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Scope of Work for San Simon Basin Dam Evaluation

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Abbreviations

- HEC-RAS - Hydrologic Engineering Center's River Analysis System
- BLM - The Bureau of Land Management
- NAU - Northern Arizona University
- DBA- Dam Breach Analysis

2.0 Required Content and Format

The San Simon basin dam system is located near the City of Safford, AZ and is in need of a DBA assessment. BLM has contacted NAU to perform a DBA on the San Simon Barrier Dam in the dam system, and report the results. The final report back to BLM shall include a comprehensive presentation by the engineering team, an analytical report, and a website containing all needed information.

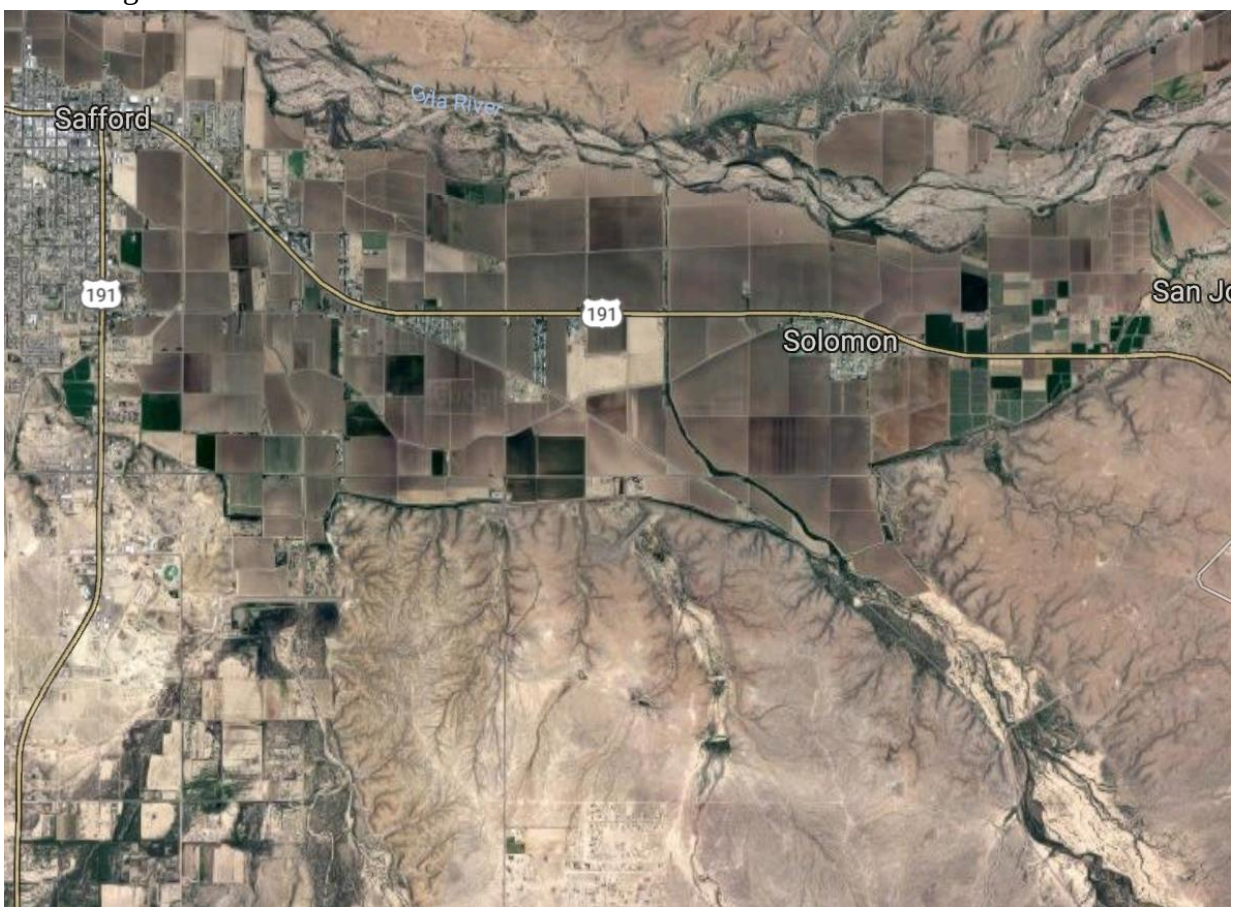

Figure 1: Map of target location.

