interviewing and the topics of discussion for each.

Physical infrastructure sub-study. Our understanding of the baseline condition of infrastructure will be based on reviews of project documentation conducted as part of our implementation study. Specifically, we will review engineering manuals and specifications to learn what was initially intended for each construction package, and will compare these initial expectations with implementer reports—such as the risk registers and descriptions of Taking-Over Certificate (TOC) processes for each construction package in SMEC's progress reports—to better understand what was finally delivered. The list of sustainability indicators to complete during our observations will be derived in part from the findings of our engineering consultant during the design trip, and will also factor information from O&M manuals that will be provided for each construction package. Table IV.7 contains a list of illustrative indicators that will be refined once we review O&M manuals. In cases where sustainability indicators are not achieved as expected, we will note cases where alternative maintenance practices took place and whether these are sufficient, even if not initially recommended in the O&M manuals.

To learn about the condition of infrastructure at endline, we will conduct direct observations during the 2021 round of data collection. We anticipate that, by this time, assets will have been in use for a sufficient amount of time to allow us to assess their sustainability. In addition, waiting more than two years will allow maintenance practices to stabilize and allow organizational capacity at LWSC and LCC to adjust to accommodate the new infrastructure and the recommendations from ISA implementers.

We may also have an opportunity to examine the sustainability of some assets in late 2018, since some assets—such as the Kaunda Square sewage ponds—will have been in use for several months by then. We will consider whether there is sufficient value to sending either our engineering consultant or a local consultant to conduct observations in late 2018 based on the timing of the handover of assets this year, the types of analysis required to assess the sustainability of the assets that are handed over early, and documentation on the post-TOC

condition and maintenance of assets from MCA-Z. For example, if a sufficient number of assets were put into use early enough that their operation and maintenance has stabilized by late 2018, and if the condition of those assets can be examined through direct observation, we will consider conducting observations of those assets in late 2018 and discussing our findings in the interim evaluation report.

Table IV.6. Primary data collection for the infrastructure sustainability study

Respondent(s)	Number of focus group discussions or interviews	Illustrative topics
Senior management at LWSC and LCC	8 interviews (6 from LWSC; 2 from LCC)	• Organizational structure for inspection, maintenance, and repair activities • Strategic asset management policy and plan • Resources available to staff • Changes relative to before the project, and perceptions of the project's effects
Inspection, maintenance, repair, and call center staff at LWSC and LCC **(NRW leak detection team members for LWSC; drainage maintenance unit for LCC)**	2 focus group discussions (one at each organization)	• Roles and responsibilities • Processes and procedures for inspection, maintenance, and repairs • Frequency of inspection and maintenance • Frequency and nature of repairs and repair calls • Resources available • Changes relative to before the project, and perceptions of the project's effects • Examination of work schedules and logs of inspection, maintenance, and repair dates
Desk staff who keep asset records **(EDAMS team for LWSC and drainage maintenance unit for LCC)**	2 interviews or focus group discussions (one at each organization), depending on how many staff are involved in these activities	• Roles and responsibilities • Processes and procedures for asset record entry and updating • Resources available • Changes relative to before the project, and perceptions of the project's effects • Demonstration of competency in use of EDAMS database for asset management • Examination of EDAMS database asset data – asset inventory hierarchy, data validation, asset condition, job cards created • Customer satisfaction and records of complaints and resolutions.

Table IV.7. Illustrative indicators of physical infrastructure sustainability

Construction package(s)	Illustrative indicator(s)
CP 1 and 2 - Core water network rehabilitation, including complete overhaul of the Iolanda treatment plant plus refurbishing reservoirs and core network pipes in the city	• Appropriate operation of both intake levels in Kafue intake station to minimize siltation • Appropriate cleaning of screens at intake station • Care of pumps at intake station • Use of the new coagulant and its effectiveness in improving water quality • Appropriate backwashing of the sand filters • Adherence to safety precautions for chlorine gas • Use of the lab to test water for total dissolved solids (TDS), biochemical oxygen demand (BOD), and chemical oxygen demand (COD) • Operations adjusted to account for varying levels of silt in intake water • Routine repair of protective coatings to pipe • River water level monitoring occurs • Frequency and duration of Iolanda plant outages • Throughput (at Iolanda plant and distribution centers) • Water quality and chlorination at distribution centers and other network points (using CDC data)
CP 3 - Rehabilitation and extension of water and sewer networks, including household connections for extension work, in Mtendere; water connections in Kamanga and other areas of Chelston	• Frequency of sewer blockages on properties • Chambers free flowing without standing effluent • Lift stations fully operational • Presence and quality of haunching in inspection chambers • Number of leaks per km of network • Take-up of connections
CP 4 - Rehabilitation of Kaunda square sewage ponds	• Screen cleaning and gravel removal • Vegetation removal • Use of the dredger for sludge collection • Sludge is present in the drying beds and organic material is being bagged and sold • Dredging operational practice is protecting against pond liner damage • Surface water skimming occurring as recommended • System throughput matches design • Quality and flow of outflow and inflow • Observance of safety practices for maintenance work
CP 5 - Rehabilitation and extension of water network in Kwamwena, Ndeke-Viorna Valley, Chipata, Ngombe, and SOS Village	• Extraction does not exceed safe yield • Groundwater quality near new wellfields
CP 6 - Construction to reduce NRW technical losses, including replacement and installation of leaking main pipes, inaccurate water meters, and leaking household connections	• Number of DMAs successfully isolated of sections of the network into DMAs • Periodic quantification of technical losses • Regular preventative maintenance of valves used to isolate the DMSs (staff days per quarter) • Maintenance of screens allows system to flow freely

Construction package(s)	Illustrative indicator(s)
CP 7 and 8 - Bombay drain improvements	• Lack of solid waste in drains and drains flowing freely • Side culverts feeding into drains are clear • Sections of drain remain aligned
CP 10 - Mazyopa drain improvements, including the Mazyopa trash trap	• Free-flowing channel at trash trap, functioning and cleaning of sediment basin • Regularly cleaning of the trash trap/lack of trash accumulation • Water levels and flows downstream of CP 10 works

We will examine whether the improvements to SWM organizational procedures and practices have resulted in increasing quantities of waste arriving at the landfill facility, rather than informally disposed of on private land and fly tipped on waste land and drainage channels.

3. Analysis plan

We will use the same methods for qualitative analysis described in section IV.D.3 (i.e., thematic framing, triangulation, contribution analysis, and political economy analysis) to assess changes in institutional capacity at LWSC and LCC and the subsequent effect on sustainability of the physical infrastructure. We will be looking for evidence on the likelihood that assumptions from the project logic are borne out, and in particular that:

- LWSC uses increased funds to invest in long-term O&M (causal link 8)
- Better financial and O&M planning improves LWSC's capacity for improved long-term O&M. NRW TA and asset management TA effectively helps LWSC establish an institutional framework and develop the necessary leadership and technical expertise to manage O&M in the long run[11] (causal link 9)
- Improved drain maintenance ensures the drainage system's continued capacity to handle rainfall, thus decreasing flooding (causal link 20*)

Institutional capacity sub-study. We will use document review and primary qualitative data to examine whether institutional elements at LWSC and LCC have changed, and whether changes are consistent with the sustainable management of infrastructure. This sub-study will begin with each organization's structure, including an assessment of the following:

- Personnel—we will examine whether each organization has adequate staffing for maintenance, inspection, record-keeping, and valuation of infrastructure assets; this will include examining whether these positions are filled and whether staff have sufficient time dedicated to these duties and the training they need to be able to fulfill their responsibilities.
- Resources—we will assess whether these teams have the resources to do their jobs, including testing and maintenance equipment, electronic devices and software for record keeping, transport, and dedicated budgets.

[11] Although we will evaluate outcomes related to NRW reduction more fully in our financial sustainability study, NRW reduction is also relevant to O&M if it increases resources available for O&M through greater revenues.

- Agency, authority, and accountability—through a political economy framework, we will study whether these teams and staff have the agency and authority to do their jobs effectively, and whether there is internal accountability for and verification of the performance of their duties.

