AguaClara

An Introduction

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Cornell University

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AguaClara

Who are we?

- AguaClara at Cornell is a group of students and faculty who **r**esearch, **i**nvent, and **d**esign sustainable water treatment technologies and **e**mpower AguaClara implementation partners.
- AguaClara at Cornell uses **project-based** and **peer-based learning** to **empower** students as they learn how to learn, teach, and make the world a better place.

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My Vision

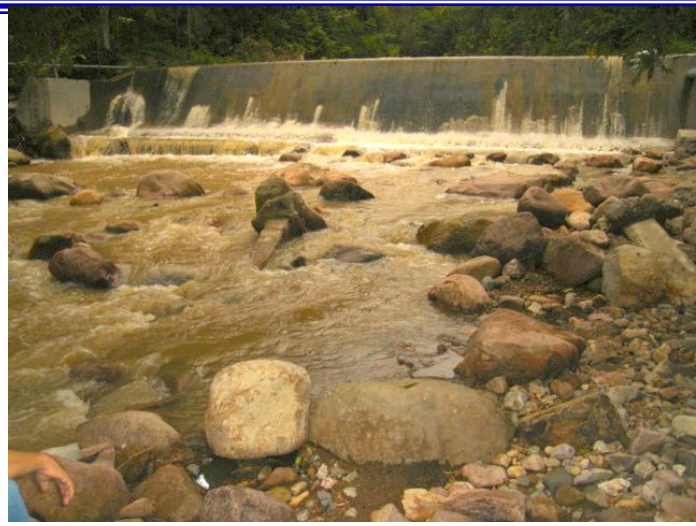
- AguaClara at Cornell is the global leader in drinking water treatment
  - for creating and disseminating sustainable drinking water treatment technologies that are the most economical AND that produce the cleanest water
  - for pioneering engineering education that empowers students to engage with and solve global challenges.

Safe Drinking Water

- We have chosen to use our skills to tackle one of the planet's great needs: municipal scale safe drinking water
- We conduct research and design high performing – low cost municipal scale drinking water treatment plants that remove turbidity and pathogens
- We have developed an innovative approach that has already proven to be successful

What is the Problem?

- Surface waters used as drinking water sources
- High turbidity especially during the rainy season
- Pathogens from surface runoff and from upstream settlements
- High incidence of diarrhea among children and adults

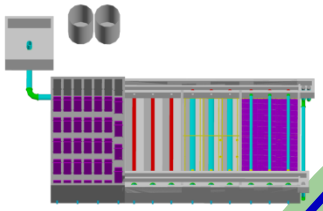



What can we do to treat the dirty water that we are providing to rural communities?