2.1 Task 1: Field Investigation

During the field assessment one of the major tasks is for the team to familiarize themselves with the area. To get a feel for the kinds of soils, terrain, and the conditions of the dam and channel. This step will result in various notes and pictures of the area to be referred to for future needs in the project. Another item of interest is the roughness of the surrounding terrain and the likely Manning's coefficient that can be attributed to that terrain. This will be used for HEC-RAS, but is also needed for overland flow, flood plain analysis, and infiltration rates. A small amount of surveying of the dam structure itself will also be conducted while on site.

2.2 Task 2: Hydrology

The hydrologic data shall include the expected rainfall depth and intensity for a 100-year storm in the area. It will also include expected infiltration data and expected time for water to travel from one end of the floodplain to the other, to find the duration of storm to be analyzed. The overland runoff flow determined from this step will be used to run the DBA in the HEC-RAS model later in the project.

2.3 Task 3: Hydraulic Analysis

The background data will be acquired and checked, reserving any data points or variables that may be needed to analyze the results or refine the conclusion that are not clear at this time. The modeling will result in multiple functioning one-dimensional HEC-RAS models that can be viewed in multiple stages of a large flow. This task will provide expected depth of flow for the DBA in the area downstream of the dam that can be used later to evaluate possible sources of property damage.

2.3.1 Geometric Parameters

The dam structure will be surveyed during the field visit down to the project site in order to determine the necessary dimensions of the structure. The channel and nearby agricultural fields will be determined using topographic data from the area.

2.3.2 Routing and Reservoir Effect

The initial phase of breaking down the survey and topographic data will be to look for locations where the flow of flood waters will most likely follow, and where pooling will occur. The areas where pooling does occur or the flow of floodwaters seems to head in a different direction must be subtracted from the overall flood flow later on.

2.3.3 Dam Breach Failure Method and Parameters

The San Simon Barrier Dam is an earthen style sediment structure with an L-shaped earth structure surrounding a concrete baffle-block transition section. There are two possibilities for failure in an earthen style dam, overtopping and piping.

2.3.3.1 Piping Failure

Piping failure occurs in an earthen dam style dam when internal erosion of the dam structure begins to occur. This causes a ‘pipe’ to form in the dam structure causing the top of the dam to eventually slip down and be washed away.

2.3.3.2 Overtopping Failure

Overtopping failure occurs in an earthen dam structure when the headwater in front of the dam exceeds the overall lip height of the dam structure, resulting in the water overtopping the crest. This leads to the floodwaters rushing over the dam and eroding the back face of the dam, resulting in catastrophic failure.

2.3.4 Peak Flow Estimation

The peak flow estimation will be based off an assumed 100-year storm event which will be determined during the hydrologic portion of the analysis. The peak flow will take into account the runoff and infiltration rates of the local area as well as natural friction sources from in the environment.

2.3.5 Steady Flow Analysis

The first test of the HEC-RAS model will be using a steady flow in order to verify that the model is operating correctly under normal conditions. This mode will be run several times to ensure the model is in working order for the simulated flood event flow.

2.3.6 Unsteady Flow Analysis

The unsteady flow analysis will be conducted as simulation of the flood event flow. The results from these models will be used for the economic analysis later in the project.

2.3.7 Sediment Transport Analysis

The San Simon Barrier Dam and the other local erosion controlling structures have been reported to be partially buried in loose sediment material. During the storm event the massive amounts of flood water will pick up loose sediment and spread it over the affected flood area, resulting in large damages.

2.3.8 Flood Map - Severity Index

A map of the total flood area will be created which will include all of the local land that has been affected by the flood waters. The map will later be overlaid with a depth of floodwater severity index that will easily identify the worst affected areas.

2.4 Task 4: Socio-Economic Impacts:

The dam basin system is located just outside the city limits of Safford, AZ leading to concerns about floods and resulting economic damage for the city and surrounding agricultural land, in the event of a dam failure. The team must determine if a flood and dam breach does occur and will the damage be contained to the farmlands outside of Safford, or will the water cause damage inside the city limits. This requires not only the results of the analysis previously discussed but also topographic and economic data about Safford and the buildings and land in the area.

