water & forestry

Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA

THE RIVER HEALTH PROGRAMME

MZIMVUBU RIVER SPRING SURVEY

SEPTEMBER 2008

REPORT PREPARED BY:

Mkosana Kululwa
Resource Protection, Department of Water Affairs & Forestry (ELS)

Lungile Gaulana
Resource Protection, Department of Water Affairs & Forestry (ELS)

Weni Elliot.
Resource Protection, Department of Water Affairs & Forestry (ELS)

Mbikwana Mlondolozi

Resource Protection, Department of Water Affairs & Forestry (ELS)

DATA COLLECTION: K. Mkosana, P, Tshatshu, L. Gaulana, E. Weni, S. Buso, M. Matsheke, N. Myeko, S. Cawe, X. Gwadana, and E. Plamstead.

EXECUTIVE SUMMARY

The National Aquatic Ecosystem Biomonitoring Programme was set up in South Africa in 1994. The aim of this programme was to monitor the health of aquatic ecosystems using biological organisms. The first focus of the programme was on rivers, with the River Health Programme (RHP) adopted on a national level and framework documents for implementation being produced in 1996. The programme aims to promote standardized and continuous monitoring and reporting on river health, and is operated at both national and provincial level.

This report provides the technical input which will underlie the State-of-Rivers Report to be produced for the Mzimvubu River System in the Eastern Cape.

The report provides results and recommendations for the first monitoring survey that spread throughout the upper, middle and lower reaches of the Mzimvubu River system, including selected tributaries. Field indices used for data collection included the South African Scoring System version 5.0 (SASS5) for macro invertebrates, the Fish Assemblage Integrity Index for fish (FAII), (VEGRAI), the Geomorphology Assessment Index (GAI) and a water quality assessment

SOUTH AFRICAN RIVER HEALTH PROGRAMME

Biological monitoring, or bio monitoring, is a method for determining the present state or ecological health of a system by assessing the health status of the organisms living in and around that system. It is based on the recognition that monitoring of physico-chemical water variables only is not sufficient to achieve integrated ecosystem monitoring, but that the additional monitoring of biological communities offers a more holistic approach. A range of communities are assessed, e.g. in-stream communities such as fish, macro invertebrates, algal forms such as diatoms, and in-stream, fringing and riparian vegetation, as well as the physical template upon which the biota depend. Physical parameters include the hydrology and water quality of the system, as well as the geomorphological shape and form of the river channel. If information on all these physical indicators is not available, a habitat integrity assessment can be conducted as it provides qualitative information on all physical indicators used in the RHP. This index primarily assesses the impact of human disturbances on riparian and in-stream habitats.

Bio monitoring is therefore an *effects or response-oriented* approach which measures various indicators, and from these measurements, makes an assessment about the health of the aquatic ecosystem. The focus of this approach is therefore the resource, specifically the status of that resource (Uys et al., 1996; Roux, 2003). Biological indicators are therefore able to provide early warning of deterioration of the system or of unsustainable use of its resources, and act as *red flags* indicating that deterioration may be taking place, but without providing any causal links. The bio monitoring technique is usually favoured for its speed, simplicity, effective results and ease of interpretation as well as for recognizing that a freshwater ecosystem is made up of many mutually dependent parts.

The South African National River Health Programme (NRHP) involves the evaluation of the present state of the country's riverine ecosystems relative to their natural state, and projection of long-term trends in river health. It therefore aims to provide information so as to support the effective management of the country's rivers. At a national level, the programme focuses on "state-of-environment" reporting, and aims to achieve the following objectives:

- Measure, assess and report on the ecological state of aquatic ecosystems
- Detect and report on spatial and temporal trends in the ecological state of aquatic ecosystems
- Identify and report on emerging problems regarding aquatic ecosystems
- Ensure that all aquatic ecosystem health report provide scientifically relevant information for the management of aquatic ecosystems

In addition to the aims of national monitoring, provincial monitoring can incorporate the following additional aims:

- To identify where impacts are occurring
- To assess the extent of impacts (pre- and post-impact monitoring)
- To audit compliance with regulatory standards or objectives
- To provide additional information for Resource Directed Measures (RDM). RDM aim to protect aquatic resources through activities such as determining the Ecological Water Requirements (EWR) or Ecological Reserve for a water

resource, and setting Resource Quality Objectives (RQO) for effective management of a system.

INTRODUCTION AND BACKGROUND

Mzimvubu River starts from an altitude of about 2 700 meters above sea level (masl) on the Drakensberg escarpment to the Indian Ocean over a distance of approximately 300 km. It drains a catchment area of approximately 19 853 sq. km (www.ewisa.co.za). The mainstem has four major tributaries; the Tsitsa, Tina, Kinira and the Mzintlava rivers, all of which their headwaters originate from the Drakensberg Mountains. After descending through the escarpment, the Mzimvubu River and its tributaries flow through deep and steep river valleys incised into the coastal belt, before discharging into the Indian Ocean at Port St Johns. The figure below shows the rough terrain of the catchment and its longitudinal profile from source to mouth.

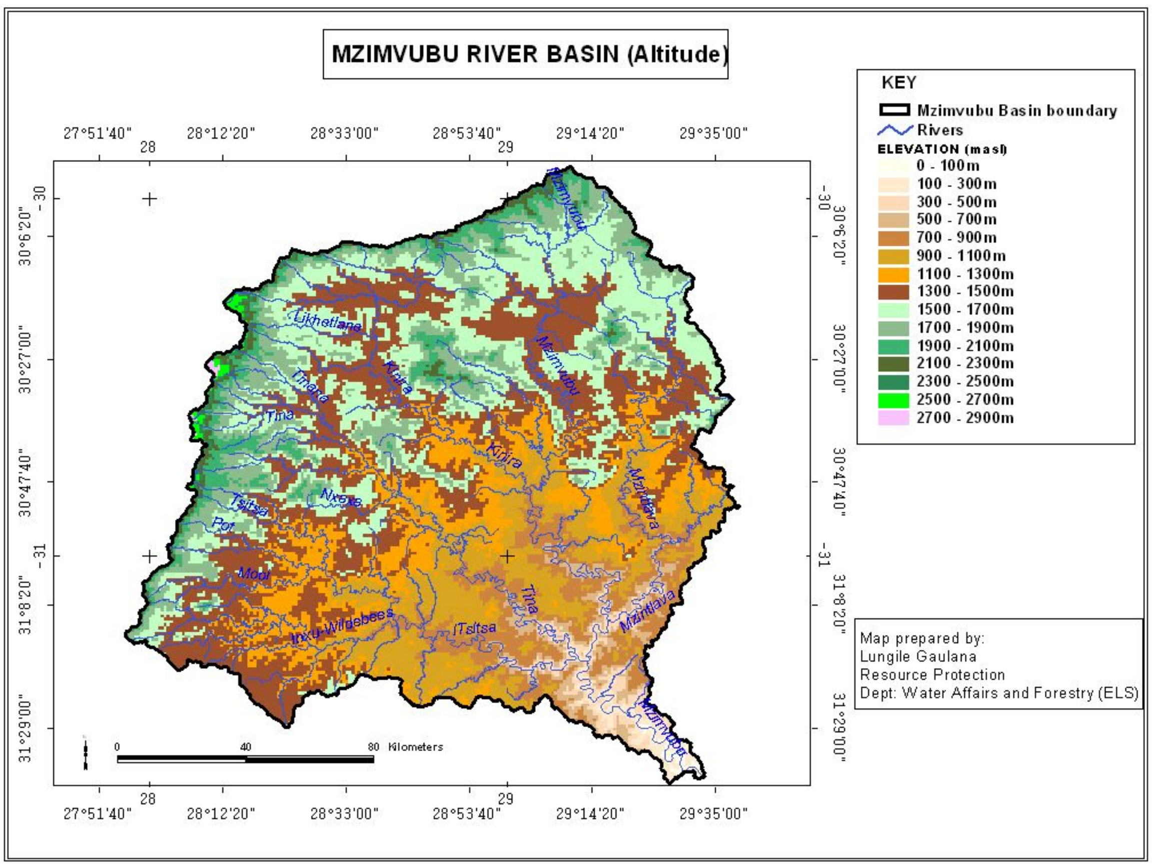


Figure 1: Showing altitude and topography of the Mzimvubu River drainage basin (Adapted from GIS coverage, DWAF: RQS).

