EFlows information systems in South Africa

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Overview of presentation

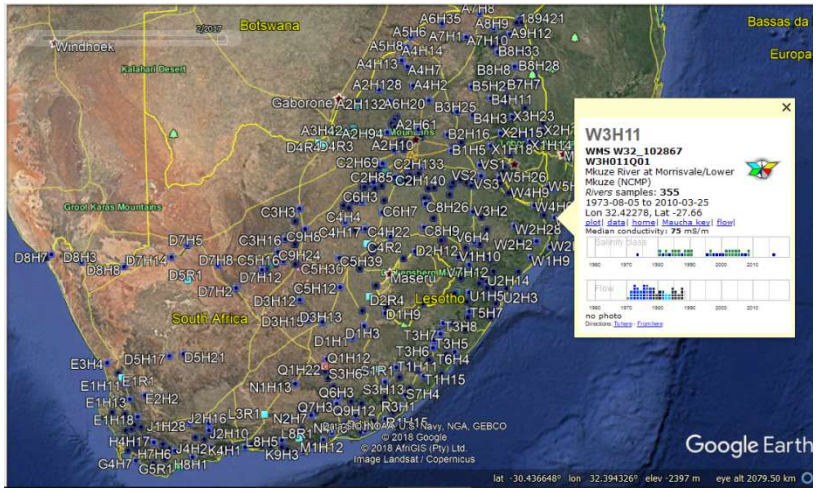
- Outputs from an EFlows assessment
- Data gathering in SA
- Outputs from Classification and RQOs
- Some examples of EFlows information systems
- An SA score card on possible components for EFlows information systems

Outputs from an EFlows assessment

- List of Stakeholders and their profiles
- Data sharing protocol
- Relevant GIS layers, delineation of the basin and site selection
- Ecological condition of the various river reaches and estuaries
- Hydrological and sediment time-series for EFlows sites/locations
- Hydraulic relationships and models constructed for EFlows sites
- Lists of indicators and links
- Specialist data and report for each discipline
- The EFlows Assessment Report, which provides the outcomes of the assessment
- The worksheets or models generated in the EFlows Assessment, and user manuals, where available
- Training course materials
- Presentations and awareness publications.

Data gathering in SA

- Rivers mandate of DWS, CapeNature, NParks
- Estuaries mandate of DEADP, CapeNature, NParks
- Oceans mandate of DEFF, MCM, NParks
- Districts, municipalities and cities



- RHP, WARMS (DWS)
- DB of river/estuary condition
- DB of flow & modelled hydrology
- Water quality database
- National biodiversity assessment

- Freshwater Biodiversity Information System (FRC)
- South African Estuary Information System (SAEON)
- National Integrated Water Information System (DWS)

Outputs from Classification & ROQs

- EFlows extrapolated basin wide and gazetted
- A monitoring programme

- Clear objectives to measure results in line with predictions and direction of change
  - Are the flows being met?
  - Are the predicted responses taking place?
- Currently is no nationally linked system in place
- Need all data to be in a platform for testing relationships, sharing results
- Real work begins now

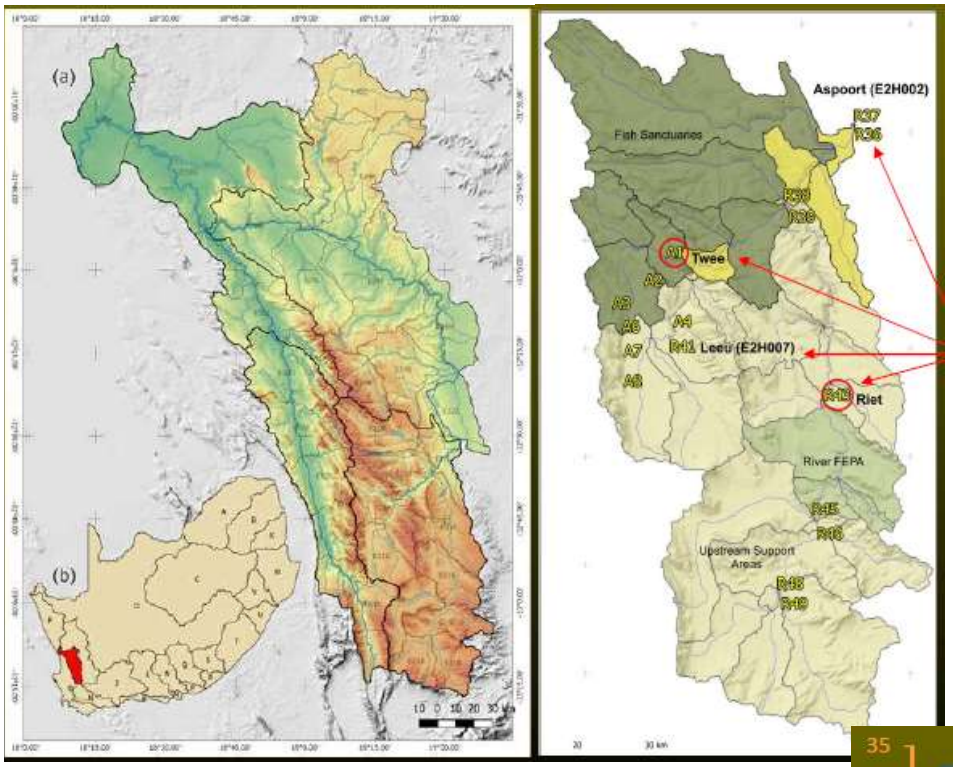
3 Examples of EFlow information systems

- Private landowners in Kouebokkeveld in the Olifants-Doring WMA monitor flow
- Lesotho government monitors EWRs and river condition d/s of the Metolong Dam
- Collaborative efforts to monitor and implement EFlows in the Inkomati WMA

