NORTHERN ARIZONA UNIVERSITY

# Final Proposal

Summit HOA Project

Fatemah Husain, Eric Carrasco, Hamad Alajmi

DEC 10 2014

Dec 10th 2014

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Mark Lamer, P.E
Northern Arizona University.
Flagstaff, AZ 86001

Dear Mr. Lamar,

The Summit HOA project team members which are; Hamad Alajmi, Fatemah Husain and Eric Carrosco are excited to work with you in your project "Summit HOA", and we would like to inform you that the team will do it's best to achieve your goals, which is examining and redesigning an unstable channel. It is our pleasure to be selected for this project, and we can ensure that the project will be done according to your request.

Attached is our Project Final Proposal "Summit HOA Project" where you will find the details about this project which will includes project understanding, scope of services, the cost of engineering services and project scheduling. We look forward to redesign and build an alternative solution design that will help solve the three homeowner's problems while meeting the Summit HOA Residential Development Standards.

If you have any questions or would like any additional information regarding our project final proposal, please feel free to contact us anytime. Thank you.

Sincerely,

| Fatemah Husain | Eric Carrasco | Hamad Alajmi |
|---|---|---|
| *Fatemah* | *Eric* | *Hamad* |

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## 1.0 Project Introduction

The purpose of the Summit Home Owner Association (HOA) project is to examine and redesign an unstable, open channel. One of the homeowners is experiencing geotechnical issues as a portion of their backyard is sliding into the channel. The slippage of the soil has created a slope instability; resulting in property damage during intense weather and lack of privacy for the homeowner. The lateral pressure from the soil has also damaged the homeowner's fence. The client requests for the fence to be reasonably higher than the sidewalk. Sediments are building up near the storm outlets due to the watershed upstream. The sediment build up is not associated with the soil slippage so the group must consider a design to reduce the blockage. This project engages the group to apply surveying, geotechnical engineering, drainage design, and structural design to meet the client's needs.

## 2.0 Project Background

The Summit HOA channel is located in Flagstaff, Arizona on Pulliam road and is adjacent to three properties. Ponderosa Trails was established as community of different residential uses geared towards homeowners. The purpose of the Development Standards is to make sure all homeowners follow the design and construction regulations. This will result in compatible neighborhoods and improved surrounding environment. A Section of The ponderosa trails residential development standards consists of site planning and landscape guidelines where will be used for grading, drainage, walls, and fencing. The team will consider these standards when re-designing the channel to avoid any violation. The standards regarding the fencing will be used in slope revision, since the fence should be at a similar height to the other neighboring fencing. Figure 2.1 shows the direction of the flow and the current culvert location


*Figure 2.1: Map view of the channel culvert and the flow direction*

*www.google.com/maps*

## 3.0 Team Qualification

**Team Manager: Eric Carrasco**

Eric Carrasco is a senior student studying civil engineering at Northern Arizona University in Flagstaff, Arizona. Eric has taken multiple core classes that relates to the Summit HOA project such as Computer Aided Drafting, Surveying, Geotechnical Engineering I & II, Applied Hydraulics, and Hydrology. He is proficient with handling surveying equipment and the engineering software Bentley FlowMaster. Eric performed individual research on asphalt mixture and experimented with fabric. Eric aslso tested the strength of pervious concrete. As an active student on campus, Eric has held executive positions in American Society of Civil Engineering (ASCE), Theta Chi Fraternity, and is currently assistant manager at his current job.

**Team Leader: Fatemah Husain.**

Fatemah Husain is a senior international student from Kuwait studying civil engineering at Northern Arizona University in Flagstaff, Arizona. Fatemah has excelled in courses including Reinforced Concrete, Water Resources Lab, Open Channel Flow, Geotechnical Engineering I & II, Hydrology, Hydraulics, and Surveying. Fatemah has some experience in channel design as she had completed a thorough analysis about the Sinclair Wash. Her analysis included a complete analytical survey of the channel. Her deepened background using software such as AutoCAD and Bentley's WaterGEM and Geostructure were integrated for the Sinclair Wash analysis. She intends to be a professor's assistant for the upcoming Open Channel Flow course.