The indicators we use for this sub-study will be guided by the organizational structure recommendations of ISA implementers, such as reports from Seureca's asset management team on LWSC and reports from Seureca's drainage and SWM team on LCC and the new SWM utility. Interviews with staff at LWSC and LCC will allow us to better understand the organizational structure and reporting hierarchy for staff responsible for infrastructure, the resources available to them, and the agency they have to perform effectively.

Next, we will examine whether maintenance, inspection, and asset management record-keeping processes have changed through a review of the policies and procedures at LWSC and LCC before and after LWSSD. Our understanding of other policies and procedures that should be assessed will be guided by our engineering consultant, O&M manuals for each of the CPs, and recommendations for best practices from ISA implementers such as Seureca's asset management and NRW teams. As an example, we anticipate assessing whether each organization has procedures in place for preventative maintenance, and to identify the assets most in need of repair, maintenance, and replacement. In our review of policies and procedures, we will not only seek out statements of policies and descriptions of the appropriate processes, but will also look for evidence during site visits to LWSC and LCC that processes have been put into practice and are conducted in a timely manner. For example, we will examine whether the EDAMS database at LWSC contains an active asset register listing recently acquired assets, and will observe work schedules and logs of inspection dates, regular maintenance activities, and repair activities for each asset to determine whether these activities are carried out in a timeframe consistent with the long-term sustainability of infrastructure. During our interviews with the staff responsible for these activities, we will also ask questions to understand whether regular maintenance and inspection activities are carried out on schedule, how repairs and emergencies are handled, whether the number of catastrophic failures and emergencies has been reduced, and whether staff face any challenges in conducting their duties.

As part of this sub-study, we will also examine whether the lab equipment provided by the project—including the inductively coupled plasma (ICP) spectrometer and LabWare software—led to any changes in water quality monitoring procedures. To do this, we will include questions about water quality monitoring when discussing changes in procedures and practices during our interviews, and will also leverage data from CDC's tests of water quality in the distribution network to see whether there is evidence that any practices discussed in the interviews have been successfully implemented.

Physical infrastructure sub-study. Under the guidance of our engineering consultant, we will assess the condition of infrastructure assets and the prospects for their long-term sustainability. The assessment will compare the condition of assets after they have been put into use to their baseline condition at the time of delivery, and will take into account the expected rate of deterioration for each asset given appropriate maintenance. In addition, we will examine whether there is evidence of regular inspection and maintenance and will seek opportunities to observe maintenance activities directly. We will take a flexible approach to judging how LWSC

and LCC are conducting maintenance. Although our first step will be to investigate whether maintenance practices are followed as provided in the O&M manuals, we will also explore whether maintenance deviations are acceptable. We intend to use our local consultant to conduct the first observations of infrastructure sustainability and use the time of our engineering consultant to probe whether alternative maintenance practices are up to standard.

F. Financial sustainability study

1. Methodology

A central piece of the outcomes study will be a study of the financial sustainability of LWSC, LCC, and the new solid waste utility. This study will consider the evidence that the interventions have resulted in the outcomes in the project logic (evaluation question #2), and more specifically the implicit subsidy and indicators such as NRW, the collection ratio, and tariff adequacy (evaluation question #3) and the long-term financial sustainability of the new drain maintenance unit within LCC and the new SWM utility (evaluation question #6). For the purposes of this evaluation, we define sustainability to mean that the utility has sufficient revenues to cover its operating costs. A naïve definition of operating costs might only include the utility's current practices, but financial sustainability actually requires that the utility have sufficient resources for preventative maintenance and replacement of exhausted infrastructure to keep the system operating at its design capacity. We propose a wider breadth of analyses for LWSC relative to the other two entities, consistent with the project's emphasis on LWSC as the primary recipient of infrastructure and TA, although we will also explore how the project has affected the financial sustainability of LCC's new drain maintenance unit and the new SWM utility. At the time of writing this report, we still do not have complete information about how these two new entities will be structured, constraining our ability to fully develop our data collection and analysis plans, which we anticipate developing further as more information becomes available.

2. Data sources

We will primarily rely on LWSC's quarterly reports (Box IV.1), since we anticipate that these will be available and will contain consistently defined indicators both at baseline and throughout the evaluation period.[12] We do not expect to have access to comparable data from LCC or the new solid waste utility, but we will also leverage reports by the TA providers which might contain relevant information, such as Seureca's NRW team's progress reports on the consumer census and database updates and Seureca's drainage and

Box IV.1. Indicators available from LWSC quarterly reports

- Gross profit margin (percent)
- Net profit
- Gross revenue
- Net revenue (less sales adjustments)
- Operating cost coverage ratio (percent)
- NRW (percent)
- Collection ratio (percent)
- Collection efficiency (percent)
- Staff per 1000 connections
- Number of customer connections
- Number of metered connections
- Water production (m^3/day)

[12] In addition to LWSC's reports, we are aware of two additional sources of data for LWSC's finances and water services: the technical audits produced by Antonaropoulos & Associates and the database provided by the International Benchmarking Network for Water and Sanitation Utilities (IBNET) available at https://database.ib-net.org. However, because the technical audits will not be available for future time periods, and because IBNET data appear to be published approximately two years after LWSC's reports for the same time period, we do not anticipate using either of these sources as the primary indicators for our analysis.

SWM team's inception report which describes the baseline situation prior to the creation of the new utility and the expectations for how it will operate.

In addition to the document review, we will include questions related to financial indicators and operational processes that contribute to these indicators in our qualitative interviews with TA providers, NWASCO, and senior managers at LWSC, LCC's drain maintenance unit, and the new solid waste utility.

Finally, we will attempt to obtain some disaggregated data from LWSC to help us better understand their operations and finances. In particular, we will work with them to obtain statistics comparable to what is in the quarterly report, but limited to just Lusaka City (since LWSC's service area extends beyond the city into other towns which do not benefit from the infrastructure and some aspects of the TA, such as the customer database update). We will also attempt to obtain data on the volume of water consumed, revenues, and the number of connections in the CP3 and CP5 neighborhoods.

3. Analysis plan

The financial sustainability study will make use of more quantitative data (indicators of financial health), but the analysis approach will still be largely qualitative as we triangulate between the quantitative and qualitative data to try to understand the project's contributions to any trends we might observe, recognizing that other influences on LWSC, LCC's drain maintenance unit, and the new SWM utility could either bolster or detract from any possible improvements set in motion by the LWSSD project. We will use the same methods for qualitative analysis described in section IV.D.3 (i.e., thematic framing, triangulation, contribution analysis, and political economy analysis based on verbatim transcripts of recorded interviews). We will use the political economy framework to help understand the balance of these forces and why LWSSD activities might have been more or less effective at prompting the desired changes. We will be looking for evidence on the likelihood that assumptions from the project logic are borne out, and in particular that:

- New water supply infrastructure leads to new customers. Water pipes built in areas where potential customers live, and households in new connection areas want to and are able to sign up for water and sanitation services (causal links 1 and 3).
- Strengthened water supply reduces physical losses, and expanded opportunities for theft are mitigated effectively by LWSC (causal link 2*).
- Installation of new meters and customer database cleanup at LWSC allows LWSC to bill customers who previously were not paying for all the water they consume, including those who previously received only estimated bills and those with illegal connections These customers, including residential, business, and government customers, subsequently pay their bills (causal link 2).
- The poor are more likely to sign up for and pay for services (part of causal link 5).

- Reduced non-revenue water improves the financial stability of LWSC (causal link 6*).
- Paying customers increase LWSC revenue. The revenue new customers—many of whom are low income and likely subsidized—bring in more than compensates for the additional cost of providing them with water services (causal link 6).
- Effective financial and O&M planning improves financial stability at LWSC. Improved management—along with the increased revenues discussed above—compensate for the increase in expenses that come with the addition of new infrastructure and new household connections (causal link 7).
- LWSC uses increased funds to invest in long-term O&M (causal link 8).
- Better financial and O&M planning improves LWSC's capacity for improved long-term O&M. TA effectively helps LWSC establish an institutional framework and develop the necessary leadership and technical expertise to manage O&M in the long run (causal link 9).

a. LWSC

Operating cost coverage based on current practices. We will begin our analysis of LWSC's financial sustainability by examining changes in LWSC's operating cost coverage (the ratio of costs to revenues). We will explore the extent to which these changes are reflective of changes in Lusaka versus other municipalities under its purview since the construction packages and some of the NRW TA focus only on Lusaka city and not the rest of the province. To better understand how LWSC's financial situation is caused by and affects service provision in Lusaka specifically, we will work with LWSC to see if they could provide disaggregated statistics that would allow us to examine indicators such as:

- the proportion of water supplied to Lusaka;
- the percentage of customers who are in Lusaka;
- the share of LWSC owned by LCC versus other municipalities; and
- the share of revenue and costs (or at least staffing) associated with Lusaka, if available.

