Ponderosa Designs

Duncan, Arizona Floodplain Feasibility Study:
Proposal Submittal: Final Proposal

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May 9th, 2017

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1.0 Project Understanding

1.1 Project Purpose: Duncan is a town located in Southeastern Arizona along the Gila River (Figure 1.1). The current population is about 800 residents, according to the 2015 census. This town has experienced consequential flooding events throughout its history due to its geographic location on the floodplain. The floods that occurred in 2005 and 1978 caused significant damage to infrastructure, agricultural crops, and property [1]. Therefore, the Duncan Flood Control Project is needed to protect the town from future flooding. This project will attempt to solve the problem of flooding by correcting the historical flow models and proposing a proper levee design.

Figure 1.1: Duncan, Arizona

Figure 1.2: Flooding on Duncan Bridge (2005)

1.2 Project Background: The project is located in Duncan, Arizona which lies three miles east of the New Mexico border in Greenlee County (Figure 1.1). This county is an area of land that is characterized by cottonwood trees, fertile soil (silt and clay), and a semi-arid climate [2]. The Duncan Floodplain project is in its third stage. The first stage of this project consisted of floodplain analysis and conceptual levee alignment design. This was done by the NAU Crown Engineering Team in partnership with Philip Ronnerud, P.E. This stage provided insight to Duncan's current risk of flooding and were based on updated topographic maps and a new 100 year flow. The software of Autodesk Civil 3D and HEC-RAS were used to model the one dimensional flow for this stage. Based on this information, the alignment of the levee was proposed to span 1.9 miles along the 3.5 mile Gila River reach. Next, the second stage of this project consisted of the NAU Hydro Engineering Team. The team was in partnership with Philip Ronnerud, P.E to create a two dimensional model of the floodplain. This model was achieved by using Flo-2D model. The team used the data from these modeling programs to conduct a more accurate levee analysis to meet the demands of the client. The third stage of the project will be done by Ponderosa Design Team. The team will set out to correct the models of

the previous two-capstone teams and modify the existing data to allow for proper flood mitigation.

1.3 Site Map:

Figure 1.3 Overhead picture of the site

1.4 Technical Considerations: Our team will be conducting remedial geological work to determine if the land is suitable to build the requested levee on. This will require two to three field visits in order to conduct an accurate assessment of the site. Information regarding the current soil conditions will need to be obtained to create simulations that reflect the site. The soil conditions can be determined by reviewing the United States Department of Agriculture (USDA) Web Soil Survey for the area of Duncan, Arizona [3]. The site visit will also provide verification of the soil data obtained from the USDA Web Soil Survey reports. These will be used to revise the Manning's Value that will be used in the modeling software. A combination of ARCGIS, HEC-RAS, and Civil-3D will be utilized to conduct simulations that will determine the expected hazards due to flooding. The fabricated modeling systems will be used to determine the existing and future conditions during a storm event.

1.5 Potential Challenges: For this project our team will need to learn how to use all of the modeling programs required. The team has no prior experience with these modeling programs. In addition, the team might experience problems contacting the client. This is due to the busy schedule of the client. The team will encounter issues regarding the simulations within HEC-RAS, in regards to determining the accurate conditions of the Gila River floodplain analysis. These issues will be resolved by conducting multiple simulations and utilizing the past simulations as references. The previous Duncan Floodplain Analysis team created multiple simulations of the site. The current team will use this information and refine the conditions to conduct an accurate analysis on the floodplain.

1.6 Stakeholders: For the Duncan Project, there are different parties that will be effected in the construction. There will be two types of stakeholders, internal and external. The internal stakeholders are those who are funding the project. The external stakeholders are the people in the surrounding area who will be impacted by the development. Internal include the US Army Corps of Engineers (USACE). They will sign off on the budget as well as the approve the construction of the new levee. Greenlee County Government is in charge of coming up with the funds to be able to create this project. They are the primary stakeholder for they are the entity that is requesting the job to be done. The external stakeholders include land owner's. The construction of a levee would require FEMA to produce a new flood risk map for insurance carriers. ADOT has a stake in the project as well, for their bridge is at risk of overtopping, the hydraulics of the bridge could be subject to modification. Local farmers are impacted because Duncan has a agriculture-based economy. The flooding puts farming land and livelihood at risk because their lands might be subject to eminent domain claims for construction of the levee. Lastly, FEMA sets the levee certification and accreditation; this to make sure that the levee meets the federal standards on design, construction, and maintenance.

