DETERMINATION OF WATER RESOURCE CLASSES, RESERVE AND RQOS IN THE LIMPOPO (A5-A9) CATCHMENTS & OLIFANTS (B9) CATCHMENT

SECTOR MEETINGS

Presented by: Gwyn Letley, Toriso Tlou, Karl Reinecke, Nico Rossouw
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WATER IS LIFE - SANITATION IS DIGNITY

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

2030 NDP

30 YEARS OF FREEDOM
South Africa 1994 - 2024

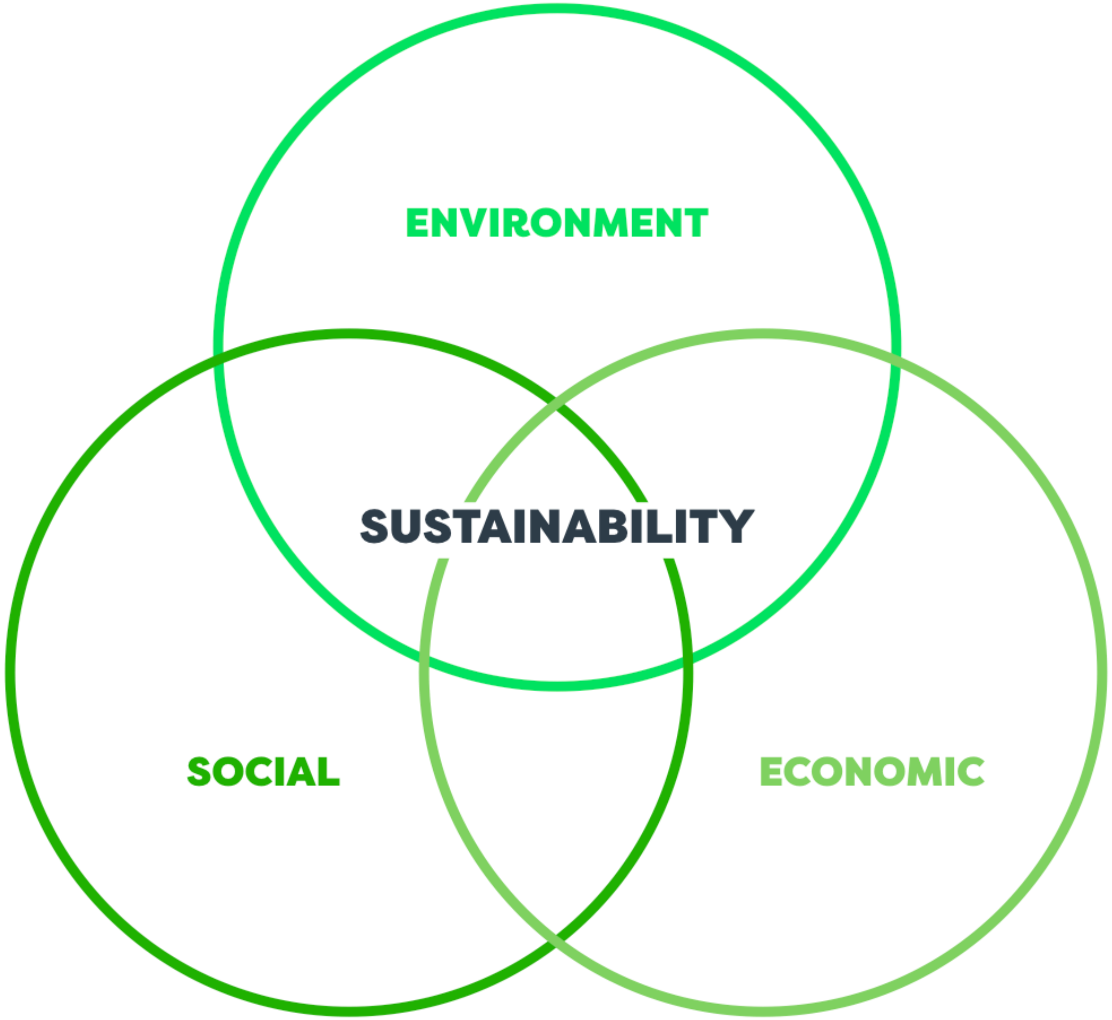
OUTLINE

1. Overview of scenarios and the evaluation process (G Letley)
2. Key comments and concerns raised by stakeholders (G Letley)
3. Water resource availability, potential water resource development & management options (T Tlou)
4. Reality checking (K Reinecke)
5. Integration of water quality (N Rossouw)
6. Biodiversity, ecosystem services, society and economy (G Letley)
7. Overall analysis, recommended water resource classes (G Letley)

INTRODUCTION & OVERVIEW OF SCENARIO ANALYSIS APPROACH

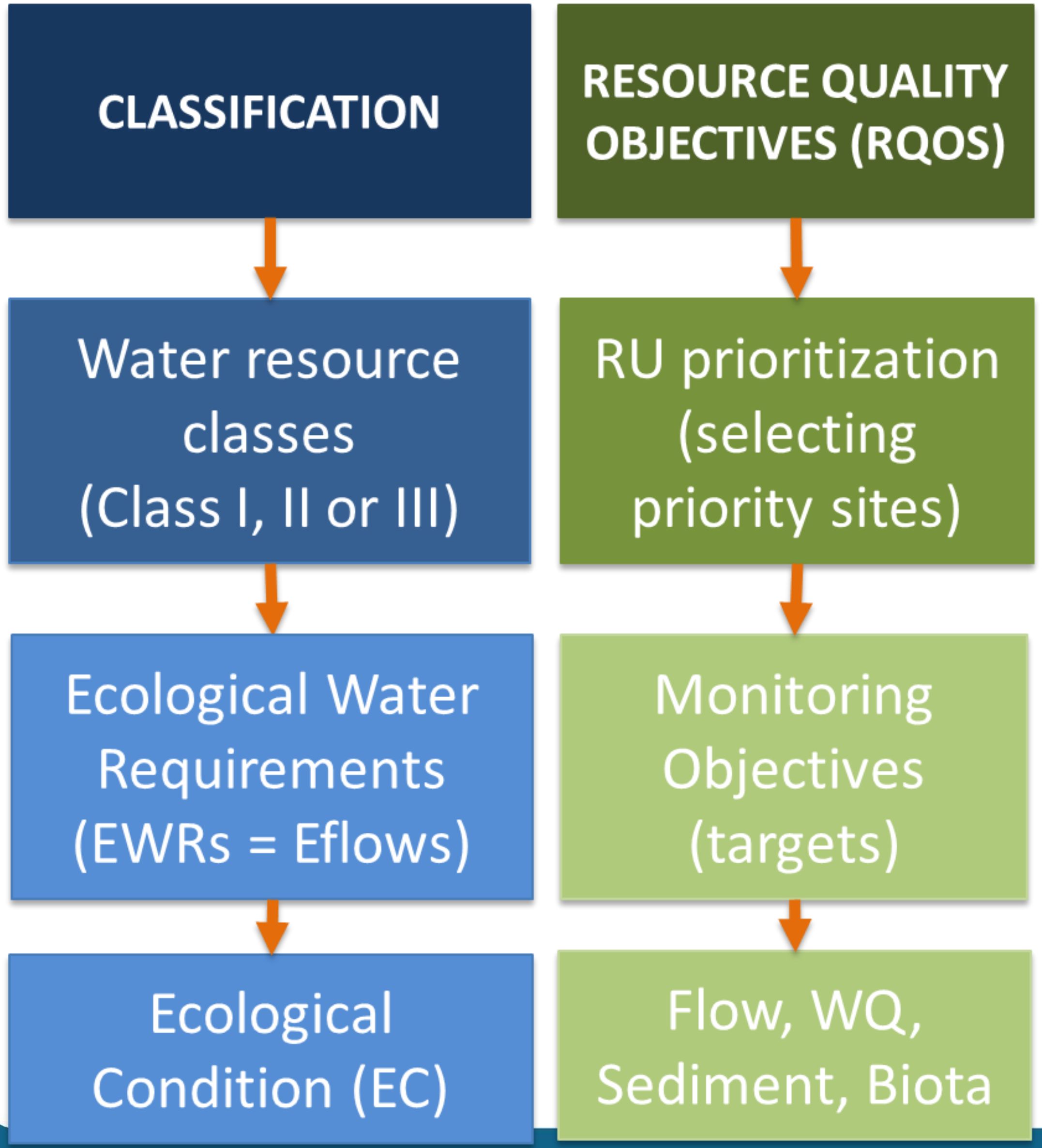
CLASSIFICATION

- Determines the ‘ecological Reserve’
  - aquatic and groundwater-dependent ecosystems.
- Involves choices which have economic and social implications
- Classification Process is to evaluate the trade-offs involved
- Decisions based on Economic, Social and Biodiversity criteria
  - not just biodiversity considerations.

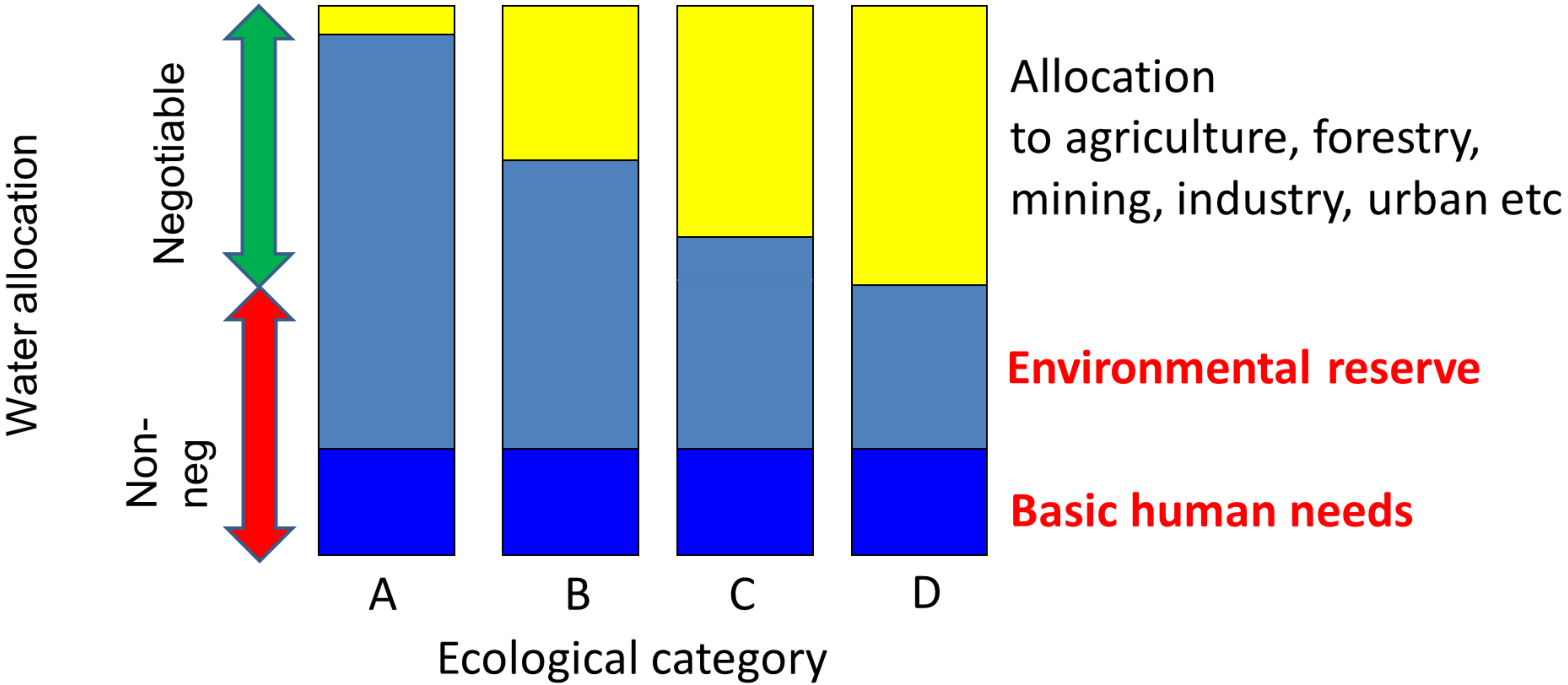


OUTCOMES FROM CLASSIFICATION PROCESS

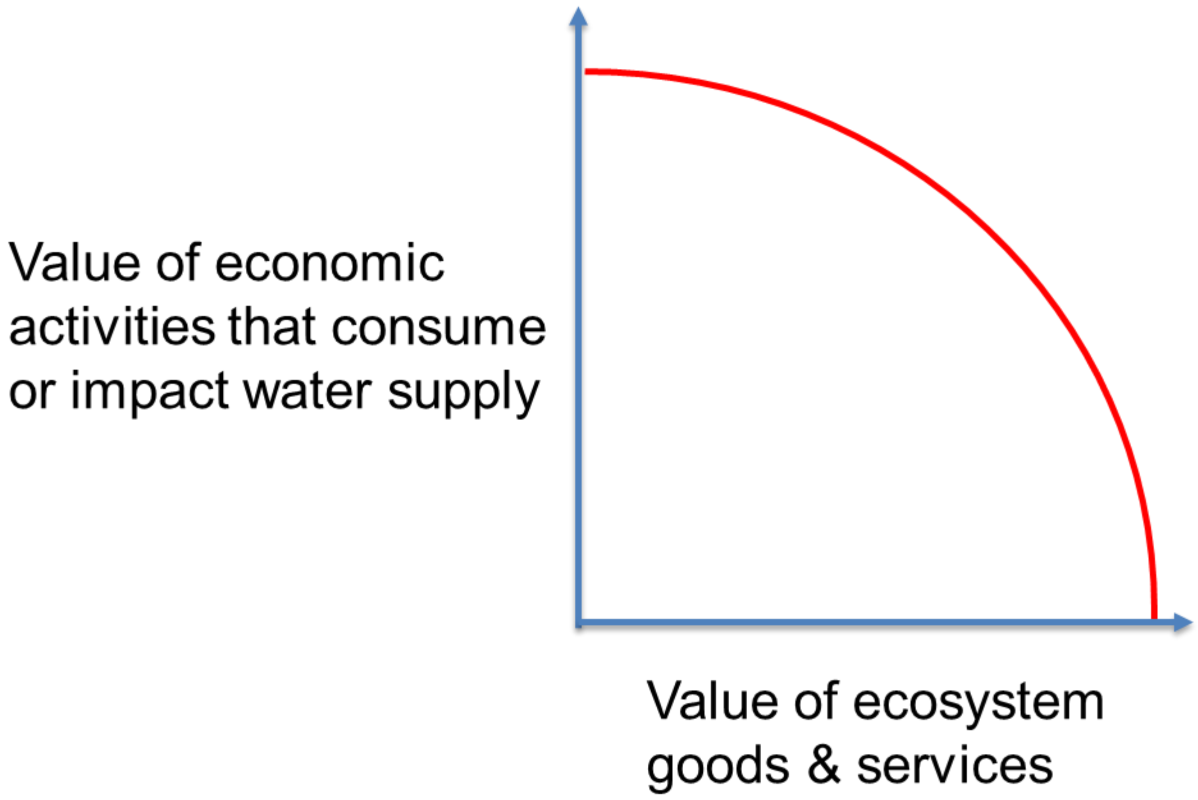
- Classification does not propose or oppose development
- It considers water use in various ways and models potential future outcomes
- The outcomes of classification are <u>water resource classes</u>
- The outcomes of RQOs are <u>monitoring objectives</u>
- Not a tool to prevent development or other environmental authorisations