Geology and Soils

The field of geology encompasses the study of the composition, structure, physical properties, dynamics, history of Earth materials, and the processes by which they are formed, moved, and changed. The escarpment of which Mzimvubu River catchment is a part consists of many different geological rock types.

According to Moon and Dardis (1988), the abortive rifting of Pangaea resulted in the deposition of the Cape Supergroup succession of quartzitic sandstone and shales. This was followed by continental glaciations which resulted to the Dwyka Formation. Accordingly, the Karoo basin was filled with sediments of the Ecca, the Molteno, Elliot, Tarkastad, Uteinhage and Clarence Formations of the Karoo sequence. Some of these sediments are widely intruded by dolerites and sills related to Drakensberg basaltic material. The predominant rock formations in Mzimvubu River Basin are sandstone, mudstone and shale of the Karoo Sequence, with some localised intrusions of dolerite dykes and sills (www.ewisa.co.za). In addition, basaltic lavas of the Drakensberg Formation occur in the upper parts of the basin and small patches of Dwyka tillite occur in the lower part of the basin. Categories of the soils in this basin are moderately deep to deep clay soils in the steep slopes of the famous Drakensberg, moderately deep clayey loams on the steep foothills of the Drakensberg and sandy loams east of the Drakensberg and as far as the Indian Ocean. The soils in the catchment are vulnerable to erosion due to their dispersive nature, duplexity and their origin from the easily weathered parent material. Less erodible material is obtained on source zones of the Drakensberg and the rejuvenated lowlands. The figure below shows the geology and soils of the Mzimvubu River catchment.

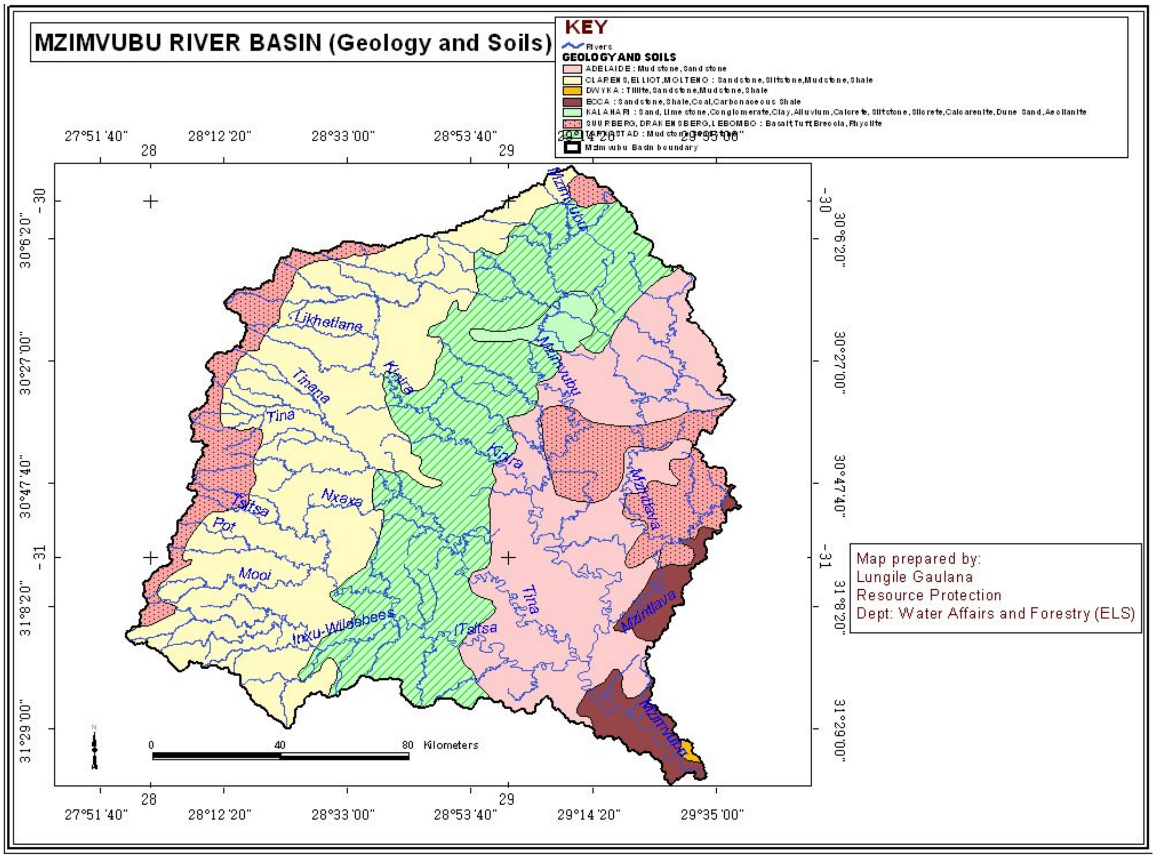


Figure 2: Geology and soils of the Mzimvubu River drainage basin (Adapted from GIS coverage, DWAF: RQS).

The Natural Vegetation.

Vegetation of any region is determined by these two major independent variables: climate and physiographic factors. Other variables determining vegetation type are aspect and topographic nature of such a section and its distance from the sea. As a result of these factors, the Mzimvubu River Basin is dominated by the grasslands in the upper and the middle reaches, as well as the tropical forests towards the coast. The vegetation varies from fertile coastal forests to grasslands being the dominant vegetation type in most parts of the study area. Patches of thicket and bushvelds dominated by *Acacia karro species* also occur while the indigenous forests are found mainly in the coastal areas. The figure below shows the vegetation types found on the Mzimvubu River Basin.

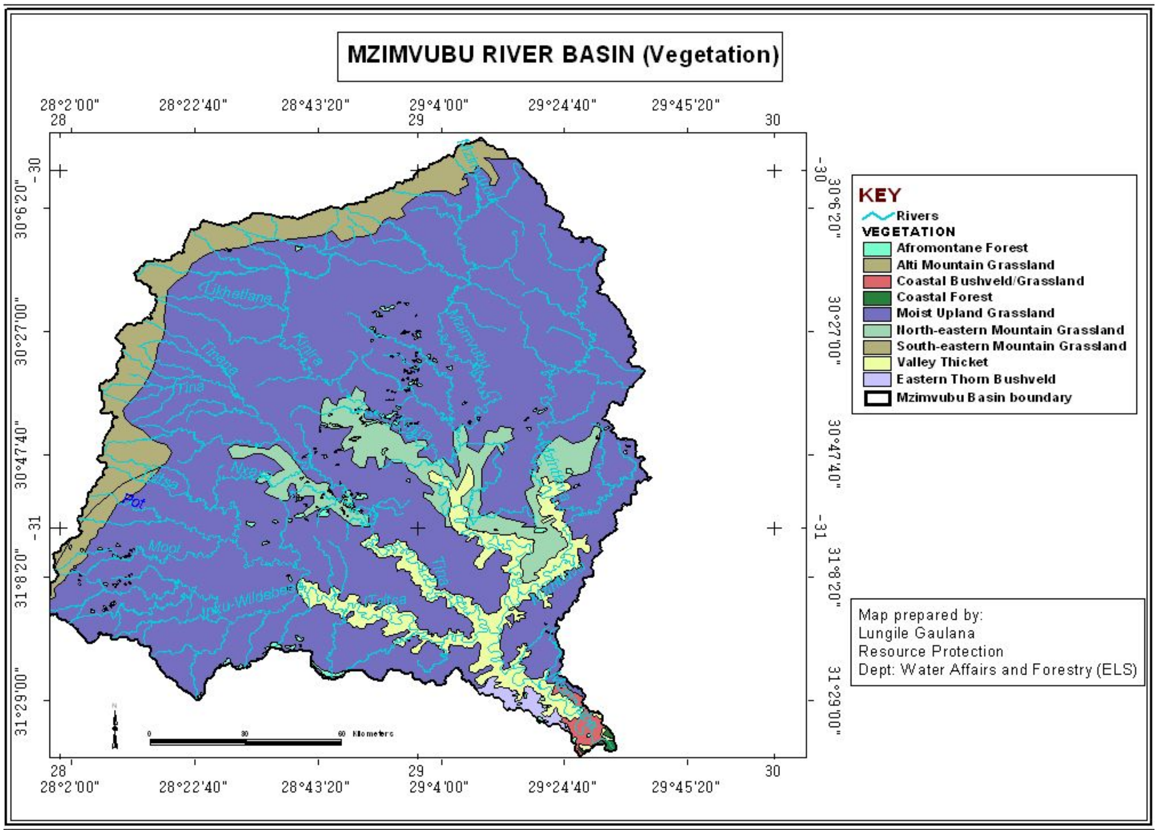


Figure 3: Vegetation of Mzimvubu River drainage basin (After Louw and Rebelo 1996)

Ecoregions.

