Identifying Priority Ecological Infrastructure in the uMngeni River Catchment

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Objective

Identify important ecological infrastructure (natural and degraded) to enhance hydrological processes (e.g. water supply, flood attenuation, sediment trapping and water quality) within the uMngeni River Catchment, and develop interventions (investment plans) for the sustained delivery of ecosystem services.
SANBI-UKZN Research Project

- Develop methods for mapping ecological infrastructure and assessing ecosystem condition
- Undertake a situational analysis of the catchment
- **Identify priority sites for intervention and monitoring needs**
- Identify potential governance, institutional and financial mechanisms and funding sources
- Develop monitoring and evaluation approaches to assess outcomes of the interventions
- Contribute to strengthening integrated water resource management in the uMngeni river catchment
- Develop an investment plan
- Extract policy-relevant lessons
Revision of land cover data (EKZNW/GeoTerra Image, 2011; Umgeni Water 2007)
Project process

Land cover map (EKZNW 2011/Umgeni Water 2007)

ACRU Hydrological Model

Hydro Ecosystem Service Delivery Identification and Prioritization

Action/Investment Plan

Different land cover types e.g. plantations, grassland, alien plants

Translate into ACRU “Hydrological Response Units” or HRUs

High current delivery e.g. water supply

High delivery with rehabilitation

Secure

Rehabilitate

GROUNDTRUTHING
ACRU hydrological model

ACRU... A Daily Time-Step, Conceptual-Physical, Process-Based Soil Water & Hydrological Budgeting Model

(Schulze 1995 and updates)
Running of the *ACRU* model for each catchment - starting in the Upper uMngeni
Running of the ACRU model for each catchment - starting in the Upper uMngeni
Derivation of hydrological response units (HRUs)

- Alien vegetation (Wattle)
- Builtup
- Commercial agric & dams
- Commercial forestry (Euc)
- Degraded grassland & thicket
- Informal residential
- Natural veg (grass & thicket)
- Pasture grass
- Riparian & wetlands
- Subsistence agriculture
- Sugarcane generalised

Key:
- Alien infestations
- Rivers and wetlands
- Degraded vegetation
- Natural vegetation
Results from the ACRU modelling

- Outputs in terms of, e.g.:
  - Wet season streamflow (water supply)
  - Dry season baseflow (winter low flows - ecological functionality, water supply)
  - Sediment generation
  - Stormflow (flooding)

- Multiple combinations of climate, soils, vegetation, etc. throughout the uMngeni River Catchment results in a variation in hydrological response - streamflow, baseflow, stormflow, sediment yield
Far greater effect on wet season streamflow when alien plants have invaded the catchment.
Far greater effect on dry season baseflow when grassland is degraded.
Rehabilitation scenarios

- Hypothetical rehabilitation of:
  - Degraded grassland to natural vegetation
  - Alien infestations to natural vegetation
  - Wetlands/rivers with limited functioning

- Goals (for example):
  - Increase in wet season streamflow (water supply to dams)
  - Increase in dry season baseflow (sustained winter flows - ecological integrity)
  - Decrease in sediment yield (prevention of loss of soil and nutrients, reduce sedimentation of dams/rivers)
  - Attenuate flooding for downstream risk areas
Prioritisation process

Underlying philosophy:

- Catchments producing **high** streamflow, **high** baseflow and **low** sediment yield from natural vegetation
- Catchments producing **low** streamflow, **low** baseflow and **high** sediment yield from degraded/infested vegetation
- Catchments producing **high** stormflow from degraded vegetation, and with **high** flooding potential

Flooding potential using catchment morphometry:

- Catchment slope
- Stream ordering (Strahler method)
- Impervious area
- Drainage density (Rho Coefficient)
- Relief ratio

High value = high flooding potential
Prioritisation process (cont.)

- Ranking of catchments using the ACRU and GIS data:
  - Ranks allocated by thresholds using percentiles
  - Eight threshold classes
  - High rank = high priority for management intervention
  - Rank values are averaged when combining catchment parameters, e.g.:

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  \text{Rank} = 8 \quad \text{(Baseflow)} + \quad \text{Rank} = 2 \quad \text{(Streamflow)} + \quad \text{Rank} = 6 \quad \text{(Sediment yield)} = \quad \text{Rank} = 5.33
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Priority catchments to rehabilitate ecological infrastructure
Priority catchments to conserve ecological infrastructure
Priority catchments for enhancing flood attenuation
Top five or six catchments for management interventions
Next steps and way forward

- Finalise modelling in the remaining catchment
- Integrate demands for hydrological services
- Incorporate water quality information
- Assess EI in priority areas (further desktop mapping, meetings/workshops, ground-truthing, etc.)
- Economic implications of restoration vs conservation, i.e. cost-benefit analysis, conserve or restore EI, etc.
- Develop investment plans
Thank You!

“If you think load-shedding is bad, brace yourself for water-shedding... coming to a tap near you. South Africa is fast running out of water, with the worst drought since 1992 leaving dams at critical levels and diminishing rivers and streams.” By NIKI MOORE.