

LID RESEARCH PROJECT FOR BLUFFDALE CITY
Project ID: CEEEn-2017CPST-007

by

ROTC Plus One Engineering
Jeremy Fowler / Project Manager
Steven Evans / Team Lead
Ryan Selee
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A Capstone project submitted to

Dan Tracer
Bluffdale City Engineering

Department of Civil and Environmental Engineering
Brigham Young University

10/30/2017

Introduction

PROJECT TITLE: LID Implementation Study
PROJECT ID: CEEEn-2017CPST-007
PROJECT SPONSOR: Bluffdale City
TEAM NAME: ROTC Plus One Engineering

By April 11, 2018, the ROTC Plus One Engineering Group will complete and present to Bluffdale City a manual detailing the proper implementation of LIDs in the city. This manual will contain a list of applicable LIDs with their respective advantages, disadvantages, maintenance requirements, limitations, proper soil and site preparation procedures, and installation procedures. The manual will contain a simple decision tree diagram displaying which LID is most appropriate for different locations and projects throughout Bluffdale.

The ROTC Plus One Engineering group consists of team members Steven Evans, Wade Bozeman, and Ryan Selee, with Jeremy Fowler serving as project manager.

While working on this project, the engineering group will meet each week and assign duties. Group members will complete their assigned duties each week, working for approximately eight hours each week. Through the course of the project, the group will obtain and analyze soil and hydrological data for the city and will research dry wells, R-tanks, swales, bioswales, Storm-tech infiltration basins, bio-filters, sand filters, gravel filters, pre-treatment boxes, cisterns and rain barrels, and permeable pavement materials. The group will determine the practicality, limitations, maintenance requirements, effectiveness, and proper implementation of each of the aforementioned LIDs. After completing this research, the group will create a comprehensive manual detailing each LID, which it will present to Bluffdale City by April 11, 2018. During the course of the project, the group will meet with Bluffdale each month and report on their progress and any challenges faced in the project. Bluffdale will use these meetings to correct the students if necessary, ensuring a quality product.

Proposed Work Plan

To create a manual on effective LID implementation in the Bluffdale area, our team has analyzed the task and broken it down into the following steps:

First, we will spend time during the remainder of the Fall semester learning EPA regulations and requirements for LID. This task will be completed by January 8, 2018.

Beginning the Winter semester, we will obtain hydrological data for Bluffdale City. Using this data, we will determine the duration and precipitation rate for 5, 10, 25, 50, and 100-year storms. This will be used to determine precipitation and runoff volumes for our analysis of each potential LID practice studied.

After obtaining and analyzing hydrological data, we will begin research and investigation of dry wells. We will determine the proper storage capacity for dry wells based on the catchment area and the permeability of the soil. We will investigate different dry well techniques, including R-tanks currently used by Spanish Fork. We will examine the R-tanks effectiveness in Spanish Fork and compare the soil and rainfall qualities of Spanish Fork to those of Bluffdale in order to determine the feasibility of R-tanks in Bluffdale. We will determine the proper maintenance intervals for these LIDs if implemented in Bluffdale.

Next, we will research and analyze the effectiveness of Storm-tech infiltration basins. We will determine the infiltration rate from these structures and investigate their compatibility with Bluffdale's soils. We will determine a proper maintenance schedule for these basins in order to prevent silt buildup and clogging of the system.

We will then investigate the effectiveness of pollutant removing LID such as bio filters, sand or gravel filters, swales and bioswales. We will determine the effectiveness of these LIDs in the Bluffdale area and analyze their costs and limitations. We will make recommendations for the proper vegetation or other material to be used in swales. We will research tree, sand, and gravel filters and determine their relative effectiveness.

Next we will research the practicality of cisterns and rain barrels. We will determine the amount of water that could be captured in these structures and reused for sprinklers. We will determine the cost effectiveness of these systems and investigate the circumstances (if any) under which cisterns would be effective in Bluffdale.

We will then research the effectiveness of permeable paving materials for both roads and sidewalks when built on Bluffdale's soils. We will also analyze the cost of these materials and their strength and endurance vs those of standard asphalt and concrete.

Having completed our LID research, we will create and submit a report to Bluffdale City detailing the effectiveness of each LID and the circumstances under which each LID could most effectively be used. We will provide specifications regarding materials, vegetation, soil, and site prep for each LID.

