

# Village Water Systems: Empowering Communities with Sustainable Water Treatment

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## Team Mission

Our team consists of students, faculty and professionals who are determined to provide communities with access to the cleanest water they can sustainably afford in an effort to improve the overall community health. We integrate our belief in the responsible use of resources with partnership models, combining water treatment systems with co-op programs that encourage economic sustainability through community investment.

## Project History

Students plan and lead site team trips to various locations to install water treatment systems. Since 2009, ozonation systems have been installed successfully in Honduras, Nicaragua, and Mexico. In May 2016, the team partnered with Forward Edge International to install a Village Water Ozonation System (VWOS) at the Trigo y Miel Community Center in Oaxaca, Mexico, where it currently serves 120 students and their families. The VWOS was implemented with a co-op business plan to enhance the economic impact on the community.



## Clients by Country

### Honduras

The missionary team of Danny and Ruth Castro is our client in Honduras. They have cultivated relationships with the local people in rural Honduras for over 10 years and helped connect our team to communities that need access to safe drinking water.

#### Los Prietos



- Awaiting approval from local governing water committee to progress in developing business model
- We are in the process of building and testing the operation of a UV disinfection system and a biosand filter for potential installation
- Water tested to have:
  - 300 CFU/100mL coliform
  - 2 CFU/100mL fecal coliform
  - Hardness = 150 mg/L
  - Alkalinity = 200 mg/L

#### Mojiman Elementary School

- Ozonation system installed in 2008 now nonfunctioning due to broken components
- Planning site team visit to deliver replacement parts

#### Los Murillos Elementary School

- Need water testing results and community size to determine system capacity and treatment method
- Awaiting approval from school committee to progress in work

### Pakistan

#### Full Gospel Assemblies Bible College



- Students reporting waterborne illnesses
- College asked for a water system that could treat the unsafe water and offset the entire annual cost of \$2500 for purchasing drinking water for 150 people

Critical Contaminants from FGA Water Testing Results		
Contaminant (mg/L)	Reported	2011 WHO Guideline
Total Dissolved Solids	912	1000
Total Hardness	296	500
Sodium	340	250
Sulfate	142	250
Total Coliform (CFU/100mL)	780	0
E. Coli (MPN/100mL)	780	0

#### Current Progress for FGA Bible College

- Acquire statement of need from client and design restraints
- Acquire water testing results and research treatment options for select contaminants
- Design and construct system with adequate capacity and determine proper dosages
- Conduct system prototype water testing with challenge water mimicking client water quality
- Deliver design and specifications to FGA Bible College and provide additional consulting services as needed

## Lessons Learned

- **Client Communication:** Communication is not only essential to delivering the right system, but it is also the key to fostering meaningful relationships with our client.
- **Cultural Awareness:** In order to alleviate issues related to cultural differences, our team has attempted to understand our clients by arranging face-to-face meetings with them when available.
- **Community Engagement:** The long-term success of this kind of project is greatly dependent on community investment.

## Conclusions

Through serving new clients, the team is broadening its water treatment consulting capabilities. We find that each community has unique challenges and we are adapting our solution methods to meet their individual needs.

