CLASSIFICATION OF SIGNIFICANT WATER RESOURCES AND DETERMINATION OF RESOURCE QUALITY OBJECTIVES FOR WATER RESOURCES IN THE USUTU TO MHLATHUZE CATCHMENTS (WP11387)

PUBLIC MEETINGS

Dates: 5 March 2024 Jozini
7 March 2024 Amsterdam

Presented by: Study Team

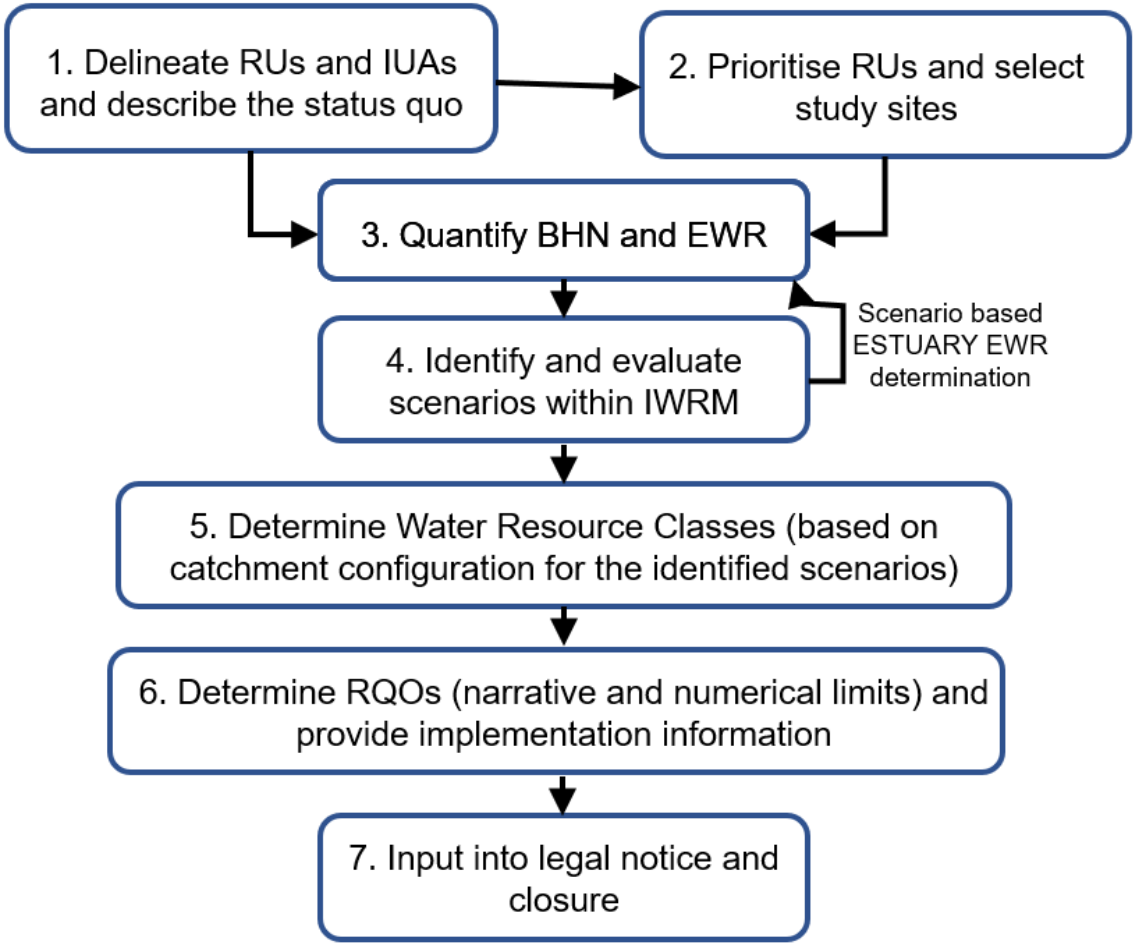
