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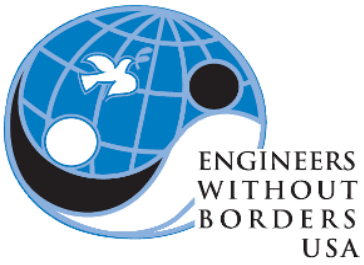

Document 521
PRE-ASSESSMENT REPORT

CHAPTER: Worcester Polytechnic Institute
COUNTRY: Guatemala
COMMUNITY: Guachthu'uq, San Cristóbal Verapaz
PROJECT: Water/Stoves for Guachthu'uq
TRAVEL DATES: July 20-August 3

PREPARED BY
David Warfel
Patrick Ford
Jennifer Moutinho

Submitted May 15, 2010

ENGINEERS WITHOUT BORDERS-USA

www.ewb-usa.org

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

1.0 Contact Information

	Name	Email	Phone	Chapter
Project Lead	David Warfel	davidwarfel@wpi.edu	305-903-2321	EWB-WPI
President	Chris Garceau	crgarceau@wpi.edu	774-262-4680	EWB-WPI
Mentor #1	Matthew Gamache	GamacheM@cdm.com	857-389-2170	Boston Professionals
Mentor #2	Creighton Peet	cpeet@wpi.edu	508-315-9395	EWB-WPI
Faculty Advisor (if applicable)	Creighton Peet	cpeet@wpi.edu	508-315-9395	EWB-WPI
Health and Safety Officer	Julie Bliss	blissj2012@wpi.edu	774-551-6213	EWB-WPI
Assistant Health and Safety Officer	Chris Garceau	crgarceau@wpi.edu	774-262-4680	EWB-WPI
NGO/Community Contact	Michelle Banks	paatitzat@gmail.com	502-4556-5763	
Education Lead	Creighton Peet	cpeet@wpi.edu	508-315-9395	EWB-WPI

2.0 Travel History

Dates of Travel	Assessment or Implementation	Description of Trip
N/A		

3.0 Travel Team

Name	E-mail	Phone	Chapter	Student or Professional
Chris Garceau	crgarceau@wpi.edu	774-262-4680	EWB-WPI	Student
David Warfel	davidwarfel@wpi.edu	305-903-2321	EWB-WPI	Student
Julie Bliss	blissj2012@wpi.edu	774-551-6213	EWB-WPI	Student
Maria Alexandra Rangel	mrangel@wpi.edu	954-205-7770	EWB-WPI	Student
Matthew Gamache	GamacheM@cdm.com	857-389-2170	Boston Professionals	Professional
Creighton Peet	cpeet@wpi.edu	508-315-9395	EWB-WPI	Professional

4.0 Safety

4.1 Travel Safety

4.1.1 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 12, 2010.
http://travel.state.gov/travel/cis_pa_tw/tw/tw_1764.html

International SOS Risk Rating: Moderate Risk

4.1.2 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)

4.1.3 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.

4.2 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 will be trained in CPR and 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.
-ISIC insurance will be purchased for all travel team members for the duration of the trip. 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.
- 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
- Rabies, 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 malaria, diarrhea, allergic reactions, skin infections, insect bites, and water contamination.

5.0 Budget

5.1 Cost

Expense	**Total Cost**
Airfare (5)	3000
On Ground (homestay, transportation)	800
Materials (water testing, GPS)	1400
Other (medical kit), on-site communication)	300
Total	**5200**

5.2 Hours

Names	**# of Weeks**	**Hours/Week**	**Trip Hours**	**Total Hours**
Project Lead David Warfel	16	8	2 weeks	128 +2 weeks
Mentors Matthew Gamache Creighton Peet	 16 4	 2 4	 1 week 2 weeks	 30 + 1 week 16 + 2 weeks
Other Team Members Chris Garceau Julie Bliss Maria Rangel	 16 16 16	 11 8 6	 2 weeks 2 weeks 2 weeks	 171 + 2 weeks 128 + 2 weeks 96 + 2 weeks

5.3 Donors and Funding

Donor Name	**Type (**company, foundation, private, in-kind**)**	**Account Kept at EWB-USA?**	**Amount $**
Various	Private	Yes/No	735
Vanderweil	Company	No	250
Tetra Tech	Company	No	500
CDM	Company	Yes	400
WPI Student Government Association	Student Fund Request	No	2552
WPI Alumni Relations		No	2000
William Collentro	In-kind (water testing equip and medical kit)	No	1200
Total Amount Raised:			**7637**

6.0 Project Location

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

7.0 Project Impact

Number of Persons directly affected: 39 families, 207 people
Number of Persons indirectly affected: 20-25 families (neighboring community of Rexquix)

8.0 Mentor Resume

Refer to Appendix A

Pre-Assessment Report Part 2 – Technical Information

1.0 INTRODUCTION

This is a report of the Worcester Polytechnic Institute Chapter of Engineers Without Borders indicating the preparedness of the group for its first 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. Contact has been established with the community and a geologist in the area prior to the trip to learn of more 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 two-week assessment trip.

