WATER SUPPLY AND SANITATION INFRASTRUCTURE IMPROVEMENT PROGRAM

(GY-L1040 – GY-X1003)

SOCIO-ECONOMIC ANNEX

INDEX

LIST OF ACRONYMS

ABM	Averting Behaviour Method
CBA	Cost-Benefit Analysis
CVM	Contingent Valuation Method
ENPV	Economic Net Present Value
ERR	Economic Rate of Return
GWI	Guyana Water Incorporated
O&M	Operating & Maintenance
NRW	Non-Revenue Water
SCF	Standard Conversion Factor
TP	Treatment Plant
WHO	World Health Organization
WTP	Willingness to Pay

1. INTRODUCTION

The general objective of the Program is to improve efficiency, quality and sustainability of the potable water services and improve sanitation infrastructure in Georgetown and other areas along the coast. The specific objectives are to: (i) improve pressure, quality and continuity of the water supply service in Georgetown, Cornelia Ida-De Kinderin; Diamond-Herstelling and Good Banana Land-Sheet Anchor-No.19; (ii) reduce the level of Non-Revenue Water (NRW) in the program areas, especially in Georgetown; (iii) improve access to sanitation for low-income households in the program areas; and (iv) strengthen Georgetown Water Incorporated (GWI) performance in its operational and management practices. To attain its objectives, the program is comprised of three components: 1) Construction, rehabilitation and expansion of water treatment plants; this component will finance the final designs and works required to improve the supply system and the water quality in the program areas, creating additional treatment capacity; 2) NRW Program; complementing component 1, this component will finance activities to reduce the NRW level in the program areas; 3) Institutional strengthening; this component will address the need to strengthen GWI capacity to manage the new infrastructure and move towards operational and managerial international standards; and 4) Improved access to sanitation; complementing the efforts made through the 2102/BL-GY, this component will finance the conversion of obsolete pit latrines into efficient septic tank units.

This Annex presents the Cost-Benefit Analysis (CBA) for the two main infrastructure components of the program, the optimization of the water system (component 1), and the NRW program (component 2), and the institutional strengthening of GWI, considered necessary for the correct operation and maintenance of the system (component 3). The components are considered as a single project ("Georgetown water supply infrastructure improvement"). The Annex is structured as follows: Section 2.1 briefly describes project and its costs; Section 2.2 presents the methodology adopted to estimate the economic benefits and the results obtained; Section 2.3 illustrates the results of cost-benefit analysis, including risk and sensitivity analyses; and Section 3 analyses the relation between tariffs and population income. The Report also includes a series of Appendices, namely: Appendix A, showing a table with the detailed cash flow of the rehabilitation of the water system project; Appendix B, summarizing the statistical analysis conducted of the WTP survey data; and Appendix C, including sampling details and the questionnaire used for the Willingness to Pay (WTP) survey.

2. GEORGETOWN WATER SUPPLY INFRASTRUCTURE IMPROVEMENT

2.1 The Project

2.1.1 Background

Established in 2002, GWI is the sole utility company responsible for providing water and sewerage services in Guyana. During the 2000s GWI managed to expand access to safe water to the population in the country: access to improved water sources increased from 89 percent in 2000 to 94 percent (98% in urban areas, 93% in rural areas) in 2010. In the same year, the share of population with access to improved sanitation stood at about 84% (88% in urban areas, 82% in rural areas). Despite these improvements, the provision of both water and sewerage services countrywide remains constrained by significant operational, financial, and institutional challenges faced by the GWI, as briefly discussed in the following paragraphs.

GWI's poor assets management, characterized by the lack of proper operation and maintenance of water supply infrastructure (pipes and equipment), has led to several problems, such as (i) gradual deterioration of the networks; (ii) unreliable service, with pressure as low as 1-3 meters and an average operating period of 16 hours/day; and (iii) low electromechanical efficiency of equipment (estimated at about 50% in 2012). These operational difficulties, together with revenue losses due to illegal connections and high energy costs (accounting for about 60% of GWI annual expenses), translate into GWI inadequate financial performance. On top of this, the 25 water treatment plants (TP) currently in operation ensure only a partial coverage of Guyanese population. Even if the level of treated water coverage has been steadily increasing (from 20% in 2001 up to 50%, based on last available data), there remain several areas receiving water below World Health Organization (WHO) quality standards, due to old, inefficient or inexistent treatment and O&M practices.

An old, piped sewer system - dating back to 1920s - serves only a minority of the population located in the capital, i.e. about 48,000 citizens of central Georgetown. Some 3,000 additional residents are served by a satellite sewer network located in Tucville and connected with the central sewer system via a trunk main. A third smaller system serves the University of Guyana, which owns and operates it. All in all, according to the results of the 2009 Guyana Demographic and Health Survey (GDHS)[1], only 4 percent of total population (11.3% in urban areas, 1.1% in rural areas) is connected to a piped sewer system. As a result, septic tanks and pit latrines represent the most common sanitation facilities in the country. In particular, according to 2009 GDHS, 48 percent of households use septic tank toilets, 24 percent use a pit latrine with slab, and 7 percent use a ventilated improved pit latrine.

2.1.2 Current Supply System in Program Areas: an Overview

The above unsatisfactory, overall situation of the provision of water services is regarded as comparatively more severe in (i) Georgetown, the capital of Guyana, and (ii) in three among the most densely populated areas outside the capital falling beyond the GWI treated water coverage (the so called, "treatment-gap areas").

In **Georgetown** there are three TPs (Shelterbelt, Central Ruimveldt and Sophia), which currently serve only 70% of the population living in the capital, and none of them meet WHO standards consistently.[2] In particular, the Shelterbelt TP, which serves 40% of the population of Georgetown, has been in operation for over 80 years and has deteriorated over time. Additional water from groundwater wells has been introduced into the TP without adequate

[1] Ministry of Health, Bureau of Statistics, and ICF Macro. 2010, *Guyana Demographic and Health Survey 2009*, Georgetown, Guyana.

[2] According to the GWI, a sensible increase in total coliform count was detected in the last year.

treatment processes being added, and the rehabilitation works carried out between 2002 and 2009 did not address the much needed TP expansion and upgrading. The two other TPs cover about 15% of the population each, while the remaining 40% receives untreated water from wells.

The distribution system dates back to 1890 and has been progressively extended to serve all developed areas within the city. It is estimated that asbestos cement pipes represent 41% of the existing system, cast iron pipes account for another 21%, and the remainder is made up of unplasticised polyvinyl chloride, high and medium density polyethylene and ductile iron pipes. According to the results of a survey recently carried out by the GWI, the pipe network has been assessed in poor conditions due to internal encrustation, breakage and corrosion, which leads to a very low performance with respect to pressures, reliability of supply and water quality.

Based on the above, water supplied by GWI in Georgetown can be broadly characterized by the following three levels of quality: (i) water treated to WHO quality standards (Sophia and Central Ruimveldt TPs), but susceptible of iron pick-up from the debris in the mains, (ii) treated water not fully meeting WHO quality standards (due to the condition of Shelter Belt TP), and (iii) untreated water. Problems due to the iron pick-up are relevant to the latter two cases as well.

The **treatment-gap areas** are located in the West Coast of Demerara and in the East Bank Demerara. In particular:

- on the West Coast of Demerara, there are two TPs (Fellowship and Vergenogen) serving around 60% of the population and working at their maximum capacity. Peri-urban areas comprised between Cornelia Ida and De Kinderen are not covered by any TP and residents are receiving untreated water of extremely poor quality from wells;
- on the East Bank Demerara, peri-urban areas between Sheet Anchor, Goed Banana Land, and No. 19, despite being located close two TPs (New Amsterdam and Rose Hall Water), do not receive treated water by any plant. Hence, the population is currently being served by four, untreated wells;
- finally, the fourth Program area - Diamond-Herstelling - is one of the fastest growing housing developments of the country. As a result of the expansion recorded in the past seven years, this area has now reached a size comparable to other major towns (New Amsterdam, Linden, Rose Hall and Anna Regina). Notwithstanding, this area remains largely underserved by TPs[3].

2.1.3 Current Supply System in Program Areas: Main Problems

Given the present conditions of the water supply system, the population located in the Program areas is confronted with severe problems to access adequate amount of quality water. More specifically, the results of both (i) the condition assessment of the supply system

[3] Two TPs (Golden Grove and Covent Garden) were constructed to supply the Diamond Housing Scheme, as well as the nearby Golden Grove and Kaneville housing schemes. However, works are of insufficient capacity for the expanded area and fail to meet the existing demand.

reported in the Feasibility Study[4], and (ii) the socioeconomic survey carried out as part of this study, highlighted the following major drawbacks.

Clearly, the most evident problem faced by GWI customers in the program areas is the extremely **poor quality of water** received. Critical physical parameters (pH, turbidity and iron content) are largely below WHO potable water quality standards in the treatment-gap areas. This information is fully confirmed by the results of the survey: only 7% of the interviewees assessed the quality of tap water supplied by the GWI as "*very good and drinkable without treating it*". Another 12.5% of the respondents, even if not satisfied by GWI water quality, drink it after some form of treatment, essentially because they cannot afford to pay for alternative water sources of higher quality. All in all, less than one fourth of the population within program areas drinks water provided by the GWI. In general, respondents' criticisms on the quality of GWI water concentrated on its bad color, typically reddish brown due to its iron content (lamented by just below three fourths of respondents), and its unpleasant taste/smell (reported by almost two thirds of the interviewees).

Discontinuity in water supply to customers also characterizes GWI services in the program areas. Generally, water is supplied for less than 16 hours per day as indicated in the Feasibility Study and confirmed by the results of the survey: 15.1 hours/day, on average, as illustrated in Table 1 below.

Table 1 Water Supply, number of hours per day

Hours per day	Share of people	Cumulated share
Less than 10 hours	*8.2%*	*8.2%*
10-11 hours	*15.0%*	*23.2%*
12-13 hours	*15.6%*	*38.8%*
14-15 hours	*20.8%*	*59.6%*
16-20 hours	*25.4%*	*85.0%*
Over 20 hours	*15.0%*	*100%*
TOTAL	***100%***	

Source: Socioeconomic Survey, Guyana, February 2014.

Frequent interruptions in the water supply service are often combined with **low water pressure**. Water pressure for the majority of households located in program areas is below the minimum acceptable level of 5m.[5] Again, the results of the survey broadly confirm this situation, with only one fourth of the interviewees reportedly enjoying strong water pressure every time and over two thirds of respondents (68.7%) reporting an instable water pressure.

Finally, the water supply system suffers of **generalized losses of drinkable water** in the network, with consequential waste of water resources and energy. The average level of NRW is estimated in the 60%-70% range nationwide, and above 70% in the capital.

[4] Draft Feasibility Study, Version 2.1: Preparation of Water and Sanitation Infrastructure Rehabilitation Programme (GY-L1040), April 2014.

[5] For more information, see the Feasibility Study, providing detailed information on the water pressure in the different 'treatment-gap areas': in Cornelia Ida-De Kinderen values range between 1.7m and 3.2m, in Diamond-Herstelling the average value is 4.3m, whereas much higher values, between 12m and 18m were detected in Goed Banana Land-Sheet Anchor-No.19.

2.1.4 Project Description

The program aims at ensuring that people located in the four identified areas gain access to potable water fully meeting WHO quality standards. This overall objective is to be achieved by (i) improving the water supply infrastructure, (ii) reducing the level of NRW from over 60% to below 50%, and (iii) strengthening the operational performance of the GWI, thereby improving its capacity to operate and maintain the new infrastructure.

In order to achieve above stated objective, the program adopts a comprehensive approach, comprising of four interrelated components, and namely:

- Component 1: Construction, rehabilitation and expansion of water treatment plants;
- Component 2: NRW program;
- Component 3: Institutional strengthening.

The key interventions to be undertaken and activities to be carried out under each component can be summarized as follows.

Component 1 – Construction, rehabilitation and expansion of water treatment plants. This component will finance the final designs and works required to improve the supply system and the water quality in the program areas, creating additional treatment capacity. The specific activities comprised in this component will include: (i) construction of five ground storage tanks to ensure water supply continuity and better pressure in the distribution network; (ii) construction of three new TPs to ensure that the water quality standards are met; (iii) rehabilitation of the Shelterbelt and the Sophia TPs, and (iv) expansion of the Central Ruimveldt TP.

Component 2 –NRW program. A significant reduction in the level of NRW of the water supply system will allow relying on smaller number of water sources, i.e. those connected to the above indicated TPs (decommissioning some of the existing untreated sources), and, at the same time, expanding production capacity to meet future demand in the program areas. The adoption of universal customer metering will further support this plan by reducing customer per capita demand. Therefore, complementing component 1, this component will finance activities to reduce the NRW level in the program areas. It will include: (i) development of a comprehensive NRW management program to address, monitor and control physical and commercial losses; (ii) system sectorization; (iii) installation of micro-meters; and (iv) network rehabilitation works. The micro-meters installation will complement the program currently being implemented by GWI and supported by the GOG, with the objective of achieving universal metering by 2020.

Component 3 – Institutional strengthening. This component will address the need to strengthen GWI capacity to manage the new infrastructure and move towards operational and managerial international standards. It will include: (i) capacity building activities on asset management and NRW reduction; (ii) creation of a NRW unit within GWI; (iii) activities to strengthen GWI's water resource management and planning capabilities (including the preparation of a groundwater management plan and the development of management tools); (iv) activities to strengthen GWI administrative, financial and commercial management (including support for the implementation of the new tariff structure); and (v) development and implementation of a monitoring and evaluation system to track the GWI performance in time.this component is meant to provide advisory services (e.g. preparation of operations manuals) and capacity building support (especially, on O&M) to raise GWI capacity to manage the new infrastructure.

Given the characteristics of the intervention, the project will be evaluated as a whole. Even though the segmentation of the cost estimates could be made by program area, the segmentation of the benefits is not possible for the case of a water utility and more specifically for the proposed program. The produced water volume savings obtained through a non-revenue program are going to be generated at different levels and stages of the network and within the utility. This means that the available water is going to be re-distributed in the network independently of the physical location of the works. GWI will redistribute the water resources on the network depending on the areas with lower levels of service which may or maybe not be located in the works area. Additionally, in some cases the water treatment plants will provide drinking water not only to the geographical areas that they serve directly, but also to other systems they could be interconnected with. Therefore there is no certainty in estimating the final benefits by sectors and it is only possible to appraise it at a program area.

