BUSITEMA UNIVERSITY
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# FACULTY OF ENGINEERING

## DEPARTMENT OF MINING AND WATER RESOURCES ENGINEEERING

## BACHELOR OF SCIENCE IN WATER RESOURCES ENGINEERING

## FINAL YEAR REPORT

## TITLE: APPLICATION OF GIS IN WATER RESOURCES MANAGEMENT OF AN ECO-FRIENDLY INDUSTRIAL PARK.

## CASE STUDY: KAMPALA INDUSTRIAL AND BUSINESS PARK (KIBP)

**BY**

**MPIIMA VICENT**

**BU/UG/2013/100**

**Tel: 0784517523/0701560512**

mpiimav@gmail.com



| MAIN SUPERVISOR | CO- SUPERVISOR |
|---|---|
| Mr. MUGISHA MOSES. | Mrs. NJUKI HOPE |

***a report submitted in partial fulfilment of the requirements for the award of the bachelor of engineering in Water Resources Engineering***

**MAY, 2017**

## DECLARATION

I MPIIMA VICENT hereby declare that every part of then Report that I have submitted in the partial fulfilment of the requirements for the award of the Bachelors of Engineering in Water Resources Engineering is genuinely my own work and a record of an original work done under the guidance of my Supervisors. And any similarities found are just a coincidence of ideas.

## APPROVAL.

This final research report has been submitted to the Faculty of Engineering, Department of Mining and Water Resources Engineering for examination with approval of my supervisors

Main Supervisor.

Mr. Mugisha Moses Signature ..... Date .....

Co- Supervisor.

Mrs. Njuki Hope Signature ..... Date .....

## DEDICATION.

I dedicate this report to my dear parents **Mr. Kiryowa Moses** and **Mrs. Nakintu Aisha** for the support, love and care they have provided to me till this time as well as my siblings, friends, relatives, course mates and Lecturers.

## ACKNOWLEDGEMENT

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I would like to sincerely thank UIA for accepting me carry out research on KIBP area. I also thank experts who trained, educated and guided me throughout the entire period, specifically Eng. Paul Echatu, Mr. Kirabira Paul and Mr. Galiwango.

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***May the good Lord bless you all.***

**ABSTRACT**

Traditional industrial parks that are challenged by high individual waste treatment costs or no treatment at all as way of curbing expenses resulting into release of toxic pollutants that end up in water bodies and associated negative impacts, pollution associated problems, non-cost effective infrastructure and other related problems that are an immediate threat to environmental sustainability. Such an alarming situation calls for establishing eco-friendly industrial parks as an ultimate solution to these environmental problems with suitably located environmental infrastructure including water treatment plants, weather forecasting stations, storm water management systems, growth of fauna etc.

For the case of Kampala Industrial and Business Park (KIBP), which is challenged with discharge of poorly treated effluent from polluting industries with in the industrial park and poor disposal of solid wastes generated resulting into contamination of surface and underground water resources hence threating their existence and ability to perform present and future ecological functions, furthermore the poor design of the industrial park (establishments in flood zones) has resulted into flooding of industries lying in the flood zones along River Namanve and polluting of Lake Victoria the final recipient point.

To address all the above, effective and efficient planning and management of water resources is the ultimate solution and this specifically addresses that by provide optimal management solutions in regards to siting solid waste management facilities and other developments with priority given to protection of water resources both surface and underground reserves.

This has been achieved by use of GIS and Multi Criteria Evaluation to site most suitable locations of a landfill, many factors have been put into consideration that include distance to roads, wetlands, industries, railways, powerlines and river Namanve, buffer maps have been developed using standard buffer distances and rasterized layers overlaid using the raster calculator in the restriction model, a suitability model has also been developed taking into consideration of slope, land use and Euclidean distance from roads where layers have been rasterized and reclassified then later overlaid using weighted overlay tool and Saaty's Analytical Hierarchy Process (AHP) used for weighting the factors above. The final suitability model which delineates the most suitable sites for a land developed was a combination of the suitability model and restriction model were final output layers were both multiplied using the raster calculator to

produce the final suitability map. Flood plain maps have also been delineated basing on the 100-year floods and prospective flood zones mapped out, this has been achieved using a combination of different softwares like HECGeoHMS, HECHMS, ArcGIS, HECGeoRAS and finally HECRAS.

It has however been found out that about 82% of the entire Industrial park has been industrialized given the fact 60% of the park was originally a wetland this possess a great threat to the vulnerable ground water reserves and surface water bodies since the risk of contamination is high. Suitable sites located for a landfill could only accommodate a landfill of size less than 10 hectares in a few selected areas of the park beyond that the water resources are at high contamination risk from the landfill, furthermore most of the industries located along the River Namanve are susceptible to flooding since most lie in the flood zones.

