LID APPROACH EFFECTIVENESS & FUNCTIONALITY STUDY
Project ID: CEEn_2016CPST_003

by

Team LID
John De Leon / Project Manager
Treyton Moore / Team Lead
Jingwen He / Geotechnical Lead
Kevin Liang / ArcGIS Lead

A Capstone project submitted to

Chris Thompson
Spanish Fork City Public Works

Department of Civil and Environmental Engineering
Brigham Young University

11/14/2016

Team LID

Treyton Moore, treyton.m2@gmail.com

November 14, 2016

Acceptance Committee
Brigham Young University
College of Engineering and Technology

Dear Acceptance Committee,

Team LID is pleased to submit this proposal for the Low Impact Development (LID) approach effectiveness & functionality study. Our engineering team understands that Spanish Fork City is looking to see if their LID approach is effective and whether it meets EPA standards.

Team LID is a highly capable team of future engineers consisting of Treyton Moore, Kevin Liang, and Jingwen Liang. We not only have technical experience of hydrology, soil mechanics, and surveying but also maintain a strong work ethic and excellent leadership skills. Each member has demonstrated strong work ethic through high grade point average. Leadership skills are shown through various positions team members have accepted or currently serve in. The combination of skills and experience makes Team LID a qualified team for investigating whether Spanish Fork's LID approach is effective and functional.

We have examined and come up with a plan on how we will fulfill the purpose of this study. We will perform percolation tests and simulate different levels of storms to test whether the LID approach is effective and functional. We will continue to be in frequent communication with Spanish Fork's Public Works Director, Chris Thompson, to ensure all required components of this investigation will be completed. We look forward to meeting person to discuss more about the particulars of this project.

Sincerely,

Team LID

Introduction

PROJECT TITLE: LID Approach Effectiveness & Functionality Study
PROJECT ID: CEEn-2016CPST-003
PROJECT SPONSOR: City of Spanish Fork Public Work
TEAM NAME: Team LID Jingwen Liang, Kevin Liang, Treyton Moore

Executive Summary

The Environmental Protection Agency (EPA) now requires that each city implements a Low Impact Development (LID) approach to stormwater management. Most cities in Utah have struggled to properly implement LID stormwater systems that meet EPA standards in their communities. Spanish Fork City (Spanish Fork) may be the first city in Utah to have adequately met these standards and is looking to analyze the performance of their LID systems to ensure compliance with the EPA.

Team LID is qualified to perform this work. All three of our team members are seniors in the Civil Engineering program at Brigham Young University. Jingwen Liang is emphasizing in geotechnical engineering and has lab experience under her belt. Kevin Liang is proficient in ArcGIS and Treyton Moore has experience as a water resources research assistant. Using the skills gained through classes and work experience, Team LID is prepared to analyze the LID stormwater systems in Spanish Fork.

In order to meet the requirements outlined by Spanish Fork, we will visit the site a number of times to collect data that will allow us to estimate the infiltration rate of the R-tanks and the surrounding soil. With these data and information regarding various design storms, we will determine the percentage of stormwater runoff that the current LID system can store. We will then compare the current LID capacity with EPA standards to ensure its compliance. Furthermore, we will examine the system to evaluate silt build-up so that a proper maintenance schedule can be determined.

Each team member will work at least 8 hours every week to complete this project on time. We will meet as needed with the graduate student mentor and Spanish Fork in order to ensure a quality completion of this project.

Proposed Work Plan

In order to effectively analyze the LID effectiveness in Spanish Fork, our team has analyzed the task and broken it down into the following steps.

Before our initial site visit on January 20, 2017, we will obtain the hydrological data for the LID neighborhoods in Spanish Fork. Using these data, we will establish the duration and rainfall intensity for design storms of 5, 10, 25, 50, and 100-year storms. We will also measure the areas of the impermeable and permeable surfaces of the designated neighborhoods using ArcGIS. We will then calculate the runoff volume for each design storm. Furthermore, the volume and storage capacity of the existing R-tank structures will be determined before we schedule our initial site visit.

During our initial site visit, we will run on-site tests to determine the infiltration rate of the R-tank structures, and we will collect a soil sample from the LID neighborhood to run a percolation test and calculate the infiltration rate of the soil. Once we've collected the necessary data, we will calculate the percentage of runoff that is stored in/infiltrated in the R-tank structures during each of the design storms; these percentages will be compared to the EPA standards to ensure the standard is being met. We will then schedule a second site visit for March 4, 2017.

