Document 521
PRE-ASSESSMENT REPORT

CHAPTER: Worcester Polytechnic Institute
COUNTRY: Guatemala
COMMUNITY: Guachthu'uq, San Cristóbal Verapaz
PROJECT: Water/Stoves for Guachthu'uq
TRAVEL DATES:

PREPARED BY
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ENGINEERS WITHOUT BORDERS-USA
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Document 521 - Pre-Assessment Report
EWB-WPI
Guachthu'uq, San Cristóbal Verapaz, Guatemala
Water and Stoves for Guachthu'uq

Pre-Assessment Report Part 1 – Administrative Information

1. Contact Information

	Name	Email	Phone	Chapter
Project Lead	Chris Garceau	crgarceau@wpi.edu	774-262-4680	EWB-WPI
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Health and Safety Officer	Alexandra Vresilovic	avresilovic@wpi.edu	518-265-8234	EWB-WPI
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Education Lead	Creighton Peet	cpeet@wpi.edu	508-315-9395	EWB-WPI

2. Travel History

Dates of Travel	Assessment or Implementation	Description of Trip
07/23/2010-08/07/2010	**Assessment Trip**	**Second Assessment Trip**

3. Travel Team

Name	E-mail	Phone	Chapter	Student or Professional
Chris Garceau	crgarceau@wpi.edu	774-262-4680	EWB-WPI	Student
Alberto Phillips	aphillips@wpi.edu	954-540-5047	EWB-WPI	Student
Julie Bliss	blissj2012@wpi.edu	774-551-6213	EWB-WPI	Student
Kali Manning	kmanning@wpi.edu	585-857-0717	EWB-WPI	Student
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Matthew Gamache	GamacheM@cdm.com	857-389-2170	Boston Professionals	Professional
Creighton Peet	cpeet@wpi.edu	508-315-9395	EWB-WPI	Professional

4. Safety

1. Travel Safety

A. Department of State Travel Warning/Alert and International SOS Travel Risk Ratings

There are no current travel restrictions or warnings by the U.S. State Department pertaining to Guatemala according to their website (below) as of May 13, 2011
http://travel.state.gov/travel/cis_pa_tw/tw/tw_1764.html

International SOS Risk Rating: Moderate Risk

B. Point to point travel details

- Worcester Polytechnic Institute à Boston Logan Airport (cars)
- Boston Logan Airport à La Aurara International Airport - Guatemala City, Guatemala (flight)
- La Aurara International Airport à San Cristóbal Verapaz- CeCEP Language School (private van, escorted by native speaker)
- CeCEP Language School à Village of Guachthu'uq (private van, escorted by native speaker)
- Homestays

C. On-the-ground phone number and email for travel team

Julie Bliss: 774-551-6213

The remainder of on-the-ground phone numbers will be acquired once the cell phones are purchased. See section 3.0 for a list of the travel team's email addresses.

2. Site Safety – Health and Safety Plan

Pre-Trip Safety Considerations:
· Vaccinations needed for the Guatemala site will be up to date (As recommended by our local travel clinics and the CDC website).
· The safety plan presented here will be reviewed with all travel team members prior to departure and again after arriving on site.
· Four team members are trained in CPR and First Aid.

-One member is trained in Wilderness First Aid
· Two team members will be appointed trip health and safety officers. (noted above)
· A buddy system will be enforced; no one will travel alone and translators will always be present.
-Ace Travel Assistance Program insurance and support services will be available for all travel team members for the duration of the trip for all trip members who are either students or employees of WPI. This insurance is required for all travelers by WPI. This insurance covers emergency evacuation. Travelers are responsible for purchasing their own international medical coverage if they do not have it already.
-Standard to EWB-WPI on all trips, the team's mentor and HSO will give a "safety talk" once in-country. This talk will take place on the first night of the trip and covers all aspects of personal safety and precautionary measures. The HSO will give at least one "safety talk" per day during the duration of the trip.

Specific Issues:
· Water and food-borne illnesses are a serious concern. All water used for drinking or cooking will be boiled before use or come from purchased bottled water.
· Precautions (such as drinking plenty of water) will be taken in an effort to prevent heat-related illnesses.

All EWB-WPI traveling members will visit locally-recommended travel clinics at least 4-6 weeks before the trip to Guatemala. Based on health and immunization history, trip activities, and destination area, the health-care provider will determine what vaccinations and medications are needed. The Centers for Disease Control and Prevention recommends receiving a vaccine for the following Vaccine-Preventable Diseases:
· Routine Vaccinations: Measles/mumps/rubella (MMR), diphtheria/pertussis/tetanus (DPT), Polio
· Hepatitis A&B, and Typhoid are mandatory vaccinations for our assessment trip and will be received by the travel team prior to departure.

The health-care provider will also educate EWB-WPI members about personal health risks and disease exposures that may occur while in Guatemala. These include: diarrhea, allergic reactions, skin infections, insect bites, and water contamination.

5. Budget

1. Cost

Expense	Total Cost
Airfare (8)	4400
On Ground (homestay, transportation)	3300
Translators	800
Total	8500

2. Hours spent on EWB

Names	# of weeks	Hours/Week	Trip Hours	Total Hours
Mentors				
Matthew Gamache	32	3	1 week	96 + 1 week
Creighton Peet	32	3	2 weeks	96 +2 weeks
Team Members				
Chris Garceau	32	8	2 weeks	256+ 2 weeks
Julie Bliss	32	8	2 weeks	256+ 2 weeks
Alberto Phillips	16	6	2 weeks	96+ 2 weeks
Emily Dudley	24	8	2 weeks	192+ 2 weeks
Kali Manning	16	6	2 weeks	96+ 2 weeks
Alexandra Vresilovic	32	8	2 weeks	256+ 2 weeks

3. Donors and Funding

Donor Name	Type	Account kept at EWB-USA?	Amount
CDM	Company	Yes	400
Fundraising Night	In-Kind Donations	No	2500
Rotary Club	Foundation	No	3000
Cutler Associates	Company	No	1800
Fundraising	Other	No	1000
CDM Mentor Assistance	Company	Yes	1500
Total			**10,200**