The World Wildlife Fund defines an ecoregion as a large unit of land or water containing a geographically distinct assemblage of species, natural communities, and environmental conditions. The use of the term ecoregion is an outgrowth of a surge of interest in ecosystems and their functioning. Level I Ecoregions of South Africa is the delineanation derived from terrain and vegetation, with some consideration of altitude, rainfall, runoff variability, air temperature, geology and soil (Kleynhans *et al* 2005). A more detailed Level II Ecoregions have been developed as well. Mzimvubu River Basin's Level I ecoregions vary considerably from the upper part of the catchment towards the sea. The catchment consists of the Eastern Escarpment Mountains, South Eastern Uplands and Eastern Coastal Belt Level I Ecoregion from the upper part of the catchment to the Indian Ocean respectively. The figure below shows the Levels I and II ecoregions of the Mzimvubu River catchment.

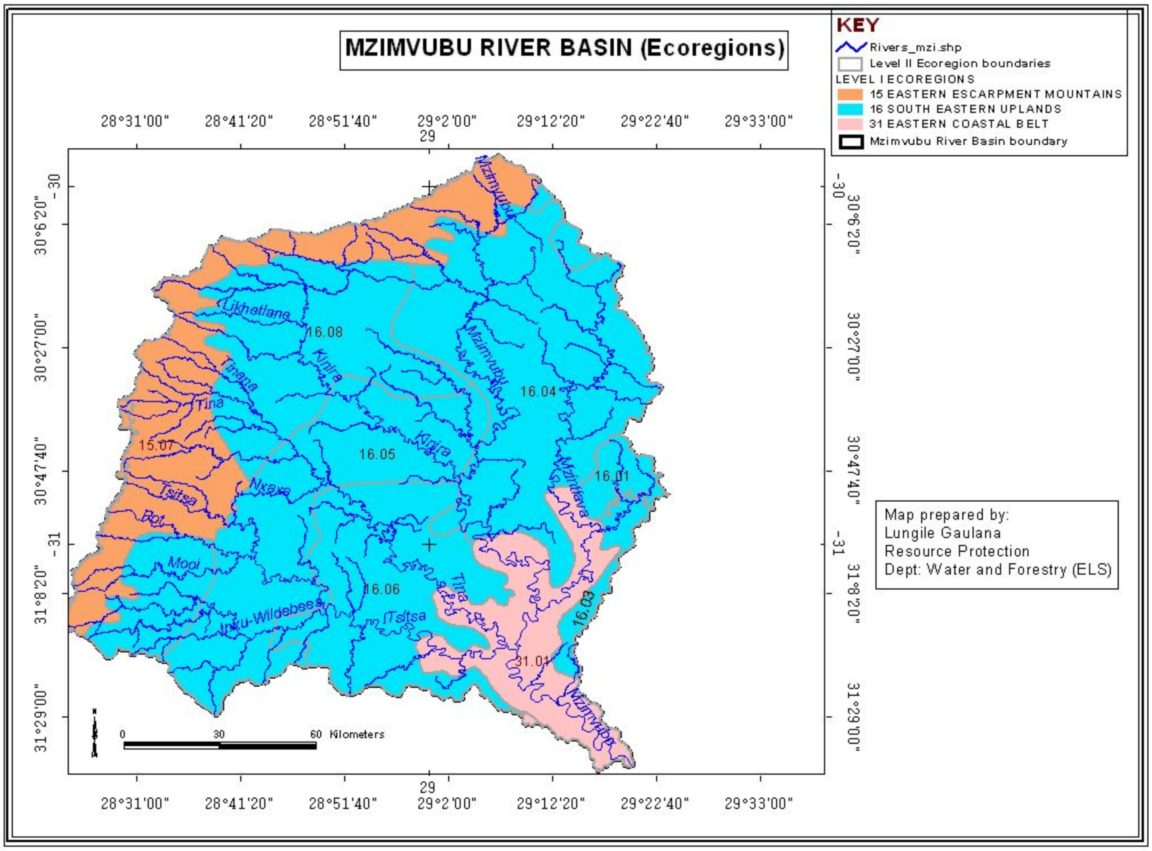


Figure 4: Showing Levels I and II Ecoregions of the Mzimvubu River drainage basin (Adapted from Kleynhans *et* al, 2005).

Major Land Use Activities

The term land use is used to define the human modification of natural environment or wilderness into environment such as fields, pastures, and settlements. Land use and land management practices have a significant impact on natural resources. Information on landuse can be used to develop solutions for natural resource management issues like water quality and flooding. For instance, water bodies in a catchment where the natural vegetation has been removed will have different water quality and flooding than those in areas that are in their wilderness state.

DWAF (2005) explains that most of the land-use activity in the former Transkei region is dominated by subsistence agriculture. Severe erosion can be observed throughout the area as a result of improper pasture management such as overgrazing, vegetation removal, and ploughing practices on steep slopes and on the riparian zone. Major landuse practices observed on Mzimvubu catchment during the survey are the following:

- Agriculture which includes commercial agriculture with farm dams, irrigation schemes, crop production and animal husbandry as well as subsistence agriculture which is mainly maize fields, vegetable gardens and livestock.
- Forest Plantations, which consist of Black wattle (*Acacia meansii*), different Pinus species (Pines) and Blue Gum tree (*Eucalyptus globulus*).
- Rural and Urban settlements.

It could be noted that overgrazing, vegetation removal and alien invasion especially by Black Wattle has exacerbated erosion. Also high population densities might have had a negative effect on the natural resources of the catchment. Recent National Landuse coverage (nlc 2000) shows that pre-dominant landuse activities include subsistence and commercial agriculture, grasslands and forest plantations. The figure below shows landuse of the Mzimvubu River catchment.

