FLOOD MAPPING
Project ID: CEEn_2018CPST_DR_004

by

The Flood Stoppers
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A Capstone Statement of Work

Submitted to

Fidel Perez
INDRHI – Instituto Nacional de Recursos Hidráulicos

Department of Civil and Environmental Engineering
Brigham Young University

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Introduction

PROJECT TITLE: FLOOD MAPPING
PROJECT ID: CEEn_2018CPST_DR_004
PROJECT SPONSOR: INDRHI – Instituto Nacional de Recursos Hidráulicos
TEAM NAME: The Flood Stoppers

The main purpose of this project is to explore and monitor flooding in certain regions of the Dominican Republic in order to provide tools to raise awareness of the negative socioeconomic impact that the floods have in the country. This project will explore the utility of the HAND procedures currently in development and will help compile population density and infrastructure layers to assess the impact and damages costs. Moreover, the project will explore the use of satellite imagery together with model data to validate and monitor real-time floods. The group will also continue validation exercises of the streamflow prediction ECMWF forecasts.

To accomplish the goal mentioned, the team will develop an app which will facilitate and enable the tracking of floods data. Additionally, the group will provide progress reports and a PowerPoint presentation to present the results. The four main milestones of the project are meeting with INDRHI representative (milestone I), the 30% completion report (milestone II), trip to the Dominican Republic to implement the project (milestone III), and submit final presentation, report, and presentation for approval (milestone IV). Milestone I has a due date on November 15th, 2018. Milestone II due date is December 12th, 2018, Milestone III begins on January 25th, 2019, and Milestone IV due date is April 11th, 2019.

Proposed Work Plan

The most important deliverable of the project is the web-based application that will be installed on INDRHI's (Instituto Nacional de Recursos Hidraúlicos) Tethys portal. This application will build off the work of Corey Krewson, a BYU graduate student. The creation of the app will constitute of at least the following steps:

- Gather GIS data on the socioeconomic characteristics of the Dominican Republic.
- Upload the data to Geoserver in a format that is usable by the application.
- Determine the best way to analyze the economic impact of a forecasted flood.
- Create an interface for a web-based application that shows forecasted flood maps and the associated socioeconomic impacts.
- Connect the application to the Streamflow Prediction Tool to create dynamic flood maps.
- Create an algorithm to compute a description of the socioeconomic impact of the predicted flood.
- Create a presentation and final report documenting the results of the project.
- Translate all reporting material into Spanish.

Most of the work for this project will be performed on BYU campus in association with the BYU Hydroinformatics Lab. In-person meetings with the sponsor will be held in Provo during the week of November 12-15 and in the Dominican Republic during the week of January 28-February 1. Team meetings will be held weekly in the BYU Engineering Building to discuss work progress and challenges.

The project will be completed when INDRHI has been delivered a web-based application that predicts and describes flooding by creating detailed flood maps for forecasted storms in the Dominican Republic. These flood maps will describe both the geographic area affected by upcoming flooding, the socioeconomic characteristics of that area, and socioeconomic impact of the potential floods.

Schedule

Week	Milestones
10/08/18-10/12/18	• Submit our statement of work. • Meet with Corey Krewson and discuss his current progress with the app, as well as how we might be able to build on it to include the impacts of flooding in the Dominican Republic. • Start to build a specification manual of what we want to have to app accomplish, and how we are going to do that. • Weekly Progress Meeting.
10/15/18-10/19/18	• Submit our regular status report 2. • Research more specific details on the open source software and data we will need to build our application. • **Wade and Dan**: Research server we can use to store the data that we are provided. • **Jared and Seth**: Research open source GIS software that we can use to do spatial analysis. • Weekly Progress Meeting.
10/22/18-10/26/18	• Submit our regular status report 3. • Continue to research more into open source software and how we can implement it into our app. • Weekly Progress Meeting.
10/29/18-11/02/18	• Finish spec and start to run testing on what we have found. • Submit our regular status report 4. • Weekly Progress Meeting.
11/05/18-11/09/18	• Submit our regular status report 5. • Weekly Progress Meeting.
11/12/18-11/16/18	• Continue to build a working model of our GIS model that we will use to perform analysis. • Submit our regular status report 6. • Meet with sponsor. • Weekly Progress Meeting.
11/19/18-11/23/18	• Continue to build a working model of our GIS model that we will use to perform analysis. • Submit our regular status report 7. • Weekly Progress Meeting.
11/26/18-11/30/18	• Continue to build a working model of our GIS model that we will use to perform analysis. • Submit our regular status report 8. • Weekly Progress Meeting.
12/03/18-12/07/18	• Continue to build a working model of our GIS model that we will use to perform analysis. • Weekly Progress Meeting.

