



water & forestry

Department:
Water Affairs and Forestry
REPUBLIC OF SOUTH AFRICA



BIOMONITORING OF THE GREAT KEI RIVER SYSTEM

APRIL 2010

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EXECUTIVE SUMMARY

The main objective of the South African National Aquatic Environmental Health Monitoring Programme (NAEHMP) makes use of the instream and riparian biological communities like vegetation, invertebrates and fish to assess the ecological 'health' of rivers as well as physical attributes or drivers of the ecosystem like hydrology, geomorphology and water quality. These biological communities are always found in rivers and they are often affected by any disturbance that occurs in the river ecosystem.

This report provides the results of the biomonitoring survey that was undertaken in in the Great Kei River Basin in April 2010 (Autumn survey). Field apparatus used for data collection included the Geomorphological field sheet, South African Scoring System version 5.0 (SASS5) for macro invertebrates, and the Fish Assemblage Integrity Index (FAII) for fish. Physical water quality measurements were not done due to lack of the equipment: multimeter.

The Department: Water Affairs and Forestry (DWA): Eastern Cape National Aquatic Environmental Health Monitoring Programme (former RHP) involves the use of Biomonitoring as a tool to determine the health of the aquatic ecosystems. The programme aims to promote homogeneous and constant monitoring and reporting on the Eastern Cape rivers ecosystem health. The Great Kei River is one of the systems monitored by the Eastern Cape DWA, hence monitoring survey was conducted.

This report provides information on the Present Ecological State of the Great Kei River Basin in Autumn.

INTRODUCTION

An Autumn survey of aquatic ecosystem components (geomorphology, water quality, macro-invertebrates and fish) was conducted in the Great Kei River early April. 5th to 9th, to obtain indication of the 'health' of the river. This survey was conducted during the period of heavy rains on that catchment.

Major Land Use Activities

Observed on the study area are markedly different units of landuse activities which include the following:

- Animal husbandry (Beef, dairy, sheep, poultry and goats)
- Crop production (maize and vegetables).
- Game farming (Builder beast, antelope, warthog, rabbits and kudu)
- Rural and Urban settlements.
- Commercial farming lands occur mostly on the western side of the catchment (mainly Lucerne). This is where extensive irrigation occurs.

It could be noticed that most of the land in the catchment is unimproved and degraded grasslands.

METHODOLOGY

The Great Kei River survey was conducted in Autumn (April 2010). Additional site selection was done on the upper reaches of the Tsomo River with the aim of finding the reference condition for the 16 South Eastern Uplands Level I Ecoregion. 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. The survey was done by collecting data on predetermined accessible sites.

A Total of eleven sites along the Great Kei River were selected for route seasonal monitoring. During this survey the macroinvertebrate samples were only conducted in five sites and this was due to high flows and horrific weather conditions (M. Rubuxa, 2010, invertebrate report).

The sites were selected in three sections of the catchment viz.

1. The upper reaches, where the survey took place right upstream of all the selected major tributaries.
2. The middle reaches, where the preference was on confluences and impoundments.
3. The lower reaches, where the survey will be done to assess the overall impact on the Great Kei River Basin.

The following implements were to be used during the analysis:

- a) The Geomorphological Assessment Index (GAI), which was used to assess the Present Geomorphological State of a river at a particular reach.
- b) Basic water quality parameters were measured at each site (electrical conductivity, pH, Temperature and TDS).
- c) The SASS5 biomonitoring technique was used to sample aquatic macroinvertebrates.
- d) An electro-fisher shocker was used to assess the presence or absence of different fish species at each site.
- e) 1: 50 000 topographic maps and Google images were used to find and locate the predetermined survey sites, as well as to act as a desktop estimate at a catchment level.
- f) The Global Positioning System (GPS), to locate the sites of assessment and to navigate the directions to the site.
- g) ArcView 3.2: a GIS software was used as a tool for data storage, analyses, manipulation and interpretation of data.

AIMS

The main aim of the survey was to review the overall Present Ecological State of Great Kei River Basin in Autumn. 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 model.