Operating cost coverage including preventative maintenance. If LWSC's current practices do not include preventative maintenance, an assessment of its present costs and revenue may not provide a complete picture of its future financial health. For example, if LWSC consistently defers routine maintenance and inspection tasks, its cost coverage ratio may appear strong, but its assets may be at a higher risk of catastrophic failure, leading to much higher future costs and adverse impacts on Lusaka residents. To provide a better picture of LWSC's financial sustainability, we will leverage information from the infrastructure sustainability study on the adequacy of LWSC's inspection, maintenance, and repair practices to comment on how these factors could impact current and future costs.

We will also attempt to determine the effect of externally provided resources—such as funding and equipment provided by donor projects—on LWSC's financial health, and will comment on how dependence on external resources may positively or negatively affect the sustainability of its financial status. To do this, we will leverage information on the Kafue Bulk project and LSP, and will also request information from LWSC and include questions in our

interviews with LWSC senior management on the extent to which these and projects either directly finance LWSC operations or provide services that replace LWSC's services.

In the rest of this section, we describe several sub-studies we plan to undertake to explore factors that underlie the cost recovery ratio.

Implicit subsidies. We will use the **Hidden Cost Calculator** (Ebinger 2006) to estimate changes over time in the extent to which LWSC's revenue from water provision may be inefficient. The Hidden Cost Calculator calculates the difference between actual revenues and the revenues from fully efficient operations according to the following equation:

$$H = Q_e\left(T_c - T_e\right) + \frac{Q_e T_c\left(l_m - l_n\right)}{\left(1 - l_m\right)} + Q_e T_e\left(1 - R\right)$$

where

Q_e = end user consumption
T_c = average cost-recovery price
T_e = weighted average end user tariff
l_m = total loss rate
l_n = normative loss rate
R = collection rate

We will rely on LWSC quarterly reports for $Q_e, T_e, l_{m,}$ and R. T_c should reflect the costs of preventative maintenance, but based on what we heard during our January 2018 mission to Lusaka, LWSC might not be able to estimate these costs. We will estimate T_c based on Seureca asset management TA team's recommendations to LWSC. Finally, following Ebinger (2006), we will assume $l_n = 0.2$

The components of the equation can be divided into three categories of potential inefficiency:

1) $Q_e\left(T_c - T_e\right)$: tariff and billing structure losses, including losses due to a tariff that doesn't cover the costs of water production or due to estimated billing for unmetered customers;

2) $\frac{Q_e T_c\left(l_m - l_n\right)}{\left(1 - l_m\right)}$: unaccounted losses, including leakage and unauthorized use beyond the expected or normative rate; and

3) $Q_e T_e\left(1 - R\right)$: losses from uncollected bills.

Taken together, losses in these categories are referred to as implicit subsidies. Because the model separately calculates inefficiencies from these three categories, we will also use it to examine the relative magnitude of changes in hidden costs associated with each category. Since some amount of water loss is expected in any system, we will examine the sensitivity of

estimated hidden costs in the "unaccounted losses" category to various normative rates of water loss.

Changes in the financial health of LWSC could be attributable to influences other than the project. To better understand how project components affected any changes we observe, we will conduct two analyses that shed light on whether the outputs that the project was designed to improve have been realized: a NRW reduction analysis and a new extensions analysis.

NRW reductions. To understand how project components to address NRW have succeeded, we will conduct an analysis that separately examines each source of NRW targeted by the project, using the American Water Works Association's water balance taxonomy (Figure IV.3).

Figure IV.3. Sources of NRW

<table>
<tr><td rowspan="9">System input volume (corrected for known errors)</td><td rowspan="4">Authorized consumption</td><td rowspan="2">Billed authorized consumption</td><td>Billed metered consumption</td><td rowspan="2">Revenue water</td></tr>
<tr><td>Billed unmetered consumption</td></tr>
<tr><td rowspan="2">Unbilled authorized consumption</td><td>Unbilled metered consumption</td><td rowspan="7">Non-revenue water</td></tr>
<tr><td>Unbilled unmetered consumption</td></tr>
<tr><td rowspan="5">Water losses</td><td rowspan="3">Apparent losses</td><td>Unauthorized consumption</td></tr>
<tr><td>Customer metering inaccuracies</td></tr>
<tr><td>Systematic data handling errors</td></tr>
<tr><td rowspan="3">Real losses</td><td>Leakage on transmission and distribution mains</td></tr>
<tr><td>Leakage and overflow at utility's storage tanks</td></tr>
<tr><td>Leakage on service connections up to point of customer metering</td></tr>
</table>

Source: American Water Works Association 2012

- **Real losses (leaks) and unauthorized consumption.** The Hidden Cost Calculator provides an estimate of "total losses"—including leakage and unauthorized consumption—using the difference between water supplied to the system and end user consumption. We anticipate that directly estimating the extent to which these losses are driven by leaks will be challenging and infeasible within our scope. We will use AWWA's methods for estimating real losses. We will also attempt to estimate the extent of unauthorized consumption using data collected by Seureca's NRW team on the number of "illegal connections" and through our interviews with LWSC management.
- **Apparent losses from systematic data handling errors.** One potential source of NRW is the consumption of water by customers who are missing from LWSC's customer billing database. Seureca's NRW team made efforts to reduce these losses by conducting a census of potential customers in Lusaka to be integrated into LWSC's customer database. To measure the extent of losses from this source at baseline, we will leverage findings from Seureca's NRW team on the number of customers in their census that were not listed in

LWSC's database, and will estimate the losses owing to these missing customers based on the average consumption per meter. To estimate the extent to which this has improved as a result of the project, we will also leverage observations from our implementation study that indicate whether LWSC's database was successfully updated using Seureca's census, and assess LWSC's practices to keep the customer database current during our 2021 data collection round.

- **Apparent losses from customer metering inaccuracies.** LWSC may lose revenue if its estimates of consumption are inaccurate. Inaccuracies may be due to faulty meters, poor estimates of consumption for unmetered customers, or systematically underreported consumption by meter readers (either intentionally or unintentionally). We will leverage our interviews with Seureca's NRW team for the implementation study to explore whether Seureca's efforts to add new meters to the water lines of customers with no meters or potentially faulty meters provide a direct source of data for the extent to which consumption estimates are inaccurate for customers with faulty meters or no meters.[13] We will also leverage our interviews with LWSC staff to learn about the current processes they follow to determine whose consumption will be billed using meters, and how consumption and billing is estimated for others. During our interviews with LWSC management, we will ask how LWSC ensures that large consumers in particular have accurate meters and we will probe the extent to which meter readers provide inaccurate readings.
- **Unbilled authorized consumption.** As discussed in the Project Overview section, a substantial source of revenue loss prior to the compact was unbilled water consumption from government bodies. While a conditions precedent required that the government start paying its water bills, the most recent sustainability audit notes a sharp decline in LWSC's bill collection from the government in 2016 (Antonaropoulos & Associates 2017). In addition, stakeholders noted during our design trip that there was a risk that the government would stop paying once the compact ended. During our meetings with LWSC's NRW team in the 2018 and 2021 data collection rounds, we will ask questions to better understand the status of this revenue source during and after the compact, and will examine through a political economy lens the causes of and potential solutions to any lapses in payment.

New extensions. If we are able to obtain the necessary data from LWSC, we will estimate revenues and growth in residential connections for neighborhoods with new water extensions to see whether these neighborhoods affect LWSC's financial sustainability in the ways anticipated by the project's logic model. For example, we will assess whether newly connected peri-urban neighborhoods (such as Mtendere and Chipata) are associated with lower revenue per connection than middle class neighborhoods (such as Kwamwena and Ndeke-Viorno Valley). In addition, we will comment on whether the "virtuous cycle" predicted by the logic model—in which improved financial sustainability leads to improved service, which in turn attracts more usage and improves financial sustainability—appears to be occurring.