Schedule

10/25/2017 – Initial Meeting with Bluffdale City, Begin intensive LID research

11/22/2017 – Follow-up meeting with Bluffdale City

12/13/2017 – Update with Bluffdale City

01/08/2018 – Complete Studying of EPA LID regulations

01/22/2018 – Complete Hydrological Data for Bluffdale City

01/24/2018 – Update with Bluffdale City

02/05/2018 – Complete research of Dry Wells

02/07/2018 – Update with Bluffdale City

02/19/2018 – Complete Research of Storm-tech Infiltration Basins

02/21/2018 – Update with Bluffdale City

03/05/2018 – Complete Analysis of Pollutant Removing Filters

03/07/2018 – Update with Bluffdale City

03/12/2018 – Complete Research on practicality of Cisterns and Rain Barrels

03/14/2018 – Update with Bluffdale City

03/26/2018 – Complete Research on Permeable Paving Materials

03/28/2018- Update with Bluffdale City

04/11/2018 – Present Completed Report to Bluffdale City

Facilities, Tools, Data and Equipment

Equipment necessary for this project is mainly computer software provided by BYU. We will begin our research of each LID by searching electronic sources and using electronic data. As necessary, we will gather further information from nearby sources. We plan to gain LID information from Spanish Fork city concerning their LID implementations. We also plan to discuss LID with Dr Burian of the University of Utah and to gather information from him. We will obtain soil data from Bluffdale's Storm Water Master Plan on the city website and from the NRCS soil survey. We will obtain hydrological data from the USGS. We will use this data to determine the effectiveness of LIDs and estimate runoff and infiltration volumes.

Project Budget

01/08/2018 – Complete Studying of EPA LID regulations (24 man hours)

01/22/2018 – Complete Hydrological Data for Bluffdale City (24 man hours)

02/05/2018 – Complete research of Dry Wells (50 man hours)

02/19/2018 – Complete Research of Storm-tech Infiltration Basins (50 man hours)

03/05/2018 – Complete Analysis of Pollutant Removing Filters (50 man hours)

03/12/2018 – Complete Research on practicality of Cisterns and Rain Barrels (24 man hours)

03/26/2018 – Complete Research on Permeable Paving Materials (50 man hours)

04/11/2018 – Present Completed Report to Bluffdale City (50 man hours)

Deliverables

1. Short monthly status reports documenting challenges, solutions & progress and answering the following questions:
 - What challenges have your team encountered in your Capstone project?
 - What actions did your team decided to do to overcome these challenges?
 - Any progress in overcoming these challenges?
 - Is the project on schedule?
 - Summarize the progress and current status of our project.
2. A final report with design alternatives for the project that include economic and environmental considerations.
3. A poster reflecting a summary of our project.
4. A presentation summarizing our project to be presented to Bluffdale City.
5. A manual containing a list of applicable LIDs in Bluffdale. The manual will detail the applicability, advantages, disadvantages, performance, maintenance, and limitations of each LID standard. The manual will also list instructions, guidelines, and specifications for the proper preparation, installation, and maintenance for each LID. The manual will contain a simple decision tree diagram displaying which LID should be used for differing situations.

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

ROTC Plus One Engineering is composed of three aspiring engineers. Two of the team members have their emphasis in water resources, and two of the team members have years of leadership and team work experience through their respective Reserve Officer Training Corps (ROTC) programs. Steven Evans leads the team coordinating our efforts, and participating in the work. Ryan Selee and Wade Bozeman provide man hours for research and creating reports and presentations.

Steven Evans is a Senior in Civil and Environmental Engineering at Brigham Young University with a 3.97 GPA. He has been working for Provo City as an engineering intern for the last year, where he has gained some experience with the development process, become familiar with City codes and standards. Steven has enjoyed and excelled in coursework in hydraulics and soil mechanics and looks forward to implementing some of that knowledge in this project. Steven loves to work hard.

Ryan Selee is a Senior in Civil and Environmental Engineering at Brigham Young University, and a member of the Army ROTC. He has begun the course work on his emphasis in water resources and spent the last four years learning leadership alongside civil engineering. His background in pasture and livestock shelter development and maintenance in the rain shadow of the Washington Cascade Mountains provided him with up close experience in storm water. He looks forward to working with Bluffdale City and learning more about storm water management and Low Impact Development.

Wade Bozeman is a Senior in Civil and Environmental Engineering at Brigham Young University, a member of Air Force ROTC, and has secured a pilot slot with the United States Air Force. Working for the Forest Service, he has become familiar with civil engineering practices in the field, and learned how to implement what he has learned in school. Wade is very optimistic about this project and looks forward to helping Bluffdale City make good decisions that will keep it in check with upcoming EPA regulations on development.

Appendix A

Steven Evans

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801-900-1715 • stevenwevans2@gmail.com

EDUCATION

Brigham Young University

Provo, UT

- BS Civil and Environmental Engineering
- Coursework in transportation, hydraulics, soil mechanics, structural analysis, GIS, groundwater modeling, and computer programming.
- 3.97 GPA.

April, 2018

WORK EXPERIENCE

Provo City Engineering

Provo, UT

Intern

January, 2017 – Present

- Assisted Provo's engineers in design and drafting using AutoCAD Civil 3D.
- Assisted in GIS mapping, and pavement management using ArcMap.
- Assisted in surveying, traffic studies, traffic modeling (using Synchro), and utility marking.
- Prepared concept designs, concept maps, cost estimates, and bond estimates.
- Prepared bid documents, bid tabs, and traffic reports.
- Reviewed and signed off on plans during the building permit process.

