Assessment – Post-Trip Report

Executive Summary	
Community:	Los Churuneles II
Country:	Guatemala
Chapter:	Kansas City Professional Chapter
Submittal Date:	10/20/2019
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REIC and other mentors:	Scott Struck, PhD (REIC), Stephen Collins (professional mentor)
Scope of Work for the project (50 words) [1]	Design and implement modifications to an existing water supply system in a town of 480. Project potentially includes installation of water transmission piping, a water storage tank, water distribution piping and a water treatment system.
Scope of Work for the trip (100 words) [2]	This was the first assessment trip where: 1) initial design concepts were presented to the community for input, 2) final survey data was collected and the project site was investigated, this included the sources intake site, the proposed storage tank location and community geography for distribution planning and 3) land agreements were discussed.
Proposed Next Step (100 words) [3]	The Kansas City Professional Chapter will finalize the alternatives analysis and submit for approval. The project is tentatively slated for construction to begin in August 2020. There are proposed alternatives for each sub-scope of the project. See the potential solutions considered for more detailed alternatives information.
Describe Recent Contact with Community, NGO, and in country partners. (100 words) [4]	Primary contact is through the EWB-Guatemala office. We regularly schedule, send and receive messages via Whatsapp with EWB-Guatemala.
Describe the Chapters current fundraising goals and milestones. (100 words) [5]	The program is on track to fundraise for the implementation costs. The chapter has enough reserves to cover most of the project implementation costs. The chapter just held a trivia night fundraiser in May that exceeded expectations. In August the chapter's biggest annual fundraiser is expected to keep project fundraising goals on track.
☒ [6]	**IS THE PROGRAM STILL ON TRACK TO MEET THE EWB PROJECT EXPECTATIONS?**

Project Timeline [1]			
Major Milestone	**Previous Date [3]**	**Current Date [3]**	**Description**
Program Adoption Date	02/26/2019		
Project Approval Date	05/02/2019		
Completed Assessment Trip	08/25/2019		Trip to complete data collection and to form relationships with community, contractors, and suppliers.
Planned Implementation Trip	Not Previously Planned	08/15/2020	Trip to construct water supply infrastructure.
Planned M&E Trip	Not Previously Planned	02/13/2021	Trip to monitor the system performance and conduct minor repairs.

Table of Contents

1.0 Project Description

1.1 Project Background and History

The program in Guatemala was opened in early 2019. The first project in Los Churuneles II kicked off in the second quarter of 2019, and the project team traveled to the community in August 2019 for the first assessment trip. Since the inception of this project, partnerships have been formed with the EWB-Guatemala office and its constituents. During the assessment trip, the team formed relationships with the leaders of Los Churuneles II and its community organizations, including the Community Development Council, COCODE.

1.2 Project Context

Los Churuneles II is a small, conservative, and rural community in southwestern Guatemala with a population of approximately 450 people. Traditionally, men are involved in agriculture farming of corn and beans, and women weave, make clothes and take care of the children. However, need for and training in skilled labor in surrounding towns is a growing demographic and some people leave the community to work elsewhere. The community has a significant need to overhaul and replace the current water system for it's failure to meet the demands of the people. The existing water infrastructure is supplied solely by the local spring through a series of limited distribution channels, which are estimated to be 30 years old. The spring box supplies water to two other local communities, although this is not likely to be the cause of the lack of water quantity in the Los Churuneles II community as the infrastructure developed to divide the quantity of water evenly between the three communities is well designed and established. The existing storage tank in Los Churuneles II that is connected to the distribution network receives and distributes spring water at 9.5 gpm.

It is the goal of the Kansas City Professional Chapter to support this community with its immediate water storage, distribution, and treatment needs. Specifically, the project team assessed the benefits and community desire for a new storage tank on the purchased land along with an improved distribution system and the implementation of a treatment method. Through a new piping network, storage tank, and treatment system, potable water may be supplied to the community to meet domestic needs.

1.3 Project Goals/Objective

The trip objectives include the following:

1. Establish communication between the community, partners, and EWB.
2. Learn more about the community through questionnaires and interviews.
3. Establish if a water quality testing program is necessary and feasible.

4. Investigate and gather data on the existing water and electric infrastructure.
5. Determine modifications needed and scope of project.

A multi-disciplinary approach to the infrastructure assessment was completed as described in the following sections. The assessment did not provide reason for any modifications to the scope of this project during the implementation phase.

The overall project objective is to bring the people of Los Churuneles II a consistent and reliable supply of water year round from a centralized system. Here are a few pointed objectives that will divide the overall project goal into three actionable design areas:

1. New water storage tank
2. Distribution piping network
3. Potable water treatment system

A design for a new water storage tank is necessary so that the community has a tank with a capacity that supports the growing population. Also, an improved tank location at a higher elevation will provide the distribution system more necessary head pressure. Finally, and most importantly, a new tank must be built because the owner of the land that their existing tank is built on has asked for it to be removed.

The distribution network will be designed to - as much as possible - divide equally the available water throughout the community so that each family can anticipate when and how much water they are getting throughout the day.

A potable water treatment system will be implemented so that the community will have a long-lasting supply of clean treated water. This is one part of the design that the team will be extra sensitive to. Community perceptions and preferences on treatment methods, water taste and water appearance could have a large impact on the direction of the design of this system.

1.4 Scope of Work

The central focus of the scope of work is to provide the community with more reliable access to water. The existing system consists of a spring catchment box and distribution piping from the box directly to the homes. The community is marked by large differences in elevation, and this existing system design creates inconsistencies in water supply. Specifically, homes at higher elevations suffer from extreme lack of water and have reported that they often only have water between midnight and 3 am.

A preliminary design was developed for a new system by Agua para La Salud in 2018 at the village's request. This information was shared with the KC Professional Chapter by EWB-Guatemala who subsequently sent the design drawings to the team for reference. This proposed design consists of a conduction line, water storage tank, chlorination system, and distribution network with meters. This new system would rely on the same spring box source for water supply. The flow at the water source has been measured 0.6 liters/second. If the Guatemalan government standard of 80-120 liters per person per day is followed, this would provide enough water for approximately 500 people. The approximate cost of the proposed system was determined to be $35,000.

This preliminary design encompassed the different scopes of work for the project. These scopes can be best defined as Source, Transmission, Storage, and Treatment. The source, or springbox, is necessary for collection of water while the transmission system (water distribution piping) allows water to flow from the spring box to the homes of the community. The storage system would consist primarily of a water storage tank. The final portion of scope may include a treatment system in order to provide water that can be safely consumed by the community. All four portions of scope will need to be executed thoroughly in order to provide the community with the improved water supply that they need.

1.5 Potential Solutions Considered

To achieve community goals, this project requires a multifaceted approach and, as such, the project team considered multiple potential solutions for each task of the project. Each task follows with its own potential solutions.

