Rotary PPP Team for Mwanga, Tanzania

Report on Visit of January 2013

PPP Team

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In collaboration with the District of Mwanga, Kilimanjaro, Tanzania, and the Village Councils of each village, some Ward Councilors, and Mayors

With grateful appreciation to the leaders and villagers in Lambo, Kituri, Kileo, Kiruru, Lembeni, Mforo, Kisangiro
and the subvillages Kichwa Ng'ombe and Mkizingo.

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Final Report: July 2013

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APPENDICES

Executive Summary.

Overview and Goals

In January 2013 this Program Planning and Performance Evaluation (PPP) Team traveled to the Kilimanjaro Region of Tanzania to work with local Rotarians, government officials, and residents in the District of Mwanga. The PPP Team was requested to identify community needs through stakeholder interviews and documentation of existing facility capacity. Then based upon the needs assessment, consider alternatives for addressing the identified needs and make design recommendations for WaSH projects in needy villages in the area.

The goals of the Team were to:

- Assess the current status of water supplies, sanitation and hygiene practices.
- Personally view conditions in each village, listen to leaders and women about their needs, view homes and outbuildings, water sources, toilets, and learn of the daily activities and challenges they face.
- Gather village data and utilize the Decision Support Tool from UNC (University of North Carolina), and integrate it into our data gathering and decision process; and to provide field observation for Ryan Cronk, an MS Water Engineer student from UNC;
- Identify opportunities to improve sanitation, hygiene, and increase the availability of clean water
- Work with the Rotary Club of Moshi-Mwanga, and Mwanga District office and its water engineer, to generate base information for large scale sustainable WaSH projects.

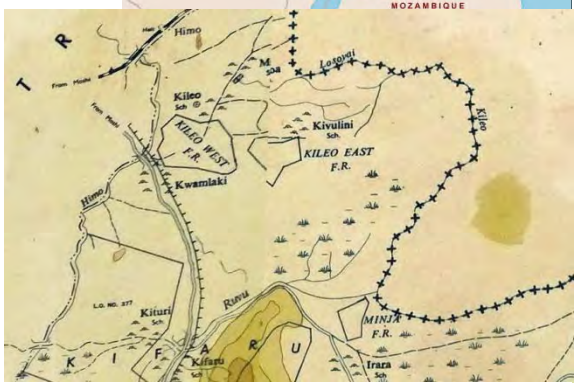
This report discusses the results of the study, and provides recommendations for projects to the Rotary Club of Moshi-Mwanga and their international partners, Rotary International and The Rotary Foundation, Wasrag, and others, to further the design and implement a program to improve sanitation and the availability of clean water for these villages in the Mwanga District.

Country

Tanzania is a large country in East Africa, where rural access to clean water and adequate sanitation is low. Insufficient water, mostly of poor quality, contributes to high childhood mortality rates, lowered education levels, low life expectancies, economic hardship, limited agriculture and lesser chance for self-improvement, medical and health problems which could be avoided, much personal suffering and overall poverty.

Region

Mwanga is approximately 100 kilometers south of Mt. Kilimanjaro, and surrounded by internationally acclaimed wild game parks. Much of Mwanga is semi-arid lowlands with the majority of people living in scattered villages of a few hundred to several thousand residents.



1 Map of some Northern Villages in Mwanga

Sparse rainfall comes in two seasons, with long dry seasons between. The water sources for humans and domestic animals were mostly developed in the 1950s to 1970s and are now in poor condition. The area needs new and rehabilitated water supplies, and villages also need assistance with improved sanitation and personal hygiene practices. The water table is lower than in the past, but in reach of

boreholes with submersible pumps.

The Regional Secretariat provides local government support for districts in policy, technology, budget, and coordination with some agencies. An engineer is employed by GIZ, a German technology firm hired to assist the Regional Secretariat, and he is assigned to assist the Same and Mwanga areas.

Communities
The communities we were asked to visit were selected by the Mwanga District and its water engineer, in consultation with Rotary Club members, based on high community need for water (highly rationed or unavailable), the government inability to provide water, and the lack of support from other NGOs or funders. Each community had unique aspects, but all shared a profound scarcity or lack of water, and all had a single-minded goal to improve the water situation. (Specific information on each community can be found on page 17).

Approach
Local Rotarians and the district water engineer organized our visits to the communities. The PPP Team prepared by searching and reading about Tanzania (WaSH need, water policy, water point measurement, etc.), news about WaSH work in the area, and listening to team members Gerald and Tanzania Rotarians and the Elibariki & Amon about the history of their clubs and projects. We also spent time, emails and group discussion on logistics of the trip, preparation, defining our roles and how to prepare.

The host Rotarians and district water engineer provided invaluable assistance in sharing their experiences and formative plans. They also helped arranged to recruit young professionals to assist in community surveys using the UNC Decision Support Tool. In each village we attended community meetings, listened to statements or testimonials by both leaders and women, often greeted with a welcome dance, food and drink. We asked, and were given permission, to visit three homes – low, middle and high socio-economic status, as selected by each community.

We asked for several forms of baseline information in advance of the field visit (national standards and data maps, studies, NGOs working, current projects, etc.). We also did field water quality tests, and took a few representative samples to a qualified testing lab in Arusha, the nearest large city. And we had a number of very interesting small *ad hoc* group discussions, in the villages.

Collaboration & Need
In every community, we received the full cooperation from leaders, women and men who spoke up at meetings, from the owners of homes we visited, and during informal discussions as we walked about the village. At all levels (district officials, water engineer, Rotarians and community leaders & members), it was made clear that there would be full cooperation with Rotary, that all we needed to do was ask and receive assistance -- and that water was the highest priority community need expressed. This cohesion and unanimity is significant and favorable.

To ensure our final recommendations met the needs of the communities, conditions, social and culture aspects, and practical concerns, we discussed our tentative findings and recommendations with the District water engineer, Regional Secretariat water engineer-advisor, and the key local Rotarians. We also reviewed the draft of this report with them.

Stakeholders
The most significant stakeholders are:

- RC Moshi-Mwanga
- Ward and community councilors and mayors
- The most influential women in each community.

- District Council and Water Engineer, Public Health depts.
- Regional Secretariat Water Division (including Klaus Schaffer, Engineer)
- Ministry of Water, and Education
- Water providers (NGOs, shops, kiosks)
- NGOs willing to be partners
- Pangani Water Board

Potential partner NGOs were named, and we had a brief meeting with staff members of Compassion International Tanzania child ministry development center, World Vision and Empower Tanzania; but no clear partnerships with Rotary exist at present. A new potentially beneficial partnership may be with Water Missions International, an engineering NGO.

Local Rotary Capacity

Moshi-Mwanga is a newer Rotary Club, has some project experience, and a few members have been involved in community work for NGO employers or Rotary projects. Club leaders are encouraging all club members to join in the project work.

We note this club is qualified under the New Grants Model, as well as with the Tanzania Division of Home Affairs (see Appendix H). The small size and member makeup, however, leaves us concerned about its capacity to single-handedly initiate, implement and manage projects of this magnitude. For this reason, we recommend that they engage both a Tanzanian Project Manager and a local community development specialist familiar with the area.

We are confident that the local Rotarians and water engineer for the Mwanga District will be able to do many aspects (e.g. identify and work with contractors and community leaders), and they will continue to be actively involved and jointly direct the projects. The local Rotary club receives strong support from AG Faye Cran, but little direct support from country or District 9200 leaders. There is no Rotary WaSH team for the country or region to support this Rotary club, although Wasrag has attempted on several occasions to work with Rotary leaders to form one.

Use of This Report

Included in this report (Appendix J) is a bibliography of resources accumulated during the visit. Copies of the final report on a flash drive will be provided to each team member, the District water engineer, and Regional Secretariat water engineer advisor with all these resources included, so they can be used in continued planning. Included will be all maps, contracts, plans, reports and baseline data and many photos we took during our visit. Copies of the report will also be posted on the Wasrag website at www.wasrag.org.

Project Planning

This report, with our findings and recommendations, can be a basis for continued local planning by the Rotarians and the Mwanga District water engineer, guiding them in the criteria for choosing villages, the project scope, some good and appropriate methods, early low cost alternatives, and the focus and attributes of each community's WaSH project. Given our limited time, the long reports, documents and maps provided during the visit, it was not feasible to further define each project or develop detailed budgets for the projects and still provide a timely report. If we had a few more days on the ground plus time to connect with service providers that might have been feasible, and we could have explored potential partnerships in person with other NGOs, discussed technical issues and borehole location with the Pangani Basin Water Board (PWB), and probably set the stage for collaboration with the national Water Ministry.

Findings

Water is very scarce in all the villages we visited. This results in diarrhea and disease, open skin sores, many hours every day for women and girls to find and haul water, a loss of income from growing crops, raising animals and milk production, villagers being forced to move from their home,

and increased domestic disputes. Despite two rainy seasons there is little rainwater harvesting (only a few wealthy homes and public buildings), and what exists is of poor quality.

There is some open defecation, especially while traveling on foot or while herding animals, but most homes have simple pit latrines with no hole covers. Many have concrete slabs, but some are simply holes in the ground. Most toilets are in very primitive outbuildings constructed of sticks and mud, which does not weather well. The Rotary Club of Moshi-Mwanga is working closely with the District of Mwanga and its water engineer to improve the situation, but they need assistance and international partner support to enable households to improve their situations.

Project Priorities and Summary

All of the villages we visited have a high priority need for water, and important needs for improved sanitation, toilets, hand washing and personal hygiene. Though it is hard to choose among villages, we have listed them in priority order in the table on Page __. We recommend that planning keep in mind population growth due to return of families, migration to villages with water, plus normal population growth rates. Where villages are near a common source, and shallow boreholes are not an option, we recommend shared boreholes with distribution to both; but only if they can politically share control and management, jointly decide on tariffs and how the systems will be monitored, maintained, and made sustainable.

Water Systems:

We recommend that:

- Existing pipes be tested before further use and replaced as needed.
- Where the water table is close to the ground surface, boreholes be dug using sludging or other low cost manual methods, then equipped with rope pumps (using a local experienced subject matter expert).
- In areas with deeper water tables, studies by PWB combined with satellite imagery be used to identify best locations for new boreholes, pilot boreholes be drilled to confirm the adequacy and quality of the groundwater, and production boreholes be drilled to depths that allow for future drops in the water table,
- Adequately sized storage vessels should be located to provide gravity supply to as many locations as possible.
- Distribution piping should be included to deliver water to village centers and individual homes as is practical. In villages, women, girls, boys and men should be trained in proper methods to clean water containers, store water safely, household point of use treatment, and hand washing.

Sanitation

We recommend a strategy to improve sanitation for all homes, including these aspects:

- Assure all pit latrines have slabs;
- Install covers over slab openings to prevent flies from conveying contamination.
- Assure any vent pipes are well screened.
- Make simple urinals for males and females with jugs to collect urine for dilution as fertilizer;
- instruct on best methods to collect and use animal feces as fertilizer. Then (if willing) or over time, move the community toward UDDT (urine diverting dry toilets) or ecosan toilets which fully use both human urine and feces in local plant nutrient cycles.

Hygiene

We recommend a carefully developed and strong program of personal health and hygiene, with training in hand washing, construction of simple hand wash stations like tippy taps, with monitoring of improvements in hygiene and continued change in behavior.

Monitoring

Other than anecdotal information, and known limits imposed by the District on piped water due to scarcity, there is no monitoring system. Demand, use and supply are relative unknowns, except at selected points near sources. A full-fledged monitoring system must be designed and included in each water project Rotary does, with metering, water quality testing, with assigned monitors that report to the water board and village leaders as well as the RC Moshi-Mwanga lead Rotarian.

After the trip we learned that the Pangani Water Basin is developing an information management system including a management database system, DSS (decision support system) information tools, and a GIS (geographical information system) database. They intend to link the three systems. We recommend that Mwanga District and RC Moshi-Mwanga ask PWB's assistance in using these villages in Mwanga as a test bed, to gain interest and bring more government resources to bear.

Evaluation

It is a bit early to think of who and what will be evaluated at project completion. Periodic reviews and mid-course corrections are recommended. Perhaps the NGO that Rotary partners with will have the staff able to complete needed evaluations. If not, we think the PWB or Water Ministry can recommend a party to do an independent evaluation, comparing outcomes to the original goals of the project in each village.

1.0 The Team

The Rotary Club of Moshi-Mwanga (RC Moshi-Mwanga), working with the Mwanga District engineer, began to identify villages and opportunities to help them with priority needs about a year ago. RC Moshi-Mwanga learned of the PEP Pilot, and on November 3, 2012 requested a PPP Team of professional volunteers to assist.

This PPP Team's purposes were:

- To respond to the Club's interest to assist several villages;
- To review baseline data, spring and borehole data, and the conditions and usage of toilets.
- To speak with village leaders and women, and
- To independently review suggestions by the District Water Engineer.

Because there is not yet a standing Rotary WaSH Team for Tanzania or this region, our team also provided guidance to RC Moshi-Mwanga on how to select villages it can best assist, who its strategic partners might be, and what steps it should make toward project selection, design, costing and application for a Global Grant.

This PPP Team visited Mwanga, Tanzania in January 2013, It included the following:

- **Stew Martin**, PPP Team Leader. Stew is Past President of RC Seaside in Oregon USA, District 5100; a former industrial engineer, business lawyer, District 5100 Water & Sanitation Coordinator since 2007, a member of Wasrag Operations Team since Summer 2012 with a focus on development of Regional WaSH Teams. Stew has been involved in Rotary WaSH projects for many years, in Indonesia, Honduras, India and other countries.
- **Gerald Klonglan**, Ph.D. of RC Ames in Iowa USA, District 6000. Dr. Klonglan, a rural sociologist, was on the faculty of the College of Agriculture, Iowa State University, Ames, Iowa for 39 years. District 6000 has a 10-year relationship with the three Rotary clubs of Moshi, Mwanga and Moshi-Mwanga. Matching Grants between these clubs have focused on water supply, equipping a health center, and providing a village water distribution system with 22 taps. Direct club donations have focused on economic development and education.
- **Mark Henne**, a hydrogeologist and attorney, serves as the current District Governor for Rotary District 6360 in Southwestern Michigan, USA. He is a member of RC East Lansing. Mark has worked on water and environmental studies throughout the United States, and previously in Ghana, Nigeria and Kenya.
- **Rochelle Holm,** Ph.D. in Environmental Science, with a specialty in African water quality and risk communication, living in Malawi. Dr. Holm serves as the Manager of the Mzuzu University Centre of Excellence in Water and Sanitation and its SMART Centre, which improves the living standards of people in Malawi through the provision of innovative, low cost and sustainable, water and sanitation solutions.
- **Juma Yahaya,** Water Engineer for District of Mwanga, former contract engineer with the Tanzania Ministry of Water, who has a relationship with RC Moshi-Mwanga since 2009.
- **Dr. Mark Mvungi**, Past President of RC Moshi-Mwanga 2010-2011, he is a medical doctor and serves as the clinic director at Kilimanjaro Medical Center in Moshi.

- **Tegemea Mfanga**, Secretary of RC Moshi-Mwanga, has served as a education officer for Mramba Pri. School, and previously worked for head of the unit for the deaf.

The PPP Team also received invaluable assistance from the following:

- **Ryan Cronk,** MS in Water Engineering at University of North Carolina, where his current studies funded by the U.S. E.P.A. (Environmental Protection Agency) focus on WaSH in Schools around the world.
- **Justin Rewerts**, an experienced water well driller from Nevada, Iowa, who surveyed 15 boreholes in the Mwanga area, and made video-camera inspections and recordings for 10 of them during this team visit.
- **George Dugan** water well driller, who assisted Justin.

2.0 Methodology and Approach

2.1 Team Process

Team leader Stew Martin and Professor Gerald reviewed available baseline information: including reports, NGO project summaries, and a partial list of stakeholders. The team met with government officials and a regional WaSH representative, and learned about projects worked on by NGOs. Data surveys were completed for all villages using multiple in-person visits by surveyors trained by Ryan Cronk of UNC.

The team visited villages to view living conditions, gather information about how the villagers get and use water, and learn how closely the community members meet WaSH standards. A site visit commonly began with a collective meeting with the village leaders and many were followed by a description of the meeting's goals. Information was solicited from leaders and community members. In each community, typically between 5 and 15 individuals shared personal stories about their challenges in obtaining water, and how it affects their lives or the community as a whole. The community members spoke in either the local language of the village or Kiswahili, which was translated by Rotarians, and the team members were able to gauge the reaction of other community members to what was being said. It appeared as though the relayed information was highly credible, and reflected common problems and concerns for that community.

During the community meeting, attendees were asked to collectively identify examples of three homes of community members of low, moderate, and high affluence. Later, the team viewed these homes, observed and photographed conditions along the way and spoke with villagers on a one-to-one basis. In all villages, team members were invited to enter these homes. At several villages, where feasible, the team viewed the community water taps.

These personal visits to the communities were very valuable in understanding the lifestyle and needs of the villages for improved water supplies, sanitation and hygiene programs. We were able to validate information received from other sources, gather additional data and identify gaps in our knowledge.

After visiting several communities, the team found living conditions and challenges were fairly similar throughout the group. Differences were usually in the distance to travel for water, the affordability of water, family wealth, and the quality of the water obtained (which to them is unknown). Some members of the team also viewed in-use and abandoned boreholes in the community, and water distribution points gone "dry".

2.2 UNC Decision Support Tool

Our PPP Team used a semi-automated Decision Support Tool to assist in data gathering, in six of the seven communities. Survey results are located in the table at _____. The tool was developed by Wasrag and University of North Carolina Gillings School of Health to gather relevant data, and guide decisions on WaSH technologies and community aspects.

Our team conducted some of the initial interviews. But, given the number of villages and the work involved, recruited survey people to use the tool in each village. Those detailed results helped us and can guide the Rotary club and Mwanga district engineer in the future. In summary, while we found the data gathered to be useful, the Excel tool was difficult to use. Fortunately Ryan Cronk from UNC was present, and it became more useful when all questions were condensed into a single Word table, modified to be less ambiguous, and printed for surveyors.

2.3 Country Background

Tanzania is a large East African country with many rural areas needing WaSH. About 46% of rural areas have water access and 34% have adequate sanitation. Tanzania has made good progress in reducing mortality for children under 5 years of age. Compared to neighboring countries, its mortality rate is slightly lower than Kenya but significantly higher than Rwanda. However, rural water source access is not improving significantly. (see lower Gapminder World chart at right) . We were informed that some water systems we studied were installed before Tanzania achieved its independence in 1961.