6. Project Location

Longitude: 90º 29' 24.37" W *(Degrees, Minutes, Seconds)*
Latitude: 15º 22' 13.04" N *(Degrees, Minutes, Seconds)*

7. Project Impact

Number of Persons directly affected: 41 families, 280 people
Number of Persons indirectly affected: 80 families (neighboring community of Rexquix and Pamoc)

8. Mentor Resume

Refer to Appendix A

Pre-Assessment Report Part 2 – Technical Information

1. INTRODUCTION

This is a report of the Worcester Polytechnic Institute Chapter of Engineers Without Borders indicating the preparedness of the group for its second assessment trip to Guachthu'uq, Guatemala. The team has prepared all aspects involved in the trip and researched different options to provide the community with a more sustainable and accessible water source and efficient stoves. On the first assessment trip EWB-WPI was able to establish initial contact with the community and identify the greatest needs of the community through group discussions. The team was able to establish contact with a range of specialists including local geologists whom we were able to learn a wide variety of information ranging from the social impacts of the project, to technical details of the location and community homes. Various topics of discussion included safety, sustainability and efficiency of the potentially implemented technology. The travel details, days, and tasks of the group have been carefully planned such that as much useful information may be brought back from the project site as possible in a safe manner, so that information for a future build trip will have been completely researched. The intent of this document is to provide a report for third-party persons of all the steps and background information of the project and to gain a better understanding of the goals and accomplishments of the team's second assessment trip.

2. PROGRAM BACKGROUND

The following information is from the 501- Projection Application Form and from our 522-Post Assessment Report:

The health of the families who live in the community is affected by injuries/illnesses related to the use of wood stoves, limited access to water, poor nutrition, and substandard housing. While the needs of the community are many, the families have identified access to water and stove design as perhaps their most pressing concerns. The proposed program, Healthy Families: Guachthu'uq, will address these concerns using a holistic approach that includes both addressing the problems directly and educating the community about environmental issues that affect their health and access to resources. The projects will improve overall community health and hygiene, particularly the quality of life for women and children, who are charged with collecting both firewood and water. Together, the two projects have far-reaching positive environmental impacts as well.

Families in Guachthu'uq use open fires for cooking. As a result women and children suffer disproportionately from burns, as well as chronic cough and respiratory infections from spending

so much time inhaling smoke. The health of women and children will improve as their exposure to smoke decreases. Their involvement with other aspects of community life will also be greater as the time required for the collection of firewood will decrease due to more fuel efficient stoves. Improved stove design will not only cut down on smoke inhalation, it will also lessen the risk of fires as many of the homes in the community are made of wood. While some effort has been made to encourage the planting of new trees, demand for wood is beginning to surpass supply as many trees are located on private property, which residents have no access to. In February of 2009, a landslide roughly 2-3 kilometers west of the community killed more than 30 people. While the exact cause of the slide has yet to be determined, deforestation has been cited as a contributing factor.

During the dry season (March – May) the community relies on a spring water collection system/ diversion box located 1 km downhill. For the families that live directly off the main road, the elevation from the source to the POU is roughly 25-30 degrees; for those families that live in the hills above the road, the elevation is considerable higher. This source is located on private property, and there have been some problems with the owner with regard to access. In 2006, the land owner and the families who live in the communities that access the spring (Guachthu'uq, Las Arrugas, and La Reforma) agreed to restrict community access to the actual diversion box and to construct an area about 100 meters away from the source where families can collect water and wash clothing. This has helped community relations, but the distance between the spring and the community of Guachthu'uq continues to be a problem as families must make many trips per day to meet their basic needs. Although residents of Guachthu'uq recently received water catchment tanks from the municipal government, their efficiency and use need to be evaluated. The dry season in the region of Alta Verapaz has become longer and the rainy season (July – December) is beset by rising temperatures and decreased rainfall. Access to water will allow families to bathe and wash their clothing more regularly, and have more access to water for treating injuries, which will reduce the incidences of scabies, rashes and infections.

While the two projects are very different, there are significant overlapping positive impacts as well. Improved stove design will allow families to use less fuel for boiling water used for consumption. The need for less fuel will also help cut down on deforestation in the community, which will help protect natural water sources.

The proposed program also includes a community education component that will work with children and youth in the community on the issue of environmental stewardship as it relates to community health.

3. OBJECTIVES OF SITE ASSESSMENT TRIP

The overall objective of this assessment trip is to assess the community further so that future implementation of stoves and rainwater harvesting systems can be planned. Below is a list of goals for the assessment trip:

1. Provide community with preliminary designs and establish agreement on future direction of project.

The team believes that implementation of rainwater harvesting systems and stoves would be most successful if done at the individual household level, but these ideas and the preliminary designs associated with them need to be communicated with the community before the project progresses any further so that both parties are in clear agreement with each other, and the future direction of the project is clear. This will require multiple meetings and much discussion.

2. Complete detailed surveys of the homes chosen to be recipients of the pilot projects.

Another topic of discussion to be included in community meetings will be the team's desire to pilot approximately three stoves and rainwater harvesting systems in individuals' homes on our next trip. During this trip, the community will ultimately decide which families will participate in the pilot projects. The EWB-WPI team will be able to assist the community with this decision (if needed) after assessing which houses have the greatest need and ease of implementation, and coincide with the community members decision. Factors such as the sizes and conditions of roofs, soil composition, and space, will be considered.

3. Discuss project costs with community and determine costs and availability of specific construction materials.

It is essential that the community understands the costs associated with the project and costs/maintenance required for each stove and rainwater catchment unit. Although cost estimates of each cannot be approximated until the team conducts house assessments, we will convey to them from the beginning that the community must contribute monetarily to the project. Once house assessments have been completed and material costs have been determined, the team will present the information to the community to further discuss the feasibility of the projects. For instance, if individual catchment systems prove to be too expensive, then a community system may be preferable.

