Memorandum

To: Dr. Bridget Bero & Mark Lamer

From: Fawaz Alotaibi, Devin Kelley, Hilary Sizemore, and Bruce Connolly

Date: 10/10/2013

Re: Scope and Schedule of "Oak Creek" Capstone Project

1.0 Purpose of Memorandum

The purpose of this memorandum is to lay out the scope and schedule for the project. The scope will include what programs will be used, what will be obtained from said programs, and how these programs will help the team organize the data. The schedule provides a general guideline on what will be accomplished at what time. Due to the preliminary nature of the schedule, certain tasks may either need to have more or less days added to the task. This will become more evident as the semester progresses.

2.0 Scope of Services

The Oak Creek River crossing will entail mostly hydrological and hydraulic data in order to design a new crossing and to protect the current crossing. The new crossing should incorporate box culverts, per the residents at Rancho Mission Shangri-La Subdivision. The project will incorporate regulations and preliminary data collected from varying State and Federal agencies (i.e. ADEQ, EPA, Army Corps, etc.). The data collected from the agencies will help establish certain parameters that will be used to model the project site in order to design the most economical and safest crossing.

The scope (provided below) outlines what deliverables will be generated from the research and modeling.

Item Number	Description
	Research Research that will be completed pertains to government agencies' regulations per construction, safety, design requirements, and performance requirements. Adequate research insures the optimal design potential.

A.1	Army Corps: The Army Corps of Engineers is a governing agency that deals with the hydrological and hydraulic nature of projects. Their manuals will be referenced for the following areas of interest: • Flood protection procedures • Sustainability and protection of the river (i.e. Oak Creek) • Ecological protection of the area
A.2	ADEQ: The Arizona Department of Environmental Quality (ADEQ) has declared Oak Creek a Unique Water Status. ADEQ regulations will need to be addressed in order for the agency to issue a permit. This is to insure the water quality of Oak Creek will be unharmed during and after any construction and or armoring of the existing structure. Their manuals will be referenced for the following: • Ecological protection procedures for Oak Creek River • Construction procedures while working along river • Methods for digging within Oak Creek River • Construction permits • Any possible earthwork (cut and fill) that will be required to improve or hinder flow • SWPPP (Stormwater Pollution Prevent Plan) • Watershed description Clean Water Act, Sections 404 and 401 will need to be addressed in order show that discharge of dredged and or fill material will be kept to acceptable levels.
A.3	ADOT: Due to the project site's close proximity to US-89A, certain procedures will have to be taken in order to ensure the safety of the construction crew. ADOT will be referenced for the following: • Construction phasing • Right-of-Way • Permits for construction vehicles to access crossing ADOT will be used for traffic purposes that include the permission for construction vehicles to access the narrow crossing road, possible rerouting for traffic, right-of-way, and encroachment.
A.4	EPA: The EPA has numerous regulations in terms of the protection of streams and rivers within the US. 40 CFR part 232.1-232.3 will be referenced to discuss the moving of heavy materials in the river. The following will be referenced through the EPA: • Construction permits • Water maintenance • Any possible vegetation disturbance • CFRs (Code of Federal Regulations) relating to the project
A.5	Forest Service: The Forest Service will be considered for the protection of the surrounding flora and fauna. Certain manuals that will be needed will address the following:

	• Construction procedures • Possible endangered species affected by construction • Prevent any unwanted interaction between construction and the surrounding environment • Maximum noise levels at certain times of the day • Allowable lightning for construction The Forest Service's main priority is the protection of the surrounding flora, the fauna native to the area, and the protection of workers.
A.6	Arizona Game and Fish: The team will focus in the fishing regulations that affect the project. The types of fish present near the project site will need to be protected to an extent. The following topics will be addressed by Arizona Game and Fish manuals: • Protection of fauna • Allowed discharges in river • Construction procedures over the river • Endangered species present in area
A.7	Safety: Safety is the main concern for the project. Many precautions will be taken to ensure the safety of workers. The following procedures will be some of the precautions implemented: • Traffic barriers • Guardrails • Little to no exposure to any toxic chemicals • PPE for workers Future safety protocols will be developed as the research process continues and other factors must be taken into consideration.
	<u>Modeling</u> All software that will develop an understanding for the low water crossing and surrounding environment are categorized as modeling. The multiple software that will be used are to develop certainty in design alternatives.
B.1	HEC-HMS: HEC-HMS will be used to determine the amount of precipitation the project site may encounter within the foreseeable future. HEC-HMS will provide the following data: • Annual amount of precipitation received at crossing • The amount of runoff the crossing may encounter in a given year for a given storm-year • When floods are most common and the numerical data of said floods • The effects of snowmelt and evapotranspiration at the crossing HEC-HMS will help establish the needed data in order to run Culvert Master to estimate an appropriate size for the culverts.
B.2	HEC-RAS: The hydrologic Engineering Centers River Analysis System (HEC-RAS) is a