WATER IS LIFE - SANITATION IS DIGNITY

water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

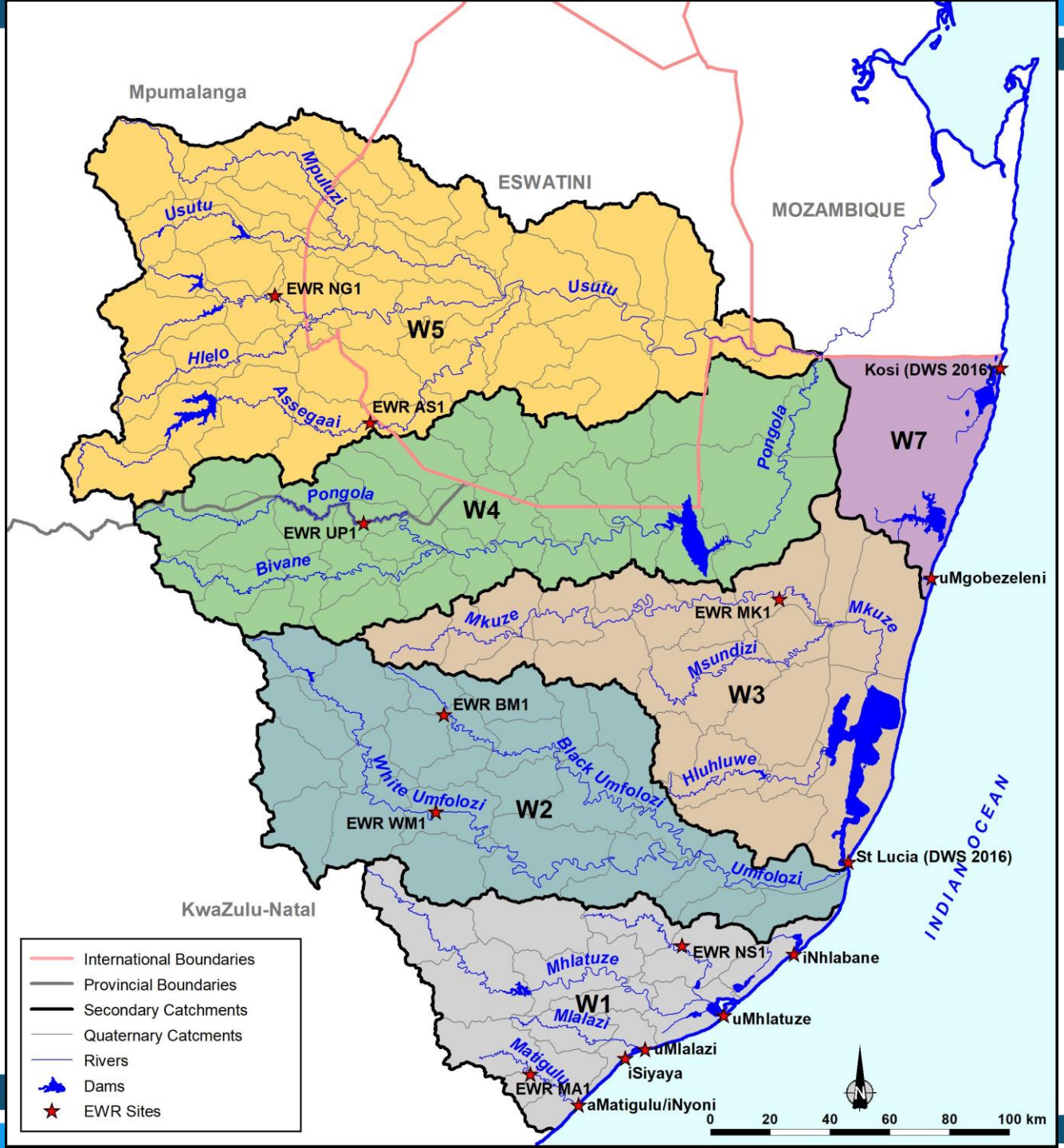
2030 NDP

The STUDY PLAN is according to the integrated framework for *Water Resource Classification, Resource Quality Objectives (RQOs) and the Reserve*