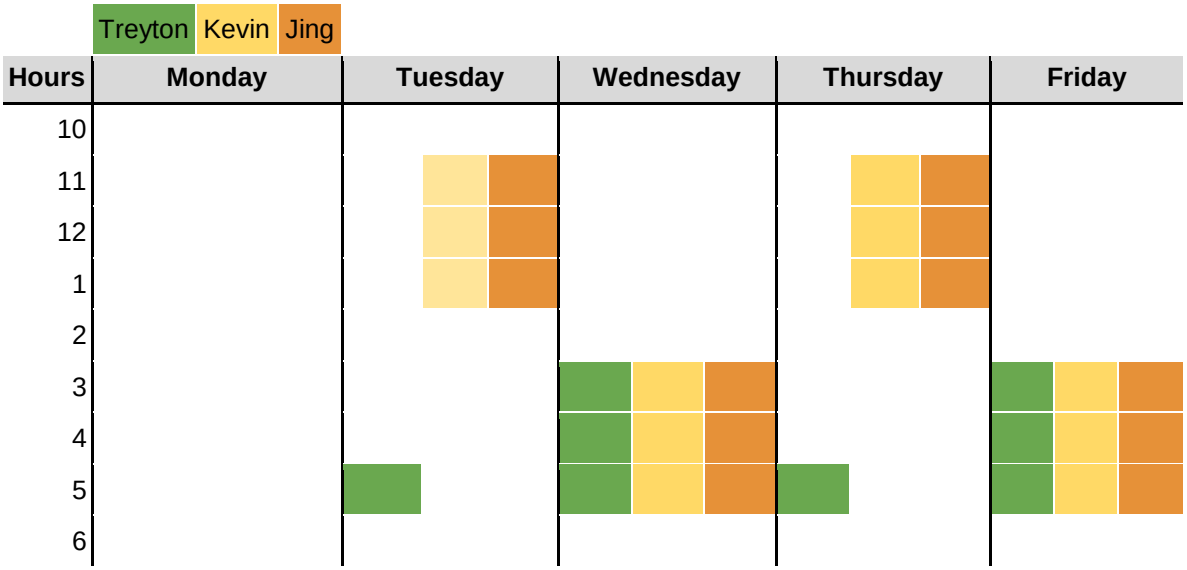
During the second site visit, we will excavate the amount of silt build-up in the entrance to the R-tanks. After measuring silt build-up, we will determine the appropriate time intervals for routine maintenance. It is essential that the silt in the R-tanks be removed periodically to ensure that the water can infiltrate properly. We will determine appropriate maintenance time intervals before March 15, 2017.

Lastly, with the data collected throughout the duration of this project, we will investigate possible design improvements or alternative storage solutions. Any and all off site work will be performed on campus at BYU. Through this proposed work plan, we will provide the following: The infiltration rate of the water from the R-tanks into the surrounding groundwater, the infiltration rate from a percolation test on a soil sample from the LID neighborhood, a proposed maintenance schedule based on the rate of silt build-up, the required stormwater retention capacity for the design storms, and the percentage of stormwater runoff from the design storms that can be stored on site. We will also provide our recommendations for possible improvements to the LID design, we will determine if the current design is in compliance with EPA standards, and we will document of the social and environmental impacts of LID.

Schedule

Date	Milestone
January 20	Initial site visit
February 3	Analyzing stormwater retention capacity
February 17	Comparing capacity to EPA standards
March 4	Silt build-up investigation
March 15	Determining required level of maintenance for regular operation
March 25	Investigating design improvements or alternative storage
April 10	All deliverables completed and submitted

Weekly Work Schedule



Facilities, Tools, Data and Equipment

Data	Tool/Equipment	Purpose
Dimensions and structure of the R-tank	Measuring tape, factory instruction, blueprint	Calculate the storage capacity of existing R-tanks
Site visit: how much runoff can be infiltrated from/stored in the R-tank	Timer, fire hydrant, measuring tape, development plan, GIS	Calculate the infiltration rate and on site storage capacity of R-tank
Infiltration rate of surrounding soil/permeable areas	Shovel, timer, water, measuring tape	Calculate the infiltration rate of surrounding soil/permeable areas
Site visit: silt build-up in the pipes leading to R-tank	Shovel, scale, measuring tape	Calculate the maintenance time