- Viability of the current source.
    - Through two preliminary assessments the team was able to conclude that the flow at the sources is likely adequate for the community's needs. The main question is this: Once a fully functioning system is implemented, how will that affect the other end users of this water source?
    - The primary option would be to use the current source as the water supply.
    - The secondary option would be to work with the community to identify other potential water sources. An alternate source would have to be close to the community and be able to supply water to the community through a gravity fed system.
- Transmission
    - After further investigation on May 15, 2019 it was determined that the flow rate at the source and the flow rate at a collection tank downstream were nearly identical. This finding was verified by the

assessment trip in August 2019 as well. This indicates that the transmission piping is likely functioning correctly between the source and the existing storage tank.
    - The primary option would be to reuse all of the existing transmission piping.
    - An alternative would be to salvage sections of the existing transmission piping and replace sections if it is found that there are deficiencies in the piping.
    - An alternative would be to replace the entire transmission piping system if it is deemed that a new pipeline is the only solution that will provide a life cycle of 20+ years. However, if the community is invested in the idea of a new transmission line, this might be the best solution.
- Storage
    - The current function of Tank 2 is limited in scope as no water is stored in it. It will not have the capacity to function as the community storage tank. Two potential solutions to the lack of sufficient water storage include:
    - Concrete pad with HDPE tank
        - This solution is the easiest to construct and the cheapest. However, storage capacity will be limited to the largest locally available tank. With a plastic tank earthquakes are not an issue. If the concrete pad is damaged by such an event, it would be easier and cheaper to repair than repairing a concrete tank.
    - Concrete tank
        - This solution is more difficult to construct and more expensive. However, this tank should last longer than its plastic counterpart and be sturdier in the long term. The existing storage tanks and similar structures in the community are made of concrete so this would be a typical design for the community members. However, earthquakes could be an issue for this tank construction method.
- Treatment
    - Water quality results from tests taken on May 15, 2019 show that E. Coli and other contaminants are present in the water source. The EWB-Guatemala contacts will conduct a second round of water quality tests in the coming weeks to confirm the first round of tests as the testing conditions were not able to be maintained during the assessment trip.
    - After this second set of tests are conducted, the type of water treatment will be carefully considered and identified to best suit the community's needs.

    - Chlorination
        - This is a popular form of water treatment. There are different ways to implement this treatment method whether it is at the system level or a point-of-use method.
        - Consideration must be taken to how the community members perceive chlorine as a viable treatment method. Upon asking members of COCODE their thoughts on chlorination, there did not seem to be any strong feelings against it.
    - Combination carbon and sand filter
        - A carbon/sand filter might not suffice in eliminating all of the contaminants found during the water quality tests. This needs to be verified post-assessment trip.
        - However, a carbon/sand filter could still be used as a secondary treatment method.
    - UV treatment (requires electricity and may not have the available materials for replacement locally)
        - This treatment method could prove to be a good solution given the availability of replacement materials, community understanding of how to maintain the system, and readily available electricity to power UV lights.
- Distribution
    - To understand and develop realistic solutions to the current problems with the distribution system, the team will need to gather more data.
        - One potential solution could include zoning the community to mitigate pressure and flow shortages for houses at the end of the distribution line.
        - Another solution could be to simply remove and replace the current distribution piping. This approach assumes that the problems within the system are related to old or improperly installed piping as opposed to poor system design.

The design of this system will be more thoroughly analyzed in the alternatives analysis.

1.6 Project Team

The Responsible Engineer In Charge is Scott Struck. The professional mentor is Stephen Collins. The internal reviewers are Adam Byrnes and Audrey Freiberger of the Kansas City Professional chapter. The Project Lead is Jake Sanders and the Director of Projects is John Kelley. These are the team leaders who are collaborating with many other engineers and volunteers with the EWB-KC

chapter to see this project through a successful implementation. Each of the team leaders have resumes on their respective Volunteer Village member profile.

1.7 Community Partners

The Community Development Council COCODE is the official organization legally recognized by the municipality of Sololá and the state and will be serving as the CBO for this project. The board of directors of this organization is elected every four years, and the current board of nine members was elected 6 months ago to address the need of improved potable water system in the community. The COCODE board of directors are elected for four year terms by community members through a voting process that includes every person. Once they are elected, they need to be legalized by the municipality. Once they have the municipality's recognition, they begin their community mandate. The community is represented through COCODE and everyone in the community is able to share their opinions and ideas. COCODE in conjunction with the community will have the ultimate decision authority for this project. The COCODE will work with the municipality, EWB-KC, and EWB-Guatemala to provide unskilled labor during the project implementation and will be responsible for maintenance, operation of the system, and planning the implementation of collection fees for the drinking water once the service gets established. COCODE will also coordinate all the logistics for the community's contribution to the project.

The Non-Governmental Organization (NGO) our chapter will be working with for this project is the Engineers Without Borders Guatemala office. Their primary function will be to facilitate the in-country aspects of the project as well as help and advise our chapter for critical project decisions. The deputy director, Waleska Crowe, is the primary contact from EWB for the Municipality of Sololá and the COCODE of Los Churuneles II.

The local government partner is the Municipality of Sololá. The municipality will provide 25% of the cost for materials. They are also open to help the community with any paperwork that they need to complete to get the construction permissions. When the construction is completed, the municipality will be able to provide assistance if the community needs it.

1.8 Similar Projects

The Kansas State University project in El Amate, Guatemala had lessons learned to share that were beneficial to the Los Churuneles II project team. The EWB-KSU project team highlighted the advantage of having local EWB offices in Guatemala and encouraged leveraging that connection. For example, they utilized a bus/taxi service and the EWB truck while traveling. They also

mentioned using the accommodations recommended by the EWB office in Guatemala. Kristen Jones of the EWB-KSU travel team reflected on their engineering design and lessons learned by stating “we probably should have gone with our gut and the design that is most common in the area. We had all our calculations and drawings finished for a traditional septic tank and leach field but ended up changing everything about a week before the report was due to incorporate plastic septic tanks instead. About a year after the project was completed, only 2/3 latrines are working, and there were many complications during construction. I think this may have been avoided if we went with a more traditional or naturalistic design.” Taking this lesson learned, the EWB-KC chapter will be calculating before making last minute changes that could make or break the outcome of the project. Kristen also mentioned the challenge of communicating with in-country partners and recommended using WhatsApp group messages and an efficient way to communicate. EWB-KC will contact our in-country partners using WhatsApp.

The EWB-KC Los Churuneles II project team was in communication with Macy Scott of the University of Colorado at Boulder chapter of EWB about their ongoing water system project in Caserio Totolya, Guatemala. Macy’s biggest advice was to allot more time than is thought necessary for every activity and task. The goal of the Caserio Totolya project is very similar to the goal of the Los Churuneles II project. Both are water distribution projects with the water originating at a spring that is shared by multiple communities. As both communities are located in similar regions of Guatemala, both also contend with a dry season that limits the amount of water the communities receive for parts of the year. EWB-CU provided three options in their Alternative Analysis for the materials of pipe for the conduction line replacement: PVC, HDPE, and galvanized steel. The Caserio Totolya project has compared the three options and is moving forward with design using a HDPE conduction line. Implementation will occur in the summer of 2019.

Max Schmiege of the Wisconsin Professional Chapter was able to provide some insight into working in Guatemala. “I have worked on projects in Guatemala for 15+ years, mainly bridges and water systems. I would suggest using the various resources regarding water system design that EWB has available on its website. Plan plenty of time into your schedule to communicate and coordinate with the local EWB contacts and specific community leaders. Think simple as much as possible in terms of design.”

Based on the information gathered from other project teams with similar projects in similar regions of Guatemala, the Los Churuneles II project team made every effort to utilize all resources available when it came to communication with the EWB team in Guatemala and the community itself. More time was accounted for

in the schedule to ensure that all necessary information was able to be collected during the trip to the community.

2.0 Assessment Results and Data Collected

The Assessment phase of EWB-USA's ICP program has four main tasks:

- **Partnership Formation:** Meet with all project partners and determine if all parties are committed to the project, willing to communicate, and able to support the maintenance of the project. This should result in the signing of the partnership agreement.
- **Project Feasibility:** Determine if the economic, social, environmental and technical viability of the project is feasible considering the chapter's technical and funding constraints and the community's ability to support long term maintenance.
- **Data Collection:** Collect the relevant data necessary to design the project and determine the projects potential impact.
- **Go Or No Go:** Make a "go/no go" decision about continuing with the project.

During this assessment trip, the project team was able to complete all of these tasks. The following sections present the results of the assessment.

2.1 Partnership Formation

2.1.1 Community Members

A positive relationship was developed between the EWB-KC travel team and the members of Los Churuneles II. We took time to meet with each household and ask questions about the workings of their personal water system and taps, addressing any specific requests or complaints when possible. An effort was also made to speak a few basic phrases in the local language - much to the enjoyment of the community members. An initial meeting was held upon the arrival of the travel team that the entire community was invited to in order to introduce the members of EWB-KC to the community and for the community to have a chance to speak with us in a formal setting. A final, closing meeting was held with the community to express gratitude for their hospitality and to convey a summary of the findings from the week.

