NAU CENE 476

Fall 2017

Background Research for San Simon Basin Dam Evaluation

Submitted By: Bowei Zeng, Jinyang Lu, Mike Gallio, Brendan Garrison

SEPTEMBER 14, 2017

Table of Contents

List of Tables

N/A

List of Figures

N/A

Abbreviations

- DBA - Dam Breach Analysis
- HEC-RAS - Hydrologic Engineering Center's River Analysis System
- ISC - Industrial Source Complex Model
- BLM - Bureau of Land Management
- GIS - Geographic Information System

1.0 Description of Technical Aspects

The San Simon Dam system is categorized as a low-hazard dam. A low hazard dam is a system that does not cause casualties, serious economic losses, or major environmental impact to the surrounding area. The decision to remove a dam is complex, requiring owners and regulators to weigh a dam's current value in accomplishing its original purpose. The design purpose includes flood control, agriculture, recreation, and power generation. Other passive benefits include the dam's ongoing effects on public safety, water quality, fish, and cultural values[1].

2.0 Civil and Environmental Technical Aspects

2.1 Hydrological observation

The dams have changed the river hydrological function by raising the water level and slowing down the flow. Demolition of the dams directly affects the runoff regulation, land-use changes, and the hydrologic models corresponding to the rivers. This could result in a downstream water flow increase by changing the seasonal hydrologic data and allowing for more sources of water input. Removing the dam systems would also eliminate the detaining function of the system, resulting in much faster velocities and more destructive supercritical flows.

2.2 Pollution evaluation

If the dam is removed, air pollution may be created by the demolition process. The main pollutant is dust during the dam removal process which can cause respiratory problems in humans. Prior to applying a correction to existing emissions inventories, additional field studies are required. In view of the good agreement between the ISC and data collected in the desert, daytime conditions but the poor agreement between the ISC and measurements under stable conditions with large roughness heights, some selected field studies that span a range of land cover and atmospheric stabilities are recommended[2]. In the lower reaches of the river to produce high sediment flow, the water supply along the river and the impact of fish; to take the way of mechanical removal, to consider the problem of sediment accumulation shelved.

2.3 Ecological investigation

Dam removal can affect the river water ecosystem and biodiversity in two aspects, short-term and long-term. The main short-term effect would include increased erosion of surrounding channels due to supercritical flow regimes running through the dirt lined channels. This will change the immediate habitat for the organisms of the ecosystem. The long-term removal of the dams may increase the populations and diversity of aquatic insects, fish and other organisms. Perennial wetlands around the detention basins may be lost, but new wetlands and waterfront ecosystems are likely to develop along the river banks.

3.0 Humanity impact assessment

Based on the team meeting with BLM, the dams are considered a low-hazard system. This means that failure is unlikely to result in loss of life and result in minor increases to existing flood levels at roads and buildings [3]. However, there still is risk for the humans living around

the wash basin area, so community outreach is necessary. A site visit is necessary so that we can properly determine the impacts to the surrounding environment and populations.

4.0 Dam Breach Analysis

4.1 Purpose of Report

A Dam Breach Analysis or DBA is used to assess the consequences of a dam failure. It can be used to evaluate the the areas that will be flooded and determine the height of the flooding for an expected storm event. Evaluated events are for both storm based failures, as well as "sunny day failures" which assume the dam failed on an average flow da [4].

4.2 Method of Analysis

Using software such as HEC-GeoRAS, HEC-RAS, and ArcGIS, the DBA can be completed [5]. In order to effectively perform the analysis the elevation and volume of the current reservoir as well as the Manning's coefficient of the flow must be determined. Generally, a 50-year storm or a perceivable max precipitation is used to evaluate the breach [4]. Using these softwares it is effective to perform event based analysis. This analysis will result in maximum water surface elevation, channel velocity, and a floodplain inundation map. [6]

5.0 References

[1] "Dam Removal Case Studies - Headwaters Economics", Headwaters Economics, 2017. [Online].Available:https://headwaters economics.org/economic-development/local-studies/dam-removal-case-studies/. [Accessed: 13- Sep- 2017].

[2]V. Etyemezian, J. Gillies, H. Kuhns and D. Nikolic, FIELD TESTING AND EVALUATION OF DUST DEPOSITION AND REMOVAL MECHANISMS: FINAL REPORT. NOAA: DRI, 2003, p. 7.

[3]"Dam Safety Home", Mde.maryland.gov, 2017. [Online]. Available: http://www.mde.maryland.gov/programs/water/DamSafety/Pages/index.aspx. [Accessed: 14- Sep- 2017].

[4]E. G. Beadenkopf, Federal Guidelines for Inundation Mapping of Flood Risks Associated With Dam Incidents and Failures, 1st ed. United States Government, 2013.

[5]P. Sharma, “Dam Break Analysis Using HEC-RAS and HEC-GeoRAS – A Case Study of Ajwa Reservoir,” Journal of Water Resources and Ocean Science, vol. 5, no. 6, p. 108, 2016.

[6]V. P. Singh and P. D. Scarlatos, “Analysis of Gradual Earth-Dam Failure,” Journal of Hydraulic Engineering, vol. 114, no. 1, pp. 21–42, 1988