Pre-Intervention, Baseline Report:
Lusaka Water Supply, Sanitation, and Drainage (LWSSD) Project

Water supply, sanitation, and drainage conditions in Lusaka, Zambia, 2016-2017

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From: Centers for Disease Control and Prevention (CDC): Lusaka Water Supply, Sanitation, and Drainage (LWSSD) Project Evaluation Team: Joan Brunkard, PhD, Martin Meltzer, PhD, Jennifer Murphy, PhD, Sydney Hubbard, MPH, Lauren Cunningham, MPH, Sunkyung Kim, PhD, Seonghye Jeon, PhD, Manjunath Shankar, PhD, Bishwa Adhikari, PhD

To: Millennium Challenge Corporation

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DISCLAIMER: The findings and conclusions of this report are those of the authors and do not necessarily represent the official position of the U.S. Centers for Disease Control and Prevention (CDC).

List of Acronyms

ARI	Acute Respiratory Infection
BOD	Biochemical Oxygen Demand
BREC	Biomedical Research Ethics Committee
CBD	Central Business District
CDC	United States Centers for Disease Control and Prevention
CFU	Colony Forming Units
CP	Contract Package
CSO	Zambian Central Statistics Office
DD	Difference in Differences
DMA	District Metering Area
ERR	Economic Rate of Return
FCR	Free Chlorine Residual
GIS	Global Information Systems
GPS	Global Positioning System
GRZ	Government of Zambia
HH	Household
HPC	Heterotrophic Plate Count
IEC	Information, Education and Communication
IRB	Institutional Review Board
IQR	Interquartile Range
LCC	Lusaka City Council
LWSC	Lusaka Water and Sewerage Company
LWSSD	Lusaka Water Supply, Sanitation, and Drainage Project
M&E	Monitoring and Evaluation
MCA-Z	Millennium Challenge Account Zambia
MCC	Millennium Challenge Corporation
MDG	Millennium Development Goals
mg/L	Milligrams per Liter
MOH	Zambian Ministry of Health
MOU	Memorandum of Understanding
NTU	Nephelometric Turbidity Units
P.I.	Principal Investigator
PPM	Parts per million (equivalent to milligrams per liter, mg/L)
PSM	Propensity Score Matching
PSU	Primary Sampling Unit
PUA	Peri-Urban Area
QA/QC	Quality Assurance/Quality Control
SEA	Standard Enumeration Area
SFTP	Secure File Transfer Protocol
SOP	Standard Operating Procedures
SRS	Simple Random Sample
SSU	Secondary Sampling Unit
TSS	Total Suspended Solids
USG	United States Government

UTH	University Teaching Hospital
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization
WTP	Water Treatment Plant
ZABS	Zambia Bureau of Standards
ZMW	Zambian kwacha

1. Executive Summary

Background

In Lusaka, the capital city of Zambia, the water and sanitation infrastructure was built in the 1960s and 1970s when the population was less than 300,000 residents. System maintenance and construction of new infrastructure have not kept pace with population growth – as of 2010 Lusaka District had 1.7 million residents (Central Statistics Office, 2012), and by 2035, the population is projected to exceed 5 million (Millennium Challenge Corporation, 2012). The government of Zambia (GRZ) has identified lack of water and sanitation infrastructure as a key constraint to economic growth. Consequently, GRZ is implementing a large-scale, 5-year Lusaka Water Supply, Sanitation and Drainage (LWSSD) project aimed at improving and expanding the city's water supply, sanitation, and drainage infrastructure. It is anticipated that such improvements and expansions will facilitate economic growth by reducing the negative economic impact of factors such as waterborne diseases (e.g. diarrhea and respiratory infections), the time households spend collecting water, and the impact of flooding on both businesses and households.

Project funding

The US $354 million funding for the LWSSD project was granted through the Millennium Challenge Corporation (MCC), a development agency of the United States, and is being implemented by the Millennium Challenge Account – Zambia (MCA-Z), administered through the GRZ. Approximately US $190 million is budgeted for water system upgrades and expansion, US $60 million on improvements to sanitation and sewage treatment plants and collection lines, and US $95 million on improvements and upgrades to the main storm drainage network in Lusaka (the "Bombay Drain"). CDC entered into an inter-agency agreement with MCC to serve as the Independent Evaluator of the LWSSD project; this report describes the baseline findings of that evaluation, prior to any water, sanitation or drainage interventions.

Project scope and beneficiaries

The proposed improvements to the water distribution system include rehabilitation of the Iolanda Water Treatment plant, extending the water distribution network to peri-urban areas (PUAs) with few household connections (Chipata/SOS East, Ng'ombe, Kamanga), rehabilitation of poorly functioning community water kiosks (Chipata/SOS East, Ng'ombe, Kamanga, Mtendere), construction of new community water kiosks (Chipata/SOS East, Ng'ombe, Kamanga, Mtendere), and installation of household water meters (Lusaka). The Sanitation project activities will extend the sewerage network to households in a large peri-urban area (Mtendere), and rehabilitate the Kaunda Square Waste Stabilisation Ponds. Both the Water Supply and Sanitation activities are

expected to provide new infrastructure and rehabilitate existing infrastructure. The project's Drainage activities will expand and pave the Bombay Drain, which runs through a busy commercial and residential area of Lusaka. The drainage activities are expected to create new drainage infrastructure and improve the existing infrastructure, leading to decreased flooding, and thus reduction in flood-related losses in business revenue and property damage.

It has been estimated that over 1.5 million people will benefit from the project activities over a 20 year timeframe (MCC, ERR report, 2013). The number of beneficiaries by type of project intervention is shown in Table ES1. Some households and individuals would benefit from more than one activity (e.g., Mtendere will benefit from both improved water supply and sanitation).

Table ES1: Projected number of beneficiaries of the Lusaka Water Supply, Sanitation and Drainage project over 20 years[§] by intervention type, and location[**]

Intervention Type	**Water Supply**			**Sanitation**	**Drainage**
Intervention Location	System-wide[*]	Central distribution line[†]	Chelston Distribution Line[‡]	Mtendere, Kaunda Square, Chelston	City-wide (Bombay Road drain)
Total beneficiaries by intervention	860,000	318,566	250,102	155,280	188,005

*System wide improvements include rehabilitation of the pumping capacity of the Iolanda Water Treatment plant.
[†]Central water distribution line improvements will impact the following Lusaka peri-urban areas: Chipata/SOS East, Ng'ombe.
[‡]Chelston water distribution line improvements will impact the following Lusaka peri-urban areas: Mtendere, Kamanga, Ndeke/Vorna Valley, Kwamwena.
[§]ERR model projections based on 2012-2032 timeframe
[**]Some beneficiaries are counted in multiple activities, so numbers may not add up to the total number of 1.5 million beneficiaries

Project evaluation: Key indicators

The U.S. Centers for Disease Control and Prevention (CDC) proposed to evaluate the impact of the LWSSD project investments by measuring the key indicators listed in Table ES2.

Table ES2: Indicators to be measured in control and intervention peri-urban areas during the impact evaluation of the Lusaka Water Supply, Sanitation and Drainage project

Indicator	Level of Measurement
Access to improved water supply[*]	Household
Access to piped water supply in house or yard	Household
Time spent gathering water	Household and individual
Residential water consumption (liters per day per household)	Household
Prevalence of diarrhea in children <5 years old of age (7-day recall)	Household and individual
Prevalence of respiratory Illness in children <5 years old of age (7-day recall)	Household and individual
Percentage of respondents washing hands with soap	Household
Access to improved sanitation[†]	Household
Access to flush toilet connected to sewerage network	Household
Percentage of household water[‡] samples with FCR <0.2 mg/L[§]	Household
Percentage of household water[‡] samples positive for *E. coli* [¶]	Household
Percentage of household water[‡] samples with nitrates ≥50 mg/L[#]	Household
Adult employment status	Household
Average household expenditure (annualized) (ZMW)	Household
Continuity of water supply service	Household
Average household income	Household
Household garbage disposal	Household
Travel time during flooding	Individual
Frequency of flooding	Household and business
Property damage due to flooding	Household and business
Percentage of business closures due to flooding	Business

[*]Improved Water Supply: communal tap, protected well, piped water inside the house, piped water outside the house within stand/plot, piped water from neighbor, piped water from another compound, kiosk from another compound.
[†]Improved Sanitation: pit latrine with slab, ventilated pit latrine, and flush toilet.
[‡]Household water was defined as stored or point-of-consumption (POC) water; samples were collected from 1,909 intervention and 1,922 control households (3,831 households overall); in households in which both stored and POC water were tested, the least favorable value (i.e., lowest FCR result, highest *E. coli* result, highest nitrates result) of the two measures was chosen.
[§]World Health Organization (WHO) recommendation for FCR at distribution system point of delivery is ≥0.2 mg/L.
[¶]WHO guideline for drinking water is no detectable *E. coli* in a 100 mL sample.
[#]WHO guideline for nitrates in drinking water is less than 50 mg/L.
FCR: free chlorine residual
mg/L: milligrams per liter

Scope and size of pre-intervention baseline surveys

The CDC evaluation plan, finalized and approved in May 2015, includes a series of surveys to collect data to measure the indicators listed in Table ES2. The plan called for surveys to be administered twice, before and after the interventions have been implemented. This report provides results from the pre-intervention, "baseline" surveys only, before any works had been implemented. The survey type, dates of data collection and size of survey are recorded in Table ES3. Thus these results cannot, by themselves, be used to measure the impact of any project improvements. Assessment of any impact of the project improvements will require conducting a similar set of surveys *after* the infrastructure improvements have been completed. We believe that these surveys of water, sanitation and drainage conditions are among the largest and most comprehensive conducted in Africa in the past 10-15 years.

Table ES3: Pre-intervention, baseline surveys: Goals, scope, timeline

Baseline Survey	Project Component Being Evaluated	Data Collection Dates	Number of Field Staff	Surveys Completed	Data Collection Firm
WASH Survey*	Water supply and sanitation improvements	October 17th, 2016-October 26th, 2017	20-28	12,512 households; household water* testing in 3,831 households	NORC University of Chicago/ RuralNet Associates†
Household Drainage Survey	Drainage improvements	February 1st, 2016-May 6th, 2016	24	3,142 households	CDC
Business Drainage Survey	Drainage improvements	March 21st, 2016-April 15th, 2016	8	587 businesses	CDC
Traffic Drainage Study	Drainage improvements	January 28th, 2016-April 27th, 2016	31	93,392 vehicles; 420 total round trips	CDC

*Household water was defined as any household where stored or point-of-consumption (POC) water was tested. In addition; source water used by a subset of households was also tested.

†Contracted by MCA-Z to implement the CDC developed survey questionnaire and sampling design.

CDC = U.S. Centers for Disease Control and Prevention

WASH = Water, sanitation, and hygiene

Project evaluation – Design: Water supply and sanitation (WASH) survey

To assess the baseline conditions in PUAs that will receive improvements in water supply and sanitation, CDC in collaboration with NORC at the University of Chicago and RuralNet Associates, Ltd (RuralNet), conducted a Water, Sanitation, and Hygiene (WASH) survey among 12,512 randomly selected households. To account for the seasonal differences in key outcomes such as diarrheal disease incidence, data collection for the baseline evaluation occurred over a full year (October 2016 – October 2017). The survey sample was divided approximately in two – with one half of the survey being of households that are in the intervention PUAs. The intervention areas (Chipata/SOS East, Kamanga, Mtendere East/West, Ng'ombe) are all scheduled to receive modifications to the drinking water distribution system (e.g., replacement of old pipelines and kiosks, installation of new pipelines and kiosks). Additionally, Mtendere East is scheduled to receive a new sewer network. The other half of the households surveyed are designated as "control areas," and are in peri-urban areas that will not receive direct upgrades and improvements (except the rehabilitation of the pumping capacity of the Iolanda Water Treatment Plant and other proposed distribution system network improvements such as replacing damaged pipes). Control areas that had similar water, sanitation and socio-economic characteristics to the intervention areas were selected based on the most recent census data. Including control areas allows, after post-intervention data are collected, comparison of impact of both before-and-after interventions and with-and-without interventions. Including the ability to compare with-and-without interventions will allow for adjustments in assessment of project impacts due to any factors outside of the project that may impact measurement of the indicators over time (e.g., factors such as the average number of children in a household attending school could impact time spent collecting water).

Household drinking water was defined as stored water (water stored in a container within the household [e.g., buckets]) and point-of-consumption (POC) water (water contained in a vessel immediately prior to consumption [e.g., cup]). Household drinking water samples from a subset of intervention (n=1909) and control (n=1922) households were tested throughout the baseline survey time period to provide information about the quality of water consumed in survey households. Samples of source water, defined as the delivery point of water from a distribution system (e.g., municipal kiosks, household-level taps) or private borehole, from a subset of households were also tested to better assess the quality of water prior to storage in the household. Water samples were analyzed for free chlorine residual (FCR) at the point of collection and for concentrations of total coliforms, *E. coli* (a fecal indicator bacterium), and nitrates at the Zambia Bureau of Standards (ZABS) Laboratory. Results were compared to the following internationally-accepted drinking water quality recommendations: ≥0.2 mg/L free chlorine residual (FCR); no *E. coli* in 100 mL samples; and <50 mg/L nitrates. Additional water quality measures that indicate water treatment efficacy, including turbidity (source water only) and total coliforms (all sample types), were also measured.

Project evaluation – Design: Drainage-related surveys

To assess the baseline, pre-project impact of flooding in and around Lusaka's central drainage system (the Bombay Drain), CDC in partnership with MCA-Z and MCC conducted three related cross-sectional baseline surveys from January 2016 through May 2016. The household baseline drainage survey collected data from 3,142 randomly selected households in the drainage catchment area and was designed to measure, at the household level, a list of indicators similar to that shown in Table ES2. Additionally data were collected on the impact of flooding (due to overflow from the Bombay drain) on households such as flooding frequency, property damage, and travel time to work or school. The business baseline drainage survey collected data from 587 randomly selected businesses in and near the Kamwala market. The Bombay drain runs next to the market, and the business survey was designed to measure the impact of routine flooding on business activities. The third drainage baseline survey was a set of traffic (vehicle and pedestrian) flow surveys, conducted over 3 months, at 14 intersections in downtown Lusaka typically impacted by flooding, plus two other intersections unaffected by flooding. Due to the unique hydrogeology of the Bombay drain catchment area, we could not identify suitable control groups for the households and businesses next to the drain. Consequently, the impact of the drainage improvements can be assessed by before-and-after analyses of the indicators, without control groups providing a with-and-without intervention analysis.

Results – Baseline, pre-intervention: Water, Sanitation and Hygiene (WASH) survey

Table ES4 presents some of the key baseline (before improvements to water supply and sanitation conditions) indicator data collected during the large scale (approximately 12,500 households) water, sanitation and hygiene survey. Of the surveyed households, 26% (n= 3,278) reported having at least one household member with general illness (either diarrhea and/or respiratory illness) in the past 7 days; 13% (n=1,600) for diarrhea and 16% (n= 1,993) for respiratory illness only. For children under the age of five (n=8,079), 8% (n= 648) had diarrhea and 10% (n= 800) had respiratory illness in the past 7 days.

Table ES4. Pre-intervention, baseline proportions and means across all key indicators for the Lusaka Water Supply, Sanitation, and Drainage (LWSSD) project Water, Sanitation, and Hygiene survey—Lusaka, Zambia (October 2016 – October 2017)

Key Indicator	Proportion/Mean at Baseline			
	Control households (n=6229)*	Intervention households (n=6283)*	p-value	Overall households (n=12,512)*
Access to improved water supply[†]	92.2%	74.7%	<0.0001	83.5%
Access to piped water supply in house or yard	26.9%	30.4%	<0.0001	28.6%
Time spent gathering water (hours/week)	5.9	6.4	<0.001	6.2
Residential water consumption (liters per day per household)	111.8	115.6	0.04	113.7
Prevalence of diarrhea <5 (7-day recall)	7.6%	8.5%	0.2	8.0%
Prevalence of respiratory Illness <5 (7-day recall)	10.1%	9.8%	0.7	9.9%
Percentage of respondents washing hands with soap	60.5%	60.9%	0.6	60.7%
Access to improved sanitation[‡]	92.1%	91.3%	0.07	91.7%
Access to flush toilet sewerage	1.6%	0.6%	0	1.1%
Percentage of household water[§] samples with FCR <0.2 mg/L[¶]	88.8%	88.4%	0.8	88.6%
Percentage of household water[§] samples positive for *E. coli*[#]	78.3%	73.4%	0.0004	75.8%
Percentage of household water[§] samples with nitrates ≥50 mg/L**	64.5%	48.4%	<0.0001	56.5%
Adult employment status	60.1%	59.9%	0.06	60.0%
Average household expenditure (annualized) (ZMW)	31,277	32,768	<0.0001	32,000

*n may vary by small numbers due to missing values; numbers may not add to 100% due to rounding

[†]Improved Water Supply: communal tap, protected well, piped water inside the house, piped water outside the house within stand/plot, piped water from neighbor, piped water from another compound, kiosk from another compound.

[‡]Improved Sanitation: pit latrine with slab, ventilated pit latrine, and flush toilet.

[§]Household water was defined as stored or point-of-consumption (POC) water; samples were collected from 1909 intervention and 1922 control households (3831 households overall); in households in which both stored and POC water were tested, the least favorable value (i.e., lowest FCR result, highest *E. coli* result, highest nitrates result) of the two measures was chosen.

[¶]World Health Organization (WHO) recommendation for FCR at distribution system point of delivery is ≥0.2 mg/L.

[#]WHO guideline for drinking water is no detectable *E. coli* in a 100 mL sample.

**WHO guideline for nitrates in drinking water is less than 50 mg/L.

FCR: free chlorine residual; mg/L: milligrams per liter; ZMW: Zambia kwacha

When comparing the measurements of indicators collected by the household WASH survey, there were a number of statistically significant differences in intervention versus control areas. The following key indicators had a significant difference (p=<0.05): time spent gathering water, access to improved water supply, access to piped water supply in the house or yard, residential water consumption, average annual household expenditure, percentage of household water samples positive for *E. coli*, and percentage of household water samples with nitrates concentrations ≥50 mg/L. However, it is important to note that while these differences were statistically significant, some of the differences were relatively small (e.g., 111 liters vs 115 liters for residential water consumption). CDC examined the indicators by PUA to determine if specific PUAs were driving the differences (See Appendix 10, Figures 2, 4, 5 for a review of these analyses). The differences identified during the baseline survey may require adjustments to control selection for an endline evaluation, or utilization of Propensity Score Matching (PSM) or other analytic methods in analyses.

The remaining key indicators showed no statistically significant difference between intervention and control areas: access to improved sanitation, prevalence of diarrhea, prevalence of respiratory illness, percentage of respondents washing their hands with soap, percentage of household water samples with FCR that does not meet the WHO recommendation (≥0.2 mg/L), and adult employment status.

Results – Baseline, Pre-intervention, Water quality

Free chlorine residual (FCR) was measured in 3818 household water samples; 89% of all household water samples had a FCR <0.2 mg/L and therefore did not meet the WHO recommendation for FCR in drinking water (≥0.2 mg/L) (Table ES4). The mean FCR concentration for control household water samples was 0.15 mg/L (median: 0.04 mg/L) and the mean FCR for intervention household water samples was 0.12 mg/L (median: 0.04 mg/L). There were no statistically significant differences in the proportion of samples with <0.2 mg/L FCR or with FCR concentration between control and intervention household water samples.

E. coli was measured in 3771 household water samples; 76% of all household water samples were positive for *E. coli* and therefore did not meet the WHO guideline for drinking water (no *E. coli* in a 100 mL sample) (Table ES4). There was a statistically significant difference in the proportion of samples positive for *E. coli* between control and intervention household water samples (78% vs. 73%, respectively; p=0.004). The *E. coli* geometric mean for both control and intervention household water samples was 3 CFU/100 mL.

Nitrates were measured in 3749 household water samples; 57% of all household water samples had nitrates ≥50 mg/L and therefore did not meet the WHO guidelines for drinking water (<50 mg/L) (Table ES4). The mean nitrates concentration for control household water samples was 158 mg/L (median: 85 mg/L) and the mean FCR for intervention household water samples was 76 mg/L (median: 47 mg/L). There were statistically significant differences in the proportion of samples with nitrates ≥50 mg/L and

with mean nitrates concentration between control and intervention household water samples. Source water quality testing results can be found in Section 6: Findings.

Results – Baseline, pre-intervention, Drainage indicator data – Households

The baseline household drainage survey was conducted during February-May 2016. A total of 3,142 randomly-selected households were interviewed and asked about flood-related impacts; health outcomes; and economic, demographic and WASH-related factors. Sixty percent of households reported experiencing flooding during the month before the interview. Flooding was defined as 'flooding in or around your home, compound, or community.' Mean duration of flooding was 3.3 days, median 2 days (range 1-31 days). Households also reported spending significantly more time traveling to work (45 minutes versus 34 minutes, $p<0.001$) and to school (30 minutes versus 22 minutes, $p<0.001$) during periods of flooding compared to periods of non-flooding. Twenty percent of households reported having at least one member with diarrhea or respiratory illness in the prior 7 days. Diarrhea and respiratory illness were 8% and 7%, respectively among children less than 5 years old.

Results – Baseline, pre-intervention, Drainage indicator data – Business survey

Of those businesses surveyed, 477 (81%) experienced flooding in the past rainy season (defined as approximately October 2015 through April 2016). However, fewer than 28% reported shutting down due to flooding. 147 (31%) businesses reported property destruction. The average value of property destroyed was 5,675 ZMW (approximately $568) (SD: 13,867 ZMW) and 50% of business valued their property destroyed at below 1,000 ZMW (approximately $100). There were 361 (78.1%) businesses that reported a decrease in revenue because of flooding in contrast to 41 (8.9%) who reported an increase. Overall the combined reports of both increases and decreases, showed the net impact was a mean (SD) net revenue loss of 6089 (SD 10534) ZMW from 271 business. 50% of business reported a net revenue loss of 3000 ZMW (see Appendices 4-6 for complete results).

Results – Baseline, pre-intervention, Drainage indicator data – Traffic flow survey

To measure the impact of flooding on traffic flow, enumeration teams counted vehicles passing through primary, secondary and control intersections in downtown Lusaka. These intersections had been identified, with help from the Lusaka police, as most likely to be negatively impacted by flooding, to the extent that traffic is routinely disrupted (i.e., slowed) due to flooding. Enumeration teams counted vehicles at 15 intersections over 77 days. With over 90,000 vehicles counted, the main finding is that the number of vehicles passing through intersections increased by 3.6% due to rain or floods during baseline observations. For the travel time component, enumeration teams measured times on

40 routes with over 400 round trips. On average it took 1.66 minutes (3%) longer per round trip during flooding during baseline observations.

The data tables from each drainage survey (household, business, and traffic) are found in Appendices 4-6.

Overall baseline survey conclusions:

The following are the key findings from the LWSSD project evaluation baseline surveys.

1) Statistically significant differences were found between intervention and control groups in a number of key indicators including time spent gathering water, access to improved water supply, access to piped water supply in the house or yard, residential water consumption, average annual household expenditure, percentage of household water samples positive for *E. coli*, and percentage of household water samples with nitrates ≥50 mg/L. No statistically significant differences were found between intervention and control groups in other key indicators including access to improved sanitation, prevalence of diarrhea, prevalence of respiratory illness, proportion of households washing hands with soap, adult employment status, and percentage of household water samples with FCR <0.2 mg/L. A number of the differences found were relatively small (e.g., 111 liters vs 115 liters for residential water consumption); however, these findings may require adjustments to control selection for an endline evaluation, or utilization of propensity score matching or other analytic methods in analyses.

2) Household water quality was poor across both intervention and control households. Most (89%) of household water samples tested did not have an adequate FCR for protection against pathogen contamination (WHO recommendation of ≥0.2 mg/L). The majority (76%) of household water samples tested were positive for *E. coli*, an indicator of fecal contamination, and therefore did not meet the WHO guideline for drinking water. More than half (57%) of household water samples tested had nitrates concentration above the WHO guideline value of 50 mg/L.

3) Prevalence of diarrhea and respiratory illness were approximately 8% and 10% for children under 5 years of age, respectively. These findings were consistent across both the household WASH and drainage baseline surveys and are consistent with waterborne disease prevalence estimates for children under 5 found in other countries.

4) Households in peri-urban Lusaka routinely spend approximately 6.5 hours per week collecting water.

5) The majority of households had access to improved water and sanitation according to the Joint Monitoring Program definitions; however, only 28% of households had access to piped water in their house or yard and only 1% of households had a flush toilet connected to a sewer network, the primary WASH interventions being implemented at the household level as part of the LWSSD project.

6) The three drainage-related surveys found significant flood-related impacts for households and businesses. Sixty percent of households reporting flooding in their neighborhood in the previous month and businesses reported loss of revenue, property damage and increased travel times as a result of flooding.

MAIN REPORT

2. Overview of Compact and Interventions Evaluated

MCC in partnership with the Government of Zambia (GRZ) is implementing a large-scale, $354354 million upgrade and extension of the water, sanitation, and drainage infrastructure in Lusaka to increase population access to potable water, sanitation, and flood protection. The Lusaka Water Supply, Sanitation and Drainage (LWSSD) project (the Compact) will strengthen and upgrade the main surface water treatment plant for Lusaka, extend water supply and sanitation networks into areas with limited household water connections and toilets, rehabilitate existing water kiosks, and improve the drainage network for the primary business district and surrounding residential communities along the Bombay drainage catchment area in Lusaka. The location, type, and scope of the Compact interventions was determined by MCC, GRZ, MCA-Z, and key stakeholders such as the Lusaka Water and Sewerage Company (LWSC) and the Lusaka City Council.

Compact activities included the following:

Core Water Network Rehabilitation (Water Supply): Rehabilitation of the Iolanda treatment plant to restore production to 110,000 m^3/day from 98,000 m^3/day, rehabilitation of transmission mains and distribution centers, and strengthening of the primary distribution system. This component is expected to benefit approximately 860,000 people by providing more reliable water service and increased water supply and coverage. MCA-Z refers to these sub-projects as LP-1, LP-6, LS-1. These sub-projects are part of Contract Packages (CP) (e.g., construction projects) 1 and 2.

Chelston Distribution Line Rehabilitation and Expansion (Water Supply): Extension and rehabilitation of secondary and tertiary networks into the Central and Chelston Branch district metering areas, including the extension of distribution pipes into residential areas to facilitate new household connections, construction of new water kiosks, and rehabilitation of existing kiosks. Over 568,000 beneficiaries are expected from these activities: 416,000 from rehabilitation and 152,000 from network expansion. Beneficiaries are located in Chipata/SOS East, Ng'ombe, Kamanga, Mtendere, Kwamwena, and Ndeke/Vorna Valley. MCA-Z refers to these sub-projects as LS-2 and LS-3. These sub-projects are part of CPs 3 and 5.

Chelston and Kaunda Square Sewersheds Rehabilitation and Expansion (Sanitation): Expand sewer network to facilitate new household and business connections in Mtendere, upgrade Chelston sewage pumping station and Kaunda Square interceptor, and upgrade and expand the Kaunda Square Wastewater Stabilisation Ponds. 98,000 beneficiaries are projected from the expanded sewer network

in Mtendere; nearly 57,000 beneficiaries are expected from rehabilitative sanitation interventions. MCA-Z refers to these sub-projects as CSE-44, CSU-4, CSU-15, TU-5, TE-3. These sub-projects are part of CPs 3 and 4.

Bombay and Mazyopa Drain Improvements (Drainage): Extension and rehabilitation of the Bombay drainage system in central Lusaka, and rehabilitation of the Mazyopa Drain in Northern Lusaka to accommodate the expected increased flow from the Bombay Drain. An estimated 188,000 people are expected to benefit from these drainage improvements. These sub-projects are part of CPs 7 and 8.

The CDC baseline evaluation of the Lusaka Water Supply Sanitation and Drainage project (LWSSD) examined key health and economic indicators in peri-urban and urban areas around Lusaka, Zambia that received water supply interventions (municipal water network extensions and new and rehabilitated water kiosks): Chipata/SOS East, Ng'ombe, and Kamanga (CP3 and CP5). The evaluation also examined the combined sanitation and water supply interventions in Mtendere. Both areas of Mtendere (West and East) received an extension of the sewerage network and water supply (CP3 and CP4). The evaluation also examined the urban and peri-urban areas within the 250 meter catchment of the Bombay Drain improvements (CP 7 and 8) to study flooding impacts on the surrounding community and businesses as well as health and economic indicators.

2.1 Program Logic

Logic Models of Compact Activities

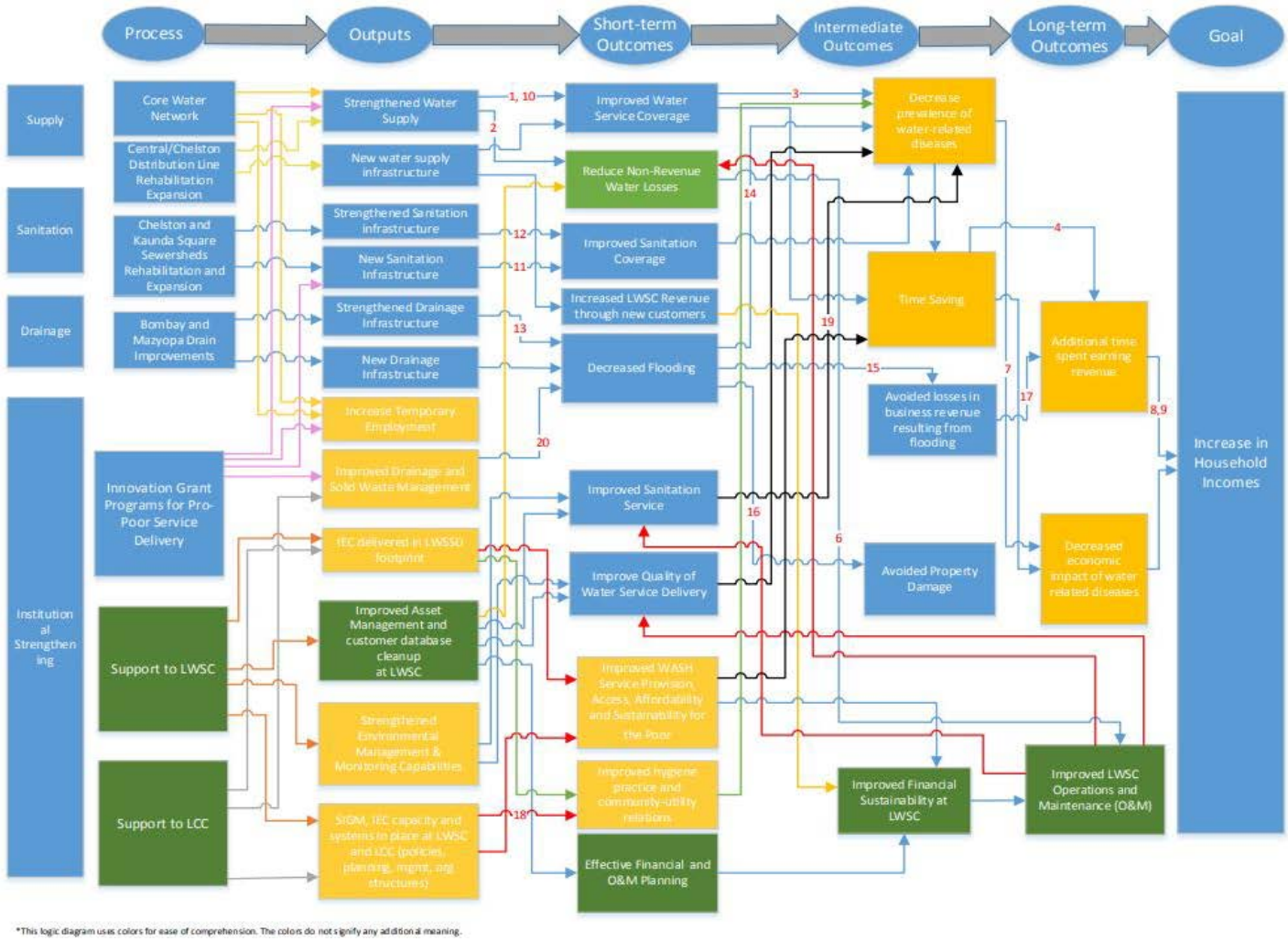
The Water Supply Compact Activities will rehabilitate the Iolanda Water Treatment plant, extend the water distribution network to peri-urban areas with few household connections, rehabilitate poorly functioning water kiosks, construct new water kiosks, and meter household connections. The Sanitation Compact Activities will extend the sewerage network to a large peri-urban area (Mtendere) and rehabilitate the Kaunda Square Waste Stabilization Ponds. Both the Water Supply and Sanitation activities are expected to provide new infrastructure and rehabilitate existing infrastructure. These Compact activities are expected to lead to improved water coverage, improved sanitation coverage, a decrease in the prevalence of water-related diseases, time savings for households related to water collection, time savings related to illness and care-taking from the prevention of waterborne diseases, and an overall decrease in the economic impact of water-related diseases on Lusaka. Time savings are also expected to translate into additional time adults can spend earning revenue.

The Drainage Compact Activities will expand and pave the Bombay Drain, which runs through a busy commercial and residential area of Lusaka. The drainage activities are expected to create new drainage

infrastructure and improve the existing infrastructure which MCC anticipates will lead to decreased flooding, minimized losses in business revenue from resulting floods, and avoided property damage.

Cross Cutting Activities such as Asset Management and Environmental Management, and Information, Education and Communication (IEC) activities, are expected to complement Compact Activities by building capacity among residents to adopt good sanitation and hygiene practices and increasing the capacity of LWSC and LCC staff to manage and sustain the provided assets and upgraded infrastructure. These cross-cutting activities will not be evaluated by CDC. The logic model displaying the inputs, outputs, short-term outcomes, intermediate outcomes, long-term outcomes, and the overall end goal of all Compact activities can be found directly below.

Figure 1: Example Zambia Compact LWSSD Logic Model (August 2017)



*This logic diagram uses colors for ease of comprehension. The colors do not signify any additional meaning.

2.1.1. Compact Level/Project Level

It has been estimated that over 1.5 million people will benefit from the project activities over a 20-year timeframe (MCC, ERR report, 2013). The number of beneficiaries by type of project intervention is shown in Table ES1. Some households and individuals will benefit from more than one activity (e.g., Mtendere will benefit from both improved water supply and sanitation).

Table 2.1. Number of beneficiaries of the Lusaka Water Supply, Sanitation and Drainage project by intervention type, and location

Intervention Type	**Water Supply**			**Sanitation**	**Drainage**
Intervention Location	System-wide*	Central distribution line†	Chelston Distribution Line‡	Mtendere, Kaunda Square, Chelston	City-wide (Bombay Road drain)
Total beneficiaries by intervention	860,000	318,566	250,102	155,280	188,005
No. Rehabilitation Beneficiaries	-	*282,662*	*133,750*	*56,931*	-
No. of Network Expansion Beneficiaries	-	*35,904*	*116,352*	*98,349*	-

*System wide improvements include rehabilitation of the pumping capacity of the Iolanda Water Treatment plant.
†Central water distribution line improvements will impact the following Lusaka peri-urban areas: Chipata/SOS East, Ng'ombe.
‡Chelston water distribution line improvements will impact the following Lusaka peri-urban areas: Mtendere, Kamanga, Ndeke/Vorna Valley, Kwamwena.

Table 2.2. Summary of Zambia Compact Activities for the Lusaka Water Supply, Sanitation, and Drainage (LWSSD) Project

WATER SUPPLY* - $83.3 million

Compact Activities & Tasks	Communities & Populations Impacted	Estimated Number of Beneficiaries
Rehabilitation of Iolanda Treatment Plant 1. Rehabilitation of intake works at Kafue. 2. Rehabilitation of Iolanda treatment plant and pumps. 3. Rehabilitation of Chilanga booster pumping station. 4. Rehabilitation of raw and treated water transmission main. 5. Rehabilitation of 9 distribution centers. 6. Extension of the SCADA system.	Iolanda WTP to Stuart Park. Lusaka Water Works, Lumumba, High Court, Woodlands, Mass Media, Mtendere, Quarry, Chelston & Chawama.	**860,000**
Strengthening of Primary (backbone) Distribution System	All communities supplied by LWSC	**860,000**
Distribution Network in Central Branch (increase water coverage) 1. Extension of secondary and tertiary networks into central branch District Metering Areas (DMA) specifically to Ng'ombe, SOS East and Chipata. 2. Supply and installation of consumer connections and water meters. 3. Construction of water kiosks (30).	**Ng'ombe -21,600 people** 15 kiosks to supply 12,600 **SOS East - 5,808 people** **Chipata – 35,090 people**	**318,565**
Distribution Network in Chelston Branch 1. Extension of secondary and tertiary networks into Chelston branch DMAs. 2. Supply and installation of consumer connections and water meters. 3. Construction of kiosks. 4. Drilling and equipping of 14 boreholes. ***5.*** Construction of 1 elevated and 1 ground reinforced concrete reservoirs.	**Mtendere – 52,844 people** **Kamanga - 10,590 people** **Kwamwena – 39,667 people** **Ndeke-Vorna Valley- 31,169 people**	**250,000**

*Information and numbers for water supply interventions drawn from Gauff Ingenieure: 90% Design Review Report – Water Supply, 2013.

SANITATION[†] – Total: $48.58 million. Admin: $7.33 million

Compact Activities & Tasks	Communities & Populations Impacted	Estimated Number of Beneficiaries
Chelston Sewage Pumping Station 1. Provision of 2 new pumps designed to operate on a duty/standby basis with a capacity of 55 L/s at 27m total head. 2. Provision of two new 2,050m long force main in PE100 HDPE pipe, 250mm diameter PN10 pressure rated. 3. Improvements to the pumping station to raise wet well wall levels and the land levels within the station to prevent inundation of the station with flood waters. 4. Provision of a new 30m² operator's building to replace the existing structures which will be demolished to make way for raising of ground levels.	**Chelston**- Area between Great East Road and Palm Drive. High cost- **1,249 people** (227 households) **Medium cost- 3,806 people** (692 households)	**5,055**
Sewer Expansion in Mtendere 1. New sewer network covering	Mtendere- **98,349 people**	**98,349** **74 commercial properties**
Kaunda Square Interceptor Upgrade	Kaunda Square	**Not available**
Kaunda Square Stabilization Ponds Upgrade & Expansion *(Current capacity 18,000 household, but caters for 56,000; and not meeting effluent standards)* ***Rehabilitation, upgrading (TU-5)*** 1. Modification of existing structures where possible. 2. Demolition and rebuilding of the rest of existing structure. 3. Removal of vegetation. 4. Dredging of ponds. 5. Construction of new sludge drying beds. 6. Construction of new pond across the road. 7. Construction of utility building and guard house. 8. Erection of fence around the ponds. ***Expansion (TE-3) of dilapidated ponds*** 1. A floating sludge removal facility (to be shared with other ponds) 2. Access roads to the ponds site and service road around the ponds.	Kaunda Square (low cost residential area) Mtendere- **156,000 people by 2015** Local farmers	

[†] Information and numbers for sanitation interventions drawn from Gauff Ingenieure: 90% Design Review Report – Sanitation, 2012.

DRAINAGE[‡] - $95.2 million

Compact Activities & Tasks	Communities and Populations Impacted[§]	Estimated Number of Beneficiaries
The Bombay Drain 1. Segment 1 (11.6 km) 2. Segment 2 (5.2 km) 3. Segment 3 (2.2 km) 4. Segment 4 (2.6 km) 5. Segment 5 (2.1 km)	Kamwala Kabwata Silwizya Independence Chaisa Nkoloma Libala Harry Mwaanga Nkumbula Ngwerere Lubwa Roma Raphael Chota Mpulungu	**188,005[§]** **Direct: 2,760 (DIPP 2011), 3,717 (2030)** **Indirect non-priority areas: 127,200 (DIPP 2011), 204,403 (2030)**
The ZESCO Link Drain(1 km)	Kalambo Road Cairo Road	

[‡]Information and numbers for drainage interventions drawn from Gauff Ingenieure: 65% Design Report – Drainage, 2013.
[§]The list of communities affected and beneficiary estimates have been updated from that which originally appears in the Gauff Design Reports to reflect the de-scoping of the Lumumba Drain.

2.1.2. Program Participants

The study population for the pre-intervention, baseline evaluation of the LWSSD Project consisted of households and business owners living in urban and peri-urban areas throughout Lusaka. Survey participants were any adult (aged 18 and over) male or female head of household. Participants were drawn from intervention and control areas. These heads of household also answered questions pertaining to all individuals in their household. The Zambian Central Statistics Office (CSO) defines a household as a group of people that normally cook, eat, and live together who may or may not be related by blood. Furthermore, to be eligible for inclusion, occupants must have been living in their current residence for at least 2 months. A business is broadly defined and could be a stall, stand, shop, wholesaler, factory or any unit where revenue-generating activity occurs.

2.1.3. Geographic Coverage

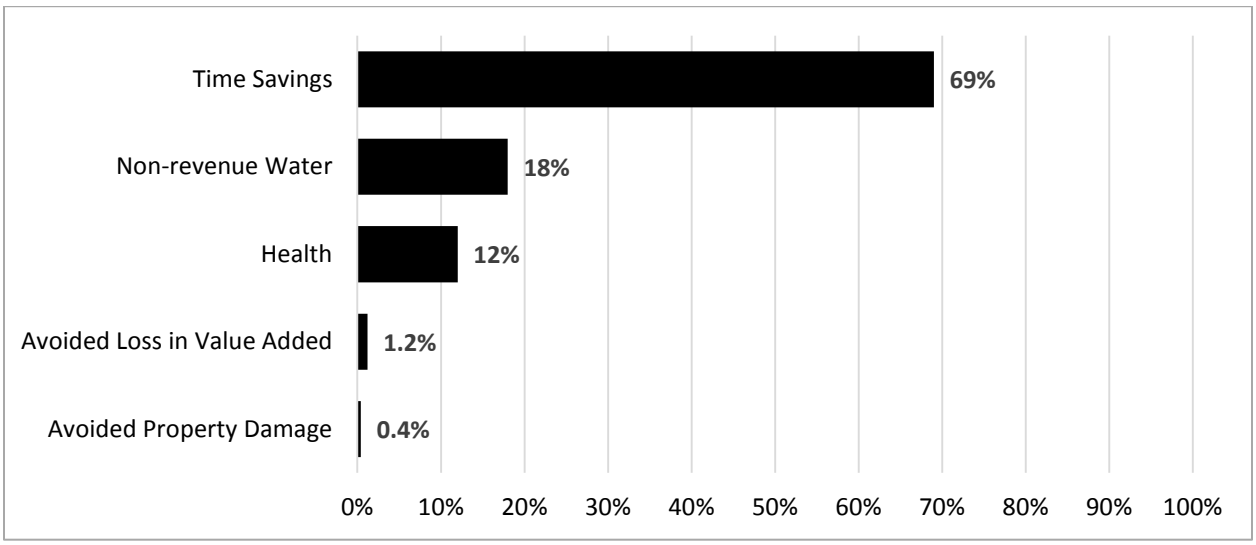
Urban and peri-urban areas throughout the capital city Lusaka, Zambia.

2.2. ERR and Beneficiary Analysis

MCC develops an Economic Rate of Return (ERR) to project the financial benefits of their Compacts. The expected economic impacts of the LWSSD Compact are derived from five benefit streams which are described below. See the figure below for a graphical representation of the contribution from each benefit stream.

- Health: Lower incidence of water- and sanitation-related diseases (e.g., diarrheal disease and acute respiratory infections) will decrease the time and years of life lost due to illness. The benefit stream of decreased illness is calculated by assigning a dollar value to the productive time saved.
- Time Savings: Time savings are expected from the water supply and drainage interventions in the form of less time spent collecting water and commuting (travel time) in Lusaka, respectively. This benefit stream is calculated by assigning a dollar value to time saved.
- Non-revenue Water: LWSC is expected to increase their income and profitability by decreasing the amount of non-revenue water in the system and increasing the number of legal customers with water meters.
- Avoided Property Damage: Decreased flooding is expected to translate into avoided property damage and repair costs among households situated in the floodplain of the Bombay drainage system.
- Avoided Loss in Value Added: Flooding can force businesses to close temporarily and can also limit customers' ability to shop at these businesses. Decreased flooding is expected to minimize these disruptions and increase the profitability of businesses located in the Bombay drain floodplain catchment area.