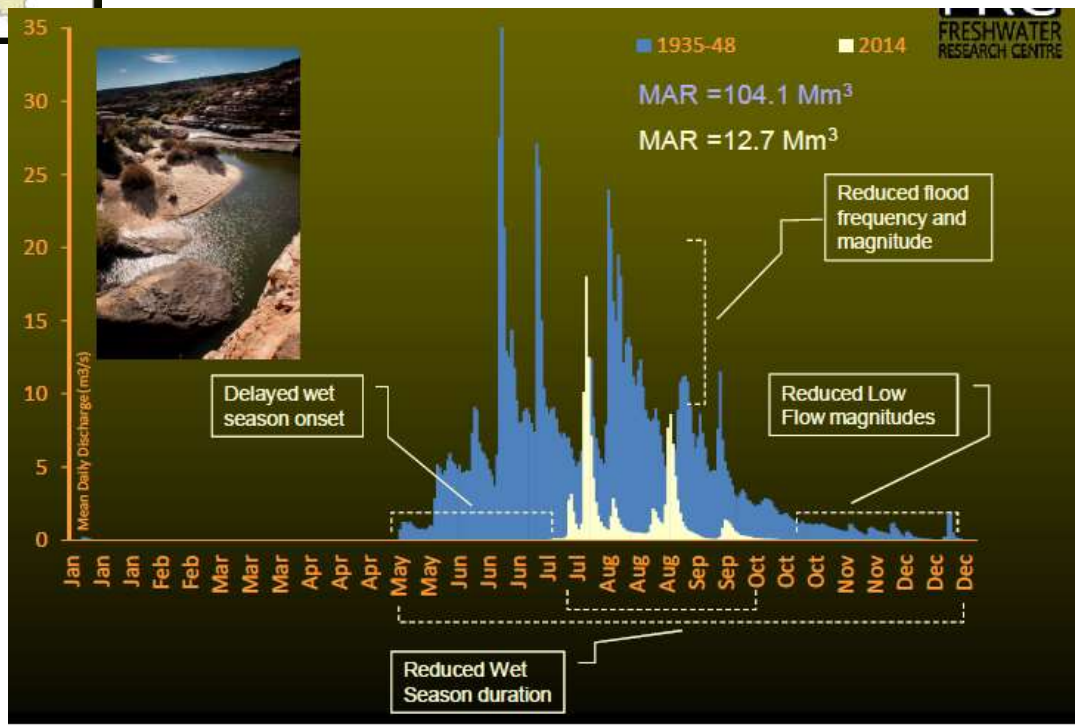
Kouebokkeveld – EFlows systems

- WRC funded research project by the FRC
- A tool to calculate whether the flow regimes is being met or not
- Calculates monthly flows retrospectively
- Not intended for basins with major water resource developments or for use with dam operating rules
    - » WRC research project: Paxton et al. 2016. Developing an elementary tool for Ecological Reserve Monitoring in South Africa's Freshwater Ecosystem Priority Areas (FEPAs): a pilot study in the Koue Bokkeveld