Since unit costs of water distribution may vary across neighborhoods, and since we do not expect to obtain neighborhood-level costs from LWSC, we do not anticipate calculating cost

[13] In initial meetings with Seureca's NRW team during our design trip, Seureca indicated that they are adding meters to some customer lines for diagnostic purposes. However, we do not yet know how these customers are selected, or what diagnostics are being performed.

coverage ratios or net profit at the neighborhood level. Instead, we will comment on the range of costs in each neighborhood that would be required for each neighborhood to be self-sustaining or to cross-subsidize other areas. We will also attempt to compare maintenance expenses between CP 3 and CP 5 neighborhoods and other parts of the city with older pipes since we would expect maintenance costs to be lower in the newly served neighborhoods.

Tariff adjustments. As part of their TA to LWSC, Cowater is assessing the adequacy of the current tariff schedule and is planning to propose revisions to the schedule. To complement this work, we will examine the process required to adjust the tariff schedule and the feasibility of making adjustments. While we have learned that NWASCO can adjust LWSC's tariff if LWSC can demonstrate that the tariff structure does not cover their costs, through our qualitative interviews we will gather information from NWASCO and LWSC about how the "cost plus" tariff model is implemented in practice and whether LWSC's current cost and revenue monitoring practices are sufficient to provide the information required by NWASCO to make adjustments.

b. LCC

Because many of LCC's activities are not relevant to LWSSD and a new utility is being created to take over SWM from LCC, our analysis of the financial sustainability of LCC will focus on its drainage maintenance activities. Because we do not anticipate any direct revenue streams from drainage services, our analysis will focus on assessing LCC's costs relative to the amount of funding it receives for drainage maintenance activities.

Cost assessment. Our first step will combine two elements: 1) an assessment of changes in LCC's actual drainage maintenance costs relative to the amount of funding it receives for cost-bearing activities; and 2) an assessment of the costs associated with sustainably managed and maintained infrastructure, based on the findings of the infrastructure sustainability study. Drawing from discussions during our design trip, we anticipate that the funding available for drainage maintenance may be shared with other priorities, and that costs may also not be systematically recorded. Therefore, we will also seek to learn about the security of funding for drainage maintenance, and anticipate that data on actual costs and funding will be obtained through interviews with manager-level staff in addition to financial documentation from LCC. To understand the costs associated with sustainably managed infrastructure, we will triangulate data on actual costs, any information from the stormwater management master plan that helps quantify the costs associated with sustainable practices, and information from interviews with LCC staff. Our analysis will be guided by our engineering consultant. We will also attempt to learn, through our interviews, whether and how the improvements to the Bombay and Mazyopa drains have affected costs or funding for drainage maintenance, and whether any costs are borne by residents downstream of the drainage improvements, where flooding could occur.

Reasons for cost findings. Our next step will be to learn the reasons for our findings regarding funding, actual costs, and sustainable costs. For example, if actual costs are very similar to the amount of funding available, we will explore whether this is because expenditures are constrained by limited funding, whether funding is set to match proposed costs, or another reason. If costs are substantially less than funding, we will investigate whether this is because funding is truly in excess of requirements for sustainable drainage maintenance, because actual expenditures are less than those consistent with sustainable practices, because funding nominally

available for drainage maintenance is not actually earmarked or accessible for this purpose, or another reason. We anticipate that this analysis will be guided by our political economy lens and based on interviews conducted during the 2018 and 2021 data collection rounds with LCC staff and other stakeholders who understand the incentives and political constraints under which LCC staff operate, such as staff at the Ministry of Finance or the Ministry of Housing and Infrastructure Development.

c. The new SWM utility

As discussed above, a new utility is being formed to take responsibility for Lusaka's SWM services. Because the utility's formation is still in early stages, our plan for assessing its financial sustainability is preliminary and will continued to be refined as new information becomes available. Our final plan will depend on 1) the structure of the new utility—including the services it provides, whether it will have revenue sources, and how it will otherwise be funded—and 2) the sources of data available for the new utility.

We currently anticipate a twofold approach. First, we will conduct an analysis of total costs, funding sources, and any revenue sources similar to the overall financial health analysis described for LWSC above. If the utility's purview extends beyond the city of Lusaka or beyond SWM activities, we will seek to obtain either financial indicators that are specific to Lusaka's SWM services or indicators that help understand the extent to which total costs, funding, and revenue pertain to Lusaka's SWM services—such as the percentage of total customers visiting the dump site who live in Lusaka, or the share of the utility owned by LCC versus other municipalities. To measure changes over time, we will attempt to compare costs, funding, and revenue at the new utility to baseline costs and funding associated with LCC's SWM activities.

Second, we will compare actual costs to the costs associated with sustainable SWM practices using a process similar to what is described above for LCC, and will comment on whether funding and revenue sources are adequate for sustainable practices. As with LCC, we will attempt to learn the underlying reasons for any findings regarding financial sustainability, guided by our political economy lens.

G. SIGM, IEC, and SM study

1. Methodology

Our SIGM, IEC, and SM study will examine the institutional effects of TA that focused on building the capacity of LWSC, LCC, and the new SWM utility to address the needs of low-income residents and women (SIGM) and to improve communications regarding behavior change, safety, uptake of services, and care of physical assets (IEC and SM).[14] This study will consider the evidence that the interventions have resulted in the outcomes in the project logic (evaluation question #2), and more specifically the improvements in SWM and drain maintenance (evaluation questions #6 and #8); the contributions of the IGP to household-level outcomes (evaluation question #7); IEC and SM associated with the infrastructure works (evaluation question #9); and changes in LWSC and LCC's abilities to provide gender-

[14] The effects of these activities on customers will be studied in the beneficiary study.

responsive, appropriate, affordable, and sustainable services for the poor and to plan, develop, and manage IEC and SM campaigns in the future (evaluation question #10).

2. Data sources

To identify the outcome indicators we will assess, we will draw from the implementation study's findings on 1) the TA activities conducted by Cowater and their community mobilizers along with recommendations in Cowater's final reports, including policies, staffing considerations, budget items, services, and campaigns that the target organizations should be implementing; and 2) the work done by Seureca's SWM team to institute inclusive policies in the new SWM utility.

We will then interview staff at LWSC, LCC, and the new SWM utility to assess progress on SIGM, IEC, and SM goals. Table IV.8 summarizes the interviews we will conduct in both rounds of the evaluation.

Table IV.8. Primary data collection for the SIGM, IEC, and SM study

Respondent(s)	Number of focus group discussions or interviews	Illustrative topics
Senior management at LWSC, LCC, and the SWM utility	3 interviews (one at each organization)	• Policies and organizational structure (including staffing and budget) to support SIGM and IEC activities • Changes relative to before the project, and perceptions of the project's effects - New means for customers to interact with the service provider, new systems for communicating with and following up with customers, new services offered, new payment options, etc.
Staff involved with SIGM, IEC, and SM at LWSC, LCC, and the SWM utility	3 focus group discussions or interviews, depending on the number of staff involved (one at each organization)	• Roles and responsibilities • Resources available • Mechanisms for supporting SIGM across the entity's operations • IEC and SM activities undertaken in communities - Operations at the SCAP office in Mtendere (LWSC only) • Changes relative to before the project, and perceptions of the project's effects - Challenges encountered within the entity and interfacing with communities - Progress within the entity and interfacing with communities

3. Analysis plan

We will use the same methods for qualitative analysis described in section IV.D.3 (i.e., thematic framing, triangulation, contribution analysis, and political economy analysis) to assess changes in institutional capacity at LWSC, LCC, and the new SWM utility. We will be looking for evidence on the likelihood that assumptions from the project logic are borne out; in particular that:

- …[H]ouseholds in new connection areas want to and are able to sign up for water and sanitation services (causal link 3).
- …[R]esidential… customers subsequently pay their bills (causal link 2)
- LWSC develops sufficient SIGM and IEC capacity and systems to improve WASH service provision, access, affordability, and sustainability (SAAS) for the poor. LWSC develops policies that effectively include women and poor households in its services, and continues to have the capacity to implement gender and social inclusion programs (causal link 4).
- Improved WASH SAAS makes it easier for the poor to pay for water services, so they are more likely to sign up for and pay for services (causal link 5).
- IEC effectively changes individuals' hygiene behavior and is institutionalized so that activities continue in the future (causal link 18*).