Gravity Water Supply

Spring box or dam

Distribution Tank



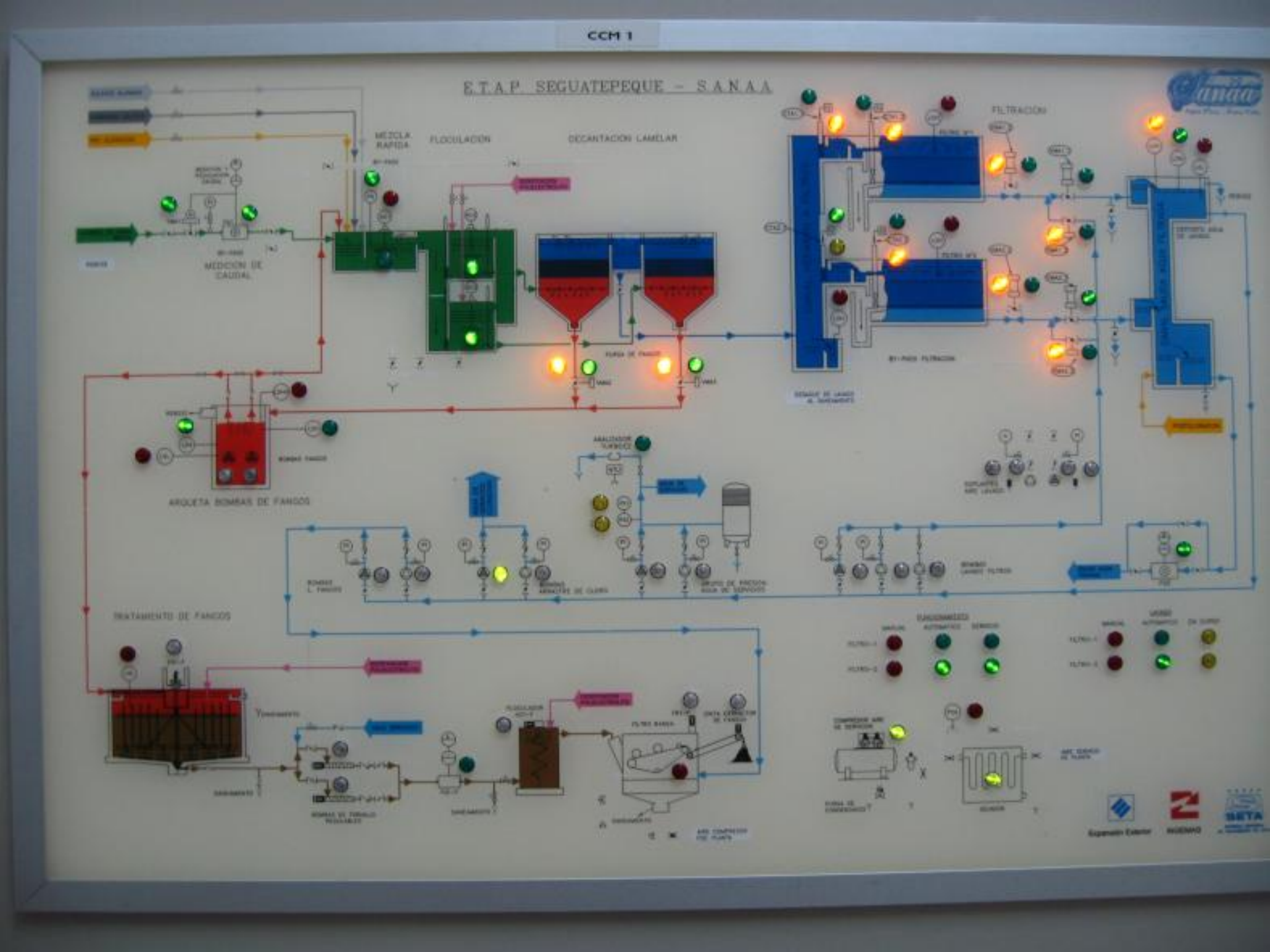
Problems even in the dry season…

Stream water

After flocculation/sedimentation

What is the conventional solution?

- Flocculation – sedimentation – filtration – disinfection
- Technologies from early and mid 1900's
- "Advances" over the last 50 years have focused on automation that have made the system more expensive and more difficult to maintain


CCM 1
E.T.A.P SEGUATEPEQUE - S.A.N.A.A
MEZCLA RAPIDA
FLOCULACION
DECANTACION LAMELAR
FILTRACION
MEDICION DE CAUDAL
ARQUETA BOMBAS DE FANGOS
TRATAMIENTO DE FANGOS

How big is the market?

- 2 billion need safe water
- Assume 25% live in communities between 1000 and 50,000 (as is the case in Honduras)
- Assume 25% of those are using surface water
- 125 million need AguaClara water treatment plants
- 10 year time frame for implementation
- Assume 10,000 people per plant
- 1250 plants per year!
- This estimate ignores the disruptive nature of the AguaClara technologies

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The Grand Challenge

- To serve 125 million in 10 years AguaClara implementation partners would need to be building approximately 3 plants per day
- We need to scale up rapidly
  - 3 plants under construction in Honduras this year! (Marcala, Alauca, Atima)
  - 3 different funding sources (none dependent on AguaClara at Cornell for funding)
  - MWA, WFP, Aguanova, INFOM

Water Treatment Myth

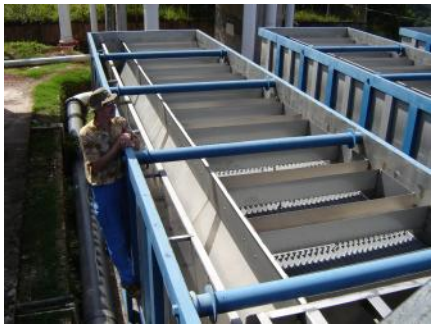
- Conventional Engineering - Resource poor communities can't maintain drinking water treatment plants due to their lack of education, inability to provide maintenance, and lack of economic capacity

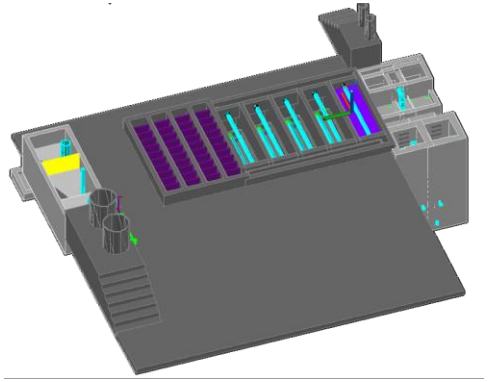
  Blame the Victim

- AguaClara insight – Conventional water treatment plants fail because they
  - aren't designed for ease of use by the operator,
  - are dependent on an unreliable and expensive energy source - electricity,
  - are vulnerable to multiple failure modes

AguaClara is a game changing innovation

- Instead of delivering **hardware**
- AguaClara delivers **knowledge**
- Instead of **locking** up the knowledge with patents
- AguaClara **shares** the knowledge and improves performance with a systems (operations research) approach
- We design for the context and use feedback to improve





Cuatro Comunidades

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How do we make dirty water clean?