The team will inform the community to determine what needs to be done to secure local funding for the project through the local government and any other available sources. Municipal funding

was mentioned as a feasible fundraising opportunity on the team's first assessment trip. We also hope to meet with local non-governmental organizations, including the Rotary Club in Cobán, to increase our network and fundraising potential in Guatemala.

4. Create foundation for direct communication with the village

EWB-WPI understands that a reliable year-round means of communication with the community is necessary for the future success of the proposed projects. Therefore, one of the primary goals of the team is to identify, and begin to coordinate with, at least one community member or other local that is willing to be responsible for staying in contact with EWB-WPI.

We want to better understand the community's perspective on the project, and we want to reach an agreement with the community on final designs and cost expectations. We want to make sure that the community is actively involved with this project and that they will be able to sustain it after implementation. With this said, we hope to also create some type of written agreement (MOU) to ensure the project's success.

5. Conduct further water quality tests on the community's water tanks and spring source.

We will be conducting more tests on the rainwater catchment tanks. We will be testing pH, turbidity, coliform (e. coli and total) as well as nitrates. Results from these tests will further explain and identify which treatment options for us to go forward with in our catchment tanks. See chart in section 5.2.

4. COMMUNITY INFORMATION

1. Description of Community

Demographics
Guachthu'uq/Rehquensal is a rural Mayan Poqomchi community of 39 families, 41 houses, and about 280 people, located about three kilometers west of San Cristóbal Verapaz. While many women are monolingual in Poqomchi', many community members speak both Spanish and Poqomchi'. The residents are a mix of Protestant Evangelicals and Catholics and are involved in traditional Mayan spirituality as well. Community Infrastructure There are five local communities that make up one micro-region, all connected by one road. These communities, in order from the top of the mountain to the bottom, are Pamac, Rexquix, Guachthu'uq/Rehquensal, and Las Arrugas. There is one mostly unpaved road that goes through the area starting at San Cristóbal and ending at the highest community of the micro-region (Pamac). Most families in Guachthu'uq do not own a transportation vehicle or bicycle, so walking is their primary eans of transportation. There are power lines running up the road but only a couple of community

members can afford or have access to electricity in their homes. The houses are spread throughout the community with most houses located approximately 50 yards from the next one, though some areas have two or three houses within close proximity. This typically occurs because one of the family members got married and built a house next door to their parents. Most houses in the community are made of wood and have iron corrugated roofs.They have dirt floors that often flood in the rainy season.

Work
The women primarily take care of the home although a few (particularly younger women and some girls as young as eleven years old) work in the town of San Cristóbal as domestics. The women and children gather water every day and tend to the house, while the men gather wood for fuel. Some men might travel to work at a large farm for weeks at a time. Their main year-round water source is located at a private "finca," or estate, at the bottom of the community. There, the women do laundry and gather drinking water with their children. Depending on where the family lives, it takes anywhere from a half-hour to an hour and a half to bring water to their homes. Most of the families do not own much land, if any at all, so they usually buy their food and wood from others who own land. There is almost no livestock in the community. The average family may own one or two chickens at most, which provides eggs and meat occasionally.

Education
Children attend school when they are not working with their parents. The children from Guachthu'uq/Rehquensal have two primary schools to choose from. One is in the neighboring community of Rexquix (uphill) and the other is in Las Arrugas (downhill). The schools terminate at sixth grade and boys are more likely than girls to reach the higher grades (4th- 6th). Most children do not attend school after the 6th grade, but if they do, then they must travel to San Cristóbal and attend the schools there. Some children drop out for a year or more to provide assistance to their families. For this reason, ages of students in each grade are not consistent. Information on health and hygiene are rarely covered in the schools. The children's education revolves primarily around basic math, and reading and writing Spanish.

2. Community/NGO Resources and Constraints

The current COCODE (Community Development Council) meets regularly with the entire community (both men and women) to generate and discuss solutions for issues that affect them. In general, the EWB-WPI project team found the COCODE to be very organized. The president of Guachthu'uq/Rehquensal's COCODE is Don Domingo. He is also the Vice President of the COCODE for the micro-region. The community recognizes that their limited access to water and fuel consumption for cooking are also environmental issues, and they are committed to the creation of a program that is both sustainable and has a positive impact on their environment and health. They are aware of deforestation in the region and the contamination loss of natural resources. The community will contribute labor, tools and some materials (e.g., clay and wood)

to the EWB-WPI project.

The cost of maintenance of the proposed project is a concern as the community's resources are limited. An annual maintenance fee would hopefully cover any repairs and also encourage everyone in the community to care for the project's infrastructure.

3. Community Relations

Paat Itz'at is an arts education organization based in Washington, DC, that is assisting EWB-WPI with the project. The NGO project coordinator, Michelle Banks, lives in San Cristóbal six months out of the year and brings high school students from the US to volunteer in schools in the San Cristóbal region. Paat Itz'at is helping with logistics and the community education component of the project. They are currently working with children in the community on a documentary project that will serve as both community education and fundraising.

EWB-WPI relied primarily on Humberto Moran, Don Domingo, and Domingo's son, Angel, for Spanish-to-Poqomchi' translation. Michelle Banks of Paat Itz'at and the CeCEP language school provided English-to-Spanish translation when needed.

EWB-WPI also met with Sergio Moran (Humberto Moran's brother). Sergio is an instructor in the Department of Geology at the University of San Carlos campus in Cobán. The team held two meetings with him and his colleagues and students while on the trip. He is eager to help with this project and has provided us with geological maps and data from the watershed. In future trips he may be able to provide the team with water testing equipment.

Sergio introduced EWB-WPI to Gilles Brocard, a French graduate student from Université de Lausanne (UNIL) who had been doing seismic and geological studies in the San Cristóbal area. The group met with Gilles during the trip and collected information regarding the geology of Guachthu'uq and water quality in Lake Chichoj in San Cristóbal.

The group also met with one of Sergio's and Humberto's brothers, Hannibal, who provided us with Spanish-to-Poqomchi translation and access to the community of Las Arrugas, located downhill from Rehquensal.