CONTENT OF PRESENTATION

- What is Classification?
- What is happening today in the study area? – Status Quo
- How could things change in the study area? - Scenarios
- How do we balance the different needs/demands? (Ecological requirements, i.e. the Reserve and use)
- What are Water Resource Classes?
- How do we implement and monitor Classes? (Resource Quality Objectives)

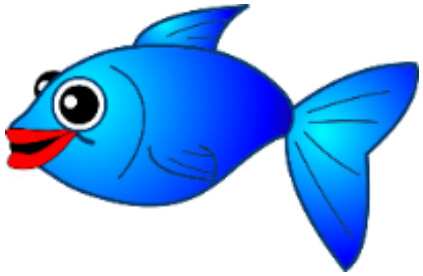

Mpumalanga
ESWATINI
MOZAMBIQUE
KwaZulu-Natal
INDIAN OCEAN
Mpuluzi
Usutu
Usutu
EWR NG1
W5
Hlelo
Assegaai
EWR AS1
Pongola
Pongola
W4
EWR UP1
Bivane
W7
Kosi (DWS 2016)
uMgobezeleni
EWR MK1
Mkuze
Mkuze
Msundizi
W3
EWR BM1
Black Umfolozi
Hluhluwe
White Umfolozi
W2
EWR WM1
Umfolozi
St Lucia (DWS 2016)
EWR NS1
iNhlabane
Mhlatuze
W1
uMhlatuze
Mlalazi
uMlalazi
Matigulu
iSiyaya
EWR MA1
aMatigulu/iNyoni
International Boundaries
Provincial Boundaries
Secondary Catchments
Quaternary Catcments
Rivers
Dams
EWR Sites
0 20 40 60 80 100 km

CLASSIFICATION
– how does it work?

WHAT IS CLASSIFICATION?

Balance between

Protection (Ecology)



Expressed as Ecological state

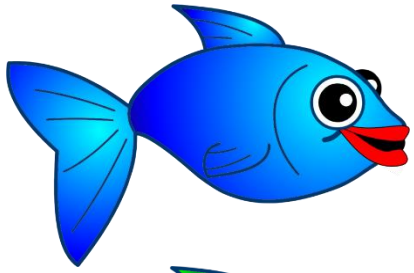
&

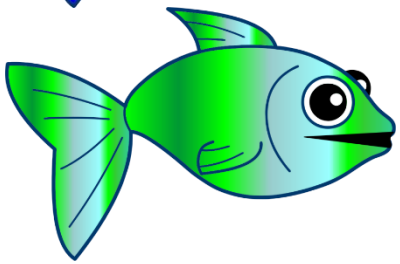
Use

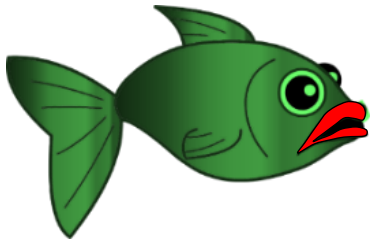
includes Water balance, user quality, socio-economics

HOW IS CLASSIFICATION DESCRIBED?

Ecology

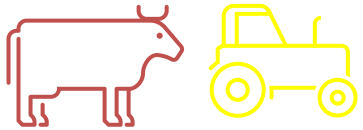


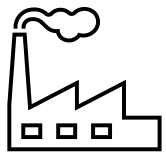




CLASSES	DESCRIPTION
I	Ecology: Mostly in good condition. Use: Minimal
II	Ecology: Mostly in moderate condition Use: Medium
III	Ecology: Mostly in poor condition. Use: High, so a work-horse river.