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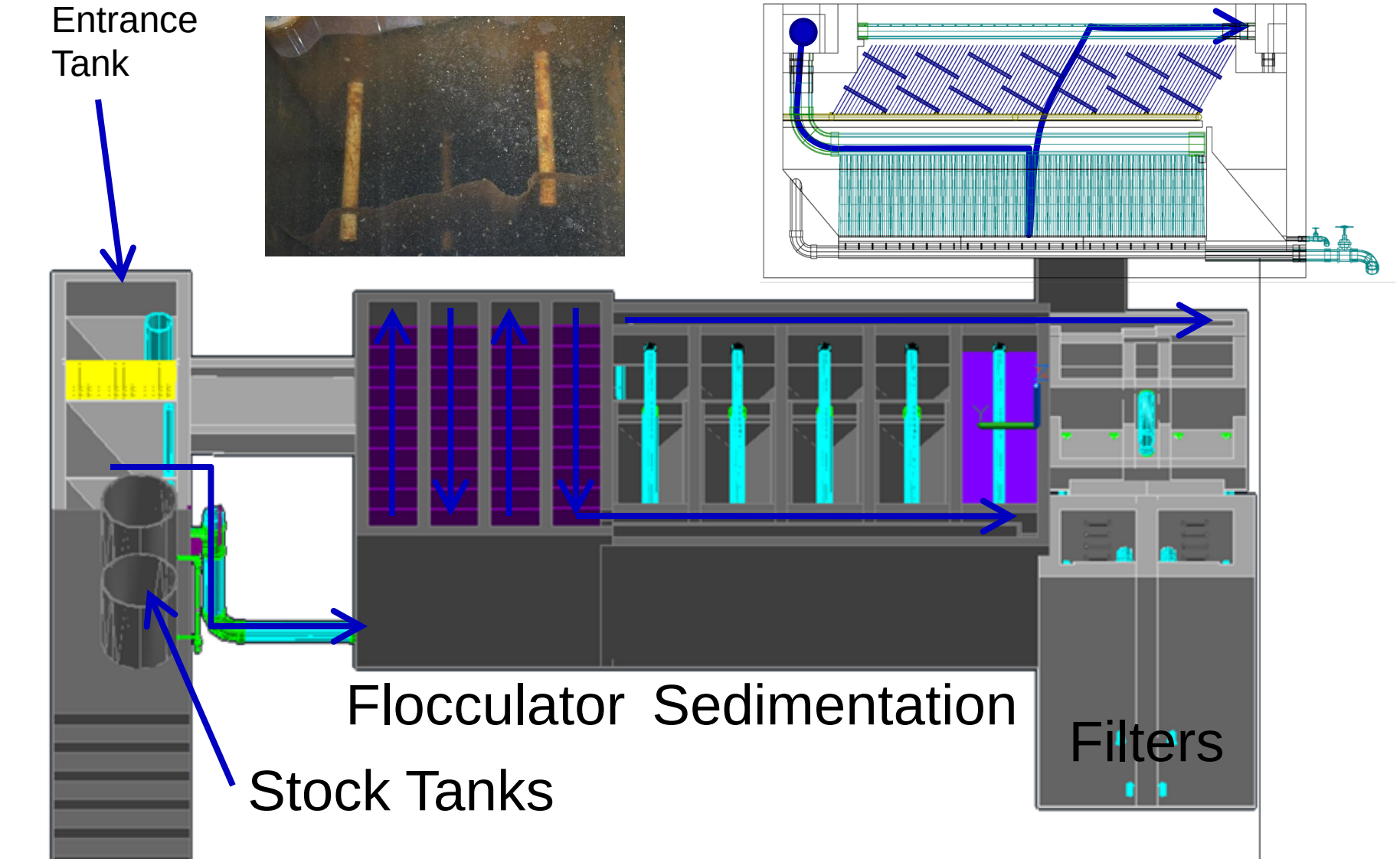
Potable w/0 Electricity