2.1.2 CBO Leaders

An excellent working relationship was established between the eight members of the local organization - COCODE - and the members of EWB-KC. Four members of COCODE were present each day to support and translate for the group as we spoke with all households in the community. A meeting was held upon our arrival to make introductions and ensure that we had everything we needed to be

comfortable while staying in the community. Once all of the surveying and data collection had been completed, a final meeting was held between COCODE and the travel team to review all of the findings and present a clear path forward, making sure that expectations were aligned between both parties. Finally, a friendly game of soccer was scheduled and played upon the insistence of the members of COCODE, further cementing the relationship between the two groups.

2.1.3 Local Government

EWB-Guatemala has been in contact with the municipality of Solola - the president and members of the council - and the project has the support of the local government. Although the local government leadership changes every four years and will have an election in 2019/2020, EWB-Guatemala expects that the project will continue to have the support of the municipality of Solola despite this change.

2.1.4 Contractors

Due to the limited ability of the travel team members to leave the community, no meetings were held with contractors. As EWB-Guatemala is well established and active in supporting this project, it is expected that they will be able to best handle arranging meetings and agreements with contractors prior to the implementation trip.

2.1.5 Suppliers

Due to the limited ability of the travel team members to leave the community, no meetings were held with suppliers. As Los Churuneles II is located close to the larger city of Solola and the community is consistently building homes and other structures, it is expected that we will use the same suppliers that they already have established.

2.2 Project Feasibility

The primary factor in determining whether or not this water supply project is feasible is to define a system owner and maintainer. If there is not a specific person or group of people that are in charge of the maintenance and upkeep of the system, it will deteriorate. Consequences of this could include increases in contaminants in the water source or complete or partial loss of functionality due to broken pipe, valves, etc. Therefore, during the assessment trip it was imperative to identify who would be the system owner. In this case, the COCODE would be the default system owner. There are plenty of willing and able people in the community that could serve as the lead of maintenance and upkeep. As the project progresses, the team will discuss with the community the necessity of having a dedicated person for maintenance and upkeep.

2.3 Data Collection

2.3.1 Detailed Technical Data

2.3.1.1 General Data Collected

Our travel team of five members each had a specific role in collecting data as we surveyed houses and the community's water system. Two members of the team focused on talking with COCODE and community members. One of those two members would usually translate while the other took notes. Two different members of our team tested for water quality and recorded the results. Lastly, the fifth person on our team used a GPS receiver and phone to collect GPS data.

2.3.1.2 Survey and Geospatial Data Collected

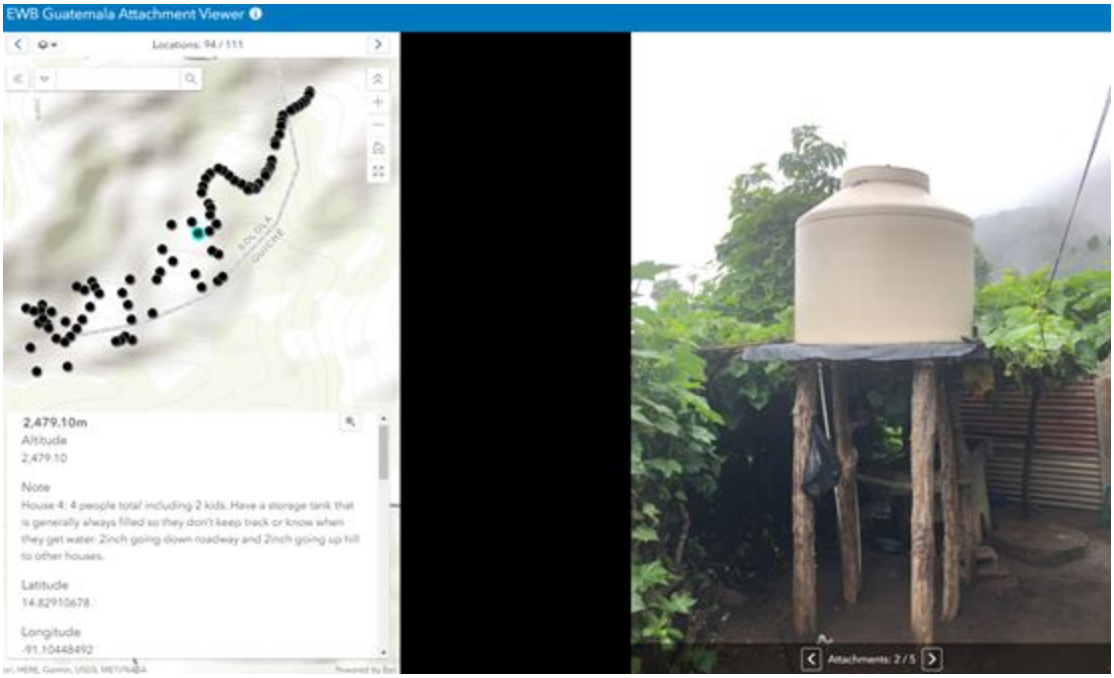
A GPS receiver was paired to a phone over Bluetooth and the ArcGIS collector app with a local downloaded map to allow for offline functionality was used to collect GPS data. A handheld GPS was also used as a backup to record points. The data collected can be arranged into three categories.

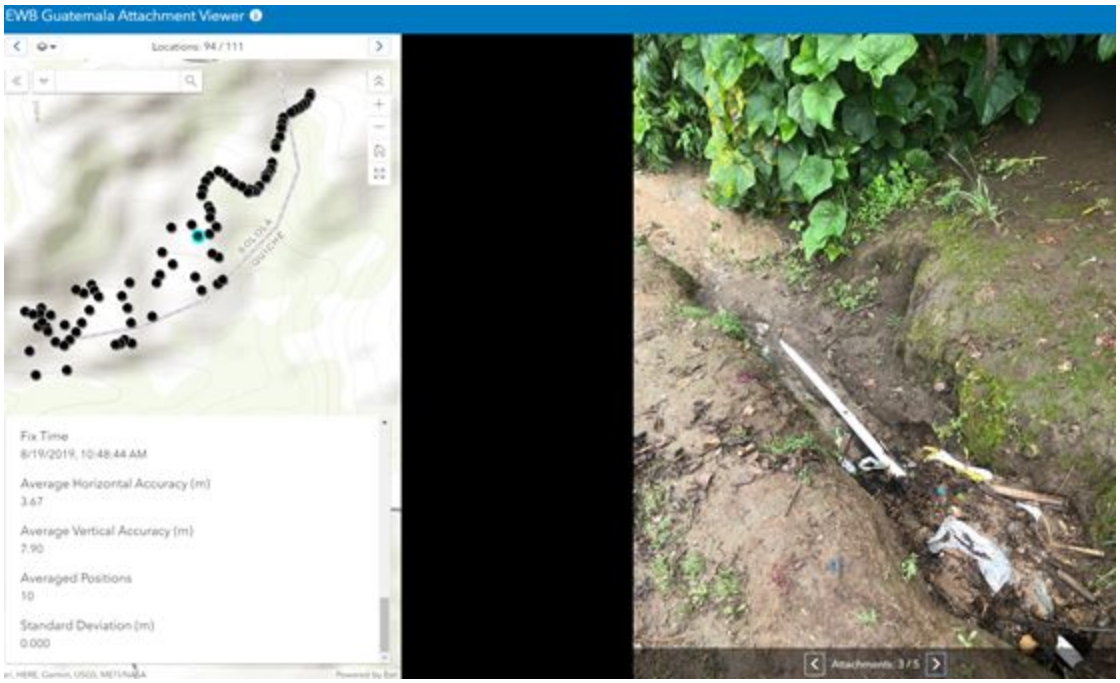
1. Household Data

   A GPS point was collected from an average of 10 consecutive points at each household our chapter visited in Los Churnnueles II. In most cases, this was in very close proximity to the house's water tap. The average horizontal accuracy was about 3-4 meters and average vertical accuracy was about 5-8 meters for this subset of points, which are chapter was happy with considering the pretesting of the GPS and the remoteness of the community. Most houses had a clear view of the sky which granted access to about 11-12 satellites in most cases but houses closer to the valley saw less accurate.

