

Bajo Gavilan

Aqueduct Design
2014 iDesign



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Outline

- Project Overview
- Community Background
- Field Assessment
- Proposed Design
- Summary



Project Overview

- **International Senior Design Project**
 - Gravity-fed water distribution system
- **Traveled to Panama from 8/10-8/24**
- **Field Assessment in Bajo Gavilan**
 - Determine community needs
 - Survey proposed aqueduct route
 - Worked with local PCV
- **Fall 2014: Provide final design recommendations**



Bajo Gavilan, Bocas del Toro, Panama



Bajo Gavilan

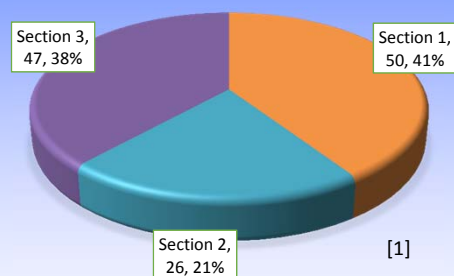
- **Ngäbe community**
 - Indigenous to Panama
 - Subsistence farmers
- **Population**
 - 124 people, 16 households
 - 59% Female, 41% Male
 - 67% of population under the age of 20
- **Hot and humid**



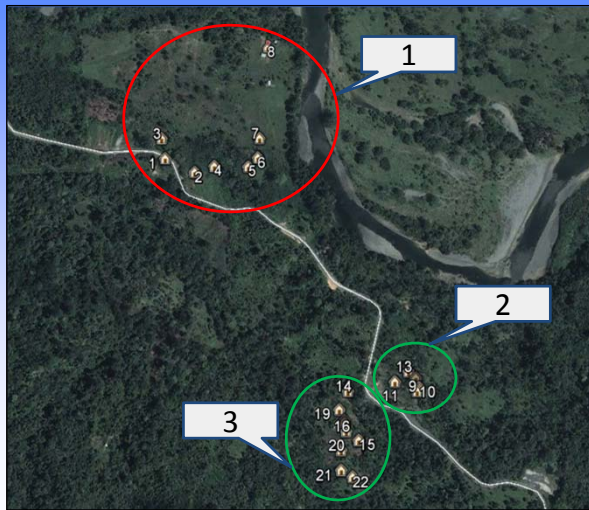
Bajo Gavilan



Population by Section



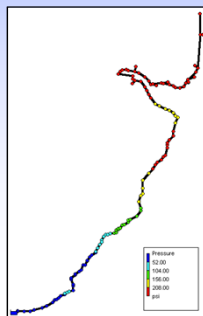
Bajo Gavilan: Current Situation



Photos from [1]

Objectives

To survey, model, and design a sustainable aqueduct system that will provide fresh water for section 1 of the Bajo Gavilan community

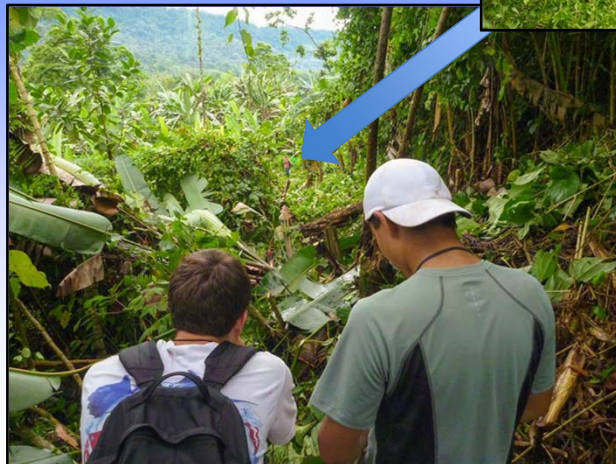


Field Assessment

1. Determine flow rate of new mountain spring source
2. Survey a proposed aqueduct route that will supply water to section 1
3. Test the water quality of the source



