Cornell University
School of Civil and
Environmental Engineering

AguaClara
aguaclara.cee.cornell.edu

Monday, October 06, 2008

Dear Stephanie Sprayberry,

I am writing on behalf of the AguaClara project at Cornell University to apply for funds in support of our effort to develop and implement high performing sustainable technologies for production of safe drinking water from surface waters for application in the Global South. I am writing on the recommendation of Barry Schnorr, who was a student in my course, Sustainable Small Scale Water Supplies and is now an Associate at ENVIRON. He suggested that the AguaClara project would be a good match for the ENVIRON Foundation.

In the attached document I have described our goals for the next year and indicated ways that ENVIRON could help AguaClara develop and disseminate the technologies that we are already piloting in Honduras. If you have any questions or would like additional details I would be happy to discuss the AguaClara project with you.

Sincerely,

_____	_____
Monroe Weber-Shirk Date	Len Lion Date
Senior Lecturer	Director of Civil and Environmental Engineering
AguaClara Director	

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AguaClara proposal

Mission Statement

AguaClara (clear water) is a project in Civil and Environmental Engineering at Cornell University that strives to improve water quality through innovative research, knowledge transfer, open source engineering and design of sustainable, replicable water treatment systems.

AguaClara Project Description

The AguaClara project is a high profile project at Cornell University and is frequently in the Cornell press because it closely matches the university mission. AguaClara is comprised of a faculty leader and a group of approximately 60 Cornell University students, a number which has continued to grow from year to year. Working together with partner organizations, the AguaClara team is developing a robust, sustainable, gravity powered, municipal scale water treatment plant design for use in the Global South that can be built using locally available materials. The hands-on research and design experience with an international context creates an engineering education that changes lives. The AguaClara project combines research and development with service learning and outreach in an approach that benefits Cornell, the students, our donors, our partners in the Global South, and most of all, the people who for the first time have safe drinking water.

Each year, an estimated 1.7 to 2.2 million persons die from waterborne diseases. Most of these deaths are due to diarrheal diseases, and most occur in children and other vulnerable populations. The total burden of morbidity due to unsafe drinking water is difficult to estimate, but over 1 billion episodes of gastroenteritis and other infections are attributed to it each year. In September 2000, world leaders assembled at the Millennium Summit and created the Millennium Development Goals, an ambitious agenda for reducing poverty and improving lives. One goal was to halve, by 2015, the proportion of people without sustainable access to safe drinking water, using 1990 as a benchmark. This works out to providing for an additional 400,000 people every day until 2015. With these numbers the demand for better and more economical water treatment technology is enormous.

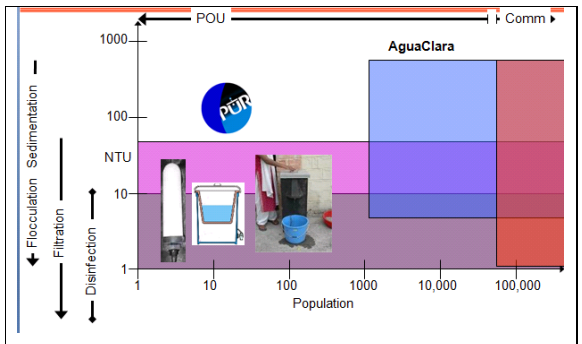

Figure 1. The AguaClara niche (in blue), treating very turbid surface waters for municipalities using robust, gravity powered unit processes to produce microbiologically safe drinking water.

The AguaClara team has identified a niche in the water treatment sector that needs a better solution. That niche is surface waters that are very turbid (above 50 NTU) at least some of the time and population centers greater than 1000 (Figure 1). For influent waters under 10 NTU,

disinfection is adequate for providing potable water. Above 10 NTU, simply disinfecting is ineffective. For turbidity levels from about 10 to 50 NTU, filtration becomes necessary in addition to the disinfection. This is to prevent the harmful effects associated with disinfecting water with considerable organic matter in it. This is the niche that most point of use (POU) devices have come to fill. Such devices include ceramic, sand, and clay pot filters. These devices however are limited to producing water for drinking and cooking, but do not produce sufficient quantities for bathing and washing. Further up on the turbidity scale, flocculation and sedimentation become necessary. At this level few POU devices will work, because most filters will clog. Pur, however does provide a POU chemical system which functions in this range. But again, it only provides about 2 liters per person per day. Each POU systems can only be used by a single family and they often have to be replaced every couple of years. POU systems tend to be similar in cost to the AguaClara water treatment plants if the basis of comparison is cost per person served. However, if compared based on the cost per unit water treated the AguaClara technology is approximately 100 times more economical.