In addition to this raw data, pictures and notes were attached to most points. Notes were taken based on the conversations with each family that was home at the time and included things such as when the house got water, how many people lived there, and general problems the family had with water. Pictures of the surroundings and helpful information such as exposed pipe, water tanks, and taps were taken as helpful references in the future designs and to help paint a general picture of the community and its current water system.

A typical house survey using ArcGIS is shown in the following screenshots.

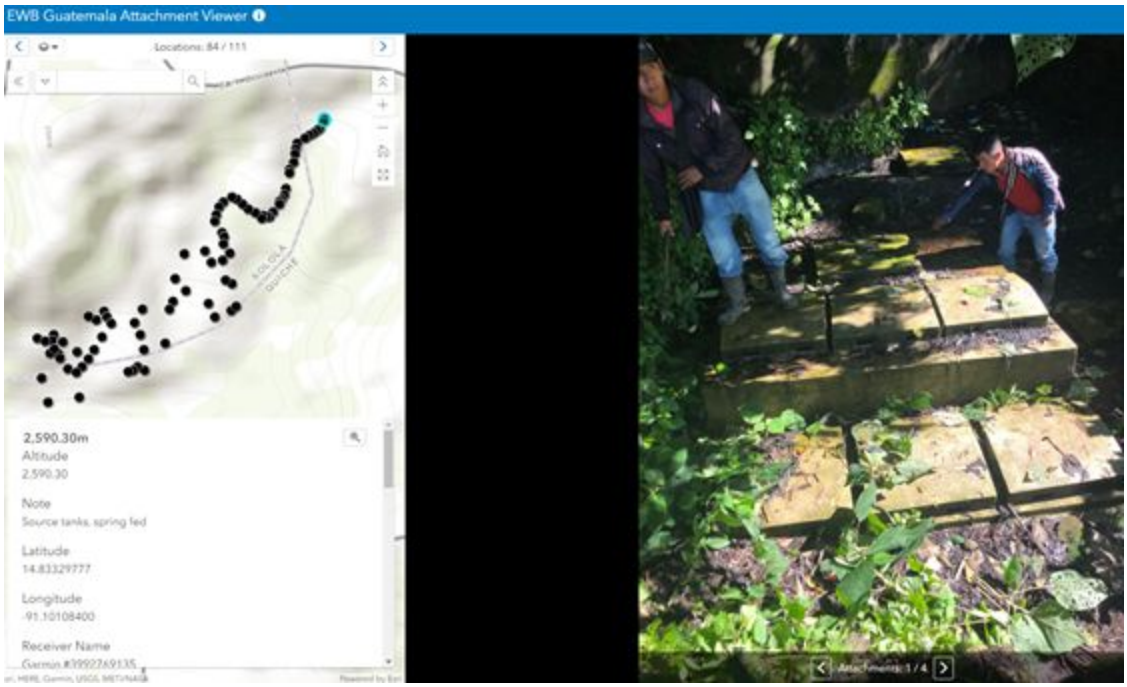


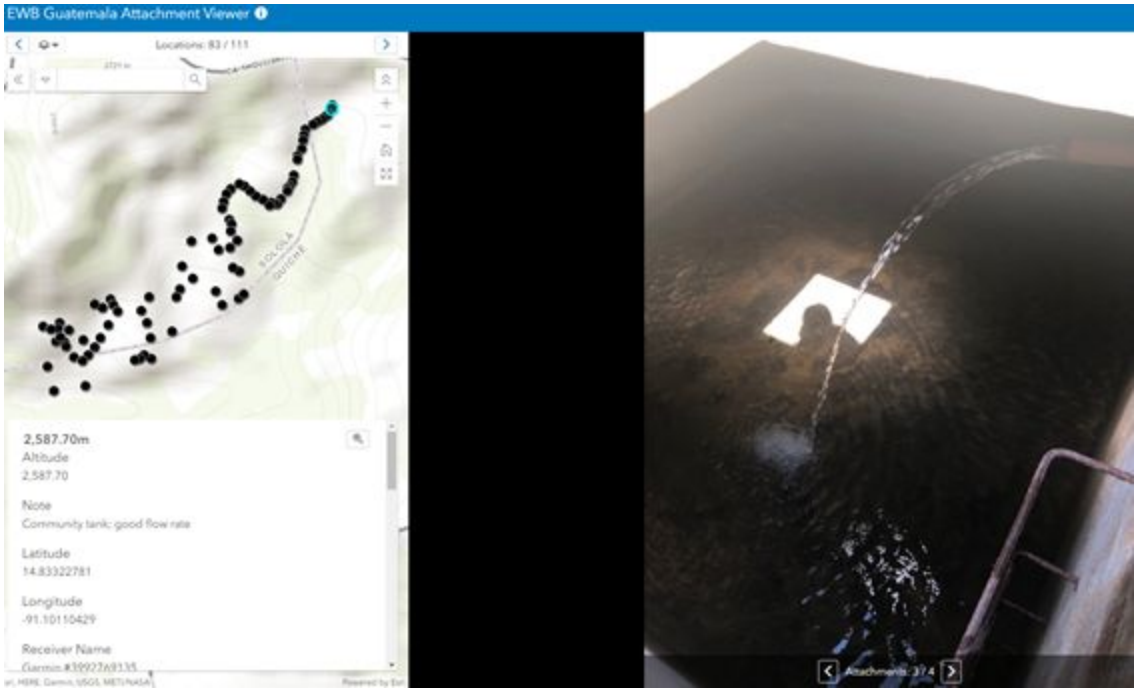


2. Water Source Data

Like the house surveys, our chapter took points, notes, and pictures at the water source and along the water transmission path to the community. Most of the pipe was buried, but the community had a good idea of where it was buried and took us on that path. We tried to take points about every 20-30 feet or when there was a major bend and elevation changes. An average of 10 points were taken at the water source but to speed up the process a single point was collected, and few pictures were taken at various spots as we walked the pipeline from the source to the community.

The following ArcGIS screenshots includes data from the water source.