COURSE OF THE SURVEY

1. Tsomo Upper reaches.

The site is located at Tsomo River at S31° 15' 52.18" and E27° 42' 54.32" It is situated in an incised channel with flood benches.

GEOMORPHOLOGY.

The site is in a single- thread, pool-riffle system of which its river bed consists of boulders as pre-dominant substrate types (Plate 1). Forty-five percent of morphological units were observed at a site. These units form habitat abundance and diversity for aquatic flora and fauna. A road curvet at the site deprives the migration route towards the upper most part of the river reach. The Geomorphological Assessment Index (GAI) reveals that the river at a site is on A condition in terms of Present Geomorphological State, suggesting that there were minimal changes on that part of the river reach. In fact alien invasion, few developments and commercial farming (mainly lucerne) as well as water abstraction (pipes observed) were those minimal changes thereof. In addition, the confidence in terms of classification of South African rivers was low due to inaccessibility towards the upper most part of the reach due to dense overhanging vegetation along the riparian zone.

INVERTEBRATES

The site forms part of one of the tributaries of the Great Kei, and the species diversity was high and therefore the site is at a good condition. The *Baetidae* also dominated the macroinvertebrate samples followed by the *Heptageniidae* of which all represent the *Ephemeroptera* taxa. The samples were only collected from only two biotopes (stones and GSM) and this shows that the ecological state of the site is in good condition for the macroinvertebrates.

FISH

No fish collected at a site though there is diversity of habitats for fish.

Plate 1 on the appropriate page shows the Tsomo River upper reaches site.



Plate 1(a) Water was very clear during site visit.

(b) A group of young scholars interested.....

Tsomo at R56 Bridge

The site is located at Tsomo River at $S31^{\circ} 22' 02.2''$ and $E27^{\circ} 40' 14.6''$ at an altitude of 1178 masl.

GEOMORPHOLOGY

The river at a reach is a multiple thread, straight, pool-rapid and a mixed channel dominated by bedrock and boulders. It is a braided channel with about 62% of morphological units described on the Geomorphological Assessment field sheet. The GAI model shows that the site is an A class in terms of its Present Geomorphological State . Sediment sampling could not be done due to the site's fluvial morphological state of fixed boulder and bedrock material, as well as high flows (Plate 2).

MACROINVERTEBRATES

No assessment should be done due to high flows.

FISH

Site had all suitable fish habitats but the high flows had negative impacts on fish distribution. However, *L. aenus* species were caught, with one adult and one juvenile.



Plate 2. Black wattle is a major setback at a site area.

Tsomo at Komkulu

The site is geographically situated at Tsomo River at S31° 36' 33.3" and E27° 40' 35.4" at an altitude of 1108 masl.

GEOMORPHOLOGY

The river at a reach is a single thread, sinuous, mixed, pool-riffle system, often in a flat bed reach type. Morphological units dropped to about 56% as compared to 75% of summer survey (2009) due to high flows that had inundated some of the morphological units, e.g. mid-channel bars swamped by the water. The GAI model shows that the site is at C class in terms of that Present Geomorphological State. No sediment sampling could be done at a site due high flows.

MACROINVERTERBRATES

No sampling could be done due to extreme high flows.

FISH

No sampling could be done due to extreme high flows (Plate 3).

The plate below shows Tsomo River at Komkhulu during high flows.



Plate 3. Tsomo at Komkhulu during Autumn survey, 2010, note the dark clouds at a distance; an evidence of on-coming rain. This is the tributary of the Great Kei !!!

Black Kei at Bulhoek.

The team could not make it to the site area due to hail, heavy rainfall and muddy road (Plate below).



Plate 4. Heavy rain with hailstones in action.

White Kei Below Xonxa Dam

The site is located in the White Kei at 31° 51' 18.9" and 27 ° 11' 22.5" at an altitude of 886masl.

