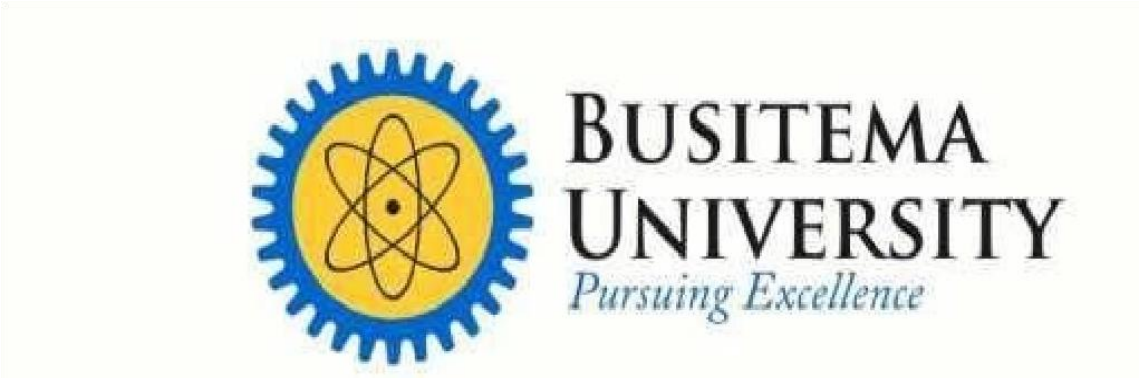

FACULTY OF ENGINEERING

DEPARTMENT OF MINING AND WATER RESOURCES ENGINEERING

BACHELOR OF SCIENCE IN WATER RESOURCES ENGINEERING

FINAL YEAR PROJECT

DAM BREACH MODELLING AND FLOOD INUNDATION MAPPING OF AN EARTH EMBANKMENT DAM USING HECRAS: A CASE STUDY OF BUJAGALI HYDROPOWER PLANT.

BY:

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Abstract.

Analysis and simulation of embankment dam breach events and the resulting floods is critical to differentiating and reducing threats due to potential dam failures. Development of effective emergency action plans requires accurate prediction of inundation levels and the time of flood wave arrival at downstream critical locations. Embankment dams are commonly built in Uganda as they provide benefits to the local population, mainly agricultural activity and generation of hydropower. However, its massive potential energy reservoir would impose risk of sudden containment breach leading to loss of life and property at inhabited downstream area. This research is deemed to provide a dam break analysis of Bujagali Dam to generate breach hydrograph and inundation map as a result of dam break event under overtopping failure. The Hydrologic Engineering Center's River Analysis System (HEC-RAS) is capable to model 1-dimensional (1-D) and 2-dimensional (2-D) dam failure event by utilizing hydrological and terrain information generating unsteady state flow simulation of the dam breach. The process for gathering and preparing data, estimating breach parameters, creating one dimensional and two-dimensional unsteady-flow model in HECRAS, performing a dam failure analysis for dam failure scenario and mapping the flood propagation are outlined in this paper. From 2-D analysis, it is found that the breach flow of Bujagali Dam failure can achieve 14,277.84 m3/s for overtopping failure. Furthermore, the expected arrival time of flood wave at selected locations also presented in this paper. However, 2-D model was able to generate inundation map due to dam failure in wider area which can provide insight of flood hazard risk level, The simulation results were mapped using the GIS extension tool on ArcMap. Inundation mapping of water surface profile result from dam failure models provides a level of the flood hazard and provides insight for emergency action plan.

Key Words: Dam Breach, Modelling, DEM, HEC-RAS, Hydrograph, Inundation

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May the good Lord reward you all!

DECLARATION

I, **BWANIKA MARK BALIKUDDEMBE,** here by certify and confirm that the information I have written in this final year project is a result of my own effort, research and has not been submitted before to any university or institution of higher learning for any academic award.

BWANIKA MARK BALIKUDDEMBE

Signature: ..... Date: .....

APPROVAL

This work has been compiled with guidance and consultation from my supervisor;

Main Supervisor

Name: **Mr. Kimbowa George**

Signature:  Date 7th, June, 2023

DEDICATION

This dissertation is dedicated to my Mother Nankya Mary for her constant love and dedication to my education and her desire for the fulfillment of my life dreams.

LIST OF ACRONYMS

DWRM Directorate OF Water Resources Management

MWE Ministry of Water and Environment

UEGCL Uganda Electricity Generation Company Limited

FEMA Federation Emergency and management Authority

HEC-RAS Hydrological Engineering Centre- River Analysis System

GIS Geographical Interface System

HEC Hydrologic Engineering Centre

DEM Digital Elevation Model

PMF Probable Maximum Flood

RAS River analysis System

TIN Triangulated Irregular Network

HPP Hydro power plant

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CHAPTER ONE

1.0 INTRODUCTION

This chapter includes the following; background to the study, statement of the problem, objectives of the study, the purpose of the study, the scope of the study which includes the conceptual scope, geographical scope, and time scope, and finally the significance of the study.

1.1 Background

The construction of dams is perhaps the best method for safeguarding sustainable water supply (Bharath et al., 2021; Derdous et al., 2015) and overcoming the growing population's rising water demand (Bharath et al., 2021). A dam is a barrier that stores water and plays a vibrant role in the country's economy (Abhijith, 2017; Kahraman & Kaya, 2009). Dams serve various purposes like irrigation, water supply, flood control, and power generation (Hadjerioua et al., 2015). Even though dams are very beneficial for society (Derdous et al., 2015), floods arising from dam failure have caused the most devastating disasters (Rotondo & Pellicani, 2018), bringing about considerable property harm, catastrophic effects on human safety, ecological quality, and the landscape (ACEWM, 1826; Deangeli et al., 2009; Hadjerioua et al., 2015). the Safety factor is considered in designing, but the dams still fail due to many causes like piping, overtopping, earthquakes, etc. (Rong et al., 2019)

Globally, there have been several dam failures that have occurred throughout the world which include the Banqiuo reservoir dam (China), the south fork dam (Pennsylvania, USA), the sempor dam failure in Indonesia, and the panshet dam failure in India. (Nag, 2018) The failure of the Banqiuo reservoir dam in China was the deadliest dam failure ever. It was established to control floods downstream and also generate hydroelectricity. The reservoir had a capacity of 492 million cubic meters. Although initially, the dam exhibited several cracks and signs of other constructional errors, after repairs, it was claimed that the dam was unbreakable. A catastrophic disaster struck as the dam gave way and massive volumes of water engulfed the nearby areas. The dam failure caused an estimated 171,000 deaths, millions of people were displaced and huge property losses were also recorded. (Nag, 2018)

Africa has also experienced dam failures i.e. the failure of the tailing dam structures constructed by mining companies this includes the collapse of the tailing dam at merriespruit in south Africa

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APPENDIX A: BUJAGALI DAM DRAWINGS