Use

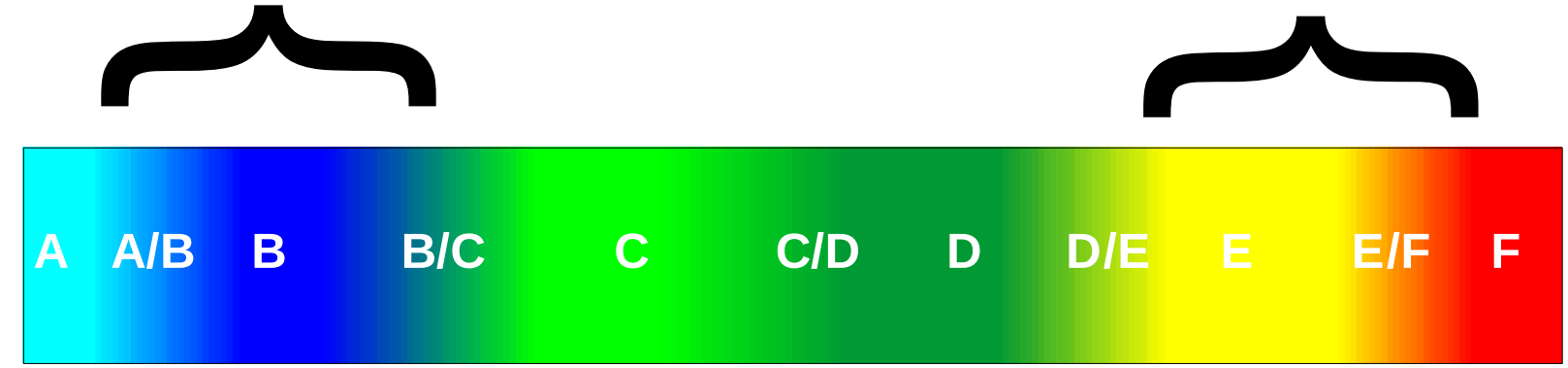




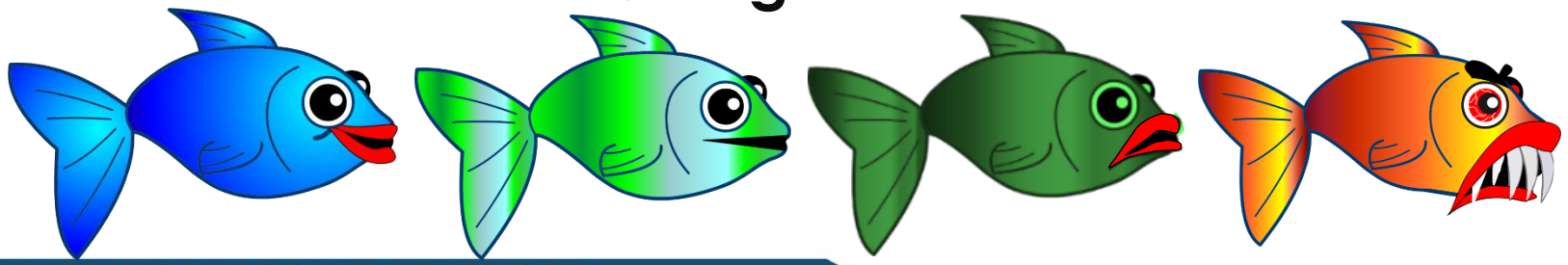
HOW IS ECOLOGY DESCRIBED?

Close to Natural: Good condition

Very different to Natural: Very Poor condition



Categories



WHAT SCALE DO WE CLASSIFY AT?