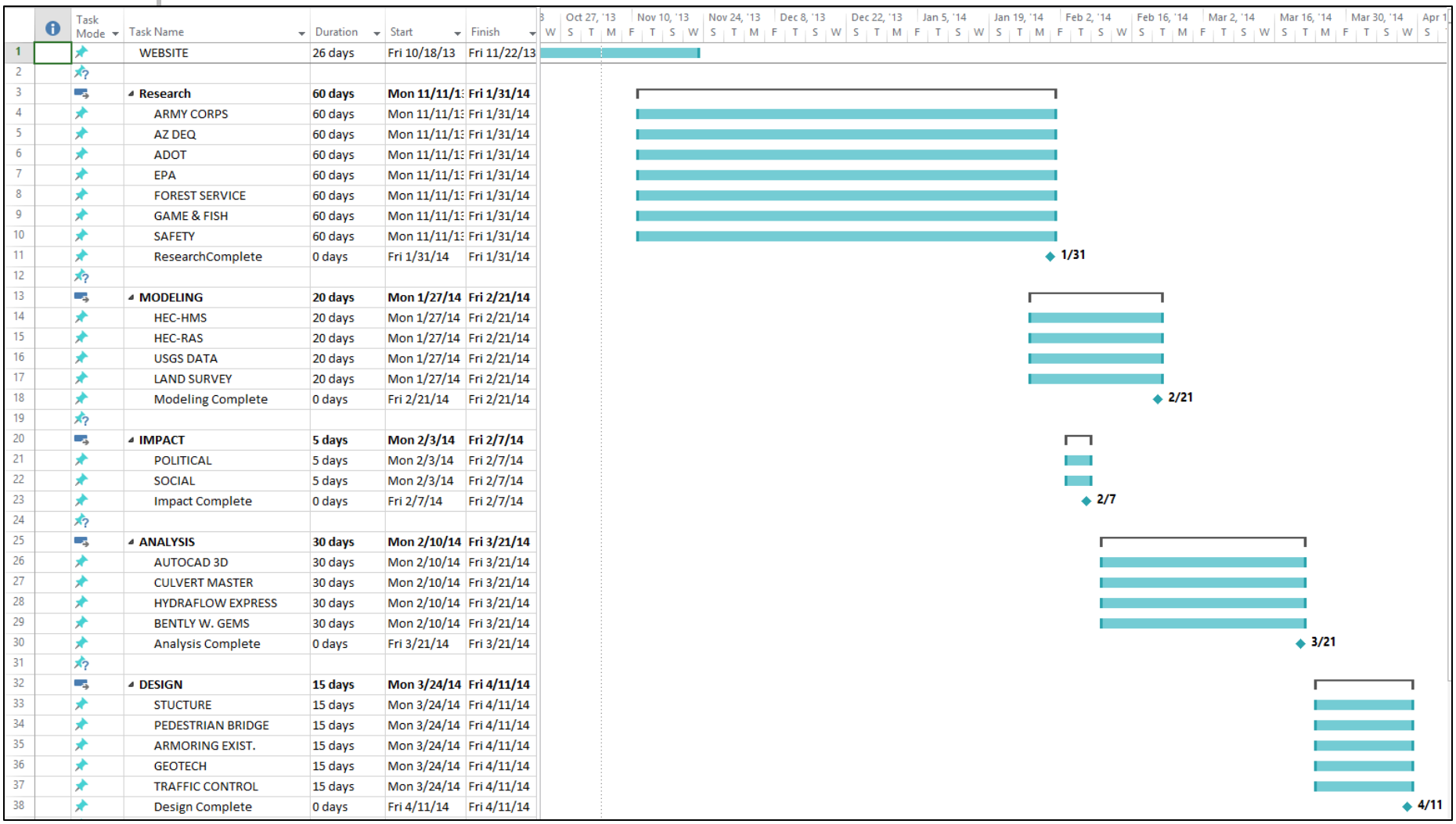
	modeling software that will perform the following procedures: • One-dimensional steady flow calculations • Unsteady flow calculations • Sediment transport • Water temperature modeling. This modeling software was developed by the Army Corps of Engineers to manage natural water channels. This system will be used to manage the up-stream channel reach of the low water crossing as well as the effect of stream changes due to maintenance and excavation. This modeling relies on the completion of the channel reach surveying. All surveying data will be used to create the cross sections of the stream reach.
B.3	USGS Data: The U.S. Geological Survey (USGS) data will be used to estimate the stream flow. The data from USGS will give the team the following: • Maximum and minimum daily discharge • Stream gage measurements to analyze the stream flow • How stream flow fluctuates throughout the year • What influence each year-storm has on the discharge The USGS data is necessary to estimate flood magnitude and to expect the time of the flood. The team will use the stream flow data to determine possible overtopping caused by a flood. The USGS data will also help determine certain physical feature of the area, such as the fault line that coincides with Oak Creek River.
B.4	Land Survey: The land surrounding the project site and the river will be surveyed to document the change in elevation within the river and around the crossing. This data will help with the following: • Elevation changes of area • Cross-sectional area of the river • River's slopes
	<u>Impacts</u> Impacts of the project are taken into consideration for the benefit of the client and surrounding community to evaluate. The social and political impacts of the low water crossing are developed based on contractor interpretation.
C.1	Political: Many political factors have to be accounted for within the project. The project itself is situated over an extremely important water channel that cannot be hampered with extensively. The community is adamant about having as few conflicts within the river, so the community's wishes must be taken into consideration. Much animosity has been shown by the community when large projects are proposed in the area. This animosity should not be met with the size of the team's project.
C.2	Social: The protection of the river is one of the highest social impacts. Much of the tourism and economy is based off of Oak Creek River. Thus, it must not be affected