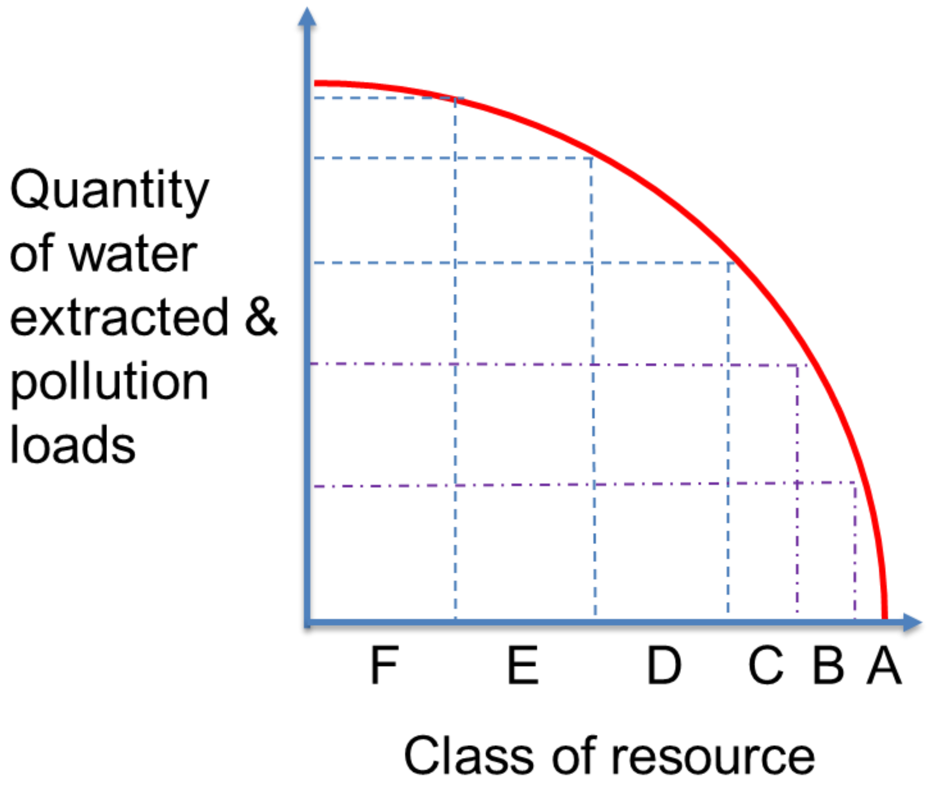


WHAT IS NEGOTIABLE

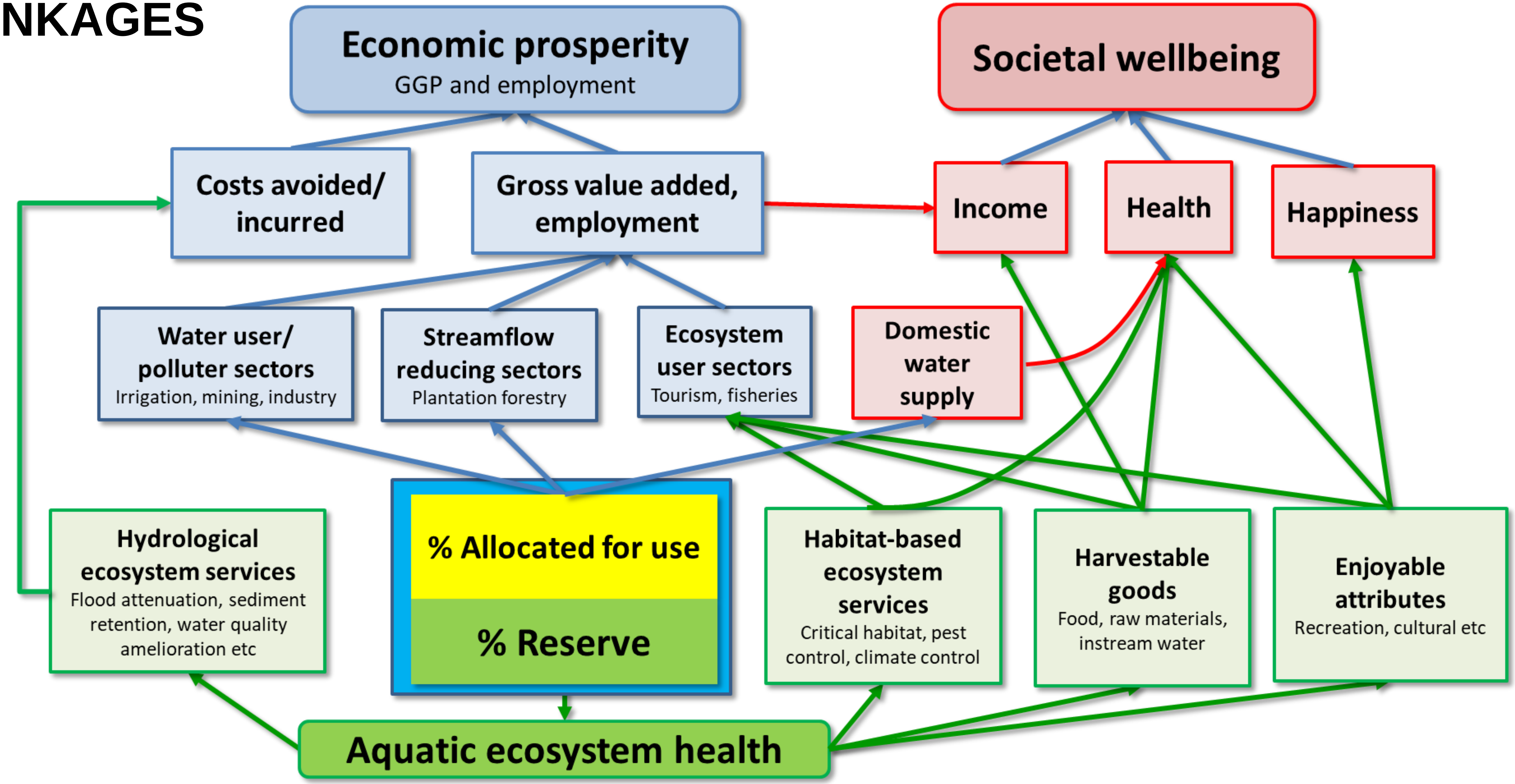


TRADE-OFFS INHERENT IN CLASSIFICATION





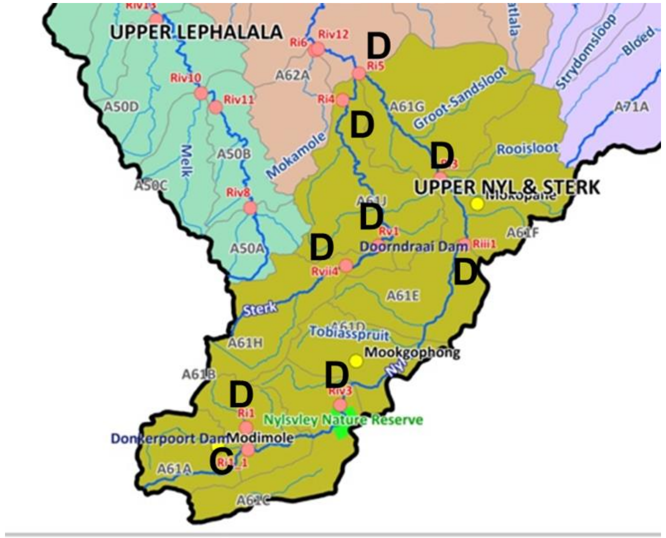
LINKAGES

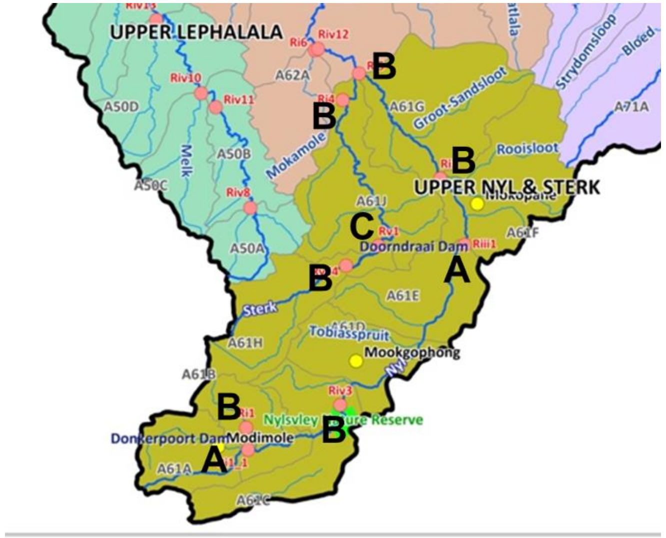


Economic prosperity
GGP and employment
Societal wellbeing
Costs avoided/ incurred
Gross value added, employment
Income
Health
Happiness
Water user/ polluter sectors
Irrigation, mining, industry
Streamflow reducing sectors
Plantation forestry
Ecosystem user sectors
Tourism, fisheries
Domestic water supply
Hydrological ecosystem services
Flood attenuation, sediment retention, water quality amelioration etc
% Allocated for use
% Reserve
Habitat-based ecosystem services
Critical habitat, pest control, climate control
Harvestable goods
Food, raw materials, instream water
Enjoyable attributes
Recreation, cultural etc
Aquatic ecosystem health

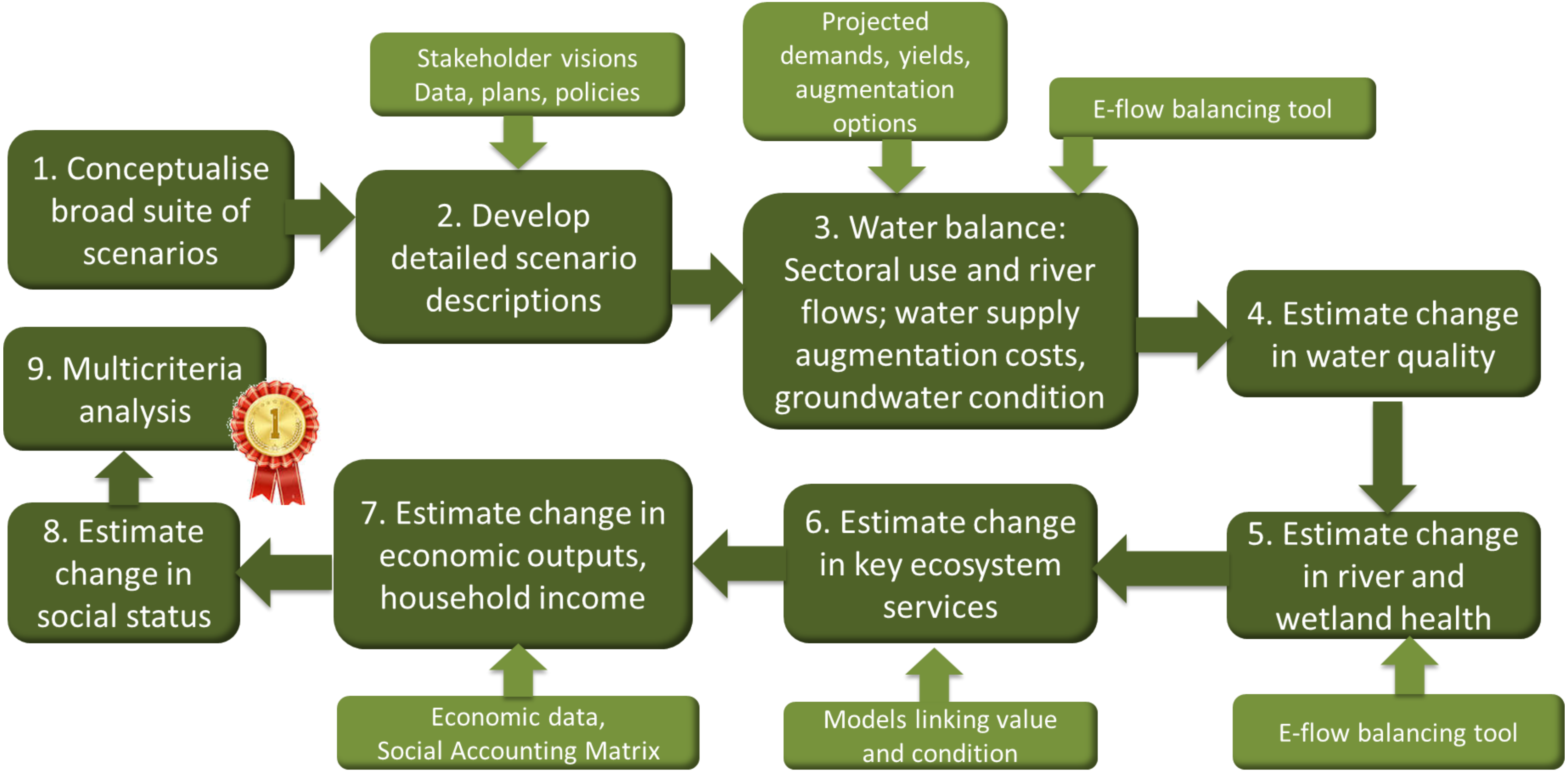
SCENARIO ANALYSIS

- Pragmatic way to reach a decision on allocation
- Less computationally complex than mathematical maximisation / optimization
- But still a multiscale, multidimensional, dynamic (time-dependent) problem
- Can be compared using
  - Cost-benefit Analysis or
  - Multi-Criteria Analysis





SCENARIO EVALUATION PROCESS



SCENARIOS

#	Scenario	Abbreviation	Description
1	**Maintain Present Ecological Status**	PES	Rivers and wetlands maintained in most recently assessed condition.
2	**Ecological Bottom Line**	ESBC	All water resources maintained in D class (i.e. the “ecological bottom line”), maximising volume available for economic activities. i.e. a “constrained” development scenario.
3	**Biodiversity Economy**	BE	Rivers maintained in best attainable state (BAS) to facilitate sustainable biodiversity economy founded on a strong conservation outcome.
4	**Unconstrained Development**	DEV	Water demands for all future planned or potential developments are met as far as possible without any limit on ecological condition (i.e. can have worse than a D category).
5	**Spatially-targeted Conservation and Development**	STCD	Areas of high conservation value are protected by meeting RECs (including at LIMCOM sites), while other areas (not high ecological priority) allow sustainable use of water, within the constraint of min D category.

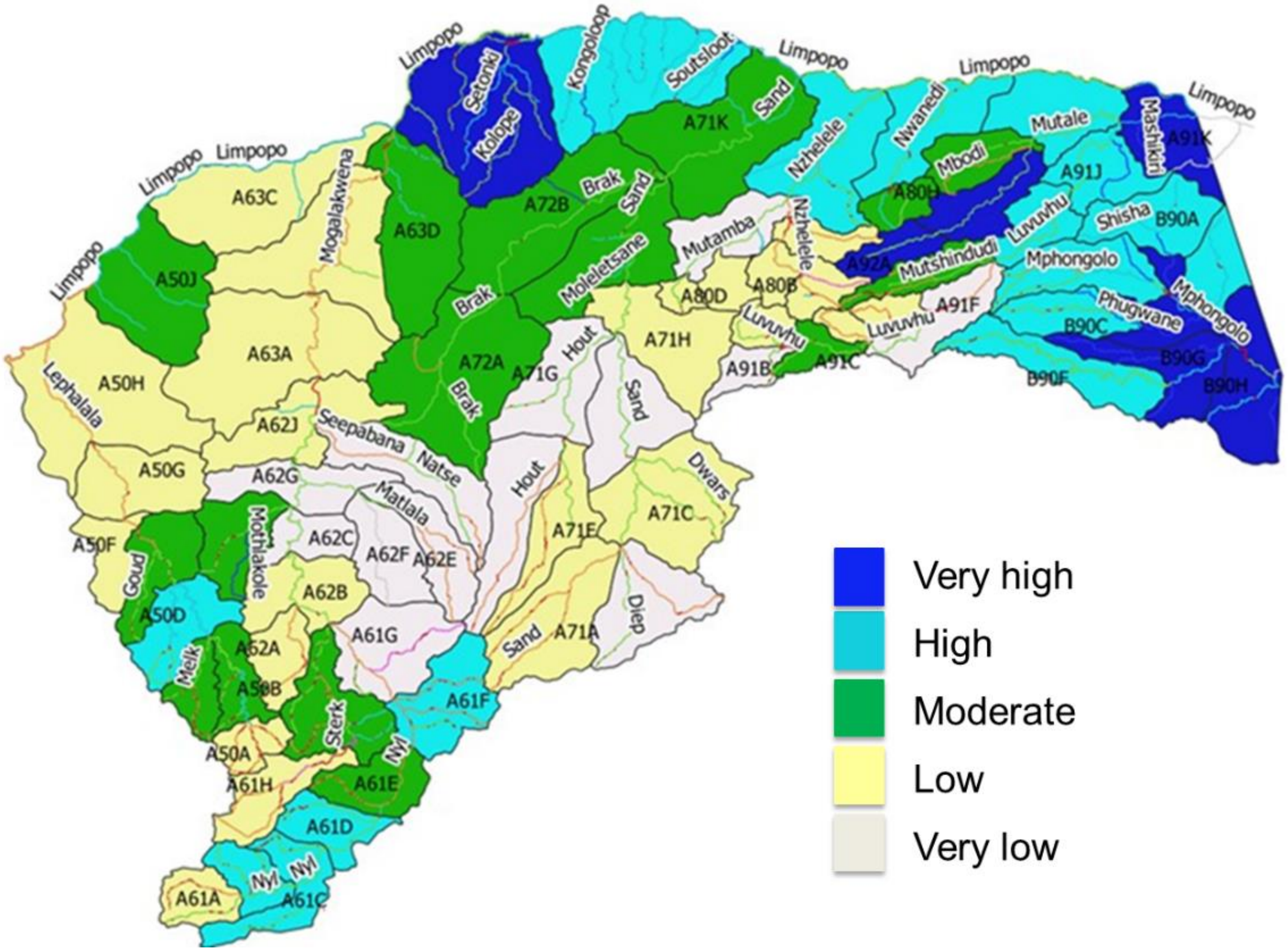
ECOLOGICAL IMPORTANCE

- Each quat was scored in terms of a range of criteria
  - Protected areas, CBAs, ESAs, SWSAs
  - River and wetland ecological importance
  - Fish sanctuaries, fish support areas, FEPAs
- Scores were normalised and then a weighted average calculated

Category	Weight	Relative weights
Protected areas	2.6	0.19
Critical Biodiversity Areas 1	1.0	0.07
Critical Biodiversity Areas 2	0.5	0.04
Ecological Support Areas 1	0.3	0.02
Ecological Support Areas 2	0.3	0.02
High priority wetlands	1.25	0.09
Surface Water Source Areas – groundwater	0.5	0.04
Surface Water Source Areas – surface water	0.5	0.04
Fish sanctuaries 1 (vulnerable/ near threatened)	0.4	0.03
Fish sanctuaries 2 (critically endangered)	1.0	0.07
Present Ecological Status A	0.8	0.06
Present Ecological Status B	0.5	0.04
Ecological Importance High	1.0	0.14
Ecological Importance Very High	0.7	0.05
Freshwater Ecosystem Priority Area	0.7	0.05
Fish Support Area	0.5	0.04
Phase 2 FEPA	0.3	0.02
Upstream Management Area	0.2	0.01
Sum	14.1	1

ECOLOGICAL IMPORTANCE

- High scoring areas consolidated into conservation areas

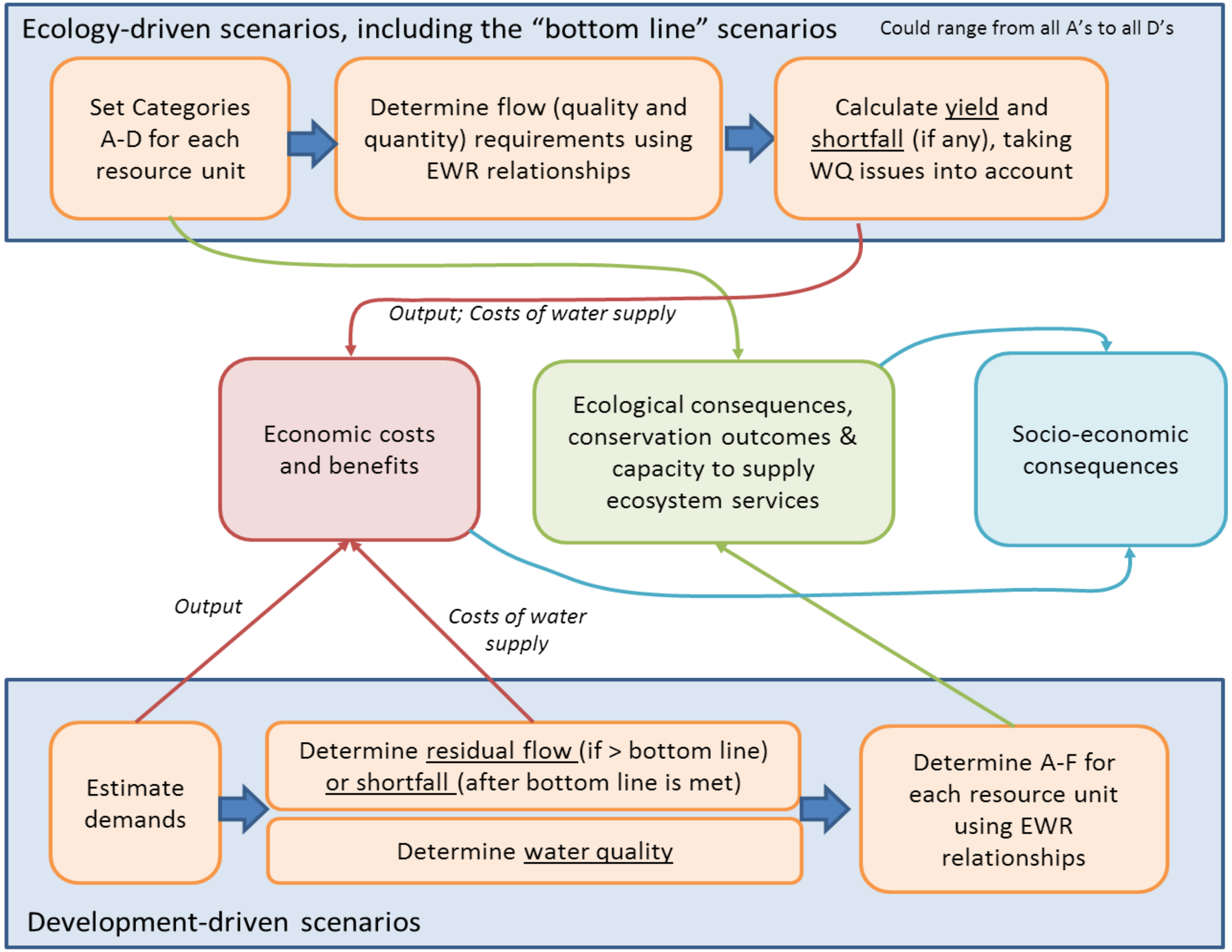


THE STCD SCENARIO

- Conservation areas used to select quats for improving flows and ECs where possible & for limiting water intensive/ polluting development in these areas
  - Increased flows in catchments upstream of EWR sites to meet RECs
  - Increased flows in high and very high priority catchments (where possible)
  - Reduced development by 50% (compared to DEV scenario)
  - No room for providing water for further development activities.

ECOLOGICAL VS DEVELOPMENT DRIVEN SCENARIOS

	Scenario	Ecological categories
1	Maintain Present Ecological Status	PES
2	Ecological bottom line	All D's
3	Biodiversity Economy	All best attainable state
4	Unconstrained Development	Determined residually (no constraint)
5	Spatially-targeted Conservation and Development	Some areas BAS, other areas D's



KEY COMMENTS RECEIVED FROM STAKEHOLDERS

KEY STAKEHOLDER COMMENTS

- Clearer representation of water resource availability and water balances for the study area.
- Potential future development and future water requirements, management options included in the scenario evaluation
- Better integration of WQ into evaluation process
- Assumptions regarding nature-based tourism
- Consideration of uncertainty / risk
- Inclusion of sense of place and downstream impacts

WATER RESOURCE AVAILABILITY, POTENTIAL WATER RESOURCE DEVELOPMENT & MANAGEMENT OPTIONS

CURRENT WATER USE / REQUIREMENTS PER IUA

- Baseline for assessment of the water balance between existing water resources/ transfers with the current water use
  - Base date for current water use / requirements
  - Based on data/information from official DWS reports – Recon strategy
  - For some LM – annual reports used to determine water use
- For each IUA
  - Water use sectors were identified
  - Current water requirements as of 2020 were determined from existing records and reports
  - Authorised water use entitlements determined for the irrigation sector in particular

FUTURE WATER REQUIREMENTS PER IUA

- Some assumptions were made in the future development
  - Base date for future developments – 2050 but undertaken per annual projections
  - Irrigation agriculture – allocated in m3/ha/annum would not increase. However where the allocation is not being fully utilised – this was allowed to increase to its authorised water use entitlement
  - Growth in population and improvements in LoS provision factored for the domestic sector – key drivers of future requirements
  - Industries – the future water requirements of the MMSEZ (Mutale & Makhado) were included
    - Timing of development of these industries not known – assumed that by 2050 MMSEZ would be fully developed
    - Link between MMSEZ and coal mining development – Sand / Nzhelele was factored in the assessment of the future development options

COMPARISON BETWEEN CURRENT (2020) DEVELOPMENT TO FUTURE DEVELOPMENTS

IUA	Total		Domestic		Mining and industry		Irrigation agriculture		Livestock	
	Present (2020)	Development (2050)	Present (2020)	Development (2050)	Present (2020)	Development (2050)	Present (2020)	Development (2050)	Present (2020)	Development (2050)
Upper Lephalala	33.82	36.12	2.82	4.34			28.61	29.33	2.39	2.45
Lower Lephalala	17.40	21.46	3.10	6.79			14.30	14.66		
Upper Nyl & Sterk	25.87	43.79	10.26	22.41	10.64	16.28	4.97	5.09		
Mogalakwena	62.82	66.20	3.34	5.22			55.98	57.39	3.50	3.59
Upper Sand	58.98	129.09	40.99	89.35	5.10	23.65	12.89	16.09		
Lower Sand	125.92	230.24	7.51	18.45	4.50	95.00	113.91	116.79		
Nzhelele/Ṅwanedi	42.93	54.53	8.02	14.44	0.50	2.04	34.41	38.06		
Upper Luvuvhu	83.39	129.76	41.63	83.57			41.76	46.19		
Lower Luvuvhu/Mutale	7.45	8.48	0.62	0.93			6.83	7.55		
Shingwedzi	11.70	19.70	7.50	15.06			4.20	4.65		
Total	**470.27**	**739.37**	**125.79**	**260.56**	**20.74**	**136.97**	**317.85**	**335.80**	**5.89**	**6.04**
		1.52%		**2.46%**		**6.49%**		**0.18%**		**0.08%**