2.0 Project Scope:

In order to execute the Duncan Flood Project, the Ponderosa Design Team must first assess the client's needs by conducting a public forum (town meeting) . The client is Phillip Ronnerud and the City of Duncan, Arizona. From the forum, The City of Duncan expressed multiple viewpoints on what direction this project should take. The major consensus was that the citizens would like to see that the design should lead towards protecting the town from a 100 year flood event or the at a minimum lower the risk of the town. Ponderosa Design team will provide the following services for the town of Duncan, Arizona upon approval from Phillip Ronnerud. The provided services are discussed in further detail within the following sections.

2.1 Project Start Up and Data Collection

2.1.1 Providing all HEC-RAS and Flo 2-D Data: Updated models of Gila River floodplain were constructed by the past capstone teams before Ponderosa Designs assembled. These models will serve as a baseline for Ponderosa Designs to narrow their scope and act as aid for the final design. After becoming familiar with the models, Ponderosa Designs will alter the existing models with guidance by Tom Loomis, to the requirements of the client. These models will then be processed by the computer systems that Tom Loomis will provide. Dedicated processing systems will allow for multiple models to be tested to determine errors

and refinement needs. Ponderosa Design will deliver a adjusted model with the existing agricultural levees edited out. In addition, all possible solutions that the team creates will be edited back into the system. Lastly, the team will provide the client will the revised HEC-RAS and Flo-2D reports, rating tables, and error/warning reports.

2.1.2 Troubleshooting Previous Data: According to Ponderosa Design's technical Advisor Tom Loomis, the existing models are about 90% complete. Therefore, Ponderosa Designs will be revising and completing the models under the guidance of Tom Loomis. If any errors are identified, these problems will be trouble shot. The team will ensure all hydraulic modeling is complete (HEC-RAS and Flo-2D) and provide a working model before levee design takes place. Therefore, the team will provide the client with the before and after results of their modeling. This will take place in the form of modeling reports, rating tables, and graphs.

2.1.3 Purpose of Troubleshooting Data: Ponderosa Designs will be provided new data for design. Insight from the citizens of Duncan will guide the team to produce solutions that are both feasible and low impact on the surrounding lands. The team will take the observations and insights from the site investigation/forum to troubleshoot the models using the current hydraulic information. The towns input is critical to developing a proper design solution. The design solution impacts their land and budget. Therefore, it was concluded that Ponderosa designs will model the improvements made on bridge hydraulics and land restoration.

2.2 Land Use and GIS Data

2.2.1 Lidar Data: Lidar Survey data will be used in the area to determine the elevation of the sections along the project area. These elevations will then be used in the various modeling software that the team will be using. The modeling software will determine the different flow routes of the 100 year flood events. Ponderosa Designs will provide information regarding the layout of the land by means of topographic Lidar analysis. The collected data will be utilized to determine accurate roughness coefficients of the given land to benefit the HEC-RAS and Flo-2D simulations. The determined roughness factors will provide results to better understand the characteristics of the floodplain. The Lidar Data will be utilized but not provided as a final deliverable.

2.2.2 GIS Data: GIS data will be used to determine the areas at risk of flooding. This data will then be used to narrow down to the areas of concern. The areas of concern are in the potential flooding zones. These areas will then be assessed with respect to the modeling. This will determine what course of action should be used at each of these zones. The GIS Data will be utilized but not provided as a final deliverable.

2.2.3 Using Data for Design: Data for this project will be provided by the Town of Duncan and Phil Ronnerud. Supplemental data will be supplied from the USGA for the local soil conditions. All of the GIS, survey, and soil information will be used for improving bridge hydraulics and levee design but will not be provided as a final deliverable.