Project Budget

January

Su	M	Tu	W	Th	F	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

February

Su	M	Tu	W	Th	F	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28				

March

Su	M	Tu	W	Th	F	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

April

Su	M	Tu	W	Th	F	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

Milestones

Jan 20	Initial site visit
Feb 3	Analyzing stormwater
Feb 17	Compare EPA standards
Mar 4	Silt build-up investigation
Mar 15	Determining required maintenance
Mar 25	Investigate design improvement
Apr 10	All deliverables complete

Estimated number of hours per week: 32hrs

Lighter colored days: days project will be worked on.
Darker colored days: Milestones

Deliverables

1. Short monthly status reports documenting challenges, solutions & progress
    - What challenges have our team encountered in our Capstone project?
    - What actions did our team decide to do to overcome these challenges?
    - Any progress in overcoming these challenges?
    - Summarize the current status of our Capstone Project
    - Did challenges negatively impact the progress of our project?

2. A final report with design alternatives for the project that include economic and environmental considerations

Type	Length Requirements (minimums)	Frequency of Delivery	Format
Hydrological Analysis	Full Analysis of 5, 10, 25, 50, 100-year design storms with a 1-page report	Once during the duration of the project	Excel for the analysis, Word for the report
Stormwater storage capacity calculations and EPA standard comparison	Required calculations/measurements with an associated paragraph of explanation	Once during the duration of the project	Excel for calculations, Word for explanation
Routine Maintenance Report	1-page report of procedures and results from excavation of pipe leading to R-tanks, and silt build-up calculations	Once during the duration of the project	Excel for calculations, Word for report
Infiltration Rate Analysis	2-page report of procedures and results from calculating infiltration rates on-site and from the percolation test	Once during the duration of the project	Excel for calculations, Word for report.

3. A poster reflecting a summary of our project to be presented to students, faculty and other interested individuals in the final undergraduate seminar

4. A presentation summarizing our project to be presented to our sponsor

All deliverables will be completed by Monday April 10th.

Performance Standards

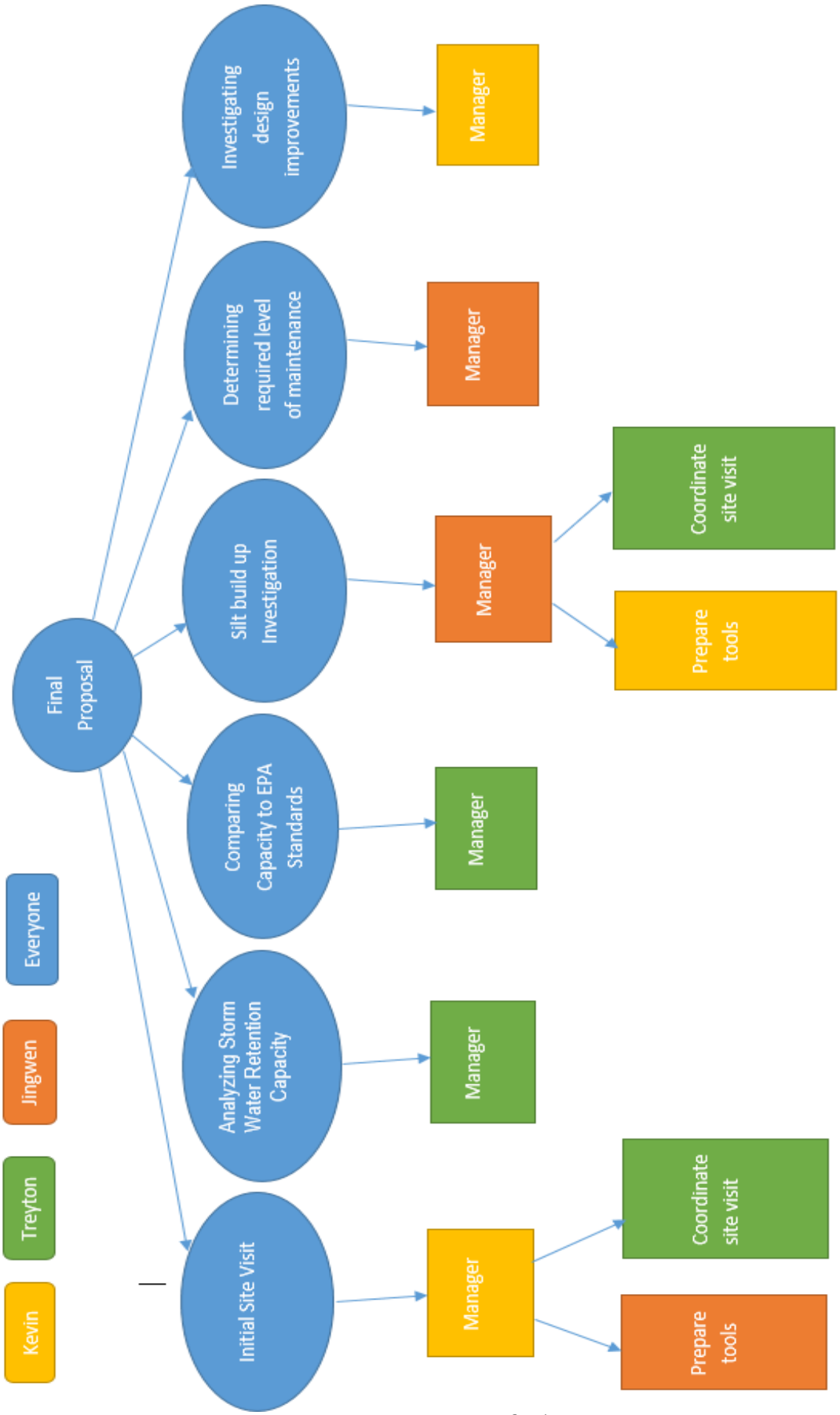
Team will provide work for this Capstone project "as is" using best practices and with best effort. Project results cannot be construed as work performed by licensed professionals and cannot be used as "stamped deliverables" without first being reviewed, approved, and stamped by a qualified and relevant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