4. Community Priorities

The families have identified access to water and improved stove design as their most pressing concerns but have had trouble prioritizing one over the other. They have stated that any project pertaining to efficient stoves or an improved water system would be greatly appreciated.

5. DATA COLLECTION AND ANALYSIS

1. Site Mapping

As of now, the team's knowledge of important locations in the community has been acquired by David Warfel's visit in December 2009, phone calls with Michelle Banks, and data acquired through our first assessment trip. The team has already created a general map of the village indicating major infrastructure such as community meeting places and existing/potential water sources shown in Appendix B.

Since general mapping of the area has been completed, and we do not forecast the need for a detailed survey of the area, there will be no need for additional technical site mapping. Important political/social boundaries will be recorded as well as how they affect the possibility of implementing rain catchment tanks and the locations of them. The team will also photograph all important terrain and community infrastructure import to our implementation.

2. Technical Data Collection

The data to be collected on this assessment trip will be used to help determine the future of the rainwater catchment and stove projects. Further tests will be conducted in the water quality of the spring source and more importantly in the rainwater catchment tanks of individual households. Data pertaining to the rainwater catchment and stove projects will be primarily focused on detailed assessment to be completed at each home in the community. We will also determine the costs and availability of materials needed for implementation. The specifics of data to be collected are presented below in the Water Quality, Rainwater Harvesting, and Stoves subsections.

Water Quality

After analyzing the water from the first assessment trip, our findings showed that the water from rainwater catchment tanks was significantly cleaner than the water in the stream. Because we were not able to test the water for bacteria, it is important that we retest the catchment tank water to further decide which method should be used to treat the water and if it is even necessary. The table below outlines the tests that will be performed on water in the catchment tanks to help us decide whether physical or chemical treatment is necessary. If possible, samples of 'first flush' water will be collected during the first 10 minutes of a rainstorm. Most contaminants that would impact the quality of the water in the rainfall tanks would result from first flush runoff from the roof. Quantifying this potential loading would be very helpful in determining the importance of planning to treat this water or to develop a bypass for first flush water.

Test	Type	Source
Turbidity	Direct Reading Meter	HACH Model No. 2100Q01
Total Coliform Bacteria/E.coli	Quantitative Field Test Kit	LaMotte Easy Gels
pH	Test Strips	HACH
Temperature	Direct Reading Thermometer	-
Dissolved Oxygen	Meter – Portable Colorimeter	HACH #2515025/AccuVac
Nitrate	Meter – Portable Colorimeter	HACH #2511025/AccuVac

Rainwater Harvesting

During our first assessment trip in 2010, we determined that efficient use of household rainwater catchment systems should be sufficient (based on rainfall data from the University in Cobán) to sustain each household throughout the year. We know that approximately half of the families in the community have received rainwater collection tanks from the government, but anecdotal evidence suggests that these tanks have not been able to provide enough water for household usage. The primary goal of this trip is to visit each home (39 in total) in the community and determine how each home could be retrofitted to improve its catchment efficiency. The assessments will focus on the following questions:

- How many rainfall catchment tanks do the household own?
- How many rainfall catchment tanks are connected and being used?
- How much square footage of rooftop is utilized in the catchment system?
    - What is the next potential area that could be utilized for the catchment system instead of the rooftop?
- What is the condition of rooftop? {Picture to be taken}
- What materials is the roof made of?
- Are gutters used?
- What is the condition of the gutters? {Picture to be taken}
- Is there tree/branch cover above the roof? {Picture to be taken}
- How much water does the household use per day?
    - How many trips to collect water are made each day?
    - How many people live in the house?
    - How large, in liters is the bucket that is used to collect water?
    - If they had enough water at home would they do their laundry there?
- How has the rainfall catchment tank(s) been used?

- How often is the rainfall catchment tank dry?

Pictures will be taken to document roof and gutter conditions at each home. GPS coordinates of each house will be taken. These data will be input to a spreadsheet worksheet (one for each of the 39 homes) to determine the best course of action for each home. The amount of work to be undertaken is expected to vary from house to house depending on the answers to these questions. Some homes may simply need tree branch cutting to increase system efficiency to a sustainable level while others may need to purchase more tanks and/or improve the rooftop. The survey data sheet template (which also includes questions on stove usage and needs) prepared for the trip has been included as Appendix C of this document.

Stove Design

The home survey will include several questions pertaining to stove usage. These questions will include:

- How is cooking performed? {Picture to be taken}
- How much wood is burned each day?
- What is the height of the current cooking surface? {Picture to be taken}
- What size and shape of pot is used for cooking? {Picture to be taken}
- What is the structure of the soil?

Many of the stove designs in use in developing countries utilize a combination of bricks, clay, cement, and/or metals. It will be important to determine which of these designs will be a good fit with the materials available to the community. To determine this, we will have to talk to local builders in San Cristobal. They should be able to provide substantial guidance on this issue.

3. Monitoring and Evaluation Data

In addition to the data collection efforts detailed in Section 2 of this report, a sustained data collection effort, performed by chosen community members, will be essential to the success of the project. Once the home surveys are completed, a handful of homes will be identified for further (year round) data collection. Notably, some homeowners that have a functioning rainwater catchment system will be asked to note the following:

- Days when the rainwater tanks are dry
- Days when the rainwater tanks were used (when water was extracted from the tank for in-home usage)
- Days when it rained

To facilitate this, calendars (1 month per page) will be provided that have the letters D, U, and R on them. The idea would be that D would be circled for dry days, U for days when the tanks are used and R would be circled for days in which it rained. We will work with the community leaders to determine whether or not this system will work (would calendar usage be culturally appropriate, for example). We have identified (during our 2010 trip) businesses that can make printouts and copies of documents so that we can adjust these data sheets if necessary. A template for these data sheets (one month only) has been included as Appendix B.