Triangulation with findings from the beneficiary study described in the next section will be especially important, since the institutional changes at the three entities are intended to result in better outcomes at the household level.

H. Beneficiary study

1. Methodology

In our beneficiary study, we will examine the extent to which the project activities resulted in the outcomes outlined in the project logic (evaluation question #2), including customer satisfaction and improved household knowledge, attitudes, behaviors related to payment for water, sewer, and SWM services. Our beneficiary study will complement the CDC's impact evaluation, which will estimate changes in service coverage, water usage, health, and time savings attributable to the LWSSD project, though neither our beneficiary study nor the CDC's impact evaluation will be able to separately identify the effects of individual components of the project. That said, as noted in Table IV.2, our beneficiary study will explore the potential contributions of certain project components in particular, including the IGP (evaluation question #7), IEC and SM during the construction phase (evaluation question #9), and SIGM and IEC TA (evaluation question #10). Triangulating between IGP project documents and data collected for the beneficiary study, with context from the implementation study, we will investigate the extent to which the IGP contributed to household outcomes in the specific areas where those projects were active. The construction IEC and SM, and SIGM and IEC TA can be more plausibly linked to household-level outcomes, though it might be difficult to distinguish between the effects of the direct IEC and SM delivered during the construction phase and the longer-term effects of the SIGM and IEC TA to LWSC, LCC, and the new SWM utility.

2. Data sources

Additions to the CDC endline household survey. Table IV.9 lists the key indicators for our beneficiary study, which we propose be added to the CDC's endline household survey instrument. This is a preliminary list that will be updated depending on what we learn from the implementation study. In particular, we might suggest adding questions to track coverage of IGP grantees' programs in certain neighborhoods, or suggest adding questions to track the effects of specific approaches undertaken through SCAP to encourage households to connect to the water

and sewer networks. We anticipate that too much time will have elapsed between delivery of the initial IEC and SM messaging and the CDC's endline for it to be feasible to include questions tracking exposure to those campaigns, but we will reassess based on the findings of the implementation study. When developing our recommendations for additions to the CDC's survey, we will work with LWSC, LCC, and the new SWM utility to draft questions that could capture awareness of and satisfaction with new community engagement tactics and messages that have been catalyzed by the SIGM TA.

Primary qualitative data collection. We plan to conduct focus group discussions with members of targeted beneficiary households during our 2018-2019 data collection round and again during our endline round in 2021. The timing of our first round of focus group discussions was originally intended to allow an opportunity for households to connect to water and sewer networks that might not be completed until after the compact ends. We plan to conduct these focus group discussions in mid-2019 regardless of the status of construction to capture beneficiaries' perspective on the progress of the works, and to take a snapshot of household outcomes in between the CDC's two household survey rounds. The second round of focus group discussions will allow us to gauge how outcomes have continued to evolve over the medium term as the infrastructure requires maintenance and the effects of the TA on management of LWSC, LCC, and the new SWM utility matures. Findings from the CDC's baseline survey and our implementation study will provide a starting point from which to develop protocols for household focus group discussions that can go more in depth.

We plan to conduct 24 focus group discussions in our 2018-2019 round (22 in 2021), including respondents in each of the neighborhoods targeted by InfrA (aside from CP1 and 2 which benefit the entire network and CP4 since the households it serves are upstream of the benefits). At the request of MCC's Environment and Social Protection team, we will also conduct two focus group discussions with LRP participants to assess the effects of the program on their ability to recover income lost when construction projects rendered their previous livelihoods impossible (the implementer has already conducted a short-term evaluation using a matched-comparison group design, which we will use to inform development of our protocol for the focus group discussions with LRP participants). Topics to be covered in each FDG, including the characteristics of respondents, are summarized in Table IV.10. By recruiting diverse participants, we hope to cover a range of perspectives. In choosing the distribution of FGDs across topics, we try to balance the need to answer many research questions against the necessity to go in depth for each topic.

To supplement our findings in the focus group discussions on experiences with SWM, we will also try to obtain data on the quantity of residential waste delivered to the dump. The quantity of trash delivered to the dump is an indicator of improvements in SWM services, both from more households being served by trash collection services and from more trash being collected from those who already had service.

Table IV.9. Illustrative indicators proposed as additions to the CDC endline survey instrument

Topic	Already included in the CDC's baseline	Additional indicators proposed
Connections to new sewage and water networks	• Whether the household is connected to the water and sewer networks	• Whether the sewer/water network reaches their home • Reasons the household has or has not connected to the sewer/water network (categorical responses including costs, perceived quality of service, logistical challenges, etc.) • Perceived benefits/drawbacks of connecting to the network (categorical responses) • Awareness of requirement to connect to the sewer network according to the Public Health Act • Status of decommissioning the pit latrine • Presence of a bathing facility
Quality of service and satisfaction with water service	• Number of days in past week that water was available from the drinking water source • Average number of hours per day that water was available from the drinking water source	• Among kiosk users and households connected to the network: split supply availability into continuity of supply (days per week and hours per day when water service is typically available) and supply disruptions (deviations from regular intermittent supply) • Among connected households: satisfaction with LWSC service provision - overall - quality of water - availability of supply - information received from LWSC - responsiveness to complaints and service requests
Quality of service and satisfaction with sewer service	Disposal of other items (toilet paper, newspaper, sanitary pads, garbage, nappies/diapers, other) into the toilet or latrine	Among connected households: • Frequency of blockages in the network • Response time from LWSC to clear blockages
Quality of service and satisfaction with SWM service	• Garbage disposal methods • Who collects the garbage • Amount paid per month	• Awareness of SWM utility, franchises, and CBEs • Availability of trash collection services • Experience with services, including affordability, timeliness of collection, interactions with the utility or trash collectors, and perceived quality of services • Perceptions of cleanliness of streets and drains • Satisfaction with conditions at the local waste collection site (if applicable)

TABLE IV.9 (*continued*)

Topic	Already included in the CDC's baseline	Additional indicators proposed
Knowledge, attitudes, and behaviors regarding service costs and payments	[none]	Separately for LWSC and SWM services: • Comprehension of tariff structure for water (among connected households), sewer (among connected households), and SWM (all households) • Mode of payment (cash versus using mobile banking) • Satisfaction with payment options • Frequency of payment • Partial or full payment

Table IV.10. Summary of qualitative data collection for beneficiary study

Respondents	Number of focus group discussions (per round)	Project activities	Illustrative topics
CP3 households: Mtendere East (water & sewer)	4 (2 each with connected and unconnected households; for each type of household, 1 with women and 1 with men)	IEC Expansion and rehabilitation of water and sewer networks SCAP	• IEC during construction (2018-2019 only) • Access to water - For connected households: exposure to IEC and SM, why they chose to connect to the network, experience with connecting to the network, availability of funding for connections, satisfaction with water availability and reliability - For unconnected households: exposure to IEC and SM, whether network access was available, and if so, why they chose not to connect; experiences with kiosk access, satisfaction with water availability and reliability • Access to sewer network - For connected households: reasons for connecting, the ease of connecting their homes and toilets to inspection chambers, whether sewage backups occurred, toilet financing and construction options - For unconnected households: whether sewer access was available, and if so, why they chose not to connect • Perceptions of LWSC - Utility's customer outreach, gender, and social inclusion efforts
CP3 households: Mtendere West (sewer only)	4 (2 each with connected and unconnected households; for each type of household, 1 with women and 1 with men)	IEC Expansion and rehabilitation of sewer networks SCAP	• IEC during construction (2018-2019 only) • Access to sewer network - For connected households: exposure to IEC and SM, reasons for connecting, the ease of connecting their homes and toilets to inspection chambers, whether sewage backups occurred, toilet financing and construction options - For unconnected households: exposure to IEC and SM, whether sewer access was available, and if so, why they chose not to connect • Perceptions of LWSC - Utility's customer outreach, gender, and social inclusion efforts

Table IV.9 (*continued*)