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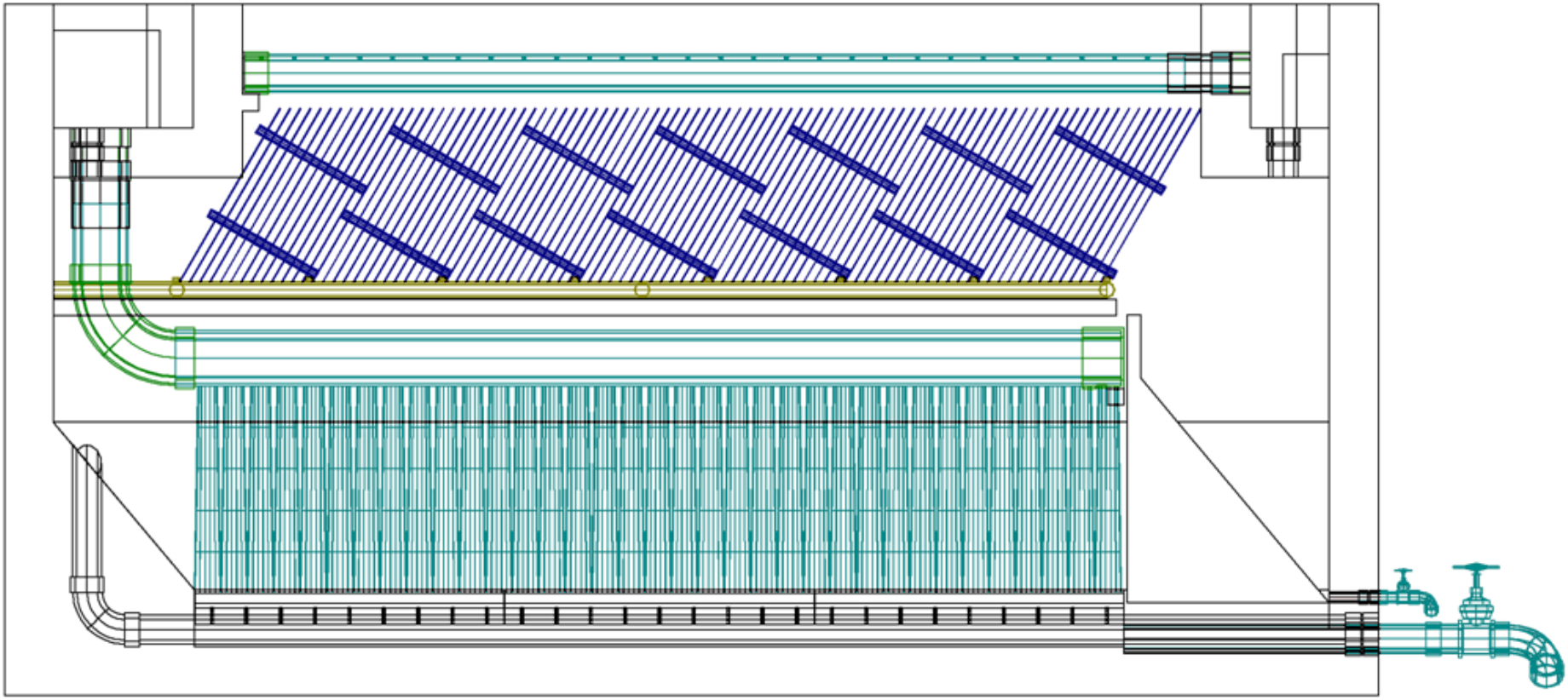
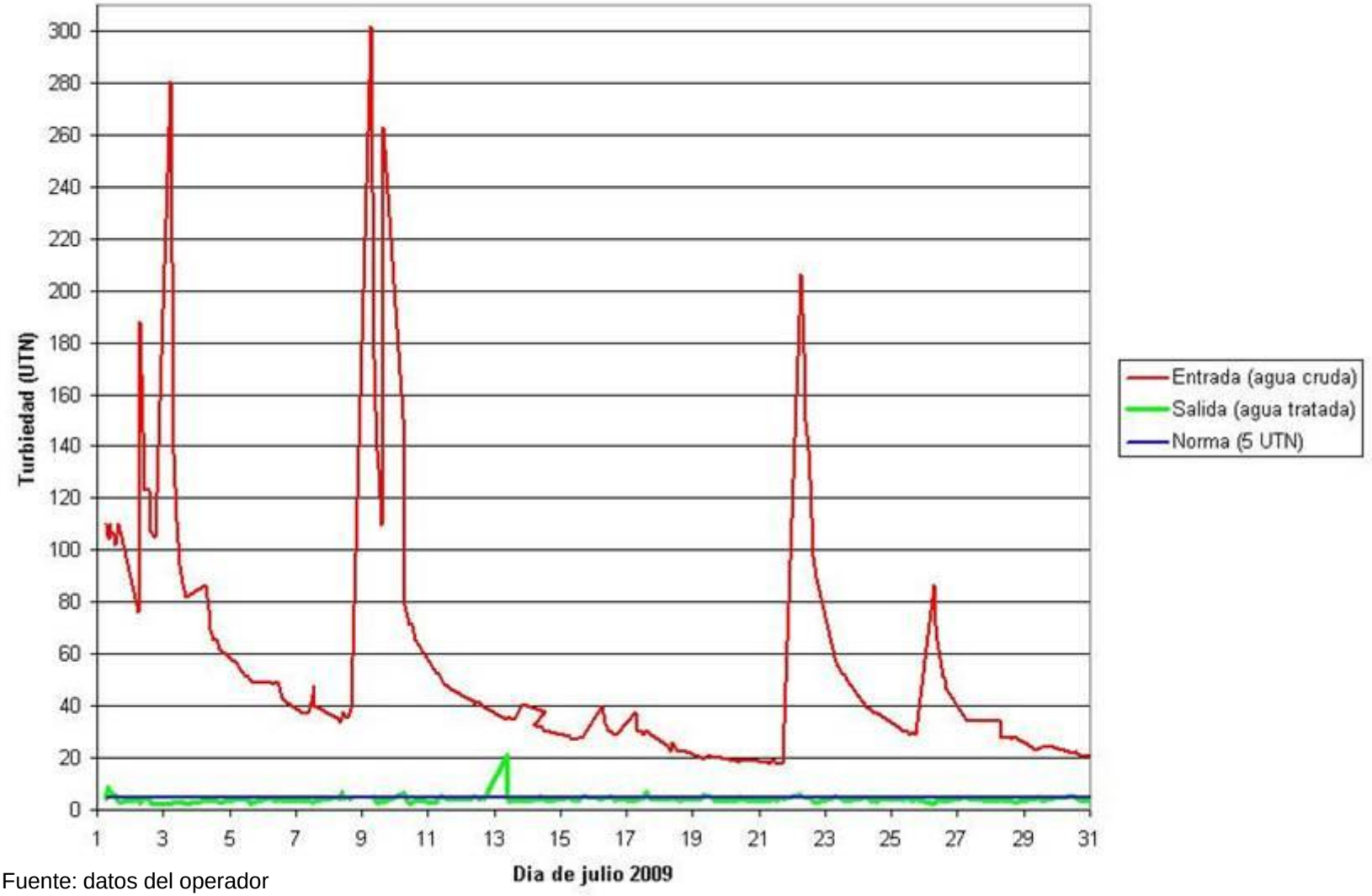
Sedimentation