Figure 2: Illustration of Project Economic Benefits by Category



Source: Millennium Challenge Corporation: Economic Rate of Return, 2014

3. Literature Review of the Evidence

The U.N. Millennium Development Goals (MDGs) for water and sanitation were to halve the proportion of people without access to improved drinking water and sanitation facilities between 1990 and 2015 (WHO and UNICEF, 2013). Despite meeting the water goal and progressing towards the sanitation goal, at the end of 2011 there remained 768 million people without access to an improved water source and another 2.5 billion without access to improved sanitation facilities (WHO and UNICEF, 2013). Lack of access to improved water and sanitation facilities can result in diarrheal illness, which causes 760,000 deaths among children under 5 each year (WHO, 2013). This lack of access can also lead to respiratory illness (Dinh et al., 2006; Hennessy et al., 2008; Luby and Hadler, 2008). Worldwide, acute lower respiratory infections caused over 900,000 deaths among children under 5 in 2013 (WHO, 2014). As the MDG initiative drew to a close, a new set of Sustainable Development Goals (SDGs) were developed to replace the MDGs. By 2030 the water and sanitation SDGs aim to achieve universal, equitable access to drinking water and sanitation (United Nations, 2014). In order to achieve this ambitious goal, significant expansion of water and sanitation infrastructure will be required. Common strategies to provide better access to water and sanitation facilities have included introducing community wells, point-of-use water disinfection, and latrines to rural communities (Fewtrell et al., 2005; Waddington et al., 2009; Clasen et al., 2010; Wolf et al., 2014).

More than 50% of the world's population lived in cities in 2011 and additional urbanization is expected; in Africa, the urban population is projected to triple by 2050 (United Nations, 2012). Many cities are not equipped with the necessary water and sanitation infrastructure to support such substantial urban population growth. In 2011, an estimated 132 million and 728 million urban dwellers did not have access to improved water and sanitation, respectively (WHO and UNICEF, 2013). In Zambia, approximately 40% of the population lives in urban areas. From 1990 – 2011 the proportion of the urban population with access to improved water sources decreased from 89% to 86%, and the proportion with access to improved sanitation also decreased, from 61% to 56% (WHO and UNICEF, 2013).

Limited access to adequate water and sanitation is one of the key developmental challenges faced by Zambia. Zambia has a high poverty rate, at 74% in 2010 (using a Purchasing Power Parity at US$1.25 per day), compared to 49% in the World Bank's low income countries aggregate grouping (World Bank, 2015). In addition, Zambia has high income inequality, with a GINI Index of 57.1 in 2015 (World Bank, 2015). Key indicators of health are similarly low. Life expectancy at birth in 2013 was 58 in Zambia, compared to 62 in the World Bank's low income countries aggregate grouping (World Bank, 2015). The mortality rate for children under 5 (per 1,000 live births) was 87 in 2013; in the World Banks's low income countries aggregate grouping the mortality rate was 76 (World Bank, 2015). Malnutrition (stunting) is also prevalent in Zambia, at 46% in 2007 (World Bank, 2015). These indicators are directly or indirectly related to the status of water supply and sanitation infrastructure, and underscore the universal necessity of equitable access to WASH facilities.

The lack of adequate water and sanitation infrastructure is apparent in Lusaka, where the current infrastructure - built in the 1960s and 1970s for a population of 300,000 - is not sufficient to meet the needs of

the current population of 1.8 million (Central Statistics Office, 2011). The situation is especially acute in low-income, peri-urban areas (PUA) in Lusaka, which constitute approximately 70% of the Lusaka population (Central Statistics Office, 2010). In 2010, only 24% of peri-urban households had piped water to the home or plot, and nearly 60% collected their water from community sources such as kiosks (Central Statistics Office, 2010). Lusaka Water and Sewerage Company (LWSC) estimates that water is available an average of 17 hours per day in the network, however, some peri-urban areas have access to water for an average of only 4 hours per day (CDC, unpublished data).

Access to sanitation infrastructure in PUAs is similarly low, where nearly 88% of households use pit latrines (Central Statistics Office, 2010). However, a majority of these pit latrines do not meet the definition of "improved" (e.g., pit latrines without a slab or shared pit latrines) (Central Statistics Office, 2012) and many are not properly constructed (Millennium Challenge Corporation, 2012). Coupled with the karst geology in much of Lusaka (Gauff Ingenieure, 2013b) - which is highly permeable and characterized by caves and cracks - these latrines can contaminate the shallow wells that some peri-urban residents use as a water source (Millennium Challenge Corporation, 2012), and can lead to diarrheal illness and outbreaks.

The drainage infrastructure in Lusaka is also challenged and has degraded from a lack of maintenance (Millennium Challenge Corporation, 2012). In addition, informal residential areas have been built in areas that are close to drains, and these areas are particularly prone to flooding (Gauff Ingenieure, 2013b). Topographically, Lusaka is fairly flat, and consequently, parts of the city are inundated each rainy season (November to April), leading to additional risk of waterborne illness (Gauff Ingenieure, 2013b). Furthermore, because Lusaka has a high water table (Gauff Ingenieure, 2013c), flooding can be severe and longer in duration in areas with karst geology when the water table reaches the ground surface (Gauff Ingenieure, 2013b).

Given the current state of WASH infrastructure in Lusaka, infrastructure expansion and revitalization will become increasingly more important to health and well-being as urbanization trends continue. The infrastructure interventions planned as part of the Compact aim to, among other things, decrease waterborne disease and promote economic growth by building new and rehabilitating existing community kiosk connections, expanding residential water supply and sanitation networks to underserved areas, and rehabilitating the drainage system.

A review of the literature offers strong evidence for the benefits of better WASH infrastructure. The importance of water supply has been shown in meta-analyses that found water supply interventions - such as installing standpipes or household connections - reduce diarrheal illness by 25-37% (Fewtrell et al., 2005; Wolf et al., 2014; Esrey et al., 1991). A meta-regression conducted by Wolf et al. to identify the health effects of different types of water supply interventions found a relative risk for diarrheal disease of 0.86 (95% CI: 0.72, 1.03) from interventions that provided piped water connections (with non-continuous flow) to households that previously relied on improved community sources (e.g., stand pipes), and a relative risk of 0.21 (95% CI: 0.08, 0.56) in interventions that provided continuous, high quality piped water connections to households that previously relied on improved community sources (Wolf et al., 2014). While the illness reduction from a continuous connection is based on limited evidence from a single study, the meta-regression identifies the

health benefits that can be achieved from household connections that provide continuous water supply, which are envisioned in the intervention in Lusaka.

The health benefits of closer and more reliable access to water sources has been shown in several other studies. For example, one multi-country study in sub-Saharan Africa found that even a 5-minute decrease in one-way travel time was associated with decreased diarrheal disease incidence and improved weight-for-age measures (Pickering & Davis, 2012). Closer access to piped water has also been found to be protective against diarrheal morbidity (Thompson, 2001), and to reduce diarrheal illness duration (Jalan & Ravallion, 2003). Further, close access to piped water, either in the home or compound, has been linked to an increase in the quantity of water used (Devoto et al., 2011; Thompson, 2001), and increased water consumption has been shown to be protective against diarrheal disease (Shrestha et al., 2013).

Lacking water access and infrastructure has also been linked to respiratory diseases. A 2004 study in Vietnam found the lack of an indoor water source to be associated with the development of influenza A H5N1 infection (Dinh et al., 2006). Another study in rural Alaska found higher hospitalization rates for pneumonia, influenza, and respiratory syncytial virus (for children under 5) in regions with lower proportions of in-home water service (Hennessy et al., 2008). And a study in Bangladesh found having a place inside the house with water to WASH hands to be protective against children under 5 reporting a cough or difficulty breathing in the last 7 days (Luby and Hadler, 2008).

There is also significant evidence to support the importance of improved sanitation on health (Fewtrell et al., 2005; Waddington et al., 2009; Wolf et al., 2014). However, as nearly 88% of peri-urban households in Lusaka already have access to a pit latrine (CSO 2010), and the LWSSD Compact aims to facilitate household connection to the sewer system via a flush toilet, this review of the literature will be limited in scope to the health benefits associated with sewer-connected toilets. Sewer connections have been widely shown to decrease diarrhea; one meta-analysis found a 31% reduction in diarrheal morbidity among households with access to a toilet (Waddington et al., 2009). In addition, a meta-regression, though based on findings from only two studies, found a relative risk for diarrheal disease of 0.37 (95% CI: 0.31, 0.44) for sanitation interventions that provided a sewer-connected toilet where before there was an improved sanitation facility (e.g., a latrine) (Wolf et al., 2014). Installations of sewer connections in large urban cities in Brazil and Iran also demonstrated a decrease in diarrheal prevalence; Barreto and colleagues found a decrease of 22% in Salvador, Brazil, while Kolahi et al. found diarrheal incidence to decrease by 9% in Tehran, Iran (Barreto et al., 2007; Kolahi et al., 2009). Furthermore, a study in peri-urban Lima, Peru, found the lack of a sewer connection to be associated with decreased child growth (Checkley et al., 2004). While considering these findings, it is important to note the studies are non-experimental in design (i.e., the site of interventions was not determined by the authors), and therefore there is a risk for confounding. Randomized, experimental interventions that provide sewer connections are few given the inherent cost of sanitation infrastructure and equity considerations. However, the studies presented, though limited in their study design, demonstrate the substantial health gains that can result from sewerage connections in urban areas.

The benefits of adequate drainage infrastructure can also be found in the literature. In another observational study in Brazil, the combined benefits of drainage and sewerage were demonstrated by Moraes et al., who found a 40% and nearly 70% lower incidence of diarrhea in neighborhoods that had drainage systems or both

drainage and sewerage systems, respectively, compared to neighborhoods that had neither (Moraes et al., 2003). In Lusaka, higher incidence of cholera has been linked to areas that have smaller, insufficient drainage networks, and thus less flood control (Sasaki et al., 2009).

Diarrheal illness can also create a financial burden for households as a result of medical and transportation costs. Furthermore, illness can prevent a person from working or require that they stay home to care for ill family members, resulting in potential income lost. This financial burden is measured in a study in three African countries (The Gambia, Kenya, and Mali) that found the total average cost per episode of diarrheal illness to range from $2.63 to $6.24 (Rheingans et al., 2012). The potential gain in productive days due to averted diarrheal illness is also substantial. One cost-benefit analysis reported a worldwide gain of 310 and 550 million working days for adults 15 to 59 years old by meeting the MDGs for water and sanitation and achieving universal access to improved water supply and sanitation facilities, respectively (Hutton et al., 2007). In sub-Saharan African countries, the economic loss associated with inadequate access to water supply and sanitation is estimated to be 4.3% of annual GDP (Hutton, 2013). In Zambia, the economic loss associated with inadequate sanitation alone is estimated to be 1.3% of the national GDP, an equivalent of approximately $194 million dollars. Nearly $180 million of that loss is attributed to premature death from WASH-related diarrhea, diarrheal disease-related healthcare costs, and productivity loss while sick with or accessing healthcare for diarrheal illness (Water and Sanitation Program, 2012).

Beneficiaries of new or improved water supply infrastructure may also save time by spending less time collecting water. Water collection can take considerable time in homes that do not have private piped water connections (Hutton et al., 2007; Sorenson et al., 2011). Hutton et al. compiled findings of the time spent in other studies, which ranged from 0.5 hours to 4-7 hours per day (Hutton et al., 2007). Women, predominantly, and children, are mostly responsible for water collection in these households (Sorenson et al., 2011). As a result of the time burden of water collection – due to the lack of infrastructure – as well as a woman's other household responsibilities, it is postulated that women are less able to enter the work force (Agénor et al., 2010; Koolwal & van de Walle, 2010). Indeed, a cost-benefit analysis of water supply and sanitation interventions found that more than 210 billion hours per year would be saved by universally providing piped water and sewer connected toilets to most countries of sub-Saharan Africa (Hutton et al., 2007). Furthermore, it is estimated that universal access to an improved water supply alone would lead to a benefit of over 8 billion US dollars per year, with nearly 50% attributed to time savings in water collection (Hutton, 2013). However, some studies have found that time saved in water collection does not necessarily result in women spending additional time in "productive activities" (Devoto et al., 2011; Koolwal & van de Walle, 2010). More recently, several large well-designed intervention studies have found limited or no effect of WASH-related interventions on diarrhea and child growth (Null et al. 2018; Luby et al., 2018; Humphrey et al. 2019).

4. Evaluation Design

There are three components of the evaluation design, including the household WASH survey; the drainage-related surveys among households, businesses and of traffic patterns; and a routine water quality monitoring study of the Lusaka drinking water distribution system. Each will be described separately.

(i) Evaluation of WASH interventions

To evaluate water supply and sanitation interventions, two quantitative evaluations were planned. The first evaluation was of areas that will only receive water supply interventions (network extensions into peri-urban areas, new and rehabilitated water kiosks): Chipata/SOS East, Ng'ombe, and Kamanga. The second evaluation was of the combined sanitation and water supply intervention in Mtendere. Both areas of Mtendere (West and East) will receive an extension of the sewerage network, however differing levels of water supply are proposed due to differences in baseline water supply coverage. In Mtendere East, there is a lower level of existing water supply infrastructure while in Mtendere West approximately 70% of households already have water connections (LWSC personal communication, 2014).

CDC collected baseline data for these evaluations through cross-sectional surveys in households in both intervention and control areas. Data collection was designed to occur in two separate phases, at baseline and after the implementation of all Compact interventions. This report presents the results from the baseline data collection, before the implementation of the interventions. In each phase, surveys will be administered over the course of 12 months, without repeat at the same household. Year-round data collection was implemented to account for seasonal differences in key outcomes (e.g., illness and water collection time) and for logistical considerations with respect to data collection efforts associated with the required sample size for the household survey. Similar methodological approaches (i.e., year-round data collection to account for seasonality and other temporal trends) have been used in previous WASH intervention evaluations (Luby et al., 2011; Boisson et al., 2013; Huda et al, 2012) and studies on diarrheal incidence and prevalence at the population level (Feiken et al., 2011; Omore et al., 2013; Nasrin et al., 2013; Breiman et al., 2012; Njuguna et al., 2013). This evaluation design will allow for identification of health and economic outcomes attributable to Compact interventions by comparing key characteristics of interest among intervention and control groups over time (pre-post) using regression models (difference in difference approach).

Household drinking water samples from a subset of control and intervention households (n= 1922 and 1909, respectively) were tested in the baseline survey. These data provide information about the quality of water consumed in survey households. Household drinking water was defined as stored water (water stored in a container within the household [e.g., buckets]) and point-of-consumption (POC) water (water contained in a vessel immediately prior to consumption [e.g., cup]). Samples of source water, defined as the delivery point of water from a distribution system (e.g., municipal kiosks, household-level taps) or private borehole, from a subset of households were also tested to better assess the quality of water prior to storage in the households. Water samples were analyzed for free chlorine residual (FCR) at the point of collection and for concentrations of *E. coli* (a fecal indicator bacterium), and nitrates at the Zambia Bureau of Standards (ZABS) Laboratory. Results were compared to the following internationally-accepted drinking water quality recommendations: ≥0.2 mg/L free chlorine residual (FCR); no *E. coli* in 100 mL samples; and <50 mg/L nitrates. Additional water quality measures that indicate water treatment efficacy, including turbidity (source water only) and total coliforms (all sample types), were also measured in the field and laboratory, respectively.

Baseline data collection around the water and sanitation interventions began in October 2016 and ended October 2017. Data were collected in collaboration with the National Opinion Research Center at the University of Chicago (NORC) and RuralNet Associates, Ltd.

(ii) Evaluation of drainage interventions: Impact on Households, Businesses and Traffic

Household Survey: Changes in household health, economic, and time saving-related indicators that are attributable to Compact drainage interventions were planned to be evaluated quantitatively through randomized cross-sectional household surveys. These surveys were planned to be conducted throughout the Bombay drain catchment area, but primarily in the flood-affected households and communities that are directly adjacent to the Bombay Drain, where the greatest impact from drainage interventions is expected. The Bombay drain catchment area is unique to Lusaka, due to the hydrogeology of the drain, drain geography and size, and the characteristics of the residential areas that lie within its catchment area. As a result, a control group for the communities within the Bombay drain catchment area could not be identified in Lusaka. Consequently, the household-level benefits attributable to the drainage intervention were to be evaluated using a pre- and post- compact intervention evaluation design.

Data collection for this evaluation was planned to occur in two phases: at baseline and after the intervention has been completed. Approximately 3100 flood-affected households were planned to be surveyed in each phase. The rainy season usually ends in March or April and data collection for the baseline, pre-intervention evaluation began in January 2016 and ended in May 2016.. The household drainage survey instrument includes short modules on water, sanitation, and hygiene adapted from the primary household survey instrument, with an additional module specific to the impacts of flooding (see Appendix 1).

Business Survey: Improvements to the Bombay Drainage System are expected to decrease the frequency and duration of floods; thereby benefitting the businesses located along the drain by reducing flood-related repair and maintenance costs and minimizing flood related revenue losses. The drainage interventions also aim to decrease employees' travel time and reduce water-related illnesses among employees, such as diarrhea.

For the baseline, pre-intervention evaluation, surveys were administered to businesses located in the Kamwala Market, a major market located along the drain. Businesses located in close vicinity to, but outside of the Kamwala Market were also included. Surveyed businesses were selected at random to ensure a representative sample. Because of the previously described unique hydrogeological and business/entrepreneurial characteristics of the markets and businesses along the Bombay Drainage System, a control area with similar characteristics was not identified in Lusaka. Subsequently, a a pre- and post-compact intervention evaluation design was chosen (See Appendix 9). Baseline data collection for the business evaluation around drainage intervention began in March 2016 and ended in April 2016.

Traffic Component: Improvements to the Bombay Drainage System are expected to decrease the frequency and duration of floods, thereby ensuring a smoother flow of traffic in the catchment area and averting travel time lost due to congestion. To evaluate the effects of this intervention, CDC conducted an observational evaluation of traffic in the catchment area during periods without flooding and periods when flooding is anticipated or had occurred. Similar to the household and business drainage impact evaluation designs, a pre-

post analysis was planned to be conducted with counts and travel time measurements occurring at baseline and after the intervention is completed. The main objectives of the traffic evaluation were:

1. To estimate the impact of the drainage intervention on traffic volume by vehicle type
2. To estimate the impact of the drainage intervention on travel time by vehicle type

Baseline data collection for the traffic study began in January 2016 and ended in April 2016.

(iii) Routine monitoring of drinking water and sanitation utilities

Routine water quality monitoring of Lusaka's drinking water distribution network and Kaunda Square Stabilisation Ponds began in December 2017. The assessment monitored the drinking water distribution network from the Iolanda Water Treatment Plant to end-point taps at community kiosks, businesses, and households in Lusaka, as well as boreholes that supplement the system. Water quality parameters that were measured throughout the distribution network on a monthly to quarterly basis (depending on system component type) include *E. coli*, total coliforms, heterotrophic plate count (HPC) bacteria, nitrates, free chlorine residual, lead, turbidity, pH, conductivity, and temperature. Wastewater quality parameters that were measured at Kaunda Square Stabilisation Ponds on a monthly basis include *E. coli*, biochemical oxygen demand (BOD), total nitrogen, total phosphorus, total suspended solids (TSS), pH, conductivity, temperature. The study continued through September 2019 and findings will be described in a separate report.

4.1. Evaluation type

The overall evaluation was designed as an impact evaluation. The WASH evaluation was designed to compare health and WASH indicators in intervention and control groups before and after project implementation using a difference-in-difference approach. The drainage evaluation was designed to compare health and WASH indicators in intervention areas before and after project implementation using a pre-post analysis. The routine water quality monitoring study was designed to compare water quality parameters in intervention and select control areas before, during, and after Compact drinking water and sanitation interventions are complete to assess changes over time.

4.2. Evaluation Questions

The Zambia Compact is comprised of interventions to the water, sanitation, and drainage infrastructure in the city of Lusaka. The goals of these interventions include reducing poverty through economic development, decreasing the incidence of waterborne and water-related diseases, and generating time savings for businesses and households. To evaluate the impact of the Compact interventions the following evaluation questions were developed by MCC, MCA-Z, and CDC.

Health

- What are the health benefits attributable to each type of Compact activity?

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?

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?

Flooding

- Is there a decrease in the frequency, intensity and duration of flooding?
- Is there a decrease in property damage and loss of business caused by flooding?
- Is there a decrease in travel time due to reduced flooding?

4.3. Methodology

Given the cause-and-effect nature of the Compact as described in the logic model, CDC recommended an impact evaluation as the most appropriate method to evaluate the effect of the interventions. The impact of interventions to extend water supply and sanitation networks to residential areas was designed to be evaluated by comparing pre and post outcome measures in both intervention and control (counterfactual) areas. Control 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. A suitable control group for the households and businesses that will be affected by the drainage intervention in central Lusaka does not exist. Therefore, the impact of the drainage intervention on households and businesses was designed to be estimated using pre-post comparisons with no control group.

The primary quantitative study design is a prospective, cross-sectional intervention-control and pre-post impact evaluation of new water supply and sanitation interventions and drainage improvement interventions. CDC proposed to evaluate the changes in outcome measures between baseline and post-intervention time periods within the intervention areas and compare these measures to any differences observed in the control areas during the same time period after LWSSD interventions were implemented. The results presented in this report describe the baseline findings of the evaluation, prior to any water, sanitation or drainage interventions.

4.3.1. Power calculations, sample size requirements

A target total of 15,460 households will need to be sampled at each time point (baseline and post-implementation); 3,092 households will need to be sampled in each of the three intervention areas (water supply only; water supply and sanitation; drainage) and 6,184 from a single control group in order to be 80% powered to detect the smallest hypothesized difference of a 20% relative reduction in diarrhea prevalence from 15% to 12%. Assuming a baseline prevalence of 15%, a 20% relative reduction at post-intervention (in the 7 day period prevalence of diarrheal illness among children under 5) and 80% power, a simple random sample (SRS) would necessitate that 1,546 households be sampled per intervention area and 3,092 from the single control area. However, due to the cluster sampling strategy described, the sample size must take into account the potential design effect of the correlated data.

Table 4.1. Sample Size for Household Survey Evaluation of Water Supply, Sanitation, and Drainage Interventions, Lusaka, Zambia

<table>
<tr><th rowspan="3">Intervention</th><th colspan="5">Number of Households</th></tr>
<tr><th colspan="2">With Simple Random Sample</th><th colspan="2">Add Design Effect of 2*</th><th>Final Sample Size</th></tr>
<tr><th>Each Intervention Area</th><th>Single Control Area†</th><th>Each Intervention Area</th><th>Single Control Area†</th><th>Combined Intervention and Control</th></tr>
<tr><td>Water Supply‡</td><td>1,546</td><td rowspan="2">3,092</td><td>3,092</td><td rowspan="2">6,184</td><td rowspan="2">12,368</td></tr>
<tr><td>Water Supply and Sanitation‡</td><td>1,546</td><td>3,092</td></tr>
<tr><td>Drainage§</td><td>1,546</td><td>NA</td><td>3,092</td><td>NA</td><td>3,092</td></tr>
<tr><td>Total</td><td>4,638</td><td>3,092</td><td>9,276</td><td>6,184</td><td>15,460</td></tr>
</table>

*Sample size must be increased by a factor of 2 to account for the potential design effect introduced by cluster sampling
†Control areas are peri-urban areas (PUAs) that do not receive interventions, and are used to assess the impact of water and sanitation interventions
‡Data collection occurred from October 2016 to October 2017
§Data collection occurred from January 2016 to May 2016

4.3.2. Study sample (required sample size, sample frame, selection process, stratification, stages of sample selection, design omissions in the sample, level of representation, strategy for absent respondents)

A two-stage cluster sampling strategy was employed for the WASH baseline and drainage household surveys. The primary sampling units were the "Standard Enumeration Areas" (SEAs) provided by the Zambian Central Statistics Office (CSO). Households within each randomly selected SEA were the secondary sampling units (SSU). Google Earth aerial images of Lusaka provided by the CDC GIS Unit showed all building structures within each SEA. Each structure contained multiple households (SSUs) that needed to be identified and enumerated through the process of "geocoding". Teams of enumerators were assigned SEAs for

enumeration/identification of all households. An enumeration team would enter an assigned SEA and use the GPS enabled app "Avenza PDF Maps" on their Android tablets to locate structures. The enumeration team walked structure to structure locating the exact number of households in each SEA and dropping "pins" that allowed the household geo-coordinates ("geocode") to be captured and saved. The teams sent the maps with the captured household coordinates to CDC staff who then randomly selected 75 households in each SEA (1-42 for surveying and the remaining 43-75 as potential replacements in case of refusals, vacant households, ineligible households, etc.). These maps were then reloaded back onto the same enumeration team's tablets and used to locate the randomly selected households for interviews.

For the WASH baseline survey sampling frame, 50 SEAs from the water supply and sanitation intervention areas (Mtendere East and Mtendere West) were selected using probability proportional to size (PPS) sampling. In the water supply intervention areas (Chipata/SOS, Kamanga, and Ng'ombe), 75 SEAs were selected using the same method. For the control areas, 150 SEAs were selected using PPS sampling. Thus, the total sampling frame for the survey consisted of 275 SEAs in peri-urban areas around Lusaka. Due to the lower number of SEAs available in Mtendere East and Mtendere West, only 50 SEAs were selected in the primary sampling unit stage instead of 75 SEAs. In order to have the same number of households per treatment area (~3,000) and a 1:1 intervention to control household interview ratio across all treatments areas, the number of households being randomly selected and interviewed in Mtendere East and West was increased from 42 to 62 households. In all other areas, 42 households were interviewed per SEA. Overall, 3,186 households were sampled in the water supply only intervention areas; 3,097 households were sampled in the water supply and sanitation intervention areas; and 6,229 households were sample from control areas.

E. coli concentration was considered the most important parameter for assessment of water quality improvement. Sample size determination for number of households to receive water quality testing was based on drinking water stored in the household. Due to limited availability of information on residents' household water quality, sample size calculation was based on LWSC's 2013 distribution system water quality monitoring reports. Because LWSC did not test for *E. coli*, the WHO-recommended microbial standard assessing distribution systems, and instead tested for a less-specific fecal indicator (fecal coliforms), LWSC's fecal coliform results (83% of samples were <1 CFU [colony forming unit]/100 mL) were used as a conservative proxy for *E. coli*. Sample size calculation designated improvement to 90%, or an overall 7% detectable difference in water quality at a power of 90%. Drinking water stored in the households of 1,516 intervention and 1,516 control households were targeted for inclusion in the study. Additional samples of POC drinking water and source water samples were collected from 25% of stored water households; this percentage was chosen based on logistical considerations. Overall, within each selected SEA, 11 stored water samples, 3 point-of-consumption water samples, and 3 source water samples were randomly selected from the 42 or 62 households that had been selected for a household interview.

WASH Household Replacement Strategy:
Households that were selected for an interview could be replaced for the following reasons:

- A household was selected for an interview and no one was home after three visits.

- A head of household or their spouse did not consent to be interviewed.
- A head of household or their spouse were under the age of 18.
- A household had not been living in that structure for 2 or more months.
- A head of household or their spouse could only be found on Sunday (enumerators did not work on Sundays)
- If the head of household or their spouse were only found outside of field hours (8:30am to 3:30pm).
- If the household was selected for water collection but the right type(s) of water was not available, that household was still interviewed, but another was selected to take its place as an interview with water collection.

If a household needed to be replaced for one of these reasons, supervisors would assign the enumerator the nearest replacement household from the replacement pool (households randomly selected as 43-75 or 63-85 for Mtendere East and West) and the enumerator would note the replacement in their field control sheet.

Household Drainage Sampling Frame: For the household drainage survey, the sampling frame was generated by overlaying census SEA boundaries and the boundary of the Bombay drainage catchment area using ArcView GIS. SEAs that were located within approximately 250 meters on either side of the Bombay Drain, where the greatest impact of flooding and flooding reduction was expected, were eligible for random selection. Once a list of SEAs that fell in this catchment area was generated, PPS sampling was used to select 75 SEAs for the sampling frame. Forty-two households located in each of these selected SEAs were then randomly selected for inclusion in the evaluation. Overall, 3,142 households were sampled in the drainage intervention catchment area. This part of the evaluation is a pre/post comparison with no control group.

Household Drainage Replacement Strategy: The household drainage survey used the same replacement protocol as the WASH survey without water replacements (as there was no water sampling in the household drainage survey).

Business Drainage Sampling Frame:

The market area was defined and divided into three general locales (See Appendix 9b):

1. Kamwala Interior: Interior of Kamwala Market
2. Kamwala Exterior: Exterior of Kamwala Market i.e. outer perimeter: shops facing outward from market.
3. Along Bombay drain: Business along Bombay Road and connecting roads, south of Independence Ave, and north of Chongwe Road.

The enumerators went to all the existing businesses and created a sampling frame. In Kamwala interior and exterior regions they used the shop numbers already given by Kamwala committee and Chinese Management Company. Detailed sketch maps of all the shops were done by hand and shop numbers marked (See Appendix 9b). A simple random sample of around 24% (9% to 45%) of enlisted businesses was drawn by CDC using MS

Excel. A sufficient pool of replacement businesses was also sampled in case of refusal and other circumstances. Overall, 280 businesses inside the Kamwala Market were surveyed as well 60 businesses outside of the Kamwala Market. In addition, 247 businesses along the Bombay Drain (transient vendors) were surveyed, for a total of 587 business surveyed all together.

The survey instrument is provided in Appendix 2 and details of the conduct of survey operations is provided in Appendix 9b

Traffic Study:

Component 1: Survey-Traffic Volume and Impact of Flooding

To measure the impact of flooding due to inadequate drainage on flow of traffic and travel time, Travel surveys were conducted. In the first survey of traffic volume 10 traffic intersections or other heavily trafficked locations were selected in the evaluation area that is subject to frequent flooding (Appendix 9a: Figure A9.1). enumerators counted the number of vehicles, passengers, and pedestrians that crossed the intersections in any direction. A more detailed description of methodology can be found in Appendix 9a.

Component 2: Impact of Flooding: Travel Time Evaluation

This evaluation measured the average travel time for vehicles and pedestrians along identified routes during periods of flooding and non-flooding. Routes were identified between selected major traffic nodes in Lusaka, and cut through areas that are affected by flooding. Further details are provided in Appendix 9b.

5. Data Sources and Outcome Definitions

Table 5.1 Primary data collected at households in urban and peri-urban areas of Lusaka, Zambia from January 2016 to May 2016 (drainage, business, and traffic surveys) and October 2016 to October 2017 (baseline WASH survey).

Indicator	Indicator Definition	Level of Measurement	Survey
Access to improved water supply*	Percentage of households whose main drinking water source is a private household tap, public tap, borehole, or protected well	Household	WASH household survey
Access to piped water supply in house or yard	Percentage of households that have a piped water supply in the house or yard	Household	WASH household survey
Time spent gathering water	Amount of time households spend gathering water per round trip (measured in hours per week)	Household and individual	WASH household survey

Indicator	Indicator Definition	Level of Measurement	Survey
Residential water consumption	Average water consumption per household per day in liters	Household	WASH household survey
Prevalence of waterborne diseasePercentage of households and individuals with diarrhea, acute respiratory infection (ARI), in last 7 daysHousehold and individualWASH and Drainage household surveysPrevalence of diarrhea in children <5 (7-day recall)	Percentage of children less than 5 years of age with diarrhea in last 7 days	Household and individual	WASH and Drainage surveys
Prevalence of respiratory Illness in children <5 (7-day recall)	Percentage of children less than 5 years of age with acute respiratory infection (ARI), in last 7 days	Household and individual	WASH and Drainage surveys
Percent of people practicing safe hygiene	Percentage of respondents who report washing hands with soap and soap is present	Household	WASH household survey
Access to improved sanitation†	Percentage of households with access to improved sanitation	Household	WASH household survey
Access to flush toilet sewerage	Percentage of households who get access to and use a flush toilet to a piped sewer system	Household	WASH household survey
Adult employment status	Percentage of adult household members who are employed	Household	WASH and Drainage household surveys
Average household expenditure (annualized) (ZMW)	Average household income per year based on expenditure patterns. Annualized Zambian kwacha (ZMW).	Household	WASH and Drainage household surveys

Indicator	Indicator Definition	Level of Measurement	Survey
Continuity of water supply service	Average hours of service per day for water supply	Household	WASH household survey
Percentage of business closures due to flooding	Percentage of time businesses were closed as a result of flooding	Business	Drainage Business survey
Percentage of household water[‡] samples with FCR <0.2 mg/L[§]	Percentage of household water samples with FCR <0.2 mg/L	Household, Community	WASH household survey
Percentage of household water[‡] samples positive for *E. coli*[¶]	Percentage of household water samples positive for *E. coli*	Household, Community	WASH household survey
Percentage of household water[‡] samples with nitrates ≥50 mg/L[#]	Percentage of household water samples with nitrates greater than or equal to 50 mg/L	Household, Community	WASH household survey
Household garbage disposal	Percentage of households with a garbage disposal system	Household	Drainage household survey
Travel time during flooding	Amount of time spent travelling from one place to another in Lusaka during flooding	Individual, Business	Drainage household and business surveys
Frequency of flooding	Percentage of time there is flooding per month in surveyed houses and businesses	Household and business	Drainage household and business surveys
Property damage due to flooding	Amount of property damage to households and businesses caused by flooding per month	Household and business	Drainage business and household surveys

[*]Improved Water Supply: communal tap, protected well, piped water inside the house, piped water outside the house within stand/plot, piped water from neighbor, piped water from another compound, kiosk from another compound.

[†]Improved Sanitation: pit latrine with slab, ventilated pit latrine, and flush toilet.

[‡]Household water was defined as stored or point-of-consumption (POC) water; samples were collected from 1,909 intervention and 1,922 control households (3,831 households overall); in households in which both stored and POC water were tested, the least favorable value (i.e., lowest FCR result, highest *E. coli* result, highest nitrates result) of the two measures was chosen.

[§]World Health Organization (WHO) recommendation for FCR at distribution system point of delivery is ≥0.2 mg/L.

[¶]WHO guideline for drinking water is no detectable *E. coli* in a 100 mL sample.

[#]WHO guideline for nitrates in drinking water is less than 50 mg/L.

FCR: free chlorine residual

mg/L: milligrams per liter

6. Findings

6.1. Descriptive Statistics of Key Variables

6.1.1. WASH Evaluation

6.1.1.1. Major survey findings

Surveys were completed among 12,512 randomly selected households during October 2016–October 2017 among intervention (n=6,283) and control (n=6,229) households. Household drinking water (both stored and POC) samples were collected from 3,831 (control=1,922 households; intervention=1,909 households) and tested for FCR, total coliforms, *E. coli*, and nitrates.

Statistically significant differences were found between intervention and control groups in a number of key indicators including time spent gathering water, access to improved water supply, access to piped water supply in the house or yard, residential water consumption, average annual household expenditure, percentage of household water samples positive for *E. coli* (therefore not meeting WHO guideline of no *E. coli* in a 100 mL sample), and percentage of household water samples with nitrates ≥50 mg/L (therefore not meeting the WHO guideline of <50 mg/L) (Table 6.1). No statistically significant differences were found between intervention and control groups in other key indicators including access to improved sanitation, prevalence of diarrhea, prevalence of respiratory illness, proportion of households washing hands with soap, adult employment status, and percentage of household water samples with FCR <0.2 mg/L (therefore not meeting the WHO recommendation of ≥0.2 mg/L for drinking water). A number of the differences found were relatively small (e.g., 111 liters vs 115 liters for residential water consumption). Appendix 10 provides some additional details and results. For example approximately 72% of responding households stated that they were able to access safe water every day for the past 7 days (Appendix 10: Figure A10.1a). However, only 62% of households stated that they were able to access sufficient drinking water in the past 7 days (Appendix 10: Figure A10.1b). The majority of households consumed less than 140 liters/day (Appendix 10: Figure A10.8), and approximately 69% of households obtained their water from "off premises" sources (such as communal tap or water kiosk, protected well, unprotected well, private borehole, piped water from neighbor, surface water (stream/pond), piped water from another compound) (Appendix 10 Figure A10.3).

Household expenditures were almost equally divided between food items and non-food-items (Appendix 10: Table A10.3 and Figure A10.11). Note that amounts reported for "pocket money" and "transportation" are suspected to be incorrect (see Appendix 5, Figure A5.3.1 and Tables A5.3b). Most households (approximately 63%) reported renting their accommodations, and approximately 27% reported owning their house (Appendix 10 Figure A10.9). The 5 most commonly reported durable goods owned by households were cell phones (92%), TV sets (79%), radios (63%), fridges (55%) and DVD players (55%) (Appendix 10: Figures A10.10).

Illness

A significant proportion (26%) of households reported illness among a household member in the previous week. Prevalence of diarrhea and respiratory illness were 3.5% and 3.0% overall, and 8% and 9.9% for children under 5 years of age, respectively.

WASH

The majority of households had access to improved water and sanitation according to the Joint Monitoring Program definitions (see above and Appendix 10); however, only 28% of households had access to piped water in their house or yard and only 1% of households had a flush toilet connected to a sewer network, the primary WASH interventions being implemented at the household level as part of the LWSSD project. Households spend a significant amount of time collecting water, on average 6.5 hours per week. Respondents with piped water on premises reported spending a median of approximately 120 ZMW/ month on water. Those households collecting water from kiosks reported spending a median of approximately 2 ZMW/ day (Appendix 10 Figures A10.3, A10.6). Of households that paid for water connection fees (n=515), households spent 1108 ZKW on average for household water connection fees.

Household water quality was poor across both intervention and control households. Most (89%) of household water samples tested did not have an adequate FCR for protection against contamination (WHO recommendation of ≥0.2 mg/L). The majority (76%) of household water samples tested were positive for *E. coli*, an indicator of fecal contamination, and therefore did not meet the WHO guideline. More than half (57%) of household water samples tested had nitrates concentration above the WHO guideline value of 50 mg/L.

Table 6.1. Pre-intervention, baseline proportions and means across key survey indicators for the Lusaka Water Supply, Sanitation, and Drainage (LWSSD) project Water, Sanitation, and Hygiene survey Lusaka, Zambia (October 2016 – October 2017)

	Proportion/Mean at Baseline			
Key Indicator	**Control households (n=6229)***	**Intervention households (n=6283)***	**p-value**	**Overall households (n=12,512)***
Access to improved water supply†	92.2%	74.7%	<0.0001	83.5%
Access to piped water supply in house or yard	26.9%	30.4%	<0.0001	28.6%
Time spent gathering water (hours/week)	5.9	6.4	<0.001	6.2
Residential water consumption (liters per household per day)	111.8	115.6	0.04	113.7
Prevalence of diarrhea <5 (7-day recall)	7.6%	8.5%	0.2	8.0%
Prevalence of respiratory Illness <5 (7-day recall)	10.1%	9.8%	0.7	9.9%
Percentage of respondents washing hands with soap	60.5%	60.9%	0.6	60.7%
Access to improved sanitation‡	92.1%	91.3%	0.07	91.7%
Access to flush toilet sewerage	1.6%	0.6%	0	1.1%

Percentage of household water[§] samples with FCR <0.2 mg/L[¶]	88.8%	88.4%	0.8	88.6%
Percentage of household water[§] samples positive for *E. coli*[#]	78.3%	73.4%	0.0004	75.8%
Percentage of household water[§] samples with nitrates ≥50 mg/L**	64.5%	48.4%	<0.0001	56.5%
Adult employment status	60.1%	59.9%	0.06	60.0%
Average household expenditure (annualized) (ZMW)	31,277	32,768	<0.0001	32,000

*n may vary by small numbers due to missing values; numbers may not add to 100% due to rounding

[†]Improved Water Supply: communal tap, protected well, piped water inside the house, piped water outside the house within stand/plot, piped water from neighbor, piped water from another compound, kiosk from another compound.

[‡]Improved Sanitation: pit latrine with slab, ventilated pit latrine, and flush toilet.

*Household water was defined as any household where stored or point-of-consumption (POC) water was tested; in households in which both stored and POC were tested, the least favorable value of the two is presented (i.e., lowest FCR result, highest *E. coli* result, highest nitrates result).

[†]World Health Organization (WHO) recommendation for FCR at distribution system point of delivery is ≥0.2 mg/L.

[‡]WHO guideline for drinking water is no detectable *E. coli* in a 100 mL sample.

[§]WHO guideline for nitrates in drinking water is less than 50 mg/L. FCR: free chlorine residual

mg/L: milligrams per liter

ZMW: Zambia kwacha

Table 6.1.b Pre-intervention, baseline proportions and means across key socio-economic variables for the Lusaka Water Supply, Sanitation, and Drainage (LWSSD) project Water, Sanitation, and Hygiene survey Lusaka, Zambia (October 2016 – October 2017)

Socio-economic variable	Proportion/Mean at Baseline			
	Control households (n=6229)*	Intervention households (n=6283)*	p-value	Overall households (n=12,512)*
Education (primary or less)	3855 (62%)	3548 (57%)	<0.001	7403 (59%)
Education (secondary or above)	2366 (38%)	2730 (43%)	<0.001	5096 (41%)
Average household expenditure (annualized) (ZMW)	31,277	32,768	<0.0001	32,000
HH size, mean [median]	4.9 [5.0]	4.8 [4.0]	0.129	4.9 [5.0]
Female Head of Household	1303 (21%)	1447 (23%)	0.005	2750 (22%)
Asset: Owned laptop or car	827 (13%)	991 (16%)	<0.001	1818 (15%)

6.1.1.2. Major water quality findings

Between October 2016 and October 2017, household drinking water (stored and POC) samples were collected from 3831 households (control=1922 households; intervention=1909 households) and tested for FCR, total coliforms, *E. coli*, and nitrates. An overview of the key household water quality indicators is presented in Table 6.2. Due to the frequency of total coliform detection (3644/3771 [96.6%]) of all household water samples), only *E. coli*, the international fecal indicator bacterial standard for water quality, will be reported.

Table 6.2. Pre-intervention, baseline proportions across key household water quality indicators for the Lusaka Water Supply, Sanitation, and Drainage (LWSSD) project Water, Sanitation, and Hygiene (WASH) survey Lusaka, Zambia (October 2016 – October 2017)

Key Indicator	Control households* (n=1922)	Intervention households* (n=1909)	p-value†	Overall households* (n=3831)
Percentage of household water‡ samples with FCR <0.2 mg/L§	88.8%	88.4%	0.8	88.6%
Percentage of household water‡ samples positive for *E. coli*¶	78.3%	73.4%	0.004	75.8%
Percentage of household water‡ samples with nitrates ≥50 mg/L#	64.5%	48.4%	<0.0001	56.5%

*n may vary by small numbers due to missing values; numbers may not add to 100% due to rounding

†p-value was calculated using the Chi-Square test for homogeneity

‡Household water was defined as any household where stored or point-of-consumption (POC) water was tested; in households in which both stored and POC were tested, the least favorable value of the two is presented (i.e., lowest FCR result, highest *E. coli* result, highest nitrates result).

§World Health Organization (WHO) recommendation for FCR at distribution system point of delivery is ≥0.2 mg/L

¶WHO guideline for drinking water is no detectable *E. coli* in a 100 mL sample

#WHO guideline for nitrates in drinking water is less than 50 mg/L

FCR: free chlorine residual
mg/L: milligrams per liter

Free chlorine residual (FCR)

FCR was measured in 3818 (control=1915; intervention=1903) household water samples; 89% of all household water samples had FCR <0.2 mg/L (Table 6.2) and the overall mean FCR was 0.13 mg/L (median: 0.04 mg/L) (Table 6.3). There was no statistically significant difference in the proportion of samples with <0.2 mg/L FCR between control and intervention household water samples (89% vs. 88%, respectively; p=0.8). The mean FCR for control household water samples was 0.15 mg/L (median: 0.04 mg/L) and the mean FCR for intervention household water samples was 0.12 mg/L (median: 0.04 mg/L); there was no statistically significant difference in FCR concentration between control and intervention household water samples (p=0.8).

