

**DRAFT ENVIRONMENTAL MANAGEMENT
FRAMEWORK FOR THE
UMGUNGUNDLOVU DISTRICT
MUNICIPALITY: Flood Risk Specialist
Report**



Institute of
Natural Resources

DRAFT ENVIRONMENTAL MANAGEMENT FRAMEWORK FOR THE UMGUNGUNDLOVU DISTRICT MUNICIPALITY

FLOOD ZONE SPECIALIST REPORT

Prepared For



Prepared by



Institute of
Natural Resources

P.O. Box 100396, Scottsville, 3209
67 St Patricks Road, Scottsville, 3201

Tel: 033 346 0796

Fax: 033346 0895

e-mail: info@inr.org.za

MAY 2017

TABLE OF CONTENTS

1. INTRODUCTION	3
2. APPROACH TO THE IDENTIFICATION OF FLOOD AREAS FOR THE EMF	3
Flood area sensitivity assessment	3
3. IDENTIFIED FLOOD SENSITIVITY ZONES.....	5
4. DEVELOPMENT OBJECTIVES AND EIA GUIDELINES	6
5. CLASSIFICATION OF FLOOD ZONE COMPATABILITY WITH LAND USE ACTIVITIES	7

LIST OF FIGURES

FIGURE 1: FLOOD SENSITIVITY AREAS IDENTIFIED FOR THE DISTRICT.....	5
--------------------------------------------------------------------	---

LIST OF TABLES

TABLE 1: FLOOD ZONE SENSITIVITY ZONES	5
TABLE 2: FLOOD ZONE DEVELOPMENT OBJECTIVES AND EIA GUIDELINES.....	6
TABLE 3: IMPACT SCORES OF THE LISTED LAND USE ACTIVITES ON THE FLOOD ZONES.....	7

1. INTRODUCTION

Areas at risk of flooding are incorporated into the EMF to provide guidance for developers and planners with respect to the environmental risks associated with a particular area. Flood risk is in some ways very different to the other environmental layers included in the EMF in that the direction of the risk is inverted and it is the environment which poses the risk to the development. The flood areas do however play an important role in flood mitigation as energy is dissipated as water floods into these areas, particularly if the vegetation and topography provide a rough surface over which the flood waters must travel. These areas should therefore be protected. Areas at risk of flooding pose a high level of constraint to development both in terms of risk to the development and in terms of the functional ecological role these areas play and thus these areas should be identified and included in the ECF. This specialist report outlines the method used to identify these areas.

2. APPROACH TO THE IDENTIFICATION OF FLOOD AREAS FOR THE EMF

Flood area sensitivity assessment

Definition of sensitivity

Three different areas or zones have been identified as flood-sensitive areas as part of this assessment. These are areas covered by:

1. the 1 in 20 year return interval flood level
2. the 1 in 50 year return interval flood level
3. the 1 in 100 year return interval flood level

These areas represent the flood levels which are realised by floods at the return period specified. This is a statistical calculation and it does not ensure that the 1 in 100 year flood will not occur twice in two years. This is an important consideration given the impact of climate change and the projected increase in frequency of severe storms.

The areas within these flood areas also have an important role to play in mitigating flood impacts downstream. The higher the surface roughness of these areas, the more energy is taken out of water flooding over this area, which in turn reduces the impact of flooding downstream. Developments in this zone can serve to reduce the natural surface roughness, reducing the flood attenuation service level provided to vulnerable areas downstream.

Approach to mapping flood-sensitive areas

Originally proposed approach

The following flood risk area mapping method was included in the original EMF proposal:

The mapping of flood risk areas will be undertaken using a raster based GIS elevation buffer approach which will include the following steps:

1. Identify and delineate the major river channels using a flow accumulation model
2. Estimate the relative potential magnitude of the flow based on catchment size.
3. Assign an elevation to the river channels based on a digital elevation model.
4. Buffer the stream grid by elevation to 3 classes of river rise

5. Assign terrestrial elevation cells to stream cells using a Euclidean allocation on a digital elevation model
6. Identifying all areas falling within different flood level categories
7. Weighting areas of the catchment according to gradient.
8. Assigning a risk category to terrestrial areas

Thus a layer will be generated identifying areas at varying degrees of risk from flooding.

Riparian areas will be mapped using a combination of the above process and vegetation mapping as undertaken as part of the land cover mapping process.

This approach has some limitations which were outlined at the first project steering committee meeting. Primarily, these centre on the fact that the method is based on topography and does not include a hydrological or hydraulic component. The Project Steering Committee expressed concern over the limitations and requested that other approaches be investigated, particularly for the KFAs where greater accuracy is sought.

