Water Distribution System in El Tesoro, Guatemala

Problem Statement

The community of El Tesoro, Guatemala has been trying to access clean water for over 30 years. Since 2021, this University's Engineers Without Borders (EWB) Chapter has partnered with El Tesoro, as well as with a number of other stakeholders, to solve this problem through the design and implementation of a gravity-fed water distribution system.

Project Components

Spring box
- Captures spring water (spring comes out of rocks at the back of the box)
- Concrete spring box integrated into mountain terrain
- Collects spring water for distribution

Distribution Tank
- Stores water before distribution to the community
- Holds 25 cubic meters of water
- Constructed out of ferrocement that adheres to a rebar and chicken wire interior
- Chlorinator to add chlorine to the water

Conduction and Distribution Lines
- Pipelines from the spring to the distribution tank (conduction line) and the distribution tank to the 120 home connections (distribution line)
- Buried PVC where possible as shown to the left
- Exposed metal pipe where terrain is too rocky to dig

Project Outcomes

Clean Water Access

After this project, the community members of El Tesoro will have access to reliable clean water for the first time. This will greatly impact public health, as community members will be able to drink and bathe in water free from bacteria or other contaminants. Children who would otherwise have to spend time collecting water will now be able to attend school full-time, allowing them to make the most of their education. Adults who would have had to spend large portions of their paycheck on water will now be free to spend that money elsewhere, enabling the economic development of their families. The people of El Tesoro, with access to the basic human right of safe water, are empowered to continue working and changing their community for the better.

Sustainable Solution

In addition to the technical design of the water distribution system that has been constructed, this project also emphasized the sustainability and longevity of the system. To this end, health and hygiene trainings were conducted on how to safely and effectively use clean water, as well as system management trainings on how to manage the connection fees, operation, and maintenance of the system. With these tools, community members are empowered to take care of their system and use it to the maximum possible benefit of their community.

Engineering for Impact

Students working on this project gained real-world experience using their engineering skills to make a difference. They learned from the examples of professional engineers and faculty at their university that when technical know-how is combined with a desire to solve a pressing problem, great outcomes can happen.

Project Team and Stakeholders

REIC (Responsible Engineer in Charge)
- Licensed Professional Engineer in charge of signing off on the EWB project
- Instructed the students on every aspect of the design process
- Valuable coach and mentor to all students on the team

Students
- Led the design of the project
- Formed teams to tackle hydraulics, structural calcs, water quality issues, and construction preparations
- Traveled to El Tesoro two times to review the design of the project and assist with tank construction

Community of El Tesoro
- Took initiative to buy the spring and begin this water project for their community
- Invested throughout the project process: formed partnership with EWB, in touch throughout design, funded home connections, and provided labor for construction process

Professional Mentors
- Structural, water, wastewater, and water quality professional engineers assisted with the project
- Guided students through the design of system components
- Traveled to Guatemala with students to share expertise on-site

EWB-Guatemala
- Coordinated communication with El Tesoro and purchasing of materials from local suppliers
- Guatemalan Professional Engineer to approve all project designs and documents
- Conducted trainings on the management of the water distribution system

Rotary International
- Funded large portion of the project through their Global Grant
- Partnership between local chapter to student university and Rotary chapter near the community in Guatemala

Faculty
- Assisted students with design of project
- Liaison between student chapter and the rest of the university
- Traveled with students to Guatemala to share years of experience traveling to similar areas

Knowledge and Skills Gained

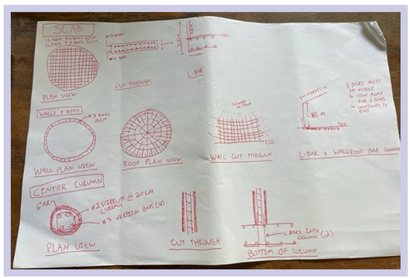
Technical
- Tank sizing
- Pipe sizing (in EPANet)
- Structural calculations for a water tank
- Rebar design and calculations
- Water quality testing and test results
- Construction takeoffs
- Construction scheduling (using Excel)
- AutoCad drawings

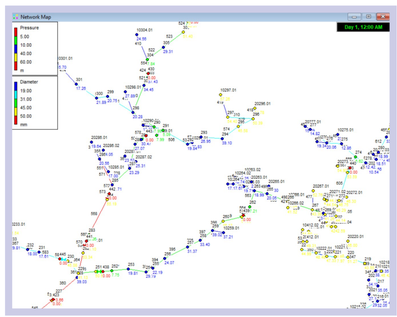
Non-Technical
- Fundraising and project accounting
- Risk management
- Leadership and teamwork
- Networking
- Social responsibility
- International relationships
- Material availability and familiarity considerations

Lesson Learned: Utilize Local Materials and Expertise
The ferrocement being placed on the interior of the tank here would not typically be used in the United States because it is time-consuming to apply and difficult to work with, but in El Tesoro, it is cheap, available, and the contractors are familiar with its uses.

Lesson Learned: Sustainable, Humanitarian Engineering
The REIC for the project explains concepts to students in the dug-out distribution tank foundation. He provided an example of how to dedicate a career towards using engineering for the greater good around the globe

Lesson Learned: Technical Communication
These rebar drawings were made on-site in Guatemala to better explain to both community members and student team members the rebar design for the distribution tank





Lesson Learned: Hydraulic System Analysis
EPANet was used to calculate the pressures, velocities, and diameters of all pipes in the distribution network

Project Timeline

First Community Attempt (1990)
El Tesoro starts their first water project, but it fails due to a lack of outside support

Second Community Attempt
El Tesoro tries to bring stream water to their community, but it again fails due to lack of support

Third Community Attempt
El Tesoro drills for three artisanal wells, but none reach water

Fourth Community Attempt
El Tesoro attempts a water project with a spring 18 km from their community, but they cannot transport the water that far and the project fails

Start of Current Project (2020-2021)
El Tesoro purchases a spring 4 km away from their community and reaches out to EWB-Guatemala to begin a partnership

Project Adoption (May 2021)
University Student EWB Chapter adopts the chapter, chooses project leads, and forms a team of mentors

Remote Assessment (Summer 2021)
University EWB Chapter partners with professional Guatemalan surveyor to complete survey of water distribution project

Alternatives Analysis Design Work (Fall 2021)
Student design team, with support from professional mentors, analyzes alternatives for system chlorination, tank materials, and tank sizes

Final Design Work (Spring 2022)
Student design team, with support from professional mentors, completes design of spring box, conduction line, chlorination, distribution tank, and distribution line

Plan-in-hand Site Visit (May 2022)
Student leads travel with project REIC and engineering faculty member to the project site to make any design changes needed before construction starts

Project Implementation Begins (June 2022)
Construction begins with spring box construction

Tank Construction Site Visit (August 2022)
Student design team members travel with project REIC and engineering faculty members to assist with construction of distribution tank

Water in Distribution Tank (December 2022)
Construction has been completed to the point where water is flowing into the distribution tank from the spring

Current Project Status (April 2023)
Construction has been completed on all project components except for the final home connections; when these are finished, El Tesoro community members will be able to turn on their taps for fresh water