EXISTING WATER RESOURCE AVAILABILITY

- Water Resource Availability Studies
  - Used to determine the available resources in each IUA
  - Determined the yield of each resource
- Water Resource available per IUA
  - For each IUA the surface water dams, farm dams, groundwater, return flows were determined
  - Mogalakwena & Sand Catchment
    - Dependent on transfers from neighbouring catchments
    - Identified and current transfers / allocations included in water resource assessment

WATER RESOURCE AVAILABILITY

IUA	Dam	Historical Firm Yield (million m3/a)	1:50 Yield of the Dam (1920-2020)	Integrated Yield
Upper Lephalala	Farm Dams	31.98	-	-
	Run of River Abstractions	1.35	-	-
	Groundwater Abstraciton	1.07	-	-
	Total available resource	**34.40**	**-**	**-**
Lower Lephalala	Farm Dams	14.50	-	-
	Run of River Abstractions	0.95	-	-
	Groundwater Abstraciton	2.02	-	-
	Total available resource	**17.47**	**-**	**-**
Upper Nyl & Sterk	Farm Dams	-	-	-
	Donkerpoort Dam	3.65	-	-
	Doorndraai Dam	9.64	-	-
	Water Transfer - Roodeplaat dam	9.96	-	-
	Groundwater	1.35	-	-
	Mogalakwena Transfer	8.90	-	-
	System yield from integration			
	Total available resource	**33.51**	**-**	**-**
Mogalakwena	Farm Dams	-	-	-
	Glen Alpine Dam	7.09	-	-
	Groundwater - Irrigation	50.00	-	-
	Groundwater - Domestic	5.60	-	-
	Total available resource	**62.69**	**-**	**-**

POTENTIAL WATER RESOURCE DEVELOPMENT & MANAGEMENT OPTIONS

IUA	Dam	Historical Firm Yield (million m3/a)	1:50 Yield of the Dam (1920-2020)	Integrated Yield
Upper Sand	Seshego Dam	0.58	-	-
	Ebenezer Transfer	17.03	-	-
	Dap Naude Transfer	6.57	-	-
	Olifantspoort Transfer	19.50	-	-
	Groundwater	2.45	-	-
	Houtriver Dam	1.42	-	-
	Molepo Dam	2.19	-	-
	Groundwater - Irrigation	15.00	-	-
	Total available resource	**64.74**	**-**	**-**
Lower Sand	Limpopo River Alluvial Aquifer	7.50	-	-
	Albasini Dam	4.91	-	-
	Groundwater - Sinthumile	5.00	-	-
	Nandoni Bulk Pipeline	10.00	-	-
	Groundwater - Rural communities	2.45	-	-
	-	-	-	-
	Return Flows - Polokwane	26.50	-	-
	Groundwater - Irrigation	85.00	-	-
	Total available resource	**141.36**	**-**	**-**
Nzhelele / Nwanedi	Nzhelele Dam	23.92	-	-
	Cross Dam	3.50	-	-
	Luphephe Dam	9.17	-	-
	Nwanedi Dam	1.62	-	-
	Musthedzi Dam	2.69	-	-
	Total available resource	**40.90**	**-**	**-**

POTENTIAL WATER RESOURCE DEVELOPMENT & MANAGEMENT OPTIONS

IUA	Dam	Historical Firm Yield (million m3/a)	1:50 Yield of the Dam (1920-2020)	Integrated Yield
Upper Luvhuvhu	Nandoni Dam	70.00	-	-
	Vondo Dam	21.90	-	-
	Mukumbani Dam	-	-	-
	Damani Dam	5.30	-	-
	Mambedi Dam	-	-	-
	Albasini Dam	3.90	-	-
	-	-	-	-
	Groundwater - Irrigation	-	-	-
	Total available resource	**101.10**	**-**	**-**
Lower Luvhuvhu / Mutale	Nandoni Dam	6.50	-	-
	Lake Fundudzi	-	-	-
	-	-	-	-
	Groundater - Domestic	1.50	-	-
	Total available resource	**8.00**	**-**	**-**
Shingwedzi	Makuleke Dam	6.50	-	-
	Nandoni Dam	2.50	-	-
	Vondo Dam	-	-	-
	Groundater - Domestic	2.50	-	-
	Total available resource	**11.50**	**-**	**-**
	Total Water Resources - Limpopo Rivers	**515.66**	**-**	**-**

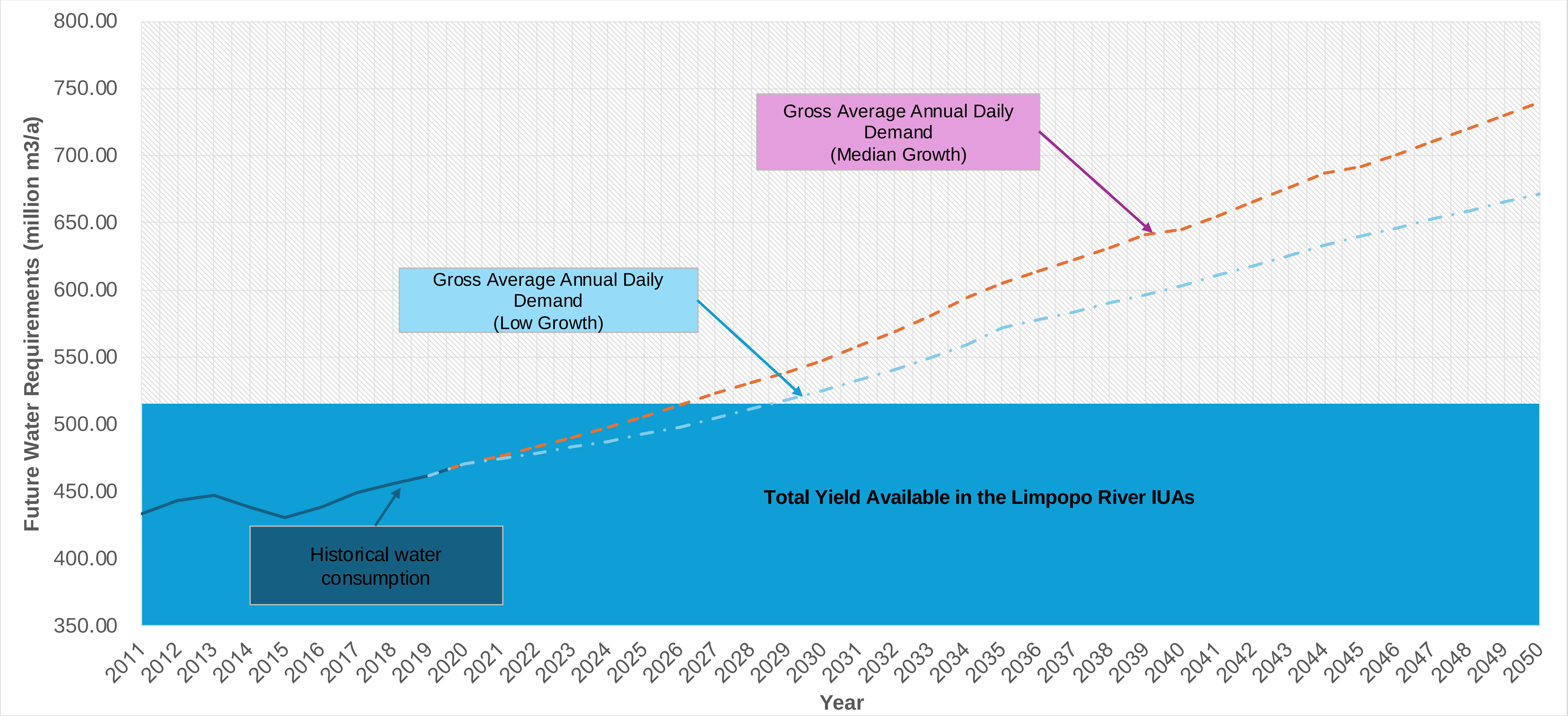
WATER BALANCE ASSESSMENT PER IUA

IUA	Water Availability / Requirements		2020		2025		2030		2035		2040		2050	
			Yield	Actual Demand	Yield	Projected Demand	Yield	Projected Demand	Yield	Projected Demand	Yield	Projected Demand	Yield	Projected Demand
Upper Sand														
	Water Availability		**64.74**		**64.74**		**64.74**		**64.74**		**64.74**		**64.74**	
	Surface water		4.20		4.20		4.20		4.20		4.20		4.20	
	Groundwater		17.45		17.45		17.45		17.45		17.45		17.45	
	Water Transfers		43.10		43.10		43.10		43.10		43.10		43.10	
	Water Reuse													
	Water Requirements without WC/WDM			**58.98**		**61.95**		**73.26**		**83.84**		**95.17**		**129.10**
	Domestic & Industries			40.99		39.36		46.73		53.60		62.58		89.35
	Mining & Industries			5.10		8.00		10.43		14.14		16.50		23.65
	Power Generation			-		-				-		-		-
	Irrigation			12.89		14.58		16.10		16.10		16.10		16.10
	Balance 1 - Water Requirements without WC/WDM Interventions			**5.77**		**2.80**		**- 8.51**		**- 19.09**		**- 30.43**		**- 64.36**

WATER BALANCE ASSESSMENT PER IUA

IUA	Water Availability / Requirements		2020		2025		2030		2035		2040		2050	
			Yield	Actual Demand	Yield	Projected Demand	Yield	Projected Demand	Yield	Projected Demand	Yield	Projected Demand	Yield	Projected Demand
	Water Availability		**141.36**		**141.36**		**141.36**		**141.36**		**141.36**		**141.36**	
	Surface water		4.91		4.91		4.91		4.91		4.91		4.91	
	Groundwater		99.95		99.95		99.95		99.95		99.95		99.95	
	Water Transfers		10.00		10.00		10.00		10.00		10.00		10.00	
	Unconventional Sources		26.50		26.50		26.50		26.50		26.50		26.50	
Lower Sand	**Water Requirements without WC/WDM**			**125.92**		**138.35**		**152.78**		**188.81**		**202.60**		**230.24**
	Domestic & Industries			7.51		13.06		13.98		15.02		15.82		18.45
	Mining & Industries			4.50		8.50		22.01		57.00		70.00		95.00
	Power Generation			-		-		-		-		-		-
	Irrigation			113.91		116.79		116.79		116.79		116.79		116.79
	Balance 1 - Water Requirements wihtout WC/WDM			**15.44**		**3.01**		**- 11.42**		**- 47.45**		**- 61.25**		**- 88.88**

WATER BALANCE ASSESSMENT



POTENTIAL WATER MANAGEMENT TO IMPROVE UTILISATION OF EXISTING WATER RESOURCES

- In order to delay development of major water resource infrastructure
  - Non-Revenue Water Management (NRW)
  - Water Reuse Scheme Options
  - Water recycling
  - Desalination of brackish water
- No very detailed work undertaken
  - Relied on existing studies undertaken in the catchments
  - Performance benchmarks based on unit consumption

POTENTIAL WATER MANAGEMENT TO IMPROVE UTILISATION OF EXISTING WATER RESOURCES

- NRW Management – significant inefficiencies – high physical losses & commercial losses
  - Protection of the environment
    - Reducing demand will result in reduced water abstractions – results in increased stream flows
    - Managing demand side – ecosystem protection from overutilization of the water resources
  - Protect existing water resources
    - Removal of invasive alien plants – improves surface runoff & yield of existing water resources
    - Minimising pollution of water resources – meeting effluent discharge standards
  - Reliability of supply
- Water Reuse Scheme – significant return flows or poor quality impacting downstream use – flow regime
  - Significant potential in Upper & Lower Sand
  - Address water quality issues impacting on downstream use & flow regime for the ecology

IUA	Driver Node(s)	Management Options				
		WC/WDM	Removal of IAPs	Return Flows Upstream of Key Node	Water Reuse Scheme Option	Total
Upper Sand	Sand River - Ri16	10.72		31.45	20.07	42.17
Lower Sand	Sand River - Ri22					-
	Sand River - Ri25					
Sub-Total Savings		**10.72**	-	**31.45**	**20.07**	**42.17**

POTENTIAL WATER MANAGEMENT TO IMPROVE UTILISATION OF EXISTING WATER RESOURCES

- Alien vegetation clearing
  - IAP consume more water than indigenous plants
  - Potential to increase run-off where there is significant IAPs
  - Improve quality of the water resources
  - Increased yield where there are dams downstream
    - Upper Nzhelele
    - Mutale River
    - Luvhuvhu
- Water Recycling
  - Increasing process water for industries – increasing potential for recycling –
  - It reduces the abstractions as additional water required is mainly make-up – due to evaporation, effluent discharge, etc
  - Zero Liquid Effluent discharge – to reduce operating costs

CURTAILMENT OF EXISTING USERS

- The need to improve the flows to meet the REC
  - Curtailment of existing users
  - Approach was to use a tool that would equitably reduce users where necessary
    - Drought operating rules were adapted to undertake the curtailment based on assurance of supply of different uses
    - Applied to flows for the different scenarios, BE, STCD and Dev
- Curtailments were limited as far as possible
  - Ensuring the management options are implemented
  - Additional water for future needs of domestic & industries

Category /Water User	Priority Classification				
	Low 90% Assurance (1 in 10 years)	Medium Low 95% Assurance (1 in 20 years)	Medium 98% Assurance (1 in 50 years)	High 99% Assurance (1 in 100 years)	Very High (99.5% Assurance) (1 in 200 years)
Domestic & Urban	5%	15%	20%	40%	20%
Mining, Industries & Power Generation	5%	20%	20%	35%	20%
Irrigation	30%	35%	20%	15%	0%
Return Flows	25%	25%	20%	20%	10%

Curtailment Level	0	1	2	3	4	5

EXTENT OF CURTAILMENT-UPPER LUVHUVHU IUA

	Water Requirements			
Water User	**2050 Development**	**STCD Scenario curtailment vol**	**Total Reduction per Water User**	**% Reduction**
Domestic & Urban	83.57	2.75	1.77	1%
Mining & Industries	-		-	0%
Irrigation	46.19		0.98	1%
Livestock	-		-	0%
EWR				
Total	**129.76**		**2.75**	

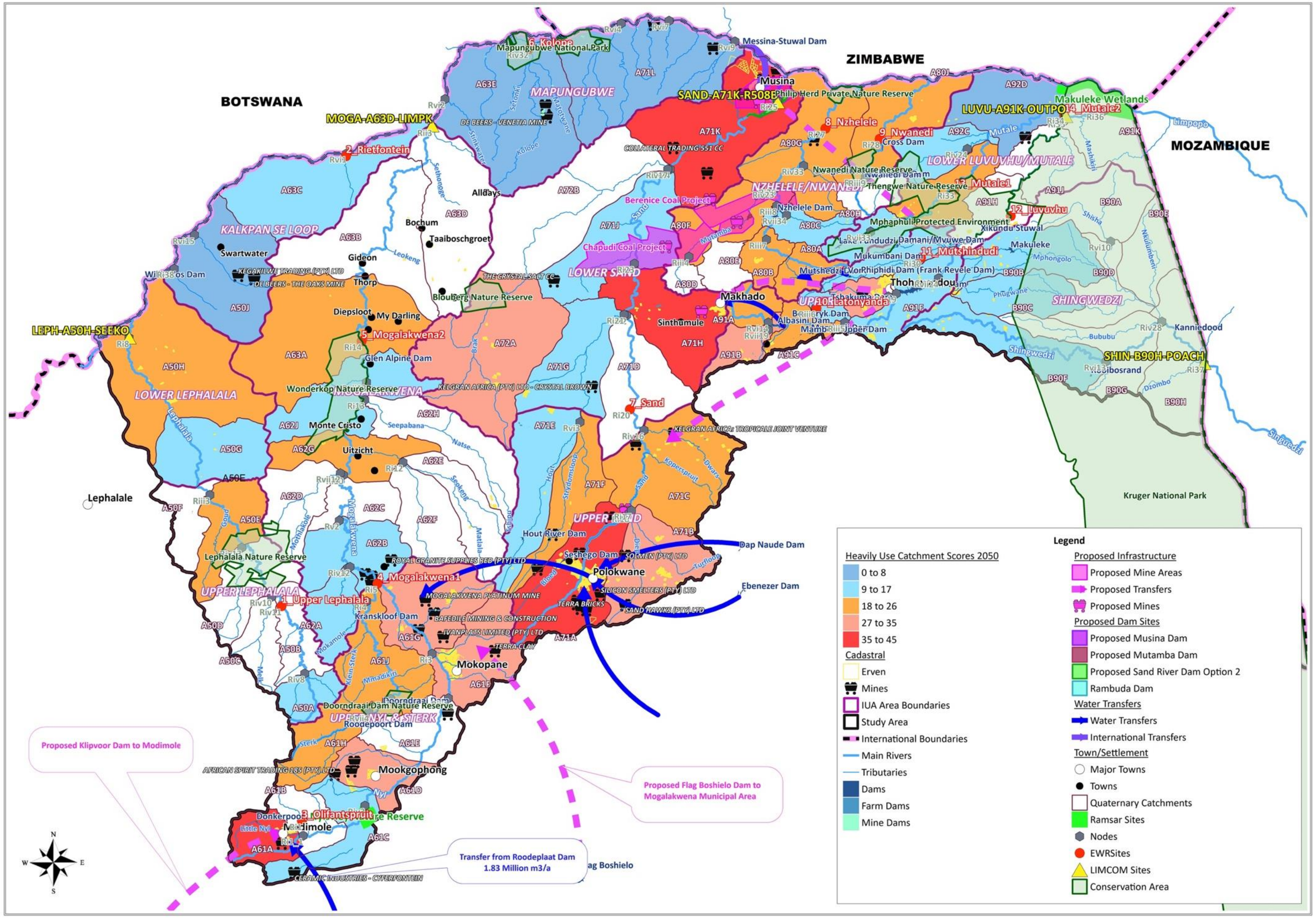
	Water Requirements			
Water User	**2050 Development**	**BE Scenario curtailment vol**	**Total Reduction per Water User**	**% Reduction**
Domestic & Urban	83.57	16.11	10.38	8%
Mining & Industries	-		-	0%
Irrigation	46.19		5.73	4%
Livestock	-		-	0%
EWR				
Total	**129.76**		**16.11**	

EXTENT OF CURTAILMENT

			Natural	PES		BE		Change in	Reason	Source	Purpose	Management Optionsto Meet Increased Flows
	Node	River	Vol	Vol	EC	Vol	EC	flow	Development	Where from?	Where to?	
	Upper Nyl and Sterk IUA											
A61H	Rvii4	Sterk	35.56	22.09	E	29.89	D	Up		There is no additional water. Only way is curtailment of existing and future demands of 10.98 million m3/a mainly irrigation agriculture	Pumps in the Sterk River used by farmers to abstract water released from the dam	Reduce allocations from Roodepoort & Doorndraai Dams - Mainly irrigators and mines, Undertake WC/WDM in Mokopane. Potential save 4.48 million m3/a, Improve water use by mines & irrigators , Undertake compulsory licensing
A61H	Rv1	Sterk	39.6	12.13	E	34.41	B	Up				
A61J	Ri4	Sterk	58.17	22.87	C	49.99	A	Up				
A61B	Ri1	Olifantspruit	8.11	7.61	C	7.61	C					
A61A	Ri1-1	Nyl	23.8	21.41	C	21.41	C					
A61C	Riv3	Nyl	23.44	21.55	C	24.52	B/C	Up		Additional water can only come from IBT and directly discharging upstream Ri1, 2nd option is curtailment of users by 8.1 million m3/a, in the Nyl & Upper Mogalakwena. A reduction of 18.8%.	Water is directly transferred to Mookgophong from groundwater & Mokopane WTW from Doorndraai Dam in Sterk	Reduce the domestic absttraction from Donkerpoort Dam to meet the irncreased flow. Undertake WC/WDM in Modimolle. Potential saving of 1.1 million m3/a, More potential from return flows Modimolle WwTW, Mookgophong WwTW & Mokopane WwTW. -Quality issues?
A61E	Riii1	Nyl	32.7	24.18	D	29.72	C	Up				
A61F	Ri3	Mogalakwena	52.78	36.99	D	47.68	C	Up				
A61G	Ri5	Mogalakwena	133.27	77.49	C	115.3	A/B	Up				
	Mogalakwena IUA											
A62B	Riv12	Mogalakwena	136.05	79.92	C	117.73	A/B	Up		No additional water can be made available other than IBT. No plans for IBT. To increase river flow, curtailment water users, domestic & irrigation agriculture. Approximately 44.14 million m3/a to be cut. This accounts for 66.6 % of the Dev water requirements.	Borehole pumps from the groundwater aquifers & river pumps downstream of Glen Alpine Dam	It is important to note that of the 44.168 million m3/a - 13.88 million m3/a would be contributed by increased flows in the Upper Nyl & Sterk River. Therefore, the amount to be curtailed in Mogalakwena is 30.28 million m3/a. The section between A62B to A62C can only rely on upstream flows. There are no structures to regulate flows. The increased flow at Node Ri14 can be regulated by curtailing irrigators dependent on Glen Alpine Dam
A62A	Ri6	Mokamole	15.01	12.55	D	12.55	D					
A62B	Rv2	Mogalakwena	161.14	100.98	C	130.04	B	Up				
A62D	Rvii12	Klein Mogalakwena	5.04	3.94	C	3.94	C					
A62C	Ri10	Mogalakwena	165.59	103.86	C	147.76	A/B	Up				
A62F	Ri12	Matlalane	9.65	8.19	C	8.19	C					
A62H	Ri13	Seepabana	4.71	4.14	D	4.14	D					
A62J	Rvii13	Mogalakwena	190.98	125.31	C	173.43	B	Up				
A63A	Ri14	Mogalakwena	193.27	114.3	C	175.54	A/B	Up				
A63D	Rii3	Mogalakwena	205.52	120.45	C	168.5	B	Up				