2.1.5 Investment Costs

According to information provided by the Feasibility Study, the total value of planned investments at market prices almost reach US$ 27.5 million. This includes the cost of the works and the indirect cost of investment, such as the cost of administration, work supervision and physical contingencies.

The total investment breakdown per cost item is reproduced in the Table 2 below, whereas Table 3 shows the value of investment costs over time.

Table 2 - Investment Costs, per cost item

Cost Item	US$ ('000)
Civil Works & Pipes	10,162
Electromechanical equipment & metal work	6,291
Network rehabilitation	4,430
Water meter installation	2,006
Mains cleansing	500
Work supervision	1,500
Contingencies	1,307
TOTAL	**26,196**

Table 3 - Investment Costs, per year (US$ '000)

Cost Item	2014	2015	2016	Total
Civil Works & Pipes	508	6,605	3,048	10,162
Electromechanical equipment & metal work	0	3,460	2,831	6,291
Network rehabilitation	0	2,658	1,772	4,430

Water meter installation / Mains cleansing	1,253	1,253	0	2,506
Work supervision	75	975	450	1,500
Contingencies	0	0	1,307	1,307
TOTAL				**26,196**

To transform the above financial (investment) costs in economic costs, conversion factors should be applied. Key considerations with reference to the calculation of the conversion factors in Guyana are summarized here below:

- **No macroeconomic conversion factors** are used as Guyana is a very open economy, applying a liberal trade policy. Therefore, there is no need to apply a Standard Conversion Factor (SCF) to local goods. Indeed, according to the Ministry of Finance, the total revenue to be generated by customs and trade taxes is budgeted at about GYD 14 billion (US$ 70 million) for the fiscal year 2013[6], as opposed to a total value of trade (import plus export) of about US$ 3.4 billion. Therefore, the SCF for Guyana is very close to 1;

- **Duties and taxes are exempt** in similar projects in Guyana. Therefore, the financial costs already exclude them;

- **Costs for both skilled and unskilled labor has been shadow-priced** in order to reflect labor market distortions and to capture the opportunity cost of labor in a context characterized by high levels of unemployment and underemployment. In particular, in the case of <u>skilled workers</u>, wage costs, which actually represent transfers, have been deducted from market salaries. According to Deloitte International Tax[7], in Guyana there is no payroll tax, but employers withhold and pay social security contributions under Guyana's National Insurance Scheme. In particular, employers pay 7.8% of salaries and employees pay 5.2% of monthly earnings between GYD 5 and 104,278 (giving a total of 13%). Accordingly, the conversion factor for skilled labor (CFSL) has been set at 0.885 (i.e. the ratio between 113% and 100%).

The following shortcut formula has been applied to calculate the conversion factor for unskilled labor (CFUL):

$$CFUL = W * CFLS * (1 - u)$$

where, *W* is the market wage, and *u* is the local unemployment/underemployment rate.

As data on employment from the 2012 Census are not yet available, neither reliable, recent labor force statistics nor detailed statistical information on the local labor market exists. The most recent estimate formulated by the World Bank sets unemployment as a share of total labor force at 21% over the 2007-2011 period, countrywide.[8] However, this data does not duly take into account the share of underemployed and discouraged workers who have lost

[6] Guyana, *Estimates of the Public Sector – Current and Capital Revenue and Expenditure for the year 2013,* Volume 1.
[7] Deloitte International Tax, *Guyana Highlights 2013*.
[8] World Bank, *World Development Indicators 2013*, Washington, DC: World Bank.

hope to find a job, likely to represent a non-negligible share of total population. Under these conditions, the combined unemployment and underemployment rate (u) has been conservatively set at 35% for unskilled laborers. Based on these parameters, labor costs have been shadow-priced at 57.5% of market wage for unskilled laborers.

Based on the above, and considering the incidence of skilled and unskilled labor on different investment costs, the conversion factors reported in Table 4 have been applied.

Table 4 – Conversion Factors

Cost Item	Labor Cost Incidence	Conversion Factor
Civil Works & Pipes	• 30% unskilled personnel • 20% skilled personnel	0.850
Electromechanical equipment	• 15% unskilled personnel • 25% skilled personnel	0.877
Network rehabilitation	• 30% unskilled personnel • 20% skilled personnel	0.850
Water meter installation / Mains cleansing	• 40% unskilled personnel • 50% skilled personnel	0.742
Contingencies	• weighted average of different cost items	0.847
Work supervision	• 100% skilled personnel	0.885

Replacement costs and Residual Value

The economic life of four main investment costs is illustrated in Table 5 here below.

Table 5 - Economic life

Assets	Economic life
Electro-mechanical equipment	10 years
Civil works and pipes	30 years
Network rehabilitation	30 years
Water meters	20 years

The time horizon of the CBA is set at 21 years. Therefore, replacement costs for the electro-mechanical equipment (pumps, tank agitator, etc.) and metal work (steel slabs, ladders, etc.) have been duly included in the analysis; their value has been set at US$ 5.5 at year 13.

The residual value of the investment has been calculated as the sum of the value of all investment components at the end of the period of analysis, by using the straight line depreciation approach based on the economic life as indicated in table 5 above. The resulting residual value at the year 2034 is US$ 6.15 million.

2.1.6 Operating and Maintenance Costs

Operating and Maintenance (O&M) costs generated by the program exclusively refer to the additional cost of labor, power and chemicals that will be incurred at the new and rehabilitated TPs. Indeed, the potential decline of annual O&M costs, due to a reduced incidence of repair works following network rehabilitation, has been deemed as negligible. The estimation of the annual O&M costs has been performed based on unit costs currently incurred at US$0.15/cubic metre of water treated.

From an incremental point of view the following considerations apply:

- While no change in the number of staff is foreseen at rehabilitated/expanded TPs in Georgetown, additional labor is required to operate the three new TPs in treatment-gap areas. According to the Feasibility Study (and based on staff at the existing works), a total of four employees are required per each TP. Therefore, based on the assumption that the total annual salary per employee is about GYD 2 million (US$10,000), the incremental staff cost is set at about US$ 385,000 per year. Taking into consideration that the above incremental cost includes for maintenance staff as well as operators, skilled and unskilled labor are estimated to account respectively for 75% and 25% of additional staff costs. Therefore, a conversion factor of 0.808 has been applied. Considering that the works will be fully automatic, a subsequent consideration for GWI can be to consider operating the works as unmanned, linked by telemetry to a central control room and visited daily;

- The energy charge is by far the most important cost borne by the GWI for its operations. Under the program, the opening of three TPs and the expansion of the treatment capacity in Georgetown will generate a sizable increase in the annual energy costs, while additional costs of pumping raw water from wells as well as of high-lift pumps delivering water into supply are expected to be marginal, thanks to energy savings resulting from not pumping at the sources to be closed down. All in all, the additional energy costs (including fuel for the standby generators) have estimated at about US$1,370,000 on an annual basis. As the tariff charged by the Guyana Power & Light Inc. in Georgetown and surrounding areas is assumed to adequately reflect the marginal supply cost of electricity, no conversion factor has been applied;

- Other inputs utilized at the new TPs include chemicals. However, as a result of the adopted water treatment process, chemicals utilization will be kept at minimal levels: the annual cost of additional chemicals has been estimated at mere US$ 27,000. The incremental cost has been based upon data provided by GWI for chemical usage at the existing treatment works. Coherently with above discussion about the lack of need of macroeconomic conversion factors, no conversion factor has been applied.

O&M costs have been assumed to remain as current until the new TPs become fully operational and then the full estimated increase in O&M will apply. In other words, the full additional amount of annual O&M costs - i.e. US$1.71 million - will apply first in 2017, and then remain constant over the entire time horizon.

2.2 The economic benefits

2.2.1 Program Beneficiaries

As a result of the program, all households located in the program areas are expected to benefit from the interventions. In Georgetown, thanks to the additional treatment capacity, the rehabilitation of the Shelter Belt works, the reduction of NRW levels, the reduction in per capita demand resulting from the introduction of universal metering, and the mains cleansing, quality and/or quantity of water supplied to all GWI clients will improve, even if to a different extent. In treatment-gap areas, all GWI clients (currently receiving untreated water) will obtain treated water after the program. Further, with the decreased levels of NRW in the treatment-gap areas, some of the water previously "lost" as leakage will become available to the GWI to supply to new customers. The increased water available, together with the reduced per capita demand resulting from customer metering will enable the GWI to increase service coverage in the treatment-gap areas. Depending upon their current source of water, these new customers can be expected to receive better quality water than at present.

To estimate the total number of beneficiaries in different program areas, data were taken from the last Census conducted by the Bureau of Statistics in 2012. Furthermore, in the case of Georgetown, beneficiaries were divided in two groups to reflect the different extent of the water supply improvement they will benefit as a result of the program. As of end 2012, the total number of potential beneficiaries located in the four identified areas was set at almost 180,000 people, equivalent to about 55,000 households. More detailed information of the number of beneficiaries in each program area is provided in Table 6 below.

Table 6 - Potential Program Beneficiaries, 2012

Program Area	**# of people**	**Household size**	**# of households**
Georgetown, of which	118,363	3.15	37,523
- major improvement *(from WHO non-compliant to WHO fully-compliant)*	*43,929*		*13,946*
- minor improvement *(elimination of discoloration and/or from WHO partially-compliant to WHO fully-compliant)*	*74,434*		*23,630*
Cornelia Ida-De Kinderen (*major improvement)*	21,550	3.35	6,440
Diamond-Herstelling (*major improvement)*	23,267	3.44	6,756
Goed Banana Land-Sheet Anchor-No. 19 (*major improvement)*	15,953	3.48	4,580
Total	**179,133**		**55,299**

Source: 2012 Census.

In order to estimate the annual number of program beneficiaries over the 21-year time horizon of the program, the following assumptions have been adopted:

- First, the **annual population growth rate** for each area was set based on past demographic trend, i.e. by comparing data on population recorded between the two census dates (2002 and 2012). With the exception of Diamond–Herstelling, in all intervention areas, the population marginally fell in the last 10 years; hence, a zero increase has been assumed. The total population located in Diamond–Herstelling increased from 14,596 in 2002 to 23,267 in 2012. Based on the assumption that such an increase actually occurred in the last five years of the period, the recent, annual growth rate of population was estimated at 10%. However, considering that largest expansion of housing scheme development has reportedly largely occurred, the annual population growth rate in this area has been assumed to rapidly decline between 2012 and 2017. Since then, total population has been assumed to remain stable (in line with other program areas);

- Second, as for the **GWI coverage**, the percentage of the population who are water supply customers of the GWI has been set at 100% in Georgetown since the very beginning. As for the treatment-gap areas, the GWI coverage, currently estimated at 86%, has been assumed to remain unchanged over the program time-horizon;

- Third, in accordance with the **program implementation plan**, treatment-gap areas are expected to fully benefit from program interventions starting from the beginning of year 2017. In Georgetown a less uniform situation has been assumed: 'minor improvements' beneficiaries will fully benefit already in year 2016, as mains cleansing are to be carried out in 2014 and 2015, whereas more time will be required for those benefiting of 'major improvements', as the full conversion from untreated to treated water supply is expected to be achieved by year 2019.

Based on the above, forecasts for the population benefitting by the program over the time-horizon are indicated in Table 7 here below.

Table 7 - Beneficiaries Estimation, 2016-2035

Program Area	2016	2017	2018	2019	2020	2021-2034
Georgetown (*major improvement*)	-	32,674	41,965	43,929	43,929	43,929
Georgetown (*minor improvement*)	74,434	74,434	74,434	74,434	74,434	74,434
Cornelia Ida-De Kinderen	-	18,533	18,533	18,533	18,533	18,533
Diamond-Herstelling	-	26,730	26,730	26,730	26,730	26,730
Goed Banana Land-Sheet Anchor-No. 19	-	13,720	13,720	13,720	13,720	13,720
Total	**74,434**	**166,091**	**175,382**	**177,346**	**177,346**	**177,346**

2.2.2 Program Benefits

In order to assess the most relevant benefits generated by the program the Willingness to Pay (WTP) approach, which allows to estimate the money value of improved water supply services through users' revealed preferences or stated preferences, has been applied. In other words, program benefits have been quantified by: (i) directly asking to a sample of the relevant households about their WTP for improved water supply services (the ***'stated preference'*** approach), and (ii) analyzing information on the averting behaviors developed by the same households to cope with the effects of insufficient and unsafe water services (the '***revealed preference'*** approach). To that end, a socioeconomic survey to a sample of 1,000 households was carried out in the program areas during the month of February 2014 (for details see Appendix C). It is important to mention that the sample of population covered by the survey is located exclusively in areas that are going to benefit most from program interventions, i.e. excluding parts of Georgetown where comparatively smaller water quality improvements are expected after program.

Among different stated preference methods, the Contingent Valuation Method (CVM) has been applied and, in particular, the referendum-style "take it or leave it" elicitation method. This method requires the respondent to indicate approval or disproval for a single, pre-determined monetary value, which is varied across the interview sample. In particular, the acceptance of the program at the cost of a quarterly increase in the water bill of GYD1,000, GYD2,000, GYD4,000, GYD6,000 and GYD10,000 (US$4.8, US$9.7, US$19.4, US$29.1 and US$48.4) has been randomly tested, and the mean and median WTP have been estimated using both nonparametric and parametric response models.

Various log-logistic and logit response models including a broad set of water supply-related indicators and several household and respondent socio-economic characteristics as explanatory variables have been tested[9]. In the preferred model specification, the acceptance dummy is regressed against: (i) a constant, (ii) the log of the bid level, (iii) the log of income, and three dummies identifying households that (iv) are home owners, (v) have a water meter, and (vi) consider bottled water as the main source of drinking water. All the coefficients, but 'bottled water', are significant and with the expected sign. Indeed, the probability of a "yes" response turns out to be negatively correlated with the bid level, systematically lower for households having a water meter (less satisfied with the GWI services, as water meter installation typically leads to higher water bills and smaller consumption levels) and being home owners (renters are likely to display a higher WTP, as in many cases, they do not pay the water bill separately, but as part of the rent fee), and positively correlated with the household income. More specifically, the income elasticity of the WTP is statistically significant at the 1% level and roughly equal to 0.5 (safe tap water is a 'normal good' whose WTP tends to increase less than proportionally by increasing income)[10].

Table 8 - Log-logistic model

	Coefficient	Std. error
Const	12.584***	1.1520
log Bid	-1.993***	0.151
log Income	1.052***	0.152
Home owner	-0.425**	0.193
Water meter	-0.714***	0.176
Bottled water	0.201	0.136

Obs.: 919
Significance levels: *** 1%; ** 5%; * 10%.

