# Document 521
# PRE-ASSESSMENT REPORT

CHAPTER: Rensselaer Polytechnic Institute
COUNTRY: Panama
COMMUNITY: Isla Popa II (Sandubidi)
PROJECT: Development of Clean Water Sources
TRAVEL DATES: August 11-20, 2013

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PREPARED BY
Alex Angilella, Vincenz Buhler, Kathleen DiMilia, Jesse Freitas, Kyle Geisler, Ambar Mena, Kammi Shah

June 16, 2013

ENGINEERS WITHOUT BORDERS-USA
www.ewb-usa.org

 

# Pre-Assessment Report Part 1 – Administrative Information

## 1.0 Contact Information

| Project Title | Name | Email | Phone | Chapter Name or Organization Name |
|---|---|---|---|---|
| **Project Leads** | Kyle Geisler | kgeisler52@gmail.com | 845-399-1497 | EWB-RPI |
| **President** | Kathleen DiMilia | kathleendimilia@gmail.com | 845-707-1481 | EWB-RPI |
| **Mentor #1** | Alexander Michaels | Alexander.Michaels@arcadis-us.com | 518-275-7621 | EWB-RPI |
| **Mentor #2** | David Railsback | David.Railsback@arcadis-us.com | 978-895-3220 | EWB-RPI |
| **Faculty Advisor (if applicable)** | Chip Kilduff | kilduff@rpi.edu | 518-276-2042 | EWB-RPI |
| **Health and Safety Officer** | Vincenz Buhler | vincenz541@gmail.com | 904-563-0917 | EWB-RPI |
| **Assistant Health and Safety Officer** | Kammi Shah | kammishah@gmail.com | 908-279-4875 | EWB-RPI |
| **Education Lead** | Jesse Freitas | freitas.jesse@gmail.com | 973-303-7536 | EWB-RPI |
| **NGO/Community Contact** | Rajan Patel | Rajan.Patel@ch2m.com | | EWB-Panama |

## 2.0 Travel History

| Dates of Travel | Assessment or Implementation | Description of Trip |
|---|---|---|
| Jan. 7-12, 2012 | Assessment 1 | First trip to assess project feasibility, community's main problems, and create a relationship with the community members. |
| Aug. 12-21, 2012 | Assessment 2 | Second trip to collect additional data, forge partnerships with local organizations, and sign a contract with the community of Isla Popa II. |

## 3.0 Travel Team (Should be 8 or fewer):

| # | Name | E-mail | Phone | Chapter | Student or Professional |
|---|---|---|---|---|---|
| 1 | Kyle Geisler | kgeisler52@gmail. com | 845-399-1497 | EWB-RPI | Student |
| 2 | Vincenz Buhler | vincenz541@gmail.com | 904-563-0197 | EWB-RPI | Student |
| 3 | Kammi Shah | kammishah@gmail.com | 908-279-4875 | EWB-RPI | Student |
| 4 | Jesse Freitas | freitas.jesse@gmail.com | 973-303-7536 | EWB-RPI | Student |
| 5 | Ambar Mena | menaa2@rpi.edu | 857-919-5829 | EWB-RPI | Student |
| 6 | Alexander Michaels | Alexander.Michaels@arcadis-us.com | 518-275-7621 | EWB-RPI | Professional |
| 7 | David Railsback | David.Railsback@arcadis-us.com | 978-895-3220 | EWB-RPI | Professional |
| 8 | Chip Kilduff | kilduff@rpi.edu | 518-276-2042 | EWB-RPI | Professional |

 

## 4.0 Health and Safety

Our travel team will follow the site-specific HASP that has been prepared for this specific trip and has been submitted as a standalone document along with this pre-trip report.

## 5.0 Monitoring - Identify Projects to be Monitored on this Trip

| Project Type | Project Discipline(s) | Date of Completion (m/d/y) |
|---|---|---|
| N/A | N/A | N/A |

## 6.0 Budget

### 6.1 Project Budget

**Project ID**: 8801
**Type of Trip: I**

**Trip type: A**= Assessment; **I**= Implementation; **M**= Monitoring & Evaluation

| Trip Expense Category | Estimated Expenses |
|---|---|
| ***Direct Costs*** | |
| **Travel** | |
| Airfare | 3600.00 |
| Gas | |
| Rental Vehicle | |
| Taxis/Drivers | 100.00 |
| Misc. | |
| ***Travel Sub-Total*** | $3700.00 |
| **Travel Logistics** | |
| Exit Fees/ Visas | |
| Inoculations | |
| Insurance | $42 |
| Licenses & Fees | |
| Medical Exams | |
| Passport Issuance | |
| Misc. | |
| ***Travel Logistics Sub-Total*** | $42 |
| **Food & Lodging** | |
| Lodging | $450 |

 

| | |
|---|---|
| Food & Beverage (Non-alcoholic) | $500 |
| Misc. | |
| ***Food & Lodging Sub-Total*** | $950.00 |
| **Labor** | |
| In-Country logistical support | |
| Local Skilled labor | $200 |
| Misc. | |
| ***Labor Sub-Total*** | $200.00 |
| **EWB-USA** | |
| Program QA/QC **(1)** See below | $500.00 |
| ***EWB-USA Sub-Total*** | $500.00 |
| **Project Materials & Equipment (Major Category Summary) add rows if needed** | |
| | |
| Incubator | 3797.00 |
| Sample Rack | |
| Thermometer and Whirlpak bags | |
| filter and vacuum assembly | |
| DR/850 Colorimeter | 1041.00 |
| Arsenic Low Range Test Kit | 152.00 |
| 3, 12V Backup Batteries | 150.00 |
| High Range Accuvac Ampules 25pk | 29.25 |
| Low Range Accuvac Ampules 25pk | 29.25 |
| Formazin Standard | 66.95 |
| Silicone Oil | 11.05 |
| Stab Cal Standard | 71.29 |
| DIOH 4L | 24.29 |
| DPD Free Chlorine Reagent test'N Tube 50pk | 50.59 |
| DPD Total Chlorine Reagent Test'N Tube 50pk | 50.59 |
| ***Project Materials & Equipment Sub-Total*** | $5473.26 |
| **Misc. *(Major Category Summary)*** | |
| Report Preparation | |

| | |
|---|---|
| Advertising & Marketing | |
| Postage & Delivery | |
| Misc. Other | |
| ***Misc. Sub-Total*** | $0 |
| **TOTAL** | $10,865.26 |

(1) Program QA/QC
Assessment = $1,500
Implementation = $3,675
Monitoring = $1,125

**EWB-USA National office use:**

| | |
|---|---|
| ***Indirect Costs*** | |
| **EWB-USA** | |
| Program Infrastructure **(2)** See Below | |
| ***Sub-Total*** | $0 |
| ***TRIP GRAND TOTAL (Does not include Non-Budget Items)*** | $0 |

(2) Program Infrastructure
Assessment = $500
Implementation = $1,225
Monitoring = $375

**Non-Budget Items:**

| | |
|---|---|
| ***Additional Contributions to Project Costs*** | |
| **Community** | |
| Labor | |
| Materials | |
| Logistics | |
| Cash | |
| Other | |
| ***Community Sub-Total*** | $0 |
| **EWB-USA Professional Service In-Kind** | |
| Professional Service Hours | |
| Hours converted to $ *(1 hour = $100)* | $0 |
| ***Professional Service In-Kind Sub-Total*** | $0 |

| ***TRIP GRAND TOTAL (Includes Non-Budget Items)*** | $0 |
|---|---|

**Chapter Revenue**

| ***Funds Raised for Project by Source*** | **Actual Raised to Date** |
|---|---|
| **Source and Amount *(Expand as Needed)*** | |
| Engineering Societies | 0 |
| Corporations | 0 |
| University | 10,000.00 |
| Rotary | 0 |
| Grants - Government | 0 |
| Grants - Foundation/Trusts | 0 |
| Grants - EWB-USA program | 23,500.00 |
| Other Nonprofits | 0 |
| Individuals | 1,403.54 |
| Special Events | 1,812.00 |
| Misc. | |
| EWB-USA Program QA/QC Subsidy **(3)** See below | |
| EWB-USA Program Infrastructure Discount Amount | |
| ***Total*** | $36,715.54 |

| **Remaining Funds Needed** | **$** |
|---|---|

(3)  Program QA/QC & Infrastructure Subsidy:
Assessment = $1500
Implementation = $3,900
Monitoring = $1,000