**Design Specialist: Hamad Alajmi.**

Hamad Alajmi is a senior international student originally from Kuwait studying environmental engineering at Northern Arizona University in Flagstaff, Arizona. Throughout Hamad's academic career, he took courses such as Solid & Hazard Waste Management, Water Resources II, classical Open Channel Flow, Water/Waste-Water Units Design, Geotechnical Engineering, Surveying, and Computer Aided Drafting that could benefit the design progress of the Summit HOA project. In addition to his work, Hamad is also involved in leadership roles with the National Union of Kuwaiti Students.

# 4.0 Project Details

## 4.1 Stakeholders

The stakeholders for the project are:

- The clients: Mr. Mark Lamer, Cynthia Lamer, and Jennifer Olsen.
- Summit HOA at Ponderosa Trail
- City of Flagstaff


Figure 3.1.1: The Summit HOA.
*Photo Taken by Hamad*


Figure 3.1.2: City of Flagstaff
*www.flagstaff.az.gov*

Figure 3.1.3: Mr. Mark Lamer
*www.nau.edu*

## 4.2 Existing Condition

After meeting with the client/technical advisor, the problem with the channel has been clear. It have been noted that the channel has stability issues due to some dirt covering the outlet of the culvert. Now the channel is covered with settlement soils that caused a drop in energy grade line (Figure 3.2.1). The channel stability issue is affecting a homeowner's backyard. The fence of the backyard is slipping down into the channel (Figure 3.2.2).

Figure 3.2.1: Channel Outlet.

Figure 3.2.2: Fence slipping into the channel

### 4.3 Technical Needs

It is important to understand that the cause of the problem can be solved. The team visited the site to assess the slope issue and investigated the problem by researching similar problems. This type of issue needs hydraulics, hydrology, surveying, geotechnical and structural analysis. Surveying will be necessary to develop the dimensions of the channel and the culvert, which will be beneficial in all other analysis. The team will set a day to survey the channel using surveying equipment. Hydrological analysis will help determine the rainfall and runoff estimation of the channel area by applying different hydrological formulas from the City of Flagstaff Stormwater Management Design Manual [1]**.** Hydraulics analysis is important for designing pipe system and storm drain for the channel using the design flow calculated from the hydrological formulas. The pipe and storm drain design must sufficiently convey the flow. Additionally, the team must perform geotechnical analysis for the soil in the channel by performing various soil tests to identify the soil classification and characteristics for the slope revision. This procedure is important so the soil does not settle further into the channel. The soil type will be helpful for structural analysis because knowing the soil strength is essential for building a retaining wall. The retaining wall will resist lateral pressure. Once the analysis is known, the team can consider possible solutions to solve the problem.

### 4.5 Challenges and Concerns

There will be some challenges completing this projects, one being there are culverts in the channel that cannot be removed or altered, because they are part of City of Flagstaff properties, this will eliminate the alternative solutions for the channel. However, the group can think of other solution that will not interfere with City of Flagstaff properties and satisfy the client.

## 5.0 Scope of Services

Scope of service contains all the tasks that must be done for this project. Each task has subtasks that explain the main task in detail. Subtasks include data collection, design tasks, regulatory issues/expulsions, and deliverables.

### 5.1 Preliminary Research

Research is an important part of the scope. It is necessary to thoroughly understand the project in order to begin with the design analysis. There are three primary ways of collecting information for the Summit HOA project:

#### *5.1.1 Background Knowledge*

Background knowledge will include all information and data researched that is beneficial to start the project. The team will study subject matters in the field of surveying, geotechnical engineering, hydraulics, hydrology, and structural analysis. Additional research will include regulation provided by the Summit HOA so the group can formulate project alternatives. Some restrictions have already been established for walls, drainage, grading, and fencing by the Homeowner association and Ponderosa Trail [1] [2]. These constraints will be taken into consideration when preparing the project design.

#### *5.1.2 Professional Consulting*

Professional input and project suggestions are valuable resources for the final design. The group members are going to set appointments to meet with the technical advisor and Northern Arizona University professors to gain further project understanding. For example, the technical advisor has already suggested three design alternatives that the

group should pursue to improve the current situation and to make the client satisfied. Asking people with proper experience for the project will provide the group with insight. The rate of meeting with professionals will be up to the discretion of the group leader.

*5.1.3 Field Evaluation*

Prior to any project design or modeling, the group will have to perform multiple field investigations. The purpose of the field evaluation is to determine the current situation of the open channel and where to proceed for the project. Team members will visit the site at least twice a month; take pictures and notes to determine the best design for the Summit HOA project.