[9] For more detailed information, see Annex B.
[10] Again, for a more detailed analysis of the marginal effects on log WTP of explanatory variables derived from the log-logistic model, with the associated standard errors and 95% confidence intervals, see Annex B.

The (i) mean WTP, (ii) truncated mean WTP, (iii) adjusted truncated mean WTP, and (iv) median WTP, per quarter for improved water supply services derived from the above model, along with the standard errors and the 95% confidence intervals, are reported in Table 9 overleaf. The adjusted truncated mean WTP is regarded as the most reliable estimate (and it is also rather constant across different models). Therefore, program beneficiaries are estimated to be willing to pay an additional GYD6,210 (US$30.1) per quarter.

Table 9 - WTP Estimate

	GYD	95% Confidence interval
Mean WTP	7,083	6,061 - 8,656
Truncated mean WTP	5,162	4,838 - 5,466
Adjusted truncated mean WTP	**6,210**	**5,589 - 6,841**
Median WTP	4,494	4,117 - 4,901

The estimation of the WTP based on the CVM has been largely corroborated by the results achieved based on 'revealed preference' approach and, more specifically, the Averting Behavior Method (ABM). This method exploits information on the defensive ("averting") behaviors developed by people to cope with the effects of insufficient and unsafe water services to assess the additional money households would pay for improved water supply.

According to the results of the survey, only 7.9% of the households located in program areas drink water supplied by GWI without sustaining any averting behavior expense, while the vast majority of the households (74.05%) buy bottled water, with an estimated purchasing quarterly expenditure of GYD11,177 (US$54.1), on average. The remainder encompasses: (i) households using filters and/or add bleach (8.3%, quarterly expenses amount to GYD 4,695 (US$22.7)), (ii) households boiling water (5.6%, estimated mean cost of GYD 4,057 (US$19.6) on a quarterly basis); (iii) households using rainwater harvesting systems (6.5%, estimated mean quarterly cost of GYD 1,000 (US$4.8)), and (iv) households hauling water (1.1%, estimated mean quarterly cost of GYD 1,266 (US$6.1)).[11]

Based on the above data, the mean (median) averting expenses are estimated at GYD 9,025 (US$43.7) (GYD 6,720 (US$32.5)), values significantly higher than the mean (median) WTP estimated by the CVM, i.e. 6,210 GYD (US$30.1) (GYD 4,500 (US$21.8)). However, the ABM may well overestimate WTP when averting behavior expenses involve sunk costs and provide joint production (as it is actually the case for bottled water, which, not only provide safe water, but also improve its "aesthetic quality"). If corrections are introduced to adjust for the violation of these assumptions, averting behavior expenses decline to GYD 6,460 (US$31.3) (median: GYD 5,040 (US$24.4)), on average. The ratio between stated average (median) WTP and revealed average (median) WTP becomes 96% (89%)[12].

[11] It is worth noting, that, in a few cases, two different water treatment procedures are jointly undertaken by households: 3.8% households boil water and use filters and/or bleach. As a result, the sum of percentages does not add up to 100%.

[12] This result is consistent with the meta-analysis by Carson *et al.* (1996), who made more than 600 comparisons of CVM to revealed preference (RP) estimates for quasi-public goods finding that the CVM estimates are on average lower than RP estimates, with the mean CV/RP ratio being 0.89.

To sum up, benefits generated by the program have been estimated at GYD 6,210 (US$31) per quarter for households that will experience a substantial improvement in water quality received from the GWI. In case of households located in Georgetown already receiving treated water, but only partially compliant with WHO standards and/or discolored due to iron pick-up, benefits have been **conservatively** estimated as one third of the estimated WTP value, i.e. GYD 2,070 (US$10.35) per quarter.

2.3 The results

2.3.1 Cost-Benefit Analysis Results

As illustrated in table 10 here below, the program is economically viable, showing an Economic Rate of Return (ERR) of 13.4 percent and an Economic Net Present Value (ENPV) of US$1.8 million.

Table 10 - Results of the Economic Analysis

ENPV	ERR
US$ 1,815,899	13.4%

The cash flows of the project are described in detail in Appendix A.

2.3.2 Sensitivity and Risk Analysis

The **sensitivity analysis** defined the following major risk variables: investment and O&M costs overruns and the WTP for improved water supply services. The former variable is largely under management control, whereas WTP is based on consumer's preferences and is, therefore, largely beyond management control.

Table 11 - Results of Sensitivity Analysis

Change in Risk Variables	**ERR (%)**
WTP decreased by 10%	10.9
Civil works and pipes costs increased by 10%	12.8
Civil works and pipes costs increased by 20%	12.3
Electromechanical equipment and metal work costs increased by 10%	13.0
Electromechanical equipment and metal work costs increased by 20%	12.5
Network rehabilitation costs increased by 10%	13.2
Network rehabilitation costs increased by 20%	12.9
O&M costs increased by 10%	12.7
O&M costs increased by 20%	11.9

The program is fully resilient to variations of the investment costs. Indeed, even a substantial increase (+20%) of these risk variables only marginally affects the ERR value, whose value fall in the 12.9% (in the case of network rehabilitation) - 12.3% (in the case of civil works and pipes) range. A slightly higher reduction of the ERR (down to 11.9%) is generated by a 20% increment of O&M costs. Furthermore, such an increase is regarded as an extremely unlikely event, as measures aimed at optimizing both cost of energy and chemical usage are expected to be devised at the design stage.

The program is comparatively more sensitive to changes of the WTP: in the case of a 10% reduction, the ERR decreases to 10.9%. However, three aspects are worth to be mentioned. First, as discussed in Annex B, several robustness tests have been run, confirming the reliability of the CVM estimate of WTP. Second, the WTP value estimated based on the ABM is higher than the CVM estimate used to assess the economic viability of the program. Third, program benefits are estimated based on the conservative assumption that WTP of beneficiaries of 'minor' water quality improvements, i.e. households already receiving treated water, but only partially compliant with WHO standards and/or discolored due to iron pick-up, represents 50% of the estimated WTP. If such a proportion were to be augmented up to 75%, a 10% reduction of mean WTP would not modify considerations on the economic viability of the program: the ENPV remains largely positive, with an ERR of 14.4%.

In this respect, it is important to stress that the rather conservatively set ratio between the WTP of beneficiaries of major and minor water quality improvements significantly affects the economic performance of the program, and the achieved ERR can be regarded as the lower bound estimation. Indeed, the program displays much higher ERRs (up to over 20%) as well as high resilience to changes of the mean WTP if less conservative ratios are assumed. This is clearly illustrated by a ***scenario analysis*** covering the following two scenarios:

- Scenario A: WTP for minor water quality improvements is set at 75% of mean WTP; and
- Scenario B: WTP for minor water quality improvements is set equal to the mean WTP.

Table 12 - Results of Scenario Analysis

Change in WTP	Scenario A (75%)		Scenario B (100%)	
	ERR	ENPV*	ERR	ENPV*
Mean WTP	17.2%	6.6	20.9%	11.5
WTP decreased by 10%	14.4%	3.0	17.8%	7.3
WTP decreased by 20%	11.5%	-0.7	14.6%	3.2

*ENPV is expressed in US$ millions

In the **risk analysis** the results of the economic analysis have been recalculated by changing the major risk variables all at the same time (10,000 iterations have been accomplished with Latin Hypercube sampling).[13]

The risk analysis has been carried out assuming the following distributions:

- WTP: a normal distribution centered around the base value with a coefficient of variation of 0.05;[14]
- Total investment costs in each period: triangle distribution with values ranging from 80% to 120% of the original costs;

[13] All the calculations are made using @RISK Version 4.5.2 (Palisade Corporation).
[14] The coefficient of variation is estimated from the bootstrapped distribution of the mean WTP.

- O&M costs: triangle distribution with values ranging from 80% to 120% of the original costs.

The risk analysis has carried out in the base (lower bound) case as well as in the two alternative scenarios, illustrated above. The results of the risk analysis for the two variables of interest (ENPV and ERR) are summarized in Table 13.

Table 13 - Results of Risk Analysis

Statistic	Base Case (WTP @50%)		Scenario A (WTP@75%)		Scenario B (WTP @100%)	
	ERR	ENPV	ERR	ENPV	ERR	ENPV
Mean	13.5%	1,816	17.2%	6,641	20.9%	11,467
Median	13.5%	1,841	17.2%	6,646	20.9%	11,435
5^{th} percentile	10.9%	-1,422	14.5%	3,201	17.8%	7,652
95^{th} percentile	16.1%	4,980	20.2%	10,092	24.3%	15,358
Minimum	8.3%	-4,839	10.8%	-1,426	13.6%	2,256
Maximum	20.7%	10,563	24.7%	15,118	28.4%	19,361
Correlation						
WTP	0.779	0.805	0.761	0.844	0.752	0.876
Tot inv cost Y2	-0.507	-0.475	-0.527	-0.422	-0.554	-0.391
Tot inv cost Y3	-0.268	-0.254	-0.294	-0.250	-0.282	-0.217
Tot inv cost Y1	-0.058	-0.053	-0.055	-0.041	-0.067	-0.043

ENPV is expressed in US$ ‘000

The risk analysis confirms the results from the sensitivity analysis. In the base case, the probability that the ENPV posts a value above zero (i.e. that the ERR is higher than 12%), is set at about 82.5%, as illustrated in Figure 1. In scenarios A and B, the probability that the ENPV is positive is higher than 99% (Figures 2 and 3). The ERR is very large and almost always higher than 12%. In particular, in scenario A (B), the mean ERR is 17.2% (20.9%). The WTP and, to a lesser extent, the investment costs in the second and third year are the variables with the largest impact on the economic viability of the program.