GEOMORPHOLOGY

The dominant substrate material at a site is a fixed boulders and a bedrock material (Plate 5). Irregular shape of boulder/cobble shows that the material is directly from localized adjacent hillslopes. Fine sand deposits along the river bank and a point bar were observed. This fine material should be from suspension and could be deposited as the result of reduced energy of the water from the dam release. Morphological units observed dropped to 50% as compared to 63% of 2009 summer survey, but GAI indicates that the site is still at C class. The plate below shows the White Kei River 'horn' below Xonxa Dam.



Plate 5. Shape of alluvium at a site indicates that the material is directly from adjacent hillslope.

MACROINVERTERBRATES

Species diversity was not high at this site and the *Baetidae* were the most abundant and were represented in all biotopes. The *Psephenidae* were also represented and that may have an effect on the score as they are high scorers according to SASS5, thus putting the site to a fair condition.

FISH

Fast deep, fast shallow and slow deep habitats suited the yellowfish. The river forms two islands and has backwater as well. Different sediment characteristics are boulders and bedrock at the site. The net was used there when the shocker failed. Fish caught was a species of *L. aenus* of which there were 13 juveniles and one adult.

White Kei at St. Marks

The site is located at White Kei River at S32° 0' 49.6" and E27° 22' 27.2".

GEOMORPHOLOGY

No adequate assessment at a site could be done due to extremely high flows (sediment assessment not done). There was also evidence of recent floods; a lot of debris deposited on a floodline. About 79% of morphological units observed as compared to 67% of previous surveys. This was due to flowing waters on the overflow (secondary) channels.

MACROINVERTEBRATES

No sampling could be done due to extreme high flows.

FISH

This site is dominated by bedrock, fast deep flows (suitable for the yellowfish), backwater and a small secondary channel on the left river bank.

No sampling could be done due to extreme high flows. Plate 7 below shows White Kei at St. Marks.



Plate 7. High flows and water very turbid due to suspended fine sediments. Sand deposits along the river bank are mainly from catchment processes dominated by erosion. The cumulus clouds with rain can be seen at a distance.

Black Kei at Turnstream

The site is located at the Black Kei River at S32 10 42.58 and 27 19 50 at an altitude of 690 masl.

GEOMORPHOLOGY

The GAI model shows that the site is at B class in terms of its Present Geomorphological State. No changes observed as compared to previous surveys except minimal increase in turbidity and increased levels water levels. Plate 8 shows Black Kei at Turstream.

MACROCROINVERTEBRATES

Species diversity at this site was low and there was only one biotope sampled during the survey due to high flows. The taxa represented were *Ephemeroptera*, *Diptera* and the *Trichoptera* they are all referred to as stone inhabitants. Therefore, the results showed that this site is at a poor condition.

FISH

Very good intact bedrock banks, with vegetation resulting to excellent habitat for fish. All 4 fish habitats available. 30 juveniles of *Labeobarbus aenus* were caught.



Plate 8. Black Kei at Turnstream. No change as compared to previous surveys.

Great Kei at Gaika Fort

The site is located at S32°16' 60" and E27° 39' 09" at an altitude of 596 masl.

GEOMORPHOLOGY

High flows and high levels of sedimentation were observed in the Great Kei at Gaika Fort. Plate 9 below shows the Gaika Fort site of the Great Kei River catchment below the confluence of the two 'horns', that is, the White Kei and the Black Kei. Specific changes in terms of substrate characteristics were observed at the site. Dangerous fine sediments were observed at the river reach (plate 9 b). These fine sediments should due to catchment processes. In fact most of the sediment sources are the gullies, especially on the first order streams at the catchment level (refer also to satellite images: Google Earth). Other fine sediments are due to fluvial deposits from upstream as well from the river banks and the river bed. The GAI model shows that the site is at C class in terms of its Present Geomorphological State. No sediment sampling was done at a site due to high flows.

MACROVERTEBRATES

This site consists of many boulders and these are attached to the river bed. Vegetation is also abundant, but due to high flows only the GSM and stones were sampled. The abundance of non-kickable boulders made it difficult to collect samples and therefore a low score can be associated with high flows and inaccessibility accordingly. Therefore, the results of this survey put the site at poor condition.