**Exclusion:** At this point, the group will only focus on the open channel and will exclude any points on the other side of South Pulliam road and South Amethyst Road.

**5.2 Surveying**

*5.2.1 Field Survey*

The team will arrange specific days to survey the open channel and the area surrounding the project. Using total station equipment, the group will use the known coordinate from the Ponderosa Trials Unit 8 Construction Plan as control points. The team will then create five additional control points by recording and averaging the coordinates of local brass marks. This step is necessary so the group can perform multiple resections with less data error. The channel dimensions that will be measured by the group and will include the height, base, slope, and length. These parameters will help aid the project analysis. The area surrounding the project will be measured to understand where the watershed flows. By properly recording survey points of the open channel, the group will have a straightforward approach with the remaining major tasks.

*5.2.2 Topography in AutoCAD*

A topographic map will be developed on the computer engineering software, AutoCAD, after the team collects the survey data. The purpose of this task is to

identify the specific location of every object within the project area. This task is intended to provide accurate details of the final design and reduce the chance of mistake among the group members.

## 5.3 Geotechnical Design

### *5.3.1 Soil Testing*

The team will perform three soil test: A unit weight test, sieve analysis test, and direct shear test. The unit weight test will identify the mass per unit volume of the soil specimen. The sieve analysis will determine the soil type using USCS soil classification. This process will identify the type of soil the team is working with and its general characteristics. The class of soil will help determine an appropriate design to resolve the slope instability. The direct shear test will evaluate the strength of the soil. Knowing the soil type is important so the engineering group can choose the right fill soil for the site and prevent failure due to settlement.

The soil test will determine the foundation for the retaining wall. Based on the soil properties, the depth of the foundation can be determined. The shear test will give the team an idea of the soil strength and how much weight it can stand when building a retaining wall.

### *5.3.2 Slope Design/Fill*

The group will adjust the current slope of the channel and the homeowner's fence to improve their privacy and property. The team will fill the channel with sufficient soil and keep a surface runoff. The height of the fence will be extend to approximately a foot above the sidewalk elevation.

## 5.4 Drainage Design

### *5.4.1 Hydrology*

Rainfall and runoff analysis is important for this project. Runoff is generated by rainstorms and its occurrence and quantity are dependent on the characteristics of the rainfall event. The intensity, duration and distribution of the rainstorms must be determined to have an awareness of the amount of water that the channel area receives. Local hydrology will be determined for the project using NOAA ATLAS 14

Data estimation. The City of Flagstaff storm water design manual will help convert the estimation into a design flow.

### *5.4.2 Hydraulics*

The client noted that the current drain of the open channel is clogged with sediment during the group's initial site investigation. The team will design a system that will have a supercritical flow so the current will remove the sediment building up at the outlet. Parameters such as the roughness coefficient, pipe size, and general hydraulics equations will be applied in this project after the hydrology is determined.

### *5.4.3 Open Channel*

The open channel must be designed according to City of Flagstaff standards. The existing culvert at the channel will not be altered or removed, but a redesign of the channel can be implemented. The team will consider the channel important parameters.

### *5.4.4 Culvert Design*

When the team determines the amount of water flowing into the channel by hydraulics and hydrology analysis, the culvert type can be specified, either inlet control or outlet control. From there, the team can proceed with the culvert design. Velocity limitation, Debris control, headwater limitation, tail water consideration, and outlet protection are some of the engineering design criteria the team must study for the project. The purpose of the culvert design is to convey surface water from the location.

### *5.4.5 Storm Drain design*

A storm drain design would be suitable for the project. The storm drain is intended to collect and transferring the rainfall without any complications of overbanking. Culverts connected to the storm drainage system will be considered part of the system. The design will follow the City of Flagstaff storm water design manual. The design will include pipe system that carries the water from the storm drain to the existing culvert. Junctions and headwalls will also be considered for the storm drain.

## 5.5 Structural Design

### *5.5.1 Material Selection*

The group will determine the material necessary for the project if the soil slippage continues. The team will test various materials and figure out the best structural design. The group will also create a free body diagram in Risa 2D software as the structure deflects under a load. These testing are important in structures because they show how a material handles different earth pressure.