2.3 Design Preparation

2.3.1 Revise Bridge Hydraulics: The models from the previous capstone teams will be adapted to the specifications of Phil Ronnerud and Tom Loomis. These models will be have updated roughness factors and appropriate widths of the bridge piers. The process behind this deliverable will be outlined in the following section.

2.3.1.1 Widen Piers and Adjust N-Values: Under the guidance of Phil Ronnerud and Tom Loomis, Ponderosa designs will revise the existing model for the Main Street Bridge. The bridge will be updated for appropriate pier distance. This will account for debris that would typically build up on the bridge, restricting the flow. Phil Ronnerud informed the team that these pillar dimensions will have to be tripled to account for the debris that builds up on the pillars over the course of a flooding event. These new bridge dimensions and N-values will be then be accounted for in the final model design report deliverable.

2.3.1.2 Bridge Design Alternatives: Ponderosa Designs will look into adjusting the features of the bridge with modeling programs to improve the flow under the bridge. These changes include the removal of a protective fencing that is located on the upstream side of the bridge. This fence impedes the movement of debris and water across it. In addition, the team will look into changing the shape of the pillars to prevent debris from accumulating, this can include the addition of debris fins and sweepers.

These changes will be confirmed with the ADOT Design Standards. The final report deliverable will include all bridge alterations.

2.3.2 Revise Flo-2D Model: The Flo-2D model from the past capstone group will need to be revised, removing the agricultural levee that is currently in the existing model and restricting the water flow of water in the area. Once the levee is removed on the models, Ponderosa Designs will then use the adapted model to determine the new parameters of the river. Using the feedback from Phil Ronnerud, the team will provide an appropriate levee alignment and/or levee adaptations in the form of a Flo-2D report.

2.3.3 Levee Standards (US Army Corps) and Regulations [5]: The final design should comply with the US Army Corps standards. Any design aspects that does not meet these standards needs approval from the Greenlee County Engineer. Greenlee County is then responsible for seeking approval from the US Army Corps. According to the US Army Corps, levees are classified according to the area they protect such as urban or agricultural. Due to the Town of Duncan's unique area being in proximity to farmlands, this project will need to provide the design for an agricultural and urban levee. Agricultural levees will provide flood protection in lands used for agricultural purposes and urban levees will provide protection to residential, industrial, and commercial properties [5]. The standards that the team is complying by will be presented in the form of a list in the final design report.

2.3.4 Background of Successful Levees: Ponderosa Designs will use past successful levees to aid in the design of the levee for Duncan. The team will be focusing on agricultural levees due to costs constraints, time permitting the team will look into large scale alternatives. This information will come from the FEMA website and the plans/specification of levees in Arizona. The levees used and referenced will be in accordance to the FEMA and the US Army Corps regulations. This information will be used but not presented as a final deliverable.

2.3.5 AutoCAD Civil 3D [6]: AutoCAD Civil 3D will aid the design of the levee if that becomes the ideal situation. The modeling programs will allow for an overview of the alignment for the levee, a profile will be constructed to determine the levee heights. Following that, the dimensions will be imported into HEC-RAS for analysis. AutoCAD Civil 3D files will also serve as the base for the construction plans to be made. If this design alternative is chosen, the team will provide a plan and profile view of the proposed levee.

2.3.6 Maricopa County Hydraulic Design Manual [7]: The Maricopa County Hydraulic Design Manual will provide the team with a understanding of their hydraulic constraints. The client requested that this manual be used in order to make sure the modeling changes meet the Arizona code/standards. The team will compose a list of all the codes and standards that are applicable to the modeling changes/bridge hydraulics. A list of the codes used from this design manual will be listed in the final design report.

2.3.7 Floodplain Management Ordinance [8]: The Floodplain Management Ordinance adopted by the Flood Control District of Greenlee County will provide information regarding the land parcels that are affected by potential flooding, set forth the compliance regulations for any additional designing, and hazards associated with the floodplain. Ponderosa design will refer to the above document to determine the compliance of the suggested design, the design must satisfy any and all regulations set forth. A list of these regulations will be outlined in the final design report.