Figure 1 - Cumulative Distribution of ENPV

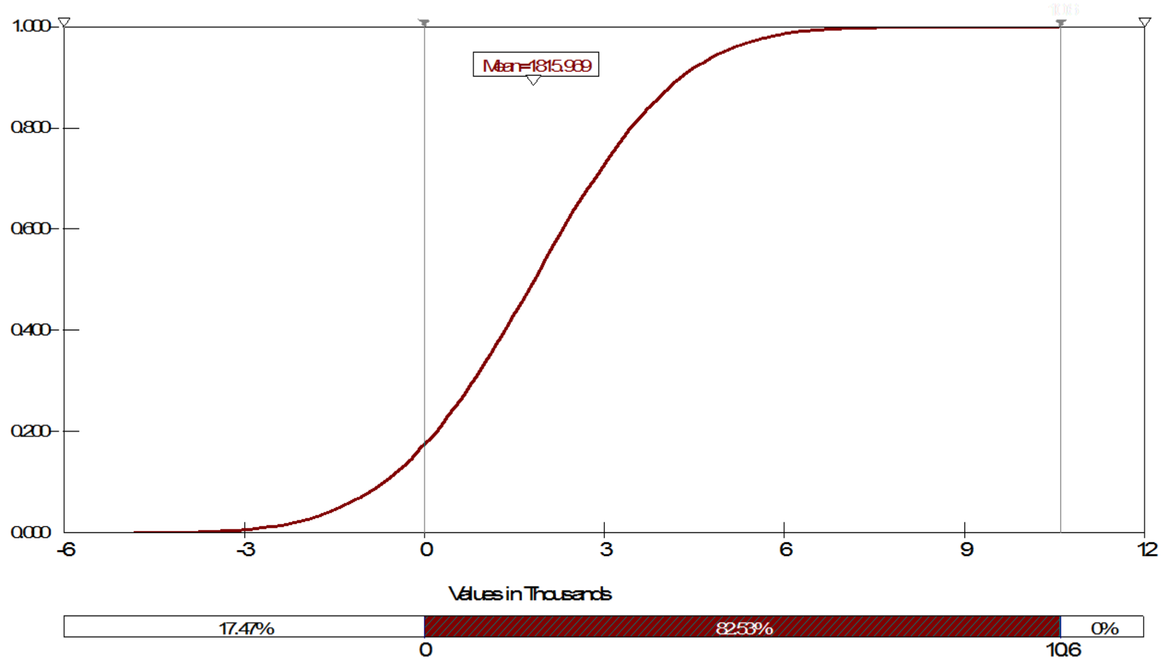


Figure 2 Cumulative Distribution of ENPV – Scenario A

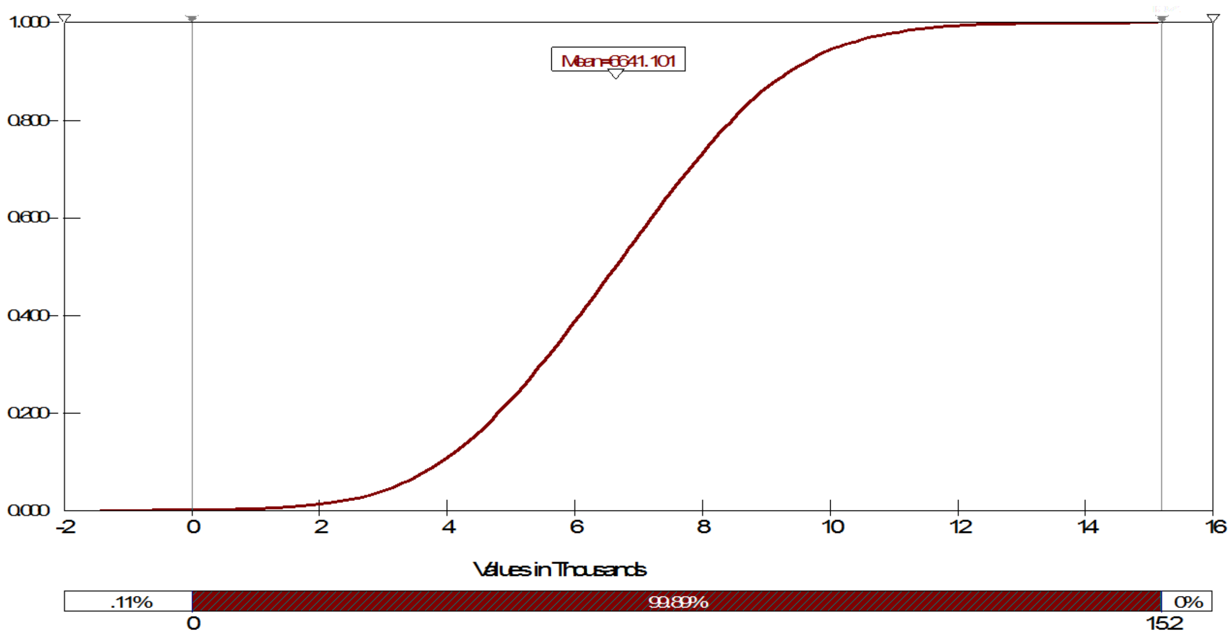
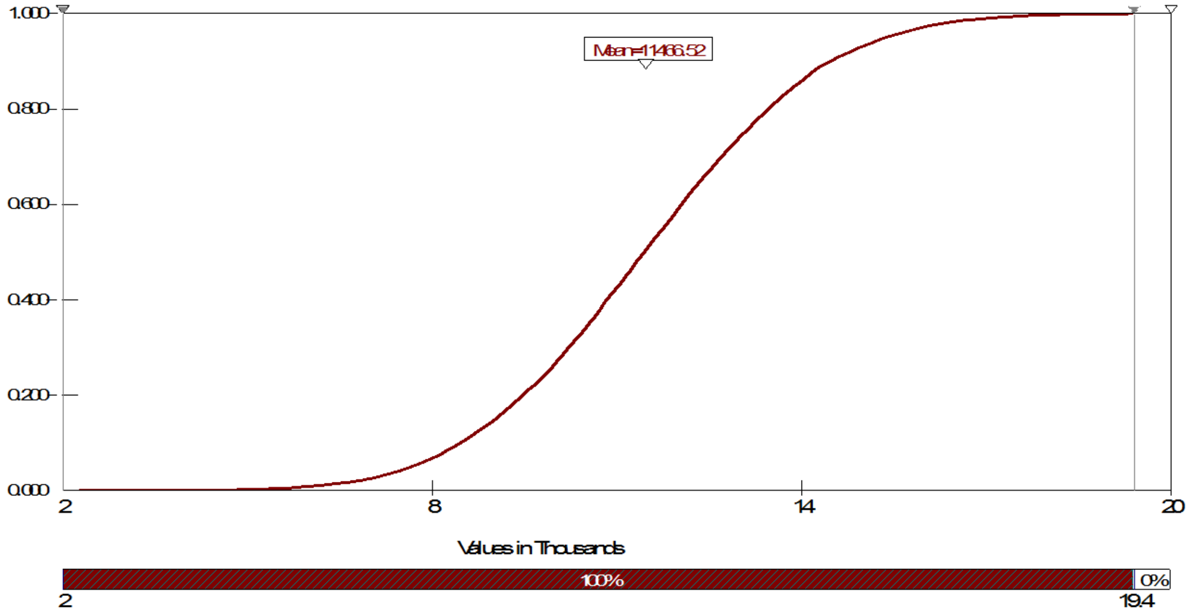


Figure 3 Cumulative Distribution of ENPV – Scenario B



3. TARIFF STRUCTURE AND POPULATION INCOME

Currently, GWI clients are charged a water bill on a quarterly basis. The water tariff system in includes two types of tariff for residential users: (i) a flat water charge of GYD 2,950 (US$ 14.3) for un-metered connections, and (ii) a volumetric tariff of GYD 63 per cubic meter for metered connections. With and average water consumption of about $20m^3$/month per household, the quarterly charge a household with a metered connection is approximately GYD 3,780 (US$18.3).

In 2013, the economic regulator of the sector, the PUC, has approved a new tariff adjustment which plans to update, harmonize, and rationalize the tariff system of the company. The new tariff system is expected to be in place in 2014. In the new tariff system, residential customers that receive treated water will face two types of tariffs: (i) a monthly flat water charge of GYD 1,800 (US$ 8.7) for un-metered connections, and (ii) for metered connections, a fixed monthly charge of GYD 300 (US$1.46) and a volumetric tariff of GYD 76 (US$ 0.37) per cubic meter for a consumption between 0 and 12 cubic meters, GYD 95 (US$ 0.46) per cubic meter for a consumption between 13 and 20 cubic meters, and GYD 112 (US$ 0.54) per cubic meter for a consumption of 21 cubic meters and above. With and average water consumption of about $20m^3$/month per household, the monthly charge a household with a metered connection is approximately GYD 1,972 (US$9.6)

According to the socioeconomic survey conducted in the project area in February 2014, the average household income was GYD 95,705 per month (US$465) and the average household income for those households in the poorest quintile was GYD 50,000 (US$243). With the current tariff structure the water charges represent, on average, between 1% and 1.3% of the average household income (depending if the household has an unmetered or metered connection, respectively), which is an acceptable value according to international standards. For those families in the poorest quintile, the charge represents between 2% and 2.5% of their income, which is also below the internationally accepted level. With the new tariff structure the water charges will represent, on average, between 1.9% and 2.1% of the average household income (also depending if the household has an unmetered or metered connection, respectively). While for those families in the poorest quintile, the charge will represent between 3.6% and 3.9% of their income, which is also below the internationally accepted level.

APPENDICES

APPENDIX 1 – TABLE FOR ECONOMIC ANALYSIS (US$ thousands)

Item/Year	CF	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Civil works & Pipes	0.850	432	5,611	2,590																		
Electromechanical & Metal work	0.877	0	3,033	2,482																		
Network rehabilitation	0.850	0	2,258	1,505																		
Micro-meter installation/mains cleansing	0.742	929	929	0																		
Work supervision	0.885	66	863	398																		
Contingencies	0.848	0	0	1,108																		
Investments costs		**1,427**	**12,695**	**8,083**																		
Replacement costs														5,514								
Residual value																						-6,154
Other investment items																						
Total investment costs		**1,427**	**12,695**	**8,083**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**5,514**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**-6,154**
Staff costs	0.81				312	312	312	312	312	312	312	312	312	312	312	312	312	312	312	312	312	312
Energy costs	1.00				1,370	1,370	1,370	1,370	1,370	1,370	1,370	1,370	1,370	1,370	1,370	1,370	1,370	1,370	1,370	1,370	1,370	1,370
Chemicals	1.00				27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27	27
Total O&M costs		**0**	**0**	**0**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**	**1,709**
Economic Benefits				1,467.4	4,897.5	5,263.9	5,341.3	5,341.3	5,341.3	5,341.3	5,341.3	5,341.3	5,341.3	5,341.3	5,341.3	5,341.3	5,341.3	5,341.3	5,341.3	5,341.3	5,341.3	5,341.3
Total benefits		**0**	**0**	**1,467**	**4,898**	**5,264**	**5,341**	**5,341**	**5,341**	**5,341**	**5,341**	**5,341**	**5,341**	**5,341**	**5,341**	**5,341**	**5,341**	**5,341**	**5,341**	**5,341**	**5,341**	**5,341**
Net economic benefits		**-1,427**	**-12,695**	**-6,616**	**3,189**	**3,555**	**3,633**	**3,633**	**3,633**	**3,633**	**3,633**	**3,633**	**3,633**	**-1,882**	**3,633**	**3,633**	**3,633**	**3,633**	**3,633**	**3,633**	**3,633**	**9,787**

APPENDIX 2 – WTP SURVEY - STATISTICAL ANALYSIS

B.1 Introduction

This Appendix is devoted to present different models tested to estimate the household Willingness-To-Pay (WTP) for the program. WTP for safe and reliable drinking water has been estimated using both stated preferences and revealed preferences, that is, via Contingent Valuation Method (CVM) and Adverting Behavior Method (ABM). As for the former, WTP were elicited using the closed-ended, single-bound dichotomous choice (DC) format[15] and the mean and median WTP are estimated using both nonparametric and parametric response models, as illustrated in Section B.2. Section B.3 deals with the ABM, showing WTP values estimated by looking at the direct and indirect costs borne by households because of the lack of a safe and reliable water supply.

B.2 WTP Estimation: Contingent Valuation

Introduction. As usual in single-bounded referendum DC format, each respondent is presented with a single charge (the "bid level") for the water supply improvement, which she/he may either accept or reject. The bid level is varied across respondents to estimate a survival function with the related welfare measures: mean and median WTP. In particular, the acceptance of the program at the cost of a quarterly increase in the water bill of GYD 1,000 (US$4.8), 2,000 (US$9.7), 4,000 (US$19.4), 6,000 (US$29.1) and 10,000 (US$48.4) was randomly tested.

Nonparametric response models. As expected, the fraction of positive responses in the sample decreases as the bid amount increases, meaning that people are indeed sensitive to the price level of the service. This is clearly illustrated in Table B.1, which summarizes the relation between responses and bid levels.

Table B.1 Cross-tabulation of response against bid level

Response	BID (in GYD)					Total
	1,000	2,000	4,000	6,000	10,000	
Yes	184 92.0%	152 76.0%	110 55.0%	58 29.0%	38 19.0%	542 54.2%
No	10 5.0%	39 19.5%	77 38.5%	129 64.5%	142 71.0%	397 39.7%

[15] Although other methods of preference elicitation have been proved more efficient – e.g. open-ended questions, multinomial choice experiments, choice-based conjoint analysis, contingent rankings, double/triple-bounded dichotomous choice (Carson & Hanemann, 2005) –, the binary discrete choice question is the only method that is incentive compatible provided that: (i) a coercive payment mechanism is in place, i.e. the agents are required to pay independent of their own answer if the majority is in favor; (ii) the offer is "take-it-or-leave-it", i.e. the answer doesn't influence any other offer that may be made to agents (Carson and Hanemann, 2005). All the other methods require further assumptions to assure that strategic behavior does not produce biases and inconsistencies. So, for instance, in direct open-ended questions strategic behavior might lead to a flatter WTP distribution (Brookshire, Ives and Schulze, 1976), whereas in double-bounded DC, it might lead to lower stated WTP in the second answer (McFadden and Leonard, 1993; Carson & Hanemann, 2005).

Don't Know	6 3.0%	9 4.5%	13 6.5%	13 6.5%	20 10.0%	61 6.1%
Total	200	200	200	200	200	1000

Pearson chi-square test = 310.148 (8df, p-value = .0000)

The fraction of "no" responses changes across areas: Herstelling-Diamond (Sheet Anchor-No. 19) shows a slightly higher (lower) fraction of rejection (see Table B.2).

Table B.2 Cross-tabulation of response against area

Response	Area				Total
	Georgetown	**Cornelia Ida-De Kinderen**	**Herstelling-Diamond**	**Sheet Anchor-No.19**	
Yes	117 48.8%	127 56.4%	111 46.2%	187 63.4%	542 54.2%
No	98 40.8%	95 42.2%	106 44.2%	98 33.2%	397 39.7%
Don't Know	25 10.4%	3 1.3%	23 9.6%	10 3.4%	61 6.1%
Total	240	225	240	295	1000

Pearson chi-square test = 37.722 (6df, p-value = .0000)

Using the data on responses and bid levels, the survival function has been estimated non-parametrically by using (i) the Kriström's (1990) method, which piecewise linearly interpolates each pair of estimated response probabilities; and (ii) the more conservative Kaplan-Meier-Turnbull method (Turnbull, 1976). The results are summarized in Figures B.1 and B.2. Table B.3 reports the associated three types of WTP estimates for each survival function[16]: (i) Spearman-Karber mean WTP, (ii) Kaplan-Meier mean WTP (or Turnbull lower bound on mean WTP), and (iii) median WTP. The Spearman-Karber mean WTP ranges from about GYD 5,170 (US$25) to 6,070 (US$29.4). The median WTP with the Kriström's method turns out to be GYD 4,635 (US$22.4).

[16] In Kriström's method, the upper support of the estimated WTP distribution is computed using the last linear interpolation. All the calculations were done using the R package DCchoice developed by Tomoaki Nakatani.

Figure B.1 Nonparametric estimation of response distribution (linear interpolation)

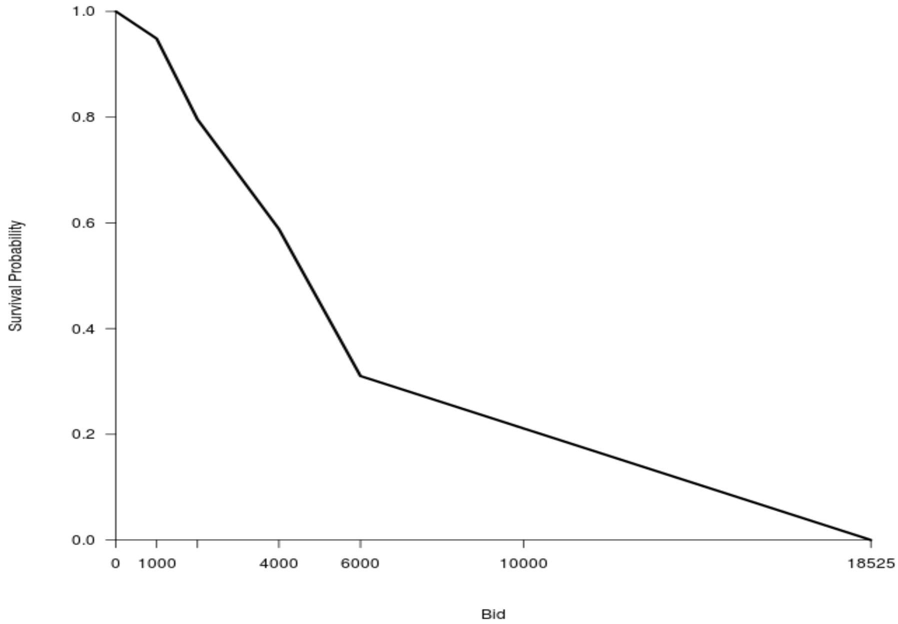


Figure B.2 Nonparametric estimation of response distribution (Kaplan-Meier-Turnbull method)