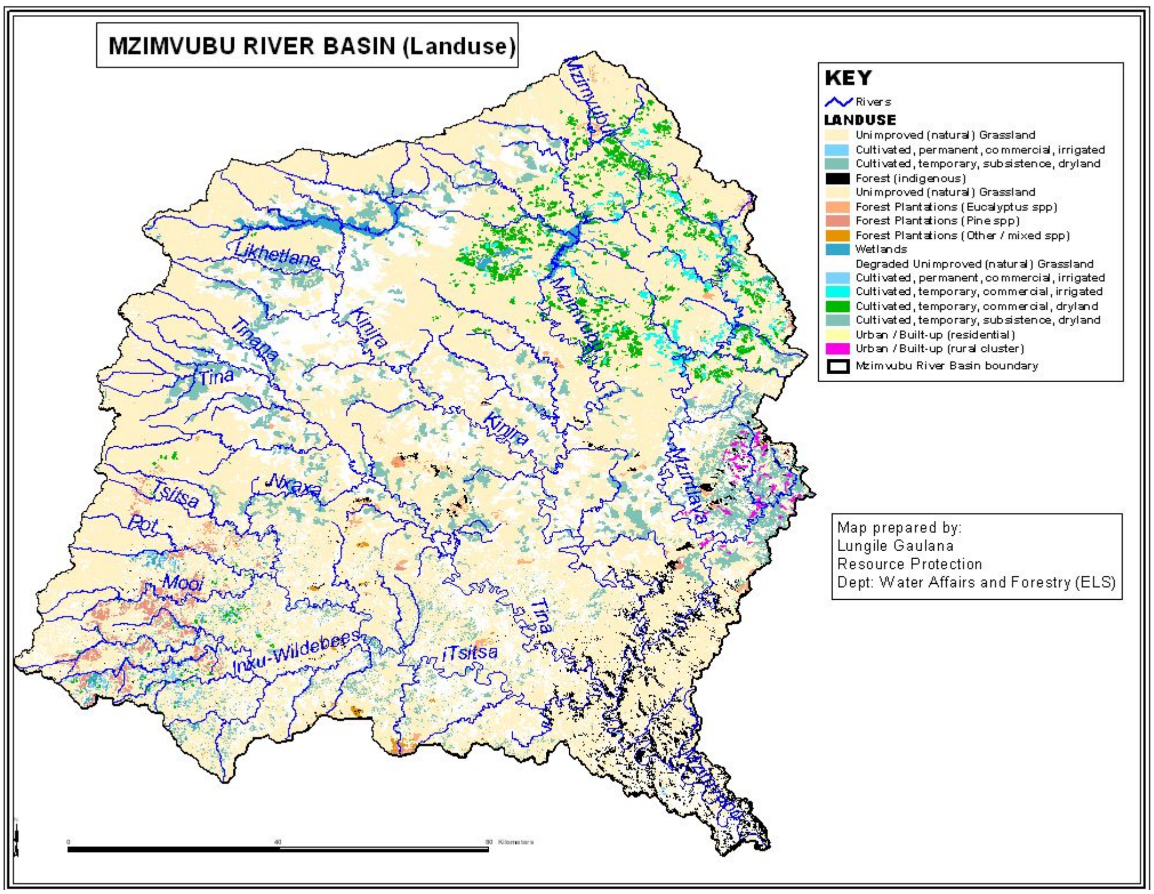


Figure 5. Landuse of the Mzimvubu River Basin (After National Landuse coverage, 2000).

METHODOLOGY

Mzimvubu River survey was conducted in spring (29 September 2008 until the 4th of October 2008). The participants involved were from Resource Protection (DWAF), Municipality & Walter Sisulu University. Ecosystem components assessed were two drivers of the ecosystem; geomorphology and water quality as well two responses of the ecosystem, mainly macro invertebrates and fish. Geomorphological processes determine river channel morphology which provides the physical environment within which stream biota live. Changes to channel form occurs both naturally and as a result of man-made changes to rivers or their catchments (e.g. impoundments, water transfers, agriculture). Aquatic ecosystems and their biota are affected by turbidity, suspended solids, temperature, pH, salinity, concentrations of dissolved ions, nutrients, oxygen, biocides and trace metals. Changes in these due to pollution, geomorphological or hydrological factors can have detrimental or even lethal effects on aquatic organisms. Invertebrate communities respond relatively quickly to localized conditions in a river, especially water quality, though their existence also depends on habitat diversity. They are common, have a wide range of sensitivities, and have a suitable life-cycle duration that indicates short- to medium-term impacts of water quality. Fish comprise one of the main biological components of aquatic ecosystems. Because they are relatively long-lived and mobile, they can indicate long-term influences (years) and general habitat conditions in a river reach. They represent a variety of trophic levels and hence integrate effects of environmental changes.

For geomorphological assessment field sheets were used to evaluate the overall Present Geomorphological State of each site.
In addition, the measuring tape was used to measure sediment categories on a transect selected. Google Earth, Aerial photographs 1:50 000 and 1: 250 000 Topographic maps would be utilized for desktop estimate of the catchment.

Water quality parameters (temperature, pH, dissolved oxygen and conductivity) were measured using multimeter.

Macro invertebrates were sampled using SASS5 at each of the selected sites Considering SASS5 is designed for low to moderate flows (Dickens and Graham, 2002), At each of the sites, all available biotopes were sampled using the SASS5 collecting protocol (Dickens and Graham, 2002). ASPT is considered to be the least variable of the SASS5 scores (Dickens and Graham, 2002); it was utilized to determine river health class for each site using default benchmark values.

Fish assessment was done using electro-fish shocker and a seine net depending on the biotope assessed.

AIMS

The basic aim of the survey was to review the overall Present Ecological State of Mzimvubu River drainage basin. The results of the survey would serve as an input to the National Aquatic Environmental Health Monitoring Programme (River Health Programme), Reserve determination for Resource Directed Measures & EcoStatus.

RELEVANCE OF ECOSYSTEM COMPONETS AND CLASSIFICATION SYSTEM TO BIOMONITORING

The table below shows the Geomorphology classification systems for the present state.

Table I: Class boundary range for geomorphology (after Wadeson 1999 & Rowntree, 2003)

CATEGORY	DESCRIPTION
A	• Unmodified, natural;
B	• Largely natural with few modifications; • A small change in geomorphology and natural habitats.
C	• Moderately modified; • A change in geomorphology and instream habitat but geomorphic thresholds does not appear to have not been crossed.
D	• Largely modified; • Large changes in geomorphology and instream habitat, geomorphic thresholds appear to have been crossed with the river moving towards a new equilibrium.
E	• Seriously modified; • The loss of natural instream habitat is extensive. The system appears to be extremely unstable.
F	• Critically modified; • Channel Modifications have reached a critical level with an almost total loss of natural instream habitat. Geomorphological changes are virtually irreversible.

Table II. Default benchmark river health class boundaries for SASS5

RIVER HEALTH CLASS	**ECOLOGICAL PERSPECTIVE**	**MANAGEMENT PERPECTIVE**
Natural	No or negligible modification of instream and riparian habitats and biota.	Protected rivers; relatively untouched by human hands; no discharges or impoundments allowed.
Good	Ecosystem essentially in good state; biodiversity largely intact.	Some human-related disturbance, but mostly of low impact potential.
Fair	Sensitive species may be lost; lower abundances of biological populations are likely to occur: or sometimes, higher abundances of tolerant or opportunistic species occur.	Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation.
Poor	Habitat diversity and availability have declined; mostly only tolerant species present; species present are often diseased; population dynamics have been disrupted.	Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve river health, e.g. to restore flow patterns, river habitats or water quality.

COURSE OF THE SURVEY

A. GEOMORPHOLOGY

SITE 1: Tina Reference Site

The site is located at an incised channel with flood benches. This means that there is a small portion of the reach where the sediment from eroded hillslope can be trapped, that is only flood benches. It is a single thread, straight, pool-riffle and an alluvial channel dominated by cobbles/boulders. It has about 50% of morphological units, that is, the variety of habitat types for aquatic biota. It could be observed that minor erosion occurred at a local scale. The Geomorphological Assessment Index (GAI) model shows that the site is at B class in terms of its present ecological state.

SITE 2: Tsitsa above Potrivier Pass

The site is located at a confined channel between two steep valleys. This means that no portion of a reach where sediment from eroded hillslope can be trapped by any means, especially if the riparian zone vegetation has been removed. It is a mixed channel where both the bedrock and alluvium are present but it is mainly dominated by bedrock. The channel is a pool-riffle. It has about 49% of morphological units where the living biota can survive. There is a localized erosion and sedimentation. Vegetation removal and subsistence farming are major disturbances. The figure below shows the percentage of sediment proportions on a site. It can be noted that there were fines deposited in the river channel.