2.0 PROGRAM BACKGROUND

The following information is from the 501- Projection Application Form:

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 tripsper 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.

3.0 OBJECTIVES OF SITE ASSESSMENT TRIP

The primary goal of this assessment trip is to establish a positive and productive relationship with the Guachthu'uq community. We want to better understand the community's perspective on the project, and we want to learn how best to meet the community's needs. We will meet and talk with as many community members as possible to better understand their perceptions and expectations. We also hope to identify people who could potentially serve as leaders on a water management board. In addition, we would like to learn more about the local laws, regulations and standards, as well as the cultural, religious, and social characteristics of the village. We also plan to investigate other water systems and projects that are currently operating in surrounding communities. 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.

Other assessment trip goals include water testing and site mapping. We will test the quality of the local water at all potential water sources, specifically the downhill spring, dried uphill spring, and in the various water catchment tanks located throughout the village. Site mapping will be conducted so that a general map of the community can be created. In addition, the effectiveness of open-fire cooking and existing water systems will be evaluated along with the community's consumption of resources and waste disposal.

4.0 COMMUNITY INFORMATION

4.1 Description of Community

Guachthu'uq is a rural Maya Poqomchi' community of 39 families (203 people) located about 3km west of San Cristóbal Verapaz. The surrounding environment is mountainous and lush in vegetation. The women are primarily homemakers, 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 families tend small plots for subsistence. Men work at agricultural or building jobs in San Cristóbal or other parts of Guatemala. Average family income is in the area of US$500 annually (roughly $2-3 a day). While some people are monolingual in Poqomchi' (particularly women), many speak both Spanish and Poqomchi'. The residents are a mix of Protestant Evangelicals and Catholics (there are also some people who are involved in traditional Mayan spirituality).

4.2 Community/NGO Resources and Constraints

The current COCODE, the village's elected body, is very organized and meets regularly with the whole community (both men and women) to discuss and come up with solutions for issues that affect them. The community recognizes that their limited access to water and fuel consumption for cooking are also environmental issues and is committed to the creation of a program that is both sustainable and has a positive environmental impact. Their research has made them much more aware of deforestation in the region and the contamination/disappearance of resources. The community will contribute labor, tools and some materials (e.g., sand for cement, wood) as well as limited room and board for volunteers.

The cost of maintenance of the proposed project is a concern as the community's resources are limited. There is also a concern that some people in the community will not abide by the rules and care for the project. An annual maintenance fee will hopefully cover any repairs and also encourage everyone in the community to care for the project.

4.3 Community Relations

Paat Itz'at (formally the Pacayas Project), an arts education organization based in Washington, DC, is assisting with the project; the project coordinator lives in San Cristóbal six months out of

the year and brings high school students from the US to volunteer in schools in the region. Paat Itz'at will help with coordination and will organize the community education component. They are currently working with children in the community on a documentary project that will serve as both a community education tool and can serve as a fundraising tool for the project.

We also have relations with an instructor in the Department of Geology at the University of San Carlos campus in Cobán. He is eager to help EWB in this project and has offered to provide us with geological maps and GPS equipment.

Humberto Moran (Sergio's brother) is fluent in both Spanish and Poqomchi'. He has worked with the people of Guachthu'uq for many years and is willing to help us with language translation throughout the duration of our trip.

4.4 Community Priorities

The families have identified access to water and stove design as perhaps their most pressing concerns but have had trouble prioritizing one over the other.

5.0 DATA COLLECTION AND ANALYSIS

5.1 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 research using Google Earth. The team will create a general map of the village indicating major infrastructure such as community meeting places and existing/potential water sources. Important political/social boundaries will be recorded as well. Elevations and distances will be collected with a handheld GPS unit and measuring tape. The GPS unit will be used to approximate large horizontal distances (e.g., center of community to existing/potential water sources) and measuring tapes will be used for shorter distances (e.g, dimensions of streams and houses). All GPS data will be uploaded upon the team's return to the US so that it may be edited and saved for safekeeping.

The team will also obtain geological and topographical maps at a scale of 1:50,000 from Sergio Moran, Geology instructor at the University of San Carlos in Cobán, Guatemala. Maps may also be purchased from the Geologic Institute in Guatemala (Instituto Geográfico Nacional-IGN). The team will also photograph all important terrain and community infrastructure.

5.2 Technical Data Collection

The technical data to be collected on the assessment trip will be used to help determine the future of the water and stove projects. In terms of the water, we will be doing several water quality tests on all potential sources, including any local springs or surface water, so that we can define the viability and feasibility of each source. The Table below lists the tests we will be conducting as well as the collection method we will use to complete them.