Table 6.3. Baseline average free chlorine residual (FCR)* in peri-urban area (PUA) water samples, by water type; Lusaka Water Supply, Sanitation, and Drainage (LWSSD) project, Lusaka, Zambia (October 2016 – October 2017)

	Control PUAs		Intervention PUAs			All PUAs	
Water type	**n**	**Mean FCR (Median) (mg/L)**	**n**	**Mean FCR (Median) (mg/L)**	**p-value†**	**n**	**Mean FCR (Median) (mg/L)**
Household water‡	1915	0.15 (0.04)	1903	0.12 (0.04)	0.03	3818	0.13 (0.04)
Source water	432	0.23 (0.05)	410	0.21 (0.04)	0.6	842	0.22 (0.05)

*World Health Organization (WHO) recommendation for FCR at distribution system point of delivery is ≥0.2 mg/L.
† p-value was calculated using the Wilcoxon Rank Sum test.
‡Household water was defined as any household where stored or point-of-consumption (POC) water was tested; for households in which both stored and POC were tested, the least favorable value of the two was used (i.e., lowest FCR result).
Note: test range <0.02 to 2.00 mg/L
mg/L: milligrams per liter
PUA: peri-urban area

E. coli

E. coli was measured in 3771 (control=1898; intervention=1873) household water samples; 76% of all household water samples were positive for *E. coli* (Table 6.2) and the overall *E. coli* geometric mean was 3 colony forming units (CFU) per 100 mL (Table 6.4). There was a statistically significant difference in the proportion of samples positive for *E. coli* between control and intervention household water samples (78% vs. 73%, respectively; p=0.004). The *E. coli* geometric mean for both control and intervention household water samples was 3 CFU/100 mL; there was a statistically significant difference in the *E. coli* geometric mean between control and intervention household water samples (p=0.02).

Table 6.4. Baseline average *E. coli* in peri-urban area (PUA) water samples, by water type; Lusaka Water Supply, Sanitation, and Drainage (LWSSD) project, Lusaka, Zambia (October 2016 – October 2017)

	Control PUAs		Intervention PUAs			All PUAs	
Water type	**n**	**Geometric Mean (CFU/100 mL)**	**n**	**Geometric Mean (CFU/100 mL)**	**p-value†**	**n**	**Geometric Mean (CFU/100 mL)**
Household water‡	1898	3	1873	3	0.02	3769	3
Source water	423	1	402	1	0.04	825	1

*World Health Organization (WHO) guideline for drinking water is no detectable *E. coli* in a 100 mL sample.
† p-value was calculated using the Wilcoxon Rank Sum test.
‡Household water was defined as any household where stored or point-of-consumption (POC) water was tested; for households in which both stored and POC were tested, the least favorable value of the two was used (i.e., highest *E. coli* result).
Note: test range <1 to 200 CFU/100 mL
CFU: colony forming unit
PUA: peri-urban area

Nitrates

Nitrates were measured in 3749 (control=1846; intervention=1903) household water samples; 57% of all household water samples had nitrates ≥50 mg/L (Table 6.2) and the overall mean nitrates concentration was 117 mg/L (median: 61 mg/L) (Table 6.5). There was a statistically significant difference in the proportion of samples with nitrates ≥50 mg/L between control and intervention household water samples (65% vs. 48%, p<0.0001). The mean nitrates concentration for control household water samples was 158 mg/L (median: 85 mg/L) and the mean nitrates concentration for intervention household water samples was 76 mg/L (median: 47 mg/L); there was a statistically significant difference in the average nitrates concentration between control and intervention household water samples (p<0.0001).

Table 6.5. Baseline average nitrates in peri-urban area (PUA) water samples, by water type; Lusaka Water Supply, Sanitation, and Drainage (LWSSD) project, Lusaka, Zambia (October 2016 – October 2017)

	Control PUAs		Intervention PUAs			All PUAs	
Water type	**n**	**Mean (Median) (mg/L)**	**n**	**Mean (Median) (mg/L)**	**p-value†**	**n**	**Mean (Median) (mg/L)**
Household water‡	1889	158.2 (84.5)	1886	75.5 (46.6)	<0.0001	3375	116.9 (60.5)
Source water	424	152.5 (86.9)	402	75.7 (48.6)	<0.0001	826	115.1 (61.6)

*World Health Organization (WHO) guideline for nitrates in drinking water less than 50 mg/L.
† p-value was calculated using the Wilcoxon Rank Sum test.
‡Household water was defined as any household where stored or point-of-consumption (POC) water was tested; for households in which both stored and POC were tested, the least favorable value of the two was used (i.e., highest nitrates result).
Note: test range <1 to 1400 mg/L
mg/L: milligrams per liter
PUA: peri-urban area

Source water samples

Between October 2016 and October 2017, source water samples were collected from 842 water sources used by survey households (control=432 households; intervention=410 households) and tested for FCR, turbidity, total coliforms, *E. coli*, and nitrates. An overview of the key source water quality measures is presented in Table 6.6. Due to the frequency of total coliform detection (81% of source water samples), only *E. coli*, the international fecal indicator bacterial standard for water quality, will be reported.

Table 6.6. Pre-intervention, baseline proportions across key source water quality indicators for the Lusaka Water Supply, Sanitation, and Drainage (LWSSD) project Water, Sanitation, and Hygiene (WASH) survey Lusaka, Zambia (October 2016 – October 2017)

Key Indicator	Control sources* (n=432)	Intervention sources* (n=410)	p-value[†]	Overall sources* (n=442)
Percentage of source[‡] samples with FCR <0.2 mg/L[§]	81%	76%	0.1	79%
Percentage of source water[‡] samples with turbidity ≥1 NTU**	52%	60%	0.03	56%
Percentage of source water[‡] samples positive for *E. coli*[¶]	46%	37%	0.008	41%
Percentage of source water[‡] samples with nitrates ≥50 mg/L[#]	63%	50%	<0.0001	57%

*n may vary by small numbers due to missing values; numbers may not add to 100% due to rounding
[†]p-value was calculated using the Chi-Square test for homogeneity
[‡]Source water was defined as the delivery point of water from a distribution system (e.g., municipal kiosks, household-level taps) or private borehole from which the survey household collects drinking water.
[§]World Health Organization (WHO) recommendation for FCR at distribution system point of delivery is ≥0.2 mg/L
[¶]WHO guideline for drinking water is no detectable *E. coli* in a 100 mL sample
[#]WHO guideline for nitrates in drinking water is less than 50 mg/L.
**WHO guideline for turbidity in drinking water is less than 1 NTU.
FCR: free chlorine residual
mg/L: milligrams per liter
NTU: nephelometric turbidity unit

Free chlorine residual (FCR)

FCR was measured in 842 (control=432; intervention=410) source water samples; 79% of all source water samples had a free chlorine residual <0.2 mg/L (Table 6.7) and the overall mean FCR was 0.22 mg/L (median 0.05 mg/L) (Table 6.3). There was no statistically significant difference in the proportion of samples with <0.2 mg/L FCR between control and intervention source water samples (81% vs. 76%, p=0.1). The mean FCR for control source water samples was 0.23 mg/L (median: 0.05 mg/L) and the mean FCR for intervention source water samples was 0.21 mg/L (median: 0.04 mg/L).

Turbidity

Turbidity was measured in 768 (control=396; intervention=372) source water samples; 56% of all source water samples had turbidity >1 Nephelometric Turbidity Unit (NTU) and the overall mean turbidity was 1.7 NTU (median 1.1 NTU) (data not shown). There was no statistically significant difference in the proportion of samples with turbidity >1 NTU between control and intervention source water samples (52% vs. 60%, p=0.03). The mean turbidity for control source water samples was 1.7 NTU (median: 1.0 NTU) and the mean turbidity for intervention source water samples was 1.7 NTU (median: 1.2 NTU).

E. coli

E. coli was measured in 825 (control=423; intervention=402) source water samples; 41% of all source water samples were positive for *E. coli* (Table 6.6) and the overall *E. coli* geometric mean was 3 CFU/100 mL (Table 6.5). There was a statistically significant difference in the proportion of samples positive for *E. coli* between control and intervention source water samples (46% vs. 37%, p=0.008). The *E. coli* geometric mean for both control and intervention source water samples was 3 CFU/100 mL.

Nitrates

Nitrates were measured in 826 (control=424; intervention=402) source water samples; 57% of all source water samples had nitrates ≥50 mg/L (Table 6.2) and the overall mean nitrates concentration was 115 mg/L (median: 62 mg/L) (Table 6.6). There was a statistically significant difference in the proportion of samples with nitrates ≥50 mg/L between control and intervention source water samples (63% vs. 50%, p<0.0001). The mean nitrates concentration for control source water samples was 153 mg/L (median: 87 mg/L) and the mean nitrates concentration for intervention source water samples was 76 mg/L (median: 47 mg/L).

6.1.2. Household Drainage Evaluation

To allow assessment of the impact of improvements in the central drainage system (the Bombay Drainage System) that runs through Lusaka, three related drainage-related baseline surveys were conducted in the period January 2016 through May 2016. These surveys were: A survey of 3,142 households in the drainage catchment area during February-May 2016; a survey measuring the impact of flooding on business activity of 587 businesses; and, a set of traffic flow surveys of traffic at 14 intersections (+ 2 control intersections) in downtown Lusaka likely impacted by flooding due to poor drainage. These 3 drainage-related surveys found significant flood-related impacts for both households and businesses. Approximately 60% of households reporting flooding in their neighborhood in the previous month and businesses reported loss of revenue, property damage and increased travel times as a result of flooding. Additional findings from the drainage related surveys are summarized in the tables and sections below, and in Appendices 6, 7 and 8.

<u>Impact of illnesses: Household level: Household drainage survey</u>

At a household level, approximately 19% of households reported that at least one household member had been sick with diarrhea or flu-like illness in the prior 7 day period (Table 6.7). This is slightly lower than the approximate 27% of households reporting at least one household member had been sick, measured in the larger baseline household WASH survey (Section 6.1.1.1). The 19% measurement implies that, on average, every 5-6 weeks households experience at least one member sick with diarrhea or a flu-like illness.

Table 6.7. Percentage of households having at least one member who experienced illness (diarrhea or respiratory) in the 7 days prior to interview

Illness Household Level	n	%
Yes	592	18.9
No	2545	81.1
Don't know	3	0.1

Impact of illnesses: Individual level: Household drainage survey

At an individual level, approximately 5% of individuals reported diarrhea or flu-like illness in the prior 7-day period (Table 6.8). The 7-day incidence of disease (diarrhea or flu-like illness), however, differed greatly by age, with approximately 14% of children under 5 reporting diarrhea or flu-like illness in the prior 7-day period (Table 6.8). The 7-day incidence decreased to 3.5% for persons 6-17 years, and 3.9% for adults ≥18 years. The finding that the burden of diarrhea and acute respiratory illness is driven by illness in children less than 5 years of age is consistent with other studies and national health surveys in multiple countries.

The reported disease burden was approximately equally divided, in all age groups, between diarrhea and flu-like (respiratory) illnesses (Tables 6.9 and 6.10). The larger household WASH survey also found that the reported disease burden was approximately equally divided between diarrhea and flu-like illnesses (Section 6.1.1.1).

Table 6.8. Percentage of individuals who experienced illness (diarrhea or 'flu-like illness) in the seven days prior to interview

Illness Individual Level	n	% (PR) (*denominators are total individual population in that category)
Total	738	
Age, years		
≤5	271	13.6
6 to 17	131	3.5
≥18	325	3.9
Missing	11	
Gender		

Table 6.8. Percentage of individuals who experienced illness (diarrhea or 'flu-like illness) in the seven days prior to interview		
Male	321	4.7
Female	414	5.5
Missing	3	

Table 6.9. Percentage of individuals who experienced diarrhea in the seven days prior to interview		
Illness Individual Level-Diarrhea	**n**	**% (PR)** (*denominators are total individual population in that category)
Total	430	
Age, years		
≤5	156	7.8
6 to 17	73	1.9
≥18	193	2.3
Missing	8	

Table 6.10. Percentage of individuals who experienced flu-like illness in the seven days prior to interview		
Illness Individual Level-Respiratory Illness	**n**	**% (PR)** (*denominators are total individual population in that category)
Total	351	
Age, years		
≤5	139	7.0
6 to 17	65	1.7
≥18	144	1.7
Missing	3	

Impact of flooding: Household drainage survey

Sixty percent of households reported experiencing flooding during the prior month (Table 6.11). Flooding was defined as 'flooding in or around your home, compound, or community.' Mean duration of flooding was 3.3 days, median 2 days (range 1-31 days) (Appendix 6, Section H).

Table 6.11. Percentage of households that experienced flooding in the month prior to interview		
Flooding in the last month	**n**	**%**
Yes	1884	60.0
No	1244	39.6
Don't know	14	0.5
Total	3142	

Impact of flooding: Expenditures: Household drainage survey

Only 6.5% of households reported experiencing household or property damage as a result of floodwaters. Damage to the building or walls (40%), clothing (20%), and furniture (17%) were most commonly reported (Appendix 6, Section H). Approximately 24% of households reported spending an average of ZMW 538 on 'investments' to protect against flooding (Appendix 6, Section H).

Impact of flooding: Increased travel time due to flooding: Household drainage survey

Almost all households reported that they had at least one member who attended school (Appendix 6, Section H). Flooding caused an average increase of 7 minutes (median: 10 minutes) to get to school, and an average of 2 days of missed school (Appendix 6, Section H). Flooding also increased, by an average of approximately 8 minutes (median: 5 minutes), the reported time taken to get to market. Flooding also increased travel time to work, by an average approximately 10 minutes (Appendix 6, Section H) (c.f., Table 6.14: Business owners report on commute time to work impacted by flooding).

6.1.3. Business Drainage Evaluation

The business baseline survey was carried out from March 21st 2016 to April 15th 2016. A total of 587 businesses were surveyed in the Kamwala market and the surrounding streets. (See Figures 1 and 2 in Appendix 9: Supplement 1). Details of the number of businesses, in Kamwala, the type of businesses (e.g., wholesaler, retailer, service etc.), type of products sold, number of employees and customers per day (dry season), gross monthly income, and years established in current location are provided in Appendix 7 (Tables A7.1 – A7.6; A7.13 – A7.14).

Impact of flooding: Business days flooded and lost

Of those businesses surveyed, 477 (81%) experienced flooding in the past rainy season (defined as approximately October 2015 through April 2016). However, fewer than 28% reported shutting down due to flooding. February and March were the months that had more flood days and days when businesses closed down compared to January and December (Table 6.12, below)

Table 6.12. Distribution of flood days and business shut days over the season

Month	Parameter	Mean	Median	Standard deviation	N
December	Days flooded	2.50	0.00	5.53	165
	Days business shut down	0.73	0.00	1.53	67
January	Days flooded	4.37	2.00	7.47	144
	Days business shut down	1.22	0.00	2.44	67
February	Days flooded	7.72	4.00	8.52	149
	Days business shut down	1.72	1.00	2.03	67
March	Days flooded	7.99	5.00	8.83	187
	Days business shut down	1.88	1.00	2.31	83

Impact of flooding: Business revenue lost: Business drainage survey

In general, the majority of business reported a negative (i.e., loss of revenue) due to flooding (Table 6.13). The size of the loss of revenue varied greatly. There were 361 (78%) businesses that reported a decrease in revenue because of flooding in contrast to 41 (9%) who reported an increase, and 60 businesses reported no loss (Table 6.13). Combing the reports of increases and decreases provided a net a mean (SD) net revenue loss of 6,089 (10,534) ZMW from 271 business (Table 6.13). Further, 50% of business reported a net revenue loss of 3,000 ZMW.

Table 6.13. Impact of floods on business revenue

	Revenue increase/ decrease (ZMW)				
Label	**Mean**	**Standard Deviation**	**Median**	**Range**	**N**
Revenue increased due to floods	2,800	4,175	1,000	(100-15,000)	28
Revenue decreased due to floods	-7,114	-10,567	-3,500	(-70,000 - -50)	243
Net revenue	-6,090	10,534	-3,000	(-70000 -15000)	271

Impact of flooding: Late to work: Business drainage survey

Almost 50% (289/587) of the businesses reported that flooding affected workers' ability to get to work on time. Thirty-one percent of workers (600/1885) were late for an average (SD) of 77 (62) minutes. The median time that workers were late was 1 hour during floods (Appendix Table A7.8).

Impact of flooding: Property destruction and related costs: Business drainage survey

Flooding caused 147 (31%) businesses to report property losses (destruction). The average value of property destroyed was 5,675 ZMW (SD: 13,867 ZMW) and 50% of business valued their property destroyed at below 1000 ZMW (Appendix Table A7.7). The types of property destroyed is recorded in Appendix Table A7.9, with the most common (74%) being sales goods. Some surveyed business (approximately 30%) reported spending money to protect against future flooding. These business spent an average of 4,131 MZW (median: 300) (Appendix Table A7.12). It is noted that no respondent, during the pilot study of the questionnaire, knew about, or reported purchasing, flood insurance. Due to this non-response, the question about purchasing of flood insurance was removed from the final questionnaire used.

Impact of flooding: Other costs: Business drainage survey

Flooding was also associated with increased difficulties in logistics. Surveyed businesses reported flood-related average reduction of approximately 40% in the number of goods vehicles either loading or offloading (Appendix tables A7.10 and A7.11).

Of additional note is that 60% of the surveyed business owners thought that other businesses experienced worse flood-related losses than they did (Appendix Table A7.16).

6.1.4. Traffic Drainage Survey

To measure the impact of flooding due to inadequate drainage on flow (volume) of traffic and travel time, travel surveys were conducted.

Impact of flooding: Traffic flow: Traffic drainage survey

To measure the impact of flooding on traffic flow, from 28 January to 26 April 2016, enumerating teams counted vehicles passing through previously identified intersections in downtown Lusaka. These intersection had been identified, with help from the Lusaka police, as most likely to be negatively impacted by flooding (i.e., slowed). The intersections monitored are shown in in Appendix 9 (Figure A9.1).

From 28 January – 14 March 2016, the survey recorded at the monitored intersections a total of 93,392 vehicles and pedestrians, including 7,020 pedestrians (Appendix 8 Table A8.2). The average number of vehicles, "other' and pedestrians by intersection per 15-minute survey time slot is shown in Table 6.14.

Table 6.14: Average number of traffic passing through different intersection Lusaka (15 minutes intervals, 6:30 AM to 6:30 PM: Jan 28 – Mar 14, 2016)†

	Vehicular traffic				
Type of Intersection*	**Not Categorized**	**Public Transport**	**Car/Taxi**	**Other (e.g., bicycles)**	**Pedestrian**
(C1) Lumuba & Vubu	19	88	35	22	39
(C2) Lumumba & Great North	113	72	45	-	107
(P1) Kaufe Roundabout	276	201	70	12	323
(P2) Kabwe Roundabout	297	207	58	156	80
(P3) Cairo & Church	296	249	15	7	254
(P4) Church & Dedan Kima..	127	168	11	4	114
(P5) Sind & Chilimubulu	68	62	19	4	105
(P6) Mukashi & Mukosa	49	77	4	6	55
(S1) Lumumba & Ben Bella	116	83	40	-	261
(S2) Lumumba & Mumbwa	126	94	37	-	316
(S3) Lumumba & Kalambo	126	123	56	-	93
(S4) Church & Dushambe	78	146	8	-	20
(S5) Makishi & Great East	136	182	30	-	18
(S6) Burma & Jacaranda	105	138	13	3	32
(S7) Bombay & Chongwe	32	46	7	7	64
Total††	**130 (93)**	**145 (90)**	**34 (35)**	**7 (14)**	**158 (144)**

†The average number of vehicles passing through the intersections represent the average traffic volume in 15 minutes time slots (from 6:30 AM to 6:30 PM). Vehicle categories are mutually exclusive.

* P=Primary intersection, S=Secondary intersection and C=Control Intersection. Primary Intersections are were flooding is likely to occur and flood waters drain into Bombay Drain. Secondary Intersections are affected by the congestion that overflows from primary intersections, but they may not be necessarily flooded. Control Intersections may get flooded, but flood waters do not drain into Bombay Drain. See Appendix 9, Figure A9.1 for map.

††Number in parentheses are standard deviations from mean.

Impact of flooding: Traffic flow and impact of rain: Traffic drainage survey

The impact of rain on traffic flow is shown in Table 6.15. Overall, rain was associated with a 6% reduction in traffic flow through the 15 intersections monitored (Table 6.14). It may appear paradoxical that rain is associated with, for the category of "other vehicles," a 14% increase in traffic flow (Table 6.15). However, the absolute numbers are very similar – 7 other vehicles (no rain) versus 8 vehicles (yes rain). Pedestrian traffic, possibly because pedestrians are more exposed to weather conditions compared to those in vehicles, had a more notable rain-related drop in flow (-31%) (Table 6.15).

Table 6.15: Average impact of rain on traffic flow passing through different intersection Lusaka, Zambia (15 minutes intervals, 6:30 AM to 6:30 PM: Jan 28 – Mar 14, 2016)

Vehicle type*	Mean vehicles per 15 minute observation				
	Rain No		Rain Yes		Difference
Public transportation	145		146		1%
Cars, Taxis	34		30		-12%
Other vehicles	7		8		14%
All vehicles	*84*		*79*		*-6%*
Pedestrians	159		110		-31%

* "Public transportation" refers to buses and mini-buses; "other vehicles" refers to motor bikes, vans, pick-up trucks, public service vehicles (e.g., police, ambulance)

Impact of flooding: Traffic time: Traffic drainage survey

In the 37 travel routes survey (Appendix 9b for details), the average round trip took approximately 56 minutes (27 minutes outbound form city center, 29 minutes inbound) (Appendix 8 Table A8.3).

7. Administrative

7.1. Summary of Institutional Review Board requirements and clearances (in-country, international)

Evaluation protocols were submitted to the Institutional Review Board (IRB) of CDC in Atlanta, to the IRB at NORC, and to the Biomedical Research Ethics Committee (BREC) at the University of Zambia (UNZA) for approval prior to the start of data collection. Both CDC and NORC's IRBs reviewed the protocols and determined them to be non-research evaluations. UNZA's BREC approved the study protocol.

7.2. Data Access, Privacy and Documentation Plan

7.2.1. WASH Evaluation

Data Security and Privacy

The Android tablets used by RuralNet enumerators for the baseline evaluation of the water supply and sanitation interventions were installed with CommCare software application for conducting interviews. ODK provides various levels of security. Field staff collected data using this software and once a form was complete, it was stored in an encrypted form on the device. In addition, the enumerators used authentication to access the tablet (passcode, password etc.). CommCare works offline, and so the encrypted form was kept on the device until network was available. Enumerators and supervisors had the ability to edit data before it was sent to the server. However, once the data had been transmitted, no field staff had access to it.

CommCare transmitted completed forms using encryption to the server over a secure socket (SSL) and the data were stored in their encrypted form. The data on the server were only available to a user with security clearance (username and password). A back up of the data was created on a daily basis to a secondary drive.

All interview data collected using the tablets were stored electronically on RuralNet's servers. The primary storage for the forms generated by the tablet were hosted on a cloud server with secondary back up on a server. The primary server was hosted by ONA (https://ona.io/) and the secondary server was an ODK Aggregate server deployed on Google's cloud server (https://cloud.google.com/appengine/). The forms were encrypted using asymmetric public key encryption at the time the form was finalized within CommCare. This encrypted form was then submitted to the server and downloaded later with tools that supply the asymmetric private key to decrypt and export the form data. This process ensured that the finalized forms were encrypted before being submitted to RuralNet's server, remained encrypted while stored on the servers, and remained encrypted as the data and attachments were pulled into tools that facilitated downloading of the data.

Files used to enumerate and select households and data extracts were saved to NORC's secure servers. NORC restricted access to folders, unless access was needed in the performance of staff duties. Files with personally identifying information (PII) were stored to restricted access network folders with one folder for the household survey data extracts and a separate folder for all household sampling information. NORC's SFTP

site had three folders for this project with restricted access. One folder was used by MCA-Zambia and NORC, one was used by CDC and NORC and the third was used by RuralNet and NORC.

Data stored to the Export and Sample file folders were archived on a nightly basis. At the conclusion of the project, all folders with PII were deleted upon acceptance of the final data deliverables by MCA-Zambia.

DATA SHARING

Based on guidance from MCA-Zambia, all data were submitted to CDC only. A data sharing agreement allowed NORC to grant CDC staff access to data files saved to NORC's SFTP and to the CommCare data collection system used by RuralNet. Data were submitted to CDC in encrypted format using NORC's SFTP site. A secure password was used. Each approved user at CDC had their own log in and password to download the data.

At the conclusion of the project and after acceptance of the data by MCA-Zambia and the CDC, all PII will be securely deleted from NORC's SFTP and documentation of the deletion forwarded to MCA-Zambia. CDC Atlanta is the sole holder of the dataset on their secure branch share drive with restricted access only to project staff.

7.2.2. Drainage Evaluation

Data from the drainage evaluation were entered into a REDCap online database. REDCap (Vanderbilt University, TN) is a server-based online database platform. The data entered were stored on a secure server located at CDC Atlanta. Access was restricted to authorized personnel only. Double data entry reconciliations were performed using SAS v. 9. 4 (SAS, Cary, NC). Note: Data entry was only conducted for the drainage baseline surveys since they were conducted on paper instruments and the WASH baseline surveys were electronic data capture.

Data entry for the household drainage survey was conducted at the MCA-Z head office in Lusaka. Data entry operators manually entered hard copy survey data into a REDCap database on secure CDC laptops. All range checks and skips were controlled by REDCap and the operators could not override them. Range and consistency checks were also incorporated into the REDCap database.

After the overall completion of data entry, access rights to REDCap were removed for all non-CDC personnel and the hard copies of the completed questionnaires were moved to CDC-Zambia office premises.

7.3. Dissemination Plan (description of products and on-line, presentation dissemination efforts)

Once the final report is reviewed by MCC and MCA-Z, CDC is responsible for presentations at MCC headquarters and at MCA-Z headquarters. The report will be shared with a variety of stakeholders from different government line Ministries and partners within Zambia. CDC is also responsible for reviewing any materials developed by MCC public relations for dissemination on the MCC website for quality assurance. CDC may also participate in other MCC-financed dissemination and training events, such as MCC M&E college and the Annual MCC Impact Evaluation Workshop.

7.4. Evaluation Team roles and responsibilities

As the Independent Evaluator, CDC is ultimately charged with designing and carrying out, under MCC oversight, an unbiased, objective and rigorous evaluation of Compact activities pertaining to water supply, sanitation and drainage. Since the strength of the impact evaluation relies largely on the quality of data used, the CDC shall oversee data collection and provide technical assistance to data collection entities to ensure that the sample, instruments, and field implementation are adequate to meet the requirements of the impact evaluation.

CDC's evaluation team is composed of three Principal Investigators for the epidemiologic, economics and environmental microbiology components of the evaluation. The evaluation team contains additional staff with backgrounds in epidemiology, economics, statistics, WASH, clinical medicine, and program evaluation.

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Appendices:

Appendix 1: Household Drainage Questionnaire

BASELINE HOUSEHOLD QUESTIONNAIRE FINAL (AFTER PILOTING DURING TRAINING)

Impact Evaluation of Lusaka Water Supply, Sanitation, and Drainage Project

Survey Instrument

Drainage Evaluation; Brief Water and Sanitation Evaluation

2/03/2016 version

CDC
CENTERS FOR DISEASE CONTROL AND PREVENTION

Evaluation by CDC for Millennium Challenge Corporation

MILLENNIUM CHALLENGE CORPORATION
MCC
UNITED STATES OF AMERICA

Household Identifiers

Record ID:

Date of Visit 1: _ _ /_ _ / _ _ _ _ (Day/Month/Year) **Interviewer's name Visit 1:** _____

Result 1:

Date of Visit 2: _ _ /_ _ / _ _ _ _ (Day/Month/Year) **Interviewer's name Visit 2:** _____
Result 2:
Date of Visit 3: _ _ /_ _ / _ _ _ _ (Day/Month/Year) **Interviewer's name Visit 3:** _____
Result 3: **Replaced by (if applicable):**_____
Result Codes:
Completed = 1
No respondent available at time of visit = 2
Refused = 3
Other (Specify): _____ = 4

Ward (please circle one):Nkoloma Kamwala Kabwata Libala Harry Mwaanga Silwizya Independence

Lubwa Roma Ngwerere Chaisa Raphael Chota Mpulungu

Township:_____

Household Label number from map: _____
SEA No: _____ GPS Coordinate: -_____S
+_____E

INFOMRED CONSENT PROCESS (circle one): Done / Not Done

Signature of Interviewer: _____

Field Supervisor: _____
Data Entry:
Data Entry Operator 1: _____ Date of Data Entry1: _ _ /_ _ / _ _ _ _ (Day/Month/Year)
Date Entry Operator 2:_____ Date of Data Entry 2:_____

ENUMERATOR: Ask to speak to the male or female head of the household. If the male or female head of household is not there, arrange to come back when one of them will be present.

Screening questions in Informed Consent: Are you the head of this household (male or female) or the spouse?
____Yes ____ No

Has your family been living in this house for 2 or more months?
____ Yes (1)
____ No (0) **End Survey**. **Thank respondent for their time.**
____ Don't Know (99) **End Survey**. **Thank respondent for their time.**

ENUMERATOR: Are you interviewing the male or female head of the household or spouse?
____ Male (1) ____ Female (2)

Interview Start Time- __ _:__ _

A. Household Demographics

1) **Can you please tell me your age?**
   ____ Years ____ Don't Know (99) ____ Refused (77)

2) **What is the highest level of education you have completed?**
   Primary_____(1) Secondary_____(2) Tertiary_____(3) N/A_____(4) Don't Know__ (99) ___ Refused (77)

3) **Do you /your family own or rent this house?**
   ____ Own (1) ____ Rent (2) **Go to Q6** ____ Other, specify (88):_____

4) **Do you have a title or deed?**
   ____ Yes (1) ____ No (0) ____ Don't Know (99) _____Refused (77)

5) **Do you have any tenants in this compound? That is, are you the landlord of a building in this compound?**
   ____ Yes (1) ____ No (0) ____ Don't Know (99)

6) **Can you tell me how long your family has lived in this house or the year that you moved into this house? (*If less than one year specify in months, otherwise answer in years. Fractions are ok e.g., 4.5 years*)**
   _____ Years in house ***OR*** _____Months in house
   _____ Year moved in
   _____ Don't Know (99)

7) **How many rooms are in the household, excluding the kitchen or bathroom/s?**
   _____ Rooms

8) **How many people currently live in this house? I am only talking about people who normally sleep and eat at the house, not visitors or people staying temporarily.**
   _____ People

I would like to ask you a few things about each person living in the house, starting with yourself. (Instruction: *Complete the table below for all persons living in your household. Fill out one row per person before moving to next household member. Don't count visitors.)*

HHM ID	Mark 'X' for Head of House hold	Age in years OR date of birth (if unknown DK)	Sex: M/F	Currently in School: Y/N	If less than or equal to 5 years of age (Born on or after 2011):			
					A	B	C	D
					Is the child's under 5 card available? Y/N *(If Yes go to B; If No go to D)*	Record the number of rotavirus vaccination doses from the card: 0/1/2/>2/DK (*Go to C*)	Record the date of the last rotavirus vaccine from the card (MM/ YYYY) (*Go to Q 14*)	If no under 5 card, how many rotavirus vaccinations do you remember him or her receiving? 0/1/2/>2/DK
1							___/____	
2							___/____	
3							___/____	
4							___/____	
5							___/____	
6							___/____	
7							___/____	
8							___/____	
9							___/____	
10							___/____	
11							___/____	
12							___/____	
13							___/____	
14							___/____	
15							___/____	

B. Sickness and Associated Costs

Now I would like to ask you about people in your household who may have been sick with diarrhea or flu-like illness in the last 7 days

1. **Has anyone in your house been sick with diarrhea or flu-like illness in the past 7 days? By flu-like illness I mean having a fever AND a cough or sore throat. (*Utilize calendar as a memory aid if needed*)**
   ____ Yes (1)
   ____ No (0) **Go to Page 9, Brief Water Collection**
   ____ Don't know (99) **Go to Page 9, Brief Water Collection**

2. **How many members of your household were sick with diarrhea or flu-like illness in the past 7 days?**
   ____ Ill household members
   ____ Don't know (99)

3. **Now I would like to ask you more about the illness they had (*Use one column per person. Fill out each column all the way to the bottom of the table before starting a column for the next ill person)***

	Sick Household Members				
Q		**Gender & Age (e.g., F 10)**			
A	**Did (name) have….? (*circle a response for EACH symptom*)**				
i	**Diarrhea** (*3+ loose or watery stools in 24 hours*)	Y N DK	Y N DK	Y N DK	Y N DK
ii	**Fever** (*at least 38°C or parental perception*)	Y N DK	Y N DK	Y N DK	Y N DK
iii	**Cough**	Y N DK	Y N DK	Y N DK	Y N DK
iv	**Sore Throat**	Y N DK	Y N DK	Y N DK	Y N DK
B	**If sick person had <u>diarrhea</u> answer questions below**				
i	When did diarrhea begin? (*Enter date as DD/MM/YYYY)*	__/__/__	__/__/__	__/__/__	__/__/_
ii	Number of days with diarrhea? (*If a range, take average and round up*)	___Days	___Days	___Days	__Days
iii	Is diarrhea ongoing?	Y N DK	Y N DK	Y N DK	Y N DK
iv	Maximum number of loose stools (or times person went to the toilet) in a 24 hour period *(If exact number unknown, ask for and record one of the following ranges: "3 to 5" "6 to 7" or "too numerous to count (TNTC)")*				
v	Was there blood in the stool?	Y N DK	Y N DK	Y N DK	Y N DK
C	**If sick person had <u>fever AND (cough or sore throat)</u> answer questions in below**				
i	When did the illness begin? (*Enter date as DD/MM/YYYY*)	__/__/__	__/__/__	__/__/__	__/__/_
ii	Number of days ill? (*If a range, take average and round up*)	___Days	___Days	___Days	__Days
iii	Is illness ongoing?	Y N DK	Y N DK	Y N DK	Y N DK

D	**Activities missed due to illness (*ask for all types of illness*)**				
i	Miss work because they were sick? (*If no go to Dii)*	Y N DK N/A	Y N DK N/A	Y N DK N/A	Y N DK N/A
	Number of days (D) or hours (H) missed (*If a range, take average and round up*)	___	___	___	___
	Did he/she lose wages/earnings for the days they took time off for illness? (*If no go to Dii*)	Y N DK N/A	Y N DK N/A	Y N DK N/A	Y N DK N/A
	If yes, amount of wages lost **per day** (ZMW)				
ii	Miss school because they were sick? (*if no go to Diii)*	Y N DK N/A	Y N DK N/A	Y N DK N/A	Y N DK N/A
	Number of days missed	___Days	___Days	___Days	___Days
iii	Have to skip household chores/work like fetching water, cooking, cleaning, or caring for kids (*if no go to Q Ei)*	Y N DK N/A	Y N DK N/A	Y N DK N/A	Y N DK N/A
	Number of days (D) or hours (H) skipped	___	___	___	___
E	**Treatment and Cost (*ask for all types of illness*)**				
i	Did the sick person get treatment for the illness, such as visiting a clinic, hospital, pharmacist, or healer, taking medication, or having lab tests done? (*If no, go to Section C)*	Y N DK	Y N DK	Y N DK	Y N DK
ii	Did your household spend any money on the treatment for this illness? Treatment includes any money you spent on clinic or doctor visits, medications, lab tests, and hospitalizations (*If no go to Q Eiii)*	Y N DK	Y N DK	Y N DK	Y N DK
	If yes, how much did you spend? (ZMW) (*Enter a number or DK [don't know])*				
iii	Did you have to spend any money on transportation for this person's illness? This includes going to or from the clinic, pharmacy, hospital, etc. (*If no, go to Q Fi)*	Y N DK	Y N DK	Y N DK	Y N DK
	If yes, how much did you spend on transportation? (ZMW) (*Enter a number or DK [don't know])*				
F	**Time Use: (*ask for all types of illness*)**				
i	If _ (name)_visited a clinic or health center, how many times did they go? (*Enter a number or DK [don't know]. Skip this question and go to Q Fii if did not visit clinic or Health Center)*				
	On average, how long did it take you to see the doctor or nurse, including round-trip travel time? (*Enter a number or DK [don't know]. Specify hours or minutes*)				

ii	Did (name) need to be hospitalized for this illness? (*Hospitalized means spending at least one night in the hospital. Go to Section C if No or DK [Don't Know])*	Y N DK	Y N DK	Y N DK	Y N DK
	How many days were they hospitalized? (*Enter a number or DK [don't know])*				

C. Caretaker Time Loss

1. **Did anyone stay home from work or did you have to pay someone to take care of (sick household member)?**
   ____ Yes (1)
   ____ No (0) **Go to Page 9 – Brief Water Collection**

	People who stayed home to care for sick household members				
Q2		Gender and Age (e.g., F 10)			
A	Does this person (the caretaker) live in the house? *If yes, skip section C. (example: Parent)* *If no, skip section D. (example: maid or hired help)*	Y N DK	Y N DK	Y N DK	Y N DK
B	How many days did they stay at the home to take care of __ (name)?	___Days	___Days	__Days	__Days
C	Did they get paid to take care of __ (name)? *(Circle one)*	Y N DK	Y N DK	Y N DK	Y N DK
i	How much were they paid for caregiving, **in total?** (ZMW) (*Enter a number or DK [don't know])*				
D	Did they lose wages or earnings for the days they were at home to take care of __ (name)? *(Circle one. If no, go to Section D)*	Y N DK	Y N DK	Y N DK	Y N DK
i	How much did they lose **in total?** (ZMW) (*Enter a number or DK [don't know])*				

D. Brief Water Collection

Now I am going to ask you questions about the water your household uses.

1) **During the past week, where did you get your DRINKING WATER? What was your main source of drinking water? (*Select the best answer. Observe source if respondent cannot describe it or you are unsure.)***
   ____ Communal tap/Water kiosk (1)
   ____ Protected well/Borehole (2)
   ____ Unprotected well/Borehole (3)
   ____ Piped water inside house (4)
   ____ Piped water outside house within stand/plot (5)
   ____ Piped water from neighbor/friend (6)
   ____ Surface water (stream/pond) (7)
   _____Bottled Water/ Packaged Water (8)
   ____ Other, specify (88):_____
   ____ Don't know (99)
   ____ Refused (77)

2) **In the past week, how many days was water available from this source?**
   _____ Days
   _____ Don't know (99)

3) **On average, how many hours per day was water available from this source?**
   _____ Hours
   _____ Minutes
   _____ Don't know (99)

4) **During the past week did you get DRINKING WATER from any other source(s)?**
   ____ Yes (1)
   ____ No (0) ***Go to Q6***
   ____ Don't know (99) ***Go to Q6***

5) **What was/were the other source(s)? (DO NOT read answers. Select all that are stated).**

   ____ Communal tap/Water kiosk (1)
   ____ Protected well/Borehole (2)
   ____ Unprotected well/Borehole (3)
   ____ Piped water inside house (4)
   ____ Piped water outside house within stand/plot (5)
   ____ Piped water from neighbor (6)
   ____ Surface water (stream/pond) (7)
   _____Bottled Water/ Packaged Water (8)
   _____Other, specify (88):_____
   ____ Don't know (99)
   ____ Refused (77)

6) **How much water does your household use in a typical day, measured in buckets OR liters?** I am asking about ALL of the water your household uses in a day, whether for drinking, bathing, cleaning or something else. This water

could come from ANYWHERE, including taps in your home or plot, water kiosks, communal taps, wells, boreholes, neighbors, etc. (*If household collects water in buckets of multiple sizes, list the number and capacity of each that is used in Bucket A, B, C.)*

	Number	Capacity (liters)	Don't Know (99)
Bucket			
Container			
Drum			
Other			

For households with piped water in the house who do not store water:
Estimated use_____ (liters or m3)
Water Bill reading___m^3 _____kwacha
Amount paid: _____
Periodicity of bill (fixed charge or prepaid): ____monthly _____every two weeks _____Other, specify
Other_____
Don't know _____

E. Water Storage and Treatment

Now I would like to ask you about how you keep drinking water in your house.

1) **ENUMERATOR: Does the household collect water from a water kiosk or communal tap?**
   ____ Yes (1)
   ____ No (0) ***Go to Q4***
   ____ Don't know (99) ***Go to Q4***

2) **When you collect water from a kiosk or communal tap, do the kiosk operators treat the water or do something to it like add bleach when you collect it?**
   ____ Yes (1)
   ____ Sometimes (2)
   ____ No (0) ***Go to Q4***
   ____ Don't know (99) ***Go to Q4***
   ____ Do not collect water from a kiosk (98) ***Go to Q4***

3) **What do the kiosk operators do to the water you collect?**
   ____ Pour bleach into water (1)
   ____ Put a tablet into the water (2)
   ____ Other (88), specify:_____
   ____ Don't know (99)

4) **Do you normally treat or do something to your drinking water, such as adding chlorine, boiling it, or filtering it?**
   ____ Yes (1)
   ____ No (0)
   ____ Don't know (99)

5) **Did you treat or do something to the drinking water in your home today, such as adding chlorine, boiling it, or filtering it?**
   ____ Yes (1)
   ____ No (0) **Go to Q8**
   ____ Don't know (99) **Go to Q8**

6) **What did you do to your water?** ***(DO NOT read answers. Mark all that apply)***
   ____ Boil water (0/1)
   ____ Bleach/chlorine (0/1)
   ____ Filter water (0/1)
   ____ Other (0/1) Specify: _____

7) **Please show me the boiling pot, tablet, filter, or other item that you used.** ***(Enumerator: Confirm presence of pot, tablet, filter, or other item.)***
   ____ Item present (1)
   ____ Item not present (0)

8) **Please show me the containers you mainly put your <u>drinking</u> water in inside your house? (*OBSERVE and select the main container type(s) the household identifies as using.)***

____ Buckets (1)
____ Plastic jerrycan/Container with screw top (e.g., plastic bottle) (2)
____ Drum (3)____ Other (88), specify: _____
____ Do not use a container (4) . **Go to Q11**
____ Unable to observe (5) ..... **Go to Q10**
____ Don't know (99) ..... **Go to Q10**
____ Refused (77) ..... **Go to Q10**

9) ***OBSERVE - How many of the water storage containers are covered?***
____ All (1)
____ Some (2)
____ None (0)
____ Unable to observe (3)

10) How do you get water from this container to drink? Can you please show me how? (*OBSERVE and select what the respondent does)*
____ Dipping (w/ ladle, cup, or hand) (1)
____ Pouring (2)
____ Through a spigot or tap (3)
____ Other(88), specify:_____
____ Don't know (99)
____ Refused to show (77)

F. Brief Sanitation Module

1) Now we are going to talk about sanitation and toilets. Can you show me the toilet facility your house NORMALLY uses? *OBSERVE: What type of toilet is it? If respondent will not show you, ask them to describe it. Choose the best answer.*

____ Pit latrine with slab (1)	**Go to Q3**
____ Pit latrine without slab (2)	**Go to Q3**
____ Ventilated improved pit latrine (VIP) (3)	**Go to Q3**
____ Bucket/chamber pot (4)	**Go to Q6**
____ Flush toilet (5)	**Go to Q2**
____ No facilities/open defecation/bushes/plastic bags (6)	**Go to Q6**
____ Other (88), specify	**Go to Q3**
____ Don't know (99)	**Go to Q3**
____ Refused (77)	**Go to Q3**

2) Where is the waste flushed to?
____ Piped sewer system (1)
____ Septic tank (2)
____ Latrine hole (3)
____ Some other place (i.e., river, drainage ditch) (4)
____Other (88), specify _____
____ Don't know (99)

3) Is your toilet or latrine just for this household or shared with other households?

____ Just this household (1) **Go to Q6**
____ Shared (2)
____ Don't know (99) **Go to Q6**
____ Refused (77) **Go to Q6**

4) How many households share it, including your own?

