

FLOOD EARLY WARNING
Project ID: CEE_n_2018CPST-DR-003

by

WEL Water
Chris Edwards
Jacob Lewis
Hunter Williams

A Capstone Statement of Work

Submitted to

Fidel Perez
INDRHI

Department of Civil and Environmental Engineering
Brigham Young University

October 8, 2018

Introduction

PROJECT TITLE: FLOOD EARLY WARNING
PROJECT ID: CEEEn_2018CPST_DR_003
PROJECT SPONSOR: INDRHI
TEAM NAME: WEL Water

The goal of this Capstone project is to create a GIS database that can be used to predict floods in the Dominican Republic. This will allow INDRHI (Instituto Nacional de Recursos Hidráulicos) officials to send timely warnings to citizens living in affected areas. The database will not be expected to create warnings on its own; rather, it should be easily integrated into existing online dashboards, and assist in data consolidation. In an effort to achieve this goal, team members will spend weekly meetings familiarizing themselves with datasets, such as ONAMET (Oficina Nacional de Meteorología) and NOAA (National Oceanic and Atmospheric Administration) precipitation forecasts, and programs, such as ArcGIS Pro, in order to create said database. Team members will meet with INDRHI officials in November to better understand the requirements of INDRHI. Weekly reports will be taken to measure team progress throughout the semester, with an expectation that 30% of the project will be completed by December 6, 2018. Team members will travel to the Dominican Republic in January 2019 in order to receive direct feedback from INDRHI officials. It is expected that teams will spend October to December of 2018 simply learning the tools necessary for the project.

Proposed Work Plan

During our weekly meetings, our team will gather either in a study room or a CAEDM laboratory on the campus of Brigham Young University to explore and seek to understand the data that is available for use. This will include a familiarity with NOAA, GFS (Global Forecast System), and ONAMET data, which includes precipitation forecasts, historical precipitation, and historical streamflow data for the Dominican Republic. Throughout this process, other types of data may also be found and utilized.

The team will test the compatibility of this data with ArcGIS software to create different layers and functions that can be used to predict flooding in the Dominican Republic. Since we will not meet with the representatives from the country until November 6-8 and again upon visit to the country, all work will be used to prepare ideas focused on the use of the data, ArcGIS, and other software (such as HVH) to best fit the needs of the country.

While performing this research, our team will be in contact with Fidel Perez via email. Fidel is the focal point of contact with the team in the Dominican Republic. As we produce ideas, we will send them to Fidel to verify if they meet the scope that he needs. Fidel and other representatives from the country will come to the U.S. from November 6-8, at which time we will meet and organize a clear scope and expectations of the project.

At the end of January, our team will make a ten day visit to the Dominican Republic to present our ideas pertaining to the use of the data and software mentioned above and collect feedback. At that time, we will solidify the scope and define the deliverables that our team will create.

Upon our return to the U.S., our team will continue to meet weekly to produce the promised deliverable items, which will be ready for use by the team in the Dominican Republic by April 25, 2019.

Schedule

Important Dates:

- Nov 6-8: INDRHI visit at BYU
- December 10: 30% Completion Report
- Jan 25 – Feb 3: Visit to the Dominican Republic
- April 8-12: Final Project Presentation

Pre-visit weekly meetings, held Thursdays at 8:00 AM:

- Oct 11
 - Real-time precipitation data from operating stations
 - Shapefiles of rivers, watershed divisions, and provinces
 - Request example of bulletin
- Oct 18
 - NOAA GFS Precipitation Forecast
 - Transfer forecast to contours
- Oct 25
 - ONAMET Precipitation Forecast
 - Transfer forecast to contours
- Nov 1
 - Preparation for meeting with INDRHI
- Nov 8
 - Hydrographs from Hec-HMS and GSSHA for GFS and ONAMET forecasts
- Nov 15
 - Meeting with Dr. Amanda Hughes from IT
 - Flood Tags
- Nov 29:
 - Investigate additional data, such as Landsat aerial imagery
- Dec 6
 - Review 30% Completion Report
- Jan 10:
 - Review previously studied data-sets to determine which will be most helpful
- Jan 17:
 - Preparation for site visit
 - Presentation of how investigated data can be useful to INDRHI for flood warning
- Jan 24:
 - Final preparations for site visit

Post-visit tasks:

- Develop GIS that compiles each dataset to help inform decision makers
- Prepare data to be added to an online dashboard
- Validation of BYU Stream Flow Prediction Tool in the Dominican Republic
- Prepare final poster
- Prepare final presentation

Facilities, Tools, Data and Equipment

Facilities:

- **BYU**
 - BYU facilities, such as the CAEDM lab and Engineering Building study rooms, will be used for team meetings as well as data research and compilation.
- **INDHRI**
 - INDHRI facilities in the Dominican Republic will be used in meeting with INDHRI officials.