Statement of Qualification

Treyton Moore is currently a Senior in the civil engineering program at BYU. He has worked as a water resources research assistant at BYU for the past year and is very passionate about water resources. Treyton has also worked as a TA for the Mechanics of Materials class at BYU, giving him experience in leading and communicating ideas to others. He is a current member of the engineering honors society Tau Beta Pi and loves working hard and getting his hands dirty. Treyton will be acting as the team leader for this project.

Jingwen He is a Senior in the Civil Engineering program at BYU. She has taken all the 300 level Civil Engineering classes and has a basic understanding of all different disciplines in this major. Her main focus of study is Geotech. She has been working as a Geotech research assistance since April 2016. Jingwen has passion in studying soil mechanics, and she is talented in understanding this subject. She is also currently a TA for Soil Mechanics class. Her experience in Geotech qualifies her to be the person in charge of the soil testing in this project.

Kevin Liang is a Senior in the Civil Engineering program at BYU. He is currently working as a water resource research assistant at BYU designing apps that model groundwater. He has also worked in Acute Engineering, giving him experience with real engineering projects and coordinating between engineers and customers. Kevin has experience with ArcGIS and will be assisting in surveying aspects of this project. He is currently serving in the ITE presidency because he loves to work with people.


Everyone
Jingwen
Treyton
Kevin
Final Proposal
Initial Site Visit
Analyzing Storm Water Retention Capacity
Comparing Capacity to EPA Standards
Silt build up Investigation
Determining required level of maintenance
Investigating design improvements
Manager
Manager
Manager
Manager
Manager
Coordinate site visit
Prepare tools
Coordinate site visit
Prepare tools

Appendix A

Treyton Michael Moore

1850 N University Ave. Apt. 101 Provo, UT 84604 (801) 651-9676 Treyton.M2@gmail.com

Objective

Work for Spanish Fork City on the LID stormwater system analysis

Education

B.S. Civil Engineering | December 2017 | **GPA:** 3.85/4.0 Brigham | Young University, Provo, UT

Experience

Water Resources Research Assistant | Brigham Young University | April 2016 - Present

Managed data regarding the sediment transport of over 15,000 measurements

Analyzed video of low-head dams to measure the length of differing hydraulic jumps

Mechanics of Materials TA | Brigham Young University | August 2015 - April 2016

Mastered the concepts of stress, strain, and Mohr's Circle

Taught the above concepts to 188 students to promote their success in the course

Compliance Agent | ForeverGreen International, LLC | September 2014 - August 2015

Investigated websites of customers daily to ensure their compliance with the policies and procedures

Tracked product complaints to ensure good manufacturing process

Skills & Abilities

Communication

Co-authored a 20-page technical research paper, that compared alternative fuel sources for vehicles