Methods: Survey



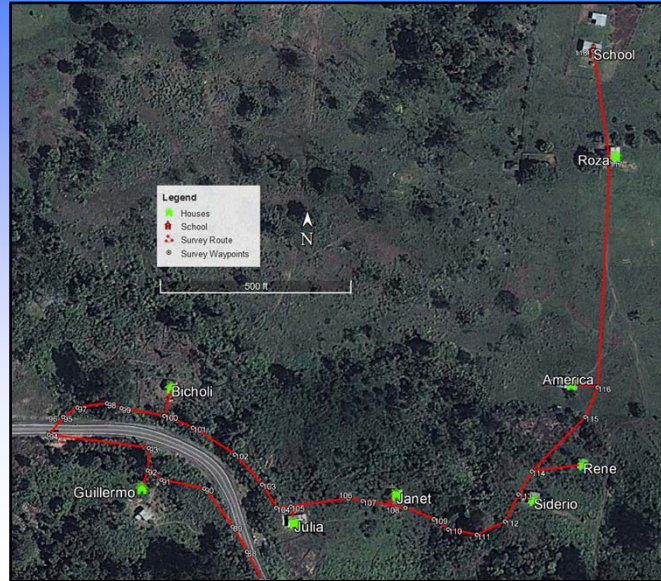
Methods: Water Flow Rate



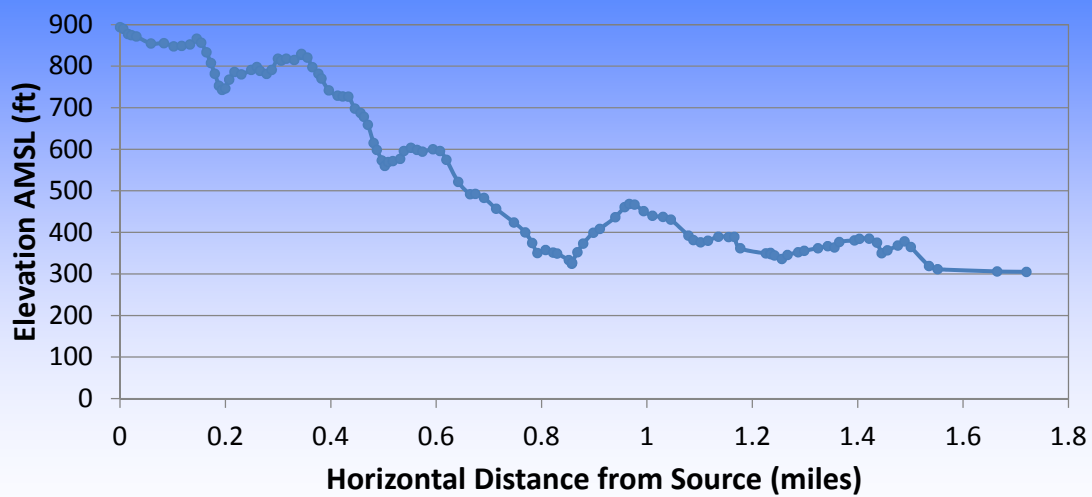
Methods: Water Quality



Survey Results: Proposed Route



Survey Results: Elevation Profile

