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GREENGREY
ENGINEERING

Museum of Northern Arizona Meadow Riparian Habitat Enhancement Proposal

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1.0 Project Overview

The Museum of Northern Arizona has proposed a project to restore the riparian spring habitat closely surrounding Coyote Springs and to improve the accessibility for the residents of The Peaks. The Peaks is a senior community that houses senior citizens, some with disabilities. That being said, any proposed ramps and sidewalks must follow the 2010 ADA Guidelines, provided by the Americans with Disabilities Act. The Museum hopes to promote plant diversity and preserve the cultural heritage sites while making the area more accessible for the senior community. Further technical considerations that will take place will include removing old concrete infrastructure and piping, increase the meandering channel and wet meadow habitat, and providing an environmentally appropriate trail to conduct on appropriate wetland vegetation land.

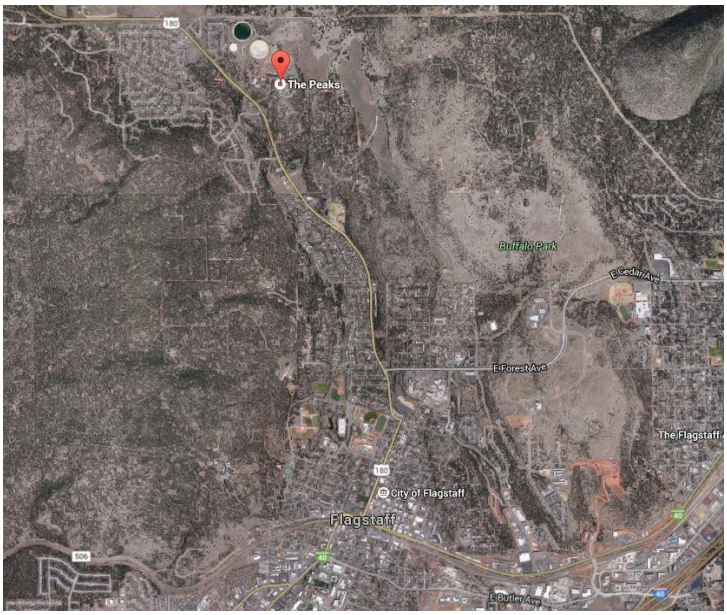


Figure 1: Project Location

Coyote Springs is located between The Peaks senior living community and the Museum of Northern Arizona's research campus. Currently, there is a dirt trail leading from the street to the spring. Figure 1 shows the precise location, which is roughly four miles from Northern Arizona University. The riparian habitat surrounding Coyote Springs is overgrown and inaccessible for the many senior citizens living at The Peaks. Figure 2 shows the general conditions of the surrounding habitat. There also seems to be a flourishing community of wildlife that shares ecological values, such as indigenous vegetation, reptiles, insects and birds living surrounding the location. Therefore, the main objective is to design various alternatives to develop a secure and biodiversity friendly ecological system within the environment to improve

the accessibility to Coyote Springs without removing an excess of the natural and cultural habitat. Hence, this location can be improved so that it can become a common gathering place for the residents of The Peaks and the citizens of Flagstaff.

Figure 2: Downstream Conditions

2.0 Scope Of Services

The scope of services for this project will provide the goals and needs of the project by identifying each of the tasks needed to complete the final alternative designs. Coyote Springs, which is located between the Peaks Senior Living Community and the Museum of Northern Arizona's research campus. This was the preliminary visit to the location was made to assess the condition of the current riparian habitat and surrounding area. Pathways and channel flow studies have also been investigated to understand the project's potential. Upon approval of this written proposal, Team MNA is going to provide the following services:

2.1 Geotechnical Analysis

Before generating design concepts, it is important to know the soil characteristics onsite. To do this, GreenGrey will be using existing geotechnical data from AARK Stream Restoration, LLC. The data will be used to determine any effects of expanding the stream footprint, building a pathway, and several other design components. In order to get a general sense of the soil onsite, a USGS Soil Data Survey was conducted. By analyzing several nearby sites, it is assumed that the majority of soil in the area is a stony clay loam variety. This soil is typically found in grassy plains and has characteristics that lead to a high amount of runoff. The Area of Interest (AOI) used for the survey is shown in Figure 3.

Deliverables

- Soil characteristics.
- Soil settlement characteristics.
- Infiltration characteristics.