Renewable water resources have declined in this region in recent years. Poor overall functionality is attributable to ownership/management issues, age of equipment, resource type (groundwater or surface water), extraction method (pump or gravity feed), mode of payment, coverage, and distribution of domestic water points within a district or ward.

In Mwanga District, many water system components were built between the 1950s and '80s. Nationwide according to a thorough review (*Water Point Mapping - the Experience of SNV Tanzania, Pg. 3, with baseline data from Mwanga Water Department*); most pre-2005 water

production and distribution systems are not functional. A 20-year design life was typical, and a serious need exists for plans and funding for system rehabilitation and replacement.

Nationally, funding partners include World Bank through its IDA (International Development Association) program, African Development Bank, and a number of NGOs. The Millennium Challenge Corporation also contributes to the WaSH sector. NGOs and funding partners include various churches, Care International, Compassion International, ICF (Engineers Without Borders in Spain), World Vision, SAIPRO and Del Mundo Spaniola.

2.4 National and Regional Policies

The National Water Sector Development Program (WSDP) and National Strategy (NWSDS) provide for the Ministry of Water to assist PMO-RALG (Offices of Regional Administration and Local Government) to devolve services to Regional Secretariats (RS). The RS advises each District and provides technical resources including consultants from GIZ, a large German consulting firm. The link between the Ministry of Water and a regional government is the RWST (Regional Water Sanitation Team), which coordinates water supply initiatives, water use planning and allocation.

District, ward level governments, and community user associations own and manage their water systems using demand responsive approaches, participatory planning, and decentralization of services. Districts can do larger projects when they have outside funding sources, and village water committees do smaller projects directly with NGO partners and service providers.

National policy for rural areas prescribes that each district or community should fully recover operating and maintenance costs from users, including a 5% contribution to new capital costs. This does not always occur, and some donors do not ensure these systems are in place. (In urban areas, full recovery of capital costs is the goal.) It is also a national goal that 2.5% of the cost of new capital water projects be contributed by villages, typically through provision of local labor and some local materials, rarely cash. These local contributions are reflected in project budgets, and then are credited when in-kind value is delivered.

A Sector-Wide Approach to Planning (SWAP) also exists to coordinate urban and rural agencies/operators in one national investment and regulatory scheme.

Due to limited government funds, NGOs and donors provide much of the capital and technical assistance.

Tanzania contains nine designated water basins, each with its own administrative oversight. The water basin in the Mwanga area is overseen by the PWB which issues permits for boreholes installations and streams to be contained or tapped. Once a permit is issued, there is no limit in the amount of water that is removed from the source. This is a concern for long-term resource sustainability.

2.5 Geology, Hydrogeology and Climate of Mwanga District.

The Mwanga District is located in a mountainous, semi-arid region of northern Tanzania. Two mountain ranges, the South Pare Mountains to the north and Kiteto Mountains to the south, are separated by a broad, flat valley created by the alluvium that has eroded from these ranges. The valley is approximately 820 to 1000 meters above sea level, and the surrounding mountains rise to peaks of 1845 meters.

Mwanga District includes communities in multiple microclimates. The amount and duration of rain received in each microclimate is significantly influenced by the geography of each area and the overall climate of East Africa. Trade winds carry moist air from the Indian Ocean. When this air encounters the South Pare and Kiteto mountain ranges, it rises, cools and precipitates. As a result, the mountain areas surrounding the valley receive most of the precipitation throughout the year and have lush foliage even as the lowlands bake in the sun.

Rainfall in the Mwanga Valley is much more seasonal. Two rainy seasons exist within the valley and rainfall varies by season, coming mostly between November and May with a small dry season in February and March. The driest season is from June to October. Average annual rainfall in the valley is approximately 400-600mm (16-24") per annum, but sometimes as little as 300 mm (12").

See further information in **Appendix B** - **Hydrogeology of the Mwanga District**.

2.6 Needs Assessment - Profiles of Communities in Mwanga District

We assessed seven communities in the Mwanga district (see list on page 17). Data was collected using observation, quantitative survey collection from hired local enumerators, qualitative interview questions from the PPP team, and review of documents provided by district water engineer. Survey results are located in the table in Appendix D.

There have been many WaSH projects in the Mwanga area. In 1974 a storage tank was built by the Tanzania government to capture water from the Vumari spring. This spring is now dry. In the 1950s the Mwanga spring was captured and piped locally to the railroad steam engines, and to provide water for some residents in Mwanga town. The spring flow is now much reduced. The railroad no longer runs, but the storage tank and pipe infrastructure remains and could be improved.

The communities ranged in size from approximately 450 to 2300 individuals. Average household size ranged from 5 – 8 persons. Vocational activities of these communities were primarily farmers and livestock keepers. None had skill sets directly related to WASH projects. No other skill sets were identified through the survey. The average household income for people interviewed in these villages ranges from $114 to $570 annually, but many may be poorer. And, many are subsistence farmers without an annual income.

2.7 Stakeholders. We identified the following stakeholders:

- **Government Agencies.** Mwanga District Council, including the Mwanga District planning officer, District water engineer; RC Moshi-Mwanga, Ward Council, Sub-Village council, are primary stakeholders. Though involved late in our process, we believe the National Water Minister and the ministry, the Regional Secretariat, and perhaps the Pangani Water Basin should be included as stakeholder.

- **Wards & Villages:** At the community level, stakeholders vary. Six of seven villages have a village water committee, but some were relatively inactive as there has been no water project work recently. None of them have health and environment committees. Five of seven communities receive local support from the

district water engineer, though such support does not actually meet the demands of the community; and one community indicated it received support from the district health officer. One community (Kisangiro) indicated they receive support from a livestock extension officer. Community survey respondents of some villages indicated there were no NGOs that worked in their villages. We are not aware of any direct national or international support for the WaSH needs of these seven villages.

Permission and involvement of villagers is a priority to ensure the villages "own" the project work and dedicate themselves to it. We recommend that village meetings continue to be held to discuss each community's priorities, and that the village council agree on who will lead and plan any selected projects.

We learned that community plans should involve the Ward executive council. The District Engineer and local Rotarians will advise the best path. If schools are included then the District Education officer, District Executive Director (his boss) should also be stakeholders.

- **Non-Government Organizations.** Two villages indicated they had received support from NGOs. Supporters include Tanganyika Christian Refugees Service (TCRS) in Lambo village, Tanzania National Park (TANAPA) in Kileo. Other *potential* stakeholders include: WSDP (Tanzania government, Ministry of Water Resources), Moshi-Mwanga-Mwanga Water Supply and Sewerage Improvement Project (BADEA/MOW), USAID (US Agency for International Development), JICA (Japan International Cooperation Agency), and RCC/Ebenezer.

It has been noted by others studying Tanzania that districts are often understaffed and underpaid. The District office needs additional budget and personnel to do a complete job, and there should be an improved process for NGO and donor project coordination. To accomplish the contemplated projects in the seven villages, based on the team's observations, we believe there is strong motivation and sufficient community strength. We observed and heard of no political problems or strife that would be an obstacle to project design, implementation, maintenance or fair use by members of the community. Additional staff dedicated to WaSH needs of rural villages around Mwanga town would allow project planning, design, and coordination with potential donors, as well as regular monitoring.

Support and Added Resources are available from:

- SHIPO is an NGO which can assist villages in the Mwnga district with training and implementation of:: manual drilling of tube wells (SHIPO method), install and maintain rope pumps, rainwater harvesting programs, recharging groundwater, and in construction of designs for improved sanitation. Contact: Morten van Donk, Program Manager, SHIPO, E-mail: morten.shipo@gmail.com, Phone: +255 768019413
- Local consultants, we may not have met
- Church groups
- TRF and Wasrag

2.8 Environmental and Water Resources.

Five of seven villages have access to an improved water source, piped water (public tap), although the water source may be questionable. Of those with access to piped water, reliability, accessibility, and availability are of greatest concern. The distance to tap sources ranged from 100 meters to 1 kilometer and in some cases as far as 14 kilometers in those areas that have no

access to an improved water source. A few homes in each community had rudimentary rooftop rainwater harvesting systems.

WHO Core Guidelines (2011) define "access to water" to mean that it is available within one kilometer of the home, and within a 30 minute round-trip. This was not the case in any village we visited, at least for more than an occasional trickle of water.

Some poor unimproved surface sources such as seasonal streams exist in some of the seven communities, but their present methods of water treatment and storage are unhealthy. Treatment methods include straining with a cloth, occasional boiling, and very rarely use of a water filter. Primary methods of storage included plastic and clay containers. The most common vessel was a squarish, yellow, 20-liter container with narrow mouth and lid. The only NGO that is doing WASH activities in Mwanga District is SNV, which is building capacity in villages on how to start and establish Community Water User's Organizations, and proper method of water usage to the community; not providing water or sanitation facilities in the villages we visited.

Each community had inadequate (< 20 L per person per day) or low (20 to 40 L per person per day) access to drinking water. Water scarcity is a major concern in all seven villages. Water scarcity becomes more severe in the longer of two dry seasons (June to November) forcing many community residents to travel long distances to fetch drinking water or pay for water service.

Only some of the seven communities perceive their water source to be polluted; but our water quality samples indicate that several of them are likely contaminated with bacteria, and have significant dissolved solids. For instance, Mark Mvungi indicated In Kituri where the contamination was heavy, some people knew their water was not safe and they saw the result, as many children and adults were getting diarrhea diseases and some even died. Only one or two people said they tried some decontamination of the water.
NGOs are involved in these villages for HIV and female genital mutilation, but none are involved in providing water or sanitation facilities. Mwanga Rotarians or the District Water Engineer will likely need to conduct further water quality testing and conduct training on maintaining safe water.

Water can in Kitchen of Mwanga home

2.9 Health centers and schools

Health centers and schools were observed at a number of the field sites. We heard anecdotally that many of their cases are for dysentery and diarrhea due to poor water and sanitation, and that many villagers cannot go to the centers due to cost, distance, or both.

2.10 Technical

All the communities indicated an ability to conduct basic operations and maintenance if their water supply becomes non-functional. Most of the technical and repair capacity comes from the Mwanga district water engineer. Basic spare parts seemed to be readily available nearby in Mwanga, or the larger city of Moshi.

2.11. Social and Cultural

All of the communities had a clearly-identified community leader and most had committees and groups who provide support. These committees frequently included women's groups, and women are involved in decision-making. No clear disparities were found between groups, and the communities were all ethnically homogenous Christians and Muslims who live as neighbors. Communities lack technical WaSH capacity, but seem to have strong governance structures.

2.12 Gender equality; Empowerment of Women.

Women and children are the most significantly impacted by the dire need for water. It was encouraging to observe the role of women in sub-village council and environmental clubs. National policy in Tanzania requires that women should comprise two-thirds of water user committees. In the Mwanga villages there are a few more women than men, but close to 50/50. Women are clearly involved in the management of day-to-day water use and consumption, and as an integral part of domestic and community planning. The women are proud, traditional and willing to speak up towards getting water, and water improvements, even when they had a lesser role than men in community meetings. We were impressed with how male village leaders invited women to speak openly, and asked a respected elder woman to close the meeting with her comments. Empowerment may not be a significant obstacle.

2.13 Children

A high proportion of the children appeared cheerful. Some children had open skin sores, but no severe cases of malnutrition were observed. Primary and secondary schools were in the area, but some villages do not meet the national guideline for schools (one primary school per village, one secondary school per ward.)

Education is typically through Standard 7 at primary school, equivalent to grades 1 to 7 in the United States. Most village youth stop their education at Standard 7 and many drop out at Standard 3 or 4, especially boys required to tend domestic animals. Some go to secondary school (Forms 1 to 4, equivalent to grades 8-11). A few continue to Forms 5 & 6 (equivalent to grade 12 and first year of community college). After that, they are eligible to enter (a) trade and technical schools or (b) University for a three-year BA or BS degree (Engineers take four years); or (c) other specialized training. A few people in Mwanga town have bachelor's degrees, such as the District water engineer.

2.14 Cooperation and training

Everywhere we went, people were uniform in their agreement that water supply and scarcity were their number one priority. At the District, ward and village level, all assured us without prompting that rotary would have their full cooperation. The community leaders look forward to working with Rotary. The women especially are excited about the WaSH program and readily invited us into their homes, kitchen areas, living and storage quarters, bathing areas and toilets.

Rotarians and the Mwanga District are aware of and use such train-the-trainer programs. Identifying people in the villages who are willing to be trained, and who in turn will train other villagers and monitor their behavior will be critical. The villages should decide whether those trainers are volunteers or compensated; and if compensated, the initial few months of compensation might be included in the project budget.

The existing technical capacity in the District is moderate, and in wards and villages it is low.

Each village water and sanitation committee will need to select a bookkeeper, a monitor of domestic point (DP) meters, someone to administer the token system, then make total of charges to families, collect them, and account for all water used.

2.15 Village Selection.

The seven villages we investigated were selected jointly by the Mwanga District, Water Engineer, Juma Yahaya, and the Rotarians. Our Team observed that they are all suffering significant water scarcity, with no projects in process, and are not yet supported by any other funder or NGO. During our visit, we recommended that Rotarians and the Mwanga District Engineer select villages based on several factors:

- Strong community leadership,
- Need;
- Community willingness to be involved in all stages of project development and implementation.
- Status of the community's existing water and sanitation committees or other sanitation-based organization.
- Social cohesiveness of the community.
- Willingness of the community members to do much of the work themselves – to ensure these communities take ownership of the projects.

The RC Moshi-Mwanga and District Water Engineer provided the priority list.

We recommend that first priority in allocating resources be given to the more distant rural villages. The more compact and urban villages near towns are somewhat better off, closer to town water supplies, and may be able to access water service by Mwanga town through MAUWASA.

Depending on the cooperating NGO, project manager, community development person, and design choices, we recommend that one, two or a maximum of three villages, be selected for the first TRF global grant application. In this way, the project remains manageable and can be completed in a reasonable time.

For the next round of villages a second global grant can be applied for using similar or improved methods. If feasible, consider overlapping the project development and funding: as implementation for the first project is started, the second project's funding and planning commences; and as implementation is wrapping up the second global grant application is submitted, with confidence that the prior methods and timeline were successful (or improved). If a third grant is needed, it can be even more tightly overlapped.

To confirm the choice of villages, we recommend that a Rotary Community Corps (RCC) or village water committee be established, and that small self-made and low-cost projects be used to verify the commitment of villagers and their leaders. Examples are explained in the low-cost alternatives on Page 41. The RCC may be appropriate for the ward or village level, to be determined by RC Moshi-Mwanga after local discussions. Then the relationship will be firmly established for the larger, more challenging project.

The RC Moshi-Mwanga and District water engineer agree, and this PPP Team supports, working on the following villages in the priority order shown. The reasons are partially illustrated in the

table below, but also please refer to the section immediately above; **Community Findings, Water;** and **Water Supply Analysis**, among other sections for more complete explanation.

Exhibit 1: Priority villages determined by District Water Engineer and Rotary Club of Moshi-Mwanga

Priority Villages Determined by District Water Engineer and Rotary Club of Moshi-Mwanga

SubVillage (and Ward)	No. of Homes (2002 census)	No.People (2002 census)	Present Springs (S) & Boreholes (BH)	New Sources	Distribution System improvements	Reasons
Kituri	1268	6340	One borehole & handpump (children operate), river ¼ KM with crocodiles, no DP (water tap) or distribution	Sludging & rope pumps; or central borehole	None exist now. With shallow wells and rope pumps, water delivery is decentralized. With borehole, new pipe distribution is needed.	Extreme dryness, need and distance; apparent good cooperation/unity within village. A central borehole provides some benefits, also risk from single-source.
Kivulini	941	4706	Only shallow wells around their homes	Shallow wells and deep wells		Needs new source; easiest appears to be spring in Kileo. We did not visit Kivulini, but heard about it from the district engineer.
Kileo	883	4415	- One source of shallow well of Mtindi spring	Same source (Shallow well at Mtindi spring)	Exist but need an extension and some repairs.	Excellent spring source, can be used & shared with Kivulini or other neighbors; however, see preconditions.
Mforo, Kichwa Ng'ombe & Kisangiro	172	859	One deep borehole with solar power		No pipe line for distribution	3 subvillage group around existing borehole
Lembeni	730	4367	There is an existing spring at nearby village,	Deep well if possible	There is a pipe line network, but is of old age and not distributed to cover all area of the village	
Mbambua (Mkizingo)	462	2310	No source	Deep well	No source of water	

SubVillage (and Ward)	No. of Homes (2002 census)	No.People (2002 census)	Present Springs (S) & Boreholes (BH)	New Sources	Distribution System improvements	Reasons
					No pipe line at all except one old storage tank that was getting water from Kisangiro spring	
Kiruru (Ibweijewa)	683	3417	Chang'ombe spring	Deep Borehole	Exist but need an extension and some repairs.	
Lambo	686	3430	One Deep borehole	No need of New source	Exist but need an extension and some repairs.	
Mwanga Urban	3560	17,800	4 Numbers of boreholes: Two have them has been recently drilled. (April 2013)	No need of new source	Exist but need an extension and some repairs.	The plan of MWANGUWASA for Mwanga town is to extend to rural villages nearby, but it sorely lacks supply, plus distribution to them. Rotary having a role and cost-sharing f0r the rural part of this makes sense.

Note: 2012 census figures will be available in 2013. Figures used in this table are from the 2002 census with approximately 3% per year annual increases.

Here is added detail about some villages:

Kituri. This community has a large area of several square kilometers located in the lowlands. Houses are scattered throughout the area, with occasional clustered settlements. When we first entered the village center, a child was pumping water from a borehole with a large metal hand pump. While walking around the largest cluster of dwellings, the team learned that a few hand-dug covered pits were used to retrieve groundwater from a depth of approximately two meters. During the dry season, the water level drops and although it becomes more difficult to retrieve water from the pits, water does remain available. At another location within the village, a hand-dug borehole had been equipped with a demonstration rope pump to retrieve water, installed by the NGO SHIPO located in Southern Tanzania.

Kileo. This village near Kivulini has water source at Mtindi spring, and could share it. There are pipe leaks, as no high-pressure testing is done, only normal operating pump or gravity pressures. Vandalism or illegal connections can be spotted from the surface, with water spraying or wet soil surface.

Mforo is in a three sub-village group that surrounds a relatively new borehole, installed by a private donor.

Lembeni. Here exceptional community closeness and cohesion were observed, along with the respectful way women are involved in the community discussion.