Respondents	Number of focus group discussions (per round)	Project activities	Illustrative topics
CP5 households: Kwamwena and Ndeke-Vorna Valley (middle-income)	2 (mix of men and women)	IEC Expansion and rehabilitation of water networks	• IEC during construction (2018-2019 only) • Access to water - For connected households: why they chose to connect to the network, experience with connecting to the network, availability of funding for connections, satisfaction with water availability and reliability - For unconnected households: whether network access was available, and if so, why they chose not to connect; experiences with kiosk access, water availability, and reliability
CP5 households: low income households with new kiosk access	2 (women only)	IEC Expansion and rehabilitation of water networks	• IEC during construction (2018-2019 only) • Access to water - Experiences with kiosk access, water availability, and reliability • Perceptions of LWSC - Utility's customer outreach, gender, and social inclusion efforts
CP6 households (2018-2019 only)	2 (women only)	IEC Water network rehabilitation Meter replacement or rehabilitation	• IEC during construction (2018-2019 only) • Whether households received new/improved meters - If so, experiences with new/improved meters and billing • Experiences with improved water network
CP7, 8, 10 households: **near drains**	2 (women only)	IEC Drainage improvements	• IEC during construction (2018-2019 only) • Perceptions of frequency and severity of flooding • Experiences with flooding, including environmental and health hazards • Property damage from flooding • Impacts of flooding on ability to engage in work or attend school • Impacts of flooding on travel time
CP7, 8, 10 households: **drainage catchment area**	2 (women only)	Drainage improvements	• Same as above (possibly excluding IEC), to compare experiences for households of varying distance to improved drains

Table IV.9 (*continued*)

Respondents	Number of focus group discussions (per round)	Project activities	Illustrative topics
CP7, 8, 10 business owners: **along drains**	2 (one each with men and women separately)	IEC Drainage improvements	• IEC during construction (2018-2019 only) • Perceptions of frequency and severity of flooding • Property damage from flooding • Impacts of flooding on productivity, and revenues • Frequency and duration of business closure due to flooding • Impacts of flooding on travel time
CP7, 8, 10 households: **downstream of new drains**	2 (women only)	Drainage improvements	• Same as above (excluding IEC), to compare experiences for households of varying distance to improved drains, and in particular, capture the possibility for increased flooding downstream of the drainage improvements
LRP participants	2 (one each with men and women separately; mix of business types)	LRP	• Extent to which LRP improved participants' business and technical skills and reasons why/why not • Extent to which participants' new business have succeeded and why/why not • Extent to which LRP improved participants' income and employment and reasons why/why not • Extent to which participants' new businesses and training have affected family members' employment • Impact of new livelihoods on participants' home and family life

3. Analysis plan

We will use the same methods for qualitative analysis described in section IV.D.3 (i.e., thematic framing, triangulation, contribution analysis, and political economy analysis) to assess changes in outcomes at the household level. For indicators that were included in the CDC baseline survey, we will explicitly examine evidence for whether several of the project logic assumptions detailed in Table IV.1 held, including:

- …[H]ouseholds in new connection areas want to and are able to sign up for water and sanitation services (causal link 3).
- …[R]esidential… customers subsequently pay their bills (causal link 2)
- Improved WASH SAAS makes it easier for the poor to pay for water services, so they are more likely to sign up for and pay for services (causal link 5).
- IEC effectively changes individuals' hygiene behavior and is institutionalized so that activities continue in the future (causal link 18*).

For indicators which are only being added to the CDC survey in the endline round, we will not be able to do any sort of comparative analyses, but rather will factor it into our contribution analysis.

I. Investment study

1. Methodology

The investment study addresses evaluation question #4: "How did the use of the Sustainability Agreement, and the Lusaka Water Supply and Sanitation Master Investment Plans by LWSC, MCC, MCA-Zambia, other donors, and the government contribute to additional investments and the overall sustainability of water and sanitation sectors?" To answer this, we will assess the extent to which:

- other investments in Lusaka's water, sanitation, drainage, and solid waste infrastructure or services occur as a result of LWSSD ("crowding in") or might be reduced as a result of LWSSD ("crowding out")
- any subsequent projects leverage the master plans or lessons learned from LWSSD to improve their efficacy
- any concurrent or subsequent projects could affect the outcomes we will study as part of our evaluation

Studying whether LWSSD led to crowding in, crowding out, or adjustments to the strategies employed by other projects will add breadth to our assessment of the project's overall effects. Understanding how other projects may have affected the same outcomes we study will improve our ability to attribute outcomes to the project versus other activities occurring in Lusaka at the same time.

We anticipate that the LSP will be a key focus of this analysis, due to its large scale and its potential to have effects on LWSC's structure and its customers within our evaluation's

timeframe. LSP is a five-year program that aims to improve sanitation infrastructure and management in Lusaka and is based on the sanitation master plan designed as part of LWSSD. It comprises a total investment of 240M euros from four donors: the European Investment Bank, the KfW Development Bank, the African Development Bank, and the World Bank.

LSP has the potential to interact with LWSSD in several ways. First, LSP may affect the same outcomes as LWSSD. For example, LSP's infrastructure components may affect sanitation-related outcomes for the same beneficiaries as LWSSD. Second, one of LSP's components is an organizational restructuring of LWSC. This could mean, for example, that the individuals being trained at LWSC under LWSSD are reassigned to different roles, or that some components of the technical assistance planned under LWSSD must be postponed while the reorganization occurs. Lastly, LSP's implementation team includes several LWSC staff and is housed within LWSC. This could potentially mean that individuals well placed to effect changes recommended by LWSSD are occupied with LSP implementation.

Another project we will monitor is the Kafue Bulk Water Supply project, a $150M investment undertaken by the Government of Zambia thanks to a loan from the EXIM Bank of China to extract, treat, and pipe to Lusaka an additional 50M cubic meters of water per day from the Kafue River. Water supplied through the project may increase the load on core distribution network assets being rehabilitated under LWSSD's CP1 and CP2 investments, and could affect the outcomes of households that are potential beneficiaries of LWSSD. In addition, both CP1 and the Kafue Bulk Water Supply project will increase the rate of water extraction from the Kafue River, potentially impacting water levels and the sustainability of the river as a source of water.

In addition to these projects, we will monitor other developments in Lusaka that are potentially relevant—such as the Lusaka Water Security Initiative (LuWSI), a multi-stakeholder initiative to improve collaboration around water resource-related research and advocacy in Lusaka—and will be attentive to the possibility that new projects may emerge as relevant.

2. Data sources

To conduct the investment study, we will rely on the following data sources:

- **Documentation from other donor-funded projects** such as LSP and the Kafue Bulk Project will help us understand the extent to which these projects exist because of LWSSD ("crowding in"), or adopted policies, principles, or lessons learned from LWSSD. Documentation will also help us understand whether the outcomes affected by each project potentially overlap with those that LWSSD could impact.
- **Interviews with LWSC managers** will help us understand whether LWSSD has changed their vision or practice for the management of subsequent donor-funded projects, and whether LWSSD crowded out or diminished support for other investments. We will also assess whether the demands of managing large infrastructure projects or other TA engagements distracts LWSC leadership, staff, and financial resources from the maintenance required to sustain the infrastructure and management practices supported by LWSSD.
- **Interviews with the Ministry of Local Government and Housing and the Ministry of Water Development, Sanitation and Environmental Protection, in addition to a review of the Sustainability Agreement and the Lusaka Water Supply and Sanitation Master**

Investment Plans will help us track whether other investments in LWSC or LCC have taken place post-compact through the private sector, international donors, or the government, and the extent to which these have been influenced by LWSSD.

- On a case-by-case basis, we will consider whether it is of sufficient value to conduct interviews with the leadership or staff of other projects to better understand how each project might be relevant for our evaluation of LWSSD.

We envision conducting no more than six to eight interviews for the investment study, which we will undertake in both the 2018-2019 and 2021 round to assess changes over time and reflect new projects developed in the interim.

3. Analysis plan

We will use the same methods for qualitative analysis described in section IV.D.3 (i.e., thematic framing, triangulation, contribution analysis, and political economy analysis) to assess how the LWSSD project, and the master plans that grew out of the compact development process, have changed the funding landscape for water, sanitation, drainage, and SWM in Lusaka, and how this has affected LWSC's operations.