2.3.8 ADOT Drainage Design Manual [9]: The Arizona Department of Transportation Drainage Design Manual will be used to assess the soil conditions in the area of interest. The manual presents approaches, methods, and procedures for the design of drainage structures on projects impacting Arizona highways. The AASHTO Model Drainage Manual will be used to constrain the design, based on the existing conditions of the area. The list of regulations that the team uses from this design manual will be outlined in the final design report.

2.4 Permitting

2.4.1 Land Use and Vegetation Management: The levee design set forth by Ponderosa Designs shall not conflict with the Land Use and Resource Policy Plan (LURPP) of Greenlee County [10]. Ponderosa Designs will be responsible for researching and understanding the LURPP standards thoroughly and applying the standards to any design changes made. Upon final design, the team shall re-analyze the design to determine its compliance with the LURPP standards [10]. The team is aware that no channel excavation can take place in order to protect the habitat. The team will focus on natural stream and vegetation management if possible. The list of regulations that the team uses from this manual will be outlined in the final design report.

2.4.2 Easements and Right of Way: During the design use of eminent domain might have to be enacted to purchase land from citizens for public use. The land will be bought giving appropriate compensation to the previous land owner using an appraiser to determine the cost of the land [2]. The team will provide a map of the county/town easements in the final design report.

2.4.3 US Army Corps of Engineers [3]: The City shall obtain a permit for construction (ENG FORM 4345) from the US Army Corps of Engineers in order to complete the project. The US Army Corps of Engineers regulates any construction on navigable waters within the nation. The permit shall explain the details of the project, identify any environmental hazards, and provide information regarding the property owners that will be affected by the construction. Ponderosa Designs will provide a picture of the permit in the final design report.

2.5 Coordination

2.5.1 Coordination with the Client: Ponderosa designs will maintain contact with the client Phil Ronnerud until the projects and class completion in December of 2017. The team will be contacting Phil Ronnerud by means of email, telephone, and in-person meetings.

2.5.2 Coordination with City: Phil Ronnerud will be held responsible for coordinating meetings with the city. Ponderosa Designs will submit time periods that would be ideal for the team to travel to Duncan for these meetings to take place.

2.5.3 Coordination with FEMA: Ponderosa Designs will adhere to FEMA's design standards for levees by demonstrating that the levee system will meet the National Flood Insurance Program (NFIP) requirements. The requirements for these levees are described in Title 44, Chapter 1, Section 65.10 of the Code of Federal Regulations (44 CFR Section 65.10) [11].

2.5.4 Brush Clearance and Habitat Restoration: Tamarisk (or Salt cedar) is an extremely invasive plant that was found during the site investigation. Tamarisk typically replaces the native vegetation by out competing it. This decreases the overall biodiversity of the area. This invasive plant grows into the waterway causing blockages and excess debris during flooding events. Ponderosa designs

will look into available funding to determine the feasibility of Tamarisk removal in the area.

2.6 Impacts

2.6.1 Health: Ponderosa Designs shall design the levee with health impacts in mind. The design shall not inflict health hazards on the surrounding community. This will be done in accordance with the American Society of Civil Engineers Code of Ethics. The team will operate within this code. The main object is to protect public health and well-being.

2.6.2 Environmental: All design elements set forth by the Ponderosa Designs levee construction shall not harm the environment in any form. The following standard shall regulate the construction methods (The Clean Water Act- Section 404). The construction material utilized for the design will undergo proper testing to ensure that it meets requirements set forth by Section 404 of the Clean Water Act [12].

2.6.3 Economic: Ponderosa designs will determine possible sources for funding the project and will provide an invoice for the work done by the team. Ultimately, the responsibility for funding will come from the City of Duncan. They will cover the capital costs.