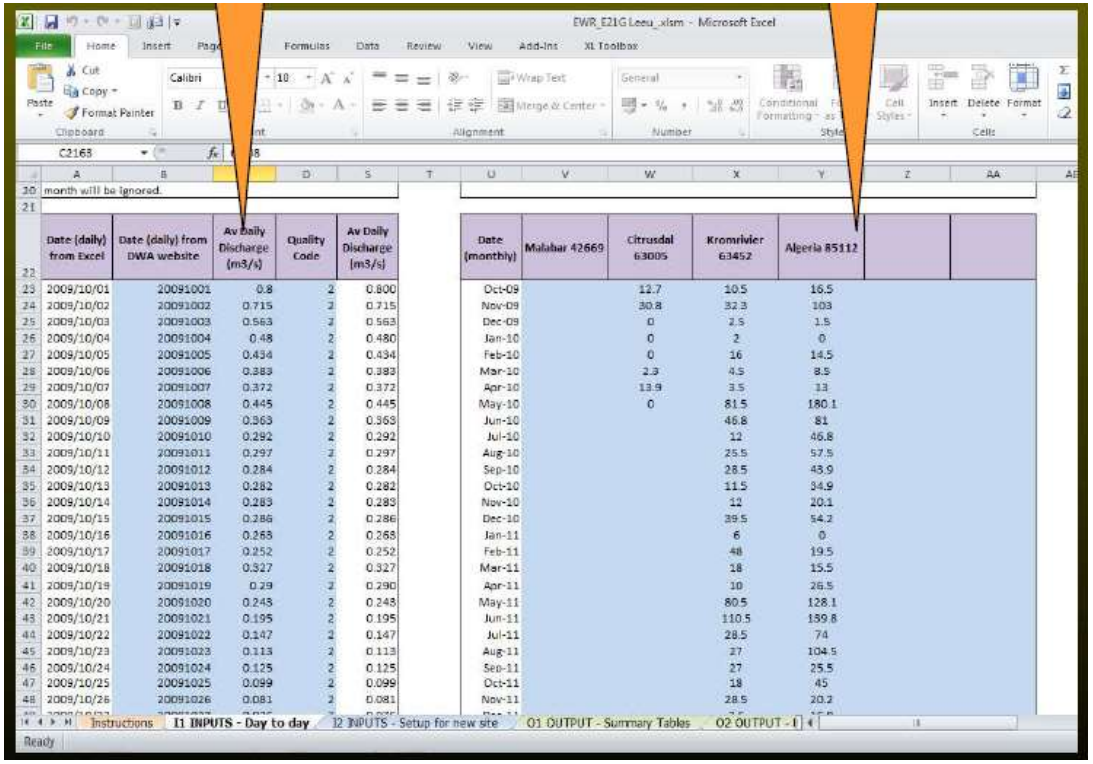
Study area

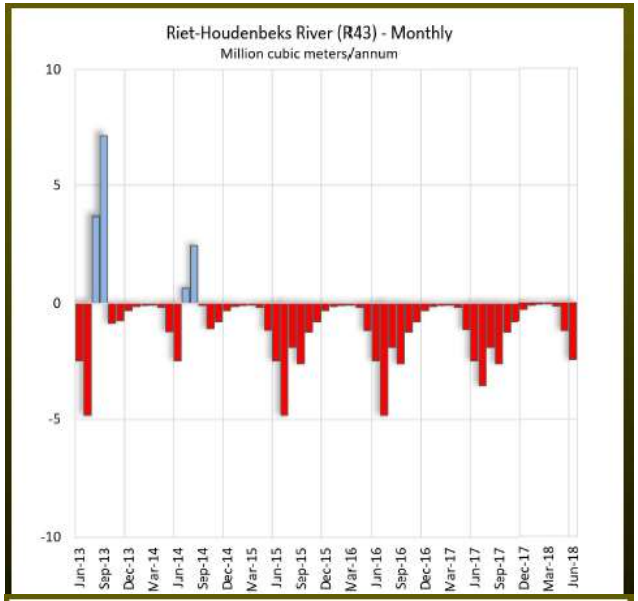


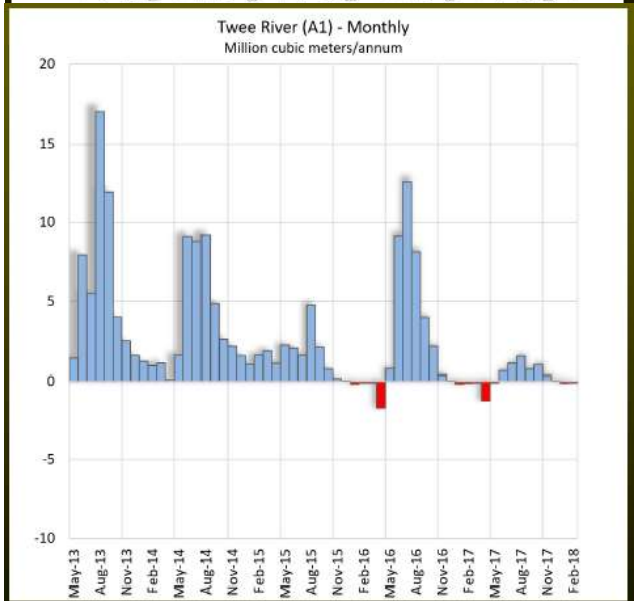
- Project shared by landowners, DWS, EWT, FRC, CapeNature