J. Data collection plan

Table IV.11 summarizes the planned primary data collection across all studies in the first round of the evaluation. Because we will not be interviewing MCC, MCA-Z, project implementers, and oversight entities at endline, there will be approximately half as many interviews although the number of focus group discussions will hardly change.

Table IV.11. Primary data collection

	2018-2019		2021	
Study	Maximum number of interviews	Maximum number of focus group discussions	Maximum number of interviews	Maximum number of focus group discussions
Implementation	48	1		
Infrastructure sustainability	(8)	4	8	4
Financial sustainability	(10)		10	
SIGM, IEC, and SM	(3)	3+(1)	3	3
Beneficiary		24		22
Investment	(8)		8	
Total	**48**	**32**	**29**	**29**

Note: Parentheses indicate interviews with respondents who are included in the implementation study and thus do not count again toward the total number of interviews.

Staffing. Due to the relatively low number of interviews and focus group discussions planned under this evaluation, the high fixed costs of adequately training a local firm, and the quality risks inherent in subcontracting data collection, Mathematica plans to have its own staff

and consultant(s) conduct the interviews and facilitate the focus group discussions. Mathematica's consultants will transcribe and translate the focus group discussions and any interviews that are not conducted in English (see the discussion of data quality processes below). English interviews will be transcribed either by a local firm or one based in the U.S. depending on the price, quality, and timeline. Mathematica will be responsible for all coding and analysis.

Data quality processes. The success of the evaluation depends on the collection of high quality data, particularly the accuracy, reliability, and timeliness of the data. Close interaction with and oversight of local consultants and any firms engaged for transcription and translation services throughout the data collection process will be essential to ensuring data quality. Mathematica's researchers will conducting pre-testing and piloting activities to ensure the effectiveness of field protocols and instruments. After interviews are conducted, we will review a sample of qualitative data collection transcripts to verify them against the recordings from the interviews and focus group discussions.

K. Challenges and limitations

- **Attribution to LWSSD versus other projects and events.** As noted in the description of the investment study, there are several other projects that could be influencing the same outcomes that the LWSSD project was targeting. Without a counterfactual for LWSC and LCC in the absence of the LWSSD project, it is not possible to know what changes in outcomes are due to LWSSD versus the other projects that are also under way. The cholera outbreak of late 2017-early 2018 is another good example of an event that was unrelated to the LWSSD project but which could have led LWSC to be on a different trajectory (specifically, one in which quality of water and continuity of supply are higher priorities, leading to more emphasis on maintenance and attention to proper chlorination in particular). Our contribution analysis approach will triangulate between various data sources to assess the extent to which the LWSSD project likely contributed to the changes over time.
- **Inability to separately identify effects of specific project components.** As depicted in the project logic, InfrA and ISA and their sub-activities complemented one another and jointly influenced the targeted outcomes, making it difficult to know exactly which activities or sub-activities were driving the effects. For example, in Mtendere, households could benefit from network extensions and improvements in service quality thanks to the ISA TA to LWSC. Using the project logic as our analytical framework, the qualitative data collected through the implementation study will be our best resource for comparing the relative contributions of different project activities to each outcome of interest.
- **Lack of baseline household survey data on key outcomes related to SIGM and financial sustainability of water, sewer, and SWM services.** Because this evaluation was only commissioned as the project was almost completed, there was no opportunity to collect baseline data that could be used to measure changes in outcomes related to perceived service quality or household knowledge, attitudes, behaviors related to payment for services. Luckily, it seems there is an opportunity to leverage the endline household survey round planned as part of the impact evaluation to cost-effectively collect at least one round of data on these outcomes. The qualitative data (which can include retrospective comparisons) will hopefully help contextualize that single observation, suggesting the extent of improvements that could be due to LWSSD.

- **Difficulty differentiating LWSC outcomes in Lusaka City versus the rest of LWSC's service area.** The LWSSD project focused on infrastructure improvements to LWSC's network in Lusaka City specifically, whereas the utility generally does not disaggregate performance indicators for the city versus the rest of its service area. Consequently, there is a risk that improvements in service provision in Lusaka City might be obscured when averaged across the rest of the utility's service area that did not benefit from the infrastructure investments or some of the TA activities (such as the census of customers to reduce commercial losses). We will endeavor to work with LWSC to understand the extent to which improvements might be attenuated if LWSC is not able to report on Lusaka City specifically.
- **Uncertainty regarding the nature of the new SWM utility.** At the time that this design report was being drafted, the SWM utility still had not been created. Without clarity on its mandate and business model, it is difficult to know exactly what data we should collect or from whom. We will continue to update plans for the financial sustainability and beneficiary analyses as the plans for the new utility are finalized.
- **Paucity of baseline data on drainage and SWM services.** LCC has not maintained transparent records of the costs of maintaining the drainage network or providing SWM services prior to the LWSSD project. Without such data, it is impossible to quantify the reduction in subsidies required by the new model of drain maintenance under a separate unit at LCC and an autonomous SWM utility.

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V. UPDATING THE ERR

After concluding the evaluation, we will compute the post-compact ERR using updated estimates of benefits and costs. This post-compact ERR will not only enable MCC and other stakeholders to determine whether the LWSSD project was a sound investment (by comparing the ERR to MCC's "hurdle rate" of 10 percent) but will also permit a comparison to other actual or possible investments.

Most of the impacts that drive the ERR calculations are under the purview of the CDC impact evaluation rather than our evaluation. Reductions in NRW losses are the one benefit stream in the ERR that will come from our performance evaluation, so we will use our findings on NRW in conjunction with the CDC's data to produce the post-compact ERR estimate. As discussed above, the ERR only included a reduction in physical NRW losses, but it may be appropriate to value the reduction in commercial NRW losses as well. Our evaluation will gather data on reductions in both physical and commercial water losses, creating an opportunity to include both in the re-calculation of the ERR.

The main drivers of the ERR model are presented in Table V.1. For each, we note whether the assumption is something that is addressed by the project—for example, the incidence of diseases that should be reduced by cleaner water—or is external to the project, such as population growth rates. In the third column, we summarize new data that will be available to update the ERR in 2021.

For our ex-post ERR we will use MCC's ERR model and update parameter values wherever possible based on data from the evaluations and other available data, as presented in Table V.1. In the course of our evaluation, we may discover costs or benefit streams not included in MCC's ERR model. If the data for these cost/benefit streams are available either through our evaluation or through other sources, we consider whether it is feasible to add these costs and/or benefits to an updated model based on the one originally developed by MCC. If we determine that a more substantial revision to the model would be necessary but infeasible to undertake given the budget for this activity, we will at least offer suggestions for alternative methods for modeling costs and benefits based on the findings of the evaluation. Suggestions for alternative modeling approaches might be helpful for ERR models for future projects.

Table V.1. Data for the updated ERR

Key assumptions	Addressed by the Project?	New data available to update ERR?
Time savings from water supply and drainage improvements		
Time spent collecting water, before and after the project	Y	The CDC's baseline survey collected data on time spent collecting water and the same questions will be included at endline. Data from the two survey rounds can be used to update the amount of water collection time saved in the ERR.
Value of time (also included in health benefits below)	N	Alternative data sources for wages are available from the World Bank, and can be incorporated into the updated ERR.
Travel time saved from reduced flooding	Y	The CDC included travel time in their baseline survey but found very small increases in travel time during floods, so they are unlikely to measure travel time at endline. We will include perceptions of changes in travel delays due to flooding in the qualitative data collection for the beneficiary study, but based on the CDC's baseline results, it will probably make the most sense to remove this benefit stream from the ERR.
Health benefits		
Disease incidence (infectious diarrhea, intestinal nematodes, malaria, lymphatic filariasis, and schistosomiasis)	Y	Prevalence and incidence of diarrhea in the past 7 days was included in the CDC's baseline survey and will also be included at endline. Since the CDC did not collect baseline prevalence or incidence for other disease outcomes, we would either need to (1) find an alternative source that would have both pre- and post-LWSSD estimates for Lusaka, (2) make informed assumptions, or (3) remove these benefit streams from the ERR.
Stunting	Y	We will not have estimates of stunting, as it is a long-term outcome beyond the timeframe of the project. MCC extrapolated from estimated diarrhea incidence to estimate stunting, so we can make similar estimates using updated rates of diarrhea.
LWSC revenue benefits from a reduction in NRW		
Reduced NRW	Y	Our evaluation will include estimates of NRW based on LWSC's quarterly reports. MCC's ERR included only physical losses, but we could incorporate commercial losses as well, since both are included in the quarterly reports.
Avoided property damages		
Value of property damage due to flooding	Y	The CDC's baseline business survey collected data on property damages incurred due to flooding. The CDC is not likely to repeat the business survey at endline, so we have incorporated focus group discussions with business owners to gauge changes. We can include informed assumptions in the updated ERR.
Avoided loss in value added		
Productive time lost due to flooding	Y	The CDC's baseline business survey asked about the amount of productive time lost in floods. Estimates of value added came from a World Bank enterprise survey that estimated the total value of all economic activity in Lusaka. These data will only be updated if the World Bank or another entity conducts another survey in the future. As for the value of property damage due to flooding, we can include informed assumptions based on our qualitative data collection in the updated ERR.