The tests that will be conducted are listed as follows:

Test	Type	Source
Turbidity	Direct Reading Meter	HACH Model No. 2100Q01
Total Dissolved Solids/Conductivity	Direct Reading Meter	Myron L Model No. 512M5
Total Coliform Bacteria/E.coli	Quantitative Field Test Kit	LaMotte Easy Gels
Total Alkalinity	Test Kit - Drop Count	HACH #244301
Total Hardness	Test Kit - Drop Count	HACH #145500
pH	Test Strips	HACH
Temperature	Direct Reading Thermometer	-
Dissolved Oxygen	Meter – Portable Colorimeter	HACH #2515025/AccuVac
Total Iron	Meter – Portable Colorimeter	HACH #2507025/AccuVac
Nitrate	Meter – Portable Colorimeter	HACH #2511025/AccuVac
Nitrite	Meter – Portable Colorimeter	HACH #2512025/AccuVac
Ammonia	Meter – Portable Colorimeter	HACH #2604545/Ready to Use
Phosphate	Meter – Portable Colorimeter	HACH #2508025/AccuVac
Pesticides	EPA-PEST-8081A	Alpha Analytical – Westborough MA

We will also try to determine the approximate depth of the water table in various locations for the possible implementation of a well. We will also be assessing the current water supply by measuring the depth and dimensions of the sources as well as the flow rates of streams.

We know that some families in the community have received rainwater collection tanks. We plan on learning how they work and will also acquire the dimensions of the tanks and roofs. Water quality tests will also be performed on the water in the tanks.

Acquiring the square footage of homes and noting the placement of household items will provide the team with a workable size for the stove design. Locally available materials as well as their costs will be identified as well. Evaluation of data relating to stoves is discussed below in section 5.3.

5.3 Monitoring and Evaluation Data

Though there is already a rainfall catchment system in place, there is concern that the community does not always receive enough rainfall to satisfy the amount of water needed. The team plans to involve the community in monitoring water levels over an extended period of time. This will provide us with useful data while we are back home and will also allow the community to start actively participating in the project. We will also monitor the amount of water used in the community per day from the current source(s) and catchment tanks as well as the time it takes to retrieve it. We will compare with data with World Health Organization (WHO) standards. We will also evaluate the existing catchment system and look into methods to improve its sanitation. The overall sanitation within the community, including waste disposal, latrines, etc., will also be monitored.

We will also estimate the amount of firewood that is generally collected for stove use as well as the amount of time it takes to retrieve it. We also feel that it is important to learn the local cooking methods. We will need to evaluate the likelihood that the community will be willing to use a stove outside rather than inside their homes.

Data and miscellaneous notes will be recorded daily by each team member. These notes will be stored electronically upon return. These data will be printed to ensure that data will not be lost over the course of the proposed project.

6.0 SCHEDULE OF TASKS

July 20 to August 3

Overview

Week 1: Establish relations with community; begin village mapping and resource inventory.
Week 2: Continue to interact with community while collecting technical data as time allows

(water testing, site mapping with GPS, monitoring and evaluation data associated with water/firewood collection and rainwater catchment)

Details

Day 1: Travel

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

Day 2-5: Establish rapport

Collect necessary maps from Sergio Moran or IGN (Instituto Geográfico Nacional)
Meeting Don Domingo and town elders
Meeting other local officials and persons of interest (Owner of ranch where current source is located and public health officials)
Visit and locate hardware stores for implementation information
Tour neighboring villages (Las Arrugas- existing water pump, Rexquix- dried up source)

Day 6-12: Technical Data

Professional mentor Matthew Gamache arrives- share information
Conduct water quality tests
More detailed site mapping with handheld GPS unit.

Day 12-13: Further analysis of data

Draft Post-Assessment Report and upload photos/maps

Day 14: Depart

7.0 PROJECT FEASIBILITY

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

- Adequate community 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

8.0 MENTOR ASSESSMENT

By Matthew Gamache

I have been working with the WPI student chapter of EWB since they applied for their project, approximately one year ago. Since the project was awarded last August, the team of students has met for weekly general body meetings, weekly technical committee meetings, and regular fundraising and culture committee meetings. The students have shown outstanding initiative on this project, taking prudent steps in preparing for their first assessment trip. The primary goal of this first trip is to get to know the community and gain their trust. The students will also perform some water quality sampling and create a rough baseline map of the project area. To prepare for the trip, the students have completed all of the necessary documentation, including this 521 form, two travelers have attended a health and safety workshop and three student travelers have become First Aid and CPR certified. Additionally, members of the technical committee have met informally with WPI professors to learn about surveying, water quality testing, sustainability, and cultural sensitivity/culture shock. This trip should form the foundation for a long-lasting relationship between the students and the community.

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.

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