### *5.5.2 Retaining Wall*

If a structure is necessary for the Summit project, the team will create a retaining wall for the capstone project to help reinforce the geotechnical aspect. The retaining wall will prevent further slippage into the open channel and further damages to the property. A retaining wall shall be built to follow the Summit HOA architectural guidelines and will be aesthetically pleasing to the client as well. The wall will run along the open channel with the approval of all three homeowners.

According to Ponderosa Trails Residential Development Standards article 2, concrete block wall is not allowed [2]. Therefore, the team will look for different wall materials such as stone veneer and brick. The material selection will be based on esthetic, cost, availability, and client preference. The wall should not exceed six feet in height, as stated in the article. The height is measured from the natural grading. And the foundation depth will be determined based on the soil type and characteristics.

## 5.6 Project Management

### *5.6.1 Construction Plan*

A major task for this project is to create construction plans that thoroughly convey the design requirements to the clients. The scaled plans are to be constructed on a software and will provide multiple views of the channel including a cross section and profile of the existing and redesign. The construction plans will include wall design, foundation, and material information and will be located in a title block that easily

labels the subject. Addition information that is important to the plans yet too excessive will be noted and located in the final proposal for further information.

### *5.6.2 Meetings*

Team members meetings must be held at least once a week to discuss tasks that each member has to do for the next team project deliverable. Team meetings are intended to discuss the feedback received from the technical advisor, plan the course of action, and adjust all errors if existed. Client meetings are to be done as needed. Team members will meet with the client to inform him with project's updates.
Deliverables for this task is meeting minutes and meeting agenda.

## 5.7 Deliverables

### *5.7.1 Final Presentation*

The group will practice and prepare a 15-minute power point presentation for the client and owner of the Summit HOA project. Each member of the team will practice their communication skills as they will explain the project understanding and propose design solution for the project. This is an important task because the group must convince the client that they have organized a concise scope of service for the project.

### *5.7.2 Final Design Report*

The design report is due at the end of the spring semester, and it will include data analysis, design alternatives, project cost, and all research done for the project. The report must be written professionally and follow report format and requirements. The document will sum the design process and shall incorporate feedback from the client, instructor, and technical advisor. The final report should include previous revisions, grading rubric, and a formal letter.

### *5.7.3 Website*

An essential project deliverables is the development of a website that is aesthetically pleasing, organized and concisely explains the Summit HOA design process. The website will not include project information until next semester and will be updated frequently.

## 6.0 Broader Impacts

The team understands that the redesign of the channel will have several broader impacts. The purpose of this project is to not only provide a solution that makes the homeowners satisfied, but to design a cost effective alternative that promotes public health and safety of the Flagstaff community. The team will take into consideration that drainage system must comply with the City Flagstaff's regulations and know that any adjustments will affect those that occur downstream. For example, the design should work properly even after the fill soil settles, and the design shall accommodate runoff of land development.

## 7.0 Project Schedule

In order to have good organization of the task, a Gantt chart was generated with starting date, ending date, and duration for each task. The timeline of the tasks is organized based on what task must be performed first and its length of work. The Gantt chart will begin with the literature review starting this semester and ending with the final report due April 23, 2015. It is important to keep viewing information about the project regularly through project designing. The Gantt chart is attached in Appendix 1.

## 8.0 Cost and Staffing

Table 1. Engineering Divisions

| ***Classification*** | ***Code*** |
|---|---|
| Senior Engineer | S.ENG |
| Engineer | ENG |
| Lab Technician | LAB.T |
| Administrative Assistant | A.A |

This memo is a brief introduction to the proposed staffing plan and the proposed budget. The project-staffing plan is divided into four classifications along with an abbreviated code as seen in Table 1 above.