For large population centers conventional municipal water treatment plants are commonly used. These plants often illustrate the problem with "high tech" solutions and suggest that a better name would be dependent technology since they only work under optimal conditions. They use technology that is dependent on a well developed infrastructure including electrical grid and access to a supply chain for the specialized components.

We have partnered with Agua Para el Pueblo (APP), a Honduran non-governmental organization that has been building water supply systems for over 24 years. Two AguaClara Engineers, Cornell graduates, have year long internships with APP and are providing training to APP engineers and technicians as well as providing feedback to the AguaClara team at Cornell. APP has built two AguaClara water treatment plants (Ojojona and Tamara – see Figure 2 and Figure 3) and is encouraging us to develop even more economical designs. The goal is to reduce capital costs further so that communities can self finance the AguaClara plants. We will continue to refine our design algorithms based on feedback from the plants in Honduras and our research program at Cornell University. We also anticipate that in a few years we will be able to reduce the number of interns in Honduras as APP will be able to build the facilities without our assistance.

Figure 2. AguaClara water treatment plant in Tamara Honduras that serves 3500 people.

There are many thousands of communities throughout Latin America that have untreated surface water and thus there is an excellent opportunity to continue building AguaClara facilities. We anticipate establishing new partnerships with organizations

in other regions that also have inadequately treated surface waters used as drinking water. Our long term goal is to spread this technology globally. We envision that the technology will initially spread from Honduras to other countries in Latin America. It is also likely that we will launch a new site outside of Latin America.

Figure 3. Inside the Tamara water treatment plant showing the vertical flow flocculators and vertical flow sedimentation tanks.

What Sets Us Apart

The AguaClara team isn't just trying to provide safe water for a few thousand people. The team has assessed the scale of the global problem and is conducting the research and developing the design tools so that we can provide robust designs for free to the global community so that engineering firms and municipalities can build these facilities. To meet this challenge we have 11 research teams investigating a range of topics including flocculation, floc blanket clarifiers, plate settlers, and the interactions between these processes. We are also developing analytical models of rapid mix, flocculation, and sedimentation to ensure that the algorithms that we use in design capture the important physics. A pilot plant, which treats river water at the University's water treatment plant, allows us to alter and try out different configurations which could then be applied to future plants or to retrofit current plants. Other teams are conducting bench scale experiments with a more theoretical approach. These research teams adapt as the different project needs come up. A past team created the chlorinator we use in our plants and which is now replacing existing chlorinators in communities where chlorination is their only water treatment.

The research teams are investigating the parameters and creating the design guidelines that are then incorporated into the AguaClara design tool. The design tool is the result of many thousands of hours of effort to create robust design algorithms describing every aspect of the water treatment plant. The design tool includes several hundred parameters that are calculated in an integrated set of MathCAD worksheets.

The AguaClara technology is capable of treating a wide range of influent turbidity levels and can service communities with populations greater than 1,000. We have already created detailed designs for facilities ranging from 2000 people up to 20,000 people. We will continue expanding that range over the next years. Our plants have an overall cost of structural design, build, operate, train, transfer, and monitor for less than $20 per person served for communities with a population of 2000 and even lower costs for larger communities. The overall operation and maintenance cost of $2 per person per year.

The AguaClara team has already developed a suite of technologies that work together to produce clean water without the need for electricity and at a cost that is lower than point of use devices that are often touted as the solution to the lack of clean water. Many student groups and university projects are focused on producing points of use water treatment systems. Although point of use systems will

undoubtedly be important for many very small or dispersed rural communities, we are convinced that the AguaClara municipal scale solution is much more economical, better for public health, and preferred by the communities. We are developing the technologies and then providing the training and capacity building so that our partners in the Global South can go on building more of these water treatment plants.

We recognize that with many thousands of communities lacking safe water, that the AguaClara team can't possibly design individual water treatment plants for all of those communities. To increase our impact AguaClara has developed a web based automated design tool that will deliver fully detailed three dimensional design drawings and parts lists for AguaClara water treatment plants. The designer will select the flow capacity, and a small number of other parameters. The customized design (Figure 4) is then created in approximately 5 minutes of computation time. The automated design software is modular and components can easily be modified to incorporate new design guidelines or plant layouts. This software makes it possible to move from research results thru the design phase quickly. The online tool will be available globally for engineers to rapidly create designs for AguaClara water treatment plants. This tool will significantly reduce one of the most costly aspects of the plants, the engineering.