POTENTIAL WATER RESOURCE DEVELOPMENT & MANAGEMENT OPTIONS

IUA	Development Option	Name	Additional Water Required	Additional water supplied (Mm^3/a)	Total Cost R million	URV @8% (R/m3)
Upper Nyl & Sterk	Water transfer	Klipvoor Dam - Upper Nyl	10.28	6.85	2 237.97	R12.16
	Water transfer	Flag Boshielo to Mogalakwena Municipality		3.4	527.5	R5.73
Mogalakwena	Groundwater		3.51	3.5	87.1	R0.82
Upper Sand	Water transfer	Nandoni Dam to Polokwane	64.35	64.4	9,795.4	R5.67
Lower Sand	Dam	Musina Dam (no pumped scheme)	88.88	13	2,600.0	R7.45
	Dam	Musina Dam off channel storage		44	11,440.0	R9.68
	Dam	Sand River Dam		223	44,154.0	R11.80
	Water transfer	From Beit Bridge Zim		15	2,970.0	R11.80
Nzhelele / Nwanedi IUA	Dam	Mutamba River	11.13	2.1	556.5	R9.87
	Water conservation + demand management	Refurbishment of irrigation canals		6.2	1,050.5	R6.29
Lower Luvuvhu & Mutale IUA	Dam	Rambuda Dam	0.48	16.7	3,907.8	R13.94
	Dam	Tswera Dam		53	5,512.0	R3.44
	Dam	Paswane Dam		43	4,515.0	R2.96
	Dam	Thengwe Dam		51	5,559.0	R4.06



BOTSWANA
ZIMBABWE
MOZAMBIQUE
Kruger National Park
Messina-Stuwal Dam
Musina
Mapungubwe National Park
MAPUNGUBWE
6_Kolope
SAND-A71K-R508B
Philip Herd Private Nature Reserve
MOGA-A63D-LIMPK
LUVU-A91K-OUTPO
14_Mutale2
Makuleke Wetlands
8_Nzhelele
9_Nwanedi
LOWER LUVUVHU/MUTALE
NZHELELE/NWANEDI
13_Mutale1
12_Luvuvhu
11_Mutshindudi
10_Latonyanda
2_Rietfontein
KALKPAN SE LOOP
LOWER SAND
Berenice Coal Project
Chapudi Coal Project
Makhado
Thohoyandou
SHINGWEDZI
SHIN-B90H-POACH
LEPH-A50H-SEEKO
5_Mogalakwena2
MOGALAKWENA
LOWER LEPHALALA
7_Sand
Lephalale
Lephalala Nature Reserve
UPPER LEPHALALA
1_Upper Lephalala
4_Mogalakwena1
UPPER SAND
Polokwane
Dap Naude Dam
Ebenezer Dam
Mokopane
UPPER NYL & STERK
Mookgophong
3_Olifantspruit
Modimole
Proposed Klipvoor Dam to Modimole
Proposed Flag Boshielo Dam to Mogalakwena Municipal Area
Transfer from Roodeplaat Dam 1.83 Million m3/a
Flag Boshielo
Legend
Heavily Use Catchment Scores 2050
0 to 8
9 to 17
18 to 26
27 to 35
35 to 45
Cadastral
Erven
Mines
IUA Area Boundaries
Study Area
International Boundaries
Main Rivers
Tributaries
Dams
Farm Dams
Mine Dams
Proposed Infrastructure
Proposed Mine Areas
Proposed Transfers
Proposed Mines
Proposed Dam Sites
Proposed Musina Dam
Proposed Mutamba Dam
Proposed Sand River Dam Option 2
Rambuda Dam
Water Transfers
Water Transfers
International Transfers
Town/Settlement
Major Towns
Towns
Quaternary Catchments
Ramsar Sites
Nodes
EWRSites
LIMCOM Sites
Conservation Area