### 6.2 Donors and Funding

| Donor Name | Type (company, foundation, private, in-kind) | Account Kept at EWB-USA? | Amount |
|---|---|---|---|
| Boeing (F11) | Company | Y | $4,000.00 |
| Arcadis (F11) | Company | Y | $2,000.00 |
| Pratt and Whitney (S12) | Company | Y | $8,500.00 |
| Boeing (S12) | Company | Y | $2,000.00 |
| Arcadis (S12) | Company | Y | $2,000.00 |
| SoE Dean's Global Initiatives Grant (F13) | University | N | $10,000.00 |
| Boeing (F13) | Company | Y | $1,500.00 |
| Pratt and Whitney (F13) | Company | Y | $3,500.00 |
| **Total Amount Raised:** | | | **$33,500.00** |

## 7.0 Project Discipline(s): Check the specific project discipline(s) addressed in this report. Check all that apply.

**Water Supply**
__x_ Source Development
__x_ Water Storage
__x_ Water Distribution
__x_ Water Treatment
_____ Water Pump

**Sanitation**
_____ Latrine
_____ Gray Water System
_____ Black Water System

**Structures**
_____ Bridge
_____ Building

**Civil Works**
_____ Roads
_____ Drainage
_____ Dams

**Energy**
_____ Fuel
_____ Electricity

**Agriculture**
_____ Irrigation Pump
_____ Irrigation Line
_____ Water Storage
_____ Soil Improvement
_____ Fish Farm
_____ Crop Processing Equipment

**Information Systems**
_____ Computer Service

## 8.0 Project Location
**Latitude:** 8.183333
**Longitude:** -82.11667

## 9.0 Project Impact
**Number of Persons directly affected:** 350
**Number of Persons indirectly affected:** 350+

 

**10.0 Professional Mentor/Technical Lead Resume - Please see document *405 - Mentor Qualifications* for Professional Mentor/Technical Lead requirements related to the project area. This can be found in the Sourcebook Downloads on the member pages of the website.**

The resume of Alexander Michaels can be found in Appendix A.

The resume of David Railsback can be found in Appendix B.

The resume of Jams (Chip) Kilduff can be found in Appendix C.

# Pre-Assessment Report Part 2 – Technical Information

## 1.0 EXECUTIVE SUMMARY

In preparing to travel on a third assessment trip to Sandubidi, this document expresses a detailed understanding of the problem and presents the plan for collecting information necessary to formulate an appropriate solution. The student chapter of Engineers Without Borders at Rensselaer Polytechnic Institute (EWB-RPI) has been working with the community of Isla Popa II since November 2010 to assess the need for and design a solution that provides a sustainable source of clean water for approximately 350 community members.

Student members and professional mentors have conducted assessment trips in January and August of 2012, building a working relationship with the newly founded community water board, other leaders, and in-country partners as well as determining the most feasible solutions to address the critical concerns for water supply and quality. Chapter members have proposed to construct a centralized rainwater catchment system which will be built on the community pavilion for the first phase of implementation. The pavilion water catchment system will be designed to supply the communities youth with a sufficient supply of water. During this trip the travel team will collect all the necessary data to move forward with the design and construction of this system.

This trip will allow EWB-RPI to acquire all the necessary structural data to support the preliminary design and implementation process. We will also continue to strengthen relations with Isla Popa II by agreeing on a financial contribution and operation and maintenance services. Important data to the design of our preliminary solution includes testing more water samples and collection of more precise census information of the community. Specifically, the structural information on materials locally available and the rooftop supports will allow EWB-RPI to move into the design phase after returning from this trip.

The project will be built in collaboration with community members, with the community contributing a portion of the cost for construction materials and the majority of the labor. Following completion, the project will be owned by the community and monitored by the community water board. During the implementation phase, a maintenance and operation plan will be discussed with and taught to community members to ensure sustainability of the project is achieved.

 

## 2.0 INTRODUCTION

Isla Popa II is a Panamanian community in grave need of improved access to clean water. Most of the community's 350 inhabitants drink, cook, and clean with water acquired from contaminated water sources. During the first assessment trip, the chapter found evidence of arsenic contamination throughout the community's water supply. The proposed assessment trip detailed herein will refine the knowledge of material availability, community financial contributions, and technical and structural information on the community buildings. Additionally, EWB-RPI plans to further engage the community in the design specifications in order to promote sustainable engineering practices. The proposed assessment trip will serve to provide EWB-RPI with the information necessary to finalize the proposed preliminary design along with an agreement regarding how the community will fund and perform maintenance operations.

## 3.0 PROGRAM BACKGROUND

The community of Sandubidi does not have reliable access to clean water. During the first assessment trip, it was established that the community runs out of water during the dry seasons (February to May and September to October) resulting in numerous community members drinking unsanitary water from shallow, uncovered wells. During the rainy seasons (May to August and November to January), water gathered by the existing rain catchment systems is generally available, and there is only one known problem with the rainwater, arsenic contamination. Laboratory testing conducted by the University of Panama supports our finding that rainwater is a safer water source than the wells that the community currently uses.

Although most families have rain catchment systems, many are not adequately sized. If the family does not have a catchment system, they either use makeshift barrels to catch rainwater or in many cases are forced to use water from one of the many wells throughout the community. Many such wells are shallow holes dug into the ground, which are exposed at the surface and are not protected from surface runoff and contamination by animals.

## 4.0 PROJECT DESCRIPTION

Most of the community's 350 members drink, cook, and clean with water acquired from contaminated sources. Much of the community's inhabitants exhibit symptoms that can be linked to arsenic exposure and nearly all suffer from some level of dehydration. Arsenic was found in low concentrations in the rainwater catchment systems currently in use throughout the community. Families that do not have a catchment system drink from makeshift catchment systems, contaminated wells, or publicly available storage tanks located at the community's school. During the rainy season water is abundant; however there is insufficient storage to provide sufficient water for community members through the dry season. The chapter is working with the community to develop the best solution to these problems.

Displayed on the following page are sample images of the community mapping EWB-RPI has completed thus far. During the coming assessment trip the travel team has proposed to revisit the task of collecting data to accompany the current GPS maps that have been developed. The team is working to gather more accurate dimensional data of all homes, documentation of roof supports and roof condition, along with a one-page questionnaire to be completed with a

 

member from each household. The questionnaire will be aimed at recording an estimation of each household's water usage to be used in the sizing of catchment tanks to homes. Additional topics will be finalized prior to travelling.

Figure 1: Arial View of Isla Popa II with GPS Waypoints

 

Figure 2: Sample of Data Collected For Each Home

| | | | | |
|---|---|---|---|---|
| **Waypoint #** | 31 | | | |
| **Waypoint name** | Ramon's House | | | |
| **Location Description** | Actual house | | | |
| **Building Roof Type** | Metal | | | |
| **Building Roof Size** | 25'1"x57'4" | | | |
| **Tank Stand Roof Type** | Uses building roof | | | |
| **Tank Roof Size** | Uses building roof | | | |
| **# of Tanks** | 2 | | | |
| **Filter Type** | Screen | | | |
| **Tank Stand Material** | Wooden | | | |
| **Tank Stand Description** | 5' off ground | | | |
| **Extra Info** | Both 750 gl tanks, has cloth over faucet for extra filtration, purple and yellow painted house, 5 people live there | | | |