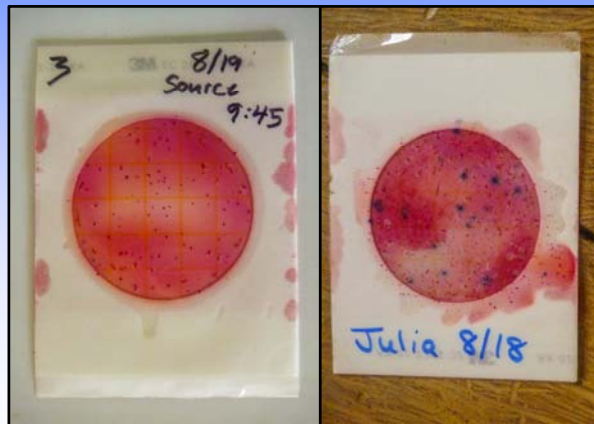


Other Results

Flow Rates

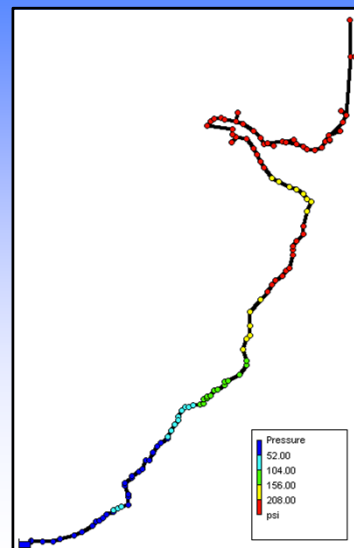
- Spring = 6.9 GPM
- Demand = 2.0 GPM

Water Quality

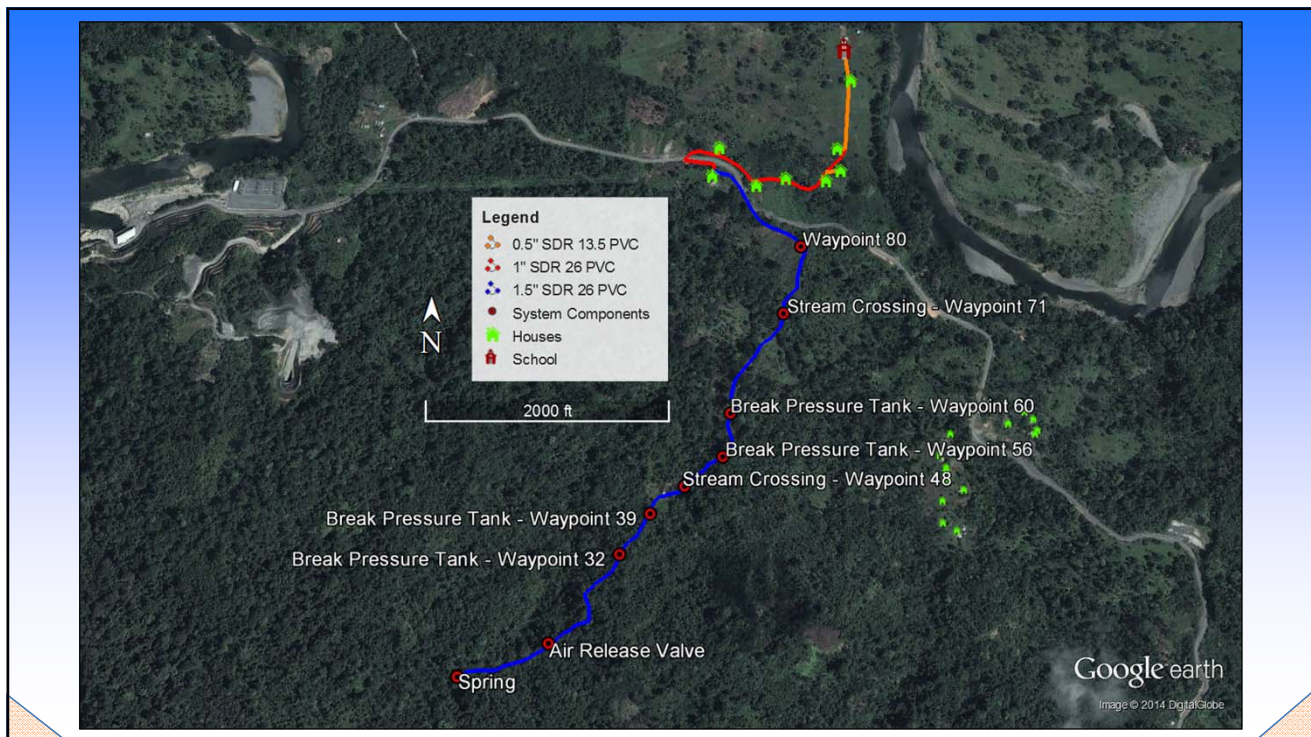
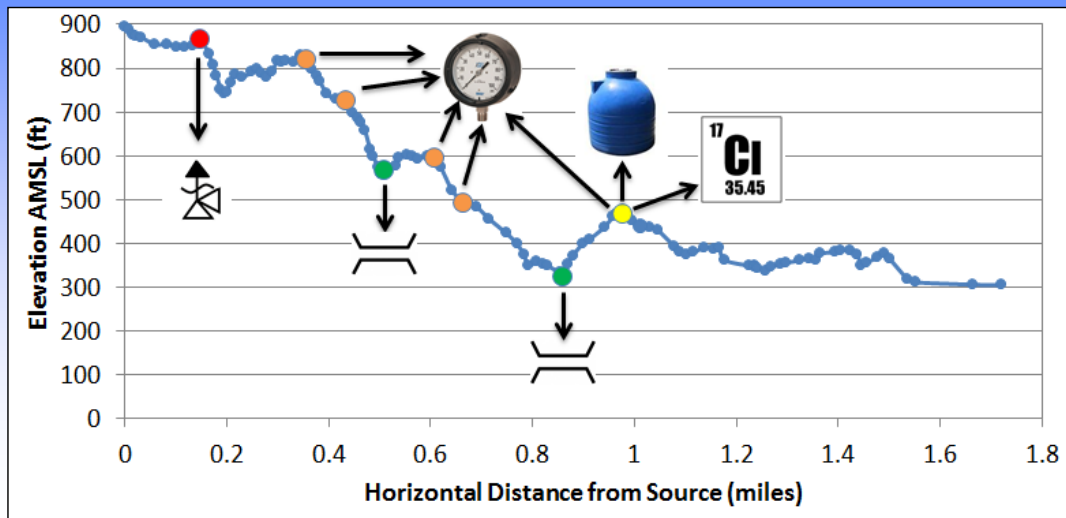