FISH

Sampling was given a shot, although flows were high, as a result, no fish were caught.



Plate 9(a). High flows and water very turbid. (b) High volumes of sedimentation on the right bank

Kubusi: The Bridge

The site is located at Kubusi River at S32° 30' 26.4" and E27° 43' 53.0" at an elevation of 438 masl.

GEOMORPHOLOGY

No significant changes as compared to previous surveys. Morphological units (biotopes) observed comprise about 57%, that is, small decrease as compared to previous surveys, mainly due to small increase in base flows. For example, the bedrock pavement was covered by the water. Dominant features in the channel are fixed boulders and some few cobbles together with bedrock. Plate 11 shows the Kubusi River bridge site.

The GAI model however, shows that the river at a reach is at B class and therefore impacts of the dam further upstream still exists, together with the impacts of the bridge at a site area.

MACROINVERTEBRATES

The species diversity at this site was high and they put the site to a fair condition as indicated by SASS. The most dominant taxa were *Ephemeroptera*, *Diptera* and the *Coleoptera*, and the *Baetidae* were the most dominant in the samples. The vegetation at this site was very patchy and most of it was fringing, therefore; there were only few species found on the vegetation samples and that may be associated with the lack of habitat.

FISH

This site is dominated by boulders and bedrock. The flows were shallow fast and shallow slow. Net ineffective in this site, only shocker. Water was clear and we could see the fish from outside. *Glossogobius callidus* are the fish species observed and they consisted of 8 juveniles.

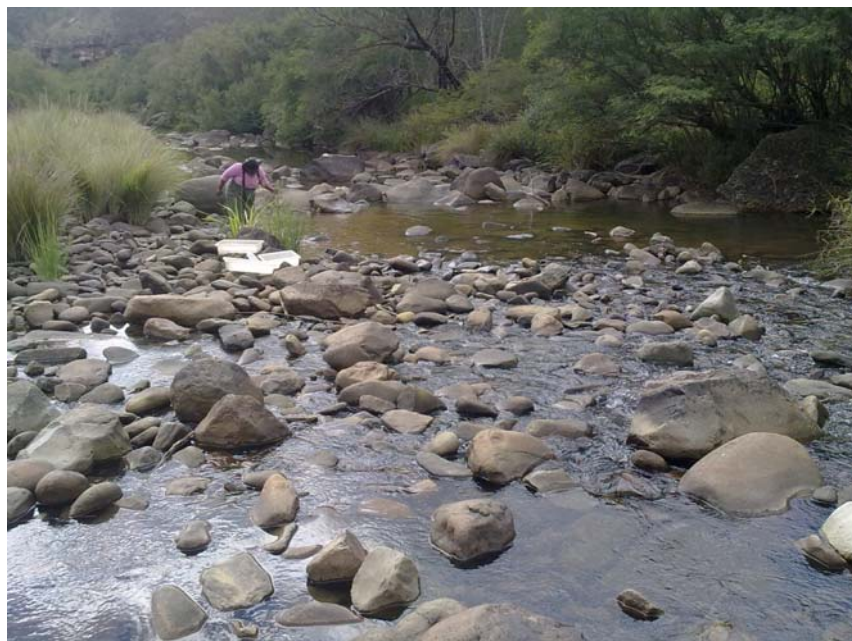


Plate 11. A typical alluvial channel with coarse and rough sediments.

Great Kei below N2 Brige

No sediment sampling and proper assessment could be done in the Great Kei River site at N2 bridge site due to excessive current/velocity of the water as well as blowing winds from upstream direction. Most of the cobbles and small boulders were submerged by the water.

The GAI model shows that the site is at C class in terms of its present state. Some few of *Lantana spp* were still uncontrolled. Excessive sediment mining still taking place on the riparian zone. Plate 12 shows the Great Kei River at N2 Bridge.



Plate 12 (a). Kei River bridge site during high flows.

Plate 12.(b) Note the shape of grasses showing blowing winds.

Great Kei at Glen.

NB: (call Johan at 076 383 9331 for arrangements to open the gate).