REALITY CHECKING RIVER FLOWS AND EC'S

Ecological Water Requirements…

Summary of EWR Estimate for the cumulative quaternary catchment G22D

```
Summary of Desktop (Version 2) estimate for Quaternary Catchment Area:
Total Runoff: Bvii7

Annual Flows (Mill. cu. m or index values):
MAR                          =    4.495
S.Dev.                       =    2.711
CV                           =    0.603
Q75                          =    0.037
Q75/MMF                      =    0.099
BFI Index                    =    0.345
CV(JJA+JFM) Index            =    1.250

  Ecological Category = C

Total EWR                    =    1.038 (23.08 %MAR)
Maint. Lowflow               =    0.664 (14.77 %MAR)
Drought Lowflow              =    0.312 ( 6.94 %MAR)
Maint. Highflow              =    0.374 ( 8.31 %MAR)

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

Month	Natural Flows			Modified Flows (EWR)			
				Low flows		High Flows	Total Flows
	Mean	SD	CV	Maint.	Drought	Maint.	Maint.
Oct	0.264	0.222	0.843	0.074	0.038	0.013	0.087
Nov	0.113	0.071	0.628	0.046	0.024	0.001	0.047
Dec	0.053	0.011	0.214	0.025	0.014	0.000	0.025
Jan	0.038	0.012	0.316	0.019	0.011	0.000	0.019
Feb	0.032	0.007	0.233	0.017	0.009	0.000	0.017
Mar	0.031	0.013	0.416	0.016	0.007	0.000	0.016
Apr	0.101	0.215	2.121	0.021	0.012	0.000	0.021
May	0.284	0.402	1.416	0.035	0.018	0.031	0.066
Jun	0.673	0.703	1.045	0.067	0.019	0.078	0.145
Jul	1.124	1.083	0.964	0.109	0.039	0.161	0.270
Aug	1.164	0.903	0.776	0.129	0.066	0.030	0.159
Sep	0.619	0.486	0.785	0.106	0.054	0.059	0.165

Tab table
- Natural Mean Annual Runoff
- Reserve Requirements

Recommended Ecological Category (REC) in which the River should be managed

The Ecological Reserve requirements to meet the REC.

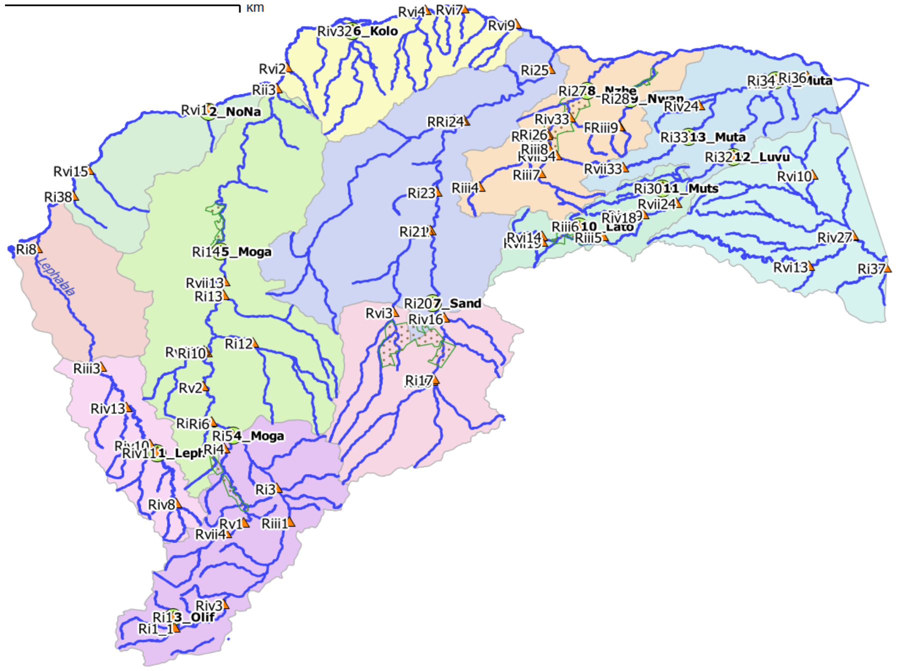
Summarizes the average flows required per month to maintain the system in that REC

APPROACH TO MODELLING RIVER FLOW AND HEALTH

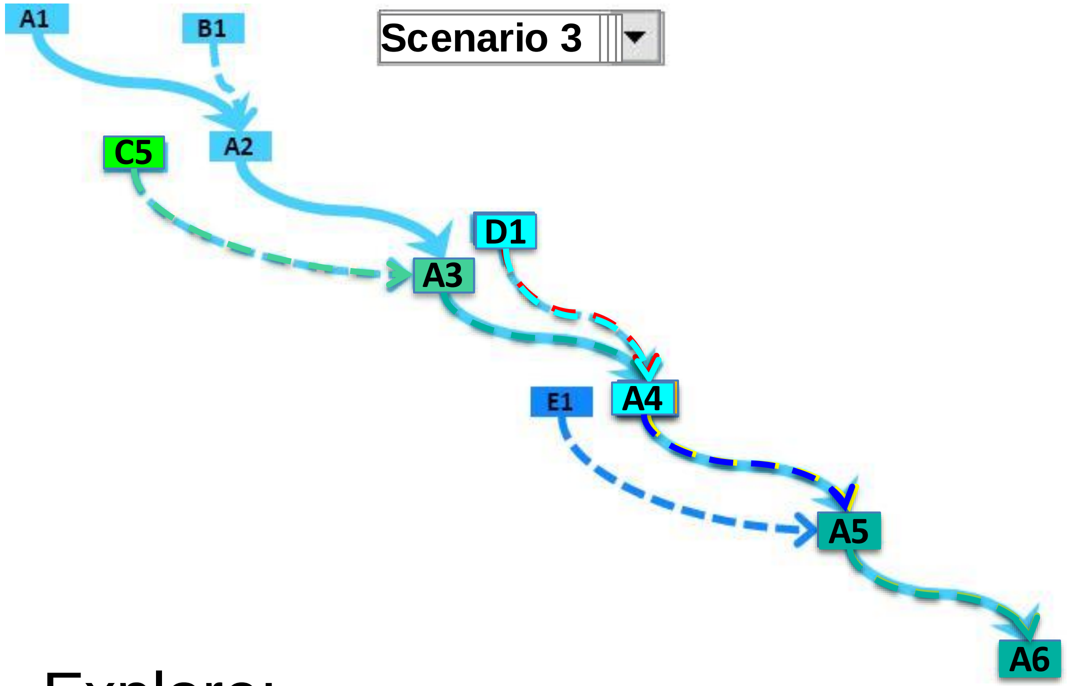
- Created a model in MSExcel with macros to run and view scenarios
- Is a water balance model using volumes
- Is interactive…by changing flow at any site, one can view how the flows and condition of that and downstream sites change
- Is called the Balancing Tool

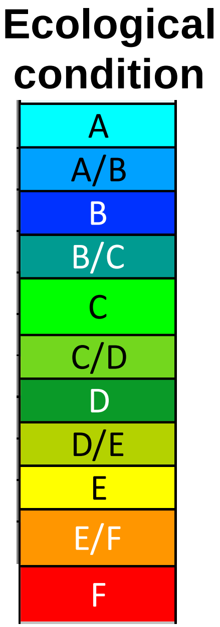
THE BALANCING TOOL

- The BT lays out the flow of water through a number of **nodes** (75) from upstream to downstream, west to east
  - **14 EWR sites** used in the detailed EFlows assessment in DRIFT
  - **61 additional nodes** for broader spatial representation (incl. LIMCOM)
  - 8 of the 75 nodes are stand-alone (no upstream or downstream nodes (including the DRIFT site 2_Rietfontein)
- Changes are based on flow alone



EXPLORING SCENARIOS





Explore:

Ecological states

Changes in flow (annually, seasonally)

Contributions of particular reaches

BACKGROUND DATA / INPUTS (1)

1. List of sites and nodes
2. For all sites for Natural and Present Day (2023) (Current, Baseline):
   a. Average monthly **volumes**
   b. Present **Ecological Status** (PESs), A to F
   c. Associated with the Present volumes are **Flow States** (BFSs), based on seasonal %s of Natural flows, also A to F

So, may have FS of B, but PES of D if there are other e.g. water quality issues.

BACKGROUND DATA / INPUTS (2)

For all sites:

3. Average monthly volumes for EWRs for Ecological Categories A to D from the Revised Desktop Model
   - Generally have PES, one up and one down from the Revised Desktop Model
   - Other Ecological Categories use averages of Desktop results and referring to River Type (Hydrological Index and flow pattern)
4. Average monthly volumes for modelled scenarios

OUTPUTS

- Outputs are:
  - Tables, map and schematic of resulting Ecological Categories
  - Annual and monthly volumes at each node
  - Annual and seasonal distribution of volume as %s of Natural
  - Deficits and surpluses of volume in delivering the flows required to meet the ECs
  - etc., etc.
- Information from here (volumes, EC) is provided to further model e.g. Yield etc. for the socio-economic assessment

ADJUSTMENTS TO FLOW VOLUMES AND ECOLOGICAL CONDITION

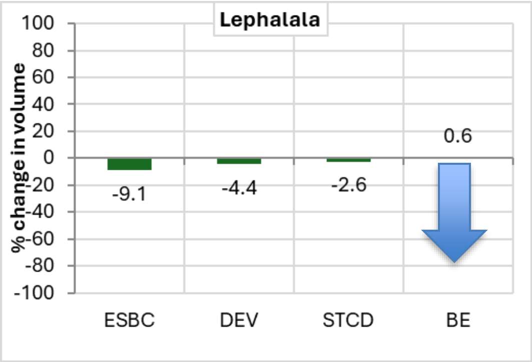
- No major adjustments to PES, ESBC, DEV
  - (‘cept for BHN and WQ condition),
- No adjustments to Kalkpan se Loop, Shingwedzi
- Adjustments made for all others
  - Are the volumes requested in STCD, BE realistically available?
    - case-by-case in some instances but generally were too high
    - Resulted in unrealistic ecological outcomes in some instances
    - Where can the water possibly come from?
    - Went through a number of revisions questioning these increases on a case-by-case basis

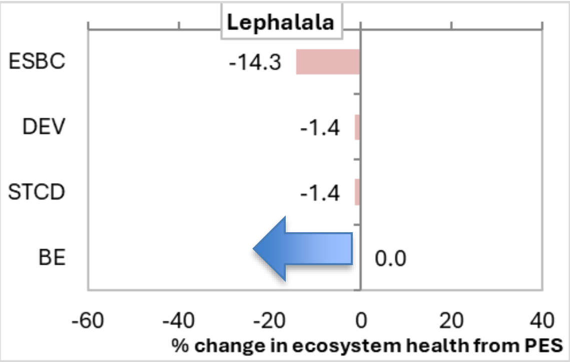
EXAMPLE OF FLOW VOLUME AND RIVER CONDITION TABLES – SAND RIVER

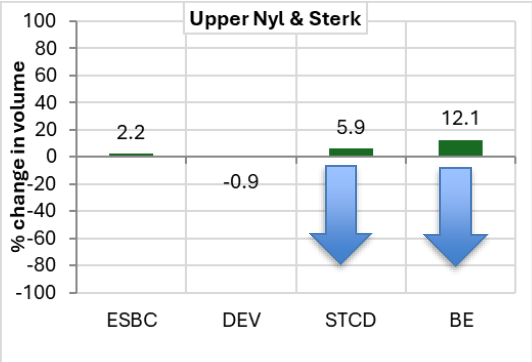
Node	River	Natural	PES		ESBC		BE		DEV		STCD	
		Vol	Vol	EC	Vol	EC	Vol	EC	Vol	EC	Vol	EC
Upper Sand IUA												
Rvi3	Hout	6.92	3.07	C	2.97	C	5.00	A	2.88	C	2.88	C
Ri21	Hout	11.70	5.88	C	5.16	C/D	8.53	A/B	4.85	C/D	4.85	C/D
Ri16	Sand	11.05	13.11	D	13.11	D	13.11	D	41.17	D	41.17	D
Ri17	Diep	7.83	6.10	D	5.16	D	6.10	D	5.96	D	5.96	D
Riv16	Dwars	2.43	1.51	C	1.13	C/D	1.71	B/C	1.38	C	1.38	C
Lower Sand IUA												
Ri20	Sand	27.45	23.48	C	22.34	C	26.41	B/C	51.25	C	51.25	C
Ri22	Sand	31.59	24.12	C	23.74	C	28.90	B/C	51.78	C	51.78	C
Ri23	Sand	52.35	36.90	C	33.32	C/D	44.01	B/C	35.99	C	35.99	C
Ri24	Sand	62.54	45.82	C	37.64	C/D	50.73	B/C	44.88	C	44.88	C
Riv17	Brak	13.55	12.16	C	8.26	D	12.16	C	12.13	C	12.13	C
Ri25	Sand	85.32	64.16	C	48.18	C/D	71.06	C	63.15	C	63.15	C

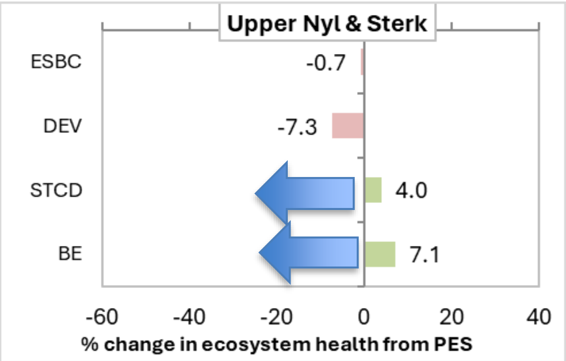
		Nat	PES		ESBC		BE		DEV		STCD	
Node	River	Vol	Vol	EC	Vol	EC	Vol	EC	Vol	EC	Vol	EC
Upper Sand IUA												
Rvi3	Hout	6.92	2.88	C	2.79	C	2.99	C	2.88	C	2.88	C
Ri21	Hout	11.7	5.59	C	4.87	C/D	5.59	C	4.85	C/D	5.48	C/D
Ri16	Sand	11.05	12.97	D	12.97	D	17.17	D	41.17	D/E	29.79	D/E
Ri17	Diep	7.83	5.96	D	5.02	E	6.08	D	5.96	D	5.96	D