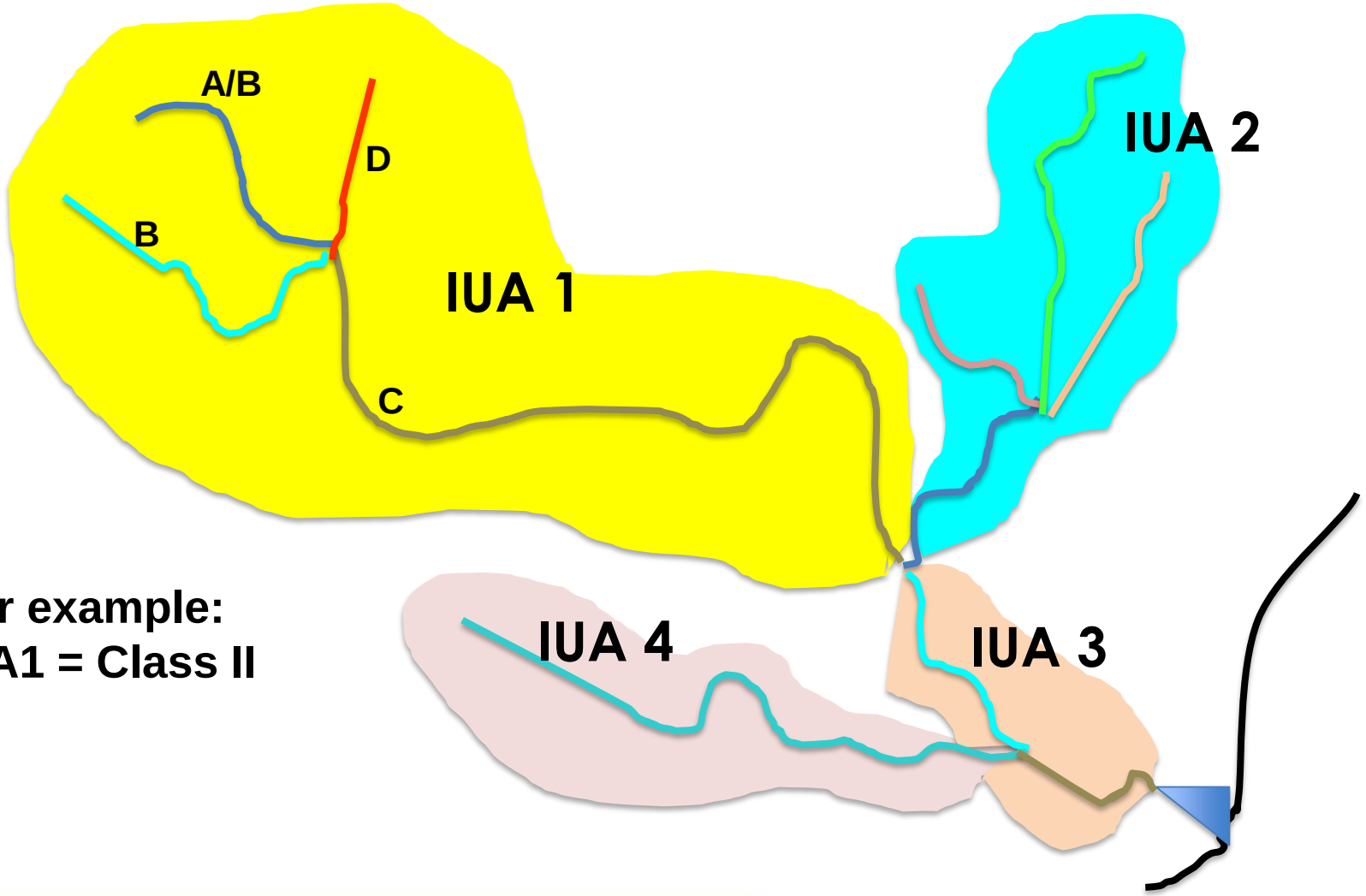
- **Classify every Integrated Unit of Analysis (IUA), i.e. the delineation unit for Classification**

  IUAs are similar in terms of land use &/or ecological state. So, an IUA consist of many river reaches and/or estuaries.