Number of households _____ Don't know (99) _____

5) How many people share it, including those in your household?

Number of people _____ Don't know (99) _____

6) *OBSERVE – Are there feces (human or animal) visible in the yard/plot?*

____ Yes (1)
____ No (0)
____ Not evaluable (3)

G. Hygiene Module

1) When do you usually WASH your hands? (DO NOT read options. CONTINUE TO PROMPT *"ANY OTHER TIMES?" CHECK ALL THAT RESPONDENT MENTIONS.)*

____ Before eating
____ After cleaning child who defecated
____ After disposing the chamber
____ After handling trash
____ After contact with animals
____ Other, specify_____
____ Before cooking/preparing baby food
____ After using toilet
____ Before you nurse
____ After working
____ Never ***Go to Section H***

2) What do you usually WASH your hands with?

____ Water only (1) ***Go to Section H***
____ Water and soap (2) ***Go to Q3***
____ Water and something else (3), specify:_____ ***Go to Section H***
____ Ashes ***Go to Section H***
____ Don't know (99) ***Go to Section H***
____ Refuse (77) ***Go to Section H***

3) Please show me the soap that you use. *(Enumerator: Confirm the presence of soap.)*

____ Soap present (1)
____ Soap not present (0)
____ Refuse (77)

H. Household Garbage Disposal

1) What are the ways that you dispose of garbage? (*Select all that apply.)*

____ Garbage collected from house **Go to Q2**
____ Burn
____ Bury/pit
____ Roadside dump

____ Drainage ditch
____ Put in latrine/toilet
____ Don't Know
____ Garbage bay/Council bins
____ Other, specify _____
____ Refused

2) Who collects your garbage? (*Mark the best answer.)*

____ LCC/the city (1)
____ Private Company or community based enterprise (2)
____ Hired individuals (3)
____ Other (88), specify _____
____ Don't know (99)
____ Refused (77)

I. Flooding

***NOTE:* Many of the questions in the section ask about the effects of flooding in "the last month." The time period of measurement for flooding may be adjusted after field testing the survey instrument.**

Now I would like to ask you about flooding and how it affects you, your household, community, and compound.

1) Did you experience flooding in the last month? This could be flooding at your home, in the streets, or in your community or compound.

____ Yes (1)
____ No (0) **Go to Q5**
____ Don't know (99)

2) During the last month, about how many days was there flooding in or around your house, compound, or the streets outside? (*If no flooding in a month, enter "0". If they say "after every rain" prompt for a number of days, and if they can't give a number then enter "DK")*

____Hours ____ Days ____ Don't Know (99)

3) During the last month did flood waters damage or destroy any property at your house?

____ Yes (1)
____ No (0) **Go to Q5**

4) What type of property did it damage or destroy? *(Do not read list. Continue to prompt, "anything else." Select all that apply.)*

____ Building/Walls
____ Groceries/pantry
____ Electronic equipment
____ Vehicles/bicycles
____ Other appliances
____ Cell phones
____ Books/stationeries
____ Clothes/shoes
____ Furniture
____ Plants/garden
____ Other, specify_____

5) **Have you done anything or spent any money to protect against FUTURE flooding, like purchasing sand-bags or water-proof equipment in the last year?**

____ Yes (1)
____ No (0) **Go to Q7**
____ Don't know (99) **Go to Q7**
Other, specify,_____

6) **How much did you spend on those investments? (*If something was done but no money was spent, enter "0".)***

____ ZMW
____ Don't know (99)
____ Refuse (77)

7) **Were there any deaths (from drowning or injury) of people living in your household associated with the flooding during the last year?**

____ Yes (1)
____ No (0)
____ Don't know (99)

Now I am going to ask you about the amount of time it took household members to travel around town with and without flooding. If household members are in school go Q8. If no household members are in school go to Q9

8) **On average, how long did it take household members to get to school? I would like to know this for all household members that attend school. (*Fill out table below for all household members that attend school)***

	HH members that go to school				
	1	**2**	**3**	**4**	**5**
Sex/ Age					
Time in minutes to get to school. WITHOUT FLOODING *(Enter a number or DK)*					
Time in minutes to get to school. WITH FLOODING *(Enter a number or DK)*					
Did flooding during the last month prevent anyone from going to school entirely?	Y N DK	Y N DK	Y N DK	Y N DK	Y N DK
If yes, Days of school missed					

9) **On average, during the last month, how long did it take to get to the market with and without flooding, in minutes?**

____ Minutes without flooding _____ Minutes with flooding
____ Don't know (99) ____ Don't know (99)

10) **How Many household members work?____**

(If no household member works, go to page 18 - Time Use and Expenditures)

11) **During the past month, on average how long did it take household members to get to work each day, in minutes?** I would like to know this for all household members that are 18 or older and are working. (*Fill out table below for all working household members that are 18 years of age or older)*

	HH members that go to work				
	1	**2**	**3**	**4**	**5**
Sex/ Age					
Time in minutes to get to work. WITHOUT FLOODING *(Enter a number or DK)*					
Time in minutes to get to work. WITH FLOODING *(Enter a number or DK)*					
N/A: Works from home					
N/A: Doesn't go to work when it rains					

J. Time Use and Expenditures

Now I would like to ask some questions about working, looking for work, and household expenditures during the last month.

1. **I will start by asking you about time spent working and looking for work for household members age 18 and older.** *(Fill out a column in this table for each member of the household who is 18 or older. Answer all questions for one household member before moving to the next.)*

	Adult Household Members				
Q	**In the last month did _(name)_:**	**Gender and Age (e.g., F 20)**			
A	**Are you/are they doing any activities where you/they earned money?** This includes things like working for a wage, doing piecework, running a shop, or selling things on the road. **(*Circle one. If No go to B)***	Y N DK	Y N DK	Y N DK	Y N DK
i	Days worked per week, on average				
ii	Hours worked per day, on average				
B	**Are you/are they looking for work? (*Circle one. If no, got to question 2)***	Y N DK	Y N DK	Y N DK	Y N DK
i	Days spent looking for work per week, on average				
ii	Hours spent looking for work per day, on average				

Expenditures:

2. **Now I would like to ask you about different things your household has spent money on. Focusing on the last 7 days, has your household purchased any following food items?**

Consumption Items	Q	No = 0 Yes = 1 Don't Know = 2 Refused = 3	If yes, how much was spent (ZMW)?	If amount spent not known, how much was purchased?	Notes
Cereals and grains					
Mealie meal (kg)	i				
Bread (loaf/buns)	ii				
Rice (kg)	iii				
Other (e.g., flour, maize, noodles, sampo), Specify:	iv				
Meats, Eggs, and Fish	**5-2**				
Kapenta (kg)	i				
Other fish (any) (kg)	ii				
Eggs (dozen)	iii				
Poultry (kg)	iv				
Other (e.g., beef, pork, sausage), Specify:	v				
Vegetables					
Tomato (kg)	i				
Onion (kg)	ii				
Green vegetables (kg)	iii				
Other, Specify (kg):	iv				
Fruits/Local fruits					
All (kg)	i				
Sugar, Salt, oil and Spices					
Cooking oil (liter)	i				
Sugar (kg)	ii				
Salt (pack)	iii				
Other, Specify:	iv				
Dairy Products					
Milk (fresh, powdered)	i				
Butter/Margarine (kg)	ii				
Other (e.g., yogurt, cremora), Specify:	iii				
Pulses/Legumes					
Dry beans (kg)	i				
Ground nuts/Peanuts (kg)	ii				
Other (e.g., soya chunks, soybeans), Specify:	iii				
Beverages					
Tea, coffee (pack)	i				

Soft drinks/fruit juice (liter)	ii				
Alcohol (liter)	iii				

3. Have you or any members of your household had any expenses for the following <u>non-food items</u> during past month? I will read you a list.

	Q	No = 0 Yes = 1 Don't Know = 2 Refused = 3	If Yes, how much did you spend in a month? (ZMW)
Non-food items	6-1		
Electricity	i		
Rent or mortgage	ii		
Cell phone minutes/bill (for the WHOLE household)	iii		
Public transport – Taxi, Bus, Minibus	iv		
Personal products such as soap, shampoo, razor blades, toothbrush and tooth paste, or cosmetics and skin cream (*Read all options)*	v		
Hair braiding or hair care	vi		
Clothing	vii		
Charcoal/ firewood /kerosene	viii		
Gas/petrol	ix		
Cigarettes/tobacco	x		

4. Has your household had any expenses for the following <u>healthcare items</u> during past month?

Healthcare Expenses	Q	No = 0 Yes = 1 Don't Know = 2 Refused = 3	Specify the amount spent (ZMW) and a time period if 1 month total not known
Doctor/clinic/health center visit fees	i		
Medications: All (e.g., from pharmacy/chemist or drugstore [self-prescribed])	ii		
Other, specify:	iii		

5. Has your household had any education related expenses in the past year? This includes things like tuition, daily fees, uniforms, school supplies, or transportation

____ Yes (1)
____ No (0) **Go to Q8**
____ Don't know (99) **Go to Q8**
____ Refused (77) **Go to Q8**

6. How many household members are in school? *(Enumerator: check this response matches question A9)*

_____
If "0" go to Q8

7. **I will now start asking you about the money your household may have spent on household members in school. (*Use one section per household member. Fill out each section for all the education expenses before starting a new section for the next household member)***

Q	Household School-attendee 1			
		No = 0 Yes = 1 Don't Know = 2 Refused = 3	No. terms per year	Kwacha (ZMW) per term
7.a.i	Did your household spend money on tuition for this person in the last year?			
7.a.ii	During the past year, has your household spent money on any other items for __(name's)__ schooling, such as:	No = 0 Yes = 1 Don't Know = 2 Refused = 3	Amount spent (ZMW) per day	
7.a.ii.A	Daily school fees/pocket money			
7.a.ii.B	Transport (e.g., minibus, petrol)			
7.a.iii	During the past year, has your household spent money on any other items for __(name's)__ schooling, such as:	No = 0 Yes = 1 Don't Know = 2 Refused = 3	Amount spent (ZMW) last year. If 1-yr total is not known try to get total for a different time period (e.g., 200 ZMW last month)	
7.a.iii.A	Uniform/Shoes			
7.a.iii.B	School supplies like stationaries or textbooks			
7.a.iii.C	Other, specify:			
Q	Household School-attendee 2			
		No = 0 Yes = 1 Don't Know = 2 Refused = 3	No. terms per year	Kwacha (ZMW) per term
7.b.i	Did your household spend money on tuition for this person in the last year?			
7.b.ii	During the past year, has your household spent money on any other items for __(name's)__ schooling, such as:	No = 0 Yes = 1 Don't Know = 2 Refused = 3	Amount spent (ZMW) per day	
7.b.ii.A	Daily school fees / pocket money			
7.b.ii.B	Transport (e.g., minibus, petrol)			

7.b.iii	**During the past year, has your household spent money on any other items for __(name's)__ schooling, such as:**	**No = 0 Yes = 1 Don't Know = 2 Refused = 3**	**Amount spent (ZMW) last year. If 1-yr total is not known try to get total for a different time period (e.g., 200 ZMW last month)**	
7.b.iii.A	Uniform/Shoes			
7.b.iii.B	School supplies like stationaries or textbooks			
7.b.iii.C	Other, specify:			
Q	**Household School-attendee 3**			
		No = 0 Yes = 1 Don't Know = 2 Refused = 3	**No. terms per year**	**Kwacha (ZMW) per term**
7.c.i	**Did your household spend money on tuition for this person in the last year?**			
7.c.ii	**During the past year, has your household spent money on any other items for __(name's)__ schooling, such as:**	**No = 0 Yes = 1 Don't Know = 2 Refused = 3**	**Amount spent (ZMW) per day**	
7.c.ii.A	Daily school fees / pocket money			
7.c.ii.B	Transport (e.g., minibus, petrol)			
7.c.iii	**During the past year, has your household spent money on any other items for __(name's)__ schooling, such as:**	**No = 0 Yes = 1 Don't Know = 2 Refused = 3**	**Amount spent (ZMW) last year. If 1-yr total is not known try to get total for a different time period (e.g., 200 ZMW last month)**	
7.c.iii.A	Uniform/Shoes			
7.c.iii.B	School supplies like stationaries or textbooks			
7.c.iii.C	Other, specify:			
Q	**Household School-attendee 4**			
		No = 0 Yes = 1 Don't Know = 2 Refused = 3	**No. terms per year**	**Kwacha (ZMW) per term**
7.d.i	**Did your household spend money on tuition for this person in the last year?**			
7.d.ii	**During the past year, has your household spent money on any other items for __(name's)__ schooling, such as:**	**No = 0 Yes = 1 Don't Know = 2 Refused = 3**	**Amount spent (ZMW) per day**	
7.d.ii.A	Daily school fees / pocket money			
7.d.ii.B	Transport (e.g., minibus, petrol)			

7.d.iii	**During the past year, has your household spent money on any other items for __(name's)__ schooling, such as:**	**No = 0 Yes = 1 Don't Know = 2 Refused = 3**	**Amount spent (ZMW) last year. If 1-yr total is not known try to get total for a different time period (e.g., 200 ZMW last month)**	
7.d.iii.A	Uniform/Shoes			
7.d.iii.B	School supplies like stationaries or textbooks			
7.d.iii.C	Other, specify:			
Q	**Household School-attendee 5**			
		No = 0 Yes = 1 Don't Know = 2 Refused = 3	**No. terms per year**	**Kwacha (ZMW) per term**
7.e.i	**Did your household spend money on tuition for this person in the last year?**			
7.e.ii	**During the past year, has your household spent money on any other items for __(name's)__ schooling, such as:**	**No = 0 Yes = 1 Don't Know = 2 Refused = 3**	**Amount spent (ZMW) per day**	
7.e.ii.A	Daily school fees pocket money			
7.e.ii.B	Transport (e.g., minibus, petrol)			
7.e.iii	**During the past year, has your household spent money on any other items for __(name's)__ schooling, such as:**	**No = 0 Yes = 1 Don't Know = 2 Refused = 3**	**Amount spent (ZMW) last year. If 1-yr total is not known try to get total for a different time period (e.g., 200 ZMW last month)**	
7.e.iii.A	Uniform/Shoes			
7.e.iii.B	School supplies like stationaries or textbooks			
7.e.iii.C	Other, specify:			

8. Does your household have any of the following <u>durable goods</u>?

	Q	No = 0 Yes = 1 Don't Know = 2 Refused = 3
Durable goods		
Cell phones	i	
Radio	ii	
Refrigerator/Freezer	iii	
Television	iv	
Cooker	v	

	Q	No = 0 Yes = 1 Don't Know = 2 Refused = 3
Bicycle	vi	
Car	vii	
Sofa	viii	
DVD Player	ix	
Computer	x	

9. What is the MAIN type of fuel used for cooking in your household? ***(Choose the best answer)***

____ Charcoal (1)
____ Electricity (2) ***Go to Section K***
____ Wood (3)
____ Paraffin (4)
____ Other (88), specify _____
____ Don't know (99)
____ Refused (77)

10. Is there electricity in your house?

____ Yes (1)
____ No (0)
____ Don't know (99)

K. Observations

Thank you very much for taking the time to speak with me and answering our questions. Now I would like to observe a few things about your house and then I will be finished with the interview

1) ***OBSERVE - What type of roofing does this house have? (Select all that apply)***
   ____ Metal/Iron sheets (1)
   ____ Asbestos (2)
   ____ Wood planks (3)
   ____ Ceramic tiles/Harvey tiles (4)
   ____ Cardboard (5)
   ____ Wood (6)
   ____ Cement (7)
   ____)
   ____ Mud tiles (9)
   ____ Other (88), specify _____
   ____ Don't know (99)

2) ***OBSERVE - What is the flooring material? (Select all that apply)***
   ____ Concrete (1)
   ____ Cement (2)
   ____ Brick (3)
   ____ Tiles (4)
   ____ Mud (5)
   ____ Wood (not wooden tiles) (6)
   ____ Other (88), specify _____
   ____ Don't know (99)

3) ***OBSERVE - What is the material used for the walls? (Select all that apply)***
   ____ Concrete/Cement blocks/bricks (1)
   ____ Burnt bricks (2)
   ____ Mud bricks (3)
   ____ Compressed mud (4)
   ____ Iron sheets (5)
   ____ Asbestos/hardwood/wood (6)
   ____ Other (88), specify _____
   ____ Don't know (99)

Interview Stop Time- _ _:_ _

<u>Comments:</u>

Appendix 2: Business Drainage Questionnaire

[NOTE: description of conduct of survey in Appendix 9b]

BASELINE BUSINESS QUESTIONNAIRE FINAL (AFTER PILOTING DURING TRAINING)

Impact Evaluation of Lusaka Water Supply, Sanitation, and Drainage Project

Survey Instrument

Business Survey to Assess Flood Impact

3/16/2016 Version

Draft: Please, do not copy or circulate!!

Evaluation by CDC for Millennium Challenge Corporation

Business Identifiers

Record ID:

Date of Visit 1: _ _ /_ _ / _ _ _ _ (Day/Month/Year) **Interviewer's name Visit 1:** _____
Result 1: _____
Date of Visit 2: _ _ /_ _ / _ _ _ _ (Day/Month/Year) **Interviewer's name Visit 2:** _____
Result 2: _____
Date of Visit 3: _ _ /_ _ / _ _ _ _ (Day/Month/Year) **Interviewer's name Visit 3:** _____
Result 3:_____
Result Codes:

1 COMPLETED
2 NO BUSINESS MEMBER AT SHOP OR NO ELIGIBLE RESPONDENT AT SHOP AT TIME OF VISIT
3. BUSINESS VACANT OR ADDRESS NOT A BUSINESS
4 REFUSED
5 OTHER (Specify):

Sample Area: _____ Market Name :_____
BLOCK:_____ Shop Number: _____

INFORMED CONSENT PROCESS (circle one): Done / Not Done

Signature of Interviewer: _____

Field Supervisor: _____
Data Entry:
Data Entry Operator 1: _____ Date of Data Entry1: _ _ /_ _ / _ _ _ _ (Day/Month/Year)
Date Entry Operator 2:_____ Date of Data Entry 2:_ _ /_ _ / _ _ _ _ (Day/Month/Year)

ENUMERATOR: Ask to speak to the male or female business owner. If the male or female business owner is not there, arrange to come back when one of them will be present.

Screening questions in Informed Consent: Are you the business owner (male or female)?
____Yes (1) ____Proxy/Co-owner (2) ____ No (0) **END SURVEY. Thank respondent for their time.**

Has this business been in existence and present in this area for more than 12 months?
____ Yes (1)
____ No (0) **End Survey**. **Thank respondent for their time.**
____ Don't Know (99) **End Survey**. **Thank respondent for their time.**

ENUMERATOR: Is the respondent male or female? ____ Male (1) ____ Female (2)
Interview Start Time- __ _:__ _

A. Business Background

1) **What type of business is this?**
   ____ Wholesaler (1)
   ____ Retailer (2)
   ____ Manufacturing (3)
   ____ Service Industry (4)
   ____ Restaurant/Canteen (5)
   ____ Other, specify (88): _____

2) **What does this business primarily sell? *(Select the best answer)***
   ____ Clothing/Fabrics (1)
   ____ Shoes/Sandals (2)
   ____ Household Items (3)
   ____ Services (e.g. repair, tailoring) (4)
   ____ Restaurant/Catering (5)
   ____ Grocery and food items (6)
   _____Electrical Appliances and items (7)
   _____Hardware and other building materials (8)
   _____Cellphone and accessories (9)
   ____ Other, specify (88): _____

3) **How many people work at this business (including business owner)?**
   ____ Number of workers ____ Don't Know (99)

4) **How many years has this business been going/operating?**
   ____ Years ____ Don't Know (99)

5) **How long has this business been in this location?**
   ____ Years ***OR*** ____ Months

6) **How long have you worked in this location?**
   ____ More than 6 months (1) ***OR*** ____ Less than six months (2)

If answer to Question 6 is less than 6 months (i.e. they have not worked at the shop during the rainy season, then stop, and ask to speak to somebody else)

7) **During the dry season (May to October), without any floods, how many customers/clients do you serve on a typical day?**
   ____ Customers ____Refused (77) ____ Don't Know (99)

8) **During the dry season, without any floods, how many delivery vehicles of any type (trucks, cars, taxis, etc.) *unload* goods at/for your business in a typical week?**
   ____ Number of delivery vehicles
   ____ Don't Know (99)
   ____ Not applicable (95)

9) **During the dry season, without any floods, how many delivery vehicles of any type (trucks, cars, taxis, etc.) *load up* goods from your business to be taken elsewhere in a typical week?**
____ Number of delivery vehicles
____ Don't Know (99)
____ Not applicable (95)

10) **What is your average income/sales revenue in a month? Please tell me the amount in rebased Kwacha, and before any expenses, taxes, or other deductions.**
_____ ZMW
____ Don't Know (99)
____ Refused (77)

B. Flooding

1) **Now I would like to ask you some questions about how flooding has affected your business. Have you experienced flooding in or around this business in the past year?**
____ Yes (1)
____ No (0) **Go to Section C**

2) **How many days, on average, was there flooding by/around your business in the month of ….?**

Month	**Days of Flooding: Enter the number of days OR 99 if don't know**
March	
February	
January	
December	
Other, specify:_____	

3) **Has the business been ever shut down because of flooding?**
___ Yes (1)
___No (0) Go to Question 5
4) **How many days, on average, was the business shut down because of the flooding in ….?**

Month	**Days business shut down due to flooding: Enter the number of days OR 99 if don't know**
December	
January	
February	
March	
Other, specify:_____	

5) **Did the flooding destroy any property?**
____ Yes (1)

____ No (0) **Go to Q9**

6) **What type of property did it destroy? *(Select all that apply)***
____ Building (1)
____ Sales goods (2)
____ Equipment (3)
____ Raw materials (4)
____ Vehicles (5)
____ Other (88), Please specify : _____

7) **Can you give an estimate of the cost of all the property that was destroyed during flooding? (*If no, probe: What would be the loss for vehicles, what would be the loss for the building/walls, etc. and then add up all the cost estimates)***
_____ ZMW
____ Don't Know (99)
____ Refused (77)

Enter 99 for Don't Know or 77 for Refused

8) **How did you pay for the repairs or replacements due to the flood damage? (*Select all that apply)***
____ Special reserve/contingency fund (1)
____ Business savings (2
____ Personal savings (3)
____ Cash flow (4)
_____ Emergency bank loan (5)
_____Incurred a write off /loss (6)
____ Other, specify (88): _____

9) **Did you get any help or compensation from the government or other entity to help pay for the flood / flood damage?**
____ Yes (1)
____ No (0) **Go to Q11**
_____Don't Know (99)
____Refused (77)

10) **What was the total amount of compensation you received from the government or other entity?**
_____ZMW
_____ In Kind (57) Specify: _____
____ Don't Know (99)
____ Refused (77)

11) **Did you hire any extra employees to help make repairs or manage issues caused by flooding?**
____ Yes (1)
____ No (0) **Go to Q13**

12) **How much money did you spend to hire these extra workers? This includes any money you spent on piece workers, such as wheel barrow haulers.**
_____ ZMW

____ Don't Know (99)
____ Refused (77)

13) When compared to dry season, did your revenue increase or decrease because of the flooding?
____ Increase (1) Go to Q14
_____Decrease (2) Go to Q15
____ Remains the same (3)Go to Q16
___Don't know (99)) **Go to Q16**

14) By what amount or percentage did your revenue increase as a result of the flooding?
_____ ZMW ***OR*** ____ Percentage Go to Q16
____ Don't Know (99)
____ Refused (77)

15) By what amount or percentage did your revenue decrease as a result of the flooding?
_____ ZMW ***OR*** ____ Percentage
____ Don't Know (99)
____ Refused (77)

16) As a result of the floods, did you have to lay off / furlough any workers (either during or after the flooding)?
____ Yes (1)
____ No (0) **Go to Q18**

17) How many workers were laid off/ furloughed due to the flooding?
____ Number of workers
____ Don't Know (99)
____ Refused (77)

18) Did you reduce pay for workers because of flooding?
____ Yes (1)
____ No (0) **Go to Q 20**
____ Don't Know (99) **Go to Q20**
____ Refused (77) **Go to Q20**

19) If you had to reduce pay, what was the total amount that it was reduced by (total, for all workers, summed)?

_____ ZMW _____%
____ Don't Know (99)
____ Refused (77)

20) Did flooding affect employees' ability to get to work on time?
____ Yes (1)
____ No (0) **Go to Q23**

21) On average, how many workers were late for work during flooding?
____ Number of workers

____ Don't Know (99)

22) **On average, how many minutes were they late?**
____ Number of vehicles
____ Don't Know (99)

23) **During flooding, how many delivery vehicles of any type (trucks, cars, taxis, etc.) *unloaded* goods at/for your business in a typical week?**
____ Number of delivery vehicles
____ Don't Know (99)
____ Not applicable (95)

24) **During flooding, how many delivery vehicles of any type (trucks, cars, taxis, etc.) *loaded up* goods from your business to be taken elsewhere in a typical ?**
____ Number of Vehicles
____ Don't Know (99)
____ Not applicable (95)

25) **After the flooding, how many business days did it take until your business returned to normal? That is, the way it was before flooding?**
____Not Affected at all (1)
_____ Number of hours before return to normal
____ Number of business days before return to normal
____ Still not back to normal (2)
____ Don't Know (99)

C. Mitigation Efforts Against Flooding

1) **Did you make any new investments to protect against flooding in the future, like constructing barriers/buying sand bags /making channels or water-proof equipment/flood insurance?**
____ Yes (1)
____ No (0) **Go to Section D**

2) **How much did you pay for these investments?**
_____ ZMW
____ Don't Know (99)
____ Refused (77)

Extra Space for Additional Notes:

Comments from the enumerator:

D. Other Businesses and Opinions

1) **Now I would like to ask you about how flooding may have affected other business and people in your community. During the past rainy season, do you know of any other businesses that were affected by flooding?**
   ____ Yes (1)
   ____ No (0) **Go to Q3**

2) **Were these business affected more than you, less than you, or to a similar in degree and nature as you were?**
   ____ Similar to mine (1)
   ____ Worse than mine (2)
   ____ Not as much as mine (3)
   ____ Don't know (99)

3) **Did you get sick because of the flooding any time in the past?**
   ____ Yes (1)
   ____ No (0) **Go to Q5**

4) **What were you sick with? (select all that apply)**
   ____ Diarrhea (1)
   ____ Cough (2)
   ____ Other (88), specify : _____
   ____ Don't know (99)

5) **Do you know of other people that have been sick because of the flooding?**
   ____ Yes (1)
   ____ No (0) **Go to Q7**

6) **What were they sick with? (select all that apply)**
   ____ Diarrhea (1)
   ____ Cough (2)
   ____ Other, specify (88): _____
   ____ Don't know (99)

7) **Would you like to share your opinion about the flooding and its impacts on your business and the community?**
   ____ Yes (1) **Record response below, as exactly as possible.**
   ____ No (0) **End Survey. Thank the respondent for their time.**

   Opinion
_____
   _____
   _____
   _____

Interview End Time- __ _:__ _

Appendix 3: WASH Evaluation Questionnaire

LWSSD WASH Baseline Household Survey--English

Household Identifiers

1) SEA No: _____

2) Household Unique Identifier: _____

3) Township/Peri-Urban Area: _____

4) **Interviewer's name [PROGRAMMER USE A DROP DOWN LIST TO DISPLAY NAMES]: _____**

Programmer: Questions 5, 6, and 7 should appear in the "Enter Sampled Households" section of the tablet

5) ENUMERATOR: Is this a replacement household?

1 Yes (1)

2 No (0) **Go to HI8**

6) **ENUMERATOR:** For this replacement household, which water types require testing? (select all that apply)

HINT: The replacement household should be flagged for the same water types as the original household

_____ Stored

_____ Source

_____ Point-of-consumption

_____ None

7). **ENUMERATOR:** What was the household ID number of the original household that needs replacement?

_____

PROGRAMMER: Entering the HH ID # (1-75) should call up the flags for that original household from the pre-load file.

PROGRAMMER: Start Time

8) ENUMERATOR: Is the head of household or spouse home?

1 Yes, contact is the head of household or his/her spouse **Go to HI8a**

2 Yes, contact is not the head of household **Go to HI10**

3 No **Go to M1**

8a) Has your family been living in this house for 2 or more months?

____ Yes (1)

____ No (0) **Go to END_TEXT**

____ Don't Know (-99) **Go to END_TEXT.**

____ Refused (-77) **Go to END_TEXT.**

9) I would like to speak with you about your household. First I will read you additional information about what we are doing and with your permission will ask you questions about your household.

Go to ENUMERATOR INSTRUCTION 3

10) ENUMERATOR: Is the head of household or his/her spouse available?

1 Yes **Go to HI8a**

2 No **Go to M1**

PROGRAMMER: Consent Start Time

ENUMERATOR INSTRUCTION 3: Read the paper consent statement to the respondent and hand them the information sheet, ask if there are any questions and then ask the respondent to sign the consent form.

11) ENUMERATOR: Was consent provided for the interview?

1 Yes

2 No **Go to M1**

Programmer: *Populate next question if this is a water sample household*

11 a) ENUMERATOR: Was consent provided for water sample collection?

1. Yes
2. No Programmer : Skip water sample availability and water collection sections and go to Section A: Household Demographics. Blue dot become yellow

12) ENUMERATOR: Are you interviewing the male or female head of the household/spouse?

____ Male (1) ____ Female (2)

Water Sample Availability

PROGRAMMER DISPLAY ONLY IF House is flagged for STORED Water Testing BASED ON PRELOAD AND CONSENT "YES" in H11a

1. Do you store your drinking water in a container at your household?
   a. Yes (1)
   b. No (0) Proceed with questionnaire Section A demographics. Blue dot become yellow.
   c. Refused (-77) Proceed with questionnaire Section A demographics. Blue dot become yellow.

2. Is there stored drinking water available at the household that you can give us?

   Yes (1)
   No –do not store water (2) Proceed with questionnaire Section A demographics. Blue dot become yellow.
   No –water is completely frozen (3) Proceed with questionnaire Section A demographics. Blue dot become yellow.
   No –explanation not known (4) Proceed with questionnaire Section A demographics. Blue dot become yellow.
   No- insufficient volume of water (6) Proceed with questionnaire Section A demographics. Blue dot become yellow.
   Refused (-77) Proceed with questionnaire Section A demographics. Blue dot become yellow.
   No -Other, specify (66):_____ Proceed with questionnaire Section A demographics. Blue dot become yellow.

PROGRAMMER DISPLAY ONLY IF House is Flagged for SOURCE water testing BASED ON PRELOAD AND CONSENT "YES" in H11a

1. Is there drinking water available at your main drinking water source right now?

   Yes (1) If yes, ENUMERATOR: Go check source to see if drinking water is available.
   No (0) Proceed with questionnaire Section A demographics. Blue dot become yellow.

PROGRAMMER DISPLAY ONLY IF House is flagged for POINT-OF-CONSUMPTION water testing BASED ON PRELOAD AND CONSENT "YES" in H11a

1. Is there ready-to-drink, point-of-consumption water (in other words, a glass of water) available that you can give us?
   Yes (1)
   No (0) Proceed with questionnaire Section A demographics. Blue dot become yellow.
   Refused (-77) Proceed with questionnaire Section A demographics. Blue dot become yellow.

PROGRAMMER: If a household needs to be replaced for any type of water quality testing, the enumerator will proceed with the questionnaire but no water will be collected or tested and the Water Sampling questions will not be asked. After completing the questionnaire, the enumerator should call the supervisor to replace/re-assign based on replacement protocol. The replacement household will be flagged for the same water samples as the original household.
WATER Sampling– Source Water

PROGRAMMER: If the response to any of the Water Availability questions is "No" or CONSENT "NO" for H11a then this section should not appear.

Source Water – No duplicate

PROGRAMMER: This section should only appear if the household is flagged for source water sampling and is not duplicated.

ENUMERATOR: I would now like to collect water from the source. This is where you collect your drinking water.
ENUMERATOR: The source may not be located at the household.

1) Name of enumerator collecting sample :: _____
   Programmer: Make this a drop down.

2) Type of water source:
   _____Communal tap/Water kiosk (1)
   ____ Protected well (2)
   ____ Unprotected well (3)
   ____ Private Borehole on your plot (4)
   ____Private borehole somewhere else (5)
   ____ Piped water inside house (**6)**
   ____ Piped water outside house within stand/plot (**7)**
   ____ Piped water from neighbor (**8)**
   ____ Surface water (stream/pond) (9)
   ____ Manufacture-packaged bottledwater (10)
   ____ Refilled bottled water
   ____ Other, specify (66):_____
   ____ Don't know (-99)
   ____ Refused (-77)

3) ENUMERATOR: Is the source located at the respondent's home?
   1 Yes –Skip to Q5

2 No

ENUMERATOR: If the source is not at the household, you will now walk to the source and then proceed with collection.

4) Collect GPS Coordinate for Source : -_____S
+_____E

ENUMERATOR: Select a barcode label. Label the purple and white bag with this barcode label. You will now collect the *E. coliE. coli* sample for the laboratory. Explain to the respondent that you are taking water quality samples.

5) Scan barcode on the purple and white sample bag:_____
PROGRAMMER: Add a checkbox below this question next to the statement "Barcode will not scan". If barcode will not scan, allow Enumerator to select checkbox. When this checkbox is ticked, the following question must be filled out:
Hand-enter the barcode number from the purple and white sample bag: _____

PROGRAMMER: New page of survey. Question 6 (hand-enter barcode) is required.

6) Hand-enter the barcode number from the purple and white sample bag: _____

PROGRAMMER: Barcode should be 4 numbers.

PROGRAMMER: Compare response to Question 5 to Question6. If the two responses do not match have an error message appear that says "Response to Question 6 does not match response to Question 5. These two responses must match. Verify correct number is recorded for Questions 5 and 6."

ENUMERATOR: Using sterile techniques and the purple and white sample bag, collect sample of the source water for *E. coliE. coli* analysis. Immediately place sample bags into a cooler containing freezer packs and close cooler. Samples must remain chilled (2-8 °C) during transport to the contract laboratory. Explain to the respondent that you are taking water quality samples.

ENUMERATOR: Using the same strip of barcode labels for this source, label the black and yellow bag with the next barcode. You will now collect the nitrate sample for the laboratory.

7) Scan barcode on black and yellow sample bag:_____
PROGRAMMER: Add a checkbox below this question next to the statement "Barcode will not scan". If barcode will not scan, allow Enumerator to select checkbox. When this checkbox is ticked, the following question must be filled out:
Hand-enter the barcode number from the black and yellow sample bag: _____

PROGRAMMER: New page of survey. Make Question 8 required.

8) Hand-enter the barcode number from the black and yellow sample bag: _____

PROGRAMMER: Barcode should be 4 numbers.

PROGRAMMER: Compare response to Question 7 to Question 8. If the two responses do not match have an error message appear that says "Response to Question 8 does not match response to Question 7. These two responses must match. Verify correct number is recorded for Questions 7 and 8."

ENUMERATOR: Using sterile techniques and the black and yellow bag collect sample of source water for nitrate analysis. Immediately place sample bag into a cooler containing freezer packs. Sample must remain chilled (2-8 °C) during transport to the contract laboratory. Explain to the respondent that you are taking water quality samples.

ENUMERATOR: Collect a sample of source water and immediately perform tests according to standard procedures for the following measures: free chlorine. Record results.

9) Free chlorine result (mg/L): _____ _____ . _____ _____
PROGRAMMER: If result is greater than 8.0 mg/L then alert enumerator to double check that result was entered correctly.
PROGRAMMER: If the source was listed as "Communal tap/Water kiosk (1)" in question 2 under "Water Sampling-Source Water" and result is less than 0.2 mg/L then make this dialogue box appear: "You have recorded a free chlorine result less than 0.2 mg/L at a communal tap/water kiosk. Please report this source to your supervisor after completion of this interview."
PROGRAMMER: Add a checkbox below this question next to the statement "Negative result". If chlorine result is negative, allow Enumerator to select checkbox. When this checkbox is ticked, allow a negative value to be entered for the following question must be filled out:
Free chlorine result (mg/L): _____

9a. Was the chlorine result flashing or negative?

- ☐ No (0)
- ☐ Flashing (1)
- ☐ Negative (2)

10) Time record free chlorine result (hh:mm) __ __ : __ __

ENUMERATOR: Using the turbidity kit, collect and measure a sample for turbidity analysis at the RuralNet office.
11) Turbidity result (NTU): _____
PROGRAMMER: Results must be greater than or equal to 0. If result is greater than 1000 NTU or less than 0 NTU then alert enumerator to double check that result was entered correctly. Note: this is a prompt not a range. The enumerator will be entering this value at the RuralNet office AFTER the interview is over.

ENUMERATOR: Using the pressure gauge, you will now measure water pressure of the source water.
12) Were you able to measure water pressure?
Yes (1)
No (0) Go to Q14

13) Water pressure result (psi):_____

PROGRAMMER; Set verification limits for water pressure results. Results must be greater than or equal to 0 and less than or equal to 210.

14) Check that each item you just completed for source water at this household
____ I collected 2 samples of 100 mL for laboratory analysis
____ Samples were placed in a cooler with ice packs
____ I completed free chlorine analysis
____ Turbidity vial collected for analysis at RuralNet office
____ Water pressure reading collected or attempted

15) What is the temperature of the sample cooler (°C)? _____
PROGRAMMER: If result is greater than 9.9 degrees C then alert enumerator to double check that result was entered correctly. Note: This is a prompt not a range.

Source Water – Duplicate
PROGRAMMER: This section should only appear if the household is flagged for source water sampling and **is** duplicated.

ENUMERATOR: I would now like to collect water from the source. This is where you collect your drinking water.
ENUMERATOR: The source may not be located at the household.

1) Name of enumerator collecting sample and taking measurement: _____
Programmer: Make this a dropdown.

2) Type of water source:
_____Communal tap/Water kiosk (1)
____ Protected well (2)
____ Unprotected well (3)
____ Private Borehole on your plot (4)
____Private borehole somewhere else (5)
____ Piped water inside house (**6)**
____ Piped water outside house within stand/plot (**7)**
____ Piped water from neighbor (**8)**
____ Surface water (stream/pond) (9)
____ Manufacture-packaged bottled water (10)
____ Refilled bottled water
____ Other, specify (66):_____
____ Don't know (-99)
____ Refused (-77)

3) ENUMERATOR: Is the source located at the respondent's home?
a. Yes –Skip to Q5
b. No

ENUMERATOR: If the source is not at the household, you will now walk to the source and then proceed with collection.
4) Collect GPS Coordinate for Source : -_____S
+_____E

ENUMERATOR: Select the next barcode label. Label the first purple and white bag with this barcode label.

5) Scan barcode on the first purple and white sample bag:_____
   PROGRAMMER: Add a checkbox below this question next to the statement "Barcode will not scan". If barcode will not scan, allow Enumerator to select checkbox. When this checkbox is ticked, the following question must be filled out:
   Hand-enter the barcode number from the purple and white sample bag: _____

   PROGRAMMER: New page of survey. Question 6 (hand-enter barcode) is required.

6) Hand-enter the barcode number from the first purple and white sample bag: _____

   PROGRAMMER: Barcode should be 4 numbers.

   PROGRAMMER: Compare response to Question 5 to Question 6. If the two responses do not match have an error message appear that says "Response to Question 6 does not match response to Question 5. These two responses must match. Verify correct number is recorded for Questions 5 and 6."

ENUMERATOR: Using sterile techniques and the purple and white sample bag, collect the first sample of the source water for *E. coliE. coli* analysis. Immediately place sample bags into a cooler containing freezer packs and close cooler. Samples must remain chilled (2-8 °C) during transport to the contract laboratory. Explain to the respondent that you are taking water quality samples.

ENUMERATOR: Label a second **purple and white bag** with the second white barcode.

7) Scan barcode on this second purple and white sample bag:_____
   PROGRAMMER: Add a checkbox below this question next to the statement "Barcode will not scan". If barcode will not scan, allow Enumerator to select checkbox. When this checkbox is ticked, the following question must be filled out:
   Hand-enter the barcode number from the purple and white sample bag: _____

   PROGRAMMER: New page of survey. Make Question 8 required.

8) Hand-enter the barcode number from this second purple and white bag sample bag: _____

   PROGRAMMER: Barcode should be 4 numbers

   PROGRAMMER: Compare response to Question 7 to Question 8. If the two responses do not match have an error message appear that says "Response to Question 8 does not match response to Question 7. These two responses must match. Verify correct number is recorded for Questions 7 and 8."

   ENUMERATOR: Using sterile techniques and the purple and white bag collect the second sample of point-of-consumption water for *E. coliE. coli* analysis. Immediately place sample bag into a cooler containing freezer packs and close cooler. Sample must remain chilled (2-8 °C) during transport to the contract laboratory. Explain to the respondent that you are taking water quality samples.

   ENUMERATOR: Select the next barcode. Label the black and yellow bag with this barcode label. You will now collect the nitrate samples for the laboratory from the source water.

9) Scan barcode on the first black and yellow sample bag:_____
PROGRAMMER: Add a checkbox below this question next to the statement "Barcode will not scan". If barcode will not scan, allow Enumerator to select checkbox. When this checkbox is ticked, the following question must be filled out:
Hand-enter the barcode number from the black and yellow sample bag: _____

PROGRAMMER: New page of survey. Make Question 10 required.

10) Hand-enter the barcode number from the first black and yellow sample bag: _____

PROGRAMMER: Barcode should be 4 numbers.

PROGRAMMER: Compare response to Question 9 to Question 10. If the two responses do not match have an error message appear that says "Response to Question 10 does not match response to Question 9. These two responses must match. Verify correct number is recorded for Questions 9 and 10."

ENUMERATOR: Using sterile techniques and the black and yellow bag collect the second sample of source water for nitrate analysis. Immediately place sample bag into a cooler containing freezer packs and close cooler. Sample must remain chilled (2-8 °C) during transport to the contract laboratory. Explain to the respondent that you are taking water quality samples.

ENUMERATOR: Select the next white barcode. Label the second black and yellow bag with this barcode label.

11) Scan barcode on the second black and yellow sample bag:_____
PROGRAMMER: Add a checkbox below this question next to the statement "Barcode will not scan". If barcode will not scan, allow Enumerator to select checkbox. When this checkbox is ticked, the following question must be filled out:
Hand-enter the barcode number from the black and yellow sample bag: _____

PROGRAMMER: New page of survey. Make Question 12 required.

12) Hand-enter the barcode number from the first black and yellow sample bag: _____

PROGRAMMER: Barcode should be 4 numbers.

PROGRAMMER: Compare response to Question 11 to Question 12. If the two responses do not match have an error message appear that says "Response to Question 12 does not match response to Question 11. These two responses must match. Verify correct number is recorded for Questions 11 and 12."

ENUMERATOR: Using sterile techniques and the black and yellow bag collect the second sample of source water for nitrate analysis. Immediately place sample bag into a cooler containing freezer packs and close cooler. Sample must remain chilled (2-8 °C) during transport to the contract laboratory. Explain to the respondent that you are taking water quality samples.

ENUMERATOR: Collect the first sample of source water and immediately perform tests according to standard

procedures for the following measures: free chlorine. Record results.

13) First free chlorine result (mg/L): _____ _____ . _____ _____
PROGRAMMER: If result is greater than 8.0 mg/L then alert enumerator to double check that result was entered correctly.
PROGRAMMER: If the source was listed as "Communal tap/Water kiosk (1)" in question 2 under "Water Sampling- Source Water" and result is less than 0.2 mg/L then make this dialogue box appear: "You have recorded a free chlorine result less than 0.2 mg/L at a communal tap/water kiosk. Please report this source to your supervisor after completion of this interview."
PROGRAMMER: Add a checkbox below this question next to the statement "Negative result". If chlorine result is negative, allow Enumerator to select checkbox. When this checkbox is ticked, allow a negative value to be entered for the following question must be filled out:
Free chlorine result (mg/L): _____

13a. Was the chlorine result flashing or negative?