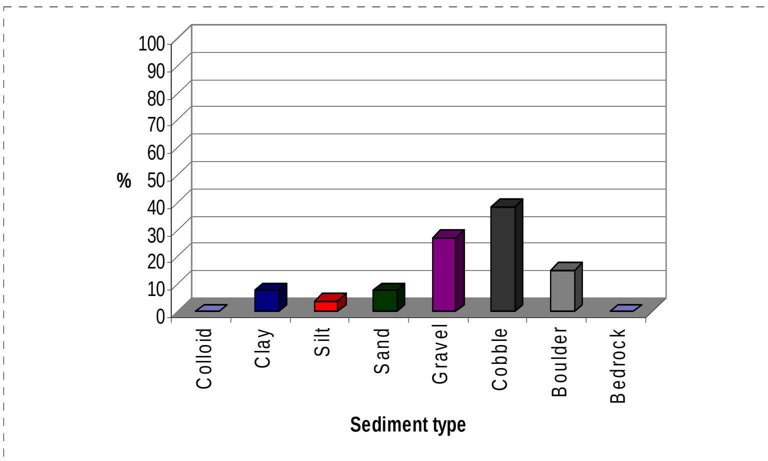


Figure 6. Showing percentage distribution of sediment types at Tsitsa above Potrivier Pass.

The Geomorphological Assessment Index (GAI) model shows that the site is at B/C class in terms of its present ecological state.

SITE 3: Mzimvubu AT JOAN'S BRIDGE.

The site is located at a reach confined on one side. This means that the eroded sediment from the hillslope can either be trapped alternatively at a flood-bench either at the right or the left side of the river, but never both. It is a single thread, mixed with both the bedrock and alluvium and a pool-riffle system. The channel is rich in morphological units (about 67% present), both for the bedrock and alluvium. There was very small localized erosion and deposition observed and the GAI model reveals that the river at a site is at A in terms of geomorphology.

SITE 4: KINIRA AT MABUA

The site is also located at a reach confined on one side. It is a single thread pool-riffle system in an active meandering state. Overflow channel was observed, suggesting increased flooding combined with vegetation removal. Flat sand bed was also noticed which is an evidence of increased sedimentation. The sources of sediment at a reach scale are gullies and sheet erosion on the hillslope, accompanied by presence of alien *Acacia meansii* species. The latter also plays a significant part on river bank failure and collapse with the resultant increase in the deposition of fine material. Figure 6 below shows the variability of sediment found in the channel. Although boulders and cobbles are dominant material, sand and gravel deposits can also be noticed.

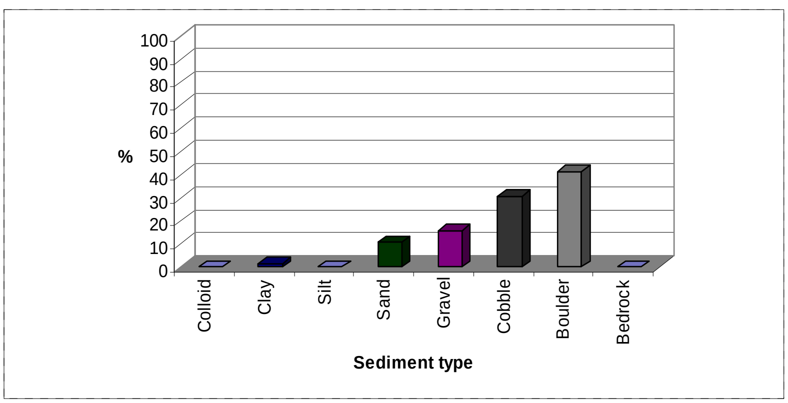


Figure 7. Showing percentage distribution of sediment types at Kinira at Mabua.

The Geomorphological Assessment Index (GAI) model shows that the site is at C class in terms of its present ecological state, suggesting a change in geomorphology and instream habitat

SITE 5: MZINTLAVA BELOW FRANKLIN VLEI.

The site is geographically located below a wetland where the river is at an active meandering state. In terms of channel confinement, the site is positioned where alternating bedrock cliffs are opposite moderate slopes. The possibility is that the boulder material can be from the cliffs immediately after weathering of rocks have occurred, while the alluvial material can be from both upstream and from the moderate slope. It is a single thread pool-riffle with deep pools, fixed boulder and cobbles. Since there was anthropogenic deposition of cobbles from excavation, no sediment samples were taken. The site has about 38% of habitat diversity, that is, the morphological units. However, the GAI model suggests that the river at a site is at A/B, which is at a near natural condition in terms of its fluvial geomorphology.

SITE 6: MZIMVUBU AT SPRINGFONTEIN FARM.

The site is also located at a reach where the floodplain is confined on one side. This means that the eroded sediment from the hillslope can either be trapped alternatively at a floodplain either at the right or the left side of the river, but never both. It is a single thread, alluvial and a pool-riffle system. This is where the river is experiencing a sinuous situation, with erosion of the river bank alternating with deposition of sediment on either left or right bank. The morphological units on a river constitute about 33%. Boulders and cobbles are dominant features of the system with gravel material and small proportion of fines deposited in between the dominant material. The figure below shows sediment proportions of a site.

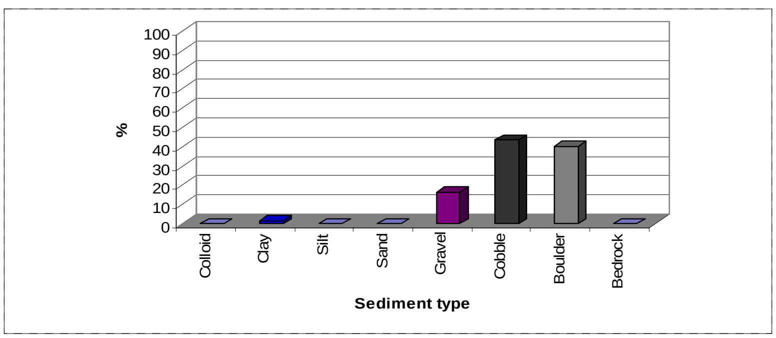


Figure 8. Showing percentage distribution of sediment types of Mzimvubu at Springfontein.

The GAI model reveals that the river at a site is at A/B; a near natural condition with negligible modifications.

SITE 7: TINA AT TSOLOBENG

This site is situated at a confined valley flood plain. This means that on both sides of the river there are moderate slopes and broad floodplains. Such places are attractive for agricultural purposes, especially ploughing for crop production. The site is in a single thread, pool-riffle and alluvial channel. A lot of sheet erosion and deep gullies as well as grazing are major catchment processes occurring on the adjacent hillslopes. Vegetation had also been removed, possible for fuelwood collection. A dam under construction above the site also contributes to sedimentation of the entire reach hence it is a seriously embedded river system. As it can be detected in the figure below, the site had a lot of fine material like gravel, sand, silt and clay in between the boulders and cobbles, with other fine material attached to the bedrock.

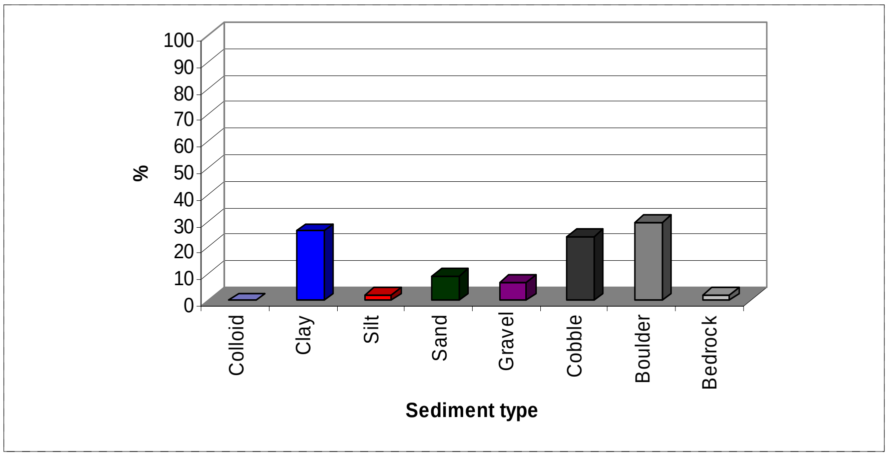


Figure 9. Showing percentage distribution of sediment types of Tina at Tsolobeng.

While running the GAI model, it shows that the river at a site is at C/D class; a situation whereby the geomorphic changes have been largely modified.