System Modeling and Analysis

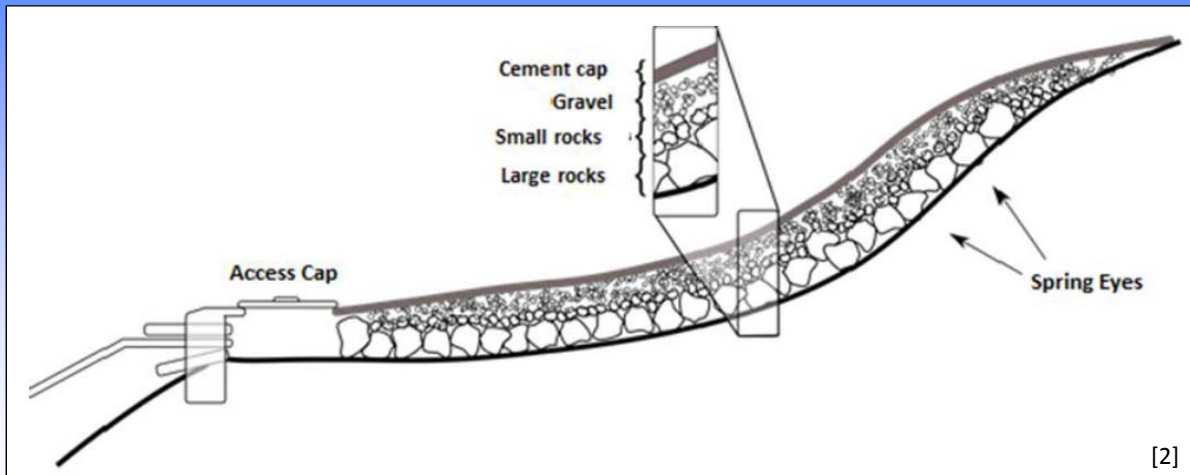
- **EPANET**
 - Pipe diameter
 - Location of storage tank
 - Quantity and location of break pressure tanks
- **Neatwork**
 - Downstream of storage tank only
 - Pipe diameter optimization
- **Air block analysis**
 - Location of air release valves