Fluent in both written and spoken Italian

Leadership

Taught basic communication (Italian) and financial management to new missionaries for 9 months

Conducted the weekly meetings of an Italian church congregation of 25 people for six months

Co-lead an Italian church congregation of 25 people for six months

Instructed a group of 30 missionaries for five months in Italy

Technology

VBA basic programming through Excel

Microsoft Office Suite

AutoCAD (3 years)

Awards:

Tau Beta Pi Member, inducted 3/12/2016

Jingwen He

1727 Willowbrook Dr, Provo, UT 84606
Phone: (801)616-9103, E-mail:jingwenhe78@gmail.com

Education

Bachelor of Science, *Brigham Young University*, Provo, Utah, U.S. 9/2013-Present

- Major: Civil Engineering
- GPA: 3.97
- Graduation date: April, 2017

Work Experience

Geo-technology Research Assistance, *Brigham Young University*, Provo, Utah, U.S. 4/2016-Present

- Perform calculations for hundreds of earthquake data points
- Use EZ-FRISK to analyze earthquake damage

Transportation Research Assistance, *Brigham Young University*, Provo, Utah, U.S. 4/2016-9/2016

- Run models and perform site visits for highway safety analysis
- Review and test on 3 user's manuals
- Create more than 40 highway reports for UDOT

Instructor, *Brigham Young University*, Provo, Utah, U.S. 9/2015-4/2016

- Create curriculum for a 200 level Cantonese class
- Teach a college class of 6-8 students
- Plan and distribute assignments for the teaching assistant and have regular meetings with the assistant

Teacher, *Missionary Training Center*, Provo, Utah, U.S. 9/2013-8/2015

- Provided instructions on structure and grammar of Mandarin Chinese to over 300 students
- Presented daily training on communication, teaching skills, goal setting and conflict resolutions
- Conducted weekly discussions with co-worker to improve teaching methods

Service

Volunteer, *The Church of Jesus Christ of Latter-day Saints*, Melbourne, Australia 12/2011-5/2013

- Worked with volunteers from over 6 different countries
- Provided training to help other volunteers set effective goals and work with other people
- Made contact with about 30 people every day

Volunteer, *2010 Guangzhou Asian Games*, Guangzhou, China 10/2010-11/2010

- Coordinated work with other volunteers
- Provided guidance for people around the world

Skills and Qualities

- Fluent in Mandarin and Cantonese
- Global leadership skills
- Focused, diligent and patient
- Microsoft office, Auto CAD

Kevin Liang

1727 Willowbrook Dr. Provo UT 84606 (801) 471-6213 kevin9kai@gmail.com

Education

Bachelor Degree: Civil Engineering **December 2017**
Brigham Young University
- Related Coursework: Land Surveying, Concrete, Masonry, & Asphalt

Associates Degree: Science **June 2011**
Utah Valley University

Skills

- Fluent Dutch and Cantonese
- Revit, Auto CAD, Excel spread sheets & Excel VBA programming
- Land Surveying, GIS and data collection, properties of different material

Work Experience

Research Assistant **Sept 2016 - Current**
Brigham Young University - Provo, UT
- Design a Tethys app modeling groundwater flow equations.
- Coordinated with other engineers to make app user friendly.
- Learned computer languages: Python, Java and HTML.

Engineer in Training **Apr 2016 - Sept 2016**
Acute Engineering - Orem, UT
- Calculated roof, snow and wind loads of a building.
- Provided structural engineering for residential base plans and extensions of plans.
- Prepared engineering addendums for building plan modifications.
- Coordinated with PE engineers on structural plan.

Mechanical Drafter **June 2015 - Apr 2016**
Brigham Young University - Provo, UT
- Modeled over 30,000 sq. ft. of HVAC in campus buildings using Autodesk software.
- Coordinated between different engineers, architects and interior designers on projects.

Volunteer Experience

BYU ASCE **Aug 2014 - Current**
- Service Committee: Helped with planning service projects for ASCE members.
- Assisted Orem city with designing storage units for seasonal equipment.

BYU ITE **Jan 2015 - Current**
- Organized ITE activates and service opportunities such as Highway Clean up.
- Provided communication between clubs to merge advertising.

Full-Time Volunteer Representative **Oct 2012 - Oct 2014**
The Church of Jesus Christ of Latter Day Saints
- Provided weekly training for 4-8 volunteers on professional communication skills