SITE 8: KINIRA DRIFT

This site is situated at a confined valley flood plain. Similarly, this suggests that on both sides of the river there are moderate slopes and broad floodplains where agricultural practices like crop production are expected. The site is at a single thread, pool-riffle system dominated by bedrock material. It is rich in morphological units about 83%, which means that it is naturally a ‘home’ for diversity of species. However, a gauging weir immediately upstream of the site might have an influence on species migration from downstream to upstream. Active erosion on the hillslope could be observed, and this erosion is accelerated by *Acacia meansii* invasion. Because the site is dominated by bedrock and sand deposits only, no sediment samples taken. The GAI model puts the site at a C category with moderate modifications where there is a change in geomorphology and instream habitat but geomorphic thresholds does not appear to have not been irritated.

SITE 9: MZINTLAVA AT NTSHAKENI.

This is also a confined valley floodplain. It a pool-rapid river system with a straight and a single thread channel. The river at a site is dominated by boulders; a character of a transitional zone. It has about 79% of morphological units suggesting diversity of habitat for aquatic biota. However, active hillslope erosion, vegetation removal and overgrazing are abundant. This is a characteristic of poor pasture management which can affect adjacent water resources. Sediment sampling was carried out at a site. The figure below shows the results of sediment sampling.

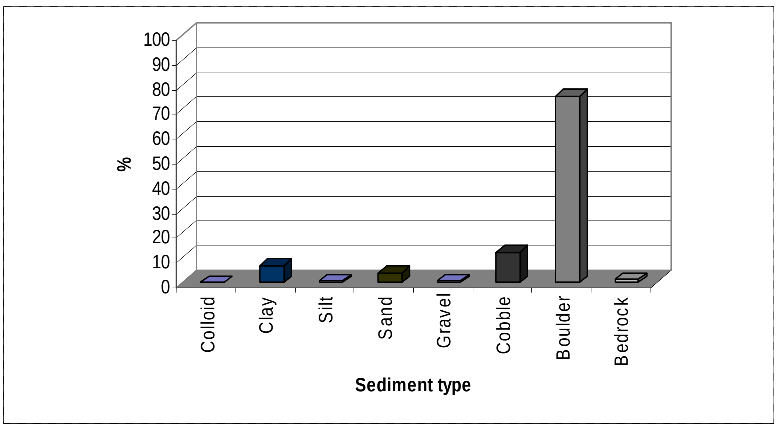


Figure 10. Showing percentage distribution of sediment types of Mzintlava at Ntshakeni.

From this it can be examined that the site is invaded by fine material like sand, silt and clay particles. When running the GAI model, the site can be classified as in a C class on its Present Geomorphological State.

SITE 10: MZIMVUBU AT N2

The site is geographically located on a confined valley floodplain. It is an anastomosing channel with numerous bars and sub-channels. The river at a site is at a dynamic sinuous condition. It is a mixed alluvial, pool-riffle system where both the bedrock and alluvium are dominant features. Moderate erosion occurs at a reach scale. Sediment mining (cobbles, boulders and cobbles) was taking place directly in a river channel. In addition, concrete material was deposited in the river channel and thus no sediment sampling whatsoever would be taken. Morphological units constituted about 42%.

Although erosion on neighboring hillslopes was minimal, the GAI model demonstrates that the river at a site is at C class.

SITE 11: TINA AT N2

The site is at a confined valley floodplain. It is a multi-thread, mixed, pool-riffle system dominated by boulders. Erosion at catchment scale very minimal and there is less vegetation removal. About 83% of morphological units were present. As it can be illustrated in the figure below, very little fine material is found in the river at that site.

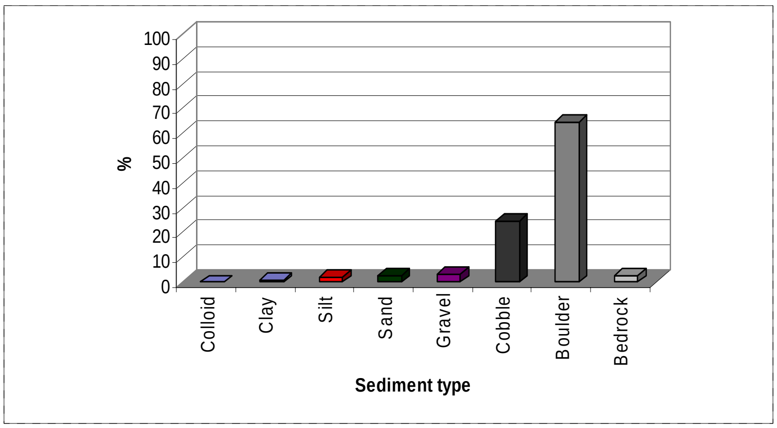


Figure 11. Showing percentage distribution of sediment types of Tina River at N2.

The GAI model demonstrates that the Present Geomorphological State of the river at a site is at B class.

SITE 12: TSITSA AT LALENI

The site is also at a confined valley floodplain. It is a single thread, sinuous, pool-riffle and a mixed channel although it is composed of the cobbles as a dominant sediment type. Active erosion at a reach scale could be noticed. Deep gullies were present throughout the adjacent hillslopes of the river reach. Vegetation removal and extensive livestock grazing was also evident. Weirs and causeways were also present. The figure below show the proportion of sediment types on the river at a site. It can be noticed that the cobbles are dominant features though the boulders are also evident. The silts, sands and gravel deposits are probably from sediment sources like gullies and the overgrazed and moderately eroded neighboring hillslope.

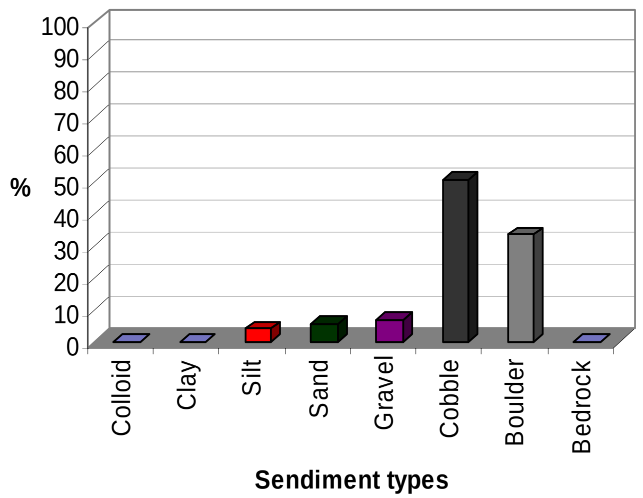


Figure 12. Showing percentage distribution of sediment types of Tsitsa at Laleni.

The GAI model illustrates that the river at a site is at B/C Present Geomorphological State.

SITE 13: MZINTLAVA AT KUPOYI

This site is an incised channel with flood benches. This means that there is a small portion of the reach where the sediment from eroded hillslope can be trapped, that is only flood benches. Such a site is vulnerable to sedimentation by the material directly from the hillslope, provided that there is less vegetation and easily weathered geological formation. It is a single thread, straight, mixed alluvial channel. In addition, it is located at a pool-riffle segment dominated by cobbles and boulders where the living biota can survive. The site is very poor in morphological units (about 38%). At a reach scale there are few slopes under cultivation and tiny vegetation removal.

The figure below shows the results of sediment types sampled at a site. It can be noticed that the sediment sampled is dominated mainly by cobbles though the boulders are also major features observed. Some gravel deposits also exist that are probably from adjacent hillslopes and upstream of the site as well as from the river bank.