3.0 Community Findings – Water Situation.

3.1 Findings.

At all levels of the community, from local government to individual women in sub villages, water scarcity is the priority issue. Every day, women and children individually spend many hours gathering water. Collectively, the time spent obtaining water is enormous. This time would be much better spent learning, engaging in entrepreneurial activities, and improving personal hygiene. This social cost caused by not having water is high and debilitating.

The daily lives of residents in Mwanga District are limited by the availability, lack of delivery, and quality of water. It is scarce up to eight months of the year. Many hours, major effort and family financial resources are expended getting water and making it more drinkable.

Livelihood. Most villagers are subsistence farmers. Although many grow crops, much of the population herds cattle, goats, and some sheep. When insufficient water is available for livestock (much of the year), milk production is reduced or stops all together, and cattle become sick and die. Improved availability of water will significantly improve the financial stability of herding families in the District, and reduce poverty over time.

Livestock. Livestock was seen in most field investigation areas and is usually an indication of household wealth. The families are herders who must travel for water or to graze; they are not nomadic pastoralists. The team observed significant variability in the number and type of livestock between villages and households within a village. For instance near Kisangaro, the large number of cattle, sheep and goat herds indicate that although water availability is a severe problem, these cattle are a source of income for the people in the village. In Mhezi however, the team observed only a few chickens and even fewer cattle, indicating the village was poorer overall.

The team learned that grazing is not unevenly managed or rotated. Confined feeding operations would benefit from biogas, a clean source of fuel for cooking, providing safer air and reduced deforestation. Biogas generators are available from Nairobi, Kenya, according to Sabine Winkler, program director for the Pare diocese. RC Moshi-Mwanga may wish to help the villagers evolve to more stationary animal raising, with new water sources, water troughs, and biogas generation.

Goats with no water to drink

The investigation area consists of settled households. No nomadic households were observed; however, interviewed women and teachers indicated that boys do not attend school because they are tending their herds, and are away from home months at a time. Part of this herd movement is required to find river water for the animals, thus improved water supplies would reduce the amount of time boys are away from home, and increase educational opportunities for boys.

3.2 Description of Current Water Systems

The current water systems are a mixture of boreholes, surface water, and community kiosks. Community kiosks are used near Mwanga Town. Most of these kiosks were dry due to water scarcity. Those with water operate for limited hours each day, or sometimes each week. Demand nearly always exceeds supply as indicated by the long queues of empty buckets surrounding the water points. Deep, mechanically-drilled boreholes were used in the villages surrounding Mwanga Town, although many were in disrepair. In these villages, water is most often collected from small springs and surface water. In many cases, this required a significant amount of family time to acquire water for cooking and consumption. Villagers communicated they typically only bathe once or twice a week, and normally in the same contaminated surface water where they obtained water for drinking and cooking. Small-scale rainwater harvesting is being used sporadically.

Availability of Water. Groundwater, surface water and rainwater are available in the Mwanga area, but quantities of all are limited. As expected, water availability is seasonal, with the dry seasons posing the most stress on the availability of water. Surface water supplies are heavily used, but groundwater resources have been tapped very little. Because the villages are scattered and few boreholes presently exist, increased pumping of groundwater from boreholes is unlikely to significantly lower the existing water table.

Learning from a borehole that failed after 2 years

Public Systems, Boreholes, Leaks. Older public water systems depended largely on unreliable surface and near-surface water sources, and recently on groundwater pumped from boreholes. The two main boreholes for the water system in Mwanga town, were reduced to low flows when visited by the team. Except in the mountains directly northeast of Mwanga, all streambeds observed

by the team were dry.

Boreholes in this area of Tanzania sometimes fail more quickly than expected due to poor design and construction. Some can be rehabilitated to restore and increase capacity, but others may need to be abandoned and replaced. In the case of the two main boreholes in Mwanga, one is serviceable and the other should be abandoned and redrilled. (See borehole report by Rewerts, Appendix C.)

An inadequate and very leaky piping system distributes water within Mwanga Town and to some nearby villages. Some of the leakage results from the inadequate earth cover above the pipes, which allows pipe joints to break with even minimal stress created when a vehicle crosses them. Water loss due to leakage from the piping system is estimated to be in the range of 40 to 60 percent. In some areas, existing pipelines need to be replaced with new pipes buried at great enough depth so that the possibility of breakage due to vehicle transit is eliminated. A comprehensive test and evaluation of the existing water distribution system will identify where repairs and improvements are needed.

Surface Water. Water is often obtained by villagers from sources with high concentrations of bacteria. In some locations, during the dry season, water comes from creeks or ponds where cattle and goats graze. These animals defecate while wading in or near water bodies, and are a major source of bacterial contamination of surface water sources.

Access. In these villages of Mwanga District, international and Tanzania standards are rarely met. [1]

Many of the villages we studied in Mwanga District have no boreholes or nearby surface water sources. One borehole (photo, right) was abandoned after only 2 years use. The burden of obtaining water usually falls on women and children. According to village women, water is commonly obtained by walking to sources two to 11 kilometers (one to seven miles) away from where it is needed.

They expend significant time and effort to obtain water; sometimes the biggest task every day. If young and strong enough, a woman or girl may carry 20 liters (45 lbs.) of water while walking. This is the sole supply for an entire family, typically ranging from four to 10 people – far short of what they need. A burrow or bicycle can carry more water, but these cannot be afforded by most households. Men rarely spend time obtaining water.

[1] See Appendix F from World Health Organization (WHO) *Guidelines for Drinking Water Quality at* Pg 84. It shows the water which is required, sufficient and continuous, for personal and domestic uses. These uses include drinking, personal sanitation, washing of clothes, food preparation, personal and household hygiene.

Between **50 and 100 liters** of water per person per day are needed to ensure that most basic needs are met and few health concerns arise. The WHO international standard is that water should be available within 500 meters of each dwelling, and that no more than 300 people should have to rely on water coming from a single tap. Tanzania's national standards are higher: walk no more than 400 meters to obtain water, and fewer than 250 individuals per tap.

In 2010 the United Nations' General Assembly:

- "Recognizes the right to *safe and clean drinking water and sanitation as a human right that is essential* for the full enjoyment of life and all human rights;
- "Calls upon States and *international organizations* to provide financial resources, capacity-building and technology transfer, through international assistance and cooperation, in particular to developing countries, in order to scale up efforts to provide safe, clean, accessible and affordable drinking water and sanitation for all."

3.3 Drinking Water Use

Household drinking water is most often retrieved and stored in plastic buckets and covered containers. Household storage containers included yellow, 20-liter containers for hauling, plastic pails, clay pots and occasionally large drums of metal or plastic. These vessels likely are handled by numerous individuals in a household, contributing to bacterial transfer and contamination. We observed no household point-of-use filtering before consumption at a household in the Mwanga villages.

Water is also used for livestock. A number of large cattle, sheep and goat herds were observed, requiring a significant volume of needed water. Livestock drank from a few troughs near boreholes herded there by men (often boys) from their homes many kilometers away. We learned that the ability to increase herds was significantly limited by the lack of water.

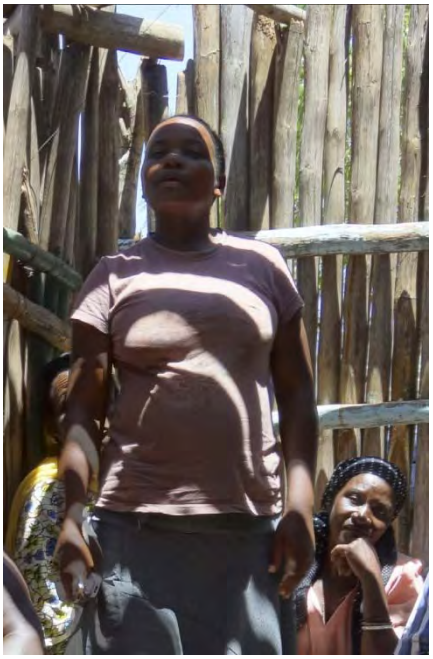
3.4 Quality of Drinking Water.

The quality of drinking water was analyzed in households in the Mwanga area (see Appendix E). It was found that pH was reasonably neutral, salt and dissolved solids could be quite high, and domestic water samples had fecal coliform colonies too numerous to count. The number of samples that could be collected was small, but based on our observation of homes, habits and water use, we suspect the water quality for most households is similar.

Community members are typically unaware of the quality of the water they use, thinking the visually clear water is safe to consume - or when purchased from commercial sources in town would be safe – but it is not.

3.5 Conservation.

Water conservation *per se* is not practiced except as required by water scarcity. Water use was clearly being optimized for daily survival and not wasted.



Woman concerned about safety

3.6 Personal Safety

In community meetings, women told us of the "surprising events" (using sensitive and politically correct language), and occasional rapes when they traveled long distances to haul water. One woman said she was raped several times, and is afraid she will contract HIV. Other woman explained they walk several kilometers, each direction, sometimes at night. In theory, this was the time when she could help wake her children and prepare them for school, but they are not always able to accomplish that, due to the time-consuming search for water.

3.7 Metering

Metering of water usage is nonexistent in villages; there are some meters used at the boreholes and some commercial users in Mwanga Town. Where water is delivered by the municipal water system, customer rates have traditionally been low, and charged as a flat monthly fee. The income generated by these fees is insufficient to support the operation and maintenance, let alone needed improvements to the system. Metering at distribution points and collection of sufficient fees can aid revenue for water system repairs and improvements for future sustainability.

3.8 Water Supply Analysis

The main boreholes in Mwanga are insufficient in quantity for the town, let alone the surrounding villages. One is in poor condition, they are decades old, need work. A major national project to deliver water from a distant dam and lake seems unlikely. Rehabilitation of boreholes and drilling new ones appears to be the most stable and productive source of new water. Sources of water include:

- **Borehole Water.** Boreholes (narrow "water wells" in American English) have been installed is several areas of Mwanga District. Although most information about the drilling techniques that were used to construct these boreholes is lost or missing, it appears as though these boreholes have typically been constructed by mechanically drilling to supposedly competent rock to the top of the bedrock, setting steel or PVC casing, and further drilling until groundwater is reached.

  A detailed survey of boreholes in the Mwanga area was conducted by Justin Rewerts with the assistance of George Dugan. This coordination was somewhat fortuitous. To our team and the District water engineer, Justin's contribution was invaluable, and we recommend that Wasrag and TRF send him on other PPP teams in the future. The observations and recommended rehabilitation activities are recommended in the Appendix C. A sample borehole video can be seen at http://youtu.be/oG2Sq_V9pOc.

  The video log for one borehole revealed that although an eight-inch (20 cm) surface casing had been installed, the diameter of the borehole at and below the water table was only 5 inches (13 cm). The borehole was only drilled an additional 20 meters below the static water level in the borehole, thereby limiting the available drawdown, and thus the water production capacity of the borehole. The static water level in the borehole was approximately 80 meters below the ground surface. This depth to groundwater is expected to be common across most of the Mwanga Valley. Boreholes here are commonly drilled only 20 meters past the depth where water is first encountered, thus if the water table falls, the borehole life is limited.

- **Surface Water.** For much of the population of Mwanga District, water is obtained from surface impoundments, small surface reservoirs, small streams, shallow pits dug into hillsides to increase the flow of water seeps, and roadside puddles. Water tanks were observed in several locations. These are filled when water is available, and used during the first part of drier seasons. When local water tanks are empty, water must be carried from an alternative source. Of the villages visited by the team, the farthest distance that water was carried from surface water was approximately 5 kilometers.

- **Rainwater.** While we recognize it is not the permanent solution, during the two rainy seasons (several months of each year), all village homes should be encouraged to implement rainwater harvesting using appropriate tested designs with larger drums, sheet metal roofs and sloped gutters which are placed close enough to the roofline to catch both slow and fast runoff. (We saw some installations with gutters too below the edge of the roof, so the runoff in moderate to heavy rainfall; likely overshoots the gutter.) The system needs a sieve or pre-filter. Both the roof surface and sieve should be periodically cleaned. This is an opportunity for a starter project, before the larger global grant is approved.

- **Water Treatment, Deforestation.** In these villages there is rare or no water treatment, except boiling – which many families do not do, or not consistently. We are told part of the reason is that traditionally, boiling water causes it to lose taste. WaterGuard, a locally available chlorine treatment, is available and observed at local shops at a low price. Some

family members travel long distances to collect firewood, and trees are being cut and split, with firewood sold to others. Deforestation has occurred over the decades; villagers spoke of how there were plentiful trees in previous decades, and those that have tried to plant trees cannot make them survive due to water scarcity, and probably topsoil erosion. Some families buy charcoal by the bag.

- **Tariffs and Financial Management.** A number of interesting observations can be inferred from the field visits. In Kiruru Ibweijewa village, a more affluent area, 1000 TSH was charged per month per home for those who are taking water from public kiosk, and 2500 TSH per home to those who are having private connections. This means for three 55-gallon drums of water, the cost is approximately 4 TZS per liter (1¢ USD per gallon). Although the water was not literally free, this cost does not begin to support a sufficient contribution toward maintenance and operations, let alone needed capital improvements. It creates an unjustified expectation of nearly free water.

  National experience in Tanzania has shown that "free water" won't work. Current policy requires users to pay for operation, maintenance and part of future capital improvements. Studies show payment by the bucket, or for short durations (e.g. weekly) work best.

3.9 Identified Problems and Issues

The PPP Team observed and discussed the following specific Issues for the particular locations identified:

3.9.1 Issue 1: Lack of Water Committees or RCCs.

While some wards have a water committee, and occasionally a subvillage has a water officer, it appears additional water committee development is needed at all levels. We recommend that training, standard forms, rate schedules, job descriptions, and a thorough program be initiated in each village where Rotary works, long before construction occurs. It will take time to elect trusted community members to a committee, and for them to work out roles, decide how operation and maintenance will be done, identify costs, help establish a budget, divide responsibilities among the committee members and others, and agree on water use fees. They may consider sliding scales for the poorer community members.

The eventual operation and maintenance plan worked out by RC Moshi-Mwanga, Mwanga district and each village, should identify how repairs will be made, who will be responsible for maintaining and repairing the system, what spare parts need to be available immediately or on order, and funds that will be needed for maintenance, parts and repair. The water committee, health committee, or both, should also be charged with deciding the best and most appropriate toilet design, sanitation and handwashing practices based on the initial choices put forth by this report, and project manager(s) selected by RC Moshi-Mwanga. They may hold community education sessions, do surveys, or test samplings.

In addition or instead, a Rotary Community Corps (see the handbook) can be used in the villages. These multi-disciplinary RCC's can provide assistance in other areas other than water distribution, sanitation and handwashing projects, such as assisting students in getting books, shoes, and school supplies, encouraging better animal husbandry, or helping villagers develop entrepreneurial activities.

We recommend that the global grant application include an explanation of which community infrastructure will be used (water committee, board or RCC), recommendations of leaders, or how RC Moshi-Mwanga will develop projects in each selected community.

3.9.2 Issue 2: Leakage from Existing Water Pipeline System

While being transported the team observed some locations with exposed pipelines that are part of Mwanga's existing water distribution system. The team learned from the Mwanga Water District that an estimated of about 30 percent of the water entering its pipeline system is lost due to leakage. To address this issue, the team recommends that the existing pipeline system be pressure-tested to identify leaks. Several approaches can be taken.

Using existing or newly-installed valves, the distribution system should be segmented. For each segment, all outlet points should be closed, and the pipeline should be pressurized with air or water to at least 80 psi (550 kPa). The pressure on the pipeline segment should be measured with a pressure gauge. If the pipeline segment is intact, no pressure drop should be observed within 30 minutes. If leakage is indicated by the pressure gauge, the location of leakage should be identified by listening (if the pressure is exerted by air), or by visible staining of the soil (if the system is tested with water). If the location of the leak cannot be detected, it may be necessary to increase the pressure on the pipeline segment up to 120 psi (830 kPa). Exertion of pressure above the rating for the pipeline is not recommended. This may be a challenge logistically, but we believe the long-term value outweighs the cost.

3.9.3 Issue 3: Need for Rehabilitation and New Boreholes

As explained above, existing boreholes are insufficient and need rehabilitation. The optimal locations for the boreholes should be selected using enhanced aerial imagery. (See Water Sources, in Recommendations).

Testing Precondition, Meters. Before any borehole rehabilitation or additional sources are developed from Mwanga Town to nearby rural villages, we recommend that Mwanga District first test the pipelines, fix the leaks, and install meters. Meters will aid in leak detection (e.g. at the source, mid-point and at tap stands), measure the water lost due to leakage, and provide a basis for each household to pay a fair cost for water.

3.9.4 Issue 4: Need for Additional Water Production in Mwanga Town

Although Mwanga Spring might not be suitable for the installation of additional boreholes, other options exist to increase the availability of water in Mwanga Town: the rehabilitation of existing boreholes, and the installation of new boreholes.

Video surveys of out-of-service boreholes in Mwanga Town show that with moderate rehabilitation, these existing boreholes can be improved to increase their production capacity. Several common deficiencies were identified through the video surveys of the existing boreholes, and inspection of pumping equipment:

Update: In April 2013 the Mwanga Council with assistance by the Ministry of Water, succeeded to drill two deep boreholes at Mwanga Town. The drilling company was Drilling and Dam Construction Agency (DDCA), which is a government agency. The yield of these boreholes are $50m^3$/hr. and $85m^3$/hr., respectively. Already, one borehole (of $50m^3$/hr) has been utilized, and put into existing system, the other one is not yet used. These new water sources will satisfy the current and near-future needs of Mwanga Town (2500m3/day(plus be sufficient for the following villages near Mwanga: Kisangiro, Kichwa Ng'ombe and Mforo. So for those villages, Rotary and its partners can focus on rehabilitation, pipe runs up to 14km will be needed, system improvements.

3.9.8 Issue 5. Borehole Drilling Methods.

It can be expensive to drill boreholes, especially if they produce brackish or salty water or have low production capacities. Mark and Stew met with the two largest driller companies, both of good reputations, located in Arusha. The cost per meter for drilled 8" boreholes is in

the range of 250,000 TZS ($150 USD; this excludes VAT tax of 18% which can be waived upon District application); perhaps 50% more for 10-12” sizes.

A pilot probe may be 6" diameter, then when successful raised to 8" to 10-12", with resulting casings of 6” to 10”. The maximum realistic depth is about 250m for 8" casing, for 12" closer to 100m in granite.