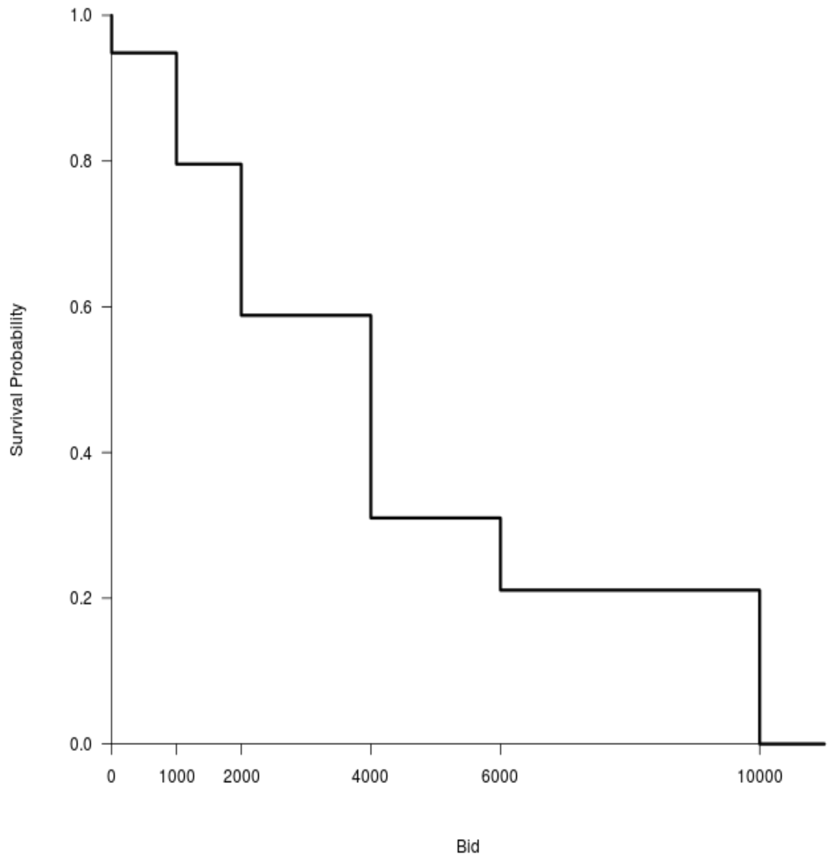


Table B.3 Nonparametric estimates of WTP

Kriström method	Mean (Kaplan-Meier)	4,385.5
	Mean (Spearman-Karber)	6,071.3
	Median	4,634.6
Kaplan-Meier-Turnbull method	Mean (Kaplan-Meier)	4,385.5
	Mean (Spearman-Karber)	5,171.3
	Median	4,000-6,000

Parametric response models. To estimate the mean and median WTP (and the underlying latent WTP distribution from the dichotomous choice WTP responses (yes=1 and no=0), parametric approaches have also been adopted, where this dummy variable is regressed against a constant (the bid offer, BID), and a vector of explanatory variables (X). In particular, the following two models were estimated:[17]

- ***log-logistic models*** (log-linear-in-bid), where the response probability distribution is assumed to be log-logistic:[18]

$$\Pr(\text{response is 'yes'}) = 1+\exp(-(\beta_0 + \beta_1 \ln \text{BID} + \beta_3 \text{X}))^{-1}$$

with β being the parameters to be estimated;

- ***logit response models*** (linear-in-bid), where the response distribution is logistic.[19]

$$\Pr(\text{response is 'yes'}) = 1+\exp(-(\beta_0 + \beta_1 \text{BID} + \beta_3 \text{X}))^{-1}.$$

A variety of water supply-related indicators and various household and respondent socioeconomic characteristics were included among the explanatory variables. In particular:

- ***household-related variables***, i.e. the location area, the value of monthly household income, home ownership (a dummy variable taking the value 1 if the household owns the house and 0 otherwise), and household size;

- ***individual related variables***, such as respondent's age and gender;

- ***water source-related variables***, going from the amount paid by the household in connection with the last water bill, to the presence of a water meter and storage tank, from

[17] For an analytical treatment, see for instance Hanemann (1984, 1989), Cameron (1988) and Carson and Hanemann (2005). Useful references are also Gunatilake, Yang, Pattanayak, and Choe (2007) and Vaughan, Russell, Rodriguez and Darling (1999).
[18] This functional form can be derived from the Bishop–Heberlein Random Utility Model (RUM) assuming that the difference in the random terms is a standard logistic random variable (Carson and Hanemann, 2005). This was the form originally employed by Bishop and Heberlein (1979) when they introduced the single-bounded referendum format for CV.
[19] Logit response models derive from the RUM version of the Box–Cox model when the difference in the random terms is a standard logistic random variable (Carson and Hanemann, 2005).

indicators measuring the continuity of the supply services (days per week the household receives water, hours per day the household receives water, water pressure) to subjective perception of tap water quality;

- ***averting behavior related variables*** (bottled water as the main source of drinking water or not; expenditure on bottled water).

All the variables and the average profile of the respondents in the sample are summarized in Table B.4.

Table B.4 Average profile of respondents in the sample (n = 939)

	Variable	Definition	Mean	Median	S.D.
	BID	Additional quarterly fee charged for water improvement presented to respondents in the CV survey (in GYD)	4,522	4,000	3,179
Household related	GEORGETOWN	If the household is located in Georgetown (1 = Yes, 0 = No)	0.23	0	0.42
	CORNELIA	If the household is located in Cornelia Ida-De Kinderen (1 = Yes, 0 = No)	0.24	0	0.43
	HERSTELLING	If the household is located in Herstelling-Diamond (1 = Yes, 0 = No)	0.23	0	0.42
	SHEET ANCHOR	If the household is located in Sheet Anchor-No.11 (1 = Yes, 0 = No)	0.30	0	0.46
	INCOME	Monthly household income (in thousand GYD)	96.41	80	58.92
	OWN	If the respondent is owner of the house (1 = Yes, 0 = No)	0.74	1	0.44
	SIZE	Number of people in the house	3.98	4	2.05
Individual related	AGE	Age of the respondent (in years)	47.03	45	14.18
	GENDER	Gender of the respondent (1 = Male, 0 = Female)	0.52	1	0.50
Water source related	BILL	Water bill in the last quarter (in thousand GYD)	5,412	3,450	7,003
	BILLPAID	If the household fully paid the last water bill (1 = Yes, 0 = No)	0.81	1	0.40
	METER	If the household has a water meter (1 = Yes, 0 = No)	0.41	0	0.49
	DAYS	Days per week the household receive water from the piped system	6.89	7	0.59
	HOURS	Hours per day the household receive water from the piped system	15.2	14	4.85
	PRESSURE	Evaluation of the water pressure (0 = Weak; 1 = Sometimes strong, sometimes weak; 2 = Strong)	1.10	1	0.55
	QUALITY	Subjective perception of the quality of tap water (0 = not drinkable and not good for cooking or hand washing; 1 = not drinkable, but good for cooking and hand washing; 2 = drinkable)	0.95	1	0.42
	TANK	If the household has a water storage tank (1 = Yes, 0 = No)	0.75	1	0.43
Averting behavior related	BOTTLEWAT	If the main source of drinking water is bottled water (1 = Yes, 0 = No)	0.73	1	0.44
	BOTTLEEXP	Quarterly expenditure on bottled water (in thousand GYD)[20]	7.74	6.00	8.85

[20] The variable has been computed using questions C.6 (How often do you buy your drinking water?) and C.7 (How much do you pay each time you buy water?) of the survey. In particular, C.7 has been multiplied by: 80 if C.6 = 1(Every day); 40 if C.6 =2 (Every 2 days); 36 if C.6 = 3 (3 times a week); 24 if C.6 = 4 (2 times a week); 12 if C.6 = 5 (1 time per week); 6 if C.6 = 6 (2 times a month); 3 if C.6 = 7 (1 time per month). 18 observations whose values were not reasonable (the quarterly expenditure on bottled water turned out to be higher than the quarterly expenditure on food) were removed from the analysis.

A very general log-logistic model, where the yes/no response is regressed against all the explanatory variables (***Model I***), represented the starting point. Through the sequential elimination of statistically non-significant explanatory variables,[21] Model I was refined to achieve ***Model II***. In Model II, the response dummy is regressed against: (i) the log of the bid level, (ii) the log of income, and three dummies identifying households that (iii) are home owners, (iv) have a water meter, and (v) consider bottled water as the main source of drinking water. All the coefficients, but the purchase of bottle water, are significant and with the expected sign. Indeed, the probability of a "yes" response turns out to be negatively correlated with the bid level, systematically lower for households having a water meter and being home owners, and positively correlated with the household income.

In ***Models III and IV***, the same process was repeated including three dummies to identify the four different geographical areas: the probability of a "yes" response turns out to be, *ceteris paribus*, slightly lower (higher) in Herstelling-Diamond (Sheet Anchor-No. 19) with respect to Georgetown. In ***Models V-VIII***, the whole process was repeated using a logit response parametric functional form (linear-in-bid model). The sign and the statistical significance of the coefficients do not change, but the logit models show a lower goodness-of-fit: the pseudo R-squared of the log-logistic models are systematically higher, while their (Akaike and Bayesian) information criteria are lower.

Main results are summarized in Table B.5, while Table B.6 shows some robustness check using different error distributions for linear and log-linear models. The log-linear-in-bid models (Models II, IX and XI) have a goodness-of-fit always higher than the linear-in-bid models (Models VI and X, i.e. the logit and probit models). Among the former, Model II fits the data better than Model IX and XI, where the error distribution is assumed to be, respectively, log-normal and Weibull. Therefore, ***Model II can be safely regarded as the preferred specification.***

For each model, Tables B.5 and B.6 also report: (i) the mean WTP, (ii) the truncated mean WTP, (iii) the adjusted truncated mean WTP, and (iv) the median WTP, with the associated 95% confidence intervals. The mean and median WTP can be computed from the parameters in each model using the formulas discussed in Hanemann (1984; 1989), Carson and Hanemann (2005) and Boyle *et al.* (1988).[22] The truncated mean is the expected value computed with a truncation at the maximum bid level (10,000 in the present analysis). This is usually done for the log-logistic model, since, as stressed by Hanemann (1984), in these models the mean WTP is highly sensitive to the presence of outliers. The adjusted truncated mean is the mean WTP truncated at the maximum bid with the adjustment suggested by Boyle *et al.* (1988) to correct for the violation of the properties of the cumulative distribution function in the original formula of the truncated mean. The 95% confidence intervals of each estimate are computed by means of nonparametric pairs bootstrap, i.e. by re-sampling with replacement from all (non-missing) observations of each individual and estimating the model on each bootstrap sample to calculate an empirical distribution of the associated WTP. The upper and the lower bound of the interval are then computed by looking at the 2.5% and 97.5% percentiles of the derived distribution. Since for each WTP 1,000 repetitions were performed, the lower and the upper bound of the 95% confidence interval are hence equal to the 25th and the 975th sorted estimates, respectively.[23]

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[21] At each step the variable with the highest *p*-value is excluded, and the process goes on until all the remaining variables have a one-sided *p*-value greater than 0.1.

[22] In linear-in-bid logit and probit models, the reported mean WTP is computed using the formula: $\log(1+\exp(\beta_0 + \boldsymbol{\beta}_3 \mathbf{X}))/\beta_1$, which is computed by imposing a non-negativity constraint on WTP. Without such constraint in these models the mean WTP is equal to the median WTP: $-(\beta_0 + \boldsymbol{\beta}_3 \mathbf{X}))/\beta_1$.

[23] An alternative method is the parametric bootstrap suggested by Krinsky and Robb (1986; 1990), where various WTP are computed for each draw of simulated parameters and the parameters are drawn from a multivariate normal distribution, whose mean is equal to the vector of the parameter estimates and the variance-covariance is equal to the

The estimated mean WTP ranges from roughly GYD 5,500 (US$26.6) to 7,000 (US$33.9) in the estimated models. In the preferred specifications (Model II and, to a lesser extent, Model IV), it is the highest (about GYD 7,000 (US$33.9)). The point estimates of the truncated mean are instead significantly lower and more constant across the different specifications, ranging from GYD 5,050 (US$24.5) to 5,400 (US$26.2) (equal to roughly GYD 5,160 (US$25) in Models II and IV). ***The adjusted truncated mean WTP is also rather constant, ranging from GYD 5,750 (US$27.8) to 6,250 (US$30.3), and equal to roughly GYD 6,200 (US$30) in Models II and IV*** (quite close to the Spearman-Karber mean in the nonparametric estimates using the Kriström's method: GYD 6,070 (US$29.4)). Finally, the median WTP is the lowest, ranging from GYD 4,400 to 5,500 (US$21.3 to 26.6) and equal to GYD 4,500 (US$21.8) in Models II and IV (still fairly consistent with the nonparametric estimates).

Considering that the average (median) quarterly water bill currently paid by the respondents is about GYD 5,400 (US$26.2) (GYD 3,450 (US$16.7)), a ***WTP of GYD 6,200 (US$30) amounts to accepting a substantial increase in the water bill, i.e. +115% (+180%).*** The increase in monthly water bills is equivalent to 2.14% (2.58%) of the mean (median) income in the sample. Thus, for the average (median) household, the monthly GWI water supply expenditures would increase from 1.87% (1.44%) to 4.01% (4.02%) of household monthly income.

variance-covariance matrix of the parameter estimates. See, among the others, Poe, Severance-Lossin and Welsh (1994) for an empirical application, and Hole (2007), who conducted simulation experiments to compare the performance of the parametric and nonparametric bootstrap. For each estimate, we also computed the Krinsky and Robb's confidence intervals: they are almost always fairly similar to the ones calculated via nonparametric bootstrap.

