MILLENNIUM CHALLENGE GEORGIA FUND / MCG
REDUCING POVERTY THROUGH GROWTH

Millennium Challenge Georgia Fund

RID Impact Evaluation Project

Impact Evaluation Design And Data Collection

Deliverable E

Appendixes

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TBILISI BUSINESS SERVICE CENTER

ACT Marketing Research & Consulting

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LIST OF ABBREVIATIONS

ACT	ACT Research
ADA	Agriculture Development Activity
CGE	Computable General Equilibrium (analysis and models)
CRRC	Caucasus Research Resource Center
CV	Compensating Variation
DS	Department of Statistics of Georgia
ERR	Economic Rate of Return
EUR	Euro
EV	Equivalent Variation
FDI	Foreign Direct Investment
FIZ	Free Industrial Zone (in Poti, and perhaps in Kutaisi)
GoG	Government of Georgia
GRDF	Georgia Regional Development Fund
IDP	Internally Displaced Person
IEC	Information, Education and Communication campaign
ISET	International School of Economics at Tbilisi State University
MCC	Millennium Challenge Corporation
MCG	Millennium Challenge Georgia
NRW	Non-Revenue Water
PE	Partial Equilibrium (analysis)
RID Project	The entire Regional Infrastructure Rehabilitation Project
RID Projects	The individual city projects within the RID Project
RID IEP	RID Impact Evaluation Project
ROW	Rest of the World
SACE	Statistical Classification of Economic Activities in the European Community
SAM	Social Accounting Matrix

SPSS	Statistical Package for Social Sciences.
S-J	Samtskhe-Javakheti Road Rehabilitation
TBSC	Tbilisi Business Service Center
USD	United States Dollar

APPENDIX A

CONTEXT, KEY RESEARCH QUESTIONS AND RID IEP STATUS

A CONTEXT, KEY RESEARCH QUESTIONS AND RID IEP STATUS

Over the last six months,[1] Tbilisi Business Service Center (TBSC), the International School of Economics at Tbilisi State University (ISET) and ACT Research (ACT) have gained an understanding of the Regional Infrastructure Development (RID) projects for Kobuleti, Kutaisi, Poti, Bakuriani and Borjomi. The RID IEP sought to understand how municipal drinking water rehabilitation and wastewater treatment will impact businesses, economic growth, poverty rates and the quality of life for over 250 000 Georgians living in these cities.

Through consultations with Millennium Challenge Georgia (MCG), three rounds of site visits to the RID cities, discussions with municipal stakeholders and literatures and survey reviews, the RID IEP has gained a good understanding of how the impacts of water quality and quantity improvement can be measured. Over this time period, the RID IEP also considered how best to measure the impact of the rehabilitations given the time constraints of the RID IEP, each RID projects' completion date and the timing of the impacts.

The RID IEP believes that the Impact Evaluation Design, shown in the Report that accompanies these Appendixes, best suits the local conditions, project timeline and needs of the specific research questions posed in the terms of reference.

This Appendix has two Sections. The first Section describes the context of the RID IEP within MCC and MCG. This is based on a review of publicly available information from MCC and conversations with MCG.

The key research questions, (exactly) from the terms of reference, are then listed with an elaboration on each as to the results that can be expected from the RID IEP in each area. Our interpretations of the key research questions have been reviewed with MCG on several occasions so there should be no remaining uncertainty as to meanings.

A.1 CONTEXT FOR THE RID IEP

While preparing the Impact Evaluation Design the RID IEP reviewed the MCC website to gain an understanding of its approach to impact measurement. Extracts from the website are presented in this Section along with comments on their influence on the Design.

> "MCC is committed to conducting independent impact evaluations of its programs as an integral part of its focus on results. These rigorous assessments of project impact often enhance the design of programs, provide critical information regarding the performance of specific activities, and contribute to a broader understanding of development effectiveness.
>
> "An impact evaluation measures the changes in individual, household or community income and well-being that result from a particular project or program. The distinctive feature of an impact evaluation is the use of a counterfactual, which identifies what would have happened to the beneficiaries absent the program. This counterfactual is critical to understanding the improvements in people's lives that are directly caused by the program."

[1] Mid-December 2008 to late July 2009, when the final draft of this Report is submitted to MCG.

The Design is rigorous and expansive. We have applied the best methods available to quantify impact in the areas noted in the Key Research Questions. Wherever possible we have applied treatment and control methods to ensure that counterfactuals are as clear as possible. We have also gone beyond only measuring impact in order to provide guidance for future infrastructure projects of this type. The methods also are designed to facilitate sound calculations of overall Economic Rate of Return (ERR).

MCC notes three ways that improved water and sanitation can general additional income to beneficiaries:

> "Decreased cost of water. Improved water supplies can lower the costs of water use and/or reduce the time spent obtaining water, which can generate income if time is used in a more productive manner.
>
> "Reduced incidence of disease. Improved water supplies and/or sanitation services can lower the incidence of water-borne disease among users and the wider community. The reduction in morbidity and mortality can raise labor productivity over the long term.
>
> "Increase in private business activity. Improved water supplies can facilitate business expansion. Many businesses rely on water as a production input, and a more convenient water supply can reduce the cost of that input."

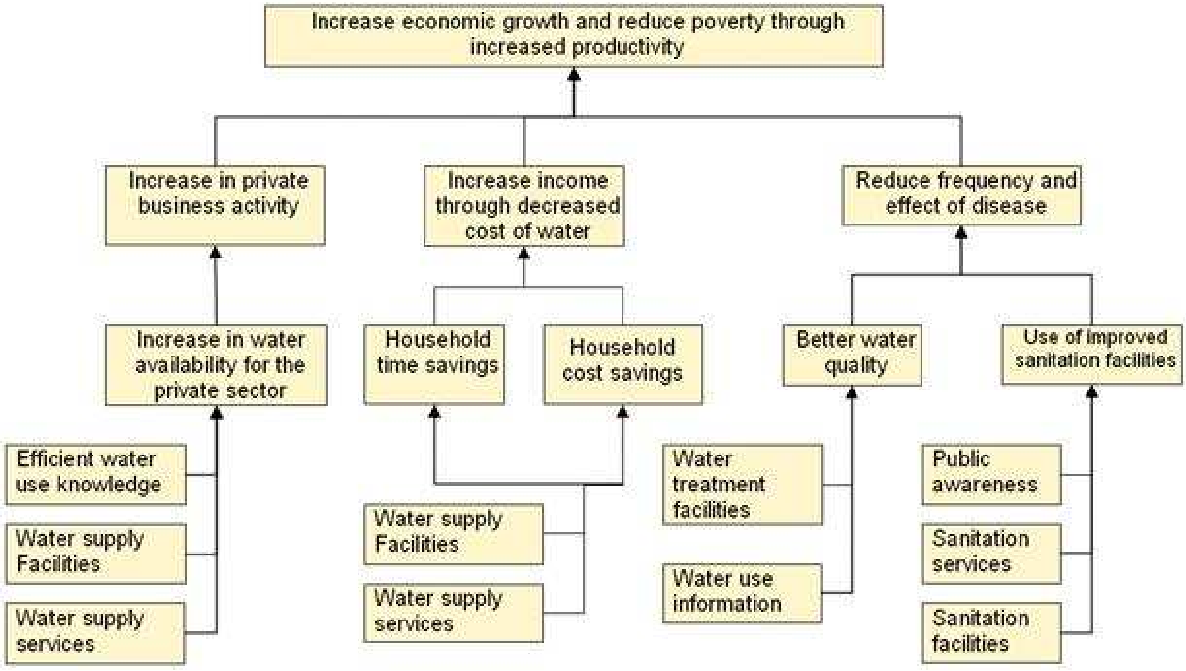
The Design addresses each of these benefit areas. Decreased water cost (a direct effect) is estimated for both individual households and firms using micro-model analysis. At present a baseline incidence of water-borne disease will be established using pre- post survey analysis. This can be compared to the ex-post results when the ex-post survey work is done. Changes in business activity will be estimated as part of the CGE analysis. The first two areas are addressed with a proper treatment and control design.

> "Although the proximate benefits of water and sanitation projects are clear, their wider impact is often improperly understood. The drought of serious study on the matter has in many cases left important questions without answers. MCC-funded projects examine not only the direct impact of improved water and sanitation in terms of time savings and/or reduced illness, but also the broader impact these interventions have on productivity and poverty reduction."

The use of CGE analysis and micro-simulation analysis is directed at just this issue. The Design will enable us to well estimate impact on productivity and poverty, including distribution of income issues.

MCC shows its overall approach to impact measurement for water system with the following chart from the MCC website. Every box in the approach is addressed in one or more ways by the Impact Evaluation Design.

1. MCC Approach To Impact Measurement For Water Systems



Source: MCC Website.

A.2 KEY RESEARCH QUESTIONS

The RID IEP work is focused on the key research questions developed by MCG and expressed in the terms of reference. The following four Sub-Sections discuss the four key research questions and (examples of) how the Impact Measurement Design will answer the question. The last Sub-Section discusses a number of other issues raised in the terms of reference.

A.2.1 What is the impact of each RID project on reducing poverty and fostering economic growth in the communities where projects are implemented and neighboring communities?

Impact is very broadly defined in the context of the Design. Once the renovated water systems begin operation, impact will include direct effects (*e.g.*, how much less households spend pumping water from their own well) and indirect effects (*e.g.*, how does citywide GDP change). In the Design we focus on identifying the full range of impact areas (arranged in a hierarchy) and then quantitative measures of direct and indirect impacts (quantitative metrics). Where quantitative measures are not suitable (*e.g.*, taste of water) we have relied on qualitative measures (qualitative metrics).

The Design will provide measures of *poverty reduction* at both the macro- and micro-levels. On the macro-level we will estimate changes in household income among three types of representative households. We will then delve into changes in the structure of household income within each of the representative household types at the micro-level. Based on some testing we have done with greatly simplified models, a likely outcome will be that 1) overall household income rises from better water systems and 2) income disparities increase with wealthier households receiving the greatest increase in benefits.

The Design provides measures of changes in income levels; it does not attempt to define poverty per se. In fact, the exact definition of poverty is not really needed for the analysis to proceed (*e.g.*, we will be able to report results using any income level or consumption indicators as the cutoff for poverty or extreme poverty). We will take guidance from MCG when needed on the definition of poverty that will be used.

We will estimate *economic growth* (*i.e.*, changes in local and national GDP) through the use of economic macro-models. This will be disaggregated among industries important in each of the RID cities. The change in GDP will include both direct effects (*e.g.*, individual household coping costs extrapolated to the entire city) and indirect effects (*e.g.*, the effect that lower spending on coping has on the wider economy).

The Design provides impact measurement at both the individual RID city (*community*) level, all the RID cities together and nationally. These measurements will be for direct impacts (*e.g.*, time spent ensuring a water supply for a household – there are significantly different coping strategies by city) and indirect impacts (*e.g.*, GDP growth). The effect of the RID projects on *neighboring communities* will be quantified in terms of labor mobility (*i.e.*, people moving to the RID cities in response to greater demand for labor).

A.2.2 What is the *aggregate impact* of all RID projects on *poverty* and *economic growth* (in terms of household income and value-added for businesses)?

The RID IEP will measure the macro- and micro-level impacts of the RID projects. The macro-economic models will provide the *aggregate impact* (*e.g.*, *GDP growth* by RID city, including both direct and indirect impact).

The aggregate (direct and indirect) impacts, both economic activity and profits, will be disaggregated to the level of individual households and firms with a number of micro-simulations. These will differentiate impact by household and business income levels. In particular, the impact of the RID projects on *poverty* will be examined.

A.2.3 What is the impact of the RID water and sanitation *interventions* on *health* and *productivity* in the communities where projects are implemented?

The Design focuses on estimating the implications of the RID project *interventions* (*i.e.*, the five water systems and two sewer systems). A key feature of the economic models is that they permit clear identification of the causal factors for economic growth such as the water and sewer systems or other enablers.

Health measurement will be dealt with qualitatively. Water quality is tested in most of the RID cities though the reliability of that testing is open to question.[2] It is beyond the scope of the RID IEP to install water quality monitoring systems that would be needed for quantitative conclusions. Consequently, the design calls for a summary of existing testing results plus qualitative measures (*e.g.*, self-reports by households of water borne diseases over the past year).

The combination of micro- and macro-models will provide direct measures of the impact of the RID projects on output, prices and wages (*i.e.*, on *productivity*).

[2] The local water utilities appear to take testing seriously, but the methodologies used for sample selection and testing are not modern.

A.2.4 What is the impact of complementary RID activity with other Program Activities (*e.g.*, ADA or GRDF)?

The Design includes a number of case studies that will characterize the impact of the RID projects on *other Program Activities*, specifically the ADA and GRDF. The case studies will focus on the intersection of benefits and costs from the RID projects on the first hand and the other Program Activities on the second hand.

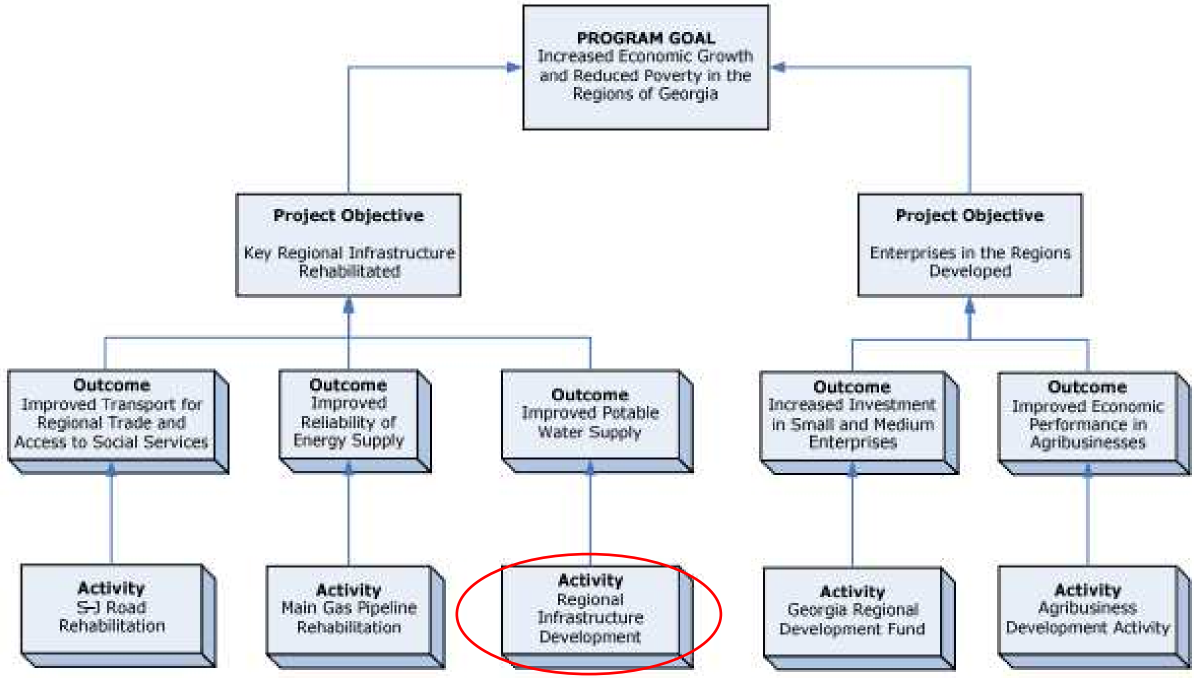
Case studies were selected for this purpose because the number of complementary projects is somewhat limited. Four of 146 ADA projects are in a RID city (*i.e.*, Kutaisi) representing 260 000 USD of the total seven million USD disbursed (four percent). These projects include a meat processor and fruit dryer (significant users of potable water) and a greenhouse and nut processor (small users of potable water). The number of projects is sufficiently low to permit a case study approach.

A.2.5 Other Issues Raised In The RFP

There are a number of other issues raised in the terms of reference that bear upon the key research questions such as whether overall RID objectives are being achieved and distribution of benefits by gender, age and so forth. Each of these other issues is described in the following paragraphs.

Whether Goals, Objectives And Targets Of The Project Have Been Achieved, If Not Explain The Reasons. Portions of the Design were created with the measurement of goals, objectives and targets, as specified in the M&E Plan, in mind. The following chart shows the general organizations of these levels of impact. The Outcome (improved potable water supply) and the Project Objective (key regional infrastructure rehabilitated) will be achieved simply by the completion of the RID projects. The Impact Measurement Design focuses on measuring achievement of the overall Program Goal (increased economic growth and reduced poverty in the regions of Georgia). The Design will measure these things at the macro- and micro-levels.

2. <u>Goal, Objective, Outcome And Activity Of The RID</u>



Source: MCG M&E Plan

The M&E Plan identifies one assumption and a number of risks for achieving the intended results. The Design includes assessment of consumers' willingness to pay. This is approached from an economic perspective (*e.g.*, will the actual total cost of water be reduced after RID projects are complete) and from a consumer behavior perspective (*e.g.*, consumers' stated propensity to switch). The Design will permit assessment of the risk situation after implementation of the ex-post portion of the Project (*i.e.*, Phase III).

3. <u>Assumptions And Risks For Outcome 3: Improved Potable Water Supply</u>

ASSUMPTION	RISK
▪ **Reliable water supply will contribute to consumers' willingness to pay**	▪ Actual operation and maintenance cost can exce ▪ Willingness of population to pay service fee to owners of the infrastructure system ▪ Limited financial capacity of the municipalities to maintain rehabilitated systems ▪ GoG default on operations and maintenance

Source: MCG M&E Plan

The Design will measure the Economic Rate of Return (ERR) for each of the RID projects (and for RID overall) in a number of ways. Well established and relatively new measures of ERR are used.

4. <u>Expected Economic Rate Of Return For RID Projects</u>

PROJECT	ECONOMIC RATE OF RETURN
Bakuriani	17,8%
Poti	15,4
Kobuleti	17,7
Kutaisi	18,0
Borjomi	15,9

Source: MCG M&E Plan

The Design will also measure the number of affected beneficiaries.

5. Expected Number Of Beneficiaries For RID Projects

ACTIVITY	BENEFICIARIES
Regional Infrastructure Rehabilitation Project	
S-J Road Rehabilitation	53 988
Main Gas Pipeline Rehabilitation	n.a.
RID	265 964
Enterprise Development Project	
GRDF	4 400
ADA	54 246

Source: MCG M&E Plan

A number of M&E indicators apply to the RID projects. The following chart shows these indicators and representative Design features for each indicator. At the end of Phases I and II the values for each indicator will have been estimated (*i.e.*, forecast). At the end of Phase III the achievement of these estimates will be measureable.

6. M&E Indicators Related To The RID Projects

INDICATOR	DEFINITION	REPRESENTATIVE DESIGN FEATURES
Program Goal: Increased Economic Growth And Reduced Poverty In The Regions Of Georgia		
Household Benefits Generated Form Program Interventions	Aggregate cumulative household savings derived from RID and S-J Road Rehabilitation and household net incomes derived from ADA and GRDF	Estimated overall increases in GDP at both the RID city and national levels
Project Objective: Key Regional Infrastructure Rehabilitated		
Household Savings From Infrastructure Activities	Aggregate cumulative savings in vehicle operating costs from S-J Road activity and savings in household utility expenditures from RID activity	Expected savings in coping costs at both the individual household and firm level and the economy-wide levels in each of the five RID cities
Outcome: Improved Potable Water Supply		
Savings In Household Expenditures For All RID Sub-Projects	Savings in household costs associated with the reduction of household utility costs, increased water quality and improved supply availability	Expected savings in coping costs at both the individual household and firm level and the economy-wide levels in each of the five RID cities
Population Served By All RID Sub-Projects	Total number of population of cities: Poti, Kutaisi, Kobuleti, Borjomi and town Bakuriani, which will benefit from the improved potable water supply sys	Expected number of people served by the RID project in each RID city, including breakdowns by gender and age
Water Consumption	Average amount of liters of water consumed per capita, per day	Expected number of liters used by different types of households and businesses

Source: MCG M&E Plan

<u>Identify Any Unintended Positive Or Negative Impact Of The Project.</u> The Design is intentionally very broad; impact is being measured in many different areas. We expect that unintended positive and negative impacts will become apparent in both the quantitative and qualitative parts of the Design.

<u>Assess Impact Of The Project On Economic Growth, Poverty Reduction, Income Of Project Beneficiaries At Various Project Locations, As Well As At The Aggregate Level.</u> Each of these areas is addressed by the Design. The economic models will provide macro-level results. The micro-models will do the same at the level of the individual household and firm. Distributional effects will be assessed with micro-simulation analysis.

Analyze Beneficiaries, Including Their Number, Characteristics, Including Gender, Age, Rural Or Urban Location And Income Level. There will be an in-depth demographic section for each survey. The Design provides for reporting results by gender, age, location and income level. Note that essentially all beneficiaries live in urban areas. Consequently there will be few results for rural areas.

Assess Sustainability Of The Projects Implemented. At the end of the RID IEP we will summarize the RID projects in terms of their sustainability. These will be qualitative assessments.

The project will also evaluate the effects of the investments in terms of public deficits and tax collection. If revenues rise as a result of them, this will indirectly tell us that these kinds of exogenous investments are sustainable in the future from the point of view of the national/local governments.

Estimate Final Economic Rate Of Return For Each Project Funded, Comparison To The Target Figures And Explanation For Any Difference. The Design provides for collection of complete economic information for benefits from the RID projects. These will be compared to project costs and a number of measures of the rate of return will be calculated.

General Lessons Learned That Can Be Used In Other Similar Projects. The RID IEP will summarize general lessons learned in qualitative form as part of the final report.

APPENDIX B

ECONOMIC AND ENVIRONMENTAL DESCRIPTONS OF RID CITIES

B ECONOMIC AND ENVIRONMENTAL DESCRIPTIONS OF RID CITIES

It is expected that the economic and environmental situations will improve in the RID cities as a result of the RID projects. The design of the methods to be used to measure that improvement (*i.e.*, the Impact Evaluation Design) requires an understanding of the present economic and environmental situations in each RID city. These conditions are described in this Appendix.

The Appendix starts with an overview of the conditions in several of the RID cities vis-à-vis the RID IEP. This Section is a summary of an existing RID IEP report.[3] The Appendix concludes with separate Sections on each RID city.

B.1 OVERVIEW OF RID CITIES AND IMPLICATIONS FOR RID IEP

Early in the Project we formed a number of preliminary observations and categorized them into several areas: overall benefits, issues with individual projects (cities) and issues with measuring Economic Rate Of Return (ERR). We revisited these observations in the context of the Design and have found that most remain valid as described below.

B.1.1 Overall Benefits

Observations on overall benefits included project-wide findings that influenced the Impact Measurement Design. Different and uncertain starting and ending dates of the water projects and uneven timing for the realization of potential benefits guided our Design. For example, the project in Kobuleti will likely not be finished before the end of the MCG Compact; this makes an ex-post study in Kobuleti very unlikely. Consequently, the Design has a strong economic forecasting element that applies even without ex-post data.

The following chart shows the most current estimates of RID project timings.

7. Current Status Of RID Projects

PROJECT (firmness of dates)	WATER SYSTEM			SEWER SYSTEM	
	SUPPLY	DISTRIBUTION NETWORK	METERING	COLLECTION NETWORK	TREATMENT PLANT
Kutaisi (firm)	Before November 2010	Before October 2010	Before November 2010	n.a	n.a
Poti (completed)	Complete	Complete, minor repair works under way	Complete	n.a	n.a
Kobuleti (semi-firm)	Before June 2010	Before November 2010	Before November 2010	Before November 2010	Before November 2010
Borjomi (semi-firm)	Before October 2010	Before November 2010	Before November 2010	Before November 2010	Before November 2010
Bakuriani (semi-firm)	Before October 2010	Before October 2010	Before October 2010	Before October 2010	Before November 2010

Source: Board Memos.

[3] *RID Impact Evaluation Project Preliminary Observations Final*, January 28, 2009.

We also found in feasibility studies conducted previously, that the Present Value (PV) of benefits are primarily "loss of tourists avoided" with large variation in total PV of benefits among the RID projects. In particular, almost 100 percent of benefits arise from the "loss of tourists avoided" in Borjomi, Bakuriani and Kobuleti, while energy savings and improvement in water quality are the most important sources of PV of benefits for Poti and Kutaisi.

The term "loss of tourists avoided" is subject to several interpretations. Consequently, the Design does not use this particular measure of impact. Rather, the number of hotel rooms and the occupancy rate of hotels are used as measures of impact.[4] The broad range of economic indicators of impact (*e.g.*, effect on GDP, real wages, real prices) makes this one particular measure of impact un-necessary.

We concluded that firms and individuals have found practical, although costly, ways to cope with unreliable water supplies. They install private wells and storage tanks to smooth the water supply. In order to estimate the benefits of rehabilitated water systems for households and businesses, clear distinction between sunk costs and benefits has been made in the Design. For existing businesses, the cost of wells and tanks are mostly sunk costs, while for new businesses the avoided cost of new wells and tanks will be counted as benefits. Perhaps counter intuitively, existing firms who have already incurred fixed coping costs (*e.g.*, digging a well) will be at a somewhat competitive disadvantage compared to new firms who will not need to incur fixed coping costs. Currently, water costs for both businesses and households include both fees paid to the utility plus ongoing coping costs. New water systems have the potential to reduce these costs.

The planned tariff structures have businesses paying substantially more than households, a cross-subsidy. This is required to keep tariffs affordable for households. Some businesses will find that it is still less expensive to use their own well and tanks rather than use the new water system. Consequently, benefits to these businesses will not occur. Some benefits will accrue primarily as a result of change in peoples' behavior, since the 24/7 water supply is expected to reduce the overall water consumption. This is mainly due to idling water tanks. There are several other potential sources of benefits which need careful handling; these are reflected in the Design.

B.1.2 <u>Issues With Individual Cities</u>

There are issues with individual RID projects (cities) that complicate the method of measuring impact and ERR. Obtaining a genuine baseline in Poti is problematic, since the baseline requires data from before the water system becomes operational. On the other hand, doing ex-post work in Kobuleti seems problematic, since the water project is expected to be finished in 2011 or later – after the end of the MCG Compact. Another complexity has been identified in Kutaisi, where the benefits will not be uniformly distributed, due to heterogeneity of the level of infrastructure development. The Design reflects these issues.

B.1.3 <u>Issues With Measuring Economic Rate Of Return (ERR)</u>

Impact and ERR of the RID projects largely depends on general economic environment in the country. The August war and the general international financial situation may cause the NPV of projects to fall precipitously. Normally, benefits are in the context of extra growth due to

[4] Taking the number of hotel rooms and occupancy rates at two different moments in time could give an estimate of the "number of tourists avoided" if desired.

the intervention (*e.g.*, a new water system). However, economic activity in the RID cities may actually decline during the survey period due to general economic conditions. As a result, impact and economic benefit can be defined as negative growth avoided due to the water system.

There is a well developed Design (EIRR, ENPV) for measuring the Economic Rate of Return (ERR). However more rigorous financial method(s) for measuring ERR can be added. Once the economic benefits are estimated, forecasted and quantified, EIRR and ENPV can be applied to them, but there are some caveats, such as discount rate and decision criterion in the case of ENPV. EIRR needs more careful handling, since the reinvestment rate assumption is often criticized by the academics. Some problems with EIRR can be solved by using the Modified Economic Internal Rate of Return (MEIRR). According to MEIRR, Investments (outflows) are discounted to the present and benefits (inflows) are taken to the future. As a result, MEIRR is an interest rate that sets PV of outflows equal to terminal value. MEIRR has another attractive feature of being able to aggregate independent projects with different time horizons. We have discounted the investment outflows for each RID project and have calculated the future value of potential benefits for each RID project and for RID generally.

B.2 KUTAISI

The situation in each RID city is somewhat different from that of other cities. This Section describes the situation in Kutaisi based on reviews of the feasibility reports and four on-site visits in January through May 2009. A total of 15 man days were spent by the RID IEP team in Kutaisi to collect information shown in this Section.

B.2.1 General Description

Kutaisi, the second largest city in Georgia, has a population of 188 600 people.[5] The city used to be a major industrial center in Georgia. The truck factory, the main enterprise in the city, employed about 45,000 people; the factory does not operate today although parts have been privatized and are operating. Kutaisi was also a center for the agriculture, mineral and timber industries in the Imereti region. After the collapse of the Soviet Union, the region lost traditional markets for its products and supply relations.

At its peak, the city population was around 250 000, but now it has dropped to 188 600. The population reported prior to economic collapse in Georgia was 232,510 (1989 census), suggesting a 1.7 percent average reduction rate per annum. The actual population of the city is considered to be even lower, since many registered inhabitants of Kutaisi reside in other areas. The number of Internally Displaced Persons (IDPs) residing in Kutaisi was estimated at 14 180 in 2003.[6]

B.2.2 Water Situation

The city has struggled with a water supply shortage for years. Moreover, Kutaisi has never had a 24/7 water supply, except several small districts in the city. Kutaisi's first water supply was constructed in 1928 and the system has gradually expanded to serve the city using only

[5] According to Department of Statistics of Georgia (DS) census conducted in 2002
[6] UNCHR, 2003, as reported in Jacobs Gibb FS

groundwater sources. In recent years the system has deteriorated due to underinvestment in infrastructure. The main issues related to water problems can be summarized as follows:

- Poor condition of water distribution network resulting in high leakage
- The system requires constant pumping, which is both expensive and unreliable due to energy cut-offs (electricity supply problem has been solved recently)
- Low collection rates
- High risk of water borne diseases
- Sewage treatment facilities are not operational and sewage flows directly into the adjacent river.

In January, 2009 rehabilitation of distribution network was finished on two main avenues of the city and works were under way on another 28 streets. The Kutaisi RID project is expected to be finished by 2010.

Kuttskalkanali, the local water utility, supplies more than 180 000 people with water, plus 2 000 people in Gumati village, located to the north of the city and 3 000 people in small villages close to the main well field sources. According to water-company records, in 2004, a total of 37,5 million m^3 of water were abstracted from the well fields, while only 18,6 million m^3 was billed to consumers.

City inhabitants are supplied with water according to a predetermined schedule. Different areas have different schedules and various lengths of water supply period. This difference is mainly due to geographical location. About 75 percent of the population receives water six hours every other day. The rest of the population is supplied with water on a daily basis, up to 18 hours a day. This imbalance is due to asymmetric location of residential areas in the city. Stable provision of electricity has made it possible to supply water to the city according to a stable schedule. Reportedly, this increased the level of satisfaction of households and improved collection rates.

Almost 60 percent of city inhabitants live in apartment blocks, while the rest reside in private houses. There are 760 apartment blocks in the city. People have found practical, but costly ways to cope with the inefficient water supply. A large portion of the population living in private houses have their own wells, while inhabitants of residential blocks use individual and community water tanks to store water.

Storing water in tanks is believed to increase overall consumption of water, since the volumes of water tanks are greater than the volume of water used in one day; when water is available people empty (waste) the remaining water from the tank and fill it with fresh water. As a result, reservoirs from which city are supplied are not enough to provide water 24/7. Given normal consumption patterns and reduction in leaks in the distribution network, the current capacity of reservoirs would be sufficient to supply the city with water up to 18 hours a day.

The vast majority of consumed water by households is not metered, while 100 percent of businesses use water meters. Consumption for connections that are not metered is derived through the application of normative values to the registered population in each apartment.

The quality of water supplied to population reportedly has been improving during recent years. A laboratory operated by the local water utility conducts water quality tests on a regular basis and the share of substandard quality water cases has been decreasing. Reportedly, no serious water borne diseases have been observed in the city recently.

The rehabilitation project entails:

- Rehabilitation of the wells at the source
- Rehabilitation of reservoirs and pumping stations
- Installation of new pumps
- Partial rehabilitation of the existing city network (both water and sewer)
- Cleaning and inspection equipment and urgent repairs into the wastewater system in several, most vulnerable areas
- Supply and installation of water meters for 100 percent of households
- Financial and operational restructuring of the Kuttskalkanali LLC.

The estimated cost of the project is $20.5 million. Up to $12 million is financed by MCG.

B.2.3 Key Industries

As already mentioned, Kutaisi used to be a large industrial center, but after the collapse of the Soviet Union, the city lost this role. However, Kutaisi still remains an important part of the Georgian economy.

The main economic activities in Kutaisi are centered on the service and trade sectors. Industry, once the largest sector, now accounts for about 25 percent of the local domestic product[7]. Most of the present industry can be characterized as light industry including food processing, small shoe factories, furniture and stone carving enterprises. The beer and lemonade factory AIA, which is the largest private consumer of water in Kutaisi, is an important enterprise in the city. The city has well developed commercial, retail and banking sectors, which provide important sources of employment. One can also observe an increasing number of residential blocks and commercial spaces being developed in the city.

Four new enterprises have been financed in Kutaisi by CNFA, within the framework of the ADA. These enterprises include a fruit dryer, nut processing plant, meat processing plant and a greenhouse. A total of 260 000 USD has been invested in these enterprises by MCG through the ADA. These enterprises are small, but are important since the Imereti region (the center of which is Kutaisi) has a rich agricultural sector and there is a potential to develop agricultural products processing facilities in the city. Another project, financed by MCG, through GRDF is the construction of a hotel in Kutaisi.

Another factor that adds importance to Kutaisi is its location. The city is easily accessible and remains one of the major traffic and transit points for the flow of goods between Europe and the CIS countries and Asia. The city is close to Georgia's sea ports of Batumi and Poti.

[7] Jacobs Gibb FS estimates.

Recent initiative of the Government of Georgia to reconstruct the historical part of the city is aimed at turning the city into an attractive place for tourists. Kutaisi is one of oldest cities in Georgia, surrounded by many important and ancient churches and cathedrals.

B.2.4 Final Observations

Benefits received by citizens from current water system are asymmetric. Some residential areas are located near the main water distribution pipeline and as a result they benefit from longer schedules of water supply. In the city, where the length of internal water network makes up 450 km, only 32 km is planned to be replaced.

Even after the completion of water system rehabilitation, citizens of Kutaisi won't be supplied with water 24 hours a day, primarily due to leaks from non-rehabilitated water mains. This complicates the task of measuring maximum potential benefits, since the maximum benefits will hardly be achieved.

In the Avtokarkhana district, with a population of 40 000 people, where the largest part of infrastructure is planned to be replaced, real estate prices have gone up and urbanization of this part of the city will most probably continue with higher rates. This part of the city will receive more benefits from infrastructure development than any other part of the city. As a result, results for this district might be treated individually. This district is also important for health issues, since currently 90 percent of water quality test failures come from this part of Kutaisi.

Due to use of outdated and inefficient water pumps by the water utility and the extensive usage of water pumps by households to pressurize water, electricity consumption in the city is high. Energy usage is expected to drop by 40 percent after rehabilitation. The Kutaisi Municipality subsidizes the water utility by 4 GEL million per year.

Some businesses (*e.g.* AIA) believe that water is and will be very expensive (3,5 GEL per m^3 for businesses) and that the quality of water is and will be poor. They are planning to search for another source of water (a spring) or dig their own well. According to their estimates, costs will be lower if they utilize their own well or transport water from nearby springs. To develop alternative sources of water is even easier for other enterprises. For example, while AIA can not use water from the well for lemonade or beer production, hotels can and do utilize wells and might not be motivated switch to the new water supply system if the water tariff is high.

Another observation is that governmental institutions, such as military bases and a prison are top users of water in the city. As a result RID IEP team has decided to treat these organizations individually. The approach to be utilized for evaluating the impact of RID on these organizations is discussed further in Chapter 8 of the accompanying Report.

B.3 POTI

This Section describes the situation in Poti based on reviews of the feasibility reports and three on-site visits in January through May 2009. A total of 10 man days were spent by the RID IEP in Poti to collect information shown in this Section.

B.3.1 General Description

Poti is one of the most important cities in Georgia due to its strategic significance as the main sea port of Georgia. More than eight million tons of cargo enters Georgia through the Port each year. The population of the city is 47 400 people.[8] Poti port employs up to 1 500 people. The RAK Investment Authority, the largest stakeholder and management operator of the Port, plans to invest many millions of dollars for further development of the Port and the development of the Free Industrial Zone (FIZ) around the Port.

B.3.2 Water Situation

The Poti water system rehabilitation is essentially complete. The new system became operative on January 19, 2009. Reservoirs and the Norisi-Poti and Grouli-Norisi water pipelines are finished, with 40 kilometers of the internal water network rehabilitated. However, the 24/7 water supply is not yet available to the city inhabitants. The local water company is refraining from full delivery until metering is complete. Water meters are installed for 70 to 80 percent of the population. After the completion of the metering process, 24 hour water supply will be provided to the city. About 50 percent of population will be using collective meters, while the rest private ones. Another factor inhibiting 24/7 water supply is that switching of new water system, with higher pressure, is expected to create problems for existing, outdated part of the water distribution system. During the interview, the head of the Poti water utility mentioned that more than 120 breaks in the water distribution system have been observed since February, soon after the new water supply system became operational. The majority of them have been repaired and works are under way on rest of the cases.

Currently, water is still supplied to city inhabitants according to a predetermined schedule for several hours a day. Households generally use water tanks in order to cope with the water supply schedule. More than 80 percent of the population uses water tanks. Extensive use of water pumps by inhabitants results in high energy usage. Water wells are not common in Poti, since the quality of underground water is poor. However, there are some places in the city where the quality of groundwater from the well more or less meets the minimum standards.

Previously, the shortage of water at the source was the main reason for scheduled supply of water. Diseases caused by the water shortage have been observed twice in recent years. In 2002, up to 500 inhabitants were infected by hepatitis and 30 people in 2006. Recently, in March 2009 another case of infection occurred although the reason (*i.e.*, water, food or some other source) is not yet confirmed.

The Poti Sea Port is the largest user of water in the city, mainly for two reasons. The Port provides ships with water, 1 000 to 1 500 m^3 of water per day on average, and at the same time the Port has the largest number of employees in the city, up to 1 500. Water is supplied to ships entering Poti through expeditor companies. Every ship is serviced by a certain transport or expeditor company. The expeditor company contacts the Port and asks for a certain amount of water for their ship. Then the Port supplies ships with potable water. In the past there used to be problems with water supply and in about ten percent of cases ships had to wait a day or two for water; this problem is now solved. The price of water for ships entering the port is 4,5 USD plus 18 percent VAT per m^3.

[8] According to DS 2002 census.

It is expected, that demand for water from the businesses in the FIZ will average 30 thousand m^3 per month. It would have been almost impossible to provide the FIZ with such amounts of water without the new water system. However, in the Jacobs GIBB feasibility study, dated March, 2006, demand from FIZ was not taken into account while calculating the future expected demand. It is still unclear what will be the demand for water from the FIZ, since out of about 150 potential tenant places, only two have been occupied and the consumption of water largely depends on the nature of businesses to be developed in the Poti Free Industrial Zone.

The rehabilitation project addressed the following issues:

- Construction of the new headwork at the Grouli Spring source
- Construction of a 47 km transmission water pipeline (Grouli-Nosiri)
- Emergency rehabilitation of the existing transmission 35 km water pipeline (Nabada-Nosiri)
- Emergency rehabilitation of the water supply network in Poti
- Supply and installation of water meters for 100 percent of households
- Financial and operational restructuring of the Poti Tskalkanali LLC.

Total cost of the project is 15,87 million USD, from which 5,5 million USD is financed by MCG.

B.3.3 Key Industries

The Poti Sea Port is the most important enterprise in the city, employing up to 1 500 people. A very large part of local economy is developed around Port activities. Warehouses, transportation and logistics companies have offices and representations in the city. More than 4 000 companies are registered in the city. Recently, Nikora, the largest Georgian meat producer, opened a new factory in Poti, which will supply Western Georgia with meat products.

Development of the FIZ in Poti is expected to be the main driver of economic growth of the city and the region as a whole. Construction within the FIZ is expected to become one of the largest sectors of the local economy. One can already notice increasing number of residential and commercial spaces being developed in Poti. The hotel business is also expected to grow further. One of the projects financed by MCG through GRDF was construction of a hotel in Poti.

B.3.4 Final Observations

Citizens have concerns about the new water system. Many believe that pipes in residential blocks are outdated and that they will fail under 24-hour high pressure. Another concern stems from public water meters, which are (or going to be) installed for residential blocks. People believe that allocation of water fees will not be fair and will be subject to continuous disputes.

It is expected that collection will amount 60 to 70 thousand GEL per month, after the completion of metering process. In the past collection rates were low, 5 to 7 thousand GEL per month, currently standing at 25 thousand GEL. Essentially 100 percent of local businesses have their own water meters, although many businesses operating out of homes (*e.g.*, car washes) are not metered.

While forecasting Poti water demand quantity, the FIZ was not taken into account. We will clarify whether the new water system is able to service FIZ once it is developed.

Representatives of the local municipality believe that it will be difficult to determine the effects of the new water system. However, the combination of improved electricity and water supply will bring benefits for businesses. They believe that the opening of Nikora's meat production factory in Poti can be attributed to stable electricity supply. The entrance of SJS in Poti is another argument for this. New water system on the other hand will facilitate construction to be undertaken in FIZ.

Like Kutaisi, governmental institutions are large consumers of water in Poti. Three military bases located in Poti are one of the top users of water. Another military base located in Senaki, a nearby city, is also supplied with water by the Poti water utility[9]. Given the importance of governmental institutions in terms of water consumption, the RID IEP team decided to approach this issue separately and details are discussed further in Chapter 8 of the accompanying Report.

B.4 KOBULETI

This Section describes the situation in Kobuleti based on reviews of the feasibility reports and three on-site visits in January through May 2009. A total of eight man days were spent by the RID IEP in Kobuleti to collect information shown in this Section.

B.4.1 General Description

Kobuleti is a small town located on the Black Sea coast, with a population of about 20 000 people.[10] The town is the most popular place in Georgia for tourists in summer and during peak season the maximum number of tourists reaches 50 000.[11] Total housing stock in the city is around 6 100, most of which are private houses. Up to 18,000 households reside in the city.

During recent years the tourist infrastructure in Kobuleti has been evolving and many hotels and guesthouses have been built. Kobuleti is expected to become the major tourism center in the area. Privatization of state owned enterprises in the Adjara region increased both Foreign Direct Investment (FDI) and domestic investment in the tourism infrastructure of the city.

B.4.2 Water Situation

Water is supplied to city inhabitants on average six to ten hours a day, according to a predefined schedule. The difference in length of water supply is mainly due to geographic location (*i.e.* locations far from the pumping stations are supplied water for shorter periods of time each day).

[9] Recently, Poti water utility took control over Senaki water utility
[10] 18 600 by 2002 census and 20 964 people, 5 073 households, according to Kobuleti City Administration
[11] Kobuleti Municipality estimates

The initial design of the system (during the Soviet era) was to construct a 10 000 m^3 reservoir, pump water into it from the source, and then rely on gravity flow to supply the distribution system. However, construction of the reservoir was not finished; currently water is directly pumped into the network, resulting in low pressure, high pumping costs and variable supply.

There is no data available on current water consumption, since neither produced nor consumed water are metered. Preliminary estimates of water consumption can be made though. According to Kobuleti water utility, 2.6 million cubic meters of water was pumped to the system in 2008 and it is estimated that only 1.1 million cubic meters of water were actually delivered to customers, suggesting 59% Non-Revenue Water (NWR) ratio.

Due to the low pressure and unstable water supply, city inhabitants have dug their own wells, and installed water tanks to provide access to water 24/7. This is particularly important for households that utilize their homes as guesthouses. Households residing in apartment blocks have installed private pumps to ensure that water reaches high floors. Coping costs for hotels are even higher, since they need large water tanks and more efficient (and energy intensive) pumps to create comfort for visitors. Costs associated with installment of water tanks are not trivial. One of the small hotels, with 70 beds, spent up to 8 000 USD to dig the well and install an elevated water tank sufficient for the hotel.

The rehabilitation project entails:

- Rehabilitation of the pumping station (3 pumps)
- Construction of a reservoir
- Rehabilitation of main pipes in vicinity of the reservoir-pumping station
- Repairing the well shafts
- Installation of equipment along existing pipes
- Installation of measurement instruments and setting up gauging stations
- Repairing the existing water network
- Repairing the existing waste water network and pumping stations
- Installation of water meters (5 700 households and 300 group meters)
- Construction of waste water treatment plant using the phyto-depuration technology.

The cost of the project is estimated at 22,2 million USD, from which 18,8 million USD is financed by MCG. The project is expected to be finished in two to three years. The exact completion date is not yet known.

B.4.3 Key Industries

Tourism is the largest and most important industry in Kobuleti and main source of income for households. Besides luxury hotels, inhabitants utilize their homes as guesthouses. The largest majority of households living in private houses rent rooms to Georgian and foreign tourists during the summer season. According to Kobuleti City Administration data[12] households accommodate up to 15,000 tourists during summer, while a total of 126 hotels accommodate up to 5,500 visitors. It is estimated that during summer 80,000 tourists visit the city. Large numbers of tourists visiting Kobuleti come from neighboring Armenia. The season in Kobuleti lasts for 1,5 months.

Apart from hotels and guesthouses, businesses in the city are developed mainly around the tourism industry. Large numbers of cafes, restaurants and similar enterprises are open in the city during summer, while only few of them remain open all year round. Retail activities, such as small shops appear in the city mainly in summer.

The food industry is also small in the city, mainly designed to serve the permanent population during the year and tourists during summer. Bakeries, a dairy factory and other similar small scale food processing enterprises operate in the city.

Privatization of state owned enterprises in Adjara region accelerated the growth of tourism sector and development of infrastructure. Up to 10 hotels are expected to be built by Kazakh investors, one of which is a 28-story hotel, worth 80 million USD. High demand for hotels resulted in increase of the construction sector. Several Georgian real estate developers are building large hotels and residential blocks in the city. Recently, Georgian Palace Hotel, a five star, 156 room hotel opened in Kobuleti. Spring and part of Autumn are good time for construction works in the city. Owners of hotels and guesthouses use their savings to reconstruct their building, or expand the size of their hotels and guesthouses.

The August war with Russia had significant negative impact on Kobuleti. The number of tourists decreased significantly and households and businesses failed to repay the seasonal loans which they borrow from banks to make up their houses and tourist facilities for the summer (actually, for August). The Government designed a bailout package of 15 million GEL to save households in trouble. On the other hand, the local municipality failed to collect planned taxes and couldn’t finance planned infrastructure development projects.

The war, combined with the global financial/economic crisis decreased the investment inflows to the city. During the first three quarters of 2008 more than 100 construction permits were issued while during the last quarter of 2008 only nine permits were issued.

B.4.4 Final Observations

The sewer system is the main problem for city inhabitants and businesses. During focus groups with households and interviews with businesses, people mentioned that during the summer the sewer network becomes overloaded and they face serious sanitation problems. The capacity of the sewer is not enough and unless it is rehabilitated it will be very difficult to connect new hotels to the sewer network. Even the Georgian Palace Hotel, mentioned above, had difficulty connecting to the municipal sewer system. Inefficiency filtration systems results in flows of unfiltered wastewater into the river, which on the other hand flows into the Black Sea. A water shortage is also a vulnerable problem for city inhabitants, but they have developed coping strategies and are able to secure more or less stable water supplies.

In Kobuleti the sewer service fee is higher than water supply fee. Households pay 0,80 GEL per household member for water, and 1,00 GEL for sewer service. The same is true for

[12] As reported in THALES-EC – SOGREAH – GKW Feasibility Study, 2006

businesses, however they pay 1,70 GEL per cubic meter of water and 2,30 GEL per cubic meter of wastewater discharge. Only few businesses are metered in Kobuleti, while no households are metered. As a result, payment for water and sewer service is based on normative water consumption, predetermined by the water utility. Households, who rent rooms to tourists, have to pay 2,00 GEL per tourist. Another interesting point is that people living on first and second floor have to pay a higher fee than those living on higher floors. This is due to the fact that water reaches lower floors better and as a result it is considered that water consumption is higher.

Poor service creates reluctance among households and businesses to pay water bills. Only 27 percent of households pay water bills, while for businesses and other organizations the collection rate is 95 percent and 77 percent respectively. The overall collection rate is 49 percent.

It is expected by local government officials that reconstruction of the water supply system and sewer network will create additional incentives for businesses to enter the city. The head of the Kobuleti Municipality mentioned to the RID IEP that the decision of foreign investors to build a 28 storied hotel in Kobuleti was facilitated when they heard about the upcoming water system rehabilitation project. However, it’s difficult to infer to what extent the rehabilitation project influenced their investment decision.

B.5 BAKURIANI

This Section describes the situation in Bakuriani based on reviews of the feasibility reports and three on-site visits in March through May 2009. A total of eight man days were spent by the RID IEP in Bakuriani to collect information shown in this Section.

B.5.1 General Description

Bakuriani is a small town in the Samtskhe-Javakheti region. It is part of the Borjomi municipality and is a very popular place for winter tourism. The city has a permanent population of 2 000 people and 560 households. Bakuriani hosts 3 000 tourists at any one time during the peak tourism season. The skiing resort is located at an altitude of 1 700 meters. Bakuriani is also a popular place for tourists during the summer. As a result, unlike Kobuleti, Bakuriani benefits from longer tourist seasons.

B.5.2 Water Situation

The water supply system was first constructed in Bakuriani in 1936 and the newest pipes in the distribution network date back to 1972. The outdated water system is unable to operate efficiently and the population cannot be supplied with high quality water 24/7. Minimum length of water supply is on average five hours a day. During the spring, water can be supplied 24 hours a day. However the quality of water is very low, especially during the spring.

The water utility does not have sufficient filtering capacity (12 liters per second, versus the required 90 liters per second) and as a result unfiltered water is supplied to inhabitants. Water supplied by the water utility is not used for drinking. Potable water is collected by households from nearby springs. Automobiles and horses are used for transporting potable water from springs.