During our 2010 assessment trip, we initiated contact with the Geology professors and students of the University in Cobán. These students expressed an interest in our project and volunteered to assist with data collection, if possible. One way in which they could help would be to establish and monitor a rainfall gauge on the campus in Cobán. Daily or weekly records of total rainfall (inches per week for example) would be extremely helpful to project. Specifically, these data would be used to ensure that rainfall amounts and trends have not changed much since rainfall data has stopped being collected and to provide a check on the data collected by the community members with respect to rainfall. It is noted that spatial variations in rainfall will exist between Cobán and San Cristobal Verapaz. However, we feel that the creation of this gauge would be very beneficial.

6. SCHEDULE OF TASKS

July 23 to August 7

Overview

Week 1:

- Meet with community and discuss plans for the future.
- Present plans for stove and water assessments
- Organize and conduct home surveys
- Perform water quality sampling and analysis

Week 2:

- Work with community members to:
  - Establish data collection plan
  - Establish communication plan
  - Explain the project's need to be partially community funded and discuss how this can be accomplished
  - Determine if the community would be interested in a community rainwater catchment tank in the future
    - Identify where that tank or tanks could be located
  - Identify households to be used as pilots
- Meet with other area-organizations including NGOs, non-profit organizations, and the Geology department at the University of Cobán
  - Establish data collection plan with the University and local collaborators in San Cristobal
  - Establish communication plan with the University
  - Acquire contact information for the Rotary Club in Cobán to interface with our primary project donors, the Rotary Club of Falmouth
- Meet with local builders to assess available building materials and typical stove construction in the area

Details

Day 1: Travel

Travel from Boston to Miami/Texas to Guatemala City to San Cristóbal.

Day 2-3: Community Meeting and Design Presentation

Become acquainted with the area
Meet with community and discuss plans for future
Have community determine community members' skills (to help implement project)
Present plans for stove and water assessment
· Discuss pilot project, and which homes may potentially be pilot project homes

Day 4-8: House and Skill Assessment

Access each house to determine best for pilot projects
Sample soil around the community to determine the soil structure to assist with stove designs
Test rainwater for bacteria
Map out potential rainwater tank locations for pilot project (only for the chosen ones)

Day 8-11: Meetings with NGOs/non-profits and government groups

Meet with other organizations in the area
Meet with Rotary Club in Cobán (Tuesdays at 7:00 PM)
Present the community with potential designs (drawings) for stove and rainwater tanks
Discuss treatment options
Explain the projects need to be partially community funded and discuss how this can be accomplished
Establish a contact or a few contacts in community and San Cristobal
Update and present written agreement regarding project in terms of payment
Talk to community about plans for government funding
Establish data collection plan with the community
Determine if the community would be interested in a community rainwater catchment tank in the future
Identify where that tank/tanks could be located

Day 12-14: Finish up unfinished work from previous days

Materials assessment (cost, availability, etc.)
Collaboration and future planning

Day 15: Depart from San Cristobal to Antigua

Day 16: Travel from Antigua to Guatemala City Airport and leave Guatemala

7. PROJECT FEASIBILITY

Criteria that will be used to determine the feasibility of the project:

- Adequate community investment, including monetary support
- Adequate geological and or geographical features for a new water collection system
- Adequate local availability of materials for initial construction and eventual repair, if necessary
- Adequate availability of trained/skilled workers
- Adequate funding to maintain system, equipment, or technologies involved

<u>Individual Rainwater Catchment</u>
-ability for individual families to maintain their catchment setup
-affordability at the individual family/household level
-team's current design may not be adequate for the roof/home
-space for catchment setup
-stability of structures

Improved Wood-burning Stoves
-affordability at the individual level
-space for the stove
-design feasibility in relation to height of people and what height they like to cook at
-design based on family/household size, types of food cooked and utensils used for cooking

Water Treatment
-quality of water in tanks

8. MENTOR ASSESSMENT

By Matthew Gamache

Over the course of last year's two-week assessment trip, the team was able to meet most of the trip's goals. The team excelled (with the help of our NGO contacts) in forming a relationship with the Guachthu'uq/Rehquensal community. Initial meetings with the community leaders were very well received. The team did an excellent job articulating the goals and expectations of our 5-year project to the community leaders. Additionally, it was clear from discussions with the community leaders that the people were cognizant of the most pressing issues affecting their daily lives and health and well-being (water supply, water quality, and stoves).

Upon return to campus, the students spent the following semester digesting the experience and data/information gained during those two weeks. It was originally thought that preparations could be made for a 2011 implementation trip. However, a more thorough assessment of the data (and the data gaps) and a fine tuning of the project's core objectives led to the decision to prepare for a followup assessment trip. I believe this was a most prudent decision as it will better facilitate community buy-in of the ultimate design.

The upcoming assessment trip will focus on completing comprehensive surveys of each of the 39 houses in the village to ultimately determine how to proceed with rainfall catchment system improvements on each house. Information collected on cooking styles and needs will help the team choose the best stove design for the village as well.

Throughout the upcoming trip the team hopes to strengthen the bonds already formed with the villagers and the professors and students at the University in Coban. It is our desire to get both of these parties vested in the project and collecting data through the next year.

Over the course of my 3 years as professional mentor of this EWB student chapter, the students have shown outstanding initiative and dedication to the project. I am looking forward to this summer's upcoming trip as an opportunity to build a greater understanding of the problems at hand. Based on what I have observed during chapter meetings, technical discussions and conference calls, I am fully confident that the trip will be a success.