Figure 3: Additional Photos of Marker 31 as Displayed in Google Earth

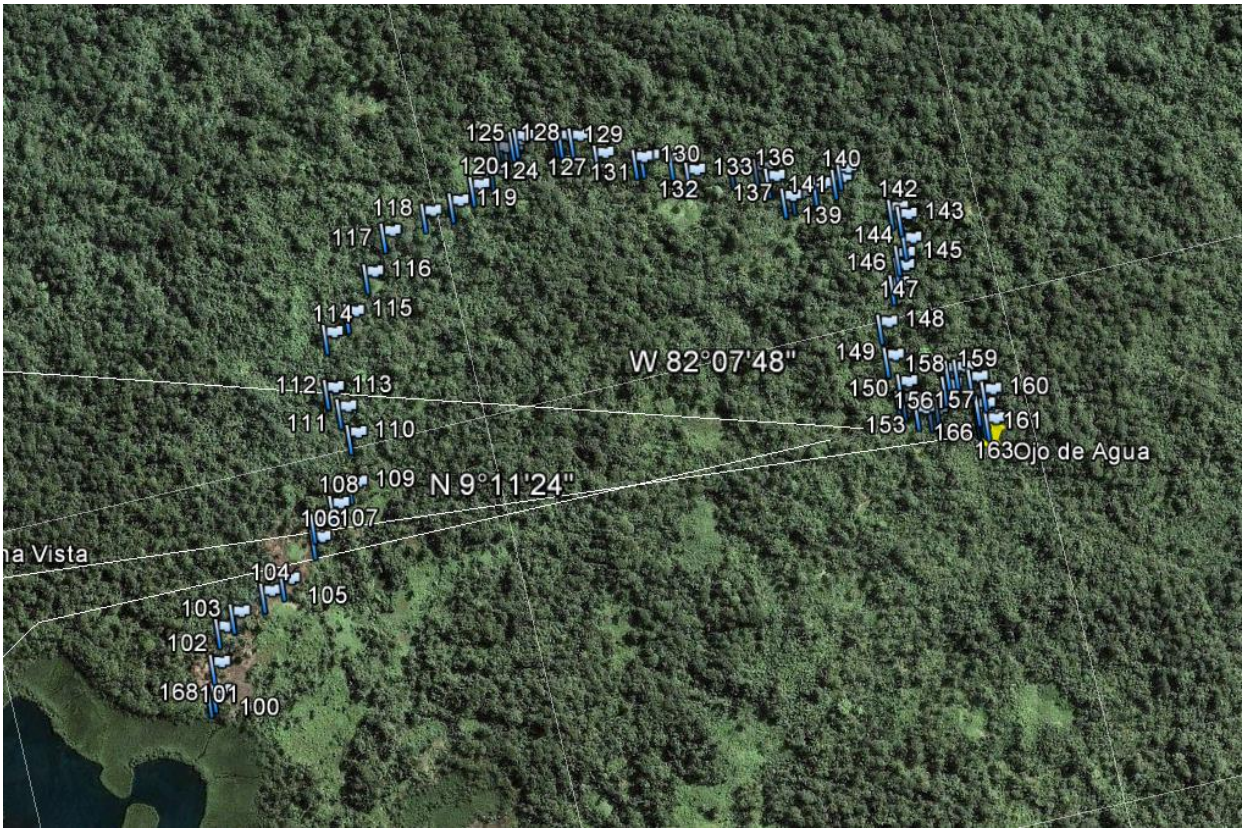

Figure 4: Marking of Trail to Ojo de Agua

## 5.0 OBJECTIVES OF SITE ASSESSMENT TRIP

The goal of this third assessment trip is to gather all information necessary to finalize design specifications for the implementation phase and to promote program sustainability. On the previous assessment trips water testing was performed and in-country partner relationships were established. Using the preliminary results, this assessment trip looks to collect data on the availability of necessary materials in the area as well as structural and technical assessments of community owned buildings. These structural and technical assessments include the determination of material type and dimensions of the roof to ensure it will be able to support fully loaded gutters, measurements of the available rooftop catchment area, and an estimated number of beneficiaries. There will be further assessment of Ojo de Agua and the possibility of an aqueduct to ensure the method selected during alternatives analysis is still best suited for the community.

In addition to technical assessment, the team will establish a basis for community financial contribution to operation and maintenance. We will also be working with the community to finalize the design according to their preferences within the design constraints. EWB-RPI established many relationships with in-country partners on the previous trip. We will continue to improve these relationships so while we are not in the community there are more outlets for communication and information.

 

# 6.0 COMMUNITY INFORMATION

## 6.1 Description of Community

Sandubidi is a small town inhabited by approximately 350 people, including 150 children. The community is located on Isla Popa, a 19 kilometer boat ride from Isla Colon. Local boat owners provide transportation to and from Isla Colon. The approximate number of residential buildings in Sandubidi is 32, with 5-10 people living in each house. The community suffers greatly from waterborne illnesses. Headaches and bacterial skin infections are very common. The maximum income in the community is $8 per day, while many have no income at all. Primary occupations include fishing, lobster diving, woodcutting, craftsmanship, and working in restaurants located near the island.

The people of Sandubidi are of the Ngobe tribe and speak both the native language Nboeri and Spanish but mainly just a “mountain” version of Spanish. The main religions are “Mama Tata” (an offshoot of Christianity), Jehova’s Witness, and other evangelical Christian religions. The community is currently expanding its tourism industry in addition to selling handmade crafts to visitors. In 2012, the community worked with outside partners to revitalize the homes in the village to attract tourists.

## 6.2 Community and Partnering Organization/NGO Resources and Constraints

In August 2010, a Peace Corps volunteer (Kate Douglass) began working with the community. While Kate planned on using her Peace Corps funding to supply some water improvement projects, the community reached out to EWB-USA for help in September of 2010. The community does not have strong financial resources, so the project must be cost effective and affordable. Labor and transportation are available, as the local men are experts in woodworking and gathering of local materials, and some even have their own boats. During the last trips, the chapter was given contact information for two local hardware stores as well as a hotel, Popa Paradise, near the community that has offered to aid in shipping and storage of building supplies. Since then, EWB-RPI’s partnering organization, EWB-Panama has provided the chapter with additional recommendations for purchasing materials in-country. The chapter has also been in contact with another hotel in the area, Hotel Laguna Azul Eco Lodge, which has expressed interest in assisting EWB-RPI with the water project. Both hotels have offered assistance in logistics for materials transportation. In this assessment, the chapter will consider the availability of local materials as well as the transportation method when considering different alternatives.

According to the Peace Corps volunteer, construction is feasible any time other than November, the holiday season for the native people. The rainy season is from November to January, however rain is common year round in the area. This will be accounted for in the construction plan via a contingency plan.

The community had a very good relationship with the Peace Corps. While Kate was the only volunteer in the community until she left this past June, two others have previously been in the community.

 

The chapter's current NGO in-country partnership is with EWB-Panama. The chapter has been collaborating with EWB-Panama since the planning for the second assessment trip in August of 2012. This partner has signed an agreement with EWB-RPI to assist the chapter with travel arrangements, connecting with other in-country contacts, mentoring in all technical and social aspects of the project, and to help in any way possible. Being a division of EWB, EWB-Panama has extensive experience in projects similar to EWB-RPI's project and are well connected throughout Panama. One member of EWB-Panama who will be assisting the travel team on this trip also works for another organization, Footprint Possibilities Inc. With this organization, the EWB-Panama member installs rainwater catchment systems throughout communities in Panama. He will be visiting the community during the chapter's planned travel dates to assess the construction site future implementation trips. The EWB-Panama representative will report his recommendations for the rainwater catchment system to the travel team members. Another member of EWB-Panama, who will be working with the chapter to plan the trip, may also be travelling to meet the community if he is available.

Another partner the chapter will be working with on this trip is the Floating Doctors. This group of doctors serves the Bocas Del Toro region and has been a great asset on the past two trips. The chapter plans on meeting with the group again during this trip. In the past, the Floating Doctors have offered their views of the community from a health perspective. The group has volunteered to help us however possible including sharing medical data, assisting with materials transportation, and collaborating to educate the community. The main constraint with this organization is that they are very busy. Fortunately, they have been working on establishing a more permanent residence in the community. At this point, the Floating Doctors have been visiting Sandubidi monthly for approximately two years.

## 6.3 Community Relations

The community president is Porfirio and the leader of the Water Board is Hombrosio. The chapter has had separate biweekly phone calls with Porfirio and Hombrosio, about developments within the community and within the project proceedings. They have provided opinions regarding how they feel as well as how the community generally feels about specific aspects of the project. On the upcoming trip, effort will be made to establish a stronger understanding with the community on their responsibilities for the project from this point on. This includes financial contributions, operations, and maintenance.

The chapter will also be furthering its relationship, as well as the community's relationship, with EWB-Panama. On the previous assessment trip, two members of EWB-Panama joined the travel team in the community throughout the duration of our stay there.

## 6.4 Community Priorities

The community's main priority is to obtain a reliable source of clean drinking water that is available to every member of the community with an emphasis on the children of the community.. Members have expressed that it also a top priority that the system either be available to all members, or be individual systems installed on each house. According to the Peace Corps volunteer, if the system were installed on only some houses, conflict may arise between the community members. They want cleaner water for cooking and cleaning as well as drinking. They also want this water system to be of low cost to implement and maintain due to their financial concerns. The community's second priority after obtaining cleaner water is to

 

have electricity in the school. The community believes it will bring more opportunities to the students if the building has electricity.

## 7.0 DATA COLLECTION AND ANALYSIS

### 7.1 Site Mapping

1. Identify locations with availability of various sand sizes for possible later use in a sand filtration system. EWB-RPI plans to document grain size of sand samples through the use of standard sized sieves. Along with estimations of quantities available.
2. Identify and document available locations and quantities of gravel for use in stone lined drainage ditches.
3. Photograph and observe grade of possible locations to place tank stand and accompanying drainage ditches.
4. Record accurate dimensions of homes throughout the community for later use in sizing of potable water storage tanks.
5. Document dimension of lumber that community members typically harvest.