Obtaining casing and well screens locally or on short ship times is not a problem. While pumps can be used to be compatible with nearly any power supply (120, 240 or 440 volt, single- or three-phase), three-phase 240 or 440 volt pumps are preferred. Grundfos brand pumps are most desired due to their durability. Electric submerged pumps can cost as little as $4,000 to $6,000 USD. Grundfos also manufactures solar-powered pumps. Not counting the borehole drilling, a complete system with photovoltaic cells and pumps can range from $20,000 to $30,000 USD, depending on make and capacity.

3.9.9 Issue 6 - Water Quality and Treatment Concerns

Based on our small water samples and comments by the Mwanga District water engineer, there appears to be little groundwater contamination by fluoride, no arsenic, and modest to serious dissolved solids. Salinity is a problem in some boreholes, and might become a problem for future boreholes. Sometimes the problems of salinity are known during drilling, sometimes they arise several months or years after the well is installed. The drillers interviewed by the team who are familiar with the problem did not suggest any easy solutions. For some boreholes, increasing the well depth, isolating the depth interval producing the lower quality water, and sealing this interval has helped. Sometimes it is necessary to abandon the well, and drill a new borehole nearby. RC Moshi-Mwanga and the District should consider how they will fund a situation where a borehole turns up dry, or saline, and a new one needs to be drilled. Additional grant proceeds from TRF are not permitted to rescue a difficult situation such as that.

Water treatment in these villages is rudimentary or non-existent. The reasons are not well understood. Some boil water. In Masandare women demonstrated at a watering hole the use of a wire sieve to remove large particles, then fire pit ash as a coagulant and settling agent. The water was still heavily contaminated with bacteria, not to mention fine solids, terrible smell and taste. But that was all they know to do.

We found no chemical treatment being used in homes, or awareness of it, though Waterguard can be purchased in Mwanga town. At a school, a poster showed the conventional wisdom of using cloth to filter followed by boiling. There is presently rare use of ceramic candle filters, apparently donated to only select homes by aid agencies; we saw one.

4.0 Community Findings - Sanitation.

Based on the team’s assessment, expertise, additional data collection, and experience in the community, our team finds the highest priority in the minds of villagers is safe water. They associate water scarcity with nearly all of their problems and missed opportunities. In truth, some of the problems and suffering are due to poor sanitation and hygiene practices, but this awareness will only come with education and long-lasting promotion of new behaviors.

Bathing area

Bathing. Human bathing in surface water bodies appears uncommon, perhaps in part because we saw few surface water bodies in these villages. Many homes have outbuildings, adjacent to or near latrines. Bath water is obtained from the same sources as drinking water. The ability of people to bathe and children to be clean is compromised by the lack of water.

Open Defecation. Outdoor defecation appears to be common for nomadic herdsmen (often boys), but otherwise rare. Women explained that children, and sometimes men and women, defecate openly when they have no access to a latrine or toilet (e.g. when walking or herding), but most usually use the latrine at home. We are unsure whether a CLTS (community led total sanitation) program is needed or would be appropriate for the area. Instead improved toilets, family "standards", leadership and peer pressure may suffice.

In all the villages visited, most homes have nearby pit latrines. These latrines were generally clean; however, few latrines contained water to clean after toileting (many had empty water containers). There was no use of toilet paper, nor a toilet design for anal cleansing, even though many of the villagers are Muslim. Some poor homes we visited had no latrine, but indicated they were allowed to use that of a neighbor.

Pit Latrines. Typically pit latrines are simple structures constructed using red mud over a lattice of sticks, sometimes with embedded stones (fist size to 12-15cm). Some had thin walls with no stones, some were low so one had to duck to enter, while others were full height and sturdier.

Few latrines are constructed with courses of brick made from red mud-like adobe, but where they had been built, the bricks lacked a fiber or straw matrix to hold the fines of the mud, and resulting erosion was evident. Some poorer families had a small, open unimproved shallow pits, but most had a cement slab or floor over an unlined pit. These pits were unlined, even in schools; nothing keeps contamination from entering groundwater. Few septic tanks or drain fields were found in the villages. Even at the wealthiest homes and in the refurbished schools, toilets were built either directly over unlined pits below the slab, or with the toilet connected to an adjacent pit by a simple downward angled pipe.

Nearly universally, the cover over the pit consisted of a cement slab with a single oval or rectangular opening, sometimes with raised cement pads to squat on. We saw no pit covers to prevent flies from entering the pit or to reduce odor (even in new school toilets), nor did the openings for ventilation in home latrines have any fly screens. (The latrines for one new school were equipped with fly screens). Sometimes the slab was broken, or small sections had collapsed. For most toilets the mud walls had partly eroded away, exposing the underlying wood structure or stones. Often the wall erosion was great enough to leave several small or large holes where weather could enter.

We found one demonstration toilet made by ICF (Engineers without Borders) that was sturdier, had a stucco exterior and sturdy wood door with hinges; but few similar latrines were seen in that village, and only one similar latrine was found in Ishinde.

Water at Pit Latrines. There were often small open buckets or the bottoms cut from containers (approximately five liters) used to hold water resting on the floor of toilets. Most of these containers were empty, but sometimes a cup or dipper present. In speaking with people, some explained that the buckets were used to clean the toilet floor, but some said for handwashing or anal cleansing (a Muslim tradition) - but there seemed to be no consistency in these uses, no routine of good hygiene practices, nor any specific training or monitoring program.

Latrine Design, Longevity. The pit latrine structures, in practice, last about 5 years, sometimes 10 years, and are usually sturdy enough for that lifetime. Most villagers do not have sufficient resources or community assistance to replace their toilet, thus they were in poor condition, with several holes, structural weakness, and broken slabs. Some were nearly or completely full of waste. Emptying latrines is not feasible in this area. One family's latrine had thick plastic cloth installed on the corners and openings to fill holes in the decaying walls.

When the pit filled, he had dug a parallel pit next to the latrine, and laid sticks across the pit. He explained the latrine was over 10 years old, and it was full. It was his intent was to dig a lateral opening from the latrine's pit to this new open pit, to allow the sewage to flow from one pit to the other.

Covers. We saw no covers for pit latrines to protect against flies or other vectors, let alone smell. Water trap toilets are not part of local culture and introduce unnecessary water into the pits.

Nutrient Cycle. Urine and feces are not presently separated, and the individuals interviewed were unaware that urine and feces have value as nutrients for plants, soil and beneficial insects and invertebrates. When this possibility was discussed with a group of women, they listened intently with little comment or reaction. When discussed with one man who had a latrine in very poor condition, he said he did not believe this. In another discussion with a group of six men, they all listened intently, seeming to want to learn more.

Sanitation Awareness. While there is some migratory and occasional local open defecation, we are reluctant to recommend a full-fledged CLTS (Community Led Total Sanitation) effort. Instead, a culturally-appropriate educational program should be developed

Animals and Their Waste. Many people are raising animals, cows, goats and sheep, for both milk and meat. Chickens were also being raised, but seemingly primarily for boiled eggs, a regular part of the local diet, less so as meat. Only a few people interviewed understood the value of animal waste as fertilizer; most left animal waste where it fell. Even a relatively wealthy farmer in Ishinde who had a seven-cow herd, brokered milk for several farmers, and a large four-bedroom electrified house with four separate outbuildings for storage, kitchen, bathing and toilets, did nothing with the animal waste.

5.0 Community Findings – Hygiene and Handwashing

Handwashing. Encouragement of handwashing has the opportunity for a huge improvement in household health. We observed no handwash stations outside latrines, bathing rooms, or near homes in any villages we visited; nor were there any community handwash stations. People in some of the wealthier homes used small water pitchers and basins, occasionally with soap, before meals. Others had open basins or buckets in which people dipped their hands, but no real cleansing.

Villagers also use indigenous plant leaves to wipe their hands, and a bud/fruit of the same plant as a replacement for soap. We encountered no soap-making, or use of ashes as a substitute for soap, though these may exist. We saw no evidence of towels or hand-drying, and they may be wiping hands on contaminated clothing. There was no waterless cleansers (e.g. alcohol based). Routine handwashing is no doubt limited to some extent by a lack of water.

The extent and details of personal hygiene and handwashing deserves further study, so the Rotarians (with a community development specialist) can understand the specific behaviors at present, and what may need to be taught, and changed.

Though we were unable to survey all schools, we found and heard of no concrete handwashing stations with taps, locks, or any greywater recycling. As an example of what can be done: in the Same District, at the Kitamuri Primary School in Kitamuri village, Stesheni ward, there was a concrete handwashing station with about 15 metal taps, each of which can be locked closed. This project, along with toilet blocks, was done by CARE International and CRS (Catholic Relief Services); see the report in the bibliography.. There was also a grey water recapture system (with low water level at present). Although we did not investigate many schools, we understand this was among the best in the area. No low-cost, local, hand washing stations, such as a tippy-tap, were observed to be present.

General Health Education. We suspect that villagers have limited knowledge about the importance of hand washing in reducing disease transmission. Investing in WaSH education could materially improve health of people in villages of this District.

There is clearly a need for general health education, hygiene training and promotion. And there are people to do it: the Mwanga District health officer, and the ward and village health officers, as well as other NGOs working in the area. We recommend that for now, RC Moshi-Mwanga not tackle this, and stay focused on WaSH so the project is more streamlined and can be successful. The club can evaluate opportunities to expand the program later.

6.0 Community Findings – Energy

Based on our assessment, Mwanga District expertise, and additional data collection from the community, the available energy sources include:

- **Electricity** is presently available in the Mwanga District near most villages in both 440 and 220 volt, and single- and three-phase. The Mwanga District and approved contractors require that all new borehole pumps are equipped with voltage protection systems.

- **Solar energy** and resulting electricity exist in many places in Africa, thus parts and supply chain are reasonably available. We recommend where used by Rotary, that only high quality panels be selected, that they be made theft-proof and tamper proof (e.g. aluminum or steel frames), and be resistant to damage from wind, sand, birds, etc. Although dust is usually washed by rain and doesn't diminish panel output much, a procedure should be established by the RCC or water committee for periodic cleaning.

- **Wind.** From our observations and discussions with others, there may be a regular wind resource in the Mwanga area, and some of us wondered if windmills could drive water pumps. Could it be that availability of designs, parts and technicians is a problem, to be overcome?

  Mark advised that the depth to groundwater in these villages is too much for wind power using a simple pump with a piston and leathers. The pump must be set about 10 feet below the

water table. A rod connected to the pump moves the piston up and down inside a pipe, and lifts the water up the pipe. Here, the rod connecting the windmill to the pump would need to be very long including the height of the windmill, risking rubbing and premature failure. Plus , the timing of wind does not match the need for electricity as well as solar, so some form of storage is needed such as water raised by pumps into tanks.

- **Energy Use.** We observed in most villages that a few people had electricity. It was much more prevalent in the villages closest to Mwanga town, which are more compact, have more commerce and may have been settled earlier. Some homes have new systems installed over the old. Some use only utility electricity, some only solar, and occasionally a home has both. And it appeared most homes have no electricity. We heard anecdotally that electricity is considered to be expensive, and outages are frequent. This warrants further study to quantify what is available and is affordable in or near each village.

7.0 Recommendations.

Based on the foregoing observations, analysis and findings, our Team recommends:

7.1 Holistic WaSH -- Water, Sanitation & Hygiene Are All Linked. From our many observations and conversations, we know that water scarcity and improved access closer to homes are the key issues for villagers. They seem less concerned with water quality, sanitation and hygiene which are equally or more important for long-term benefits to health. All those factors together will allow (as people wish) mothers to focus on domestic responsibilities other than hauling water, and fathers to focus on animal-raising and business opportunities. Making water supply improvements alone, without also improving sanitation, water quality, toilets (especially control of flies), household container cleanliness, handwashing and personal hygiene, will provide only modest health benefits. Our experience shows it is harder to train on these latter items, and change behaviors, after water system improvements have been delivered.

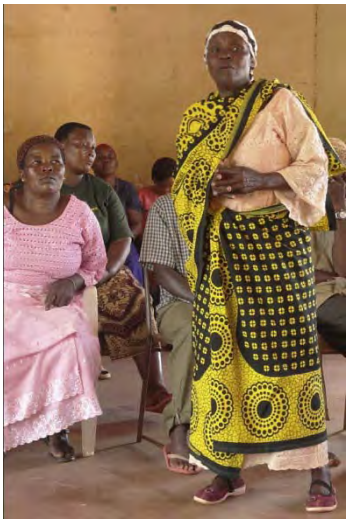
7.2 Overall Planning. We recommend the whole project package of WaSH improvements be planned at once. It should be strategically implemented in a way that water quality, sanitation and hygiene are socially and psychologically linked with providing plentiful water. The objective is to have an integrated understanding; and that is not fulfilled by supplying water first, and then later trying to introduce the value of water filters, improved toilets and better hygiene in an effort to improve health. In discussing this idea with ward and village leaders as well as Rotarians, they seemed to understand it's all a holistic package, not satisfy the need for water first, or alone.

7.3 Temporary Water. Planning and implementation to do the water systems correctly, as well as fundraising, will take time - several months or a year. Water is so scarce in the priority villages, we recommend the District of Mwanga and RC Moshi-Mwanga design and ask for international Rotary club financial support for temporary measures to truck water to villages, and store it in large polypropylene tanks on metal frames with a few taps,. This would demonstrate that Rotary is promptly responding to their priority needs, and it will give the water committee or RCC an opportunity to develop methods to allocate water, identify costs and begin collecting enough revenue to support a more permanent water system. This will also provide immediate relief for villagers from the daily stress of procuring water, but it may be insufficient for healthy animal raising. Consistent with national policy, the tariff should be sufficient to cover maintenance and operation costs, and allow for a modest (e.g. 5%) contribution to the capital improvement.

7.4 Integrated Program. Simultaneous to the temporary measures, the sanitation and hygiene program should be developed and materials assembled, so that as water becomes available, people will learn about sanitation and hygiene. This could occur either as temporary water improvements are being supplied, or as crews are on-site make permanent improvements (surveyors, borehole drilling, tank construction, pipe laying). In this way, the integration of all three WaSH aspects will coincide and be introduced to villagers as one concept while the living conditions in the village improve. Latrines or better toilets can be rebuilt or newly installed, inexpensive urinals can be used short-term to fertilize crops, benefits (with water and fertilizer) will be seen, and handwashing and hygiene practices can be taught. Perhaps after water is more available, but before the project is complete, eco-san or UDDT toilets can be introduced, and the early adopters will persuade others to join the effort as time goes on.

7.5 Community Management. Before permanent water improvements are made, the water committee or RCC needs to assume responsibility for the operation, maintenance, monitoring, collection of revenues and fiscal management of the completed system. As part of this work, a permanent tariff system must be created.

7.6 Household Qualification. We observed a level of formality exists in some social customs, perhaps due to the influence of German, English or local cultures. As the permanent system is being finished, it may be appropriate to consider a qualification program: each household will be trained in WaSH techniques, show their plans to improve their toilet (if needed), demonstrate they know how to use, clean and maintain water containers, bathing areas and toilets, and report when and how the family members will wash their hands and use other personal hygiene measures. After qualifying a family unit, the parents would be eligible to have access to the new water system, pay for tokens, and participate in community discussions on how to improve the system.



7.7 Behavior Change. We think a behavior monitoring system should be arranged for each village, so that village leaders, the village Water Committee, as well as RC Moshi-Mwanga and the Mwanga District water engineer, can all be assured that the agreed new behaviors are taking place and there is a social method for addressing noncompliance. Portions of the CLTS strategy, which has been used in other countries, may be appropriate for this area.

7.8 Water Sources. A key goal of any wash project here will be the identification of any new underground aquifers, sufficient in quantity and quality for the villages. We recommend the use of professionals such as PWB for borehole location, and the use of satellite imagery as developed by Professor Emeritus Bob Vincent (current DG District 6600). These are good locations for increased capture of groundwater. Ideally new water sources in boreholes will be located close to village centers to reduce distribution costs; or between villages sharing the source. There is a technical training step involved to use the satellite imagery; perhaps if Tanzania national or water basin offices wished to implement this, we could introduce them to Prof. Vincent.

7.9 Water Distribution, Taps & Domestic Points. Submersible pumps should be used to fill nearby storage tanks with lateral distribution and possibly smaller satellite storage tanks. Domestic water points (taps) will be located by the District water engineer in their normal manner, close to housing clusters, and with enough to accommodate future population increases and still have fewer than 200 people supplied by each domestic tap.

7.10 Recommended Pump Methods. Hand-pumps may not be expensive, must have local parts supply, but they move less water than may be desirable. Electric pumps seem preferred as they can distribute water from one borehole to taps throughout a village; but there needs to be a stable and affordable source of electricity, or solar power. As noted elsewhere, we recommend that solar arrays with matching submersible pumps be employed where economically feasible, especially where electricity is distant or expensive. An excellent combined concrete structure, solar array in a protected frame, and elevated tank can be obtained from WMI. If water is contaminated, chlorination, monitoring and automated token features should also be included.

Two basic approaches in planning community water sources in lowlands exist – centralized borehole and decentralized shallow hand-dug wells. Each has advantages and disadvantages:

Option	Advantages	Disadvantages
Centralized Water System	• Single centralized system easier to monitor and maintain • Ability to meter water at all points of use	• Higher capital costs than installation of boreholes using sludging techniques • Greater threat that illegal taps will compromise system • Increased need to monitor system for water breaks • May require more assistance by District Water Engineer to keep it running smoothly
Individual boreholes installed using sludging and equipped with rope pumps	• Lower capital costs (estimated $1000 USD per borehole) • Ability of local trained individuals to hand-install wells using simple equipment and supplies • Increased opportunities for creation of local borehole installation and maintenance enterprises • Monitoring of system for needed repairs	• Difficult to determine usage by each household • Tariffs not easily set to match household consumption • Decentralized decision-making may be less consistent or uniform, possible fairness issues

- A Central Borehole – water quality is probably more improved, pipes protect water from swampy situations and bacteria from pit toilets; however, Illegal taps are a risk, and metering adds to cost. Key concerns are cost of installation, complexity to maintain, and single source reliance. A conservation rate is possible, or easier. The Community would need it fully explained why this system is an advantage.
- Many Rope Pumps – decentralized, community ownership because they more involved, trained contractors entrepreneurs create a base of experienced people to maintain the systems;
- Decentralize water – this would require a multi-person

arrangement, in several areas. If the community cannot afford it, we can use microfinance to assist household purchases (typically with 8 to 20% interest rates). SHIPO does this in Southern Tanzania, in Njombe. The focus is on training local businesses that will produce and sell a range of new low cost water and sanitation solutions. The goal is to establish a sustainable and compatible supply sector of options which can reduce costs of communal systems and that are affordable for (groups of) households, the so-called "self supply."