Tools:

- **ArcGIS Pro**
 - ArcGIS Pro will be used to combine various layers of data into a final deliverable.
- **Tethys Portal**
 - BYU's Tethys Portal will be used for data collection.
- **Floodtags.com**
 - Floodtags.com will be used to assist with flood tracking and warning using social media.
- **HydroServer Lite**
 - HydroServer Lite will be used for data collection.

Data:

- **OMANET/NOAA/NWS**
 - Weather and precipitation forecasts from the Oficina Nacional de Meteorologia, National Oceanic and Atmospheric Association, and National Weather Service will be analyzed to establish weather and flooding patterns.
- **Other shapefiles**
 - Various other shapefiles will be found to assist with the project. These may include rivers, streams, water levels, vegetation, etc.

Equipment:

- It is not anticipated that any specialized equipment will be necessary for the completion of this project. Computers will be used for the analysis and manipulation of acquired data.

Project Budget

Team Meetings:

- Team meetings will occur weekly until the final deliverables are presented.
- Each meeting is estimated to take 60-75 minutes.
- The total estimated meeting time is 25 hours.

Data Research:

- To understand each of the datasets mentioned above, research will be conducted outside of meeting times.
- This research needs to be completed by January 25, 2018.
- The total estimated research time is 40 hours.

Reports and Presentations:

- Weekly reports will be completed as part of team meetings.
- The 30% Completion report will be a summary of the first 3 months of work.
- The first 3 weeks of January will be used to prepare to present researched data to INDRHI during the site visit.
- The final presentation and will be completed during the ten weeks following the site visit.
- The total estimated time for preparing reports and presentations (excluding the weekly reports) is 40 hours.

Site Visit

- The duration of the site visit will be 10 days, including travel.
- This is estimated to include 6-7 work days, or 50 hours.

Final Deliverables:

- The final product will include GIS and perhaps a web-based dashboard.
- This will be developed during the 10 weeks following the site visit.
- The total estimated time is 120 hours.

Total Hours:

- The current total estimated time for this project is 280 hours.

Deliverables

The deliverables for this project include:

1. Short, regular status reports documenting challenges, solutions, and progress.
2. A presentation summarizing recommendations of datasets to use for flood warning, delivered during the site visit in January.
3. A GIS database for use of decision makers containing each desired dataset. This data will be prepared such that it can be added to an online dashboard.
4. A final report summarizing the GIS data and functionality.
5. A poster reflecting a summary of the project.
6. A presentation given to the client summarizing the findings of the project.

Performance Standards

Team will provide work for this Capstone project “as is” using best practices and with best effort. Project results cannot be construed as work performed by licensed professionals and cannot be used as “stamped deliverables” without first being reviewed, approved and stamped by a qualified and relevant license professional engineer.

Statement of Qualification

Dr. Jim Nelson:

Dr. Nelson is a professor in the Civil and Environmental Engineering Department in the Ira A. Fulton School of Engineering at Brigham Young University. He has worked at the school since 1989. He holds a Bachelor's Degree, Master's Degree, and Ph.D. of Science in Civil and Environmental Engineering from Brigham Young University. He is the primary architect of the Watershed Modeling System (WMS) used by thousands of government, education, and private institutions worldwide. He specializes in Hydrology and GIS systems.

Fidel Perez:

Fidel is the head of the Department of Hydrology at the Dominican National Institute of Water Resources.

Jason Biesinger:

Jason is Master's Student at Brigham Young University, working under Dr. Nelson. Jason has been working with the Dominican National Institute of Water Resources to develop software tools intended to make data analysis easier.

Amanda Hughes:

Amanda is an Assistant Professor of Information Technology at Brigham Young University. She holds a bachelor's degree in Computer Science from BYU and a Master's degree and Ph.D. in Computer Science from the University of Colorado Boulder. She is a recognized research leader in Crisis Informatics.

Corey Krewson:

Corey is a Master's student at Brigham Young University who works with Dr. Nelson.

Rohit Khattar:

Rohit is a Ph.D. student at Brigham Young University who works with Dr. Nelson

Chris Edwards, Jacob Lewis, and Hunter Williams:

Chris, Jacob, and Hunter are undergraduate students at Brigham Young University in their senior year, each pursuing bachelor's degrees in Civil and Environmental Engineering.

Appendix A

Christopher Edwards

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Education

CIVIL ENGINEERING | BRIGHAM YOUNG UNIVERSITY | APRIL 2019

- Current GPA: 3.99
- Minor: Business Management

Work Experience

HYDROINFORMATICS RESEARCH ASSISTANT | BYU | MAY 2018 – PRESENT

- Delineated watersheds using ArcGIS Software to simulate streamflow in specific areas
- Analyzed historical streamflow simulations using Python to validate forecasting model

CIVIL ENGINEERING INTERN | BYU PHYSICAL FACILITIES | APRIL 2016 – APRIL 2018

- Produced plans for a \$100,000 house demolition and parking lot construction project
- Updated campus maps in AutoCAD to provide accurate reference for future projects
- Standardized construction details in AutoCAD to ensure uniform work across campus
- Aided in the design of campus construction projects not outsourced to a contractor