- **Provide the Catchment Configuration for every IUA, i.e. provide the ecological state for each of the river reaches and estuaries in the catchment.**

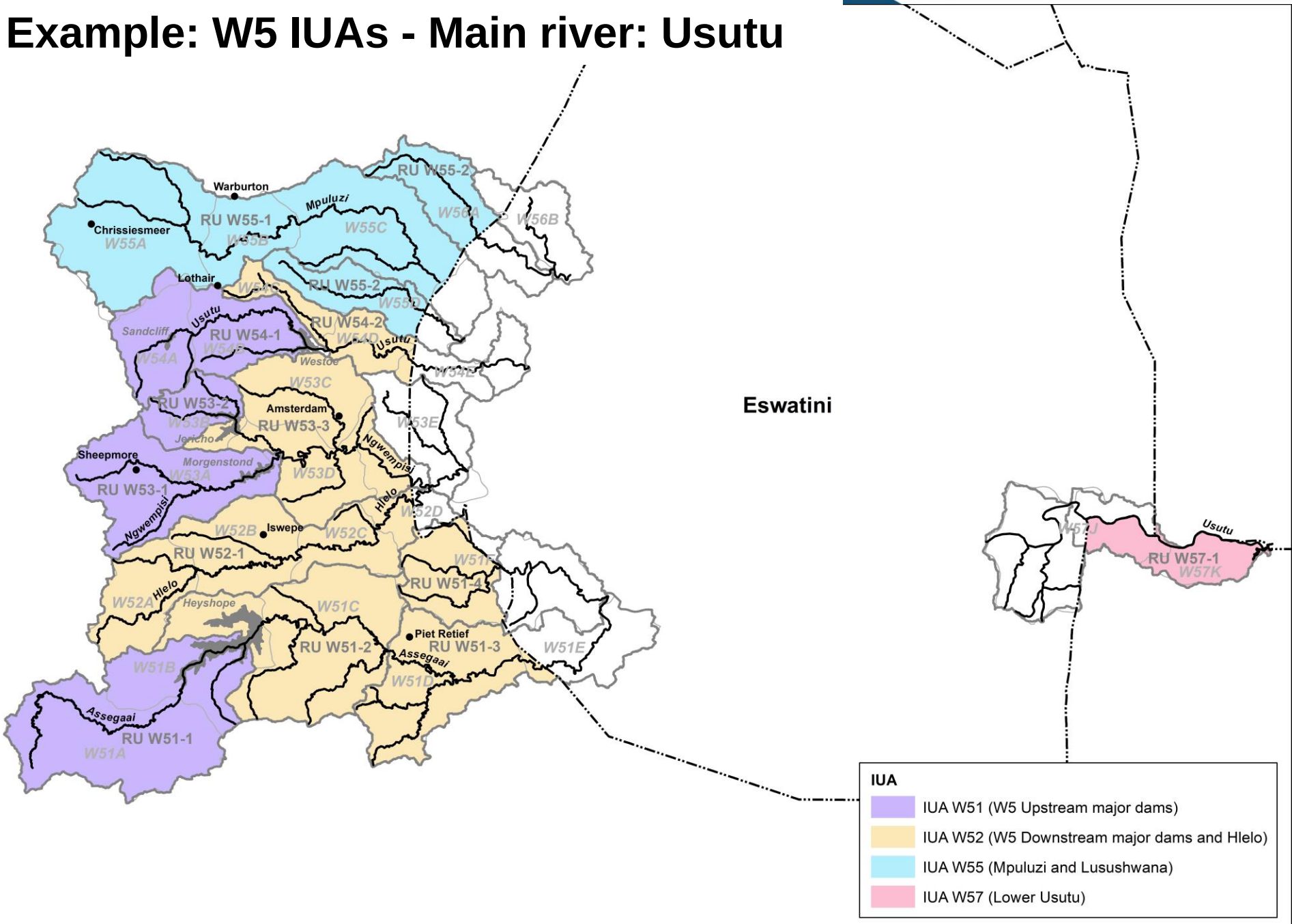
- **Ecological state can be the Present Ecological State (PES), a Recommended Ecological Category (REC), or another Category linked to a developmental scenario. The final selected category is called the Target Ecological Category (TEC; for management purposes) once classified.**