Proposed Design

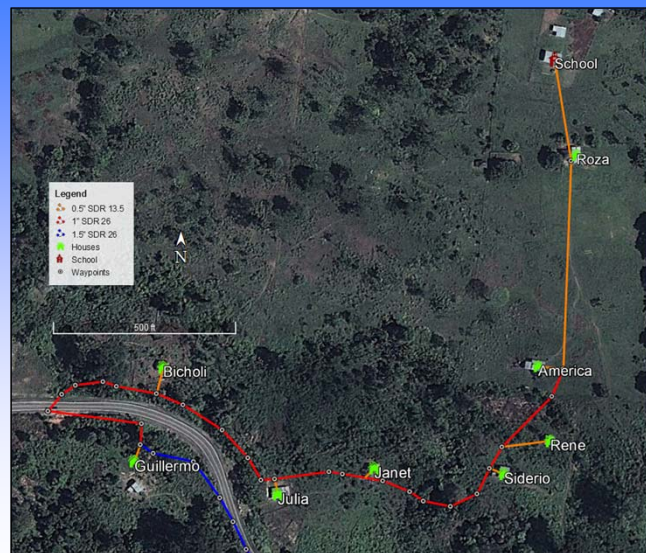


Spring Box



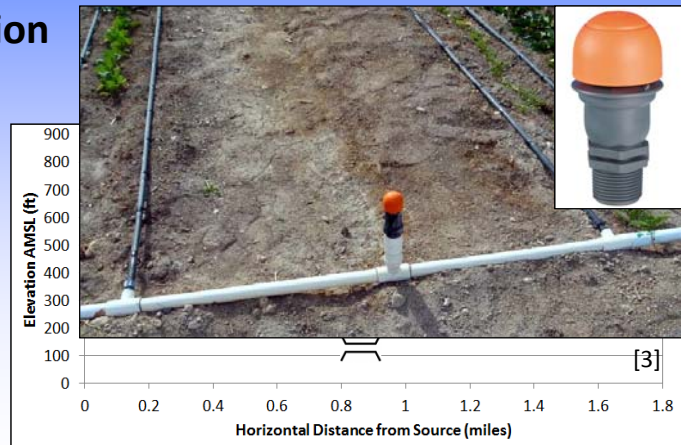
Aqueduct Line

- Different pipe diameters
- Buried 1.5' underground
- Components
 - Air release valve
 - Stream crossings
 - Break pressure tanks



Aqueduct Line: Air Release Valves

- Prevents air blocks in system
- Used in subsurface irrigation
- Floating ball mechanism



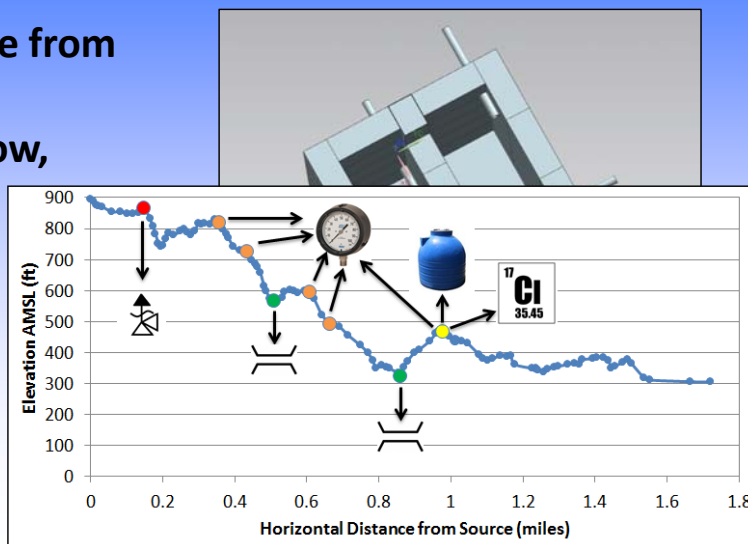
Aqueduct Line: Stream Crossings

- Galvanized iron pipe
- Buried 2' below deepest portion of stream bed
- Anchored at both sides



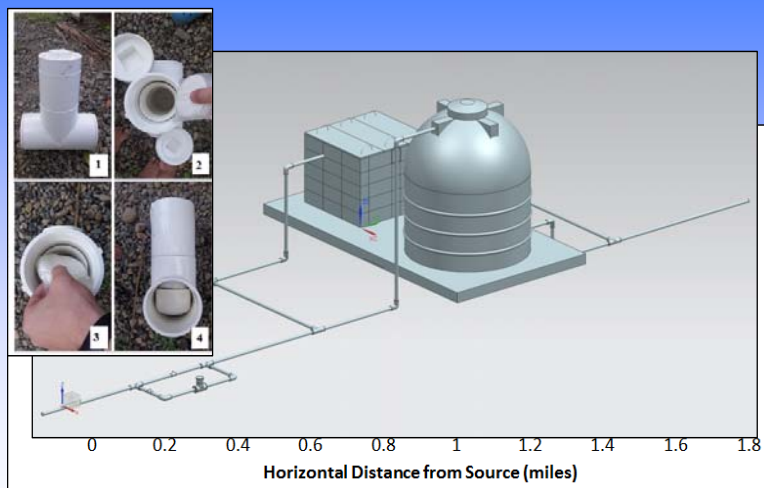
Aqueduct Line: Break Pressure Tanks

- Prevents pipe failure from water pressure
- Inlet, outlet, overflow, clean-out pipes