The water reservoir is not sufficient to meet the demand for water. The capacity of the existing water reservoir is 1 000 m^3 and according to the ongoing water system rehabilitation project construction of two 2 000 m^3 capacity reservoirs are planned. According to a water utility representative, water is clean during winter and it gets muddy during spring, due to snow melting. During cold winter weather the water supply system easily fails and 80 percent of households have to bring water from nearby springs.

Some hotels in the city have their own water supply system. For example, the Villa Park Hotel, one of the largest hotels in Bakuriani, has built its own 19 km, 70 mm diameter water pipeline which connects the Hotel with the old reservoir, which has also been rehabilitated by the Hotel owners. Despite this autonomy, the Hotel has three 16 m^3 water tanks to meet the water demand of guests. It is estimated that on average, one tourist uses about 0,75 m^3 of water per day. As a result, the Hotel does not use water supplied by water utility, they only pay for the sewer. Other hotels have also found practical ways to avoid dependence on the local water supply.

The water rehabilitation project entails:

- Water supply-water quality improvement and security of supply
- Production metering
- Leak reduction and network management
- Reduction in infiltration, exfiltration, blockages, flooding and breakages
- Household and business metering
- Improving operation and maintenance capabilities
- Improving laboratory test facilities.

The total investment amount for the project is 7,9 million USD, from which MCG will finance 6,7 million USD.

B.5.3 Key Industries

Tourism is the major source of income for local citizens. Besides luxury hotels, inhabitants utilize their homes as guesthouses. More than 70 hotels are present in the town. No other important businesses are developed in the resort. Individuals and households residing in Bakuriani or nearby villages supply natural food products to hotels and visitors. Unlike Kobuleti, the population of Bakuriani and nearby villages benefit from longer tourist season, but the scale of the business is smaller.

B.5.4 Final Observations

One important feature about water consumption in Bakuriani is that due to low winter temperatures, people leave their water taps open to prevent pipe freezing. This increases the consumption of water to quite high levels. A similar phenomenon can be observed in Borjomi with much less in Kutaisi, Poti and Kobuleti.

There are some doubts whether hotels will switch from their own existing water supplies to the central water supply system. Some hotels claim that water is and will be very expensive; they believe it is less costly for them to transport water from the spring. For example, in an interview a Villa Park Hotel representative mentioned that in case of improvement in the water supply, they will continue using their own facilities together with water supplied by the utility. Today, the Hotel spends on about 750 GEL on electricity per month (for pumping) water, while 300 GEL is spent on bottled water for drinking. The hotel uses 30 m^3 of water per day. They have also assigned two technical staff to deal with their water supply.

Officially, water costs 3,6 GEL per m^3 for enterprises, while households pay 1,0 GEL per household member per month. However, because hotels do not have operating water meters, hotels are charged a fixed fee per visitor, which is estimated to use 0,75 m^3 of water per day, almost four times as much as normal. Given the difficulty to account for the exact number of visitors, the water utility claims that hotels are cheating and the total sum collected from hotels during one month in 2008 amounted to 29 600 GEL.[13]

The structure of the Bakuriani economy is similar to that of Kobuleti and Borjomi (discussed below). This enables us to combine these three cities in one stratum, which makes is easier to find a group of cities for control purposes.

B.6 BORJOMI

This Section describes the situation in Borjomi based on reviews of the feasibility reports and two on-site visits in March through May 2009. A total of eight man days were spent by the RID IEP in Borjomi to collect information shown in this Section.

B.6.1 General Description

Borjomi is one of the best known resorts in Georgia and it used to be a popular place for tourists during the Soviet era. With a population of 15 000 people, Borjomi remains a popular place to visit during the summer. The majority of visitors come from other parts of Georgia. The maximum number of tourist the city hosts is 15 000 people at a time. Famous for its springs, the town is where the Borjomi mineral water factory is located.

B.6.2 Water Situation

The water supply system was constructed in Borjomi in 1932 to 1935. The total length of the internal distribution network is 54 km and the length of sewer network is 18 km. The entire distribution network and sewer system will be replaced within the framework of the RID project. Construction of a new reservoir and the main pipeline (22 km) connecting the reservoir with the city is planned. Pumping stations will also be installed in several areas to provide sufficient pressure. The project is expected to be finished by 2011.

A total of 7 000 households are supplied with water by the water utility. There are 5 500 households in Borjomi and 80 to 90 firms. Up to 60 percent of the city (located on lower altitude areas) is supplied with water eight to nine hours a day, while the rest is supplied only six hours a day. The main problem that causes interrupted supply of water is the small volume

[13] This suggests (only) about 365 guests per night during the high season (29 600 GEL ÷ 3,6 GEL/m^3 ÷ 0,75 m^3/guest-day).

of the water reservoirs; after the reconstruction of the reservoirs the water utility will be able to supply the city with water at least 18 hours a day.

There is not sufficient filtering capacity (slow filtering) and currently mostly unfiltered water is supplied to the population. Chlorination is not stable; the water utility uses it from time to time. The water utility claims to have a good laboratory and five to six water tests are conducted in every district every day. Reportedly, there have not been recent cases of water borne disease in the city. When the Gujarula River (which supplies 60 percent of the city with water) gets muddy, the water utility utilizes pumps located near the Borjomula River to supply the city with cleaner water. However, pumping costs are high and in case they are switched on, on average 10 000 GEL is paid for electricity per month.

Reportedly, when the water is on pressure is enough for water to reach high storied buildings. In order to smooth consumption up to 80 percent of the population uses water tanks (one m^3 on average), while very few people use wells. Some households have their own springs. When water is muddy, usually during springtime, people do not use municipal water for drinking. Some people prefer to bring water from springs, even when the municipal water is clean. Some people hold the water supplied by the utility from day to day. A few people boil municipal water before use.

Only five or six water meters are installed in the entire city. The water utility does not wish to install other meters because they are frequently damaged by variable water pressure. Damages are also caused to the meters by muddy water. There are frequent failures in the distribution system; losses in the water supply and distribution system is an important problem for the water utility. Almost 50 percent of water is lost on the way to Borjomi (in Tsagveri). Losses are huge in the distribution network as well. One of the most serious problems for the water utility is low collection rates – only 15 to 20 percent of the population pays water bills regularly. Collection rates from businesses attain almost 98%.

The rehabilitation project entails:

- Raw water treatment plant (RWTP) at Sadgeri
- 7 km trunk main from RWTP to Borjomi reservoirs
- Re-equipment of Sadgeri spring water intake and pumping station
- Rehabilitation of Borjomi water supply distribution network and meters installation
- Reconstruction of potable water reservoirs
- Supply of water meters.

The cost of the project is estimated at 11 million USD from which MCG is financing 8,8 million USD.

B.6.3 <u>Key Industries</u>

Tourism is the largest industry in Borjomi. Hotels, guesthouses and local households accommodate up to 15,000 tourists during summer. The mineral water industry is also very well developed in the city. The mineral water factory, owned by Georgian Glass and Mineral Water (the Borjomi brand) employs up to 700 people. The retail and food processing industries are designed to serve permanent the population of the city and incoming tourists during the summer season.

B.6.4 Final Observations

Water is an important problem for the local population and businesses in the city. It is impossible to rely on the supply of water from the water utility and people have developed coping strategies to secure their water supply. Unlike Kobuleti, Kutaisi and Poti and like Bakuriani natural springs are a popular alternative source of water supply in Borjomi. Unlike other RID target cities, municipal water is rarely used for drinking purposes. Especially hotels and guesthouses are reluctant to offer municipal water for drinking to visitors in order to avoid potential problems. They mainly bring water from nearby springs. Municipal water is mainly used for technical purposes. As for coping strategies, some hotels and guesthouses, as well as individual households have their own tanks to ensure 24/7 access to water. Others have dug their own wells.

Like Bakuriani and Kobuleti, Borjomi's economy mainly relies on tourism and as already mentioned, can be included in the same strata for control purposes. These three cities will be handled as one economy and will be compared to a group of cities with similar characteristics.

APPENDIX C

HISTORY, THEORETICAL UNDERPINNINGS AND PRACTICAL USE OF CGE ANALYSIS

C HISTORY, THEORETICAL UNDERPINNINGS AND PRACTICAL USE OF CGE ANALYSIS

The previous Section described CGE analysis in practical terms. This Section discusses the history and theoretical underpinnings of CGE analysis and models.

A CGE model is based on general equilibrium theory, first developed by Walras (1874) over a century ago and then elaborated and improved upon by many others such as Edgeworth, Arrow, Debreu, Scarf and others. In 1954 Arrow and Debreu introduced the first complete general equilibrium model. Over the past half-century the CGE model approach has been refined and applied to numerous economic problems, including impact evaluations.

General equilibrium models, of which CGE models are one variant, consider all parts of the economy and can model how the introduction of a price-change, a policy, an intervention or another shock will ripple throughout the economy causing shifts in prices and output-levels until the economy reaches a different equilibrium. The responses by various sectors and actors of the economy to the shock would thus be the impact of the shock. CGE models can be used to examine and quantify impacts retrospectively and also can be used to prognosticate using scenario analysis.[14]

General equilibrium theory remained a conceptual framework for nearly 100 years due to the limitations of computers and their ability to model something as complex and robust as an economy. However, with advances in computing technology this barrier has been largely removed.

1.1 THEORETICAL ORIGIN

To find the historical origin of general equilibrium theory, we have to go back to the Marginal Utility or Neo-classical School (school of economics active in the third quarter of the 19th Century). From the theoretical basis of this school, Gossen (1854), Jevons (1871) and Walras (1874) – who used mathematical notations– and Menger (1871) – who did not – made the first steps in the development of the theory. The most effective and relevant author among them, and the one who can be considered the father of general equilibrium theory, is Walras (1874).

General equilibrium's simplest problem lies in the analysis of exchange economies. In this type of economy, the demander's budget restriction is established by his initial resource endowment and the price index. The individual demand function represents the equilibrium of the individual consumer confronted with the given price system. The market demand function is obtained as the aggregation of individual functions and market equilibrium emerges when we find a price for which the addition of net demands equals zero. This idea was already expressed by classical economics theory when it stated that supply should match demand; Cournot (1838) in his discussion on international money flow and Mill (1848) in his arguments on international trade, had already sensed it. Nevertheless, its expression as a mathematical equation set is due to Walras (1874).

Years later, Pareto (1909) defined a property of market equilibrium. If every consumer kept an equilibrium assignment of his goods and if utility functions were susceptible to being differentiated then it meant that goods were divisible and that an infinitesimal assignment

[14] For the RID IEP, CGE analysis is being used *at this moment to quantify impact prospectively*. *During ex-post work* (by the RID IEP or others), CGE analysis can be used to *quantify and understand impact respectively*.

would not affect the utility levels if it did not affect the budget restriction levels. The so-called Pareto optimum could happen in competitive equilibrium but it would require more severe conditions. The first theorem to develop this question was the one elaborated by Arrow (1951).

The following step in the development of an economy's general equilibrium was the introduction of production under the condition of not taking time into consideration. The aim was to minimize production costs given the market prices. As in the previous case, market equilibrium could be achieved when, at one price, supply matched demand.

Although Walras contemplated a productive sector whose industries only produced one good, the natural generalization of this model included the introduction of more than just one output, a task completed by Hicks (1939).

Previous to that, Cassel (1918) had developed a model with a productive sector, understood as a set of potential linear activities. He applied a simplified Walrasian model that preserved demand functions and production coefficients but did not deduce the demand functions from the utility functions or preferences. The model was generalized by Von Neumann (1937) to allow the articulation of production in a spatial context.

Koopmans (1951) made a more complete and elaborated analysis creating a model where intermediate products were explicitly introduced. But the general linear model of production was not sufficiently appropriate to treat the choice of activities as a cost-minimizing process, given the price vector and the quantities. Minimization had to be replaced by a condition according to which no activity could provide benefits and no activity in a competitive equilibrium could suffer any losses.

This was exactly the condition used by Walras to initially define production equilibrium in a model with fixed production coefficients. In any case, this condition was first used in a general production model by Von Neumann (1937); it was called the Neumann law for production activities models.

On the other side, an alternative model of the productive sector was developed that emphasized productive organization or the enterprise rather than activities or technology. The equilibrium condition in the productive sector was that each enterprise maximize its benefits, obtained as the value of the input-output combination on its production possibilities, given the input and output prices. This vision of production, made explicit in a partial equilibrium context by Cournot (1938), was already implicit in the work of Marshall (1890) and Pareto (1909) and became quite explicit in a general equilibrium context in the work of Hicks (1939) and especially in the Arrow-Debreu model (1954).

It is exactly this model, that of Arrow and Debreu (1954), that we can identify as the first complete general equilibrium model. It formally demonstrated the existence of equilibrium with a productive sector formed by enterprises. Each enterprise had a set of production possibilities based on the resources it owned. The productive sector reached equilibrium when each enterprise chose the input-output combination of its set of technical possibilities that maximized the benefits at market prices. This model was, in addition, the first to directly include preferences in the manner of Walras through hypotheses on the demand side.

To the end, the theory that Walras developed was the most complete and detailed general temporal equilibrium model ever elaborated, something totally unexpected given that it was as well the first formal general equilibrium model. Walras was able to achieve a model where money, production, saving level, the prices of capital goods and services and the interest rate were all determined. Obviously, its later development completed and improved the original version.

C.1 FROM THEORY TO APPLICATION

The step from the theoretical to the applied dimension took place between 1930 and 1940, when discussions arose on the feasibility of calculating Pareto optimal resources allocations for an economy that was socialist and susceptible of being used by planners (see Von Mises, 1920; Hayek, 1940; Robbins, 1934; and Lange, 1936). Leontief (1941) with his input-output analysis made the subsequent development, actually the most decisive step in the attempt to reconstruct Walras' theory to an empirical dimension and to definitely apply it to economic policies.

Later on, the linear and non-linear planning models of the 1950s and 1960s, based on the works by Kantarovich (1939), Koopmans (1947) and others, were seen as an improvement of the input-output techniques through the introduction of optimization and as the first attempt to develop an applied general equilibrium.

In the 1950s, attention moved from a derivation of Comparative Statics to demonstrating the existence of equilibrium. Wald (1951) had already defended Walras' law and had provided the necessary proofs to demonstrate the existence of equilibrium. The use of differential calculus, topological analysis and the theory of convexity allowed authors as Arrow and Debreu (1954) and others to demonstrate the existence of equilibrium in very general models. The main mathematical tool that they used was Brouwer's fixed-point theorem.

Scarf (1973) developed a computational algorithm to find fixed points that satisfied the conditions of Brouwer's fixed-point theorem. This algorithm could be used to calculate equilibrium in economic models.

Many of the first general equilibrium models used this algorithm for their resolution. Some of the present models are still based on that method, although more rapid variations developed by Merril (1971), Eaves (1974); Kuhn and McKinnon (1975), Van der Laan and Talman (1979) and Broadie (1984) are also used. From the latter, Merril's variation is the one most often applied. Newton-type methods or local linearity techniques can be as well implemented. Even though convergence is not guaranteed, these last methods can be as quick, if not more, as the former.

Another approach, implicit in the work of Harberger (1962), consisted in using a linearized equilibrium system to obtain an approximate equilibrium and, in certain cases, to improve the initial estimator through multi-stage procedures so that approximation errors are eliminated. This method was also adopted by Johansen (1960), and improved by Dixon, Parmenter, Ryland and Sutton (1982), de Melo and Robinson (1980), among others, who elaborated the first applied general equilibrium models as such.

C.2 COMPUTATIONAL ISSUES

The main problems faced by applied CGE modelers have changed substantially over time. As emphasized by Shoven and Whalley (1984), initially there was a lot of concern about the power of computational methods to find the solution to large and non-linear systems of equations.

Today, after the development of efficient algorithms to that purpose, attention has switched towards the availability of reliable data for calibration, or towards systematic sensitivity analysis to evaluate the impact of different parameter-value choices. Furthermore, in an attempt to obtain more realistic model specifications, authors have incorporated novel assumptions: imperfect competition in product and factor markets, factor mobility between different spatial locations and structural equations related to inter-temporal optimization by firms and consumers.

There is standard software to completely adjust data, calibrate models and reach equilibrium points. The most popular include GEMODEL, GEMPACK and, especially, GAMS, with all their different solvers, or resolution algorithms adapted to the different models' necessities (*e.g.*, database dimensions; multiregional, dynamic or static models). It seems that nowadays the problem is not to resolve the equilibrium but, as in other fields of economic theory, the difficulties in obtaining data in order to specify the parameters and the skill of the economists to actually specify them.

At the beginning of the 80's, the World Bank developed the General Algebraic Modeling System (GAMS). It was created to build a CGE model to capture the impact of the NAFTA in USA, Canada and Mexico. It was specifically designed for modeling linear, nonlinear and mixed integer optimization problems. The system is especially useful with large, complex problems. GAMS is available for use on personal computers, workstations, mainframes and supercomputers. GAMS allows the user to concentrate on the modeling problem by making the setup simple. The system takes care of the time-consuming details of the specific machine and system software implementation. GAMS is especially useful for handling large, complex, one-of-a-kind problems which may require many revisions to establish an accurate model. The system models problems in a highly compact and natural way. The user can change the formulation quickly and easily, can change from one solver to another, and can even convert from linear to nonlinear with little trouble.

GAMS lets the user concentrate on modeling. By eliminating the need to think about purely technical machine-specific problems such as address calculations, storage assignments, subroutine linkage, and input-output and flow control, GAMS increases the time available for conceptualizing and running the model, and analyzing the results. GAMS structures good modeling habits itself by requiring concise and exact specification of entities and relationships. The GAMS language is formally similar to commonly used programming languages. It is therefore familiar to anyone with programming experience.

C.3 REPRESENTATIVE USES OF CGE ANALYSIS AND MODELS

One of the great advantages of general equilibrium models is their capacity to explain the consequences of major changes in a particular sector in relation to the economy as a whole. The consequences of a change in an economic policy are frequently analyzed assuming that changes are generally small and using linear approaches based on relevant elasticity estimates. If the number of sectors is small, two-sector models as used in international trade theory are equally employed. However, if it is a disaggregated model and several changes take place, there is no option but to resort to the construction of general equilibrium numeric models for the economy to be studied.

Reviewing the pioneer applications of this type of modeling, we find the main areas on which applied general equilibrium models have had a great impact. These uses of general equilibrium models, of which CGE models are one variant, are described in the following Sub-Sections.

C.3.1 Fiscal Policy Analysis

In the taxing area, from the first two-sector models by Harberger (1962) and Shoven and Whalley (1977) we have moved to modeling on a greater scale like Piggot and Whalley (1977) did for Great Britain; Ballard, Fullerton, Shoven and Whalley (1985) for the United States; Kehoe and Serra-Puche (1981) for Mexico; Keller (1980) for Holland and Piggot (1980) for Australia, among others. This is the area where this type of economic modeling has been more widely adapted and developed.

C.3.2 Trade Policy Analysis

The analysis of general equilibrium applied to the study of trade policies has revolved around the issue of protectionism and its consequences on an economy's efficiency and well-being. Trade models can be classified into two main groups. On the one hand, there are small economy models (closed economies), whose main characteristic is price endogeneity. On the other, we find great economy models (open economies) that incorporate the assumption of price exogeneity in all trade goods.

We can mention, among others, the global general equilibrium models developed by Deardorff and Stern (1986) and Whalley (1985b) that were used to evaluate political options in the negotiation rounds at the GATT meetings. Dixon, Parmenter, Sutton and Vicent (1982) attempted a great scale model in Australia that has been used by government to evaluate various commercial options in that country. Also, a group of models developed by the World Bank for different countries (Dervis, De Melo and Robinson, 1982) has provided information to the decision-making processes of the borrowing countries, as well as to different trade liberalization options for various developing countries.

C.3.3 Migratory Policy Analysis

Applied general equilibrium models are also used in the study of population movements. They may adopt a purely urban perspective, as in the work by King (1977), or a regional perspective, as in the analysis made by Kehoe and Novola (1991) on the Mexican economy. The latter analyzes the effects of alternative fiscal policies on emigration from rural to urban areas.

C.3.4 Interregional Policy Analysis

The impact of interregional policies has also been analyzed with these instruments. We find the works by Jones and Whalley (1986), which develop a regional model for Canada that emphasizes issues related with partial labor mobility. Serra-Puche (1984) develops the same type of model for the Mexican economy, and Ginsburgh and Waelbroeck (1981) for the Indian economy.

C.3.5 Agrarian Policy Analysis

Good examples are the works by Keyzer and Wim (1994), who analyze food policies in Indonesia or that of Parikh (1994) on Indian agrarian policies. The latter is focused on the public distribution system (PDS) according to which the government provides and offers some first necessity goods (rice, sugar, oil, flour and gasoline) at prices below the market price. Golden and Knudsen (1992) study the effects of trade liberalization on agriculture.

C.3.6 Stabilization Policy Analysis

The adverse external shocks experienced by most developed countries from the beginning of the 1980s, with falling exports, foreign trade losses, high interest rates and debt increments due to the US dollar appreciation, led, together with the decrease of trade bank benefits, to drastic adjustments. Subsequent adjustment programs were designed mostly separately by the IMF and the World Bank.

These programs were characterized by emphasizing both demand, when reducing short-term depressions, and measures on the supply side that allowed for greater efficiency through structural adjustments. The two components of the strategy (stabilization and structural adjustment) were not casually separated, partly due to the dimension of the required adjustments.

Macro-models and standard general equilibrium models have proved inappropriate to analyze these problems. The elevated aggregations of macro-models tend to consider the movement of resources between sectors and classes. On the other hand, in standard general equilibrium models money is neutral and it only affects relative prices. There is no theoretically satisfying way to study inflation, nominal wage rigidity or exchange rate nominal policies with traditional general equilibrium models. For this reason, some economists have developed so-called “general equilibrium financial models”. They try to integrate money and financial assets into the multi-sector and multi-class structure of general equilibrium models. Despite these efforts, there is no consensus yet on the introduction of money and financial assets into the general equilibrium theory. Authors like Lewis (1994), who studied the case of Turkey, and Fargeix and Sadoulet (1994) for Ecuador, have contributed to this line of study.

C.3.7 Modeling Under Conditions Of Imperfect Competition

The analysis of policies based on classical economic theory is supported on the hypothesis of an existing competitive equilibrium. We know that in reality competitive equilibrium does not always occur and, consequently, there are monopolistic markets, oligopolies, monopolistic competitions, externalities, scale economies and so forth. In other words, there are markets with different degrees of imperfection.

Economists who have developed general equilibrium models have certainly noticed this reality and have tried to include its variety in their modeling. We have the works of Negishi (1961) who first suggested that in the theory of monopolistic competition partial equilibrium analysis must be extended to general equilibrium analysis. Radner (1968) developed a general equilibrium model under conditions of uncertainty. Krugman (1979) studied product differentiation model, trying to bring applied general equilibrium analysis closer to reality. Dixon (1987) analyzed the possibility of imperfect competition within the macroeconomic frame of general equilibrium. Bonano (1990) defended the development of a general equilibrium theory that included imperfect competition. De Melo and Roland-Holst (1994) studied South Korea’s multi-sector general equilibrium model and examined if import tariffs and export subsidies in this model could be combined to promote the development of sectors with scale revenues and oligopolistic behaviors. Ginsburgh developed the model in a monopolistic scenario and, finally, Brown, DeMarzo and Eaves (1996) researched on the existence of general equilibrium models for economies with incomplete assets markets.

C.3.8 Inter-Temporal Exchange Modeling

All previous analyses share one aspect: they only take past and present into account when making decisions. The resulting models are static. The inter-temporal treatment of exchange decisions allows the models to enter dynamic territory. Works on this line are those by Benjamin (1994) on investment expectations in Bolivia, Cameroun and Indonesia; Blitzer, Eckaus, Lahiri and Meeraus (1994) on the impact of restrictions on coal extraction in Egypt; Mercenier and Sampaïo de Souza (1994) on the structural adjustment of Brazilian economy; and Berthélémy and Bourguignon (1994) on North-South-OPPP relationships.

C.3.9 Water Analysis

Over the past two decades CGE Analysis has been applied to studying the impacts of water policies. Gomez *et al.* (2004) provides a nice summary of several CGE water projects:

> “Berck, Robinson and Goldman (1991) who use a CGE (model) which studies the reduction of water use in San Joaquin Valley as an efficient alternative to solve drainage problems. Dixon (1990), Horridge *et al*. (1993), Decaluwé *et al*. (1999) and Thabet *et al*. (1999) analyze the impact and efficiency of water prices. Seung *et al*. (1998) study the welfare gains of transferring water from agricultural to recreational uses in the Walker River Basin. Seung *et al*. (2000) combine a dynamic CGE model with a recreation demand model to analyze the temporal effects of water reallocation in Churchill County (Nevada). Diao and Roe (2000) provide a CGE model to analyze the consequences of a protectionist agricultural policy in Morocco and show how the liberalization of agricultural markets creates the necessary conditions for the implementation of efficient water pricing (particularly through the possibility of a market for water in the rural sector). Goodman (2000) shows how temporary water exchanges provide a lower cost option than the building up of new dams or the enlargement of the existing water storage facilities.”

Given the important economic functions water can perform, environmental engineers have been working to integrate traditional environmental modeling methods with CGE. The *Journal of Ecological Economics* recently devoted an entire issue to integrated hydro-economic modeling with an emphasis on new CGE applications (see van Heerden *et al*. (2008); Strzepek *et al*. (2008); Brouwer *et al*. (2008)).

C.3.10 New Areas Of Application

Applied general equilibrium models are so versatile that their use has spread to specific areas where there was no previous room for global analyses and where almost no formal works on impact measures had been yet developed. Included among these new uses are traditional analysis of the environment, economic cycles and development economics.

Focusing on environmental analyses, applied general equilibrium models have been successfully implemented in the last few years in this field. Some of the applications of this Design can be seen in André, Cardenete and Velázquez (2005), O’Ryan *et al*. (2005), Schafer and Jacoby (2005), Willenbockel (2004), Yao and Liu (2000) and a presentation of the state of the art in Kehoe, Srinivasan and Whalley (2005). These models have also been recently applied to the analysis of climate change in works by Nijkamp, Wang and Kremers (2005), Kremers, Nijkamp and Wang (2002), Böhringer, Loschel, and Rutherford (2006) or Springer (2003).

APPENDIX D

DESCRIPTIONS OF SIMPLIFIED CGE MODEL

D DESCRIPTION OF SIMPLIFIED CGE MODEL

The RID IEP created a model of a simple economy including three productive sectors (*i.e.*, large hotels, small guesthouses, water sector) and two types of households.[15] It created a typical SAM and estimated the model parameters. The model was calibrated to an equilibrium state without a new water system using data from a small survey among hotels in several locations.[16]

In the model consumers have the following utility function:

$$U(C_h, C_g, S) = \ln\left(\theta \int C_h{}^{\rho} dh + C_g{}^{\rho}\right) + \gamma \ln W$$

- C_h – Consumption of Hotel Services
- C_g – Consumption of Guesthouses
- W – Consumption of Water
- Θ – Preference Parameter, more than one
- ρ – Substitutability Parameter, between zero and one
- γ – Relative Value of Water With Respect to Hotels and Households.

Hotels in the model have the following cost function, which they try to minimize:

$$C(q_H) = \left(\frac{w}{\alpha}\right)^{\alpha} \left(\frac{p_s}{1-\alpha}\right)^{1-\alpha} \frac{1}{\overline{K}} q_H + F$$

Guesthouses minimize the following cost function:

$$C(q_G) = \left(\frac{w}{\alpha}\right)^{\alpha} \left(\frac{p_s}{1-\alpha}\right)^{1-\alpha} \frac{1}{\overline{K}} q_G$$

The water sector (*i.e.*, the water utility company) minimizes the following cost function:

$$C(W) = \left(\frac{w}{\beta}\right)^{\beta} \left(\frac{r}{1-\beta}\right)^{1-\beta} \frac{1}{A} W$$

Variables in the above cost functions are defined below:

- *W* – Wage
- β – Share of labor in total cost for water utility

[15] This simplified CGE model is described in a discussion document (*CGE For Poets – With GAMS Software*, May 18, 2009).
[16] This survey was done to better understand the ways hotels cope with water problems. These results were primarily used to create the micro-coping-models discussed in previous Chapters.

- r – Cost of capital (*i.e.*, interest rate)
- *A* – Level of technology
- α – Share of labor in the Production Cost for Hotels and Guest houses
- *p* – Price of water, Numeraire (*i.e.*, equals 1)
- *K*-bar – Technology for hotels and guest houses
- *F* – Fixed costs for hotels
- q_H – Quantity produced by hotels
- q_G – Quantity produced by guesthouses

The following chart shows the initial SAM of the simplified economy.

8. Initial SAM Of The Simplified Economy

	Hotels	Guest houses	Water	Capital	Labor	Household 1	Household 2
Hotels	0	0	0	0	0	70,6	102,6
Guest houses	0	0	0	0	0	0	6,4
Water	45	6,1	0	0	0	81,8	206,4
Capital	0	0	167,6	0	0	0	0
Labor	128,2	0,3	172	0	0	0	0
Household 1	0	0	0	0	152,4	0	0
Household 2	0	0	0	167,6	147,8	0	0

Source: RID IEP Analysis.

Using the business micro-models the parameters of the CGE model were estimated as shown in the following chart

9. Initial Parameters For The Simplified CGE Model

TAX	Tax Rate On Income	0
NU	Markup In Monopolistically Competitive Sector	1,33
SIGMA	Elasticity Of Substitution Between Hotels And Guest Houses	4
THETA	Quality Shift Parameter For Monopolistic Hotels In Utility Function	3
L	Aggregate Population In The City	20
K	Aggregate Stock Of Capital Owned By People From The City	20
BETA	Elasticity Of Local Production Of Services With Respect To Labor	0,5
GAMMA	Relative Taste For Local Services In Utility Function	0,05
ALPHA	Elasticity Of Local Production By Hotels With Respect To Labor	1
KBAR	Shift (Productivity) Parameter In Production Of Hotels	1
F	Fixed Cost In Monopolistically Competitive Sector	100

Source: RID IEP Analysis.

The Initial run of the model yielded the results shown in the following chart.

10. Initial Results For The Simplified CGE Model

W	Nominal Wage In The City	24,211
R	Global Price Of Capital	10
PZ	Price Of Guest Houses	20,645
PM	Price Of Monopolistic Hotels	27,52
N	Number Of Monopolistic Hotels	5,14
I	Aggregate Income In The City	684,224
PI	Price Index To Measure Welfare	3,457
WELF	Welfare Index For Representative Worker	7,003
VK	Inflow-Outflow Of Capital To The City	-18,371
QZ	Quantity Produced By All Guest Houses	0,18
QM	Quantity Produced By Each Monopolistic Hotel	4,607
QW	Quantity Of Water	32,582

Source: RID IEP Analysis.

A single shock of a new water system was applied to this greatly simplified model. Fixed costs and productivity parameters are exogenous in the model, which are affected by the shock.[17] The production functions were changed to reflect the new technology and the CGE model was re-calibrated, giving a new SAM. Comparing the pre- and post-change SAMS estimated the sum of direct, indirect and induced changes in the economy (*i.e.*, estimate of overall impact).

The impact of the new water system is summarized in the following chart.

11. Representative Results For Large Hotels For The Simplified CGE Model

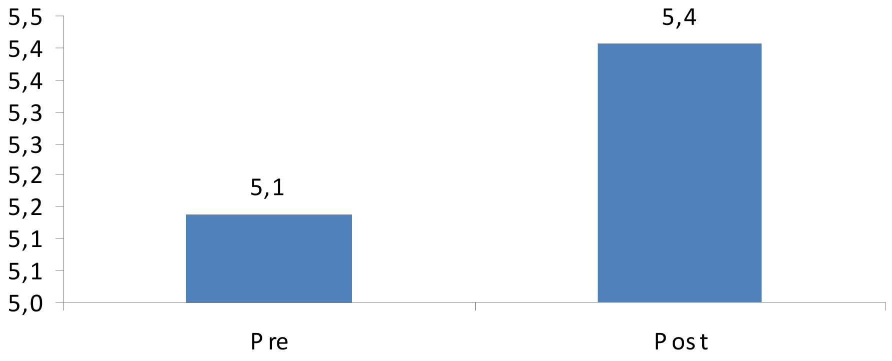
ENDOGENOUS VARIABLES	KBAR=1 F=100 Pre	KBAR=1.5 F=95 Post-Rehabilitation Picture For Different Values Of KBAR And Fixed Cost	KBAR=2 F=90	KBAR=2.5 F=85	KBAR=3 F=80	KBAR=3.5 F=75	KBAR=4 F=70
NOMINAL WAGE IN THE CITY	24,21	24,18	24,15	24,12	24,09	24,06	24,03
GLOBAL PRICE OF CAPITAL	10	10	10	10	10	10	10
PRICE OF GUEST HOUSES	20,6	13,7	10,3	8,2	6,9	5,9	5,1
PRICE OF MONOPOLISTIC HOTELS	27,5	18,3	13,7	11,0	9,1	7,8	6,8
NUMBER OF MONOPOLISTIC HOTELS	5,1	5,4	5,7	6,0	6,4	6,8	7,3
AGGREGATE INCOME IN THE CITY	684	684	683	682	682	681	681
PRICE INDEX TO MEASURE WELFARE	3,5	2,3	1,7	1,4	1,1	1,0	0,8
WELFARE INDEX FOR REPRESENTATIVE WORKER	7	10	14	18	21	25	29
INFLOW-OUTFLOW OF CAPITAL TO THE CITY	(18)	(18)	(18)	(18)	(18)	(18)	(18)
QUANTITY PRODUCED BY ALL GUEST HOUSES	0,18	0,26	0,32	0,38	0,43	0,47	0,51
QUANTITY PRODUCED BY EACH MONOPOLISTIC HOTEL	4,6	6,6	8,3	9,8	11,1	12,2	13,0
QUANTITY OF WATER	32,58	32,55	32,53	32,50	32,47	32,44	32,41

Source: RID IEP Analysis.

Following several charts show the effect of water system rehabilitation on selected various endogenous variables of the model. Due to decrease in fixed costs, new entrants have higher incentive to enter the market, than they had before rehabilitation. As a result, number of hotels increased on the market as shown in the following chart.

[17] The rehabilitation of water system will decrease fixed cost for new entrants, since they will no longer have to invest in alternative water system to secure water supply, while water utility companies will benefit from increased productivity.

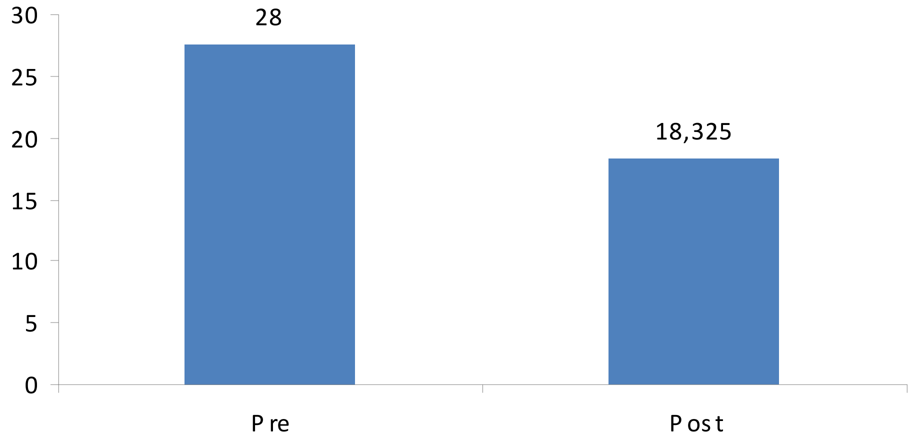
12. Change In The Number Of Hotels For The Simplified CGE Model



Source: RID IEP Analysis.

Increasing competition on the market pushed down the prices for hotel service. The effect is captured on the following chart.

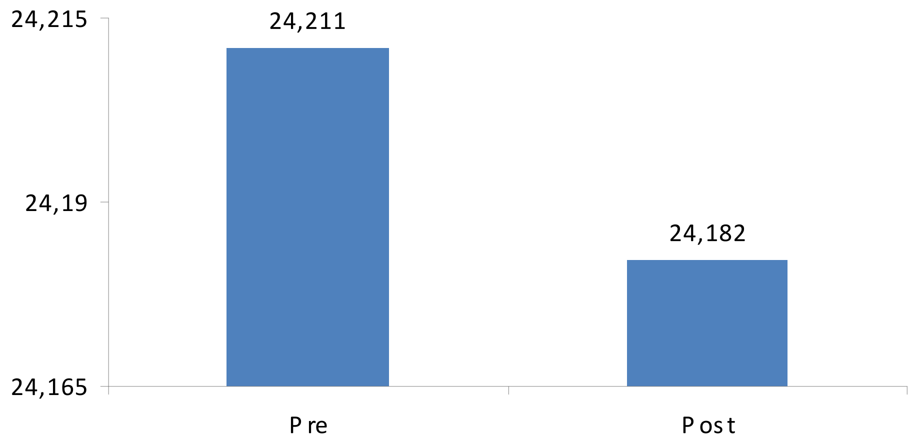
13. Change In Prices Of Hotel Service For The Simplified CGE Model



Source: RID IEP Analysis.

The decrease in prices of hotel services decreased general price levels in the economy (since it comprises of only three sectors and services of hotels and guesthouses are substitutable), leading to a decrease in nominal wages as shown in the following chart.

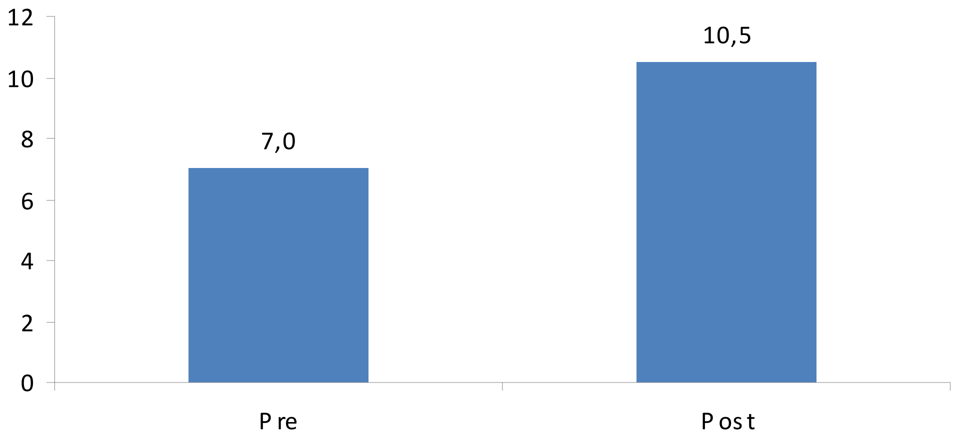
14. Change In Nominal Wages For The Simplified CGE Model



Source: RID IEP Analysis.

However, the welfare index (*i.e.*, real wage) of a representative worker increased in the simplified economy as shown in the following chart.

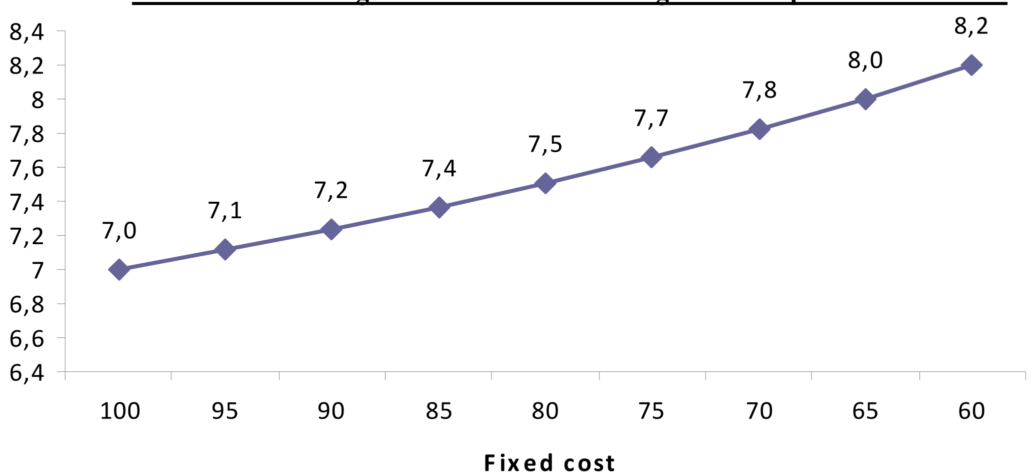
15. Change In Nominal Wages For Simplified CGE Model



Source: RID IEP Analysis.

The above charts showed how a single shift of one value of an exogenous parameter to another makes a difference. It is also possible to graph the results for a set of different values of exogenous parameters (*i.e.*, to define a function of each endogenous variable). For example, the following chart shows how welfare changes as fixed costs for starting a business decrease.

16. Effect Of Decreasing Fixed Costs On Real Wages For Simplified CGE Model



Source: RID IEP Analysis.

Note that these results are for a very simplified economy and the results from the full CGE models used for the RID IEP will be very different. Nevertheless, the results from this simplified model suggest the type of results that can be expected from the full RID IEP CGE analysis.

APPENDIX E

E INDIVIDUAL HOUSEHOLDS IMPACT GROUP – WATER AND SEWER COST

CITYWIDE VALUES / მნიშვნელობა ქალაქის მასშტაბით

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
	Unit Electricity Cost	GEL/kW-hr	0,0960	
	Municipal Water Tariff Based On Number Of HH Members	GEL/HH me ber-mo	1,00	Not used.
	Municipal Water Tariff Based On Entire HH	GEL/HH-mo	4,00	Not used.
	Municipal Water Tariff Based On Single Connection	GEL/connectio n-mo	3,00	Not used.
	Municipal Water Tariff Based On Municipal Water Usage	GEL/m^3	1,70	
	Municipal Water Tariff Based On Combined Municipal And Other Source Water Usage	GEL/m^3	2,50	Not used.
	Municipal Sewage Discharge Tariff Based On Number Of HH Members	GEL/HH me ber-mo	1,00	
	Municipal Sewage Discharge Tariff Based On Entire HH	GEL/HH-mo	4,00	
	Municipal Sewage Discharge Tariff Based On Single Connection	GEL/connectio n-mo	2,50	
	Municipal Sewage Discharge Tariff Based On Municipal Water Usage	GEL/m^3	2,10	
	Municipal Sewage Discharge Tariff Based On Combined Municipal And Other Source Water Usage	GEL/m^3	2,30	

FIXED COST OF MUNICIPAL WATER AND SEWER CONNECTIONS / ფიქსირებული ხარჯი მუნიციპალური წყალმომარაგების და საკანალიზაციო სისტემის მიერთების

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Municipal Water Connection = Water Connection Fee + Water Installation Works Cost **Fixed HH Cost Of Municipal Water Connection = Fixed Cost Of Municipal Water Connection / Number Of HHs Sharing Municipal Water Connection Today** **Fixed Cost Of Municipal Sewer Connection = Sewer Connection Fee + Sewer Installation Works Cost** **Fixed HH Cost Of Municipal Sewer Connection = Fixed Cost Of Municipal Sewer Connection / Number Of HHs Sharing Municipal Sewer Connection Today** **Fixed HH Cost Of Municipal Water And Sewer Connections = Fixed HH Cost Of Municipal Water Connection + Fixed HH Cost Of Municipal Sewer Connection**	Year Of Conecting To Municipal Water		1960	
	Water Connection Fee	GEL	500	
	Water Installation Works Cost	GEL	700	
	Fixed Cost Of Municipal Water Connection	**GEL**	**1 200**	
	Number Of HHs Sharing Municipal Water Connection Today		1	
	Fixed HH Cost Of Municipal Water Connection	**GEL**	**1 200**	
	Year Of Connecting To Municipal Sewer		1960	
	Sewer Connection Fee	GEL	400	
	Sewer Installation Works Cost	GEL	1 000	
	Fixed Cost Of Municipal Sewer Connection	**GEL**	**1 400**	
	Number Of HHs Sharing Municipal Sewer Connection Today		1	
	Fixed HH Cost Of Municipal Sewer Connection	**GEL**	**1 400**	
	Fixed HH Cost Of Municipal Water And Sewer Connections	**GEL**	**2 600**	

FIXED COST OF WATER WELL SYSTEM / ფიქსირებული ხარჯი წყლის ჭის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Water Wells = Number Of Water Wells * (Average Depth Of Water Wells * (Unit Water Well Lining Pipe Cost + Unit Water Well Digging And Well-Lining Installation Cost)) **Fixed Cost Of Water Well Pumps = Number Of Water Well Pumps * Unit Water Well Pump Cost** **Fixed Cost Of Water Well System = Fixed Cost Of Water Wells + Fixed Cost Of Water Well Pumps + Water Well Electrical Control System Cost + Testing Of Water At Startup Cost** **Fixed HH Cost Of Water Well System = Fixed Cost Of Water Well System / Number of HHs Sharing Water Well System Today**	Year Of Constructing Wells		1960	
	Number Of Water Wells		1	
	Average Depth Of Water Wells	m	65	
	Unit Water Well Lining Pipe Cost	GEL/m	5	
	Unit Water Well Digging And Well-Lining Installation Cost	GEL/m	35	
	Fixed Cost Of Water Wells	**GEL**	**2 600**	
	Number Of Water Well Pumps		3	Combine all wells if more than one.
	Unit Water Well Pump Cost	GEL	700	
	Fixed Cost Of Water Well Pumps	**GEL**	**2 100**	
	Water Well Electrical Control System Cost	GEL	400	
	Testing Of Water At Startup Cost	GEL	15	
	Fixed Cost Of Water Well System	**GEL**	**5 115**	
	Number of HHs Sharing Water Well System Today		1	
	Fixed HH Cost Of Water Well System	**GEL**	**5 115**	

FIXED COST OF SPRING OR DISTANT WATER SOURCE SYSTEM / ფიქსირებული ხარჯი ბუნებრივი წყაროს ან სხვა მოშორებით მდებარე წყაროს სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Spring Or Distant Water Source Head Works Pumps And Fixtures = Spring Or Distant Water Source Head Works Pump Cost + Other Head Works Fixtures Cost **Fixed Cost Of Spring Or Distant Water Source Supply Pipes = Distance To Spring Or Distant Water Source * (Unit Price Of Spring Or Distant Water Source Supply Pipe + Unit Sprint Or Distant Water Source Supply Pipe Installation Cost)** **Fixed Cost Of Spring Or Distant Water Source System = Fixed Cost Of Spring Or Distant Water Source Head Works Pumps And Fixtures + Fixed Cost Of Spring Or Distant Water Source Supply Pipes + Spring Or Distant Water Source Electrical Control System Cost + Testing Of Water At Startup Cost** **Fixed HH Cost Of Spring Or Distant Water Source System = Fixed Cost Of Spring Or Distant Water Source System / Number of HHs Sharing Spring Or Other Distant Water Source System Today**	Year Of Constructing Connection To Spring Or Distant Water Source		1965	
	Spring Or Distant Water Source Head Works Pump Cost	GEL	2000	
	Other Head Works Fixtures Cost	GEL	2000	
	Fixed Cost Of Spring Or Distant Water Source Head Works Pumps And Fixtures	**GEL**	**4 000**	
	Distance To Spring Or Distant Water Source	m	500	
	Unit Price Of Spring Or Distant Water Source Supply Pipe	GEL/m	5	
	Unit Sprint Or Distant Water Source Supply Pipe Installation Cost	GEL/m	5	
	Fixed Cost Of Spring Or Distant Water Source Supply Pipes	**GEL**	**5 000**	
	Spring Or Distant Water Source Electrical Control System Cost	GEL	400	
	Testing Of Water At Startup Cost	GEL	15	
	Fixed Cost Of Spring Or Distant Water Source System	**GEL**	**9 415**	
	Number of HHs Sharing Spring Or Other Distant Water Source System Today		4	
	Fixed HH Cost Of Spring Or Distant Water Source System	**GEL**	**2 354**	

FIXED COST OF OUTSIDE WATER STORAGE SYSTEM / ფიქსირებული ხარჯი წყლის გარე ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Outside Water Storage Tanks = Outside Water Storage Tank Cost + Outside Water Storage Tank Installation Cost **Fixed Cost Of Outside Water Storage Tank Filling Pumps = Number Of Outside Water Storage Tank Filling Pumps * Unit Outside Water Storage Tank Filling Pump Cost** **Fixed Cost Of Outside Water Storage System = Fixed Cost Of Outside Water Storage Tanks + Fixed Cost Of Outside Water Storage Tank Filling Pumps** **Fixed HH Cost Of Outside Water Storage Tank System = (Fixed Cost Of Outside Water Storage Tanks + Fixed Cost Of Outside Water Storage Tank Filling Pumps) / Number Of HHs Sharing Outside Water Storage System Today** **Unit Cost Of Outside Water Storage System = Fixed HH Cost Of Outside Water Storage Tank System / Outside Water Storage Tank Capacity**	Year Of Constructing Outside Water Storage Tanks		1975	
	Outside Water Storage Tank Capacity	m^3	3	Combine all tanks if more than one.
	Outside Water Storage Tank Cost	GEL	500	Combine all tanks if more than one.
	Outside Water Storage Tank Installation Cost	GEL	200	Combine all tanks if more than one.
	Number Of Outside Water Storage Tanks		1	Actual number of tanks.
	Fixed Cost Of Outside Water Storage Tanks	**GEL**	**700**	
	Number Of Outside Water Storage Tank Filling Pumps		2	
	Unit Outside Water Storage Tank Filling Pump Cost	GEL	80	
	Fixed Cost Of Outside Water Storage Tank Filling Pumps	**GEL**	**160**	
	Outside Water Storage Electrical Control System Cost	GEL	400	
	Fixed Cost Of Outside Water Storage System	**GEL**	**860**	
	Number Of HHs Sharing Outside Water Storage System Today		1	
	Fixed HH Cost Of Outside Water Storage Tank System	**GEL**	**860**	
	Unit Cost Of Outside Water Storage System	**GEL/m^3**	**287**	