IUAs AND CATCHMENT CONFIGURATION

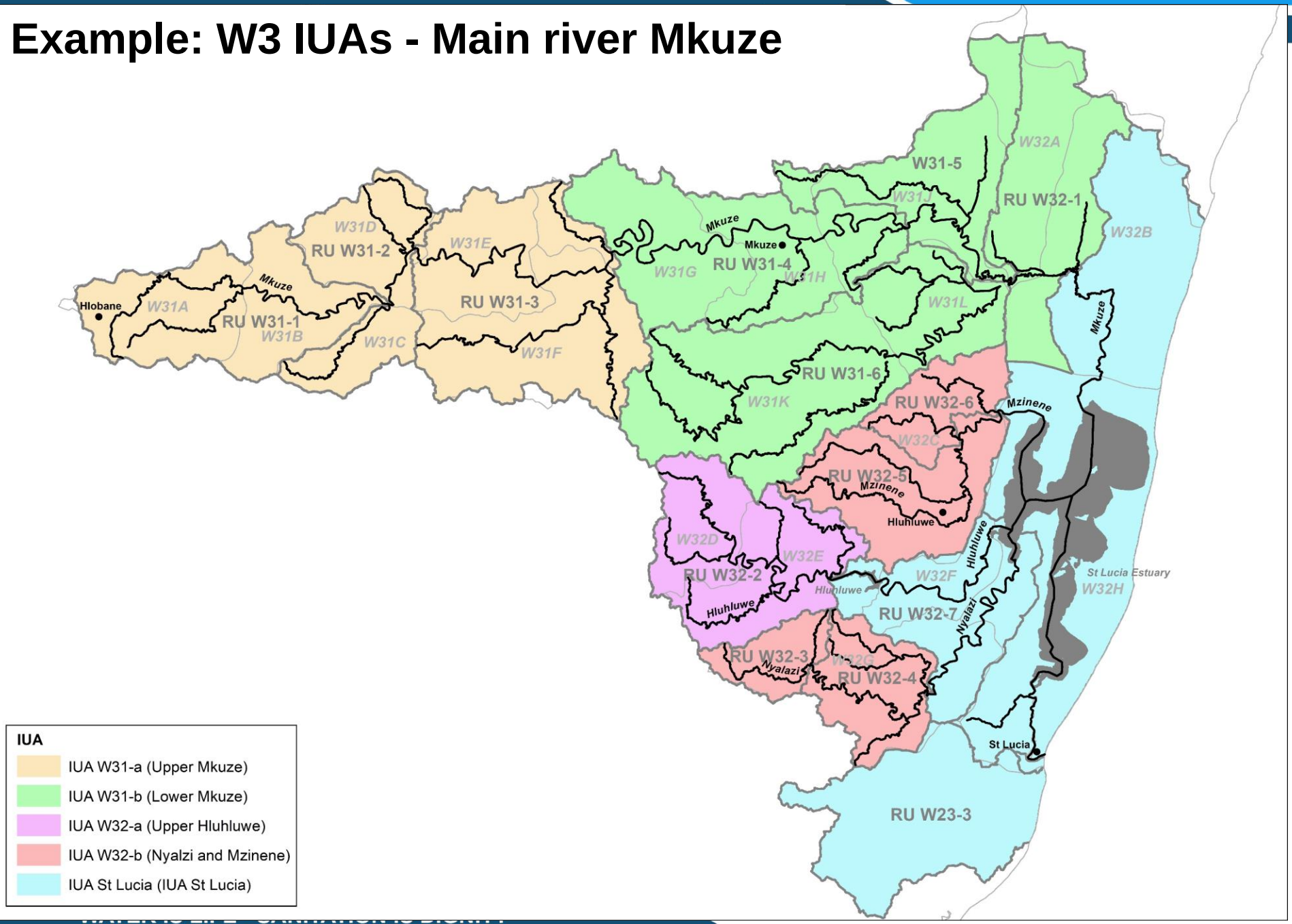


For example:
IUA1 = Class II

Example: W5 IUAs - Main river: Usutu



Example: W3 IUAs - Main river Mkuze



HOW DO WE CLASSIFY?