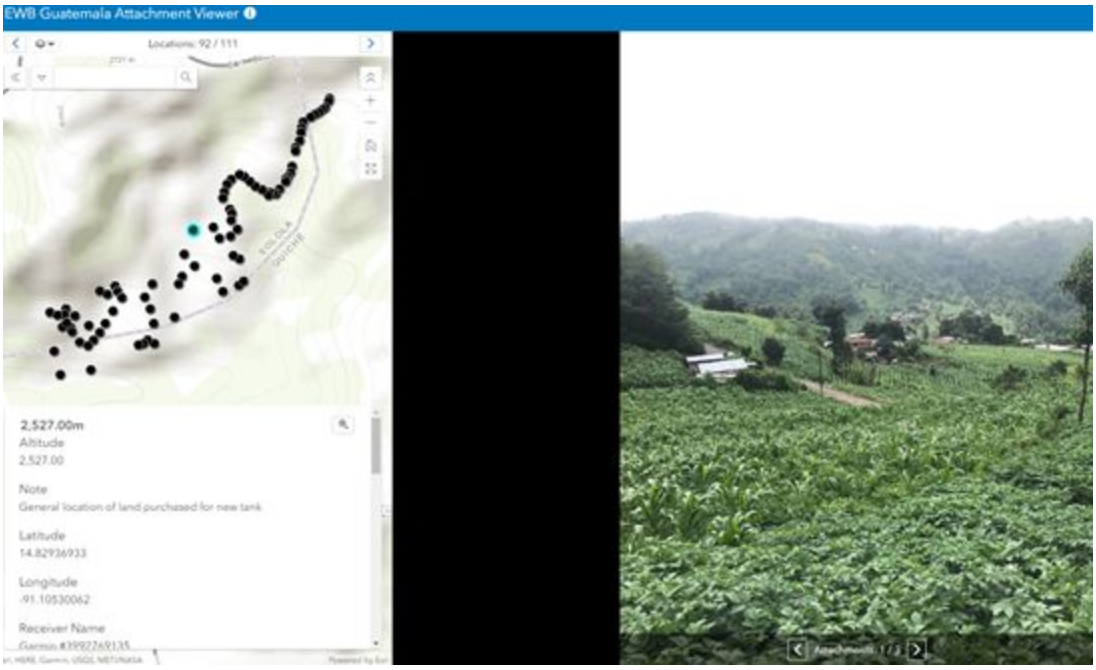


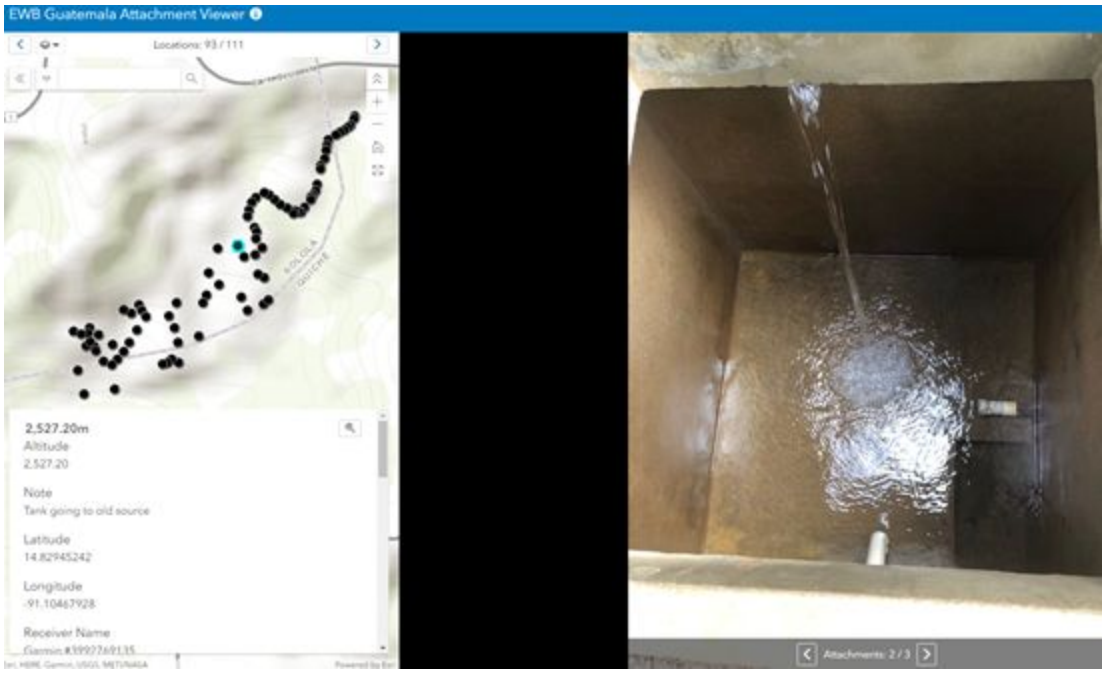


3. Miscellaneous Data

Our chapter brought the GPS receiver and phone essentially anywhere we went in the community so we captured random things that could be useful such as exposed pipe. We also captured certain places COCODE was sure to show us. For example, they showed us the location of land they purchased for a new tank and the existing small tank that acts more as a break tank than a storage tank.

The following ArcGIS screenshots show the proposed location for the new tank as well as the existing tank that the community has been asked to remove by the farmer that owns the land.





The general pattern our chapter has noticed is that houses closest to the water source have water in the morning, houses in the middle of the community have water around lunch and in the afternoon, and houses furthest from source have water late at night.

This data was uploaded to the ArcGIS as soon as our chapter reached a place with internet access. There is a lot of data to go through, and we have only scratched the surface of the ArcGIS capabilities. Ideas for future uses of this data in ArcGIS include using notes taken of when houses get water to model water flow throughout the system using an animation feature in ArcGIS. Our chapter has also discussed creating a 3D render of the community using longitude and latitude along with elevation in order to better visualize obstacles for water flow which could be helpful given a possible design of splitting the water distribution from the tank into sectors.

2.3.1.3 Data Collection Need #1

If water was available during the community surveys, we performed water quality tests. These tests included pH, salinity, conductivity, temperature, total dissolved solids,

nitrates and nitrites, total and free chlorine, hardness, and alkalinity. There were 52 households and we were able to get 43 water samples. Three tanks were also tested for water quality, two of which are near the spring box.

The Pocket Pro+ Multi 2 Tester from Hach was used to determine the pH, conductivity, temperature, total dissolved solids, and salinity of a water sample. A 5 in 1 Hach test strip illustrated the results for total and free chlorine, hardness, alkalinity, and pH. A test strip was also used to determine if nitrates and nitrites were present in the water. pH was tested twice because we did not have the pH calibration buffer solution for the Pocket Pro. The test strip provided a more accurate value for the water sample. The summary of the water quality tests are shown below. The quality of the water is good, based on standards from EWB and WHO, and has little to no contaminants. The full data sets are included in Attachment B.

Table 1: Average Water Quality Results

pH (meter)	Salinity (ppt)	Conductivity (µs)	Temperature (°F)	TDS (ppm)
7.8	0.09	161.2	65.4	171.5

Table 2: Frequent Water Quality Results

Nitrite/Nitrate (ppm)	Total/free Chlorine (ppm)	Hardness (ppm)	Alkalinity (ppm)	pH (strip)
0.0	0.0	25.0	40.0	6.8

2.3.1.4 Data Collection Need #2

The second set of data that was collected was a survey of the health of the community. The community uses pit latrines for bathrooms, however, there are flush toilets that are available to the students and teachers at the school. There are three toilets at the school but they are not accessible to the whole community. These toilets were supplied from a water storage tank above them at the school that is fed by the distribution system. The

community had installed a heated shower head so there is access to a shower as well. At each household, the EWB team asked if anyone in the family had experienced illness due to the water, or if they suspected the water was making them sick. Every household replied that they had not been sick at any point due to the water quality and that they did not believe the water quality to be a health risk. The daily water consumption varies heavily based on the access each household has to water through the distribution system. All families and households are consuming as much water as they have available, but some households have access to a greater quantity of water. Each household uses the water from the distribution system - and the sink and tap attached - for their drinking water and their cleaning water. Based on the sinks that were observed, toothbrushes were common place and when eating with the members of COCODE, most people made an attempt to clean their hands prior to eating.

No other direct questions were asked of the community members regarding the health survey questions, but assumptions are able to be made based on our interactions and observations with the people of Los Churuneles II. In general, the community was very clean and tidy with little to no garbage to be seen. As they are close to a main highway, it can be assumed that they are easily able to remove the garbage from the community or do an excellent job of colocating it in the community. There is a nurse who visits the community monthly. When the EWB travel team was visiting Los Churuneles II, the nurse was seen going through the community administering vaccinations to small children. The type of vaccination was not determined. While the nurse is in the community, the health clinic nearby the school is open and community members can stop by and meet with the nurse.