- ☐ No (0)
- ☐ Flashing (1)
- ☐ Negative (2)

14) Time record first free chlorine result (hh:mm) __ __ : __ __

ENUMERATOR: Collect the second sample of source water and immediately perform tests according to standard procedures for the following measures: free chlorine. Record results.

15) Second free chlorine result (mg/L): _____ _____ . _____ _____
PROGRAMMER: If result is greater than 8.0 mg/L then alert enumerator to double check that result was entered correctly.
PROGRAMMER: If the source was listed as "Communal tap/Water kiosk (1)" in question 2 under "Water Sampling- Source Water" and result is less than 0.2 mg/L then make this dialogue box appear: "You have recorded a free chlorine result less than 0.2 mg/L at a communal tap/water kiosk. Please report this source to your supervisor after completion of this interview."
PROGRAMMER: Add a checkbox below this question next to the statement "Negative result". If chlorine result is negative, allow Enumerator to select checkbox. When this checkbox is ticked, allow a negative value to be entered for the following question must be filled out:
Free chlorine result (mg/L): _____

15a. Was the chlorine result flashing or negative?

- ☐ No (0)
- ☐ Flashing (1)
- ☐ Negative (2)

Time record second free chlorine result (hh:mm) __ __ : __ __

ENUMERATOR: Using the turbidity kit, collect 2 samples for turbidity analysis at the RuralNet office.

16) Turbidity result, vial 1 (NTU): _____
17) Turbidity result, vial 2 (NTU): _____
PROGRAMMER: Results must be greater than or equal to 0. If result is greater than 1000 NTU or less than 0 NTU then alert enumerator to double check that result was entered correctly. Note: this is a prompt not a range. The enumerator will be entering this value at the RuralNet office AFTER the interview is over.

ENUMERATOR: Using the pressure gauge, you will now measure water pressure of the source water twice.
18) Were you able to measure water pressure?
Yes (1)
No (0) Go to Q21

19) Water pressure result 1 (psi):_____
20) Water pressure result 2 (psi): _____

PROGRAMMER; Set verification limits for water pressure results. Results must be greater than or equal to 0 and less than or equal to 210.

21) Check that each item you just completed for source water at this household
____ I collected 4 samples of 100 mL for laboratory analysis
____ Samples were placed in a cooler with ice packs
____ I completed free chlorine analysis
____ Two turbidity vials collected for analysis at RuralNet office
____ Two water pressure readings collected or attempted

22) What is the temperature of the sample cooler (°C)? _____
*PROGRAMMER: S*et verification limits for temperature results. If result is greater than 9.9 degrees C then alert enumerator to double check that result was entered correctly.

PROGRAMMER: Interview Start Time

A. Household Demographics
11) Can you please tell me your age?
____ Years PROG: SKIP TO A2 ____ Don't Know (-99) ____ Refused (-77)

1_1) Are you over the age of 18?
____ Yes
____ No PROG: GO TO END_TEXT
____ Refused (-77) PROG: GO TO END_TEXT

12) What is the highest level of education you have completed? (ENUMERATORS: primary=1-7, secondary=8-12 grade, tertiary=college and higher).
Primary_____(1) Secondary_____(2) Tertiary_____(3) N/A (did not complete primary)_____(4)
Don't Know__ (-99) ___ Refused (-77)

13) Do you or your family own or rent this house?
____ Own (1) ____ Rent (2) **Go to Q5** ____ Family House (3) ___ Refused (-77) **Go to Q5**
____ Other, specify (66):_____ **Go to Q5**

14) Do you have a title deed?

____ Yes (1) ____ No (0) ___ Refused (-77) ____ Don't Know (-99)

15) Do you have any tenants in this compound? That is, are you the landlord of a building in this compound?

____ Yes (1) ____ No (0) ___ Refused (-77) ____ Don't Know (-99)

16) Can you tell me how long your family has lived in this house or the year that you moved into this house? (*If less than one year specify in months, otherwise answer in years.*)

_____ Years in house ***OR*** _____Months in house

_____ Year moved in

_____ Refused (-77)

_____ Don't Know (-99)

PROGRAMMER: Soft check for 2 months or < 2 months

17) How many rooms are in the house, excluding the kitchen and bathroom?

_____ rooms

___ Refused (-77)

18) How many people currently live in this house? I am only talking about people who normally sleep and eat at the house, not visitors or people staying temporarily. ENUMERATOR: Include children at boarding school or college, household members gone visiting or on temporary work assignments. Do not include long-term visitors, live in domestic help or marital separations.]

_____ people

___ Refused (-77)

19) **I would like to ask you to tell me a few things about each person living in the house, starting with yourself. (*Complete the household roster below for all persons living in your household. Fill out one row per person before moving to next household member. Don't count visitors.)* PROGRAMMER: The roster should capture up to 25 household members.**

ID		How old are you/is he/she? Years Months OR When was he/she born? Please provide the year or date of birth. Year OR date of birth (*If unknown record age,* REF (-77)/DK(-99)) *PROGRAMMER: Calculate age from DOB. If only year provided calculate from 6/30/2016 minus 6/30/YEAR*	ENUMERATOR: Record the gender if known. If not known ask: Is this person male or female? Sex: M/F/REF	Are you/Is he/she currently in school? ENUMERATOR: Include preschool, primary, secondary, university, night school, etc. In School: Y/N/REF Programmer: skip to next person in roster if over 5 years.	If less than or equal to 5 years of age:			
					A	B	C	D
					Is his/her under 5 card available? Y/N *(If Yes go to B; If No go to D)*	ENUMERATOR: Record the number of rotavirus vaccination doses from the card: 0/1/2/>2/ REF (-77)/DK (-99)/Not on card (0/1/2/>2 *Go to C*) (REF, DK, Not on card *Go to D*)	ENUMERATOR: Record the date of the last rotavirus vaccine from the card (MM/ YYYY) (Programmer: skip to next person in roster, *Go to B1 after last person in the Household*)	How many rotavirus vaccinations or vaccinations for diarrhea do you remember him or her receiving? 0/1/2/>2/REF (-77)/DK (-99)
1							___/____	
2							___/____	
3							___/____	
4							___/____	
5							___/____	
6							___/____	
7							___/____	
8							___/____	
9							___/____	
10							___/____	
11							___/____	
12							___/____	
13							___/____	
14							___/____	
15							___/____	

B. Sickness and Associated Costs

Now I would like to ask you about people in your household who may have been sick in the last 7 days

1) **Has anyone in your house been sick with diarrhea or flu-like illness in the past 7 days, since last PROGRAMMER FILL IN DAY FOR 6 DAYS AGO thru yesterday? By diarrhea, I mean having 3 or more loose or watery stools in a 24 hour-period. By flu-like illness I mean having a fever AND a cough or a sore throat. (*Utilize calendar as a memory aid if needed*)**
   ____ Yes (1)
   ____ No (0) **Go to Section D**
   ____ Refused (-77) **Go to Section D**
   ____ Don't know (-99) **Go to Section D**

2) **Who are the HH MEMBERS who were sick with diarrhea or flu-like illness in the past 7 days?**

   PROGRAMMER: Display the whole household roaster (regardless of age) for enumerator to select. Upon selection, selected members should be asked the questions in table

3) **Now I would like to ask you more about the illness you/he/she had (PROGRAMMER: *Use one column per person. Fill out each column all the way to the bottom of the table before starting a column for the next ill person)***

	Sick Household Members				
Q		**Gender & Age (e.g., M 26)**			
A	**In the past 7 days, did you/he/she have….?**				
i	**Diarrhea**, *by diarrhea I mean 3 or more loose or watery stools in a 24 hour period*	Y N REF DK	Y N REF DK	Y N REF DK	Y N REF DK
ii	**A Fever** *by fever I mean a fever of at least 38°C or if you thought that you/he/she had a fever*	Y N REF DK	Y N REF DK	Y N REF DK	Y N REF DK
iii	**A Cough**	Y N REF DK	Y N REF DK	Y N REF DK	Y N REF DK
iv	**A Sore Throat** **PROGRAMMER: based on symptoms selected section B or C or both should be displayed. Sections D, E and F are common to either or both illness.**	Y N REF DK	Y N REF DK	Y N REF DK	Y N REF DK
B	**Programmer: If sick person had <u>diarrhea</u> answer questions in section B (based on Section A)**				
i	When did your/his/her diarrhea begin? (*This date can be before the past 7 days. Enter date as DD/MM/YYYY)*	__/__/__ REF (-77) DK (-99)	__/__/__ REF (-77) DK (-99)	__/__/__ REF (-77) DK (-99)	__/__/_ REF (-77) DK (-99)
ii	How many days have you/has he/she had diarrhea? (*The number of days can be greater than 7 if the illness started before the past 7 days. If a range, probe first and then take average and round up*)	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)	__Days REF(-77) DK (-99)
iii	Do you/Does he/she currently have diarrhea?	Y N REF DK	Y N REF DK	Y N REF DK	Y N REF DK

iv	What was the maximum number of loose or watery stools that you/he/she had in any 24 hour period within the past 7 days? *(If exact number unknown, probe first and then take average and round up; "too numerous to count (TNTC)")*	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)
v	Was there blood in his/her stool?	Y N REF DK	Y N REF DK	Y N REF DK	Y N REF DK
C	**Programmer: If sick person had <u>fever AND cough or sore throat</u> answer questions in section C (based on Section A)**				
i	When did your/his/her fever and cough or sore throat begin? (*This date can be before the past 7 days. Enter date as DD/MM/YYYY*)	__/__/__ REF(-77) DK (-99)	__/__/__ REF(-77) DK (-99)	__/__/__ REF(-77) DK (-99)	__/__/_ REF(-77) DK (-99)
ii	How many days have you/has he/she been ill with fever and cough or sore throat? (*The number of days can be greater than 7 if the illness started before the past 7 days. If a range, probe first and then take average and round up*)	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)	__Days REF(-77) DK (-99)
iii	Do you/Does he/she currently have a fever and cough or sore throat?	Y N REF DK	Y N REF DK	Y N REF DK	Y N REF DK
D	**Activities missed due to illness (*ask for either diarrhea or flu-like illness*)**				
i	*(PROGRAMMER: if household member is <18 skip to Dii)* Due to this sickness with diarrhea or flu-like illness, did you/he/she miss work? (*If no go to Dii)*	Y N REF DK N/A	Y N REF DK N/A	Y N REF DK N/A	Y N REF DK N/A
	Including today, how many days of work did you/he/she miss due to the diarrhea or flu-like illness? (*If a range, probe first and then take average and round up*)	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)
	Did you/he/she lose wages/earnings for the days he/she took time off for illness? (*If no go to Dii*)	Y N REF DK N/A	Y N REF DK N/A	Y N REF DK N/A	Y N REF DK N/A
	What was the amount of wages lost **per day** (ZMW)?	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)
ii	Did you/he/she miss school because he/she was sick with diarrhea or flu-like illness? (*if no go to Diii) (Programmer: only ask (Dii) for hh member if this person is at school. Filter by response in B9)*	Y N REF DK N/A	Y N REF DK N/A	Y N REF DK N/A	Y N REF DK N/A
	Including today, how many days of school did you/he/she miss due to the diarrhea or flu-like illness? (*If a range, probe first and then take average and round up*)	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)

iii	*(PROGRAMMER: if household member is <2 skip to Ei)* Did you/he/she have to skip household chores/work (for example: fetching water, cooking, cleaning, or caring for kids because he/she was sick)? (*if no go to Q Ei)*	Y N REF DK N/A	Y N REF DK N/A	Y N REF DK N/A	Y N REF DK N/A
	Including today, how many days of doing chores/work did you/he/she skip?	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)
E	**Treatment and Cost (*ask for all types of illness*)**				
i	At any time, did you/he/she get treatment for the illness, such as visiting a clinic, health center, hospital, pharmacist, or healer, taking medication, or having lab tests done? (*If no, go to Section C)*	Y N REF DK	Y N REF DK	Y N REF DK	Y N REF DK
ii	Did your household spend any money on the treatment for your/his/her illness? Treatment includes any money you spent on clinic, health center or doctor visits, medications, lab tests, and hospitalizations (*If no go to Q Eiii)*	Y N REF DK	Y N REF DK	Y N REF DK	Y N REF DK
	How much did you spend? (ZMW) (*Enter a number or DK [don't know])*	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)
iii	Did your household spend any money on transportation for your/his/her illness? This includes going to or from the clinic, health center, pharmacy, hospital, etc. (*If no, go to Q Fi)*	Y N REF DK	Y N REF DK	Y N REF DK	Y N REF DK
	How much did you spend on transportation? (ZMW) (*Enter a number or DK [don't know])*	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)
F	**Time Use: (*ask for all types of illness*)** *Programmer: skip this section if the answer is NO for Ei*				
i	In the last 7 days, how many times did you/he/she go to the clinic, health center, hospital, pharmacist or healer? (*Enter a number or DK [don't know]. Skip this question and go to Q Fii if did not visit clinic or Health Center) (Programmer: skip this question if the answer is NO for Ei)*	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)
	On average, how long did it take you/him/her to see the doctor or nurse, including round-trip travel time (e.g. walking, waiting, seeing the doctor and returning home)? (*Enter a number or DK [don't know]. Specify hours or minutes*)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)

ii	In the last 7 days, did you/he/she need to be hospitalized for this illness? (*Hospitalized means spending at least one night in the hospital. Go to Section C if No or DK [Don't Know])*	Y N REF DK	Y N REF DK	Y N REF DK	Y N REF DK
	How many days was you/he/she hospitalized? (*Enter a number or DK [don't know])*	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)

C. Caretaker Time Loss

1. **Did any household members stay home from work to take care of the sick household member(s) due to diarrhea or flu-like illness?** *Enumerator: Please note, staff that work in the household and took care of a sick household member should be included in this table as non-household members. For housewife/stay at home mom, answer yes if unable to do normal household chores.*
   ____ Yes (1) Programmer: Display household member roster
   ____ No (0) **Go to Question 2**
   ____ Refused (-77) **Go to Question 2**
   ____DK (-99) **Go to Question 2**

PROGRAMMER: DISPLAY ALL HOUSEHOLD MEMBERS (regardless of age). Which household members stayed home? For each selected household member Ask question below questions:

	People who stayed home to care for sick household members			
1.	[redacted]	**Gender and Age (e.g., M 29)**		
A	How many days did you/he/she stay at the home to take care of the sick person? ENUMERATOR: For housewife or stay at home mom include days if unable to do normal household chores.	___Days REF(-77) DK (-99)	___Days REF(-77) DK (-99)	__Days REF(-77) DK (-99)
B	Did you/he/she lose wages or earnings for the day(s) he/she was at home to take care of the sick person(s)? *(Circle one. If no, go to Question 2)*	Y N REF DK	Y N REF DK	Y N REF DK
Bi	How much did you/he/she lose from wages or earnings **in total** while caring for **the** sick person? (ZMW) (*Enter a number or DK [don't know])*	_____ _REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ _REF(-77) DK (-99)

2. Did any non-household members stay home?
   ____ Yes (1)
   ____ No (0) **Go to Section D**
   ____ Refused (-77) **Go to Section D**
   ____DK (-99) **Go to Section D**

3. How many non-household members stayed home?
   _____Number
   _____Don't Know (-99) **Go to Section D**
   _____Refused (-77) **Go to Section D**

PROGRAMMER: CREATE NEW ROSTER RECORDS FOR UP TO 5 NON-HOUSEHOLD MEMBERS AND LOOP THRU Q4 , Q5, and Q6 below FOR EACH NON-HOUSEHOLD MEMBER, CREATING PERSON ID FOR EACH.

4. ENUMERATOR: RECORD IF KNOWN: Thinking about the first/next non-household member, were they male or female?

_____Male
_____Female
_____Don't Know (-99)
_____Refused (-77)

5. (Thinking about the first/next non-household member,) What is his/her age?

____Years
_____Don't Know (-99)
_____Refused (-77)

6	Did he/she (Programmer display Gender and Age) get paid to take care of the sick person, *(Circle one) (If no, REF, DK Go to next non-household member or section D if it last non-household member)*	Y N REF DK	Y N REF DK	Y N REF DK
i	ENUMERATOR: If domestic staff enter 0 and do not ask the question. How much was he/she paid for caregiving of the sick person(s) **in total?** (ZMW) (*Enter a number or DK [don't know])*	_____ _REF(-77) DK (-99)	_____ __REF(-77) DK (-99)	_____ _REF(-77) DK (-99)

D. WATER Collection

Now I am going to ask you questions about the water your household uses.

1) **During the past 7 days, where did your household get your DRINKING WATER? By that I mean what was your household's MAIN source of drinking water in the past 7 days? (ENUMERATOR: *DO NOT read answers. Select the best answer. Observe source if respondent cannot describe it or you are unsure.)***

_____Communal tap/Water kiosk (1)
____ Protected well (2)
____ Unprotected well (3)
____ Private Borehole on your plot (4)
____Private borehole somewhere else (5)
____ Piped water inside house (**6)**
____ Piped water outside house within stand/plot (**7)**
____ Piped water from neighbor (**8)**
____ Surface water (stream/pond) (9)
____ Manufacture-packaged bottled water (10)
____ Refilled bottled water
____ Other, specify (66):_____
____ Don't know (-99)
____ Refused (-77)

1 a) Is your main source of drinking water stored in an outside tank prior to use?

____ Yes (1)
____ No (0)

____ Don't know (-99)
____ Refused (-77

2) **In the past 7 days, how many days was DRINKING water available from this source?**
_____ Days
_____ Don't know (-99)
_____Refused (-77)

3) **On average, how many hours per day was DRINKING water available from this source in the past 7 days?**
_____ Hours
_____ Don't know (-99)
_____Refused (-77)

4) **During the past 7 days did your household get DRINKING WATER from any other source(s)?**
____ Yes (1)
____ No (0) ***go to Q6***
____ Don't know (-99) ***go to Q6***
____ Refused (-77) ***go to Q6***

5) **What was/were the other source(s) for DRINKING WATER? (ENUMERATOR:** ***DO NOT read answers. Select all that are stated)*****.**
_____Communal tap/Water kiosk (1)
____ Protected well (2)
____ Unprotected well (3)
____ Private Borehole on your plot (4)
____Private borehole somewhere else (5)
____ Piped water inside house (**6)**
____ Piped water outside house within stand/plot (**7)**
____ Piped water from neighbor (**8)**
____ Surface water (stream/pond) (9)
____ Manufacturer-packaged bottled water (10)
_____ Refilled bottled water
____ Other, specify (66):_____
____ Don't know (-99)
____ Refused (-77)

6) **How many days in the past 7 days was your household unable to get ENOUGH WATER (that is water for ALL USES, including water for drinking, sanitation, cooking, washing of clothes, personal and household hygiene, and so on)?**
_____ Days ***If response is "0" go to Q9 If piped water (response 6 or 7 to QD1). If not piped water - go to Q16***
_____ Don't know (-99)
_____ Refused (-77)

7) **How many days in the past 7 days was your household unable to get enough water for DRINKING ONLY?**
_____ Days ***If response is "0" go to Q9 If piped water (response 6 or 7 to QD1). If not piped water - go to Q16***

_____ Don't know (-99)
_____ Refused (-77)

8) **Why couldn't your household get enough water for DRINKING? (ENUMERATOR: *DO NOT read responses. Select all that apply.*)**
____ Water is not available at all times during the day (1)
____ Water source is not open all days of the week (2)
____ Water kiosk is broken or not working (3)
____ Water queue is too long (4)
____ Takes too long to collect water (5)
____ Water source is too far from home (6)
____ Costs too much/don't have enough money (7)
____ Don't have a reliable person to fetch water (8)
____ I have difficulty transporting enough water (9)
____ Water pressure is too low (10)
____ Lack storage facility (11)
____ No electricity at the kiosk (12)
____ Refused (-77)
____ DK (-99)
____ Other, specify (66): _____

PROGRAMMER: If more than one response selected in Q8, then ask
"Which is the main the reason for not being able to collect enough water?"
PROGRAMMER: Options selected in Q8

Now I would like to ask about how much your household spends on water (this includes water for ALL uses e.g. drinking, sanitation, cooking, washing of clothes, personal and household hygiene).

Programmer : Display questions 9 to 15 only if piped water selected in Q D1 i.e. response 6 or 7

9) **What is the source of the piped water i.e. from where do you get your water?**
_____LWSC main network (1)
_____LWSC other network like reservoir (2)
_____Community water trust (3)
-_____Private network/source (borewell /others) 4 **Go to Q16**
_____Other Specify _____
_____Don't Know (-99)
_____Refused (-77)

10) **Did your household pay an initial connection fee for your piped water?**
____ Yes (1)
____ No (2) **Go to Q13**
____ Refused (-77) **Go to Q13**
____ Don't know (-99) **Go to Q13**

11) What was the cost of the initial connection fee, in cash, for your household? Include the connection fee, do not include other costs, such as those for a plumber.

____ ZMW
____ Refused (-77)
____ Don't know (-99)

12) Did your household receive financial assistance for the initial connection fee? Include financial assistance from the program and not from family or friends.

____ Yes, this made it possible to pay the fee in entirety (1)
____ Yes but had to arrange additional funds (2)
____ No (0)
____ Refused (-77)
____ Don't know (-99)

13) Is your most recent water bill available and can you show it to me

_____Yes (1)
____ No(0) Go to Q15
____ Refused(-77) Go to Q15

14) ENUMERATOR: Record the following information from the water bill

Estimated use_____ (liters or m3)
Water Bill reading___m^3 _____kwacha
Amount paid: _____
Periodicity of bill (fixed charge or prepaid): ____monthly _____every two weeks _____Other, specify
Other_____
Don't know (-99) _____
Programmer : Display if landlord i.e Yes (1) response in Section A question 5.
Water bill includes information for tenant's usage
PROGRAMMER: After the bill details are entered go to Q16

15) In a typical month, how much does your household spend on water for the tap in your home or plot?

____ ZMW
____ Refused (-77)
____ Don't Know (-99)

16) In a typical day, does your household buy any water from water kiosks or communal taps?

____ Yes (1)
____ No (0) ***go to Q18***
____ Refused (-77) ***go to Q18***
____ Don't know (-99) ***go to Q18***

17) How much does your household spend on kiosk or communal tap water in a typical day?

____ ZMW per**: day week** (circle one)_____
____ Refused (-77)
____ Don't Know (-99)

18) In a typical day does your household spend any money on bottled or packaged water?

____ Yes (1)
____ No (0) ***go to Q20***
____ Refused (-77) ***go to Q20***
____ Don't know (-99) ***go to Q20***

19) How much does your household spend on bottled water in a typical day?

____ ZMW
____ Refused (-77)
____ Don't Know (-99)

20) In a typical day, does your household spend any money on other types of water, like buying water from a neighbor, a private bore hole or any other source?

____ Yes (1), specify:_____
____ No (0) ***go to Q22***
____ Refused (-77) ***go to Q22***
____ Don't know (-99) ***go to Q22***

21) How much does your household spend on this water in a typical day?

____ ZMW ____ Refused (-77) ____ Don't Know (-99)

22) Is the tap in your home or your plot metered by the water company?

____ Yes (1)
____ No (0) Go to Q24
_____N/A (-88) Go to Q24
____ Refused (-77) Go to Q24
____ Don't know (-99) Go to Q24

23) How much water in kiloliters does your household use for all purposes in a typical month?

____ Kiloliters
____ Refused (-77)
____ Don't Know (-99)

24) How much water does your household use in a typical day, measured in buckets, containers, drums, or other types of water containers? I am asking about ALL of the water your household uses in a day, whether for drinking, bathing, cleaning or something else. This water could come from ANYWHERE, including taps in your home or plot, water kiosks, communal taps, wells, boreholes, neighbors, etc.
(ENUMERATOR: ***If household uses buckets of multiple sizes, list the number and capacity of each that is used in Bucket A, B, C.)***

	Number	Capacity (liters)	Refused (-77)	Don't Know (-99)
Bucket				
Container				
Drum				
Other				

PROGRAMMER: Skip to Section E if D1 is 6. Proceed to Section D25, 26, 27 and 28 if D1 is not 6.

25) Next I'd like to know how much time people in your house spend collecting water. Who are the main water collectors for your household, that is, people who collect water at least twice per week?
PROGRAMMER: List all gender and ages from household roster except for those <2 yrs.
ENUMERATOR: Select all that apply and include only household members. Do not include staff or other non-household members that may be paid to collect water.
PROGRAMMER: Add option for Only non-household members with a skip to D27

26)

Main household water collectors					
Q	[redacted]	**Gender & Age (e.g., M 29)**			
A	**How much time did you/HH MEMBER spend collecting water per day? This includes time spent walking, waiting, filling buckets, and bringing them back to the house**	____hours (range 0-24)____minutes (range 0-60) _REF(-77) DK (-99)	_____ __REF(-77) DK (-99)	_____ __REF(-77) DK (-99)	_____ _REF(-77) DK (-99)
B	**How many days per week do you/does he/she collect water each week?**	_____ _REF(-77) DK (-99) Range (0-7)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)	_____ REF(-77) DK (-99)

Programmer: Questions 26 and 27 will display only if non household member selected

27) Did you pay anyone to collect water for your household in the past week?

____ Yes (1)
____ No (0) ***go to Section E***

____ Refused (-77) ***go to Section E***
____ Don't know (-99) ***go to Section E***

28) How much did you pay in total for water collection in the last week?
____ ZMW
____ Refused (-77)
____ Don't Know (-99)

E. WATER Storage and Treatment
Now I would like to ask you about how your household keeps drinking water in your house.

1) ENUMERATOR: Does the household collect water from a water kiosk or communal tap?
____ Yes (1)
____ No (0) ***go to Q4***
____ Refused (-77) ***go to Q4***
____ Don't know (-99) ***go to Q4***

2) When your household collects water from a kiosk or communal tap, do the kiosk operators treat the water or do something to it like add chlorine?
____ Yes (1)
____ Sometimes (2)
____ No (0) ***go to Q4***
____ Refused (-77) ***go to Q4***
____ Don't know (-99) ***go to Q4***

3) What do the kiosk operators do to the water collected by your household?
____ Pour bleach/chlorine into water (1)
____ Put a tablet into the water (2)
____ Other (66), specify:_____
____ Refused (-77)
____ Don't know (-99)

4) Does your household normally treat or do something to the drinking water stored in your home, such as adding chlorine, boiling it, or filtering it?
____ Yes (1)
____ No (0)
____ Refused (-77)
____ Don't know (-99)

5) Did your household treat or do something to the stored drinking water in your home currently, such as adding chlorine, boiling it, or filtering it?
____ Yes (1)
____ No (0) **Go to Q8_**
____ Refused (-77) **Go to Q8**
____ Don't know (-99) **Go to Q8**

6) **What did your household do to the stored drinking water in the house?** ***(DO NOT read answers. Mark all that apply)***

____ Boil water (1)
____ Bleach/chlorine (2)
____ Filter water (3)
____ Other (66) Specify: _____
____ Refused (--77) **Go to Q8**
____ Don't know (-99) **Go to Q8**

7) **Please show me the boiling pot, tablet, filter, or other item that you used.** ***(Enumerator: Confirm presence of pot, tablet, filter, or other item.)***

____ Item present (1)
____ Item not present (0)

8) **Please show me the containers where your household mainly stores your <u>drinking</u> water inside your house. (*ENUMERATOR: OBSERVE and select the main container type(s) the household identifies as using.)***

____ Plastic or metal buckets (1)
____ Plastic jerrycan (2)
____ Drum/Barrel (250 L) (3)
____ Container with screw top (e.g., plastic bottle, glass bottle) (4)
____ Other (66), specify:_____
____ Do not use a container (5) **Go to Section F**
____ Unable to observe (6) **Go to Section F**
____ Don't know (-99) **Go to Section F**
____ Refused (-77) **Go to Section F**

9) ***ENUMERATOR: OBSERVE - How many of the water storage containers are covered?***

____ All (1)
____ Some (2)
____ None (0)
____ Unable to observe (3)

10) **Does your household refrigerate your stored water?**

____ Yes (1)
_____ No (0)
____ Sometimes (2)
____ Don't know (-99)
____ Refused (-77)

11) **How does your household get water from this container to drink? Can you please show me how? (*ENUMERATOR: OBSERVE and select what the respondent does)***

____ Dipping (w/ ladle, cup, or hand) (1)
____ Pouring (2)
____ Through a spigot or tap (3)

____ Other (66), specify:_____
____ Don't know (-99)
____ Refused (-77)

F. Sanitation Module

1) **Now we are going to talk about sanitation and toilets. Can you show me the toilet facility your household NORMALLY uses?** ***ENUMERATOR: OBSERVE: What type of toilet is it? If respondent will not show you, ask them to describe it. Choose the best answer.***
____ Pit latrine with slab (1) **Go to Q3**
____ Pit latrine without slab (2) **Go to Q3**
____ Ventilated improved pit latrine (VIP) (3) **Go to Q3**
____ Bucket/chamber pot (4) **Go to Q15**
____ Flush toilet (5) **Go to Q2**
____ No facilities/bushes/plastic bags (6) **Go to Q15**
____ Other (66), specify **Go to Q3**
____ Don't know (-99) **Go to Q1**2
____ Refused (-77) **Go to Q12**

2) **Where is the waste flushed to?**
____ Piped sewer system (1)
____ Septic tank (2)
____ Latrine hole (3)
____ Some other place (i.e., river, drainage ditch) (4)
____ Refused (-77)
____ Other (66), specify _____
____ Don't know (-99)

3) **Beside this toilet, do you use any other toilet facility within or outside your home*?***
____ Yes (1)
____ No (2) **If Household has Flush Toilet in Q1 Go to Q6; Otherwise Go to Q12**
____ Refused (-77) **If Household has Flush Toilet in Q1 Go to Q6; Otherwise Go to Q12**
____ Don't know (-99) **If Household has Flush Toilet in Q1Go to Q6; Otherwise Go to Q12**

4) **Can you show me this other toilet facility?** ***ENUMERATOR: OBSERVE: What type of toilet is it? If respondent will not show you, ask them to describe it. Choose the best answer.***
____ Pit latrine with slab (1) **Go to Q12**
____ Pit latrine without slab (2) **Go to Q12**
____ Ventilated improved pit latrine (VIP) (3) **Go to Q12**
____ Bucket/chamber pot (4) **Go to Q15**
____ Flush toilet (5) **Go to Q5**
____ No facilities/bushes/plastic bags (6) **Go to Q15**
____ Other (66), specify _____ **Go to Q12**
____ Don't know (-99) **Go to Q12**
____ Refused (-77) **Go to Q12**

5) **For this other toilet, where is the waste flushed to?**
____ Piped sewer system (1)
____ Septic tank (2)
____ Latrine hole (3)
____ Some other place (i.e., river, drainage ditch) (4)
____ Refused (-77)
____ Other (66), specify _____
____ Don't know (-99)

6) **Did your household have to pay for the toilet?**
____ Yes (1)
____ No (0) **Go to Q12**
____ Refused (-77) **Go to Q12**
____ Don't know (-99) **Go to Q12**

7) **How much did your household pay for the toilet, in cash? Include cost of the toilet and any construction or plumbing and/or septic costs.**
____ ZMW for self-built latrine
____ ZMW for project/municipal latrine
____ ZMW for flush toilet
____ Refused (-77)
____ Don't know (-99)

8) **Did your household receive financial assistance for building the toilet?**
____ Yes, this made it possible to pay the fee in entirety (1)
____ Yes but had to arrange additional funds (2)
____ No (0)
____ Refused (-77)
____ Don't know (-99)

9) **Did your household have to pay to connect to the sewer?**
____ Yes (1)
____ No (0) **Go to Q12**
____ Refused (-77) **Go to Q12**
____ Don't know (-99) **Go to Q12**

10) **How much did your household pay to connect to the sewer, in cash? Include costs of road digging and connecting pipes and connection fees.**
____ ZMW for the connection fee to the sewer (Include costs of road digging and connecting pipes and connection fees)
____ Refused (-77)
____ Don't know (-99)

11) **Did your household receive financial assistance to connect to the sewer?**
____ Yes, this made it possible to pay the fee in entirety (1)

____ Yes but had to arrange additional funds (2)
____ No (0)
____ Refused (-77)
____ Don't know (-99)

12) Is your toilet or latrine just for this household or shared with other households?
____ Just this household (1) **Go to Q**15
____ Shared (2)
____ Don't know (-99) **Go to Q15**
____ Refused (-77) **Go to Q**15

13) How many households share it, not counting your own? Please provide your best estimate
Number of households _____ Refused (-77) ____ Don't know (-99) ____

14) How many people share it, including those in your household? Please provide your best estimate.
Number of people _____ Refused (-77) ____ Don't know (-99) _____

15) How does your household dispose of the feces of young children that do not use the toilet or latrine? (*Select all that apply. Read options if interviewee does not understand the question)*
____ Chamber rinsed into latrine (1)
____ Chamber rinsed into drain/ditch (2)
____ Newspaper/plastic bag with feces thrown into latrine (3)
____ Newspaper/plastic bag with feces thrown into garbage (4)
____ Nothing/left where it is (5)
____ Buried (6)
____ Moved off of plot (7)
____ Collect from ground and move to pit latrine (8)
____ Do not have young children (9)
____ Do not have young children (10)
____ Refused (-77)
____ Other (66), specify _____
____ Don't know (-99)

PROGRAMMER: Display Q16-21, If response in Q1 is 1, 2, 3 or 5. Otherwise go to Section G.

16) Do you feel that your toilet is safe to use at night?
____ Yes (1) **Go to Q18**
____ No (0)
____ Don't know (-99) **Go to Q18**
____ Refused (-77) **Go to Q18**

17) Why is it not safe to use at night?
____ Fear of attack (1)
____ May step in refuse (2)
____ Fear of falling in (3)
____ Other (66), specify _____
____ Don't know (-99)
____ Refused (-77)

18) What do women in your household use at night for the toilet? *(Mark all that apply.)*

____ Same toilet as during the day (1)
____ Wait to use toilet until morning (2)
____ Chamber pot or bucket (3)
____ Plastic bag (4)
____ Not applicable (-88)
____ Other (66), specify _____
____ Don't know (-99)
____ Refused (-77)

19) What do men in your household use at night for the toilet? *(Mark all that apply.)*

____ Same toilet as during the day (1)
____ Wait to use toilet until morning (2)
____ Chamber pot or bucket (3)
____ Plastic bag (4)
____ Not applicable (-88)
____ Other (66), specify _____
____ Don't know (-99)
____ Refused (-77)

20) What do children under age 12 in your household use at night for the toilet? *(Mark all that apply.)*

____ Same toilet as during day (1)
____ Wait to use toilet until morning (2)
____ Chamber pot or bucket (3)
____ Plastic bag (4)
____ Other (66), specify _____
____ Don't know (-99)
____ Refused (-77)
____ N/A (-88)

21) In addition to human waste, does your household dispose of anything else in your toilet? I will read you a short list. (*Read all options.)*

Item	**Does your household dispose of [ITEM] in the toilet or latrine?** **Yes = 1; No = 0; Don't know = 2; Refused = 3**
Toilet Paper	
Newspaper	
Sanitary Pads	
Garbage	
Nappies/Diapers	
Anything else? :_____	

G. Hygiene Module

1) **When do you usually WASH your hands? (*ENUMERATOR: Do not read responses. Continue to prompt "ANY OTHER TIMES? Or "Before or after which activities" Select all that apply.)***

____ Before eating
____ After cleaning child who defecated
____ After disposing the chamber
____ After handling trash
____ After doing housework
____After greeting others
____Before drinking
____ After contact with animals
____ Other, specify____
____ Before cooking/preparing baby food
____ After using toilet
____ Before you breastfeed
____ After working
____ After eating
____In the morning
____ In the morning when you wake up
____ Never ***Go to Section H***
_____ Refused ***Go to Section H***

2) **What do you usually WASH your hands with?**

____ Water only (1) ***Go to Section H***
____ Water and soap/detergent (2) ***Go to Q3***
____ Water and something else (3), specify:_____ ***Go to Section H***
____ Don't know (-99) ***Go to Section H***
____ Refused (-77) ***Go to Section H***

3) **Please show me the soap that your household uses. *(Enumerator: Confirm presence of soap.)***

____ Soap/detergent present (1)
____ Soap/detergent not present (0)
____ Refused (-77)

4) Is there a towel available to dry hands after washing? ***(Enumerator: Confirm presence of towel.)***

____ Towel present (1)
____ Towel not present (0)
____ Refused (-77)

H. Household Garbage Disposal

Now I am going to ask you about household garbage disposal.

1) **What are the ways that your household disposes of garbage? (*Select all that apply.)***

____ Garbage collected from house
____ Burn **Go to Section I**
____ Drainage ditch **Go to Section I**
____ Put in latrine/toilet **Go to Section I**
____ Don't Know **Go to Section I**
____ Bury/pit **Go to Section I**
____ Roadside dump **Go to Section I**
____ Garbage bay/Council bins
____ Other, specify _____
____ Refused **Go to Section I**

2) **Who collects your household's garbage? (*Mark the best answer.)***

____ LCC/the city (1)
____ Private Company or community based enterprise (2)
____ Hired individuals (3)
____ No one (4)
____ Other (66), specify _____
____ Don't know (-99)
____ Refused (-77)

3) How much does your household pay per month for garbage removal, in cash?

____ ZMW
____ Paid as Part of the rental, (1)
____ Refused (-77)
____ Don't know (-99)

I. Time Use and Expenditures

Now I would like to ask some questions about working, looking for work, and household expenditures during the last month.

1. **I will start by asking you about time spent working and looking for work by household members aged 18 and older.** ***(PROGRAMMER: Loop through column in this table for each member of the household who is 18 or older. Answer all questions for one household member before moving to the next.)***

	Adult Household Members				
Q	**In the last month did __:**	**Gender and Age (e.g., M29)**			
A	**Do you/he/she do any activities where you/he/she earned money? This includes things like working for a wage, doing piecework, running a shop, or selling things. This excludes remittances and landlords who are just receiving rent, not doing maintenance or labor. (*Circle one. If No, REF, or DK go to B)***	Y N REF DK	Y N REF DK	Y N REF DK	Y N REF DK
i	How many days did you/he/she work per week, on average?	_____ _REF(-77) DK (-99)	_____ __REF(-77) DK (-99)	_____ __REF(-77) DK (-99)	_____ _REF(-77) DK (-99)
ii	How many hours did you/he/she work per day, on average?	_____ _REF(-77) DK (-99)	_____ __REF(-77) DK (-99)	_____ __REF(-77) DK (-99)	_____ _REF(-77) DK (-99)
B	**PROGRAMMER: If Q1a is yes, skip to I2 you/he/she look for work? (*Circle one. If NO, REF, or DK go to question 2)***	Y N REF DK	Y N REF DK	Y N REF DK	Y N REF DK
i	How many days did you/he/she spend looking for work per week, on average?	_____ _REF(-77) DK (-99)	_____ __REF(-77) DK (-99)	_____ __REF(-77) DK (-99)	_____ _REF(-77) DK (-99)
ii	How many hours did you/he/she spend looking for work per day, on average?	_____ _REF(-77) DK (-99)	_____ __REF(-77) DK (-99)	_____ __REF(-77) DK (-99)	_____ _REF(-77) DK (-99)

Expenditures:

2. **Now I would like to ask you about different things your household has spent money on. Focusing on the last 7 days, has your household purchased any of the following food items? Please include items purchased only for your household and not for business purposes.**

   2A. First, I would like to ask about cereals and grains. Did your household purchase any of the following items in the last 7 days? Please include items purchased only for your household and not for business purposes. Please select all that apply

   i. Mealie meal
   ii. Bread
   iii. Rice
   iv. Any other cereal or grains (e.g., flour, maize, noodles, samp), Please specify:_____
   v. Refused
   vi. DK

2Ai. How much was spent on [PROGRAMMER: PIPE IN NAME in 2A]
2Aii. How much was purchased or how much [PIPE IN NAME In 2A] did you buy?
[PROGRAMMER: Try having 2Ai and 2Aii in a table on the same screen]

Consumption Items	Q	No = 0 Yes = 1 Don't Know = 2 Refused = 3 PROGRAMMER: Response of 0, 2 or 3, skip to next item	How much was spent (ZMW)? REF(-77) DK (-99) PROGRAMMER: If amount known skip to next product	How much was purchased? OR How much ITEM did you buy? REF(-77) DK (-99)	Notes ENUMERATOR: record unit other than what is specified in the question here
Cereals and grains	**5-1**				
Mealie meal (kg)	i				
Bread (loaf/buns)	ii				
Rice (kg)	iii				
Any other cereal or grains (e.g., flour, maize, noodles, samp), Please specify:	iv				
Meats, Eggs, and Fish	**5-2**				
Kapenta (kg)	i				
Other fish (any) (kg)	ii				
Eggs	iii				
Poultry/Chicken/Quails/Etc (kg)	iv				

Any other meat (e.g., beef, pork, sausage), Please specify:	v				
Vegetables	**5-3**				
Tomato (kg)	i				
Onion (kg)	ii				
Green vegetables (kg)	iii				
Any other vegetables, Please specify (kg):	iv				
Fruit	**5-4**				
All (kg)	i				
Sugar, Salt, oil and Spices	**5-5**				
Cooking oil (liter)	i				
Sugar (kg)	ii				
Salt (pack)	iii				
Any other spices, Please specify:	iv				
Dairy Products	**5-6**				
Milk (fresh, powdered)	i				
Butter/Margarine (kg)	ii				
Any other dairy products (e.g., yogurt, cremora), Please specify:	iii				
Pulses/Legumes	**5-7**				
Dry beans (kg)	i				
Ground nuts/Peanuts (kg)	ii				
Any other beans, nuts or legumes (e.g., soya chunks, soybeans), Please specify:	iii				
Beverages	**5-8**				
Tea, coffee (pack)	i				
Soft drinks/fruit juice (liter)	ii				
Alcohol (liter)	iii				

3. Have you or any members of your household had any expenses for the following <u>non-food items</u> during the past month? I will read you a list.

	Q	No = 0 Yes = 1 Don't Know = 2 Refused = 3 PROGRAMMER: Response of 0, 2 or 3, skip to next item	How much did your household spend in the past month? (ZMW) REF(-77) DK (-99)

Non-food items	6-1		
Electricity/ZESCO	i		
Rent or mortgage/home loan	ii		
Cell phone minutes/bill (for the WHOLE household)	iii		
Public transport, such as a Taxi, Bus, or Minibus, not including expenses for transportation to and from school	iv		
Personal products such as soap, shampoo, pomade, razor blades, toothbrush and tooth paste, or cosmetics and skin cream (ENUMERATOR: *Read all options)*	v		
Hair braiding, barber or salon visits	vi		
Clothing, not including school uniforms	vii		
Charcoal/ firewood /kerosene/LPG used for cooking	viii		
Cigarettes/tobacco	ix		
Gas/petrol/GENSET/candles	x		
Education expenses for non-household members	xi		
Child care	xii		
Entertainment/recreation (such as movies, restaurants, eating outside, beer tavern, popcorn, ice water, etc)	xiii		
Anything else; specify	xiv		
Anything else; specify	xv		

4. Has your household had any expenses for the following <u>healthcare items</u> during the past month? Please do not include any healthcare expenses that we have already discussed.

ENUMERATOR: Expenses recorded above in the sickness section should not be included.