2.4 Task 4: Socio- Economic Impacts: Define Flood Concern Area

This task is heavily impacted by the floodplain analysis from the HEC-RAS model previously discussed. The flood area determined in the second step of the model will be used for this concern area. This area will be any place that is determined to have more than 1in of water above the soil surface. These areas will be laid over a map and formed for each flood situation. These will later be combined to predict the worst possible and most extensive area of concern.

2.4.1 Task 4: Socio-Economic Impacts: Considered Loss sources

Within this area an inventory of all structures, sources of income, and pieces of infrastructure will be accounted for. These structures will the be examined and evaluated for their importance in the analysis as not all structures damaged or destroyed by the flood are to be evaluated and counted. The structures will only be assessed for water damage during this step, no other further damage assessment will be necessary. Then once all possible loss sources are identified for the area, they shall then be researched, and an expected damages cost will be associated with the structure.

2.4.2 Task 4: Socio-Economic Impacts: Map of AO including Districts and types of Structures

For this task, a topographic map of the area is to be created. This will include all areas affected by the resulting DBA. While the topographic map is created, two more maps will be designed and evaluated. One will contain information about the percentage of loss sources within a section and the other map shall include the areas that will be affected by flow and the expected depth of the flow above ground at those areas. All three of these maps can be overlaid and compared to establish the total cost of damages and the areas to expect damage. The map will also provide relative depths in specific areas, allowing research into the extent of the injuries in those areas.

2.5 Task 5: Project Deliverables:

2.5.1 Project Deliverables: DBA report

The deliverables produced from this project will be a finished DBA report including damages and the damage impact area in Safford, AZ. This report will be grouped with a comprehensive website containing all of the project information and all useful research documents used on the project. This can help future teams continue the San Simon basin project and expand the scope of the project to meet more BLM requests. A final in-person presentation will be provided at the conclusion of the project that will include all resulting data and findings.

Figure 2: Location of the Safford where the target dam located

2.5.2 Project Deliverables: Presentations

A final presentation shall be performed in May of 2018 to showcase for the client the results of the analysis. This presentation shall be approximately fifteen minutes long and contain a question and answer section as well as a full explanation of the project and the methods used to analyze the data.

2.6 Task 6: Project Management:

Project management is throughout the project's life and it is to meet the needs of the project as they come up. Management includes holding meetings, organizing presentations, and other major tasks. Project management is the use of a variety of related skills, methods, and tools to meet or exceed the requirements of the project stakeholders[3].

2.6.1 Task 6: Project Management: Meetings

Project meetings will be coordinated and performed by the engineering team, the teams grading instructor, the team's technical advisor, and BLM contacts. This continuous communication between multiple parties shall ensure a favorable product for all groups.

2.7 Project Limitations

The major limitations for this project stem from the condensed time frame of the project as well as the lack of experience of the engineering team. The lack of experience of the

engineering team is because the engineers are still students and the relatively narrow field of specialties of the engineers. These limitations are part of the factors that dictate both the challenges and expected exclusions of the project scope.

2.7.1 Challenges

The challenges facing this project are mostly a result of lack of experience for the engineering team. These challenges include but are not limited to cost estimation and use of the analysis software. The software limitation will arise from most of the team learning the software as they progress and any limitation to the software available through NAU. The estimates made will be based on the resulting area analyzed below the flood and the average costs of similar structures in Arizona, they will not include or account for all possible details or any error in the data. Another major challenge will be performing this project in the desired time frame while working around all involved groups schedules.

2.7.2 Exclusions

There shall be no analysis of contaminants of any kind analyzed for this project. There will also be no analysis of the structure of the dam or the likelihood of its failure, only the results of the said failure will be analyzed. There will be no dam removal costs considered for this project. The project will not compare the cost of dam repairs, dismantlement, or reconstruction. There shall be no surveying, or other forms of field data collection performed by the engineering team and all data shall be sourced secondhand. The engineering team maintains the right to exclude other project complications that may be unforeseen if the future exclusions are made on reasonable terms and are outside the experience of the engineering team.

References

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