In-field flood mapping exercise

The project team undertook a rough costing of undertaking a hydrologically and hydraulically based flood mapping exercise focusing on specific sites. The following steps were proposed:

- Obtain a sub-metre DTM covering the identified focus areas. This will require LiDAR data to be obtained as this is the most efficient/cost-effective way to cover many/large areas. The LiDAR could cost in the region of R250 000.00 for all sites.
- In absence of a high resolution DTM, conduct in-field surveys. This will require engineers to map out river cross-sections to define the channel profile. This is the most efficient/cost-effective way to cover few/small areas.
- Run a hydrological model to derive return period design flood (e.g. 1: 50 or 1:100 year flood) and run 2D HECRAS using the DTM or 1D HECRAS using the cross-sections. 2D HECRAS is more powerful and efficient than 1D as the latter requires more time for a professional to process the cross-section information and import into HECRAS. . The flood modelling and HECRAS would be in the region of R50k to R75k per site
- Map out the HECRAS results to show flood risk areas.

Overall, the proposed flood determination/mapping would require a large budget given the extent of areas. Assuming 10 sites each covering 100 ha, this would likely cost up to R1 million. On this basis it was determined that it was not a feasible option for the EMF process.

Flood Risk Information System

The PSC also recommended that the project team investigate a product produced by JG Africa for the Department of Human Settlements. The team subsequently sourced the documentation and data for this tool from the Department of Human Settlements and assessed it for applicability in the EMF process.

The Flood Risk Information System (FRIS) is a GIS based system which uses existing hydrological and flow information from a number of sites across the province to generate design flood values for these areas using the JPV method, with Veld Zone regionalisation and using the General Extreme Value (GEV) probability distribution, as developed by G6rgens (2007). These values were then extrapolated to other catchments based on catchment characteristics. This approach has provided a high level flood risk assessment tool which although is limited by the resolution of available terrain

models, is founded on hydrological and hydraulic modelling. This approach was presented to the PSC as the most efficient method for obtaining a flood risk layer for the District. This was accepted by the PSC and a FRIS output layer was generated for the study area.

IDENTIFIED FLOOD SENSITIVITY ZONES

Sensitivity zones are determined based on the 1:100yr, 1:50 and 1:20yr flood lines. All of these areas are potentially highly at risk and thus are classified as highly sensitive. Although the riparian environment is very sensitive to disturbance, the risk from flooding lies mainly with the development and vulnerable areas downstream. The flood zones identified by the FRIS product are illustrated in Figure 1 and presented in Table 1.