### 7.2 Technical Data Collection

**Water Testing**
The table below shows the parameters EWB-RPI tested during the first and second assessment trips and the future work to be conducted for each during the proposed assessment trip. The list of measurements was taken from the Water Quality Testing Guideline 2010 (1). All of the tests listed will be conducted at selected sampling sites. The sampling sites will be re-evaluated once in the community. Currently, they include two water tanks at the school, a representative well from each barrio, the mangroves, the teacher's water supply, and the water at the house of the last Peace Corps volunteer.

During the first assessment trip, equipment failure precluded a specific conductivity test. In order to prevent the reoccurrence of this situation, the travel team will check functionality and take inventory of equipment prior to departure. Furthermore, RPI lab facilities will be used to sterilize containers for collection.

Please refer to Appendix D for tables summarizing water quality data obtained during the first and second assessment trips.

*Table 1: Water Testing Parameters and Proposed Future Work*

| Measurement | Future Work | Concern | Standard |
|---|---|---|---|
| Turbidity | Colorimetric test | Health | 5 NTU (2) |
| TDS | Test with filter/scale | Health | 500 mg/L (2) |

 

| | | | |
|---|---|---|---|
| TSS | Test with filter/scale | Health | |
| Specific Conductivity | Test in field with meter | Health | |
| Bacteria | Conduct multiple field tests or send to lab | Health | |
| Arsenic | Repeat | Health | |
| Fluoride | None | Health | 4.0 mg/L (2) |
| pH | Repeat. Colorimetric strip | Health | 6.5-8.5 (2) |
| Temp | Repeat if convenient | Health | |
| Color | Colorimetric strip | Health | 15 color units (2) |
| Alkalinity | Repeat. Colorimetric strip | Engineering/aesthetic | |
| Dissolved O2 | Test in field with meter | Health | |
| Iron | Test in field with colorimetric strip | Engineering/aesthetic | |
| Nitrates/Nitrites | Repeat if. Colorimetric strip | Health | 10 mg/L as N, 1mg/L as N (2) |
| Ammonia | Test in field with colorimetric strip | Health/aesthetic | |
| Chlorine | Do not repeat unless Chlorine is used. | Health/aesthetic | 4.0 mg/L (2) |

### 7.2.1 Turbidity

A DR/850 Colorimeter will be used to perform a preprogrammed turbidity test.

### 7.2.2 TDS/TSS

According to the EPA, TDS/TSS testing cannot be tested in the field due to the sensitivity of the required balance. Samples will be collected in a clean container and transported to a lab for testing (2).

### 7.2.3 Specific Conductivity

The meter from the previous assessment will be re-inspected for defects. If the meter does not work and again none are found, it will be replaced before the assessment trip occurs.

### 7.2.4 Bacteria

It is generally of practice to start microbial analysis within 1 hour of sample collection. For drinking water (for compliance purposes), do not hold for longer than 30 hours when testing for coliform bacteria and preferably refrigerate at $<10^0$C during transit. For heterotrophic plate counts, do not hold longer than 8 hours. (3)
The Floating Doctors expressed concern over bacterial contamination in the water sources. August 2012 results from the University of Panama lab have suggested unacceptable levels of coliform contamination. Membrane filtration tests will be conducted to determine the extent of coliform contamination. Fecal coliforms will be the specified indicator of bacterial contamination. The Hach MEL/850 Portable Water Laboratory will be used to conduct membrane filtration fecal coliform testing.

### 7.2.5 Arsenic

Due to the high concentrations of inorganic arsenic in the tests conducted during the initial assessment trips, arsenic testing will be repeated to assure consistency of results. A test kit will be purchased to measure inorganic and organic arsenic. The necessary reagents will be prepared before the assessment trip.

### 7.2.6 pH, Alkalinity, Iron, Nitrates/Nitrites, and Ammonia

The tests for these parameters are performed using colorimetric strip tests that can be easily implemented in the field. No instruction is necessary beyond familiarity with the directions on the test kits to be transported to the community.

1. Latham, Kelly; EWB Water Testing Guidelines 2012
2. Standard Methods for the Examination of Water and Wastewater, American Public Health Association; 1999. (http://www.umass.edu/tei/mwwp/acrobat/sm9010-40intro.PDF)
3. Environmental Protection Agency, 03/06/12;
http://water.epa.gov/type/rsl/monitoring/vms58.cfm

**Structural and Material Analysis**

The following is a list of the structural measurements and material analysis that we will be collecting information on during this next assessment trip

- Available rooftop catchment area
- Currently used roofing material
- Condition of rooftop material
- Roof and building dimensions
- Local availability and cost of tools and materials (ex. dimensional lumber)
- Number of beneficiaries for catchment system
- Maximum load on soil under tank stands

 

- Drainage plan to prevent undermining of tank stands

## 8.0 MONITORING

### 8.1 Monitoring plan for current project

| Metric | Qualitative Measures | Quantitative Measures |
|---|---|---|
| Water Quality | Use of local water sources compared to bottled water and other drinks | Total coliform count, arsenic content, total dissolved solids, and other parameters |
| Community Health | Community opinion regarding health of individuals | Health data as reported by Floating Doctors |
| Water Supply | Community opinion of sufficiency of water supply | Length of the average drought, average quantity of water delivered |

### 8.2 General Methods for Data Collection

#### 8.2.1 Water Quality

Total coliform count – a total coliform count will be performed on samples collected by the travel team by an external lab. This procedure achieved useful results on the second assessment trip.

Arsenic content – colorimetric tests will be performed on site as in the first two assessment trips. Required materials include bottles for sampling, reagents, and test strips

Total dissolved solids – an optical test will be performed in the field with a Hach DR/890 colorimeter. The stated detection limit of the colorimeter is 22.1 mg/L. The stated testing method requires blending the sample. Another homogenizing process will likely be used in the trip.

Turbidity - an optical test will be performed in the field with a Hach DR/890 colorimeter. The stated detection limit of the colorimeter is 1 FAU, which is equivalent to 1 NTU.

Usage – compare the usage of the local water source to bottled water and other drinks by observing and monitoring; the growth plastic trash and refuse, community opinion of water usage, NGO opinion of water usage, and observed water usage.

#### 8.2.2 Community Health

Health Data – the Floating Doctors record the services that they provide for the people of Sandubidi. Cataloging the incidence of kidney and skin related problems will contribute to monitoring overall project effectiveness.

Community Opinion – Consistently surveying the community before, during, and after the implementation process will provide data for the community opinion of their own health.

#### 8.2.3 Water Supply

Average Drought – collecting data on the average drought requires the help of the community. Selected community members will monitor record the number of days without water in the tanks.

 

Average Water Quantity Delivered – community members will monitor water levels before and after rainfalls to understand the quantity of water collected.

Community Opinion - Consistently surveying the community before, during, and after the implementation process will provide data for the community opinion on the adequacy of the water supply.

### 8.3 Monitoring of past-implemented projects

N/A

 

## 9.0 COMMUNITY AGREEMENT/CONTRACT

A la Comunidad de Popa II

Para generar un acuerdo que establece claramente las responsabilidades que le corresponde a cada parte y que se espera que cumpla, hemos escrito este documento. Las dos partes, Ingenieros sin Fronteras Instituto Politécnico Rensselaer (EWB RPI) y la comunidad de la Isla Popa II, demuestran que aceptan los términos atreves de firmar abajo.

Los términos establecidos a los que la comunidad se va a ceñir incluyen el contribuir al proyecto para traerle agua potable a la comunidad atreves de financiamiamiento, del trabajo de la comunidad y/ o materiales. La comunidad también va a ser responsable de inspeccionar regularmente, del mantenimiento y del arreglo futuro de los componentes de este proyecto una vez terminado, con la ayuda prometida y el respaldo técnico del capitulo de EWB RPI, aun cuando sea por teléfono, email o atreves del socio en el país. Además el representante designado por la comunidad de Popa II será responsable de comunicarse con EWB RPI.

EWB RPI va a tratar de buscar la mejor y mas apropiada solución para mejorar la obtención y calidad del agua de la Comunidad de la Isla Popa II, al igual de encontrarle y presentarle un ONG(s) a la comunidad de la Isla Popa II, para impulsar la cooperación entre las partes durante el tiempo que exista este ~~contrato~~ acuerdo y asegurarse de que el ONG local sea aceptado por la comunidad de la Isla Popa II. La materia prima usada por el capitulo del EWB RPI se va a adquirir cerca de la Isla Popa II y se dará información de su origen, garantizando así que sea material que se encuentre en ese lugar. Las dos partes van a compartir la responsabilidad de conseguir los materiales en la fase de construcción.