Key assumptions	Addressed by the Project?	New data available to update ERR?
Project costs		
Costs from MCC and the Government of Zambia	Y	The current ERR calculation uses both estimated project cost data from MCC and estimated cost data on sanitation connections and maintenance that are borne by the Government of Zambia. Our post-compact evaluation will have access to final implementation cost data from MCC that we can use to update the calculations. We will also attempt to gather up-to-date cost data from the Government of Zambia on connections and maintenance.
Overarching assumptions		
Number of program beneficiaries	Y	A major assumption underlying all benefits, as well as some of the costs, is the number of people benefitting from project activities. As the project progresses we will update the number of beneficiaries of each activity.

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VI. EVALUATION ADMINISTRATION AND MANAGEMENT

In this chapter, we discuss several administrative issues relevant to managing the evaluation and present a timeline of the evaluation activities.

A. Summary of institutional review board requirements and clearances

Mathematica is committed to protecting the rights and welfare of human subjects and will prepare and submit an application for approval of the research and data collection plans to an institutional review board (IRB) registered with the Office for Human Research Protections within the U.S. Department of Health and Human Services. We intend to use Health Media Lab as our US IRB, based on our positive experience with it on previous MCC projects. We will also seek local IRB approval from the University of Zambia's Biomedical Research Ethics Committee. We will submit the required documents, including a research protocol providing details of the study and data collection activity, copies of all data collection instruments, and a completed IRB questionnaire that summarizes the key elements of the research protocol and plans for protecting participants' confidentiality. The data collection instruments that we will prepare and share with the IRB will include consent statements approved by MCC that guarantee the confidentiality of respondents to the extent possible.

We will provide evidence of IRB approvals to MCC. IRB approval is valid for one year and we will submit annual renewals for subsequent approvals as data collection proceeds through follow-up collection processes. We expect that the annual renewals will require minimal updates to the core application materials, because we will collect similar data to track over time. If data collection instruments change substantially from those that the IRBs approved, then we will reapply for review. Small changes to the instruments (such as rewording of questions, reordering of questions, or editing changes) do not require reapplication, but the finalized instruments must be submitted to the IRBs for documentation. We will submit the instruments for review in English to Health Media Lab and in both English and Nyanja to the University of Zambia.

B. Data protection

Mathematica and its consultants will ensure confidentiality of all respondents, including confidentiality of participating in the data collection, confidentiality of personally identifiable information, and other sensitive data. For the primary qualitative data to be collected under this evaluation, the Mathematica team will ensure the safe handling and transfer of electronic files, and ensure that they are stored on Mathematica's secure server. Data files will be accessible only to project team members who clean or analyze the data. All project team members have signed a nondisclosure agreement pertaining to confidential information. If needed, electronic data files will be shared with Mathematica using a secure file transfer system, such as a file transfer protocol, file exchange website (FX site), or a SharePoint site. For internal control and audit purposes, if any paper forms are used, Mathematica will identify a mechanism for storing these data for the entire duration of the project, which includes the base contract and the subsequent option contracts. All of the data collected using the evaluation budget are the property of Mathematica and will be delivered to Mathematica at the end of the contract. All files with sensitive information, including those for secondary data analyses and document review, will be stored in a designated encrypted project folder, which is secured with AES 256-bit encryption.

C. Preparing data files for access, privacy, and documentation

After producing and finalizing the interim and final evaluation reports, we will prepare corresponding de-identified data files, users' manuals, and codebooks for the qualitative data according to the most recent guidelines set forth by MCC. We will work with MCC's Disclosure Review Board to find a mutually agreeable solution regarding the necessity and potential to create de-identified data files. Public use data files will be free of personal or geographic identifiers that would enable unassisted identification of individual respondents or their households, and we will remove or adjust data that introduce reasonable risks of deductive disclosure of the identity of individual participants.

D. Dissemination plan

The Mathematica team will produce a policy brief for the interim and final results that will include a core set of results and lessons. We will also present both the interim and final evaluation findings in person to MCC, technical and non-technical project stakeholders, and policymakers in Zambia. Furthermore, we will participate in any other MCC-financed dissemination and training events related to the findings from the interim and final evaluation reports. We expect the broader research community to have strong interest in the findings from the evaluation. To facilitate wider dissemination of findings and lessons, we will collaborate with MCC and other stakeholders to identify additional forums—conferences, workshops, and publications—to disseminate the results and encourage other donors and implementers to integrate the findings into their programming.

E. Evaluation team's roles and responsibilities

Our team has extensive experience and expertise in evaluation design, data collection, and analysis to meet MCC's evaluation needs. **Dr. Clair Null** oversees the project team and provides technical leadership. She is responsible for managing the evaluation team, leading the design and implementation of the evaluation, and contributing to and overseeing data collection efforts. Dr. Null also monitors the project's budget and schedule, and she manages communication with MCC, local partners, and other stakeholders. **Mr. Randall Blair** will serve as the task lead for qualitative data collection and analysis. **Dr. Paolo Abarcar** works alongside Dr. Null and Mr. Blair to conduct and oversee data collection and contribute to the analyses and reporting on all components of the evaluation. **Ms. Elena Moroz**, the junior analyst on the team, will provide support for instrumentation development, data collection management, data analysis, and reporting. **Dr. Evan Borkum** will provide quality assurance reviews for all key deliverables for this project.

Mathematica is working closely with a team of expert consultants with a unique combination of the qualifications and skills needed to conduct a successful evaluation of the LWSSD. **Dr. Loay Hidmi** is a civil engineer who serves as the water utility management specialist on the team. **Mr. Stephen Clamp** serves as the water, sanitation, and drainage engineer on the team, and is responsible for advising on protocols for field observations of the infrastructure. **Mr. Rueben Lifuka**, a political economist and solid waste specialist, will assist with developing qualitative instruments, recruiting stakeholders to participate in key-informant interviews, and analyzing the qualitative data using political economy frameworks. **Ms. Muleya Sonde** and **Ms. Grace Msichili** are our local data collection consultants, responsible for

conducting focus group discussions, overseeing transcription and translation, and contributing to analysis of the qualitative data. The local data collection consultantswill also arrange site visits of Mathematica personnel, keep our team apprised of program developments, and assist with communications with MPCA, LWSC, and LCC after MCA-Z closes.

F. Evaluation timeline and reporting schedule

The evaluation activities presented in Table VI.1 below will include an interim and final round of data collection. We expect the interim data collection to begin in the 3rd quarter of 2018 with two more rounds of interviews and focus group discussions occurring in Q2 and Q3 of 2019, depending on when project activities are completed. We plan to submit the interim report in two installments: the implementation study findings in Q2 of 2019 and the findings from all other components of the evaluation by the end of 2019. The final round of data collection will begin in late 2021. We will conduct data cleaning and analysis in 2022. We expect to submit the final evaluation report, which will integrate findings from all evaluation components, by the 3rd quarter of 2022, again incorporating feedback from stakeholders after the presentation of the draft report.

Table VI.1. Evaluation timeline

Round	Data collection	Data cleaning and analysis	First draft report expected	Final draft report expected
Interim	Q3 2018, Q2 and Q3 2019	Q3 2018 – Q4 2019	Q4 2019	Q1 2020
Final	Q3-Q4 2021	Q1 2022	Q2 2022	Q3 2022

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