APPENDIX A MENTOR RESUME

Matthew Gamache, P.E.
Water Resources Engineer

Registration
Professional Engineer: Massachusetts, 2007

Education
M.S. – Environmental Water Resources Engineering, University of Michigan, 2002
B.S. – Civil Engineering, Worcester Polytechnic Institute, 1999

Mr. Gamache is a water resources engineer who specializes in subsurface hydrologic, contaminant transport, and saltwater intrusion modeling. These models have been used to assess groundwater flow paths, travel times, contaminant concentrations, and saltwater movement for litigation support, delineation of drinking water protection zones, drinking water supply management plans, aquifer storage and recovery systems (ASR), tracer tests, and design of groundwater remediation systems.
Mr. Gamache has also developed several open channel flow/hydraulic routing models using the HEC-RAS software package. These models have been used to assess the impact of culvert replacements, routing changes, pump station operations and energy dissipation structures on both steady and unsteady flow systems.
Groundwater Modeler, Long Island, New York. Mr. Gamache helped develop a transient regional groundwater flow and transport model for the western portion of Long Island, New York encompassing Queens, Nassau and Suffolk counties. This model incorporated aspects of previously developed steady state models of Long Island, the Great Neck Peninsula and an industrial facility in Nassau County. The model has been used to gain a better understanding of the transient nature of contaminant plumes on the island and to predict the fate of these plumes in the future. The model was also used to assist in the optimization of two, local, pump and treat recovery operations, each lasting less than 1 month in duration. The model is intended to be used by the client for forensic analyses, remedial optimization and public water supply protection.
Project Engineer, Puchack Well Field Superfund Site, Pennsauken Township, New Jersey. Mr. Gamache performed groundwater modeling in support of a pilot test conducted in a hexavalent Chromium-contaminated aquifer. Simulations included the use of non-linear sorption, kinetics and density dependent flow to simulate the fate and transport of several reducing agents that were injected into the aquifer. The results of the simulations were used to refine previous estimates of hydraulic and transport properties present at the site and to develop plans for full-scale remediation. Mr. Gamache has worked closely with representatives from the U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers (USACE), the U.S. Geological Survey (USGS), and the New Jersey Department of Environmental Protection throughout this project.
Project Engineer, New York City, New York. Mr. Gamache helped develop a 100-year transient groundwater

flow and saltwater intrusion model for the western portion of Long Island, New York encompassing Kings, Queens, Nassau and Suffolk counties. This model is currently being used by Mr. Gamache to assess the viability of future water supply options for New York City DEP.

Project Engineer, Dublin City Council, Dublin, Ireland. Mr. Gamache developed 26 watershed catchment models to assess phosphorous mitigation measures in the Eastern River Basin District (ERBD) of the Republic of Ireland. Mr. Gamache used MikeBasin and Mike11 to simulate diffuse and point source flows and phosphorous concentrations within each catchment. Model output has been used as input to the River Basin Management System (RBMS). Recommended measures will be presented to each county within the ERBD based on modeling results.

Project Engineer, Groundwater Study for Jubail and Yanbu, Saudi Arabia. Mr. Gamache is currently conducting groundwater flow and contaminant transport modeling for the Royal Commission of Jubail and Yanbu to identify sources of subsurface contamination and recommend mitigation measures in the industrial cities of Jubail and Yanbu, Saudi Arabia. This study is the first comprehensive investigation of subsurface contaminant migration since the commencement of large-scale industrial activities in Jubail and Yanbu. The models for each city are being assembled and calibrated using data collected regularly by the Royal Commission since the construction of the industrial cities in the 1970s. At the conclusion of the project, Mr. Gamache will conduct training sessions with Royal Commission staff to facilitate the future use of these tools.

Groundwater Modeling Studies, San Gabriel Basin, California. Mr. Gamache is currently conducting groundwater modeling in support of remedial investigation and design in the El Monte and Puente Valley operable units of the San Gabriel Basin superfund site in Southern California. These studies included regional modeling of the 170 square mile San Gabriel Basin, incorporating over 300 water supply production wells and applied recharge averaging more than 125,000 acre-feet/year. Multi-year transient simulations reproduced observed water level fluctuations of more than 100 feet.

Project Engineer, Suffolk Downs Culvert Replacement, Revere, Massachusetts. Mr. Gamache developed a HEC-RAS model for a portion of Sales Creek that flows through the Suffolk Downs race track in Revere, Massachusetts. The model was used to assess the client's plans to reduce the occurrences of flooding by replacing three on-site culverts. The model, which incorporated several culverts, a pumping station and a tide gate, was simulated in unsteady mode for a number of storm events and proposed pipe sizes. Mr. Gamache made several presentations of the model findings to Boston and Revere city officials.

Project Engineer, City of West Palm Beach Water Catchment Area Flow Improvement Study, Florida. Mr. Gamache assisted in the development of an unsteady HEC-RAS model used to study water catchment area routing in West Palm Beach, Florida. Model recommendations will be used to help optimize future catchment area operations.

Project Engineer, Warren County Wellhead Protection Plan, Ohio. Mr. Gamache assisted in the development and calibration of a Visual MODFLOW site model used to delineate 5 and 10-year wellhead protection zones for two production well fields in Ohio. Mr. Gamache assisted in the creation of the Warren County Wellhead Protection Plan Report, submitted to the county in July 2004.

Project Engineer, North Conway Wellhead Protection Plan, New Hampshire. Mr. Gamache used an existing MODFLOW model of North Conway, New Hampshire to delineate wellhead protection zones for four public supply wells.

Groundwater Modeler, Litigation Support, California. Mr. Gamache assisted in the creation and analysis of groundwater flow and contaminant transport simulations in support of expert testimony at an industrial site in California.