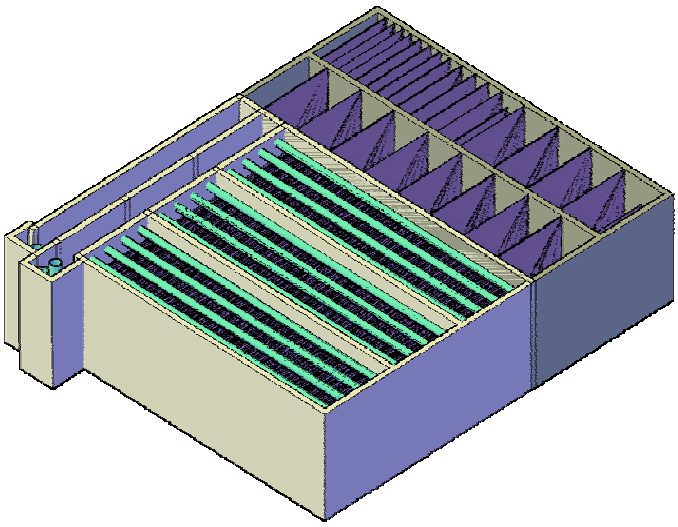

Figure 4. Computer generated design that was drawn automatically using design tools created by the AguaClara team.

Even though four plants have been built in Honduras already, with another on the way, the design is not perfect. With each new plant generation, we are progressively improving the design. The research done by the research division of AguaClara is in part what is making this happen. We are proposing to continue our research on a number of critical design components of drinking water treatment plants. We benefit from an established project team with a great deal of undergraduate enthusiasm that makes it possible to work on multiple research tasks simultaneously without requiring the large budget that would normally be required for graduate student research.

All of this work is geared towards perfecting the AguaClara technology. The results from this research will make it possible to reliable produce treated water with a turbidity of less than 1 NTU. We are currently able to meet the World Health Organization 5 NTU goal, and are confident that by refining the design of the flocculator and the sedimentation tank that we will be able to meet the 1 NTU goal

without the use of filtration. We have created this goal because filters require many valves and either many filter boxes or pumps for backwashing.

How You Can Help Us

The AguaClara budget for 2008 – 2009 is $300,000. The Sanjuan Foundation and Cornell University are contributing approximately $200,000 to the project. ENVIRON could support graduate students who help provide leadership for the team, summer internships, both in Honduras and at Cornell, summer salary for the director, a proposed program assistant, or research supplies. The program assistant is a key position that will help coordinate project activities and make it possible for the project to continue to grow. (A complete description is available at https://confluence.cornell.edu/display/AGUACLARA/Program+Assistant.) One of the major research expenses we anticipate early next year is the construction of a pilot scale sedimentation tank that incorporates vertical upflow, floc blanket, sludge accumulator, and plate settlers. This will make it possible to test and evaluate the complete system of treatment steps that we are developing. Regardless of the project activities that ENVIRON Foundation chooses to fund, the Foundation can be confident that the funds will be helping develop robust and accessible safe drinking water technologies.

Future Funding

AguaClara is funded by the Sanjuan Foundation and Cornell University. We have already received a commitment from the College of Engineering for continued support through June of 2010 and the Sanjuan Foundation has a commitment through 2012. We expect that our funding options will continue to evolve as the project grows and makes a larger contribution to global water supply.

Brief Biography and contact information for Monroe Weber-Shirk

I have a Ph.D. in Environmental Engineering from Cornell University where I am a Senior Lecture and Director of the AguaClara project. My research specialization is in drinking water treatment.

I worked in Honduras for two years in the 1980's and out of those experiences I developed a strong interest in researching and designing better water treatment technologies for drinking water. A few years ago I was able to begin working with Agua Para el Pueblo (APP) in Honduras. I learned to know Jacobo Nuñez, the director of APP, in 1982 when I was working in the Salvadoran refugee camps in Honduras. Although we had been out of touch for about 16 years, it was easy to begin working together again. On a trip to Honduras in 2004 with a team of Cornell students Jacobo asked how they could clean up the turbid water that is a common problem in the surface water supplies used for drinking water. At the time I knew what the answer was for communities in the US, but I knew that we needed a different solution for Honduras. The AguaClara project is the result of the search to find a robust drinking water treatment solution that works in the Global South.

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