FIXED COST OF WATER DISTRIBUTION SYSTEM / ფიქსირებული ხარჯი წყლის გამანაწილებელი სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Water Distribution Pipes = Water Distribution Pipe Length * (Unit Wate Distribution Pipe Cost + Unit Water Distribution Pipe Installation Cost) **Fixed Cost Of Water Distribution Pumps = Number Of Water Distribution Pumps * Unit Water Distribution Pump Cost** **Fixed Cost Of Water Distribution System = Fixed Cost Of Water Distribution Pipes + Fixed Cost Of Water Distribution Pumps + Water Distribution Electrical Control System Cost** **Fixed HH Cost Of Water Distribution System = Fixed Cost Of Water Distribution System / Number Of HHs Sharing Water Distribution System Today**	Year Of Constructing Distribution System		1995	
	Water Distribution Pipe Length	m	200	
	Unit Wate Distribution Pipe Cost	GEL/m	3	
	Unit Water Distribution Pipe Installation Cost	GEL/m	5	
	Fixed Cost Of Water Distribution Pipes	**GEL**	**1 600**	
	Number Of Water Distribution Pumps		2	
	Unit Water Distribution Pump Cost	GEL	80	
	Fixed Cost Of Water Distribution Pumps	**GEL**	**160**	
	Water Distribution Electrical Control System Cost	GEL	400	
	Fixed Cost Of Water Distribution System	**GEL**	**2 160**	
	Number Of HHs Sharing Water Distribution System Today		1	
	Fixed HH Cost Of Water Distribution System	**GEL**	**2 160**	

FIXED COST OF INSIDE WATER STORAGE SYSTEM / ფიქსირებული ხარჯი წყლის შიდა ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Inside Water Storage Tanks = Number Of Inside Water Storage Tanks * Unit Inside Water Storage Tank Cost **Fixed Cost Of Inside Water Storage Pumps = Number Of Inside Water Storage Pumps * Unit Inside Water Storage Pump Cost** **Fixed Cost Of Inside Water Storage System = Fixed Cost Of Inside Water Storage Tanks + Fixed Cost Of Inside Water Storage Pumps + Inside Water Storage Electrical Control System Cost** **Fixed HH Cost Of Inside Water Storage System = Fixed Cost Of Inside Water Storage System / Number Of HHs Sharing Inside Water Storage System Today**	Inside Water Storage Tank Capacity	m^3	0,5	Combine all tanks if more than one.
	Number Of Inside Water Storage Tanks		5	Actual number of tanks.
	Unit Inside Water Storage Tank Cost	GEL	10	
	Fixed Cost Of Inside Water Storage Tanks	**GEL**	**50**	
	Number Of Inside Water Storage Pumps		1	
	Unit Inside Water Storage Pump Cost	GEL	25	
	Fixed Cost Of Inside Water Storage Pumps	**GEL**	**25**	
	Inside Water Storage Electrical Control System Cost	GEL	50	
	Fixed Cost Of Inside Water Storage System	**GEL**	**125**	
	Number Of HHs Sharing Inside Water Storage System Today		1	
	Fixed HH Cost Of Inside Water Storage System	**GEL**	**125**	

FIXED COST OF BUCKETS AND OTHER MOVEABLE WATER STORAGE CONTAINERS / ფიქსირებული ხარჯი ვედროების და სხვა მოძრავი წყლის შესანახი ჭურჭლის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Buckets And Other Movable Water Storage Containers = Number Of Buckets Or Other Movable Water Storage Containers * Unit Bucket Or Other Movable Water Storage Container Cost **Fixed HH Cost Of Buckets And Other Movable Water Storage Containers = Fixed Cost Of Buckets And Other Movable Water Storage Containers / Number Of HHs Sharing Buckets And Other Movable Water Storage Containers Today**	Type Of Bucket Or Other Movable Water Storage Container			Create a list
	Capacity Of Buckets Or Other Movable Water Storage Containers	liter	50,0	Combine all buckets and containers if more than one.
	Number Of Buckets Or Other Movable Water Storage Containers		5	Actual number of buckets and containers.
	Unit Bucket Or Other Movable Water Storage Container Cost	GEL	10	
	Fixed Cost Of Buckets And Other Movable Water Storage Containers	**GEL**	**50**	
	Number Of HHs Sharing Buckets And Other Movable Water Storage Containers Today		1	
	Fixed HH Cost Of Buckets And Other Movable Water Storage Containers	**GEL**	**50**	

FIXED COST OF WATER FILTER SYSTEM / ფიქსირებული ხარჯი წყლის ფილტრის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Water Filters = Number Of Water Filters * (Unit Water Filter Cost + Unit Water Filter Installation Cost) **Fixed HH Cost Of Water Filter System = Fixed Cost Of Water Filters / Number Of HHs Sharing Water Filter System Today**	Year Of Buying Water Filter		1990	
	Number Of Water Filters		1	
	Unit Water Filter Cost	GEL	250	
	Unit Water Filter Installation Cost	GEL	50	
	Fixed Cost Of Water Filters	**GEL**	**300**	
	Number Of HHs Sharing Water Filter System Today		2	
	Fixed HH Cost Of Water Filter System	**GEL**	**150**	

FIXED COST OF SEWAGE STORAGE SYSTEM / ფიქსირებული ხარჯი საკანალიზაციო ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Sewage Storage Tanks = Sewage Storage Tank Cost + Sewage Storage Tank Installation Cost **Fixed Cost Of Sewage Storage Pipes = Sewer Pipe To Sewage Storage Tank Length * (Unit Sewer Storage Pipe Cost + Unit Sewer Storage Pipe Installation Cost)** **Fixed Cost Of Sewage Storage Pumps = Number Of Sewage Storage Pumps * Unit Sewage Storage Pump Cost** **Fixed Cost Of Sewage Storage System = Fixed Cost Of Sewage Storage Tanks + Fixed Cost Of Sewage Storage Pipes + Fixed Cost Of Sewage Storage Pumps + Sewage Storage Electrical Control System Cost** **Fixed HH Cost Of Sewage Storage System = Fixed Cost Of Sewage Storage System / Number Of HHs Sharing Sewage Storage System Today**	Year Of Constructing Sewage Storage System		1995	
	Sewage Storage Tank Capacity	m^3	25	Combine all tanks if more than one
	Sewage Storage Tank Cost	GEL	5 000	Combine all tanks if more than one
	Sewage Storage Tank Installation Cost	GEL	200	Combine all tanks if more than one
	Number Of Sewage Storage Tanks		1	Actual number of tanks
	Fixed Cost Of Sewage Storage Tanks	**GEL**	**5 200**	
	Sewer Pipe To Sewage Storage Tank Length	m	20	
	Unit Sewer Storage Pipe Cost	GEL/m	35	
	Unit Sewer Storage Pipe Installation Cost	GEL/m	10	
	Fixed Cost Of Sewage Storage Pipes	**GEL**	**900**	
	Number Of Sewage Storage Pumps		1	
	Unit Sewage Storage Pump Cost	GEL	600	
	Fixed Cost Of Sewage Storage Pumps	**GEL**	**600**	
	Sewage Storage Electrical Control System Cost	GEL	50	
	Fixed Cost Of Sewage Storage System	**GEL**	**6 750**	
	Number Of HHs Sharing Sewage Storage System Today		3	
	Fixed HH Cost Of Sewage Storage System	**GEL**	**2 250**	

FIXED COST OF SEWAGE OUTFALL SYSTEM / ფიქსირებული ხარჯი საკანალიზაციო არხის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Sewage Outfall End Works = (Number Of Sewage Outfall Pumps At Outfall * Unit Sewage Outfall Pump At Outfall Cost) + Other Sewage Outfall Fixtures Cost **Fixed Cost Of Sewage Outfall Pipes = Distance To Sewage Outfall * (Unit Price Of Sewage Outfall Pipe + Unit Sewage Outfall Pipe Installation Cost)** **Fixed Cost Of Sewage Outfall Pumps Adjacent To HH = Number Of Sewage Outfall Pumps Adjacent To HH * Unit Sewage Outfall Pump Adjacent To HH Cost** **Fixed Cost Of Sewage Outfall System = Fixed Cost Of Sewage Outfall End Works + Fixed Cost Of Sewage Outfall Pipes + Fixed Cost Of Sewage Outfall Pumps Adjacent To HH + Sewage Outfall Electrical Control System Cost** **Fixed HH Cost Of Sewage Outfall System = Fixed Cost Of Sewage Outfall System / Number Of HHs Sharing The Sewage Outfall System Today**	Year Of Constructing Sewage Outfall System		1995	
	Number Of Sewage Outfall Pumps At Outfall		1	
	Unit Sewage Outfall Pump At Outfall Cost	GEL	500	
	Other Sewage Outfall Fixtures Cost	GEL	1500	
	Fixed Cost Of Sewage Outfall End Works	**GEL**	**2 000**	
	Distance To Sewage Outfall	m	600	
	Unit Price Of Sewage Outfall Pipe	GEL/m	10	
	Unit Sewage Outfall Pipe Installation Cost	GEL/m	10	
	Fixed Cost Of Sewage Outfall Pipes	**GEL**	**12 000**	
	Number Of Sewage Outfall Pumps Adjacent To HH		1	
	Unit Sewage Outfall Pump Adjacent To HH Cost	GEL	600	
	Fixed Cost Of Sewage Outfall Pumps Adjacent To HH	**GEL**	**600**	
	Sewage Outfall Electrical Control System Cost	GEL	200	
	Fixed Cost Of Sewage Outfall System	**GEL**	**14 800**	
	Number Of HHs Sharing The Sewage Outfall System Today		10	
	Fixed HH Cost Of Sewage Outfall System	**GEL**	**1 480**	

TOTAL FIXED COST OF WATER AND SEWER FACILITIES AND EQUIPMENT / ჯამური ფიქსირებული ხარჯი წყლის და საკანალიზაციო სისტემის ინფრასტრუქტურის და დანადგარების

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Total HH Non-Coping-Related Fixed Cost For Water And Sewer = Fixed HH Cost Of Municipal Water Connection + Fixed HH Cost Of Municipal Sewer Connection **Total HH Coping-Related Fixed Cost For Water = (Fixed HH Cost Of Water Well System + Fixed HH Cost Of Spring Or Distant Water Source System + Fixed HH Cost Of Outside Water Storage Tank System + Fixed HH Cost Of Water Distribution System) * (2 / 2) + (Fixed HH Cost Of Inside Water Storage System + Fixed HH Cost Of Buckets And Other Movable Water Storage Containers + Fixed HH Cost Of Water Filter System)** **Total HH Coping-Related Fixed Cost For Sewer = Fixed HH Cost Of Sewage Storage System + Fixed HH Cost Of Sewage Outfall System** **Total HH Fixed Cost Of Water And Sewer = Total HH Non-Coping-Related Fixed Cost For Water And Sewer + Total HH Coping-Related Fixed Cost For Water + Total HH Coping-Related Fixed Cost For Sewer**	Fixed HH Cost Of Municipal Water Connection	GEL	1 200	
	Fixed HH Cost Of Municipal Sewer Connection	GEL	1 400	
	Total HH Non-Coping-Related Fixed Cost For Water And Sewer	**GEL**	**2 600**	
	Fixed HH Cost Of Water Well System	GEL	5 115	
	Fixed HH Cost Of Spring Or Distant Water Source System	GEL	2 354	
	Fixed HH Cost Of Outside Water Storage Tank System	GEL	860	
	Fixed HH Cost Of Water Distribution System	GEL	2 160	
	Fixed HH Cost Of Inside Water Storage System	GEL	125	
	Fixed HH Cost Of Buckets And Other Movable Water Storage Containers	GEL	50	
	Fixed HH Cost Of Water Filter System	GEL	150	
	Total HH Coping-Related Fixed Cost For Water	**GEL**	**10 814**	
	Fixed HH Cost Of Sewage Storage System	GEL	2 250	
	Fixed HH Cost Of Sewage Outfall System	GEL	1 480	
	Total HH Coping-Related Fixed Cost For Sewer	**GEL**	**3 730**	
	Total HH Fixed Cost Of Water And Sewer	**GEL**	**17 144**	

ANNUALIZED SEMI-VARIABLE COST OF WATER WELL SYSTEM / წლიური ნახევრადცვლადი ხარჯი წყლის ჭის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Water Well Pumps = (Number Of Water Well Pumps * Unit Water Well Pump Replacement Or Refurbishment Cost) / Expected Time Between Well Pump Replacement Or Refurbishment	Expected Time Between Well Pump Replacement Or Refurbishment	yr	3	
	Number Of Water Well Pumps		3	
	Unit Water Well Pump Replacement Or Refurbishment Cost	GEL	700	
Annualized Semi-Variable Cost Of Water Well Replacement Or Refurbishment = (Number Of Water Wells * Unit Water Well Replacement Or Refurbishment Cost) / Expected Time Between Water Well Replacement Or Refurbishment	**Annualized Semi-Variable Cost Of Water Well Pumps**	**GEL/yr**	**700**	
	Expected Time Between Water Well Replacement Or Refurbishment	yr	5	
	Number Of Water Wells		1	
Annualized Semi-Variable Cost Of Water Well Electrical System Replacement Or Refurbishment = Unit Water Well Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Water Well Electrical System Replacement Or Refurbishment	Unit Water Well Replacement Or Refurbishment Cost	GEL	1 000	
	Annualized Semi-Variable Cost Of Water Well Replacement Or Refurbishment	**GEL/yr**	**200**	
	Expected Time Between Water Well Electrical System Replacement Or Refurbishment	yr	4	
Annualized Semi-Variable Cost Of Water Well System = Annualized Semi-Variable Cost Of Water Well Pumps + Annualized Semi-Variable Cost Of Water Well Replacement Or Refurbishment + Annualized Semi-Variable Cost Of Water Well Electrical System Replacement Or Refurbishment	Unit Water Well Electrical Control System Replacement Or Refurbishment Cost	GEL	200	
	Annualized Semi-Variable Cost Of Water Well Electrical System Replacement Or Refurbishment	**GEL/yr**	**50**	
	Annualized Semi-Variable Cost Of Water Well System	**GEL/yr**	**950**	
Annualized HH Semi-Variable Cost Of Water Well System = Annualized Semi-Variable Cost Of Water Well System / Number Of HHs Sharing Water Well System Today	Number Of HHs Sharing Water Well System Today		1	
	Annualized HH Semi-Variable Cost Of Water Well System	**GEL/yr**	**950**	

ANNUALIZED SEMI-VARIABLE COST OF SPRING OR DISTANT WATER SOURCE SYSTEM / წლიური ნახევრადცვლადი ხარჯი ბუნებრივი წყაროს ან სხვა მოშორებით

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Spring Or Distant Water Source Pumps = Unit Spring Or Distant Water Source Head Works Pump Replacement Or Refurbishment Cost / Expected Time Between Spring Or Distant Water Source Head Works Pump Replacement Or Refurbishment **Annualized Semi-Variable Cost Of Spring Or Distant Water Source Head Works Fixtures = Unit Head Works Fixtures Replacement Or Refurbishment Cost / Expected Time Between Head Works Fixtures Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Spring Or Distant Water Source Supply Pipe = Unit Spring Or Distant Water Source Supply Pipe Replacement Or Refurbishment Cost / Expected Time Between Spring Or Distant Water Source Supply Pipe Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Spring Or Distant Water Sourcel Electrical System Replacement Or Refurbishment = Unit Spring Or Distant Water Source Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Spring Or Distant Water Source Electrical System Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Spring Or Distant Water** **Annualized HH Semi-Variable Cost Of Spring Or Distant Wa**	Expected Time Between Spring Or Distant Water Source Head Works Pump Replacement Or Refurbishment	yr	3	
	Unit Spring Or Distant Water Source Head Works Pump Replacement Or Refurbishment Cost	GEL	700	
	Annualized Semi-Variable Cost Of Spring Or Distant Water Source Pumps	**GEL/yr**	**233**	
	Expected Time Between Head Works Fixtures Replacement Or Refurbishment	yr	10	
	Unit Head Works Fixtures Replacement Or Refurbishment Cost	GEL	1 500	
	Annualized Semi-Variable Cost Of Spring Or Distant Water Source Head Works Fixtures	**GEL/yr**	**150**	
	Expected Time Between Spring Or Distant Water Source Supply Pipe Replacement Or Refurbishment	yr	5	
	Unit Spring Or Distant Water Source Supply Pipe Replacement Or Refurbishment Cost	GEL	1 000	
	Annualized Semi-Variable Cost Of Spring Or Distant Water Source Supply Pipe	**GEL/yr**	**200**	
	Expected Time Between Spring Or Distant Water Source Electrical System Replacement Or Refurbishment	yr	4	
	Unit Spring Or Distant Water Source Electrical Control System Replacement Or Refurbishment Cost	GEL	200	
	Annualized Semi-Variable Cost Of Spring Or Distant Water Sourcel Electrical System Replacement Or Refurbishment	**GEL/yr**	**50**	
	Annualized Semi-Variable Cost Of Spring Or Distant Water Source System	**GEL/yr**	**633**	
	Number Of HHs Sharing Spring Or Distant Water Source System Today		4	
	Annualized HH Semi-Variable Cost Of Spring Or Distant Water Source System	**GEL/yr**	**158**	

ANNUALIZED SEMI-VARIABLE COST OF WATER TESTING / წლიური ნახევრადცვლადი ხარჯი წყლის ტესტირების

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Water Testing = (Water Tests Per Year Of Municipal Water + Water Tests Per Year Of Water Well Water + Water Tests Per Year Of Spring Or Distant Source Water + Water Tests Per Year Of Other Alternative Water) * Unit Price Of Testing Water Paid By HHs **Annualized HH Semi-Variable Cost Of Water Testing = Annualized Semi-Variable Cost Of Water Testing / Number Of HHs Sharing Water Testing Today**	Water Tests Per Year Of Municipal Water		1	
	Water Tests Per Year Of Water Well Water		1	
	Water Tests Per Year Of Spring Or Distant Source Water			
	Water Tests Per Year Of Other Alternative Water			
	Unit Price Of Testing Water Paid By HHs	GEL	15	
	Annualized Semi-Variable Cost Of Water Testing	**GEL/yr**	**30**	
	Number Of HHs Sharing Water Testing Today		2	
	Annualized HH Semi-Variable Cost Of Water Testing	**GEL/yr**	**15**	

ANNUALIZED SEMI-VARIABLE COST OF OUTSIDE WATER STORAGE SYSTEM / წლიური ნახევრადცვლადი ხარჯი წყლის გარე ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Outside Water Storage Tanks = (Number Of Outside Water Storage Tanks * Unit Outside Water Storage Tank Replacement Or Refurbishment Cost) / Expected Time Between Outside Water Storage Tank Replacement Or Refurbishment	Expected Time Between Outside Water Storage Tank Replacement Or Refurbishment	yr	20	
	Number Of Outside Water Storage Tanks		1	
	Unit Outside Water Storage Tank Replacement Or Refurbishment Cost	GEL	5 000	
	Annualized Semi-Variable Cost Of Outside Water Storage Tanks	**GEL/yr**	**250**	
Annualized Semi-Variable Cost Of Outside Water Storage Tank Filling Pumps = (Number Of Outside Water Storage Tank Filling Pumps * Unit Outside Water Storage Tank Filling Pump Replacement Or Refurbishment Cost) / Expected Time Between Outside Water Storage Tank Filling Pump Replacement Or Refurbishment	Expected Time Between Outside Water Storage Tank Filling Pump Replacement Or Refurbishment	yr	2	
	Number Of Outside Water Storage Tank Filling Pumps		2	
	Unit Outside Water Storage Tank Filling Pump Replacement Or Refurbishment Cost	GEL	400	
	Annualized Semi-Variable Cost Of Outside Water Storage Tank Filling Pumps	**GEL/yr**	**400**	
Annualized Semi-Variable Cost Of Outside Water Storage Electrical System Replacement Or Refurbishment = Unit Outside Water Storage Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Outside Water Storage Electrical System Replacement Or Refurbishment	Expected Time Between Outside Water Storage Electrical System Replacement Or Refurbishment	yr	2	
	Unit Outside Water Storage Electrical Control System Replacement Or Refurbishment Cost	GEL	230	
	Annualized Semi-Variable Cost Of Outside Water Storage Electrical System Replacement Or Refurbishment	**GEL/yr**	**115**	
Annualized Semi-Variable Cost Of Outside Water Storage System = Annualized Semi-Variable Cost Of Outside Water Storage Tanks + Annualized Semi-Variable Cost Of Outside Water Storage Tank Filling Pumps + Annualized Semi-Variable Cost Of Outside Water Storage Electrical Sy	**Annualized Semi-Variable Cost Of Outside Water Storage System**	**GEL/yr**	**765**	
	Number Of HHs Sharing Outside Water Storage System Today		1	
Annualized HH Semi-Variable Cost Of Outside Water Storag	**Annualized HH Semi-Variable Cost Of Outside Water Storage System**	**GEL/yr**	**765**	

ANNUALIZED SEMI-VARIABLE COST OF WATER DISTRIBUTION SYSTEM / წლიური ნახევრადცვლადი ხარჯი წყლის გამანაწილებელი სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Water Distribution Pump = (Number Of Water Distribution Pumps * Unit Water Distribution Pump Replacement Or Refurbishment Cost) / Expected Time Between Water Distribution Pump Replacement Or Refurbishment	Expected Time Between Water Distribution Pump Replacement Or Refurbishment	yr	2	
	Number Of Water Distribution Pumps		2	
	Unit Water Distribution Pump Replacement Or Refurbishment Cost	GEL	700	
	Annualized Semi-Variable Cost Of Water Distribution Pump	**GEL/yr**	**700**	
Annualized Semi-Variable Cost Of Water Distribution Electrical System Replacement Or Refurbishment = Unit Water Distribution Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Water Distribution Electrical System Replacement Or Refurbishment	Expected Time Between Water Distribution Electrical System Replacement Or Refurbishment	yr	3	
	Unit Water Distribution Electrical Control System Replacement Or Refurbishment Cost	GEL	100	
	Annualized Semi-Variable Cost Of Water Distribution Electrical System Replacement Or Refurbishment	**GEL/yr**	**33**	
Annualized Semi-Variable Cost Of Water Distribution System = Annualized Semi-Variable Cost Of Water Distribution Pump + Annualized Semi-Variable Cost Of Water Distribution Electrical System Replacement Or Refurbishment	**Annualized Semi-Variable Cost Of Water Distribution System**	**GEL/yr**	**733**	
	Number Of HHs Sharing Water Distribution System Today		1	
Annualized HH Semi-Variable Cost Of Water Distribution System = Annualized Semi-Variable Cost Of Water	**Annualized HH Semi-Variable Cost Of Water Distribution System**	**GEL/yr**	**733**	

ANNUALIZED SEMI-VARIABLE COST OF INSIDE WATER STORAGE SYSTEM / წლიური ნახევრადცვლადი ხარჯი წყლის შიდა ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Inside Water Storage Tanks = (Number Of Inside Water Storage Tanks * Unit Inside Water Storage Tank Replacement Or Refurbishment Cost) / Expected Time Between Inside Water Storage Tank Replacement Or Refurbishment	Expected Time Between Inside Water Storage Tank Replacement Or Refurbishment	yr	5	
	Number Of Inside Water Storage Tanks		5	
	Unit Inside Water Storage Tank Replacement Or Refurbishment Cost	GEL	200	
	Annualized Semi-Variable Cost Of Inside Water Storage Tanks	**GEL/yr**	**200**	
Annualized Semi-Variable Cost Of Inside Water Storage Pumps = (Number Of Inside Storage Water Pumps * Unit Inside Water Storage Pump Replacement Or Refurbishment Cost) / Expected Time Between Inside Water Storage Pump Replacement Or Refurbishment	Expected Time Between Inside Water Storage Pump Replacement Or Refurbishment	yr	3	
	Number Of Inside Storage Water Pumps		1	
	Unit Inside Water Storage Pump Replacement Or Refurbishment Cost	GEL	100	
	Annualized Semi-Variable Cost Of Inside Water Storage Pumps	**GEL/yr**	**33**	
Annualized Semi-Variable Cost Of Inside Water Storage Electrical System Replacement Or Refurbishment = Unit Inside Water Storage Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Inside Water Storage Electrical System Replacement Or Refurbishment	Expected Time Between Inside Water Storage Electrical System Replacement Or Refurbishment	yr	4	
	Unit Inside Water Storage Electrical Control System Replacement Or Refurbishment Cost	GEL	50	
	Annualized Semi-Variable Cost Of Inside Water Storage Electrical System Replacement Or Refurbishment	**GEL/yr**	**13**	
Annualized Semi-Variable Cost Of Inside Water Storage System = Annualized Semi-Variable Cost Of Inside Water Storage Tanks + Annualized Semi-Variable Cost Of Inside Water Storage Pumps + Annualized Semi-Variable Cost Of Inside Water Storage Electrical System Replacement Or Refurbishment	**Annualized Semi-Variable Cost Of Inside Water Storage System**	**GEL/yr**	**246**	
Annualized HH Semi-Variable Cost Of Inside Water Storage	Number Of HHs Sharing Inside Water Storage System Today		1	
	Annualized HH Semi-Variable Cost Of Inside Water Storage System	**GEL/yr**	**246**	

ANNUALIZED SEMI-VARIABLE COST OF BUCKETS AND OTHER MOVEABLE WATER STORAGE CONTAINERS / წლიური ნახევრადცვლადი ხარჯი ვედროების და

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Buckets And Other Moveable Water Storage Containers = (Number Of Buckets Or Other Moveable Water Storage Containers * Unit Bucket Or Other Moveable Water Storage Container Replacement Or Refurbishment Cost) / Expected Time Between Bucket Or Other Moveable Water Storage Container Replacement Or Refurbishment	Expected Time Between Bucket Or Other Moveable Water Storage Container Replacement Or Refurbishment	yr	3	
	Number Of Buckets Or Other Moveable Water Storage Containers		5	
	Unit Bucket Or Other Moveable Water Storage Container Replacement Or Refurbishment Cost	GEL	25	
	Annualized Semi-Variable Cost Of Buckets And Other Moveable Water Storage Containers	**GEL/yr**	**42**	
Annualized HH Semi-Variable Cost Of Buckets And Other Moveable Water Storage Containers = Annualized Semi-Variable Cost Of Buckets And Other Moveable Water Storage Containers / Number Of HHs Sharing Buckets And	Number Of HHs Sharing Buckets And Other Moveable Containers Today		1	
	Annualized HH Semi-Variable Cost Of Buckets And Other Moveable Water Storage Containers	**GEL/yr**	**42**	

ANNUALIZED SEMI-VARIABLE COST OF WATER FILTER SYSTEM / წლიური ნახევრადცვლადი ხარჯი წყლის ფილტრის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Water Filters = (Number Of Water Filters * Unit Water Filter Replacement Or Refurbishment Cost) / Expected Time Between Water Filter Replacement Or Refurbishment **Annualized HH Semi-Variable Cost Of Water Filter System = Annualized Semi-Variable Cost Of Water Filters / Number Of HHs Sharing Water Filter System Today**	Expected Time Between Water Filter Replacement Or Refurbishment	yr	5	
	Number Of Water Filters		1	
	Unit Water Filter Replacement Or Refurbishment Cost	GEL	250	
	Annualized Semi-Variable Cost Of Water Filters	**GEL/yr**	**50**	
	Number Of HHs Sharing Water Filter System Today		2	
	Annualized HH Semi-Variable Cost Of Water Filter System	**GEL/yr**	**25**	

ANNUALIZED SEMI-VARIABLE COST OF SEWAGE STORAGE SYSTEM / წლიური ნახევრადცვლადი ხარჯი საკანალიზაციო ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Sewage Storage System Tanks = (Number Of Sewage Storage Tanks * Unit Sewage Storage Tank Replacement Or Refurbishment Cost) / Expected Time Between Sewage Storage Tank Replacement Or Refurbishment **Annualized Semi-Variable Cost Of Sewage Storage Pipes = (Sewage Storage Pipe Length * Unit Sewage Storage Pipe Replacement Or Refurbishment Cost) / Expected Time Between Sewage Storage Pipe Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Sewage Storage Pumps = (Number Of Sewage Storage Pumps * Unit Sewage Storage Pump Replacement Or Refurbishment Cost) / Expected Time Between Sewage Storage Pump Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Sewage Storage Electrical System Replacement Or Refurbishment = Unit Sewage Storage Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Sewage Storage Electrical System Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Sewage Storage System = Annualized Semi-Variable Cost Of Sewage Storage System Tanks + Annualized Semi-Variable Cost Of** **Annualized HH Semi-Variable Cost Of Sewage Storage Sys**	Expected Time Between Sewage Storage Tank Replacement Or Refurbishment	yr	15	
	Number Of Sewage Storage Tanks		1	
	Unit Sewage Storage Tank Replacement Or Refurbishment Cost	GEL	5 000	
	Annualized Semi-Variable Cost Of Sewage Storage System Tanks	**GEL/yr**	**333**	
	Expected Time Between Sewage Storage Pipe Replacement Or Refurbishment	yr	15	
	Sewage Storage Pipe Length	m	20	
	Unit Sewage Storage Pipe Replacement Or Refurbishment Cost	GEL/m	100	
	Annualized Semi-Variable Cost Of Sewage Storage Pipes	**GEL/yr**	**133**	
	Expected Time Between Sewage Storage Pump Replacement Or Refurbishment	yr	5	
	Number Of Sewage Storage Pumps		1	
	Unit Sewage Storage Pump Replacement Or Refurbishment Cost	GEL	300	
	Annualized Semi-Variable Cost Of Sewage Storage Pumps	**GEL/yr**	**60**	
	Expected Time Between Sewage Storage Electrical System Replacement Or Refurbishment	yr	10	
	Unit Sewage Storage Electrical Control System Replacement Or Refurbishment Cost	GEL	1 000	
	Annualized Semi-Variable Cost Of Sewage Storage Electrical System Replacement Or Refurbishment	**GEL/yr**	**100**	
	Annualized Semi-Variable Cost Of Sewage Storage System	**GEL/yr**	**627**	
	Number Of HHs Sharing Sewage Storage System Today		3	
	Annualized HH Semi-Variable Cost Of Sewage Storage System	**GEL/yr**	**209**	

ANNUALIZED SEMI-VARIABLE COST OF SEWAGE OUTFALL SYSTEM / წლიური ნახევრადცვლადი ხარჯი საკანალიზაციო არხის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Sewage Outfall End Works Pumps And Fixtures = Unit Sewage Outfall End Works Pump Replacement Or Refurbishment Cost / Expected Time Between Sewage Outfall End Works Pump Replacement Or Refurbishment	Expected Time Between Sewage Outfall End Works Pump Replacement Or Refurbishment	yr	5	
	Unit Sewage Outfall End Works Pump Replacement Or Refurbishment Cost	GEL	500	
	Expected Time Between Other Sewage Outfall Fixtures Replacement Or Refurbishment			
	Unit Other Sewage Outfall Fixtures Replacement Or Refurbishment Cost			
	Annualized Semi-Variable Cost Of Sewage Outfall End Works Pumps And Fixtures	**GEL/yr**	**100**	
Annualized Semi-Variable Cost Of Sewage Outfall Pipes = (Distance To Sewage Outfall * Unit Sewage Outfall Pipe Replacement Or Refurbishment Cost) / Expected Time Between Sewage Outfall Pipe Replacement Or Refurbishment	Expected Time Between Sewage Outfall Pipe Replacement Or Refurbishment	yr	15	
	Distance To Sewage Outfall	m	600	
	Unit Sewage Outfall Pipe Replacement Or Refurbishment Cost	GEL/m	50	
	Annualized Semi-Variable Cost Of Sewage Outfall Pipes	**GEL/yr**	**2 000**	
Annualized Semi-Variable Cost Of Sewage Outfall Pumps Adjacent To HH = (Number Of Sewage Outfall Pumps Adjacent To HH * Unit Sewage Outfall Pump Adjacent To HH Replacement Or Refurbishment Cost) / Expected Time Between Sewage Outfall Pump Adjacent To HH Replacement Or Refurbishment	Expected Time Between Sewage Outfall Pump Adjacent To HH Replacement Or Refurbishment	yr	5	
	Number Of Sewage Outfall Pumps Adjacent To HH		1	
	Unit Sewage Outfall Pump Adjacent To HH Replacement Or Refurbishment Cost	GEL	500	
	Annualized Semi-Variable Cost Of Sewage Outfall Pumps Adjacent To HH	**GEL/yr**	**100**	
Annualized Semi-Variable Cost Of Sewage Outfall Electrical System Replacement Or Refurbishment = Unit Sewage Outfall Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Sewage Outfall Electrical System Replacement Or Refurbishment	Expected Time Between Sewage Outfall Electrical System Replacement Or Refurbishment	yr	2	
	Unit Sewage Outfall Electrical Control System Replacement Or Refurbishment Cost	GEL	350	
Annualized Semi-Variable Cost Of Sewage Outfall System = Annualized Semi-Variable Cost Of Sewage Outfall End W	**Annualized Semi-Variable Cost Of Sewage Outfall Electrical System Replacement Or Refurbishment**	**GEL/yr**	**175**	
Annualized HH Semi-Variable Cost Of Sewage Outfall Syste	**Annualized Semi-Variable Cost Of Sewage Outfall System**	**GEL/yr**	**2 375**	
	Number Of HHs Sharing Sewage Outfall System Today		10	
	Annualized HH Semi-Variable Cost Of Sewage Outfall System	**GEL/yr**	**238**	

TOTAL ANNUALIZED SEMI-VARIABLE COST OF WATER AND SEWER SERVICES / ჯამური წლიური ნახევრადცვლადი ხარჯი წყალმომარაგების და საკანალიზაციო

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Total Annualized HH Semi-Variable Cost Of Water = (Annualized HH Semi-Variable Cost Of Water Well System + ... Spring Or Distant Water Source System + … Outside Water Storage System + ... Water Distribution System) * (2 / 2) + ...Inside Water Storage System + ...Buckets And Other Moveable Water Storage Containers + … Water Filter System + … Water Testing **Total Annualized HH Semi-Variable Cost Of Sewer = Annualized HH Semi-Variable Cost Of Sewage Storage System + Annualized HH Semi-Variable Cost Of Sewage Outfall System** **Total Annualized HH Semi-Variable Cost Of Water And Sewer = Total Annualized HH Semi-Variable Cost Of Water + Total Annualized HH Semi-Variable Cost Of Sewer**	Annualized HH Semi-Variable Cost Of Water Well System	GEL/yr	950	
	... Spring Or Distant Water Source System	GEL/yr	158	
	… Outside Water Storage System	GEL/yr	765	
	... Water Distribution System	GEL/yr	733	
	...Inside Water Storage System	GEL/yr	246	
	...Buckets And Other Moveable Water Storage Containers	GEL/yr	42	
	… Water Filter System	GEL/yr	25	
	… Water Testing	GEL/yr	15	
	Total Annualized HH Semi-Variable Cost Of Water	**GEL/yr**	**2 934**	
	Annualized HH Semi-Variable Cost Of Sewage Storage System	GEL/yr	209	
	Annualized HH Semi-Variable Cost Of Sewage Outfall System	GEL/yr	238	
	Total Annualized HH Semi-Variable Cost Of Sewer	**GEL/yr**	**446**	
	Total Annualized HH Semi-Variable Cost Of Water And Sewer	**GEL/yr**	**3 381**	

POWER RATING OF PUMPS / ტუმბოების სიმძლავრე და ელექტროენერგიის ფასი

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
	Power Rating Of Wate Well Pumps	kW	10	
	Load Factor Or Water Well Pumps (% of power rating)		80%	
	Power Rating Of Outside Water Storage Tank Filling Pumps	kW	20	
	Load Factor Of Outside Water Storage Tank Filling Pumps (% of power rating)		80%	
	Power Rating Of Water Distribution Pumps	kW	12	
	Load Factor Of Water Distribution Pumps (% of power rating)		80%	
	Power Rating Of Inside Water Storage Pumps	kW	12	
	Load Factor Of Inside Water Storage Pumps		80%	
	Power Rating Of Sewage Storage Pumps	kW	8	
	Load Factor Of Sewage Storage Pumps (% of power rating)		80%	
	Power Rating Of Sewage Outfall End Works Pumps	kW	40	
	Load Factor Of Sewage Outfall End Works Pumps (% of power rating)		80%	
	Power Rating Of Sewage Outfall Pumps Adjacent To HH	kW	30	
	Load Factor Of Sewage Outfall Pumps Adjacent To HH (% of power rating)		80%	

ANNUAL WATER AND SEWER BILLS / წყლამომარაგების და სკანალიზაციო მომსახურების წლიური გადასახადი

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annual HH Municipal Water Bill = Annual Municipal Water Bill / Number Of HHs Sharing Municipal Water Bill Today **Annual HH Municipal Sewer Bill = Annual Municipal Sewer Bill / Number Of HHs Sharing Municipal Sewer Bill Today**	Annual Municipal Water Bill	GEL	110	How should individual months be weighted?
	Number Of HHs Sharing Municipal Water Bill Today		1	
	Annual HH Municipal Water Bill	**GEL**	**110**	
	Perceived Additional Amount That Is Spent On Water-Related Coping	GEL	190	Estimate of all costs incurred because there is not municipal water 24/7.
	Annual Municipal Sewer Bill	GEL	120	
	Number Of HHs Sharing Municipal Sewer Bill Today		1	
	Annual HH Municipal Sewer Bill	**GEL**	**120**	
	Perceived Additional Amount That Is Spent On Sewage-Related Coping	GEL	100	Estimate of all costs incurred because there is not a suitable municipal sewer system.

ANNUAL VARIABLE COST OF WATER WELL SYSTEM / წლიური ცვლადი ხარჯი წყლის ჭის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა				COMMENT კომენტარი
			SEASON სეზონი			ANNUAL TOTAL წლიური ჯამი	
			HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი		
Annual Water Well Pump Operating Hours = Length Of Season * Number Of Water Well Pumps Used * Number Of Days In A Week Water Well Pumps Operate * Number Of Hours In A Day Wate Well Pumps Operate **Annual Variable Cost Of Water Well System = Annual Water Well Pump Operating Hours * Effective Power Draw Of Each Water Well Pump * Unit Electricity Cost** **Annual HH Variable Cost Of Water Well System = ((Annual Water Well Pump Operating Hours * Effective Power Draw Of Each Water Well Pump) * Unit Electricity Cost) / Number Of HHs Sharing Water Well System Today**	Length Of Season	wks/yr	4,3	4,3	43,4	**n.a.**	
	Number Of Water Well Pumps Used		2	1	1	**n.a.**	
	Number Of Days In A Week Water Well Pumps Operate	days/wk	7	5	4	**n.a.**	
	Number Of Hours In A Day Wate Well Pumps Operate	hr/day	5	2	1	**n.a.**	
	Annual Water Well Pump Operating Hours	**hr/year**	**301**	**43**	**174**	**518**	
	Effective Power Draw Of Each Water Well Pump	kW	8	8	8	**n.a.**	
	Annual Variable Cost Of Water Well System	**GEL/yr**	**231**	**33**	**133**	**398**	
	Number Of HHs Sharing Water Well System Today		1	1	1	**n.a.**	
	Annual HH Variable Cost Of Water Well System	**GEL/yr**	**231**	**33**	**133**	**398**	

ANNUAL VARIABLE COST OF SPRING OR DISTANT WATER SOURCE SYSTEM / წლიური ცვლადი ხარჯი ბუნებრივი წყაროს ან სხვა მოშორებით მდებარე წყაროს

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა				COMMENT კომენტარი
			SEASON სეზონი			ANNUAL TOTAL წლიური ჯამი	
			HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი		
Annual Spring Or Distant Water Source Pump Operating Hours = Length Of Season * Number Of Spring Or Distant Water Source Pumps Used * Number Of Days In A Week Spring Or Distant Water Source Pumps Operate * Number Of Hours In A Day Spring Or Distant Water Source Pumps Operate **Annual Variable Cost Of Spring Or Distant Water Source System = Annual Spring Or Distant Water Source Pump Operating Hours * Effective Power Draw Of Each Spring Or Distant Water Source Pump * Unit Electricity Cost** **Annual HH Variable Cost Of Spring Or Distant Water Source System = ((Annual Spring Or Distant Water Source Pump Operating Hours * Effective Power Draw Of Each Spring Or Distant Water Source Pump) * Unit Electricity Cost) / Number Of HHs Sharing Spring Or Distant Water Source System Today**	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Spring Or Distant Water Source Pumps Used		2	1	1	**n.a.**	
	Number Of Days In A Week Spring Or Distant Water Source Pumps Operate	days/wk	7	5	4	**n.a.**	
	Number Of Hours In A Day Spring Or Distant Water Source Pumps Operate	hr/day	5	2	1	**n.a.**	
	Annual Spring Or Distant Water Source Pump Operating Hours	**hr/year**	**301**	**43**	**174**	**518**	
	Effective Power Draw Of Each Spring Or Distant Water Source Pump	kW	8	8	8	**n.a.**	
	Annual Variable Cost Of Spring Or Distant Water Source System	**GEL/yr**	**231**	**33**	**133**	**398**	
	Number Of HHs Sharing Spring Or Distant Water Source System Today		1	1	1	**n.a.**	
	Annual HH Variable Cost Of Spring Or Distant Water Source System	**GEL/yr**	**231**	**33**	**133**	**398**	

ANNUAL VARIABLE COST OF OUTSIDE WATER STORAGE SYSTEM / წლიური ცვლადი ხარჯი წყლის გარე ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual Outside Water Storage Tank Filling Pump Operating Hours = Length Of Season * Number Of Outside Tank Filling Pumps Used * Number Of Days In A Week Outside Tank Filling Pumps Operate * Number Of Hours In A Day Outside Tank Filling Pumps Operate	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Outside Tank Filling Pumps Used		1	1	1	**n.a.**	
	Number Of Days In A Week Outside Tank Filling Pumps Operate	days	7	5	1	**n.a.**	
	Number Of Hours In A Day Outside Tank Filling Pumps Operate	hr/day	6	7	3	**n.a.**	
Annual Variable Cost Of Outside Water Storage System = Effective Power Draw Of Each Outside Water Storage Tank Filling Pump * Annual Outside Water Storage Tank Filling Pump Operating Hours * Unit Electricity Cost	**Annual Outside Water Storage Tank Filling Pump Operating Hours**	hr/yr	**181**	**151**	**130**	**461**	
	Effective Power Draw Of Each Outside Water Storage Tank Filling Pump	kW	16	16	16	**n.a.**	
	Annual Variable Cost Of Outside Water Storage System	**GEL/yr**	**277**	**231**	**200**	**709**	
Annual HH Variable Cost Of Outside Water Storage System = Annual Variable Cost Of Outside Water Storage System / Number Of HHs Sharing Outside Water Storage System Today	Number Of HHs Sharing Outside Water Storage System Today		1	1	1	1	
	Annual HH Variable Cost Of Outside Water Storage System	**GEL/yr**	**277**	**231**	**200**	**709**	

ANNUAL VARIABLE COST OF WATER DISTRIBUTION SYSTEM AND WATER SYSTEMS MANAGEMENT EMPLOYEES / წლიური ცვლადი ხარჯი წყლის გამანაწილებელი

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა				COMMENT კომენტარი
			SEASON სეზონი			ANNUAL TOTAL წლიური ჯამი	
			HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი		
Annual Water Distribution Pump Operating Hours = Length Of Season * Number Of Water Distribution Pumps Used * Number Of Days In A Week Water Distribution Pumps Operate * Number Of Hours In A Day Water Distribution Pumps Operate	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Water Distribution Pumps Used		1	1	1	**n.a.**	
	Number Of Days In A Week Water Distribution Pumps Operate	days	7	5	1	**n.a.**	
	Number Of Hours In A Day Water Distribution Pumps Operate	hr/day	5	3	2	**n.a.**	
	Annual Water Distribution Pump Operating Hours	**GEL/yr**	**151**	**65**	**87**	**302**	
Annual Variable Cost Of Water Distribution Pumps = Annual Water Distribution Pump Operating Hours * Effective Power Draw Of Each Water Distribution Pump * Unit Electricity Cost	Effective Power Draw Of Each Water Distribution Pump	kW	10	10	10	**n.a.**	
	Annual Variable Cost Of Water Distribution Pumps	**GEL/yr**	**139**	**59**	**80**	**278**	
Annual Variable Cost Of All Water Systems Management Employees = Length Of Season * 12 / 52 * Number Of Employees Devoted To All Water Systems * Monthly Gross Salary For One Employee	Number Of Employees Devoted To ***All*** Water Systems		1	1	1	**n.a.**	
	Monthly Gross Salary For One Employee	GEL/mo	100	100	100	**n.a.**	
	Annual Variable Cost Of *All* Water Systems Management Employees	**GEL**	**99**	**99**	**1 002**	**1 200**	
Annual Variable Cost Of Water Distribution System = Annual Variable Cost Of Water Distribution Pumps + Annual Variable Cost Of All Water Systems Management Employees	**Annual Variable Cost Of Water Distribution System**	**GEL**	**238**	**159**	**1 082**	**1 478**	
Annual HH Variable Cost Of Water Distribution System = Annual Variable Cost Of Water Distribution System / Number Of HHs Sharing Water Distribution System Today	Number Of HHs Sharing Water Distribution System Today		1	1	1	**n.a.**	
	Annual HH Variable Cost Of Water Distribution System	**GEL/yr**	**238**	**159**	**1 082**	**1 478**	

ANNUAL VARIABLE COST OF INSIDE WATER STORAGE SYSTEM / წლიური ცვლადი ხარჯი წყლის შიდა ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual Inside Water Storage Pump Operating Hours = Length Of Season * Number Of Inside Water Storage Pumps Used * Number Of Days In A Week Inside Water Storage Pumps Operate * Number Of Hours In A Day Inside Water Storage Pumps Operate	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Inside Water Storage Pumps Used		1	1	1	**n.a.**	
	Number Of Days In A Week Inside Water Storage Pumps Operate	days	7	5	1	**n.a.**	
	Number Of Hours In A Day Inside Water Storage Pumps Operate	hr/day	6	7	3	**n.a.**	
Annual Variable Cost Of Inside Water Storage System = Annual Inside Water Storage Pump Operating Hours * Effective Power Draw Of Each Inside Water Storage Pump * Unit Electricity Cost	**Annual Inside Water Storage Pump Operating Hours**	hr/yr	**181**	**151**	**130**	**461**	
	Effective Power Draw Of Each Inside Water Storage Pump	kW	10	10	10	**n.a.**	
Annual HH Variable Cost Of Inside Water Storage System = Annual Variable Cost Of Inside Water Storage System / Number Of HHs Sharing Inside Water Storage System Today	**Annual Variable Cost Of Inside Water Storage System**	**GEL/yr**	**166**	**139**	**120**	**425**	
	Number Of HHs Sharing Inside Water Storage System Today		1	1	1	**n.a.**	
	Annual HH Variable Cost Of Inside Water Storage System	**GEL/yr**	**166**	**139**	**120**	**425**	

ANNUAL VARIABLE COST OF TANKER TRUCK WATER / წლიური ცვლადი ხარჯი წყლის ცისტერნიანი მზიდის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Volume Of Tanker Truck Water Purchased = Length Of Season * Frequency Of Water Purchase From Tanker Truck * Amount Of Water Purchased Per Tanker Truck Order	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Frequency Of Water Purchase From Tanker Truck	trucks/wk	2	1	0	**3**	
	Amount Of Water Purchased Per Tanker Truck Order	m^3/truck	2	2	2	**n.a.**	
Annual Variable Cost Of Tanker Truck Water = Volume Of Tanker Truck Water Purchased * Delivered Price Of Tanker Truck Water	**Volume Of Tanker Truck Water Purchased**	**m3/yr**	**17**	**9**	**0**	**26**	
	Delivered Price Of Tanker Truck Water	GEL/m^3	10,00	10,00	20,00	**n.a.**	
Annual HH Variable Cost Of Tanker Truck Water = Annual Variable Cost Of Tanker Truck Water / Number Of HH Sharing Tanker Truck Water Today	**Annual Variable Cost Of Tanker Truck Water**	**GEL/yr**	**172**	**86**	**0**	**258**	
	Number Of HH Sharing Tanker Truck Water Today		2	2	2	**n.a.**	
	Annual HH Variable Cost Of Tanker Truck Water	**GEL/yr**	**86**	**43**	**0**	**129**	

ANNUAL VARIABLE COST OF BOTTLED WATER (DUE TO COPING) / წლიური ცვლადი ხარჯი ბოთლში ჩამოსხმული წყლის (გასამკლავებელი)

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
Volume Of Coping Related Bottled Water = Length Of Season * Number Of Bottles Of Water Purchased Per Week * Volume Of Bottle * Percentage Of Bottled Water That Would Not Be Purchased If There Was Good Water 24/7 (percentage purchased because water is not good 24/7) / 1000	Number Of Bottles Of Water Purchased Per Week	btl/wk	20	10	8	**38**	
	Volume Of Bottle	liter/btl	1,5	1,5	1,5	**n.a.**	
	Percentage Of Bottled Water That Would ***Not*** Be Purchased If There Was Good Water 24/7 (percentage purchased because water is not good 24/7)		70%	50%	50%	**61%**	
Annual Variable Cost Of Coping Related Bottled Water = ((Volume Of Coping Related Bottled Water * 1000) / Volume Of Bottle) * Unit Price Of Bottled Water	**Volume Of Coping Related Bottled Water**	**m^3/yr**	**0,09**	**0,03**	**0,26**	**0,38**	
	Unit Price Of Bottled Water	GEL/btl	1,00	1,00	1,00	**n.a.**	
Annual HH Variable Cost Of Coping Related Bottled Water = Annual Variable Cost Of Coping Related Bottled Water / Number Of HHs Sharing Bottled Water Today	**Annual Variable Cost Of Coping Related Bottled Water**	**GEL/yr**	**60**	**22**	**174**	**255**	
	Number Of HHs Sharing Bottled Water Today		2	2	2	**n.a.**	
	Annual HH Variable Cost Of Coping Related Bottled Water	**GEL/yr**	**30**	**11**	**87**	**128**	