2.6.4 Cultural: The proposed levee design set forth by Ponderosa Designs shall promote the cultural background of Duncan, Arizona. It shall represent all cultures on equal grounds. The proposed design shall promote the rural lifestyle of the community and impose a family-oriented outlook on the residents noted within the Land Use and Resources Policy Plan (LURPP) [10].

2.7 Exclusions

2.7.1 Permitting: Ponderosa Designs will not be responsible for the acquisition of the necessary permits for this project. Permitting for the project will need to be done in compliance with FEMA, NFIP, and any other regulatory agencies that can influence construction.

2.7.2 Construction Plans and Specifications: Ponderosa Designs will not provide the necessary blueprints for construction of this project. Neither will use Greenlee County CAD templates for final design proposal. In addition, Greenlee

County will be fully aware that Ponderosa Designs will be operating on a student CAD license and legal restriction may apply [6].

2.7.3 Time is the Resource/Economy: Ponderosa Designs recognized that time is their economy. Designs changes, implemented other than by Ponderosa Designs, will not be accepted after November 17, 2017. Accumulated designs changes that will take over 40 man hours will not be accepted after November 10, 2017. After Ponderosa Designs submits their final design, they will disband in December 2017.

2.7.4 Liability: Ponderosa Designs is not a professional organization. Therefore, the team will take no liability for performing this service. However, as practicing to become professions they will hold true to the Engineering Cannon of Ethics.

2.7.5 Public Relations: Ponderosa Designs will not be held accountable for maintaining good standing with the local populace. Relations with the local populace will need to be maintained by an outside source.

3.0 Scheduling

3.1 Scheduling Purpose: Ponderosa Designs will implement scheduling in order to determine the amount of time allocated for the given analysis. The designed scheduling will keep the team on track with the expected completion time of the analysis. The projected scheduling option will allow Ponderosa Designs to better understand the project costs associated with the analysis. This is shown within the Gantt Chart attached (Appendix 5.0).

3.2 Gantt Chart [13]: February 24, Ponderosa Designs met with their technical advisor, Tom Loomis. Tom provided an introduction to the modeling the previous teams constructed. From there, the team is tasked with familiarizing themselves with the models and the software that the will be altered in the Fall 2017 Semester. March 3 was a trip to Duncan, Arizona at which Ponderosa Designs met their secondary client, Duncan citizens. The purpose was to hear the citizens opinion of the project in order to revise the scope. Following that, importation from ARCGIS will help update the models to better accommodate the bridge hydraulics. After that, Ponderosa designs will begin to familiarize themselves with levee standards and specifications as preparations to the Fall Semester. In September, Ponderosa designs will begin to the design process. Finally, Ponderosa Designs will publish results and finding to their client and the citizens of Duncan.

3.3 Critical Path: The critical path taken within the Gantt chart is referenced to the design preparation stage. The allocated time taken by the design preparation stage is estimated at 160 days. The design preparation stage will be primarily composed of researching, designing, and simulating hydraulic analysis using the given software. These steps will be repeated until the analysis has given quality results that reflect the realistic solutions. Upon completion, the Ponderosa Designs team will strategically design a levee system in compliance with the acquired results determined by the analysis.

4.0 Cost of Engineering Services:

Table 1: Task and Total Hours

Task	How	SE	PE	EIT	Intern	Total Hours
1.0 Modeling Parameters	Background Research	8	8	8	8	32
Manning's Roughness Coefficient	Equation/ Table [1]	2	3	8	5	18
	Tamarack Removal [2]	0	0	3	5	8
1.2 Bridge Alternatives	Gate Removal	3	5	10	2.5	20.5
	Pier Adjustments	3	5	10	5	23
	Dimensions	20	40	40	10	110
1.3 Regulation Research	FEMA Regulations [3]	2	3	5	5	15
	ADOT Regulations [4]	2	3	5	5	15
	Army CORP Regulations [5]	2	3	5	5	15
2.0 Bridge Hydraulics	Teams Excel Data	15	35	5	5	60
2.1 HEC-RAS	Model Hydraulic Conditions	10	35	10	5	60
2.2 Flo-2D	Analyze Storm Conditions	5	35	20	5	65
2.3 ARCGIS	Processes Info for Models	5	10	10	5	30
3.0 Modeling Analysis	Interpreting Data	2	5	5	5	17
3.1 Recommended Solutions	Communicating Results to Client	2	5	0	0	7
3.2 Impacts	Full Scope of Impacts [6]	1	5	0	0	6
3.3 Cost Analysis	Charging Project	3	0	0	0	3
4.0 Data Collection						
4.1 Site Visit (Travel)	Travel to Duncan, Arizona	70	70	70	70	280
4.2 Public Outreach	Meeting with Town/ Engineers	3.5	3.5	3.5	3.5	14
4.3 Soil Samples	Grab Samples and Sieve Analysis	0	0	5	5	10
5.0 Project Management						