  - Support activities that will improve access to safe and clean water and sanitation with a focus on peri-urban and rural areas
  - Demonstrate a range of innovative and affordable water and sanitation technologies
  - Train the local private sector in manual well drilling, production of rope pumps, groundwater recharge, water storage tanks, irrigation, water filters, latrines and other technologies
  - Support local businesses with training in production, maintenance, management skills and formation of associations

- This is tied to the need for proper decentralized toilets: the people need to change away from pit latrines that leach, to skyloos, ecosan toilets or UDDTs (which has advantage of providing urine fertilizer and dry powdered soil amendment). To avoid toilet plumes leaching into water, a possible approach is to have small boreholes at least 25-35 ft down, so there is both horizontal spacing (say 30-40m) from the water sources plus vertical cleansing by soil. But we have concerns for the lower villages during the rainy season that this won't work well. [In some Africa locations during rainy season, toilet pits are half full of drawn water. So a skyloo, raised toilet, brick enclosure, or even thatch or wood, with an underneath chamber can provide drying or composting, and tubes for urine diversion. If an arborloo use papaya and banana trees.]

In Malawi and other locations have similar need, plus the IEEE are working on this problem, how to incorporate real-time data collection for water use, also monitoring of cookstove use, etc.

Methods for payment and monitoring: 1) electronic lock on the valve, use cell phone or mobile like device with M-Pesa or MBN National mobile banking, or 2) magnetic reader that transfers data between a card and the centralized reader. Disadvantages – all community members have to have cell phones (many do, but not all), or 3.) manual token system

In a large village like Kiruru this might mean 60 clusters with decentralized water meters, with one trained person at each. That person can become a water promoter, and be paid from a portion of proceeds, then she/he will have the incentive to keep the water point properly maintained; the rest of money goes to a central bookkeeping operation to support the larger community system. World Vision commissioned a study to evaluate all their handpump installations, improvements.

One idea is to provide a dedicated water system supervisor who is paid as much as 5% to inspect and supervise every installation, provide training and system quality assurance.

In Livingstonia, Malawi, they are currently producing their own tokens locally, ~2" (50mm) diameter PVC solid rod produced in Malawi. They then cut about 150 tokens from a one meter solid rod and produced 'brands' that can be heated in fire that will melt the PVC such as to impress 'KWUA' (Kondowe Water Users Association) on one side of the token, and a pail value (1, 2, 5, 10, 20, 50) on the other side. It is sometimes possible to get various colors of PVC rod, but the colors are not always readily available so it is generally paint into the melted depression created by the brand, or on the entire token to highlight the value of each token. Yellow is valued at one pail, blue is two pails, and red is five pails, etc. Total cost of one of these tokens is therefore approx. $ 0.20 per token, and there are using about 5000 of the various denominations of tokens, such that we have spent about $1000 to produce the tokens and get them into circulation.

The Livingstonia system is modeled after the very familiar pre-paid telephone voucher system, where the KWUA office is the wholesaler, and anyone can then resell the tokens at the retail value. The wholesale cost of the token has been Malawi Kwacha 1.75 per pail, and the retail value is MK 2 per pail, so that sellers get a 0.25 profit from every pail token sold. If someone in the village does not have any Malawi Kwacha, they can borrow from a token seller within the village – keeping all lending and borrowing within the community and not between the management of the Water Users Association and an individual.

Also, profits are built in, such that when the meters are read and water usage is charged, the amount charged is less than the MK 2 per 20 liter (volume of a pail). They pay their bills to the KWUA by tokens, and will have tokens left over. They can cash these tokens in back to the KWUA for cash. In this way, either the individual who is the owner of the distribution point (DP), or the community who is owner of the DP receives some profit for their efforts. The project works with communities such that profits are used to provide water for their 'poorest of the poor' – the communities decide who is needy and how much per month they are to be allotted through the support of the community. In this way it is the communities that are responsible for their own vulnerables, and it is not the responsibility of the WUA to figure out how to support the persons who are truly unable to pay.

In the Livingstonia system, a population of about 15,000 people are supplied with water between the mission station and 10 villages surrounding the mission station. Each village has a population of about 1000 to 1200 people

7.11 Specific Recommendations by Village:

Kituri. Here the team considered the centralized and decentralized systems described above, in how to best supply Kituri with water: (a) a centralized large borehole and a network of pipes with water distribution points, and (b) multiple low-volume boreholes hand installed using the sludging technique and equipped with rope pumps. Either might work; further study and discussion with the community will help decide.

Kileo. Before proceeding with a project here, there ought to be certain preconditions: develop a separate and stronger water board, set up a process to measure system costs, implement charges based on usage, enforce against illegal taps, develop sanctions. For the physical plant, pressure test existing pipeline system and make repairs (fixing lots of leaks), refurbish the small storage tank add others, and increase size of the pump or add one in parallel, add pipelines and add a metering system. The District engineers office has done own pressure testing, with water before backfilling.

The spring can be utilized beyond this community's needs; with discussions we hope they are willing to share water resource with Kivulini (possibly other communities), on a cost-sharing basis.

Village people will need to excavate, replace the leaking section with a new one, new couplings and fittings, re-test. All people need to be trained to spot leaks, maintenance issues, and be sensitive to water losses, as water is a precious community resource; allowing it to continue weakens the whole system.

Mforo. Here we recommend up to triple the existing production by a) pump testing the existing borehole, b) and based on pump test increase the pumping (add second pump, or replace it with a new larger pump), and c) increasing solar collection with batteries to pump up to 24 hours, or bring electricity in. The district engineer will need to do a cost/benefit analysis comparing solar to electricity, and the pumps: comparing capital and operation costs, and the community contribution. Static water level is at about 15 meters. If this combination is not sufficient, then determine a new borehole using the Pangani Water Basin together with satellite images by Bob Vincent.

Lembeni. This community needs a new borehole, use a pump test, and replace the 40 year old galvanized steel pipe system with new poly pipes instead. Locate new domestic water points (DP's) by sitting down with the community leaders and influential women, so they can decide where should they be located. Pressure test all large and small lines. Provide metering for all lines, and a token or payment system. Presently the fee is only 2000 TZS per month, insufficient to support a system; so they will need to develop a new rate structure based on usage, hopefully with a conservation rate (more usage pays increased cost per liter).

Mkizingo. We recommend a new borehole at the institutional school, where it can be secured, use a valve to isolate it from the existing system, pressure test the system, seal inside or place a liner in the tank, install meters (central, distribution and at each DP), then pipe the resulting water to the village. The community needs to set up a stronger committee, with the same recommendations as Kileo.

Kiruru. Here we recommend a new borehole at a proposed site, already located by PWB, provided that site is confirmed by high-resolution satellite imagery information. There should be new distribution using plastic pipes with several DP's. There are presently 191 private standpipes dating from 1968, with much leakage. They pay 1000 TZS per month, insufficient to sustain a new water system. While it would be ideal for all to participate, the community leaders may offer voluntary participation, so families will have to decide if they want to connect their old system to the new, which we suggest be at their own family cost. Rotary and an MFI (microfinance institution) can provide microfinance loans for people who want to connect but cannot afford it. The current "free water" system is a mere dribble, rainwater harvesting is an added source (SHIPO can train the community to implement a rainwater harvesting program), and outside sources are charging 500 to 800 TZS per 20 liter bucket. There is an independent water board in the community at present; we discussed a possible joint community water committee, with representation by both Urban area and Kiruru; a good approach if politically feasible. Electricity can be obtained on contract by the water board directly from Tenesco.

Discussing how to locate new borehole

Lambo. The existing system of about 9km pipeline system is okay, but overstretched due to the vertical lift of over 200 meters. We recommend installing a pressurized tank

midway, and that storage can provide lateral runs. And add some other 6km of distribution pipeline so as to make a total of 15km of pipeline and introduce metering for the entire system and users.

7.11 Capital Cost for Water Systems. The capital costs for water systems include the following expenses:

- Borehole rehabilitation or development (drilling new boreholes)
- Pipe, fittings and distribution via domestic water points (DP), aka tap stands, usually with supportive concrete pads.
- Storage tanks and break points for springs and hillside elevation drops
- Meters and measurement devices,
- Spare parts, manuals and training.

Note: the PPP Team does not provide here estimated costs for each village, as the Rotary Club and District water engineer have an established procedure for obtaining these, with the inclusion of our design recommendations; and choices need to be made by the district and Rotarians in cooperation with the communities. Based on discussions with the water engineer and two reputable drilling firms, however, we believe that water systems for each village will range roughly from $50,000 to over $200,000 USD.

A pro forma sample might look like this in USD:

▪ Investigation and siting	volunteer to $3,000 USD
▪ Pilot hole and borehole drilling, casing, etc.	$20,000 to 35,000 USD
▪ Submersible Pump and related parts	$10,000 USD
▪ Electrification or solar cells, power	
▪ regulation and protection	$3,000 to 10,000 USD
▪ Piping, fittings, and tap stands	$5,000 to 15,000 USD
▪ Raised storage tank for gravity feed	$8,000-15,000 USD
▪ Training and education	$5,000 USD
Probable Range for Total:	$60,000 to $95,000 USD

Notes: For the villages where water supply is now available from the new boreholes in Mwanga town (Kisangiro, Kichwa Ng'ombe and Mforo), these costs would be lower. In the Rotary project budget there should be noted an in-kind contribution by the village, for about 5% of project value. This is calculated using normal labor rates in the area, and often supplied by in-kind volunteer labor by community members. This is consistent with Tanzania national policy and local practice.

7.12 Water Treatment. Before selecting the treatment system, we recommend that RC Moshi-Mwanga and the water engineer conduct a small study in a couple of villages to determine which household water treatment methods will be most appealing to villagers, given the factors of cost, taste and utility. Among those that we think should be included in the test are: (a) diatomaceous earth dome (including sock filter, silver and activated carbon) using either a pump bulb and stop valve or two bucket system, (b) ceramic filtration, (c) chlorination or Waterguard, (d) biosand filter (perhaps a local cottage industry), (e) pasteurization with indicators like WAPI (wax pasteurization indicator), and (f) solar powered pasteurization with reflectors and a black container. However, one team member (with Africa experience) believes that (d), (e) and (f) may be difficult due to limited availability of parts and repairs, as well as the present lack of openness of community members to accept these approaches. Behavior change

is very important to project success, and should be discussed with village leaders and influential women early on.

To reduce deforestation and improve health, village residents need to be trained on water treatment options for collected or domestic tap water used, e.g. filtration, disinfection or pasteurization. Pasteurization saves fuel, and temperature indicators can be made with wax & glass, or soda straws with hot glue ("WAPI" web link). SODIS and solar heating of dark water containers may also be options families will appreciate; although they take longer, each avoids the use of firewood to improve water purity. When they can afford it, it would be beneficial to introduce biosand or ceramic filters; even clay pot filters would provide some benefit, preferably embedded with silver ions to provide germicidal assistance and reduce re-contamination risks. Waterguard use would also help, and is locally available.

We recommend training with images and posters (such as these from CAWST) so that people clearly understand the relationship between contamination of water/food and illness, diarrhea, rashes and the effects on school and ability to work. We don't recommend a single approach, as there is a wide range of incomes and some variation in lifestyles, and some family members are away from home for months tending animals -- with education, we think the choice should be left to village families. If there is enough demand, RC Moshi-Mwanga may want to help an entrepreneur start a small water filter and treatment business, creating a local source of supply.

7.13 Conservation Opportunities. When new plentiful water supplies are delivered to villages that have suffered scarcity, , there may be a tendency to waste water. It is important to educate villagers about the overall condition of water and scarcity in Mwanga District, Northern Tanzania, and the world – and the need to conserve. We recommend that specific skills for conservation be taught, and that a "conservation rate" with escalating prices per liter be created.

One conservation opportunity is the expansion of rainwater harvesting at the household and village level. Another is the use of animal water troughs, instead of allowing animals to directly access and contaminate reservoirs and streams. With education, we recommend the villages and schools be involved in brainstorming ideas for conservation.

Another opportunity is the use of grey water for non-food garden plants**.** In one village, the poorest house selected by the community was well maintained by the man who owned it. He wanted to address the water runoff from bathing, and grow plants at the same time, so he constructed his own wetland immediately around the bathing area, and decorated it with wood and rocks. When it was explained this was a modern approach in America, the man was very pleased.

7.14 Tariffs and Administration. Financing and tariff reviews show that pay-per-bucket programs are the most common way that water suppliers generate income, and that bucket and monthly payment schemes have higher rates of functionality than "never pay" or annual pay programs. Bucket/monthly programs are nearly all functioning, whereas free water systems only about 60% are functioning, and for annual pay programs none are functioning. (See Water Point Mapping – The Experience of SNV Tanzania Pgs. 4-5.)

We recommend that tariffs be affordable, timed close to the use of families, and consistent with the policy that the amount covers good quality maintenance and operation programs, with a

2.5% to 5% contribution to future capital projects.

We believe the Water Ministry, Regional Secretariat and District Engineer can provide adequate guidance on how the community should properly administer a water system. We recommend a training program include a manual, roles and responsibilities, task list, frequency and methods for each function of maintenance and operation.

For centrally provided water in villages, the current rate is 20 TZS for a 20-liter bucket. But these sources provide too little supply, and frequently are unavailable. Other boreholes nearby charge from 50 to 100 TZS per 20-liter container, occasionally more. A study will need to be done for each village to learn what the current charges for plentiful water are, and what the villagers believe they can pay. Then also what it costs in each village to train then fully fund maintenance, operation, and the government-required 5% contribution to future capital needs.

A tariff rate schedule should be proposed and agreed, before commencing serious planning, and well before Rotary funding is sought. This is potentially one of the largest challenges of the project – the participants change in attitude recognizing that safe available water is not free.

7.15 Tokens. A token system administered in each village is recommended. In Malawi, a manual token system is used successfully with a gravity fed system to assure funds are available at a local level for needed capital improvements and project oversight. A token is required for each 20-liter pail of water. Tokens are purchased locally, and portions of the monthly proceeds are designated for a) future capital improvements and b) the next month's cost for orphans, widows and the neediest individuals of the community who otherwise might not be able to afford the monetary cost of water.

The alternative is a more automated approach used by Water Missions International (WMI) in developing countries in Africa, Latin America and elsewhere. It is an excellent and award-winning system developed in collaboration with Grundfos, a large Danish pump manufacturer, and its charitable foundation. It is called Lifelink (web link), and provides automated "token" charges using a swipe card held by each family. The data is captured at the community domestic water tap, available in electronic form in local computers, and over the Internet to anyone who is authorized, The cost of this system from WMI is presently 14,000 to 18,000 USD, and is expected to drop to 3,000 to 5,000 USD by mid-2014 (a feasible implementation date for this project).

We encourage RC Moshi-Mwanga and the Mwanga District water engineer to review these and other options, then select a system that is appropriate and supportable. We will gladly provide contact information and the right person to speak with for both the Malawi and WMI-Lifelink systems.

Note: The choice of which token system, from among many, should be made after careful full investigation. Each token system has pros and cons to be considered. For instance, a manual system may require training, but will provide some income for a village employee; however manual tokens can be sold, lost, stolen or worn out. Keeping data for a manual system can be cumbersome, and provide limited utility. An automated system costs more at the start (in the grant funding), requires electricity (or solar power with batteries), may require more maintenance and a different type of training; it may still provide employment; and it submits data automatically to central computers, or stakeholders, so it can be viewed on the web. There is also an ethical concern that when the poorest have no money they have not access to water and then are forced back to use of the original unimproved water source and the water project will only benefit the more wealthy.

7.16 Quick Start, with Pilot funds. Villages will want to see some tangible results by Rotary and the Mwanga district, so we have recommended some low cost alternatives to start, for both water and sanitation projects.

Neighbor shares her shallow well

Some of these early pilot measures will need seed funds or small grants; others can be implemented now, at a local level, without seed funds. We recommend that the current lead partner clubs, RC Moshi-Mwanga and RC Ames, quickly identify some key partner clubs who want to be in "on the ground floor" – and ask them to contribute to this early pilot.

A pilot project might include installing several shallow boreholes in Mhezi using sludging techniques, and equipping them with rope pumps. A small pilot will have the benefit of verifying it is the better choice, involve the community in a significant way at the start (digging, locating the well/pumps, deciding how water will be charged for).

Although as direct club-to-club funding there is no DDF match, we recommend that the process of obtaining commitments, collecting funds, using special bank account, accounting for the funds, and providing reports on progress to the contributing clubs, be similar to a global grant. The working experience of the partners, community leaders and members, and the proof of concept are valuable, before leading to a large-scale global grant project. Rainwater harvesting can be started at a local level without seed funds, using locally available materials.

7.17 Other Examples of Low Cost Alternatives

- **Self-supply rainwater-harvesting options:** On households with corrugated metal roofs, add gutters with a strip of corrugated metal which leads into a 55-gallon drum(s) or a wire cement water tank (requires only 1 bag of cement/m3). The gutter does not need to be the full length of the roofline; even 2-3 m of gutter into a tank or drum would allow collection of water for several days after a heavy rainstorm. This alternative should not require any financial investment from RC Moshi-Mwanga. (This is the early alternative; the permanent solution should include full roof collection and larger tanks to store water for months.).
- **Self-supply household water filtration.** Siphon and table top water filters cost about $20USD per filter and are available locally. In the area of investigation, household level chemical disinfection (WaterGuard) using chlorine should also be further promoted to increase adoption. This alternative should not require any financial investment from RC Moshi-Mwanga. [Note, we found WaterGuard at a moderate size grocery store in downtown Mwanga town. At a pharmacy 10 tab packet costs 1000 TZS (about 60¢ USD), and 150ml bottle costs 800 TZS (50¢ USD).
- **Self-supply tube recharge.** In areas with boreholes with a decreasing water level, tube recharge should be promoted. Tube boreholes can recharge 50 to 500m^3 of rainwater in the ground at a cost $10. This alternative should not require any financial investment from the Rotary club. (A larger recharge system could be included for the community in the final project.)