Riv16	Dwars	2.43	1.38	C	1	D	1.49	C	1.38	C	1.38	C
Lower Sand IUA												
Ri20	Sand	27.45	23.04	C	21.91	C/D	27.51	B/C	51.25	C/D	39.86	C
Ri22	Sand	31.59	23.64	C	23.25	C/D	29.15	B/C	51.78	C	40.4	B/C
Ri23	Sand	52.35	36	C	32.41	C/D	37.1	C	35.99	C	34.72	C
Ri24	Sand	62.54	44.88	C	36.71	C/D	46.26	C	44.88	C	44.6	C
Riv17	Brak	13.55	12.13	C	8.23	D	12.13	C	12.13	C	12.13	C
Ri25	Sand	85.32	63.15	C	47.17	C/D	65.07	C	63.15	C	62.87	C

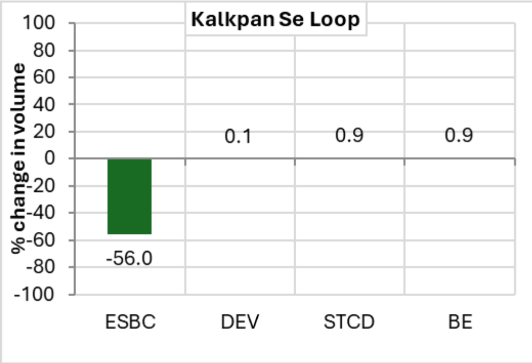
Water volumes and River health (with WQ)

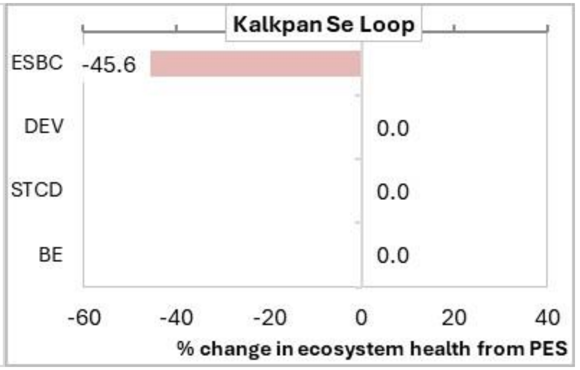


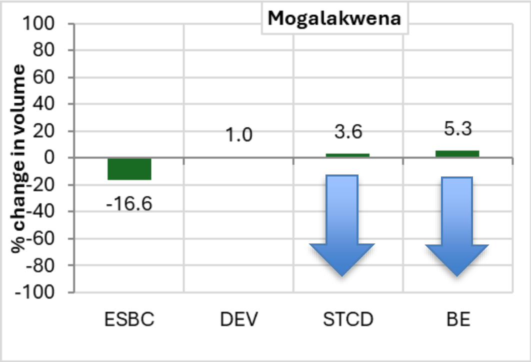


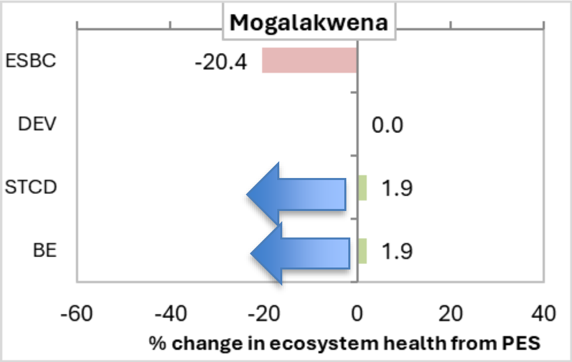


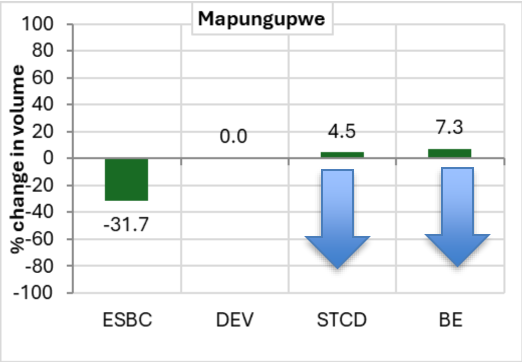


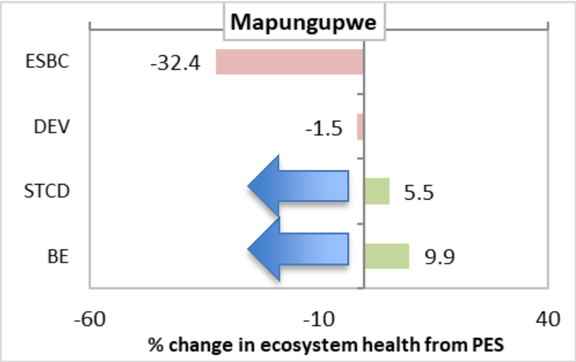




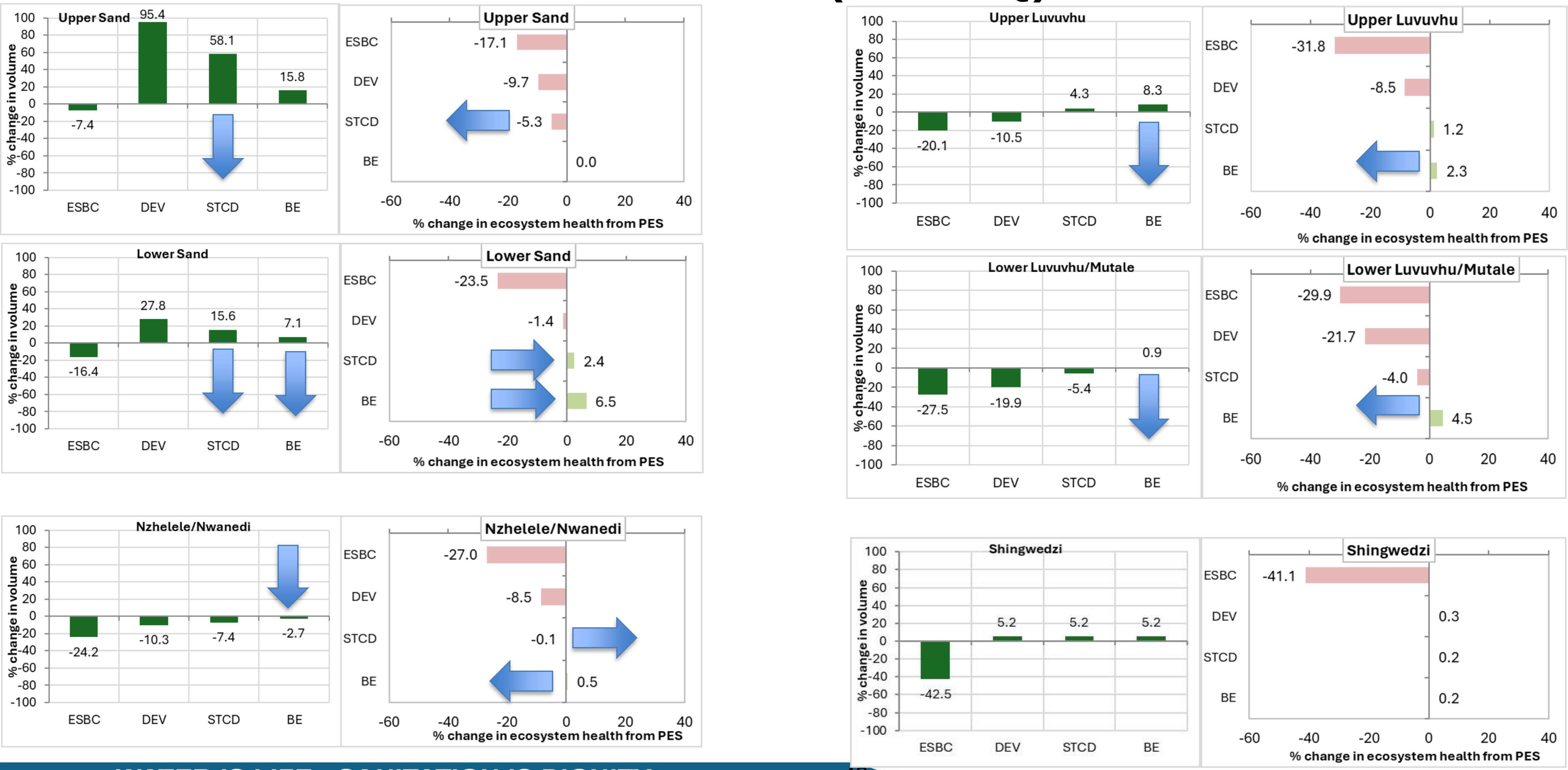






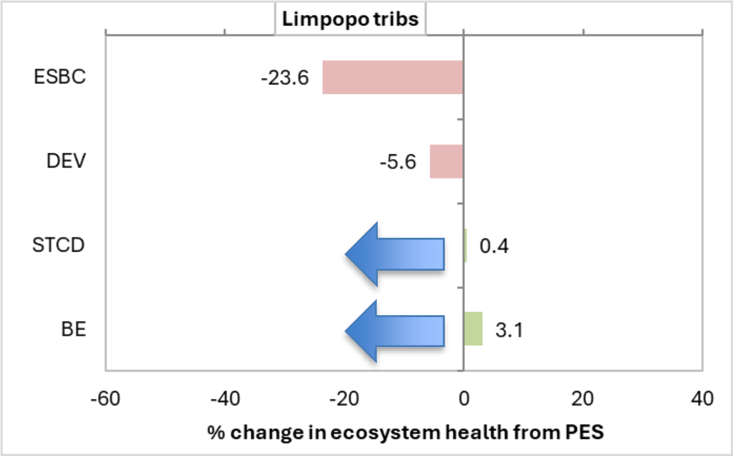


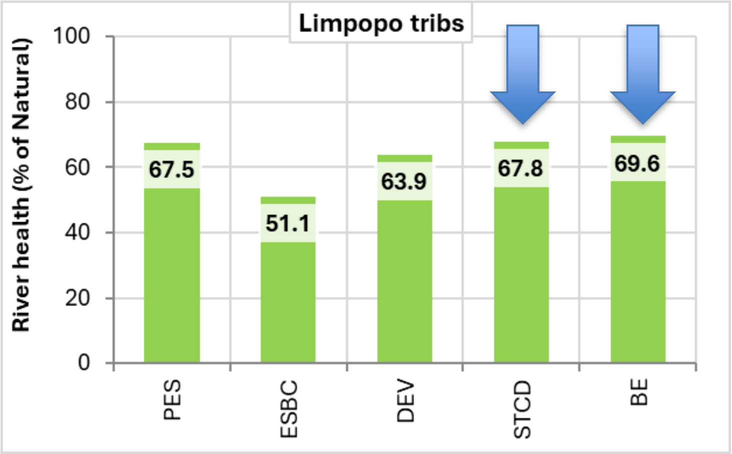
Water volumes and River health (with WQ)



SUMMARY OF OVERALL RIVER HEALTH

- A large decrease for ESBC
- A relatively small decrease for DEV
- No change in STCD
- A small improvement in BE
- PES ~ 67% of natural





INTEGRATION OF WQ INTO EVALUATION PROCESS

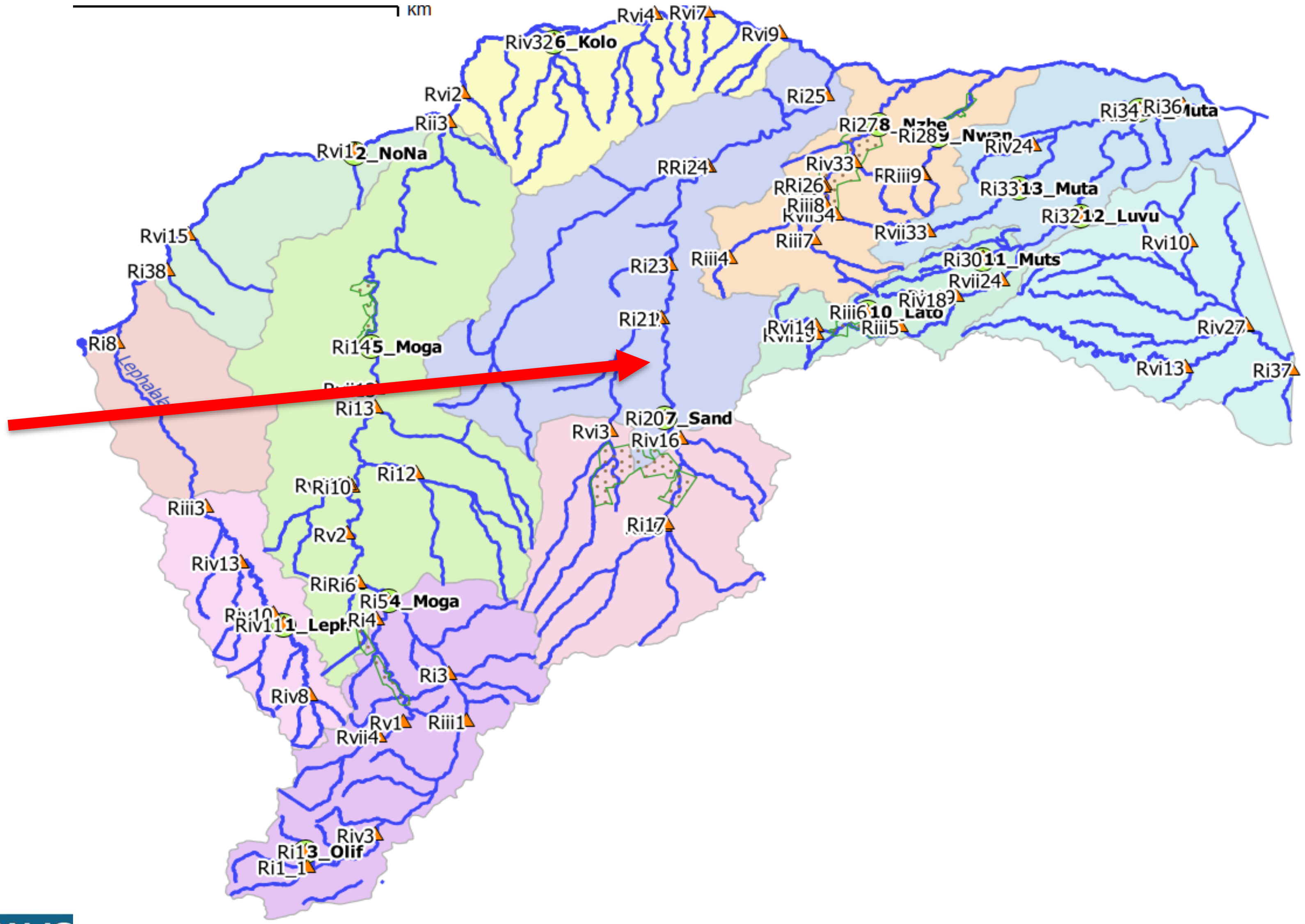
APPROACH TO ASSESSING THE WATER QUALITY IMPLICATIONS

- No modelling of water quality as for flow scenarios
- Assessment based on knowledge of water quality responses to decrease in flows, or restoring flows
- Decrease in flow means less dilution of point and nonpoint source pollution
- Maintenance of flow regime would probably maintain WQ status but over time it could deteriorate if trends continue
- Slight improvement in flow regime would probably maintain WQ status

LIKELY WATER QUALITY IMPACTS: SAND RIVER

Upper and lower Sand IUAs

- Upper Sand highly impacted by poorly performing WWTW
- Decrease in flow would aggravate impacts resulting in poorer WQ status
- Lower Sand almost nonperennial, water quality status poor – changes in flow would probably maintain poor status



LIKELY WATER QUALITY IMPACTS: SAND RIVER

Upper and lower Sand IUAs

- Upper Sand highly impacted by poorly performing WWTW
- Decrease in flow would aggravate impacts resulting in poorer WQ status
- Lower Sand almost nonperennial, water quality status poor – changes in flow would probably maintain poor status

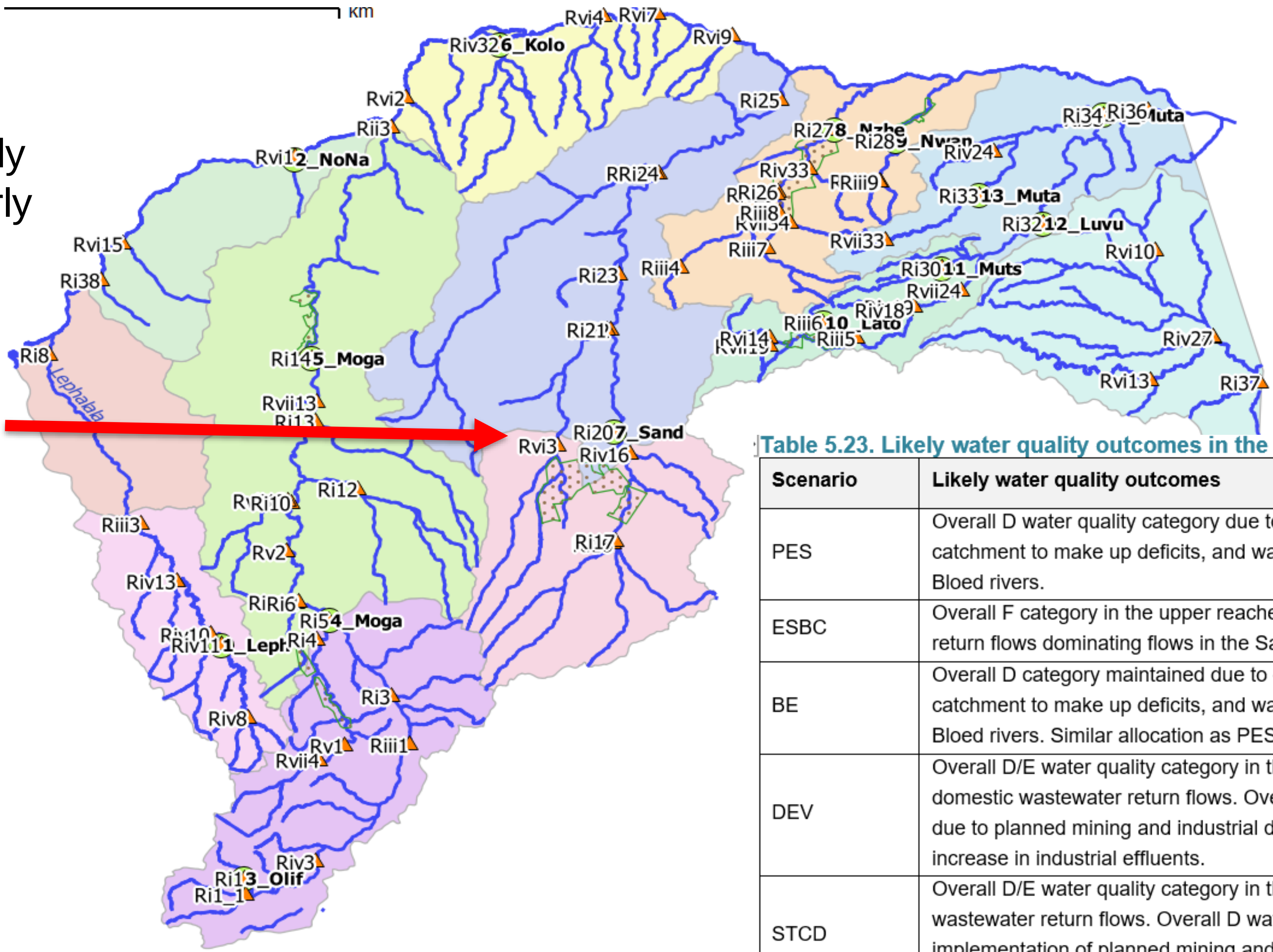


Table 5.23. Likely water quality outcomes in the Upper and Lower Sand IUAs

Scenario	Likely water quality outcomes
PES	Overall D water quality category due to overall over-allocation of water, water imported into catchment to make up deficits, and wastewater discharges dominating flows in the Sand and Bloed rivers.
ESBC	Overall F category in the upper reaches due to a large increase in domestic wastewater return flows dominating flows in the Sand and Bloed rivers downstream of Polokwane region.
BE	Overall D category maintained due to overall over-allocation of water, water imported into the catchment to make up deficits, and wastewater discharges dominating flows in the Sand and Bloed rivers. Similar allocation as PES scenario.
DEV	Overall D/E water quality category in the upper reaches due to large increase in poor quality domestic wastewater return flows. Overall D/E water quality category in the lower reaches due to planned mining and industrial developments, possible acid mine drainage effects, and increase in industrial effluents.
STCD	Overall D/E water quality category in the upper reaches due to a large increase in domestic wastewater return flows. Overall D water quality category in the lower reaches due to smaller implementation of planned mining and industrial developments, possible acid mine drainage effects, and moderate increase in industrial effluents.

LIKELY WATER QUALITY IMPACTS: SAND RIVER

Upper and lower Sand IUAs

- Upper Sand highly impacted by poorly performing WWTW
- Decrease in flow would aggravate impacts resulting in poorer WQ status
- Lower Sand almost nonperennial, water quality status poor – changes in flow would probably maintain poor status

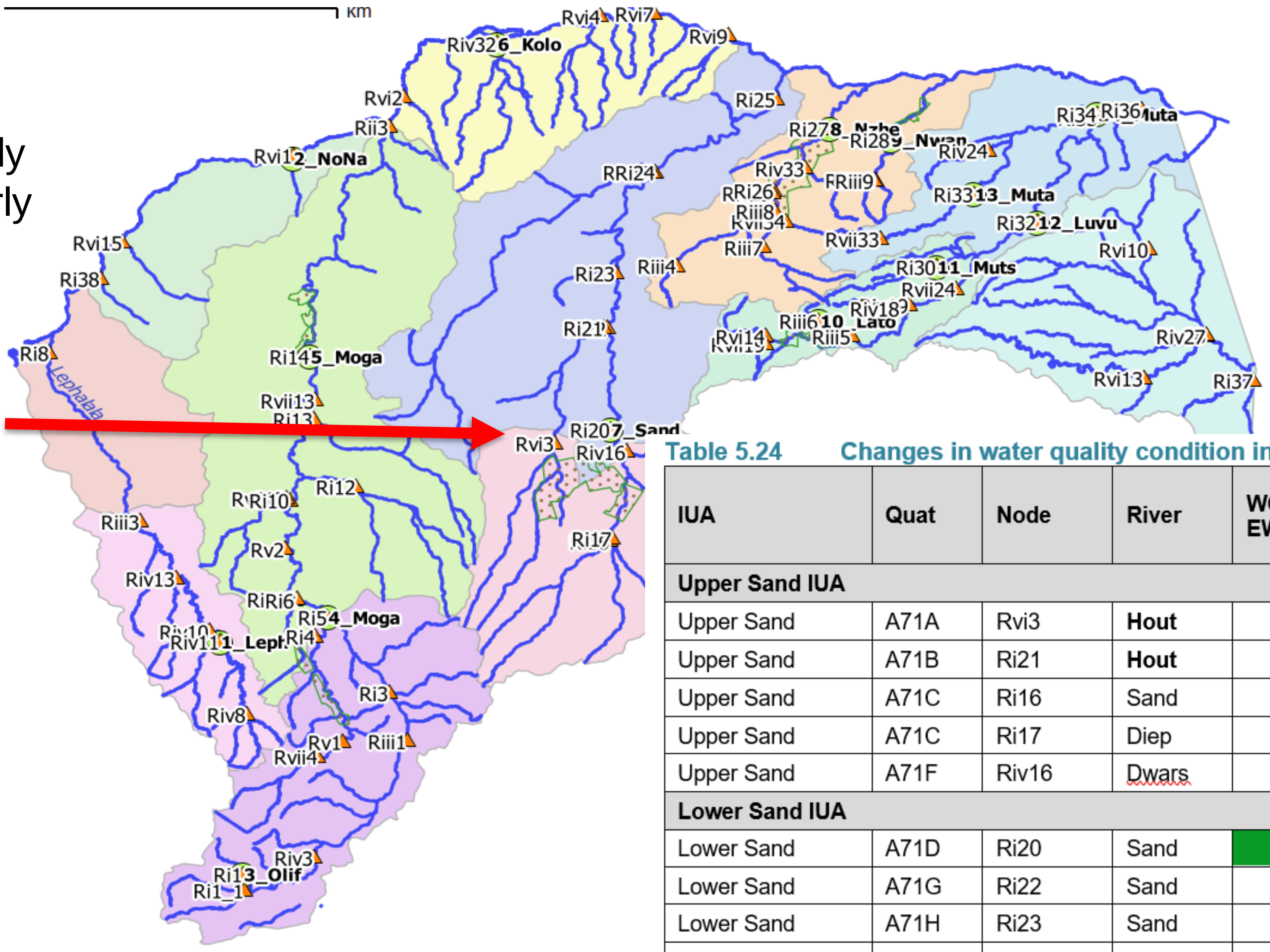


Table 5.24 Changes in water quality condition in the Upper and Lower Sand IUA

IUA	Quat	Node	River	WQ EWR	PES	DEV	STCD	BE
Upper Sand IUA								
Upper Sand	A71A	Rvi3	**Hout**		D	D	D	D
Upper Sand	A71B	Ri21	**Hout**		D	D	D	D
Upper Sand	A71C	Ri16	Sand		D	E	D/E	D
Upper Sand	A71C	Ri17	Diep		D	D/E	D/E	D
Upper Sand	A71F	Riv16	Dwars		D	D	D	D
Lower Sand IUA								
Lower Sand	A71D	Ri20	Sand	D	D	E	D/E	D
Lower Sand	A71G	Ri22	Sand		D	E	D/E	D
Lower Sand	A71H	Ri23	Sand		C	C	C	C
Lower Sand	A71J	Ri24	Sand		*C*	*D*	*C*	*C*
Lower Sand	A72B	Riv17	Brak		B	B	B	B
Lower Sand	A71K	Ri25	Sand		C	*D*	C	C

OVERALL WATER QUALITY SCORES

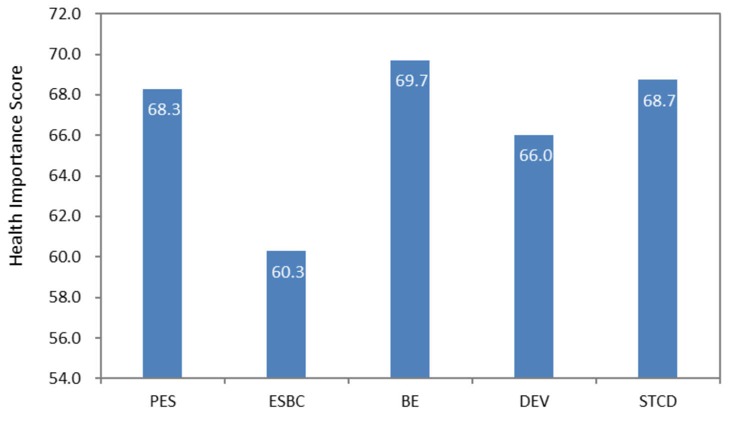
Table 6.2. The overall water quality rating in each IUA under each of the alternative scenarios.

IUA	PES	ESBC	BE	DEV	STCD
Upper and Lower Lephalala	B	B	B	B	B
Kalkpan se Loop	B/C	B/C	B/C	B/C	B/C
Upper Nyl & Sterk	C	C	C/D	C	C/D
Mogalakwena	C	C	C	C	C
Mapungubwe	B/C	C	C	C	C
Upper Sand	D	F	D	D/E	D/E
Lower Sand	C/D	F	D	D/E	D
Nzhelele/Ṅwanedi	C	D	C	D	C
Upper Luvuvhu	C	D	C	C/D	C
Lower Luvuvhu/Mutale	B	B	C	C	B/C
Shingwedzi	B/C	C	B/C	C	C

BIODIVERSITY, ECOSYSTEM SERVICES, SOCIETY AND ECONOMY

ASSESSING BIODIVERSITY

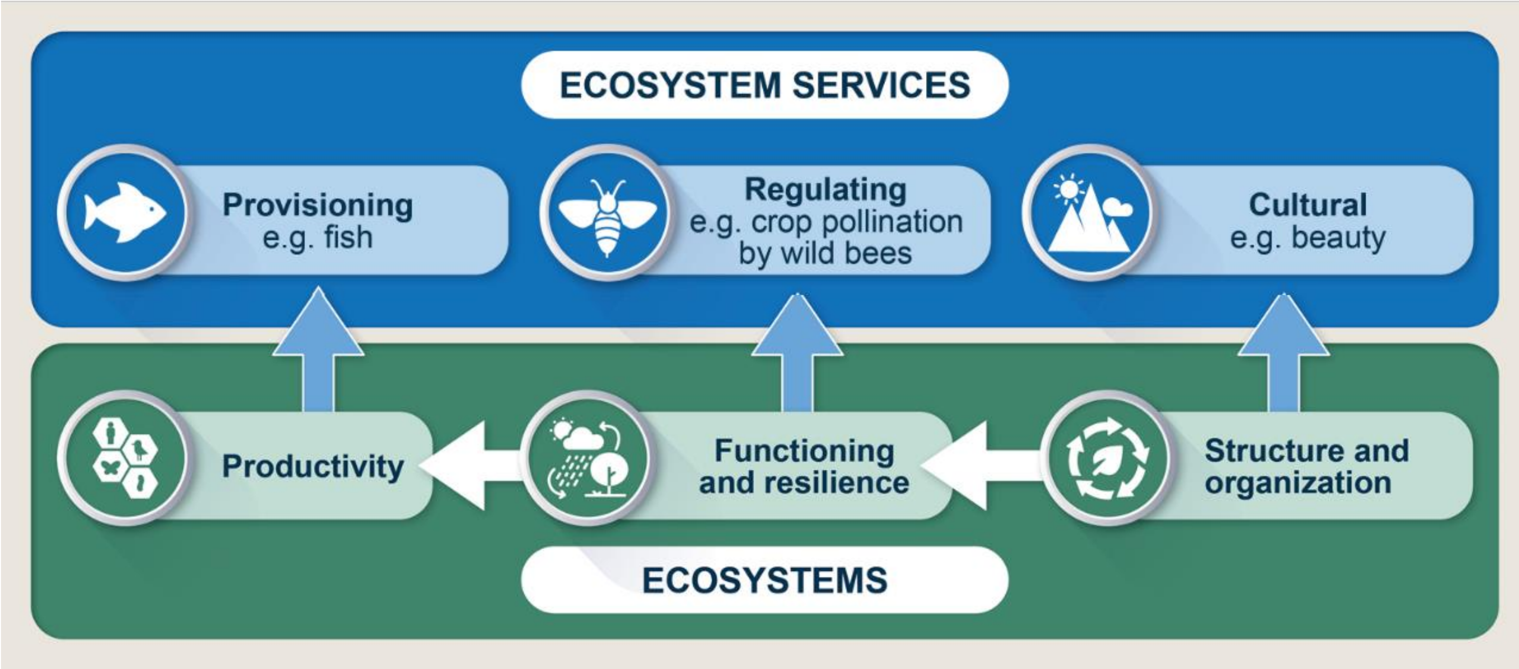
- River + wetland health and importance
- Impacts on sense of place, downstream ES
- Scored out of 100 based on ECs and importance scores from experts



IUA	PES	ESBC	BE	DEV	STCD
Lephalala (upper and lower)	67.5	64.4	67.5	64.8	67.2
Kalkpan Se Loop	74.5	60.8	74.5	74.5	74.5
Upper Nyl & Sterk	61.6	60.7	65.4	61.3	63.3
Mogalakwena	64.2	57.8	64.6	63.2	64.6
Mapungubwe	80.4	73.2	84.0	80.0	81.6
Upper Sand	55.8	52.7	57.3	55.5	56.3
Lower Sand	62.6	57.9	66.5	58.6	65.7
Nzhelele/Nwanedi	64.1	55.1	65.7	62.4	64.8
Upper Luvuvhu	60.9	49.1	61.4	55.1	60.0
Lower Luvuvhu/Mutale	76.4	63.2	76.6	68.6	74.8
Shingwedzi	83.1	68.2	83.1	82.1	83.1

ECOSYSTEM SERVICES