5.1 Coordination	Communication with Client	10	5	5	0	20
5.2 50% Report	Finish Scope/ Research	5	5	5	10	25
5.3 Impacts Report	Publish Impacts (Fall 2017)	5	5	5	10	25
5.4 Final Proposal	Final Presentation (Fall 2017)	10	10	20	5	45
5.5 Website	Complete Website (Spring 2017)	1	3	1.5	5	10.5
Summation of Hours:		189.5	301.5	259	184	934

Table 2: Positions and Qualification

Position	Qualification
Project Engineer 1	Construction Management
	Editing
	Public Speaking/ Group Communicator
	Plan analyzer
	Modeling
Senior Engineer	ARCGIS Background
	Understanding Sitemaps
	Project Researcher
	Modeling
Engineer in Training	Project Researcher
	Modeling
Staff Engineer	Open Channel Analysis Background
	Modeling

Table 3: Total Cost of Project

Classification	Billing Rate ($)/hr	Hours	Total Cost ($)	Notes
Senior Engineer	130	189.5	24635	
Project Engineer 1	90	301.5	27135	
EIT	75	259	19425	
Intern	25	184	4600	
Total Staff Cost		934	75795	
Travel (2 Trips)	$/(mile or day)	Miles or Day	Total Cost ($)	
Miles	0.5	1400	700	
Rental Car	40	4	160	
Hotel	50	10	500	*5 Rooms
Total Travel Cost			1360	
Total Costs			77155	

4.1 Modeling Parameters: This section of the table (Table 3.2) will define different parameters that could have a possible impact on the overall project. These parameters must be kept into consideration throughout the duration of the project to maintain compliance with the state and federal government. These parameters include the manning's value, bridge alternatives, and research regulations.

4.2 Manning's Values: Ponderosa Designs will conduct research on the different Manning's values that were gathered from the initial site investigation. In addition, the team will take into consideration the client's recommendation on these values. The design team will then look for alternatives to decrease the overall N-values in the area to represent a more realistic model.

4.3 Bridge Alternatives: Ponderosa Designs will adjust the pier width to account for debris build up on the bridge piers. The design team will then look into alternatives that can be used to further enhance the flow rate under the Main Street Bridge. The additional alternatives will focus on reducing the amount of debris build up for the bridge piers.

4.4. Regulation Research: Ponderosa Designs will look into the different regulations that apply to the location. These will depend on the final solution that is selected for the site. Some of these regulations will require looking into a similar project to determine the regulations that needed to be in compliance. This includes FEMA, ADOT, and the US Army Corp of Engineers Standards. Ponderosa Designs is not responsible for the acquisition of these permits and inspections.

4.5 Bridge Hydraulics: Different programs will be used over the course of the project to improve the hydraulics under and around the town bridge. These programs include HEC-RAS, Flo-2D, and ARC-GIS.

4.6 HEC-RAS [14]: HEC-RAS is a one dimensional modeling software for flow. HEC-RAS models the bridge as a hydraulic culvert. A hydraulic culvert analysis is adequate for conditions at which water depth exceeds bridge girder. HEC-RAS is accurate when flow is in bounds of the banks. Ponderosa designs will examine the existing model and attempt to update the bridge analysis portion to accommodate the bridge piers.