Table B.5 Log-logistic and logit response models

	Log-logistic response models				Logit response models			
	Model I	**Model II**	**Model III**	**Model IV**	**Model V**	**Model VI**	**Model VII**	**Model VIII**
constant	12.648***	12.584***	13.596***	12.423***	1.016	1.829***	1.836	1.573***
	(1.915)	(1.1520)	(2.034)	(1.175)	(1.279)	(0.274)	(1.426)	(0.330)
BID					-0.00049***	-0.00045***	-0.00050***	-0.00046***
					(0.00004)	(0.00003)	(0.00004)	(0.00003)
log(BID)	-2.107***	-1.993***	-2.149***	-2.043***				
	(0.172)	(0.151)	(0.175)	(0.139)				
CORNELIA			-0.057	0.128			-0.142	-0.047
			(0.362)	(0.267)			(0.353)	(0.260)
HERSTELLING			-0.650*	-0.375			-0.718**	-0.418*
			(0.360)	(0.255)			(0.348)	(0.245)
SHEET ANCHOR			0.333	0.665***			0.255	0.565**
			(0.398)	(0.245)			(0.400)	(0.240)
INCOME					0.00845***	0.01021***	0.00872***	0.01073***
					(0.00211)	(0.00163)	(0.00216)	(0.00168)
log(INCOME)	0.994***	1.052***	1.012***	1.106***				
	(0.215)	(0.152)	(0.220)	(0.160)				
OWN	-0.584*	-0.425**	-0.514*	-0.409**	-0.599**	-0.424**	-0.534**	-0.403**
	(0.273)	(0.193)	(0.276)	(0.196)	(0.267)	(0.190)	(0.271)	(0.193)
SIZE	-0.014		0.039		0.037		0.059	
	(0.060)		(0.062)		(0.060)		(0.061)	
AGE	0.007		0.005		0.001		0.000	
	(0.008)		(0.008)		(0.008)		(0.008)	
GENDER	0.102		0.095		0.152		0.157	
	(0.215)		(0.220)		(0.210)		(0.214)	
BILL	-0.0065		-0.0064		-0.00800		-0.00740	
	(0.0134)		(0.0134)		(0.01364)		(0.01368)	
BILLPAID	0.248		0.218		0.124		0.107	
	(0.289)		(0.303)		(0.278)		(0.290)	
METER	-0.731***	-0.714***	-0.591**	-0.588***	-0.663***	-0.639***	-0.553**	-0.542***
	(0.240)	(0.176)	(0.259)	(0.194)	(0.231)	(0.170)	(0.251)	(0.189)
DAYS	0.064		-0.031		0.116		0.018	
	(0.176)		(0.185)		(0.170)		(0.176)	
HOURS	-0.011		-0.005		-0.010		-0.006	
	(0.023)		(0.035)		(0.023)		(0.034)	

PRESSURE	0.051		-0.005		-0.002		-0.055	
	(0.189)		(0.200)		(0.244)		(0.196)	
QUALITY	0.064		-0.123		0.001		-0.185	
	(0.253)		(0.263)		(0.244)		(0.256)	
TANK	-0.015		0.019		-0.007		0.003	
	(0.254)		(0.267)		(0.249)		(0.251)	
BOTTLEWAT	0.317	0.201	0.476	0.382*	0.368	0.253	0.522	0.422**
	(0.289)	(0.136)	(0.296)	(0.196)	(0.281)	(0.184)	(0.289)	(0.191)
BOTTLEEXP	0.019		0.015		0.01927		0.01579	
	(0.015)		(0.014)		(0.00148)		(0.01479)	
Obs.	640	919	640	919	640	919	640	919
AIC	618.02	876.26	614.78	864.00	644.82	915.50	640.77	904.76
BIC	693.87	905.20	704.01	907.41	720.67	944.44	730.00	948.17
pseudo-R^2	0.330	0.308	0.341	0.323	0.300	0.277	0.311	0.290
adjusted pseudo-R^2	0.294	0.300	0.295	0.309	0.261	0.267	0.265	0.276
Mean WTP	6,541	7,083	6,459	6,945	5,401	5,602	5,405	5,608
(95% confidence interval)	(5,491-7,671)	(6,061-8,656)	(5,379-7,553)	(5,948-8,245)	(4,942-5,920)	(5,250-6,016)	(4,953-5,923)	(5,194-6,045)
Truncated mean WTP	5,047	5,162	5,054	5,169	5,206	5,335	5,221	5,357
(95% confidence interval)	(4,714-5,390)	(4,838-5,466)	(4,640-5,408)	(4,841-5,468)	(4,831-5,635)	(5,005-5,663)	(4,855-5,650)	(5,031-5,692)
Adjusted truncated mean	5,930	6,210	5,916	6,187	5,723	6,016	5,720	6,014
WTP (95% confidence interval)	(5,331-6,681)	(5,589-6,841)	(5,149-6,563)	(5,577-6,843)	(5,126-6,454)	(5,468-6,663)	(5,126-6,416)	(5,445-6,645)
Median WTP	4,373	4,494	4,392	4,513	5,246	5,415	5,262	5,437
(95% confidence interval)	(3,979-4,825)	(4,117-4,901)	(3,930-4,849)	(4,135-4,915)	(4,805-5,783)	(5,006-5,842)	(4,837-5,782)	(5,036-5,862)

Dependent variable: dichotomous choice WTP responses. Standard errors in parenthesis. Bootstrap confidence intervals for mean and median WTP. Significance levels: *** 1%; ** 5%; * 10%. Mean WTP for logit models calculated imposing the nonnegative constraint (note: without such constraint in logit models the mean WTP is equal to the median WTP).

Table B.6 Parametric response models: error distribution and estimated WTP

	Error distribution in the model				
	Log-logistic Model II	**Logistic Model VI**	**Log-normal Model IX**	**Normal Model X**	**Weibull Model XI**
constant	12.584***	-1.503*	7.336***	-0.868*	9.658***
	(1.1520)	(0.631)	(0.641)	(0.370)	(0.820)
BID		-0.00045***		-0.00026***	
		(0.00003)		(0.00002)	
log(BID)	-1.993***		-1.164***		-1.405***
	(0.151)		(0.073)		(0.090)
log(INCOME)	1.052***	0.982***	0.609***	0.572***	0.669***
	(0.152)	(0.146)	(0.0868)	(0.084)	(0.098)
OWN	-0.425**	-0.383***	-0.236***	-0.210*	-0.273**
	(0.193)	(0.190)	(0.112)	(0.110)	(0.131)
METER	-0.714***	-0.692***	-0.397***	-0.393***	-0.474***
	(0.176)	(0.172)	(0.101)	(0.099)	(0.114)
BOTTLEWAT	0.201	0.250	0.134	0.155	0.123
	(0.136)	(0.184)	(0.110)	(0.107)	(0.123)
Obs.	919	919	919	919	919
pseudo-R^2	0.308	0.279	0.308	0.279	0.302
AIC	876.26	912.51	876.60	912.74	884.43
BIC	905.20	941.45	905.54	941.68	913.37
Mean WTP	7083	5589	6467	5600	5794
(95% confidence interval)	(6061-8656)	(5174-6026)	(5727-7415)	(5191-6043)	(5262-6406)
Truncated mean WTP	5162	5328	5177	5388	5281
(95% confidence interval)	(4838-5466)	(5007-5625)	(4882-5467)	(5056-5713)	(4967-5613)
Adjusted truncated mean WTP	6210	5996	6271	6091	6223
(95% confidence interval)	(5589-6841)	(5436-6608)	(5696-6925)	(5500-6757)	(5559-6964)
Median WTP	4494	5405	4470	5477	4900
(95% confidence interval)	(4117-4901)	(5008-5805)	(4120-4867)	(5065-5910)	(4503-5363)

Dependent variable: dichotomous choice WTP responses. Standard errors in parenthesis. Bootstrap confidence intervals for mean and median WTP. Significance levels: *** 1%; ** 5%; * 10%. Mean WTP for logit and probit models calculated imposing the nonnegative constraint (without such constraint in these models the mean WTP is equal to the median WTP).

For Model II, the marginal effects on log WTP of explanatory variables derived from the log-logistic model, with the associated standard errors and 95% confidence intervals (Cameron, 1988)[1], are illustrated in Table B.7 and can be summarized as follows:

- the income elasticity of the WTP is statistically significant at the 1% level and roughly equal to 0.5 (safe tap water is a 'normal good' whose WTP tends to increase less than proportionally by increasing income). The scale parameter (κ) is statistically greater than zero, meaning that people react to price changes;

- the WTP decreases by roughly (i) 20% for home owners (renters are likely to display a higher WTP, as in many cases, they do not pay the water bill separately, but as part of the rent fee), and (ii) 30% for households having a water meter (less satisfied with the GWI services, as water meter installation typically leads to higher water bills and smaller consumption levels);

- finally, bottled water being the main source of drinking water has a slightly positive association with WTP, although not statistically significant at the 10% level. A causal interpretation of this coefficient can be hardly given, since BOTTLEWAT is clearly endogenous; in other words, people who have a higher WTP for safe and reliable tap water, on average, can have a higher propensity to buy bottled water. Such a consideration is further supported by the results shown in Table B.8, where, in order to check for the endogeneity bias, a bivariate probit specification that includes an additional equation for bottled water consumption has been estimated. The correlation of the errors in the two equations is indeed positive as expected and statistically different from zero at the 1% level.

Table B.7 Marginal effects on log WTP

	Coefficient	Standard error	Two-sided *p*-value	95% confidence interval	
log(INCOME)	0.528	0.074	0.000	0.383	0.673
OWN	-0.213	0.097	0.029	-0.404	-0.022
METER	-0.358	0.087	0.000	-0.529	-0.187
BOTTLEWAT	0.101	0.095	0.288	-0.085	0.286
κ (scale parameter)	0.502	0.034	0.000	0.435	0.569

Marginal effects on log WTP derived from the log-logistic model (Cameron, 1988). Standard errors computed using the delta method.

[1] As discussed by Cameron (1988), the marginal impact of each explanatory variable on the conditional expected value of log WTP is a nonlinear combination of the parameters estimated in the standard log-logistic model. In particular, we have that: $\partial E(\ln WTP|\mathbf{X}) / \partial x_i = -\beta_i / \beta_1$, where x_i is the regressor *i*, β_i the associated parameter and β_1 the parameter attached to log BID. The scale parameter in Cameron's (1988) specification, measuring the sensitivity of people to price change, can be computed as $-1/\beta_1$. The reported standard errors have been computed using the Taylor series approximation (delta method).

Table B.8 Bivariate probit model

	Dependent variable	
	RESPONSE	**BOTTLEWAT**
CORNELIA	0.0417	-0.147
	(0.178)	(0.172)
HERSTELLING	-0.317*	0.364**
	(0.168)	(0.182)
SHEET ANCHOR	0.215	-0.219
	(0.175)	(0.170)
BID	-0.00029***	
	(0.00002)	
INCOME	0.00550***	0.00061
	(0.00107)	(0.00098)
OWN	-0.293**	
	(0.140)	
BILL		0.026**
		(0.011)
BILLPAID		0.322**
		(0.151)
METER	-0.324**	
	(0.136)	
QUALITY1	0.021	-0.025
	(0.176)	(0.175)
QUALITY2	-0.600**	-2.638***
	(0.293)	(0.445)
Obs.	685	
Log-likelihood	-629.77	
rho	0.224	
p-value of independence test (Null hypothesis: rho = 0)	0.007	

Unreported constants. Standard errors in parenthesis. Significance levels: *** 1%; ** 5%; * 10%.

Finally, as illustrated in Table B.9, which summarizes the results of the separate estimations of the log-logistic Model II for each of the four program areas, the mean and median WTP for improved water service tend to be higher in Sheet Anchor-No. 19 and lower in Herstelling-Diamond with respect to what happens in Georgetown and Cornelia Ida-De Kinderen.

Table B.9 WTP by geographical area

	Georgetown	Cornelia Ida-De Kinderen	Herstelling-Diamond	Sheet Anchor-No. 19
constant	13.733***	10.625***	27.292***	9.251***
	(2.588)	(2.241)	(4.334)	(1.980)
log(BID)	-2.103***	-1.882***	-4.058***	-1.523***
	(0.283)	(0.274)	(0.584)	(0.222)
log(INCOME)	0.744**	1.295***	1.436***	1.063***
	(0.378)	(0.324)	(0.4794)	(0.244)
OWN	0.171	-1.141***	-0.475	-0.281
	(0.380)	(0.432)	(0.563)	(0.341)
METER	-0.598	-1.016*	-0.261	-0.729**
	(0.375)	(0.588)	(0.513)	(0.313)
BOTTLEWAT	0.895**	0.955***	0.108	-0.277
	(0.426)	(0.396)	(0.662)	(0.310)
Obs.	215	222	197	285
Pseudo-R^2	0.325	0.321	0.572	0.247
Mean WTP	5,910	7,521	4,164	14,694
(95% confidence interval)	(4,413-8,528)	(5,369-13,493)	(3,604-4,637)	(8,447-58,635)
Truncated mean WTP	4,686	5,171	4,103	6,215
(95% confidence interval)	(4,054-5,327)	(4,498-5,882)	(3,585-4,544)	(5,615-6,818)
Adjusted truncated mean	5,348	6,314	4,180	9,272
WTP (95% confidence interval)	(4,278-6,570)	(5,037-7,994)	(3,608-4,676)	(7,352-11,667)
Median WTP	3,945	4,483	3,760	6,275
(95% confidence interval)	(3,332-4,726)	(3,706-5,525)	(3,306-4,249)	(5,114-7,947)

Dependent variable: dichotomous choice WTP responses. Standard errors in parenthesis. Bootstrap confidence intervals for mean and median WTP. Significance levels: *** 1%; ** 5%; * 10%. Mean WTP for logit and probit models calculated imposing the nonnegative constraint (without such constraint in these models the mean WTP is equal to the median WTP).

B.3 WTP Estimation: Averting Behavior Method

Introduction. Unsafe and unreliable water supply generates reductions in households' well-being (increased health risks associated with exposure to unsafe water) and increased costs in inputs used to mitigate such effects (bottled water, filtering systems, water treatment, medicines, etc.). The 'revealed preference' approach and, more specifically, the Averting Behavior Method (ABM) exploits information on the defensive ("averting") behaviors developed by people to cope with the effects of insufficient and unsafe water services to assess the additional money households would pay for improved water supply. Given that only a minority of program beneficiaries drinks GWI tap water without treating it, the survey collected a sufficiently large amount of information on the averting behaviors developed by households, allowing for the estimation of the averting costs.

WTP and ABM: Methodological Considerations. The ABM is based on the assumption that people have the opportunity to engage in averting activities to mitigate the effects of some environmental "bad" (Cropper and Oates, 1992). Theoretically, if they are utility maximizers, the savings in averting activities they engage in to counteract the harmful effects of the poor quality of water, holding utility constant, can be regarded as a correct measure of their WTP for the quality improvement (Abdalla *et al.*, 1992; Bartik, 1988; Courant and Porter, 1981; Gerking and Stanley, 1986; Harrington *et al.*, 1989; Whitehead *et al.*, 1998; Mi-Jung e*t al.*, 2002). Thus, the WTP for a marginal improvement in drinking water quality is equal to the marginal averting expenditures avoided.

As proved by Courant and Porter (1981), savings in averting expenditures are equal to the benefits of a marginal environmental improvement, holding the level of personal environmental quality constant and assuming that the environmental improvement does not directly affect utility. In fact, if the optimal personal environmental quality increases when the external environmental quality improves, the sum of changes in averting expenditures and costs of illnesses tend to be lower bound estimates of WTP (Abdalla *et al.*, 1992; Courant and Porter, 1981; Harrington and Portney, 1987; Whitehead *et al.*, 1998). However, as noted by Bartik (1988), averting expenditures provide a lower bound to WTP only under certain assumptions, i.e. (i) that they do not involve sunk costs in the purchase of durable goods; and (ii) that averting inputs do not exhibit jointness in the production of household outputs (i.e. averting inputs do not serve in the production of any other input that is valued by the household). As showed in Whitehead *et al.* (1998), when averting behaviors provide joint production, the marginal WTP for quality is the sum of: (i) the full cost of averting activities, including the opportunity cost of time;[2] (ii) the opportunity cost of illness;[3] (iii) the non-market value of the disutility of non-healthy time;[4] and (iv) the "aesthetic value" of averting behavior. The last term actually reduces the WTP for improved water infrastructures.