Data inputs and outputs





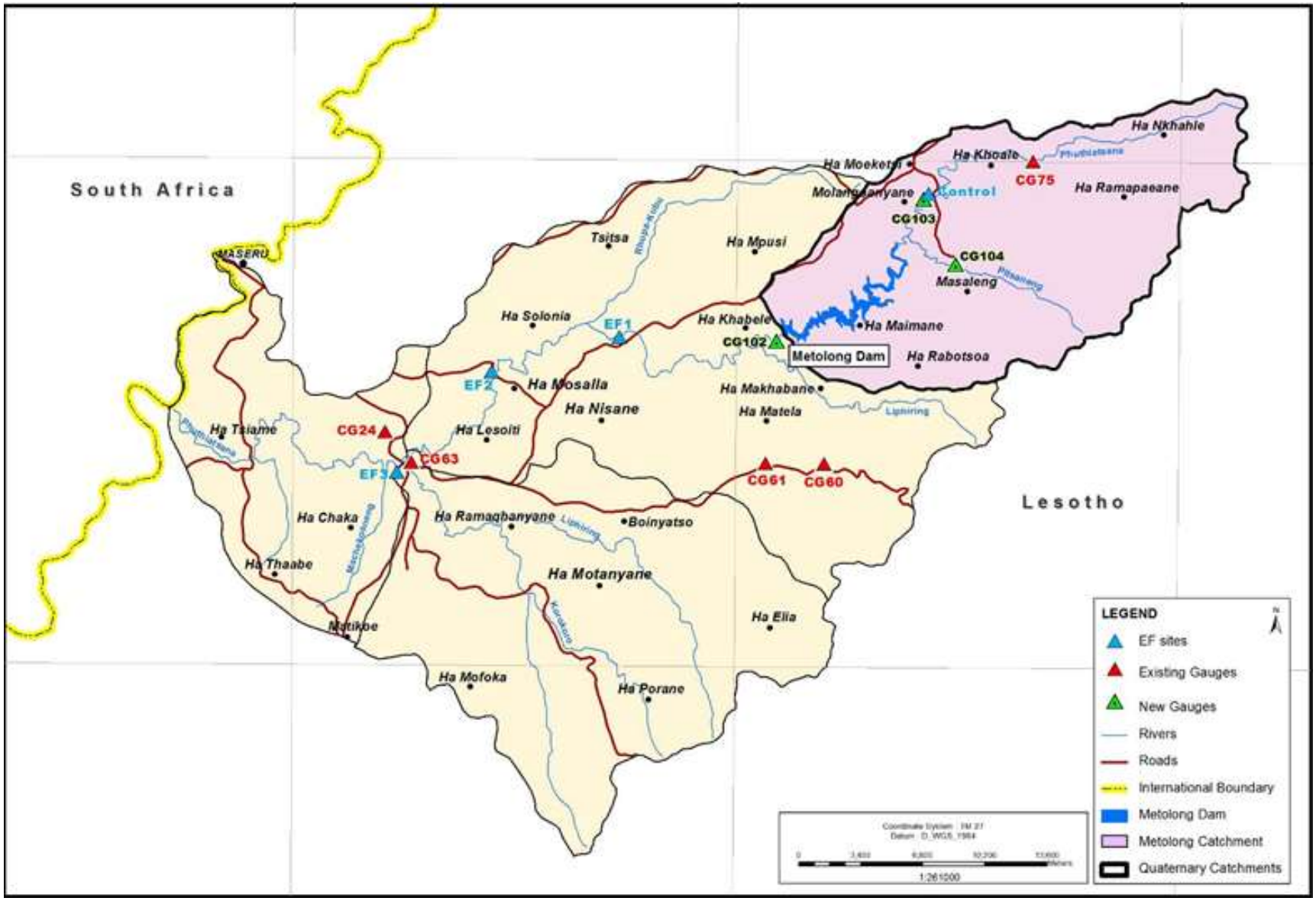


- No sediment, no condition
- Just flow retrospectively
- Self-regulated

Metolong Dam EFlows system

- A monitoring system for the Phuthiatsana River in Lesotho to monitor EWRs and river condition d/s of the Metolong Dam
- Monitoring undertaken jointly by the Commissioner of Water and Department of Water Affairs
  - » Unpublished consultancy report: Metolong Authority 2016. Metolong Dam and Water Supply Programme (MDWSP). Project: Preparation of Ecological Flow Policy and Biophysical Monitoring System. Report 7: Environmental Flow Monitoring Annual report (2015).