4.7 Flo- 2D [15]: Flo- 2D is a modeling software that utilizes the Lidar data that Ponderosa designs has access to. From this data, a grid will be generated over the desired area. Each of these grids will then take into account each of the different elements that affect flooding in the area and generate a report on how severe the flooding is for each grid elements.

4.8 ARC-GIS [16]: ARCGIS utilizes the data that the USGS creates each year to produce an accurate map and model of the area [16]. These maps will be created to portray the extent of the flooding in the Duncan area to the client and how the proposed solution will affect the flooding in the area.

4.9 Modeling Analysis: Once a model has been selected, detailed analysis must be conducted to determine the effects and feasibility of the project. Ponderosa Designs will conduct impact and cost analysis after the modeling is completed. Recommended solutions/alternatives based upon the acquired information for the different modeling systems will be provided.

4.10 Recommended Solutions: Ponderosa Designs will generate possible solutions in the form of models, and recommendations for the client. These are based upon the analytical results obtained from the modeling software. Each recommended solution will be accompanied by results from the three modeling software including a list of the manipulations/inputs used to acquire the given results.

4.11 Impacts: Ponderosa Designs will analyze the possible solutions with respect to the effect that the design will have on the immediate area as well as further downstream. The impact analysis will include a before and after construction analysis to determine the significant effect of any design changes. Ultimately, the impacts analysis will determine the feasibility of the design according to its effects to the surrounding areas.

4.12 Cost Analysis: Ponderosa designs will look into the financial feasibility of the project, identifying the possible sources of funding to determine if the project can be actually implemented. The cost analysis will include a detailed report on the budgeting and costs associated with the final solution. Ponderosa Design will complete research on the monetary values for each tasks located within Table 3.2.

4.13 Data Collection: The data collection portion of this project includes site visits, public outreach, and soil samples. These tasks will require the time of all staff members and the client.

4.14 Site Visit: Ponderosa Designs will conduct two site visits to Duncan, Arizona. This will be done in order to obtain further information on the site. During these site visits the team will be accompanied by Wilbert Odem, Phillip Ronnerud, Tom Loomis.

4.15 Public Outreach: Ponderosa Designs (along with Phillip Ronnerud and Tom Loomis) will be holding a public forum in an attempt to further understand the project from the perspective of the citizens of Duncan. From this meeting the team will adjust the scope to fit the needs of the City of Duncan.

4.16 Soil Samples: Grab samples will be taken to determine appropriate N-values for the site. These samples will then be analyzed in the Geotechnical Lab to determine the classification of the soil. In addition, analysis will be conducted using the geotechnical background/knowledge of Ponderosa Designs. The team will utilize the Manning's Equation for classical open channel hydraulics applications.

4.17 Project Management: Managing the logistics of this project will generate billable hours. This project management includes client coordination, creating the 50% and impacts report, and generating the final proposal/ website.

4.18 Coordination: The Ponderosa Design team will coordinate meetings with Wilbert Odem, the Technical Advisor. The team will also maintain steady coordination with the client Phillip Ronnerud as well as the tech advisor Tom Loomis. Models will be sent with ample time to Tom Loomis so the models can be run on the dedicated servers that he is providing.

4.19 50 % Report: Ponderosa Design will construct a report of what they did on the project halfway through the Fall Semester 2017. This report will help serve as a guide for the final report.

4.20 Impacts Report: The final design concept will have impact to the existing river channel upstream and downstream. Ponderosa Design will present the known impacts found through analysis and conceptual ideas of impact.

4.21 Final Proposal: Ponderosa Design will create a final proposal that takes into account the client's needs, and remains within the constraints of state and federal regulations.