Healthcare Expenses	Q	No = 0 Yes = 1 Don't Know = 2 Refused = 3 PROGRAMMER: Response of 0, 2 or 3, skip to next expense	Specify the amount spent (ZMW) REF(-77) DK (-99)	Specify the a time period if 1 month total not known REF(-77) DK (-99)
Doctor/clinic/health center visit fees for all health conditions, diseases among household members (e.g. diabetes, maternity, malaria, high blood pressure/BP, toothache, ear ache)	i			
Medications: All [long term illness](e.g., from pharmacy/chemist or drugstore [self-prescribed])	ii			

Any other healthcare expenses specify:	iii			

5. **Has your household had any education related expenses in the past year? This includes things like school fees, tuition, pre-school, daily pocket money, uniforms, school supplies, or transportation**
   ____ Yes (1)
   ____ No (0) **Go to Q8**
   ____ Don't know (-99) **Go to Q8**
   ____ Refused (-77) **Go to Q8**

6. **How many household members are in school?** ***(Enumerator: check this response matches question A13)***
   _____
   ____ Refused (-77)
   If "0" go to Q8

7. **I will now start asking you about the money your household may have spent on household members in school.** ***Programmer: Display all household members and allow enumerator to select those that went to school in the past academic year, and for each ask the following questions:***

   7i. Did your household spend money on school fees including boarding fees for (Programmer: Pull in gender and age ID) schooling in the 2015 (CHANGED TO 2016 IN JAN 2017) academic year?
   _____ Yes (1)
   _____ No (0) If No, DK or REF go to 7ii
   _____ Don't know (2) If No, DK or REF go to 7ii
   _____ Refused (3) If No, DK or REF go to 7ii

   7ia. In the 2015 (CHANGED TO 2016 IN JAN 2017) academic year, how many terms did you/he/she attend?
   _____ Terms
   _____ Refused (-77)
   _____ Don't know (-99)

   7ib. How much did your household spend per term for the 2015 (CHANGED TO 2016 IN JAN 2017) academic year? Kwacha (ZMW) per term
   _____ ZMW
   _____ Refused (-77)
   _____ Don't know (-99)

   7ii. Did your household spend money on tuition for the (Programmer: Pull in gender and age ID) schooling in the 2015 (CHANGED TO 2016 IN JAN 2017) academic year?
   _____ Yes (1)
   _____ No (0) If No, DK or REF go to 7iii
   _____ Don't know (2) If No, DK or REF go to 7iii
   _____ Refused (3) If No, DK or REF go to 7iii

7iia. How much did your household spend for the whole the 2015 (CHANGED TO 2016 IN JAN 2017) academic year? Kwacha (ZMW) per term

_____ ZMW
_____ Refused (-77)
_____ Don't know (-99)

7iii. During the 2015 (CHANGED TO 2016 IN JAN 2017) academic year, did you household spend money on any other items for (Programmer: Pull in gender and and age ID) such as (Select all that apply):

___ Uniform/shoes
___ School supplies like stationary or textbooks
___ PTA (Parent Teacher Association) fees
___ Anything else, specify_____

7iv. During the 2015 (CHANGED TO 2016 IN JAN 2017) academic year, did you household spend money on any other items for (Programmer: Pull in gender and and age ID) such as (Select all that apply):

___ Daily pocket money
___ Daily transport (e.g. minibus, petrol)

Programmer: For Q7iii and Q7iv, any response selected should then branch to this questions:

How much was spent in ZMW? Enumerator: If 1-yr total is not known try to get total for a different time period (e.g. 200 ZMW last month).

_____ ZMW
_____ Refused (-77)
_____ Don't know (-99)

8. Does your household have any of the following <u>durable goods</u>?

	Q	No = 0 Yes = 1 Don't Know = 2 Refused = 3 Go to next item on list	Was this item purchased within the past two years? No = 0 Yes = 1 Don't Know = 2 Refused = 3 PROGRAMMER: If 0, 2, 3 skip to next item	How much did you spend on it? (ZMW) REF(-77) DK (-99). Enumerator: If other currency, write amount and currency in enumerator comments
Durable goods	8-1			
Cell phones	i			
Radio	ii			
Refrigerator/Freezer	iii			
Television	iv			
Two plate cooker/stove				

Four plate cooker/stove	v			
Microwave oven				
Bicycle (ENUMERATOR: Record bicycles used for transport only)	vi			
Bicycles for children				
Car	vii			
Sofa	viii			
DVD Player	ix			
Computer	x			
Solar panels, lamps, etc	xi			

9. What is the MAIN type of fuel used for cooking in your household? ***(Choose the best answer)***

____ Charcoal (1)
____ Electricity (2) ***Go to Section*** K, Observations
____ Wood (3)
____ Paraffin (4)
____ Other (66), specify _____
____ Don't know (-99)
____ Refused (-77)

10. Is there electricity in your house supplied by ZESCO? ENUMERATOR: Do not include electricity from thermal or solar sources.

____ Yes (1)
____ No (0)
____ Refused (-77)
____ Don't know (-99)

K. Observations

Now I would like to observe a few things about your house.

1) ***ENUMERATOR: OBSERVE - What type of roofing does this house have? (Select all that apply)***

____ Metal/Iron sheets (1)
____ Asbestos (2)
____ Wood planks (3)
____ Ceramic tiles/Harvey tiles (4)
____ Cardboard (5)
____ Cement/Concrete (7)
____ Roofing shingles (8)
____ Mud tiles (9)
____ Other (66), specify _____
____ Don't know (-99)

2) ***ENUMERATOR: OBSERVE - What is the flooring material? (Select all that apply)***

____ Concrete (1)
____ Cement (2)

____ Brick (3)
____ Tiles (4)
____ Mud (5)
____ Wood (not wooden tiles) (6)
____ Other (66), specify _____
____ Don't know (-99)

3) ***ENUMERATOR: OBSERVE - What is the material used for the walls? (Select all that apply)***
____ Concrete blocks/slab (1)
____ Cement blocks (2)
____ Compressed cement bricks (3)
____ Burnt bricks (4)
____ Mud bricks (5)
____ Compressed mud (6)
____ Iron sheets (7)
____ Asbestos/hardwood/wood (8)
____ Other (66), specify (eg. with ceiling)_____
____ Don't know (-99)

4) ***ENUMERATOR: OBSERVE – Are there feces (human or animal) visible in the yard/plot?***
____ Yes (1)
____ No (0)
____ Not evaluable (3)

5) GPS Coordinate from Tablet: -_____S
+_____E

CHLORINE_TEXT
ENUMERATOR READ APPROPRIATE SCRIPT

SCRIPT FOR CLORIN:
We have been testing stored water in households across Lusaka and have found that three out of four households have germs in their stored water that could make people sick. That's why we're giving every household we visit this information sheet on how to treat your water with chlorine and how to store water safely to prevent contamination (hand sheet to respondent). We are also giving you a month's supply of Clorin to treat your water (hand bottle to respondent). The back side of this sheet gives instructions on how much Clorin to use in a typical 20 L bucket of water. Chlorine makes the water safe and we recommend that you continue using it to treat your stored water in the future.

SCRIPT FOR AQUATABS:
We have been testing stored water in households across Lusaka and have found that three out of four households have germs in their stored water that could make people sick. That's why we're giving every household we visit this information sheet on how to treat your water with chlorine and how to store water safely to prevent contamination (hand sheet to respondent). We are also giving you a month's supply of Aquatabs, a type of chlorine, to treat your water (hand tablets to respondent). The back side of this sheet gives instructions on how to use Aquatabs in a typical

20 L bucket of water. Chlorine makes the water safe and we recommend that you continue using it to treat your stored water in the future.

PROGRAMMER: IF NOT SELECTED FOR SOURCE WATER COLLECTION, SKIP TO SECTION END_TEXT.

M. Field Control

1) DATE OF FIRST VISIT _ _ /_ _ / _ _ _ _ (Day/Month/Year)

2) ENUMERATOR: **Interviewer's name Visit 1: _____**

3) ENUMERATOR: Enter the disposition code for the first visit to the household

1 Completed the Interview
2 No one at home or no adult at home
3 Head of household is not home
4 Entire household absent for extended period
5 Did not live in household for 2 or more months
6 Rescheduled (Interview postponed and new time scheduled)
7 Final Refusal (Interview refused/ no interview completed)
8 Dwelling vacant
9 Safety concern
10 Other Non-Interview (Specify in notes)
11 Partial Complete/Will return (Interview stopped but will continue later)
12 Partial Complete/Interview finished (Interview stopped and will not continue)
13 Temporary Refusal (Interview refused)
14 Head of household under the age of 18
15 Water samples not available

4) ENUMERATOR: Enter date and time of appointment

5) ENUMERATOR: Enter comments about how the visit went

6) ENUMERATOR: Date of second visit _ _ /_ _ / _ _ _ _ (Day/Month/Year)

7) ENUMERATOR: **Interviewer's name Visit 2: _____**

8) ENUMERATOR: Enter the disposition code for the second visit to the household

1 Completed the Interview
2 No one at home or no adult at home
3 Head of household is not home
4 Entire household absent for extended period
5 Did not live in household for 2 or more months
6 Rescheduled (Interview postponed and new time scheduled)
7 Final Refusal (Interview refused/ no interview completed)

8 Dwelling vacant
9 Safety concern
10 Other Non-Interview (Specify in notes)
11 Partial Complete/Will return (Interview stopped but will continue later)
12 Partial Complete/Interview finished (Interview stopped and will not continue)
13 Temporary Refusal (Interview refused)
14 Head of household under the age of 18
15 Water samples not available

9) ENUMERATOR: Enter date and time of appointment

10) ENUMERATOR: Enter comments about how the visit went

11) ENUMERATOR: Date of third visit _ _ /_ _ / _ _ _ _ (Day/Month/Year)

12) ENUMERATOR: **Interviewer's name Visit 3:** _____

13) ENUMERATOR: Enter the disposition code for the third visit to the household
1 Completed the Interview
2 No one at home or no adult at home
3 Head of household is not home
4 Entire household absent for extended period
5 Did not live in household for 2 or more months
6 Rescheduled (Interview postponed and new time scheduled)
7 Final Refusal (Interview refused/ no interview completed)
8 Dwelling vacant
9 Safety concern
10 Other Non-Interview (Specify in notes)
12 Partial Complete/Interview finished (Interview stopped and will not continue)
13 Temporary Refusal (Interview refused)
14 Head of household under the age of 18
15 Water samples not available

14) ENUMERATOR: Enter comments about how the visit went

15) PROGRAMMER ASK IF M3, M8 or M13 are 1: What language was most of the interview conducted in?
1 English
2 Bemba
3 Nyanja

Appendix 4: Definitions

Water Sources

Improved water source (MCC/JMP): communal tap, protected well, piped water inside the house, piped water outside the house within stand/plot, piped water from neighbor, piped water from another compound, kiosk from another compound.
Unimproved water source (MCC/JMP): unprotected well, surface water (stream/pond), bottled water, private borehole on your plot, private borehole somewhere else.
Improved water (CDC)= communal tap, piped water inside the house, piped water outside the house within stand/plot, piped water from neighbor, piped water from another compound, kiosk from another compound.
Unimproved water (CDC)= unprotected well, protected well, surface water (stream/pond), bottled water, private borehole on your plot, private borehole somewhere else.

Sanitation

Improved sanitation (MCC/JMP): Pit latrine with slab, ventilated pit latrine, flush toilet
Unimproved sanitation (MCC/JMP): Pit latrine without slab, bucket/chamber pot, no facilities/bushes/plastic
Improved sanitation (CDC 1): flush toilet
Unimproved sanitation (CDC 1): Pit latrine without slab, pit latrine with slab, ventilated pit latrine, bucket/chamber pot, no facilities/bushes/plastic bags
Improved sanitation (CDC 2): ventilated pit latrine, flush toilet
Unimproved sanitation (CDC 2): Pit latrine without slab, bucket/chamber pot, no facilities/bushes/plastic bags

Illness

Household Level General Illness: variable**=** QB1- "Has anyone in your household been sick with diarrhea or flu-like illness in the past 7 days?"
Household Level Diarrheal Illness: variable**=** created "diarrhea" variable. If a household had 1 or more individuals with diarrheal illness, diarrhea=Yes. If a household had respiratory illness ONLY or no illness, diarrhea= No.

Water Quality

Point-of-consumption (POC) water: is water contained in a vessel (e.g., cup) immediately prior to consumption.
Stored water: is water stored in a container within the household (e.g., covered buckets).
Source water: is the delivery point of water from a distribution system (e.g., kiosks, household-level taps) or groundwater (e.g., boreholes). Source water is further subdivided into Lusaka Water and Sewerage Company (LWSC) public water sources (communal taps, water kiosks), private water sources (boreholes, wells), and piped water sources (LWSC or non-LWSC tap within a neighborhood, compound, or house).
Indicator organism: An organism used as a proxy for another organism in a particular environment. For example, *E. coli* is found in the guts of warm-blooded mammals and its presence in the environment (e.g., drinking water) suggests the presence of fecal material. *E. coli* is an internationally-accepted indicator of pathogens that could also be present in fecal material as it is more likely to efficiently detect *E. coli* in a drinking water sample than a particular enteric pathogen.
Household *E. coli* Result: For some analyses, CDC combined POC and stored water *E. coli* results into one category called "household *E. coli*". For those households that received both a POC and a stored water *E. coli* tests, the larger result was taken for the "household *E. coli*" variable.
Household Free Chlorine Residual (FCR) Result: For some analyses, CDC combined POC and stored water chlorine results into one category called "household chlorine". For those households that received both a POC and a stored water chlorine tests, the lower result was taken for the "household FCR" variable.
Household Nitrates Result: For some analyses, CDC combined POC and stored water nitrates results into one category called "household nitrates". For those households that received both a POC and a stored water nitrates tests, the larger result was taken for the "household nitrates" variable.

Appendix 5: WASH Baseline Statistical Testing and Data Cleaning Notes

Table A5.1: Summary of Data Cleaning

Title	Data Issue	Resolution
Household level averages vs. individual level averages	There are some expenditure variables that have multiple observation within a single household.	When there are household expenditure variables that have multiple observations, these should be calculated as "household level average".
Dropping daily education costs (school pocket money and transportation) from total household expenditure variable	Respondents reported estimates of education-related expenses for school pocket money and school transportation that appear to be extraordinarily out-of-scope or scale of all other expenditures (see Tables A5.3 and Figure A5.3.1).	Exclude daily education costs (pocket money, transportation) from estimates of household expenditures.
Normality of continuous data	Household total expenditure and water quality testing data are not normally distributed. See Tables A5.2 (for water quality testing data), and Figures A5.4.1a – A5.4.1d.	Log transform both household total expenditure variable and lab data and merge those into the final dataset as separate variables.
Outliers for time gathering water	Some households reported seemingly incongruous (compared to estimates reported by other respondents) estimates of time taken to gather water.	Adjustments made: <=10 hr -> hrs, >10 hr -> min, 1~4 min -> hrs; (less than or equal to 10 hrs= hrs; greater than 10 hours = minutes; 1-4 minutes= hours)
Missing responses, refused, Don't know (DK), unknown, etc.	How to deal with categorical variables that have unknown/missing/DK/refused values? The frequency of occurrence of missing responses/ values is low.	Do not include unknown/missing/refused/DK in tables and analyses.
"Other" categories for source water type and toilet facility types		Dropped the "other" category in both source water analysis (safe water vs. unsafe water) and the sanitation analysis (safe sanitation vs unsafe sanitation) for the bivariate analyses. Add these values to the "missing values" with an asterisk.
Water quality lab data: geometric mean in bivariate analyses (not arithmetic mean)		Use the geometric mean when presenting water quality microbiology lab data. (i.e., total coliforms, *E. coli*).

Tables A5.2 Water Quality Testing

Table A5.2a World Health Organization (WHO) guideline values for select water quality parameters

Parameter	Guideline value
E. coli	1 CFU/100 mL
Total coliforms	Not applicable
Nitrates	50 mg/L, 100 mg/L
Free chlorine residual	0.2 mg/L
Turbidity	1 NTU

Table A5.2b Method detection limits for water quality parameters

Parameter	Lower limit of detection	Upper limit of detection
E. coli	1 CFU/100mL	200 CFU/100mL
Total coliforms	1 CFU/100mL	200 CFU/100mL
Nitrates	0.01 mg/L	1400 mg/L
Free chlorine residual	0.02 mg/L	2.00 mg/L
Turbidity	0 NTU	1000 NTU

Table A5.2c Log base-10 transformations: Method detection limits for water quality parameters

Parameter	Values less than or equal to 0 set to half the lower detection limit:
E. coli	0.5 CFU/100mL*
Total coliforms	0.5 CFU/100mL*
Nitrates	0.005 mg/L
Free chlorine residual	0.01 mg/L
Turbidity	0.001 mg/L

* also used to calculate the geometric mean

Table A5.2d Quality control samples

- Initial results were deemed not significantly different from duplicate results.
- Therefore, results are not adjusted based on quality control sample results.

Table A5.2e New analysis variable for analyzing household water quality

Household water	Household water was calculated as any household where stored or point-of-consumption (POC) water was tested; for household where both stored and POC were tested the "worst" value of the two was used (i.e., highest *E. coli* result, highest total coliforms result, highest nitrates result, highest turbidity result, lowest FCR result).

Tables and Figure A5.3: Analyzing school pocket money and transportation as part of total expenditures

Table A5.3a: Household expenditures (ZMW) by category, expenditure time interval and by group

		Expenditures (ZMW)		
Time interval	**Category**	**All**	**Control**	**Intervention**
Weekly	Food items	14,916	14,697	15,134
Monthly	Non-food items	13,704	13,374	14,032
Monthly	Healthcare	1,466	1,420	1,515
Bi-annual	Durable goods	1,683	1,638	1,726
Annual	School fees	2,941	2,646	3,236
Annual	Tuition	377	318	433
Annual	Uniform/shoes	344	337	351
Annual	School supplies	167	155	179
Annual	PTA fees	117	120	115
Annual	Other school	204	199	208
Daily	Pocket money	6,183	5,529	6,916
Daily	Transportation	13,415	14,974	12,014

Figure A5.3.1 Comparison of annualized household expenditure by expenditure category.

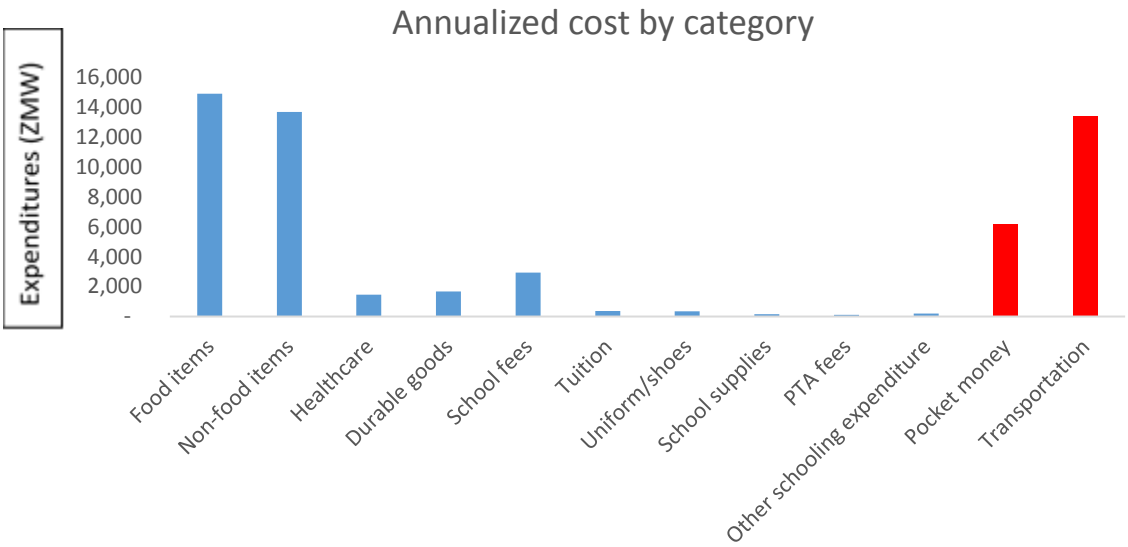


Table A5.3b: Comparison of estimated household annual costs (ZMW) with and without reported daily costs for school pocket money and transportation to school (daily costs assumed occur for 272 days per year)

TableA5.3b1: Including reported daily school pocket money and school transport costs					
Category of household expenditure	**Group surveyed**	**N**	**Mean**	**Median**	**% to total**
Education	Control	3,756	9,462	2,614	27%
	Intervention	3,812	9,983	2,770	27%
	All	7,568	9,724	2,698	27%
Total expenditure	Control	6,224	35,421	25,675	
	Intervention	6,277	36,946	27,164	
	All	12,501	36,186	26,278	

TableA5.3b2: Excluding reported daily school pocket money and school transport costs					
Category of household expenditure	**Group surveyed**	**N**	**Mean**	**Median**	**% to total**
Education	Control	3,756	2,708	1,461	9%
	Intervention	3,812	3,215	1,680	10%
	All	7,568	2,963	1,569	9%
Total expenditure	Control	6,224	31,277	24,767	
	Intervention	6,277	32,768	26,209	
	All	12,501	32,026	25,494	

Conclusions: Tables A5.3 and Figures A5.3.1: The need to exclude reported daily schooling expenditures (school pocket money and transportation)

1) Reported daily schooling expenses school pocket money and transportation) likely incorrectly reported/ measured: If we include annualized pocket money and transportation expenses, then the education expenses end up accounting for 27% of total expenditure. Excluding them, and education becomes 9-10% of total annual household expenditures.
2) Comparison to other databases: In Lusaka, education expenses are reported to account for 6.3% of total annual household expenditure. Source: 2015 Living Conditions Monitoring Survey Report from Zambia Central Statistical Office (https://www.zamstats.gov.zm)
3) Exclude reported daily school expenditures (daily school pocket money and transportation: Given the seemingly large amounts, relative to other expenses, reported for daily school pocket money and transportation, it appears that such reported amounts are inaccurate. The reason for such inaccuracy is unknown, but may likely be a mis- understanding by the respondents of the time interval requested (e.g., daily rather than say monthly or weekly). Therefore, it is recommended that, when analyzing recorded household expenditure data, these two items (school pocket money and transportation) should be dropped.

A5.4 Distribution of annual household expenditures

Recorded total annual household expenditures were not normally distributed with a long tail toward right. The mean iwas32,026 ZMW, with a median of 25,494 ZMW per year (Figure A5.4.a). Transforming the total annual household expenditure (log base 10) produced a more normally distributed data set (Figure A5.4.b).

The household annual expenditure on food has a mean of 286 ZMW and median 234 ZMW per week (Figure A5.4.c).

Total annual household expenditure on non-food items, healthcare expenses, durable goods and education had a mean of 17,223 ZMW and median of 12,028 ZMW per year (Figure A5.4.d).

Figure A5.4.a – d: Histograms of the frequency distribution of household expenditures

Figure A5.4.a

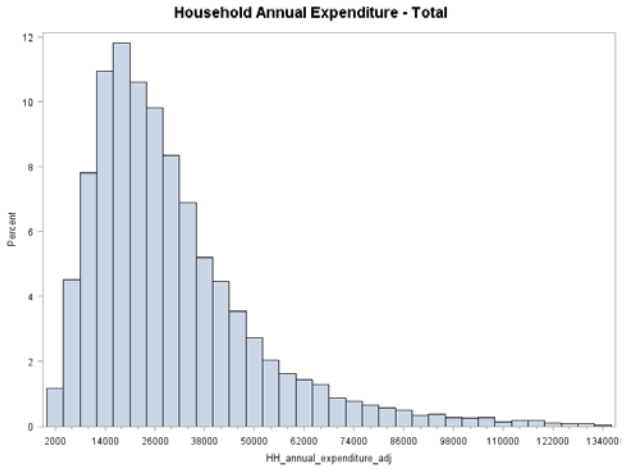


Figure A5.4.b

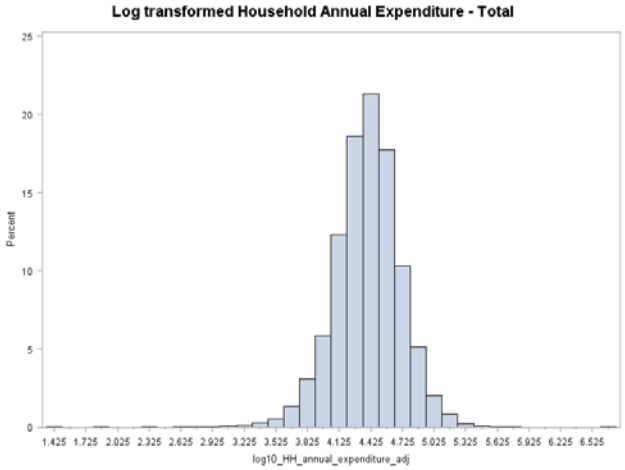


Figure A5.4.c

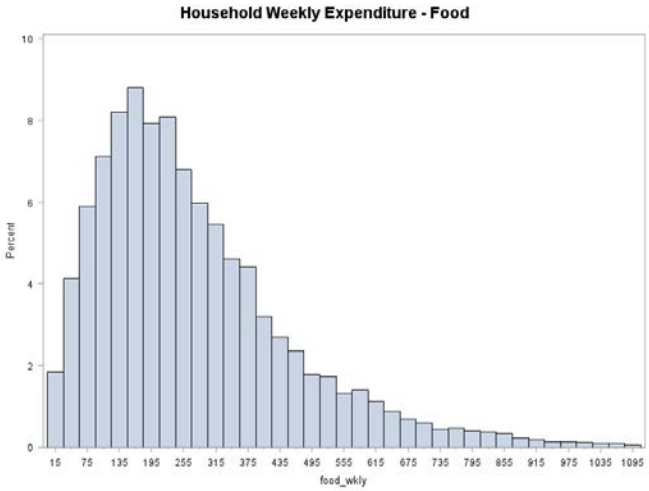
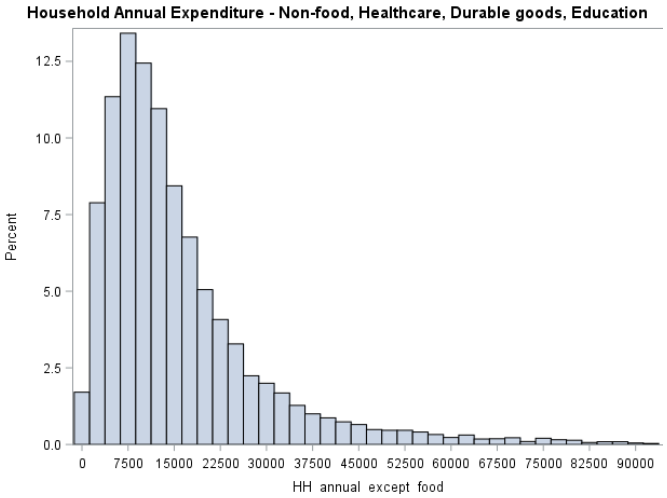


Figure A5.4.d



Appendix 6: Household Drainage Survey: Descriptive Statistics

Household Drainage Survey: Demographic Characteristics

A total of 14,346 individuals lived in the 3142 households, with a mean of 4.6 individuals per household (range 1-15) (Table A6.2). 42% of individuals in the household survey were <18 years old. Mean age for all individuals in the survey was 23 years, median 21 years (range 0-102 years). Mean age for head-of-household respondents was 38.7 years (Table A6.1). 52% of individuals in the survey were female, 48% were male (table A6.2). For 41% of respondents secondary education was the highest level they had completed; 31% of female respondents and 16% of male respondents had completed only primary education (Table A6.2).

Table A6.1: Household Age

N*	Mean	Median	Stand. deviation	Min	Max
3101	38.7	35.0	13.5	18.0	95.0

*Missing= 41

Table A6.2: Household Age

Total individual level	N	%
Total	14346	100
Age, years		
≤5	1991	13.9
6 to 17	3750	26.1
≥18	8321	58.0
Missing	284	2.0
Gender		
Male	6864	47.8
Female	7471	52.1
Missing	11	0.1
Currently In School		
Yes	5042	35.1
No	9054	63.1
Missing	250	1.7

Table A6.3: People currently living in this house

N	Mean	Median	Stand. deviation	Min	Max
3142	4.6	4.0	2.3	1.0	15.0

Table A6.4: Do you have tenants?

Landlord	N*	Percent
Yes	635	56.7
No	484	43.2
Don't Know	2	0.2

*Missing= 2021

Table A6.5: How long family has lived in house

N*	Mean	Median	Stand. deviation	Min	Max
3102	8.8	3.0	12.0	0.0	72.0

*Missing= 40

Table A6.6: Rooms in household excluding kitchen

N*	Mean	Median	Stand. deviation	Min	Max
3136	2.8	2.0	1.5	1.0	11.0

*Missing= 6

Table A6.7: Own or rent house

Own or Rent	Number	Percent
Own	1107	35.2
Rent	1903	60.6
Other	132	4.2

Table A6.8: Do you have a title or deed?

Title or Deed	Frequency*	Percent
Yes	936	83.3
No	142	12.6
Don't Know	44	3.9
Refused	2	0.2

*Missing= 2018

Table A6.9: Highest level of education completed by survey respondents.

Level of Education	Male N	Female N	Total*
Primary	144 (15.6%)	680 (30.9%)	827 (26.3%)
Secondary	394 (42.6%)	895 (40.6%)	1295 (41.2%)
Tertiary	370 (40.0%)	488 (22.2%)	859 (27.5%)
Refused/DK	17	7	9 (0.3%)
Not Applicable	14	132	146 (4.7%)

*Missing= 16

Household Drainage Survey: Household illness

19% (592/3142) of households reported that at least one household member had been sick with diarrhea or flu-like illness in the prior 7 day period (Table A6.10).

Table A6.10: Household level illness for diarrhea or flu-like illness in the prior 7 day period.

Illness in Household?	N	%
Yes	592	18.9
No	2545	81.1

Household Drainage Survey: Individual illness

5% (738/14,346) of individuals reported diarrhea or flu-like illness in the prior 7 day period. Illness prevalence ratios were 13.6% for children under 5, 3.5% for persons 6-17 years, and 3.9% for adults ≥18 years (Table A6.11). The finding that diarrhea and acute respiratory illness prevalence is driven by illness in children less than 5 years of age is consistent with other studies and national health surveys in multiple countries.

Table A6.11: Illness by age category for diarrhea or flu-like illness in prior 7 day period.

Age group	N	%*
≤5 years	271	13.6
6 to 17 years	131	3.5
≥18 years	325	3.9
Total reporting	738	

* Percentages are calculated as percent of total population in that age group.

Household Drainage Survey: Diarrhea

430 individuals reported diarrhea in the prior 7 days. Diarrhea prevalence ratios were 7.8% for children under 5, 1.9% for persons 6-17 years, and 2.3% for adults ≥18 years (Table A6.12). Median duration of illness was 3 days (range 1-32 days). 6% of individuals with diarrhea reported blood in their stool and some households reported children having diarrhea in which the number of loose stools were “too numerous to count” (Table A6.13). These reports of “too numerous to count” potentially indicates more severe causes of diarrhea, such as typhoid fever, shigellosis or cholera.

Table A6.12: Individual level illness by age category for diarrhea in prior 7 day period.

Age Group	N	% *
≤5	156	7.8
6 to 17	73	1.9
≥18	193	2.3
Missing	8	
Total	430	

*Percentages are calculated as percent of total population in that age group.

Table A6.13: If sick person had diarrhea

	Mean	Median	Std	Min, Max
Number of days with diarrhea	3.4	3.0	3.2	1.0, 32.0
Max number of loose stools in a 24 hour period	3.0	3.0	1.2	1.0, 10.0
	Yes	**No**	**DK**	**Missing**
Diarrhea ongoing	91	309	2	336
Blood in stool	27	339	22	350

Acute respiratory illness (ARI)

351 individuals reported flu-like illness. ARI prevalence ratios were 7.0% for children under 5, and 1.7% for persons 6-17 years and for adults ≥18 years (Table A6.5). Median duration of illness was 4 days (range 1-40 days).

Table A6.14: Individual level illness by age category for flu-like illness in prior 7 day period.

Reported Respiratory Illness by Age Group*	N	% of each age group*
≤5	139	7.0
6 to 17	65	1.7
≥18	144	1.7
Missing	3	
Total	351	

*Respiratory illness= fever AND (cough or sore throat)
** Percentages are calculated as percent of total population in that age group.

Table A6.15: If sick person had fever AND (cough or sore throat)

	Mean	Median	Std	Min, Max
Number of days ill	5.1	4.0	3.4	1.0, 40.0
	Yes	**No**	**DK**	**Missing**
Illness ongoing	182	162	2	5

Rotavirus vaccine coverage

1064 individuals produced an under-5 vaccination card, which records the types of vaccines that a child receives, along with additional data such as vaccination dates, and vaccine lot. Of these, 68% were fully vaccinated against rotavirus (had received two doses); 6% had received one dose, and 24% had not been vaccinated (Table A6.6).

Table A6.6: Rotavirus vaccine coverage for children under 5, Lusaka District.

Rotavirus Vaccine Coverage	N	%
0 doses	254	23.9

1 doses	62	5.8
2 doses	726	68.2
Total	1064	100

Household Drainage Survey: Flooding frequency and property damage

Sixty percent of households reported experiencing flooding during the prior month (Table A6.17). Flooding was defined as 'flooding in or around your home, compound, or community.' Mean duration of flooding was 3.3 days, median 2 days (range 1-31 days) (Table A6.18). Only 6.5% of households reported experiencing household or property damage as a result of floodwaters (Table A6.19). Damage to the building or walls (40%), clothing (20%), and furniture (17%) were most commonly reported (Table A6.20).

Table A6.17: Respondents who experienced flooding during the prior month.

Flooding in the last month	N	%*
Yes	1884	60
No	1244	40
Don't know	14	1
Total	3142	100

* Percentages rounded to whole number

Table A6.18: Days of flooding during last month.

N*	Mean	Median	Stand. deviation	Min	Max
1283	3.3	2.0	3.6	1.0	31.0

* Of those who said "Yes" to flooding in the last month, approximately 600 responded "Don't know" when asked how many days was there flooding in or around your house.

Table A6.19: During the last month, did flood waters damage or destroy any property at your house?

Flood waters damage any property?	N*	%
Yes	123	6.5
No	1769	93.5
Total	1892	

*Missing= 1250

Table A6.20: What type of property was destroyed (of those reporting flood damage)?

Property destroyed	N	%
Building/walls	49	29.7
Clothes/shoes	25	15.1
Furniture	21	12.7
Other	20	12.1
Plants/garden	13	7.9
Groceries/pantry	9	5.5

Property destroyed	N	%
Electronic equipment	9	5.5
Books/stationeries	7	4.2
Vehicles/bicycles	6	3.6
Other appliances	5	3.0
Cell phones	1	0.6

Table A6.21: Have you done anything or spent any money to protect against future flooding?

Spent any money to protect against future flooding?	N*	%
Yes	741	23.6
No	2389	76.2
Don't know	5	0.2
Total	3135	

*Missing= 7

Table A6.22: How much did you spend on investments to protect against future flooding?

N	Mean	Median	Standard deviation	Min	Max
579	538.2	0.0	2577.8	0.0	35000.0

Table A6.23: Were there any death (from drowning or injury) of people living in your household associated with the flooding during the last year?

Death or injury due to flooding	N	%
Yes	25	0.8
No	3090	99.1
Don't know	4	0.1
Total	3119	

Household Drainage Survey: Impact of travel time due to flooding

Median reported travel times were significantly longer during periods with flooding compared to periods with no flooding, for travel to school (15 minutes vs. 25 minutes) (Table A6.25); to market (15 minutes vs 20 minutes) (Table A6.26), and work (30 minutes vs. 40 minutes) (Table A6.28).

Table A6.24: How many household members go to school?

Number go to school?	N	%
0	7	0.33
1	703	32.68
2	641	29.80
3	434	20.18
4	224	10.41
5	93	4.32
6	29	1.35
7	12	0.56
8	4	0.19
9	4	0.19

Table A6.25: How long did it take household members to get to school?

Number go to school	4,974	
Time (Mins) to Get to School WITHOUT Flooding	Mean; Median 22.3; 15.0	Min; Max 0.0; 300.0
Time (Mins) to Get to School WITH Flooding	29.9; 25.0	0.0; 320.0
Number of School Days Missed Due to Flooding	635	
	Mean; Median 2.0; 2.0	Min; Max 1.0; 14.0

Table A6.26: How long did it take to get to the market with and without flooding, in minutes?

How long to get to market without flooding[1]	N = 2,545	
	Mean; Median 18.44; 15	Min; Max 0; 180
How long to get to market with flooding[1]	N = 1,898	
	Mean; Median 25.78; 20	Min; Max 0, 240

[1]For paired test, calculated with those having both without and with flooding: t value: -29.62; P< 0.0001

Table A6.27: How many household members work?

Household Members Work per Household	N* Households	%
1	1579	50.8
2	975	31.4
3	188	6.1
4	40	1.3
5	17	0.6
6	2	0.1
7	1	0.0
Total Households	3110	
Total number of working adults: all households	4357 Working adults	30

*Missing= 32

Table A6.28: Time spent working and looking for work for household members age 18 and older

	Yes	No	Total
Adults ≥ 18 years currently working	4479	3275	7754
Adults ≥ 18 years currently looking for work	623	2589	3212

Table A6.29: Number of days per week working or looking for work

Label	N	Mean	Median	Stand. deviation	Min	Max
Number of days working per week	4376	5.69	6	1.06	0.25	7
Number of days per week looking for work	526	3.74	3	1.9	0	7

Table A6.30: Number of hours per day working or looking for work

Label	N	Mean	Median	Stand. deviation	Min	Max
Number of hours worked per day	4098	8.41	8	1.67	1	10
Number of hours per day looking for work	467	5.37	5	2.38	0	10

Table A6.31: During the past month, on average how long did it take household members to get to work each day, in minutes?

	N = 2793	
Average Time to Get to Work WITHOUT Flooding[1]	Mean; median 34.72; 30	Min; Max 0; 220
	N = 2183	
Average Time to Get to Work WITH Flooding	Mean, median 44.24; 40	Min; Max 0; 250

[1]For paired test, calculated with those having both without and with flooding: t value: -31.64; P< 0.0001

Household Drainage Survey: Illnesses and Associated Costs

Table A6.32: Activities missed due to illness*

Miss work	Yes: 72	No: 164	DK:† 424	Missing: 74
Number of days missed	Mean; Median 3.3; 2.0 (std dev: 4.8) Min; Max 1.0; 40.0			
Lose wages/earnings for the days off for illness?	Yes: 29	No: 33	DK: 7	Missing: 660
If yes, amount of wages lost per day	Mean; Median 881; 250 (std dev: 1,818) Min; Max 90; 5,000			
Miss school because sick?	Yes: 108	No: 139	DK: 380	Missing: 107
Number of school days missed	Mean; Median 2.4; 2.0 (std dev: 1.5) Min; Max 1.0; 9.0			
Have to skip household chores	Yes: 94	No: 205	DK: 279	Missing: 156
Number of days skipped household chores	Mean; Median 2.7; 2.0 (std dev: 2.0) Min; Max 1.0; 13	2.0	2.0	1.0, 13.0

Treatment **and treatment costs: All illness**

Did sick person get treatment?	Yes: 419	No: 295	DK:* 0	Missing: 20
Did your household spend money for this treatment?	Yes: 357	No: 215	DK: 1	Missing: 161
How much spent?	Mean; Median 40; 10 (std dev: 178) Min; Max 0; 3,000			
Did you spend money on transportation for this illness	Yes: 111	No: 449	DK: 0	Missing: 174
If yes, how much?	Mean; Median 32; 10 (std dev: 101) Min; Max 2; 1,000			

Time Use for all **types**

If clinic visited, how many times?	Mean; Median 1.4; 1.0 (std dev: 2.0) Min; Max 0; 30			
On average, how long did it take to see the doctor (minutes)	Mean; Median 77; 30 (std dev: 102) Min; Max 0; 600			
Did ill individual need to be hospitalized?	Yes: 10	No: 284	DK:* 0	Missing: 440
If hospitalized, how many days in hospital? (N=9)	Mean; Median 2.7; 2.0 Min; Max 1; 7			

Table A6.35: Anybody stay home from work or was anybody paid to take care of sick household member?

Category	N	%
Yes	113	19.6
No	463	80.4
Total	576	

Table A6.36: If yes, how many stayed home to take care of sick people?

Number of caretakers	Frequency	Percent
1	109	96
2	3	3
3	1	1

Table A6.37: Gender of Caretakers

Gender	Frequency	Percent
Male	9	10.11
Female	80	89.89

Table A6.38: Age of Caretakers

N	Mean	Median	Stand. deviation	Minimum	Maximum
80	31.46	30.50	8.40	19.00	66.00

Table A6.39: Details of caretakers

Does the caretaker live in the house?	Yes: 107	No: 11	DK:* 8 0	Missing: 1658
If yes, caretaker lives in house, how many days did they stay at home to take care ill individual?	Mean; Median 3.7; 3.0 (std dev: 3.9) Min; Max 0; 32			
Did caretakers lose wages for staying at home?	Yes: 14	No: 68	DK: 3	Missing: 1691
If yes, how much did they lose in total	Mean; Median 650; 200 (std dev: 883) Min; Max 20; 3,000			
If caretaker does NOT live in house, did they get paid?	Yes: 2	No: 9	DK: 0	Missing: 1173
How much were they paid for caregiving in total?	Min; Max 20; 200			

Water Collection

During this past week, where did you get your drinking water?

Source	N	%
Communal Tap/Water Kiosk	1026	32.7
Piped water inside house	970	30.9
Piped water outside house within stand/plot	620	19.7
Piped water from neighbor	303	9.6
Bottled water/Packaged water	126	4.0
Other (well, borehole, surface water, etc.)	96	3.1

In the past week, how many days was water available from this source?

N	Mean	Median	Stand. deviation	Min	Max
3111	6.8	7.0	0.9	0.0	7.0

Table A6.42: On average, how many hours per day was water available from this source?

N	Mean	Median	Stand. deviation	Min	Max
2952	15.8	18.0	8.5	0.0	24.0

Table A6.43: During the past week did you get drinking water from any other source?

Other source	N	%
Yes	496	15.8
No	2637	84.1
Don't know	4	0.1
Total	3137	

Table A6.44: What was/were the other water sources?

Source	N	Percent
Piped water from neighbor	118	38.1
Protected well/Borehole	67	21.6
Communal Tap/Water Kiosk	57	18.4
Piped water outside house within stand/plot	25	8.1
Piped water inside house	24	7.7
Unprotected well/Borehole	18	5.8
Surface water (stream/pond)	1	0.3
Total	310	100

Table A6.45: How much water does your household use in a typical day?

Water Use In a Typical Day	Mean	Median	Standard deviation	Min	Max
Bucket	103.5	70	202.6	4	4500
Container	63.3	40.0	259.1	1	8250
Drum	178.5	120.0	194.8	20	1000
Other	76.5	60.0	152.7	1	2000
Total	136.0	100.0	274.5	1	8250

Table A6.46: Households with piped water

Water Use In a Typical Day	N	Mean	Median	Standard deviation	Min	Max
Estimated Use (L)	117	607.2	100.0	1812.3	4.0	12000.0
Water Bill Reading (cubic meters consumed in last bill)	81	52.5	20.0	171.8	3.0	1366.0
Amount Paid (for monthly in Kwacha)	590	181.4	150.0	140.0	15.0	1200.0
Amount Paid (for biweekly in Kwacha)	33	140.8	135.0	69.0	30.0	350.0

Household Drainage Survey: Water Storage and Treatment

Table A6.47: Does the household collect water from a water kiosk or communal tap?

Water collected from a kiosk or communal tap?	N*	%
Yes	1066	33.9
No	2075	66.1
Total	3141	

*Missing= 1

Table A6.48: Do the kiosk operators treat the water?

Do kiosk operators treat the water?	N	%
Yes	551	17.5
Sometimes	55	1.8
No	259	8.2
Don't know	196	6.2
Don't collect from kiosk/missing	2081	66.2
Total	3142	

Table A6.49: What do the kiosk operators do to the water they collect?

What do kiosk operators do to the water they collect?	N	%
Pour bleach into water	575	18.3
Put a tablet into the water	1	0.03
Other	1	0.03
Don't know	15	0.5
Missing	2550	81.2
Total	3142	

Table A6.50: Do you normally treat or do something to your drinking water?

Do you normally treat your drinking water?	N	%
Yes	1282	40.8
No	1825	58.1
Not Applicable	26	0.8
Don't know	4	0.1
Missing	5	0.2
Total	3142	

Table A6.51: Did you treat or do something to your drinking water TODAY?

Treat drinking water today?	N	%
Yes	749	23.8
No	2349	74.8
Not Applicable	26	0.8
Don't know	15	0.5
Missing	3	0.1
Total	3142	

Table A6.52: What did you do to your water [to make it safer to use]?