7.18 Opportunities for Sanitation Improvement. Depending on best design for toilets and how soon they can be constructed in each village, there are opportunities for Rotary to demonstrate and teach villagers how to make these improvements right away:

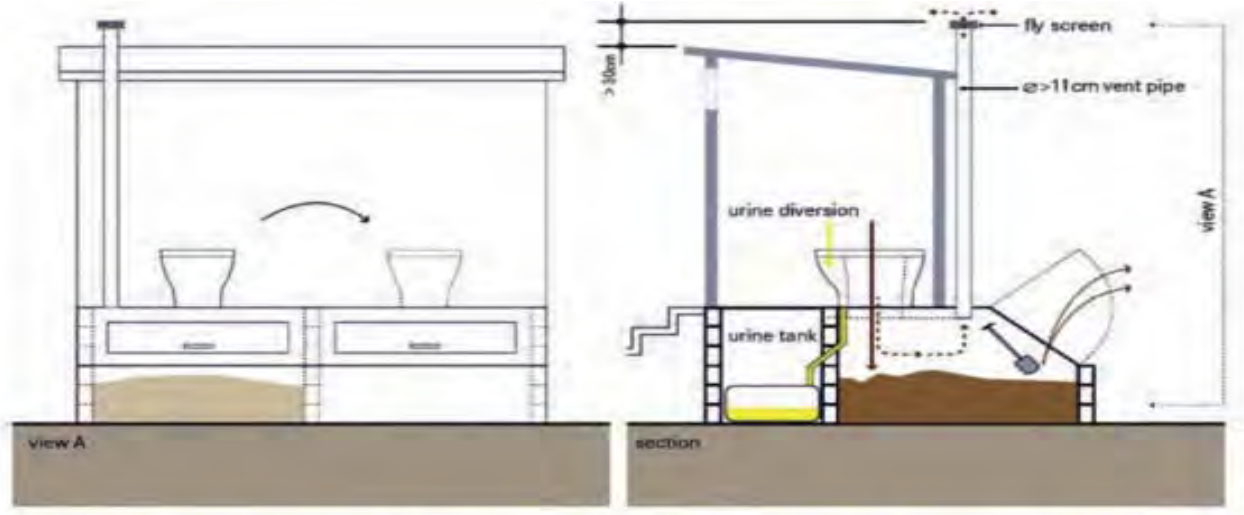
- Use better construction methods for structural longevity, such as adding fibers to the mud matrix and making the outside durable yet flexible in a weather-resistant skin; the fibers could be sisal, palm leaves, shredded bark, etc.; however, this may also increase the potential for termite infestation.
- Make a thicker slab with an improved concrete mix that will last longer and allows for cleaning, possibly with reinforcing wire mesh.
- Provide a lightweight, durable, easily removable cover to prevent flies and smells.
- If an existing structure & slab can accommodate it, add a vent pipe with cover and insect screen (the old style ventilated latrine). We are ambivalent about fly screen, as in our observations flies were not overly prevalent around toilets (although they were prevalent around food), and fly screen is not easy to integrate with current primitive construction methods.
- Provide a slope or drain for the fluid from anal cleansing or cleaning the slab, with a small distribution method or rocky pit under the soil surface.
- Provide a separate urinal for boys and men (concrete trough or plastic receiver).
- Handwash station outside each toilet.
- A clip for towels to dry hands.

After education and training, most of these improvements can be completed by villagers without substantial cash donations from Rotary. We recommend that Rotary begin a Train the Trainers program so that representatives from each village can learn, then teach, toilet improvements like this.

Sanitation & Toilets. As discussed above, a community-wide program to improve toilets, add latrine covers, collect urine and use it as fertilizer, dry and decompose feces as a soil amendment, make toilets durable and weatherproof, should be part of each WaSH project. Besides the public health aspect, the community leaders can perhaps figure out a way to make this a fun, social experiment by providing prizes for the most-improved toilets. [This is highly cultural, and some people respond to non-health aspects.] With a limited number of toilet designs, the community can form construction teams and training sections. It is essential to have a person in charge to assure designs are properly constructed, and quality is maintained.

Covers. We recommend that a simple latrine cover be used in all villages. It can be made at home, or perhaps this is a local manufacturing or business opportunity.

Urine & Feces Recycling. Based on successes in Malawi, and many studies and recommendations by established organizations, we recommend simple urinals (e.g. cut plastic jugs with tubes and



Double Chamber UDDT with Solar Access Doors to Faeces Chamber (See: WaterAid in Nepal (2011) - Technical Handbook - Construction of ecological sanitation latrine . Source: et al Tilley 2008)

containers) or other locally acceptable design should be used to collect urine, for dilution and distribution either by manual sprinkling or via tubes to gardens and plantings. In Zanzibar, they are using a urinal design made from coconuts, with good success. This will increase crop yields, and return urine to the nutrient cycle. A ratio of 4 parts water to 1 part urine is sufficient.

Dry Toilets. We recommend eco-san toilets, or UDDT (urine diverting dry toilets), also called Skyloo toilets (used in East Africa). They are used to capture urine and feces in containers above-ground, or partly embedded in a slope, lined with bricks, heavy plastic or cement. These are particularly recommended where rainy season raises the water table within 10 meters of the surface, or in rocky or gravel soil conditions. Arborloo latrines are inexpensive and worthy of consideration, used to grow trees.

The materials and construction methods should be selected by the villagers after education and demonstration toilets are built and discussed. Villagers need education about the nutrient value and safety of using diluted urine as fertilizer, and decomposed human waste as a soil amendment, and perhaps testimonials from other villages that have successfully used them. In Malawi, fertilizer from human waste is a prized asset, and is not brought to market for sale.; however, it takes 2 to 3 years of education for this concept to be widely accepted. Such toilets are sustainable, reusable, do not become defunct when full, and require septic tank, pumping or removal of raw sludge.
With these ecologically sound toilets, after each use, the person will sprinkle a mixture of ash or any minced vegetable matter such as leaves or needles (kitchen scraps are not recommended), or healthy dirt, over the feces so they are completely covered. The combination of no or little urine and this layering avoids smell and precludes insects.

Access panels allow periodic turning of the mass with a hand tool. If dry toilets are placed on a slope, the access can be downslope, reducing the height, construction materials and cost,

This approach will reduce the volume of waste (moisture probably leaches through pits now), capture fecal matter for the nutrient cycle, and reduce the need to demolish old pit latrines and rebuild them. It may justify better quality superstructures that are serviceable and better withstand weather (e.g. stucco coating over brick). Many designs are available, and Wasrag will be pleased to assist RC Moshi-Mwanga and Mwanga District water engineer in a sensitive local design.

Another approach has removable tubs within a substructure, under the ecosan pan, and the tubs are sealed and left until they contain a safe, decomposed and crumbly dry soil amendment. This toilet design is suited and recommended for both village homes and schools.

Using human waste on food crops will take time, some early adopters followed by proven results for villagers to accept as a whole (see Peter Morgan's work and photos here).

7.19 Handwashing. Handwashing is the most important aspect of hygiene, as it directly affects personal health, transmission of disease, school attendance, the ability to work, and overall community health. We recommend improving what the villagers presently use, in an evolutionary series of steps. This is a public health education issue. Education can start in schools, then move to parents of students, and finally become a village-wide program using health education officials in the village or ward, and community health workers brought in by Rotary or the Mwanga District. The governments (Mwanga to RS to national) in Tanzania will have resources on this. Some techniques that help are:

- Posters and murals on toilets and school and toilet walls.
- Artwork, with colorful positive messages for children (culturally appropriate) by local artists

- Low cost, household level methods:
  - Pitchers and basins with soap trays.
  - Tippy-tap stations outside latrines.
  - Plastic bottles with holes in the bottom, with wire hooks on top, dipped into a water bucket and hung to make a sprinkler.
  - Soap trays attached outside restroom walls.
  - if ash is used in toilets and there is enough, it can be used in lieu of bar soap.

We suggest the health officer/trainer in each community give the people some alternative designs/approaches, and let the community decide the specifics (improves sense of ownership):

- In much of Africa, Tippy Tap handwash stations are used, made from readily available materials at low cost.
- The current method in these villages of using basins with pitchers can be made more effective, provided there is a way to keep the outside of the pitchers clean for the next user while holding soap or ash. Alternative designs reviewed by the community leaders and women, and positive promotion, will be beneficial.
- Here are some resources for Tippy Tap designs we have for your consideration:
  - http://bit.ly/fMT3HD - good video on building a tippy tap by Uganda girl and her brother.
  - http://bit.ly/Z9FB7v - how to make a tippy tap more portable, e.g. when boys are herding; this one also adds an eyelet to redirect the treadle pull string, dowels to set the top bar, easily removable jug, and moveable stone/concrete base.
  - http://bit.ly/fIOwnv - how to build tippy tap.
  - http://bit.ly/XVweyT - some aspects of a handwashing campaign

7.20 Project Management. Rotary humanitarian grants are for projects initiated and managed by Rotary clubs, or districts. RC Moshi-Mwanga will need to consider, and then decide how the overall management of this large project will be delegated, either to individual volunteer Rotarians or outside, possibly to a part-time paid project manager. As requested, we give here a brief position description and some activities:

- The PM (Project Manager) will have experience and skills in project management in developing countries (preferably Tanzania), of a similar size and nature, used to timelines and delegation, accurate accounting, be fluent in Swahili and live full-time in Tanzania. The PM will work closely with the RC Moshi-Mwanga in understanding the club's goals or objectives, the TRF Terms and Conditions, the contemplated project(s), as well as working with the District engineer to obtain BOQ (business proposals and supplies) and price quotations. The PM will prepare a timeline with milestones for stages of project design, implementation and post-project measurement.

  The PM ought to have some technical expertise, and be a proficient communicator, with international Rotary partners, TRF and Wasrag. The PM will probably have a bachelor's degree or better. The RC Club lead person or treasurer will work with the PM and District engineer, to assure that funds are applied as needed for supplies or contactor payments.

- We recommend that either the PM, or a separate person who works closely with the PM, be in charge of coordinated Community Development. They will interface with the village leaders, trainers, and assure behavioral change. They will also assist villages with the local "politics" of WaSH and setting up an agreed system for the community. Given the culture here, perhaps this is an older respected gentleman. It may be that some of these PM roles can be fulfilled by Mwanga District as a collaborative partner.

7.21 Rural Community Development. In addition to a project manager, we recommend strongly that a community development person be involved to interface with the Rotary club, Mwanga District. This person will work closely at the village level -- with the village leaders, local trainers, and assure behavioral change occurs. They would take care to stay out of the local "politics" of water. Perhaps this is an older respected gentleman (often more respected in this culture). This person should be a good leader experienced in community development. [We met with Mark Leveri in Mwanga, who may be a good person for this position.]

The RC and District ought to jointly interview a few recommended people. This should be discussed by Rotarians, Water Engineer, Government officials and approved by the Board of Directors of RC Moshi-Mwanga. We think also a second source for rural development officer might be from the Mwanga district council.

Possible outcomes expected from the community development leader:

- Develop stepwise approach to education, behavior change.
- Stimulate or lead hands-on activities by villagers.
- Celebration of their accomplishments.
- Measurement and monitoring of outcomes.
- Reporting of village-by-village details to overall Project Manager, Rotary club and District, plus occasional updates to International partner clubs/districts.
- Follow recognized approaches (see programs and recommendations from UNICEF, WHO, African International Development Bank, World Bank and others).

7.22 Process for Village Development. We recommend that the Rotary club and Mwanga District, and any collaborating NGOs, jointly outline a process for the development of Water Boards and community and personal responsibility, around the use of water and providing adequate local toilets, plus improved handwashing and personal hygiene. There may be guidance from WHO on water board composition and operation. Here are a few component parts discussed with the RC Moshi-Mwanga and Mwanga District water engineer:

- Pilot project for low-cost alternatives such as rainwater harvesting, storage of water in polypropylene tanks, and low cost toilet and sanitation improvements.
- RC Moshi-Mwanga has agreed to do rainwater harvesting. The Rotarians should commit to capturing rainwater at their own homes, so that they can lead by example, and help villagers construct several additional rainwater capture systems to demonstrate their effectiveness during the upcoming rainy season.– RC Moshi-Mwanga will determine which village(s), how to do it, how to report back to sponsor RCs.
- Approach nearby large business for in-kind and cash donations: develop a plan, a specific itemized request, and be jointly presented by a rehearsed mix of District officials, Rotary business members and village leaders.
- Empowerment: Rotary Club Mwanga can to develop an empowerment program for the villages. Pilot Sponsor clubs will cover the costs of trainers, travel and materials, food and

water during the training at a very modest cost. Although some NGOs pay trainees to attend training sessions, this is counterproductive and discouraged. The trainers should use interactive methods to demonstrate the behavioral change that is required:

- Perhaps two successive days for two different villages; bring the training to them. We recommend villages such as Kigogo/Ishinde and Njoro.
- Ask Mama Kuku to stimulate RCs, monitor their process, encourage reports back to sponsor clubs and both the AG and Country Leader.
- Rotarian hosting – To stimulate new Rotary partnerships, long-term relationships with International sponsor Rotary clubs, we recommend that twice a year, a team of volunteer Rotarians travel to Mwanga to spend two weeks helping RC Moshi-Mwanga and the community with its service projects, followed by a one-week photo safari in Tanzania's nearby national parks.

  Target countries that might be most amenable to sending these teams are Germany, The Netherlands, Great Britain, Scandinavia, the United States and Canada.

7.23 Sample Project Timeline. A sample project timeline might include these elements:

- Month 1: Identify contractors, and ask for bills of quantities (BOQs).
- Month 1: Review and select contractors and sources of supply.
- Month 1: Identify potential training partners (NGO, health professionals) for sanitation and hygiene training.
- Month 2: Receive *pro forma* invoices, quotes, and tabulate all costs for the project.
- Month 3: Visit with Village leaders and influential women to discuss short-term low-cost projects, gain ownership and their roles, identify costs, and propose to RC Moshi-Mwanga.
- Month 4 (after funding arranged): work with RC Moshi-Mwanga and International Partner clubs to develop attachments to Global Grant application.
- Months 4 & 5: Develop detailed implementation plan and timeline.
- Month 5 or 6 (after funds received): Begin implementation, and with RC Moshi-Mwanga distribution of funds. etc.
- Month 13 (as implementation is proceeding) Work with the village to identify the people who will monitor water quality, water measurement at each DP, toilet use and cleaning, handwash and personal hygiene behaviors – write position descriptions and train them. Include methods, forms and procedures for all or most of the measures described in this section of the report.

7.24 Community Organizing & Capacity Building. Elsewhere we have recommended the use of improved water committees, RCCs (community corps), a community development person to interface with each village, and general methods to improve the capacity of the village to organize and implement a project of this magnitude. This must become their WaSH project from the start, and guidance will assist, but their self-organization is key to its success

7.25 Other Recommendations and Thoughts.

Not all families raise animals, and animals can consume a lot of water. The community will need to consider how much animals are allowed to use, how the families pay for animal water, and whether there is a different distribution system for animals than people.

Presently herding moves across long distances and large areas, perhaps causing migration damage to plants and the ecosystem. Is a lifestyle or methodology revision in order? What is the government policy, and sound lifestyle recommendations for settlement vs. nomadic herding? For another view, see this interesting TED talk by Allan Savory on How to Green the Desert and Reverse Climate Change: http://bit.ly/XOjjM9.

The 20-liter plastic container seems to be well-recognized as the standard, so for simplicity we recommend it be continued.

Agricultural settlements make it easier to provide schools, health centers and water systems. Pastoral herding and nomadic lifestyles make these more difficult. However, recommendations in this area are beyond our expertise.

8.0 Measurement Indicators & Data Collection.

To determine the impact of these projects, the Rotary club and district engineer should decide on the specific measures that will be used to determine the outcome and success of the project. There should be a study before the WaSH project begins, to establish a baseline for those indicators. We recommend that you include some kind of digital data collection for monitoring and evaluation, e.g. on an Android phone. This will provide near real-time transfer of data, and streamline data collection as compared to more manual methods with manual data collection, transcription and summary.

Indicators that the PPP Team recommends be considered follow. [TRF standard indicators have a ✔ next to them]:

- ✔ Total number of direct beneficiaries
- ✔ Number (No.) AND percentage change of people with access to improved drinking water supply
- ✔ No. AND percentage change of people with access to improved sanitation facilities
- ✔ No. AND percentage increase of people with access to disinfected water through point of use technologies
- ✔ No. AND percentage of water facilities in use one to three years after project completion
- ✔ No. of people trained
- No. of hours spent by a person each day bringing water to the household
- No. of hours spent by mothers each day caring for children
- No. of water bottles brought into the home each day, average for the last week
- No. of liters per person for personal use (drinking, food prep, bathing, toilet etc.)
- No. of children suffering from diarrhea in previous 24 hours
- Number of days children miss from school each month
- Number of cattle/goats/sheep/chickens the family has now
- The liters of each crop harvested per month from the family garden
- Percent of vegetables grown that are sold outside the household
- Sources and amounts of income received by each family
- No. of households with improved toilet designs

- No. of households with effective rainwater catchments
- E.coli rate for household point of use water containers
- No. of households using a POU water treatment (bleach, filter or other)
- No. of children under five who died per 1000ppl / year
- Other wealth indicators: radios/stereos, bikes, cell phones, TVs, refrigerators, motorcycles, cars, new shoes for children in last six months
- Environmental indicators like numbers of trees added by the community, or hectares of soil that is no longer bare or desert.

The village and Rotary club, with guidance by RC Moshi-Mwanga and the District engineer, will need to decide:

1. Who will gather this data.
2. What baseline data is available or needed before the project starts.
3. Which of the above measures will be tracked, and
4. How will it be collected and displayed.

Consider different timeframes: before the project begins, throughout development of the project, during project implementation, and after the project is completed.

The goal of collecting and analyzing the data is to achieve consistency and gather useful information that can guide the implementation of this and future projects. When the project is successful, the data will show the results of the WaSH project:, how family life and health have improved, and how people are using their time freed-up from gathering water. It will also provide good data for facilitating future entrepreneurial and economic development, with those Rotary projects.

We recommend a permanent system of monitoring water points, water quality, sanitation and hygiene be established for the indefinite future. This data should be sent periodically to the Mwanga District, RC Moshi-Mwanga, Wasrag and TRF, and possibly the PWB Office and Tanzania Water Ministry. [We understand that TRF may only require a few years of monitoring, but we believe a permanent monitoring system is more likely to lead to response, continuous maintenance, and a longer life.]

9.0 Funding - Partnerships, Collaboration and Diversification.

TRF encourages larger scale collaboration and long-term partnerships between host clubs/districts and international partner clubs/districts, other partners as well. Diversified funding supplements TRF grants.

We believe that a project for multiple villages of this size, scope, complexity and long-term sustainability requires close collaboration between RC Moshi-Mwanga and the Mwanga District (water engineer, administrator and executive), as well as other partners to deliver services and village training. Those partners might be an NGO working in this area with paid staff, a local health department, or a retired nurse or sociologist. Additional technical assistance will probably be needed from the RS office, GIZ, or Wasrag Technical Team. It may be that a future PPP Team will be needed, since this short visit limited what we could accomplish.