Turbidity removal

Results from Cuatro Comunidades – July 2009



Fuente: datos del operador

AguaClara Philosophies

- Use locally available materials rather than specialized components whenever possible
- Use a little potential energy to power the plant rather than a lot of electrical energy
- Optimize technologies to enhance sustainability in context
  - Plant operator
  - Community
- Do more with less
- Simple is beautiful

AguaClara Philosophies

- Use components that can be repaired or replaced easily be the plant operator

Abandoned package plant in La Ceiba, Honduras

AguaClara Philosophies

- Design the processes so the operator can observe its function and access all components (no enclosed tanks)

Abandoned rapid sand filters in Guatemala City

AguaClara Philosophies

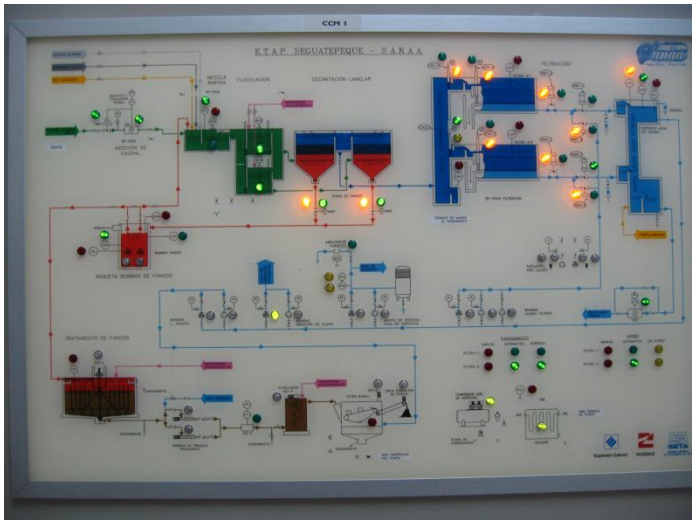
- Minimize the use of expensive components that can fail such as valves

Couldn’t they have added a few more valves to these filters?
The replacement parts for these valves are not available in Honduras…

AguaClara Philosophies

- Don’t use any electricity (the plant must be able to function even if the electrical grid fails) – No Pumps. No electronic controls.