12/10/18-12/14/18	• Submit our 30% completion report.
01/07/19-01/11/19	• Weekly Progress Meeting.
01/14/19-01/18/19	• 20% app completion. • Weekly Progress Meeting.
01/21/19-01/25/19	• Weekly Progress Meeting. • Go over and finalize deliverables.
01/28/19-02/01/19	• Go to the Dominican Republic.
02/04/19-02/08/19	• 40% app completion. • Weekly Progress Meeting.
02/11/19-02/15/19	• Weekly Progress Meeting.
02/18/19-02/22/19	• 60% app completion. • Weekly Progress Meeting.
02/25/19-03/01/19	• Weekly Progress Meeting.
03/04/19-03/08/19	• 80% app completion. • Weekly Progress Meeting.
03/11/19-03/15/19	• Weekly Progress Meeting.
03/18/19-03/22/19	• 100% app completion. • Weekly Progress Meeting.
03/25/19-03/29/19	• Debug app and test user interface. • Weekly Progress Meeting.
04/01/19-04/05/19	• Weekly Progress Meeting. • Prepare for Final Presentation
04/08/19-04/12/19	• Final Presentation
04/15/19-04/19/19	
04/22/19-04/26/19	

Facilities, Tools, Data and Equipment

The primary tool required to complete this project is a computer with the necessary software. Most of the software used will be open source. This includes the Tethys Platform that has been created by the BYU Hydroinformatics Lab. This platform will be used to create and host the application. The primary private software program that will be used is ESRI's ArcMap. This will be used to format and edit the collected GIS data for the Dominican Republic. Licenses for this program are provided free of charge to BYU students through the university. The data that is used in the app will be provided by INDRHI or will be gathered through other open sources.

Project Budget

The project will be divided in 3 phases:

Phase I - Development of the app
This phase pertains to creating the app by communicating with the sponsor (INDHRI) to understand their needs and plan the implementation of the project. This phase will last about 4 months, 3 hours/week varying according to sponsor's needs. (October 1st – January 24th).

Phase II – Implementation of the project
This phase pertains to traveling to the Dominican Republic, meet with the sponsor and implement the app. This phase will last about 10 days, 8 hours/days varying according to sponsor's needs. (January 1st – February 3rd).

Phase III – Final report and presentation
This phase pertains to preparing the final report to send to the sponsor and presentation for civil engineer peers at the university. This phase will last about 3 months, 3 hours/week. (February 3rd – April 11rd).

Deliverables

- Short regular (i.e. monthly) status reports documenting challenges, solutions & progress which will include the following:
    - Answers to 4 questions:
        - What challenges have we encountered in our Capstone project?
        - What actions did we decided to do to overcome these challenges?
        - What progress have we made in overcoming these challenges?
        - Is the project on schedule?
    - A Summary of the progress and status of our Capstone Project
    - If the challenges we faced did negatively impact the progress of our project, a brief outline of how we plan to get back on track and overcome these challenges.
- A final report with design alternatives for the project that include economic and environmental considerations.
- A poster reflecting a summary of our project to be presented to students, faculty and other interested individuals in the final undergraduate seminar
- A presentation in the form of a PowerPoint presentation summarizing our project to be presented to your sponsor and at the final undergraduate seminar
- A final web application that can be used as a tool to determine the impact of flooding that may occur in the Dominican Republic. The web application will include documentation and examples for ease of use for those who are using it.

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.

Team Flood Stoppers will be held to the highest standards of accountability, ethical behavior, teamwork, communication, time management, problem solving, and student professionalism. First, our team will demonstrate a sense of responsibility for completing tasks, realize how our performance affects overall goals and objectives, and will work independently under limited supervision, while still asking enough questions to create a product that meets the expectations of our sponsor. Second, we will demonstrate integrity, honesty, and loyalty in the performance of all tasks. Next, our team will convey information, as appropriate, to all individuals, including supervisors, mentors, and sponsors while using clear, concise language to provide timely and accurate written and oral communication.

Fourth, our team will complete the agreed work on schedule, will display timeliness in the management of the product creation, will meet deadlines for the project, and will respond quickly to client needs. Next, we will demonstrate the ability to identify problems, present alternatives and creative solutions, assess consequences, and be flexible by being open to new and alternate ideas. Lastly, our team will handle ourselves in a manner that demonstrates expertise, integrity, and commitment to Brigham Young University goals for its students.