Figure 3: AOI for USGS Survey

2.2 Hydrology Analysis.

Water Quality Test**:**

The water in the spring box is considered to be “pure” drinking water and is often used as a source for that. Therefore, the team will analyze the water quality characteristics by conducting a series of biological and chemical tests depending on the water quality available information. An example of a biological test is the coliform test, since coliform is a group of bacteria that is found in the environment. It can be presented in human feces, warm-blooded animals, plants, soil, water, and air. The coliform bacteria can be associated with many sources of pathogens, which may contain diseases, viruses, protozoa, and parasites. Water that contains coliform is very harmful for human health. An example of a chemical test is the Total Hardness test, which is a measure of the sum amount of calcium and magnesium dissolved in water.

Depending on the results, GreenGrey will conduct more water quality to tests for Alkalinity, Nutrients and PH levels. Alkalinity is the ability to neutralize inputs of acids hence it

is the same as the capacity of water to buffer pH changes. The nutrients test effect the aquatic organisms by causing lots of algae to grow in the water. Nutrients can also affect pH, water clarity and temperature, and cause water to smell and look bad. Therefore, for to assure the safety and education purpose of drinking water these tests will be conducted.

Deliverables

- The team will take water sample from the spring box.
- Conduct each test to determine the water characteristics.
- Using the USEPA Membrane Filtration Method for the Coliform test
- Using the Standard method # 2540C. Titration Method for the Hardness test.
- Using the Standard method # 2540B. Titration Method, HACH Water Analysis Handbook method 8221 for the Alkalinity test.
- The Test N' Tube Persulfate Method HACH method #10071 to test for total Nitrogen
- The Test N' Tube Salicylate Method HACH method #10031 to test for the Ammonia in the Nitrogen method
- Calculate and summarize the lab results.

Water Flow:

The spring itself is to be evaluated to determine its flow and water source. The extents and reach, as well as the flow will be evaluated. The team will be working with Dr. Larry Stevens for these tests.

Deliverables

- Analyzing the pre-existing studies on the channel with Dr. Stevens.
- The overall flow measurements will be analyzed. Staring from the stream will be a sum of the rainfall and snowfall, the spring's source of water, and the surrounding watershed runoff.

2.3 Survey Analysis

Survey data for Coyote Springs will be gathered from AARK Stream Restorations and analyzed to ensure the full extents of the site are included. The main focus in the survey data will be the area from the well house to the existing channel adjacent to Highway 180. Any areas not

included will be surveyed and added to the existing data.

Deliverables

- Civil 3D topographic map.
- Survey points files.

3.0 Important Design Elements

For the riparian spring enhancement, GreenGrey is proposing several design elements that are coherent with what the Museum of Northern Arizona is looking for. The design options will be proposed in a reasonable effort to blend with the current environment, therefore creating a more natural environment that will promote the proper function of the channel, plant diversity, wildlife habitat and preserve the cultural heritage for an enrich riparian area experience.

3.1 Water Distribution Method

Options:

- Reroute the stream channel to expand area of vegetation.
- Design a gravity fed fountain.
- Design small ponds on the site.

Figure 4: Example possibility of water distribution

3.2 Educational Component

Options:

- Install educational signs and boards
- Create educational brochures.
- Create educational websites on the current location.

Figure 5: Example educational signs

3.3 Access Pathway

Options:

- ADA compliant and possibly paved
- Design a full access pathway all around the location
- Design a limited access pathway on sectional areas

3.4 Re-vegetation

Options:

- Cooperating with AARK Stream Restoration, LLC.
- Depending on the information GreenGrey engineering will evaluate native versus non-native plants.

Figure 6: Native plants vs. non native plants

4.0 Deliverables

4.1 Project Schedule

The project schedule will be a very important part of this project. It will detail each start and end date for tasks that need to be completed for the project. Dependencies will also be covered in order to lay out the critical path of the project.

4.2 50% Proposal Report

The 50% design report will include any preliminary designs and will be used as a check-in from us to the client. Any comments or concerns from the client can be addressed within this design report.

4.3 100% Design Report

The 100% design report will include all design documents for this project. These documents will be able to be used in construction of the proposed design. It is our intent that the client will be completely on board with the selected design.

4.4 Website

This website will include overall workload and will be available to the public next semester. The website will include a homepage with full descriptive project information, links for future specified information and final designs. It will also include the client, the teams and technical advisor contact information. This will be viewable on the NAU College of Engineering, Forestry, and Natural Sciences capstone webpage.

4.5 Final Presentation

The team will conduct the final presentation and work accomplished to the client and technical advisor next semester. It will be on a technical level that will be understood by the

client. It will convey the scope of service and how it relates to the project. The final design will be very thoroughly explained in this presentation.

5.0 Exclusions

- No new geotechnical studies will be conducted.
- Green grey engineering will not be conducting new vegetation survey.
- No hydraulic models will be designed.

6.0 Schedule

The proposed project schedule along with work breakdown labels is shown in Appendix A. The schedule shows a critical path (dark purple) that splits into two segments for lab testing and initial design. This is because both of the tasks can be completed simultaneously to be more efficient.