On the Rotary funding side, RC Moshi-Mwanga has committed to utilize a TRF grant of over

$100,000 USD. We estimate a reasonable total value of the projects in a carefully selected one to three villages will be in the range of $275,000 to $400,000 USD, which (depending on the mix) translates into club and district contributions of roughly 2/3 that amount. Given typical budgets for clubs and District DDF, plus the interest expressed so far, we imagine that 2 to 5 districts and a total of 7 to 15 clubs will be involved in raising the needed funds, but this is hard to predict. We recommend RC Moshi-Mwanga with one or two other lead international clubs develop: a short flyer (pdf), PowerPoint presentation with images, possibly video clips, a *pro forma* budget showing uses of funds, and a photo/video website for photos, brief text and video clips that illustrate the need, and show the benefit that this project will bring to the villagers and their lives and livelihoods.

A pro forma sample of Rotary only funding might look like this:

9.1 Rotary Funding Sources:	TZS	USD
Clubs in No. America	80,000,000	$ 50,000
Clubs in Europe (e.g. Eng, Germ, Nederl.)	80,000,000	50,000
Average District matches (DDF, approx.)	128,000,000	80,000
TRF Match (approx.)	208,000,000	130,000
Total Potential Funding	496,000,000	$ 310,000
using conversion rate of:	1600	
Club Amounts for Temporary Village Water *(does not roll into the GG project)*		$ 8,000

Multiplier Effect, for Contributions by:	Multiplier	This --->	Becomes:
Each Rotary Club (after temp water)	**3.1**	5,000	15,500
Rotary Districts, DDF	**3.9**	10000	38,750
TRF Global Grant	**2.4**	130,000	310,000

9.2 Diversification & Enlargement. However, the projects in Mwanga would benefit from involvement and funding from other partners:

The District of Mwanga, while having its own funding needs, we think it should provide some funding in addition to the technical support given by its Commissioner and Water Engineer.

The Tanzania Water Ministry may also be a funding partner, and provide added design and technical support, based on brief conversations with Prof. Jumanne A Maghembe, Tanzania Minister of Water Resources. The Ministry + Rotary relationship ought to be developed further.

Both Water Missions International (WMI) and World Vision USA (WV-USA) seem to be willing partners for Rotary on these projects. WMI has recently decided to create a Tanzania office, and Will Furlong is visiting for the second time to discuss the project. The funding mix with WMI will need to be discussed. Along the same lines, There is already a WV-Tanzania operation (not sure how much WaSH they do), however the joint funding would come from WV-USA, in the same way it has in Ethiopia, Uganda and other Africa locations. We understand that a 1:1 match, Rotary funds and WV-USA funds, is feasible but only if the Rotary funding component is over 250,000 USD, which we recommend. This would turn a $300,000 Rotary-only project into a project value of double or more. Contact Stew Martin for more details and introductions to both WV-USA and WMI.

We recommend that these relationships be developed, joint funding and other collaboration be explored – and then the Global Grant be applied for, with those in hand. By combining two or more funding sources with Rotary, perhaps three or four villages, and project values nearing

$900,000 can be achieved.

Here is a pro forma sample of more diversified funding for this project might appear:

9.3 Potential Diversified Funding Sources:	TZS	USD
Clubs in No. America	96,000,000	$ 60,000
Clubs in Europe (e.g. Eng, Germ, Nederl.)	96,000,000	60,000
Average District matches (DDF, approx.)	144,000,000	90,000
TRF Match (approx.)	240,000,000	150,000
NGO Partner (e.g. WMI, CARE, CRS, Empower TZ)	64,000,000	40,000
Mwanga District	64,000,000	40,000
TZ Water Ministry	160,000,000	100,000
WMI, World Vision-USA or others	576,000,000	360,000
Total Potential Funding	1,440,000,000	$ 900,000
using conversion rate of:	1600	
Club Amounts for Temporary Village Water *(does not roll into the GG project)*		$ 8,000

9.4 Multiplier Effect, for Contributions by:	Multiplier	This --->	Becomes:
Each Rotary Club (after temp water)	**7.4**	5,000	37,167
Rotary Districts, DDF	**8.5**	10000	84,889
TRF Global Grant	**5.1**	150,000	764,000
NGO Partner	**19.1**	40,000	764,000
Mwanga District	**19.1**	40,000	764,000
Tanzania Water Ministry	**7.6**	100,000	764,000
World Vision USA	**2.1**	360,000	764,000

With funding nearing these amounts, it may be that most of the seven villages can be funded as one global grant. After discussion and negotiation, the partners and amounts above will probably change.

10.0 Follow-on Project Possibilities.

In discussing this situation with RC Moshi-Mwanga and the District, after the basic WaSH needs of these communities are met, they regain strength and health, crops and animals begin to return to normal, we recommend the following additional humanitarian projects be considered for Rotary:

- Subsistence farming and animal husbandry were the only income producers. We observed very little in the way of products of their labor or entrepreneurial activity: cheese from milk, baked goods from grains, woven or handmade articles, handicrafts constructed from local materials. No doubt the big water scarcity is a damper on this; but we think that training on local appropriate small business activities would be beneficial. Perhaps the Rotary club can consider this as a second- or third-round project.
- Erosion control, soil restoration and conservation, and soil amendments to restore health - aid for crops and forage.
- Microlending and microenterprise, assisting them with business activities such as improved animal husbandry (cows, goats, sheep, poultry), milk production, bee keeping, crop growing, corn milling, prepared foods, and further improvements to household WaSH systems.

- Improved cooking arrangements – solar ovens, “rocket” stoves, with vents through metal roof to reduce indoor fumes and soot, and hand-made fuel briquettes using vegetable, paper and wood waste (courtesy of Stew’s friends in RC Beaverton, D5100).
- Encouraging government to provide more and better schools, perhaps with Rotary assistance for toilets, water supply, furniture, school supplies, teaching aids, programs on health, nutrition, environment and water conservation.
- A university graduate program and student may be interested in observing, monitoring and evaluating, for a defined period, on behalf of Rotary.
- Other assistance, requested by these communities, which empower them to lead more full, productive and healthy lives, and break out of poverty.

However, these are projects to follow this one - we caution RC Moshi-Mwanga not to undertake too much at the outset; focus on the WaSH needs (priority one with all communities) and develop other aspects from those relationships and a successful program base.

11.0 Summary.

This PPP Team was impressed with the high need for water in the Mwanga region, in particular in these villages. There was unanimity by all we met or spoke with that water supply is a high local and regional priority, there should be close Rotary-Government collaboration, and there is great dedication to this purpose by the local Rotarians. We strongly recommend to TRF, Wasrag and all potential international partners and sponsors that you throw your efforts, assistance and funding behind the projects that are jointly developed.

Rotary PPP Team Report – Appendix A

The Rotarian Supplemental Narrative

The people of the Mwanga Region in Northern Tanzania are polite, pleasant, yet they have some formality from the influence of Germany and Britain. They welcomed us into their villages with dance, song, applause and open hearts. And into their homes with a transparency and willingness to share, like most of us have not seen before. They need help -- and during this trip our desire increased daily to help deliver water, sanitation, hygiene, better health, improved livelihood and learning, and reduced poverty.

The water here, our basis of life, is very scarce, of poor quality, often contaminated – yet they must drink, cook and clean with it. There is nothing more available. The government agencies are open also, provided all we asked, yet are very limited in what they can do.

The people of these Mwanga rural villages are subsistence farmers, eating all they can raise in their family gardens, or which they can obtain from neighbors. In some villages households raise a few chickens for eggs and meat, goats and cows for milk and meat; and they hope someday these will contribute to family income.

Children are suffering for lack of water, water- and dirt-borne illness, diarrhea, sores, and more. Yet there is little malnutrition. Education is lacking, in part due to poor attendance caused by water scarcity: mothers must spend many hours walking; or girls, and miss school; and boys herd animals long distances to get water, so they miss school.

The "water system" is old, in some areas ancient, and in others virtually nonexistent. What exists should be rehabilitated, or abandoned and made anew. And much more water quantity is needed to meet national and international standards, or simply a humane life. Water quality needs more testing, but our spot tests show that people believe (from appearances) that some water is safe; but it is not; and other water is known to be contaminated, but they have no choice within hours of walking or their meager financial means. Water scarcity causes less education, increases household arguments, means mothers cannot attend to children's needs (as they walk many miles), adds to community stress, and deprives them of more productive lives.

The toilets are simple, often merely holes in the dry soil; but usually with a concrete slab. But many are old, slabs break, there are no covers for flies, and little understanding of the importance of keeping contamination away from water, fingers, faces and food. There is no significant use of animal waste as fertilize. Use of urine or feces from humans for their nutrient value is hardly discussed, certainly not practiced. Yet there are some inventive residents – one showed us how he routed bathing water into a mound of plants, a modern day constructed wetland. Another is trying to repurpose his old toilet by making a pit adjacent to it (alas, it's open to the air and flies). Some used plastic to cover holes eroded by weather. And walls are sometimes deliberately shy of the roof, so they can find the wood-destroying or maize-eating insects, and bat them away before they get into the rafters or roof.

Hygiene is, in concept, understood – but lack of water has made it hard to practice what they know. And they know too little to have good health. There was almost never soap, handwashing was not done or perfunctory (not really cleansing hands from dirt and bacteria). Except in two locations, we saw no collected or utilized greywater, and no drying towels. As expected there was no toilet paper, although occasionally a leaf was evident, and no water was trapped after anal cleansing. Some toilet areas provided no privacy, so were used at night, if at all.

Water containers were dirty, and probably contaminated inside and out; but no one tests or has a procedure to sanitize them. The weekly swish of gravel and soap with a little water, then rinse, would do little to reduce the amount of unhealthy microorganisms ingested by the family.

Every leader, mother, child, shopkeeper and government official was eager to see Rotary here, and willing to help. Just our presence was praised, and they prayed, reminded and danced that we might return with new water for their villages.

These seven villages have been long neglected. They have had tiny demonstration "projects" (like a single stucco covered toilet), but no long-term solutions. These villages are like extended families, with relations living nearby, some families living there many decades, they don't want to admit that water scarcity might defeat them. They have lost people -- children have died, and families have been forced to move from their homes or face dire consequences. Plants don't yield much in the way of crops. Trees they plant, for shade, beauty and soil-holding potential, die for lack of water. Cows' udders dry up, so there is no milk, and some die due to water scarcity. Their opportunities for business and income generation dry up, also.

Rotary, of course, is not the first, and won't be the last, non-governmental organization to visit these villages. But we sensed a unique difference, because Rotary listened. We spent hours hearing their needs, their wishes, their suffering, and their hopes … and those ideas are the basis of our recommendations. We have strived mightily to only bring to the table ideas that mesh with where these villages are, and want to go … and contain our own views on what they should do, or how they should do it.

Rotary here is a respected partner, poised for great work, and we plus the RC Moshi-Mwanga have demonstrated a desire to collaborate. But this Rotary Club will need much support, assistance, and a long-term partnership with several districts in the developed world, and perhaps also learn from some neighboring Rotarians. There is enough work in these 7 villages to occupy this club and the Mwanga District of the Kilimanjaro Region, for a few years to come. And there are other villages in "line" behind these.

Finally, the women and men of the villages we visited were so thankful for our visit, so hopeful that Rotary can bring water. They asked us to please, not forget them. We remember, and seek to make a difference. We know their lives will be transformed when they have clean plentiful water, healthy toilets and good hygiene.

Thanks for reading … and caring.

Rotary PPP Team Report – Appendix B

Hydrogeology of the Mwanga District

Occurrence of Groundwater. Groundwater in the Mwanga District is found in three main aquifers controlled by the topography and geology:

- near-surface unconfined aquifers in weathered formations,
- somewhat deeper aquifers in semi-consolidated weathered formations, and
- bedrock aquifers.

Near Surface Aquifers in Mountainous Areas. In the mountains, near-surface aquifers are found in thin soil veneers overlying rock, and in the erosion sands and gravels deposited in swales in narrow valleys and ravines. Water in upland area soils flow toward the swales and valleys. In some areas, this groundwater creates springs which feed vigorous creeks that pour down the mountainside. Unfortunately, the team did not find evidence that during dry periods, water in these streams reaches lowland areas of Mwanga District. In most areas, water percolates as subterranean groundwater flow until it recharges the regional aquifers.

While visiting the village of Mhezi, the team observed a large upland meadow in a 100 -meter wide swale between two hillsides. At the base of the meadow, a small stream was being used to collect water by students of the local secondary school. Groundwater in the upland meadow is expected to be within several centimeters of the ground surface.

Near Surface Aquifers in the Lowlands. The lowlands are filled with alluvium, which is sand, gravel, silt and clay eroded from the surrounding mountains and hillsides, carried by water and wind to these areas, and deposited above either weathered bedrock, or deeper competent bedrock material. The thickness of the alluvium is variable, depending largely on the topography of the buried rock. Borehole logs suggest that competent bedrock is commonly encountered between 40 and 60 meters below the ground surface.

The geological processes of erosion and deposition in rivers and streams separates minerals and create discontinuous layers (lenses) of less permeable clay and silt, and other lenses of more permeable sand and gravel. The pathway of a stream changes with geologic time, thus sand bars and clay will eventually become buried below new deposits. After deposition and burial beneath new erosional material, these sand and gravel lenses can become saturated with groundwater and become aquifers. Where the buried sand and gravel lenses are extensive and are underlain by similarly extensive clay lenses, usable unconfined aquifers can exist. If the clay lens is not laterally extensive, small quantities of groundwater will be trapped, but it will flow over the edges of the confining layer. Geological reports for the Mwanga Valley have not identified the existence of laterally extensive clay, or the existence a regional unconfined aquifer in the alluvium. For this reason, where groundwater is found at shallow depths in the alluvium, it is most likely perched, and should not be considered a reliable long-term water supply.

Deep Aquifers in Alluvium. In some, but not all areas of the lowlands, groundwater exists in deeper portions of the alluvium overlying and perhaps hydraulically connected to the even deeper bedrock aquifers. Groundwater in these formations flows through sand and gravel layers separated by layers of silt and clay. In most areas of the valley, water in the deep alluvium is believed to recharge the bedrock aquifers; however, if water is pumped from deeper sections of the alluvium, the decrease in hydraulic head will cause water in the bedrock to recharge the alluvial aquifers.

Bedrock Aquifers. The Mwanga District is underlain by Precambrian igneous and metamorphic rocks of the Usagarian systems. These high-grade metamorphic rocks include granites, gneisses, quartzite, schists and amphibolites, and migmatites. Bedrock formations commonly contain both

small and large fractures. Some of these fractures were created when the rock first formed and cooled. Other fractures were created by earthquakes that have occurred over the millions of years since the rock was first deposited. The fractures will also change as a result of the dissolution of the rock, and deposition of minerals as water flows through them. The movement of groundwater through bedrock aquifers is highly dependent on the frequency and size of the fractures in the rock. The Mwanga District has been shook with earthquakes for millions of years, thus the bedrock is expected to be highly fractured, and thus able to transmit, store, and yield large quantities of water. The average depths to groundwater in the bedrock aquifer within lowlands are expected to be 60 to 90 meters below the ground surface.

Regional Hydrologic System. Most of the rainfall in Mwanga District falls at the higher elevations of the surrounding mountains. In these areas, precipitation rapidly infiltrates into soil, where it percolates vertically until encountering a confining layer. In the mountains, the confining layers are commonly the igneous rocks forming the mountains. After the infiltration water reaches a confining layer, it will flow laterally along the soil-rock interface. In some areas, it may reemerge as a spring, but in other areas, the water may flow to a fracture in the rock, and percolate into deeper formations.

The rock forming the South Pare and Kiteto Mountain Ranges are expected to be hydraulically connected to the bedrock below the Mwanga lowlands. Aside from Mwanga Spring, few other springs exist at lower elevations or at the base of the mountains. As a result, most of the water falling in the mountains first recharges small perched saturated zones and aquifers in the mountains. The water in these mountainous water-bearing formations, however, slowly percolates through fractures into the deep bedrock aquifers below the lowlands.

The alluvial and bedrock aquifers in the lowlands aren't only recharged by water flowing from the mountains. Direct recharge also occurs after rainfall events in the valley. During a short-duration or light rainfall event, the rain is likely absorbed by the shallow roots of surficial plants, and little recharge occurs. When the rainfall is heavy, the rain percolates into deeper soils and ultimately into the alluvial and bedrock aquifers. In the Mwanga District, the relative amount of recharge coming from precipitation in the mountains versus precipitation in lowlands is unknown. In other areas where this has been studied, most of the recharge occurs in the mountains.

Rewerts WELL COMPANY, INC.

742 W. 18TH STREET
NEVADA, IA 50201
(515) 382-2620

Feb5, 2013

Mwanga Water Engineer
Mwanga District
Mwanga , Tanzania

We were able to Camera 2 Boreholes for the village of Mwanga.
The first borehole to be inspected was Borehole Makokoro. I have no extra data , Gps or elevations on this borehole.

It was 14.8 meters deep, with a rock or some type of obstruction in the borehole.
I would suggest this borehole be abandoned. Since the water table is shallow here. It would be a better use of money to install a new borehole in the area.

The next borehole KL 266/2001: GPS E 03' 39.756 E 037'35.435, Elevation 2739 Ft
This is an 8" steel casing , 43.4 meters to the bottom. 40.1 meters to bottom of 8" casing.
Static water level is at 29.1 meters bgs.
This borehole is in very good condition, it has a little bit of sodium scale on the inside of the borehole, but not excessive. The pump is set at 39 meters, the area around the pump has a bit of black magnesium built up. Mostly due the amount of water being pumped at this level.

The pump looked to be in good condition with no build up of any kind on the outside of the pump or steel drop pipe.

I would continue using this borehole. Just keep an eye on the how deep the pumping water level gets to the opening of the pump. So it does not get low enough to start drawing air into the system.

Justin Rewerts

Rewerts Well Co. Inc.

