Valle Escondido
iDesign 2015

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Outline

- Assessment Trip
  - Community Background
  - Problem Description
  - Data Collection
- Design Proposals
  - Rainwater Catchment
  - Spring box
  - Aqueduct Development
  - Storage & treatment
- Cost Estimation
- Questions
Assessment Trip
Community Background

- Valle Escondido
  - Isla San Cristobal, Province of Bocas del Toro
- Indigenous Ngöbe community
- Population of ~300 people
- Income: Agriculture
  - Cacao, yucca, banana, dasheen, etc.
- 4th Peace Corps Volunteer
Community Background

- Valle Escondido
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Problem Description

- Illness due to contaminated water
  - Open defecation
- Spring-fed aqueduct system in place
- Alternative water sources for families not connected:
  - Open wells
  - Rainwater
Mission Statement

Diversification and enhancement of water resource systems, considering public health and sanitation.
Data Collection

- 5 wells serving 1-2 families each
  - Stagnant
- 1 main bathing area for community
- 2 existing springs for aqueduct
  - Turbidity
Data Collection

- **Wells**
  - Average ~5/ml E.coli
  - TMTC Coliforms
- **Spring Water**
  - No E.coli
  - Average ~10/ml coliforms
- **Contamination**
  - Exposed well’s
  - Broken or unburied pipes
- **Presented results to community**
Data Collection

Nitrate tests

- Wells
  - All results <1 ppm
  - Determined nitrate not a problem
Data Collection

- 6100 feet of pipe spanning 1.08 miles
- 187 feet of elevation change from spring to community
Design Objectives

- Source Protection
- Aqueduct Expansion
- Rainwater Harvesting
Design Components
Rainwater Catchment System

- PVC gutter
- Filtration
  - Mesh screen
  - First flush system
- 85 gallon tank
- Wooden stand
Monthly Precipitation Averages
Springbox Design

- Integrated open side and bottom design
  - *Gravel/stones* - filter sediment
  - *Clay* - prevent infiltration
  - *Concrete apron* - prevent erosion
Springbox Design

- Visual estimates for size
- Design Specifications
  - Rebar reinforced concrete
    - 5:1 sand/gravel to cement
  - Outflow, overflow, and sediment drain
  - Ridge around opening to prevent seepage
## Maintenance

<table>
<thead>
<tr>
<th>Occurrence</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monthly or more</td>
<td>Cleaning around site (i.e. removing leaves and debris from spring box and drainage canal, clearing brush from trail, etc.)</td>
</tr>
<tr>
<td>Every six months (or when water is not clean)</td>
<td>Open spring box and clean walls and floor, wash with bleach. Clear any debris or sediment accumulation.</td>
</tr>
<tr>
<td>Unexpected maintenance</td>
<td>Replace broken pipes, repair cracks and leaks.</td>
</tr>
</tbody>
</table>
Tapstand

- Reinforce ½” piping to house
- Wood
  - Readily available
Aqueduct: Source to Tank

Distance: 0.52 miles
Elevation Change: 147 ft
Average Grade: 6.1%
Aqueduct: Tank to Community

Distance: 0.56 miles
Elevation Change: 42 ft
Average Slope: 2.6%
- Mapped general layout of water network
- Input elevation and pipe lengths based on survey data
- 2 models: existing, proposed
EPANET: Water Demand

- Used to optimize flow to community
- Water demand of 30 gallons per day per person used
EPANET: Water Demand
EPANET: Existing Model
EPANET: Existing Model
EPANET: Proposed Model
Storage Optimization

- Current Tanks
  - 4,250 Gallons
  - Recommendations
    - Full Usage
    - Treatment
Water Treatment

- Chlorinator
  - In-Line
    - Before Tanks
  - Treatment Tablets
    - Contact Time
    - Frequency
  - Ease of Use
    - Weekly
Scheduling
Rainwater Tank Schedule

- **Flexible time frames**
  - No hired labor
  - Yellow indicates strict times
    - Concrete curing
- **Variation due to weather**
- **Maintenance**
  - Bi-annual bleach washout
  - Filter cleanout when appropriate

### Rainwater Tank Construction Schedule

<table>
<thead>
<tr>
<th>Task</th>
<th>Time (days)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
<td></td>
</tr>
<tr>
<td>Boat transport</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Construct &amp; cure rainwater tank</td>
<td>8</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Construct wooden stand</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Install PVC gutters</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Connect first flush &amp; mesh between gutters &amp; tank</td>
<td>1</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td>11</td>
<td>16</td>
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</tr>
</tbody>
</table>
Springbox Schedules

- **Construction Schedule**
  - Approximately 1 month

- **Maintenance Schedule**
  - Frequency of cleaning
    - Site
    - Box
  - Frequency of replacement
Aqueduct Replacement Time

- Time
  - Min: 107 days
  - Max: 230 days
- Based on weather and available volunteer labor

<table>
<thead>
<tr>
<th>Task</th>
<th>Time (Days)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
</tr>
<tr>
<td>Boat Transport</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Dig Pipe Trench Section</td>
<td>0.125</td>
<td>0.25</td>
</tr>
<tr>
<td>Install Piping Section</td>
<td>0.004</td>
<td>0.008</td>
</tr>
<tr>
<td>Bury Piping Section</td>
<td>0.021</td>
<td>0.063</td>
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<tr>
<td>Total Time for 15’ Section</td>
<td>0.15</td>
<td>0.321</td>
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<tr>
<td>Total Time for whole system</td>
<td>107</td>
<td>230</td>
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Cost Estimate & Summary
Cost Estimate

- Materials breakdown based on local costs
- 3 potential springs
- 15% excess piping for aqueduct
- Peace Corps Grant for rainwater tanks

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Estimated Quantity</th>
<th>Unit</th>
<th>Unit Cost</th>
<th>Total Cost</th>
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<tbody>
<tr>
<td>1</td>
<td>Spring Box</td>
<td>3</td>
<td>Individual</td>
<td>$153.50</td>
<td>$460.50</td>
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<td>2</td>
<td>Aqueduct Expansion</td>
<td>1</td>
<td>Individual</td>
<td>$4553.00</td>
<td>$4553.00</td>
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<td>3</td>
<td>Chlorinator</td>
<td>1</td>
<td>Individual</td>
<td>$19.15</td>
<td>$19.15</td>
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<td>4</td>
<td>Rainwater Catchment</td>
<td>30</td>
<td>Individual</td>
<td>$142.00</td>
<td>$4271.00</td>
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<td>Total: $9,300.00</td>
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</tbody>
</table>
Summary

- Improvements in quality
  - Springbox
  - Chlorinator
- Improvements in quantity
  - Modify storage tank setup
  - Rainwater supplement
- Overall cost: $9300