Tegucigalpa

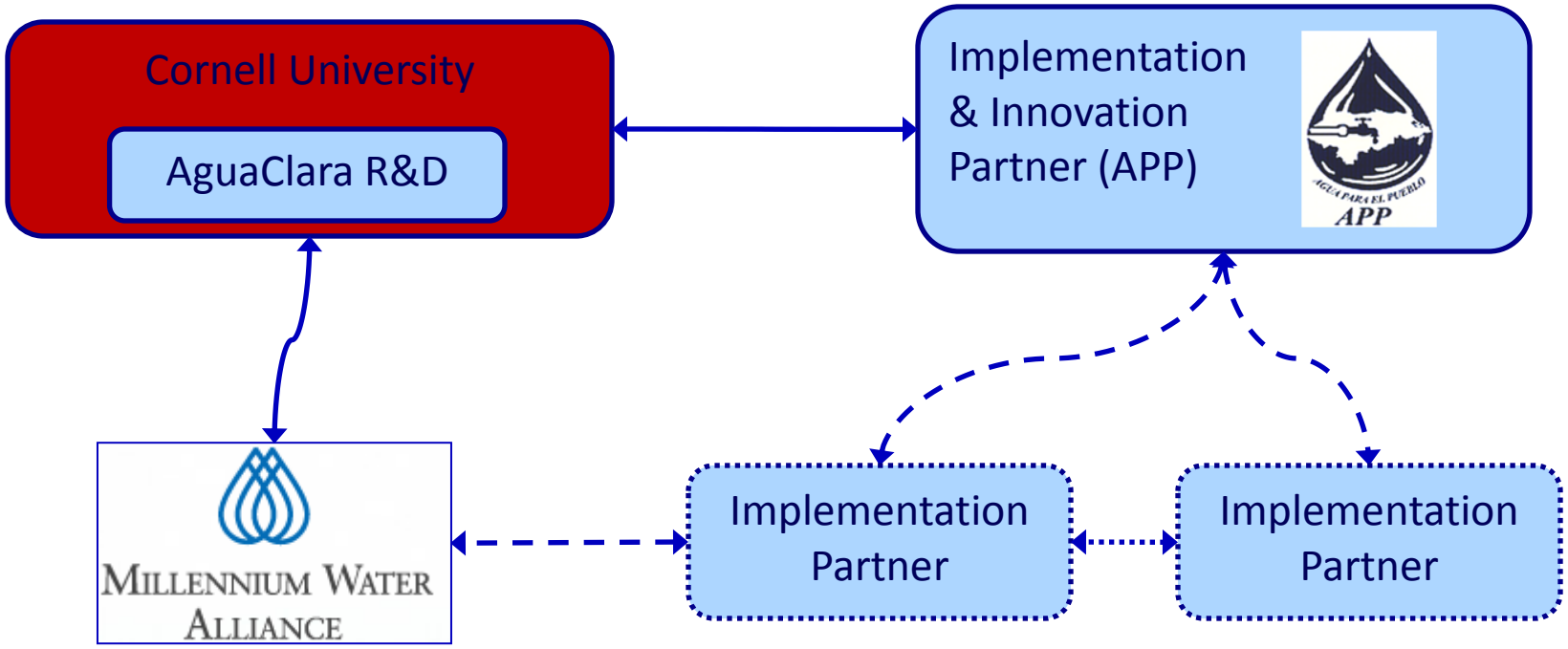


Siguatepeque, Honduras

We are committed to…

- Education and empowerment of ourselves and others
- Learning by doing (problem based learning)
- Peer-based learning
- Partnerships that empower

AguaClara Network Map



Current partnerships

Forming partnerships

Proposed partnerships

Links to sites on the web

You can navigate by clicking on buttons to get more info

Partnerships

- Agua Para el Pueblo – Honduran NGO
- Developing partnership in Guatemala and Colombia
- Developing partnership with Millennium Water Alliance
- AguaClara Engineers
- We benefit from each other's experience and skills
- The partnerships are far stronger than the individual members

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Cornell University
School of Civil and
Environmental Engineering

AguaClara at Cornell

Research, Design, & Admin

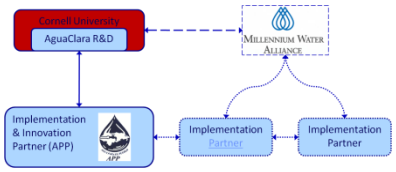
Graduate Research
Fundamental physical chemical processes for enhanced drinking water treatment