Study area - Lesotho

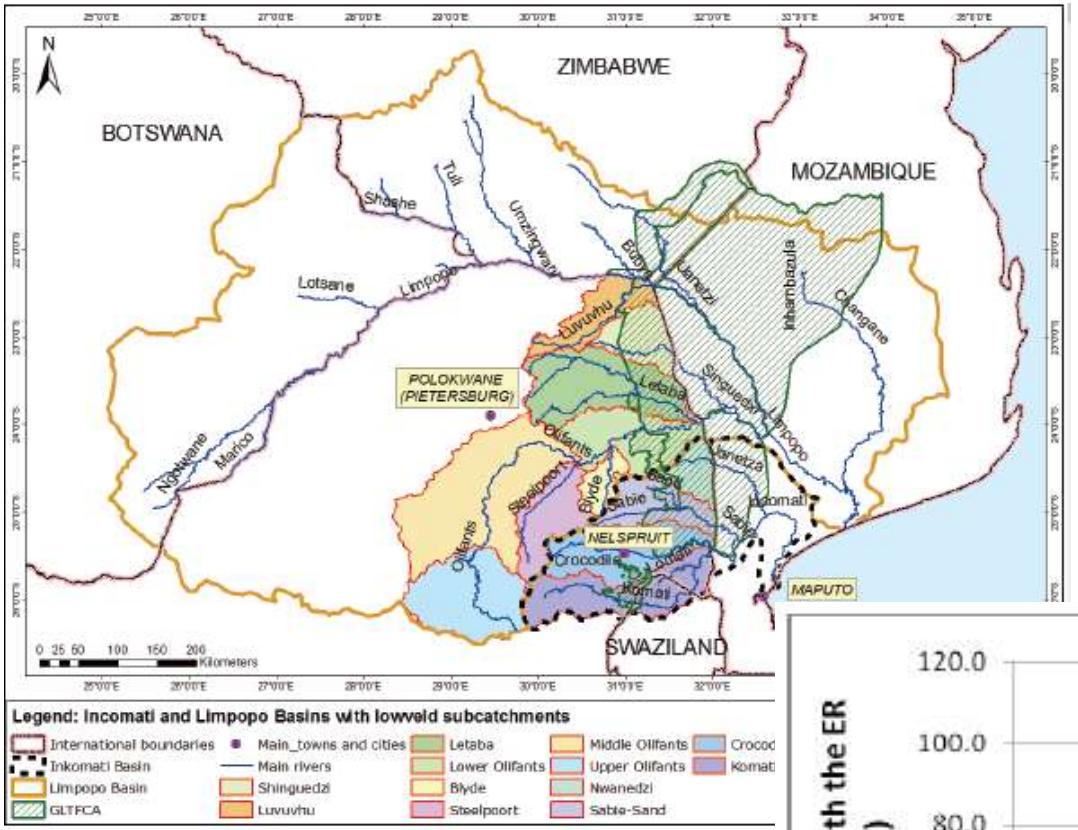


Results – targets being achieved

Phase	Discipline	EF Control		EF Site 1		EF Site 2		EF Site 3		D/S EF Site average	
Baseline	Hydrology	B	2	C	3	C	3	C	3		
	Water Quality	C	3.1	C/D	3.6	C/D	3.7	C/D	3.7		
	Geomorphology	C	3	D	4	A	1	D	4		
	Inverts	C	3	C	3	C	3	C	3		
	Fish	D	4	D	4	D	4	EF	5		
	Overall	C	**3.0**	C/D	**3.5**	C	**2.9**	C/D	**3.7**	**3.4**	C/D
2014	Hydrology	B	2	C	3	C	3	C	3		
	Water Quality	C	2.9	B/C	2.7	C	2.9	C	2.9		
	Geomorphology	C	3	D	4	C	3	D	4		
	Inverts	EF	5	D/E	4.5	D	4	D/E	4.5		
	Fish	C	3	D	4	EF	5	D	4		
	Overall	C	**3.2**	C/D	**3.6**	C/D	**3.6**	C/D	**3.7**	**3.6**	C/D
2015	Hydrology	B	2	C/D	3.5	C/D	3.5	C/D	3.5		
	Water Quality	B/C	2.6	B/C	2.6	C	2.9	C	3		
	Geomorphology	D	4	C	3	A	1.2	D	4		
	Inverts	D	4	D	4	D	4	D/E	4.5		
	Fish	EF	5	C	3	B	2	D	4		
	Overall	D	**3.5**	C	**3.2**	B/C	**2.7**	D	**3.8**	**3.2**	C

Inkomati WMA EFlows system

- Olifants River ceased flowing in 2005
- Initiated review of Lowveld rivers thought to be degrading despite legal protection
- All part of transboundary international systems
  - » WRC report: Pollard & Du Toit 2011. The shared river initiative phase I: Towards the sustainability of freshwater systems in South Africa: An exploration of factors that enable or constrain meeting the Ecological Reserve within the context of Integrated Water Resources Management in the catchments of the lowveld



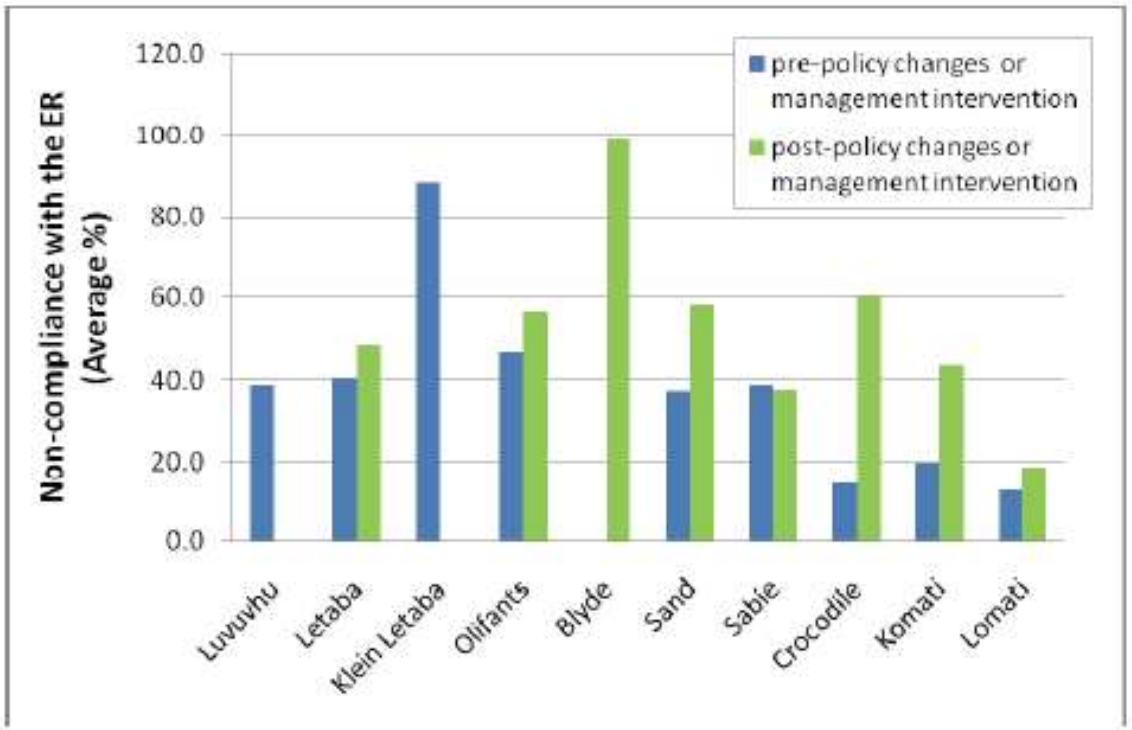


Figure 10.1: A comparison of non-compliance with the Ecological Reserve before and after policy changes or management intervention

Main issues

- Each basin had its own story
- Almost total lack of integration between role players
- Lack of leadership, no clear roles, no regulation, no consequences
- Different sectors see the same WMA with different priorities, leading to no direction and a lack of action
- Intense stakeholder process to learn, share, gain trust and self-regulate together