7.0 Staffing & Cost Engineering Services

7.1 Team MNA Qualifications

Project Engineer Manager: Noor Alsadi

Noor Alsadi is an international senior environmental engineering student from Kuwait studying at Northern Arizona University in Flagstaff, Arizona. Noor has taken multiple core classes that relates to the water quality testing and computer aided drafting, surveying, Applied Hydraulics and Hydrology classes that relates to the museum of Northern Arizona Riparian Spring Restoration project. She is proficient with handling engineering software such as HEC-RaS, Bentley FlowMaster and ArcMap systems. Noor has experience as a research assistant for published researches and articles in the department of Administration Development located in the Public Authority for Applied Education & Training (PAAET) in Kuwait.

Software Engineer Specialist: Matthew Sorenson

Matthew Sorenson is a senior engineering student pursuing a Civil Engineering Degree. Over the course of his classwork and work experience, he has acquired technical skills in AutoCAD Civil 3D, Excel, and a few other civil engineering software programs. He is pursuing an emphasis in water resources engineering. He has experience for two summers working as a Land Development Intern with Kimley- Horn & Associates in San Diego.

Lab Tech Engineer Specialist: Jasem Alrumaidheen

Jasem Alrumaidheen is a senior international student from Kuwait and studying Civil engineering at Northern Arizona University. Throughout the engineering program he took water resource class and water resource lab, surveying and geotechnical engineering. That could help with the design process for the project.

Design Engineer Specialist: Khaled Alazmi

Khaled Alazmi is a senior international student from Kuwait Studying civil engineering at Northern Arizona University. Throughout Khaled's academic career, he studied Structural Analysis, Water Resource I, Geo Technical engineering I, Computer Drafting, and other civil engineering class.Khaled had lived Australia for 3 years for studying before he came here to Flagstaff. He had been involved in student elections as a party leader for 2 years. He has some experience in construction especially the method of building houses as it is a method that is used in Kuwait. He got the construction experience through his family construction company.

7.2 Task Analysis

This 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 below.

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

Table 1: Engineering Divisions

In table 2 below, there are a total of 5 tasks needed for the project completion; and with each task, there are subtasks designated hours for each category. Design Methods include development of construction plans and AutoCAD Civil 3D drawing which includes map contouring.

Task	S.ENG (hrs.)	ENG (hrs.)	LAB.T (hrs.)	AA (hrs.)	Total hours
Data Collection					
Geotechnical Info	10	20	-	1	31
Site Hydrology	10	10	-	2	22
Site Surveying	6	11	-	2	19
Preparation for Testing					
Gathering Materials	19	40	-	22	81
Sample Gathering	19	40	-	-	59
Laboratory Testing					
Alkalinity Test	168	300	240	15	723
Nutrients Test				-	-
Hardness Test				-	-
Coliform Test				-	-
Analysis					
Results	8	16	-	-	24
Limitations	2	12	-	8	22
Recommendations	10	20	-	8	38
Impacts	10	20	-	8	38
Design Models					
Calculations	24	20	-	-	44
Design	8	20	-	-	28
Design Analysis	8	20	-	-	28
Professional Report Review	10	20	-	10	40
Final Deliverables	10	20	-	10	40
50% Submittal Report	10	50	-	5	65