After carrying out this research and analysis on KIBP area, I therefore conclude that its feasible to setup a solid waste management facility on land not greater than 12 hectares and all industries lying in the flood zone should vacate the area and allocated new land. These flood zones should however be preserved for flood management and monitoring.

## SELECTED ACRONYMS

| | |
|---|---|
| DEM | Digital Elevation Model. |
| DTM | Digital Terrain Model |
| GeoRAS | Geospatial River Analysis System |
| GIS | Geographical Information System |
| GPS | Global Positioning System |
| HEC | Hydrologic Engineering Center (U.S. Army Corps of Engineers) |
| HEC-RAS | HEC River Analysis System |
| HECGeoRAS | HEC Geospatial River Analysis System. |
| HECGeoHMS | HEC Geospatial Hydrologic Modelling System |
| HECHMS | HEC Hydrologic Modelling System |
| TIN | Triangulated Irregular Network. |
| UIA | Uganda Investment Authority. |
| USGS | United States Geological Survey |
| AHP | Analytical Hierarchy Process |
| KIBP | Kampala Industrial and Business Park |
| MCE | Multi Criteria Evaluation |
| GUI | Graphical User Interface |
| MCDA | Multi Criteria Decision Analysis |

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# 1.0 CHAPTER I -INTRODUCTION

## 1.1 Back ground.

The definition and the subsequent development of eco-industrial parks (EIPs) have been deeply based on the application of industrial ecology theory, which pays specific attention to metabolic exchanges within industrial processes to address a deep reduction of limited resource consumption and a minimization of waste production in the framework of a sustainable development approach. Despite the EIPs configurations being essentially based on the overall idea of sustainability, the problem of defining their proper location inside the territory and the consequent land use model, to minimize land consumption, have not always been central in the wide range of studies and practices concerning the EIPs.

An EIP is a community of manufacturing and service businesses seeking enhanced environmental and economic performance by collaborating in the management of environmental and resource issues including energy, water and materials. ***(Lowe and Warren. 1996: 7, 8).*** By working together, the community of businesses share a common energy source, water and a waste disposal system resulting into a collective benefit that is greater than the sum of the individual benefits each company would realize if it optimized its individual performance only. The goal of an EIP is to improve economic performance of the performing companies while minimizing their environmental impact. Furthermore, establishment of EIPs raises the business empire to a more competitive pattern, with reduced production costs, deep reduction of emissions, resource and energy consumption thus attraction of foreign donors to hold shares in the various industrial entities.

Unlike traditional industrial parks that are challenged by high individual waste treatment costs or no treatment at all as way of curbing expenses resulting into release of toxic pollutants that end up in water bodies and associated negative impacts, pollution associated problems, non-cost effective infrastructure and other related problems that are an immediate threat to environmental sustainability. Such an alarming situation calls for establishing eco-friendly industrial parks as an ultimate solution to these environmental problems with suitably located environmental

## REFERENCES


Alanbari, M. A., Al-ansari, N., Jasim, H. K., & Knutsson, S. (2014). Modeling Landfill Suitability Based on GIS and Multicriteria Decision Analysis : Case Study in Al-Mahaweelqadaa, (July), 828–851.

Approved, F., & No, O. M. B. (2009). HEC-GeoRAS GIS Tools for Support of HEC-RAS using ArcGIS ® User ' s Manual, (September).

Authority, E. P. (2016). *Environmental Guidelines Solid waste landfills.*

Brunner, G. (2010). HEC-RAS River Analysis System User ' s Manual, (January).

Matthew J. Fleming, J. H. D. (2013). HEC-GeoHMS Geospatial Hydrologic Modeling Extension User ' s Manual, (February).

Muturi, W. P., Wangai, K. J., Joash, W. T., & Joseph, N. (2014). Solid Waste Dumping Site Selection Using GIS and Remote Sensing for Kajiado County, Kenya, *4*, 693–702. https://doi.org/10.17265/2159-581X/2014.

Of, P., Council, R., & Etel, O. F. (2006). *E C O - I N D U S T R I A L project at Rantasalmi P A R K S A background report for the eco-industrial park.*

Scharffenberg, W. A. (2013). Hydrologic Modeling System User ' s Manual, (December).

Saaty, T.L. (1980) The Analytic Hierarchy Process. Mcgraw-Hill, New York.

Cantwell, R. (1999) Putting Data to Work-GIS and Site Selection Studies for Waste Management Facilities. Eurogise 1999. Conference Proceedings.

Allen, A., Brito, G., Caetano, P., Costa, C., Cummins, V., Donelly, J., Fernades, C., Koukoulas, S., O'Donell, V., Robalo, C. and Vendas, D. (2002) Procedure for the Location of Landfill Sites Using a GIS Model. *9th Congress of the International Association of Engineering Geology and the Environment*, Durban, 16-20 September 2002, 100.