EWB RPI va a ayudar atreves de conferencias telefónicas, instrucciones verbales y/o escritas y durante la fase de monitoreo. Del capitulo de RPI EWB se darán instrucciones verbales y/o escritas que cubren los métodos de inspección, mantenimiento y reparación del sistema del agua. Debe entenderse claramente que EWB RPI no garantiza que se va a dar ayuda luego de la fase de monitoreo.

Sin embargo, si la comunidad descuida en forma grave el sistema de agua a que hemos contribuido o los tanques, puede ser causal para terminar el ~~contrato~~ acuerdo entre EWB RPI y la Comunidad de la Isla ~~de~~ Popa II. EWB RPI no va a determinar como va la comunidad a mantener o llevar a cabo las inspecciones requeridas de las partes que componen el proyecto del agua.

Sin embargo, los siguientes puntos son flexibles entre EWB RPI y la comunidad de la Isla de Popa II:

. Las cantidades exactas de contribuciones de la comunidad

. La cantidad de dinero (financiación)

. El trabajo aportado por la comunidad

. Componentes y materiales

SN

SN acuerdo Las dos partes EWB RPI y la Isla ~~de~~ Popa II están de acuerdo con los términos que contiene este ~~contrato~~ y acepta ajustarse y res petar las responsabilidades del mismo; en aceptación de esto lo firman sus representantes.

Firmado el diese-ocho de Augosto del 2012

Representante autorizado por la Comunidad de la Isla de Popa II

Representante de EWB RPI

Testigos

Firma

18-8-2012

Fecha

Nombre

## 10.0 SCHEDULE OF TASKS

Preliminary Task List

- Travel (flights/cab rides/boat rides)
- Gather data necessary to construct a trapezoidal weir at Ojo De Agua and explain to community responsibility for checking water level
- Get a census of people and their drinking habits
- Community meeting to discuss
  - Chosen implementation method/design
  - Financial contribution
  - Upkeep and maintenance that will be required by a future system
  - Revision of community agreement
- Gather dimensional data of buildings to overlay on community map
- Measure rooftop dimensions
- Assess the roof of construction site (check stability and material)
- Assess entirety of the construction site
- Take samples of roof materials
- Meet with suggested vendors and find more in area
- Meet with Popa Paradise to organize material shipping and storage
- Meet with EWB Panama representative in community
- Continue water testing
- Take pictures and video documentation

We have decided to have a task list opposed to an itinerary of daily activities in order to increase flexibility due to the uncertainties that often occur. A detailed travel itinerary will be created once plane tickets have been purchased.

## 11.0 PROJECT FEASIBILITY

To determine feasibility we will evaluate the data gathered from this and our previous assessment trip based on the following criteria:

1. The community's take toward the planned implementation of a rainwater catchment system on a community building for community usage.
2. The community's willingness to contribute financially.
3. Success of the partnership between EWB-RPI and EWB-Panama based on trip planning assistance given, engineering design guidance offered, engineering experience utilized, and willingness to travel to the community during EWB-RPI trips and in between said trips.

 

# 12.0 PROFESSIONAL MENTOR/TECHNICAL LEAD ASSESSMENT

## 12.1 Professional Mentor/Technical Lead Name (who provided the assessment)

David Railsback

## 12.2 Professional Mentor/Technical Lead Assessment

The project team is moving in the right direction on the Sandubidi (Popa II) water supply project. This 521 report proposes a third assessment trip. This assessment trip should assist the team in finalizing design for a pilot rain catchment system for a community building.

In order to achieve this goal, the project team has analyzed 10 years of climate data. This information will be utilized to modify tank sizes and/or catchment areas. This will improve the quantity of water. A simulation is also under development, which will allow the project team to use actual historical precipitation data to view the performance of a rainwater catchment system based on catchment area, first flush volume, tank size, and the rate of water use. This simulation tool will help the team balance construction costs with the risk of water shortages. In addition, the simulation tool may help the team explain and market the plan to the community. These plans will be solidified during the third assessment trip, and a stronger agreement with the community will be formed to determine responsibilities for implementation. In order for this assessment trip to provide value, a detailed plan for implementation should be established prior to the assessment trip.

The project team also plans to improve the quality of water. A “first flush” system is under development. This is a device which diverts and discards the first portion of collected rainwater, thereby minimizing the debris and particles which reach the storage tank. Before implementation is possible, the project team still needs to assess the treatment required for these systems. In addition to a first flush system, filters must be considered, as well as disinfection. Just as important, a procedure for maintenance and cleaning of the rainwater catchment system must be developed. This must be accomplished prior to this assessment trip.

The community has invested time and money in existing catchment systems throughout the community, which can be optimized at minimal cost to reduce the frequency and duration of water shortages. The rainwater catchment improvement project has a high likelihood of success. It has the potential to improve water supply quantity and quality at minimal cost. It builds on existing community knowledge, encourages community involvement, and provides an opportunity to develop the relationship between the project team and the community.

During the planning and implementation of rainwater catchment improvements, the project team should continue to assess the feasibility of other alternatives. For example, the project team should not discard pipeline planning efforts. The community has a desire for a robust water supply system which will allow for population growth. A pipeline may or may not accomplish this goal. It is not possible to conclude without understanding the reliable flow rate of the water supply. A detailed study would be required, including data collection over the period of at least a year. This would require significant participation from the Sandubidi Water Board. As of yet, this level of commitment is unproven. On the August 2012 assessment trip, the project team

 

encountered lapses in community commitment when attempting to perform a scheduled visit to the water source to inspect the site, perform water quality tests and mark the location with GPS. The site visit did occur, but after days of delay.

While the team makes progress on rainwater collection improvements, the project team should concurrently advance their understanding of pipeline design and construction. A detailed analysis should be concluded in the near future. This should include a plan for data collection, preliminary design for pipeline construction, an estimate of cost, and an estimate of construction duration.

## 12.3 Professional Mentor/Technical Lead Affirmation

I acknowledge my involvement in the project and I accept responsibility for the course that the project is taking.

 

# APPENDICES

**Appendix A: Alexander Micheals Resume**
**Appendix B: David Railsback Resume**
**Appendix C: James (Chip) Kilduff Resume**
**Appendix D: Summarized Water Quality Data**

 

## Appendix A

Alexander D. Michaels
151 Jefferson Street, Building 4, Apt 2B, Saratoga Springs, NY 12866
Cell Phone: (518) 275-7621
alexanderdmichaels@gmail.com

EDUCATION
University of Rochester, 2009, Rochester, NY - Chemical Engineering

ACCOMPLISHMENTS
- Passed the Fundamentals of Engineering (FE) exam
- Advisor to RPI Engineers Without Borders Chapter
- Dean's List for multiple semesters at the University of Rochester
- Shelby A. Miller Award for best Chemical Engineering senior design project

WORK EXPERIENCE
Malcolm Pirnie, the Water Division of ARCADIS, Clifton Park, NY - Energy Engineer (2009-Present)
Currently working with the Energy Services group to provide consulting services to identify and assess energy conservation opportunities for building and process systems.
- Completed multiple energy audits of municipal wastewater treatment plants, including assessment of water distribution systems
- Working with small team manage NYSERDA Existing Facilities Pre-Qualified Program
- Managing company's review of NYSERDA Existing Facilities Pre-Qualified Program applications
- Reviewed NYSERDA incentive applications to evaluate energy savings, cost savings and
compliance with program requirements. Applications frequently included lighting, HVAC and
process systems. Total amount of incentives reviewed exceeds $1 million
- Coordinated with NYS farmers to carry out Measurement and Verification plans for NYSERDA
program incentivizing electric generation from implemented anaerobic digesters
Advisor to RPI Engineers Without Borders Chapter (2011-Present)
Working as a volunteer with RPI students, RPI staff and NGOs to help deliver water quality project in
Panama.
- Advising students to help meet technical, organizational and reporting requirements of the project
- Helped plan and took part in first project assessment trip to study current water quality conditions
and understand community culture, wants and needs
NYS Energy Research and Development Authority (NYSERDA), Albany, NY - Intern (2008-2009)
Worked to help allocate funding for projects to maximize efficiency, limit emissions and reduce fuel
consumption within the transportation group.