OFFICE ASSISTANT | BYU CENTER FOR SERVICE AND LEARNING | JANUARY – APRIL 2016

- Verified the completion of student leadership training programs to uphold club standards
- Managed legal agreements between BYU and external organizations to protect student liability

CREW SUPERVISOR | BYU CAMPUS CHICK-FIL-A | JULY – DECEMBER 2015

- Directed and trained a team of 12 employees to sell over \$500 of food per hour
- Ensured prompt service and conducted quality control to enhance customer satisfaction

Volunteer Experience

ASCE CLUB OFFICER | BYU STUDENT CHAPTER | JANUARY 2018 – PRESENT

- Organized bimonthly STEM program for kids through United Way at a local community center
- Constructed steel footbridge in Saratoga Springs to give children access to a new playground

MISSIONARY | THE CHURCH OF JESUS CHRIST OF LATTER-DAY SAINTS | MAY 2013 – 2015

- Learned to speak conversational Spanish fluently in Asuncion, Paraguay
- Managed visas and return travel for more than 200 missionaries

Jacob Lewis

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801-919-7425 | jmlewis317@gmail.com

EDUCATION

Brigham Young University (BYU) <i>Bachelor of Science in Civil Engineering</i> <ul style="list-style-type: none">Member of the BYU ASCE Networking Committee	Provo, UT April 2019
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WORK EXPERIENCE

BYU Physical Facilities <i>Civil Engineering Intern</i> <ul style="list-style-type: none">Created drawing sets in AutoCAD Civil 3D for campus projects costing more than \$100,000Maintained drawings of campus utilities through daily surveys with GPS and Total Station equipmentTrained new interns in surveying and AutoCAD	Provo, UT August 2016 – Present
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BYU Physical Facilities <i>Hardscape Construction Worker</i> <ul style="list-style-type: none">Constructed heavy landscape projects such as retaining walls and planter beds on BYU campusWorked with a team to meet deadlines and effectively use construction materials	Provo, UT April 2016 – August 2016
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BYU Police Department <i>Senior Building Security Student Officer</i> <ul style="list-style-type: none">Patrolled campus nightly to ensure security of campus buildings and equipmentEntrusted with access to multi-million-dollar campus laboratories and equipmentOrganized trainings and scheduling for 20 student officers	Provo, UT August 2014 – April 2016
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Barrick Gold Corporation <i>Student Surveyor</i> <ul style="list-style-type: none">Completed daily surveys of active mining areas, and drew daily dig plans for mining shovelsPerformed 2 to 3 daily stakeouts of gold ore deposits using GPS surveying equipment	Carlin, NV May 2011 – August 2011 and May 2014 – August 2014
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OTHER RELEVANT EXPERIENCE

Volunteer Service Representative <i>The Church of Jesus Christ of Latter-day Saints</i> <ul style="list-style-type: none">Worked 10-12 hours daily speaking with others in SpanishDeveloped leadership, managerial, and interpersonal relations skillsCollaborated with other volunteers to present trainings on goal-setting, problem-solving, etc.	San Pedro Sula, Honduras February 2012 – March 2014
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SKILLS

Technical Skills: Microsoft VBA programming, AutoCAD Civil 3D, Bluebeam Revu
Languages: Spanish

Hunter Williams

hrw819@gmail.com

(480) 532-4634

Provo, Utah

Work Experience

AutoCAD Designer, *R.B. Williams & Associates, Inc. | Phoenix, AZ* Feb 2016-Present

- Designed over 50 grading plans for commercial developments
- Completed earthwork assessments and drainage calculations for development projects
- Prepared complete plan sets for submittal to clients and municipalities
- Addressed technical problems noted by clients and municipalities
- Communicated effectively with clients, design professionals, and municipal authorities
- Trained co-workers to use AutoCAD to create effective project designs and plan sets

Backroom Associate/Shift Lead, *DownEast Outfitters | Orem, UT* Feb 2015-Jan 2016

- Processed and organized furniture inventory for in store use and deliveries
- Planned delivery routes and scheduled delivery dates and times
- Analyzed daily cash flow including sales, refunds, credits, and mischarges
- Trained co-workers to perform cash flow analyses

Sales Consultant, *Pane Frei Window Cleaning | Gilbert, AZ* Feb 2015-Jun 2015

- Advertised products to over 500 potential clients
- Prepared service cost estimates for clients
- Scheduled appointments for two technician teams

Education

Bachelor of Science, *Brigham Young University (BYU) | Provo, UT* Dec 2019

- Major: Civil and Environmental Engineering
- Passed Fundamentals of Engineering Exam (FE) Mar 2018

Volunteer Experience

Service Mission Feb 2013-Feb 2015

- Planned and lead multiple training conferences for 250 volunteers (age range: 18-75)
- Coordinated housing, transportation, and material needs for 250 volunteers
- Communicated daily with people of varying backgrounds, social positions, and economic statuses