How do you treat water?	N	%
Boil water	513	67.1
Bleach/chlorine	230	30.1
Filter water	19	2.5
Other	3	0.4
Total	765	100

Table A6.53: Please show me the boiling pot, tablet, filter, or other item that you used

Show boiling pot, tablet, filter, or other item used	N	%
Item present	642	90.4
Item not present	67	9.4
Total	710	

Table A6.54: Please show me the containers you mainly put your drinking water in inside your house

Container type	N	%
Plastic jerrycan/container with a screw top	1836	57.7
Buckets	1273	40.0
Unable to observe	48	1.5
Do not use container	17	0.5
Drum	9	0.3
Total	3183	100

Table A6.55: How many water storage containers are covered?

Water storage containers covered	N*	%
All	2521	82.4
Some	337	11.0
None	103	3.4
Unable to observe	99	3.2
Total	3060	

*Missing= 82

Table A6.56: How do you get water from this container to drink?

How do you get water from this container to drink?	N	%
Pouring	1816	57.2
Dipping (w/ladle, cup, or hand)	1268	39.9
Through a spigot or tap	81	2.6
Other	9	0.3
Total	3174	100

Household Drainage Survey: Sanitation Module

Table A6.57: What type of toilet facility does your house normally use?

Type of toilet facility	N	%
Flush toilet	1516	48.3
Pit latrine with slab	1250	39.8
Pit latrine without slab	267	8.5
Ventilated improved pit latrine (VIP)	62	2.0

Table A6.58: Where is the waste flushed to?

Waste flushed to	N	%
Piped sewer system	864	57.3
Septic tank	551	36.5
Other, Don't know	82	5.4
Latrine hole	10	0.7
Total	1508	100

Table A6.59: Is your toilet or latrine shared with other households?

	N*	%
Shared	1723	55.2
Just this household	1396	44.7
Don't know	1	0.03

*Missing =22

Table A6.60: How many households share it including your own?

N*	Mean	Median	Stand. deviation	Min	Max
1682	4.7	4.0	3.3	1.0	48.0

*39 households responded "Don't know". 2 missing.

Table A6.61: How many people share it?

N	Mean	Median	Stand. deviation	Min	Max
1105	14.8	14.0	7.8	2.0	65.0

*614 households responded "Don't know". 4 missing.

Table A6.62: Are there feces visible in the yard?

Feces in the yard?	N	%
Yes	184	5.9
No	2904	92.4
Not evaluable	29	0.9
Missing	25	0.8
Total	3142	100

Household Drainage Survey: Hygiene Module

Table A6.63: When do you usually WASH your hands? (check all that apply)

When do you WASH your hands?	N	%
After using toilet	2867	30.2
Before eating	2660	28.0
Before cooking/preparing baby food	1242	13.1
After handling trash	859	9.1
After working	763	8.0
Other	1097	11.6

Table A6.64: What do you usually WASH your hands with?

What do you usually WASH your hands with?	N*	%
Water and soap	2606	82.9
Water only	504	16.0
Water and something else	27	0.9

*Missing=5

Table A6.65: Please show me the soap you use

Variable	N*	%
Soap present	2303	88.6
Soap not present	280	10.8
Refused	16	0.6
Totals	2599	100

*Missing=54

Household Drainage Survey: Household Garbage Disposal

Table A6.66: What are the ways that you dispose of garbage? (choose all that apply)

Dispose of garbage	N	%
Garbage collected from house	2012	64.0
Drainage ditch	379	12.1
Bury/pit	350	11.1
Roadside dump	276	8.8
Garbage bay/council bins	107	3.4
Burn	92	2.9
Other	66	2.1
Don't know	13	0.4
Put in latrine/toilet	4	0.1
Refused	3	0.1

Table A6.67: Who collects your garbage?

Who collects garbage	N	%
Private company or community based enterprise	1072	53.3
LCC/the city	558	27.8
Hired individuals	297	14.8
Don't know	75	3.7
Other	8	0.4
Total	2010	100

Household Drainage Survey: Household expenditures on food and beverages

From the Table A6.68 (below), it can be seen that surveyed households spent a mean of approximately 1,572 ZMV per month (or 18,868/ year) on the listed food items. This is similar to the mean of 1,610 ZMV per month for non-food items (which includes rent), and more than the 1,039 ZMV/ mean monthly equivalent for education, and 233 KMV/ mean spent each month on healthcare (non-diarrhea). The detailed Tables below provide a breakdown of these data. One year equivalent calculated by simply multiplying the mean 7 day value by 52 weeks

Table A6.68: Household expenditures on food and beverages in last seven days (ZMW)*.

Items	N	7 day expenditure (ZMW)		Range (Week ZMW)		One Year Equivalent (Mean ZMW)**
		Mean***	SD	Min	Max	
Cereals/Grain	2,869	92	75	1.0	780	4,797
Meat & Egg/fish	2,719	124	162	1.0	2,480	6,465
Vegetables	2,908	56	41	0.5	490	2,898
Fruits	1,400	22	26	1.0	236	1,137
Sugar/salt/oil	2,189	52	84	1.0	3,000	2,711
Dairy products	1,725	38	40	1.0	465	1,951
Pulses/legumes	1,894	28	35	1.0	496	1,448
Beverages	2,157	52	127	0.5	2,716	2,725
Total	**3,142**	**363**	**328**	**0**	**4,825**	**18,868**

* Values rounded to nearest whole value. Values in Zambian Kwacha (ZMV).
**One year equivalent calculated by simply multiplying the mean 7 day value by 52 weeks.
***Data were collected per seven days. Missing values were not replaced by zero. Total mean expenditure is computed summing the expenditures of items for each HH. Due to missing values, the total mean food expenditures therefore doesn't sum up as total of means of the individual items

Table A6.69: Household expenditures (ZMW) on cereal and grain in last seven days

Cereal/Grain	N	Mean	Std. Dev.	Min	Max	One Year Equivalent (Mean $)
Mealie meal	1,246	73	27	2	324	3,782
Bread	2,621	45	33	-	287	2,380
Rice	859	43	47	2	550	2,257
Other (flour, maize, noodle)	531	36	53	1	450	1,893
Cereal and grains (total)	2,869	92	75	1	780	4,797

Meat and Eggs	N	Mean	Std. Dev.	Min	Max	One Year Equivalent (Mean $)
Kapenta	941	29	51	2	1,300	1,523
Non-Kapenta	1,275	55	63	3	700	2,853
Eggs	1,938	22	57	1	2,400	1,146
Poultry	1,367	73	87	0	700	3,817
Other (Beef, pork sausage)	1,607	61	85	3	960	3,154
Total	2,719	124	162	1	2,480	6,465

Table A6.71: Household expenditures (ZMW) on Vegetables in last seven days

Vegetables	N	Mean	Std. Dev.	Min	Max	One Year Equivalent (Mean ZMW)
Tomato	2,717	24	22	1	400	1,248
Onion	2,415	12	12	1	130	618
Green vegetable	2,641	24	19	1	250	1,272
Other vegetable	209	17	26	1	300	901
Total	2,908	56	41	1	490	2,898

Table 5. **Household expenditures (ZMW) on Fruits in last seven days**

Fruits	N	Mean	Std. Dev.	Min	Max	One Year Equivalent (Mean ZMW)
Amount (ZMW)	1400	22	26	1	236	1,137
Or Quantity (KG)	13	5	5	1	15	236

Table A6.73: Household expenditures (ZMW) on salt, sugar, spices in last seven days

Sugar, Salt, oil and Spices	N	Mean	Std. Dev.	Min	Max
Oil	1,734	39	80	-	3,000
Sugar	1,593	24	26	1.0	315
Salt	1,272	5	8	0.5	150
Others	100	23	27	1.0	110
Total	2,189	52	84	1.0	3,000

Table A6.74: Household expenditures (ZMW) on dairy products in last seven days

Dairy Products	N	Mean	Std. Dev.	Min	Max
Milk	1,352	28	31	0.5	354
Butter	604	20	18	1.0	300
Other	558	26	25	2.0	250
Total	1,725	38	40	1.0	465

Table 8**. Household expenditures (ZMW) on** Pulses/Legumes **in last seven days**

Pulses/Legumes	N	Mean	Std. Dev.	Min	Max
Dry beans	1,382	21.64	26.30	0.00	400
Ground nuts/Peanuts	931	16.59	26.01	1.00	490
Other	634	11.67	11.59	0.00	100
Total	1,894	27.85	35.10	1.00	496

Table 9. **Household expenditures (ZMW) on beverages past seven days**

Beverage	N	Mean	Std. Dev.	Min	Max
Tea and coffee	1,344	11.61	16.38	0.50	250

Soft drinks	1,451	28.93	53.49	1.00	1800
Alcohol	419	132.40	216.30	0.00	2100
Total (Drinks)	2,157	52.41	127.06	0.50	2716

Table A6.77: Household expenditures (ZMW) in non-food items in past month

Nonfood Items	N	Mean	SD	Range	
				Min	Max
Electricity	2,218	171	172	0.05	4,000
Rent/Mortgage	1,796	1003	1362	10	22,000
Cell phone	1,772	278	493	2	9,000
Public Transportation	1,557	254	350	2	5,140
Personal products	2,275	230	362	1	4,000
Hair braiding/care	1,981	130	247	0	5,000
Clothing	818	409	1179	0	30,000
Charcoal/firewood	2,515	111	214	2	10,000
Gas/petrol	599	895	1059	2	15,000
Cigarette/Tobacco	146	178	477	0.5	5,000
Non-food Total	3,121	1,610	2,051	15	32,092

Table 11. Household **healthcare expenditures (ZMW) in past month**

Item	N	Mean	SD	Min	Max
Medicine	1,054	89	245	0	4,000
Doctor	453	213	493	0	5,000
Other health care	106	233	784	1	6,000

Table A6.79: Has your household had any education related expenses in the past year?

Education Expenses	N	Percent	Cumulative Frequency
Yes	143	65.90	65.90
No	68	31.34	97.24
Refused/Don't know	6	2.30	100

Table A6.80: Household education expenditures (ZMW) in past year

Item	N	Mean	SD	Min	Max	Monthly Equivalent Mean ($)
Tuition	3142	4509	12141	0	382695	376
School fees	3142	3489	33145	0	1035440	291
Transportation (school)	3142	4000	64583	0	2752000	333

Uniform		3142	252	462	0	7000	21
Supplies		3142	127	451	0	11595	11
Other expenses	3142	93	518	0	11000	8	
Total School expenditures	3142	12,469	77,162	0	2,784,000	1,039	

Table A6.81: Goods and services owned and consumed by household

	Possession (%)		
	Yes	**No**	**N**
Durable goods			
Cell phone	95	5	3137
Radio	72	27	3137
Fridge	68	31	3137
TV	82	18	3137
Cooker	74	26	3137
Bicycle	18	82	3138
Car	71	29	3136
Sofa	78	21	3136
DVD	66	33	3137
Computer	32	66	3135
Tobacco, alcohol, beverages			
Tobacco use	6	92	3105
Alcohol	17	80	3117
Soft drinks	49	49	3128
Tea/coffee	46	53	3128
Nonfood goods			
Firewood/charcoal/	82	16	3134
Kerosene			
Public transport	57	26	2582
Electricity	72	25	2606
Hair braid	66	23	3128
Clothing	28	65	3130
Healthcare			
Doctor visit	16	83	3124
Medications	36	63	3122
Other health care	4	95	2636
Personal product	81	6	3121
Housing			
Rent/mortgage	58	40	3093

Appendix 7: Business Drainage Survey Descriptive Statistics

[NOTE: Methodology described in Appendix 9]

Table A7.1 Sampling frame and Sample- proposed vs actual vs interviewed

AREA	TOTAL No. OF BUSINESS	No. OF BUSINESS SAMPLED	Proposed	ACTUAL INTERVIEWED	PERCENTAGE
Kamwala Market Interior	1251	290	400	280	22%
Kamwala Market Exterior	664	100		60@	9%*
Along Bombay	551	275	200	247	45%*
Total	**2466**	**665**	**600**	**587**	**24%**

*Emphasis of sampling shifted to along Bombay drain to have more geographic area wise representation.
@ Businesses before replacement were visited and either refused or exhausted three visits on three different days at different times.

Table A7.2: Type of Business in and around Kamwala Market

Type of Business	No of Businesses	Percent
Wholesaler	178	30.32
Retailer	244	41.57
Manufacturing	4	0.68
Service Industry	86	14.65
Restaurant/Canteen	42	7.16
Both Wholesale and Retail	22	3.75
Other	11	1.87

Table A7.3: Number of businesses by type of product being sold

Type of Product	No of Businesses	Percent
Clothing/Fabrics	177	30.15
Shoes/sandals	57	9.71
Household Items	43	7.33
Services(e.g. repair, tailoring)	69	11.75
Restaurant/ Catering	48	8.18
Grocery and food items	50	8.52
Electrical Appliances and items	31	5.28
Hardware and other building materials	31	5.28
Cellphone and accessories	3	0.51
Other	78	13.29

Table A7.4: Number of workers employed in the business (including owner)

Number of workers	No of Businesses	Percent
1	117	20.07
2	144	24.70
3	147	25.21
4	78	13.38
5 and above	97	16.64

Table A7.5: Number of customers served per day during dry season (no-flood- May to Oct)

Number of Customers	No of Businesses	Percent
1 to 5	90	27.36
6 to 10	87	26.44
11 to 15	32	9.73
16 to 20	36	10.94
21 to 30	33	10.03

Table A7.6: Number of businesses by monthly income category before expenses, tax and other deductions

Business Income Range	No of Businesses	Percent
0 to 10,000 ZMW	263	57.55
10,001 to 20,000 ZMW	62	13.57
20,001 to 30,000 ZMW	37	8.10
30,001 to 40,000 ZMW	21	4.60
40,001 to 50,000 ZMW	24	5.25
50,001 to 75,000 ZMW	22	4.81
75,001 to 100,000 ZMW	18	3.94
> 100,000 ZMW	10	2.19

Table A7.7: Summary statistics of value (ZMW) of property destroyed due to flooding

Minimum	Lower Quartile	Mean	Median	Upper Quartile	Maximum	Standard deviation	N
10	300	5,675	1,000	4,000	10,0000	13,868	103

Table A7.8: Impact of floods on commute time to work

	Mean	Median	Range	Standard deviation	Number of Businesses
Number of workers late for work during flooding	2.11	2	0-16	1.52	285
Minutes late for work	77.08	60	0-480	62.31	266

Table A7.9: Type of Property Destroyed

Type of Property	No of Businesses	Percent
Building	8	5.06
Sales goods	117	74.05
Equipment	19	12.03
Raw materials	7	4.43
Vehicles	1	0.63
Others	6	3.80
Total	158	100

Table A7.10: Number of Goods Vehicles being loaded

	N	Vehicles loaded per day			
		Mean	Standard deviation	Minimum	Maximum
Without Floods	112	1.850696	5.791161	0.0027397	50
With Floods	70	0.717816	1.436858	0.0055556	7

Table A7.11: Number of Goods Vehicles being unloaded

	N	Mean	Standard deviation	Minimum	Maximum
Without Floods	377	0.444363	1.333154	0.00274	15
With Floods	287	0.251685	0.712443	0.00274	8

Table A7.12: Investments to protect against flooding in future

	Mean	Median	Range	Standard deviation	Number of Businesses
Total amount invested	4131	300	0-500000	38404	170

Table A7.13: Summary of Years Operating in Current Location

Minimum	Lower Quartile	Mean	Median	Upper Quartile	Maximum	Standard deviation	N
1.00	3.00	8.23	5.00	10.00	58.00	8.41	566

Table A7.14: Years of Operating in Current Location

Years in Business	Number*	Percent
1	55	9.72
2	57	10.07
3	73	12.90
4	55	9.72
5	46	8.13
6	28	4.95
7	28	4.95
8	33	5.83
9	18	3.18
10	40	7.07
11 and above	133	23.50

Table A7.15: Methods of paying for Property Damage due to floods

Method of paying for Property Damage	No	Yes	Total
Special reserve fund	585	2	587
Business Savings	571	16	587
Personal Savings	569	18	587
Cash flow	520	67	587
Emergency Bank Loan	583	4	587
Other Specify	547	40	587
Total	3375	147	3522

Table A7.16: Degree to which business owner perceives that other business were effected by flooding

	Number	Percent
Similar to mine	109	24.12
Worse to mine	282	62.39
Not as much as mine	50	11.06
Don't Know	11	2.43

Appendix 8: Traffic Study Descriptive Statistics

[NOTE: Methodology described in Appendix 9]

Traffic Flow Survey

To measure the impact of flooding on traffic flow, from 28 January to 26 April 2016, enumerating teams counted vehicles passing through previously identified intersections in downtown Lusaka. These intersection had been identified, with help from the Lusaka police, as most likely to be negatively impacted by flooding (i.e., slowed). The intersections monitored are shown in in Appendix 9 (Figure A9.1).

Table A8.1: Days counting traffic volume by type of intersection (Lusaka, 2016)

	Weekdays	Weekends	Total
Primary Intersections€€			
Cairo & Church	4.25	1	5.25
Sind & Chilimubulu	3	2	5.00
Kabwe Roundabout	4	4	8.00
Mukashi & Mukosa	4	1	5.00
Church & Dedan Kimathi	3.75	1	4.75
Kafue Roundabout	4.75	5.25	11.25
Secondary Intersections€€			
Lumumba Road and Ben Bella Road	5	2	7.00
Church Road and Dushambe Road	4	1	5.00
Makishi Road and Great East road	5	1	6.00
Lumumba Road and Mumbwa (M9)	4	0	4.00
Burma Road and Jacaranda Road	4	1	5.00
Lumumba Road and Kalambo Road	3	0	3.00
Independence Road and Burma Road	*	*	*
Bombay Road and Chongwe Road	3	0	3.00
Control Intersections			
Lumumba Road and Vubu Road	2	1	3.00
Lumumba Road and Great North Road	2	0	2.00

€€ Primary Intersections are were flooding is likely to occur and flood waters drain into Bombay Drain. Secondary Intersections are affected by the congestion that overflows from primary intersections, but they may not be necessarily flooded. Control Intersections may get flooded, but flood waters do not drain into Bombay Drain. See Appendix 9 , Figure A9.1 for map.
*Interrupted due to security issues. Replaced by Bombay road and Chongwe road

Table A8.2: Total traffic counts by category (15 minutes intervals, 6:30 am to 6:30 pm: Jan 28 – Mar 14, 2016)

Category	Total observed	Percent
Not categorized	8,060	9
Public transportation	36,556	39
Cars/taxis	36,348	39
Other (e.g., bicycles)	5,408	6
Pedestrians	7,020	8
Total	93,392	100

Travel Time

Table A8.3: Average travel time and fare charged in public transportation: Selected routes, Lusaka, Zambia, 2016.

Route Name **	Freq. per day (Round trips)	(Average Travel Time: Minutes)			Average Fare (ZMW)
		Outbound	Inbound	Round€	Round Trip*
Avondale	3	40.73	48.90	89.63	18.00
Chawama	35	17.41	21.47	38.88	17.41
Chelston	28	37.30	43.43	80.73	19.32
Chelston-Avondale	3	42.53	50.70	93.23	19.00
Chilenje	32	20.14	21.28	41.43	17.64
Chilulu/Garden	1	26.67	17.10	43.77	20.00
Chunga	1	29.98	31.85	61.83	20.00
Chawama-John Howard	1	18.53	21.45	39.98	
Chelston	1	43.88	50.68	94.57	22.00
Chilenje	4	14.47	15.97	30.44	20.00
Chunga-Chingwere	1	35.28	41.37	76.65	20.00
Garden	31	21.94	19.49	41.43	18.10
Garden Chilulu	4	24.11	18.90	43.01	18.00
Garden Compound	1	10.65	9.17	19.82	22.67
Garden/Ng'ombe	3	37.11	41.69	78.80	
Hospital	38	15.68	17.40	33.07	16.76
Hospital (UTH)	3	11.36	15.89	27.25	22.00
Kabulonga	21	29.76	30.87	60.63	20.25
Kabulonga Crossroads	2	27.38	36.05	63.43	24.00
Kabulonga Lake Road	3	28.92	57.70	86.62	20.00
Kalingalinga Mtendere	3	43.45	53.14	96.59	17.00
Kamwala South	18	21.21	19.62	40.83	16.57
Kamwala South-Yellow Shop	2	30.40	23.53	53.93	12.00
Kaunda Square	33	30.22	37.71	67.93	19.68
Kabulonga	4	26.42	44.52	70.94	21.00
Lilanda	21	28.85	29.15	58.01	18.00
Lilanda Matero	1	27.97	33.17	61.13	20.00
Master	5	59.50	.		
Matero	12	21.36	21.21	42.58	15.13
Matero Lilanda	8	24.73	28.83	53.56	18.00
Mtendere	32	33.86	36.03	69.90	18.48
Mtendere/ Kalingalinga	1	57.17	36.75	93.92	11.00
Mapuloti	1	45.32	28.07	73.38	0.00
Ng'ombe	29	39.23	39.15	78.38	19.96
Sos	4	40.31	25.74	66.05	
Woodlands	29	24.25	35.64	59.89	19.17
Woodlands-Burma	1	20.32	20.78	41.10	22.00
TOTAL	420	26.80	29.31	56.11	18.40

*Computed from one way fare. ** Few routes might be listed as different routes (different spelling) further analysis needed). € Round Trip costs are computed from average one way fares. Note: Outbound= Travel out of city center, Inbound= Returning to city cent

Table A8.4: Lusaka city public transportation routes and final bus stops (2016).

Route Name	Final Stop
Avondale	Chainda Market Twin Palm Mall Twin Palm
Chawama	Chawama Chawama
Chelston	Chelston Tina
Chelston-Avondale	Chainda
Chilenje	Chilenje Kangwa Shoprite (Chilenje)
Chilulu/Garden	Chestone Garden Police Chilenje Market
Chunga	Chipata Highland Island Ka Poster Kabanana Maplot Market (Main) Maplot Poster (Highland) Chipata-Maplot
Chawama-John Howard	Chilenje
Chelston	John Howard
Chilenje	Chunga
Chunga-Chingwere	Cockpit Garden Pama Sewer Police (Garden/Zambeef) Zambeef Garden
Garden	Garden
Garden Chilulu	Ng'ombe Market Tank
Garden Compound	Hospital
Garden/Ng'ombe	Hospital
Hospital	Cross-Roads Kabulonga **Kabulonga Crossroads**
Hospital (UTH)	Crossroads Kabulonga Crossroads

Route Name	Final Stop
Kabulonga	Crossroads
Kabulonga Crossroads	Mtendere Main Bus Stop
Kabulonga Lake Road	Asafam Kamwala South Kamwala S Police **s** Market (Kamwala South) Shalom Sharom/Hansa Farm Transformer Transformer Yellow Shop Kamwala South
Kalingalinga Mtendere	Last Station Yellow Shop Kamwala-South
Kamwala South	K. Square Kaunda Sq Market Kaunda Square Kaunda Square Bus Stop Kaunda Square Market Kaunda Square Market Kaunda Square Kaunda Square Market Main Bus Stop Kaunda Square Market
Kamwala South-Yellow Shop	Cross Roads Engen Crossroads
Kaunda Square	Market
Kabulonga	Lilanda Bus Stop Lilanda Bus Stop Lilanda Market Lilanda Oddys Lilanda Market
Lilanda	Lilanda
Lilanda Matero	Lilanda Cairo-Church Church/Cairo Engen Filling Station Town Church/Cairo
Master	Chunga/Matero

Route Name	Final Stop
Matero	Ng'ombe
Matero Lilanda	Mtendere
Mtendere	Mtendere
Mtendere/ Kalingalinga	Last Bus Stop Mtendere Last Bus Stop Mtendere Main Mtendere Market Mtendere
Mapuloti Ng'ombe	Kabanana Mapuloti Police Classical Clinic Clinic (Ng'ombe) Miracle Life New Ng'ombe Ng'ombe Ng'ombe Clinic Ng'ombe Clinic Ng'ombe Ng'ombe Clinic Ng'ombe Station Old Ng'ombe
SOS	S.O.S Sos Northrise Mall Sos Village
Woodlands	Container Container Last Bus Stop (Container) St Johns (Woodlands) Stadium-Woodlands Stadium Woodlands Woodlands Woodlands (Mosi-O-Tunya Road) Woodlands Container Woodlands Stadium Woodlands Container Woodlands Stadium
Woodlands-Burma	Mosi-O-Tunya

Appendix 9: Business and Traffic Drainage Baseline Reports

Appendix 9A: Traffic studies (vehicle counting and travel time) methodologies

Vehicle counting component: Survey teams: Thirty one enumerators to measure the impact of flooding on traffic flow were trained on Jan 26 to 27, 2016. They were grouped into 3 teams including supervisors. Two teams of 14 each (12 enumerators, 2 supervisors) were assigned to vehicle counts initially for 12 hour periods at all primary and secondary intersections. A separate team of 3 enumerators was assigned for pedestrians count at those intersections and were alternately rotated between the two main teams. Survey data has two major components: Vehicle Counts and Travel Time. The detailed methodologies used to record each component are given below.

Vehicle counting component: Dates of survey: Initially from Jan 28th to Mar 14th, 2016 both teams did only vehicle counts. From March 14th onwards only one team is involved in vehicle counts while another team measured the travel time in the city of Lusaka. Observations from all primary intersections were taken in multiple days (including weekdays and weekend days, excluding Church Road) with at least one observation/count day occurring on a holiday. Traffic passing through the secondary intersections were counted on weekdays. One secondary intersection has been replaced with another due to potential security threats from political unrests. *Appendix Table A8.3* lists the days counting traffic volume by type of intersection.

Vehicle counting component: Definition of intersections
Primary Intersections: These are intersections where traffic is primarily affected by Bombay Drainage System. In other words they are close to Bombay drain and are flooded (or has stagnating water) without the required improvements to Bombay drain. In these intersections the traffic congestions or slowdowns get diverted or detoured in the events of flooding.
Secondary Intersections: These are intersections which congested or affected due to congestion in primary intersections and they may not be necessarily flooded.
Control Intersections: These are intersections which are not affected by Bombay drain but may get flooded. The enumeration firm should be empowered to make operational decisions based on ground reality of when, where and severity of floods at intersections. The identified tentative list of proposed intersections to be studied are as follows (see attached map- sent as a separate file)

Vehicle counting component: List of Intersections: (See Appendix 9 for map of intersection locations)
Primary Intersections:

1) Sind Street and Chilimubulu Road: This intersection is near the Kamwala market. There is provision of street parking also.
2) Kaufe Roundabout: Independence Road and T2 (Cairo road) meet. Major roundabout and entry to business district. Floods affect one lane and vehicles avoid that lane leading to congestion.
3) Church Road and Dedan Kimathi Road: Intersection which has an entry to the LEVY mall. Flooding happens on at the start of the over bridge leading to Cairo road.
4) Kabue Roundabout: The other major intersection in Lusaka. This and Kaufe are the bookends for the Central Business district and is a busy intersection. Conflicting reports on whether its gets flooded or not and if so if Bombay drain will impact or not. ZESCO Drain is the one nearest to this intersection.

5) Cairo Road and Church Street: This can be a secondary intersection. Some people mention its gets flooded other do not. This intersection connects Kaufe Rounabout and Kabue Roundabout in the "middle" of Business district.
6) Mukishi Road and Mukosa Road: This is a T junction close to where Segment 4 and Segment 3 meet outflows into Bombay drain. This is a marginal community and flooding occurs. This intersection needs to be studied first because it will be impacted by CP 7 and 8. The contracts for CP 7 & 8 has been awarded and work will commence soon. It is imperative that we collect data as soon as possible at this intersection before work has started. This will also be testing ground for the team in terms of operational feasibility and lessons learned.

Secondary Intersections:

A. Lumumba Road and Ben Bella Road : Feeds into Kaufe rounabout.
B. Lumumba Road and Kalambo Road: Feeds into Kabue Roundabout
C. Lumumba Road and Mumbwa (M9) : From Kabue Roundabout
D. Independence Road and Burma Road : Feeds into Independence and Chilimubulu road
E. Church Road and Dushambe Road (or Makishi Road) feeds into Church road and Dedan Kimathi Road
F. Burma Road and Jacaranda Road: T junction. Some have mentioned this gets flooded. The L400 project work was ongoing when visited. The lanes are being expanded. Segment 2 is closest.
G. Makishi Road and Great East road

Control Intersections:

1) Lumumba Road and Vubu Road-
2) Lumumba Road and Great North Road
3) Soweto market

Vehicle counting component: Shifts and Time Periods:

Each observation day was divided into three shifts as follows

Shift 1: 06:30hrs to 10:30hrs
Shift 2: 10:30 hrs to 14:30 hrs
Shift 3: 14:30 hrs to 18:30 hrs

Each enumerator will be given two shifts to work in a day. They will get appropriate breaks during the two shifts.

Each shift is divided into 15 min intervals. The enumerators have to count for a duration of 10 mins in each interval. At a minimum this should add to 30 mins in an hour (or 7.5 mins in a 15 min interval).

Vehicle counting component: Counting procedure:

- The enumerator should fix a stationary object like light post/ tree/ bill board as the screening line and stand opposite that.
- The enumerator used the provided tally counter to keep count and not count vehicles mentally.
- The enumerators were given specific time periods to count the vehicle at the beginning of the day. They should only count during those time periods.
- The enumerators only counted vehicles that cross the screen line completely in the designated time period.
- The foreman independently counted vehicles and cross check with the log sheets.
- The enumerators recorded unusual activities like accidents, processions, VIP movements such as President's or vice President's motorcades etc., which might affect the traffic flow.

Vehicle counting component: Pedestrian Volume:
Pedestrian traffic was also be counted per 15 minute interval following the same protocols as for vehicles.

Travel Time Component: Due to procurement delays, the travel time component could not be started until March 14th, 2016, and focused solely on public transport. This evaluation measured the average travel time for vehicles and pedestrians along identified routes during periods of flooding and non-flooding. Routes were identified between selected intersections in Lusaka, and cut through areas that are affected by flooding. ***Appendix Table A8.3*** presents the routes measured for average travel time and fares charged.

Travel Time Component: Vehicle travel time over specified routes: Travel time was recorded by driving car on a round trip on each selected route. Round trips were completed during peak and non-peak times each day, on three different days. Drivers attempted to minimize time taken to cover the pre-set routes, but stayed within the posted speed limits and obeyed all relevant traffic laws. This will provide the time per unit distance per designated route.

Travel Time Component: Pedestrian travel time over specified routes: Travel time was recorded by enumerators walking pre-specified pedestrian routes. Pedestrian enumerators walked each route 3-5 times a day during peak and non-peak times, on three different days. Pedestrian enumerators walked with the intention to minimize time taken to cover the pre-set routes, but obeyed all relevant traffic laws (e.g., no jay-walking or crossing streets outside designated crossing points). This will provide the time per unit distance per designated route.

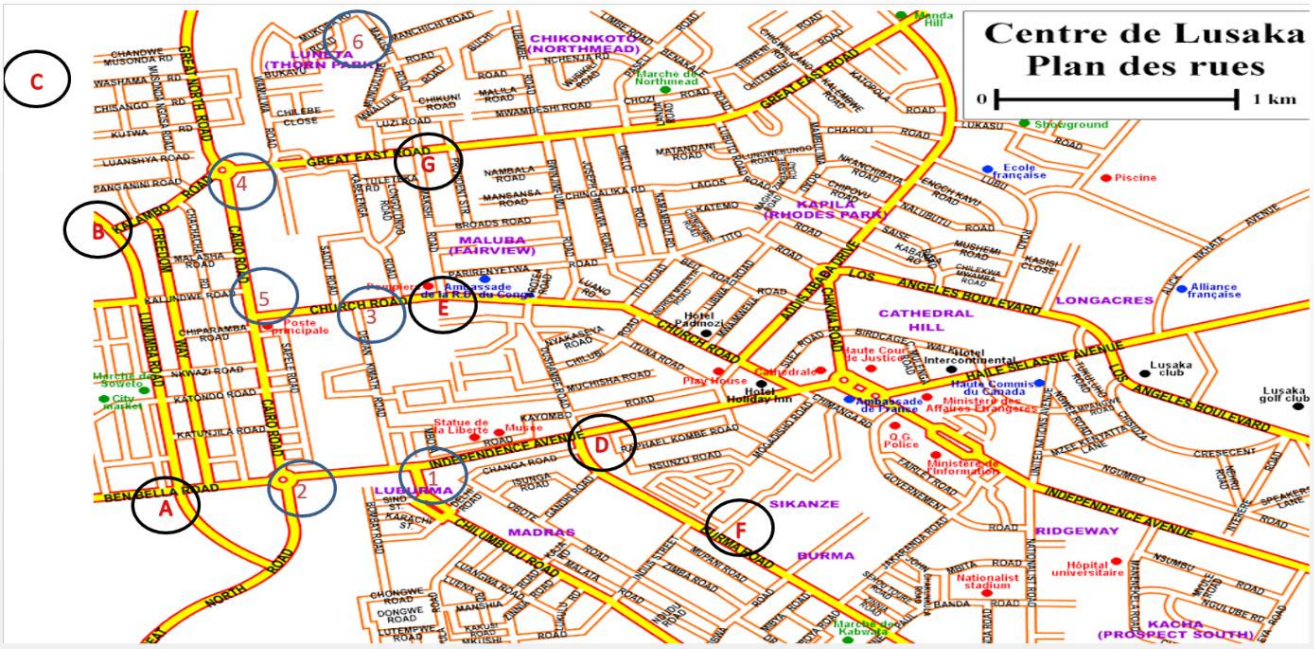


Figure A9.1: Intersections from where vehicle count data were collected

Note: Numbers inside the circle (4) are "primary intersections" and letters inside the circles (C) are "secondary intersection".

Appendix 9B: Business flooding impact study methodologies

[NOTE: Survey instrument is in Appendix 2]

Business flooding impact: Background: Improvements to the Bombay Drainage System are expected to decrease the frequency and duration of floods; thereby benefitting the businesses located along the drain by reducing flood-related repair and maintenance costs and minimizing flood related revenue losses. The drainage interventions also aimed to decrease employees' travel time.

Business flooding impact: Survey site: To evaluate the impact of flooding imperfectly controlled by existing drainage (particularly the Bombay Drain running alongside Kamwala Market - see Figures A9.2 and A9.3), a survey of businesses in a and around the Kamwala Market was conducted. No comparator business district (i.e., similar market, but not subject to seasonal flooding) was identified, and thus there was no control area.

Business flooding impact: Training of Enumerators:

The enumerators were trained from March 15th to 18th 2016. The training followed an interactive pedagogy and covered topics on introduction LWSSD project, CDC, ethics, sampling strategy and questionnaires. The training included mock interviews in English, Bemba and Nyanja and practical aspects with piloting of questionnaires in the field. For piloting, businesses located north of Independence road near Kamwala Market (not in sampling frame – Figure A9.3) was used. The questionnaire was modified and finalized based on feedback from piloting of surveys. Supervisor had the responsibility to allocate replacement businesses, coordinate with driver and report on problems encountered in filed but did not have any additional perks or incentives.

Business flooding impact: Survey Process and sampling strategy:

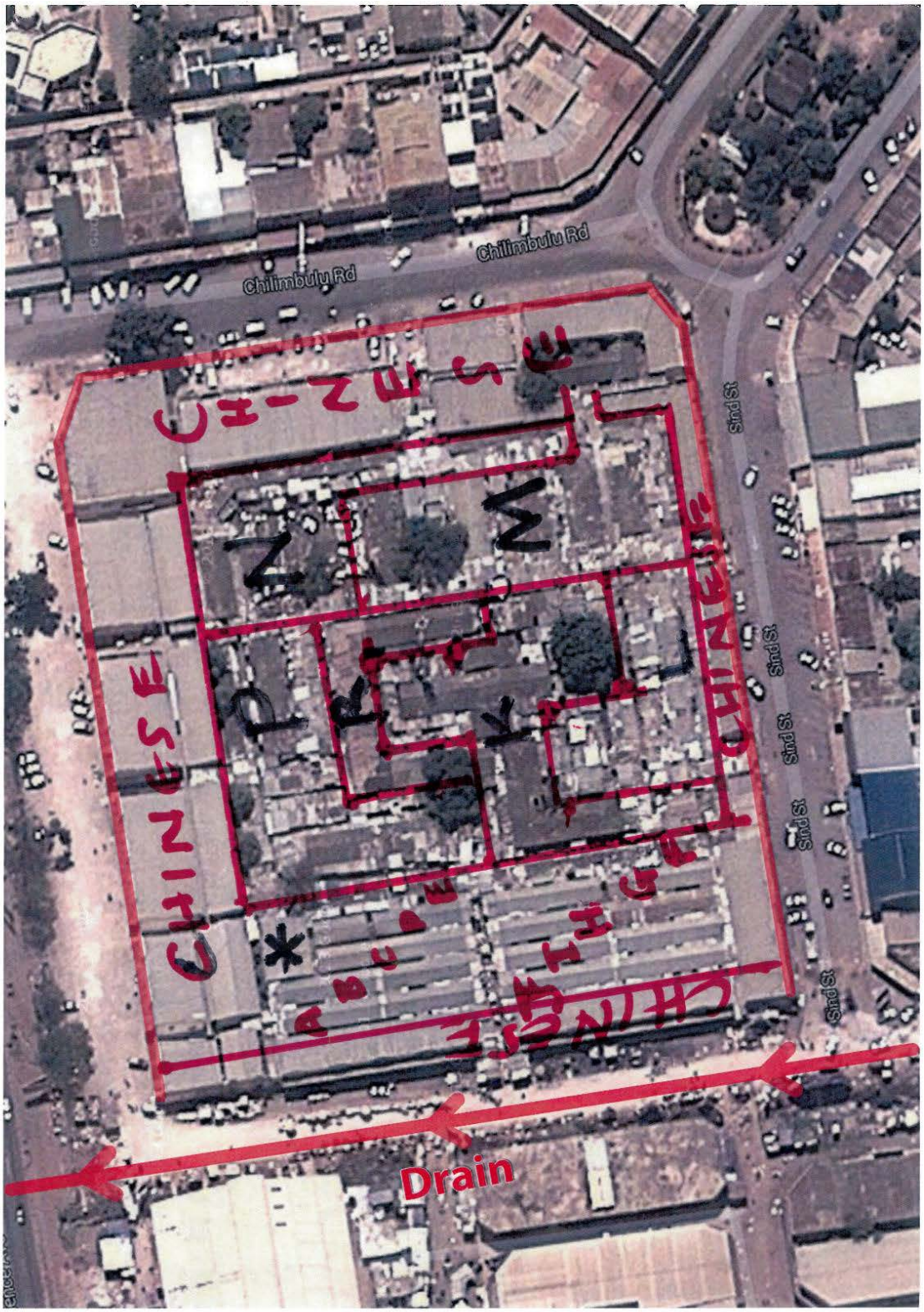
The survey was carried out from March 21st 2016 to April 15th 2016. A total of 587 businesses were surveyed in three distinct regions of Kamwala market. The following activities were carried out to accomplish this:

1) Business Community Sensitization: The business community was sensitized by
    a. Newspaper notices from communications department of MCA-Z
    b. Distribution of flyers to all the business/shops in the area
    c. Discussion and approval from Kamwala Market master, Market committee members and the Chinese Market Manager.
    d. One to one sensitization of business owners during the census/geocoding phase of the survey.
2) Geocoding/census of the Kamwala Market area: The market area was defined and divided into three general locales (See Figs 1 to 2)
    a. Kamwala Interior : Interior of Kamwala Market
    b. Kamwala Exterior: Exterior of Kamwala Market i.e. outer perimeter: shops facing outward from market.
    c. Along Bombay drain: Business along Bombay Rd and connecting roads, south of Independence Ave, and north of Chongwe Road.

3) The enumerators went to all the existing businesses and created a sampling frame. In Kamwala interior and exterior regions they used the shop numbers already given by Kamwala committee and Chinese Management Company. Detailed sketch maps of all the shops were done by hand and shop numbers marked. Along the Bombay road shops, the enumerators gave their own numbers and wrote the business name in the map. During this census, they also sensitized the owner/manager about the upcoming survey.
4) Simple Random sampling: The created sampling frame was transferred to Microsoft Excel (Microsoft Inc., Redwood, WA). A simple random sample of around 24% (9% to 45%) of enlisted businesses was drawn by CDC using MS Excel Table 1). Sufficient pool for replacement businesses were also sampled in case of refusal and other circumstances. Since Kamwala Interior and Exterior were in close proximity and the number of businesses along Bombay drain were scattered over a larger area, the sampling strategy was shifted to draw more business from the larger area. In addition the proportion varied due to the fact that the numbers proposed in the EDR were based on incomplete sampling frame and we wanted each block, shopping complex and market represented.
5) Sampling: Planned versus actual - see Table A7.5
6) Data collection: The enumerators used printed questionnaires to collect data from respondents (business owners /co-owner) after administering informed consent. The completed questionnaires were kept in a secure location on MCA-Z office premises with access restricted to CDC and CDC authorized personnel.
7) Data entry: The data entered in a REDCAP database were stored on a secure server located at CDC Atlanta. The access is restricted to authorized personnel only. The enumerators double entered the data into redcap from April 18th 2016 to April 30th 2016. The double entry was cross validated and checked for errors and mismatches using SAS 9.4 (SAS, Cary ,NC). All the errors were resolved by using the completed hard copy of the questionnaire has gold standard.

Figure A9.2: Kamwala Market: Interior and perimeter: Distribution of stalls by types (block numbers)

Kamwala Market



Note: * = Market Master's office

Figure A9.3; Aerial view of Bombay Rd, Kamwala Market and surrounding roads. The Bombay Drain runs, in this area, along the Bombay Rd. (Source: Google maps)

Appendix 10: Water and Sanitation Household Survey

These analyses refer to the large-scale household-level survey, approximately 12,500 households (c.f., Section 4, main text).

Water and Sanitation Household Survey: Key Indicators- Intervention vs. Control

Table A10.1: Key indicators for the Lusaka Water Supply, Sanitation, and Drainage (LWSSD) project Water, Sanitation, and Hygiene survey Lusaka, Zambia (October 2016 – October 2017)

	Proportion/Mean at Baseline			
Key Indicator	**Control households (n=6229)***	**Intervention households (n=6283)***	**p-value**	**Overall households (n=12,512)***
Access to improved water supply†	92.2%	74.7%	<0.0001	83.5%
Access to piped water supply in house or yard	26.9%	30.4%	<0.0001	28.6%
Time spent gathering water (hours/week)	5.9	6.4	<0.001	6.2
Residential water consumption (liters/day/HH)	111.8	115.6	0.04	113.7
Prevalence of diarrhea <5 (7-day recall)	7.6%	8.5%	0.2	8.0%
Prevalence of respiratory Illness <5 (7-day recall)	10.1%	9.8%	0.7	9.9%
% of respondents washing hands with soap	60.5%	60.9%	0.6	60.7%
Access to improved sanitation‡	92.1%	91.3%	0.07	91.7%
Access to flush toilet sewerage	1.6%	0.6%	0	1.1%
% of household water§ samples with FCR <0.2 mg/L¶	88.8%	88.4%	0.8	88.6%
% household water§ samples positive for *E. coli*#	78.3%	73.4%	0.0004	75.8%
% household water§ samples with nitrates ≥50 mg/L**	64.5%	48.4%	<0.0001	56.5%
Adult employment status	60.1%	59.9%	0.06	60.0%
Average household expenditure (annualized) (ZMW)	31,277	32,768	<0.0001	32,000

*% may not add to 100% due to rounding.

†Improved Water Supply: communal tap, protected well, piped water inside the house, piped water outside the house within stand/plot, piped water from neighbor, piped water from another compound, kiosk from another compound.

‡Improved Sanitation: pit latrine with slab, ventilated pit latrine, and flush toilet.

§Household water was calculated as any household where stored or point-of-consumption (POC) water was tested; for households in which both stored and POC were tested, the "worst" value of the two was used (i.e., highest *E. coli* result, highest total coliforms result, highest nitrates result, highest turbidity result, lowest FCR result).