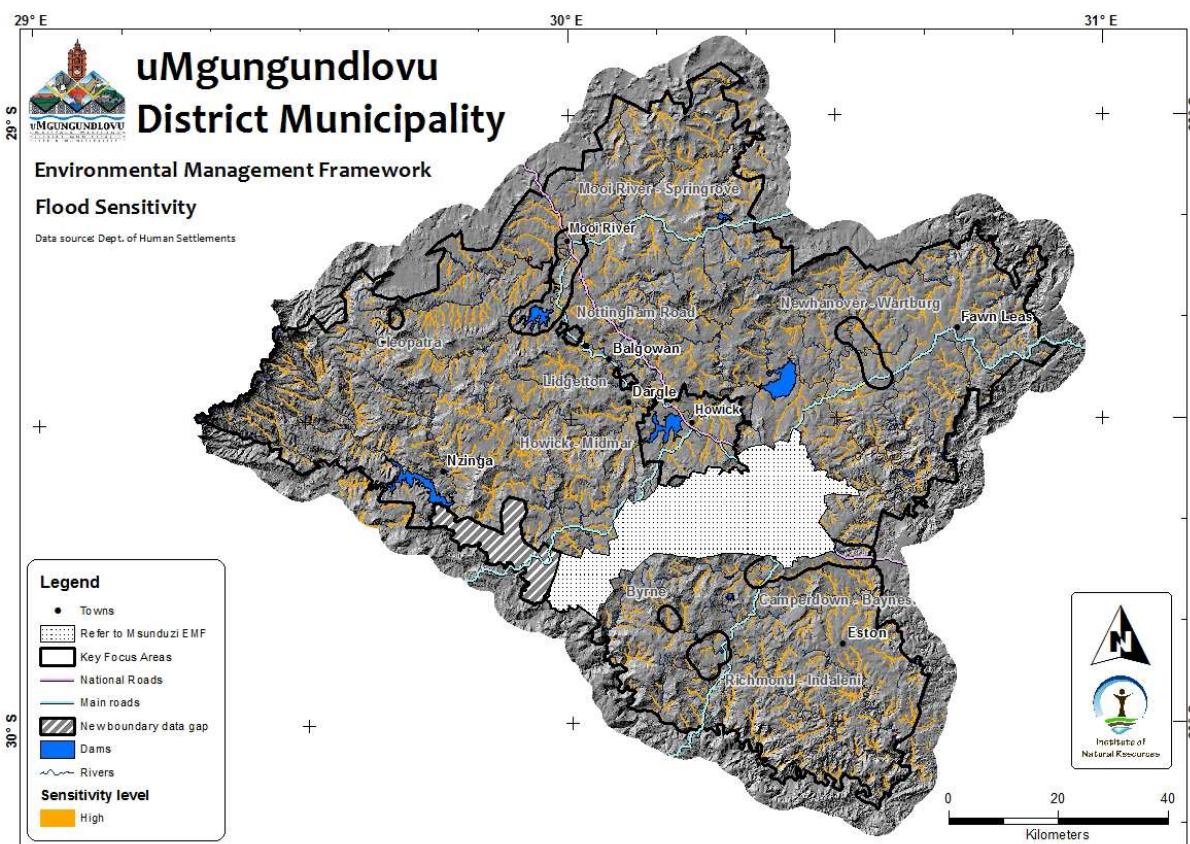


Figure 1: Flood sensitivity areas identified for the District.

Table 1: Flood zone sensitivity zones

Sensitivity Level	Flood zone
Very High	1:20 yr flood line
Very High	1:50 yr flood line
High	1:100 yr flood line

DEVELOPMENT OBJECTIVES AND EIA GUIDELINES

The Sensitivity of the different flood zones is shown in Table 2 together with the objectives for managing development in these zones and guidelines for any EIA for development of these areas.

Table 2: Flood zone development objectives and EIA guidelines

Sensitivity level	Flood zone	Development objectives	EIA guidelines
Very High	1:20 yr flood line	No infrastructural development is appropriate in this zone. Non-infrastructural activities may be appropriate if they do not disturb the river bank or its protective vegetative cover. Activities should thus be limited to those not impacting riparian vegetation and river bank stability.	A full flood assessment should be undertaken for any application for development that are not flood resilient (e.g. infrastructure) in these areas. An aquatic ecological impact assessment should also be undertaken for any development activities located in the 1:50 yr area. This assessment should include an assessment of the impact of any development on the flood attenuation service provided to downstream areas by the riparian vegetation that exists within these zones.
Very High	1:50 yr flood line	No infrastructural development is appropriate in this zone. Non-infrastructural activities may be appropriate but activities should be limited to those resilient to flood impacts. Flooding risk should be assessed by the activity proponent.	
High	1:100 yr flood line	No infrastructural development is appropriate in this zone. Non-infrastructural activities may be appropriate but activities should be limited to those resilient to flood impacts. Flooding risk is lower than other flood zone areas but should be assessed by the activity proponent.	

CLASSIFICATION OF FLOOD ZONE COMPATABILITY WITH LAND USE ACTIVITIES

For the purposes of mapping land use / environmental sensitivity compatibility, the constraint posed by flooding was assessed against the list of land use types developed for this EMF. A Score of 4 represents high constraint / incompatibility, while a score of 1 indicates low constraint and relative compatibility. Any infrastructural development is considered highly incompatible with a flood risk area. These scores are shown in Table 3.

Table 3: Impact scores of the listed land use activities on the flood zones

Land use	1:20 yr flood	1:50 yr flood	1:100 yr flood
Extensive Crop Production	4	3	2
Intensive Crop Production	4	4	3
Agri-Industry	4	4	4
Intensive Animal Production	4	4	4
Extensive Animal Production	1	1	1
Forestry	4	4	4
Civic and Social	4	4	3
Cemetery	4	4	4
Intense Mixed Use	4	4	4
Medium Mixed Use	4	4	4
Residential Only Detached	4	4	4
Residential Medium Density	4	4	4
Smallholdings	4	4	4
Small Tourism	4	4	4
Medium Tourism	4	4	4
Large Tourism	4	4	4
Airport	4	4	4
Railways and Roads	4	4	4
Transport Focus Points	4	4	4
Solid Waste Site	4	4	4
Waste Water Treatment	4	4	4
Bulk Linear Infrastructure	4	4	4
Environmental Services / Conservation	4	4	4
Active Open Space	4	4	4
Passive Open Space	4	4	4
Nature Reserve	4	4	4
Dam	4	4	4
Nature and Culture Based Tourism	4	4	4
Extractive Industry / Quarrying / Mining	4	4	4
Noxious Industry	4	4	4
Logistics Hub	4	4	4
Light Industry	4	4	4