Waypoint 80

- **Three components:**
 - In-line chlorinator
 - Storage tank
 - Break pressure tank
- **Placed on top of a concrete pad**



Household Access

- **Branching lines from main line to tapstands at homes**
- **0.5" SDR 13.5 PVC**
- **Tapstands**
 - Tees
 - Shut-off valve
 - Faucet



Photos from [1]

Construction

Date	Phase
February 2015	<ul style="list-style-type: none"> • Material purchase • Site planning • Preliminary construction
March 2015	<ul style="list-style-type: none"> • Construction of components
April 2015	<ul style="list-style-type: none"> • Pipeline construction and burial

Projected Cost

- **Waterlines Grant**
- **Labor**
 - Community contribution
 - 5,200 man-hours
 - Approximately \$2,000
- **Contingencies**
 - Additional \$1,500

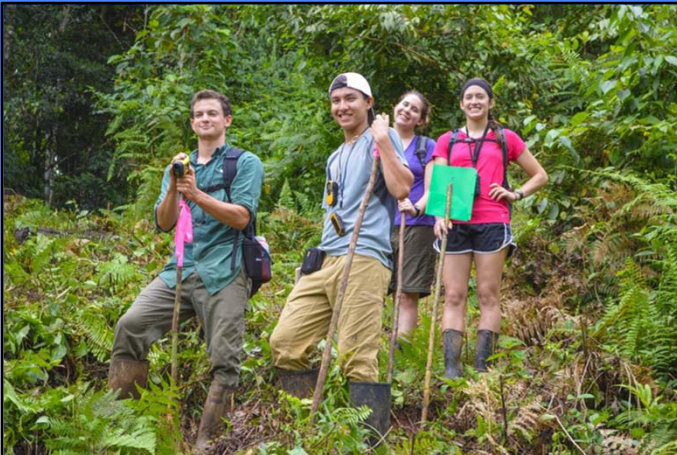
Item(s)	Cost
<i>Main Aqueduct Line</i>	\$3,300
<i>Air Release Valves</i>	\$70
<i>Low Profile Spring Box</i>	\$150
<i>Break Pressure Tanks</i>	\$1,800
<i>Waypoint 80 Concrete Pad</i>	\$1,200
<i>In-Line Chlorinator</i>	\$100
<i>Stream Crossings</i>	\$550
<i>Tapstands</i>	\$200
<i>Material Transportation</i>	\$600
Overall Cost	\$7,800

Summary

- **Traveled to Bajo Gavilan, Panama in August 2014**
 - Determined community needs:
 - Clean water for section 1 of the community
 - Surveyed proposed aqueduct route
- **Evaluated the feasibility of the system in Fall 2014**
 - Modeled and designed a sustainable system
 - Provided general recommendations for construction and maintenance
 - Provided a cost estimate and construction schedule
- **Next steps: Submit data and documents to Christina**

Acknowledgements

- **Community of Bajo Gavilan**
- **Christina Duell**
 - Peace Corps Volunteer
- **Dr. David Watkins**
 - iDesign advisor and group mentor
- **Mr. Michael Drewyor**
 - iDesign advisor
- **Thank you!**



References

- [1] Duell, C. 2014. "Community Analysis and Development Plan." Received via Email communication.
- [2] Jones, E.K. 2014. Improvements in Sustainability of Gravity-Fed Water Systems in the Comarca Ngäbe-Buglé, Panama: Spring Captures and Circuit Rider Model, a thesis report. Michigan Technological University, Houghton, MI.
- [3] Xtremehorticulture of the Desert. 2014. Air Vent Valves. Link: <http://xtremehorticulture.blogspot.com/2014/09/fertilizer-injectors-are-timesavers-but.html>. Accessed on 12/10/2014.