ANNUAL VARIABLE COST OF MANUALLY COLLECTED WATER FROM SPRING OR OTHER WATER SOURCE / წლიური ცვლადი ხარჯი ბუნებრივი წყაროდან ან სხვა

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
Volume Of Manually Collected Water From Spring Or Other Water Source = Length Of Season * Number Of Visits To Spring Or Other Water Source Per Week * Volume Of Water Manually Brought To HH Per Visit / 1000	Number Of Visits To Spring Or Other Water Source Per Week	visits/wk	3	2	1	**6**	
	Volume Of Water Manually Brought To HH Per Visit	liters/visit	50	50	50	**n.a.**	
Annual Variable Cost Of Manually Collected Water From Spring Or Other Water Source = Length Of Season * Number Of Visits To Spring Or Other Water Source Per Week * Roundtrip Distance By Vehicle To Spring Or Other Water Source * Fuel Cost	**Volume Of Manually Collected Water From Spring Or Other Water Source**	**m^3/yr**	**0,65**	**0,43**	**2,17**	**3,25**	
	Roundtrip Distance By Vehicle To Spring Or Other Water Source	km	14	14	14	**n.a.**	
	Fuel Cost	GEL/km	0,20	0,20	0,20	**n.a.**	
Annual HH Variable Cost Of Manually Collected Water From Spring Or Other Water Source = (Number Of Visits To Spring Or Other Water Source Per Week * Roundtrip Distance By Vehicle To Spring Or Other Water Source * Fuel Cost) / Number Of HHs Sharing Manually Collected Water From Spring Or Other Water Source Today	**Annual Variable Cost Of Manually Collected Water From Spring Or Other Water Source**	**GEL/yr**	**36,12**	**24,08**	**121,52**	**181,72**	
	Number Of HHs Sharing Manually Collected Water From Spring Or Other Water Source Today		2	2	2	**n.a.**	
	Annual HH Variable Cost Of Manually Collected Water From Spring Or Other Water Source	**GEL/yr**	**4,20**	**2,80**	**1,40**	**8,40**	

ANNUAL QUANTITY OF WATER FROM MUNICIPAL AND OTHER WATER SOURCES / წლიური რაოდენობა მუნიციპალური და ალტერნატიული წყაროებიდან წყლის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა — SEASON სეზონი — HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual Quantity Of Municipal Water = ((Annual Municipal Water Bill / Tariff Price Of Municipal Water)) * Estimated Share Of Water Usage By Season	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Estimated Share Of Municipal Water In Total Water Consumption		80%	80%	100%	**83%**	
Annual HH Quantity Of Municipal Water = Annual Quantity Of Municipal Water / Number Of HHs Sharing Municipal Water Connection Today	Estimated Share Of Water Usage By Season		55%	30%	15%	**100%**	
	Tariff Price Of Municipal Water	GEL/m^3	1,7000	1,7000	1,7000	**n.a.**	
Implicit Annual HH Quantity Of Water From Other Sources = (Annual Quantity Of Municipal Water / Estimated Share Of Municipal Water In Total Water Consumption) - Annual Quantity Of Municipal Water	**Annual Quantity Of Municipal Water**	**m^3/yr**	**35,59**	**19,41**	**9,71**	**64,71**	
	Number Of HHs Sharing Municipal Water Connection Today		1	1	1	**n.a.**	Must match the water bill allocation
	Annual HH Quantity Of Municipal Water	**m^3/yr**	**35,59**	**19,41**	**9,71**	**64,71**	
Implicit Annual HH Quantity Of Water From Municipal And Other Sources = Annual HH Quantity Of Municipal Water + Implicit Annual HH Quantity Of Water From Other Sources	**Implicit Annual HH Quantity Of Water From Other Sources**	**m^3/yr**	**8,90**	**4,85**	**0,00**	**13,75**	
	Implicit Annual HH Quantity Of Water From Municipal And Other Sources	**m^3/yr**	**44,49**	**24,26**	**9,71**	**78,46**	

ANNUAL IMPLICIT MARKET VALUE OF WATER FROM MUNICIPAL AND OTHER WATER SOURCES / წლიური სავარაუდო საბაზრო ფასი მუნიციპალური და

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა — SEASON სეზონი — HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual Variable Cost Of Municipal Water = Annual Quantity Of Municipal Water * Tariff Price Of Municipal Water	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Annual Variable Cost Of Municipal Water	**GEL/yr**	**60,50**	**33,00**	**16,50**	**110,00**	
Annual HH Variable Cost Of Municipal Water = Annual Variable Cost Of Municipal Water / Number Of HHs Sharing Municipal Water Connection Today	Number Of HHs Sharing Municipal Water Connection Today		1	1	1	**n.a.**	
	Annual HH Variable Cost Of Municipal Water	**GEL/yr**	**60,50**	**33,00**	**16,50**	**110,00**	
Implicit Annual HH Variable Market Value Of Water From Other Sources = Implicit Annual HH Quantity Of Water From Other Sources * Tariff Price Of Municipal Water	**Implicit Annual HH Variable Market Value Of Water From Other Sources**	**GEL/yr**	**15,13**	**8,25**	**0,00**	**23,38**	
Implicit Annual HH Variable Market Value Of Water From Municipal And Other Sources = Annual HH Variable Cost	**Implicit Annual HH Variable Market Value Of Water From Municipal And Other Sources**	**GEL/yr**	**75,63**	**41,25**	**16,50**	**133,38**	

ANNUAL VARIABLE COST OF SEWAGE STORAGE SYSTEM AND SEWAGE SYSTEMS MANAGEMENT EMPLOYEES / წლიური ცვლადი ხარჯი საკანალიზაციო ავზის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual Sewage Storage Pump Operating Hours = Length Of Season * Number Of Sewage Storage Pumps Used * Number Of Days In A Week Sewage Storage Pumps Operate * Number Of Hours In A Day Sewage Storage Pumps Operate	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Sewage Storage Pumps Used		1	1	1	**n.a.**	
	Number Of Days In A Week Sewage Storage Pumps Operate	days/wk	7	4	3	**n.a.**	
	Number Of Hours In A Day Sewage Storage Pumps Operate	hr/day	5	3	2	**n.a.**	
Annual Variable Cost Of Sewage Storage Pumps = Annual Sewage Storage Pump Operating Hours * Effective Power Draw Of Each Sewage Storage Pump * Unit Electricity Cost	**Annual Sewage Storage Pump Operating Hours**	**hr/yr**	**151**	**52**	**260**	**463**	
	Effective Power Draw Of Each Sewage Storage Pump	kW	6	6	6	**n.a.**	
Annual Variable Cost Of Sewer Systems Management Employees = Length Of Season * 12 / 52 * Number Of Employees Devoted To Sewer Systems * Monthly Gross Salary For One Employee	**Annual Variable Cost Of Sewage Storage Pumps**	**GEL/yr**	**92**	**32**	**160**	**284**	
	Number Of Employees Devoted To Sewer Systems		1	1	1	**n.a.**	
Annual Variable Cost Of Sewage Storage System = Annual Variable Cost Of Sewage Storage Pumps + Annual Variable Cost Of Sewer Systems Management Employees	Monthly Gross Salary For One Employee	GEL/mo	100	100	100	**n.a.**	
	Annual Variable Cost Of Sewer Systems Management Employees	**GEL**	**99**	**99**	**1 002**	**1 200**	
Annual HH Variable Cost Of Sewage Storage System = Annual Variable Cost Of Sewage Storage System / Number Of HHs Sharing Sewage Storage System Today	**Annual Variable Cost Of Sewage Storage System**	**GEL/yr**	**192**	**131**	**1 162**	**1 484**	
	Number Of HHs Sharing Sewage Storage System Today		3	3	3	**n.a.**	
	Annual HH Variable Cost Of Sewage Storage System	**GEL/yr**	**64**	**44**	**387**	**495**	

ANNUAL VARIABLE COST OF SEWAGE OUTFALL SYSTEM / წლიური ცვლადი ხარჯი საკანალიზაციო არხის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
Annual Sewage Outfall End Works Pumps Operating Hours = Length Of Season * Number Of Sewage Outfall End Works Pumps Used * Number Of Days In A Week Sewage Outfall End Works Pumps Operate * Number Of Hours In A Day Sewage Outfall End Works Pumps Operate	Number Of Sewage Outfall End Works Pumps Used		1	1	1	**n.a.**	
	Number Of Days In A Week Sewage Outfall End Works Pumps Operate	days	3	4	5	**n.a.**	
	Number Of Hours In A Day Sewage Outfall End Works Pumps Operate	hr/day	6	4	3	**n.a.**	
Annual Variable Cost Of Sewage Outfall End Works Pumps = Annual Sewage Outfall End Works Pumps Operating Hours * Effective Power Draw Of Sewage Outfall End Works Pump * Unit Electricity Cost	**Annual Sewage Outfall End Works Pumps Operating Hours**	**hr/yr**	**77**	**69**	**651**	**797**	
	Effective Power Draw Of Sewage Outfall End Works Pump	kW	32	32	32	**n.a.**	
	Annual Variable Cost Of Sewage Outfall End Works Pumps	**GEL/yr**	**238**	**211**	**2 000**	**2 449**	
Annual Sewage Outfall Pumps Adjacent To HH Operating Hours = Length Of Season * Number Of Sewage Outfall Pumps Adjacent To HH Used * Number Of Days In A Week Sewage Outfall Pumps Adjacent To HH Operate * Number Of Hours In A Day Sewage Outfall Pumps Adjacent To HH Operate	Number Of Sewage Outfall Pumps Adjacent To HH Used		1	1	1	**n.a.**	
	Number Of Days In A Week Sewage Outfall Pumps Adjacent To HH Operate	days	7	4	3	**n.a.**	
	Number Of Hours In A Day Sewage Outfall Pumps Adjacent To HH Operate	hr/day	6	4	3	**n.a.**	
Annual Variable Cost Of Sewage Outfall Pump Adjacent To HH = Annual Sewage Outfall Pumps Adjacent To HH Operating Hours * Effective Power Draw Of Sewage Outfall Pumps Adjacent To HH * Unit Electricity Cost	**Annual Sewage Outfall Pumps Adjacent To HH Operating Hours**	**hr/yr**	**181**	**69**	**391**	**640**	
	Effective Power Draw Of Sewage Outfall Pumps Adjacent To HH	kW	24	24	24	**n.a.**	
Annual Variable Cost Of Sewage Outfall System = Annual Variable Cost Of Sewage Outfall End Works Pumps + Annual Variable Cost Of Sewage Outfall Pump Adjacent To	**Annual Variable Cost Of Sewage Outfall Pump Adjacent To HH**	**GEL/yr**	**416**	**159**	**900**	**1 475**	
	Annual Variable Cost Of Sewage Outfall System	**GEL/yr**	**654**	**370**	**2 900**	**3 924**	
Annual HH Variable Cost Of Sewage Outfall System = Annu	Number Of HHs Sharing Sewage Outfall System Today		10	10	10	**n.a.**	
	Annual HH Variable Cost Of Sewage Outfall System	**GEL/yr**	**65**	**37**	**290**	**392**	

ANNUAL VARIABLE COST OF SEWAGE TANKER TRUCK SERVICE / წლიური ცვლადი ხარჯი ფეკალური მასის ცისტერნიანი მზიდის მომსახურები

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა — SEASON სეზონი — HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual Variable Cost Of Sewage Tanker Truck Service = Number Of Sewage Tanker Truck Orders In Season * Sewage Tanker Truck Service Cost **Annual HH Variable Cost Of Sewage Tanker Truck Service = Annual Variable Cost Of Sewage Tanker Truck Service / Number Of HHs Sharing Sewage Tanker Truck Service Today**	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Sewage Tanker Truck Orders In Season	trucks	4	1	1	**6**	
	Sewage Tanker Truck Service Cost	GEL/truck	100	100	100	**n.a.**	
	Annual Variable Cost Of Sewage Tanker Truck Service	**GEL/yr**	**400**	**100**	**100**	**600**	
	Number Of HHs Sharing Sewage Tanker Truck Service Today		2	2	2	**n.a.**	
	Annual HH Variable Cost Of Sewage Tanker Truck Service	**GEL/yr**	**200**	**50**	**50**	**300**	

PRO FORMA CALCULATION OF ANNUAL HH VARIABLE COST OF MUNICIPAL SEWER / ოჯახის წლიური ცვლადი ხარჯის პრო ფორმა გამოთვლა მუნიციპალური

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Use One Of Five Methods Of Calculating Annual HH Variable Cost Of Municipal Sewer Method One: Based On Number Of HH Members = Length Of Season * 12 / 52 * Number Of HH Members * Municipal Sewage Discharge Tariff Based On Number Of HH Members Method Two: Based On Entire HH = Length Of Season * 12 / 52 * Municipal Sewage Discharge Tariff Based On Entire HH Method Three: Based On Single Connection = Length Of Season * 12 / 52 * Municipal Sewage Discharge Tariff Based On Single Connection / Number Of HHs Sharing Municipal Sewer Connection Method Four: Based On Municipal Water Usage = Annual HH Quantity Of Municipal Water * Municipal Sewage Discharge Tariff Based On Municipal Water Usage Method Five: Based On Combined Municipal And Other Source Water Usage = Municipal Sewage Discharge Tariff Based On Combined Municipal And Other Source Water Usage * Implicit Annual HH Quantity Of Water From Municipal And Other Sources	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Water Consumption From Municipal System Connection	m^3	60,5	33,0	16,5	**110,0**	
	Water Consumption From Alternative Sources	m^3	8,9	4,9	0,0	**13,8**	
	Water Consumption From All Sources	m^3	69,4	37,9	16,5	**123,8**	
	Number Of HH Members		3	3	3	**n.a.**	
	Municipal Sewage Discharge Tariff Based On Number Of HH Members	GEL/hh member-mo	1,00	1,00	1,00	**n.a.**	
	Method One: Based On Number Of HH Members	**GEL/yr**	**2,98**	**2,98**	**30,05**	**36,00**	
	Municipal Sewage Discharge Tariff Based On Entire HH	GEL/HH-mo	4,00	4,00	4,00	**n.a.**	
	Method Two: Based On Entire HH	**GEL/yr**	**3,97**	**3,97**	**40,06**	**48,00**	
	Municipal Sewage Discharge Tariff Based On Single Connection	GEL/connection-mo	2,50	2,50	2,50	**n.a.**	
	Number Of HHs Sharing ***Municipal Sewer Connection***		1	1	1	**n.a.**	
	Method Three: Based On Single Connection	**GEL/yr**	**2,48**	**2,48**	**25,04**	**30,00**	
	Municipal Sewage Discharge Tariff Based On Municipal Water Usage	GEL/m^3	2,10	2,10	2,10	**n.a.**	
	Number Of HHs Sharing ***Municipal Water Connection***		1	1	1	**n.a.**	
	Method Four: Based On Municipal Water Usage	**GEL/yr**	**74,74**	**40,76**	**20,38**	**135,88**	
	Municipal Sewage Discharge Tariff Based On Combined Municipal And Other Source Water Usage	GEL/m^3	2,30	2,30	2,30	**n.a.**	
	Method Five: Based On Combined Municipal And Other Source Water Usage	**GEL/yr**	**102,32**	**55,81**	**22,32**	**180,45**	
	Method Used		1	5	3	**n.a.**	
	Pro Forma Annual HH Variable Cost Of Municipal Sewer Service	**GEL/yr**	**2,98**	**55,81**	**25,04**	**83,82**	

TOTAL ANNUAL HH VARIABLE COST OF WATER AND SEWER SERVICES / ჯამური ოჯახის წლიური ცვლადი ხარჯი წყალმომარაგების და საკანალიზაციო სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა – SEASON სეზონი – HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Total Annual HH Variable Coping Cost Of Water = (Annual HH Variable Cost Of Water Well System + … Spring Or Distant Water Source System + … Outside Water Storage System + … Water Distribution System) * (2 / 2) + (… Inside Water Storage System + … Tanker Truck Water + … Coping Related Bottled Water + … Manually Collected Water From Spring Or Other Water Source) **Total Annual HH Variable Cost Of Water = Total Annual HH Variable Coping Cost Of Water + Annual HH Variable Cost Of Municipal Water** **Total Annual HH Variable Coping Cost Of Sewer = Annual HH Variable Cost Of Sewage Storage System + … Sewer Outfall System + … Sewage Tanker Truck** **Total Annual HH Variable Cost Of Sewer = Total Annual HH Variable Coping Cost Of Sewer + Annual HH Variable Cost Of Sewage Service** **Total Annual HH Variable Cost Of Water And Sewer = Total Annual HH Variable Cost Of Water + Total Annual HH Variable Cost Of Sewer**	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Annual HH Variable Cost Of Water Well System	GEL/yr	231	33	133	**398**	
	… Spring Or Distant Water Source System	GEL/yr	231	33	133	**398**	
	… Outside Water Storage System	GEL/yr	277	231	200	**709**	
	… Water Distribution System	GEL/yr	238	159	1 082	**1 478**	
	… Inside Water Storage System	GEL/yr	166	139	120	**425**	
	… Tanker Truck Water	GEL/yr	86	43	0	**129**	
	… Coping Related Bottled Water	GEL/yr	30	11	87	**128**	
	… Manually Collected Water From Spring Or Other Water Source	GEL/yr	4	3	1	**8**	
	Total Annual HH Variable Coping Cost Of Water	**GEL/yr**	**1 264**	**651**	**1 756**	**3 672**	
	Annual HH Variable Cost Of Municipal Water	GEL/yr	61	33	17	**110**	
	Total Annual HH Variable Cost Of Water	**GEL/yr**	**1 325**	**684**	**1 773**	**3 782**	
	Annual HH Variable Cost Of Sewage Storage System	GEL/yr	64	44	387	**495**	
	… Sewer Outfall System	GEL/yr	65	37	290	**392**	
	… Sewage Tanker Truck	GEL/yr	200	50	50	**300**	
	Total Annual HH Variable Coping Cost Of Sewer	**GEL/yr**	**329**	**131**	**727**	**1 187**	
	Annual HH Variable Cost Of Sewage Service	GEL/yr	10	10	100	**120**	
	Total Annual HH Variable Cost Of Sewer	**GEL/yr**	**339**	**141**	**827**	**1 307**	
	Total Annual HH Variable Cost Of Water And Sewer	**GEL/yr**	**1 664**	**825**	**2 600**	**5 089**	

TOTAL ANNUALIZED HH SEMI-VARIABLE AND ANNUAL HH VARIABLE COST OF WATER AND SEWER SERVICES / ჯამური ოჯახის წლიური ცვლადი და

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა				COMMENT კომენტარი
			SEASON სეზონი			ANNUAL TOTAL წლიური ჯამი	
			HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი		
Total Annualized HH Semi-Variable And Annual HH Variable Cost Of Water = Annualized HH Semi-Variable Water Coping Cost + HH Variable Water Coping Cost + HH Municipal Water Bill **Total Annualized HH Semi-Variable And Annual HH Variable Cost Of Sewer = Annualized HH Semi-Variable Sewer Coping Cost + HH Variable Sewer Coping Cost + HH Municipal Sewer Bill** **Total Annualized HH Semi-Variable And Annual HH Variable Cost Of Water And Sewer = Total Annualized HH Semi-Variable And Annual HH Variable Cost Of Water + Total Annualized HH Semi-Variable And Annual HH Variable Cost Of Sewer**	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Annualized HH Semi-Variable Water Coping Cost	GEL/yr	243	243	2 449	**2 934**	
	HH Variable Water Coping Cost	GEL/yr	1 264	651	1 756	**3 672**	
	HH Municipal Water Bill	GEL/yr	61	33	17	**110**	
	Total Annualized HH Semi-Variable And Annual HH Variable Cost Of Water	**GEL/yr**	**1 568**	**927**	**4 222**	**6 716**	
	Annualized HH Semi-Variable Sewer Coping Cost	GEL/yr	37	37	373	**446**	
	HH Variable Sewer Coping Cost	GEL/yr	329	131	727	**1 187**	
	HH Municipal Sewer Bill	GEL/yr	3	56	25	**84**	
	Total Annualized HH Semi-Variable And Annual HH Variable Cost Of Sewer	**GEL/yr**	**369**	**223**	**1 125**	**1 717**	
	Total Annualized HH Semi-Variable And Annual HH Variable Cost Of Water And Sewer	**GEL/yr**	**1 937**	**1 150**	**5 347**	**8 433**	

ANNUAL HH TIME SPENT ON MANAGING WATER SOURCES / ოჯახის წლიური დროითი დანახარჯი წყლის წყაროების

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა — SEASON სეზონი — HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual HH Time Spent On Managing Municipal Water Connection = (Length Of Season * Time Spent Managing Municipal Water Connection) * 24 / Number Of HHs Sharing Municipal Water Connection Today **Annual HH Time Spent On Managing Water Well System = (Length Of Season * Time Spent Managing Water Well System) * 24 / Number Of HHs Sharing Water Well System Today** **Annual HH Time Spent On Managing Manually Collected Water From Spring Or Distant Water Source = Length Of Season * Number Of Visits To Spring Or Distant Water Source To Manually Collect Water Each Week * Average Roundtrip Time To Get To Spring Or Distant Water Source To Manually Collect Water * 24 / Number Of HHs Sharing Manually Collected Water From Spring Or Distant Water Source Today** **Annual HH Time Spent On Managing Water Testing = (Length Of Season * Time Spent Managing Water Testing) * 24 / Number Of HHs Sharing Water Testing Today** **Annual HH Time Spent On Managing Water Filter System = (Length Of Season * Time Spent Managing Water Filter System) * 24 / Number Of HHs Sharing Water Filter System Today** **Annual HH Time Spent On Managing Tanker Truck Water =** **Annual HH Time Spent On Managing Bottled Water (due to**	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Time Spent Managing Municipal Water Connection	hh:mm/wk	1:00	0:30	0:15	**17,3**	Season columns show hours per week during that season.
	Number Of HHs Sharing Municipal Water Connection Today		1	1	1	**n.a.**	
	Annual HH Time Spent On Managing Municipal Water Connection	**hr/yr**	**4,3**	**2,2**	**10,9**	**17,3**	Season columns show total hours during that season over one year.
	Time Spent Managing Water Well System	hh:mm/wk	0:30	0:15	1:00	**46,6**	
	Number Of HHs Sharing Water Well System Today		1	1	1	**n.a.**	
	Annual HH Time Spent On Managing Water Well System	**hr/yr**	**2,2**	**1,1**	**43,4**	**46,6**	
	Time Spent Managing Spring Or Distant Water Source	hh:mm/wk	0:30	0:15	1:00	**46,6**	
	Number Of HHs Sharing Spring Or Distant Water Source		2	2	2	**n.a.**	
	Annual HH Time Spent On Managing Spring Or Distant Water Source System	**hr/yr**	**1,1**	**0,5**	**21,7**	**23,3**	
	Number Of Visits To Spring Or Distant Water Source To Manually Collect Water Each Week	visits/wk	3	2	1	**n.a.**	
	Average Roundtrip Time To Get To Spring Or Distant Water Source To Manually Collect Water	hr/visit	1:20	1:20	1:20	**n.a.**	
	Number Of HHs Sharing Manually Collected Water From Spring Or Distant Water Source Today		2	2	2	**n.a.**	
	Annual HH Time Spent On Managing Manually Collected Water From Spring Or Distant Water Source	**hr/yr**	**8,6**	**5,7**	**28,9**	**43,3**	
	Time Spent Managing Water Testing	hh:mm/wk	1:00	0:30	0:15	**17,3**	
	Number Of HHs Sharing Water Testing Today		2	2	2	**n.a.**	
	Annual HH Time Spent On Managing Water Testing	**hr/yr**	**2,2**	**1,1**	**5,4**	**8,7**	
	Time Spent Managing Water Filter System	hh:mm/wk	0:15	1:00	0:30	**27,1**	
	Number Of HHs Sharing Water Filter System Today		2	2	2	**n.a.**	
	Annual HH Time Spent On Managing Water Filter System	**hr/yr**	**0,5**	**2,2**	**10,9**	**13,5**	
	Time Spent Managing Tanker Truck Water	hh:mm/wk	1:00	0:30	0:15	**17,3**	

Number Of HHs Sharing Tanker Truck Water Today		2	2	2	**n.a.**	
Annual HH Time Spent On Managing Tanker Truck Water	**hr/yr**	**2,2**	**1,1**	**5,4**	**8,7**	
Number Of Visits To Store To Buy Bottled Water Each Week	visits/wk	1	1	1	**n.a.**	
Average Time Needed To Get To Store And Back Each Trip	hr/visit	1:20	1:20	1:20	**n.a.**	
Percentage Of Store Trips That Would ***Not*** Occur with Good 24/7 Water		70%	50%	50%	**n.a.**	
Number Of HHs Sharing Bottled Water Today (due to coping)		2	2	2	**n.a.**	
Annual HH Time Spent On Managing Bottled Water (due to coping)	**hr/yr**	**2,0**	**1,4**	**14,5**	**17,9**	
Annual Time Spent On Managing Water Sources	**hr/yr**	**39,5**	**27,2**	**227,9**	**294,6**	
Annual HH Time Spent On Managing Water Sources	**hr/yr**	**23,0**	**15,2**	**141,1**	**179,2**	

Annual Time Spent On Managing Water Sources = Length (

Annual HH Time Spent On Managing Water Sources = Annu

ANNUAL HH TIME SPENT ON MANAGING WATER ISSUES OTHER THAN WATER SOURCES / ოჯახის წლიური დროითი დანახარჯი წყალმომარაგების საკითხები

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა				COMMENT კომენტარი
			SEASON სეზონი			ANNUAL TOTAL წლიური ჯამი	
			HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი		
	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
Annual HH Time Spent On Managing Outside Water Storage System = (Length Of Season * Time Spent Managing Outside Water Storage System) * 24 / Number Of HHs Sharing Outside Water Storage System Today	Time Spent Managing Outside Water Storage System	hh:mm/wk	0:30	0:15	1:00	**46,6**	
	Number Of HHs Sharing Outside Water Storage System Today		1	1	1	**n.a.**	
	Annual HH Time Spent On Managing Outside Water Storage System	**hr/yr**	**2,2**	**1,1**	**43,4**	**46,6**	
Annual HH Time Spent On Managing Water Distribution System = (Length Of Season * Time Spent Managing Water Distribution System) * 24 / Number Of HHs Sharing Water Distribution System Today	Time Spent Managing Water Distribution System	hh:mm/wk	0:15	1:00	0:30	**27,1**	Does not include employees used to manage water systems.
	Number Of HHs Sharing Water Distribution System Today		1	1	1	**n.a.**	
	Annual HH Time Spent On Managing Water Distribution System	**hr/yr**	**1,1**	**4,3**	**21,7**	**27,1**	
Annual HH Time Spent On Managing Inside Water Storage System = (Length Of Season * Time Spent Managing Inside Water Storage System) * 24 / Number Of HHs Sharing Inside Water Storage System Today	Time Spent Managing Inside Water Storage System	hh:mm/wk	1:00	0:30	0:15	**17,3**	
	Number Of HHs Sharing Inside Water Storage System Today		1	1	1	**n.a.**	
	Annual HH Time Spent On Managing Inside Water Storage System	**hr/yr**	**4,3**	**2,2**	**10,9**	**17,3**	
Annual HH Time Spent On Managing Buckets And Other Moveable Water Storage Containers = (Length Of Season * Time Spent Managing Buckets And Other Moveable Water Storage Containers) * 24 / Number Of HHs Sharing Buckets And Other Moveable Water Storage Containers Today	Time Spent Managing Buckets And Other Moveable Water Storage Containers	hh:mm/wk	0:30	0:15	1:00	**46,6**	
	Number Of HHs Sharing Buckets And Other Moveable Water Storage Containers Today		1	1	1	**n.a.**	
	Annual HH Time Spent On Managing Buckets And Other Moveable Water Storage Containers	**hr/yr**	**2,2**	**1,1**	**43,4**	**46,6**	
Annual HH Time Spent On Other Water Management Activities = (Length Of Season * Time Spent On Other Water Management Activities) * 24 / Number Of HH Sharing Other Water Management Activities Today	Time Spent On Other Water Management Activities	hh:mm/wk	0:15	1:00	0:30	**27,1**	
	Number Of HH Sharing Other Water Management Activities Today		2	2	2	**n.a.**	
Annual Time Spent On Managing Water Issues Other Than	**Annual HH Time Spent On Other Water Management Activities**	**hr/yr**	**0,5**	**2,2**	**10,9**	**13,5**	
Annual HH Time Spent On Managing Water Issues Other Th	**Annual Time Spent On Managing Water Issues Other Than Water Sources**	**hr/yr**	**10,8**	**12,9**	**141,1**	**164,7**	
	Annual HH Time Spent On Managing Water Issues Other Than Water Sources	**hr/yr**	**10,2**	**10,8**	**130,2**	**151,2**	

ANNUAL HH TIME SPENT ON MANAGING SEWER / ოჯახის წლიური დროითი დანახარჯი კანალიზაციაზე

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა — SEASON სეზონი — HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
Annual HH Time Spent On Managing Municipal Sewer Connection = Length Of Season * Time Spent Managing Municipal Sewer Connection / Number Of HHs Sharing Sewer Connection * 24	Time Spent Managing Municipal Sewer Connection	hh:mm/wk	0:20	0:15	0:10	**9,7**	
	Number Of HHs Sharing Sewer Connection		1	1	1	**n.a.**	
	Annual HH Time Spent On Managing Municipal Sewer Connection	**hr/yr**	**1,4**	**1,1**	**7,2**	**9,7**	
Annual HH Time Spent On Managing Sewage Storage System = Length Of Season * Time Spent Managing Sewage Storage System / Number Of HHs Sharing Sewage Storage System * 24	Time Spent Managing Sewage Storage System	hh:mm/wk	0:40	0:20	0:10	**11,5**	Does not include employees used to manage sewer systems.
	Number Of HHs Sharing Sewage Storage System		3	3	3	**n.a.**	
	Annual HH Time Spent On Managing Sewage Storage System	**hr/yr**	**1,0**	**0,5**	**2,4**	**3,8**	
Annual HH Time Spent On Managing Sewage Outfall System = Length Of Season * Time Spent Managing Sewage Outfall System / Number Of HHs Sharing Sewage Outfall System * 24	Time Spent Managing Sewage Outfall System	hh:mm/wk	1:00	1:00	1:00	**52,0**	
	Number Of HHs Sharing Sewage Outfall System		10	10	10	**n.a.**	
Annual HH Time Spent On Managing Sewage Tanker Truck Service = Length Of Season * Time Spent Managing Sewage Tanker Truck Service / Number Of HHs Sharing Sewage Tanker Truck Service * 24	**Annual HH Time Spent On Managing Sewage Outfall System**	**hr/yr**	**0,4**	**0,4**	**4,3**	**5,2**	
	Time Spent Managing Sewage Tanker Truck Service	hh:mm/wk	1:00	1:00	1:00	**52,0**	
Annual HH Time Spent On Other Sewage Management Activities = Length Of Season * Time Spent On Other Sewage Management Activities / Number Of HH Sharing Other Sewage Management Activities * 24	Number Of HHs Sharing Sewage Tanker Truck Service		2	2	2	n.a.	
	Annual HH Time Spent On Managing Sewage Tanker Truck Service	**hr/yr**	**2,2**	**2,2**	**21,7**	**26,0**	
	Time Spent On Other Sewage Management Activities	hh:mm/wk	1:00	0:30	0:15	**17,3**	
Annual Time Spent On Managing Sewer Systems = Length Of Season * (Time Spent Managing Municipal Sewer Connection + Time Spent Managing Sewage Storage System + Time Spent Managing Sewage Outfall System + T	Number Of HH Sharing Other Sewage Management Activities		2	2	2	**n.a.**	
	Annual HH Time Spent On Other Sewage Management Activities	**hr/yr**	**2,2**	**1,1**	**5,4**	**8,7**	
Annual HH Time Spent On Managing Sewer Systems = Ann	**Annual Time Spent On Managing Sewer Systems**	**hr/yr**	**17,2**	**13,3**	**112,1**	**142,6**	
	Annual HH Time Spent On Managing Sewer Systems	**hr/yr**	**7,1**	**5,2**	**41,1**	**53,4**	

TOTAL ANNUAL TIME SPENT ON MANAGING WATER AND SEWER / ჯამური ოჯახის წლიური დროითი დანახარჯი წყალმომარაგების და კანალიზაციის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Total Annual HH Time Spent Managing Water And Sewer = Annual HH Time Spent On Managing Water Sources + Annual HH Time Spent On Managing Water Issues Other Than Water Sources + Annual HH Time Spent On Managing Sewer Systems	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Annual HH Time Spent On Managing Water Sources	hr/yr	23,0	15,2	141,1	**179**	
	Annual HH Time Spent On Managing Water Issues Other Than Water Sources	hr/yr	10,2	10,8	130,2	**151**	
	Annual HH Time Spent On Managing Sewer Systems	hr/yr	7,1	5,2	41,1	**53**	
	Total Annual HH Time Spent Managing Water And Sewer	**hr/yr**	**7:12**	**4:29**	**8:37**	**384**	

WILLINGNESS TO SWITCH TO MUNICIPAL WATER AND SEWAGE SYSTEMS / მუნიციპალურ წყალმომარაგებასა და საკანალიზაციო მომსახურებაზე გადართვის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Future Annual HH Municipal Water Bill = Volume Of Water Used Today * Water Tarrff	Volume Of Water Used Today	**m^3/yr**	65	
Future Annual HH Municipal Sewer Bill = Volume Of Water Used Today * Sewer Tariff	Water Tarrff	**GEL/m^3**	1,7000	
	Sewer Tariff	**m^3/yr**	2,1000	
Future Annual HH Municipal Water And Sewer Bill = Future Annual HH Municipal Sewer Bill + Future Annual HH Municipal Water Bill	**Future Annual HH Municipal Water Bill**	**GEL/yr**	**110**	
	Future Annual HH Municipal Sewer Bill	**GEL/yr**	**136**	
Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Water And Sewer = Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Water + Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Sewer	**Future Annual HH Municipal Water And Sewer Bill**	**GEL/yr**	**246**	
	Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Water	**GEL/yr**	**6 716**	
	Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Sewer	**GEL/yr**	**1 717**	
Likelihood To Switch For Water (larger is more likely to switch) = Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Water / Future Annual HH Municipal Water Bill	**Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Water And Sewer**	**GEL/yr**	**8 433**	
	Likelihood To Switch For Water (larger is more likely to switch)		**61,06**	
Likelihood To Switch For Sewer (larger is more likely to switch) = Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Sewer / Future Annual HH Municipal Sewer Bill	**Likelihood To Switch For Sewer (larger is more likely to switch)**		**12,64**	
	Likelihood To Switch For Water And Sewer Combined (larger is more likely to switch)		**34,30**	

APPENDIX F

F INDIVIDUAL HOUSEHOLD IMPACT GROUP – WATER AUDIT

WATER CONSUMPTION BY TOILETS

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE TOILET #1	TOILET #2	TURKISH TOILET #1	TURKISH TOILET #2	ANNUAL TOTAL	COMMENT
Annual Water Consumption By Toilets = Length Of Season * 7 * Flushes Each Day For Any Purposes * Per Flush Water Consumption	Length Of Season	weeks	52	52	52	52	**n.a.**	
	Flushes Each Day For Any Purposes	#/day	2	3	4	5	**n.a.**	
	Per Flush Water Consumption	m^3	0,0100	0,0100	0,0100	0,0100	**n.a.**	
	Annual Water Consumption By Toilets	**m^3/yr**	**7,28**	**10,92**	**14,56**	**18,20**	**50,96**	

WATER CONSUMPTION BY INDOOR FAUCETS

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE KITCHEN FAUCET #1	KITCHEN FAUCET #2	BATHROOM FAUCET #1	BATHROOM FAUCET #2	ANNUAL TOTAL	COMMENT
Time Faucet Is On For All Purposes = Time Faucet Is On For Cooking Purposes + Time Faucet Is On For Potable Water Purposes + Time Faucet Is On For Hand Washing + Time Faucet Is On For Watering In-House Plants + Time Faucet Is On For Teeth Brushing + Time Faucet Is On For Washing Dishes + Time Faucet Is On For In-House Wet-Cleaning Procedures + Time Faucet Is On For Outdoor Wet-Clean Procedures + Time Faucet Is On For Laundry + Time Faucet Is On For Treating Domestic Animals + Time Faucet Is On For Storing Water + Time Faucet Is On For Other Purposes **Annual Water Consumption By Indoor Faucet = Time Faucet Is On For All Purposes * Flow Rate Of Faucet / 1000**	Time Faucet Is On For Cooking Purposes	min/day	30	20	20	20	**n.a.**	
	Time Faucet Is On For Potable Water Purposes	min/day	10	10	10	10	**n.a.**	
	Time Faucet Is On For Hand Washing	min/day	10	10	10	10	**n.a.**	
	Time Faucet Is On For Watering In-House Plants	min/day	10	10	10	10	**n.a.**	
	Time Faucet Is On For Teeth Brushing	min/day	0	0	10	10	**n.a.**	
	Time Faucet Is On For Washing Dishes	min/day	10	10	0	0	**n.a.**	
	Time Faucet Is On For In-House Wet-Cleaning Procedures	min/day	20	20	30	20	**n.a.**	
	Time Faucet Is On For Outdoor Wet-Clean Procedures	min/day	10	20	30	50	**n.a.**	
	Time Faucet Is On For Laundry	min/day	0	0	10	10	**n.a.**	
	Time Faucet Is On For Treating Domestic Animals	min/day	10	10	10	10	**n.a.**	
	Time Faucet Is On For Storing Water	min/day	50	30	40	30	**n.a.**	
	Time Faucet Is On For Other Purposes	min/day	10	10	10	10	**n.a.**	
	Time Faucet Is On For All Purposes	**min/day**	**170**	**150**	**190**	**190**	**n.a.**	
	Flow Rate Of Faucet	l/min	5,0	5,0	5,0	5,0	**n.a.**	
	Annual Water Consumption By Indoor Faucets	**m^3/yr**	**0,9**	**0,8**	**1,0**	**1,0**	**3,5**	

WATER CONSUMPTION BY OUTDOOR FAUCETS

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE							COMMENT
			FAUCET #1 - SEASON			FAUCET #2 - SEASON			ANNUAL TOTAL	
			HIGH	SHOULDER	LOW	HIGH	SHOULDER	LOW		
Time Outdoor Faucet Is On For Seasonal Activities = ((Time Faucet Is On For Outdoor Gardening + ... For Car Washing Of Own Vehicles + ... For Carpet Washing + ... For Other Non-Economic Purposes + … For Economic Purposes) * 7 * Length Of Season) / 60 Annual Water Consumption By Outdoor Faucet For Seasonal Activities = Time Outdoor Faucet Is On For Seasonal Activities * 60 * Flow Rate Of Faucet / 1000 Time Outdoor Faucet Is On For Non-Seasonal Activities = (Time Faucet Is On For Cooking Purposes + ... For Potable Water Purposes + ... For Hand Washing + ... For Watering In-House Plants + ... For Teeth Brushing + ... For Washing Dishes + ... For In-House Wet-Cleaning Procedures + ... For Outdoor Wet-Clean Procedures + ... For Laundry + ... For Treating Domestic Animals + ... For Storing Water + ... For Other Purposes) * 7 * Length Of Season / 60 Annual Water Consumption By Outdoor Faucet For Non-Seasonal Activities = Time Outdoor Faucet Is On For Non-Seasonal Activities * 60 * Flow Rate Of Faucet / 1000 Annual Water Consumption By Outdoor Faucet = Annual Wa	Length Of Season	wk/yr	4,3	4,3	43,4	4,3	4,3	43,4	**52**	
	Time Faucet Is On For Outdoor Gardening	min/day	120	50	10	120	50	10	**n.a.**	Seasonality in usage.
	... For Car Washing	min/day	30	10	0	30	10	0	**n.a.**	Use … For Economic Purposes for a carwash business.
	... For Carpet Washing	min/day	10	10	10	10	10	10	**n.a.**	
	... For Other Non-Economic Purposes	min/day	15	15	15	15	15	15	**n.a.**	
	… For Other Economic Purposes	min/day	180	150	120	0	0	0	**n.a.**	
	Time Outdoor Faucet Is On For Seasonal Activities	**hr/season**	**178**	**118**	**785**	**88**	**43**	**177**	**n.a.**	
	Flow Rate Of Faucet	l/min	5,0	5,0	5,0	5,0	5,0	5,0	**n.a.**	
	Annual Water Consumption By Outdoor Faucets For Seasonal Activities	**m^3/yr**	**53,4**	**35,4**	**235,4**	**26,3**	**12,8**	**53,2**	**416,5**	
	Time Faucet Is On For Cooking Purposes	min/day	10	10	10	10	10	10	**n.a.**	No seasonality in usage.
	... For Potable Water Purposes	min/day	30	30	30	5	5	5	**n.a.**	
	... For Hand Washing	min/day	25	25	25	5	5	5	**n.a.**	
	... For Watering In-House Plants	min/day	20	20	20	5	5	5	**n.a.**	
	... For Teeth Brushing	min/day	10	10	10	10	10	10	**n.a.**	
	... For Washing Dishes	min/day	10	10	10	10	10	10	**n.a.**	
	... For In-House Wet-Cleaning Procedures	min/day	10	10	10	10	10	10	**n.a.**	
	... For Outdoor Wet-Clean Procedures	min/day	10	10	10	10	10	10	**n.a.**	
	... For Laundry	min/day	10	10	10	10	10	10	**n.a.**	
	... For Treating Domestic Animals	min/day	10	10	10	10	10	10	**n.a.**	
	... For Storing Water	min/day	20	20	20	20	20	20	**n.a.**	
	... For Other Purposes	min/day	10,00	10	10	0,01	0	0	**n.a.**	
	Time Outdoor Faucet Is On For Non-Seasonal Activities	**hr/year**	**88**	**88**	**886**	**53**	**53**	**532**	**n.a.**	
	Annual Water Consumption By Outdoor Faucets For Non-Seasonal Activities	**m^3/yr**	**26,3**	**26,3**	**265,8**	**15,8**	**15,8**	**159,5**	**509,6**	
	Annual Water Consumption By Outdoor Faucets	**m^3/yr**	**79,77**	**61,71**	**501,27**	**42,14**	**28,60**	**212,68**	**926,2**	

WATER CONSUMPTION BY BATHROOM SHOWERHEADS AND FAUCETS

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE							COMMENT
			SHOWER / BATHTUB # 1 - SEASON			SHOWER / BATHTUB # 2 - SEASON			ANNUAL TOTAL	
			HIGH	SHOULDER	LOW	HIGH	SHOULDER	LOW		
Annual Water Consumption By Shower Head For Showers = Time Showerhead Is On For Taking Shower * 7 * Length Of Season * Flow Rate Of Shower Head / 1000 **Annual Water Consumption By Bathtub Faucet For Baths = Time Bathtub Faucet Is On For Taking Bath * 7 * Length Of Season * Flow Rate Of Bathtub Faucet / 1000** **Annual Water Consumption By Shower And Bathtub For Bathing = Annual Water Consumption By Shower Head For Showers + Annual Water Consumption By Bathtub Faucet For Baths** **Time Bathtub Faucet Is On For Non-Bathing Purposes = (Time Bathtub Faucet Is On For Cooking Purposes + ... For Potable Water Purposes + ... For Hand Washing + ... For Watering In-House Plants + ... For Teeth Brushing + ... For Washing Dishes + ... For In-House Wet-Cleaning Procedures + ... For Outdoor Wet-Clean Procedures + ... For Laundry + ... For Treating Domestic Animals + ... For Storing Water + ... For Other Purposes) * 7 * Length Of Season / 60** **Annual Water Consumption By Bathtub Faucet For Non-Bathing Purposes = Time Bathtub Faucet Is On For Non-Bathing Purposes * 60 * Flow Rate Of Bathtub Faucet / 1000** **Annual Water Consumption By Bathtub And Shower Faucets**	Length Of Season	wk/yr	4,3	4,3	43,4	4,3	4,3	43,4	**52**	
	Time Showerhead Is On For Taking Shower	min/day	30	20	10	15	10	5	**n.a.**	
	Flow Rate Of Shower Head	l/min	30,0	30,0	30,0	20,0	20,0	20,0	**n.a.**	
	Annual Water Consumption By Shower Heads For Showers	**m^3/yr**	**27,1**	**18,1**	**91,1**	**9,0**	**6,0**	**30,4**	**181,7**	
	Time Bathtub Faucet Is On For Taking Bath	min/day	15	10	5	15	10	5	**n.a.**	
	Flow Rate Of Bathtub Faucet	l/min	40,0	40,0	40,0	30,0	30,0	30,0	**n.a.**	
	Annual Water Consumption By Bathtub Faucets For Baths	**m^3/yr**	**18,1**	**12,0**	**60,8**	**13,5**	**9,0**	**45,6**	**159,0**	
	Annual Water Consumption By Shower Heads And Bathtub Faucets For Bathing	**m^3/yr**	**45,2**	**30,1**	**151,9**	**22,6**	**15,1**	**76,0**	**340,7**	
	Time Bathtub Faucet Is On For Cooking Purposes	min/day	0	0	0	0	0	0	**n.a.**	
	... For Potable Water Purposes	min/day	10	10	10	0	0	0	**n.a.**	
	... For Hand Washing	min/day	5	5	5	0	0	0	**n.a.**	
	... For Watering In-House Plants	min/day	5	5	5	10	10	10	**n.a.**	
	... For Teeth Brushing	min/day	0	0	0	0	0	0	**n.a.**	
	... For Washing Dishes	min/day	0	0	0	5	5	5	**n.a.**	
	... For In-House Wet-Cleaning Procedures	min/day	5	5	5	5	5	5	**n.a.**	
	... For Outdoor Wet-Clean Procedures	min/day	5	5	5	0	0	0	**n.a.**	
	... For Laundry	min/day	10	10	10	0	0	0	**n.a.**	
	... For Treating Domestic Animals	min/day	3	3	3	5	5	5	**n.a.**	
	... For Storing Water	min/day	0	0	0	5	5	5	**n.a.**	
	... For Other Purposes	min/day	5	5	5	10	10	10	**n.a.**	
	Time Bathtub Faucet Is On For Non-Bathing Purposes	**hr/year**	**24**	**24**	**243**	**20**	**20**	**203**	**n.a.**	
	Flow Rate Of Bathtub Faucet	l/min	40,0	40,0	40,0	30,0	30,0	30,0	**n.a.**	
	Annual Water Consumption By Bathtub Faucets For Non-Bathing Purposes	**m^3/yr**	**58**	**58**	**583**	**36**	**36**	**365**	**1 136**	
	Annual Water Consumption By Shower Heads And Bathtub Faucets	**m^3/yr**	**102,9**	**87,9**	**735,2**	**58,7**	**51,2**	**440,5**	**1 476**	

WATER CONSUMPTION BY WASHING MACHINES

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE				COMMENT
			SEASON			ANNUAL TOTAL	
			HIGH	SHOULDER	LOW		
Annual Water Consumption For Washing Machine = Number Of Loads In Washing Machine * Length Of Season * Volume Of Water Used By Washing Machine / 1000	Length Of Season	wk/yr	4,3	4,3	43,4	**52,0**	
	Number Of Loads In Washing Machine	#/wk	4	4	4	**n.a.**	
	Volume Of Water Used By Washing Machine	l/load	35,0	35,0	35,0	**n.a.**	
	Annual Water Consumption By Washing Machines	**m^3/yr**	**0,60**	**0,60**	**6,08**	**7,3**	

WATER CONSUMPTION TO FILL BUCKETS AND OTHER MOVEABLE WATER STORAGE CONTAINERS

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE				COMMENT
			ALTERNATIVE WATER SOURCE			ANNUAL TOTAL	
			SPRING WATER	BOTTLED WATER	OTHER		
Annual Water Consumption From Alternative Water Sources = Number Of Fillings * Volume Of All Moveable Buckets And Containers (in one or more containers) * Length Of Season / 1000	Length Of Season	wk/yr	4,3	4,3	43,4	**52,0**	
	Number Of Fillings	#/wk	3	3	3	**n.a.**	
	Volume Of All Moveable Buckets And Containers (in one or more containers)	l	100	15	25	**n.a.**	Combine all containers being used regularly together.
	Annual Water Consumption From Alternative Water Sources	**m^3/yr**	**1,3**	**0,2**	**3,3**	**4,7**	
Annual Water Consumption That Is Discarded When New Water Is Added To Storage Containers = Annual Water Consumption From Alternative Water Sources * Portion Of Water That Is Discarded When New Water Is Added	Portion Of Water That Is Discarded When New Water Is Added		50%	0%	30%	**n.a.**	When an empty container is filled, then this is water consumption. When some of that water is discarded before container is refilled, then that percentage is here.
	Annual Water Consumption That Is Discarded When New Water Is Added To Buckets And Other Moveable Water Storage Containers	**m^3/yr**	**0,6**	**0,0**	**1,0**	**1,6**	