Table 2. Tasks and Hourly Budgeting

| Task# | Tasks | S.ENG Hours | ENG Hours | LAB.T Hours | A.A Hours |
|---|---|---|---|---|---|
| **1.0** | **Research** | **20** | **85** | **0** | **0** |
| 1.1 | Hydrology | 5 | 20 | 0 | 0 |
| 1.2 | Hydraulics Analysis | 5 | 20 | 0 | 0 |
| 1.3 | Geotechnical Analysis | 5 | 15 | 0 | 0 |
| 1.4 | Structural Analysis | 5 | 15 | 0 | 0 |
| 1.5 | Standards and Restrictions | 0 | 15 | 0 | 0 |
| **2.0** | **Field Evaluation: Surveying** | **5** | **20** | **0** | **0** |
| **3.0** | **Meetings** | **25** | **50** | **10** | **5** |
| **4.0** | **Lab Analysis** | **5** | **20** | **30** | **0** |
| **5.0** | **Design Alternatives** | **15** | **45** | **30** | **0** |
| 5.1 | Channel Design | 5 | 15 | 10 | 0 |
| 5.2 | Drainage Design | 5 | 15 | 10 | 0 |
| 5.3 | Retaining Wall Design | 5 | 15 | 10 | 0 |
| **6.0** | **Final Design** | **10** | **50** | **0** | **0** |
| **7.0** | **Report/ Documents** | **10** | **50** | **0** | **10** |
| | **Total Hours** | **90** | **320** | **70** | **15** |

In Table 2, there are a total of seven tasks needed for the project completion; and with each task, there are three designated hours for each staff category.

Lab analysis includes development of construction plans and AutoCAD drawings which include map contouring.

Table 3: Overhead Breakdown

| Overhead | $/Mo | Final Cost for 4 Months |
|---|---|---|
| **Office supply** | 200 | $800 |
| **Rent** | 1000 | $4000 |
| **Utility** | 200 | $800 |
| **Insurance** | 200 | $800 |
| **Lab Equipment** | 500 | $2000 |
| **Software** | 500 | $2000 |
| **Total** | | **$10,600** |

Table 4. Billing and Pay Rates

| Classification | Base Pay Rate $/hr | Benefit % | Actual Pay rate $/hr | OH % | Actual Pay + OH $/hr | Profit % | Billing Rate $/hr |
|---|---|---|---|---|---|---|---|
| **S.ENG** | 45 | 30 | 60 | 35 | 80 | 12 | 90 |
| **ENG** | 30 | 20 | 36 | 35 | 50 | 12 | 60 |
| **LAB.T** | 20 | 20 | 24 | 35 | 32 | 12 | 35 |
| **A.A** | 15 | 20 | 18 | 35 | 24 | 12 | 30 |

In Table 3 above, each classification has a base pay and a factored benefit ratio in percentage in order to cover the basic costs of billable hours. Table 3 is created in order to create a profit.

Table 5. Total Cost

| ***Personnel*** | ***Classification*** | ***Hours*** | ***Pay Rate $/hr*** | ***Cost $*** |
|---|---|---|---|---|
| | S.ENG | 90 | 90 | 8,100 |
| | ENG | 320 | 60 | 19,200 |
| | LAB.T | 70 | 35 | 2,450 |
| | A.A | 15 | 30 | 450 |
| Total | | 495 | | **30,200** |