Pilot study – Crocodile River

- Near-real-time water resources operational system for the Crocodile River (monthly time step)
- The DSS optimise water needs (water allocations, irrigation requirements, flow requirements) with real time data (rainfall, river flow, water use, reservoir levels)
- Results advise on when restriction need to be imposed and to what degree to all managers and stakeholders
- Outputs delivered via sms, email and internet

Possible components of EFlows IS

- The EFlows Management Plan, which could include:
  - summary of the details of the basin, the EFlows team, EFlows Assessment method, dates, funder, etc.
  - record of decision, and chosen EFlows outputs
  - programme for monitoring compliance with, and efficacy of, chosen EFlows models/outputs?
  - a framework for implementation, including organizational capacity and competency requirements and institutional arrangements
  - reporting, record keeping and auditing/quality control arrangements
  - provisions for adaptive management
  - funding arrangements
- Licensing and other use data
- Monitoring data on whether a designated EFlows is being achieved and its efficacy in maintaining the desired ecological condition
- Detailed research on one or more aspects of the aquatic ecosystems and their response to water quality and/or the flow of water, sediment and biota
- Updated data sets for hydrology, water quality or sediment
- Updates to the EFlows model based on monitoring /research data
- Decision-support systems for planning and management

Take home messages

- Need observed flows and can install loggers
- Need good baseline data, equipment and trained teams for monitoring
- Need an experimental design with hypotheses
- Collaborate to share the load
- Let all users take ownership of their water

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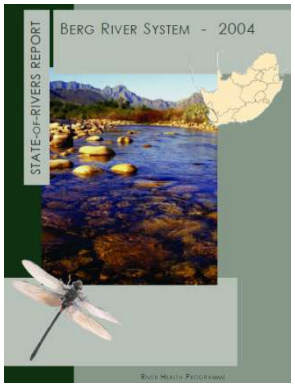
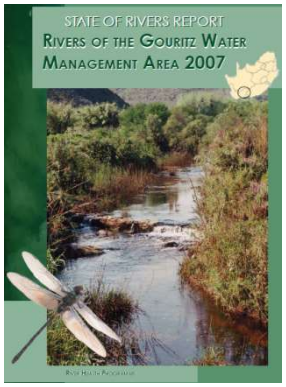
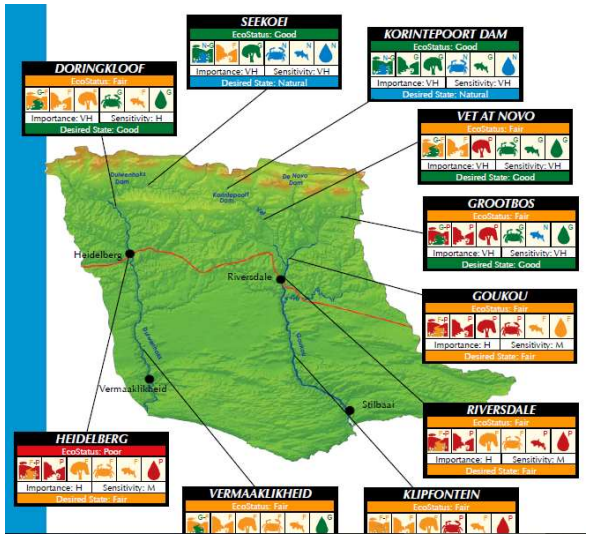
Some data outputs







Major Impacts & Management Actions

Flow modification through over-abstraction threatens the ecological functioning of the rivers. Extensive water abstraction and many off-stream dams for irrigated agriculture have had a cumulative effect on flow, particularly in summer when the rivers almost cease to flow. In addition, two major dams (Duiwenhoks River and Korintepoort) prevent smaller floods from reaching the estuary. Black wattle infestation also reduces flow and water availability.

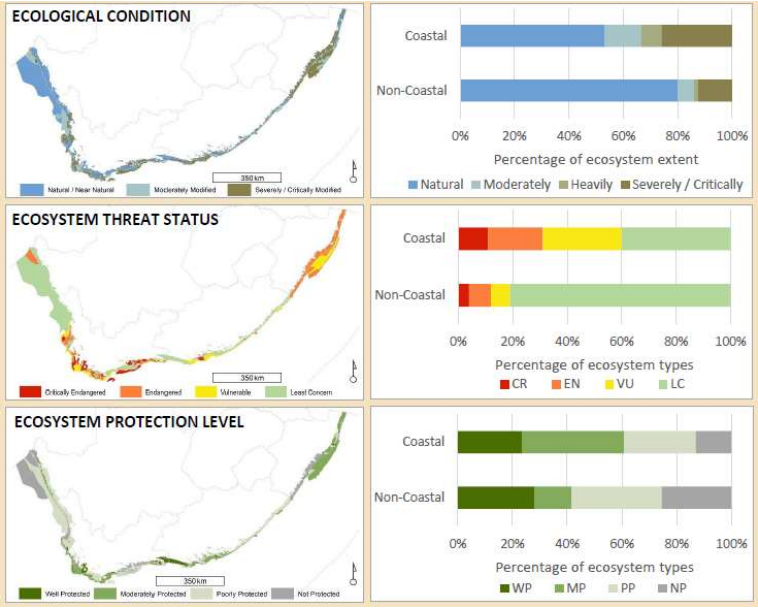
Poor ***agricultural practices*** (draining of wetlands) have impacted on wetlands, reducing their ability to act as sponges, attenuating floods and ensuring perennial flows. As a result, rivers remain dry for longer periods and flood damage is more extensive.