Statement of Qualification

- Cory Krewson - current Masters student at BYU developing a base flood mapping tool, mentor assigned to our team.
- Dr. Jim Nelson - current BYU Civil Engineering professor who teaches the majority of the water modeling classes. He is the professor in charge of leading the students going to the Dominican Republic this upcoming Winter.
- Wade Roberts - about 1.5 years of experience working at the BYU Hydroinformatics Lab.
- Jared Lillywhite - about 1 year of experience working at the BYU Hydroinformatics Lab, experience speaking Spanish.
- Dan Costa - Experience speaking Spanish, Senior studying Civil Engineering at BYU.
- Seth Barrus - Experience with water modeling software in multiple classes.

Appendix A

Seth Barrus

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OBJECTIVE: Obtain a full-time job in the Civil Engineering industry by Spring 2019

EDUCATION

Brigham Young University *Anticipated April 2019*
Provo, UT

- B.S. Degree – Civil Engineering
- GPA: 3.15
- Vice President of the BYU ASCE Student Chapter for 2018

RELEVANT COURSEWORK

- CE En 433 – Hydraulic Engineering
- CE En 531 – Hydrological Modeling
- CE En 551 – Water Facility Treatment Design

WORK EXPERIENCE

South Valley Sewer District *May 2017-August 2017, May 2018-Present*
Engineering Intern Bluffdale, UT

- Reviewed over 400 construction plans which included drafting, revising, and sending redline letters asking the design engineer to meet the District's regulations
- Surveyed using GPS instruments and integrated the points to the District's ArcMap site using GIS
- Prepared about 150 bond documents to be paid by contractors before they could begin construction
- Inspected sewer pipe on a $50 million project being constructed in Herriman
- Wrote a VBA code determining the number of sewer laterals needing to be connected to the mainline and how much more flow would be coming to the treatment plant
- Prepared 150 legal easement documents utilizing AutoCAD in determining the location of the easement

BYU Broadcasting *May 2012-April 2013, May 2015-May 2018*
Student Engineer Provo, UT

- Facilitated signal flow for nationally televised events reaching about 65 million homes
- Communicated with outside vendors ordering supplies needed for projects
- Learned to make tough, "in the moment" decisions in solving a problem

VOLUNTEER EXPERIENCE

Provo High School *November 2015-March 2018*
9th Grade Boys' Basketball Coach Provo, UT

- Spent the last three seasons coaching a team of 13 high schoolers how to work together as a team and perform to the best of their ability on and off the court
- Coordinated with parents and boosters on receiving thousands of dollars of funding for the basketball program

OTHER INFORMATION

- Member of the BYU Student Chapter of ASCE since Fall 2012
- Achieved language proficiency certificate for Indonesian
- Received First Aid and CPR Training certification
- Hobbies include rock climbing, skim boarding, working on my car, and playing piano

Dan Costa

Civil and Environmental Engineer Student

Education

Aug 2019 **Bachelor of Civil and Environmental Engineering**
Brigham Young University, Provo - UT

- GPA: 3.57/4.0
- Passed the Fundamentals of Engineering Exam (FE)
- Research Assistant, Marriot Business School (2017-2018)

Experience

May 2018 – Sep 2018 **Civil Engineering Intern**
Freeport-McMoRan, Morenci - AZ (Fortune 500 Company)

- Designed and implemented safety changes according to AASHTO Standards to an intersection located inside the Morenci Mine
- Managed a $1.2M USD parking lot and retention pond project together with a Sr. Engineer
- Coordinated with 4 different groups of contractors and 6 different company departments to perform tasks in assigned projects
- Presented an overview of two projects to 100+ employees including managers and supervisors of the company
- Created a budget and Gantt Chart for project construction

May 2017 – Sep 2017 **Civil Engineering Intern**
Earthtec Engineering, Lindon - UT

- Performed air, slump, density, and compaction tests of concrete, soils, and asphalt for 30+ different residential, public and commercial projects
- Received certification on: Nuke Gauge Safety, Concrete Technician I, and Work Place Safety.
- Communicated with contractors and clients to optimize meetings with clients and contractors
- Traveled to 20+ locations in the state of Utah using a company vehicle to collect data and perform tests

Apr 2014 – Dec 2015 **Drafter/Designer**
Grupo Torquatos, São Paulo - Brazil

- Drafted 20+ commercial projects using Autocad2D and designed partitioning walls according to architect's specifications
- Discussed plans during weekly meetings with engineers and architects to improve projects
- Communicated with clients and contractors to clarify projects and resolve concerns

Extra-Curricular Activities

Jan 2017 – May 2018 **Member of the Engineering and Technology Leadership Council (ETLC), BYU**
- Trained student club leaders to promote engineering and networking opportunities for 300+ students throughout all disciplines in the college of engineering.

