

GW1 Scope of Work



Brigham Young University

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GW1

Introduction

GW1 is a team of Brigham Young University (BYU) students that are working with water resource engineers in the Dominican Republic to come up with solutions to groundwater problems in the Dominican Republic. The Dominican Republic is located on the island of Hispaniola in the Caribbean. Their water is obtained from aquifers located on the island. When too much water is pumped out of the aquifers, saltwater is drawn into the aquifer which causes problems with water quality. Proposed new agriculture projects of Baigua I and Baigua II may cause problems with salt intrusion and water quality but would also benefit local farmers. The general objective of the engineers in the Dominican Republic is to evaluate the position of the interface between the fresh and salt water to estimate the concentration of chlorides in the wells that will be used for the agriculture projects of Baigua I and Baigua II. GW1 will facilitate the Dominican engineers in making informed decisions regarding Baigua I and Baigua II.

Understanding and Approach to Project

The coastal aquifer of Baigua is located in the municipality of Baigua, San Rafael de Yuma in the province of Altagracia in the Dominican Republic. This aquifer has an area of 560 km². On the surface of this system there are two agricultural production projects—Baigua I and II—whose main focus is the cultivation of short cycle products with high levels of salinity (spinach, lettuce, tomatoes, peppers, cabbage, and papaya). These projects seek to give incentives to small farmers in the community who have limited access to land and water.

The main water source of this project is a well field, which is pumped to feed the irrigation systems. In the period of 2005 - 2007 these wells were subjected to chemical analysis of water quality and measurements of electrical conductivity at different depths to estimate the salinity profiles and determine the position of the interface. The measurements of electrical conductivity at different depths proved that the chlorides present in groundwater evolve as a function of depth.

The Dominican Republic has collected data on electrical conductivity and concentration of different salts at wells that are part of the aquifer of Baigua. The information is located in a database but there is little organization of the data to make it useful. A way to manage and visualize the data is needed to determine where more data is needed, what data should be collected, and how often the data should be collected. The GW1 team is currently working on putting data into ArcHydro in ArcGIS to help the engineers in the Dominican Republic visualize the evolution of chlorides in the aquifer. In the past, foreign companies have brought in computer programs and helped with projects but did not provide adequate training so that the projects could continue without the help of foreign companies. The goal of GW1 is to show the engineers in the Dominican Republic what they can do with the data they are collecting and how to use the resources available to them so they can solve problems with less need for outside help.

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Specific Objectives

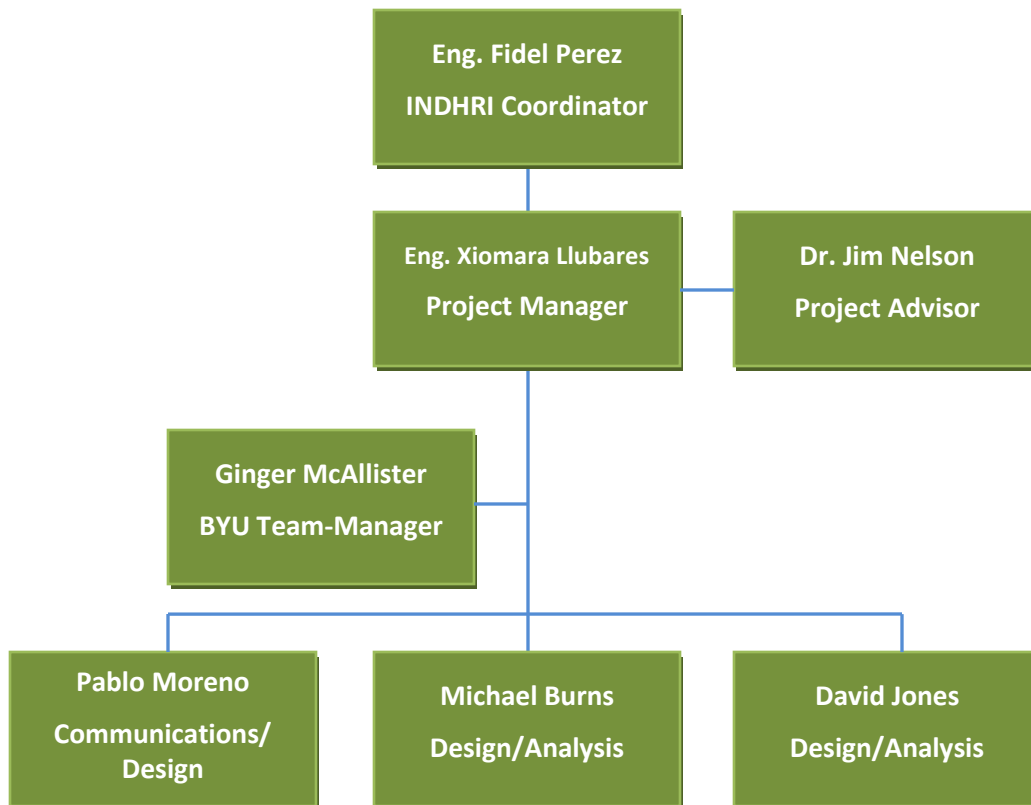
The specific objectives of the BYU GW1 team are:

- a) Teach the Dominican Republic team how to use ArcGIS to visualize and organize data
- b) Demonstrate the capabilities of GMS to model salt intrusion
- c) Help determine gaps in data and the most effective way to collect more data

ArcHydro in ArcGIS will help the Dominican Republic team organize and visualize the data they currently have available. The sample model in GMS will be used to show what can be done in the future with more data. This will help determine what data is needed for present and future goals so that data collection can be done as efficiently as possible. The hope of the BYU GW1 team is that this will help the team in the Dominican Republic achieve their objectives. The specific objectives of the Dominican Republic team are:

- a) Monitor the quality of the water in the aquifer
- b) Model the concentration of chlorides in the study zone
- c) Determine if the chloride concentrations are rising in the area

Project Team



GW1

Ginger McAllister:

Ginger is a civil engineering graduate student at BYU. She currently works as a teaching assistant for the course of Elementary Soil Mechanics. She also worked as a research assistant for a project on Hobble Creek. She has completed courses in Groundwater Modeling, Hydraulics, and Fluid Mechanics.

Pablo Moreno:

Pablo is a civil engineering graduate student at BYU. He has experience in testing and analysis of data. He currently works as a teaching assistant for the course of *Materials Science*. Also he is a research assistant for the Deer Creek team. He has worked on different projects in Mexico and China. He also worked as an intern in Chile collecting data for the design of landfills. He is currently taking a WMS course. He has completed courses on Hydrology and Hydraulics.

Michael Burns:

Michael is a senior studying civil engineering at BYU. He has completed Groundwater Modeling, Engineering Applications of GIS, Hydrology, and Environmental Engineering. He is also an EIT.

David Jones:

David is a senior studying civil engineering at BYU. He has completed Groundwater Modeling, Engineering Applications of GIS, and a GIS course offered by the geography department. His coursework experience also includes hydrology and environmental engineering.

Scope of Work and Schedule

The work to reach our objectives includes:

1. Data collection – Data pertinent to the study zone will be collected from the Dominican Republic counterparts. The data that will be needed includes well locations, groundwater depths, bore hole data (including soil properties at depth), salinity concentrations, well pumping rates, frequency and duration of pumping. This data will be requested and then sent via email or other necessary internet data transfer. Additional data or metadata will be requested if necessary via email and then sent via similar means as the initial data.
2. Data analysis – Data retrieved for the project will be analyzed to assess usability to accomplish the project objectives.
3. Data organization – Once the data is analyzed it will be placed into appropriate tables so that it can be imported in GIS and utilized in GMS or any other modeling software.
4. Project presentation – The project will be presented to the engineers in the Dominican Republic in such a way that they will be able to constructively utilize the models we create as well as continue to learn and perfect the use of the modeling software and data management we introduce to them.

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Cost Proposal

Task Schedule	Faculty Mentor: Dr. Nelson or Dr. Jones	Project Manager: Ginger McAllister	Student Designer: Pablo Moreno	Student Designer: Michael Burns	Student Designer: David Jones	Survey	CAD Tech	Clerical
Examine Capabilities of GIS with Arc Hydro GW	\$75	\$60	\$60	\$60	\$60	\$50	\$40	\$35
Find Ideal Method for Inputting Data								4
Create Time Series Plots of Chlorides Concentrations							2	
Create Raster Interpolations for Chloride Concentrations							5	
Investigate Additional GIS Capabilities (3D Analysis, Animation)		4	4	8	8			
Create or Translate Tutorials		2	8	2	2			
Examine Capabilities of GMS								
Visualize Subsurface Data (borehole data)		5		5	5			
Create Sample Groundwater Model	1	20	5	15	15			
Create or Translate Tutorials		2	8	2	2			
Visit the Dominican Republic								
Collaborate		2	4	2	2			
Demonstrate Data Visualization Options			2					
Recommend Data Management System			2					
Recommend Additional Data to Collect		2	4	2	2			
Final Presentation								
Written Report		2	2	2	2		2	
Poster							2	3
Total Hours	1	39	39	38	38	0	11	7
Cost	\$75	\$2,340	\$2,340	\$2,280	\$2,280	\$0	\$440	\$245
Total Cost					\$10,000			

Summary

As the GW1 team develops the data for the area of study in the Dominican Republic they will develop a view of how the data should be maintained in the Dominican Republic so that the local engineers can continue to develop the data in the study area. The team will also be able to develop models to characterize the data that is collected. They will then be able to demonstrate to the local engineers how they can use the same modeling tools to visualize the data how they wish. Overall, the work of the GW1 team will improve the processes by which the local engineers in the Dominican Republic manage and monitor their wells and in general their groundwater.