Project Based Courses
AguaClara: Sustainable Water Supply Project*
CEE 2550
CEE 4550
CEE 5051/5052

Summer Internships at Cornell

Lecture/Project Based Course
ENGRI 1131: Water Treatment Design

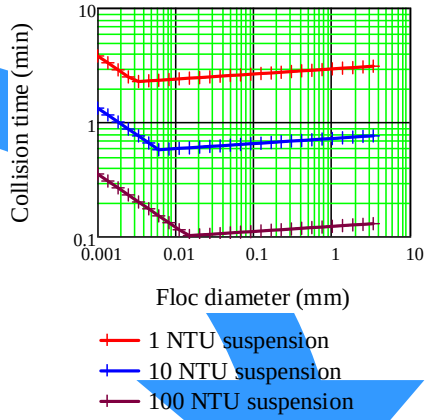
Capstone Design Course
CEE 4540: Sustainable Municipal Drinking Water Treatment



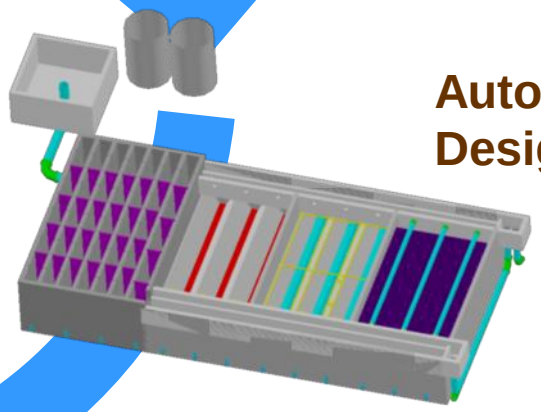
AguaClara Innovation Cycle:
Feedback Accelerates Innovation

Laboratory Research

Analytical Modeling



Automated Design



Full Scale Implementation, Capacity Building, Training, and Empowerment

Evaluation

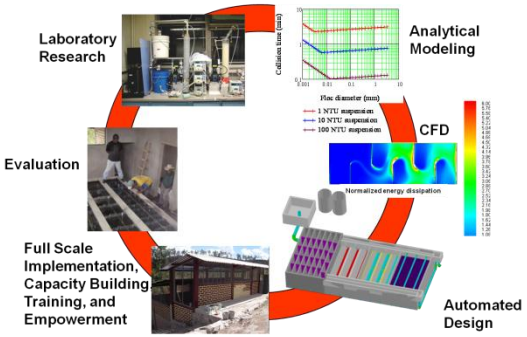
AguaClara Innovations (a sample)

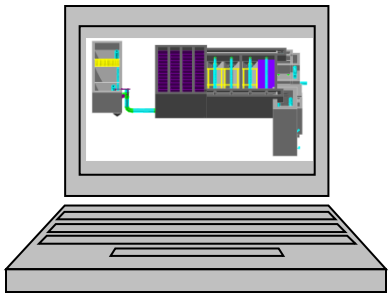
- **Non electric** drinking water treatment plants
- Semi automated chemical feed system – fluid dynamics and mechanical kinematics
- Hydraulic flocculators, sedimentation tanks, filters, plant hydraulics

Clarify, what did AguaClara invent?