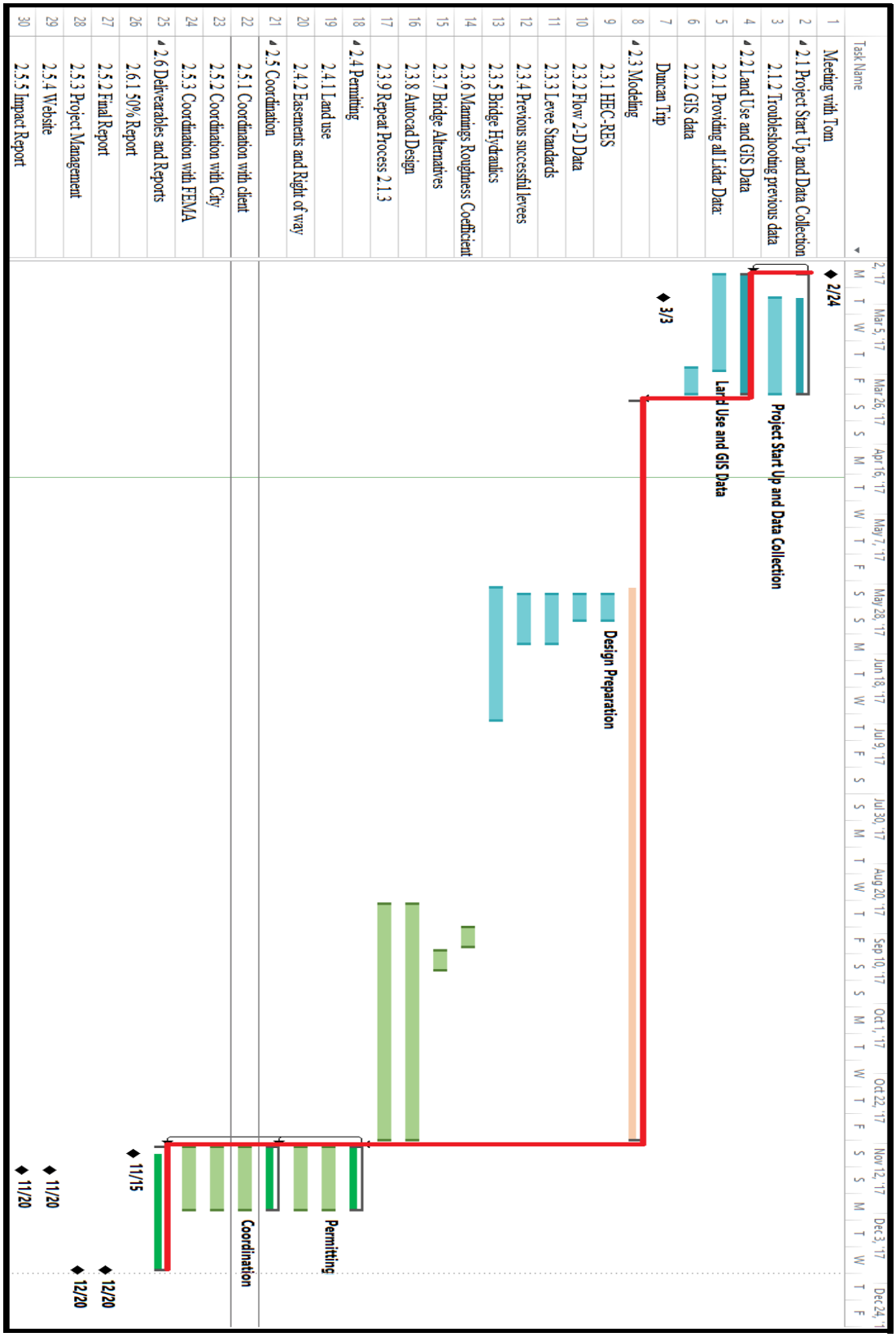
4.22 Website: Ponderosa Designs will generate and maintain a website for all information on the Duncan Capstone Project, providing all information that is required by the CENE 476 syllabus.

5.0 Explanation of Cost Table:

The cost of the project was estimated using how much time each task should take to complete and the travel expenses that would accumulate for each site visit. The labor costs were determined using the hourly estimation for each task and each position then multiplying the time by the rate to determine the billable hours. The travel expenses were calculated by using how much the first site visit costs and then multiplying by the number of times that the team would have to go.

6.0 Appendices

Gantt chart:



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