- These are benefits obtained by people from ecosystems
- Ecosystem services are fundamentally linked to biodiversity
- Biological diversity found in an ecosystem is critically important to its functioning and value

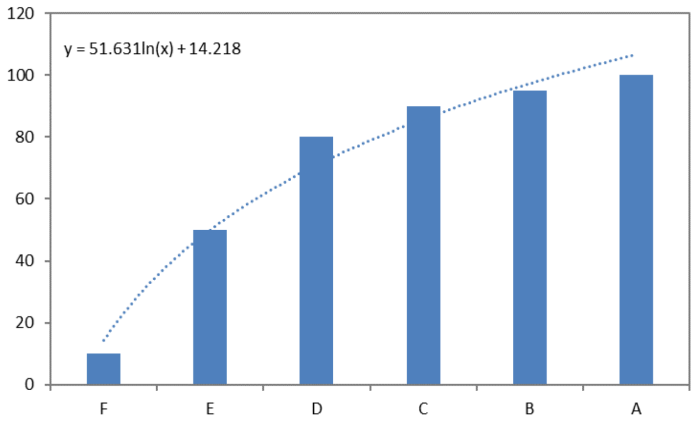


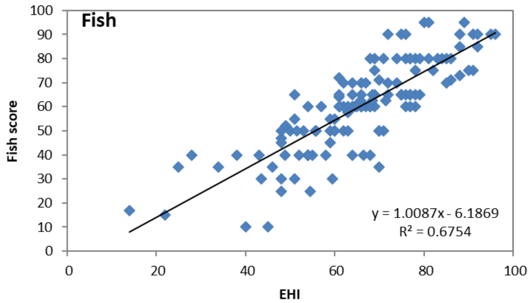
ECOSYSTEM SERVICES

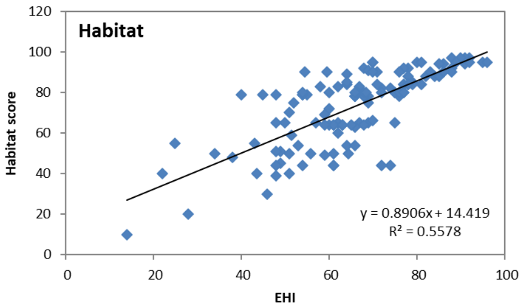
Category of service	Types of values	Description of EGSA	Independent variables related to river and wetland condition
Goods (Provisioning services)	Harvesting of wild plant and animal resources	Wild plants and fish collected on a subsistence basis for consumption	Overall health Freshwater fish abundance Wetland plant abundance
	Instream water use	Instream water used by households for basic human needs and for irrigation of small home gardens.	Water quantity and quality
Services (Regulating services)	Carbon storage and sequestration	Contribution to the amelioration of climate change damages through sequestration of carbon by riverine and wetland habitats, reduction in carbon emissions	Overall health Extent of riparian vegetation Water quantity and quality
Attributes (Cultural services)	Nature-based tourism	A river or wetland's contribution to recreation/tourism appeal of a location	Overall health Water quality

ASSESSING CHANGE IN ECOSYSTEM SERVICES

- Baseline valuation of ecosystem services – spatially explicit, focusing on main ecosystem services
- Estimation of the relationships between aquatic ecosystem health and supply of ecosystem services – produced simple models
- Models used to estimate changes under each scenario, at the level of IUAs.
- Tourism value also included assumptions on the rate of tourism growth under each scenario based on tourism projections



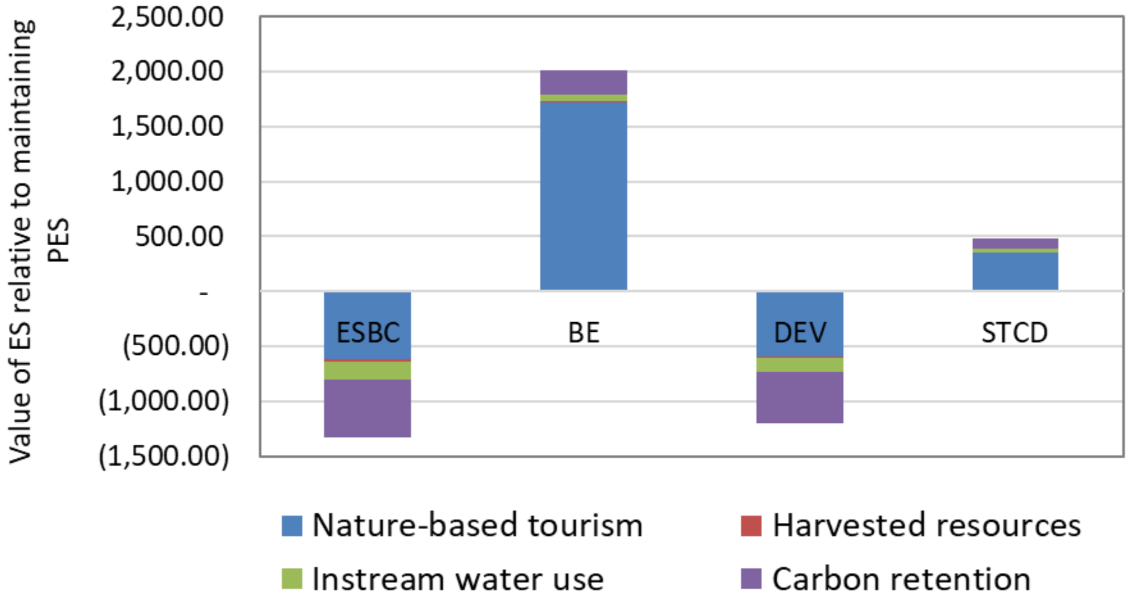




Tourism		Scenario Ecological Category					
		A	B	C	D	E	F
PES	A	1.0	1.0	0.9	0.8	0.5	0.1
	B	1.1	1.0	0.9	0.8	0.5	0.1
	C	1.1	1.1	1.0	0.9	0.6	0.1
	D	1.3	1.2	1.1	1.0	0.6	0.1
	E	2.0	1.9	1.8	1.6	1.0	0.2
	F	10.0	9.5	9.0	8.0	5.0	1.0

CHANGES IN ECOSYSTEM SERVICES

- Value of EGSA increase under BE and STCD scenarios compared to maintaining PES
- Nature-based tourism and carbon retention have the biggest losses under DEV and ESBC



ASSESSING ECONOMIC CONSEQUENCES

- Main water using sectors considered:
  - Urban and domestic use
  - Industry and mining
  - Irrigation agriculture
- Nature-based tourism - affected by changes in ecosystem health

1. Costs saved or incurred through having to supply water to meet growing demands or to meet EWR requirements.
2. Losses or gains in value added to the economy (= contribution to GDP):
   - Output: productivity of water by sector (value per m^3 of water)
   - Limpopo Social Accounting Matrix (SAM) multipliers

COSTS OF SUPPLYING WATER

- Grey infrastructure costs to meet future demand (transfers, dams)
  - Capital investment cost, cost per m3 of water supplied
- Conservation and management interventions to cover any EWR shortfalls or WQ improvements
  - Cost of IAP clearing, WCDM, water reuse (R/m3 supplied)

Nandoni Dam

WATER SUPPLY COSTS

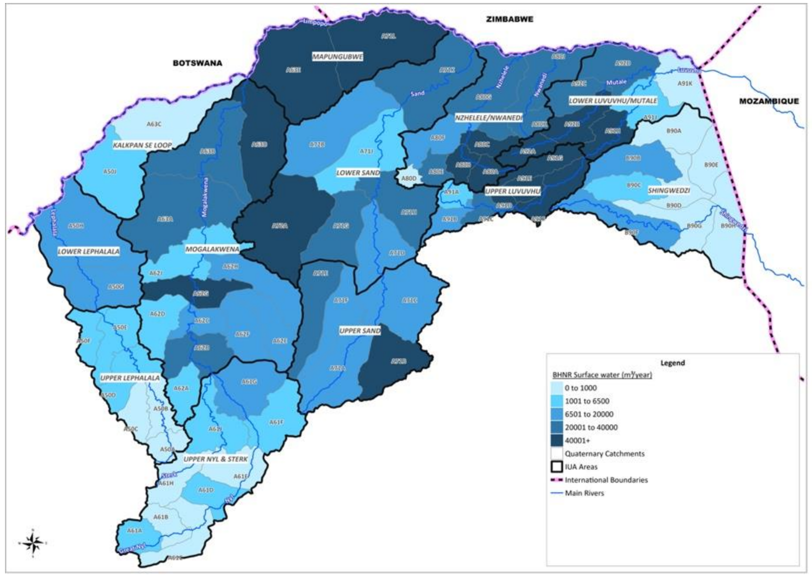
- Maintaining PES requires additional infrastructure to meet future urban/domestic needs ~R6 500 million
- DEV requires significant infrastructure to meet future urban/ domestic needs + mining/industrial development ~R22 100 million
- BE requires implementation of reuse scheme (Sand) to improve WQ and flows + conservation and management interventions to meet EWRs ~R1 600 million
- STCD requires some additional infrastructure + implementation of reuse scheme (Sand) to improve WQ and flows + conservation and management interventions to meet EWRs ~R7 700 million

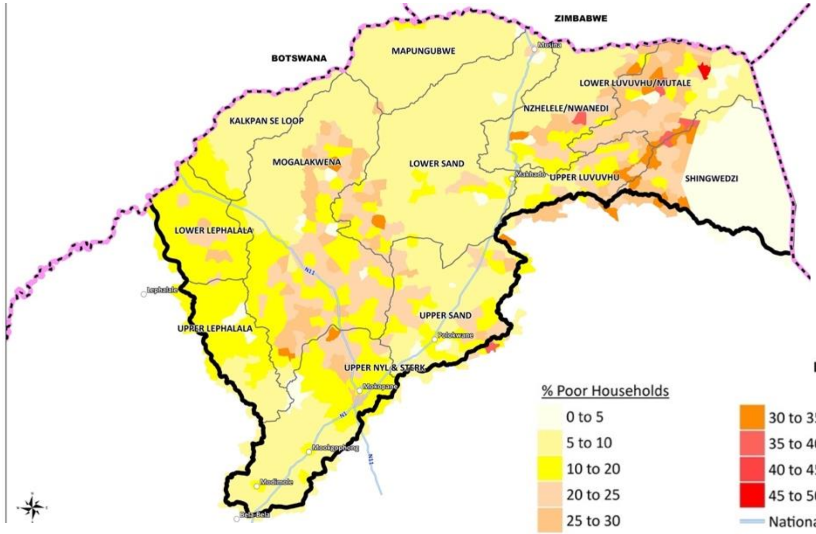
VALUE ADDED TO ECONOMY

- All other sectors held equal
- Value add highest under DEV
- DEV has significant growth in mining, industrial & agric output but with some tourism losses compared to maintaining PES
  ~R12 300 million
- BE has no mining and industrial growth but high growth in nature-based tourism which has a higher value add per unit of input
  ~R8 600 million
- STCD has some industrial growth and moderate tourism growth compared to maintaining PES ~R11 100 million

ASSESSING SOCIAL CONSEQUENCES

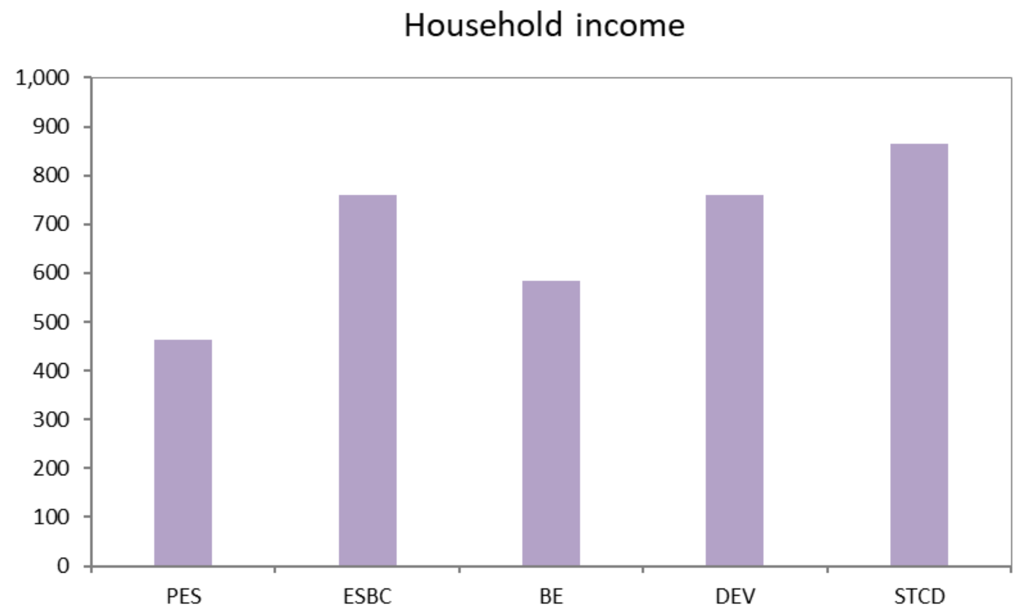
- Household income
  - Multipliers from the Limpopo Social Accounting Matrix
- Availability of water and other aquatic resources for use by vulnerable rural households.
  - Change in value of instream water use and harvested resources
- Climate impacts
  - Carbon retention in vegetation and carbon emissions





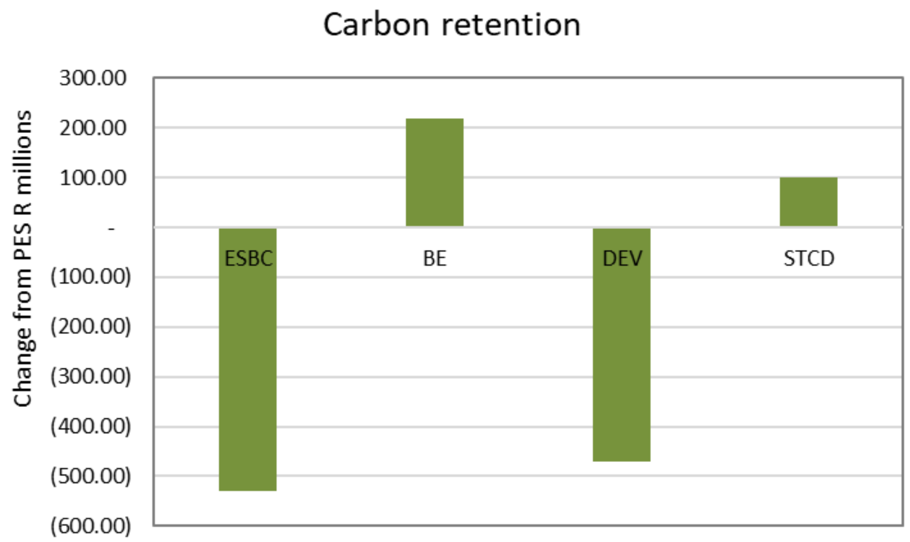
HOUSEHOLD INCOME

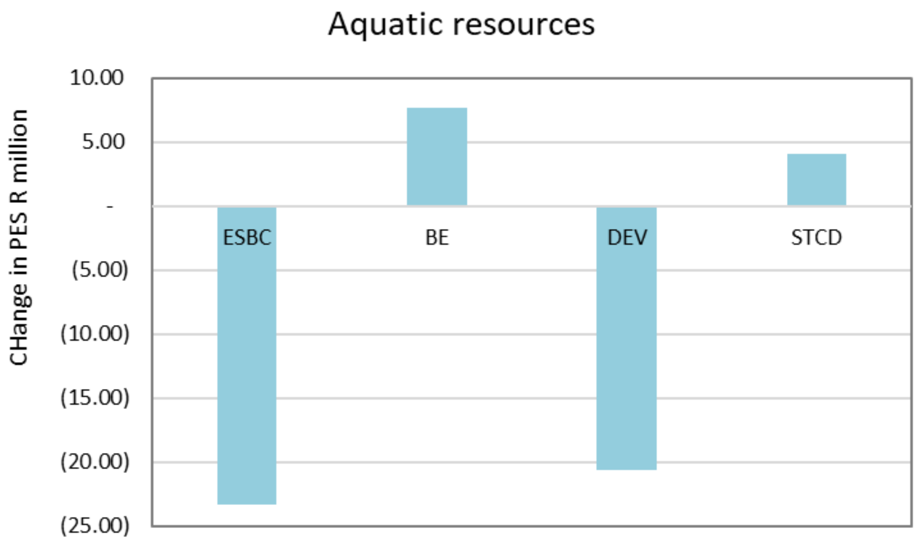
- HH income highest under the STCD due to the combination of some growth in industry and growth in tourism in the areas where there is no development under the DEV.



HARVESTED RESOURCES & CLIMATE IMPACTS

- BE scenario biggest change in carbon retention and aquatic resources compared to PES
- STCD also positive outcomes
- Under DEV and ESBC there are big losses
- Felt by the most vulnerable of society

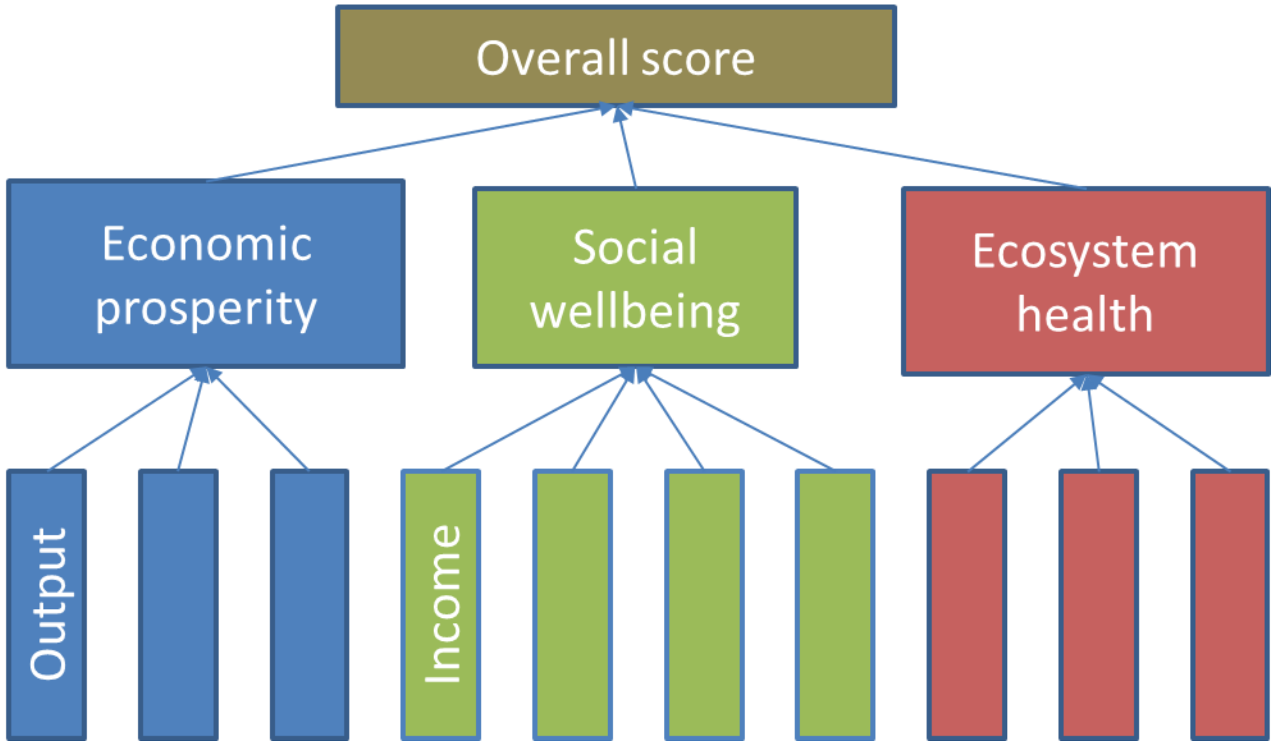




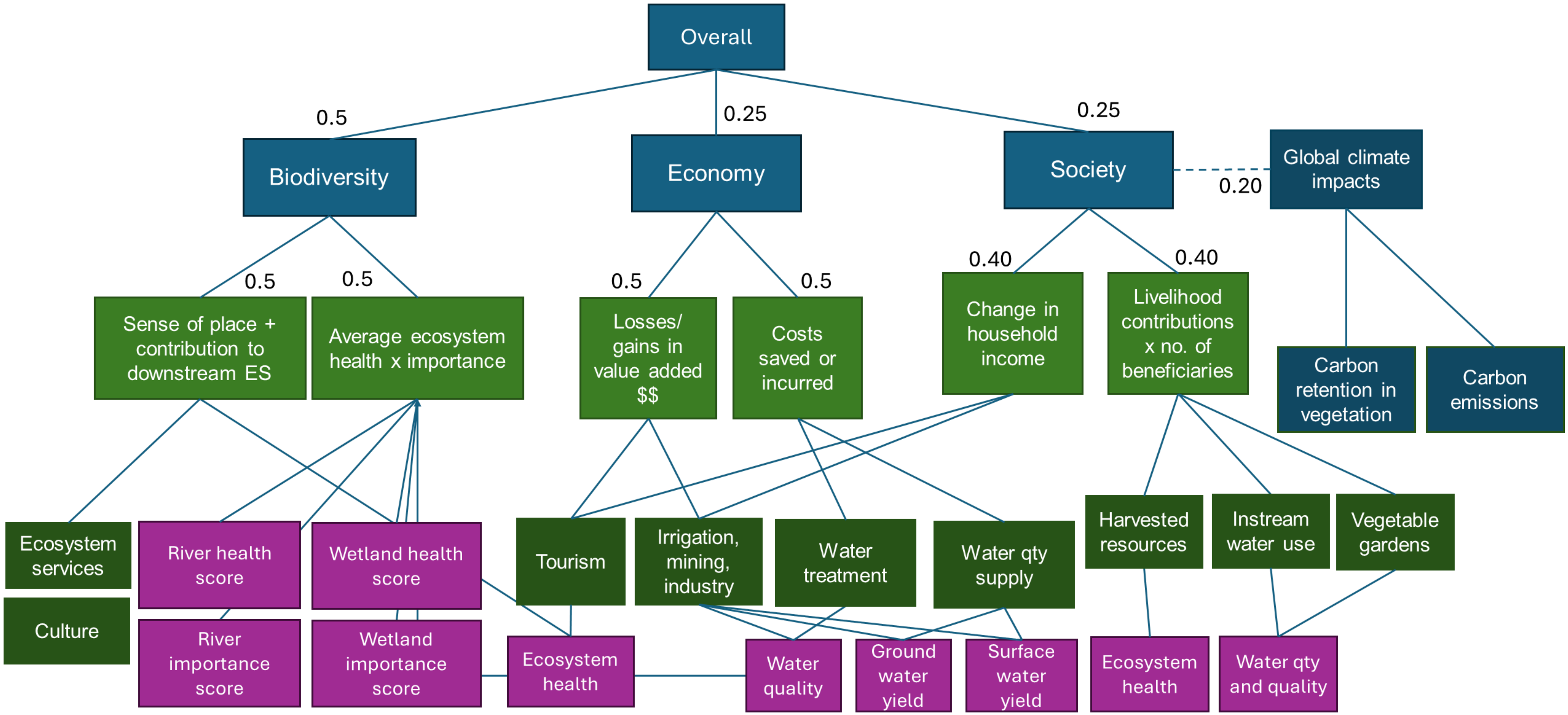
OVERALL COMPARISON OF SCENARIOS

MULTI-CRITERIA ANALYSIS (MCA)

- Each scenario is scored based on the change in a range of ecological, economic and social measures and/or indices
- Method to compare alternatives where the outcomes (consequences) are in different numerical terms
- To score scenarios,
  - Score sub-criteria
  - Then aggregate scores for main criteria
  - Then calculate overall score

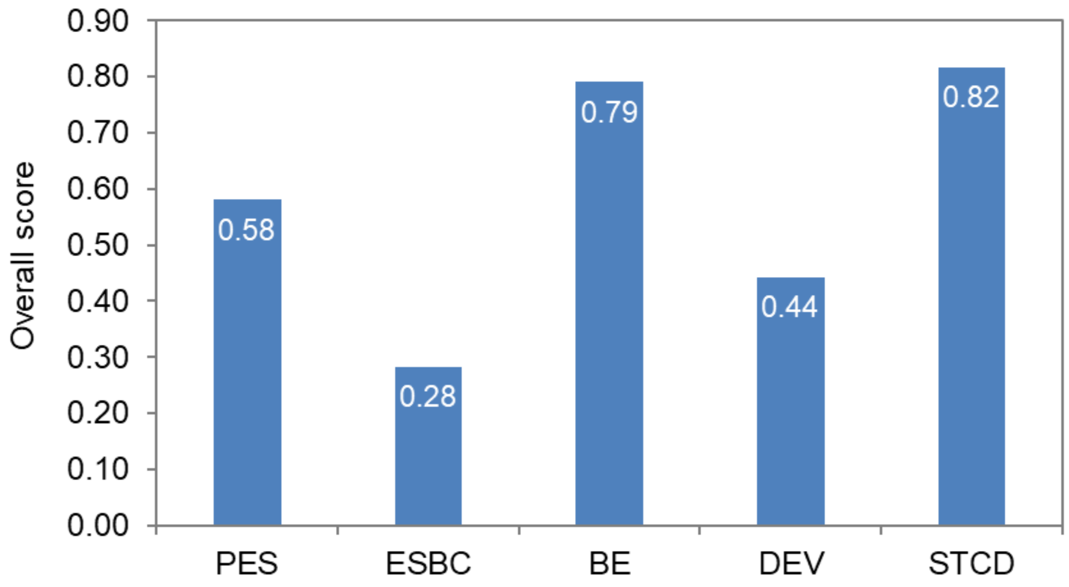


MULTICRITERIA ANALYSIS



OVERALL RANKING OF SCENARIOS

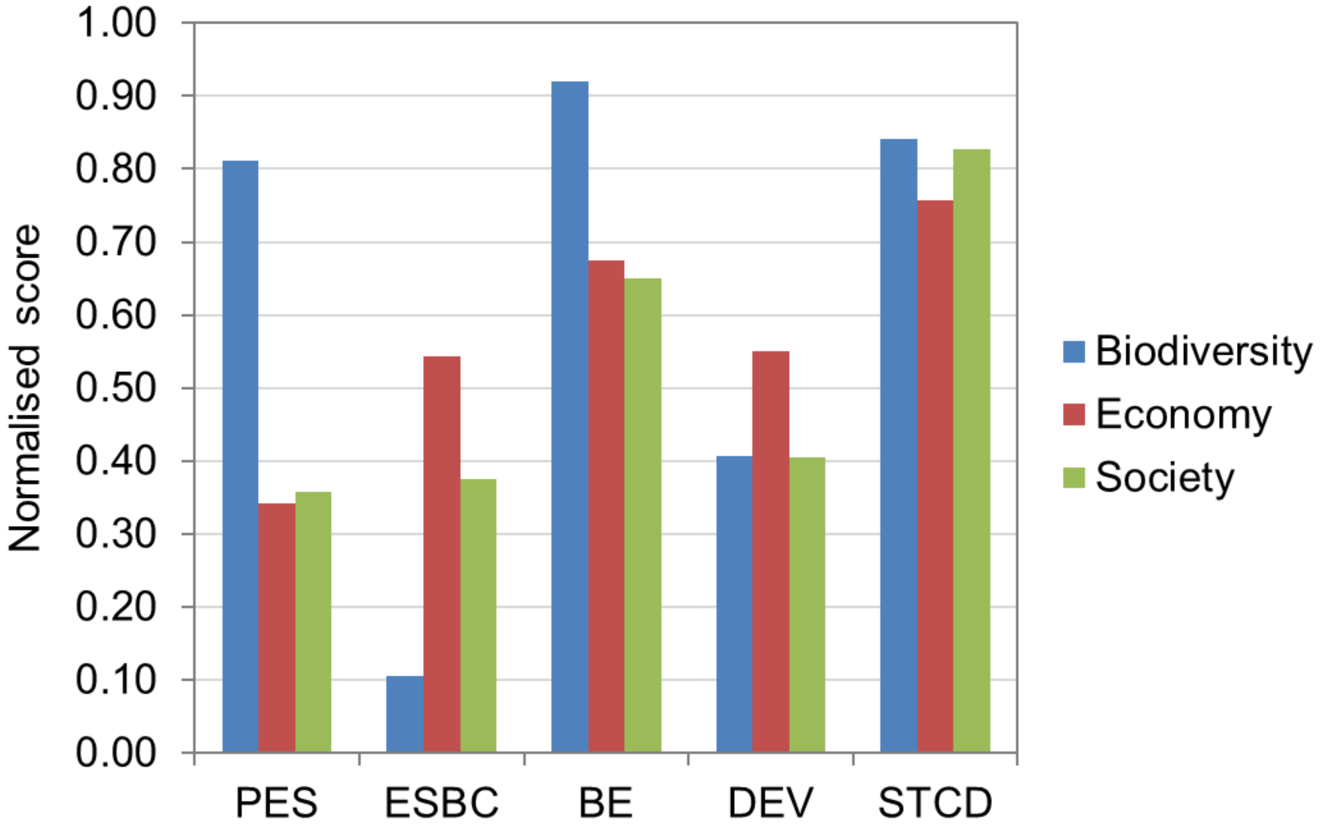
- STCD ranked highest followed by BE
- DEV very high water supply costs and biodiversity + societal impacts



Variable	PES	ESBC	BE	DEV	STCD
Biodiversity	0.81	0.11	0.92	0.41	0.84