¶WHO recommendation for minimum target FCR at distribution system point of delivery: 0.2 mg/L; 1914 control households and 1903 intervention households tested

#WHO guideline for drinking water: no *E. coli* in 100 mL sample; 1896 control households and 1873 intervention households tested

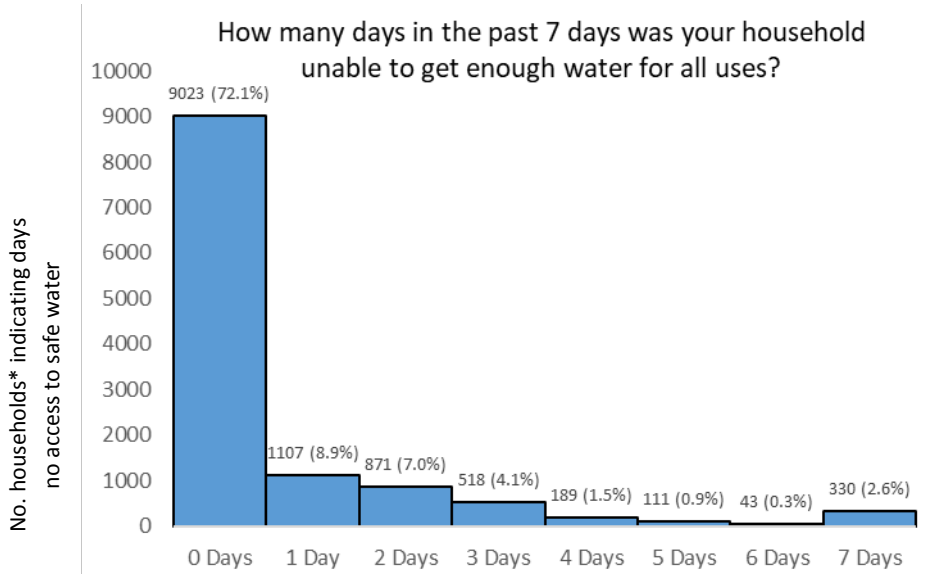
**WHO recommendation for nitrates in drinking water: less than 50 mg/L; 1889 control households and 1886 intervention households tested

FCR: free chlorine residual; HH: household; mg/L: milligrams per liter; ZMW: Zambia kwacha

Table 10.A2: Key Indicator Differences: Explanation and decision to include or exclude

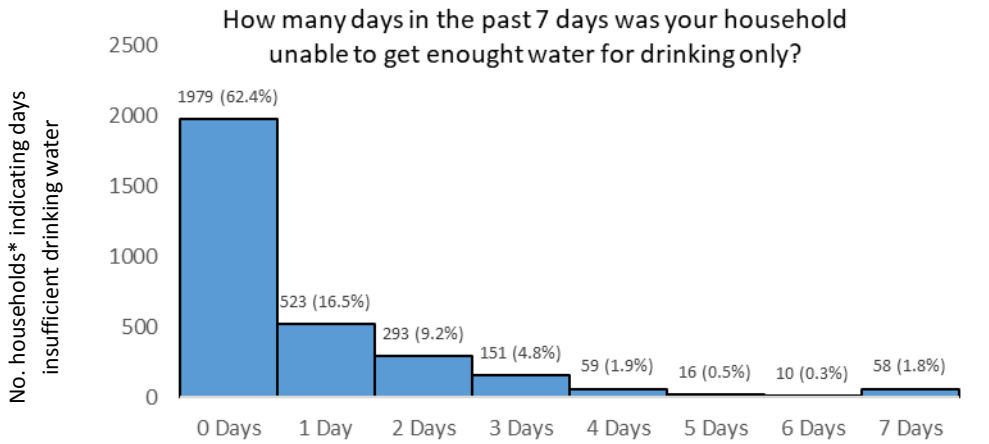
Key Indicator	Significant Difference?	Steps Taken to Examine Difference	Conclusion
Time spent gathering water	Yes	Examined all PUAs. No patterns identified.	Do not drop any PUAs
Access to improved water supply	Yes	Almost half of the control areas have close to 100% coverage. No one PUA is driving the difference. Would have to drop half of controls to not see a difference. Mtendere East and Ng'ombe are driving the lower percentage for intervention areas	Do not drop any PUAs. Leave as is. This is why the intervention areas are being targeted for intervention
Access to piped water supply in house or yard	Yes	Difference is being driven by Misisi and Chaisa on the control side. If you drop the p-value goes to 0.036.	Do not drop any PUAs. This is only a 3% difference. Most likely significant because of large sample size.
Average HH Expenditure (annualized)	Yes	Conclusion: Households in the intervention group tend to spend more than their counterparts in the control group (based on the non-parametric test). This is NOT driven by a certain township or PUA	Do not drop any PUAs

Figure A10.1a: Unable to access safe water in past 7 days



*Missing= 320

Figure A10.1b: Unable to access sufficient drink water in past 7 days



*Missing= 85

Figure A10.2: Percentage of Survey Household Accessing Safe Water Sources by PUA

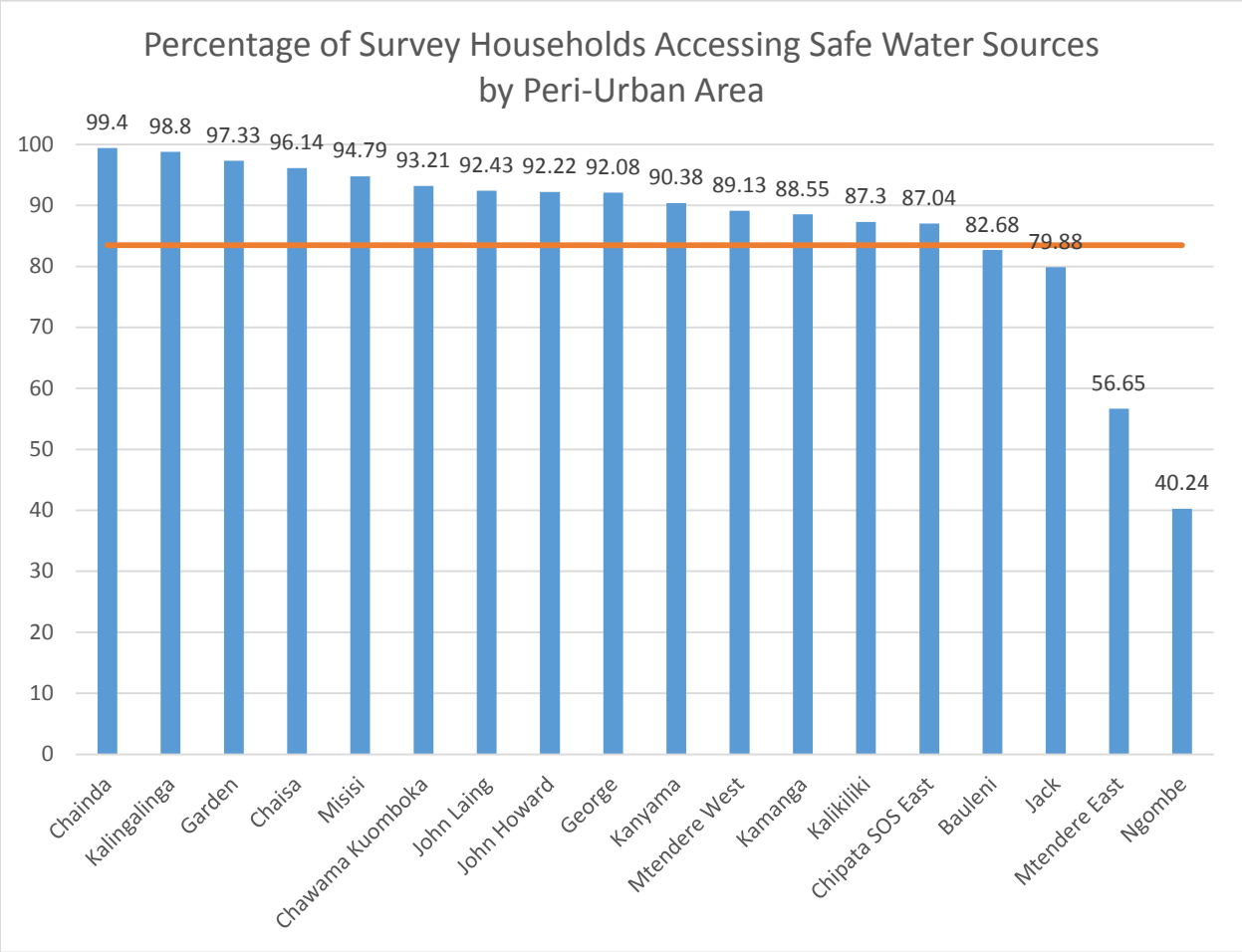
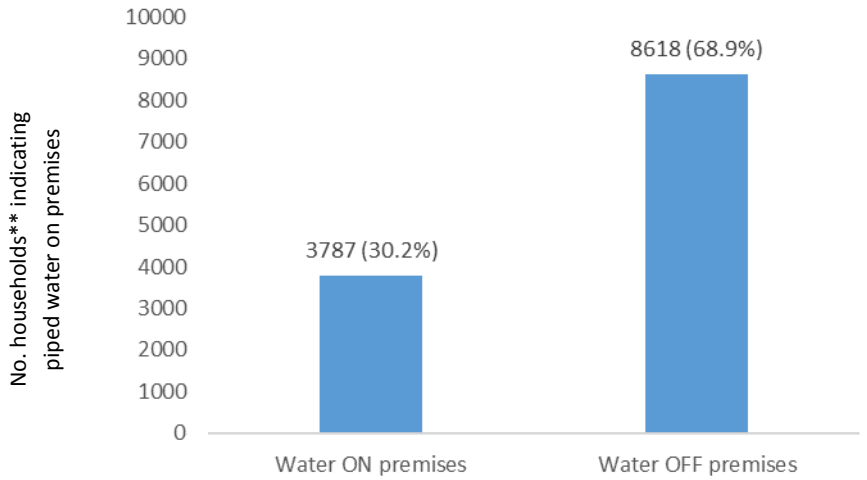
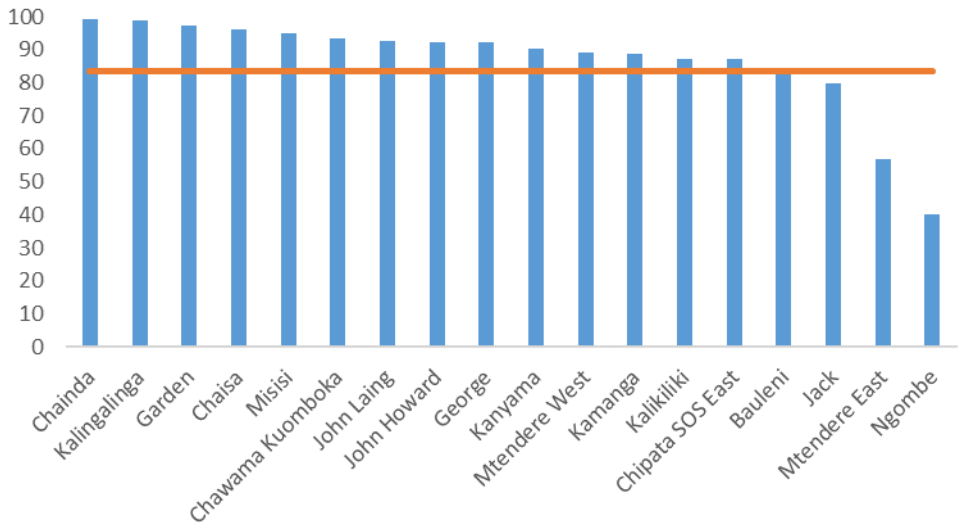


Figure A10.3: Households with water on premises versus water off premises*



*On premises= Piped water inside house, piped water outside house within stand/plot, bottled water. Off premises= Communal tap/Water kiosk, protected well, unprotected well, private borehole, piped water from neighbor, surface water (stream/pond), piped water from another compound, kiosk from another compound.
**Missing= 109

Figure A10.4: Percentage of Survey Households Accessing Safe Water Sources by Area



** In Mtendere East, there is a lower level of existing water supply infrastructure while in Mtendere West approximately 70% of households already have water connections (LWSC personal communication, 2014).

Figure A10.5: Percentage of Survey Households with Access to Piped Water Supply

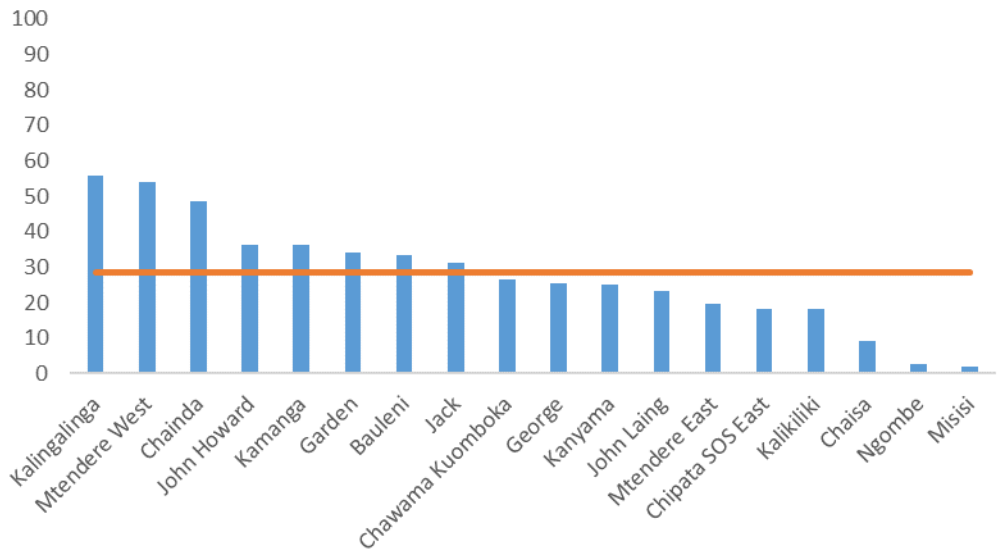
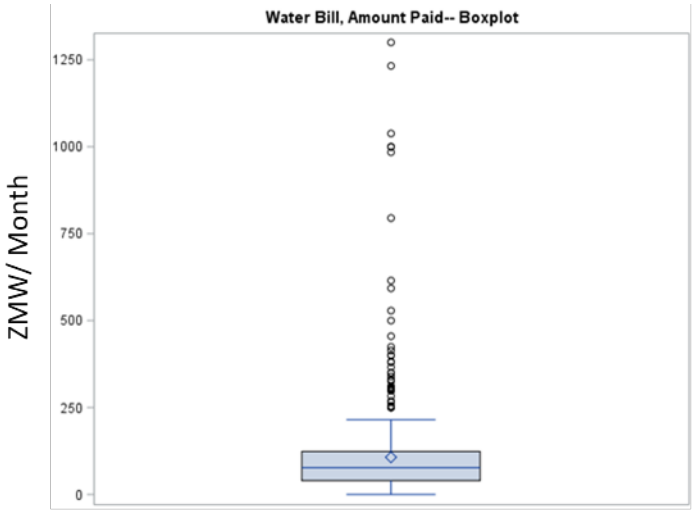


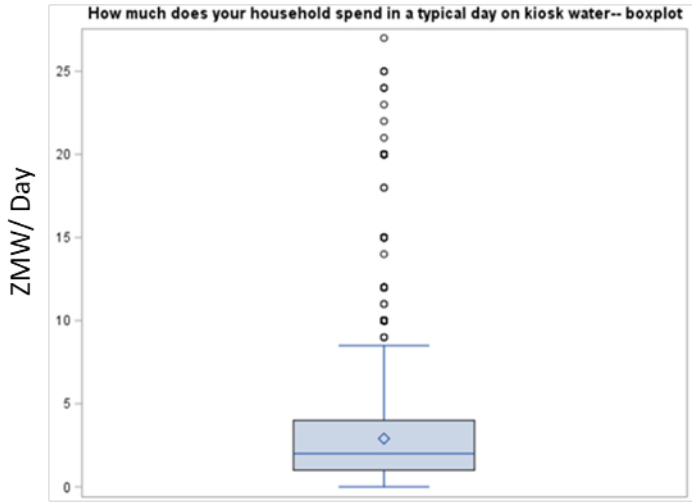
Figure A10.6: Amount paid for water by type of access to water

A: Amount paid if have piped water (ZMW/month)



*In ZMW. N= 572

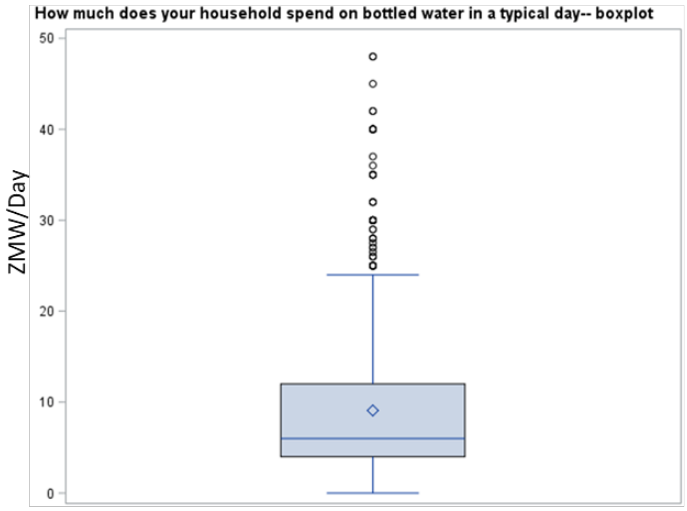
B: Amount paid if collect water from kiosk (ZMW/day)



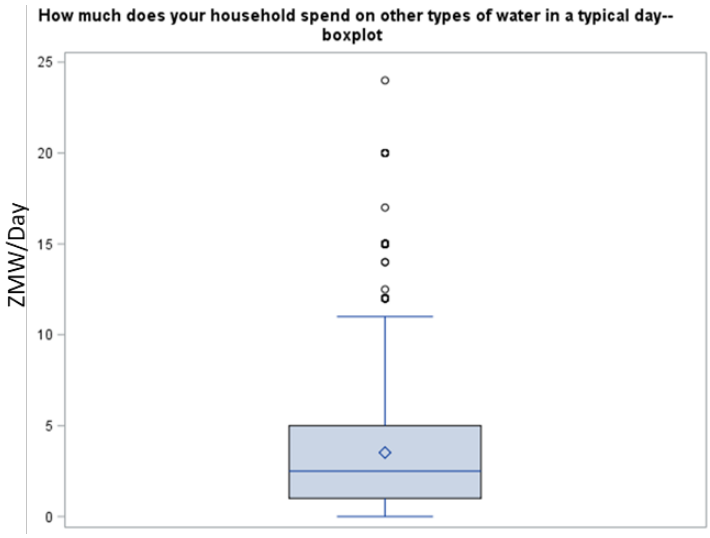
*In ZMW. N= 4804

Figure A10.7: Amount paid for bottled and other types of water*

A: Amount paid for bottled water (ZMW/day)

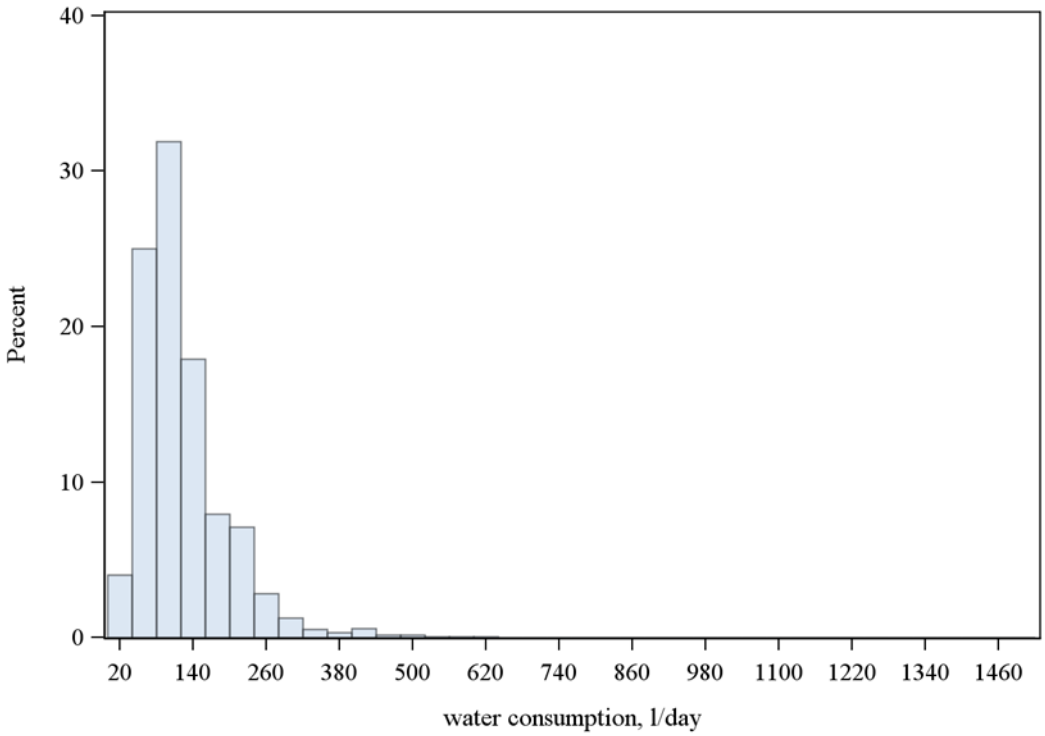


B: Amount paid for other types of water (ZMW/day)



* Other types of water include water from a private borehole, piped water from neighbor, and piped water from another compound.

Figure A10.8: Distribution of household daily water consumption



Water and Sanitation Household Survey: Household expenditures

Table A10.2: Household-level expenditures by category: Control versus intervention areas

		N	Mean	Median	Annualized mean	Difference between Intervention to Control
On the last 7 days, How much was spent (ZMW) to purchase the following food items?						
Food items	Control	6,194	281.85	234	14,697	
	Intervention	6,243	290.25	234	15,134	3%
	All	12,437	286.07	234	14,916	
During the past month, how much was spent (ZMW) for the following non-food items?						
Non-food items	Control	6,204	1,114.50	780	13,374	
	Intervention	6,258	1,169.32	846	14,032	5%
	All	12,462	1,142.03	814.5	13,704	
During the past month, how much was spent (ZMW) for the following healthcare items?						
Healthcare	Control	2,114	118.30	25	1,420	
	Intervention	2,004	126.22	30	1,515	7%
	All	4,118	122.15	30	1,466	
During the past two years, how much did you spend (ZMW) on the following durable goods?						
Durable goods	Control	4,571	3,276.63	1150	1,638	
	Intervention	4,694	3,452.16	1150	1,726	5%
	All	9,265	3,365.56	1150	1,683	
During 2016 academic year, how much was spent (ZMW) on education?8						
School fees	Control	3,067	2,645.87	1395	2,646	
	Intervention	3,063	3,235.86	1650	3,236	22%
	All	6,130	2,940.67	1500	2,941	
Tuition	Control	1,108	318.35	150	318	
	Intervention	1,150	432.64	210	433	36%
	All	2,258	376.55	180	377	
Uniform/shoes	Control	2,987	336.72	245	337	
	Intervention	2,985	350.70	245	351	4%
	All	5,972	343.71	245	344	
School supplies	Control	3,347	154.65	87	155	
	Intervention	3,371	179.28	100	179	16%
	All	6,718	167.01	90	167	
PTA fees	Control	452	119.59	60	120	
	Intervention	412	114.99	60	115	-4%
	All	864	117.40	60	117	

Other school expenditure	Control	638	198.60	60	199	
	Intervention	704	208.17	75	208	5%
	All	1,342	203.62	70	204	
Pocket money	Control	2,612	20.33	5	5,529	
	Intervention	2,327	25.43	5	6,916	25%
	All	4,939	22.73	5	6,183	
Transportation	Control	758	55.05	10	14,974	
	Intervention	843	44.17	10	12,014	-20%
	All	1,601	49.32	10	13,415	

* Note that some of the responses regarding education-related expenses may not be reliable. See Appendix 5 Figure A5.3.1 and Table A5.3

Table A10.3: Annualized (mean) household-level expenditures by category: Control versus intervention areas*†

	All	Control	Intervention
Food items	14,916	14,697	15,134
Non-food items	13,704	13,374	14,032
Healthcare	1,466	1,420	1,515
Durable goods	1,683	1,638	1,726
School fees	2,941	2,646	3,236
Tuition	377	318	433
Uniform/shoes	344	337	351
School supplies	167	155	179
PTA fees	117	120	115
Other schooling expenditure	204	199	208
Pocket money	6,183	5,529	6,916
Transportation	13,415	14,974	12,014

* One year equivalent calculated by simply multiplying the mean 7 day value by 52 weeks.

† Note: Amounts reported for “pocket money” and “transportation” are suspected to be incorrect (see Appendix 5, Figure A5.3.1 and Tables A5.3b).

Figure A10.10: Distribution of household ownership of durable goods by type

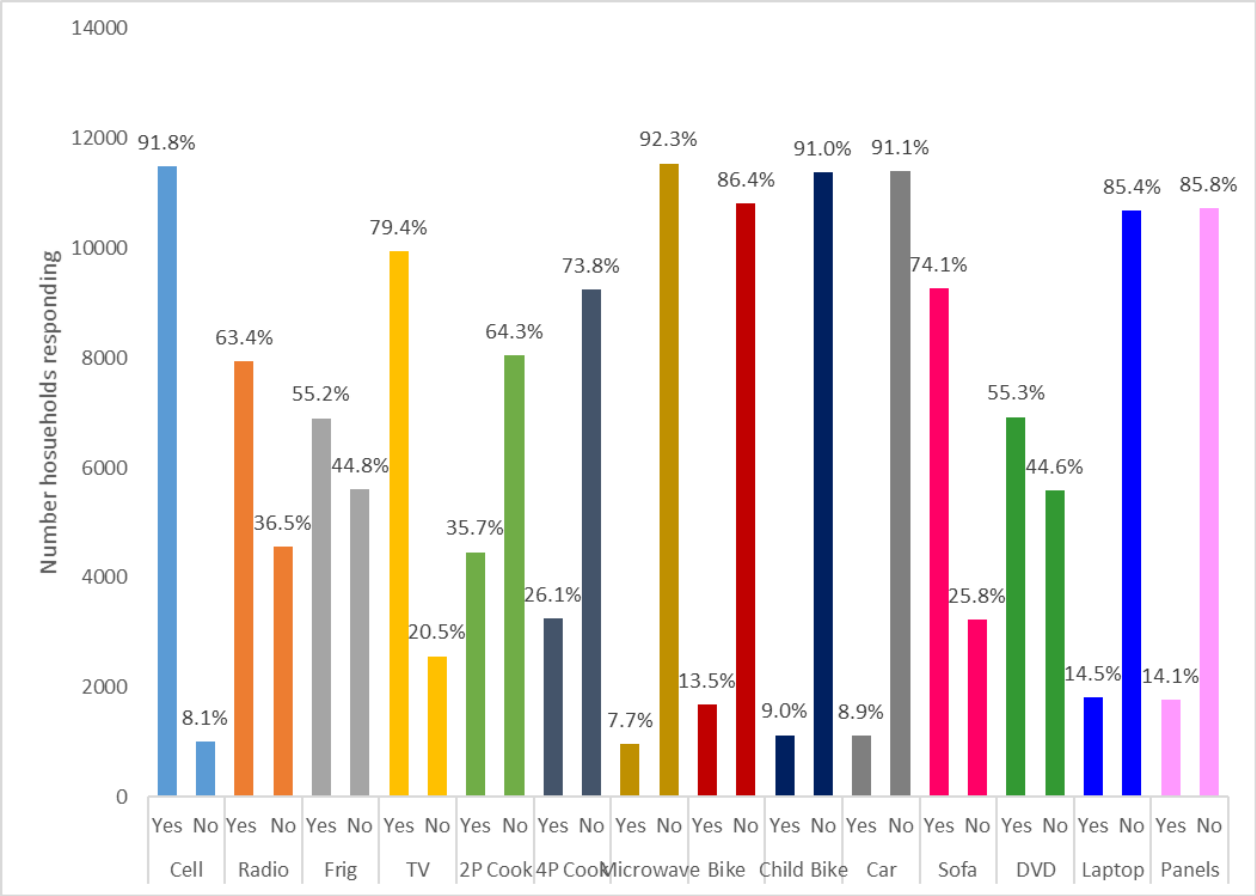
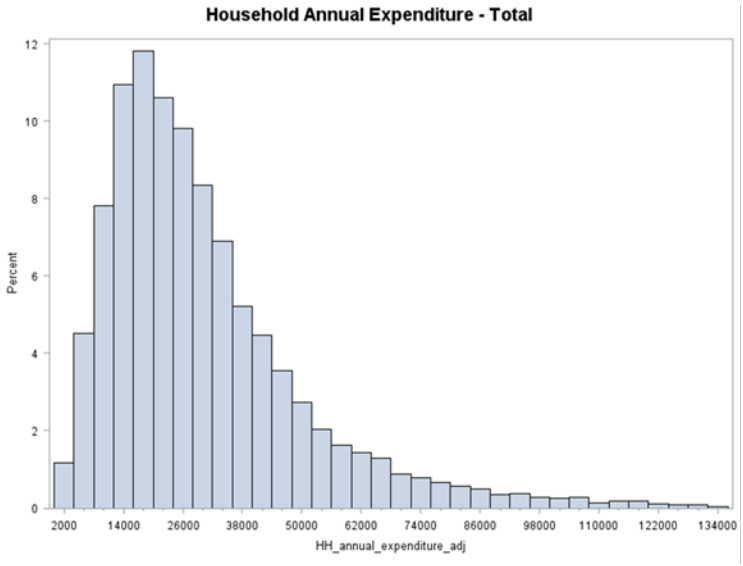
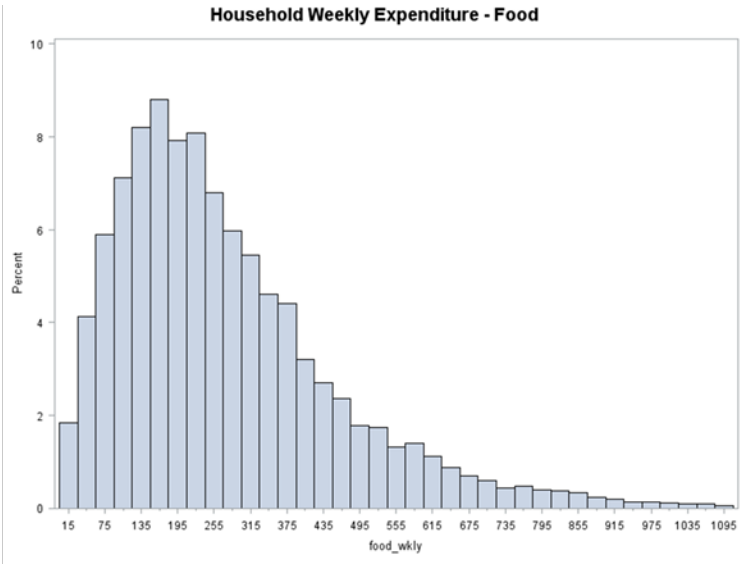


Figure A10.11: Distribution of household expenditures: Total annual and weekly food

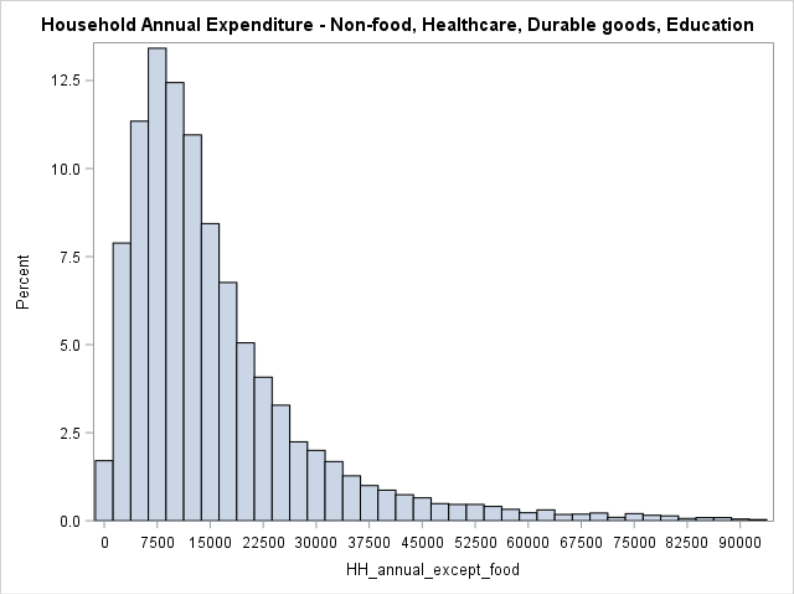


The mean annual total household expenditure (all) was 32,026 ZMW and a median of 25,494 ZMW



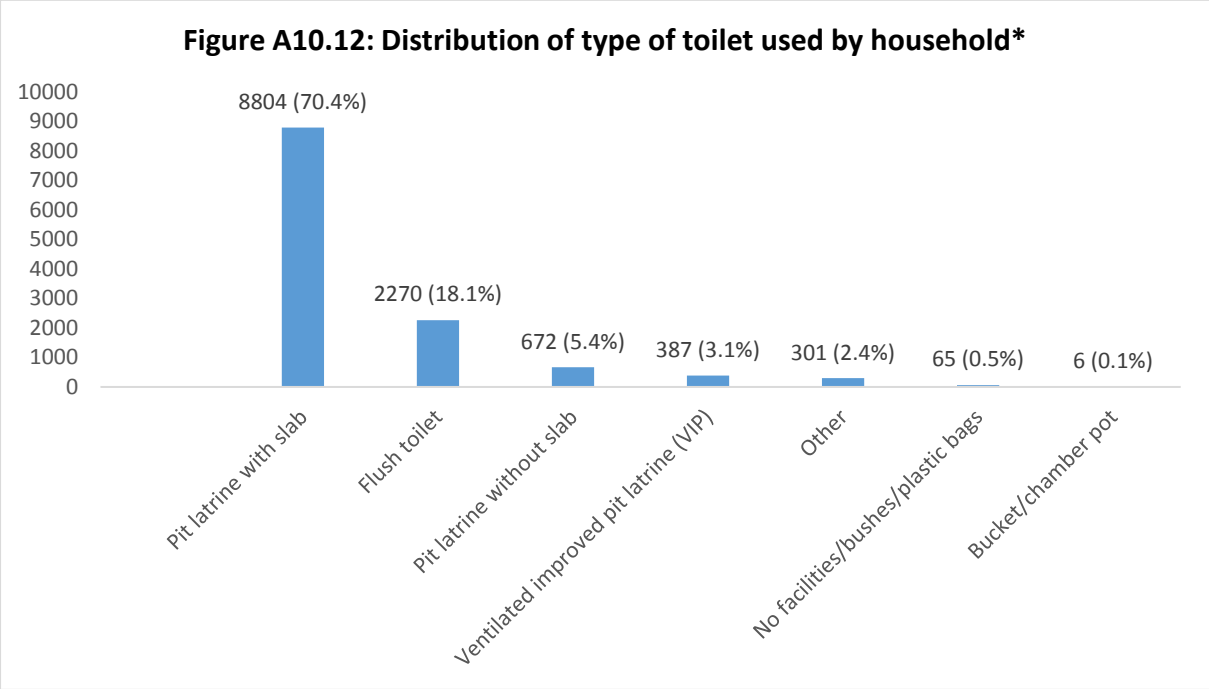
The household weekly expenditure on food had a mean of 286 ZMW and a median of 234 ZMW

Figure A10.11: Distribution of total annual household expenditure on non-food items, healthcare expenses, durable goods and education

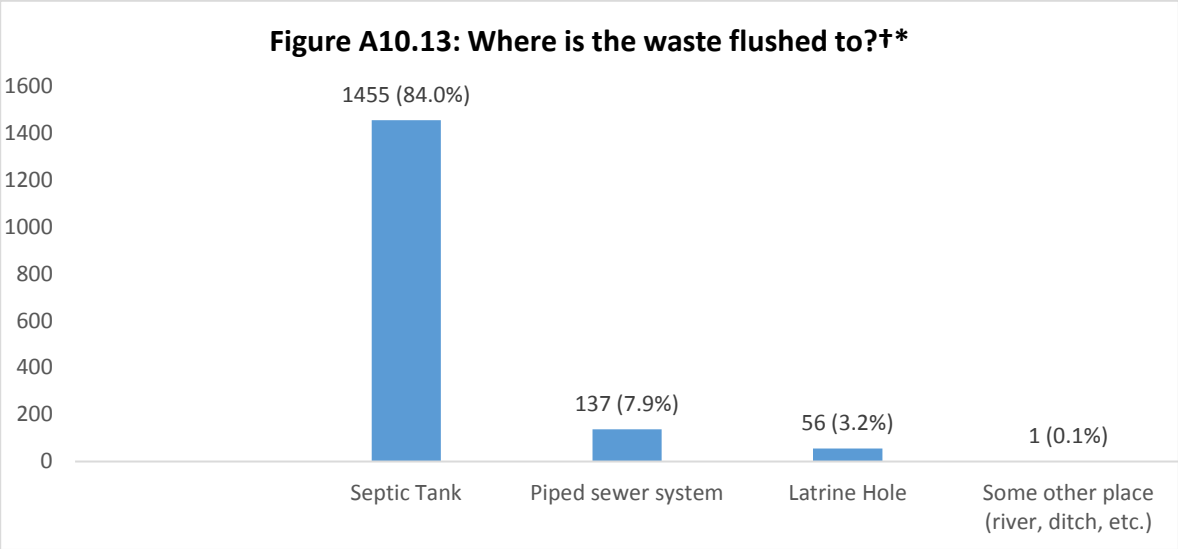


Total annual household expenditure on non-food items, healthcare expenses, durable goods and education had a mean of 17,223 ZMW and median of 12,028 ZMW

Water and Sanitation Household Survey: Sanitation



*Missing= 7



†For flush toilets only

*Missing= 81

Table A10.4: Sharing of toilet or latrine

Is your toilet or latrine shared or just for this household?	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Just this household	2121	17.05	2121	17.05
Shared	10300	82.79	12421	99.84
Refused	7	0.06	12428	99.90
Don't know	13	0.10	12441	100.00
Missing = 73				

Figure A10.14: Cost of self-built latrine (box-plot) (n=173)

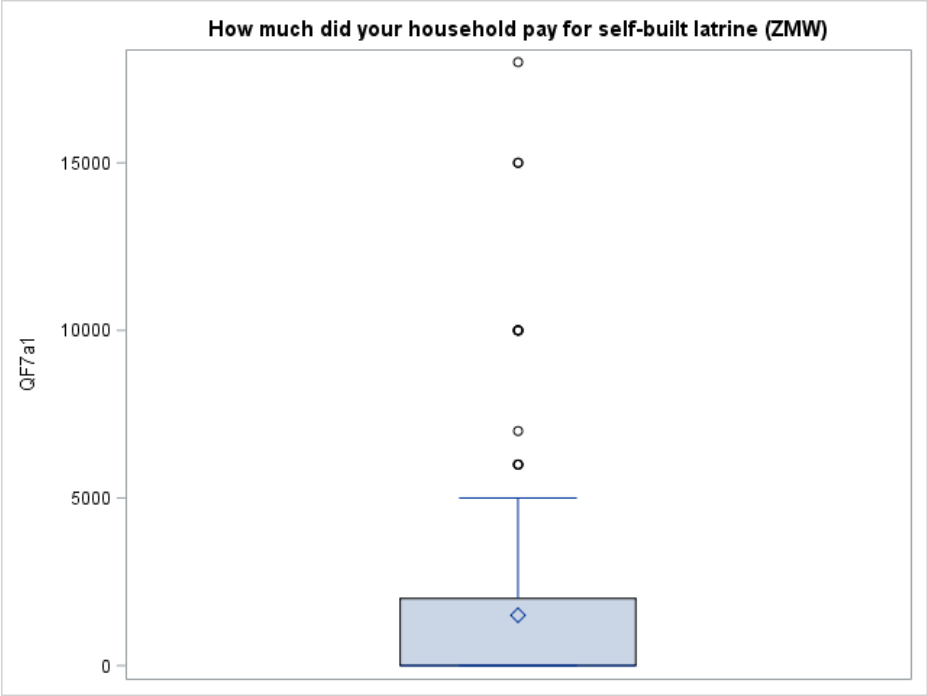
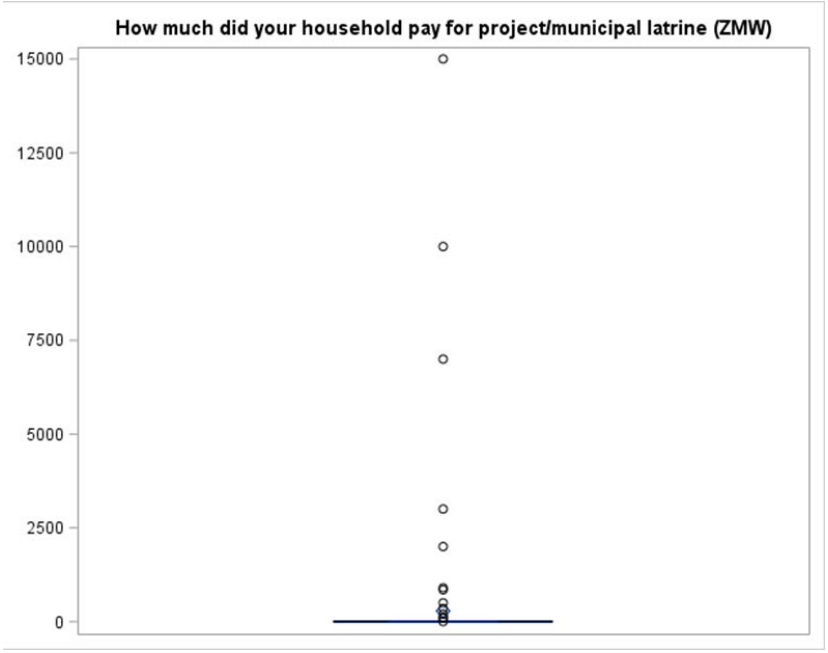


Figure A10.15: Cost of project/ municipal built latrine (box-plot)*



*N= 140. Note: 127 of the 140 paid 0 ZMW.

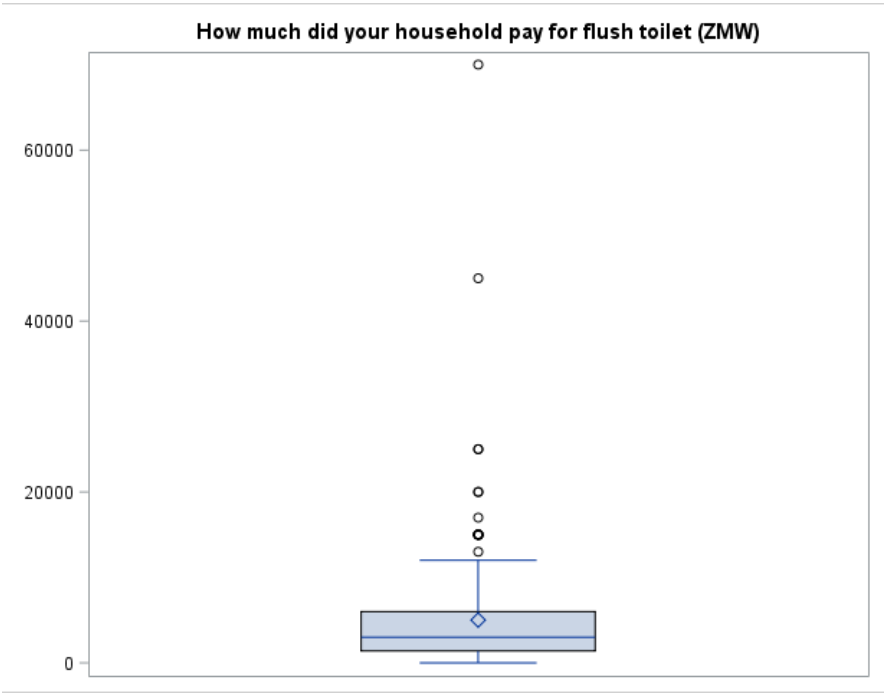



Figure A10.16: Cost of flush toilet (box-plot) (N = 231)