 

• Developed system to rank applicants and allocate funds from a legal settlement based on several
criteria, most importantly total emissions displaced and region of NYS
• Researched potential projects for the Clean Cities Challenge, which encouraged plans that
accelerate the introduction of alternative fuel vehicles
• Investigated projects to find which offered the best investment to reduce vehicle commuting miles
and emissions in NYS
Albany Molecular Research, Inc., Rensselaer, NY - Materials Management Intern (2007)
Completed projects focused on improving internal efficiency and customer satisfaction.
• Researched most popular packaging options and assembled selections into a standard packaging catalog for customers
• Developed and implemented a coding system to maximize information in the limited space
available when describing the company's inventory

PERSONAL INTERESTS
Skiing
Golf
Traveling

 

## Appendix B

David M. Railsback

### *Education*

*M.Eng. Environmental Fluid Mechanics & Hydrology January 2009*
GPA 3.86, Cornell University, Ithaca, NY

*B.S. Civil & Environmental Engineering May 2008*
GPA 3.29, Tech GPA 3.41, Cornell University, Ithaca, NY

### *Consulting Experience*

*Environmental Engineer, ARCADIS, Clifton Park, NY February 2009 - Present*
Performed hydraulic and hydrologic analysis and design for a range of engineering projects.

Bypass Tunnel of the Delaware Aqueduct, Roseton, NY

- Developed dewatering methods for a rehabilitation project at the Rondout-West Branch Tunnel. The 45-mile long, 13.5-foot diameter tunnel is one of New York City's primary drinking water aqueducts.
- Examined dewatering options, including pumping operations, using WaterCAD and other modeling software.
- Analyzed construction alternatives using WaterCAD to determine hydraulic capacities.
- Collaborated with a multidisciplinary team to produce reports and PowerPoint presentations for delivery to the New York City Department of Environmental Protection.

Wards Island Water Pollution Control Plant, New York, NY

- Participated in the secondary treatment upgrade of a 275-mgd treatment plant, including the implementation of a Biological Nitrogen Removal system.
- Provided hydraulic design support, including the design of aeration tank baffle walls and measurement of plant flows.
- Utilized HEC-RAS modeling software for aeration tank filling and draining analyses.
- Identified an opportunity to reduce the number of valves installed in the aeration tanks, resulting in an estimated savings to the client of $300,000.

Wastewater Treatment Facility Energy Conservation Study, Margaretville, NY

- Performed a facility-wide study of a 2-mgd advanced wastewater treatment facility, including an on-site audit of the facility to evaluate operations. Identified opportunities for greenhouse gas emission reduction, energy efficiency improvements and cost reduction.

 

●Analysis included pumping, membrane filtration, rotating biological contactors, septage handling, UV disinfection and aeration.
●Collaborated with building system engineers to produce a report for the client, providing sufficient detail to allow improvement projects to be evaluated and prioritized for implementation.
●Prepared probable construction costs, estimated energy savings, and provided an economic analysis for each process improvement project. The recommended projects produced an annual cost savings of $20,000 with a capital cost of $170,000, resulting in a simple payback of 8.5 years. The recommended projects generate an annual energy savings of 200,000 kWh, reducing equivalent green house gas emissions by 75,000 kg CO2 per year.

Massapequa Lake Dam, Massapequa, NY

●Performed dam break analysis using HEC-HMS, HEC-RAS and ArcGIS and prepared a dam safety report.

Southerly Water Pollution Control Plant, Cleveland, OH

●Performed hydraulic analysis for the expansion of an existing 310-mgd treatment plant, generating hydraulic profiles for proposed flow conditions and providing hydraulic analysis to support the design process.
●Performed a capacity analysis for the primary settling tanks and developed an operating strategy for storm events.
●Designed a modulating weir.

Hartford Water Pollution Control Facility, Hartford, CT

●Performed hydraulic analysis for various aspects of the 200-mgd facility expansion, including new pump stations, chemically enhanced primary clarifiers, aeration tanks, final settling tanks and outfall structure.
●Procured a commercial diving firm for the inspection of the 2,000 ft long outfall structure and coordinated the inspection with a budget of $25,000.
●Developed hydraulic profiles and gate setting schedules for construction documents.
●Coordinated with structural engineers to design aeration tank baffle walls.

Albany Combined Sewer Overflow Tributary Sampling, Albany, NY

●Performed wet-weather sample collection for a Combined Sewer Overflow (CSO) investigation of the Hudson River.
●Assisted with data analysis to isolate sources of fecal coliform.

 

### *Related Skills*

WaterCAD, HEC-RAS, HEC-HMS, Matlab, MathCAD, AutoCAD, ArcGIS, BioWin, CorMix, Microsoft Office Word, Excel & PowerPoint, Intermediate Spanish

### *Professional Certifications*

*Construction Documents Technologist (CDT) April 2010*

*Engineer in Training (EIT) April 2008*

### *Professional Organizations*

*American Water Works Association (Events Committee)*

*New York Water & Environment Association*

### *Additional Engineering Experience*

*M. Eng. Degree Project, Tsunami Run-Up, Cornell University Summer 2008*

- ●Conducted wave tank experiments to study surface velocities of breaking waves.
- ●Acquired data using wave gages and cameras (high speed and infrared).
- ●Analyzed data using Matlab, including writing code for particle image velocimetry (PIV).
- ●Assisted in the construction of a piston-type wave maker.

*Engineering Team Leader, AguaClara, Cornell University Fall 2006 – Spring 2008*

- ●Led a Cornell Engineering team in economizing the design of gravity-powered water treatment plants being built in Honduras.
- ●Designed a gravity-powered automated chemical delivery system.
- ●Participated in two site visits in Honduras, in cooperation with a Honduran partner organization.

*Research Assistant, Rapid Sand Filters, Cornell University Fall 2007 – Spring 2008*

- ●Built an experimental test apparatus to study particle removal in chemically pretreated filters used for drinking water.
- ●Conducted computer-controlled experiments and performed data analysis.

*Instructor, Introduction to AutoCAD, Cornell University Fall 2006 – Spring 2008*

- ●Presented lectures and led classroom application sessions.

### *Volunteer Experience*

*Engineering Mentor, Future Cities Competition 2009*

Introduced middle school students at Saratoga Springs Catholic School to engineering principals through participation in an urban design competition.

### *Interests*

***Whitewater Rafting (DEC Certified Guide, Hudson River Gorge, NY)***

Photography, Kayaking, Skiing, PADI Advanced Open Water Diver

 

***Awards***

*Cornell University John McMullen Dean's Scholar, Dean's List and Global Fellow*

*Eagle Scout*

 

## *Appendix C*

James E. (Chip) Kilduff
Civil and Environmental Engineering
I. Biographical Information

Name: James E. (Chip) Kilduff
Department: Civil and Environmental Engineering
Current Rank: Kodak Associate Professor
School: Engineering
First Appointment: Asst. Professor—August 5, 1996
Date of Birth: December, 1961
II. Educational Preparation

BS, University of Connecticut, Storrs 1983
MS, University of Connecticut, Storrs 1987
Ph.D., University of Michigan, Ann Arbor 1995
III. Professional Experience

Associate Professor, 2002-present, Department of Civil and Environmental Engineering Rensselaer Polytechnic Institute, Troy, NY

Assistant Professor, 2001-2002, Department of Civil and Environmental Engineering
Rensselaer Polytechnic Institute, Troy, NY

Assistant Professor, 1996-2001, Department of Environmental and Energy Engineering
Rensselaer Polytechnic Institute, Troy, NY

Postdoctoral Scholar, 1995-1996, Department of Chemical Engineering, University of California, Berkeley.

Visiting Lecturer, 1995, Department of Land Air and Water Resources, University of California, Davis.

Project Engineer, 1983-1987, Lenard Engineering, Storrs, CT.

IV. Engineering Project Experience

- Federal Paperboard Co. Inc. Performed hydrogeological investigation and developed site closure plan for paperboard sludge landfill. Established groundwater monitoring program, conducted stream water quality impact assessment, and wrote operation and maintenance manual. Final report submitted to the Connecticut Department of Environmental Protection.
- Highstead Foundation. Designed and supervised construction of an arboretum pond and earth embankment dam. Performed site investigation, soils analysis, flood flow and routing computations, low-flow water supply analysis, and earth embankment stability analysis; prepared construction drawings and supervised construction. Final report submitted to the Connecticut Department of Environmental Protection.
- Baptist Union. Designed on-site sewage disposal system for 24 unit housing complex on a hydraulically limited site. Performed site investigation, seepage analysis, environmental impact analysis;

 

specified construction methods to achieve a specified fill permeability, and conducted final permeability testing program. Final report submitted to the Connecticut Department of Environmental Protection.