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[2] So, for instance, hauling water from safe sources or the installation and maintenance of water filters, purifiers and rainwater harvesting systems might impose significant time costs. As showed by Whitehead and Van Houtven (1997), much of the differences between the estimates of averting expenses depend on the assumptions on the time cost and the depreciation rates of durable goods.

[3] The opportunity cost of illness can be measured directly using information on wages and unemployment rates.

[4] This is a non-market value that can be measured only by stated preference methods, i.e. CVM.

Averting Costs in Program Areas. According to the results of the survey, only 7.9% of the households located in program areas drink water supplied by the GWI and do not sustain any averting behavior expense (this share includes 1.1% of households who, even if they do not consider tap water good for drinking, drink it with no treatment or only minor treatments). As for the remainder, the situation can be summarized as follows:

- the vast majority of the households - 74.05% - buy bottled water and consider it the main source of drinking water.[5] The estimated purchasing cost of bottled water on a quarterly basis is GYD 11,177 (US$54.1) (718 valid observations), on average.[6] The median value of expenses is GYD 8,080 (US$39.1);

- 8.32% households use filters and/or add bleach (chlorine), with reported quarterly expenses that amount to GYD 4,695 (US$22.7), on average;

- 5.61% households boil water and this entails a time cost equal on average to GYD 4,057 (US$19.6) on a quarterly basis;

- finally, 6.51% households use rainwater harvesting systems (estimated quarterly costs: GYD 1,000 (US$4.8)) and 1.10% respondents haul water (mean: GYD 1,266 (US$6.1)).

Table B.10 summarizes the different averting activities, reporting the percentage of households in the sample actually carrying out each activity[7], the description of the way in which the direct and indirect costs of each activity have been computed and the mean and standard deviation of the associated costs.

Table B.10 Components of averting behavior expenses

Averting behavior	Contents of averting expenditures on a quarterly basis	Percentage of households in the sample	Mean (GYD)	S.D.
No averting behavior	No averting expenditure	*7.92%*	-	-
Purchases of bottled water	Purchasing cost	*74.05%*	11,177	11,760

[5] For the households who do not regard bottled water as the main source of drinking water, the expenses in bottled water were conservatively set at zero.

[6] The cost has been computed from questions C.6 (How often do you buy your drinking water?) and C.7 (How much do you pay each time you buy water?) of the survey. C.7 has been multiplied by: 80 if C.6 = 1(Every day); 40 if C.6 =2 (Every 2 days); 36 if C.6 = 3 (3 times a week); 24 if C.6 = 4 (2 times a week); 12 if C.6 = 5 (1 time per week); 6 if C.6 = 6 (2 times a month); 3 if C.6 = 7 (1 time per month). 18 observations whose values were regarded as poorly reliable (the quarterly expenditure on bottled water turned out to be higher than the quarterly expenditure on food) have been removed from the analysis.

[7] It is worth noting, that, in a few cases, several water treatment procedures are jointly undertaken by households: 3.80% households boil water and use filters and/or bleach. That's why the sum of percentages does not add up to 100%.

Home water treatment systems	Cost of filtering and/or adding bleach (chlorine)	*8.32%*	4,695	7,509
Boiling water	Time cost, computed using the monthly minimum wage (GYD 35,000) and assuming a time consumption of 2.5 minutes every person in the household every day	*5.61%*	4,057	2,000
Rainwater harvesting systems	Water tank price (GYD 40,000, life cycle: 10 years; quarterly discount rate: 2.5%)	*6.51%*	1,000	-
Hauling water	Time cost, computed using the monthly minimum wage (GYD 35,000) and assuming a time consumption of 30 minutes each time to transport two five gallon bottles, and a water consumption of 1.5 liters every person every day	*1.10%*	1,266	624.5

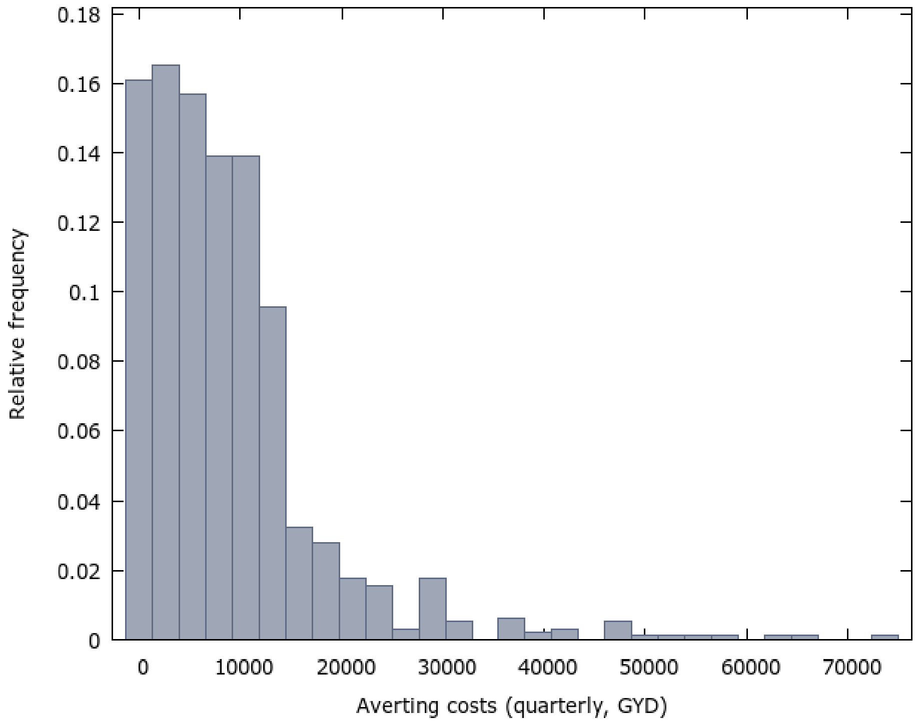
The distribution of averting behavior expenses is shown in Figure B.3, while Table B.11 shows the summary statistics: the mean (median) averting expenses are GYD 9,025 (US$43.7) (GYD 6,720 (US$32.5)), values significantly higher than the mean (median) WTP estimated by the CVM, i.e. 6,200 GYD (US$30) (GYD 4,500 (US$21.8)) (the latter accounting for 69% (70%) of the former). Such a finding looks somewhat at odds with the above methodological considerations, suggesting that averting expenditures tend to be lower bound estimates of WTP. However, as discussed before, averting behavior expenses might be considered lower bounds of WTP only as far as they do not involve sunk costs and do not provide joint production, which does not seem to be the case for bottled water, which, not only provide safe water, but also improve its “aesthetic quality”. When these conditions are violated, the ABM may well overestimate WTP.

In this respect, the estimated mean (median) averting expenses are likely to be inflated. Indeed, if the following assumptions are made (i) the price already paid for rainwater harvesting systems is completely sunk, and therefore does not contribute to WTP, and (ii) households would reduce their consumption of bottled water only by 70% if they had safe and reliable tap water, averting behavior expenses decline to GYD 6,460 (US$31.3) (median: GYD 5,040 (US$24.4)), on average. The ratio between stated average (median) WTP and revealed average (median) WTP becomes 96% (89%). This result is consistent with the meta-analysis by Carson *et al.* (1996), who made more than 600 comparisons of CVM to revealed preference (RP) estimates for quasi-public goods finding that the CVM estimates are on average lower than RP estimates, with the mean CV/RP ratio being 0.89.

Table B.11 Averting expenditures (summary statistics)

Mean	Median	S.D.	Skewness	Ex. kurtosis	5% percentile	5% percentile	Obs
9,025	6,720	11,183	6.0735	66.095	0	25,824	965

Figure B.3 Distribution of averting expenditures

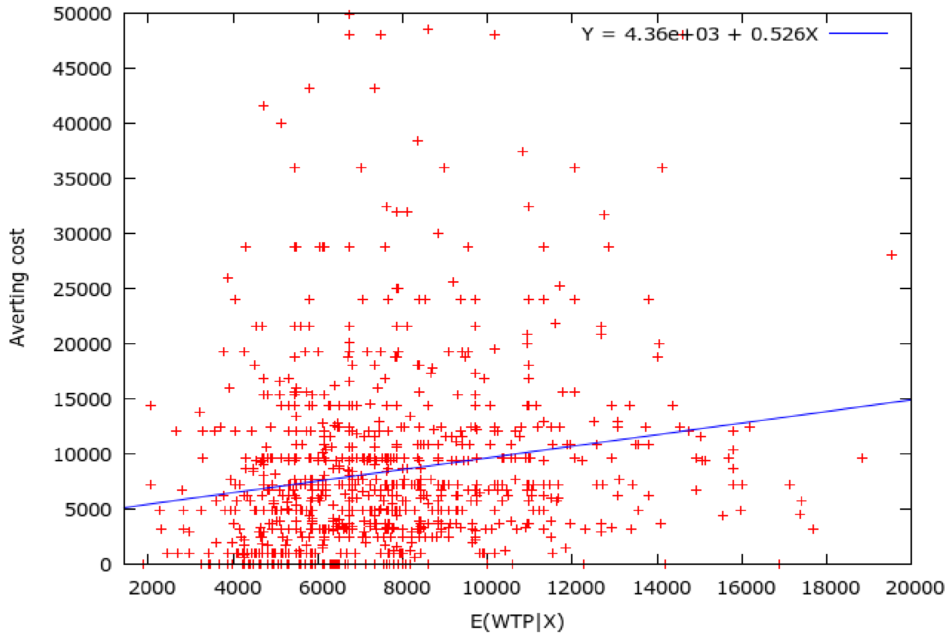


Finally, Figure B.4 shows the scatter plot of averting behavior expenses vs. conditional expected values of WTP estimated from Model II (Table 5).[8] The correlation between the two estimates is 0.15, a statistically significant value, but quite low.

[8] The expected value of the WTP conditional on the explanatory variables in the log-logistic model is equal to:

$$E(WTP \mid \mathbf{X}) = \exp(-(\beta_0 + \beta_3\,\mathbf{X})/\beta_1) \times (-\pi/\beta_1) / \sin(-\pi/\beta_1).$$

Figure B.4 Scatter plot of averting cost vs. conditional expected values of WTP estimated from the log-logistic model on CV data



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APPENDIX C – WTP SURVEY DETAILS AND QUESTIONNAIRE

1. Introduction.

The survey carried out during the months of January and February, 2014 aimed at collecting quantitative data required to:

- assess the population Willingness To Pay (WTP) for improved water supply services,
- determine the income distribution of the potential beneficiaries of the program, and
- assess the affordability of improved services to potential beneficiaries.

This section briefly elaborates on key methodological aspects of the survey and descriptive statistics of the main variables.

2. Survey Methodological Aspects

Sampling Approach. As expected, both a complete list of all residential households in each of the four selected areas and socio-economic data on the relevant population were not available. As a result, (i) no change was introduced to the original sample size, which remained set at a 1,000 households, and (ii) an alternative sampling frame has been applied. The situation was made even more complex by the fact that program interventions will affect in a differentiated way people located in different divisions of Georgetown. After repeated discussions with both GWI, the decision to focus exclusively on those areas where the most significant improvements in water supply will be experienced was taken. In practice, the survey covered the following areas of Georgetown: (i) Kitty and Charlestown (where transmission and distribution mains will be rehabilitated), (ii) Sophia (benefiting from the expansion of the water treatment plant), and (iii) West la Pentience, Alexander Village, Riverview, and Industrial estate (which, are currently served by an industrial borehole). The number of households to be surveyed in each division of Georgetown and village outside Georgetown has been determined as a proportion of the total relevant population, estimated based on information provided by the GWI on the total number of domestic connections. As a result, the retained allocation of the 1,000 interviews to be carried out across survey areas was as follows:

- Georgetown: 240 interviews;
- Cornelia Ida-De Kinderin: 225 interviews;
- Diamond-Herstelling: 240 interviews;
- Cumberland-Williamsburg: 295 interviews.

Focus Groups (FG). Four FG were conducted (one in each of the four survey areas) and attended by 6-8 participants each. All FG were organized in close collaboration with the GWI (in a couple of cases the GWI took full responsibility for the identification and mobilization of participants). During all FG, lively discussions were facilitated, typically at the presence of GWI officials. Information retrieved provided extremely valuable inputs to refine the structure of the questionnaire, ascertain the applicability of some questions, and identify possible WTP values.

Training. One full-day training session for about 15 enumerators to be employed in fieldwork was conducted on January 17, 2014 at the Regency Hotel in Georgetown.

Field Testing. Field testing was carried out in the following days after the enumerators training in all four survey areas and allowed assessing the reliability and validity of questionnaires and monitoring surveyors during the interviews. As a result of field testing, a few changes were introduced in the questionnaire. The survey was officially launched on January 22, 2014.

Questionnaire. The preparation of the questionnaire was largely informed by the survey instrument utilized to carry out previous similar surveys in Guyana. Nevertheless, a limited number of changes were introduced to tailor the survey instrument to the present program. In particular, (i) Section C, aimed at collecting detailed information on water sources alternative to the GWI water supply, was significantly simplified. Based on information collected during fieldwork (and as indicated above), the large majority of GWI customers buy bottled water for drinking purposes, while the poorest people drink GWI tap water after some sort of treatment. Therefore, all other questions on alternative sources of water were removed and a couple of questions on water treatment activities were added; (ii) at the end of the questionnaire, one question asking for the rent fee paid by interviewees has been added. The final version of questionnaire is reproduced at the end of this Appendix.

3. Summary Results

Socio-demographic Features of the Households. According to survey data, the average family size is of 4.0 people. This value is broadly consistent with information collected in 2011 by a households survey carried out within the context of the World Bank-funded *Guyana Water Sector Consolidation Project* (WASCP)[9] in comparable areas, and setting the average household size at 4.39 persons. Interesting differences emerge among survey areas, with a larger household size found in new housing schemes outside Georgetown (in Herstelling-Diamond the average household size is 4.8 people), while the smaller household size is detected in Cornelia Ida-De Kinderen (3.3 people). The two remaining survey areas - Georgetown and Cumberland-Williambsburg - display a similar household size, i.e. 3.8-3.9 people on average.