	extensively where it will be permanently disrupted. Oak Creek River plays a vital role for many of the businesses and State Parks in the area.
	Analysis Analysis of software and calculations is critical for the design process. Once modeling is complete, analysis including other software will be used to develop a full understanding of the low water crossing parameters.
D.1	AutoCAD 3D: AutoCAD 3D will be used to help establish the project site and certain parameters of the project site. The watershed that affects the project area will be delineated. This delineation will be used in HEC-HMS to estimate flooding values and state what times of the year seem to have the most trouble with flooding. AutoCAD 3D will not be used for any other design reasons besides the deliverable listed above.
D.2	Culvert Master: Culvert Master will be used to help model how the river would interact with the current crossing and what culverts should be used for the designed crossing. For Culvert Master to be used properly, data will need to be compiled on the river to help with the parameters of the analysis. Culvert Master will generate multiple scenarios for different sizes of culverts. The program will provide the following data: • Amount of flow through different sized culverts • Speed of flow through the culverts • Height of water in the culverts Culvert Master will have different storms-years to give an estimate on what size culverts should be considered for the design. These storm-years' data will be generated from HEC-HMS.
D.3	HydraFlow Express: AutoCAD is a typical engineering tool that allows 2D and 3D modeling. Within the AutoCAD software is a function called Hydra Flow. The Hydra Flow function will be used to model the effects of a culvert of different characteristics to determine best theoretical fits for this specific situation. The software will allow for box and round culverts along with material differences and sizes. Based on these results the team can provide significant knowledge of the water discharge conditions that would overtop or hinder the crossing.
D.4	Bentley WaterGEMS: Bentley WaterGEMS is a modeling application that is compatible with other programs such as AutoCAD. WaterGEMS is used to model the piping of distribution systems. In this case, WaterGEMS will produce the following: • Profile of the low water crossing with calculated water flow • When the river will overtop the crossing • Culvert behavior as discharge increases with different year-storms This is important to determine because potential pressurized pipe flow could deteriorate the stream armoring set in place with maintenance. This modeling system will help determine the discharges that are at most risk for pressurized flow.