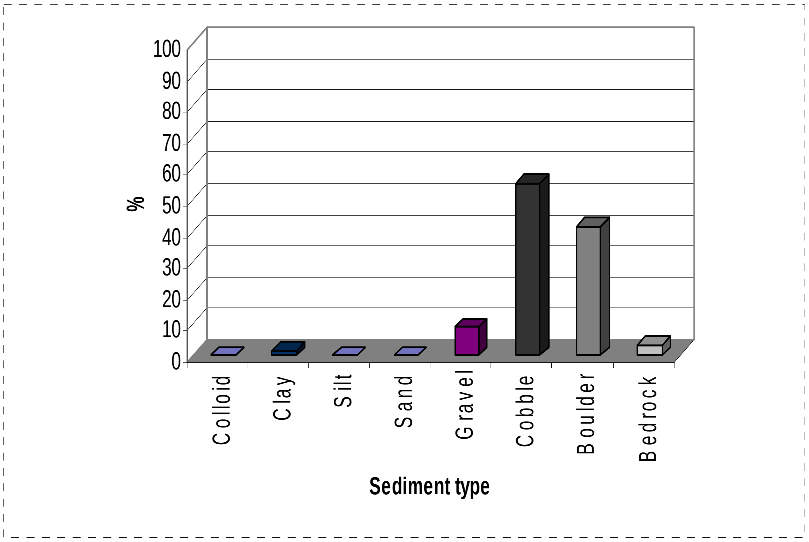


Figure 13. Showing percentage distribution of sediment types of Mzintlava at kuPoyi.

The GAI index revealed that the site can be considered as at its natural or near natural condition in terms of its fluvial geomorphology (A: negligible or no change).

SITE14: MZIMVUBU AT BUJE

Located at a rejuvenated foothill, the site is an incised channel, single thread and straight. Bedrock and fixed boulders are major physical condition in the channel and the river bank. It is a pool-riffle system, where the deep pools can act as refugia for aquatic biota during period of stress, for instance, during drought episodes. The site has numerous morphological units (+- 71%). No sediment samples were taken at a site as it consists mainly of fixed boulders and bedrock. Very small vegetation removal and alien invasion (mainly *Lantana spp*.) could be observed on a reach scale. The GAI index revealed that the site can be considered as at its natural or near natural condition in terms of its fluvial geomorphology (A: negligible or no change).

B. WATER QUALITY.

The results of water quality assessment will be shown in the form of tables and figures.

Table III: Showing the results of water quality measurements of the Mzimvubu River catchment.

Mzimvubu Survey 28/09/08 to 03/10/08

Physico-chemical properties

	Date	DO(ppt)	pH	Conductivity(mS)	Temp
Tsitsa above pot river pass)	29/09/2008	0.03	8.68	0.07	17.1
Vuvu (Tina-upper) reference site		0.05	8.79	0.12	23.5
Kinia @ Mabua	30/09/2008	0.04	8.53	0.08	18.6
Tina @ Tsolobeng		0.05	9.04	0.11	22.6
Kinira Drift		0.08	8.93	0.18	23.1
Jones Bridge	01/10/2008	0.02	8.64	0.05	17.5
Mzimvubu @ Springfontein)		0.04	8.3	0.08	20.2
Mzintlava below Fr. Vlei		0.04	8.91	0.07	19.4
Mzintlava @ Ntshakeni	02/01/2008	0.1	8.8	0.21	20.1
Mzimvubu @ N2		0.1	8.97	0.2	24.4
Tina @N2		0.05	8.99	0.11	25.1
Tsitsa @ N2		0.06	8.87	0.12	20.9
Mzintlava @ KuPoyi	03/10/2008	0.09	8.93	0.19	19.9
Mzimvubu @ Buje		0.19	9.07	0.09	19

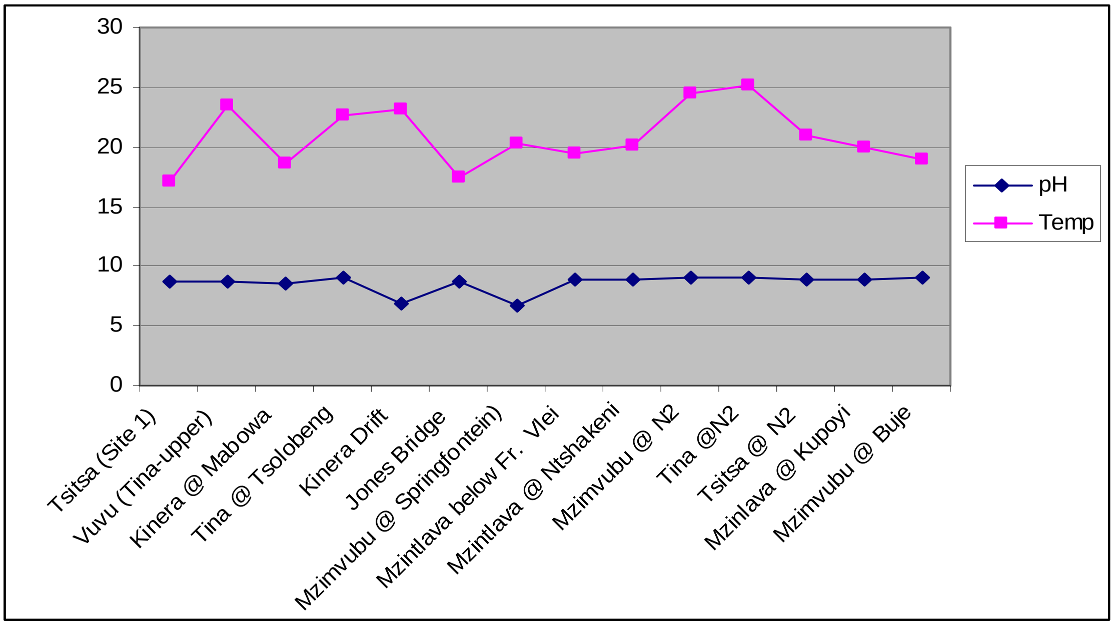
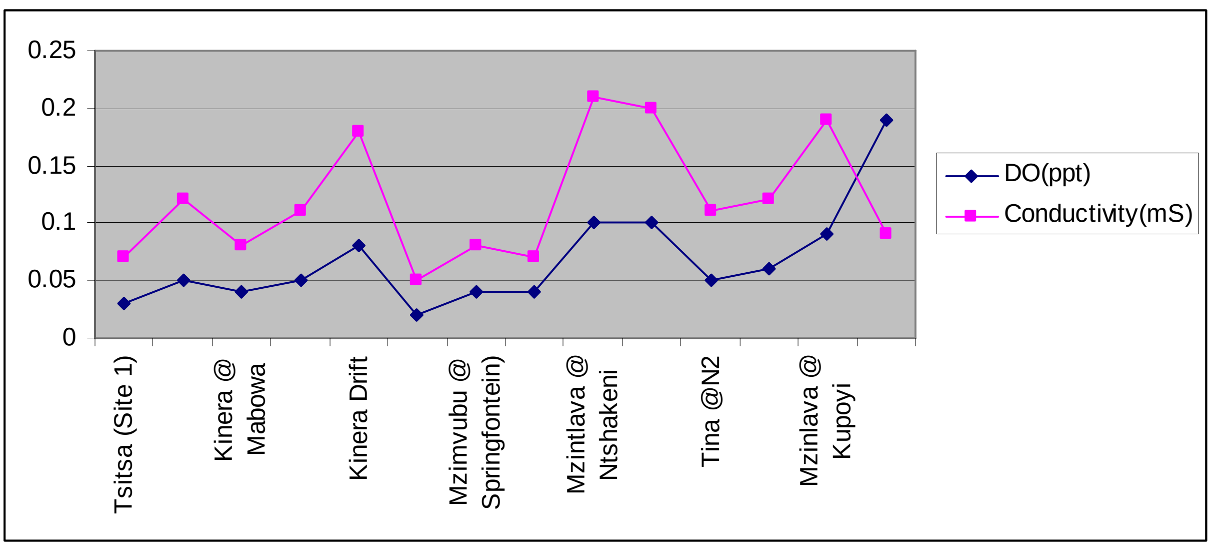


Figure14 Comparing temperature and pH.



Figure? Comparing dissolved oxygen (DO) and conductivity (note the positive correlation except at Mzintlava at KuPoyi.

C. INVERTEBRATES

The results of invertebrate assessment during the survey is shown in the figure below.