Economy	0.34	0.54	0.67	0.55	0.76
Society	0.34	0.38	0.65	0.40	0.81
Overall score	**0.58**	**0.28**	**0.79**	**0.44**	**0.81**

OVERALL RANKING OF SCENARIOS

- Trade-offs are clear
- Socio-economic gains are highest under the STCD scenario with a small gain in biodiversity when compared to PES



SENSITIVITY ANALYSIS

- Change weighting to be equal across Biodiversity, Economy, Society (0.33)
- Then STCD still ranked highest (0.80), followed by BE (0.75)
- DEV and ESBC remain low due to their overall poor biodiversity scores, high water supply costs and losses in ES

Luvuvhu River

OVERALL COMPARISON OF SCENARIOS

Scenario	Ecological Condition (SW)	Groundwater	Socio-economics
STCD	Positive biodiversity impact. A balance of ecological conditions, similar to baseline but with some improvements in high priority areas.	Consideration is given to high ecological priority areas. GW development is limited to a low to moderate stress index. The potential impact on the GW levels due to abstraction is considered less likely.	Improvement in EGSAs, moderate water supply costs, high GDP gains and highest impact on hh income.
BE	Positive biodiversity impact. Improvements in ecological conditions based on flow alone for some areas, others require management interventions.	The potential reduction in GW use for over exploited areas may result in a positive impact on GW levels, especially, during drought cycles.	Big improvement in EGSAs, lower water supply costs, lower GDP gains.
DEV	Biodiversity loss. Reductions in ecological conditions, but not as severe as the ESBC scenario, downstream WQ deteriorates.	Additional GW abstraction potential, i.e. in areas with low existing use and have a moderate to high exploitation potential. For most catchments these do not deviate significantly from the present status.	Significant decrease in EGSAs, very high water supply costs, highest gains in GDP.
ESBC	Biodiversity loss. Severe reduction in ecological conditions, downstream WQ deteriorates.	Additional GW abstraction potential, i.e. in areas with low to moderate existing use and have potential for GW development but may result in a reduction of GW contributing to baseflow or seepage springs.	Largest decrease in EGSAs, very high water supply costs, highest gains in GDP.

WATER RESOURCE CLASSES

WATER RESOURCE CLASSES

- Classes set at IUA level based on proportion of EC's in the aquatic ecosystems.

	A	B	C	D
Class I		70		
Class II			70	
Class III:				100
Alt Class II:		60		40

Class I: Minimally used

The configuration of ecological categories of the water resources within a catchment results in an overall water resource condition that is minimally altered from its pre-development condition.

Class II: Moderately used

The configuration of ecological categories of the water resources within a catchment results in an overall water resource condition that is moderately altered from its pre-development condition.

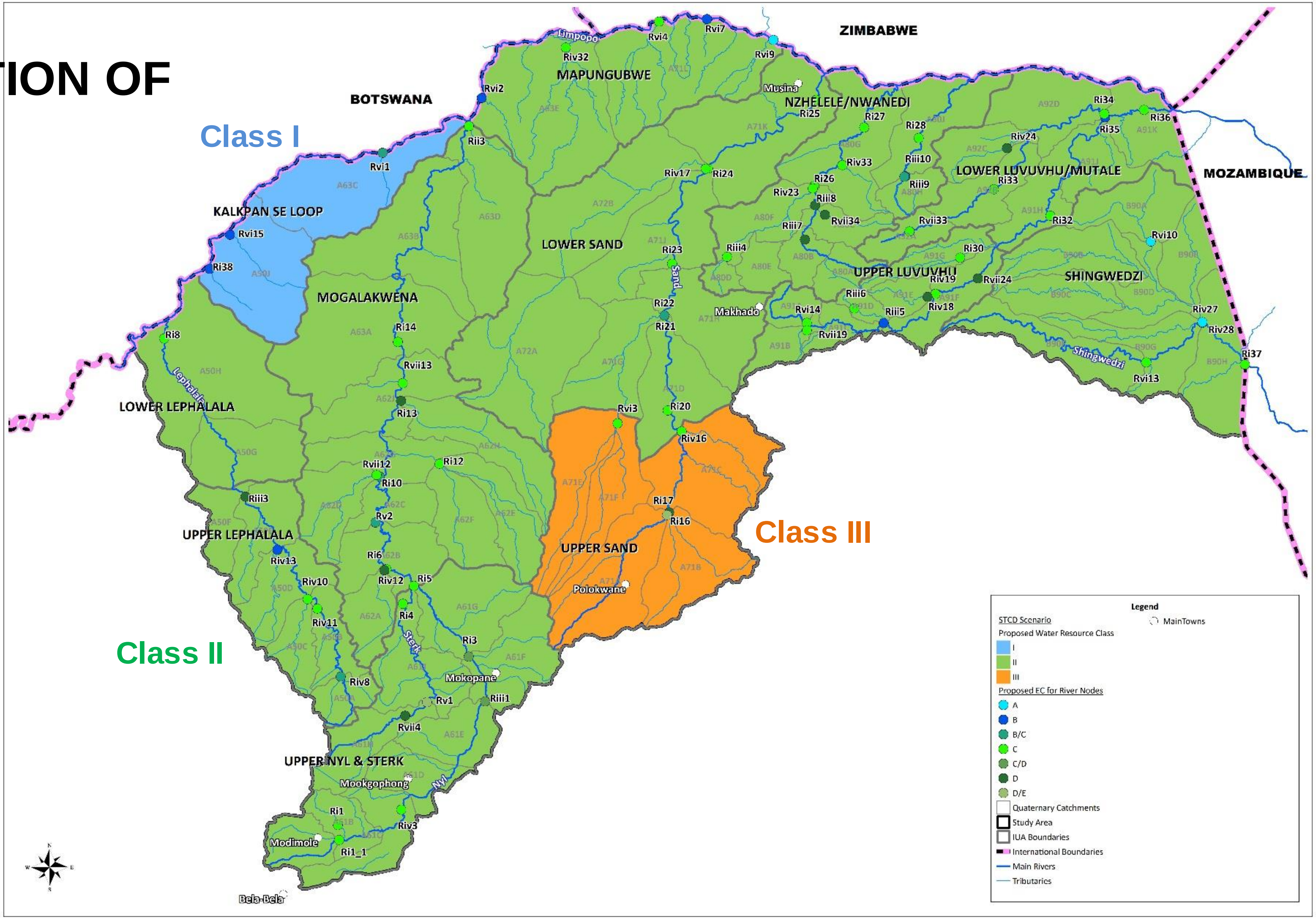
Class III: Heavily used

The configuration of ecological categories of the water resources within a catchment results in an overall water resource condition that is significantly altered from its pre-development condition.

COMPARISON OF WATER RESOURCE CLASSES

IUA	PES	ESBC	BE	DEV	STCD
Lephalala	II	II	II	II	II
Kalkpan se Loop	I	III	I	I	I
Upper Nyl & Sterk	III	III	II	III	II
Mogalakwena	II	III	II	II	II
Mapungubwe	II	III	I	II	II
Upper Sand	III	III	III	III	III
Lower Sand	II	II	II	II	II
Nzhelele/Nwanedi	II	III	II	II	II
Upper Luvuvhu	II	III	II	II	II
Lower Luvuvhu/Mutale	II	III	II	III	II
Shingwedzi	II	III	II	II	II

CONSIDERATION OF THE STCD

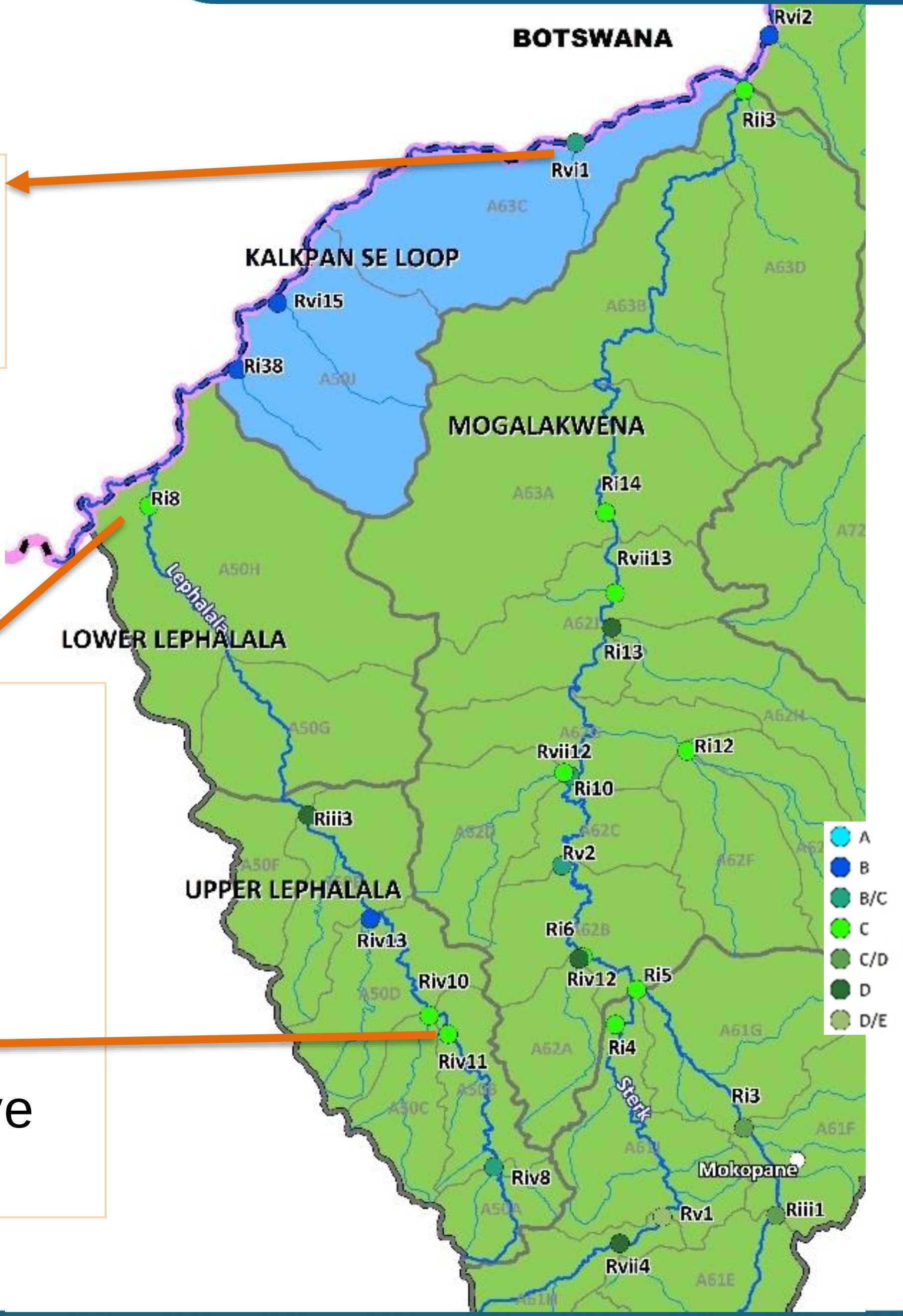


LEPHALALA & KALKPAN SE LOOP

Kalkpan se Loop
Rvi1 (EWR site 2_Rietfontein) REC: B/C
- STCD = B/C

Lephalala
Ri8 (EWR site LEPH-A50H-SEEKO) REC C
- STCD = C

Riv11 (EWR site 1_Lephalala) REC B/C
- STCD = C
- Management recommendations: Remove invasive alien plants, stock indigenous fish



UPPER NYL & STERK AND MOGALAKWENA

Mogalakwena IUA
Rii3 (EWR site MOGA-A63D-LIMPK) REC C
- STCD = B/C

Ri14 (EWR site 5_Mogalakwena2) REC C
- STCD = B/C

Ri5 (EWR site 4_Mogalakwena1) REC C
- STCD = B

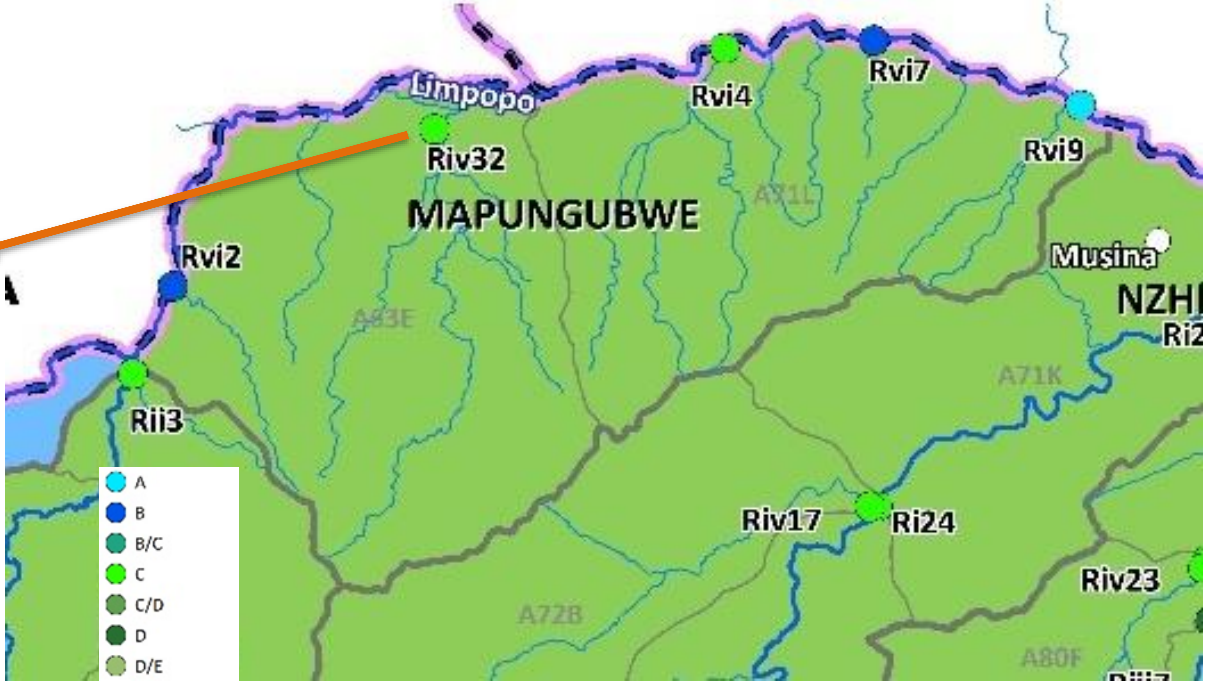
Upper Nyl & Sterk IUA
Ri1 (EWR site Olifantspruit) REC B/C
- STCD = C

Management recommendations: clear IAPs, limit water use for Nylsvlei

MAPUNGUBWE

Mapungubwe
Riv32 (EWR site 6_Kolope) REC B/C
- STCD = C

Management recommendations: Curb bank instability (at gabions), monitor recovery of riparian vegetation

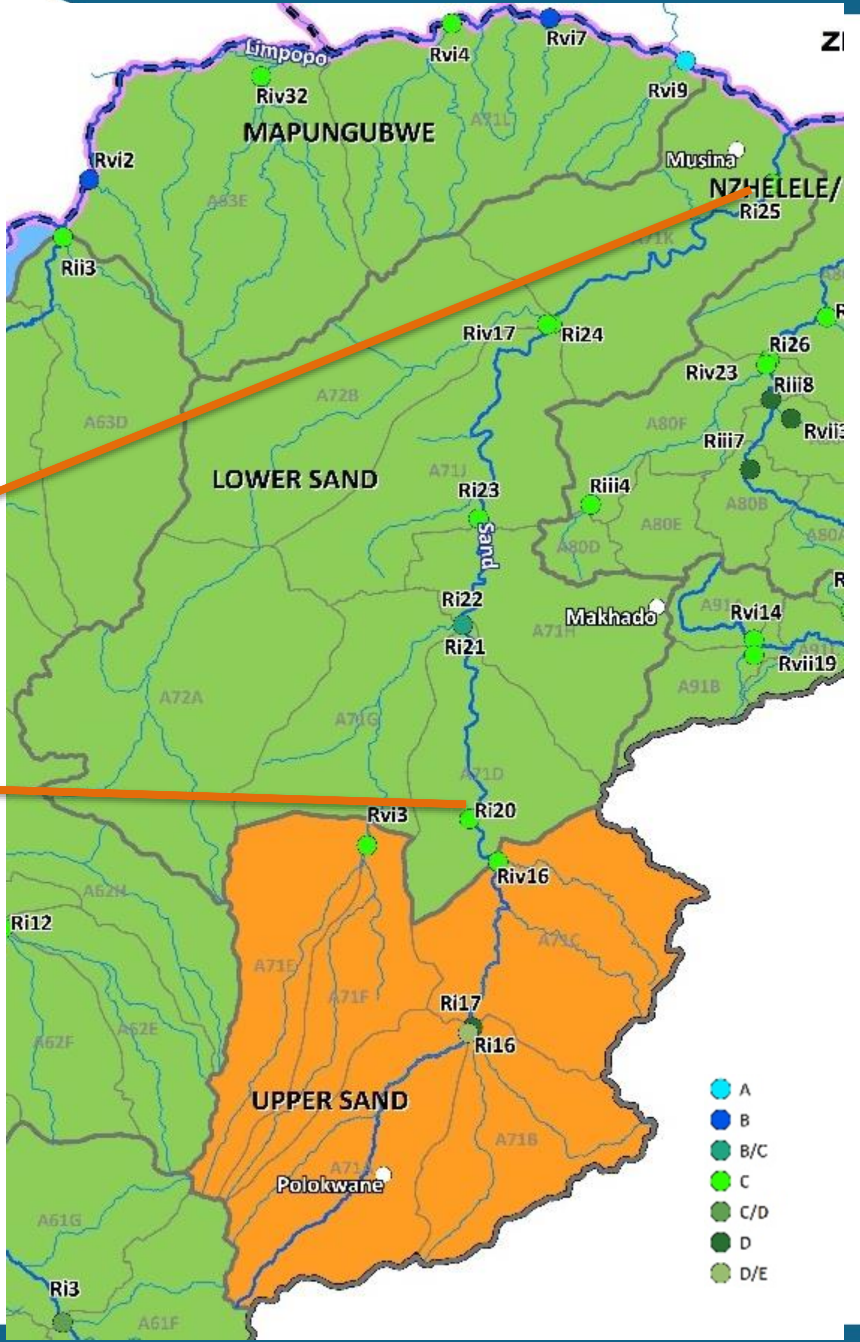


UPPER AND LOWER SAND

Lower Sand
Ri25 (EWR site SAND-A71K-R508B)   REC C
- STCD = C
- EWRs must be met at the Limpopo River, i.e. must flow into the Limpopo River

Ri20 (EWR site 7_Sand)   REC C
- STCD = C

Upper Sand
Better management of WWTW & treatment of the water currently being released into upper Sand is needed.
Consideration of water reuse scheme in Polokwane



NZHELELE / ṄWANEḒI

Nzhelele/Ṅwaneḓi

Riv27 (EWR site 8_Nzhelele) REC C

- STCD = C

Riv28 (EWR site 9_Ṅwaneḓi) REC C

- STCD = C

Management recommendations: Maintain perennial flow downstream of dams, flows to be met at the Limpopo River

UPPER AND LOWER LUVUVHU / MUTALE

Lower Luvuvhu/Mutale IUA

Ri36 (EWR site LUVU-A91K-OUTPO): REC C

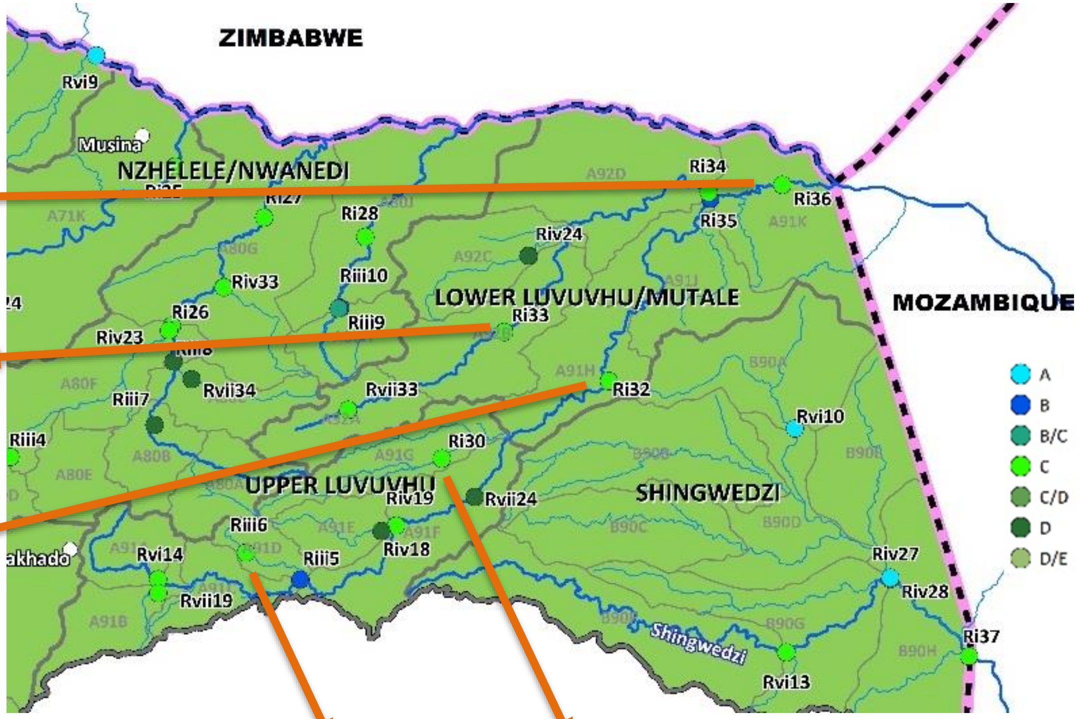
- STCD = C

Ri33 / Ri34 (EWR site 13/14_Mutale1&2): REC C

- STCD = C

Ri32 (EWR site 12_Luvuvhu): REC B/C

- STCD = B/C
- Management recommendations: better manage WWTW, control sand mining, remove IAPs



Upper Luvuvhu IUA

Riii6 (EWR site 10_Latonyanda): REC C

- STCD = C

Ri30 (EWR site 11_Mutshindudi): REC C

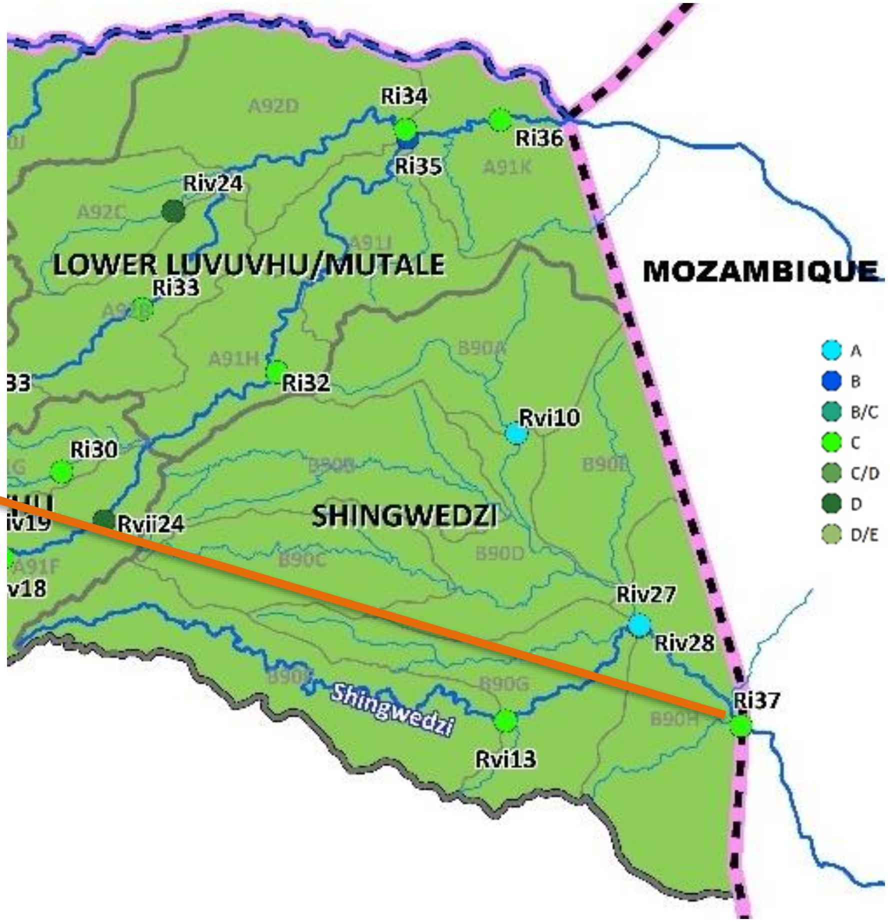
- STCD = C
- Management recommendation: remove exotic plant *Mimosa pigra)*

SHINGWEDZI

Shingwedzi IUA

Ri37 (EWR site SHIN-B90H-POACH) REC B/C

- STCD = C
- Management recommendations: improve sanitation infrastructure in the catchment, control sand mining



THANK YOU!