2.3.1.5 Data Collection Need #3

The source was assessed to determine the availability of water for the community. As it stands now, the community has an adequate amount of water to meet their basic needs, though there are concerns on how that water is distributed throughout the village. The flow rate of water

into the source was tested by using a 10 Liter bucket and timing how long it took to fill; this allowed us to see the flow rate is approximately 0.51 L/s. Per guidelines of the Guatemalan government, this flow rate should be adequate for a community of approximately 550 people as it will result in a flow rate of 80 L/day.. We also needed to determine the impact that our work may have on the other two communities that use this source. We learned the source of water is already proportionally segregated between the three and that our work is not expected to have any impact on either community.

2.3.2 Changes from planned Activities

There were no major changes to the planned activities during the assessment trip. The team was unable to collect samples for the E. coli presence test. Also, the team did not meet with contractors during the assessment trip or talk with any specific suppliers. However, during our trip to Solola and our trips to and from the community it was apparent that there were various hardware stores and materials suppliers that we will be able to procure materials from.

2.3.3 Outstanding Data Needs

The data that remains to be collected is the E. coli water quality test. EWB-KC brought 3M Petrifilm E. coli/Coliform Count Plates to perform this test, but we couldn't keep the plates refrigerated. These plates must be stored at less than 46 °F. Due to our inability to maintain proper testing conditions for a test sample, we were unable to gather that data during the assessment trip. Arturo, our project contact in the EWB-Guatemala office, will be returning to Los Churuneles II soon to perform this test.

2.4 Climate Change Data Collection

COCODE was the group of community members who were surveyed about the climate change questions. All members of this group ranged in age from 23 to 29 years of age and this is important because their knowledge of what the climate was 10+ years ago would be from when they were young and might not accurately reflect the conditions of the time. They had no comment on if the temperature is hotter or colder compared to 10 years ago. They described the rainfall patterns as changing dramatically over the last five years. Five years ago, the rain was what they would consider "normal", then about three years ago the rainy season began earlier than normal - at the end of May - and ended earlier than "normal". After the rainy season, they experience a severe lack of rain that

is very different than what they are accustomed to. This has caused problems with their crops as they are not growing as well due to the lack of water later in the growing season. They did not have any large storms to report over the last 10 years.

2.5 Go/No Go Decision

The sections below outline the relevant considerations for the team's Go/No-Go decision process for the project.

- Guatemala-EWB Office & COCODE Relations
    - Go: EWB-KC is able to develop and maintain a strong relationship with both the EWB Guatemala office and COCODE. This includes regular communication throughout the program as well as receiving support leading up to and during travel to Guatemala. COCODE's relationship with Los Churuneles II is strong and includes frequent visits to the community to assist with program planning and organization.
    - No Go: The EWB Guatemala office and COCODE are unable to provide support in the planning and execution of the projects. COCODE is unable to answer questions relevant to the success of the program.
    - **Result:** Throughout the week that the travel team spent in Los Churuneles II, there were multiple meetings between COCODE, EWB-Guatemala, and the Kansas City Professional Chapter. These meetings fostered discussions that led to a greater understanding of the needs of the project between all parties as well as formed relationships that will support mutual cooperation during the design phase of the project. Contact with COCODE and EWB-Guatemala through Whatsapp will continue to be the primary method of communication between parties.
        - **Decision:** Communication and relations between COCODE, EWB-Guatemala and the Kansas City Professional Chapter are in a good state. This criterion is a GO.
- Safety of Area of Travel
    - Go: The US State Department recognizes that the area of travel is safe for travel, and no area visited is on any sort of Do Not Travel list. Additionally, EWB-KC and the EWB Guatemala office review the area and deem it to be safe for travel.
    - No Go: Guatemala and/or the Los Churuneles II community are deemed unsafe for travel by the US State Department, the EWB Guatemala office, or EWB-KC.
    - **Result:** The region of Solola does not have a specific travel advisory from the US State Department. However, Guatemala City does. This is not a "Do not travel" advisory, but rather a "Exercise Increased Caution". The team will continue to work with EWB-Guatemala to organize trusted hired transport from the airport to the community during trips.

        - **Decision:** As long as the team is able to organize hired transport in and out of Guatemala City to get to Los Churuneles II, safety should not be of high concern. This criterion is a GO.
- Commitment of the Community
    - Go: Los Churuneles II shows in meaningful ways that it is committed to the program and is willing to contribute 5% of the funding required for projects. The community is willing and able to assist in the construction of the projects as well as provide the necessary care to maintain them.
    - No Go: Los Churuneles II is not supportive of the projects' success and its not interested or willing to maintain the projects after implementation. The community is unable to financially support the project or assist with labor in building the projects.
    - **Result:** The Community Agreement Project Partnership document has been written and signed by the Kansas City Professional Chapter. It is in the process of being signed by the COCODE of Los Churuneles II and EWB-Guatemala. The community is willing and able to contribute 5% of the project cost. Furthermore, during meetings with COCODE it was very apparent their high level of commitment to this project.
        - **Decision:** This criterion is a GO.
- Feasibility of the project
    - Go: There is a sufficient water supply in the area such that building a storage tank is a reasonable design. The construction of such a storage tank and associated distribution pipeline doesn't prevent access to water for other neighboring communities.
    - No Go: There is not sufficient water supply in the area. The construction of a storage tank and distribution line will result in neighboring communities not having sufficient water access.
    - **Result:** Multiple assessments have been done on the water source that serves Los Churuneles II, one by Agua Para La Salud, one by EWB-Guatemala and one by EWB-KC. The water sources has been deemed sufficient for the needs of the community. Construction of a storage tank and a new distribution system will only distribute the current flow to the community more efficiently. This should not affect the supply to the sectors with which the source is shared.
        - **Decision:** This criterion is a GO.

2.6 Conclusions

The team was able to gather a lot of useful data on this trip. Community surveys were by far the largest source of information critical to the project. By visiting every household in the community we were able to get firsthand information from people on what time of day they typically received water. This data still needs to be analyzed further to understand what the water availability at each house tells

us about the inefficiencies of the distribution system. This will be the most difficult problem to tackle and will likely need further input from the community to solve.

Community surveys also allowed us to get information regarding the population. The team surveyed about the number of adults and children living in each household. The total number of people in the community was estimated to be 463 people. This represented a population 50% larger than the population of 300 people that was originally communicated to the Kansas City Professional Chapter. These reports of a community population of 300 people came from Agua Para La Salud and even from COCODE members during the trip. This will have a direct impact on how much extra capacity the community has in their water source for future growth. The team will have to take into account the higher population when making decisions on the size of the storage tank, the size of the water quality system equipment and also the approach to the distribution system.

Water quality tests were taken at each household as well. These tests show a defined trend of high water quality throughout the community. As a result of the already high quality of water, there is a wider selection of treatment systems that could be viable solutions for the community.

GPS data that was collected will be integral in the design of the distribution system. The elevation change from the source to the proposed new tank location is approximately 200 ft over less than 1 km. This should provide adequate head pressure to allow for the water to arrive to the proposed new tank site. However, further analysis will be conducted to confirm. The team confirmed that the proposed tank location is at an elevation higher than the entire community. Further analysis will need to be conducted to determine if the proposed tank site will provide enough head pressure to overcome friction and fitting losses throughout the system.

A climate change survey was conducted during a meeting with COCODE. Climate change is a slow process that takes place over decades. So, to get accurate accounts to climate change questions, the interviewees must have been alive for quite some time to be able to compare how the climate was decades ago to how it is today. Every member of COCODE that we spoke with was under the age of 30. Therefore, the answers that we got to our questions varied widely. Nevertheless, there was a general consensus that the rainy season has shortened over the last 5-10 years. As a result, it is harder to cultivate their crops.

One of the most important goals that was achieved during this trip was forming a relationship with the COCODE and the people of the community. In addition to the meetings that were held with COCODE, the team also participated in two community-wide meetings. These meetings not only presented the team the

opportunity to introduce themselves, but also presented the community the opportunity to ask the team questions about the project and its goals moving forward.