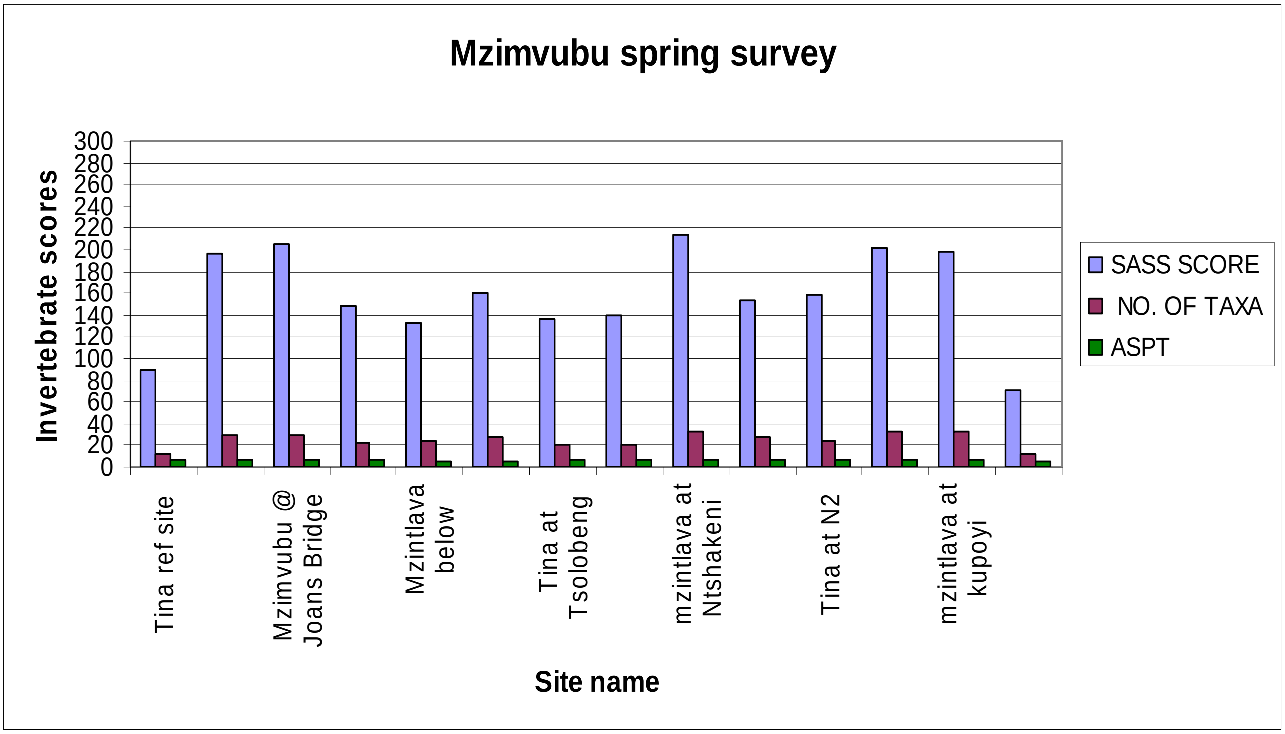


Figure 15. Results of invertebrate sampling in the Mzimvubu River Basin.

D. FISH

Fish results will be shown in the form of a table and a graph.

Table IV: Fish assessment results.

SITE	SPECIES	NUMBER OF FISH SAMPLED
Haverspruit	No sampling done	0
Tsitsa ref site	*Oncorhynchus mykiss*	9
Vuvu (Tina upper)	No fish caught	0
Kinira @ Mabua	*Oncorhynchus mykiss*	1
		23
Tina @Tsolobeng	No fish caught	0
Kinira drift	*No fish caught*	0

Mzimvubu @ Jones bridge	*Oncorhynchus mykiss*	7
Mzimvubu @ Springfontein farm	*No fish caught*	0
Mzintlava below Franklin Vlei farm	*Micropterus salmoides*	4
Mzintlava @ Ntshakeni	*Cyprinus carpio*	4
Mzimvubu@N2	*No fish caught*	0
Tina@N2	*Barbus anoplus*	19
Tsitsa@N2 Laleni	*Anguilla mossambica*	2
Mzintlava KuPoyi	*Barbus anoplus*	1
	Cyprinus carpio	4
Buje	*No fish caught*	0

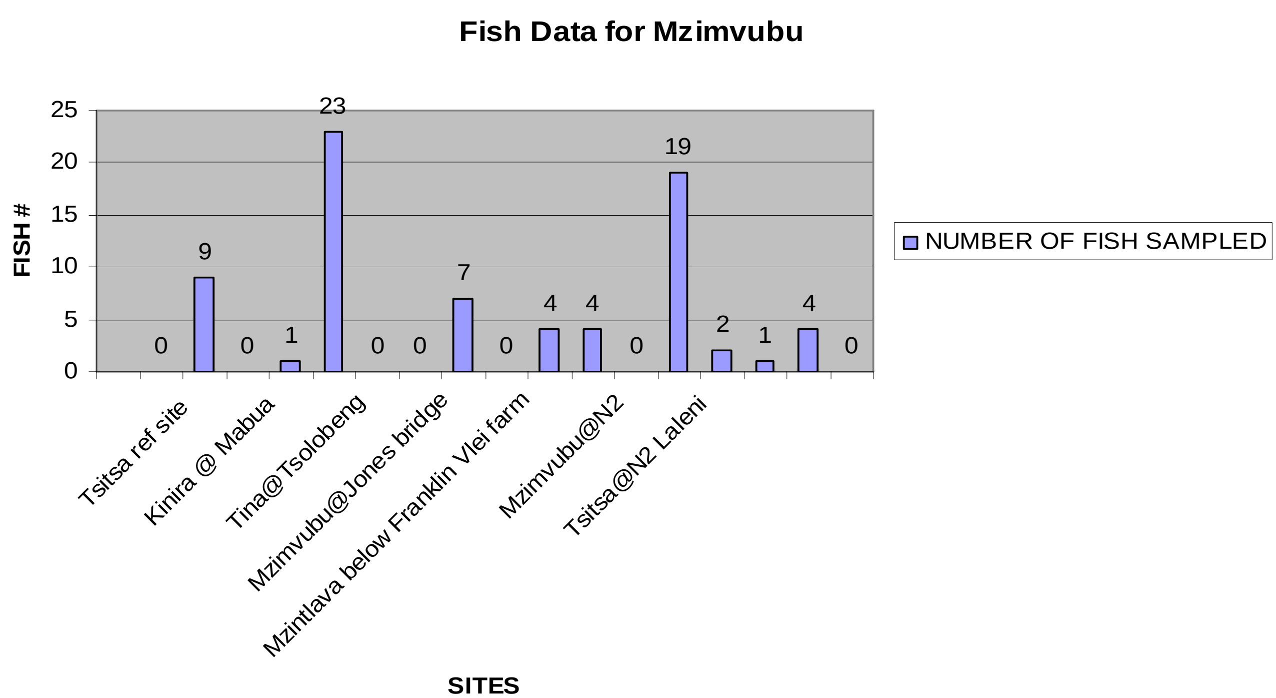


Figure 16: Fish results.

REFRENCES

A. Geber and MJM. Gabriel. 2002. Aquatic Invertebrates of South African Rivers: Illustrations. Version 2. RQS, Department: Water Affairs and Forestry, Pretoria, South Africa.

Kleynhans, CJ, Thirion, C and Moolman, J (2005). A Level I River Ecoregion Classification System for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104._Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

Louw and Rebelo. 1996. Vegetation of South Africa, Lesotho and Swaziland.

Moon, BP and Dardis, GF. 1988. The Geomorphology of Southern Africa. Department of Geography, University of Transkei, Umtata.

http://www.ewisa.co.za/misc/RiverECMzimvubu/defaultmain.htm - 22k

Skelton, P. 1993. A Complete Guide to Freshwater Fishes of Southern Africa. New Holland Publishing.

Wadeson. R 1999. R18: The Procedure For Generating Fluvial Geomorphological Information For The Intermediate And Ecological Reserve (Quantity) in Resource Directed Measures for Protection of Water Resources: River Ecosystems. Department of Water Affairs and Forestry Lizette Guest, Guest Environmental Management.

0ooooooo0oooooo0oooooo0oooooo0oooooo0oooooo0oooooo0oooooo0oooooo0