In about three fourths of cases, houses are owned by respondents (74%), with the remainder evenly split between houses rented and occupied rent-free (i.e. by people living "by arrangements"), accounting each for 13% of the sample. Almost all interviewed households own a refrigerator (96%) and a TV (98%); a slightly smaller share of interviewees has a phone at home (88%), whereas a much smaller one has a motor vehicle, only 27%.

The percentage of respondents willing and able to disclose data on household income is extremely high (data were actually provided by 976 interviewees). All in all, the mean value of

[9] The WASCP supported the improvement of water supply through construction of three water treatment plants, installation of water distribution and transmission mains and metering in the following areas: (i) Region 2 (from Queenstown to Walton Hall), (ii) Region 3 (from De Kinderen to St. Lawrence), and (iii) Region 5 (from Shieldstown to Inverness). In order to WASCP assess impacts, a post project implementation survey was carried out in 2011 and its results compared with data gathered by a baseline survey conducted out in 2008. Data mentioned in the text refers to the most recent, post project implementation survey (see, University of Guyana, *FINAL REPORT: Consultancy Services - Post Project Impact Assessment of Water Sector Consolidation Project*, March 2012).

the household monthly income is estimated at almost GYD 95,705 (US$ 480), and the median value at GYD 80,000 (US$ 400). More detailed information on household income in different survey areas is provided in Table 1 below.

Table 1 – Household Income

Statistics	Overall	Georgetown	Cornelia Ida-De Kinderin	Diamond-Herstelling	Cumberland-Williamsburg
Mean	95,705	87,609	82,957	111,383	100,425
Median	80,000	80,000	75,000	80,000	80,000

Detailed information on occupation and related monthly income were collected for 1,295 people. The average monthly income earned is about GYD 60,920 (US$305). The most common occupations among active workers are "skilled worker" (about one fourth of the workers) and "civil servant" (14% of all income earners). The average monthly income displays only limited variations across occupations, with the notable exclusion of retired people and domestic workers, earning a comparatively much smaller amount. More detailed information on the income earned per type of occupation is provided in Table 2 overleaf.

Table 2 – Income per Occupation

Occupation	Share of people	Mean Income (GYD)
Self-employed as laborer	7%	60,449
Self-employed as trader	8%	65,565
Self-employed as professional	10%	78,836
Skilled worker	24%	68,997
Unskilled worker	9%	65,208
Office worker	10%	64,546
Domestic worker	5%	33,262
Civil servant	14%	64,581
Farmer	1%	59,618
Retired	12%	27,873
TOTAL	100%	60,920

GWI Water Supply: Quality and Quantity. A mere 7% of the interviewees assessed the quality of tap water supplied from the GWI as "*very good and drinkable without treating it*" and its supply as adequate. A higher, but still minor share of interviews – 12.5% - even if not satisfied by GWI water quality, drinks it after treatment some form treatment, essentially because they cannot afford to pay for alternative water sources of higher quality. Adding bleach and/or boiling are the most common forms of treatment applied (by 74% and 55% of relevant respondents, respectively), while only 11% of people drinking treated GWI water filter it. All in all, water provided by the GWI represents as main source of drinking water for less than 20% of the survey population; a further confirmation of the poor quality of water supplied and the urgent need for improvements.

In general, respondents' criticisms on GWI water supply largely focus on quality aspects: the bad color, typically reddish brown due to its iron content, was lamented by 73% of respondents and the unpleasant taste/smell by 65%. A smaller, but still not negligible share of the respondents lamented an inadequate supply (39%). Indeed, while the vast majority of respondents (96%) get water seven days per week, the continuity of the services throughout the day is less satisfactory. Detailed information on the number of hours per days of water supply is provided in Table 7 below.

Table 3 – Water Supply

Hours per day	Share of people
Less than 10 hours	8.2%
10-11 hours	15.0%
12-13 hours	15.6%
14-17 hours	27.7%
18-23 hours	19.3%
24 hours	14.2%
TOTAL	100%

Main Sources of Drinking Water. As stated in the previous section, less than one fifth of the surveyed population primarily drinks water from the GWI. Indeed, the large majority of the interviewees (about three fourths) drink bottled water. The tiny remainder of respondents (about 8%) relies upon natural sources, essentially rainwater collected in one or more bank tank(s).

Respondents purchasing bottles of water almost invariably buy five-gallon bottles, most commonly once or twice per week (61% and 20% of the cases, respectively). The number of bottles bought each time clearly varies depending on (i) the frequency of purchase, and (ii) the size of the households. On average, households buy 14 five-gallon bottles per month (median value: 12).

As a result, the purchase of bottles of water represents a significant expenditure on top the water bill. Indeed, the total monthly expenditures per family can be assessed at about GYD 3,820 (US$19) (median value: GYD 2,880 (US$13.69)). Using the median value, the additional cost per quarter can be estimated at GYD 8,640 (US$41.8), a value well above all types of unmetered GWI tariffs and average water charge. In the end, the assessment of the additional costs incurred by the households to cope with the effects of insufficient and unsafe water services indicates a large capacity to pay higher amounts to get higher quality water.

SOCIO-ECONOMIC SURVEY – WATER INFRASTRUCTURE IMPROVEMENT PROGRAM

Date __/__/____ (dd/mm/yyyy)

Start time of interview __:__ (from 00:00 to 24:00)

Time interview ended __:__ (from 00:00 to 24:00)

Name of interviewer ___________________________

Name of respondent ___________________________
(*optional*)

Street Address ___________________________

Phone Number ___________________________
(*optional*)

Area Code[10] ___________________________

ID Code[11] ____

[10] The Area Code refers to a village or group of villages or areas of Georgetown. It is a letter between A and O.
[11] The ID Code consists of a three digit sequential number starting from 001.

Interviewer: repeat here ID Code ____

A. INTRODUCTION AND BASIC INFORMATION

Interviewer: introduce yourself and the purpose of the survey

Good morning/afternoon/evening, my name is [ABC], and I am working on a study aimed at improving the water supply system in Georgetown, Cornelia Ida-De Kinderin, Diamond-Herstelling, and Cumberland-Williamsburg. The study is financed by the Inter-American Development Bank and its purpose is to better understand the current status of water supply services in these areas and if people are able and willing to pay for an improvement of the quality of these services. In particular, I would like to discuss this with the head of the household.

Please note that the information you provide will be kept confidential. Your name and the direction of your house will not be used in any document that is written about this survey. If you do not wish to respond to a question, please let me know and I will skip to the next one. Would you be willing to answer some questions?

Interviewer: the first step is to establish the eligibility of the household under the survey. To do so, ask the question below

A.1 Is your house connected to the GWI piped water system?

Yes	1
No	0

*Interviewer: if the answer is **No** (house not connected to the piped water system), thank the respondent and conclude the interview here. Otherwise, continue with the interview*

Interviewer: if the respondent is reluctant, reiterate your point and stress that information will be kept strictly confidential. If the attitude remains negative, ask the respondent reasons for refusal thank him/her and conclude the interview here.

Interviewer: the respondent should be the head of the household. If such a person is not available when you approach the household, introduce the survey and try to set a fixed date and time for you to return and carry out the interview. If it is not possible, replace this household.

A.2 Is this household a replacement household?

Yes	1
No	0

*[if **0**, skip next question]*

A.3 Why was the previous household replaced?

The head of household was not at home and was not possible to arrange for a following meeting	1
The head of household refused to be interviewed	0

A.4 Gender

Male	1
Female	0

A.5 What is your age? _____ years

Interviewer: in certain cases, especially when the interviewee is female, it may not be appropriate to ask this question. In case, put down your best guess

A.6 Do you rent or own this house?

Owned	1
Rented	2
Other (e.g. by arrangement)	3

B. PRESENT STATUS OF WATER SUPPLY SYSTEM

B.1 Do you have a water meter for the household connection?

Yes	1
No	0

B.2 Could you please show me the last water bill received?

Yes	1
No	0

*[if **1**, skip next question]*

B.3 Why could you not show me the last water bill?

I've never received it	1	*[if 1, go to question B.8]*
I do not know where it is	2	*[if 2, go to question B.5]*
It is confidential	3	*[if 3, go to question B.5]*

B.4 Could you please give me details of the price paid for water services?
Interviewer: fill out the following table with figures indicated in the water bill receipt

#	Bill items	Answer
B.4.1	Bill Period (*Interviewer: check it refers to the last quarter)*	_____________
B.4.2	Type of tariff	_____________
B.4.3	Water consumption (*Interviewer: this applies to metered connection only*)	M3_________
B.4.4	Water rate per M3 (*Interviewer: this applies to metered connection only*)	GYD_______
B.4.5	Water charge	GYD_______
B.4.6	Balance outstanding	GYD_______
B.4.7	Payment made since the last bill	GYD_______
B.4.8	**Total**	GYD_______

[go to question B.6]

B.5 Could you please provide me with an indication of the amount you should have paid for water received from GWI in the last quarter?
______ GYD

B.6 Did you pay the amount indicated in the last water bill?

Yes, fully	2
Yes, partly	1
No	0

*[if **2**, skip next question]*

B.7 Why you did not pay the full amount indicated in the last water bill?

The service was poor	1
The bill was wrong	2
I cannot afford to pay	3
Other (specify________________)	4

B.8 How do you evaluate the water pressure?

Strong	1

Sometimes strong, sometimes weak	2
Weak	3

B.9 How many days per week do you receive water from the piped system?
______ days
B.10 How many hours per day do you receive water from the piped system?
______ hours

B.11 Do you have a water storage tank?

Yes	1
No	0

B.12. What do you think of the quality of the water from the GWI?
*Interviewer: read and record answer for **all** possible options*

#	Water quality	Yes	No
B.12.1	Very good, drinkable without treating it	1	0
B.12.2	Can't drink it, good for cooking and hand washing only	1	0
B.12.3	Bad taste and bad smell	1	0
B.12.4	Bad color	1	0
B.12.5	Not sufficient	1	0

*[if **1** recorded for B.12.1 **only**, go to section D]*

C. OTHER WATER SOURCES

C.1. What is the main source of drinking water for member of your household?

Water from the piped system	1	*[if **1**, go to question C.2]*
Bottled water	2	*[if **2**, go to question C.5]*
Other	3	*[if **3**, go to question C.8]*

C.2 Do you treat your tap water before drinking it?

Yes	1
No	0

*[if **0**, go to section D]*

C.3. What kind of method do you use to treat tap water from the GWI?
*Interviewer: read and record answer for **all** possible options*

#	Treatment method	Yes	No
C.3.1	Boil	1	0
C.3.2	Filter	1	0
C.3.3	Add bleach (chlorine)	1	0
C.3.4	Other (specify_______________)	1	0

C.4 How much do you spend to treat tap water on a weekly basis?
________ GYD
[go to Section D]

C.5 How much water do you purchase every time?

#	Type of container	Number of containers
C.5.1	1 liter bottle	______
C.5.2	1.5 liter bottle	______
C.5.3	5-gallons bottle	______

C.6 How often do you buy your drinking water?

Every day	1
Every 2 days	2
3 times a week	3
2 times a week	4
1 time per week	5
2 times a month	6
1 time per month	7
Other (specify ______________)	8

C.7 How much do you pay each time you buy water?
________ GYD
[go to Section D]

C.8 Please provide a detailed description of how you get drinking water

Interviewer: note down all relevant information, such as the source (surface water, water tankers, rainwater collection), the collection frequency, the time spent, the quantity collected, the price paid, etc.

____

____

____

D. WILLINGNESS TO PAY

Interviewer: read carefully

There is a project to improve the water supply system in your area. This project would improve the reliability of services, providing water all times during the day, and the quality of water supplied, which will be very clean and potable without treatment, thereby eliminating the need of treating/buying water as well as the occurrence of water-borne diseases, such as diarrhea and other illnesses.

Is this explanation clear to you? Do you have any questions about it?

D.1 However, the realization of this water infrastructure improvement project would require an increase of the water charge. Your household currently pays GYD … (see question B4.5 or B.5 or use the code sheet for reference) per quarter for water supply services to the GWI (and, if C.1=2, GYD … to buy bottled water, see question C.7). If you were to receive "satisfactory water supply services" as was explained, would you be for or against paying the following additional amount <u>per quarter</u>? Note that this amount would be <u>on top of your current quarterly household expenditures</u>.

#	Additional amount per quarter (in GYD)	Yes	No	Do not know
D.1.1		1	0	99

*[if **1**, skip next question]*

D.2. What is your reason for not being sure/willing to pay for improving the water supply system?

I cannot afford to pay	1
I think I pay too much for the water bill already	2
I think that these costs should be borne by GWI	3
I think that these costs should be borne by the Government	4
I do not consider the improvement of the water supply system as a valuable project	5
Other (specify_______________________________)	6

E. HOUSEHOLD DEATILS & TOTAL MONTHLY INCOME AND SAVINGS

E.1 Do you have a refrigerator?

Yes	1
No	0

E.2 Do you own a color TV?

Yes	1
No	0

E.3 Do you have a phone at home?

Yes	1
No	0

E.4 Do you have a motor vehicle?

Yes	1
No	0

E.5 What is the total number of people living in this house/apartment? _____

E.6 Could you please provide us details of any people who earn money for the household?
Interviewer: fill out the table below, using appropriate codes reported in the codes sheet.

#	Position in household	Sex (1=male, 0=female)	Age	Type of work	Last month income (in GYD)
E.6.1					
E.6.2					
E.6.3					
E.6.4					
E.6.5					
E.6.6					

E.7 Do you have any other sources of income?

#	Source of income	Last month value
E.7.1	House renting	GYD_______
E.7.2	Remittances	GYD_______
E.7.3	Other (specify___________)	GYD_______

E.8 So, can we say that the total monthly income received in this house in the last month was?
________ GYD

E.9 How much did you spend on food purchases for this house in the last month? ______GYD

E.10 How much did you spend on electricity for this house in the last month? ________ GYD

E.11 If you rent this house, what's your monthly rental payment? ________ GYD

THE SURVEY ENDS HERE, THANK YOU

Interviewer: repeat here ID Code____

END NOTES FOR THE INTERVIEWER

Do you believe that the respondent's answers are

Truthful	1
Somewhat truthful	2
Untruthful	3

Do you believe that the respondent's answers regarding figures are

Accurate	1
Somewhat accurate	2
Inaccurate	3

Note here below whatever observations or comments you may have, in particular with respect to problems that could influence results

____
____
____

END NOTES FOR THE SUPERVISOR

Date of check __/__/____ (dd/mm/yyyy)

Time of check__:__ (from 00:00 to 24:00)

Name of supervisor ___________________________

Note here below whatever observations or comments you may have regarding the validity of the interview

____
____
____