As the team progresses to the alternatives analysis and later into detailed design, there will be communication with COCODE and EWB-Guatemala to fill in any information gaps that the chapter may have. There will also be an effort by the chapter to design with materials and skilled labor availability in mind.

3.0 Baseline Monitoring Data Collection

Below is a summary of the PMEL questions and answers along with any necessary clarifications.

The community satisfaction with the current system was at approximately 5% of people. There were a couple of houses that received water all day. However, even those people knew of the problems with the existing system.

The capacity at the spring box was measured to be 0.51 L/s. This equates to a little over 44,000 L/day. With a surveyed population of approximately 465 people, this provides about 95 L/day per person which falls under the “Intermediate access” category. This flow rate was taken during the rainy season. However, data was collected in early May towards the end of the dry season and a flow rate of 0.6 L/s or 51,840 L/day. The lower of the two values was used for the sake of being conservative.

Users do not have to travel to get water. Every house has a tap and a sink. Even though the majority of houses do not receive water all day long, people will get water from the tap whenever it arrives.

The source is safely managed. It is a very secure spring box. The system is divided up into three sections, one for Los Churuneles II and the other two for different sectors of houses that are unincorporated with Los Churuneles II. Each section of the spring box has its own lid with a padlock. Only the COCODE president and a single designary from each of the two sectors have access to the spring box locks.

The existing condition of the communities water supply infrastructure was described as “Major maintenance” required. This is solely due to the fact that there are large flaws with their current system. The flow rate from their spring box should be adequate for the number of people in the community. However, the vast majority of people only receive water for a few hours out of the day. This is further explained by the answer to the “Functionality Non Performance Reason” which was “Technical design issue”.

System functionality was observed throughout the assessment trip. However, it was very intermittent or only in certain areas of the community.

3.1 Revisions to Beneficiary Analysis

The largest change to the beneficiaries of this project is simply the number of people impacted by the work. Before the assessment trip, we were told the community comprised only 300 people. However, through our unofficial census, we determined the true population to be closer to 500 people, with a very high reproduction rate of approximately 8 children per woman. This means that considerations must be given to how our system will work in the future.

4.0 Next Steps

The next steps for the project are to take the data that was collected during the assessment trip, study its impact and apply it to the three project design areas, the distribution system, the storage tank and the potable water treatment system. Each design area will have its own alternatives analysis which will all be compiled together into the alternatives analysis document that is officially due mid-January 2020.

5.0 List of Attachments

A *Attachment A: Drawing Package*
- *Los Churuneles II ArcGIS Map.pdf (uploaded to Volunteer Village)*

B *Attachment B: Data from this Assessment trip*
- *Los Churuneles II ArcGIS Data.xls (uploaded to Volunteer Village)*

C *Attachment C: Photographs*

D *Attachment D: Supplier and Contractor Reports (NOT USED)*

E *Attachment E: Partnership Agreement (uploaded to Volunteer Village)*

F *Attachment F: Monitoring Data Forms*

Attachment B

Table B1: Water Quality Data

House Number	pH (meter)	Salinity (ppt)	Conductivity (µs)	Temperature (°F)	TDS (ppm)
1	8.1	0.10	130	61	230
2	8.1	0.10	170	61	230
3	7.9	0.10	188.2	60.6	213

4	7.7	0.08	190	59.2	182
5	7.5	0.18	344	66.2	342
6	-	-	-	-	-
7	-	-	-	-	-
8	7.9	0.26	560	67.6	547
9	8.0	0.27	536	65.1	552
10	-	-	-	-	-
11	-	-	-	-	-
12	8.2	0.10	184	70.3	233
13	7.6	0.04	65.4	66.4	75.9
14	7.3	0.06	113.9	65.5	111
15	7.5	0.10	157.3	66.7	149
16	7.8	0.09	181.3	66.2	196
17	-	-	-	-	-
18	7.6	0.07	119.4	67.1	145
19	7.2	0.06	85.5	70.7	119
20	-	-	-	-	-
21	7.6	0.09	220	67.8	194
22	7.7	0.08	192.9	69.8	179
23	7.5	0.04	122.5	65.8	77.8
24	7.4	0.06	120.7	65.7	121
25	7.4	0.08	145.1	65.7	143
26	7.7	0.04	93.3	67.6	92.3
27	7.4	0.05	89.6	68.2	102
28	7.4	0.03	66.2	65.8	65.1
29	7.5	0.03	62.8	67.6	62.7
30	7.7	0.06	136.3	65.5	126
31	8.2	0.27	536	63.7	539
32	7.8	0.03	73.3	63	68.4
33	7.9	0.05	107.6	61.7	110
34	-	-	-	-	-

35	7.9	0.09	151.7	70.2	151
36	7.8	0.05	89.4	64	96.7
37	8.4	0.07	154.9	60.8	148
38	8.3	0.05	103.6	63	102
39	8.2	0.03	58.7	62.4	60.1
40	8.0	0.05	90.1	64.2	74.5
41	7.9	0.05	96.5	64.4	106
42	-	-	-	-	-
43	8.0	0.04	85.8	65.5	85.5
44	7.9	0.08	102.4	69.3	148
45	-	-	-	-	-
46	7.8	0.20	212	63.1	238
47	7.9	0.06	107.6	63.9	128
48	7.9	0.05	107.8	66	110
49	8.1	0.05	117.9	66.4	114
50	8.3	0.09	106.9	67.8	113
51	8.7	0.12	164.7	65.7	240
52	7.8	0.12	189.9	64.2	255

Table B1 - Water Quality Data Continued

House Number	Nitrite/Nitrate (ppm)	Total/free Chlorine (ppm)	Hardness (ppm)	Alkalinity (ppm)	pH (strip)	Comments
1	0	0	0	0	6.8	
2	0	0	0	0	6.8	
3	0	0	25	0	6.8	
4	0	0	0	0	6.8	
5	0	0	50	0	6.2	
6	-	-	-	-	-	Water quality wasn't tested because they get water between 4-6am.
7	-	-	-	-	-	Water quality wasn't tested because they get water between 8pm-4am.

8	0	0	0	0	6.8	President of COCODE.
9	0	0	25	40	6.2	
10	-	-	-	-	-	No water.They use rain water.
11	-	-	-	-	-	No water.
12	0	0	25	40	6.2	
13	0	0	0	0	6.8	Has its own pipeline from branch.
14	0	0	0	0	6.8	Has its own pipeline from branch.
15	0	0	0	0	6.8	Has tank but isn't connected (storage tank).
16	0	0	0	40	6.8	
17	-	-	-	-	-	No water.
18	0	0	25	40	6.2	
19	0	0	25	40	6.8	
20	-	-	-	-	-	No water. Gets water only at night
21	0	0	25	40	6.8	
22	0	0	25	40	6.8	
23	0	0	0	0	6.2	
24	0	0	25	40	6.8	
25	0	0	25	40	6.8	
26	0	0	0	0	6.8	
27	0	0	25	40	6.8	
28	2 / 0.15	0	25	40	6.8	
29	0	0	0	0	6.8	
30	0	0	0	0	6.2	
31	0	0	25	40	6.2	
32	0	0	25	40	6.8	No water now. Uses rain water (tested rain water). Gets water every 2-3 days.
33	0	0	25	40	6.8	Storage tank.
34	-	-	-	-	-	No water here.