TOTAL ANNUAL WATER CONSUMPTION

CALCULATION	DATA ELEMENT / METRIC	UNIT	ANNUAL TOTAL	COMMENT
Total Annual Water Consumption = Annual Water Consumption By Toilets + ... By Indoor Faucets + ... By Outdoor Faucets For Seasonal Activities + ... By Outdoor Faucets For Non-Seasonal Activities + ... By Shower Heads And Bathtub Faucets For Bathing + ... By Bathtub Faucets For Non-Bathing Purposes + ... By Washing Machine + ... By Alternative Water Sources	Annual Water Consumption By Toilets	m^3/yr	51	
	... By Indoor Faucets	m^3/yr	4	
	... By Outdoor Faucets For Seasonal Activities	m^3/yr	417	
	... By Outdoor Faucets For Non-Seasonal Activities	m^3/yr	510	
	... By Shower Heads And Bathtub Faucets For Bathing	m^3/yr	341	
	... By Bathtub Faucets For Non-Bathing Purposes	m^3/yr	1 136	
	... By Washing Machine	m^3/yr	7	
	... By Alternative Water Sources	m^3/yr	5	
	Total Annual Water Consumption	m^3/yr	**2 469**	

APPENDIX G

G INDIVIDUAL HOUSEHOLDS IMPACT GROUP – QUALITY OF LIFE

HEALTH INCIDENTS IN LAST TWO WEEKS / ჯანმრთელობასთან დაკავშირებული შემთხვევები გასულ თვეში

DATA ELEMENT / METRIC	UNIT	VALUE FOR FAMILY MEMBER მნიშვნელობა ოჯახის წევრისთვის						TOTAL ჯამი	COMMENTS
		CHILDREN UNDER AGE 6 6 წელზე უმცროსი ბავშვები	CHILDREN OF SCHOOL AGE სასკოლო ასაკის ბავშვები	HEALTHY ADULT MEN ჯანმრთელი ზრდასრული მამაკაცები	HEALTHY ADULT WOMEN ჯანმრთელი ზრდასრული ქალები	ELDERLY AND INFIRM MEN ასაკიანი მამაკაცები	ELDERLY AND INFIRM WOMEN ასაკიანი ქალები		
Number Of Individuals In HH	indiv							**0**	
Number Of Incidents Of Diarrhea Disease In HH In ***Last Two Weeks***	incidents							**0**	
Number Of Incidents Of Gastrointestinal Disease Other Than Diarrhea In HH In ***Last Two Weeks***	incidents							**0**	
Number Of Incidents Of Respiratory Disease In HH In ***Last Two Weeks***	incidents							**0**	
Perceived Likelihood These Incidents In ***Last Two Weeks*** Were Caused By Water Borne Disease (vs. food or other reasons)	% incidents							**n.a.**	
Number Of Incidents Where Other Family Members Also Became Ill In ***Last Two Weeks***	incidents							**0**	
Number Of Incidents Where Neighbors Also Became Ill In ***Last Two Weeks***	incidents							**0**	
How Did HH Respond To The Incidents In ***Last Two Weeks*** (e.g., self-medicate, visit doctor)	List							**n.a.**	
Among All Incidents Combined, How Many Visits To The Doctor Were Made In ***Last Two Weeks***	dr visits							**0**	
Among All Incidents Combined, How Much Did HH Spend On Visits To The Doctor In ***Last Two Weeks***	GEL							**0**	
Among All Incidents Combined, How Much Did HH Spend On Drugs In ***Last Two Weeks***	GEL							**0**	
Among All Incidents Combined, How Much Did HH Spend On Things Other Than Drugs In ***Last Two Weeks***	GEL							**0**	
Among All Incidents Combined, How Many Days Were Lost Due To Being Ill In ***Last Two Weeks*** (includes days lost of work, education, leisure or other other activities)	days							**0**	

HEALTH INCIDENTS IN LAST 12 MONTHS

DATA ELEMENT / METRIC	UNIT	VALUE FOR FAMILY MEMBER მნიშვნელაობა ოჯახის წევრისთვის						TOTAL ჯამი	COMMENTS
		CHILDREN UNDER AGE 6 6 წელზე უმცროსი ბავშვები	CHILDREN OF SCHOOL AGE სასკოლო ასაკის ბავშვები	HEALTHY ADULT MEN ჯანმრთელი ზრდასრული მამაკაცები	HEALTHY ADULT WOMEN ჯანმრთელი ზრდასრული ქალები	ELDERLY AND INFIRM MEN ასაკიანი მამაკაცები	ELDERLY AND INFIRM WOMEN ასაკიანი ქალები		
Number Of Individuals In HH	indiv							**0**	
Number Of Incidents Of Diarrhea Disease In HH In ***Last 12 Months***	incidents							**0**	
Number Of Incidents Of Gastrointestinal Disease Other Than Diarrhea In HH In ***Last 12 Months***	incidents							**0**	
Number Of Incidents Of Respiratory Disease In HH In ***Last 12 Months***	incidents							**0**	
Perceived Likelihood These Incidents In ***Last 12 Months*** Were Caused By Water Borne Disease (vs. food or other reasons)	% incidents							**n.a.**	
Number Of Incidents Where Other Family Members Also Became Ill In ***Last 12 Months***	incidents							**0**	
Number Of Incidents Where Neighbors Also Became Ill In ***Last 12 Months***	incidents							**0**	
How Did HH Respond To The Incidents In ***Last 12 Months*** (e.g., self-medicate, visit doctor)	List							**n.a.**	
Among All Incidents Combined, How Many Visits To The Doctor Were Made In ***Last 12 Months***	dr visits							**0**	
Among All Incidents Combined, How Much Did HH Spend On Visits To The Doctor In ***Last 12 Months***	GEL							**0**	
Among All Incidents Combined, How Much Did HH Spend On Drugs In ***Last 12 Months***	GEL							**0**	
Among All Incidents Combined, How Much Did HH Spend On Things Other Than Drugs In ***Last 12 Months***	GEL							**0**	
Among All Incidents Combined, How Many Days Were Lost Due To Being Ill In ***Last 12 Months*** (includes days lost of work, education, leisure or other other activities)	days							**0**	

POTABLE WATER SOURCES

DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა				COMMENTS
		SEASON / სეზონი			AVERAGE ANNUAL წლიური საშუალო	
		HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი		
Length Of Season (weeks)	wk			52	**52**	There is one definition of season in each city set by researchers.
Potable Water Source For ***Children Under Age 6***	List				**n.a.**	Source includes original source of water (e.g., Municipal, well) and how it is handled (e.g., direct connection, stored before use) (e.g., Municipal/direct, Municipal/stored).
Potable Water Source For ***Children Of School Age***	List				**n.a.**	
Potable Water Source For ***Healthy Adults***	List				**n.a.**	
Potable Water Source For ***Elderly And Infirm Adults***	List				**n.a.**	
Distance From HH To Nearest Potable Water Source	m				**n.a.**	

PERCEPTIONS ON SAFETY OF (ORIGINAL SOURCE) MUNICIPAL WATER / წყლის უსაფრთხოების აღქმა

DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON / სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	AVERAGE ANNUAL წლიური საშუალო	COMMENTS
Length Of Season (weeks)	wk	0	0	52	52	
HH Drinks Municipal Water Straight From The Tap (without treatment)	List				n.a.	Drinking water demonstrates belief in safety. Include "Yes, but only because I cannot afford an alternative" in the list.
HH Drinks Municipal Water Only After Treatment	List				n.a.	
HH Never Drinks Municipal Water	List				n.a.	
How Municipal Water Used For Potable Purposes Is Treated Before Use	List				n.a.	
Number Of Liters Of Municipal Water Treated For Potable Purposes (liters per person per day)	l				0,00	
Perception Of Average Safety/Adequacy Within Season Of Municipal Water This Year	Scale				0,00	
Perception Of Day-To-Day Variability In Safety/Adequacy Within Season Of Municipal Water This Year	Scale				0,00	
Perception Of Average Safety/Adequacy Within Season Of Municipal Water Five Years Ago	Scale				0,00	
Perception Of Average Safety/Adequacy Within Season Of Municipal Water Ten Years Ago	Scale				0,00	

PERCEPTIONS ON SAFETY OF (ORIGINAL SOURCE) ALTERNATIVE WATER SOURCE

DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON / სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	AVERAGE ANNUAL წლიური საშუალო	COMMENTS
Length Of Season (weeks)	wk	0	0	52	52	
Alternative Source(s) Of Water (if any)	List				n.a.	
HH Drinks Alternative Source Water Straight From The Tap (without treatment) (excluding bottled water)	List				n.a.	
HH Drinks Alternative Source Water Only After Treatment (excluding bottled water)	List				n.a.	
HH Never Drinks Alternative Source Water	List				n.a.	
How Alternative Source Water Used For Potable Purposes Is Treated Before Use	List				n.a.	
Number Of Liters Of Alternative Source Water Treated For Potable Purposes (liters per person per day)	l				0,00	
Perception Of Average Safety/Adequacy Within Season Of Alternative Source Water This Year	Scale				0,00	
Perception Of Day-To-Day Variability In Safety/Adequacy Within Season Of Alternative Source Water This Year	Scale				0,00	
Perception Of Average Safety/Adequacy Within Season Of Alternative Source Water Five Years Ago	Scale				0,00	
Perception Of Average Safety/Adequacy Within Season Of Alternative Source Water Ten Years Ago	Scale				0,00	

PERCEPTIONS ON SAFETY/ADEQUACY OF SEWER SYSTEM / საკანალიზაციო სისტემის უსაფრთხოების აღქმა

DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა				COMMENTS
		SEASON / სეზონი			AVERAGE ANNUAL წლიური საშუალო	
		HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი		
Length Of Season (weeks)	wk	0	0	52	52	
Distance From HH To Nearest Proper Toilet	m				**n.a.**	
Perception Of Safety/Adequacy Within Season Of ***Municipal*** Sewer System ***Within Your Household***	Scale				**0,00**	
Perception Of Safety/Adequacy Within Season Of ***Municipal*** Sewer System ***Within Your Neighborhood***	Scale				**0,00**	
Alternative Sewer System (if any)	List				**n.a.**	
Perception Of Safety/Adequacy Within Season Of ***Alternative*** Sewer System ***Within Your Household***	Scale				**0,00**	
Perception Of Safety/Adequacy Within Season Of ***Alternative*** Sewer System ***Within Your Neighborhood***	Scale				**0,00**	
Number Of Days Per Week Within Season When Sewer Smells ***Within Your Household***	days/wk				**0,00**	
Number Of Days Per Week Within Season When Sewer Smells ***Within Your Neighborhood***	days/wk				**0,00**	
Overall Satisfaction With ***Municipal*** Sewer Services	Scale				**0,00**	
Overall Satisfaction With ***Alternative*** Sewer System	Scale				**0,00**	

PERCEPTIONS ON PHYSICAL FEATURES OF WATER / წყლის ფიზიკური მახასიათებლების შესახებ აზრი

		VALUE მნიშვნელობა				
		SEASON / სეზონი			AVERAGE ANNUAL წლიური საშუალო	
DATA ELEMENT / METRIC	UNIT	HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი		COMMENTS
Length Of Season (weeks)	wk	0	0	52	52	
Perception Of Taste In Season Of ***Municipal*** Water	Scale				**0,00**	Municipal water can be either direct connection or stored before use.
Perception Of Taste In Season Of ***Alternative Source*** Water (excluding bottled water)	Scale				**0,00**	
Perception Of Smell In Season Of ***Municipal*** Water	Scale				**0,00**	
Perception Of Smell In Season Of ***Alternative Source*** Water (excluding bottled water)	Scale				**0,00**	
Perception Of Cleanliness (absence of dirt or floating particles) In Season of ***Municipal*** Water	Scale				**0,00**	
Perception Of Cleanliness (absence of dirt or floating particles) In Season Of ***Alternative Source*** Water (excluding bottled water)	Scale				**0,00**	
Perception Of Color In Season of ***Municipal*** Water	Scale				**0,00**	
Perception of Color In Season Of ***Alternative Source*** Water (excluding bottled water)	Scale				**0,00**	
Overall Satisfaction With Physical Features Of ***Municipal Water***	Scale				**0,00**	
Overall Satisfaction With Physical Features Of ***Alternative Source*** Water	Scale				**0,00**	

MUNICIPAL WATER SUPPLY SCHEDULE / მუნიციპალური წყალმომარაგების საიმედოობა

		VALUE მნიშვნელობა								
DATA ELEMENT / METRIC	UNIT	MON ორშაბათი	TUE სამშაბათი	WED ოთხშაბათი	THU ხუთშაბათი	FRI პარასკევი	SAT შაბათი	SUN	WEEKLY TOTAL OR AVERAGE	COMMENTS
Time In ***High Season*** With Any Municipal Water (water at even a very low pressure)	hr/day								**0**	A trickle of water can still be used to fill a water storage tank.
Time In ***High Season*** With Pressurized Municipal Water (such that a pump is not needed)	hr/day								**0**	If no variation among days enter same number for every day.
Time In ***Shoulder Season*** With Any Municipal Water (water at even a very low pressure)	hr/day								**0**	
Time In ***Shoulder Season*** With Pressurized Municipal Water (such that a pump is not needed)	hr/day								**0**	
Time In ***Low Season*** With Any Municipal Water (water at even a very low pressure)	hr/day								**0**	
Time In ***Low Season*** With Pressurized Municipal Water (such that a pump is not needed)	hr/day								**0**	

RELIABILITY OF MUNICIPAL WATER SUPPLY SCHEDULE

DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა				COMMENTS
		SEASON / სეზონი			AVERAGE ANNUAL წლიური საშუალო	
		HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი		
Length Of Season (weeks)	wk	0	0	52	52	
Reliability In Season Of Municipal Water Schedule (water at even a very low pressure)	Scale				**0,00**	Reliability means that water is available at the scheduled time (or not).
Reliability In Season Of Pressurized Municipal Water Schedule (such that a pump is not needed)	Scale				**0,00**	
Maximum Days In Season HH Can Go Without Any Municipal Water (water at even a very low pressure)	days				**0,00**	Essentially how long until all water in a water storage system (if any) is consumed and HH must take some extraordinary measure to obtain water.
Maximum Days In Season HH Can Go Without Pressurized Municipal Water (such that a pump is not needed)	days				**0,00**	Essentially how long until HH without a storage system can wait until it must take some extraordinary measure to obtain water.
Longest Period (number of days) In Season Without Municipal Water Over Past Year	days				**0,00**	
Extent To Which Water Storage (coping strategy) Has Eliminated The Inconvenince of Not Having Pressurized Municipal Water 24/7	Scale				**0,00**	
Overall Satisfaction With Municipal Water ***Schedule*** (frequency and length of water under pressure)	Scale				**0,00**	
Overall Satisfaction With Municipal Water ***Schedule Reliability***	Scale				**0,00**	Reliability means that water is available at the scheduled time (or not).

COMMUNICATION OF SANITATION- AND WATER-RELATED INFORMATION / ასენიზაციასა და წყალთან დაკავშირებული ინფორმაციის კომუნიკაცია

DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENTS
Time Since HH Last Received Information On The Public Health Benefits of Good Water And Sewer Systems	mo		For example, why it is important to have a city-wide water and sewer system rather than individual sewers.
Time Since HH Last Received Information On Proper Water And Sewer Hygiene Practices	mo		General information about proper sanitation practices (e.g., washing hands).
Time Since Any One School Age Child Last Received Sanitation Training In School	mo		
Extent To Which HH Follows Recommended Hygiene Practices	Scale		Ranges from All HH Members Ignore All Recommendations to All Members Always Follow All Recommnedations.
Overall Satisfaction with Level Of Knowledge About Proper Water And Sewer Hygiene Practices	Scale		
Time Since HH Last Received Information On The Water And Sewer Tariff-Setting Process	mo		
Level Of Knowledge About How The Municipal Water Bill Is Calculated	Scale		
Level Of Knowledge About How The Municipal Sewer Bill Is Calculated	Scale		
Overall Satisfaction With Level Of Knowledge About Water And Sewer Tariffs And Bills	Scale		
Time Since HH Last Received General Information On Nature Or Frequency Of Water Testing	mo		General testing of water in the system. Not specific-test oriented.
Time Since HH Last Received Information On A Specific And Relevant Water Test	mo		For example, a test carried out due to a neighbor becoming sick.
Overall Satisfaction With Level Of Knowledge About Water Testing	Scale		
Time Since HH Last Received Information On Water Conservation (importance of or methods to do)	mo		Demand-side management.
Overall Satisfaction With Level Of Knowledge About Water Conservation Methods	Scale		

SOCIAL ISSUES

DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENTS
Time Since Last Dispute With Neighbors About Water Or Sewer Bills	mo		
Time Since Last Non-Bill Dispute With Neighbor About Water Systems	mo		
Time Since Last Dispute With Neighbor About Sewer Systems	mo		

WATER CONSUMPTION AND CONSERVATION / წყლის მოხმარება და კონსერვაცია

DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENTS
Portion Of Water That Comes From Municipal Water System	%		
Portion Of Water That Comes From Alternative Sources	%		
Portion Of Water That Is Used For Domestic Purposes	%		
Portion Of Water That Is Used For Garden Purposes	%		
Portion Of Water That Is Used For Domestic Pets	%		e.g., dogs and cats.
Portion Of Water That Is Used For Farm Animals	%		e.g., cows, horses.
Portion Of Water That Is Used For Economic Purposes	%		
Portion Of Water That Is Lost To Leaks	%		e.g., leaking pipes, tanks
Portion Of Water That Is Disposed Of When Water Storage Tanks Are Re-Filled	%		e.g., is water storage tank first fully emptied before being re-filled?
Strategy Used For Water In Water Storage Tank When Fresh Water Is Available	List		e.g., is water storage tank first fully emptied before being re-filled?
Frequency Of Leaking Pipes In HH Water System	List		e.g., never, monthly, weekly, annually.
Cost Of Repairs To Leaking Pipes In Last Year	GEL		
Frequency Of Leaking Fittings In HH Water System	List		
Cost Of Repairs To Leaking Fitting In Last Year	GEL		
Water Use Reduction Or Recycling Methods Used At Present	List		

FREQUENCY OF SANITATION-RELATED ACTIVITIES AT HOME / სანიტარიასთან დაკავშირებული ღონისძიებების სიხშირე

DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა — SEASON / სეზონი — HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	AVERAGE ANNUAL წლიური საშუალო	COMMENTS
Length Of Season (weeks)	wk	0	0	52	52	
Number Of Individuals In HH	indivs				**0**	
Number Of Baths/Showers Taken ***Each Week*** Among All Inhabitants	baths/showers				**0**	
Number Of Individuals Who ***Do Not*** Wash Hands Before Nearly Every Meal	indivs				**0**	
Number Of Individuals Who Wash Hands ***With Water Only*** Before Nearly Every Meal	indivs				**0**	
Number Of Individuals Who Wash Hands ***With Soap And Water*** Before Nearly Every Meal	indivs				**0**	
Number Of Individuals Who ***Do Not*** Nearly Always Wash Hands After Using Toilet	indivs				**0**	
Number Of Individuals Who Nearly Always Wash Hands ***With Water Only*** After Using Toilet	indivs				**0**	
Number Of Individuals Who Nearly Always Wash Hands ***With Soap And Water*** After Using Toilet	indivs				**0**	
Number Of Loads Of Laundry Done ***Each Week*** Among All Inhabitants	loads/wk				**0**	
Number Of Changes Of Clothing Worn ***Each Week*** Among All Inhabitants	changes/wk				**0**	
Number Of Times Floors Are Washed ***Each Week***	#/wk				**0**	
Number Of Times Bathrooms Are Thoroughly Cleaned ***Each Week***	#/wk				**0**	
Number Of Times Kitchen Is Thoroughly Cleaned ***Each Week***	#/wk				**0**	
Number Of Times Water Buckets Or Other Moveable Containers Are Cleaned ***Each Week***	#/wk				**0**	
Average Time Between Finishing A Meal And Dishes And Pots From Meal Being Washed	min				**0**	

QUALITY OF SANITATION FACILITIES AT SCHOOL / სკოლაში სანიტარიასთან დააკავშირებული ღონისძიებების ხარისხი

DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENTS
Names Of School Where Youngest School Age Child Attends	Text		
Type Of Toilets For Students In School	List		e.g., permanent outdoor, indoor flush, Turkish.
Separate Toilets For Girls And Boys	List		
Availability Of Water In School Toilet	List		
Availability Of Soap In School Toilet	List		
Sources Of Potable Water At School	List		

INCONVENIENCE FROM LESS THAN 24/7 MUNICIPAL WATER / წყალმომარაგების და საკანალიზაციო მომსახურების ხელმისაწვდომობა

DATA ELEMENT / METRIC	UNIT	VALUE FOR FAMILY MEMBER მნიშვნელაობა ოჯახის წევრისთვის						TOTAL ჯამი	COMMENTS
		CHILDREN UNDER AGE 6 6 წელზე უმცროსი ბავშვები	CHILDREN OF SCHOOL AGE სასკოლო ასაკის ბავშვები	HEALTHY ADULT MEN ჯანმრთელი ზრდასრული მამაკაცები	HEALTHY ADULT WOMEN ჯანმრთელი ზრდასრული ქალები	ELDERLY AND INFIRM MEN ასაკიანი მამაკაცები	ELDERLY AND INFIRM WOMEN ასაკიანი ქალები		
Time Spent Managing Water Supply System	hr/wk							0	Well, water storage tanks and distribution systems. Operation, cleaning and maintenance.
Time Spent Treating Water Just Before Use	hr/wk							0	e.g., boiling, chemical treatment, manual filtering
Time Spent Managing Sewage System	hr/wk							0	Storage tank and sewage outfall systems.
Time Spent Gathering Water From Spring Or Distant Source	hr/wk							0	Spring, distant source, community tap.
Time Spent Dealing With Inconveniences Of Less Than 24/7 Municipal Water	hr/wk							0	e.g., inability to have an automatic clothes washer. In addition to amounts for obtaining water noted in previous three Metrics
Total Time That Would Be Made Available For Other Activities If Municipal Water Was Available 24/7	**hr/wk**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Level Of Non-Time Inconvenience From Having Less Than 24/7 Municipal Water	List							n.a.	
Most Likely Use Of Newly-Available Time If Municipal Water Was Available 24/7	List							n.a.	
Second Most Likely Use Of Newly-Available Time If Municipal Water Was Available 24/7	List							n.a.	

TIME SPENT WORKING IN THE HOME

DATA ELEMENT / METRIC	UNIT	VALUE FOR FAMILY MEMBER მნიშვნელაობა ოჯახის წევრისთვის						TOTAL ჯამი	COMMENTS
		CHILDREN UNDER AGE 6 6 წელზე უმცროსი ბავშვები	CHILDREN OF SCHOOL AGE სასკოლო ასაკის ბავშვები	HEALTHY ADULT MEN ჯანმრთელი ზრდასრული მამაკაცები	HEALTHY ADULT WOMEN ჯანმრთელი ზრდასრული ქალები	ELDERLY AND INFIRM MEN ასაკიანი მამაკაცები	ELDERLY AND INFIRM WOMEN ასაკიანი ქალები		
Time Spent On Cooking	hr/wk							0	
Time Spent On Caring For Children (not play)	hr/wk							0	
Time Caring For Sick HH Members (sick from water borne disease)	hr/wk							0	
Time Spent On Cleaning Around HH	hr/wk							0	
Time Spent On Other Domestic Chores	hr/wk							0	
Time Spent Working Outside The Home	hr/wk							0	

PERCEPTIONS ABOUT GENDER EQUITY RELATED TO WATER / გენდერული თანასწორობის საკითხები

DATA ELEMENT / METRIC	UNIT	AMONG GROUP OF WOMEN			COMMENTS
		HEALTHY YOUNG WOMEN (12-18)	HEALTHY ADULT WOMEN ჯანმრთელი ზრდასრული ქალები	ELDERLY AND INFIRM WOMEN ასაკიანი ქალები	
Perception About Equity Of ***Access To Water*** Between Men And Women	Scale				
Perception About Equity Of ***Access To Sanitation*** Between Men And Women	Scale				
Perception About The Level Of Privacy In ***Access To Sanitation***	Scale				
Perception About Equity Of ***Sharing Of Inconvenience*** From Not Having Municipal Water 24/7 Between Men And Women	Scale				

WILLINGNESS TO SWITCH

DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENTS
Perception About Relative Cost Of Current Arrangements To Provide Water And Using Municipal Water In Future	Scale		
Percentage Savings Over Current Arrangements That Will Motivate HH to Switch To Using Only Municipal Water in Future	%		
Perception About Liklihood Of Switching To Municipal Water Based On What Is Known Now	Scale		
After Switching, Likely Behavior Of HH Regarding Disposition Of Existing Coping Assets	List		Will HH sell assets or keep them because of risks related to new municipal water systems.

APPENDIX H

H INDIVIDUAL FIRMS IMPACT GROUP

COMPANY DEMOGRAPHICS - PRODUCTION, PRICING AND MARGIN

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა — SEASON სეზონი — HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Name Of Unit Of Output = Widget **Number Of Units Produced = Length Of Season * Total Capacity * Utilization Rate** **Annual Revenue = Number Of Units Produced * Average Price** **Annual Profit Margin = Profit Margin * Annual Revenue**	Length Of Season	wks/yr	4,3	4,3	43,4	**n.a.**	
	Name Of Unit Of Output		**Widget**			**n.a.**	
	Total Capacity	units/wk	10 500	10 500	10 500	**n.a.**	
	Utilization Rate	% of total capacity	90%	30%	5%	**n.a.**	Assume that units produced generally equals units sold.
	Number Of Units Produced	**Widgets/yr**	**40 635**	**13 545**	**22 785**	**76 965**	
	Average Price	GEL/Widget	11,50	11,00	10,00	**n.a.**	
	Profit Margin	% of price	40%	40%	40%	**n.a.**	
	Annual Revenue	**GEL**	**467 303**	**148 995**	**227 850**	**844 148**	
	Annual Production Cost	**GEL**	**280 382**	**89 397**	**136 710**	**506 489**	
	Annual Profit Margin	**GEL**	**186 921**	**59 598**	**91 140**	**337 659**	

COMPANY DEMOGRAPHICS - PRODUCTION COSTS

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა — SEASON სეზონი — HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual Labor Cost = Length Of Season * (12 / 52) * (Number Of Full Time Employees * Monthly Wage Of Full Time Employee Including All Payroll Taxes + Number Of Part Time Employees * Monthly Salary Of Part Time Employee Including All Payroll Taxes) **Other Production Cost Per Unit = (Annual Production Cost - Annual Labor Cost) / Number Of Units Produced** **Share Of Labor In Total Cost = Annual Labor Cost / Annual Production Cost**	Length Of Season	wks/yr	4,3	4,3	43,4	**n.a.**	
	Number Of Full Time Employees		20	20	20	**n.a.**	
	Monthly Wage Of Full Time Employee Including All Payroll Taxes	GEL/mo	300	300	300	**n.a.**	
	Number Of Part Time Employees		80	80	0	**n.a.**	
	Monthly Salary Of Part Time Employee Including All Payroll Taxes	GEL/mo	250	250	0	**n.a.**	
	Annual Labor Cost	**GEL**	**25 800**	**25 800**	**60 092**	**111 692**	
	Labor Cost Per Unit	**GEL/HIGH მაღალი**	**0,63**	**1,90**	**2,64**	**n.a.**	
	Other Production Cost Per Unit	**GEL/Widget**	**6,27**	**4,70**	**3,36**	**n.a.**	
	Share Of Labor In Total Cost		**9%**	**29%**	**44%**	**22%**	

FIXED COST OF MUNICIPAL WATER AND SEWER CONNECTIONS / ფიქსირებული ხარჯი მუნიციპალური წყალმომარაგების და საკანალიზაციო სისტემის მიერთების

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Municipal Water Connection = Water Connection Fee + Water Installation Works Cost **Fixed Cost Of Municipal Sewer Connection = Sewer Connection Fee + Sewer Installation Works Cost**	Year Of Conecting To Municipal Water		1960	
	Water Connection Fee	GEL	500	
	Water Installation Works Cost	GEL	700	
	Fixed Cost Of Municipal Water Connection	**GEL**	**1 200**	
	Year Of Connecting To Municipal Sewer		1960	
	Sewer Connection Fee	GEL	400	
	Sewer Installation Works Cost	GEL	1 000	
	Fixed Cost Of Municipal Sewer Connection	**GEL**	**1 400**	

FIXED COST OF WATER WELL SYSTEM / ფიქსირებული ხარჯი წყლის ჭის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Water Wells = Number Of Water Wells * (Average Depth Of Water Wells * (Unit Water Well Lining Pipe Cost + Unit Water Well Digging And Well-Lining Installation Cost)) **Fixed Cost Of Water Well Pumps = Number Of Water Well Pumps * Unit Water Well Pump Cost** **Fixed Cost Of Water Well System = Fixed Cost Of Water Wells + Fixed Cost Of Water Well Pumps + Water Well Electrical Control System Cost + Testing Of Water At Startup Cost**	Year Of Constructing Wells		1960	
	Number Of Water Wells		1	
	Average Depth Of Water Wells	m	65	
	Unit Water Well Lining Pipe Cost	GEL/m	5	
	Unit Water Well Digging And Well-Lining Installation Cost	GEL/m	35	
	Fixed Cost Of Water Wells	**GEL**	**2 600**	
	Number Of Water Well Pumps		3	Combine all wells if more than one.
	Unit Water Well Pump Cost	GEL	700	
	Fixed Cost Of Water Well Pumps	**GEL**	**2 100**	
	Water Well Electrical Control System Cost	GEL	400	
	Testing Of Water At Startup Cost	GEL	15	
	Fixed Cost Of Water Well System	**GEL**	**5 115**	

FIXED COST OF SPRING OR DISTANT WATER SOURCE SYSTEM / ფიქსირებული ხარჯი ბუნებრივი წყაროს ან სხვა მოშორებით მდებარე წყაროს სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Spring Or Distant Water Source Head Works Pumps And Fixtures = Spring Or Distant Water Source Head Works Pump Cost + Other Head Works Fixtures Cost **Fixed Cost Of Spring Or Distant Water Source Supply Pipes = Distance To Spring Or Distant Water Source * (Unit Price Of Spring Or Distant Water Source Supply Pipe + Unit Sprint Or Distant Water Source Supply Pipe Installation Cost)** **Fixed Cost Of Spring Or Distant Water Source System = Fixed Cost Of Spring Or Distant Water Source Head Works Pumps And Fixtures + Fixed Cost Of Spring Or Distant Water Source Supply Pipes + Spring Or Distant Water Source Electrical Control System Cost + Testing Of Water At Startup Cost**	Year Of Constructing Connection To Spring Or Distant Water Source		1965	
	Spring Or Distant Water Source Head Works Pump Cost	GEL	2000	
	Other Head Works Fixtures Cost	GEL	2000	
	Fixed Cost Of Spring Or Distant Water Source Head Works Pumps And Fixtures	**GEL**	**4 000**	
	Distance To Spring Or Distant Water Source	m	500	
	Unit Price Of Spring Or Distant Water Source Supply Pipe	GEL/m	5	
	Unit Sprint Or Distant Water Source Supply Pipe Installation Cost	GEL/m	5	
	Fixed Cost Of Spring Or Distant Water Source Supply Pipes	**GEL**	**5 000**	
	Spring Or Distant Water Source Electrical Control System Cost	GEL	400	
	Testing Of Water At Startup Cost	GEL	15	
	Fixed Cost Of Spring Or Distant Water Source System	**GEL**	**9 415**	

FIXED COST OF OUTSIDE WATER STORAGE SYSTEM / ფიქსირებული ხარჯი წყლის გარე ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Outside Water Storage Tanks = Outside Water Storage Tank Cost + Outside Water Storage Tank Installation Cost Fixed Cost Of Outside Water Storage Tank Filling Pumps = Number Of Outside Water Storage Tank Filling Pumps * Unit Outside Water Storage Tank Filling Pump Cost Fixed Cost Of Outside Water Storage System = Fixed Cost Of Outside Water Storage Tanks + Fixed Cost Of Outside Water Storage Tank Filling Pumps Unit Cost Of Outside Water Storage System = Fixed Cost Of Outside Water Storage System / Outside Water Storage Tank Capacity	Year Of Constructing Outside Water Storage Tanks		1975	
	Outside Water Storage Tank Capacity	m^3	3	Combine all tanks if more than one.
	Outside Water Storage Tank Cost	GEL	500	Combine all tanks if more than one.
	Outside Water Storage Tank Installation Cost	GEL	200	Combine all tanks if more than one.
	Number Of Outside Water Storage Tanks		1	Actual number of tanks.
	Fixed Cost Of Outside Water Storage Tanks	**GEL**	**700**	
	Number Of Outside Water Storage Tank Filling Pumps		2	
	Unit Outside Water Storage Tank Filling Pump Cost	GEL	80	
	Fixed Cost Of Outside Water Storage Tank Filling Pumps	**GEL**	**160**	
	Outside Water Storage Electrical Control System Cost	GEL	400	
	Fixed Cost Of Outside Water Storage System	**GEL**	**860**	
	Unit Cost Of Outside Water Storage System	**GEL/m^3**	**287**	

FIXED COST OF WATER DISTRIBUTION SYSTEM / ფიქსირებული ხარჯი წყლის გამანაწილებელი სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Water Distribution Pipes = Water Distribution Pipe Length * (Unit Wate Distribution Pipe Cost + Unit Water Distribution Pipe Installation Cost) Fixed Cost Of Water Distribution Pumps = Number Of Water Distribution Pumps * Unit Water Distribution Pump Cost Fixed Cost Of Water Distribution System = Fixed Cost Of Water Distribution Pipes + Fixed Cost Of Water Distribution Pumps + Water Distribution Electrical Control System Cost	Year Of Constructing Distribution System		1995	
	Water Distribution Pipe Length	m	200	
	Unit Wate Distribution Pipe Cost	GEL/m	3	
	Unit Water Distribution Pipe Installation Cost	GEL/m	5	
	Fixed Cost Of Water Distribution Pipes	**GEL**	**1 600**	
	Number Of Water Distribution Pumps		2	
	Unit Water Distribution Pump Cost	GEL	80	
	Fixed Cost Of Water Distribution Pumps	**GEL**	**160**	
	Water Distribution Electrical Control System Cost	GEL	400	
	Fixed Cost Of Water Distribution System	**GEL**	**2 160**	

FIXED COST OF INSIDE WATER STORAGE SYSTEM / ფიქსირებული ხარჯი წყლის შიდა ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Inside Water Storage Tanks = Number Of Inside Water Storage Tanks * Unit Inside Water Storage Tank Cost **Fixed Cost Of Inside Water Storage Pumps = Number Of Inside Water Storage Pumps * Unit Inside Water Storage Pump Cost** **Fixed Cost Of Inside Water Storage System = Fixed Cost Of Inside Water Storage Tanks + Fixed Cost Of Inside Water Storage Pumps + Inside Water Storage Electrical Control System Cost**	Inside Water Storage Tank Capacity	m^3	0,5	Combine all tanks if more than one.
	Number Of Inside Water Storage Tanks		5	Actual number of tanks.
	Unit Inside Water Storage Tank Cost	GEL	10	
	Fixed Cost Of Inside Water Storage Tanks	**GEL**	**50**	
	Number Of Inside Water Storage Pumps		1	
	Unit Inside Water Storage Pump Cost	GEL	25	
	Fixed Cost Of Inside Water Storage Pumps	**GEL**	**25**	
	Inside Water Storage Electrical Control System Cost	GEL	50	
	Fixed Cost Of Inside Water Storage System	**GEL**	**125**	

FIXED COST OF BUCKETS AND OTHER MOVEABLE WATER STORAGE CONTAINERS / ფიქსირებული ხარჯი ვედროების და სხვა მოძრავი წყლის შესანახი ჭურჭლის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Buckets And Other Movable Water Storage Containers = Number Of Buckets Or Other Movable Water Storage Containers * Unit Bucket Or Other Movable Water Storage Container Cost	Type Of Bucket Or Other Movable Water Storage Container			Create a list
	Capacity Of Buckets Or Other Movable Water Storage Containers	liter	50,0	Combine all buckets and containers if more than one.
	Number Of Buckets Or Other Movable Water Storage Containers		5	Actual number of buckets and containers.
	Unit Bucket Or Other Movable Water Storage Container Cost	GEL	10	
	Fixed Cost Of Buckets And Other Movable Water Storage Containers	**GEL**	**50**	

FIXED COST OF WATER FILTER SYSTEM / ფიქსირებული ხარჯი წყლის ფილტრის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Water Filters = Number Of Water Filters * (Unit Water Filter Cost + Unit Water Filter Installation Cost)	Year Of Buying Water Filter		1990	
	Number Of Water Filters		1	
	Unit Water Filter Cost	GEL	250	
	Unit Water Filter Installation Cost	GEL	50	
	Fixed Cost Of Water Filters	**GEL**	**300**	

FIXED COST OF SEWAGE STORAGE SYSTEM / ფიქსირებული ხარჯი საკანალიზაციო ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Fixed Cost Of Sewage Storage Tanks = Sewage Storage Tank Cost + Sewage Storage Tank Installation Cost **Fixed Cost Of Sewage Storage Pipes = Sewer Pipe To Sewage Storage Tank Length * (Unit Sewer Storage Pipe Cost + Unit Sewer Storage Pipe Installation Cost)** **Fixed Cost Of Sewage Storage Pumps = Number Of Sewage Storage Pumps * Unit Sewage Storage Pump Cost** **Fixed Cost Of Sewage Storage System = Fixed Cost Of Sewage Storage Tanks + Fixed Cost Of Sewage Storage Pipes + Fixed Cost Of Sewage Storage Pumps + Sewage Storage Electrical Control System Cost**	Year Of Constructing Sewage Storage System		1995	
	Sewage Storage Tank Capacity	m^3	25	Combine all tanks if more than one
	Sewage Storage Tank Cost	GEL	5 000	Combine all tanks if more than one
	Sewage Storage Tank Installation Cost	GEL	200	Combine all tanks if more than one
	Number Of Sewage Storage Tanks		1	Actual number of tanks
	Fixed Cost Of Sewage Storage Tanks	**GEL**	**5 200**	
	Sewer Pipe To Sewage Storage Tank Length	m	20	
	Unit Sewer Storage Pipe Cost	GEL/m	35	
	Unit Sewer Storage Pipe Installation Cost	GEL/m	10	
	Fixed Cost Of Sewage Storage Pipes	**GEL**	**900**	
	Number Of Sewage Storage Pumps		1	
	Unit Sewage Storage Pump Cost	GEL	600	
	Fixed Cost Of Sewage Storage Pumps	**GEL**	**600**	
	Sewage Storage Electrical Control System Cost	GEL	50	
	Fixed Cost Of Sewage Storage System	**GEL**	**6 750**	

FIXED COST OF SEWAGE OUTFALL SYSTEM / ფიქსირებული ხარჯი საკანალიზაციო არხის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
	Year Of Constructing Sewage Outfall System		1995	
	Number Of Sewage Outfall Pumps At Outfall		1	
	Unit Sewage Outfall Pump At Outfall Cost	GEL	500	
Fixed Cost Of Sewage Outfall End Works = (Number Of Sewage Outfall Pumps At Outfall * Unit Sewage Outfall Pump At Outfall Cost) + Other Sewage Outfall Fixtures Cost	Other Sewage Outfall Fixtures Cost	GEL	1500	
	Fixed Cost Of Sewage Outfall End Works	**GEL**	**2 000**	
Fixed Cost Of Sewage Outfall Pipes = Distance To Sewage Outfall * (Unit Price Of Sewage Outfall Pipe + Unit Sewage Outfall Pipe Installation Cost)	Distance To Sewage Outfall	m	600	
	Unit Price Of Sewage Outfall Pipe	GEL/m	10	
Fixed Cost Of Sewage Outfall Pumps Adjacent To HH = Number Of Sewage Outfall Pumps Adjacent To HH * Unit Sewage Outfall Pump Adjacent To HH Cost	Unit Sewage Outfall Pipe Installation Cost	GEL/m	10	
	Fixed Cost Of Sewage Outfall Pipes	**GEL**	**12 000**	
Fixed Cost Of Sewage Outfall System = Fixed Cost Of Sewage Outfall End Works + Fixed Cost Of Sewage Outfall Pipes + Fixed Cost Of Sewage Outfall Pumps Adjacent To HH + Sewage Outfall Electrical Control System Cost	Number Of Sewage Outfall Pumps Adjacent To HH		1	
	Unit Sewage Outfall Pump Adjacent To HH Cost	GEL	600	
	Fixed Cost Of Sewage Outfall Pumps Adjacent To HH	**GEL**	**600**	
	Sewage Outfall Electrical Control System Cost	GEL	200	
	Fixed Cost Of Sewage Outfall System	**GEL**	**14 800**	

TOTAL FIXED COST OF WATER AND SEWER FACILITIES AND EQUIPMENT / ჯამური ფიქსირებული ხარჯი წყლის და საკანალიზაციო სისტემის ინფრასტრუქტურის და დანადგარების

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Total Non-Coping-Related Fixed Cost For Water And Sewer = Fixed Cost Of Municipal Water Connection + Fixed Cost Of Municipal Sewer Connection **Total Coping-Related Fixed Cost For Water = Fixed Cost Of Water Well System + Fixed Cost Of Spring Or Distant Water Source System + Fixed Cost Of Outside Water Storage System + Fixed Cost Of Water Distribution System + Fixed Cost Of Inside Water Storage System + Fixed Cost Of Buckets And Other Movable Water Storage Containers + Fixed Cost Of Water Filters** **Total Coping-Related Fixed Cost For Sewer = Fixed Cost Of Sewage Storage System + Fixed Cost Of Sewage Outfall System** **Total Fixed Cost Of Water And Sewer = Total Non-Coping-Related Fixed Cost For Water And Sewer + Total Coping-Related Fixed Cost For Water + Total Coping-Related Fixed Cost For Sewer**	Fixed Cost Of Municipal Water Connection	GEL	1 200	
	Fixed Cost Of Municipal Sewer Connection	GEL	1 400	
	Total Non-Coping-Related Fixed Cost For Water And Sewer	**GEL**	**2 600**	
	Fixed Cost Of Water Well System	GEL	5 115	
	Fixed Cost Of Spring Or Distant Water Source System	GEL	9 415	
	Fixed Cost Of Outside Water Storage System	GEL	860	
	Fixed Cost Of Water Distribution System	GEL	2 160	
	Fixed Cost Of Inside Water Storage System	GEL	125	
	Fixed Cost Of Buckets And Other Movable Water Storage Containers	GEL	50	
	Fixed Cost Of Water Filters	GEL	300	
	Total Coping-Related Fixed Cost For Water	**GEL**	**18 025**	
	Fixed Cost Of Sewage Storage System	GEL	6 750	
	Fixed Cost Of Sewage Outfall System	GEL	14 800	
	Total Coping-Related Fixed Cost For Sewer	**GEL**	**21 550**	
	Total Fixed Cost Of Water And Sewer	**GEL**	**42 175**	

ANNUALIZED SEMI-VARIABLE COST OF WATER WELL SYSTEM / წლიური ნახევრადცვლადი ხარჯი წყლის ჭის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Water Well Pumps = (Number Of Water Well Pumps * Unit Water Well Pump Replacement Or Refurbishment Cost) / Expected Time Between Well Pump Replacement Or Refurbishment **Annualized Semi-Variable Cost Of Water Well Replacement Or Refurbishment = (Number Of Water Wells * Unit Water Well Replacement Or Refurbishment Cost) / Expected Time Between Water Well Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Water Well Electrical System Replacement Or Refurbishment = Unit Water Well Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Water Well Electrical System Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Water Well System = Annualized Semi-Variable Cost Of Water Well Pumps + Annualized Semi-Variable Cost Of Water Well Replacement Or Refurbishment + Annualized Semi-Variable Cost Of Water Well Electrical System Replacement Or Refurbishment**	Expected Time Between Well Pump Replacement Or Refurbishment	yr	3	
	Number Of Water Well Pumps		3	
	Unit Water Well Pump Replacement Or Refurbishment Cost	GEL	700	
	Annualized Semi-Variable Cost Of Water Well Pumps	**GEL/yr**	**700**	
	Expected Time Between Water Well Replacement Or Refurbishment	yr	5	
	Number Of Water Wells		1	
	Unit Water Well Replacement Or Refurbishment Cost	GEL	1 000	
	Annualized Semi-Variable Cost Of Water Well Replacement Or Refurbishment	**GEL/yr**	**200**	
	Expected Time Between Water Well Electrical System Replacement Or Refurbishment	yr	4	
	Unit Water Well Electrical Control System Replacement Or Refurbishment Cost	GEL	200	
	Annualized Semi-Variable Cost Of Water Well Electrical System Replacement Or Refurbishment	**GEL/yr**	**50**	
	Annualized Semi-Variable Cost Of Water Well System	**GEL/yr**	**950**	

ANNUALIZED SEMI-VARIABLE COST OF SPRING OR DISTANT WATER SOURCE SYSTEM / წლიური ნახევრადცვლადი ხარჯი ბუნებრივი წყაროს ან სხვა მოშორებით

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Spring Or Distant Water Source Pumps = Unit Spring Or Distant Water Source Head Works Pump Replacement Or Refurbishment Cost / Expected Time Between Spring Or Distant Water Source Head Works Pump Replacement Or Refurbishment **Annualized Semi-Variable Cost Of Spring Or Distant Water Source Head Works Fixtures = Unit Head Works Fixtures Replacement Or Refurbishment Cost / Expected Time Between Head Works Fixtures Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Spring Or Distant Water Source Supply Pipe = Unit Spring Or Distant Water Source Supply Pipe Replacement Or Refurbishment Cost / Expected Time Between Spring Or Distant Water Source Supply Pipe Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Spring Or Distant Water Sourcel Electrical System Replacement Or Refurbishment = Unit Spring Or Distant Water Source Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Spring Or Distant Water Source Electrical System Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Spring Or Distant Water**	Expected Time Between Spring Or Distant Water Source Head Works Pump Replacement Or Refurbishment	yr	3	
	Unit Spring Or Distant Water Source Head Works Pump Replacement Or Refurbishment Cost	GEL	700	
	Annualized Semi-Variable Cost Of Spring Or Distant Water Source Pumps	**GEL/yr**	**233**	
	Expected Time Between Head Works Fixtures Replacement Or Refurbishment	yr	10	
	Unit Head Works Fixtures Replacement Or Refurbishment Cost	GEL	1 500	
	Annualized Semi-Variable Cost Of Spring Or Distant Water Source Head Works Fixtures	**GEL/yr**	**150**	
	Expected Time Between Spring Or Distant Water Source Supply Pipe Replacement Or Refurbishment	yr	5	
	Unit Spring Or Distant Water Source Supply Pipe Replacement Or Refurbishment Cost	GEL	1 000	
	Annualized Semi-Variable Cost Of Spring Or Distant Water Source Supply Pipe	**GEL/yr**	**200**	
	Expected Time Between Spring Or Distant Water Source Electrical System Replacement Or Refurbishment	yr	4	
	Unit Spring Or Distant Water Source Electrical Control System Replacement Or Refurbishment Cost	GEL	200	
	Annualized Semi-Variable Cost Of Spring Or Distant Water Sourcel Electrical System Replacement Or Refurbishment	**GEL/yr**	**50**	
	Annualized Semi-Variable Cost Of Spring Or Distant Water Source System	**GEL/yr**	**633**	

ANNUALIZED SEMI-VARIABLE COST OF WATER TESTING / წლიური ნახევრადცვლადი ხარჯი წყლის ტესტირების

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Water Testing = (Water Tests Per Year Of Municipal Water + Water Tests Per Year Of Water Well Water + Water Tests Per Year Of Spring Or Distant Source Water + Water Tests Per Year Of Other Alternative Water) * Unit Price Of Testing Water Paid By HHs	Water Tests Per Year Of Municipal Water		1	
	Water Tests Per Year Of Water Well Water		1	
	Water Tests Per Year Of Spring Or Distant Source Water			
	Water Tests Per Year Of Other Alternative Water			
	Unit Price Of Testing Water Paid By HHs	GEL	15	
	Annualized Semi-Variable Cost Of Water Testing	**GEL/yr**	**30**	

ANNUALIZED SEMI-VARIABLE COST OF OUTSIDE WATER STORAGE SYSTEM / წლიური ნახევრადცვლადი ხარჯი წყლის გარე ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Outside Water Storage Tanks = (Number Of Outside Water Storage Tanks * Unit Outside Water Storage Tank Replacement Or Refurbishment Cost) / Expected Time Between Outside Water Storage Tank Replacement Or Refurbishment	Expected Time Between Outside Water Storage Tank Replacement Or Refurbishment	yr	20	
	Number Of Outside Water Storage Tanks		1	
	Unit Outside Water Storage Tank Replacement Or Refurbishment Cost	GEL	5 000	
Annualized Semi-Variable Cost Of Outside Water Storage Tank Filling Pumps = (Number Of Outside Water Storage Tank Filling Pumps * Unit Outside Water Storage Tank Filling Pump Replacement Or Refurbishment Cost) / Expected Time Between Outside Water Storage Tank Filling Pump Replacement Or Refurbishment	**Annualized Semi-Variable Cost Of Outside Water Storage Tanks**	**GEL/yr**	**250**	
	Expected Time Between Outside Water Storage Tank Filling Pump Replacement Or Refurbishment	yr	2	
	Number Of Outside Water Storage Tank Filling Pumps		2	
	Unit Outside Water Storage Tank Filling Pump Replacement Or Refurbishment Cost	GEL	400	
Annualized Semi-Variable Cost Of Outside Water Storage Electrical System Replacement Or Refurbishment = Unit Outside Water Storage Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Outside Water Storage Electrical System Replacement Or Refurbishment	**Annualized Semi-Variable Cost Of Outside Water Storage Tank Filling Pumps**	**GEL/yr**	**400**	
	Expected Time Between Outside Water Storage Electrical System Replacement Or Refurbishment	yr	2	
	Unit Outside Water Storage Electrical Control System Replacement Or Refurbishment Cost	GEL	230	
Annualized Semi-Variable Cost Of Outside Water Storage System = Annualized Semi-Variable Cost Of Outside Water Storage Tanks + Annualized Semi-Variable Cost Of Outside Water Storage Tank Filling Pumps + Annualized	**Annualized Semi-Variable Cost Of Outside Water Storage Electrical System Replacement Or Refurbishment**	**GEL/yr**	**115**	
	Annualized Semi-Variable Cost Of Outside Water Storage System	**GEL/yr**	**765**	