Sep 2018 – Today **Member of the American Society of Civil Engineer Leadership (ASCE), BYU Chapter**
- Provided networking and service opportunities for 100+ students in the Civil Engineering program at BYU

Personal Info

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Software

AutoCAD 2D	Excellent
Microsoft Office	Excellent
Revit	Very Good
AutoCAD CIVIL 3D	Good
Microsoft Project	Good

Languages

Portuguese	Fluent
Spanish	Advanced
Mandarin	Intermediate

Interests

Team Work Environment

Challenging Tasks

Leadership Opportunities

Relocation if Necessary

Opportunities to Learn

Jared C. Lillywhite

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EDUCATION

BS, Civil and Environmental Engineering Aug 2015- Dec 2019

Brigham Young University, Provo, Utah

- 3.89 GPA
- Institute of Transportation Engineers- Activities Coordinator
- Heritage Scholarship Award Recipient

PROFESSIONAL EXPERIENCE

Transportation Inspector May 2018- Present

AECOM, Salt Lake City, Utah

- Completed WAQTC Transportation Technician Qualification Program, receiving a 100% score on the Sampling, Reduction, and Density Testing Technician certification exam.
- Quickly became familiar with UDOT 2017 Standard Drawings and Specifications to ensure quality of construction for UDOT projects.
- Inspected and approved bid items for payment on various projects worth over $10 million.

Hydroinformatics Research Assistant August 2017 – May 2018

Brigham Young University, Provo, UT

- Attended and assisted in presentation at 2017 GEO Plenary in Washington, D.C.
- Developed time-saving methods for formatting streamflow data for use in statistical analysis.
- Used Spanish language skills to obtain data and share test results with water managers in Latin America
- Produced visual presentations documenting work in the Dominican Republic using ESRI software

Intern / Field Technician May 2017 – August 2017

Earthtec Engineering, Lindon, Utah

- Created thorough and detailed reports documenting soil and asphalt density tests throughout Utah.
- Received praise from supervisors for positive feedback of job performance from contractors in the field
- Became Nuclear Moisture-Density Gauge Certified

RELEVANT COURSEWORK

Geometric Design of Highways

- Currently enrolled, creating a preliminary re-design of a local intersection using AutoCAD Civil 3D.

Urban Transportation Planning

- Currently enrolled, researching the impact of shared mobility on congestion and public transit. Developing travel demand forecasting skills using Cube software.

Geospatial Software Development

- Developed a fully functioning web application to calculate the ideal route for a new bike trail between two user-selected endpoints, given user-selected parameters. Gained skills in HTML, JavaScript, CSS, and Python.

SKILLS

- Geographic Information Systems (ArcMap, ArcGISPro)
- Spanish Proficiency
- Computer Programming: VBA, Python, HTML, JavaScript, CSS
- UDOT SRDTT, CTT, and Crash Cushion Certifications
- Moderately experienced with AutoCAD Civil 3D

Wade Roberts

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SKILLS/ACHIEVEMENTS/ABILITIES

- Skilled with Python and Matlab with the ability to learn new computer programs quickly
- Highly skilled with GIS programs such as ArcGIS Pro
- Skilled with *CAD programs* such as SolidWorks, with an associates certification with SolidWorks
- One year of experience developing environmental web applications on the Django Stack
- Worked on projects with *NASA* to develop tools that allow executives in developing countries to make decisions regarding flooding

PROJECTS/RESEARCH

NASA/SERVIR Aug 2017 - Present
Research Assistant Provo, UT

- Collaborate with others as well as work individually to create web apps that provide state-of-the-art, satellite-based Earth monitoring data, geospatial information, and tools to help improve environmental decision-making among developing nations

University of Arkansas May 2017 – July 2017
Research Assistant Fayetteville, AR

- Coordinated with PhD graduate students to conduct computational material science simulations at the nanoscale using a high performance computing center.
- Refined technical reading and writing skills through researching literature and writing a final report that is expected to lead to a publication.

EDUCATION

Bachelor of Science: Civil Engineering Apr 2019
Brigham Young University Provo, UT

- GPA 3.95, GPA in Major 4.00
- Actively involved member of BYU ASCE student chapter

Associate of Science Apr 2017
Southern Utah University Cedar City, UT

- GPA 3.99
- Dean's List (Four Semesters)
- President's Scholarship Recipient

PUBLICATIONS/PRESENTATIONS

iEMSS 2018 Conference June 2018
Fort Collins, CO

- Presented on my work with Python package *Hydrostats* and its usefulness in environmental modeling.

VOLUNTEER EXPERIENCE

Organization Feb 2014-Jan 2016
LDS Missionary New Delhi, India

- Attained leadership skills while personally leading up to 25 other full time service missionaries