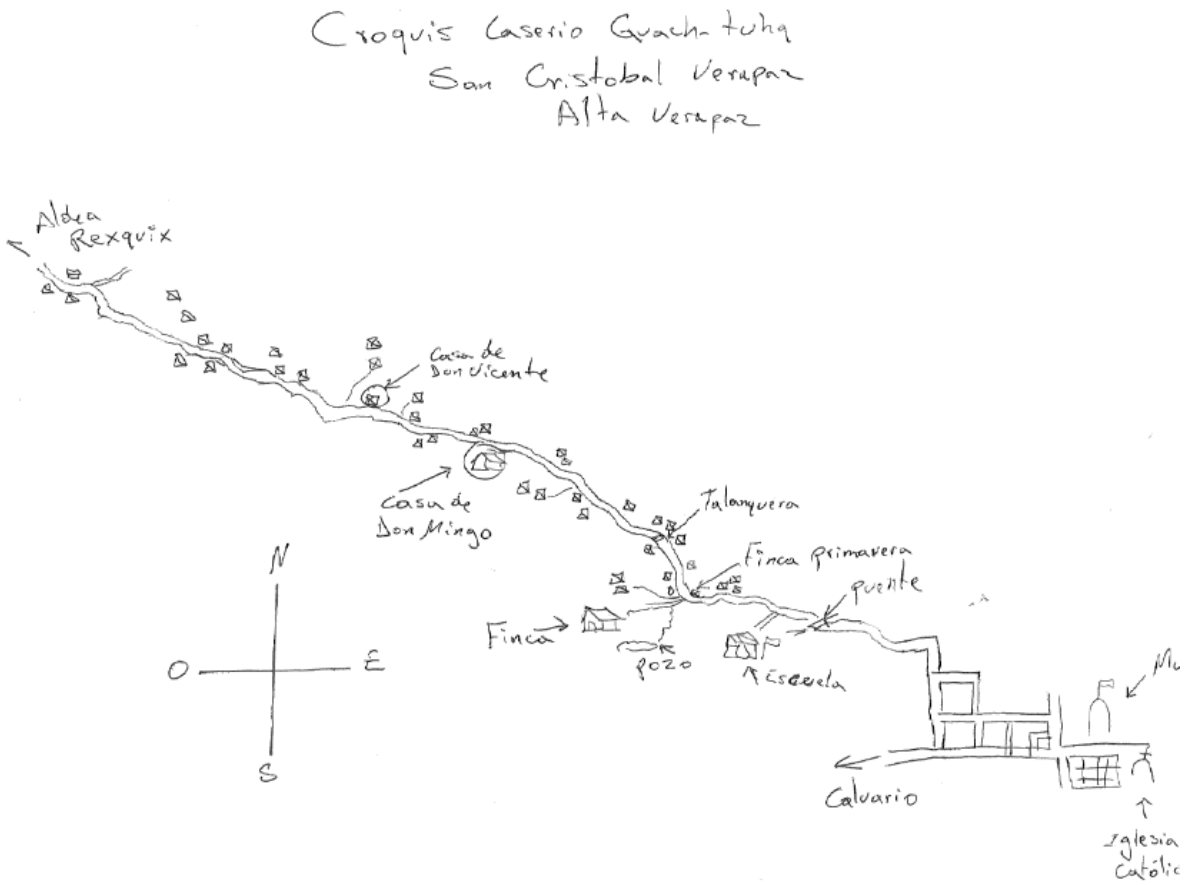
Water Resources Engineer, Marina Barrage Detailed Study and Conceptual Design, Singapore. Mr. Gamache provided hydraulic modeling support as part of the study and design of an estuarine barrage, across the mouth of the Singapore and Kallang Rivers to form a fresh-water reservoir. As part of the study, Mr. Gamache updated and simulated the existing HEC-RAS model to optimize the design of energy dissipation basins downstream of the barrage.

Groundwater Modeler, Industrial Site, California. In support of expert testimony, Mr. Gamache assisted in the simulation and analysis of hexavalent chromium plumes at an industrial site in Fresno, California. The model was applied to predictive simulations to generate estimates of contaminant levels in extraction wells and to analyze potential changes to the groundwater flow field under various remediation schemes.

Project Engineer, Town of Wilmington, Massachusetts. Mr. Gamache converted a steady HEC-2 model of the Ipswich River in Wilmington, Massachusetts into HEC-RAS and used it to assess the impact of future culvert replacements on the flood profiles.
Groundwater Modeler, Industrial Site, Florida. Mr. Gamache assisted in the evaluation of a proposed groundwater remediation design at four hazardous waste landfills. He performed mass transport simulations to evaluate potential source locations of chlorinated solvent plumes.
Research Experience. As a graduate student, Mr. Gamache focused his research on multi-phase contaminant transport modeling and surfactant enhanced remediation (SEAR). Working with the Michigan Department of Environmental Quality, Mr. Gamache created a 3-dimensional groundwater flow model to assist in the evaluation of a surfactant enhanced remediation system. Mass transport simulations were used to ensure adequate surfactant sweep volumes and contact times for a PCE contaminated aquifer in Oscoda, MI. He also used multi-phase transport models to study partitioning tracer-solvent interactions observed in sandbox experiments.
Civil/Environmental Engineer, BETA Group Inc., Various Projects. Mr. Gamache assisted in the design of submersible pump stations, wastewater treatment processes, and a treatment system for DDT contaminated sewage. He also conducted infiltration/inflow investigations of municipal sewer systems.
Hydrologist, United States Geological Survey, Various Projects. Mr. Gamache conducted extensive field work in support of a 1998 research project that monitored the affinity for natural attenuation of sewage contaminated groundwater at Otis Air Force National Guard Base. He participated in an investigation that assessed the use of an in-situ, reactive barrier to contain an upgradient chemical spill. He assisted in the design, installation and analysis of passive vapor samplers that monitored upwelling volatile gases into a lake downgradient of Otis Air Force National Guard Base. He assisted in a groundwater quality study of a municipal landfill in Sacco, Maine.
Publications/Presentations
Gamache, M., D. O'Rourke, K. Masterson, M. Maimone, and S. Coffey. "Groundwater Impacts of Stormwater Infiltration: Considerations for Low Impact Development." Presented at the New England Water Environment Association Annual Conference, January 2010.
Gamache, M., R. Schreiber, and F. Tsang. "Simulation of Pilot Scale In-Situ Fixation of Hexavalent Chromium Plume at the Puchack Well Field Superfund Site." Presented at the New England Water Environment Association Annual Conference, January 2010.
Gamache, M., D. O'Rourke, and R. Fitzgerald. "Assessing the Risk of Contamination to Supply Wells Sited in Urban Areas." Presented at the National Ground Water Association Groundwater Summit, April 1, 2009.
Masterson, K.K., M. Gamache and R. Fitzgerald. "Confined Aquifer Responses to Pumping – Potential Impacts on Plume Migration." *Arab Water World*. Vol. XXXII, no. 7 July 2008, 42-46. RIN: 44.
Gamache, M., K. Masterson and R. Fitzgerald. "Development and Calibration of a 100-Year, Transient, Saltwater Intrusion Model for Long Island, New York." 2008 National Ground Water Association Conference on Eastern Regional Ground Water Issues Proceedings, June 23, 2008.
Gamache, M., K. Masterson and R. Fitzgerald. "Development and Calibration of a 100-Year, Transient, Saltwater Intrusion Model for Long Island, New York. Presented at 2008 National Ground Water Association Conference on Eastern Regional Ground Water Issues, June 23, 2008 (presentation).
Gamache, M., K. Masterson and R. Fitzgerald. "Development and Calibration of a 100-Year, Transient, Saltwater Intrusion Model for Long Island, New York." Presented at National Ground Water Association Groundwater Summit, April 1, 2008.
Gamache, M., H. Moe, and P. Mills. "Risk-Based Approach to Estimate Diffuse Phosphorus Loading in the Eastern River Basin District, Republic of Ireland." Poster presentation at American Water Resources Association Annual Conference, November 12-15, 2007.
Masterson, K.K., M. Gamache and R. Fitzgerald. "Confined Aquifer Responses to Pumping – Potential Impacts on Plume Migration." Water Environment Federation Annual Technical Conference (WEFTEC) Proceedings, October 14-17 2007.
Ramsburg, C.A., K.D. Pennell, L.M. Abriola, G. Daniels, C.D. Drummond, M. Gamache, H-L. Hsu, E.A. Petrovskis, K.M. Rathfelder, J.L. Ryder, and T.P. Yavaraski. 2005. A Pilot-Scale Demonstration of Surfactant-Enhanced PCE Solubilization at the Bachman Road Site: (2) System Operation and Evaluation. *Environmental Science and Technology*. Vol. 39, no. 6, 1791-1801. DOI: 10.1021/es049563r.