ANNUALIZED SEMI-VARIABLE COST OF WATER DISTRIBUTION SYSTEM / წლიური ნახევრადცვლადი ხარჯი წყლის გამანაწილებელი სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Water Distribution Pump = (Number Of Water Distribution Pumps * Unit Water Distribution Pump Replacement Or Refurbishment Cost) / Expected Time Between Water Distribution Pump Replacement Or Refurbishment	Expected Time Between Water Distribution Pump Replacement Or Refurbishment	yr	2	
	Number Of Water Distribution Pumps		2	
	Unit Water Distribution Pump Replacement Or Refurbishment Cost	GEL	700	
Annualized Semi-Variable Cost Of Water Distribution Electrical System Replacement Or Refurbishment = Unit Water Distribution Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Water Distribution Electrical System Replacement Or Refurbishment	**Annualized Semi-Variable Cost Of Water Distribution Pump**	**GEL/yr**	**700**	
	Expected Time Between Water Distribution Electrical System Replacement Or Refurbishment	yr	3	
	Unit Water Distribution Electrical Control System Replacement Or Refurbishment Cost	GEL	100	
Annualized Semi-Variable Cost Of Water Distribution System = Annualized Semi-Variable Cost Of Water Distribution Pump + Annualized Semi-Variable Cost Of	**Annualized Semi-Variable Cost Of Water Distribution Electrical System Replacement Or Refurbishment**	**GEL/yr**	**33**	
	Annualized Semi-Variable Cost Of Water Distribution System	**GEL/yr**	**733**	

ANNUALIZED SEMI-VARIABLE COST OF INSIDE WATER STORAGE SYSTEM / წლიური ნახევრადცვლადი ხარჯი წყლის შიდა ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Inside Water Storage Tanks = (Number Of Inside Water Storage Tanks * Unit Inside Water Storage Tank Replacement Or Refurbishment Cost) / Expected Time Between Inside Water Storage Tank Replacement Or Refurbishment	Expected Time Between Inside Water Storage Tank Replacement Or Refurbishment	yr	5	
	Number Of Inside Water Storage Tanks		5	
	Unit Inside Water Storage Tank Replacement Or Refurbishment Cost	GEL	200	
Annualized Semi-Variable Cost Of Inside Water Storage Pumps = (Number Of Inside Storage Water Pumps * Unit Inside Water Storage Pump Replacement Or Refurbishment Cost) / Expected Time Between Inside Water Storage Pump Replacement Or Refurbishment	**Annualized Semi-Variable Cost Of Inside Water Storage Tanks**	**GEL/yr**	**200**	
	Expected Time Between Inside Water Storage Pump Replacement Or Refurbishment	yr	3	
	Number Of Inside Storage Water Pumps		1	
Annualized Semi-Variable Cost Of Inside Water Storage Electrical System Replacement Or Refurbishment = Unit Inside Water Storage Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Inside Water Storage Electrical System Replacement Or Refurbishment	Unit Inside Water Storage Pump Replacement Or Refurbishment Cost	GEL	100	
	Annualized Semi-Variable Cost Of Inside Water Storage Pumps	**GEL/yr**	**33**	
	Expected Time Between Inside Water Storage Electrical System Replacement Or Refurbishment	yr	4	
	Unit Inside Water Storage Electrical Control System Replacement Or Refurbishment Cost	GEL	50	
Annualized Semi-Variable Cost Of Inside Water Storage System = Annualized Semi-Variable Cost Of Inside Water Storage Tanks + Annualized Semi-Variable Cost Of Inside Water Storage Pumps + Annualized Semi-Variable Cost Of Inside Water Storage Electrical System Replacement Or Refurbishment	**Annualized Semi-Variable Cost Of Inside Water Storage Electrical System Replacement Or Refurbishment**	**GEL/yr**	**13**	
	Annualized Semi-Variable Cost Of Inside Water Storage System	**GEL/yr**	**246**	

ANNUALIZED SEMI-VARIABLE COST OF BUCKETS AND OTHER MOVEABLE WATER STORAGE CONTAINERS / წლიური ნახევრადცვლადი ხარჯი ვედროების და

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Buckets And Other Moveable Water Storage Containers = (Number Of Buckets Or Other Moveable Water Storage Containers * Unit Bucket Or Other Moveable Water Storage Container Replacement Or Refurbishment Cost) / Expected Time Between Bucket Or Other Moveable Water Storage Container Replacement Or Refurbishment	Expected Time Between Bucket Or Other Moveable Water Storage Container Replacement Or Refurbishment	yr	3	
	Number Of Buckets Or Other Moveable Water Storage Containers		5	
	Unit Bucket Or Other Moveable Water Storage Container Replacement Or Refurbishment Cost	GEL	25	
	Annualized Semi-Variable Cost Of Buckets And Other Moveable Water Storage Containers	**GEL/yr**	**42**	

ANNUALIZED SEMI-VARIABLE COST OF WATER FILTER SYSTEM / წლიური ნახევრადცვლადი ხარჯი წყლის ფილტრის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Water Filters = (Number Of Water Filters * Unit Water Filter Replacement Or Refurbishment Cost) / Expected Time Between Water Filter Replacement Or Refurbishment	Expected Time Between Water Filter Replacement Or Refurbishment	yr	5	
	Number Of Water Filters		1	
	Unit Water Filter Replacement Or Refurbishment Cost	GEL	250	
	Annualized Semi-Variable Cost Of Water Filters	**GEL/yr**	**50**	

ANNUALIZED SEMI-VARIABLE COST OF SEWAGE STORAGE SYSTEM / წლიური ნახევრადცვლადი ხარჯი საკანალიზაციო ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Sewage Storage System Tanks = (Number Of Sewage Storage Tanks * Unit Sewage Storage Tank Replacement Or Refurbishment Cost) / Expected Time Between Sewage Storage Tank Replacement Or Refurbishment	Expected Time Between Sewage Storage Tank Replacement Or Refurbishment	yr	15	
	Number Of Sewage Storage Tanks		1	
	Unit Sewage Storage Tank Replacement Or Refurbishment Cost	GEL	5 000	
	Annualized Semi-Variable Cost Of Sewage Storage System Tanks	**GEL/yr**	**333**	
Annualized Semi-Variable Cost Of Sewage Storage Pipes = (Sewage Storage Pipe Length * Unit Sewage Storage Pipe Replacement Or Refurbishment Cost) / Expected Time Between Sewage Storage Pipe Replacement Or Refurbishment	Expected Time Between Sewage Storage Pipe Replacement Or Refurbishment	yr	15	
	Sewage Storage Pipe Length	m	20	
	Unit Sewage Storage Pipe Replacement Or Refurbishment Cost	GEL/m	100	
	Annualized Semi-Variable Cost Of Sewage Storage Pipes	**GEL/yr**	**133**	
Annualized Semi-Variable Cost Of Sewage Storage Pumps = (Number Of Sewage Storage Pumps * Unit Sewage Storage Pump Replacement Or Refurbishment Cost) / Expected Time Between Sewage Storage Pump Replacement Or Refurbishment	Expected Time Between Sewage Storage Pump Replacement Or Refurbishment	yr	5	
	Number Of Sewage Storage Pumps		1	
	Unit Sewage Storage Pump Replacement Or Refurbishment Cost	GEL	300	
	Annualized Semi-Variable Cost Of Sewage Storage Pumps	**GEL/yr**	**60**	
Annualized Semi-Variable Cost Of Sewage Storage Electrical System Replacement Or Refurbishment = Unit Sewage Storage Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Sewage Storage Electrical System Replacement Or Refurbishment	Expected Time Between Sewage Storage Electrical System Replacement Or Refurbishment	yr	10	
	Unit Sewage Storage Electrical Control System Replacement Or Refurbishment Cost	GEL	1 000	
	Annualized Semi-Variable Cost Of Sewage Storage Electrical System Replacement Or Refurbishment	**GEL/yr**	**100**	
Annualized Semi-Variable Cost Of Sewage Storage System = Annualized Semi-Variable Cost Of Sewage Storage System Tanks + Annualized Semi-Variable Cost Of	**Annualized Semi-Variable Cost Of Sewage Storage System**	**GEL/yr**	**627**	

ANNUALIZED SEMI-VARIABLE COST OF SEWAGE OUTFALL SYSTEM / წლიური ნახევრადცვლადი ხარჯი საკანალიზაციო არხის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Annualized Semi-Variable Cost Of Sewage Outfall End Works Pumps And Fixtures = Unit Sewage Outfall End Works Pump Replacement Or Refurbishment Cost / Expected Time Between Sewage Outfall End Works Pump Replacement Or Refurbishment **Annualized Semi-Variable Cost Of Sewage Outfall Pipes = (Distance To Sewage Outfall * Unit Sewage Outfall Pipe Replacement Or Refurbishment Cost) / Expected Time Between Sewage Outfall Pipe Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Sewage Outfall Pumps Adjacent To HH = (Number Of Sewage Outfall Pumps Adjacent To HH * Unit Sewage Outfall Pump Adjacent To HH Replacement Or Refurbishment Cost) / Expected Time Between Sewage Outfall Pump Adjacent To HH Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Sewage Outfall Electrical System Replacement Or Refurbishment = Unit Sewage Outfall Electrical Control System Replacement Or Refurbishment Cost / Expected Time Between Sewage Outfall Electrical System Replacement Or Refurbishment** **Annualized Semi-Variable Cost Of Sewage Outfall System = Annualized Semi-Variable Cost Of Sewage Outfall End W**	Expected Time Between Sewage Outfall End Works Pump Replacement Or Refurbishment	yr	5	
	Unit Sewage Outfall End Works Pump Replacement Or Refurbishment Cost	GEL	500	
	Expected Time Between Other Sewage Outfall Fixtures Replacement Or Refurbishment			
	Unit Other Sewage Outfall Fixtures Replacement Or Refurbishment Cost			
	Annualized Semi-Variable Cost Of Sewage Outfall End Works Pumps And Fixtures	**GEL/yr**	**100**	
	Expected Time Between Sewage Outfall Pipe Replacement Or Refurbishment	yr	15	
	Distance To Sewage Outfall	m	600	
	Unit Sewage Outfall Pipe Replacement Or Refurbishment Cost	GEL/m	50	
	Annualized Semi-Variable Cost Of Sewage Outfall Pipes	**GEL/yr**	**2 000**	
	Expected Time Between Sewage Outfall Pump Adjacent To HH Replacement Or Refurbishment	yr	5	
	Number Of Sewage Outfall Pumps Adjacent To HH		1	
	Unit Sewage Outfall Pump Adjacent To HH Replacement Or Refurbishment Cost	GEL	500	
	Annualized Semi-Variable Cost Of Sewage Outfall Pumps Adjacent To HH	**GEL/yr**	**100**	
	Expected Time Between Sewage Outfall Electrical System Replacement Or Refurbishment	yr	2	
	Unit Sewage Outfall Electrical Control System Replacement Or Refurbishment Cost	GEL	350	
	Annualized Semi-Variable Cost Of Sewage Outfall Electrical System Replacement Or Refurbishment	**GEL/yr**	**175**	
	Annualized Semi-Variable Cost Of Sewage Outfall System	**GEL/yr**	**2 375**	

TOTAL ANNUALIZED SEMI-VARIABLE COST OF WATER AND SEWER SERVICES / ჯამური წლიური ნახევრადცვლადი ხარჯი წყალმომარაგების და საკანალიზაციო

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
Total Annualized Semi-Variable Cost Of Water = Annualized Semi-Variable Cost Of Water Well System + ... Spring Or Distant Water Source System + … Outside Water Storage System + ... Water Distribution System + ...Inside Water Storage System + ...Buckets And Other Moveable Water Storage Containers + … Water Filter System + … Water Testing **Total Annualized Semi-Variable Cost Of Sewer = Annualized Semi-Variable Cost Of Sewage Storage System + Annualized Semi-Variable Cost Of Sewage Outfall System** **Total Annualized Semi-Variable Cost Of Water And Sewer = Total Annualized Semi-Variable Cost Of Water + Total Annualized Semi-Variable Cost Of Sewer**	Annualized Semi-Variable Cost Of Water Well System	GEL/yr	950	
	... Spring Or Distant Water Source System	GEL/yr	633	
	… Outside Water Storage System	GEL/yr	765	
	... Water Distribution System	GEL/yr	733	
	...Inside Water Storage System	GEL/yr	246	
	...Buckets And Other Moveable Water Storage Containers	GEL/yr	42	
	… Water Filter System	GEL/yr	50	
	… Water Testing	GEL/yr	30	
	Total Annualized Semi-Variable Cost Of Water	**GEL/yr**	**3 449**	
	Annualized Semi-Variable Cost Of Sewage Storage System	GEL/yr	627	
	Annualized Semi-Variable Cost Of Sewage Outfall System	GEL/yr	2 375	
	Total Annualized Semi-Variable Cost Of Sewer	**GEL/yr**	**3 002**	
	Total Annualized Semi-Variable Cost Of Water And Sewer	**GEL/yr**	**6 451**	

POWER RATING OF PUMPS AND NET UNIT ELECTRICITY COST / ტუმბოების სიმძლავრე და ელექტროენერგიის ფასი

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
	Power Rating Of Wate Well Pumps	kW	10	
	Load Factor Or Water Well Pumps (% of power rating)		80%	
	Power Rating Of Outside Water Storage Tank Filling Pumps	kW	20	
	Load Factor Of Outside Water Storage Tank Filling Pumps (% of power rating)		80%	
	Power Rating Of Water Distribution Pumps	kW	12	
	Load Factor Of Water Distribution Pumps (% of power rating)		80%	
	Power Rating Of Inside Water Storage Pumps	kW	12	
	Load Factor Of Inside Water Storage Pumps		80%	
	Power Rating Of Sewage Storage Pumps	kW	8	
	Load Factor Of Sewage Storage Pumps (% of power rating)		80%	
	Power Rating Of Sewage Outfall End Works Pumps	kW	40	
	Load Factor Of Sewage Outfall End Works Pumps (% of power rating)		80%	
	Power Rating Of Sewage Outfall Pumps Adjacent To HH	kW	30	
	Load Factor Of Sewage Outfall Pumps Adjacent To HH (% of power rating)		80%	

ANNUAL WATER AND SEWER BILLS / წყლამომარაგების და სკანალიზაციო მომსახურების წლიური გადასახადი

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT კომენტარი
	Annual Municipal Water Bill	GEL	110	Should collect monthly data. See links to other cells where actual monthly data could be used instead of estimates of seasonal amounts.
	Perceived Additional Amount That Is Spent On Water-Related Coping	GEL	190	Estimate of all costs incurred because there is not municipal water 24/7. This is compared to the calculated amount to see accuracy of estimate.
	Annual Municipal Sewer Bill	GEL	120	Should collect monthly data. See links to other cells where actual monthly data could be used instead of estimates of seasonal amounts.
	Perceived Additional Amount That Is Spent On Sewage-Related Coping	GEL	100	Estimate of all costs incurred because there is not a suitable municipal sewer system. This is compared to the calculated amount to see accuracy of estimate.

ANNUAL VARIABLE COST OF WATER WELL SYSTEM / წლიური ცვლადი ხარჯი წყლის ჭის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა				COMMENT კომენტარი
			SEASON სეზონი			ANNUAL TOTAL წლიური ჯამი	
			HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი		
Annual Water Well Pump Operating Hours = Length Of Season * Number Of Water Well Pumps Used * Number Of Days In A Week Water Well Pumps Operate * Number Of Hours In A Day Wate Well Pumps Operate **Annual Variable Cost Of Water Well System = Annual Water Well Pump Operating Hours * Effective Power Draw Of Each Water Well Pump * Unit Electricity Cost**	Length Of Season	wks/yr	4,3	4,3	43,4	**n.a.**	
	Number Of Water Well Pumps Used		2	1	1	**n.a.**	
	Number Of Days In A Week Water Well Pumps Operate	days/wk	7	5	4	**n.a.**	
	Number Of Hours In A Day Wate Well Pumps Operate	hr/day	5	2	1	**n.a.**	
	Annual Water Well Pump Operating Hours	**hr/year**	**301**	**43**	**174**	**518**	
	Effective Power Draw Of Each Water Well Pump	kW	8	8	8	**n.a.**	
	Annual Variable Cost Of Water Well System	**GEL/yr**	**231**	**33**	**133**	**398**	

ANNUAL VARIABLE COST OF SPRING OR DISTANT WATER SOURCE SYSTEM / წლიური ცვლადი ხარჯი ბუნებრივი წყაროს ან სხვა მოშორებით მდებარე წყაროს

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა				COMMENT კომენტარი
			SEASON სეზონი			ANNUAL TOTAL წლიური ჯამი	
			HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი		
Annual Spring Or Distant Water Source Pump Operating Hours = Length Of Season * Number Of Spring Or Distant Water Source Pumps Used * Number Of Days In A Week Spring Or Distant Water Source Pumps Operate * Number Of Hours In A Day Spring Or Distant Water Source Pumps Operate **Annual Variable Cost Of Spring Or Distant Water Source System = Annual Spring Or Distant Water Source Pump Operating Hours * Effective Power Draw Of Each Spring Or Distant Water Source Pump * Unit Electricity Cost**	Length Of Season	wks/yr	4,3	4,3	43,4	**n.a.**	
	Number Of Spring Or Distant Water Source Pumps Used		2	1	1	**n.a.**	
	Number Of Days In A Week Spring Or Distant Water Source Pumps Operate	days/wk	7	5	4	**n.a.**	
	Number Of Hours In A Day Spring Or Distant Water Source Pumps Operate	hr/day	5	2	1	**n.a.**	
	Annual Spring Or Distant Water Source Pump Operating Hours	**hr/year**	**301**	**43**	**174**	**518**	
	Effective Power Draw Of Each Spring Or Distant Water Source Pump	kW	8	8	8	**n.a.**	
	Annual Variable Cost Of Spring Or Distant Water Source System	**GEL/yr**	**231**	**33**	**133**	**398**	

ANNUAL VARIABLE COST OF OUTSIDE WATER STORAGE SYSTEM / წლიური ცვლადი ხარჯი წყლის გარე ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა — SEASON სეზონი — HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual Outside Water Storage Tank Filling Pump Operating Hours = Length Of Season * Number Of Outside Tank Filling Pumps Used * Number Of Days In A Week Outside Tank Filling Pumps Operate * Number Of Hours In A Day Outside Tank Filling Pumps Operate **Annual Variable Cost Of Outside Water Storage System = Effective Power Draw Of Each Outside Water Storage Tank Filling Pump * Annual Outside Water Storage Tank Filling Pump Operating Hours * Unit Electricity Cost**	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Outside Tank Filling Pumps Used		1	1	1	**n.a.**	
	Number Of Days In A Week Outside Tank Filling Pumps Operate	days	7	5	1	**n.a.**	
	Number Of Hours In A Day Outside Tank Filling Pumps Operate	hr/day	6	7	3	**n.a.**	
	Annual Outside Water Storage Tank Filling Pump Operating Hours	hr/yr	**181**	**151**	**130**	**461**	
	Effective Power Draw Of Each Outside Water Storage Tank Filling Pump	kW	16	16	16	**n.a.**	
	Annual Variable Cost Of Outside Water Storage System	**GEL/yr**	**277**	**231**	**200**	**709**	

ANNUAL VARIABLE COST OF WATER DISTRIBUTION SYSTEM AND WATER SYSTEMS MANAGEMENT EMPLOYEES / წლიური ცვლადი ხარჯი წყლის გამანაწილებელი

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა — SEASON სეზონი — HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual Water Distribution Pump Operating Hours = Length Of Season * Number Of Water Distribution Pumps Used * Number Of Days In A Week Water Distribution Pumps Operate * Number Of Hours In A Day Water Distribution Pumps Operate **Annual Variable Cost Of Water Distribution Pumps = Annual Water Distribution Pump Operating Hours * Effective Power Draw Of Each Water Distribution Pump * Unit Electricity Cost** **Annual Variable Cost Of All Water Systems Management Employees = Length Of Season * 12 / 52 * Number Of Employees Devoted To All Water Systems * Monthly Gross Salary For One Employee** **Annual Variable Cost Of Water Distribution System = Annual Variable Cost Of Water Distribution Pumps + Annual Variable Cost Of All Water Systems Management Employees**	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Water Distribution Pumps Used		1	1	1	**n.a.**	
	Number Of Days In A Week Water Distribution Pumps Operate	days	7	5	1	**n.a.**	
	Number Of Hours In A Day Water Distribution Pumps Operate	hr/day	5	3	2	**n.a.**	
	Annual Water Distribution Pump Operating Hours	**GEL/yr**	**151**	**65**	**87**	**302**	
	Effective Power Draw Of Each Water Distribution Pump	kW	10	10	10	**n.a.**	
	Annual Variable Cost Of Water Distribution Pumps	**GEL/yr**	**139**	**59**	**80**	**278**	
	Number Of Employees Devoted To ***All*** Water Systems		1	1	1	**n.a.**	
	Monthly Gross Salary For One Employee	GEL/mo	100	100	100	**n.a.**	
	Annual Variable Cost Of *All* Water Systems Management Employees	**GEL**	**99**	**99**	**1 002**	**1 200**	
	Annual Variable Cost Of Water Distribution System	**GEL**	**238**	**159**	**1 082**	**1 478**	

ANNUAL VARIABLE COST OF INSIDE WATER STORAGE SYSTEM / წლიური ცვლადი ხარჯი წყლის შიდა ავზის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual Inside Water Storage Pump Operating Hours = Length Of Season * Number Of Inside Water Storage Pumps Used * Number Of Days In A Week Inside Water Storage Pumps Operate * Number Of Hours In A Day Inside Water Storage Pumps Operate **Annual Variable Cost Of Inside Water Storage System = Annual Inside Water Storage Pump Operating Hours * Effective Power Draw Of Each Inside Water Storage Pump * Unit Electricity Cost**	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Inside Water Storage Pumps Used		1	1	1	**n.a.**	
	Number Of Days In A Week Inside Water Storage Pumps Operate	days	7	5	1	**n.a.**	
	Number Of Hours In A Day Inside Water Storage Pumps Operate	hr/day	6	7	3	**n.a.**	
	Annual Inside Water Storage Pump Operating Hours	hr/yr	**181**	**151**	**130**	**461**	
	Effective Power Draw Of Each Inside Water Storage Pump	kW	10	10	10	**n.a.**	
	Annual Variable Cost Of Inside Water Storage System	**GEL/yr**	**166**	**139**	**120**	**425**	

ANNUAL VARIABLE COST OF TANKER TRUCK WATER / წლიური ცვლადი ხარჯი წყლის ცისტერნიანი მზიდის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Volume Of Tanker Truck Water Purchased = Length Of Season * Frequency Of Water Purchase From Tanker Truck * Amount Of Water Purchased Per Tanker Truck Order **Annual Variable Cost Of Tanker Truck Water = Volume Of Tanker Truck Water Purchased * Delivered Price Of Tanker Truck Water**	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Frequency Of Water Purchase From Tanker Truck	trucks/wk	2	1	0	**3**	
	Amount Of Water Purchased Per Tanker Truck Order	m^3/truck	2	2	2	**n.a.**	
	Volume Of Tanker Truck Water Purchased	**m3/yr**	**17**	**9**	**0**	**26**	
	Delivered Price Of Tanker Truck Water	GEL/m^3	10,00	10,00	20,00	**n.a.**	
	Annual Variable Cost Of Tanker Truck Water	**GEL/yr**	**172**	**86**	**0**	**258**	

ANNUAL VARIABLE COST OF BOTTLED WATER (DUE TO COPING) / წლიური ცვლადი ხარჯი ბოთლში ჩამოსხმული წყლის (გასამკლავებელი)

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Volume Of Coping Related Bottled Water = Length Of Season * Number Of Bottles Of Water Purchased Per Week * Volume Of Bottle * Percentage Of Bottled Water That Would Not Be Purchased If There Was Good Water 24/7 (percentage purchased because water is not good 24/7) / 1000 **Annual Variable Cost Of Coping Related Bottled Water = ((Volume Of Coping Related Bottled Water * 1000) / Volume Of Bottle) * Unit Price Of Bottled Water**	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Bottles Of Water Purchased Per Week	btl/wk	20	10	8	**38**	
	Volume Of Bottle	liter/btl	1,5	1,5	1,5	**n.a.**	
	Percentage Of Bottled Water That Would ***Not*** Be Purchased If There Was Good Water 24/7 (percentage purchased because water is not good 24/7)		70%	50%	50%	**61%**	
	Volume Of Coping Related Bottled Water	**m^3/yr**	**0,09**	**0,03**	**0,26**	**0,38**	
	Unit Price Of Bottled Water	GEL/btl	1,00	1,00	1,00	**n.a.**	
	Annual Variable Cost Of Coping Related Bottled Water	**GEL/yr**	**60**	**22**	**174**	**255**	

ANNUAL VARIABLE COST OF MANUALLY COLLECTED WATER FROM SPRING OR OTHER WATER SOURCE / წლიური ცვლადი ხარჯი ბუნებრივი წყაროდან ან სხვა

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Volume Of Manually Collected Water From Spring Or Other Water Source = Length Of Season * Number Of Visits To Spring Or Other Water Source Per Week * Volume Of Water Manually Brought To HH Per Visit / 1000 **Annual Variable Cost Of Manually Collected Water From Spring Or Other Water Source = Length Of Season * Number Of Visits To Spring Or Other Water Source Per Week * Roundtrip Distance By Vehicle To Spring Or Other Water Source * Fuel Cost**	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Visits To Spring Or Other Water Source Per Week	visits/wk	3	2	1	**6**	
	Volume Of Water Manually Brought To HH Per Visit	liters/visit	50	50	50	**n.a.**	
	Volume Of Manually Collected Water From Spring Or Other Water Source	**m^3/yr**	**0,65**	**0,43**	**2,17**	**3,25**	
	Roundtrip Distance By Vehicle To Spring Or Other Water Source	km	14	14	14	**n.a.**	
	Fuel Cost	GEL/km	0,20	0,20	0,20	**n.a.**	
	Annual Variable Cost Of Manually Collected Water From Spring Or Other Water Source	**GEL/yr**	**36,12**	**24,08**	**121,52**	**181,72**	

ANNUAL QUANTITY OF WATER FROM MUNICIPAL AND OTHER WATER SOURCES / წლიური რაოდენობა მუნიციპალური და ალტერნატიული წყაროებიდან წყლის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual Quantity Of Municipal Water = ((Annual Municipal Water Bill / Tariff Price Of Municipal Water)) * Estimated Share Of Water Usage By Season	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Estimated Share Of Municipal Water In Total Water Consumption		80%	80%	100%	**83%**	
Implicit Annual Quantity Of Water From Other Sources = (Annual Quantity Of Municipal Water / Estimated Share Of Municipal Water In Total Water Consumption) - Annual Quantity Of Municipal Water	Estimated Share Of Water Usage By Season		55%	30%	15%	**100%**	
	Tariff Price Of Municipal Water	GEL/m^3	1,7000	1,7000	1,7000	**n.a.**	
	Annual Quantity Of Municipal Water	**m^3/yr**	**35,59**	**19,41**	**9,71**	**64,71**	
Implicit Annual Quantity Of Water From Municipal And Other Sources = Annual Quantity Of Municipal Water + Implicit Annual Quantity Of Water From Other Sources	**Implicit Annual Quantity Of Water From Other Sources**	**m^3/yr**	**8,90**	**4,85**	**0,00**	**13,75**	
	Implicit Annual Quantity Of Water From Municipal And Other Sources	**m^3/yr**	**44,49**	**24,26**	**9,71**	**78,46**	

ANNUAL IMPLICIT MARKET VALUE OF WATER FROM MUNICIPAL AND OTHER WATER SOURCES / წლიური სავარაუდო საბაზრო ფასი მუნიციპალური და

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual Variable Cost Of Municipal Water = Annual Quantity Of Municipal Water * Tariff Price Of Municipal Water	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Annual Variable Cost Of Municipal Water	**GEL/yr**	**60,50**	**33,00**	**16,50**	**110,00**	
Implicit Annual Variable Market Value Of Water From Other Sources = Implicit Annual Quantity Of Water From Other Sources * Tariff Price Of Municipal Water	**Implicit Annual Variable Market Value Of Water From Other Sources**	**GEL/yr**	**15,13**	**8,25**	**0,00**	**23,38**	
Implicit Annual Variable Market Value Of Water From Municipal And Other Sources = Annual Variable Cost Of	**Implicit Annual Variable Market Value Of Water From Municipal And Other Sources**	**GEL/yr**	**75,63**	**41,25**	**16,50**	**133,38**	

ANNUAL VARIABLE COST OF SEWAGE STORAGE SYSTEM AND SEWAGE SYSTEMS MANAGEMENT EMPLOYEES / წლიური ცვლადი ხარჯი საკანალიზაციო ავზის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE: SEASON: HIGH	VALUE: SEASON: SHOULDER	VALUE: SEASON: LOW	VALUE: ANNUAL TOTAL	COMMENT კომენტარი
Annual Sewage Storage Pump Operating Hours = Length Of Season * Number Of Sewage Storage Pumps Used * Number Of Days In A Week Sewage Storage Pumps Operate * Number Of Hours In A Day Sewage Storage Pumps Operate	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Sewage Storage Pumps Used		1	1	1	**n.a.**	
	Number Of Days In A Week Sewage Storage Pumps Operate	days/wk	7	4	3	**n.a.**	
	Number Of Hours In A Day Sewage Storage Pumps Operate	hr/day	5	3	2	**n.a.**	
Annual Variable Cost Of Sewage Storage Pumps = Annual Sewage Storage Pump Operating Hours * Effective Power Draw Of Each Sewage Storage Pump * Unit Electricity Cost	**Annual Sewage Storage Pump Operating Hours**	**hr/yr**	**151**	**52**	**260**	**463**	
	Effective Power Draw Of Each Sewage Storage Pump	kW	6	6	6	**n.a.**	
Annual Variable Cost Of Sewer Systems Management Employees = Length Of Season * 12 / 52 * Number Of Employees Devoted To Sewer Systems * Monthly Gross Salary For One Employee	**Annual Variable Cost Of Sewage Storage Pumps**	**GEL/yr**	**92**	**32**	**160**	**284**	
	Number Of Employees Devoted To Sewer Systems		1	1	1	**n.a.**	
	Monthly Gross Salary For One Employee	GEL/mo	100	100	100	**n.a.**	
Annual Variable Cost Of Sewage Storage System = Annual Variable Cost Of Sewage Storage Pumps + Annual Variable Cost Of Sewer Systems Management Employees	**Annual Variable Cost Of Sewer Systems Management Employees**	**GEL**	**99**	**99**	**1 002**	**1 200**	
	Annual Variable Cost Of Sewage Storage System	**GEL/yr**	**192**	**131**	**1 162**	**1 484**	

ANNUAL VARIABLE COST OF SEWAGE OUTFALL SYSTEM / წლიური ცვლადი ხარჯი საკანალიზაციო არხის სისტემის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Sewage Outfall End Works Pumps Used		1	1	1	**n.a.**	
Annual Sewage Outfall End Works Pumps Operating Hours = Length Of Season * Number Of Sewage Outfall End Works Pumps Used * Number Of Days In A Week Sewage Outfall End Works Pumps Operate * Number Of Hours In A Day Sewage Outfall End Works Pumps Operate	Number Of Days In A Week Sewage Outfall End Works Pumps Operate	days	3	4	5	**n.a.**	
	Number Of Hours In A Day Sewage Outfall End Works Pumps Operate	hr/day	6	4	3	**n.a.**	
	Annual Sewage Outfall End Works Pumps Operating Hours	**hr/yr**	**77**	**69**	**651**	**797**	
Annual Variable Cost Of Sewage Outfall End Works Pumps = Annual Sewage Outfall End Works Pumps Operating Hours * Effective Power Draw Of Sewage Outfall End Works Pump * Unit Electricity Cost	Effective Power Draw Of Sewage Outfall End Works Pump	kW	32	32	32	**n.a.**	
	Annual Variable Cost Of Sewage Outfall End Works Pumps	**GEL/yr**	**238**	**211**	**2 000**	**2 449**	
Annual Sewage Outfall Pumps Adjacent To HH Operating Hours = Length Of Season * Number Of Sewage Outfall Pumps Adjacent To HH Used * Number Of Days In A Week Sewage Outfall Pumps Adjacent To HH Operate * Number Of Hours In A Day Sewage Outfall Pumps Adjacent To HH Operate	Number Of Sewage Outfall Pumps Adjacent To HH Used		1	1	1	**n.a.**	
	Number Of Days In A Week Sewage Outfall Pumps Adjacent To HH Operate	days	7	4	3	**n.a.**	
	Number Of Hours In A Day Sewage Outfall Pumps Adjacent To HH Operate	hr/day	6	4	3	**n.a.**	
Annual Variable Cost Of Sewage Outfall Pump Adjacent To HH = Annual Sewage Outfall Pumps Adjacent To HH Operating Hours * Effective Power Draw Of Sewage Outfall Pumps Adjacent To HH * Unit Electricity Cost	**Annual Sewage Outfall Pumps Adjacent To HH Operating Hours**	**hr/yr**	**181**	**69**	**391**	**640**	
Annual Variable Cost Of Sewage Outfall System = Annual Variable Cost Of Sewage Outfall End Works Pumps + Annual Variable Cost Of Sewage Outfall Pump Adjacent To	Effective Power Draw Of Sewage Outfall Pumps Adjacent To HH	kW	24	24	24	**n.a.**	
	Annual Variable Cost Of Sewage Outfall Pump Adjacent To HH	**GEL/yr**	**416**	**159**	**900**	**1 475**	
	Annual Variable Cost Of Sewage Outfall System	**GEL/yr**	**654**	**370**	**2 900**	**3 924**	

ANNUAL VARIABLE COST OF SEWAGE TANKER TRUCK SERVICE / წლიური ცვლადი ხარჯი ფეკალური მასის ცისტერნიანი მზიდის მომსახურები

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Annual Variable Cost Of Sewage Tanker Truck Service = Number Of Sewage Tanker Truck Orders In Season * Sewage Tanker Truck Service Cost	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Number Of Sewage Tanker Truck Orders In Season	trucks	4	1	1	**6**	
	Sewage Tanker Truck Service Cost	GEL/truck	100	100	100	**n.a.**	
	Annual Variable Cost Of Sewage Tanker Truck Service	**GEL/yr**	**400**	**100**	**100**	**600**	

PRO FORMA CALCULATION OF ANNUAL BUSINESS VARIABLE COST OF MUNICIPAL SEWER / ოჯახის წლიური ცვლადი ხარჯის პრო ფორმა გამოთვლა

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა SEASON სეზონი HIGH მაღალი	SHOULDER საშუალო	LOW დაბალი	ANNUAL TOTAL წლიური ჯამი	COMMENT კომენტარი
Use One Of Four Methods Of Calculating Annual Variable Cost Of Municipal Sewer	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
Method One: Based On Single Connection = Length Of Season * 12 / 52 * Municipal Sewage Discharge Tariff Based On Single Connection	Water Consumption From Municipal System Connection	m^3	35,6	19,4	9,7	**64,7**	
Method Two: Based On Municipal Water Usage = Water Consumption From Municipal System Connection * Municipal Sewage Discharge Tariff Based On Municipal Water Usage	Water Consumption From Alternative Sources	m^3	8,9	4,9	0,0	**13,8**	
Method Three: Based On Separate Municipal And Other Source Water Usage = Water Consumption From Municipal System Connection * Municipal Sewage Discharge Tariff Based On Municipal Water Usage + Water Consumption From Alternative Sources * Municipal Sewage Discharge Tariff Based On Alternative Source Water Usage	Water Consumption From All Sources	m^3	44,5	24,3	9,7	**78,5**	
Method Four: Based On Combined Municipal And Other Source Water Usage = Water Consumption From Alternative Sources * Municipal Sewage Discharge Tariff Based On Combined Municipal And Other Source Water Usage	Municipal Sewage Discharge Tariff Based On Single Connection	GEL/connection-mo	11,50	11,50	11,50	**n.a.**	
	Method One: Based On Single Connection	**GEL/yr**	**297,69**	**297,69**	**3 004,62**	**3 600,00**	
	Municipal Sewage Discharge Tariff Based On Municipal Water Usage	GEL/m^3	2,10	2,10	2,10	**n.a.**	
	Method Two: Based On Municipal Water Usage	**GEL/yr**	**74,74**	**40,76**	**20,38**	**135,88**	
	Municipal Sewage Discharge Tariff Based On Municipal Water Usage	GEL/m^3	2,10	2,10	2,10	**n.a.**	
	Municipal Sewage Discharge Tariff Based On Alternative Source Water Usage	GEL/m^3	2,30	2,30	2,30	**n.a.**	
	Method Three: Based On Separate Municipal And Other Source Water Usage	**GEL/yr**	**95,20**	**51,93**	**20,38**	**167,51**	
	Municipal Sewage Discharge Tariff Based On Combined Municipal And Other Source Water Usage	GEL/m^3	2,20	2,20	2,20	**n.a.**	
	Method Four: Based On Combined Municipal And Other Source Water Usage	**GEL/yr**	**19,57**	**10,68**	**0,00**	**30,25**	
	Method Used		2	2	2	**n.a.**	
	Pro Forma Annual Variable Cost Of Municipal Sewer Service	**GEL/yr**	**74,74**	**40,76**	**20,38**	**135,88**	

TOTAL ANNUAL BUSINESS VARIABLE COST OF WATER AND SEWER SERVICES / ჯამური ოჯახის წლიური ცვლადი ხარჯი წყალმომარაგების და საკანალიზაციო

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE				COMMENT
			SEASON			ANNUAL	
			HIGH	SHOULDER	LOW	TOTAL	კომენტარი
Total Annual Variable Coping Cost Of Water = Annual Variable Cost Of Water Well System + … Spring Or Distant Water Source System + … Outside Water Storage System + … Water Distribution System + … Inside Water Storage System + … Tanker Truck Water + … Coping Related Bottled Water + … Manually Collected Water From Spring Or Other Water Source **Total Annual Variable Cost Of Water = Total Annual Variable Coping Cost Of Water + Annual Variable Cost Of Municipal Water** **Total Annual Variable Coping Cost Of Sewer = Annual Variable Cost Of Sewage Storage System + … Sewer Outfall System + … Sewage Tanker Truck** **Total Annual Variable Cost Of Sewer = Total Annual Variable Coping Cost Of Sewer + Annual Variable Cost Of Sewage Service** **Total Annual Variable Cost Of Water And Sewer = Total Annual Variable Cost Of Water + Total Annual Variable Cost Of Sewer**	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Annual Variable Cost Of Water Well System	GEL/yr	231	33	133	**398**	
	… Spring Or Distant Water Source System	GEL/yr	231	33	133	**398**	
	… Outside Water Storage System	GEL/yr	277	231	200	**709**	
	… Water Distribution System	GEL	238	159	1 082	**1 478**	
	… Inside Water Storage System	GEL/yr	166	139	120	**425**	
	… Tanker Truck Water	GEL/yr	172	86	0	**258**	
	… Coping Related Bottled Water	GEL/yr	60	22	174	**255**	
	… Manually Collected Water From Spring Or Other Water Source	GEL/yr	36	24	122	**182**	
	Total Annual Variable Coping Cost Of Water	**GEL/yr**	**1 412**	**726**	**1 963**	**4 102**	
	Annual Variable Cost Of Municipal Water	GEL	61	33	17	**110**	
	Total Annual Variable Cost Of Water	**GEL/yr**	**1 473**	**759**	**1 980**	**4 212**	
	Annual Variable Cost Of Sewage Storage System	GEL/yr	192	131	1 162	**1 484**	
	… Sewer Outfall System	GEL/yr	654	370	2 900	**3 924**	
	… Sewage Tanker Truck	GEL/yr	400	100	100	**600**	
	Total Annual Variable Coping Cost Of Sewer	**GEL/yr**	**1 246**	**601**	**4 161**	**6 008**	
	Annual Variable Cost Of Sewage Service	GEL/yr	75	41	20	**136**	Verify that it matches actual sewer bill, if this is important for a particular analysis.
	Total Annual Variable Cost Of Sewer	**GEL/yr**	**1 320**	**642**	**4 182**	**6 144**	
	Total Annual Variable Cost Of Water And Sewer	**GEL/yr**	**2 793**	**1 401**	**6 162**	**10 355**	

TOTAL ANNUALIZED BUSINESS SEMI-VARIABLE AND ANNUAL BUSINESS VARIABLE COST OF WATER AND SEWER SERVICES / ჯამური ოჯახის წლიური ცვლადი

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE – SEASON – HIGH	VALUE – SEASON – SHOULDER	VALUE – SEASON – LOW	VALUE – ANNUAL TOTAL	COMMENT კომენტარი
Total Annualized HH Semi-Variable And Annual Variable Cost Of Water = Annualized Semi-Variable Water Coping Cost + Variable Water Coping Cost + Municipal Water Bill **Total Annualized Semi-Variable And Annual Variable Cost Of Sewer = Annualized Semi-Variable Sewer Coping Cost + Variable Sewer Coping Cost + Municipal Sewer Bill** **Total Annualized Semi-Variable And Annual Variable Cost Of Water And Sewer = Total Annualized HH Semi-Variable And Annual Variable Cost Of Water + Total Annualized Semi-Variable And Annual Variable Cost Of Sewer**	Length Of Season	wks/yr	4,3	4,3	43,4	n.a.	
	Annualized Semi-Variable Water Coping Cost	GEL/yr	285	285	2 879	**3 449**	
	Variable Water Coping Cost	GEL/yr	1 412	726	1 963	**4 102**	
	Municipal Water Bill	GEL/yr	61	33	17	**110**	
	Total Annualized HH Semi-Variable And Annual Variable Cost Of Water	**GEL/yr**	**1 758**	**1 044**	**4 859**	**7 661**	
	Annualized Semi-Variable Sewer Coping Cost	GEL/yr	248	248	2 505	**3 002**	
	Variable Sewer Coping Cost	GEL/yr	1 246	601	4 161	**6 008**	
	Municipal Sewer Bill	GEL/yr	75	41	20	**136**	
	Total Annualized Semi-Variable And Annual Variable Cost Of Sewer	**GEL/yr**	**1 569**	**890**	**6 687**	**9 145**	
	Total Annualized Semi-Variable And Annual Variable Cost Of Water And Sewer	**GEL/yr**	**3 327**	**1 934**	**11 545**	**16 806**	

WILLINGNESS TO SWITCH TO MUNICIPAL WATER AND SEWAGE SYSTEMS / მუნიციპალურ წყალმომარაგებასა და საკანალიზაციო მომსახურებაზე გადართვის

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE	COMMENT
Future Annual HH Municipal Water Bill = Volume Of Water Used Today * Water Tariff **Future Annual HH Municipal Sewer Bill = Volume Of Water Used Today * Sewer Tariff** **Future Annual HH Municipal Water And Sewer Bill = Future Annual HH Municipal Sewer Bill + Future Annual HH Municipal Water Bill** **Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Water And Sewer = Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Water + Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Sewer** **Likelihood To Switch For Water (larger is more likely to switch) = Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Water / Future Annual HH Municipal Water Bill** **Likelihood To Switch For Sewer (larger is more likely to switch) = Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Sewer / Future Annual HH Municipal Sewer Bill**	Volume Of Water Used Today	**m³/yr**	65	
	Water Tariff	**GEL/m³**	1,7000	
	Sewer Tariff	**m³/yr**	2,1000	
	Future Annual HH Municipal Water Bill	**GEL/yr**	**110**	
	Future Annual HH Municipal Sewer Bill	**GEL/yr**	**136**	
	Future Annual HH Municipal Water And Sewer Bill	**GEL/yr**	**246**	
	Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Water	**GEL/yr**	**7 661**	
	Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Sewer	**GEL/yr**	**9 145**	
	Current Annualized HH Semi-Variable And Annual HH Variable Cost Of Water And Sewer	**GEL/yr**	**16 806**	
	Likelihood To Switch For Water (larger is more likely to switch)		**69,65**	
	Likelihood To Switch For Sewer (larger is more likely to switch)		**67,30**	
	Likelihood To Switch For Water And Sewer Combined (larger is more likely to switch)		**68,35**	

APPENDIX I

I WATER UTILITIES IMPACT GROUP

WATER VOLUME PROVIDED, NON-REVENUE WATER (NRW) AND SEWAGE VOLUME TREATED

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT
Water Delivered To Network = Water Delivered To Network / 365	Water Delivered To Network	m^3/yr	2 628 000	
	Water Delivered To Network	**m^3/day**	**7 200**	
Water Delivered To Customers = Water Delivered To Customers / 365	Water Delivered To Customers	m^3/yr	1 084 219	
	Water Delivered To Customers	**m^3/day**	**2 970**	
Water Losses - NRW (non revenue water) = Water Losses - NRW (non revenue water) / 365	Water Losses - NRW (non revenue water)	m^3/yr	1 543 781	
	Water Losses - NRW (non revenue water)	**m^3/day**	**4 230**	
Water Loss Ratio (NRW to water delivered to network ratio) = (Water Delivered To Network - Water Delivered To Customers) / Water Delivered To Network	**Water Loss Ratio (NRW to water delivered to network ratio)**		**59%**	
Sewage Received = Sewage Received / 365	Sewage Received	m^3/yr	758 953	
	Sewage Received	**m^3/day**	**2 079**	

WATER SUPPLY SCHEDULE

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE / მნიშვნელობა					
			REGION 1 რეგიონი 1	REGION 2 რეგიონი 2	REGION 3 რეგიონი 3	REGION 4 რეგიონი 4	REGION 5 რეგიონი 5	TOTAL OR AVERAGE
Water Supply Schedule = Hours Per Day / Days Per Week	Region Name							**n.a.**
	Water Delivered To Network	m^3/day	1 000	1 000	1 000	2 000	2 200	**7 200**
	Average Length Of Water Supply In Last Month	hr/day	5:00	6:00	5:00	9:00	2:00	**5:20**
	Minimum Length Of Water Supply In Last Month	hr/day	3:00	4:00	2:00	6:00	1:00	**3:13**
	Maximum Length Of Water Supply In Last Month	hr/day	11:00	11:00	11:00	11:00	11:00	**11:00**
	Average Frequency Of Water Supply In Last Month	days/wk	5	5	5	5	5	**5,0**
	Minimum Frequency Of Water Supply In Last Month	days/wk	3	2	4	6	3	**3,8**
	Maximum Frequency Of Water Supply In Last Month	days/wk	7	7	7	7	7	**7,0**
	Average Duration And Frequency Of Water Provision In Last Month	**hr / days**	**5,0 / 5**	**6,0 / 5**	**5,0 / 5**	**9,0 / 5**	**2,0 / 5**	**5,3 / 5**
	Minimum Duration And Frequency Of Water Provision In Last Month	**hr / days**	**3,0 / 3**	**4,0 / 2**	**2,0 / 4**	**6,0 / 6**	**1,0 / 3**	**3,2 / 4**
	Maximum Duration And Frequency Of Water Provision In Last Month	**hr / days**	**11,0 / 7**	**11,0 / 7**	**11,0 / 7**	**11,0 / 7**	**11,0 / 7**	**11,0 / 7**
	Average Length Of Water Supply In Last Year	hr/day	5:00	6:00	5:00	9:00	2:00	**5:20**
	Minimum Length Of Water Supply In Last Year	hr/day	3:00	4:00	2:00	6:00	1:00	**3:13**
	Maximum Length Of Water Supply In Last Year	hr/day	11:00	11:00	11:00	11:00	11:00	**11:00**
	Average Frequency Of Water Supply In Last Month	days/wk	5	5	5	5	5	**5,0**
	Minimum Frequency Of Water Supply In Last Year	days/wk	3	2	4	6	3	**3,8**
	Maximum Frequency Of Water Supply In Last Year	days/wk	7	7	7	7	7	**7,0**
	Average Duration And Frequency Of Water Provision In Last Year	**hr / days**	**5,0 / 5**	**6,0 / 5**	**5,0 / 5**	**9,0 / 5**	**2,0 / 5**	**5,3 / 5**
	Minimum Duration And Frequency Of Water Provision In Last Year	**hr / days**	**3,0 / 3**	**4,0 / 2**	**2,0 / 4**	**6,0 / 6**	**1,0 / 3**	**3,2 / 4**
	Maximum Duration And Frequency Of Water Provision In Last Year	**hr / days**	**11,0 / 7**	**11,0 / 7**	**11,0 / 7**	**11,0 / 7**	**11,0 / 7**	**11,0 / 7**

WATER QUALITY TESTING

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT
Water Test Failure Ratio = Number Of Water Test Failures / Number Of Water Tests Conducted	Number Of Water Tests Conducted	#/yr	1 245	
	Number Of Successful Water Tests	#/yr	1 238	
	Number Of Water Test Failures	#/yr	7	
	Water Test Failure Ratio		**1%**	
	Share Of Water Disinfected (chlorinated)		**98%**	