BYU Department of Mathematics

Provo, UT

Grader

August, 2016 – January, 2017

- Worked for Doctor Chahal grading multi-variable calculus and proofing his tests.

Provo Parks and Recreation

Provo, UT

Laborer

April – August, 2016

- Mowed and maintained the grass at twenty parks throughout the city of Provo.

B D Stearns Concrete Construction

Lebanon, OR

Laborer

June – August, 2012

- Constructed and leveled forms according to plans; placed rebar; poured concrete.

VOLUNTEER EXPERIENCE

Provo Parks and Recreation

Provo, UT

Coach

2017

- Volunteered coaching youth soccer. Held practices, coached games, and communicated with participants and parents.

The Church of Jesus Christ of Latter-day Saints

Louisville, KY

Missionary

2013 - 2015

- Greatly improved my interpersonal and communication skills through teaching, giving community service, and training other missionaries.

SKILLS / AWARDS

- Experienced in AutoCAD Civil 3D, ArcMap, GIS, Microsoft Office, C++, and Revit.
- Experience surveying using a total station and survey grade GPS.
- Learning MODFLOW groundwater modeling and Synchro traffic modeling software.
- 2012 Citizenship Award- given to a Senior who exemplifies the highest traits of good citizenship.

Ryan Selee

1080 W 100 N, Provo, UT 84601 | (360) 984-8524 | selee.taylorryan@gmail.com

Education

BS Civil and Environmental Engineering, Brigham Young University

JUN 2018

Minor in Military Science

Provo, Utah

- Relevant Course Work: Water Resources Management, Hydraulic Engineering, Transportation Engineering, Structural Engineering, Engineering Applications of GIS

Skills & Accomplishments

Surveying, AutoCAD, Revit, ArcGIS, Eagle Scout, and Army ROTC Scholarship Recipient

Experience

Cadet, Army Reserve Officer Training Corps (ROTC) – BYU Battalion

AUG 2013 – Present

- Led peer teams of 4 to 48 cadets in rotational leadership roles
- Conducted event planning, organization, and execution as a team
- Trained 90 cadets in radio operations and land navigation

Provo, Utah

Intern/Assistant Platoon Leader, 3-13th Battalion/210th Field Artillery Brigade

JUL 2016 -

- Tracked maintenance of communications systems for 32 vehicles
- Led a logistics exercise involving 30 people and 8 tons of supplies
- Prepared the mobilization task calendar for a group of 90 people

AUG 2016

Camp Casey, Korea

Cadet, Leadership Development Course

JUN 2016 –JUL 2016

- Completed confidence courses as an individual and in a team to include rappel tower, obstacle course, and unit run
- Led 36 peers in rotational leadership roles for 16 days of field training

Fort Knox,

Kentucky

Custodian, Brigham Young University

MAY 2015 – AUG 2015

- Prepared 5 apartments per shift for new resident arrivals
- Nightly cleaned the university administration office building

Provo, Utah

Activities Support, Brigham Young University

JAN 2014 – APR 2014

- Set up and took down university sports complexes for events
- Maintained university sports equipment and facilities

Provo, Utah

Rancher, Self-employed

JAN 2008 –AUG 2013

- Constructed and maintained livestock shelter and fence
- Raised 11 sheep and 6 cows to market ready
- Marketed and sold the livestock at auction or open market

Battle Ground, Washington

- **Wade R. Bozeman**

- 407 E 100 N
- Nephi, UT 84648
- Telephone (707) 718-5503
- Email: wdbozeman@gmail.com

- **OBJECTIVE**

- Demonstrate competency and qualifications for completion of Capstone Project.

- **QUALIFICATIONS**

- Knowledgeable in the classroom and the field. Surveying/navigation and GIS competent. Currently enrolled in advanced Environmental Engineering course.

- **EDUCATION**

- BRIGHAM YOUNG UNIVERSITY: B.S. expected Jun. 2018. Civil Engineering Major. Aerospace Studies Minor. Successfully completed relevant courses in soils, GIS, and surveying, among others.

- **EXPERIENCE**

- US FOREST SERVICE: Range Aid. Applied herbicide to noxious weeds, fenced riparian areas, performed range health assessments, located stray cows, operated ATVs and UTVs, rode and ensured care of horses and mules, and checked on compaction and erosion in soils. Worked as wildland firefighter when needed.
- BRIGHAM YOUNG UNIVERSITY: Teaching Assistant. Educated students in AutoCad and Revit computer programs. Graded assignments, administered test reviews, and gave students an introduction to the Civil Engineering Program (This is a beginning level course).

- **ACHIEVEMENTS AND AWARDS**

- Eagle Scout Award Recipient.
- Various awards from the Air Force ROTC program at BYU, including for leadership and physical fitness.

- **ACTIVITIES**

- 4th year Cadet: Air Force ROTC.
- Student member: American Society of Civil Engineers.

- **REFERENCES**

- Von Black, Range Technician: (435) 686-4531
- More Available upon request.