The riparian zones in the middle and lower reaches of the Goukou and Duiwenhoks rivers, tributaries and wetlands are highly impacted by ***invasive alien plants*** (black wattle). This reduces the ability of these zones to act as buffers, reduces habitat availability for aquatic biota and causes deep incising of river channels.

Invasive alien fish in the middle and lower Goukou (largemouth bass, bluegill sunfish) and Duiwenhoks (banded tilapia, mosquitofish) rivers have reduced populations of indigenous Cape kurper, Cape galaxias and Burchell's redfin minnow.

Management Actions

- **Control water abstraction**
- **Encourage efficient water use throughout the catchment**
- **Discourage developments within wetlands**
- **Investigate the possibility of releasing environmental flows from the Korintepoort and Duiwenhoks River dams**
- **Remove alien vegetation from the riparian zone and wetland areas, and rehabilitate cleared areas with indigenous plants**
- **Eradicate alien fish from rivers, where possible**
- **Stock farm dams with indigenous fish**
- **Discourage bulldozing and riverbed modifications**



Gazetted flows

Annual Flows (Mill. cu. m or index values):

MAR = 41.939
S.Dev. = 22.220
CV = 0.530
Q75 = 0.216
Q75/MMF = 0.062
BFI Index = 0.275
CV(JJA+JFM) Index = 3.840

Ecological Category = C

Total IFR = 8.168 (19.48 %MAR)
Maint. Lowflow = 3.459 (8.25 %MAR)
Drought Lowflow = 1.004 (2.39 %MAR)
Maint. Highflow = 4.709 (11.23 %MAR)

Monthly Distributions (Mill. cu. m.)
Distribution Type : W.Cape(dry)

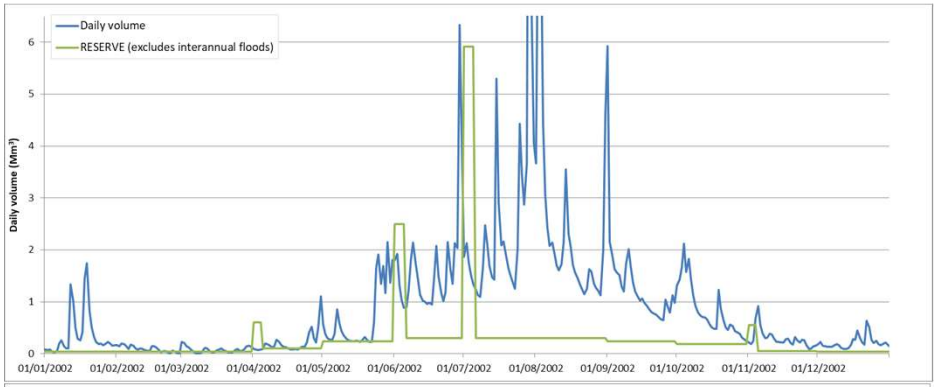
Month	Natural Flows			Modified Flows (IFR)			
				Low flows		High Flows	Total Flows
	Mean	SD	CV	Maint.	Drought	Maint.	Maint.
Oct	3.123	1.900	0.609	0.411	0.162	0.324	0.735
Nov	1.752	2.005	1.144	0.317	0.125	0.107	0.424
Dec	0.694	1.105	1.591	0.155	0.062	0.000	0.155
Jan	0.391	1.596	4.076	0.074	0.021	0.000	0.074
Feb	0.356	0.994	2.797	0.049	0.000	0.000	0.049
Mar	0.378	0.766	2.025	0.041	0.000	0.000	0.041
Apr	1.306	2.446	1.873	0.088	0.000	0.000	0.088
May	4.066	5.215	1.282	0.236	0.010	0.610	0.846
Jun	8.022	8.008	0.998	0.464	0.062	1.200	1.664
Jul	8.760	7.732	0.883	0.558	0.144	1.599	2.157
Aug	7.790	5.772	0.741	0.569	0.223	0.290	0.859
Sep	5.303	3.132	0.591	0.495	0.195	0.579	1.075

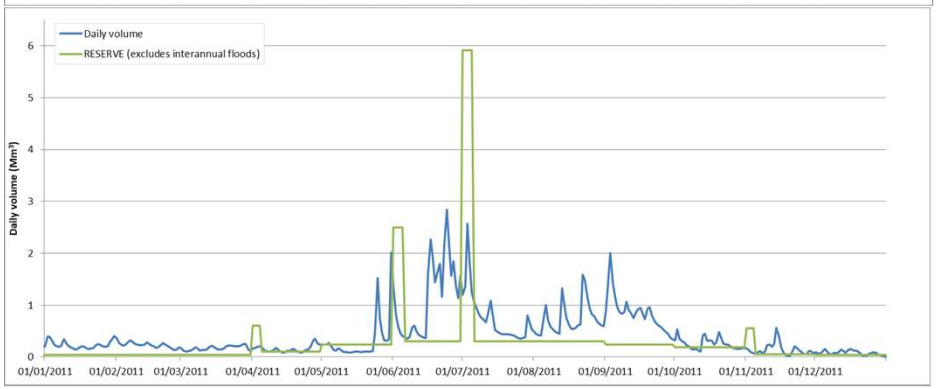
Flow Duration Curves (FDC)