TARIFFS AND CROSS-SUBSIDIES

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT
Implicit Water Consumption Per Household Member = Standard Water Consumption Per Household Member * 365 / 12 **Implicit Water Price For Households = Water Tariff Per Household Member / Implicit Water Consumption Per Household Member** **Implicit Sewage Discharged Per Household Member = Standard Sewage Discharged Per Household Member * 30** **Implicit Sewage Price For Households = Sewer Service Tariff Per Household Member Based On Municipal Water Used / Implicit Sewage Discharged Per Household Member** **Cross-Subsidy Level (from businesses to households) = (Water Tariff For Businesses + Sewer Service Tariff For Businesses Based On Municipal Water Used) / (Implicit Water Price For Households + Implicit Sewage Price For Households)** **Cross-Subsidy Level (from businesses to other organizations) = (Water Tariff For Businesses + Sewer Service Tariff For Businesses Based On Municipal Water Used) / (Water Tariff For Other Organizations + Sewer Service Tariff For Other Organizations Based On Municipal Water Used)** **Cross-Subsidy Level (from other organizations to households) = (Water Tariff For Other Organizations + Sew**	Water Tariff For Businesses	GEL/m^3	1,7000	
	Water Tariff For Other Organizations	GEL/m^3	1,3000	
	Water Tariff Per Household Member	GELmo	0,8000	
	Standard Water Consumption Per Household Member	m^3/day	0,120	
	Implicit Water Consumption Per Household Member	**m^3/mo**	**3,650**	
	Implicit Water Price For Households	**GEL/m^3**	**0,219**	
	Sewer Service Tariff For Businesses Based On Municipal Water Used	GEL/m^3	2,3000	
	Sewer Service Tariff For Other Organizations Based On Municipal Water Used	GEL/m^3	1,7000	
	Sewer Service Tariff Per Household Member Based On Municipal Water Used	GEL/m^3	1,0000	
	Standard Sewage Discharged Per Household Member	m^3/day	0,08	
	Implicit Sewage Discharged Per Household Member	**m^3/mo**	**2,520**	
	Implicit Sewage Price For Households	**GEL/m^3**	**0,397**	
	Cross-Subsidy Level (from businesses to households)		**6,493**	
	Cross-Subsidy Level (from businesses to other organizations)		**1,333**	
	Cross-Subsidy Level (from other organizations to households)		**4,870**	

NUMBER OF CUSTOMERS AND METER PENETRATION

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT
Share Of Other Organizations That Are Metered = Number Of Meters In Other Organizations / Number Of Other Organizations Served	Number Of Households Served In Private Houses		12 900	
	Number Of Households Served In Apartment Blocks		5 600	
	Number Of Businesses Served		150	
	Number Of Other Organizations Served		32	
	Number Of Tourists And Visitors To City	#/yr	40 000	
	Number Of Meters In Private Houses		0	
	Number Of Meters In Apartment Blocks With Individual Meters		0	
	Number Of Meters In Apartment Blocks With Common Meters			
	Number Of Meters In Businesses		4	
	Number Of Meters In Other Organizations		0	
	Share Of Households In Private Houses That Are Metered		**0%**	
	Share Of Households In Apartment Blocks With Individual Meter		**0%**	
	Share Of Households In Apartment Blocks With Shared Meter		**100%**	
	Share Of Businesses That Are Metered		**3%**	
	Share Of Other Organizations That Are Metered		**0%**	

WATER CONSUMPTION LEVELS

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT
Average Water Consumption By Tourists And Visitors = Water Delivered To Tourists And Visitors / Number Of Tourists And Visitors To City / 365	Water Delivered To Households	m^3/yr	810 300	
	Water Delivered To Businesses	m^3/yr	113 910	
	Water Delivered To Other Organizations	m^3/yr	80 000	
	Water Delivered To Tourists And Visitors	m^3/yr	80 000	
	Average Household Size In Private Houses (individuals)		2,3	
	Average Household Size In Apartment Blocks (individuals)		1,6	
	Water Consumption Per Capita Among All Households (excluding water delivered to tourists and visitors)	**m^3/day**	**0,070**	
	Water Consumption Per Capita In Metered Households	**m^3/day**		
	Water Consumption Per Capita In Households With Shared Meters	**m^3/day**		
	Average Water Consumption By Businesses	**m^3/day**	**2,081**	
	Average Water Consumption By Other Organizations	**m^3/day**	**6,849**	
	Average Water Consumption By Tourists And Visitors	**m^3/day**	**0,005**	

REVENUE AND COLLECTION RATES

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT
Collection Rate From Households = Bills Paid By Households / Bills Charged To Households **Collection Rate From Businesses = Bills Paid By Businesses / Bills Charged To Businesses** **Collection Rate From Other Institutions = Bills Paid By Other Institutions / Bills Charged To Other Organizations** **Overall Collection Rate = Revenue Collected (bills paid) / Total Revenue (bills charged)**	Bills Charged To Households	GEL/yr	230 742	
	Bills Paid By Households	GEL/yr	62 360	
	Collection Rate From Households		**27%**	
	Bills Charged To Businesses	GEL/yr	45 558	
	Bills Paid By Businesses	GEL/yr	43 097	
	Collection Rate From Businesses		**95%**	
	Bills Charged To Other Organizations	GEL/yr	105 766	
	Bills Paid By Other Institutions	GEL/yr	81 874	
	Collection Rate From Other Institutions		**77%**	
	Total Revenue (bills charged)	GEL/yr	382 066	
	Revenue Collected (bills paid)	GEL/yr	187 331	
	Overall Collection Rate		**49%**	

OPERATING COSTS

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT
	Number Of Employees	FTE	24	
	Number Of Technical Workers	FTE	13	
	Electricity Cost	GEL/yr	187 894	
	Net Price Of Electricity	GEL/kW-hr	0,0500	
	Electricity Consumed	kW-hr	3 757 880	
	Repair And Maintenance Cost	GEL/yr	55 000	
	Salary Expense	GEL/yr	127 000	
Share Of Water Related Costs In Total Costs 0.45	Other Operating Expense	GEL/yr	28 500	
Share Of Sewer Related Costs In Total Costs = 1 - Share Of Water Related Costs In Total Costs	Total Operating Cost	GEL/yr	398 394	
	Share Of Water Related Costs In Total Costs		**45%**	
Operating Cost For Water Network = (Electricity Cost For Water Network + Repair And Maintenance Cost For Water Network + Salary Expense For Water Network + Other Operating Expense For Water Network)	**Share Of Sewer Related Costs In Total Costs**		**55%**	
	Electricity Cost For Water Network	GEL/yr	84 552	
Operating Cost For Sewer Network = (Electricity Cost For Sewer Network + Repair And Maintenance Cost For Sewer Network + Salary Expense For Sewer Network + Other Operating Expense For Sewer Network)	Repair And Maintenance Cost For Water Network	GEL/yr	24 750	
	Salary Expense For Water Network	GEL/yr	57 150	
	Other Operating Expense For Water Network	GEL/yr	12 825	
	Operating Cost For Water Network	**GEL/yr**	**179 277**	
	Electricity Cost For Sewer Network	GEL/yr	103 342	
	Repair And Maintenance Cost For Sewer Network	GEL/yr	30 250	
	Salary Expense For Sewer Network	GEL/yr	69 850	
	Other Operating Expense For Sewer Network	GEL/yr	15 675	
	Operating Cost For Sewer Network	**GEL/yr**	**219 117**	

INFRASTRUCTURE RELIABILITY AND REPAIRS

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT
Overall Water And Sewage Systems Repair Index = (Number Of Repairs In Water System + Number Of Repairs In Sewage System) / (Number Of Breaks In Water System + Number Of Breaks In Sewage System)	Number Of Breaks In Water System	#/yr	129	
	Number Of Breaks In Sewage System	#/yr	101	
	Number Of Repairs In Water System	#/yr	127	
	Number Of Repairs In Sewage System	#/yr	101	
	Water System Reliability Index (time between breaks)	**days**	**2,8**	
	Sewage System Reliability Index (time between breaks)	**days**	**3,6**	
	Overall Water And Sewage Systems Reliability Index (time between breaks)	**days**	**1,6**	
	Overall Water And Sewage Systems Repair Index		**99%**	

MEASURES OF EFFICIENCY

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT
Number Of Employees Per 1 000 Inhabitants = ((Number Of Households Served In Private Houses * Average Household Size In Private Houses (individuals) + Number Of Households Served In Apartment Blocks * Average Household Size In Apartment Blocks (individuals)) / 1000) / Number Of Employees Energy Cost Per Cubic Meter Of Water Supplied To Customers = Electricity Cost For Water Network / (Water Delivered To Households + Water Delivered To Businesses + Water Delivered To Other Organizations + Water Delivered To Tourists And Visitors) Energy Required Per Cubic Meter Of Water = Energy Cost Per Cubic Meter Of Water Supplied To Customers / Net Price Of Electricity Revenue (bills charged) Per Full-Time Employee = Total Revenue (bills charged) / Number Of Employees Revenue (bills charged) Per Cubic Meter Of Water Delivered To Customers = Total Revenue (bills charged) / Water Delivered To Customers Average Revenue (bills charged) Per Customer = Total Revenue (bills charged) / ((Number Of Households Served In Private Houses + Number Of Households Served In Apartment Blocks + Number Of Businesses Serv Water Operating Cost Per Cubic Meter Of Water Delivered T Water Operating Cost Per Cubic Meter Of Water Delivered T	Number Of Repairs Per Technical Worker Per Year	#/yr	18	
	Number Of Employees Per 1 000 Inhabitants	FTE	1,6	
	Energy Cost Per Cubic Meter Of Water Supplied To Customers	GEL/m^3	0,08	
	Energy Required Per Cubic Meter Of Water	kW-hr/m^3	1,6	
	Revenue (bills charged) Per Full-Time Employee	GEL/FTE	15 919	
	Revenue (bills charged) Per Cubic Meter Of Water Delivered To Customers	GEL/m^3	0,4	
	Average Revenue (bills charged) Per Customer	GEL	20,5	
	Water Operating Cost Per Cubic Meter Of Water Delivered To Network	GEL/m^3	0,07	
	Water Operating Cost Per Cubic Meter Of Water Delivered To Customers	GEL/m^3	0,18	
	Sewer Operating Cost Per Cubic Meter Of Sewage Treated	GEL/m^3	0,29	
	Electricity Consumption Per Cubic Meter Of Water Delivered To Network	kW-hr/m^3	0,64	
	Electricity Consumption Per Cubic Meter Of Water Delivered To Customers	kW-hr/m^3	1,56	
	Electricity Cost Per Cubic Meter Of Water Delivered To Network	GEL/m^3	0,03	
	Electricity Cost Per Cubic Meter Of Water Delivered To Customers	GEL/m^3	0,08	
	Electricity Consumption Per Cubic Meter Of Sewage	GEL/m^3	2,72	
	Electricity Cost Per Cubic Meter Of Sewage	GEL/m^3	0,14	
	Operating Cost Per 1 000 Customer	GEL	21 325	
	Operating Cost Per 1000 GEL Revenue	GEL	1 043	

CAPACITY AND CAPACITY UTILIZATION

CALCULATION	DATA ELEMENT / METRIC	UNIT	VALUE მნიშვნელობა	COMMENT
Sewage Capacity Utilization Rate = Sewage Received / Daily Sewage Treatment Capacity	Annual Water Supply Capacity	m^3/yr	3 000 000	
	Daily Water Supply Capacity	m^3/day	8 219	
	Daily Water Supply Capacity During High Season	m^3/day	7 000	
	Daily Water Supply Capacity During Shoulder Season	m^3/day	7 000	
	Daily Water Supply Capacity During Low Season	m^3/day	7 000	
	Water Capacity Utilization Rate		**88%**	
	Annual Sewage Treatment Capacity	m^3/yr	1 000 000	
	Daily Sewage Treatment Capacity	m^3/day	2 740	
	Daily Sewage Treatment Capacity During High Season	m^3/day	1 200 000	
	Daily Sewage Treatment Capacity During Shoulder Season	m^3/day		
	Daily Sewage Treatment Capacity During Low Season	m^3/day		
	Sewage Capacity Utilization Rate		**76%**	

FINANCIAL RATIOS

RATIO	DEFINITION OF RATIO	UNIT	VALUE მნიშვნელობა	COMMENT
Profitability Ratios / მომგებიანობის კოეფიციენტები				
Return On Assets (ROA)	Net Income After Tax / [(Beginning Total Assets + Ending Total Assets) / 2]			
Return On Equity (ROE)	Net Income After Tax / [(Beginning Equity + Ending Equity) / 2]			
Net Profit Margin	Net Income After Tax / Revenue			
EBITDA	Net Income Before Tax + Interest Expense + Operating Depreciation + G&A Depreciation			
EBITDA	EBITDA / Revenue			
Liquidity Ratios / ლიკვიდურობის კოეფიციენტები				
Current Ratio	Current Assets / Current Liabilities			
Quick Ratio	(Current Assets - Restricted Cash - Inventories) / Current Liabilities			
Net Working Capital	(Current Assets - Current Liabilities) / Total Assets			
Activity Ratios / აქტივობის კოეფიციენტები				
Asset Turnover Ratio	Revenue / [(Beginning Total Assets + Ending Total Assets) / 2]			
Account Receivable Turnover Ratio	Revenue / [(Beginning Accounts Receivable + Ending Accounts Receivable) / 2]			
Average Collection Period	Accounts Receivable / Revenue * 365			
Financing Ratios / დაფინანსების კოეფიციენტები				
Debt To Equity Ratio	Total Liabilities / Total Equity			
Long-Term Debt To Equity Ratio	Debt / Total Equity			
Interest Coverage Ratio	(Net Income Before Tax + Interest Expense) / Interest Expense			
Debt Service Coverage Ratio	(Net Income Before Tax + Interest Expense) / (Interest Expense + Principal Repayment)			

APPENDIX J

CGE KEY DESIGN ISSUES AND DECISIONS

J CGE KEY DESIGN ISSUES AND DECISIONS

This Section describes ten key design issues that the RID IEP wrestled with during design of the economic analysis part of the Impact Evaluation Design. These issues, and the resulting decisions, affect not only the scope of answers that can be given (*e.g.*, level of disaggregation of household income) but also the realism of the CGE models (*e.g.*, imperfect competition with barriers to entry).

As a general rule we have always decided matters in a way that improves disaggregation possibilities and that improves realism. Usually, this has been at the expense of adding an additional level of complexity to the CGE models. However, we have always been careful to ensure that all of our key design decisions have been implemented before by other CGE modelers. We have access to papers from a broad range of authors in each of these key design areas and do not see any particular problems other than just the amount of analytic work that will be required.

Each design issue and decision is discussed separately.

J.1 DISAGGREGATION OF HOUSEHOLD INCOME

One of the Key Research Question focuses on understanding the effect of the RID projects on households with different income levels. In order to estimate this, households must be differentiated based on their income levels. This Sub-Section discusses the modeling solution RID IEP will use for this issue.

We first discuss the need to disaggregate households. This is followed by the method that we will use initially to disaggregate households at the national level. We then discuss how this disaggregation scheme will be changed to reflect the actual data received, from DS for the national SAM; the final disaggregation scheme found using this data will later be applied to the local SAMs. Finally we discuss how we will use additional economic tools to better understand the differential impact the RID projects will have on different groups of households.

Need To Disaggregate Households. Often a single representative household is used in SAMs and CGE models. However, in reality households are very different; they have different incomes, preferences and so forth. In addition, a particular change such as a new water system, will likely affect different types of households differently (*e.g.*, poor households will likely be more affected by reductions in water coping costs than will be wealthier households).

Clearly a single representative household does not match reality well.

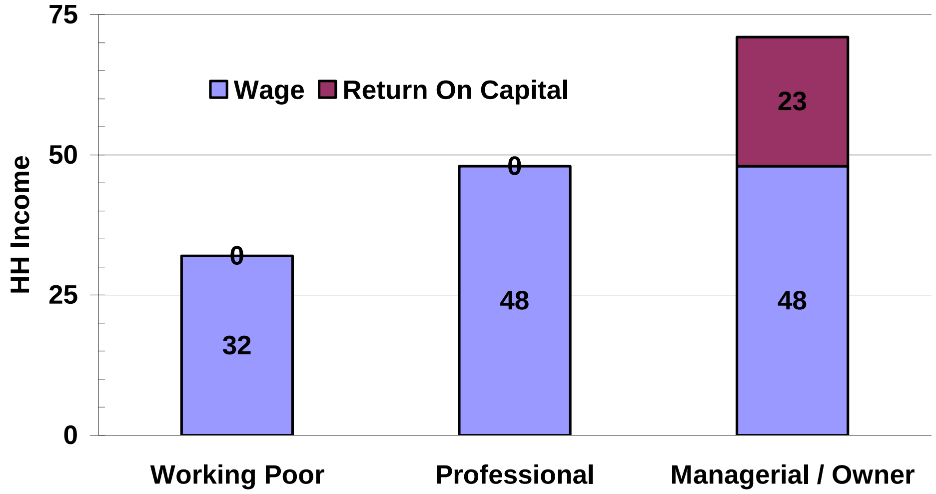
Over the past while CGE modelers have increasingly used multiple representative household types. This ranges from two or three types up to literally thousands of household types when CGE analysis is combined with further household-level analyses.

Given the key research questions related to effects on poverty, it is clear that the RID IEP cannot use a single representative household in the CGE models.

<u>Initial Disaggregation Of Households.</u> We have chosen to disaggregate households into three types for the purpose of the CGE models and SAMs.[18] At present, the three household types are shown in the following chart and are imagined as follows.

- Lower income wage earners; sometimes called the working poor, these households spend only what is received in wages (plus some income from the informal economy)
- Professional wage earners; these are households that include professionals or managers; these households spend only what is received in wages (plus some income from the informal economy)
- Owners of capital; these are households that include professionals or managers; income includes wages plus returns on capital.[19]

17. Tentative Household Types



Source: RID IEP Analysis.

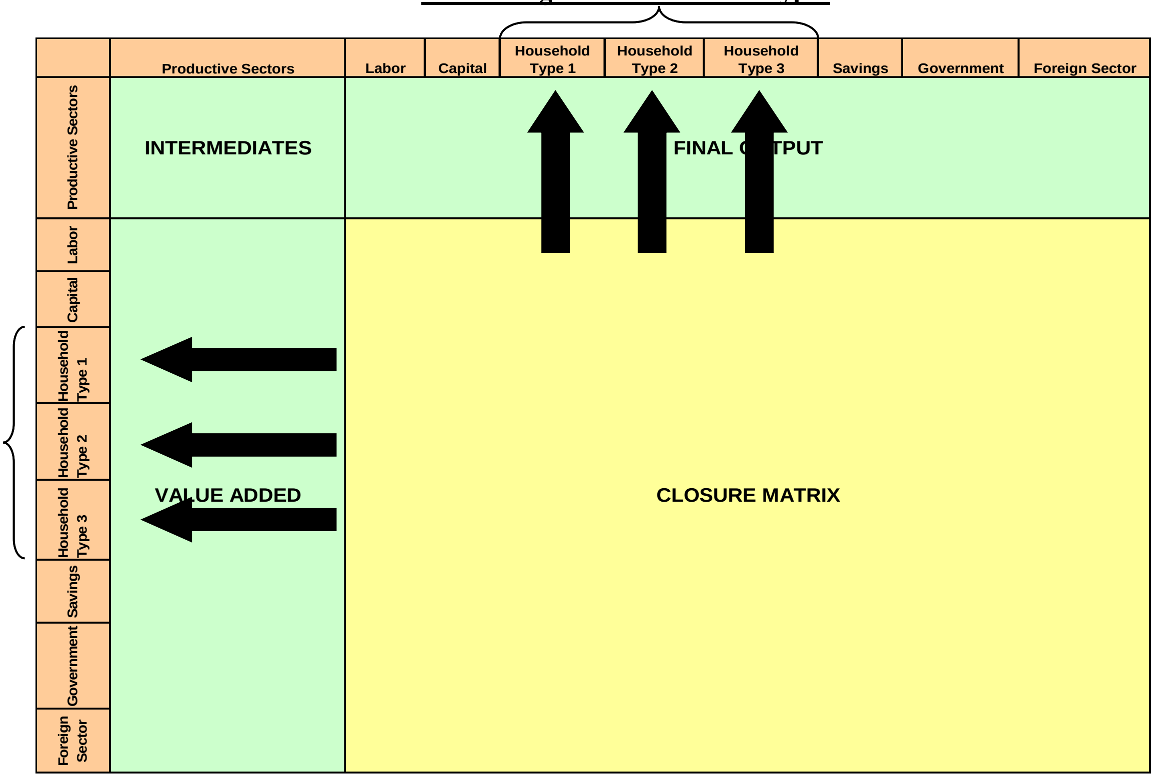
The indicated types are distinguished here generally by income level, or more properly in Georgia by expenditure level.

The complication to the SAM is straightforward; a single household type is replaced by three types as shown in the following chart. This is a trivial effort when the data is available (as it reportedly is for the national level, and as it will be for sure at the local level). The situation for the CGE model is more complex since three representative household types increases the number of equations and parameters a fair amount. However, the fact that each of the three household types is inherently more homogeneous than a single representative household would be will make model calibration somewhat easier.

[18] It should be noted that decisions about household income for the purposes of the CGE models do not affect how results are reported (disaggregated) for non-CGE model Metrics.

[19] In Georgia professionals generally fall into two groups. Those who receive a generally fixed wage only and those who have a generally fixed wage plus a share of profits (a bonus) even though they are not the official owner of the capital.

18. <u>SAM Using Three Household Types</u>



Source: RID IEP Analysis.

<u>Final Household Disaggregation Scheme.</u> When the final CGE models and SAMs are created it is likely that a different set of household types will be used. This is because the creation (and naming) of the household types is driven by differences in consumption patterns among households (*i.e.*, by their consumption functions). That is, within a CGE model the important feature that distinguishes household types is the *<u>pattern of their consumption</u>* rather than *<u>their absolute income</u>* (or expenditure) level.

Consequently, when we have access to the DS data for creating the national SAMs we will do factor or cluster analysis as needed to clarify the features of the three types of households. It is likely that income or expenditure level will be a key factor for differentiating types of households. This same classification, finalized at the national level, will be extended down to the individual RID city level.

<u>Further Analysis Of Impact On Poverty.</u> Once the CGE analysis is completed we will apply those economy-wide impacts in each of the three household types to the original household data set. A micro-simulation method will be used to distinguish between changes in average income by household types and changes in the distribution of household incomes by those same household types.

The details of the micro-simulation analysis are discussed in a later Section of this Chapter.

<u>Simple Results From The Test Model.</u> As noted in the previous Chapter, the RID IEP created a simple CGE model and SAM to test the overall Impact Evaluation Design. The three-sector, two-household-type model showed the following impacts from a new water system:

- Nominal wages (average nominal wage) decreased for both types of households

- Due to decrease in inflation, real wages (average real wage) increased for all households
- Inequality between the two types of households (between average real wages) increased
- Owners of capital gained more from the new water system than did other households.

Note that these effects come from a very simple model; actual results from the RID IEP models will be quite different.

J.2 DISAGGREGATION OF LABOR

Economists are often interested in effects of policy change on skilled and unskilled labor. Skilled labor (white-collar workers) and unskilled labor (blue-collar workers) are affected by changes differently. For example, setting a wage floor typically increases unemployment among blue-collar workers if the wage floor is higher than the equilibrium wage for unskilled labor. On the other hand, white-collar workers are less affected with wage floors since the skilled labor force already has a wage higher than the wage floor.

Another issue interesting for economic analysis is the substitutability between skilled and unskilled labor. This was the case for example with GTAP[20], where labor was disaggregated into two categories and each category was nested in production functions to understand different effects of international trade on labor categories and estimate the substitutability of skilled and unskilled labor in various industries.

The RID IEP will study the effects of the RID projects on labor with different skills. During site visits we observed that in large hotels one or more people are devoted to deal with water problems; they are always blue-collar workers. When a 24/7 water supply is available, these hotel water-specialists could be laid off. This means that productivity of hotels goes up (less spending for a given level of output) and hotel owners receive more profits while unemployment increases. This widens inequality between skilled and unskilled labor.

Education, experience and position in the company will be used as a criterion for labor disaggregation into three types:

- Blue-collar workers; workers with secondary-school-level, or lower education (*i.e.*, people employed as “workers”, with limited or no intellectual input)
- White-collar workers; workers with higher than secondary-school-level education (*i.e.* employed as “office workers” with certain level of intellectual input)
- Managers; employees, who run their own businesses, or are appointed as managers in various enterprises, without knowing the level of education.

This disaggregation will create the same difficulties as disaggregating households. However, the same balance between usefulness of results and more homogeneous groups of labor apply. This assumes that the RID IEP surveys collect the data needed to do the disaggregation; this will of course be the case.

[20] Global Trade Analysis Project

By disaggregating labor the RID IEP will be able to estimate the effects of the new water systems on workforces with different skills.

J.3 SELECTION OF STARTING CGE MODEL

The selection of the starting CGE model for the RID IEP was a key design decision. CGE models usually are not developed from scratch; rather, an existing CGE model is chosen and then modified to meet the particular needs of the moment. Starting CGE models exist in a wide variety of forms, each with particular features, advantages and disadvantages. The RID IEP evaluated a range of alternative starting CGE models to select the one that is best for the RID IEP. This selection process is described in this Sub-Section.

Static vs. Dynamic CGE Model. The first key decision in this area was whether to use a static or dynamic CGE model. Static CGE models incorporate only one period, with no inter-temporal decisions. This means that economic agents in the economy optimize their decisions only considering one period and they do it once and for all. With a static CGE model the modeler must make many forecasts (scenarios) to forecast results; this complicates model use. On the other hand, static CGE models can include many sectors, they are well behaved and they are empirically well-tested and understood in the literature.

Basic static CGE models essentially answer “what if” questions at a single moment in time. In the context of the RID project, the questions are:

- What *is* the state of the economy today without a new water system?
- What *would be* the state of the economy today if a new water system was operating today?
- What *is the difference* between the state of the economy today without and with a new water system? That is, what is the impact of the new water system?

In static CGE models impact is assumed to occur instantaneously, like throwing a light switch. Of course change does not occur in this fashion, so methods have been developed to use static CGE models to understand the time periods over which changes will occur. Said differently, the main defect of static CGE models (*i.e.*, not explicitly considering inter-temporal decisions) has been largely overcome.

Dynamic CGE models, on the other hand, explicitly consider inter-temporal decisions. Economic agents optimize their decisions in each period of time considering current income and expected incomes for all future periods. These types of models cannot include many sectors and they are considered experimental rather than empirically well-tested in the literature. The main advantage of dynamic CGE models is their ability to illuminate how changes occur over time.

The RID IEP used four criteria for deciding between starting with a static or dynamic CGE model as follows:

- Relatively easy to calibrate; assigning values to parameters (parameterization) of interest (*e.g.*, elasticity of substitution, fixed and variable costs, preferences of consumers) is straightforward

- Good explanatory power for how changes occur over time; it is best to understand how impact develops over time

- Ability to incorporate many sectors; if impact in many sectors is important then the CGE model must accommodate many sectors

- Is empirically well tested; it is best to not venture too far from established practice.

Static and dynamic CGE models were evaluated against each of these criteria as shown in the following chart. On balance, the RID IEP concluded that static CGE models are more suitable for use for the RID IEP.

19. Evaluation of Static vs. Dynamic Models

CRITERION	STATIC CGE MODELS	DYNAMIC CGE MODELS
Relatively Easy To Calibrate	●	—
Good Explanatory Power For How Changes Occur Over Time	○	●
Ability To Incorporate Many Sectors	●	—
Is Empirically Well Tested	●	○

Note: ● denotes fully meets criterion; ○ denotes partially meets criterion; — does not meet criterion.
Source: RID IEP Analysis.

Framework For The Market Structure Decision. Market structure within a CGE model reflects the type of competition that exists among firms. There are four main competition types that could be used for the RID IEP:

- Perfect competition

- Oligopoly competition

- Monopolistic competition with homogeneous firms

- Monopolistic competitive with heterogeneous firms.

Each of these alternatives is described in the following paragraphs. The descriptions are followed by an evaluation among the four alternatives using nine criteria.

Perfect Competition. Firms in this CGE model type are price takers. Markets clear and prices are set. Many firms are on the market. There are no barriers to entry for new firms; new firms enter until profits of all firms become zero, meaning that their price equals to their marginal cost (P=MC). Firms are perfect competitors and substitutes of each other, which mean they have identical products and are not distinguished from each other. The size of firms, defined by their cost function, is uncertain.

These CGE models are easy to structure mathematically and involve no particular difficulties in calibration. It is also possible to disaggregate households and labor into several groups. Labor and capital can be mobile within the model; this means that labor can move from one economy to another (as in labor can move into a RID city if the economy is doing well).

Methods exist to understand the pace of change; future can be easily forecasted. However, perfect competition CGE models are the oldest theoretical thinking in economics with regards to market structure. Its name “perfect” also emphasizes the fact that it does not resemble real-life situations which are far from being perfect and are more heterogeneous rather than homogeneous. Nevertheless, because of the popularity of the model there are many authors providing manuals of their work regarding perfect competition.

Perfect competition CGE models are available from numerous sources, including Professor M. Alejandro Cardenete, a member of the RID IEP team.

Oligopolistic Competition. In an oligopoly market structure there are only several firms with monopoly power that enables them to set price. Because of the small number of firms on the market there is strategic interaction among markets participants, which means every price or quantity decision of each firm, influence the decisions of other firms and other way round. Products of the firms are different but firms themselves can be either homogeneous or heterogeneous. The size of each type of firm is not determined. The presence of barriers to entry for new firms produces positive profits to existing firms which means they set their price more than marginal cost (P>MC).

Compared to perfect competition CGE models, oligopolistic competition CGE models are more difficult to structure mathematically and involve more effort to calibrate. However, they enable customizations to better resemble real-life in terms of heterogeneity of firms and products. Factor mobility and different types of households and labor can be included in this type of CGE model. Future periods can also be easily anticipated. From an academic point of view, oligopolistic competition CGE models are not new to the world and there is readily available code by Markunsen (University of Colorado at Boulder).

Monopolistic Competition With Homogeneous Firms. A monopolistic competition economy with homogeneous firms is similar to oligopolistic competition in the sense that firms acquire monopolistic power to set price on their different products. However, the existence of a large number of market participants limits strategic interaction among them; there is no influence of one firm’s decisions on other firms.

Firms are homogeneous on the market and their size is determined. There are barriers to entry for new firms which enables existing firms to earn positive profits by setting a so-called monopoly price (P>MC).

Monopolistic competition CGE models are moderately difficult mathematically and to calibrate. They have only a moderate level of intellectual novelty and less resemblance to real-life market structures. These CGE models are able to forecast future periods easily and to incorporate economy features such as factor mobility and different types of households and labor. Also, code is available for monopolistic models from Markunsen (University of Colorado at Boulder).

Monopolistic Competition With Heterogeneous Firms. This type of market structure has the same features as monopolistic competition with homogeneous firms with two important exceptions: firms are different from each other and not all of them necessarily earn positive profits. In the context of the RIP projects, these types of CGE models permit the consideration of old and new firms in an industry.[21]

Although these models are difficult to structure mathematically and also to calibrate, they best resemble real markets. These CGE models are able to forecast the future easily and are easily customized. One of the main advantages of this model compare to others described above is that they have a high level of intellectual novelty and reflect the most up-to-date economic thought. Factor mobility and household and labor disaggregation can be incorporated within the model. CGE software code is also available from Balisteri (Colorado School of Mines).

Selection Criteria. The four types of CGE models each have their own advantages and disadvantages. The RID IEP used nine criteria to differentiate among the choices. The criteria include both items related to fitting the needs of RID IEP (e.g., resembles real-life markets) and usability (e.g., relatively easy to calibrate).

- Good explanatory power for how changes occur over time; it is best to understand how impact develops over time
- Resembles real-life market structures; the closer the resemblance to real life the more easily understood are the results
- Permits disaggregation of households and labor; capability of the model to incorporate different types of households (*e.g.*, poor and rich) and labor (*e.g.*, skilled and unskilled)
- Permits factor mobility; models the movement of labor and capital into and out of the Studied Economy
- Relatively easy to calibrate; assigning values to parameters (parameterization) of interest (*e.g.*, elasticity of substitution, fixed and variable costs, preferences of consumers) is straightforward
- Relatively easy to customize; how much must the starting model be changed to reflect the needs of the RID IEP (*e.g.*, changing production function of firms, changing utility function of consumers, changing market structure for different sectors)
- Availability of owner’s manual; availability of the CGE model code and descriptions of its use
- Moderate mathematical complexity; increased complexity increases the likelihood of errors or the amount of time required to debug the code
- Is intellectually interesting; how novel is the model from an academic point of view.

The four types of starting CGE models were evaluated against each of these criteria as shown in the following chart. On balance, the RID IEP concluded that monopolistic competition with heterogeneous firms is most suitable for use for the RID IEP.

[21] A new water system reduces barriers to entry (i.e., fixed costs to create a private water system). This puts old firms at a competitive disadvantage compared to new firms. This effect can be analyzed with monopolistic competition with heterogeneous firms.

20. Evaluation Of Four Types Of Starting CGE Models

CRITERION	PERFECT COMPETITION	OLIGOPOLISTIC COMPETITION	MONOPOLISTIC COMPETITION WITH HOMOGENEOUS FIRMS	MONOPOLISTIC COMPETITION WITH HETEROGENEOUS FIRMS
Good Explanatory Power For How Changes Occur Over Time	●	●	●	●
Resembles Real-Life Market Structures	—	●	○	●
Permits Disaggregation Of Households And Labor	●	●	●	●
Permits Factor Mobility	●	●	●	●
Relatively Easy To Calibrate	●	—	○	—
Relatively Easy To Customize	—	●	○	●
Availability Of Owner's Manual	●	●	●	●
Moderate Mathematical Complexity	●	—	○	○
Is Intellectually Interesting	—	○	○	●

Note: ● – fully meets criterion; ○ – partially meets criterion; —: does not meet criterion.
Source: RID IEP Analysis.

The evaluation suggested that monopolistic competition with heterogeneous firms is best alternative. The greatest weakness of this alternative is that it is not relatively easy to calibrate. However, this is largely solvable by applying sufficient resources to the model and by having sufficient supplementary data about the economy (as will be the case with the firm and household data collected by the RID IEP).

<u>Actual Starting CGE Model.</u> At this point the RID IEP had decided to use a monopolistic competition with heterogeneous firms CGE model. This was the overall goal. As we reflected on how best to reach that point there were two options. The first was to take such a model "off the shelf" from authors who are not part of the RID IEP team. The second option was to use an existing perfect competition model extensively used by members of the RID IEP team (Professor M. Alejandro Cardenete) and then modify it to reflect RID IEP requirements.

To the end, the RID IEP felt that it was less risky to take an existing very-well-known model and then modify it for RID IEP purposes. This modification will be done during fieldwork.

J.4 SELECTION OF CGE SOLVER SOFTWARE

The RID IEP will use GAMS (General Algebraic Modeling System) as the CGE model solver. As noted previously, a CGE model is a large non-linear system of simultaneous equations, such as the following, with many parameters to solve for.

$$U(C_h, C_g, S) = \ln\left(\theta \int C_h{}^{\rho} dh + C_g{}^{\rho}\right) + \gamma \ln W$$

GAMS is specifically designed to help create the model (structure it) and then solve the system of linear, nonlinear and mixed integer equations. GAMS is especially useful for handling large, complex, one-of-a-kind problems which may require many revisions to establish an accurate model. GAMS is widely used in general equilibrium type economic models.

There are good reasons GAMS is one of the most widely used software for CGE modeling. GAMS lets the user concentrate on modeling. Models are described in concise algebraic statements which are easy for both humans and machines to read. GAMS is flexible and powerful; many model types are available. Models are fully portable from one computer platform to another. GAMS facilitates sensitivity analysis and models are developed and documented simultaneously.

<u>One Aside About Solving Systems Of Equations.</u> Comparing the number of parameters to estimate and the number of equations affects the solution method. If the number of parameters is less than (<) the number of equations then the parameters can be internally calculated. That is, GAMS will estimate the parameters by itself. However, it is possible that the results might not be internally consistent – part of the modeler's art.

If number of parameters is greater than (>) the number of equations then the parameters cannot be internally calculated. In this case external data is needed to calibrate. For the RID IEP CGE analysis, data from the micro-models (*e.g.*, cost behavior) will illuminate the parameter estimation.

J.5 <u>SELECTION OF PRODUCTIVE SECTORS</u>

The upper left quadrant of the SAM comprises the productive sectors of the Studied Economy. The quadrant comprises an equal number of columns (money from) and rows (money to). Each column or row is one productive sector. The CGE analysis, based on the SAM, creates results (*i.e.*, assesses impact) for each of the productive sectors, in addition to results in all the other parts of the SAM.

A key CGE analysis decision is what productive sectors to use in the CGE analysis. There are several factors that influence this decision as described in the following paragraphs.

<u>Number Of Productive Sectors.</u> The total number of productive sectors in the SAM (and the CGE model) should be from 30 to 40. On the one hand, having many sectors makes the CGE analysis more informative; some researchers have created CGE models with more than 100 sectors with estimates of impact in all 100 sectors.

On the other hand, having many productive sectors creates data availability problems and greatly complicates model formulation. Separate data and production functions are needed for each sector. Note that the number of cells in the SAM requiring data and the number of equations with parameters to estimate in the CGE model generally increase as the square of the number of sectors. It is true that many sectors have identical production functions (only parameters-to-estimate differ, and this is initially done by the CGE model solver) but, nevertheless, having many sectors does complicate the modeling process.

The conventional wisdom is that from 30 to 40 productive sectors properly balances gaining suitable information on impact and modeling difficulty. This number of sectors is only possible if there is suitable underlying data. This will be the case for the SAMs for each of the RID cities and, reportedly, for the national SAM as well.

It should be noted that one or two of the productive sectors are catch-alls (*e.g.*, other food manufacturing, other transport). These catch-all sectors include all intermediate production that is not included in the specifically named sectors.

Selection Criteria Of Sectors. Now that the target number of productive sectors was known the question became one of selecting which sectors are important enough to warrant their own column and row in the RID IEP SAM and CGE model.

Obviously, the productive sectors should be of interest to the RID IEP. The RID IEP used several criteria to define the productive sectors of interest:

- The list of productive sectors – as a whole – should be suitable for answering the Key Research Questions
- Selected productive sectors should be intensive water users; intensity of use can come from either 1) the production process used (*e.g.*, the beverage sector needs much water to produce beverages) or 2) the co-location of many people with mostly domestic water needs and (probably) a single water meter (*e.g.*, prisons, military bases, hospitals)
- Productive sectors should be important to the Studied Economy (*i.e.*, the number of firms or shares of GDP should be more than a little); productive sectors can be important at the local RID city level or nationally
- The list of productive sectors should be the same for all national and city-level SAMs; this means that many rows and columns will be close to zero in many SAMs as not all sectors are important in all RID cities.
- Suitable business expenditure data (intermediate consumption) and household expenditure data (final consumption) should be available at the national level.

The RID IEP started with a list of candidate productive sectors and sub-sectors that are intensive water users or relevant for the economy of RID cities or both. This was formed based on the information from site-visits to the RID cities. Water utility companies provided us with the data about the top water users in their cities. This information and also our own observations gave guidance to assessing water intensity and relevance of productive sectors. The following chart shows the sectors generally relevant to the RID cities:

21. Cities In Which Particular Sectors Are Intensive Users Of Water

SECTOR	RID CITY WHERE SECTOR IS MAJOR WATER USER
Big Hotels	Kobuleti, Borjomi, Bakuriani
Small Hotels	Kobuleti, Borjomi, Bakuriani, Poti
Guesthouses	Bakuriani, Kobuleti, Bakuriani
Port And Sea Transport	Poti
Transport Via Railways	Poti
Beverages	Borjomi, Kutaisi
Hospitals And Other Health Services	Kutaisi, Poti, Borjomi, Kobuleti
Government	Kutaisi
Public Defence	Kutaisi, Poti, Kutaisi
Fishing	Poti
Forestry	Poti
Logistics	Poti

Source: RID IEP Analysis

<u>Productive Sector Choice Process.</u> The published national sector classification by DS was the starting point. This document incorporates 17 main sectors and disaggregates each of them into a maximum of five levels (*i.e.*, sector, sub-sector, group, class and so forth). In total, the Georgian economy comprises more than a 1 000 sub categories of sectors.

A filtering process was used to reduce the 1 000 candidate sub-sectors to 30 to 40 productive sectors to be incorporated in the SAMs and CGE analysis.

Scores of A, B or C were given to each potential sector to access their intensity of water use and size[22] relevance while also bearing in mind other criterion for evaluation.

First, priority was given to the water intensity measure at the level of RID cities. All candidate sub-sectors that are intensive water users in one or more RID cities were included in the list.

Second, all economically important candidate sectors (with significant contribution to local GDP) in one or more RID cities were added to the list.

Third, those candidate sub-sectors that are intensive water users or are economically important at the national level (but are not intensive water users or economically important in any RID city) were added to the list.

Finally, keeping in mind the need for the "catch-all" productive sectors the rest of the economy was included at their highest aggregated level according to the DS classification.

Following is a chart that represents list of selected sectors as a result of evaluation.

[22] Size relevance of a sector is defined by number of firms in it. Scores are defined as follows: for RID cities A: more than 100 firms; C: less than 7 firms; B: in the middle. At the national level: A: more than 200 firms; C: less than 50 firms; B: in the middle

22. Evaluation And Selection Of SAM Sectors

SECTOR GROUP	#	SECTOR	HIGHEST SCORE AMONG RID CITIES OR NATION WIDE		KEY SECTOR FOR RID IEP
			INTENSITY OF WATER USE	SIZE RELEVANCE	
Agriculture	1	Grains, Fruits, Vegetables And Crops	B	A	Yes
	2	Fishing	B	A	Yes
	3	Forestry	B	A	Yes
	4	Irrigation	A	C	Yes
	5	Other Agriculture	B	C	No
Mining And Quarrying	6	Mining And Quarrying	B	C	No
Manufacturing	7	Beverages	A	A	Yes
	8	Other Food Manufacturing	B	A	Yes
	9	Other Light Manufacturing	B	B	No
	10	Manufacturing Of Construction Materials	A	C	Yes
	11	Other Heavy Manufacturing	B	B	No
Electricity, Gas, Steam And Hot Water Supply	12	Production And Distribution Of Electricity	A	B	Yes
	13	Production And Distribution Of Gas	A	B	Yes
	14	Production And Distribution Of Water*	A	B	Yes
Tourism	15	Big Hotels	A	A	Yes
	16	Small Hotels	A	C	Yes
	17	Guesthouses**	A	C	Yes
	18	Restaurants	A	B	Yes
	19	Other Tourism Services	C	C	No
Transport And Logistics	20	Transport Via Railways	A	A	Yes
	21	Sea Transport And Ports	A	A	Yes
	22	Other Transport	B	C	No
	23	Logistic Services	A	B	Yes
Post And Telecommunications	24	Post And Telecommunications	C	A	No
Trade	25	Retail Trade***	A	A	Yes
	26	Car Washes	B	B	No
	27	Other Trade	A	C	Yes
Construction	28	Construction	B	A	Yes
Financial Intermediation	29	Financial Intermediation	C	B	No
Commercial Services	30	Other Washing Services	C	A	No
	31	Other Commercial Services	A	C	Yes
Education	32	Education	B	B	No
Health Care And Social Assistance	33	Hospitals And Other Health Services	A	A	Yes
Communal, Social And Personal Services	34	Sewer Services	A	C	Yes
	35	Other Communal, Social And Personal Service	B	B	No
Activities Of Exterritorial Organizations and Bodies	36	Activities Of Exterritorial Organizations and Bodies	C	C	No
Public Defense	37	Public Defense	A	B	Yes

Source: RID IEP Analysis

The result is a total of 37 productive sectors for the RID IEP SAMs and CGE models. The table above gives the aggregated name of the sector according to DS classification indicated in the first column and while also showing evaluation results in other columns.

Evaluation Results For Selected Sectors. Based on the score of the sectors for their intensity of water use or size relevance, those were identified which are relevant for RID IEP analysis indicated in the last column of the table above. These results were derived from the following scale:

23. Scale For Defining Sector Relevance For RID IEP

Scale		
Combined Score	**Number Of Sectors**	**Sector Relevance For RID IEP**
AA	6	Yes
AB	6	
AC	7	
BA	5	
CA	2	
BB	5	No
BC	3	
CB	1	
CC	2	
TOTAL	37	n.a.

Source: RID IEP Analysis

All sector that score A for at least one criterion among two, are considered to be relevant for RID IEP. Note, that scores itself are assigned, those that are maximum result for the sector at RID city and national level. For example, sector named Beverages is given highest score for its size relevance which is not the case at national level. But, on the other hand this sector is a big participant of the local economies of two RID cities Borjomi and Kutaisi following from the fact that there is Big Brewery named "Aia" in Kutaisi and "Borjomi "mineral water producer factory in Borjomi city.

All sectors that have combined score that do not entail "A" are included in the list only for the purpose of "catching all sectors".

Finally, the decision of sector list ensures 1) that the final combination would be sufficient to answer the Key Research Questions and 2) that suitable data is available at the national level. There has been long debate with DS about finalizing list to suit data availability constraints. For example, Military Bases were one of the top water users in one of RID City, but DS was not able to provide intermediate consumption at this level. The solution was to extract sector named Defense from government institutions, which also includes Police, but for which data is available.

<u>RID IEP-Specific And EuroStat Productive Sectors.</u> The final list of productive sectors for the RID IEP is customized to meet the needs of the RID IEP. However, it is non-standard and will not be directly comparable to SAMs and CGE models in normal use.

Consequently, the RID IEP will also use a standard list of productive sectors as specified by EuroStat.

24. SAM Columns And Rows According To International Standard

	Productive Sectors
1	Agriculture
2	Mining And Quarrying
3	Manufacturing
4	Electricity, Gas, Steam And Hot Water Supply
5	Tourism
6	Transport And Logistics
7	Post And Telecommunications
8	Trade
9	Construction
10	Financial Intermediation
11	Commercial Services
12	Education
13	Health Care And Social Assistance
14	Communal, Social And Personal Services
15	Activities Of Exterritorial Organizations and Bodies
16	Government Institutions

Source: RID IEP Analysis.

J.6 SELECTION OF NON-PRODUCTIVE SECTORS

There is no established standard for listing non-productive sectors of the economy for SAM used for CGE. But, there are definite components that should be included such as: production factors (labor, capital), households, saving/investment, Government and the rest of the world (ROW).

Considering the Key Research Questions of the RID IEP and data availability from DS for constructing the national SAM the following disaggregation was made for non-productive economic agents of the Georgian economy.

Labor as a factor of production is differentiated by gender only. DS is able to provide data about labor needed for the SAM only by female and male labor force. Therefore, for national SAM we will be able to observe impact on labor only by gender. While for local SAM we are able to evaluate effect on labor categories by salary and position. This type of disaggregation of labor was described in details in previous sections.

Households are disaggregated into three income categories to observe the effect on poverty and inequality.

Government is disaggregated in two ways. First, Public Defense as an intensive user of water was included in productive sectors. Second, tax receipt account of the Government is devoted separate columns. All the rest of Government institutions are included in sector named Government.

DS is able to provide separate data about seven tax categories paid to Georgian government. Therefore we include each all of them separately.

Same composition of non-productive part is used for both Standard and RID IEP specific SAMs.

J.7 FINAL SOCIAL ACCOUNTING MATRIX DESIGN

The key design decisions discussed in previous Sub-Sections gives the final form of the RID IEP SAM and CGE model. There will be two variants, one with productive sectors usually used by researchers, including EuroStat and one with the productive sectors optimized for the needs of the RID IEP.

Productive sectors usually used by researchers are in accordance with international standards of classification of economy sectors. 17 sectors used by DS follow the same standard. The purpose for RID IEP of using this so-called ‘standard SAM” is to account for aggregated impact on the economy which might be different from disaggregated one.

For example, in RID IEP SAM Agriculture is divided into 5 groups, while standard SAM will accounts for Agriculture as a whole. Impact of water can be positive or negative for each of five different agriculture sub-sectors, but net effect might equal to zero as a result of opposite effects canceling each other. Therefore, we need to include two variants of SAM to observe aggregated effect and disaggregated one of new water system.

The following two charts show the columns (and the identically named rows) that are in the two variants of the RID IEP SAM and CGE model.

25. SAM Columns And Rows According To International Standard

	Productive Sectors
1	Agriculture
2	Mining And Quarrying
3	Manufacturing
4	Electricity, Gas, Steam And Hot Water Supply
5	Tourism
6	Transport And Logistics
7	Post And Telecommunications
8	Trade
9	Construction
10	Financial Intermediation
11	Commercial Services
12	Education
13	Health Care And Social Assistance
14	Communal, Social And Personal Services
15	Activities Of Exterritorial Organizations and Bodies
16	Public Defense
#	**Non-Productive Sectors**
1	Labor (Male)
2	Labor (Female)
3	Capital
4	HHs With Low Expenditure
5	HHs With Medium Expenditure
6	HHs With High Expenditure
7	Government
8	Personal Income Tax
9	Dividend Income Tax
10	Corporate Profit Tax
11	Property Tax
12	VAT Tax
13	Excise Tax
14	Other Taxes
15	Import Tariffs
16	Savings/Investment
17	Foreign Sector

Source: RID IEP Analysis.

Standard SAM represented in above table has 16 productive sectors as opposed to 17 by DS. This is due to fact that last sector named “Producing activities of households for own use “has a tiny share in overall economy and it was disregarded for our analysis.