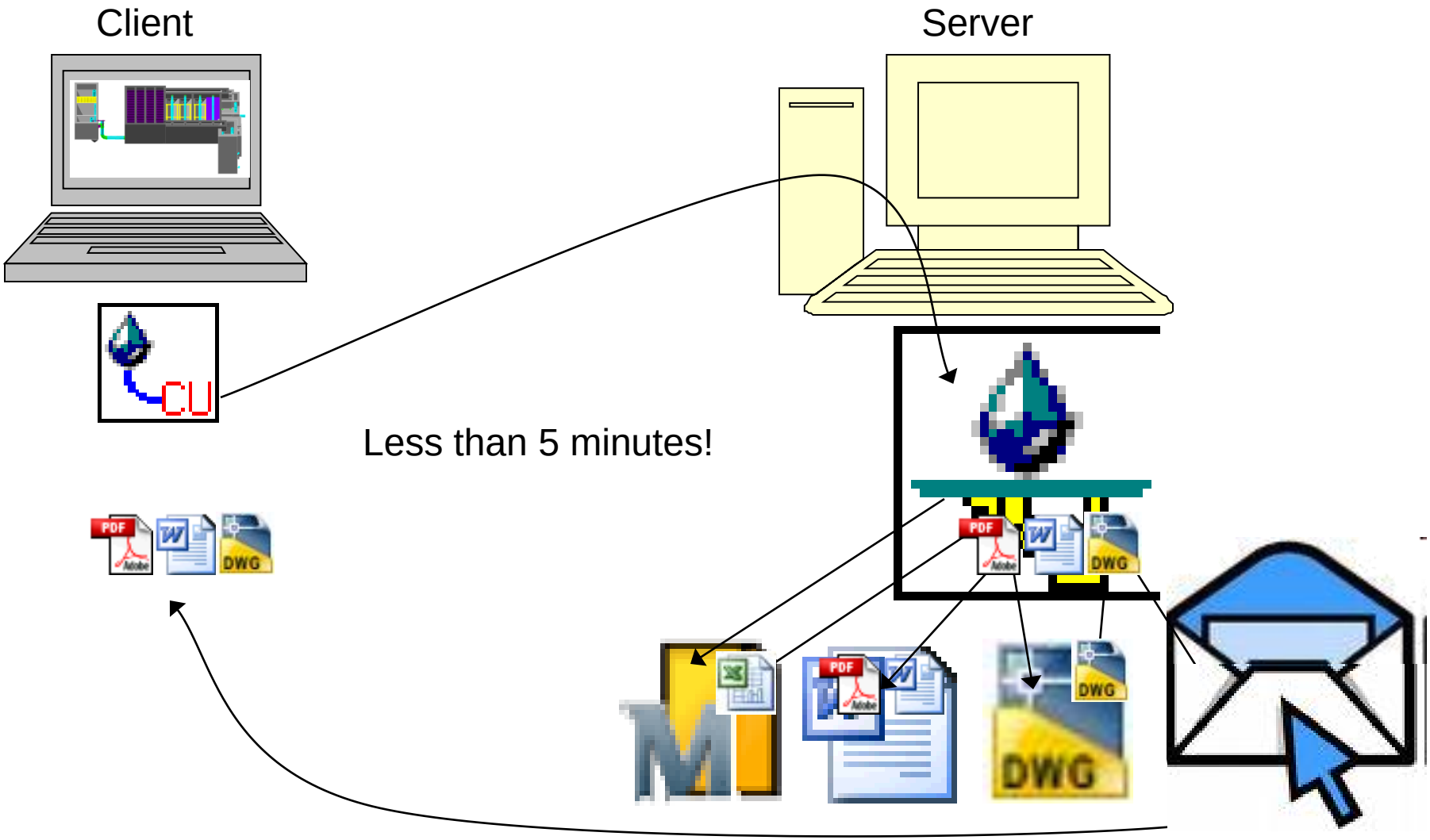
AguaClara Innovations (a sample)

- Innovative approach to service learning
- New design methodology (Bringing Henry Ford's ideas to Engineering Design)
- Web-based client server design tool (5 minutes to create a custom design!) (bringing economies of mass production to the design process)





AguaClara Design Tool



The First 6 Years: AguaClara in Honduras


Agalteca

State of AguaClara

- We have proven that smart (Cornell) engineers can produce technologies that perform better than conventional water treatment technologies (at a fraction of the capital and operating costs)
- AguaClara is recognized by the Honduran water authority (SANAA) as the technology of choice
- Other organizations (Italian gov't, Swiss gov't, CARE) are now funding construction of AguaClara facilities

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Going Viral?

- We are working on strategies to spread the technology in Central America, then Latin America and then to ???
- Developing partnerships to scale the technical and engineering support required

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Public Health and Sustainability

- Community members are no longer purchasing bottled water (saving money!)
- Water Boards are increasing their savings for emergencies and upgrades
- Health centers and community members are noticing the health effects
- Fewer children with severe diarrhea
- Cornell students are directly improving the quality of life for over 25,000 Hondurans!

AguaClara Educational Model

- Problem-based learning
  - Rich context with clear motivation
  - You are in charge of learning and developing the habits of a life long learner
- Peer-based learning
  - I can't possible teach the knowledge required to excel in all of the AguaClara projects
  - We rely on students to teach students

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Recruit new members!

- Business Admin - Marketing, press, fund raising
- Technical Admin – wiki, browser based UI for design tool
- Research – hydraulics, flocculation, sedimentation, filtration, etc.
- Design - Reactor, hydraulic, and structural
- Fabrication
- Documentation and specifications

Are we done yet?

- As we gear up to spread the AguaClara technology globally we have a LOT of work to do.
- We need to
  - standardize our designs and fabrication techniques
  - Test filtration and expand range of flowrates
  - Test and improve sed tank design
  - assess floc tank design

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Why we do what we do…

Find out more at AguaClara.cee.cornell.edu