	Design The design process incorporates all learned parameters from modeling and analysis to develop design alternatives for the low water crossing's enhancements. The client's needs and suggestions will be considered in the design direction and alternatives.
E.1	Structure: The technical structural components of the crossing will not be calculated by the team due to lack of time available and professional expertise. However, many things will be taken into consideration while designing the new crossing: • The self-weight of the crossing • The estimated dead load of the crossing • The anticipated live load applied to the crossing • Hydraulic forces
E.2	Pedestrian Bridge: A pedestrian bridge that is separate from the actual crossing will not be possible to design given the time constraint of the project. However, a portion of the crossing itself can be devoted strictly to pedestrian traffic.
E.3	Armoring Existing Crossing: Currently there is minimal armoring up and down stream of the low water crossing. It is the job of the engineers to determine the appropriate additional armoring needed to protect the low water crossing from damage brought upon by heavy discharge. Based upon modeling data, the appropriate armoring needed for the stream will be based on velocities of the stream, Reynolds' Roughness Coefficient, and the available materials. Stream armoring is usually associated with rocks and boulders that will prevent erosion along the stream bed or obstructions that are used to slow the velocities up-stream to prevent erosion and scouring. Stream armoring will be initial construction with the new crossing design, but will also have a heavy emphasis in maintenance of the crossing.
	Excluded The following tasks are excluded due to outside contracting. These tasks are needed for the overall project's life span, but will not be completed in this contract.
F.1	Geotechnical Engineering: Geotechnical engineering services will not be provided by the team due to time constraints. Geotechnical tasks will be performed by an outside engineering firm in the future.
F.2	Traffic Control: Traffic control will not be planned out by the team because of time constraints. This task will be done by an outside firm.

3.0 Schedule

The following is the schedule that has been generated to show when each service will be accomplished. This tentative schedule will serve as a guide to when the project milestones should be completed. It should be understood that the subtask durations may be altered over the course of the project, while meeting major milestone deadlines. The schedule is a comprehensive outline to the scope of the project details.



	Task Mode	Task Name	Duration	Start	Finish
1		WEBSITE	26 days	Fri 10/18/13	Fri 11/22/13
2					
3		**Research**	**60 days**	**Mon 11/11/13**	**Fri 1/31/14**
4		ARMY CORPS	60 days	Mon 11/11/13	Fri 1/31/14
5		AZ DEQ	60 days	Mon 11/11/13	Fri 1/31/14
6		ADOT	60 days	Mon 11/11/13	Fri 1/31/14
7		EPA	60 days	Mon 11/11/13	Fri 1/31/14
8		FOREST SERVICE	60 days	Mon 11/11/13	Fri 1/31/14
9		GAME & FISH	60 days	Mon 11/11/13	Fri 1/31/14
10		SAFETY	60 days	Mon 11/11/13	Fri 1/31/14
11		ResearchComplete	0 days	Fri 1/31/14	Fri 1/31/14
12					
13		**MODELING**	**20 days**	**Mon 1/27/14**	**Fri 2/21/14**
14		HEC-HMS	20 days	Mon 1/27/14	Fri 2/21/14
15		HEC-RAS	20 days	Mon 1/27/14	Fri 2/21/14
16		USGS DATA	20 days	Mon 1/27/14	Fri 2/21/14
17		LAND SURVEY	20 days	Mon 1/27/14	Fri 2/21/14
18		Modeling Complete	0 days	Fri 2/21/14	Fri 2/21/14
19					
20		**IMPACT**	**5 days**	**Mon 2/3/14**	**Fri 2/7/14**
21		POLITICAL	5 days	Mon 2/3/14	Fri 2/7/14
22		SOCIAL	5 days	Mon 2/3/14	Fri 2/7/14
23		Impact Complete	0 days	Fri 2/7/14	Fri 2/7/14
24					
25		**ANALYSIS**	**30 days**	**Mon 2/10/14**	**Fri 3/21/14**
26		AUTOCAD 3D	30 days	Mon 2/10/14	Fri 3/21/14
27		CULVERT MASTER	30 days	Mon 2/10/14	Fri 3/21/14
28		HYDRAFLOW EXPRESS	30 days	Mon 2/10/14	Fri 3/21/14
29		BENTLY W. GEMS	30 days	Mon 2/10/14	Fri 3/21/14
30		Analysis Complete	0 days	Fri 3/21/14	Fri 3/21/14
31					
32		**DESIGN**	**15 days**	**Mon 3/24/14**	**Fri 4/11/14**
33		STUCTURE	15 days	Mon 3/24/14	Fri 4/11/14
34		PEDESTRIAN BRIDGE	15 days	Mon 3/24/14	Fri 4/11/14
35		ARMORING EXIST.	15 days	Mon 3/24/14	Fri 4/11/14
36		GEOTECH	15 days	Mon 3/24/14	Fri 4/11/14
37		TRAFFIC CONTROL	15 days	Mon 3/24/14	Fri 4/11/14
38		Design Complete	0 days	Fri 4/11/14	Fri 4/11/14

Figure 3-1: The tentative schedule including milestones and approximate number of days to perform each task.

This preliminary schedule will serve as a guide on when our project should begin and where we should be at throughout the year. This schedule will be fine-tuned with sub-tasks as the semester progresses and once more details become realized through the team's research.