26. SAM Columns And Rows For RID IEP Variant

#	Productive Sectors	#	Non-Productive Sectors
1	Grains, Fruits, Vegetables And Crops	1	Labor (Male)
2	Fishing	2	Labor (Female)
3	Forestry	3	Capital
4	Irrigation	4	HHs With Low Expenditure
5	Other Agriculture	5	HHs With Medium Expenditure
6	Mining And Quarrying	6	HHs With High Expenditure
7	Beverages	7	Government
8	Other Food Manufacturing	8	Personal Income Tax
9	Other Light Manufacturing	9	Dividend Income Tax
10	Manufacturing Of Construction Materials	10	Corporate Profit Tax
11	Other Heavy Manufacturing	11	Property Tax
12	Production And Distribution Of Electricity	12	VAT Tax
13	Production And Distribution Of Gas	13	Excise Tax
14	Production And Distribution Of Water	14	Other Taxes
15	Big Hotels	15	Import Tariffs
16	Small Hotels	16	Savings/Investment
17	Guesthouses	17	Foreign Sector
18	Restaurants		
19	Other Tourism Services		
20	Transport Via Railways		
21	Sea Transport And Ports		
22	Other Transport		
23	Logistic Services		
24	Post And Telecommunications		
25	Retail Trade		
26	Car Washes		
27	Other Trade		
28	Construction		
29	Financial Intermediation		
30	Other Washing Services		
31	Other Commercial Services		
32	Education		
33	Hospitals And Other Health Services		
34	Sewer Services		
35	Other Communal, Social And Personal Service		
36	Activities Of Exterritorial Organizations and Bodies		
37	Public Defense		

Source: RID IEP Analysis.

J.8 COMPOSITION OF SOCIAL ACCOUNTING MATRIX (SAM)

A social accounting matrix (SAM) is a comprehensive, economy-wide set of accounts that quantify economic flows (incomes and expenditures) in an economy for a given period of time (usually one year). Mathematically, a SAM is a square matrix in which each account is represented by a row and a column. Each cell shows the payment from the account of its column to the account of its row. Thus, the incomes of an account appear along its row and its expenditures along its column.

The underlying principle of double-entry accounting requires that, for each account in the SAM, total revenue (row total) equals total expenditure (column total).

This section describes the inflows in and outflows from each component of SAM to other components- same as description of composition of each SAM cell. For illustration purposes

SAM table is represented that entails all basic elements but in aggregated group compared to RID IEP specific SAM described previously.

27. <u>Composition Of Columns And Rows Of SAM</u>

	Expenditures									
Receipts	Productive Sectors	Labor	Capital	Households	Government	Direct Taxes	Indirect Taxes	Savings/Investments	Foreign Sector	Total Incomes
Productive Sectors	Cell#1:Intermediate consumption of goods		Cell#14: Money Paid For Capital Owned by Firms	Cell#16: Consumption Of Final Goods	Cell#10: consumption and Transfers			Cell#11:Demand On Investment	Cell#12:Exports And Transfers	Domestic Consumption
Labor	Cell#2: Wages Paid For Labor Factor				Cell#30: Wages Paid For Labor Factor					Labor Factor Income
Capital	Cell#3:Expenses for Capital Factor				Cell#31:Expenses for Capital Factor					Revenues Of Capital
Households	Cell#4:Transfers	Cell#13: Wages Paid To HHs Holding Labor	Cell#15: Money Paid For Capital Owned by HHs	Cell#17: Inter-household Transfers	Cell#22:Transfers/ Subsidies				Cell#23:Transfers And Remittances	Revenues Of HHs
Government	Cell#5:Transfers(other than taxes)		Cell#32: Money Paid For Capital Owned by Gov	Cell#18: Transfers		Cell#26:Direct Taxes Paid By Firms	Cell#27:Inirect Taxes Paid By Firms		Cell#28:Foreign Transfers To Government	State Revenues
Direct Taxes	Cell#6:Income Tax And Other Direct Taxes			Cell#19: Property Tax And Other Direct Taxes	Cell #32 Direct Taxes paid By Government					Revenues From Direct Taxes
Indirect Taxes	Cell#7:VAT And Other Indirect Taxes				Cell #34 Indirect Taxes paid By Government					Revenues From Indirect Taxes
Savings/Investments	Cell#8:Firm Savings			Cell#20: Household Savings	Cell#24:Public Deficit/Surplus				Cell#29:FDI And Other Investments	Aggregated Savings
Foreign Sector	Cell#9:Import And Factor Incomes			Cell#21: Transfers	Cell#25:Transfers					Outflows To Foreign Sector
Total Expenditures	Expenses Of Firms	Value Added Of Labor	Value Added Of Capital	Expenditures of HHs	State Expenditures	Expenditures On Direct Taxes	Expenditures On Indirect Taxes	Investments	Receipts From Foreign Sector	Total Expenditures /Incomes

Source: RID IEP Analysis

<u>Productive Sectors.</u> 37 sectors described in previous sections are described here referred as productive sectors as a whole.

Column for this account represents expenditure breakdown of the productive sectors which includes following components:

- Intermediate consumption of each productive sector of goods from other sectors such as: products used in production process, transaction costs, marketing costs, transportation costs and etc (Cell #1)
- Expenditure of producers on labor as a factor of production (Cell #2)
- Expenditure of producer on capital as a factor of production (Cell #3)
- Money transfers of firms to households, like dividend income for owning shares of firms (Cell#4)
- Money transfers (other than taxes) of firms to government (Cell#5)
- Value Added Tax and other indirect taxes paid by productive sector participants to Government (Cell#7)
- Income tax and other direct taxes paid by productive sector participants to Government (Cell#6)

- Savings of firms, all the money not spent on this year and kept for increasing production in the next year (Cell#8)
- Money flow from productive sector to foreign sector for buying imported goods and also accounting for factor incomes (Cell#9).

The row named Productive Sectors (first row) describes income sources of productive sectors as follows:

- Intermediate consumption of each productive sector of goods from other sectors such as: products used in production process, transaction costs, marketing costs, transportation costs and etc (Cell #1)
- Consumption of final goods by state and other transfers/subsidies of Government to productive sectors (Cell #10)
- Demand on investments in productive sector (Cell #11)
- Export of domestic final goods by foreign sector and other transfers to productive sectors from abroad (Cell #12)
- Revenues of firms from owning capital (#14)
- Consumption of final goods by consumers and other transfers of households to productive sectors (Cell #16).

Labor Accounts Expenditure of labor is represented by the second column and it includes following components:

- Wages paid by firms to households who hold labor force (Cell#13).

Income Sources (row 2) of labor force include:

- Wages paid by firms for hiring labor as a factor of production (Cell #2)
- Expenditure of Government on labor as a factor of production (Cell #30).

Same values refer to the corresponding cells of column of female and male labor force.

Capital Account Expenditure of Capital is represented by the third column and it includes following components:

- Money paid by firms for capital that is owned by households (Cell #15)
- Money paid by firms for capital that is owned by firms (Cell #14)
- Revenues of government from owning capital (Cell #32).

Income sources (row three) of capital account include:

- Expenditure of producers on capital as a factor of production (Cell #3)
- Expenditure of Government on capital as a factor of production (Cell #31).

Household Accounts Expenditure of households represented by column four includes:

- Consumption of final goods by consumers and other transfers of households to productive sectors (Cell #16)
- Inter-household money transfers (Cell #17)
- Transfer of households to government, like fines (Cell #18)
- Direct taxes like property tax paid by households to government (Cell #19)
- Saving of households of productive sector (Cell #20)
- Money transfers of households to foreign sector (Cell #21).

Income of households represented by row four includes:

- Money transfers of firms to households (Cell#4)
- Wages paid by firms to households who hold labor force (Cell#13)
- Money paid by firms for capital that is owned by households (Cell #15)
- Inter-household money transfers (Cell #17)
- Money transfers/subsidies of state to households (Cell #22)
- Money transfers/subsidies of foreign sector to households , including remittances (Cell#23).

Values are same for corresponding cells of households of all income groups.

Government Accounts Expenditure of the Government represented by column five includes:

- Consumption of final goods by state and other transfers/subsidies of Government to productive sectors (Cell #10)
- Money transfers/subsidies of state to households (Cell #22)
- Government savings that is same as Public Deficit/Surplus (Cell #24)
- Money transfers of Government to foreign sector (Cell #25)
- Expenditure of Government on labor as a factor of production (Cell #30)
- Expenditure of Government on capital as a factor of production (Cell #31)
- Direct taxes paid by Government (#32)
- Indirect taxes paid by Government (#34).

Incomes sources of the Government represented by row five includes:

- Money transfers (other than taxes) of firms to Government (Cell#5)

- Transfer of households to Government, like fines (Cell #18)
- Value Added Tax and other indirect taxes paid by productive sector participants to Government (Cell #26)
- Income tax and other direct taxes paid by productive sector participants to Government Direct taxes and transfers paid by households to Government (Cell #27)
- Transfers / subsidies of foreign sector to Government (Cell #28)
- Revenues of Government from owning capital (Cell #32).

Taxes Accounts Money outflows from direct taxes, indirect taxes are represented by column six and seven include:

- Value added Tax and other indirect taxes paid by productive sector participants to Government (Cell #26)
- Income tax and other direct taxes paid by productive sector participants to Government Direct taxes and transfers paid by households to Government (Cell #27).

Money inflows to direct taxes represented by row six and seven include:

- Value added Tax and other indirect taxes paid by productive sector participants to Government (Cell#6)
- Income tax and other direct taxes paid by productive sector participants to Government (Cell#7)
- Direct taxes like property tax paid by households to Government (Cell #19)
- Direct taxes paid by Government (#32)
- Indirect taxes paid by Government (#34).

Saving/Investments Accounts Money outflows from saving/investment represented by column eight include:

- Demand on investments in productive sector including FDI (Cell#11).

Money inflows to saving/investment represented by column eight include:

- Savings of firms (Cell#8)
- Saving of households of productive sector (Cell#20)
- Government savings that is same as Public Deficit/Surplus (Cell#24)
- Foreign sector savings counting FDI (Cell #29).

Foreign Sector Accounts Money outflows from foreign sector represented by column nine include:

- Export of domestic final goods by foreign sector and other transfers to productive sectors from abroad (Cell#12)
- Money transfers/subsidies of foreign sector to households , including remittances (Cell#23)
- Transfers / subsidies of foreign sector to Government (Cell#28)
- Foreign sector savings counting FDI (Cell#29).

Money inflows to foreign sector represented by column nine include:

- Money flow from productive sector to foreign sector for buying imported goods and also accounting for factor incomes (Cell#9)
- Money transfers of households to foreign sector (Cell#21)
- Money transfers of government to foreign sector (Cell#25).

All the rest of cells have zero values.

J.9 SAM BALANCING

The quality and internal consistency of data in a SAM is an important driver of the quality of a CGE analysis. Typically, data in a SAM comes from a variety of sources with different meanings of questions and different time frames. It is also common to have to update a SAM with new data for only a portion of the SAM cells.

A key feature of SAMs is that the sum of a particular column (money spent by an economic player) must equal the sum of the matching row (money received by the same economic player). Not surprisingly, when data comes from a variety of sources the column sums usually do not equal the row sums. This necessitates the adjustments are made to the data so that the columns and rows balance. This Sub-Section discusses how SAMs will be balanced for the RID IEP.

SAM balancing is a very common problem facing CGE modelers. As a result, well established methods exist for performing the balancing. There are even some very practical how-to guides for balancing SAMs.23

In fact, the SAM balancing or updating problem is nothing but a particular case of the well-known matrix balancing problem of the linear algebra literature (Rothblum and Schneider 1989, and Schneider and Zenios 1990).

The technique most commonly used in updating a SAM is the RAS or biproportional method. The appeal of RAS arises from its extremely simple algorithmic implementation and its applicability (Jensen 1980). Its conceptual and mathematical properties are fully described in Bacharach (1970). More recently, entropy techniques from information theory have been adapted by Golan et al. (1994), Thissen and Logfren (1999) and Robinson et al. (2001) for the updating of input-output tables and SAMs. However RAS and entropy methods are closely

[23] Balancing A Social Accounting Matrix: Theory And Application; Fofana, Lemelin and Cockburn (2005).

related as Bacharach (1970, chapter 6), Schneider (1989), Schneider and Zenios (1990) and McDougall (1999) have pointed out. Indeed, in addition to the iterative scaling method of rows and columns, RAS can also be formulated as a nonlinear entropy minimization problem for the matrix of total transactions.

Accepting that SAM data is not readily available in as regular a basis as desired, updating techniques that use prior data plus partial new information will somehow alleviate the problem of not having an actual newer SAM. If we denote by A^0 an available SAM matrix, an updated matrix $\hat{A}^1$ is a projection of the matrix A^0 but it is also an estimate of the "true" but unknown matrix A^1. The distance between A^0 and $\hat{A}^1$, however minimized, entails an error, unknown in magnitude if A^1 is itself unknown, between $\hat{A}^1$ and the true matrix A^1, as Jian (2002) has recently shown using Monte Carlo simulations. When the true matrix is finally available, it is possible to measure ex-post the accuracy involved in each of the different updating procedures. Limited to input-output tables, this is the approach followed by Jensen (1980), Szyrmer (1989) and Jackson and Murray (2003), who present a thorough discussion and testing of the RAS procedure in terms of ex-post accuracy and prediction power. But when the true matrices are unknown, the usual recourse is to perform an ex-ante evaluation measuring the proximity between the given initial matrix and the updated ones (see Thissen and Logfren 1999, and Robinson et al. 2001).

The RID IEP will use the cross entropy method to adjust or calculate missing values in the SAMs. This method minimizes the distance between a known SAM and a projected (unknown) one. It does it by minimizing the squared-difference between each cell in both of them, weighing that difference by the relative importance of each entry in the known SAM. The minimization is subject to the constraints imposed by (updated) aggregate data in the projected SAM. This method can be used to help construct local SAMs from national ones, update national SAMs from local ones or to build future SAMs from current ones based on forecasts for some aggregate variables.

A way of thinking of RAS and cross entropy is suggested by classical information retrieval theory, a branch of computer science concerned with developing efficient methods of retrieving information from a data bank (Salton and McGill 1983). Whenever a query for data is formulated, a retrieval algorithm fetches documents in a data bank that are closely related to the query in some similarity sense. The higher the similarity between the query and the information contained in the retrieved documents, the more successful is the algorithm. Notice that a base SAM can be seen as a query for the true but unknown document SAM and an information retrieval algorithm will fetch from the data bank (the set of feasible SAMs) one with information content closely matching that required by the query.

J.10 CALIBRATION METHODS

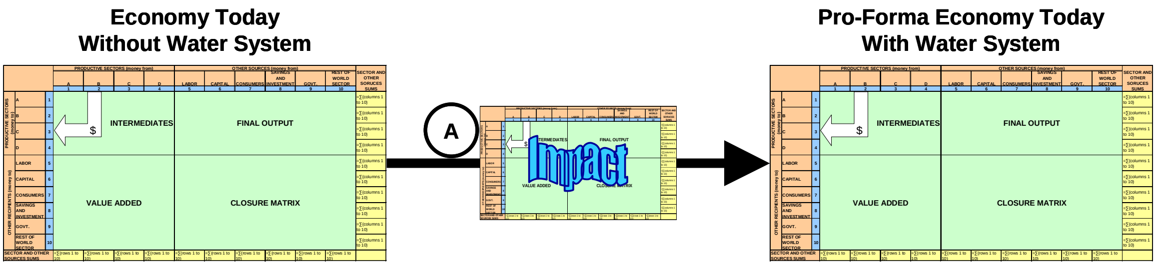
Calibration consists, as is well known, in determining a set of coefficients and parameters that, under the first order conditions derived from the optimization problems of agents, allows the model to replicate the database as benchmark equilibrium of the regional economy. We obtain the following set of parameters after calibration: a) the technical coefficients of production sectors, both domestic and foreign; b) the technical coefficients for primary factors that produce unitary Value-added; c) the share coefficients of the utility functions for consumers; and d) the tax parameters which allow us to define the effective tax rates for all taxes, both the direct and the indirect ones.

J.11 <u>FORECASTING IMPACT</u>

In order to assess the impact of the RID projects in the medium- to long-term the RID IEP will use a standard forecasting technique for CGE models. This Sub-Section describes how the RID IEP will do this.

A – Immediate Impact. The usual way to estimate impact is to start with a balanced SAM (without a new water system), calibrate a CGE model to the SAM, introduce new technology into the CGE model, let the SAM rebalance using the new technology to create an updated SAM (with a new water system) and, finally, compare the two SAMs (without and with the new water system) to estimate impact. This is shown schematically in the following chart where the immediate impact is shown as A (the differences between the two SAMs).

28. Schematic Of Estimating Impact From RID Project

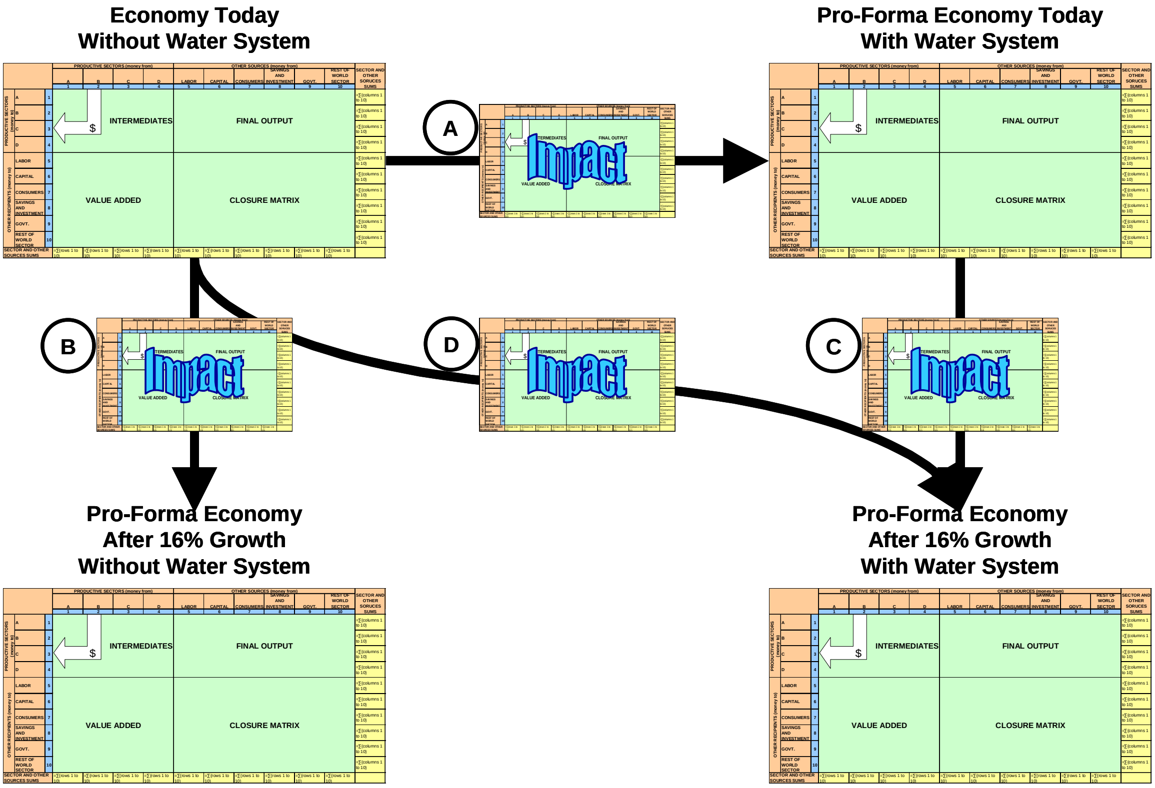


Source: RID IEP.

Typically, there is no reference to the time period it will take to reach the pro-forma state; it is assumed to occur immediately.

Apply An Exogenous Change. The RID IEP will then apply an exogenous change to both the economy today without and with the water system. For example, GDP is assumed to be 16 percent greater, stemming from an annual growth rate of 3 percent for five years. The GDP cells in the SAMs (and some related ones) are changed accordingly. The SAMs no longer balances (*i.e.*, the sum of each column does not equal the sum of the matching row). This is an unbalanced SAM. The cross-entropy method is used again to rebalance the SAMs. As shown in the following chart, there are three new comparisons of SAMs (that is three new measures of impact), that bear on the forecast.

29. Schematic Of Forecasting Impact From RID Project



Source: RID IEP Analysis.

B – Growth Without A New Water System. The impact of growth in the absence of a new water system is shown as B in the chart. This will show changes in sectoral output, wages, employment and so forth without a new water system but with a 16 percent growth of GDP (driven by the entire Georgian economy).

C – Growth With A New Water System. The impact of growth in the presence of a new water system is shown as C in the chart. This also shows changes in sectoral output, wages and so forth.

D – Combined Impact Of Water System And Growth. The overall impact of both the new water system and overall GDP growth is shown as D in the chart. As before, this shows overall changes in output by sector, wages and so forth.

Range Of Scenarios. To the end, comparing the results A through D gives a very good understanding of how the new water system influences the effect of an exogenous change on the Studied Economy. Even better understanding is achieved by testing a range of scenarios.

Economies experiences periods of expansion and contraction, although the length and depth of these cycles can be irregular. These recurring patterns of recession and recovery are called business cycles. Currently, the Georgian and the global economy are experiencing serious problems and it is a challenging task for economists to forecast the length and depth of the current and future business cycles. Given the level of complexity and uncertainty of future outcomes, economists usually develop a range of possible scenarios and assess possible outcomes given scenario assumptions. Business cycle indicators, such as GDP growth, industrial production index, capacity utilization rate, level of unemployment, inflation and several other exogenous variables are considered and each of them is assigned a value under every possible scenario.

The impact of the RID projects clearly depends on possible future economic scenarios – effects will be either amplified by the general healthiness of the economy, or attenuated due to economic downturns.

To understand the size of impact of the RID projects, several scenarios will be considered. Under each scenario the values of business cycle indicators will be agreed upon and then the impact of the RID projects for that scenario determined. We will also examine the impact of the RID projects over several time scales and for specific sectors of the economy and locations.

As one complex example, we can forecast the effect of the RID projects assuming five percent constant average growth rate of Georgian GDP with three percent annual growth in global demand for touristic services. Another scenario could be seven percent GDP growth with a four percent increase in global demand for tourism. Impacts can be investigated through changes in consumption, wages and profits in different sectors such as tourism and construction, sector-specific and overall productivity and also whether there are multiplier effects from the complementary MCG projects.

The following chart shows four possible scenarios and values of business cycle indicators:

30. Four Possible Scenarios To Test For Forecasting Purposes

EXOGENEOUS VARIABLE	SCENARIO			
	CONTRACTION	STAGNANT ECONOMY	MODERATE GROWTH	EXPANSION
GDP Growth	(3%)	0%	6%	12%
Industrial Production Growth	(2%)	1%	5%	11%
Capacity Utilization Rate	70%	80%	90%	95%
Construction Industry Growth	(5%)	0%	7%	12%
Demand Growth For Touristic Services	(5%)	0%	8%	14%

Source: RID IEP Analysis.

The RID IEP will work with MCG to develop a range of scenarios. The impact of the RID projects under each of those scenarios will be determined as described above.

Why The Effects Of RID Will Be Different Under Different Scenarios. Based on initial observations, it is expected that improved water supply and sanitation services will save significant costs for businesses, motivate potential investors to start new business and so forth. Whether these things happen depends on the economic scenario.

In a contracting economy capacity utilization rate of industrial producers fall and, as a result, they will not invest saved money to expand their business. This means that there is no multiplier effect from the RID projects; the amount of money saved by businesses is the only impact of the RID projects.

The situation is different when the economy is expanding. For example, given high demand for touristic services hotels will reinvest saved water-related costs to expand their businesses. This means that they will generate additional income from saved expenses creating a multiplier effect.

An additional impact of the RID projects that can be amplified comes from households. People in RID cities spend considerable time securing water supplies. Once they get 24/7 water supply, they will be able to work more and receive commensurately larger wages if there is demand for additional labor. It is likely that this is particularly true for women, who bear many of the difficulties of unstable water supplies. In a contracting economy, unemployment increases, while in an expanding economy demand for labor increases, suggesting higher chances of finding a job and generating additional income.

APPENDIX K

MICRO-SIMULATION ANALYSIS

K MICRO-SIMULATION ANALYSIS

This appendix discusses micro-simulation in more detail than does Chapter 9. There are four Sections. The first Section briefly introduces the concept of micro-simulation; this is a repeat of the material in Chapter 9. Then there are discussion of the type of micro-model and the links to CGE Analysis in the next two Sections. The next Section introduces the RID IEP Micro-Simulation Model. The final Section shows results of a sample analysis using data from the CRCC.

K.1 BACKGROUND

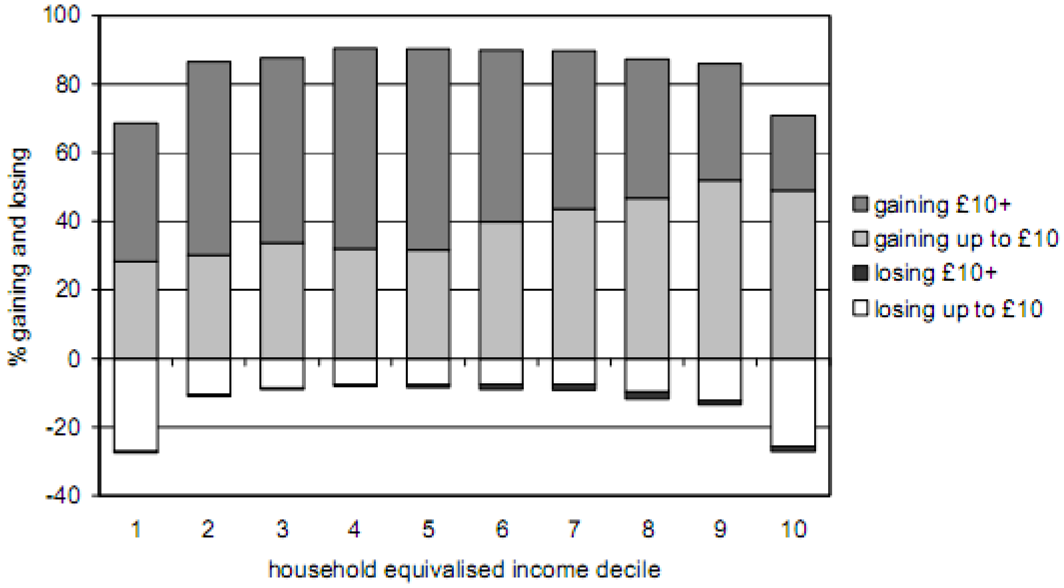
Micro-simulation is a type of partial equilibrium model in the sense that it analyzes a single subsection of the economy; the rest of the economy is considered to be exogenous. Micro-simulation is often used to assess changes in distributions of incomes or expenditures.[24] They are useful because they can detect exactly the fraction of the population that gains or loses from an economic change, and the magnitude of their gain or loss. This method will be used by the RID IEP to assess distributional effects of the RID projects.

For example, imagine a specific household with a certain income. There is a market price for all goods. The specific household consumes a certain quantity of each good, with total consumption and the consumption of each good being a function of the specific household's income, price level of each good and the consumption function for the specific household. Now introduce a change that causes prices to change (*e.g.*, a new water system). There is a new total consumption and consumption of each good. The change in consumption (overall and by good) is the effect of the change *on the specific household*. One can perform this same analysis for every household under study (*i.e.*, all households in the survey dataset) to determine the differential effect of the change *on all households*.

An example of such a result is shown in the following chart. This shows the effect of tax policies in the UK. The chart shows the percentages of the population that benefited from a particular set of changes and those who did not, separated out by income decile. As can be seen, the impact was not equal across income levels. We anticipate reporting similar type results for impact of the RID projects.

[24] For example, *Who Pays Indirect Taxes In Russia?* Decoster and Verbina, World Institute for Development Economics Research, 2003. This paper describes in very simple terms how micro-simulation was applied to an existing dataset to answer the titled question.

31. Example Of A Micro-Simulation Showing Effects On Distribution Of Household Income

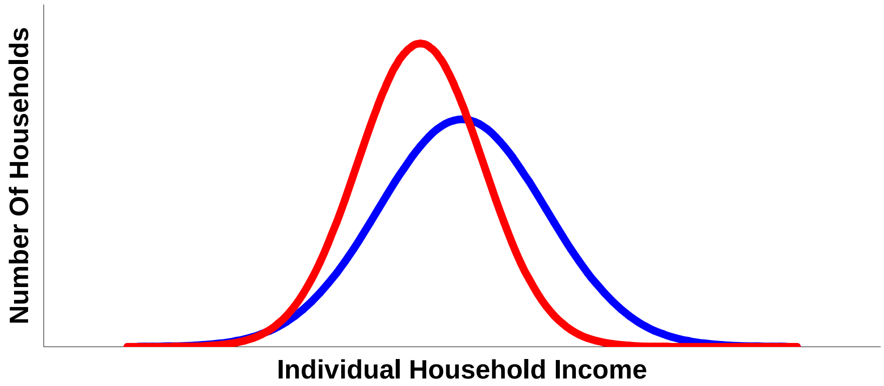


Source: ***Five Labour Budgets (1997 - 2001): Impacts On The Distribution Of Household Incomes And On Child Poverty*; Holly Sutherland**

For the RID IEP the analysis will proceed as follows. The household expenditure survey will be done among individual households. The data will be used to create SAMs and CGE models for each RID city. The new water system will be introduced creating new prices and incomes. These price and income changes will be applied to the individual households with a micro-simulation to determine differential effects.

Results will be of the type shown in the following chart.

32. Schematic Output Of RID IEP Micro-Simulation On Distribution Of Household Income



Source: RID IEP Analysis.

K.2 LEVEL OF ANALYSIS

Micro-simulations analyses vary by level of effect analyzed as described in the following three Sub-Sections.

K.2.1 Micro-Accounting (arithmetical)

These types of micro-simulations measure the effects of changes without changing the behavioral response of micro-economic agents; only first-order effects are captured. For example, the effect of price changes on consumption in a particular household is analyzed while the change in work/leisure is not. This will be the approach taken by the RID IEP.

K.2.2 <u>Behavioral.</u>

These models capture both first- and second-order effects, which mean that not only price changes on income distribution of households but also the change in behavior of consumers is considered in defining the final effect on income and poverty. The RID IEP will look at these effects in only a general way as time permits.

K.2.3 <u>Static vs. Dynamic Models</u>

There is also choice for incorporating time in micro-simulation models. Consequently, the model can be static or dynamic. Static models consider only one period for modeling as opposed to dynamic models that also involves future periods.

We will use a static micro-simulation model because it is easier to derive. Dynamic micro-simulation models are new in economic analysis and still the area of investigation. Moreover, static model can be used for changes appearing from 1 to 5 years as it is expected in our case of water system change.

K.3 <u>MICRO-SIMULATION ANALYSIS LINKED TO CGE ANALYSIS</u>

The overall economic effects of the RID projects will be determined through the CGE analysis. Those overall effects could be linked to the micro-simulation analysis in three ways as discussed in the following paragraphs. The RID IEP will use the first approach.

K.3.1 <u>Top-Down</u>

A CGE analysis computes macro-economic variables (*e.g.*, price level, growth rates). Then these macro-economic variables are used as inputs to the micro-simulation model. There is no feedback to the CGE model from the micro-simulation model.

K.3.2 <u>Bottom-Up</u>

In the bottom-up linkage, the representative household (*e.g.*, income, labor supply, tax payments) in the CGE module is calibrated based on the simulation results of the micro-simulation modules.

K.3.3 <u>Top-Down Bottom-Up.</u>

The first two approaches suffer from the drawback that not all feedback is used. The top-down bottom-up approach combines both methods through recursion. In an iterative process, one model is solved, and then information is sent to the other model, which is solved and gives feedback to the first model. This iterative process continues until the two models converge.

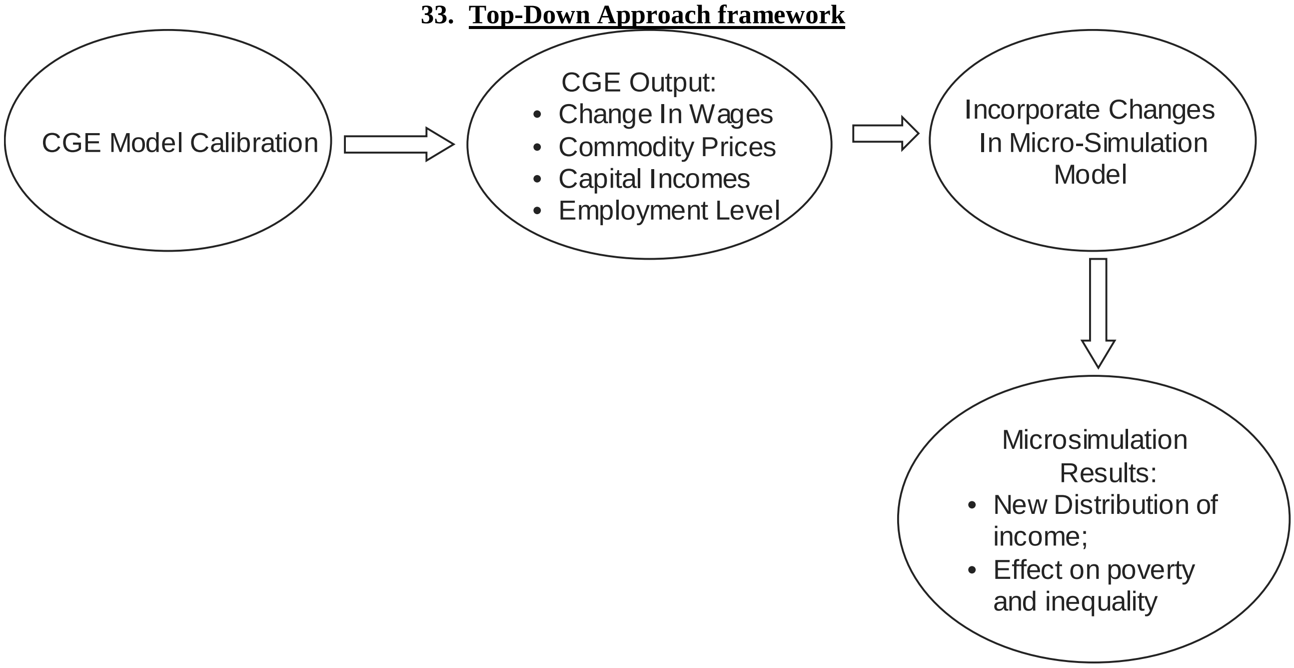
K.3.4 <u>The RID IEP Approach</u>

The RID IEP will use the Top-Down approach as we only intend to measure impact on poverty not captured by the CGE analysis. That is, the CGE analysis will give overall impact and micro-simulation will only be used to address distributional issues. Consequently, the influence runs mostly from CGE analysis to the micro-simulation analysis. The top-down approach is particularly suitable for macro-reforms.

K.4 THE RID IEP MICRO-SIMULATION MODEL

As noted previously the RID IEP will use the Top-Down approach to linking the CGE analysis to the micro-simulation analysis. The reform is simulated first at the macro-level with the CGE model and then results are passed onto the micro-simulation model. The link is through a vector of changes in some chosen variables such as prices, wage rates and unemployment levels.

33. Top-Down Approach framework



Source: RID IEP Analysis.

There is an applied behavioral micro-simulation modeling by Pr. Bourguignon used for poverty analysis called discrete choice labor supply model. The main variable of the model is the income of individuals that includes all types of incomes (e.g., wage income, capital income). On the other hand, the income of individuals is affected by their choice of status on labor market of being wage labor, self-employed or inactive / unemployed.

The following Sub-Sections describe the main concepts of the classic Bourguignon model. It should be noted, that our micro-simulation model will be based on but not identical to the Bourguignon model. Certain corrections and specifications will be incorporated subject to the micro-data obtained.

K.4.1 Behavioral Part Of Poverty Micro Simulation Model

The only behavior of individuals that Bourguignon's work considers is the choice of labor status. The model assumes that it is the most relevant behavioral change that affects income of individuals. Econometric equations for the behavioral part of the model are as follows:

34. Behavioral Part Of Micro-Simulation Model (Bourguignon 2003)

Regression model for log-wage earnings:	$Log(YL_{mi}) = a_{l(mi)} + b_{l(mi)} \cdot X_{mi} + c_{l(mi)} \cdot \lambda_{mi} + v_{mi}$	(1)
Choice of labour market status:	$LM_{mi} = \alpha_{g(mi)} + \beta_{g(mi)} \cdot Z_{mi} + \varepsilon_{mi}$	(2)

Equation (1) is called the income generating model. It shows how labor income is defined by characteristics of the individual (variable X). The characteristics also consider the status of the individual on the labor market, which can be self-employed or wage worker. Equation (1) is not estimated for inactive individuals. We can run the first equation for many different sub-groups of people to arrive as a suitable classification scheme.

Equation (2) shows the probability distribution of labor status choice for each individual. In other words, the equation suggests which labor status individuals with certain characteristics are most likely to have.

Purpose of this equation for poverty analysis is described in detail latter with an example.

K.4.2 Accounting Part Of Poverty Micro Simulation Model

Econometric equations for the accounting portion of the model are as follows:

35. Accounting Part Of Micro-Simulation Model (Bourguignon 2003)

Household *m*'s income generation model:	$Y_m = \sum_{i=1}^{NC_m} YL_{mi} \cdot W_{mi} + YE_m - taxes_m$	(3)
Household specific consumer price index:	$PCI_m = \sum_{s=1}^{10} \eta_{ms} \cdot P_{ms}$	(4)
Households' real income:	$Y_m = \frac{Y_m}{PCI_m}$	(5)

Equation (3) is the calculation of income for each household by summing all types of incomes of each member. Equations (4) and (5) show calculations of price vector and real income correspondingly.

The accounting part of the micro-simulation analysis does not count the effect of system change through behavior. It is cold accounting because in involves mathematical calculation. None of equations are estimated as opposed to behavioral model.

K.4.3 Linking CGE With Micro Simulation Model

Output from the CGE analysis, used by the micro-simulation model, includes changes in commodity prices, wage rates, capital returns and employments rates. The CGE analysis gives changes in these items due to the new water and sewer systems.

The linking procedure of the two models is done by incorporating all these macro-economic changes in the micro-simulation model by maintaining constraints as follows:

36. Linking CGE Model Results In Micro Simulation Model (Bourguignon 2003)

Household specific consumer price index:	$PCI_m = \sum_{s=1}^{NG} \eta_{ms} \cdot P_{ms} \cdot \left(1 + \Delta P_s^{CGE}\right)$	*(L.1)*
Logarithm of wage earnings:	$Log\left(YL_{mi}\right) = Log\left[\hat{YL}_{mi} \cdot \left(1 + \Delta PL^{CGE}\right)\right]$	*(L.2)*
Capital income:	$YK_m = KS_m \cdot \left(1 + \Delta PK^{CGE}\right)$	*(L.3)*
Employment level:	$\Delta EMP_l^{MS} = \Delta EMP_l^{CGE}$	*(L.4)*

Equation (L.1) is the incorporation of change in commodity prices. L.2. and L.3. show changes in wage rates and capital incomes. The last constraint (L.4) states that the percentage change in employment given by the CGE analysis must equal the percentage change of employment rate for micro-data on households. After counting all changes we get the new distribution of incomes for households and we can calculate the Gini coefficient that gives us the effect of the new water and sewer systems on poverty.

K.5 TESTING THE RID IEP MICRO SIMULATION MODEL ON CRRC DATA

We tested the above mentioned model on the individual-level micro data available from the Caucasus Research Resource Center (CRRC) in Georgia. CRRC gathers the database every year since 2004 which includes information about households covering demographics, household economic behavior, migration trends and social attitudes across the South Caucasus. The surveys' results are made public and they provide analytical opportunities for local researchers.

K.5.1 The Data And Assumptions

For the purpose of our analysis, we chose the latest data of 2008 from the same survey of the Georgian population. The only section of the data considered to be interesting for us is the one describing economic behavior of individuals. The same section gives the main dependent variable of the model – income. Individuals are asked to choose their range of monthly income from the provided options.

Assumptions for tested model are as follows:

- For simplicity of calculation (for the accounting part of the model) we have downsized the sample of 2000 individuals to 556
- Our final model calculates the poverty of households, while this quasi-model considers only individual level poverty for the purpose of easiness of calculations; otherwise, we would have summed up the individual level data by each household and perform large number of calculation for accounting part because of the large size of the sample
- In the behavioral part of the model we test income generating model, because the rest of behavioral part requires complicated econometric analysis of MLE estimation
- For simplicity of the model we do not consider log form of income generating model

- In the accounting part of the model we calculate only labor income model, because CRRC data does not include information about capital returns and commodity prices
- We assume that the only sources of incomes for households are those considered in income generating model, which are also assumed to be earnings of households from wage work and self-employments only
- Capital Return change and commodity price change are disregarded for the moment; only input from CGE model to micro-simulation is considered to be employment level change.

Finally, the model looks as follows:

37. <u>Income Generating Model For Poverty Based On CRRC Data</u>

$$Y_i = \alpha * settype + \gamma * gender + \delta * educyrs + \phi * age + \varphi * emptype$$

All variables considered in the equation denote characteristics of individual i that explains personal income are:

- Settype: Settlement type of individual (capital, urban or rural)
- Gender: Gender of individual
- Age: Age of individual
- Educyrs: Years of education of individual (except primary)
- Emptype: Employment type of individual (self-employed; wage worker)

Estimation of the model coefficients in Stata software by running simple OLS regression gives the output as follows:

38. Stata Output For Income Generating Model (Bourguignon 2003)

```
      Source |       SS       df       MS              Number of obs =     556
-------------+------------------------------           F(  5,   550) =   20.92
       Model |  3294801.48     5  658960.297           Prob > F      =  0.0000
    Residual |  17322590.6   550  31495.6193           R-squared     =  0.1598
-------------+------------------------------           Adj R-squared =  0.1522
       Total |  20617392.1   555  37148.4542           Root MSE      =  177.47

------------------------------------------------------------------------------
  persincome |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     settype |   60.69398   11.06192     5.49   0.000      38.9652    82.42276
      gender |  -97.90071   15.02883    -6.51   0.000    -127.4216   -68.37978
     educyrs |   2.393362    .972692     2.46   0.014     .4827159    4.304007
         age |  -1.746804    .518096    -3.37   0.001    -2.764493   -.729115
     emptype |   30.45088   11.74897     2.59   0.010     7.372548    53.52922
       _cons |   263.6509   43.28718     6.09   0.000     178.6225    348.6793
------------------------------------------------------------------------------
```

Source: RID IEP Analysis.

39. Estimated Income Generating Model For Poverty Based On CRRC Data

$$Y_i = 60{,}3 * settype - 97{,}9 * gender + 2{,}3 * educyrs - 1{,}7 * age + 30{,}45 * emptype$$

The next step is to link CGE to micro-simulation. Suppose, after calibration of CGE model the water system change showed the increase of wage rate and employments level by 20 percent and 10 percent correspondingly. For the purpose of incorporating these two changes into micro-simulation data the following conditions should hold:

- For working individuals we directly calculate new incomes for each individual performing calculation of multiplying old income by 20 percent; no current workers lose their jobs

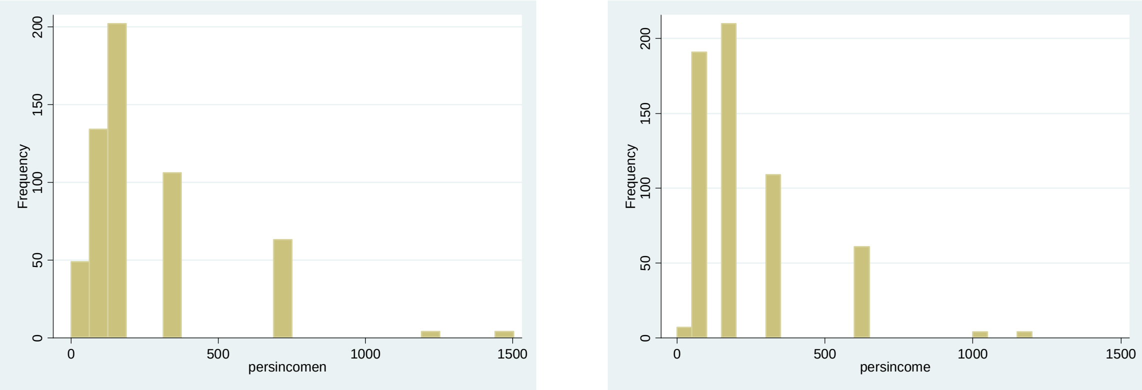
- Change in employment by CGE analysis should be equal to change in employment for micro-data.

Elaborating on the second point, the 10 percent increase in employment causes individuals who were unemployed in the beginning to alter their behavior through changes in employment status. Maximum likelihood estimation will indicate which individuals among the newly employed became self-employed or wage workers. After defining new working status of the inactive workforce, income generation model will allow the estimation of their incomes by the equation shown above. Finally, new estimated income will be multiplied by 20 percent to incorporate the accounting change.

K.5.2 Results Of Poverty Model Based On CRRC Data

The final output of the analysis conducted above is the new distribution of individual incomes after the water system changed, which was obtained due to simulation. Comparison of the stated distribution with the old one will allow calculation of two important measures for the poverty analysis: change in inequality and poverty levels. Followed are the distributions of incomes of individuals from CRRC data in the initial and simulated states.

40. Initial And Simulated Individual Income Distributions (based on CRRC data)

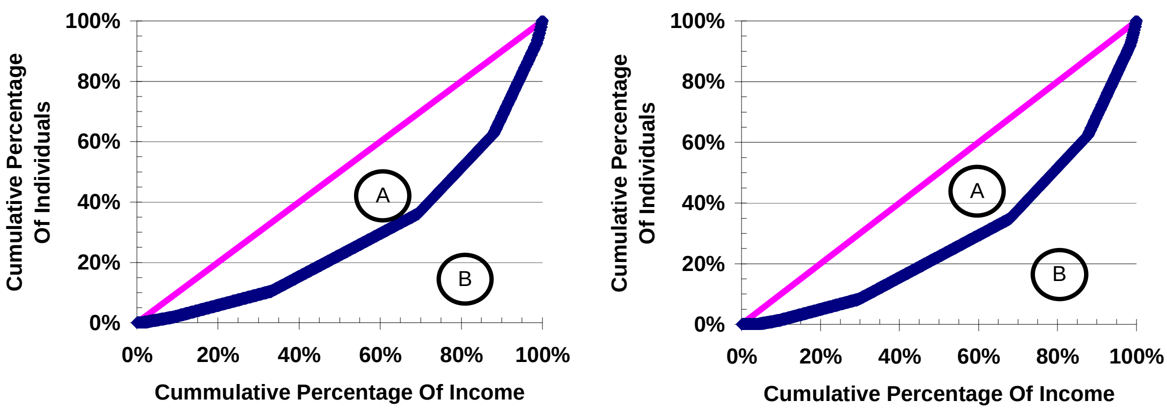


Source: RID IEP Analysis.

The left hand side of the chart shows the income distribution of individuals before the system change; the right had side shows the income distribution of individuals after the system change. Comparing the charts shows that in the new state there is a drop in the number of individuals in some lower income groups and increase in the number of individuals in other income groups. However, it is not possible to draw conclusions from this presentation of results.

A typical way to interpret changes in income levels is with Gini coefficients, coming from Lorenz curves. These are shown in the following chart. The linear segments in the curve stem from the discrete ranges of income in the CRRC data. If actual income (or expenditures) is continuous, as will be the case for the RID IEP, the curves will be smooth.

41. Before And After Lorenz Curves Illustrating Inequality Effect



Source: RID IEP Analysis.

The formula for the Gini coefficient is as follows:

42. Formula For Gini Coefficient

$$Gini = A/(A+B) = A/0.5 = 2A = 1-2B$$

Source: RID IEP Analysis

Following this formula, Gini coefficient for CRRC data equals changed from 0.419 to 0.422. The closer the Gini coefficient is to 1 the larger is the inequality between income groups. Therefore our tested micro-simulation on CRRC household data showed a small increase in inequality.

The micro-simulation also give results about the effect on poverty. The following chart shows results for each income group. It shows the average change in income among individuals that started in the income group and the total change in income among all individuals that started in the income group.

43. Effect Of Change On Poverty (levels of income)

STARTING INCOME GROUP	TOTAL FOR ALL INDIVIDUALS	AVERAGE
Zero To 50 (including)	373	7
50 To 100	1 353	10
100 To 150	5 157	25
150 To 300	5 460	51
300 To 600	7 320	120
600 To 1000	0	N/A
1000 To 1200	800	200
More Than 1200	960	240

Source: RID IEP Analysis

The following chart shows the movements of individuals between income groups as a result of the change. The first column is the starting income group while the columns are the ending income groups. For example, among the 208 individuals that started in the 100 To 150 income group 199 of them saw their income rise by an amount from zero to 50.

44. Effect On Poverty(In Quantities)

STARTING INCOME GROUP	NUMBER OF INDIVIDUALS WHOSE INCOME CHANGES BY INDICATED AMOUNTS							TOTAL
	FALLS BY MORE THAN 200	FALLS BY 200 TO 100	FALLS BY ZERO TO 100	RISES FROM ZERO TO 50	RISES FROM 50 TO 100	RISES FROM 100 TO 200	RISES BY MORE THAN 200	
Zero To 50 (including)	0	0	1	50	0	0	0	51
50 To 100	0	4	2	133	0	0	1	140
100 To 150	0	6	2	199	0	1	0	208
150 To 300	3	0	0	0	105	0	0	108
300 To 600	0	0	0	0	0	61	0	61
600 To 1000	0	0	0	0	0	0	0	0
1000 To 1200	0	0	0	0	0	4	0	4
More Than 1200	0	0	0	0	0	0	4	4
Total	3	10	5	382	105	66	5	576

Source: RID IEP Analysis

APPENDIX L

L LIST OF RID IEP METRICS

APPENDIX M

M LIST OF RID IEP DATA ELEMENTS