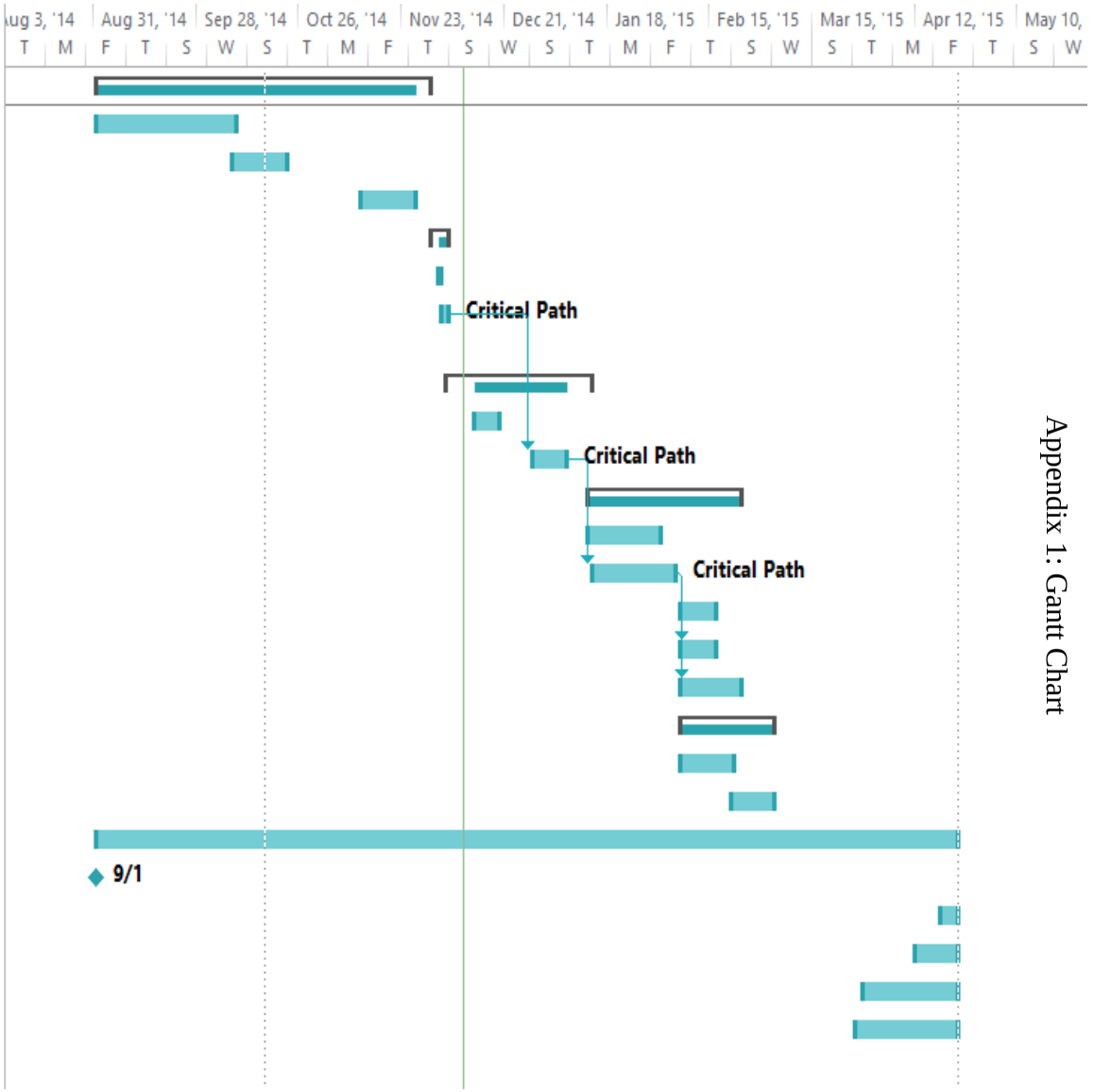
Table 4 above is a calculated combination of the second and third table in order to produce a final total estimated cost. In addition, there is an overhead cost which includes a variety of expenditures such as utilities, office rental, equipment, and so on.

## 9.0 Appendices

Appendix 1: Gantt Chart

Project schedule for the tasks and subtasks.

| | Ta M | Task Name | Duration | Prede |
|---|---|---|---|---|
| 1 | | **1 Preliminary Research** | **66 days** | |
| 2 | | 1.1 Background Information | 28 days | |
| 3 | | 1.2 Professional Consulting | 11 days | |
| 4 | | 1.3 Field Evaluation | 11 days | |
| 5 | | **2 Surveying** | **5 days** | |
| 6 | | 2.1 Field Survey | 1 day | |
| 7 | | 2.2 Topograph production in AutoCAD | 2 days | |
| 8 | | **3 Geotech.** | **28 days** | |
| 9 | | 3.1 Soil Testing | 6 days | |
| 10 | | 3.2 Fill Channel | 7 days | 7 |
| 11 | | **4 Drainage Design** | **30 days** | |
| 12 | | 4.1 Hydrology Analysis | 15 days | |
| 13 | | 4.2 Applied Hydraulics | 17 days | 10 |
| 14 | | 4.3 Open Channel Design | 7 days | |
| 15 | | 4.4 Culvert Design | 7 days | 13 |
| 16 | | 4.5 Stormdrain | 12 days | 13 |
| 17 | | **5 Structures** | **19 days** | |
| 18 | | 5.1 Material Selection | 12 days | |
| 19 | | 5.2 Retaining Wall | 9 days | |
| 20 | | **6 Project Management** | 169 days | |
| 21 | | 7 Meetings | 0 days | |
| 22 | | 8 Website | 5 days | |
| 23 | | 9 Final Report | 10 days | |
| 24 | | 10 Final Presentation | 20 days | |
| 25 | | 11 Construction Plans | 20 days | |




Appendix 1: Gantt Chart