Table 2: Tasks and Hourly Budgeting

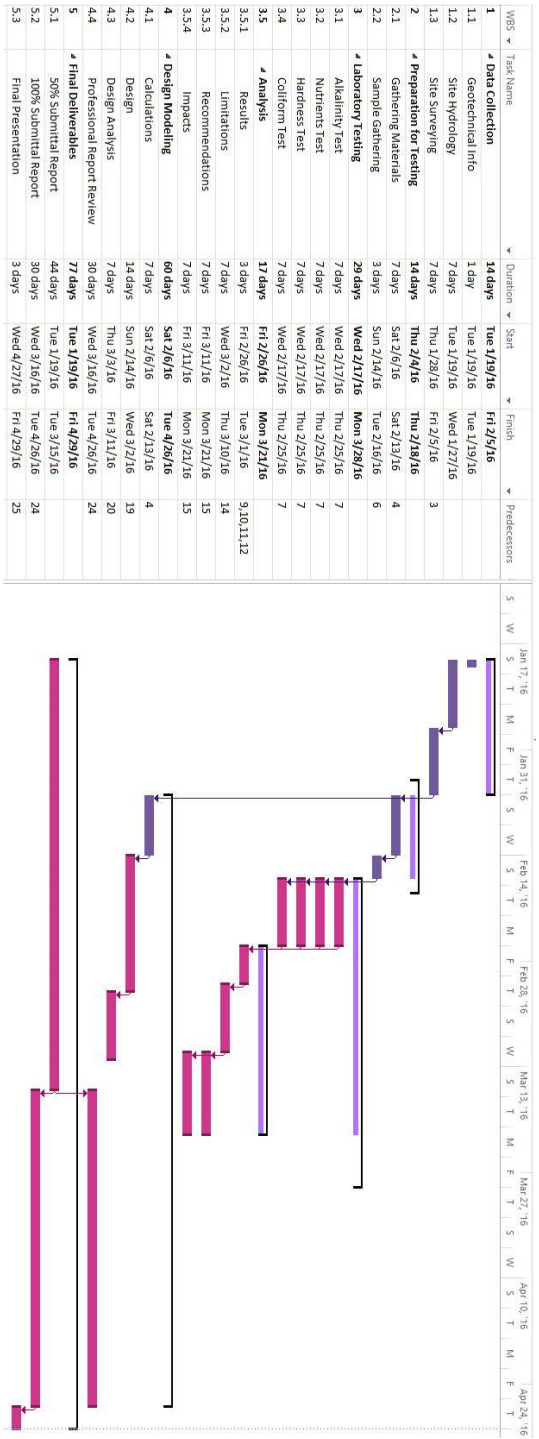
In table 3 below, each classification has a base pay and a factored benefit ratio in percentage in order to cover the basic costs of billable hours for each division.

Classification	Base Pay Rate $/hr	Benefits % of Base Pay Rate	Actual Pay	Profit % of Actual Pay	Billing Rate $/hr	Hours	Cost ($)
S.ENG	80	30	104	10	114	172	19,677
ENG	50	65	82.5	10	91	380	34,485
LAB.T	25	75	43.75	10	48	120	5,775
AA	15	90	28.5	10	31	40	1,254
Total Personnel	170	260	258.75	40	284.625	1477	61,191
Lab							3,500
Total Personnel							64,691

Table 3: Cost Breakdown

8.0 Appendices

Appendix A: Project Schedule



WBS	Task Name	Duration	Start	Finish	Predecessors
1	**Data Collection**	**14 days**	**Tue 1/19/16**	**Fri 2/5/16**	
1.1	Geotechnical Info	1 day	Tue 1/19/16	Tue 1/19/16	
1.2	Site Hydrology	7 days	Tue 1/19/16	Wed 1/27/16	
1.3	Site Surveying	7 days	Thu 1/28/16	Fri 2/5/16	3
2	**Preparation for Testing**	**14 days**	**Thu 2/4/16**	**Thu 2/18/16**	
2.1	Gathering Materials	7 days	Sat 2/6/16	Sat 2/13/16	4
2.2	Sample Gathering	3 days	Sun 2/14/16	Tue 2/16/16	6
3	**Laboratory Testing**	**29 days**	**Wed 2/17/16**	**Mon 3/28/16**	
3.1	Alkalinity Test	7 days	Wed 2/17/16	Thu 2/25/16	7
3.2	Nutrients Test	7 days	Wed 2/17/16	Thu 2/25/16	7
3.3	Hardness Test	7 days	Wed 2/17/16	Thu 2/25/16	7
3.4	Coliform Test	7 days	Wed 2/17/16	Thu 2/25/16	7
3.5	**Analysis**	**17 days**	**Fri 2/26/16**	**Mon 3/21/16**	
3.5.1	Results	3 days	Fri 2/26/16	Tue 3/1/16	9,10,11,12
3.5.2	Limitations	7 days	Wed 3/2/16	Thu 3/10/16	14
3.5.3	Recommendations	7 days	Fri 3/11/16	Mon 3/21/16	15
3.5.4	Impacts	7 days	Fri 3/11/16	Mon 3/21/16	15
4	**Design Modeling**	**60 days**	**Sat 2/6/16**	**Tue 4/26/16**	
4.1	Calculations	7 days	Sat 2/6/16	Sat 2/13/16	4
4.2	Design	14 days	Sun 2/14/16	Wed 3/2/16	19
4.3	Design Analysis	7 days	Thu 3/3/16	Fri 3/11/16	20
4.4	Professional Report Review	30 days	Wed 3/16/16	Tue 4/26/16	24
5	**Final Deliverables**	**77 days**	**Tue 1/19/16**	**Fri 4/29/16**	
5.1	50% Submittal Report	44 days	Tue 1/19/16	Tue 3/15/16	
5.2	100% Submittal Report	30 days	Wed 3/16/16	Tue 4/26/16	24
5.3	Final Presentation	3 days	Wed 4/27/16	Fri 4/29/16	25