Rotary PPP Team Report – Appendix D -- Mwanga, Tanzania, Village Survey Results

Questions	Kiruru	Kisangiro	Mforo	Kituri	Lembeni	Mkizingo	?
Surveyor Visit?	Y	Y	Y	Yes	Y	Y	N - public holiday
PPP Visit?							
Basic Community Information							
Total Population	2279	750	450	2510	1130	1104	
Men	1000	-	-	-	-	-	
Women	1279	-	-	-	-	-	
Children	-	-	-	-	-	-	
Average HH size	6	6	5	5	7	8	
Vocations							
Farming	Yes	Yes	Yes	Yes	Yes	Yes	
Livestock keeping	Yes	Yes	Yes	Yes	Yes	Yes	
Small business owner							
Office worker							
WASH related vocations?	Yes (job unlisted)	No	No			No	
Financial							
Unemployment rate?	80%	93%	96%	88%	87%	95%	
Average HH income (local, Tsh, per year)	912500	547500	182500	730000	547500	182500	
Average HH income (In USD, $)	570.31	342.18	114.06	456.25	342.19	114.06	
Banking?	Yes	Yes	Yes	Yes	Yes	Yes	
Credit?	Yes	No	No	Yes	No	Yes	
Stakeholders							
Community							
Water users committee	Yes	No	Yes	Yes	Yes	Yes	
Health committee		No					
Environment committee		No					

Government							
District health Officer							
District water engineer	Yes		Yes	Yes	Yes	Yes	
Livestock extension officer		Yes					
Non-Government							
Assemblies of God	No (to all)	No (to all)	No (to all)	No (to all)	No	NO	
Catholic Church							
Catholic Relief Services							
Compassion International							
World Vision							
ISF							
Care							
IUCN							
Water Sources/Treatment							
River/stream							
Spring							
Well				drilled shallow well w/ handpump			
Borehole		Yes	Yes				
Rooftop rainwater harvest							
Rainwater in reservoir							
Piped water (public tap)	Yes				Yes	Yes	
Availability of water supply	2 times per week	daily	daily	daily	twice per week	twice per week	
Distance to source	.4 km	12 km	2 km	25 m	10 m	15 m	
Community distribution infrastructure?							
Safe water treatment?	Yes	Yes	Yes	Yes	Yes	Yes	
Safe water treatment method?	Boil	Boil	Boil	strain through cloth	strain through cloth	water filter	
Storage?	In container with lid	In container with lid	narrow mouthed container	container with lid	container with lid	container with lid	
Current service levels	100 L/day	60 L/day	70 L/day	140 L	170 L	100 L	

Desired service levels	300 L/day	180 L/day	150 L/day	220 L	250 L	200 L	
Fresh water in wells?	Yes	Yes	No	Yes	Yes	Yes	
water sources dry up?	Aug, Sept, Oct	No	No	No	No	Yes	
Water sources appear polluted?	No	No	No	No	No	No	
Water for purchase?	600 Tsh/20 L	100 Tsh/bucket	No	No	No	Yes, 100 Tsh, private borehole	
Sanitation/Environmental							
Toilet type?	pit latrine w/ slab	pit latrine with no slab; open pit	pit latrine with no slab; open pit	pit latrine with no slab; open pit	Pit latrine with slab	pit latrine with no slab; open pit	
Shared?	No	No	No	No	No	No	
Animal waste on crops?	Yes	Yes	Yes	Yes	Yes	Yes	
Erosion?	Yes	yes	Yes	Yes	Yes	Yes	
Technical							
Basic O&M?	District water engineer	-	Community; DWE	DWE	DWE	DWE	
Advanced O&M?	District water engineer	-	District water engineer	DWE	DWE	DWE	
Spare parts available nearby?	10 km	n/a	16 km	15 km	Yes	Yes, 15 km	
Energy							
Energy sources available	wood, electricity	wood, electricity	wood, solar	wood, solar	solar, electricity	solar, electricity	
Availability of electricity	Daily	daily	n/a	n/a	daily	daily	
Social Cultural							
Community leader?	Yes	Yes	Yes	Yes	Yes	Yes	
community established?	20+	20+	20+	20+	20+	20+	
Permanent housing?	Yes	Yes	Yes	Yes	Yes	Yes	
Women participation?	Yes	Yes	yes	Yes	Yes	Yes	
Equitable water distribution?	Yes	Yes	Yes	Yes	Yes	Yes	
Institutions							
Primary schools	2	1	1	1	3	1	
Number of students?	-	-	-				

WASH?	Y	No	No	Yes	Yes	Yes	
Health facility?	Y	No	No	yes	Yes	Yes	
WASH?	Y	-	No	Yes	Yes	Yes	
Other?	vocational college	No	No	No	Yes	Yes	
WASH?	Yes	-	No	No	Yes	Yes	

Rotary PPP Team Report – Appendix E

Water Quality Results in support of the Rotary Mwanga Tanzania PPP Team

Report by: Rochelle Holm, Ph.D., PMP
Mzuzu University, Centre of Excellence in Water and Sanitation and SMART Centre Manager
P/Bag 201, Mzuzu 2, Malawi RochelleDH at hotmail.com

Samples collected by Dr. Rochelle Holm on 23 January 2013
Analysis done by Ndensari Kimaro, Head of Water Quality Laboratory Arusha, Tanzania. It was run by the government. Samples cost 60,000 TSH/each. The laboratory was observed to be in good working order.

Sample #1
Collected at Lembeni from individual household rainwater collection tank spout used as collection point.
GPS coordinates: -3.783820, 37.608149

pH = 7.25
Electrical Conductivity as 25 us/cm = 132.6
Total Dissolved Solids in mg/L = 65
Total Hardness as $CaCO_3$= 60
Fluoride in mg/L= 0.10
Chloride in mg/L = 7.8
Microbiology examination: Fecal coli form count per 100mL sample = None

REMARKS:
According to analytical results, the water is free from fecal coli form. This water is considered acceptable for human consumption.

Sample #2
Collected at Lembeni at a household point of use. Sample was from a plastic bucket in the household cooking area, container was observed to be kept covered.
GPS coordinates: -3.783820,37.608149

pH = 6.52
Electrical Conductivity as 25 us/cm =79.5
Total Dissolved Solids in mg/L = 39
Total Hardness as $CaCO_3$=30
Fluoride in mg/L = 0.08
Chloride in mg/L =7.8
Microbiology examination: Fecal coli form count per 100mL sample = TNTC (Greater than 500 colonies counted per 100mL samples)

REMARKS:
According to the analysis done, the water is highly contaminated with fecal coliform. To guarantee safety, it is recommended to thoroughly boil or disinfect drinking water. Others parameters are within the allowable standards of quality of domestic water.

Sample #3
Collected at Kiruru from household point of use. Sample was from a plastic bucket in the household cooking area, container was observed to be kept covered.
GPS coordinates: -3.709043,37.585924

pH = 6.99
Electrical Conductivity as 25 us/cm = 133.2
Total Dissolved Solids in mg/L =65
Total Hardness as $CaCO_3$= 60
Fluoride in mg/L = 0.07
Chloride in mg/L = 13.7
Microbiology examination: Fecal coli form count per 100mL sample = 18

REMARKS:
According to analytical results, the water is contaminated with fecal coli form. To guarantee safety, it is recommended to thoroughly boil or disinfect drinking water. Others parameters are within the allowable standards of quality of domestic water.

Sample #4
Collected at Kiruru from shop/restaurant alongside the main paved road. Sample was from a plastic bucket, container was observed to be kept covered. Water is used to serve patrons of the restaurant.
GPS coordinates: -3.709043,37.585924

pH = 6.57
Electrical Conductivity as 25 us/cm =168.4
Total Dissolved Solids in mg/L =82
Total Hardness as $CaCO_3$= 72
Fluoride in mg/L = 0.08
Chloride in mg/L = 14.5
Microbiology examination: Fecal coli form count per 100mL sample = TNTC (Greater than 500 colonies counted per 100mL samples)

REMARKS:
According to analytical results, the water is highly contaminated with fecal coli form. To guarantee safety, it is recommended to thoroughly boil or disinfect drinking water. Others parameters are within the allowable standards of quality of domestic water.

Sample #5
Collected at Mwanga town water sale point.
60 L of water was being sold for 100 TZS.
GPS coordinates: -3.668508,37.585338

pH = 6.86
Electrical Conductivity as 25 us/cm = 735
Total Dissolved Solids in mg/L =360
Total Hardness as $CaCO_3$= 300
Fluoride in mg/L = 0.63
Chloride in mg/L = 72.3
Microbiology examination:- Fecal coli form count per 100mL sample = 106

REMARKS:
According to analytical results, the water is contaminated with fecal coli form. To guarantee safety, it is recommended to thoroughly boil or disinfect drinking water. Others parameters are within the allowable standards of quality of domestic water.

Sample #6
Collected at Mforo from the solar powered borehole and tank system. Tank spout was used as the collection point.
GPS coordinates: -3.620893,37.547615

pH =7.52
Electrical Conductivity as 25 us/cm = 2604
Total Dissolved Solids in mg/L =1276
Total Hardness as $CaCO_3$= 868
Fluoride in mg/L = 1.02
Chloride in mg/L = 437
Microbiology examination: Fecal coli form count per 100mL sample = 251

REMARKS:
According to analytical results, the water is contaminated with fecal coli form. To guarantee safety, it is recommended to thoroughly boil or disinfect drinking water. Others parameters are within the allowable standards of quality of domestic water.

WHO Standard for Drinking Water Access

Table 5.1 Service level and quantity of water collected

Service level	Distance/time	Likely volumes of water collected	Public health risk from poor hygiene	Intervention priority and actions
No access	More than 1 km / more than 30 min round-trip	Very low: 5 litres per capita per day	**Very high** Hygiene practice compromised Basic consumption may be compromised	**Very high** Provision of basic level of service Hygiene education Household water treatment and safe storage as interim measure
Basic access	Within 1 km / within 30 min round-trip	Approximately 20 litres per capita per day on average	**High** Hygiene may be compromised Laundry may occur off-plot	**High** Provision of improved level of service Hygiene education Household water treatment and safe storage as interim measure
Intermediate access	Water provided on-plot through at least one tap (yard level)	Approximately 50 litres per capita per day on average	**Low** Hygiene should not be compromised Laundry likely to occur on-plot	**Low** Hygiene promotion still yields health gains Encourage optimal access
Optimal access	Supply of water through multiple taps within the house	100–200 litres per capita per day on average	**Very low** Hygiene should not be compromised Laundry will occur on-plot	**Very low** Hygiene promotion still yields health gains

Source: *Domestic water quantity, service level and health* (supporting document in Annex 1)

The quantities of water collected and used by households are primarily a function of the distance to the water supply or total collection time required. This broadly equates to the level of service. Four levels of service can be defined, as shown in Table 5.1.

Service level is a useful and easily measured indicator that provides a valid surrogate for the quantity of water collected by households and is the preferred indicator for surveillance. Available evidence indicates that health gains accrue from improving service level in two key stages: the delivery of water within 1 km or 30 minutes of total collection time; and when supplied to a yard level of service. Further health gains are likely to occur once water is supplied through multiple taps, as this will increase water availability for diverse hygiene practices. The volume of water collected may also depend on the reliability and cost of the water. Therefore, collection of data on these indicators is important.

THE ROTARY FOUNDATION FUTURE VISION PILOT

CLUB MEMORANDUM OF UNDERSTANDING

This document is the official Memorandum of Understanding (MOU) provided by The Rotary Foundation (TRF) for clubs participating in the Future Vision pilot. It is an agreement between the club and its district, explaining what measures the club will undertake to ensure proper implementation of global grant activities and management of Rotary Foundation Global Grant funds. By authorizing this document, the club agrees that it will comply with all Foundation requirements.

Each district may decide whether clubs that receive grant funds from the Rotary Foundation District Grant, will be held responsible for implementing the club MOU.

1. Terms of Qualification
2. Club Leadership Responsibilities for Qualification
3. Financial Management
4. Document Retention
5. Report on Use of Grant Funds
6. Method for Reporting and Resolving Misuse of Grant Funds

1. Terms of Qualification

A. Upon successful completion of the qualification requirements, the club will receive qualified status for a period of one year.

B. By entering into this agreement and receiving Rotary Foundation grant funds, the club understands and confirms that the club, as an entity, is responsible for the use of grant funds, regardless of which individual(s) or group controlled the funds.

C. The club must disclose any potential conflicts of interest and must comply with the Conflict of Interest Policy for Grant Participants as outlined in section 7.030. of the Rotary Foundation Code of Policies.

D. The club must cooperate with all district and TRF audits.

2. Club Leadership Responsibilities for Qualification

A. A club member must be appointed to manage club qualification and ensure that stewardship measures and proper grant management practices are implemented for all TRF grants.

B. The club must establish a succession plan for the transfer of grant records to ensure retention of information and documentation.

C. The club president-elect or a club-designated appointee must attend grant management and qualification training arranged by the district.

3. Financial Management

A. The club must maintain a bank account to be used only for Rotary Foundation Global Grant funds in accordance with applicable laws.

1. The account should be low or noninterest-bearing, and any interest earned must be documented and used on eligible, pre-approved grant activities or returned to TRF or the district.
2. Grant funds may not be deposited in investment accounts including but not limited to: mutual funds, certificates of deposits, bonds, and stocks.
3. Two Rotarian signatories are required on checks and withdrawals.

B. The club must create a financial management plan that includes measures to
   1. Maintain a standard set of accounts, including a complete record of all receipts and disbursements, and maintain receipts for all expenditures equal to or over US$75 or more (or those of any amount required by applicable law).
   2. Disburse grant funds, as appropriate, directly to Rotarians, vendors, and beneficiaries as approved in the grant application. Grant funds not immediately disbursed must be kept in the established project account without diversion, except for direct payment for grant activities or to return funds to the district or TRF.
   3. Maintain separate statements of income and expenses, noting interest earned and recoveries if applicable.
   4. Maintain a general ledger that separates funds according to each project
   5. Establish an inventory system for the control of equipment and other assets purchased with grant funds, and maintain records for items that are purchased, produced, or distributed through grant activities.
   6. Perform monthly bank reconciliations.
   7. Maintain a plan for transferring the custody of the bank accounts in the event of a change in leadership.
   8. Ensure all grant activities, including the conversion of funds, are in accordance with local law.

4. Document Retention

A. The club must create a document maintenance system or club archives to maintain original documents for a minimum of five years or longer if required by applicable law, including, but not limited to:
   1. Documents relating to qualification
   2. All records and documentation of policies and procedures required by the club MOU
   3. Documentation related to grants, including original documents for all grants, copies of proposals and applications, copies of grant agreements, copies of reports submitted to TRF and the district, receipts and invoices for all purchases made with grant funds, written or electronic correspondence

B. Documents must be stored in a known location that is accessible to club Rotarians and must be provided to TRF or the district upon request or in the case of an audit

5. Report on Use of Grant Funds

The club must report on the use of grant funds as outlined in the Terms and Conditions for Rotary Foundation District Grants and Global Grants.

6. Method for Reporting and Resolving Misuse of Grant Funds

The club must report any potential misuse or irregularities in grant-related activity to the district.

7. Authorization and Agreement

We, being responsible for administering grant activities for the ***Rotary Club of*** MWANGA, *certify that the club adheres to the requirements listed in this Memorandum of Understanding and will notify Rotary International* ***District*** 9200 *of any changes or revisions to club policies and procedures related to these requirements.*

Club President	
Term	2012 - 2013
Name	GASSIANO SENZIGHE
Signature	
Date	17/01/2013

Club President-Elect	
Term	2012 - 2013
Name	KABILU J. MVUNGI
Signature	
Date	17/01/2013

THE UNITED REPUBLIC OF TANZANIA

FORM S.A. 3

The Societies (Application for Registration) Rules, 1954

(Rule 5)

CERTIFICATE OF REGISTRATION
NUMBER S.A.18612

I HEREBY CERTIFY THAT **MWANGA ROTARY CLUB** has this day been registered under the Societies Act **[CAP. 337 R.E. 2002].**

Dated this **11TH** day of **FEBRUARY, 2013.**

.....
Justus T. N. Mulokozi
For: REGISTRAR OF SOCIETIES
MINISTRY OF HOME AFFAIRS

DAR ES SALAAM – TANZANIA

Rotary PPP Team - Appendix I

Rotary Club of Moshi-Mwanga - History and Role in These WaSH Projects

Chartered on 21 August 2009, and as of January 2013 it has 13 members. Its members are school teachers, health professionals, directors of rural development NGO's, farmers, an auto mechanic, a businessman and other retired professionals. The club is actively recruiting new members, and recognizes the task ahead for this WaSH project work.

RC Moshi-Mwanga is part of District 9200, and will be part of new District 9211 as of July 2013. District 9200 was designated by TRF as one of nine Future Vision districts to be included in the PEP Pilot (Project Enhancement Process) for the current Rotary year. It is therefore eligible to receive PPP Teams (Program Planning Performance and Evaluation) selected and funded by TRF & Wasrag.

a. A new Tanzania national law as of 2010 requires Rotary clubs in Tanzania to be officially registered with the Tanzania Division of Home Affairs before they can receive Rotary Foundation Global Grant funds. The registration of RC Moshi-Mwanga was approved by the Division in December 2012 (See Appendix H).

b. TRF terms and conditions require Rotary clubs to complete training and sign an MOU (memorandum of understanding). RC Moshi-Mwanga completed the training, and the MOU was submitted to the District (See Appendix G).

c. International partner districts and clubs will be needed to assist with funding, and perhaps other logistics. It would be very helpful to long-term partnerships for their members to visit RC Moshi-Mwanga and these villages. Likely international partners are: 1) Iowa, USA (long history already), 2) Germany, 3) Great Britain, and 4) New Zealand. Of these, only Iowa is already a well-established partner. Significant time and effort will be needed to gain the commitment of other international partners. We believe The Rotary Foundation has a role to assist in connecting them, and promoting this PEP Pilot project.

Appendix J: Locations of Villages and Boreholes

These GPS Coordinates were extracted from photos made during the trip:

- Solar-powered borehole between Mforo & Kisangiro - 3, 36' 47.393" S 37, 32' 11.921" E
- Borehole abandoned after 2 years service - 3, 37' 9.887" S 37, 33' 18.029" E
- Kiruru - meeting place - 3, 45' 26.033" S 37, 36' 12.101" E
- Kisangiro - subvillage Kichwa N'gombe, meeting place - 3, 36' 8.981" S 37, 32' 54.888"E
- Kituri - meeting place - 3, 30' 43.247" S 37, 33' 43.157" E
- Lembeni - meeting place - 3, 47' 3.617" S 37, 36' 47.291" E
- Mkinzingo in Mbambua - meeting place - 3, 47' 10.583" S 37, 33' 31.919" E
- New Borehole at Lembo in Hills near Shigatini - 3, 39' 5.987" S 37, 37' 55.889" E
- New site for borehole, corn field per Pangani Basin survey - 3, 42' 45.119" S 37, 35' 5.081" E

Appendix K: Bibliography

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[end of report]