35	0	0	25	40	6.8	No water now. Water tested was from the source and stored.
36	0	0	25	40	6.2	Water slowed down once we turned on the tap (basically stopped). Main line runs about 3 meters away from the house.
37	0	0	25	40	6.8	Storage tank with filter.
38	0	0	25	40	6.8	No water now. Tested water from previous night that they stored.
39	0	0	0	0	6.8	No water now.
40	0	0	0	0	6.8	No water now. Tested water that was stored in the house.
41	0	0	0	0	6.8	No water now.
42	-	-	-	-	-	No tap. They get water from house 41
43	0	0	0	0	6.8	Water slowed down once we turned on the tap (basically stopped).
44	0	0	25	40	6.2	
45	-	-	-	-	-	No water here.
46	0	0	0	0	6.8	No water now.
47	0	0	25	40	6.8	No water now.
48	0	0	25	40	6.2	No water now. Tap was already open when we arrived. Gets water around 2-5am.
49	0	0	25	40	6.2	No water now. Gets water around 1-5am.
50	0	0	25	40	6.2	No water now. Gets water around 1-5am.
51	0	0	25	40	6.2	No water now.
52	0	0	25	40	6.2	No water now. Gets water around 9pm-5am.

Table B1: Tank Water Quality Data

Tank Number	pH (meter)	Salinity (ppt)	Conductivity (µs)	Temperature (°F)	TDS (ppm)
1	7.7	0.07	132.3	61.2	130
2	8.3	0.22	418	62.6	433
3	7.1	0.07	142	64	138

Table B1: Tank Water Quality Data Continued

Tank Number	Nitrite/Nitrate (ppm)	Total/free Chlorine (ppm)	Hardness (ppm)	Alkalinity (ppm)	pH (strip)	Comments
1	0	0	25	40	6.2	
2	0	0	0	0	6.8	Tank near Spring 1.
3	0	0	50	40	6.8	Tank near Spring 2.

Table B2: Community Survey Data

House Number	Total Number of people	Adults	Children
1	9	2	7
2	5	2	3
3	28	6	22
4	4	2	2
5	7	2	5
6	10	2	8
7			
8	18	4	14
9	4	2	2
10	7	2	5
11	9	2	7
12	18	4	14
13	13	6	7
14	12	9	3
15	5	2	3

16	10	7	3
17	7	5	2
18	8	2	6
19	7	7	0
20	10	7	3
21	10	7	3
22	6	4	2
23	11	5	6
24	12	6	6
25	12	5	7
26	7	6	1
27	9	6	3
28	9	6	3
29	9	9	0
30	4	4	0
31	10	2	8
32	12	2	10
33	23	15	8
34	8	2	6
35	10	4	6
36	8	2	6
37	9	3	6
38	5	4	1
39	11	4	7
40	3	2	1
41	5	5	0
42	6	2	4
43	9	2	7
44	13	6	7
45			
46	4	2	2

46.5	7	2	5
47	12	8	4
48			
49	8	8	0
50	4	4	0
51	6	6	0
52	10	2	8
Total	**463**	**220**	**243**

Table B2: Community Survey Data - Water Timing

House Number	Hours When There is Water		Duration (Hours)	Notes	Home of COCODE member?
	Start Time	End Time			
1	1:00:00 AM	8:00:00 AM	7	-	
2	-	-	-	Only get water every 2-3 days and it comes slowly when they do have it.	
3	4:00:00 AM	7:00:00 AM	3	Get water every day.	
4	-	-	-	Have a tank so they don't know when they get water.	
5	8:00:00 AM	3:00:00 PM	7	Get water every day.	Victor
6	4:00:00 AM	6:00:00 AM	2	Get water every day.	
7	8:00:00 PM	4:00:00 AM	8	The main pipeline runs through their home, about a meter below ground.	
8	-	-	-	Always have water.	Efrain
9	-	-	-	Always have water but the flow is slow, takes about 2 hours to fill up their tank.	
10	-	-	-	Never have water, use rainwater for clothes and get drinking water from neighbors.	
11	-	-	-	get a little bit of water at night	
12	8:00:00 AM	9:00:00 AM	1	Have water during day but not	

				constantly, have a heavy flow when there is water, a man telling us this had a mental illness so it may not be correct.	
13	1:00:00 PM	8:00:00 AM		When they have water they have a lot, stops completely in the afternoon.	
14	-	-		Have water off and on during the day/night, when they do have it they have a lot, from the same branch as #13.	Yes
15	9:00 AM	11:00:00 AM	2	Have a tank that fills during those hours, when there is rain they get more water.	
16	-	-	-	Same branch as #13,14,15, some days they have no water at all.	
17	1:00:00 AM	3:00:00 AM	2	Only get water during the night and it is infrequent.	
18	6:00:00 PM	7:00:00 AM	13	From 6pm-7am they get a constant light flow, other hours they get water randomly.	
19	4:00:00 AM	10:00:00 AM	6	Flow is slightly more during the rainy season. spring right next to their house they don't use.	
20	11:00:00 PM	3:00:00 AM	4	There was no water when we were there, the house is at a higher elevation than the main pipeline.	
21	6:00:00 AM	2:00:00 PM	8	They have water in the morning but it goes away in the afternoon.	
22	10:00:00 PM	11:00:00 AM	13	Have water during the night always, occasionally during the day.	
23	-	-	-	They had A LOT of water and very fast flow when we were there, said they have water every day.	
24	10:00:00 PM	6:00:00 AM	8	Always have water during the night, occasionally during the day, there was A LOT of water when we were there.	

25	-	-	-	A LOT of water when we were there, they get a little bit during the night.	
26	8:00:00 AM	12:00:00 PM	4	A LOT of water when we were there.	
27	-	-	-	Uses the same tube as #26, flow decreases if both are turned on at the same time. When one doesn't have water the other also doesn't have water.	
28	-	-	-	Always have water.	
29	-	-	-	Always have water.	
30	-	-	-	Always have water.	
31	10:00 PM	1:00 AM	3	They have a tank, never have water during the day.	
32	4:00 AM	6:00 AM	2	Have water every 2 or 3 days, they drink rainwater, the pipe comes directly off the main line.	
33	12:00 AM	5:00 AM	5	Tank, get water at night and it fills the tank.	
34	-	-	-	No water.	
35	8:00 PM	12:00 AM	4	Never have water during the day.	
36	-	-	-	Only a few meters off the main line and they didn't have any water. we think there is no water in the central pipeline here.	
37	5:00 PM	8:00 AM		Get water randomly in those hours, have a tank that fills when they get water.	
38	9:00 PM	6:00 AM	9	No water while we were there, get water at night.	
39	4:00 PM	6:00 AM	14	No water while we were there, get water at night, use tanks to store it.	
40	7:00 PM	6:00 AM	11	Get water every day, use rainwater to drink.	
41	7:00 PM	6:00 AM	11	No water when we were there.	

42	-	-	-	Don't currently have a tap, use water from #41, want a tap when we return.	
43	4:00 PM	10:00 AM	14	Had water when we turned the tap but it stopped, share water with another house in their courtyard.	
44	-	-	-	Little bit of water when we visited.	
45	-	-	-	No water, no people to ask.	
46	8:00 PM	6:00 AM	10	2 houses share, they want an additional tap when we return.	
47	8:00 PM	5:00 AM	9	No water when we were there.	Diego
48	2:00 AM	6:00 AM	4	Tap was open when we arrived and there was no water.	
49	1:00 AM	5:00 AM	4	No water while we were there.	
50	1:00 AM	5:00 PM	4	No water while we were there.	
51	10:00 PM	5:00 AM	8	No water while we were there.	
52	9:00 PM	5:00 AM	7	No water while we were there.	

Attachment C: Photographs

Photo 1: Existing water distribution system exposed near the main road running through the community.

Photo 2: Members of COCODE and the EWB-KC travel team taking water samples at the existing storage tank in a corn field in the community.

Photo 3: Members of COCODE and EWB-KC evaluating the structure that divides water flow from the source between Los Churuneles II and two other nearby communities.

Photo 4: View of the community of Los Churuneles II.

Photo 5: Members of EWB-KC and COCODE interviewing a community member about the water quality and quantity at their place of residence.

Photo 6: Rebar and wood framing used in the construction of a new house in the community.

Photo 7: CMU used in the construction of residential house.

Photo 8: All members of COCODE and EWB-KC.