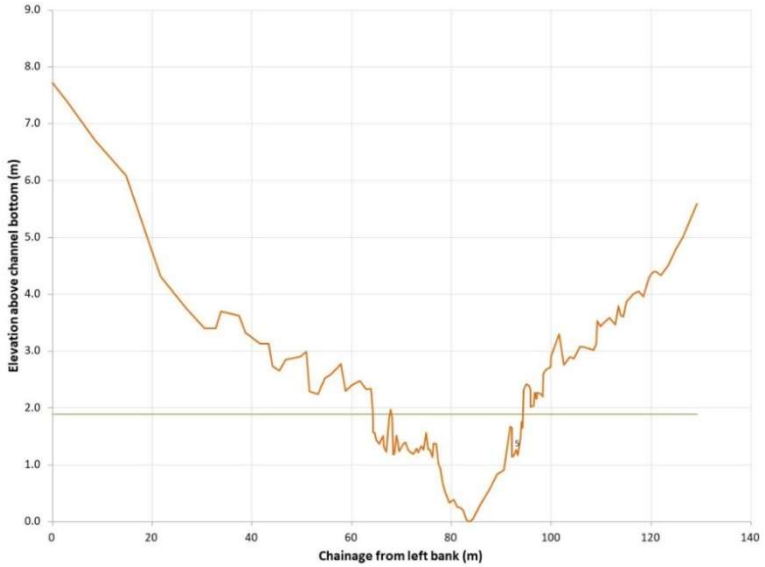
Month	% Points									
	10%	20%	30%	40%	50%	60%	70%	80%	90%	99%
Oct	0.367	0.363	0.354	0.334	0.297	0.242	0.177	0.118	0.083	0.074
Nov	0.223	0.220	0.213	0.196	0.168	0.131	0.093	0.067	0.055	0.053
Dec	0.082	0.081	0.078	0.073	0.063	0.049	0.036	0.028	0.024	0.024
Jan	0.039	0.038	0.036	0.032	0.026	0.018	0.012	0.009	0.008	0.008
Feb	0.028	0.028	0.027	0.024	0.019	0.013	0.006	0.002	0.000	0.000
Mar	0.022	0.021	0.020	0.018	0.015	0.010	0.005	0.002	0.000	0.000
Apr	0.049	0.048	0.046	0.043	0.037	0.028	0.017	0.008	0.002	0.000
May	0.406	0.403	0.394	0.377	0.344	0.290	0.214	0.129	0.058	0.008
Jun	0.826	0.819	0.803	0.769	0.706	0.602	0.455	0.286	0.142	0.044
Jul	1.471	1.314	1.180	1.060	0.943	0.749	0.631	0.466	0.275	0.138
Aug	0.536	0.498	0.464	0.428	0.365	0.321	0.258	0.186	0.125	0.096
Sep	0.746	0.670	0.605	0.544	0.434	0.377	0.296	0.205	0.130	0.100

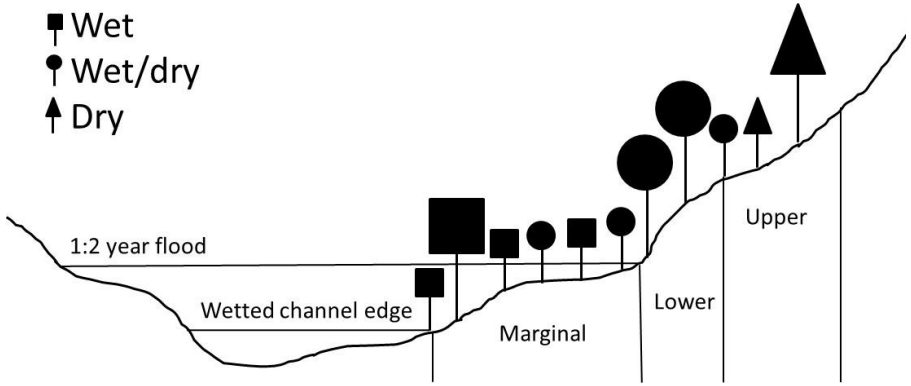
Wettest year (exceeded only 10% of the time) — Average year — Dryest year (exceeded > 99% of the time)

Monitoring programme

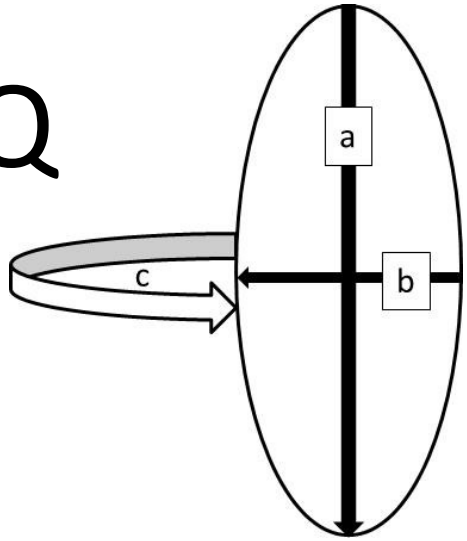








WQ



Current position

- The Classification draws a baseline
- The RQOs provide objectives for monitoring
- This means once the assessments are done the real work begins
- Need big databases and people to run them
- Are training courses for the various components, lots of data being gathered by different people with little coordination, sharing
- Implementing RQOs is a work in progress
- Is going to be about collaboration, data sharing and self-regulation