## Acknowledgements

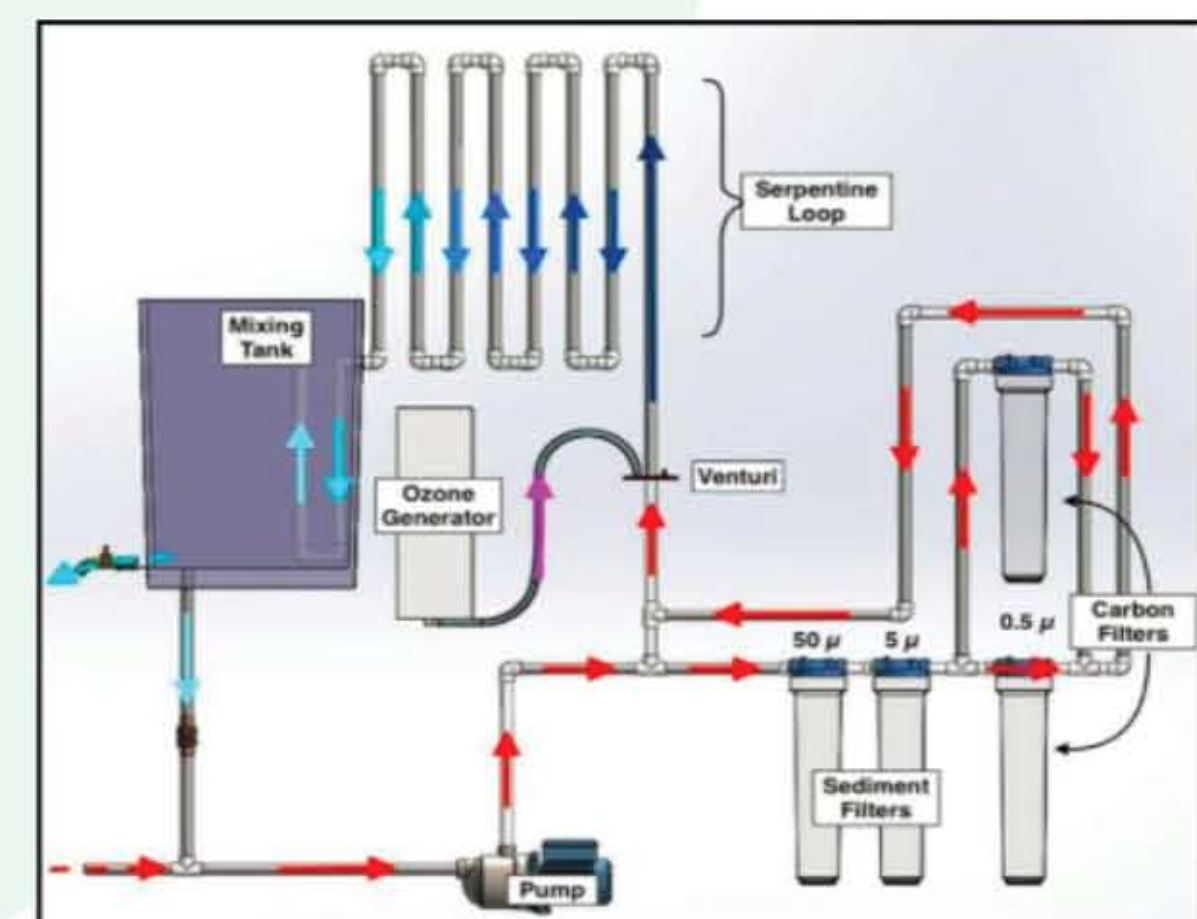
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## Water Treatment Options

### Ozone Disinfection

- Ozone gas bubbles through water and reacts with:
  - Viruses
  - Bacteria
  - Metals
  - Taste/Odor Compounds
- More effective than chlorine and does not affect taste of water
- Treatment effectiveness monitored by oxidation-reduction potential probe (750mV)
- Limitations:
  - High capital & operation costs ~\$3000
  - Ozone gas is irritating
  - Requires complex equipment

The VWOS is a 300-gallon batch-treatment system that features a serpentine loop to extend water contact time with ozone.



### Ultraviolet (UV) Disinfection

- Ultraviolet light passes through water and deactivates bacteria and virus DNA, which prevents their replication
- Treatment process does not add chemicals to water
- Limitations:
  - Moderate capital and operation costs ~\$1500
  - UV light intensity reduced when water is turbid
  - Monthly maintenance and annual lamp replacement needed
  - Does not prevent regrowth of microbes post treatment

Our UV system is designed to operate at a flow rate of 2.5 gallons per minute to provide 900 gallons per school day at Los Prietos.



### Biosand Filtration

- Biosand filter removal capabilities
  - Viruses
  - Bacteria
  - Particulates
  - Taste/Odor Compounds
- Affordable installation and operation costs ~\$300
- Can find construction materials locally
- Limitations:
  - Requires frequent usage and maintenance to ensure adequate performance
  - No affordable method of frequently testing the treated water quality
  - Max hydraulic loading rate ~4gpm per sqft

Our biosand filter is designed to produce 60 gallons per school day at Los Prietos.