- Town of Ledyard, CT. Modified final closure plan for a municipal waste landfill. Established groundwater monitoring program, and conducted an environmental impact analysis. Final report submitted to the Connecticut Department of Environmental Protection.
- Town of Groton, CT. Designed a lagoon and drying bed for water treatment alum sludge. Performed pilot drying tests, backwash water settling tests, hydraulic diffuser design; prepared construction drawings, and supervised construction.
- U.S. Fish and Wildlife Service. Performed Phase II engineering investigation of Greenwood Lake Dam. Designed and conducted subsurface investigation, conducted soil testing program, performed stability analysis, flood flow and routing computations, and prepared inundation mappings. Final report submitted to the Army Corps of Engineers.
- Warren Corporation. Designed and installed a flow monitoring system for wool dyeing operation. Prepared discharge permit, and provided administrative services for pollution control.
- ConnTech Co., Inc. Prepared environmental impact assessment of 64 unit housing project. Designed groundwater monitoring program, and performed hydrogeological investigation, analyzed surface and subsurface hydrologic budget. Final report submitted to the Town of Mansfield, CT.
- The Traverse Group, Inc. Analyzed impact of co-solvent on TCE adsorption by activated carbon.
- Christy Hill Builders. Designed pump station and water distribution network for 50 lot subdivision.

V. Courses Taught

- Applied Hydrology & Hydraulics
- Environmental Engineering Laboratory
- Bench Scale Design
- Civil Engineering Capstone Design
- Environmental Chemodynamics
- Environmental Mass Transport Processes
- Physicochemical Processes, Advanced Physicochemical Processes
- Environmental Engineering Process Design
- Groundwater Hydrology
- Biological Processes in Environmental Engineering

VI. Research Projects

- Quantitative Structure Property Relationships to Predict Removal of ESC/PPCPs in Water Treatment Processes, $225,000 (2009) 2 yrs.
- Evaluating Carbon Nanotubes as Adsorbents for Water Treatment. AWWA Research Foundation, $145,564 (2007) 2 yrs.

- Workshop: Frontiers in Environmental Engineering Education. National Science Foundation, $80,388 (2006) 1 yr.

- National Student Design Competition: Design of Filtration Systems for Rural Nepal. US Environmental Protection Agency P3 Program, $10,000 (2006) 1 yr. (Co-PI Simeon Komisar, Rensselaer Polytechnic Institute)

 

• Peroxy-acid Pretreatment-Microbial Degradation: A Hybrid Approach to Remediation of Contaminated Sediments & Soils - A Phase II Study (TSE03-O). National Science Foundation, BES-0329464, $213,531 (2003) (co-P.I.'s: M. Nyman, T. Abrajano, S. Komisar, Rensselaer Polytechnic Institute)

• Graft Polymerization as a Route to Control Nanofiltration Membrane Surface Properties to Manage Risk of EPA Candidate Contaminants and Reduce NOM Fouling. Environmental Protection Agency, $349,000 (2002) 3 yrs. (co-P.I. Georges Belfort, Rensselaer Polytechnic Institute).

• Collaborative Research: Sorption Reversibility of Hydrophobic Compounds in Geosorbents. National Science Foundation, $260,741 (2001), 3 yrs.

• Characterization of Dissolved Organic Matter in the Biosphere Ocean. Columbia University Biosphere Center/Packard Foundation, $12,000 (2000), 1 yr.

• Membrane Processes for DBP Precursor Control: Effects of Colloid Stability and Membrane Surface Chemistry on Flux and Rejection, NSF CAREER, $200,000 (2000), 4 years.

• Brominated DBP Formation and Speciation Based on the Specific UV Absorbance Distribution of Natural Waters, EPA Science to Achieve Results Program, $391,473 (2000), 3 yrs (subcontract to T. Karanfil, Clemson University).

• Peroxy Acid Petreatment-Microbial Degradation: A Hybrid Approach to Remediation of Contaminated Sediments. National Science Foundation, $98,566 (2000), 2 years. (co-P.I.'s: M. Nyman, J. Abrajano, S. Komisar, Rensselaer Polytechnic Institute)

• Tailoring Activated Carbon Surfaces for Water, Wastewater, and Hazardous Waste Treatment and Recovery Operations (EPA) $250,000 (1999), 2 years. (co-P.I.: T. Karanfil, Clemson University).

• Used Oil Reclamation, Alliance for Oil Reclamation, $11,629 (1998), 1 yr.

• Acquisition of Instrumentation for Characterizing the Continuum of Environmental Colloids and Particles in Aqueous Systems, National Science Foundation, $522,189 (1998), 3 yrs. (co-P.I.'s: S. Komisar, J. Zehr, S. Collier, and R. Bopp, Rensselaer Polytechnic Institute)

• Membrane Fouling: Influence of Natural Organic Matter Properties and Membrane Surface Treatment. U.S. Department of the Interior, Bureau of Reclamation, $120,081 (1998), 1 yr. (co-P.I.: G. Belfort, Rensselaer Polytechnic Institute).

• Effects of Disinfection Byproduct Precursors and Pathogenic Protozoa on Potable Water Quality and Treatability: Applications for A Mobile Testing Laboratory, RPI Strategic Initiative, $25,000 (1997), 1 yr.

• An Assessment of Selected Technologies for the Reduction in Taste and Odor Problems Associated with the Growth of Nuisance Algae in Edgecomb Pond, Town of Bolton Landing, NY (through the New York State Energy Research and Development Authority), $52,365 (1997), 2 years. (co-P.I: S. Komisar, Rensselaer).

VII. Publications

 

- Books, Book Chapters, and Monographs (8)
- Refereed Journal Articles (33)
- Refereed Conference Proceedings (7)
- Major Research Reports (4)

Selected Publications

1. Yuan, Y.; Kilduff, J.E. Hydrodynamic Modeling of NOM Transport in UF: Effects of Charge Density and Ionic Strength on Effective Size and Sieving. Environmental Science and Technology, Vol. 43, No. 14, 5449-5454 (2009).
2. Zhou, M.; Kilduff, J.E.; Belfort, G. High Throughput Screening to Modify Surface Properties and Obtain High Performance Membranes. Chapter in New Membranes and Advanced Materials for Wastewater Treatment. A. Mueller, B. Guiyesse and A. Sarkar, Eds. American Chemical Society Symposium Series, Washington, DC, 2009.
3. Zhou, M.; Liu, H.; Kilduff, J.E.; Langer, R.; Anderson, Daniel G.; Belfort, G. High Throughput Membrane Surface Modification to Control NOM Fouling. Environmental Science and Technology, Vol. 43, No. 10, 3865–3871 (2009).
4. Kilduff, J.E. (with the AAEE Environmental Engineering Body of Knowledge Working Group). Environmental Engineering Body of Knowledge: Summary Report. Environmental Engineer: Applied Research and Practice. Vol. 44, No. 3, 21-33 (2008).
5. Tan, Y.; Kilduff, J.E.; Karanfil, T. Natural Dissolved Organic Matter Removal and Subsequent Disinfection Byproduct Formation: A Comparison of Ion Exchange and Activated Carbon. Chapter in Occurrence, Formation Health Effects and Control of Disinfection By-Products in Drinking Water. T. Karanfil, S.W. Krasner, P. Westerhoff, and Y. Xie, Eds. American Chemical Society Symposium Series, Washington, DC, 2008.
6. Tan, Y.; Kilduff, J.E. Factors affecting selectivity during dissolved organic matter removal by anion-exchange resins. Water Research, 41: 4211-4221 (2007).
7. Kilduff, J. Membrane Processes for Disinfection By-Product Formation Control. Chapter in Advances in Control of Disinfection By-products in Drinking Water Systems. Nikolau, A.; Rizzo, L.; Selcuk, H., Eds. Nova Science Publishers (2007) ISBN-10: 1600213227.
8. Pimenta, A.C.O.; Kilduff, J.E. Oxidative Coupling and the Irreversible Adsorption of Phenol by Graphite. Journal of Colloid and Interface Science, 293 (2006) 278–289.
9. Tan, Y.; Kilduff, J.E.; Kitis, M.; Karanfil, T. Dissolved Organic Matter Removal and Disinfection Byproduct Formation Control Using Ion Exchange. Desalination 176: 189–200 (2005).
10. Kilduff, J.E.; Mattaraj, S.; Zhou, M.; Belfort, G. Kinetics of Membrane Flux Decline: The Role of Natural Colloids and Mitigation via Membrane Surface Modification. Journal of Nanoparticle Research 7: 525–544 (2005).