Ramsburg, C.A., L.M. Abriola, K.D. Pennell, F.E. Löffler, M. Gamache, B.K. Amos, and E.A. Petrovskis. 2004. Stimulated Microbial Reductive Dechlorination following Surfactant Treatment at the Bachman Road Site. *Environmental Science and Technology*, Vol. 38, no. 22, 5902-5914. DOI: 10.1021/es049675i.
Gamache, M., R.S. Schreiber, and W.D. Weight, "Assessing and Re-naturalizing Streams Impacted by Mining". September 25 and 26, 2003. Poster presentation at the *University of Montana, Riverine Science and Stream Re-Naturalization* workshop.
Weight, W.D., R.P. Schreiber, and M. Gamache, "Numerical Evaluation of the Effective Saturated Thickness in Pumping Tests". Presented at the *International Water Modeling Center MODFLOW and More 2003* conference. September 2003.
Gamache, M., R.S. Schreiber, and W.D. Weight, "Estimating Induced Infiltration and Cross-River Flow from Numerical Modeling". Presented at the *International Water Modeling Center MODFLOW and More 2003* conference. September 2003. Poster presentation at the *University of Montana, Riverine Science and Stream Re-Naturalization* workshop.
Ramsburg, C.A., L.M. Abriola, K.D. Pennell, F.E. Löffler, M. Gamache, E.A. Petrovskis. 2003. Impacts of Residual Surfactant on Tetrachloroethene (PCE) Degradation Following Pilot-Scale SEAR Treatment at a Chloroethene-Impacted Site. European Geophysical Society-American Geophysical Union-European Union of Geosciences Joint Assembly, Nice, France. 6-11 April 2003.
Abriola, L.M., C.A. Ramsburg, K.D. Pennell, F.E. Löffler, M. Gamache, E.A. Petrovskis. 2003. Post-Treatment monitoring and Biological Activity at the Bachman Road Surfactant-Enhanced Aquifer Remediation Site. 225th National Meeting of the American Chemical Society, New Orleans, LA. 23-27 March 2003

APPENDIX B



Appendix C

Rainwater Catchment Data

To be used to collect information on individuals' rainwater catchment systems

House 1

Gutters

EXISTING CONDITIONS			
#	Material	Dimensions	Condition
1			
2			
3			
4			

Roof

EXISTING CONDITIONS				
#	Material	Dimensions	Slope	Condition
1				
2				
3				
4				

Gutter- Roof Connection

EXISTING CONDITIONS			
#	Material	Condition	Notes
1			
2			
3			
4			

Gutter to Tank Set-up: Pipes

EXISTING CONDITIONS			
#	Material	Length	Diameter
1			
2			

3			
4			

Collection Tank

EXISTING CONDITIONS						
#	Material	Height	Diameter	Volume	Valve height	Runout Time
1						
2						
3						
4						

Miscellaneous

Tree Cover	Space

Notes:

Condition= poor, moderate, good

Slope= use level or approximate visually

-Come up with a system to label each house

-Sketch layout

-Take pictures of each and label

Gutters

MATERIAL NEEDED FOR IMPROVEMENTS		
# of Units	Cost/Unit	Total Cost

Roof

MATERIAL NEEDED FOR IMPROVEMENTS		
# of Units	Cost/Unit	Total Cost

Gutter- Roof Connection

MATERIAL NEEDED FOR IMPROVEMENTS		
# of Units	Cost/Unit	Total Cost

Gutter to Tank Set-up: Pipes

MATERIAL NEEDED FOR IMPROVEMENTS		
# of Units	Cost/Unit	Total Cost

Collection Tank

MATERIAL NEEDED FOR IMPROVEMENTS		
# of Units	Cost/Unit	Total Cost

SUM OF COSTS

Stove Data

			Floor Space Available (in)				Floor Space Available (cm)			
	Space Required (inches)	Space Required (cm)	Room 1	Room 2	Room 3	Room 4	Room 1	Room 2	Room 3	Room 4

Home 1										
Home 2										
Home 3										
Home 4										
Home 5										
Home 6										

			Floor Space Available (in)				Floor Space Available (cm)			
	Space Required (inches)	Space Required (cm)	Room 1	Room 2	Room 3	Room 4	Room 1	Room 2	Room 3	Room 4
Home 1										
Home 2										
Home 3										
Home 4										
Home 5										
Home 6										