The site is located at the Great Kei immediately below the confluence of the Great Kei and the Gcuwa tributary at S32° 32' 41.1" and E28° 11' 37.9" at an elevation of 65 masl.

GEOMORPHOLOGY

No proper assessment could be done in the Great Kei River site at Glen site due to high flows, very deep pools and poor access along the river reach. Transects accessed previously were inundated by the water.

Plate 13 shows the Great Kei River site at Glen immediately after recent annual floods.

MACROINVERTEBRATES

No assessment could be done due to high flows.

FISH

No sampling here due to high flows. Nice pools and "waterfalls" over the dominant bedrock. Stones were slippery due to algae from sewerage from the wastewater plant.



Plate 13.(a): Note alien invasion.

Plate 13.(b): Alluvium almost submerged by the water.

DISCUSSIONS

High sedimentation and water very turbid during high flows on the Tarkastad geological formation with sandstones and mudstones. The level of sedimentation and turbidity increases with changes in landuse and environmental degradation (e.g. below the confluence of the two 'horns': Gaika Fort site. The levels of sedimentation and turbidity decreases with the downstream impacts of the impoundments. Alien invasion is still a pre-dominant process along the Great Kei River basin; an environmental issue that needs to be taken into account.

Comparing with the previous survey for the sites that were sampled to date there is a significant change and this might be the results of high flows experienced during the current survey. Some sites such as Kubusi Bridge and Gaika Fort were in a good condition in the previous survey and now ranged from fair to Poor, respectively. The site Below Xonxa dam was in a fair condition and this shows that dam release during the current survey had no significant impact in the abundance and species diversity; therefore in agreement with the previous survey.

Generally, the catchment as a whole has very good varying habitats for fish. This was evidenced by the previous fish survey (Summer 2009). The seasonal conditions (high flows in this autumn) led to a significant decrease in the fish caught in the system, as their habitat was vigorously disturbed. Unlike during the 2009 summer fish survey in this catchment, there was a poor fish distribution throughout the catchment. The smallmouth yellowfish, *Labeobarbus aenus*, was the dominant fish in this system. Only the tributary (Kubusie at the bridge) hosted the river gobby, *Glossogobius callidus*.

CONCLUSIONS

The Great Kei River survey was conducted from the Upper reaches to the Lower reaches although other recommended sites could not be assessed due to their 'poor' conditions for assessment. Very minimal changes has occurred as a result of high flows and these changes can be replenished during low flow period; which is a natural phenomena in almost all the aquatic ecosystem except more anthropogenic landuse activities increase. Most affected sites are those located on poor soils and vegetation, especially on the former Transkei and Ciskei areas where environmental management strategies and education can be considered as inadequate. It can be concluded that, high flows thus resulting to poor sampling strategy had a significant impact on the abundance of the invertebrates in this survey. Therefore, these results are not a true reflection of the status of this system due to bad weather which led to some site not to be accessible.

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RECOMMENDATIONS

There is a requirement of:

- o Assessment of the catchment for all the seasons especially for the responses (riparian vegetation, invertebrates and fish).
- o Proper management strategies by the CMA, especially on the Tarkastad and Adelaide geomorphological Formations where mudstones and sandstones are dominant soil types susceptible erosion (refer also to Great Kei Report: summer survey, 2009).
- o Community Based Natural Resource Management (CBNRM),that is, putting the local communities in the center of water resource management strategy. Participatory approach could form part of this CBNRM, of which each and every member of the society should consider him/herself as part of the ecosystem.
- o Environmental Impact Assessments.
- o Environmental Education and awareness campaigns to the public.
- o Creation of buffer zones on the riparian zone and most sensitive areas. Geographic Information Systems could serve as a tool to support this by targeting areas with potential risks.

The data can be archived safely, in order to compare it against the next autumn results. This will help in determining the trends and river behaviour in different seasons, using fish as indicators.

REFERENCES

Geber, A. and Gabriel, MJM. 2002. Aquatic Invertebrates of South African Rivers. Institute for Water Quality Studies, Department: Water Affairs and Forestry.

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

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