VIII. Professional and Public Lectures

- Presentations at Professional Meetings (77)
- Invited Lectures and Seminars (12)

IX. Honors and Awards

The Earle Riggs Graduate Fellowship, University of Michigan (1987); Collingwood Prize, the American Society of Civil Engineers (American Society of Civil Engineers, 1990); Winner, the Shimizu Essay Contest, the Shimizu Corporation and the American Society of Civil Engineers (1992); Outstanding Achievement Award, University of Michigan, College of Engineering (1992); Basic Research Fellowship, American Society of Civil Engineers (1993); Academic Achievement Award, Doctoral Thesis, American Water Works Association (1996); National Science Foundation Faculty Early Career Development

 

(CAREER) Award (2000); Rensselaer Young Faculty Research Award (2001); University of Connecticut Department of Civil and Environmental Engineering Distinguished Alumni Award (2004); American Chemical Society Graduate Student Award in Environmental Chemistry (2008) awarded to Mingyan Zhou, PhD candidate. Tau Beta Pi National Engineering Honor Society , Chi Epsilon Civil Engineering Honor Society, Sigma Xi Research Society

 

## Appendix D

**Table 1 Summarized Water Testing Data Jan-Aug 2012**

| Name | Date | pH | Temperature (F) | Total Coliform (MPN/100ml) | Fecal Coliform (MPN/100ml) | Heterotrophic Coliform (CFU/ml) |
|---|---|---|---|---|---|---|
| Method | N/A | Colorimetric/EPA9040B | Glass Thermometer | APHA - Standard Methods | APHA - Standard Methods | APHA - Standard Methods |
| Covered Well | 8/20/2012 | N/A | N/A | 2.40E+04 | 1.50E+03 | 2.70E+05 |
| School Rainwater | 8/20/2012 | N/A | N/A | 36 | <30 | 1.10E+05 |
| Pure Rainwater | 8/12/2012 | 5 | 79 | N/A | N/A | N/A |
| Black School Tank | 8/15/2012 | 5.5 | 85 | N/A | N/A | N/A |
| Church Tank | 8/15/2012 | 6 | 85 | N/A | N/A | N/A |
| Black Medical Center Tank | 8/15/2012 | 9 | 85 | N/A | N/A | N/A |
| Covered Well A | 8/15/2012 | 7 | 85 | N/A | N/A | N/A |
| Covered Well B | 8/17/2012 | 6 | 70 | N/A | N/A | N/A |
| Ojo de Agua | 8/18/2012 | 7 | N/A | N/A | N/A | N/A |
| School 1 | 01/xx/2012 | 5 | 82 | N/A | N/A | N/A |
| School 2 | 01/xx/2012 | 5 | 82 | N/A | N/A | N/A |
| Medical Center (Cloth Cover) | 01/xx/2012 | 6 | 82 | N/A | N/A | N/A |
| Church (Screen Cover) | 01/xx/2012 | 6 | 83 | N/A | N/A | N/A |
| Mangrove | 01/xx/2012 | 9 | 82 | N/A | N/A | N/A |
| Covered Well | 01/xx/2012 | 6 | 82 | N/A | N/A | N/A |
| Uncovered | 01/xx/2012 | 7.5 | 82 | N/A | N/A | N/A |

| | | | | | | |
|---|---|---|---|---|---|---|
| Well | | | | | | |
| Kate's House (Dirty/not cleaned tank) | 01/xx/2012 | 6 | 82 | N/A | N/A | N/A |
| Cleaned Tank | 01/xx/2012 | 7 | 84 | N/A | N/A | N/A |
| Dirty roof | 01/xx/2012 | 6 | 85 | N/A | N/A | N/A |
| Visitor's Hut (Small roof) | 01/xx/2012 | 6 | 82 | N/A | N/A | N/A |
| New zinc roof (Small roof) | 01/xx/2012 | 7 | 82 | N/A | N/A | N/A |
| Bottled water (Control) | 01/xx/2012 | 7 | 82 | N/A | N/A | N/A |

**Table 2 Summarized Water Testing Data Jan-Aug 2012 (cont.)**

| Name | Alkalinity (ppm) | Nitrate (ppm) | Nitrite (ppm) | Arsenic (ppb) | Chlorine | Conductivity (µS/cm) |
|---|---|---|---|---|---|---|
| Method | N/A | Colorimetric/EPA9040B | Glass Thermometer | APHA - Standard Methods | APHA - Standard Methods | APHA - Standard Methods |
| Covered Well | N/A | N/A | N/A | N/A | N/A | N/A |
| School Rainwater | N/A | N/A | N/A | N/A | N/A | N/A |
| Pure Rainwater | 0 | 0 | 0 | 0 | N/A | N/A |
| Black School Tank | 0 | 0.5 | 0 | 0 | N/A | N/A |
| Church Tank | 60 | 0 | 0 | 30 | N/A | N/A |
| Black Medical Center Tank | 120 | 0 | 0 | 40 | N/A | N/A |
| Covered Well A | 180 | 2 | 0 | 70-100 | N/A | N/A |
| Covered Well B | 0 | 1 | 0 | 30 | N/A | N/A |

| | | | | | | |
|---|---|---|---|---|---|---|
| Ojo de Agua | N/A | 0 | 0 | 50, 70 (repeated) | N/A | N/A |
| School 1 | 0 | 0 | 0 | 0? | 0 | N/A |
| School 2 | 0 | 0 | 0 | 50 | 0 | N/A |
| Medical Center (Cloth Cover) | 10 | 0 | 0 | 30 | 0 | N/A |
| Church (Screen Cover) | 0 | 0 | 0 | 50 | 0 | N/A |
| Mangrove | 80-240 | 0 | 0 | 20 | 0 | N/A |
| Covered Well | 20 | 3 | 0 | 70-300 | 0 | N/A |
| Uncovered Well | 20 | 1 | 0 | 70-150 | 0 | N/A |
| Kate's House (Dirty/not cleaned tank) | 0 | 0 | 0 | 20 | 0 | N/A |
| Cleaned Tank | 0 | 0 | 0 | 0 | 0 | N/A |
| Dirty roof | 40 | 0 | 0 | 30 | 0 | N/A |
| Visitor's Hut (Small roof) | 0 | 0 | 0 | 30-70 | 0 | N/A |
| New zinc roof (Small roof) | 0 | 0 | 0 | N/A | 0 | N/A |
| Bottled water (Control) | 0 | 0 | 0 | 0 | 0 | N/A |

**Table 3 Summarized Water Testing Data Jan-Aug 2012 (cont.)**

| Name | Sulfates (mg/L) | Turbidity (NTU) | Total Solids (mg/L) | Suspended Solids (mg/L) |
|---|---|---|---|---|
| Method | SM4500-SO42-E/Colorimetric | SM2130B | SM2540B | SM2540D |
| Covered Well | 2.68 | 75.9 | 198 | 128 |
| School Rainwater | 1.14 | 1.02 | 96 | 39 |
| Pure Rainwater | N/A | N/A | N/A | N/A |
| Black School Tank | N/A | N/A | N/A | N/A |
| Church Tank | N/A | N/A | N/A | N/A |
| Black Medical Center Tank | N/A | N/A | N/A | N/A |
| Covered Well A | N/A | N/A | N/A | N/A |
| Covered Well B | N/A | N/A | N/A | N/A |
| Ojo de Agua | N/A | N/A | N/A | N/A |
| School 1 | N/A | N/A | N/A | N/A |
| School 2 | N/A | N/A | N/A | N/A |
| Medical Center (Cloth Cover) | N/A | N/A | N/A | N/A |
| Church (Screen Cover) | N/A | N/A | N/A | N/A |
| Mangrove | N/A | N/A | N/A | N/A |
| Covered Well | N/A | N/A | N/A | N/A |
| Uncovered Well | N/A | N/A | N/A | N/A |
| Kate's House (Dirty/not cleaned tank) | N/A | N/A | N/A | N/A |
| Cleaned Tank | N/A | N/A | N/A | N/A |

| | | | | |
|---|---|---|---|---|
| Dirty roof | N/A | N/A | N/A | N/A |
| Visitor's Hut (Small roof) | N/A | N/A | N/A | N/A |
| New zinc roof (Small roof) | N/A | N/A | N/A | N/A |
| Bottled water (Control) | N/A | N/A | N/A | N/A |

**Tables Table 1, Table 2, and**

Table 3 summarize the data collected during the previous two assessment trips (January 2012 and August 2012). August 2012 is colored green (top), and January 2012 is colored blue (bottom). The covered well and school rainwater samples were tested by The University of Panama Lab. All other testing was performed by EWB-RPI with colorimetric strips. The reader may note that there are multiple entries with the same or similar names (e.g. covered well, covered well A, and covered well B). While these repeated data are meant to give an understanding of the water qualities of a certain water source, they are reported separately to show that they were not collected at the same source

 