- Gather relevant information
- Build a step-by-step picture of the study area in terms of water resources:
  - present uses and implications
  - the ecological state and water requirements
  - future needs (ecological and user)
- Determine a balance – and implications/consequences of changes
- Apply numerous analysis tools

ASPECTS CONSIDERED IN CLASS DETERMINATION

- **Ecological Water Requirements:**
  - **88 Resource Units with biophysical sites/nodes and 8 estuaries.**
- **User water requirements (How much water is used and discharged?):**
  - **Quantity and quality.**
- **Hydrological assessment (How much water is available?):**
  - **Applied available data and models.**
- **Socio-economic activities relying on water:**
  - **GDP, Jobs (water stored and abstracted as well as wastewater discharges).**
  - **EcoSystem Services (use of water in the rivers).**
- **What are consequences (ecological, economic, ecosystem services) under certain scenarios, e.g. climate change.**

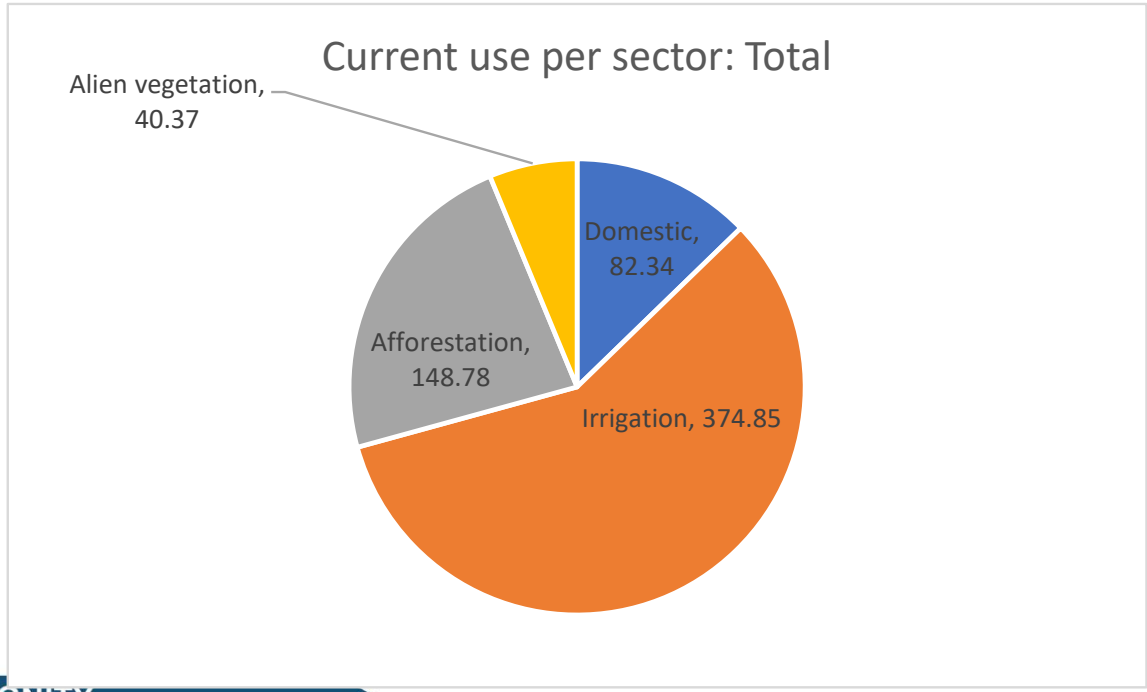
WATER RESOURCES

What is happening today?
- Status quo and Water use

WATER USE: PONGOLA TO UMFOLOZI

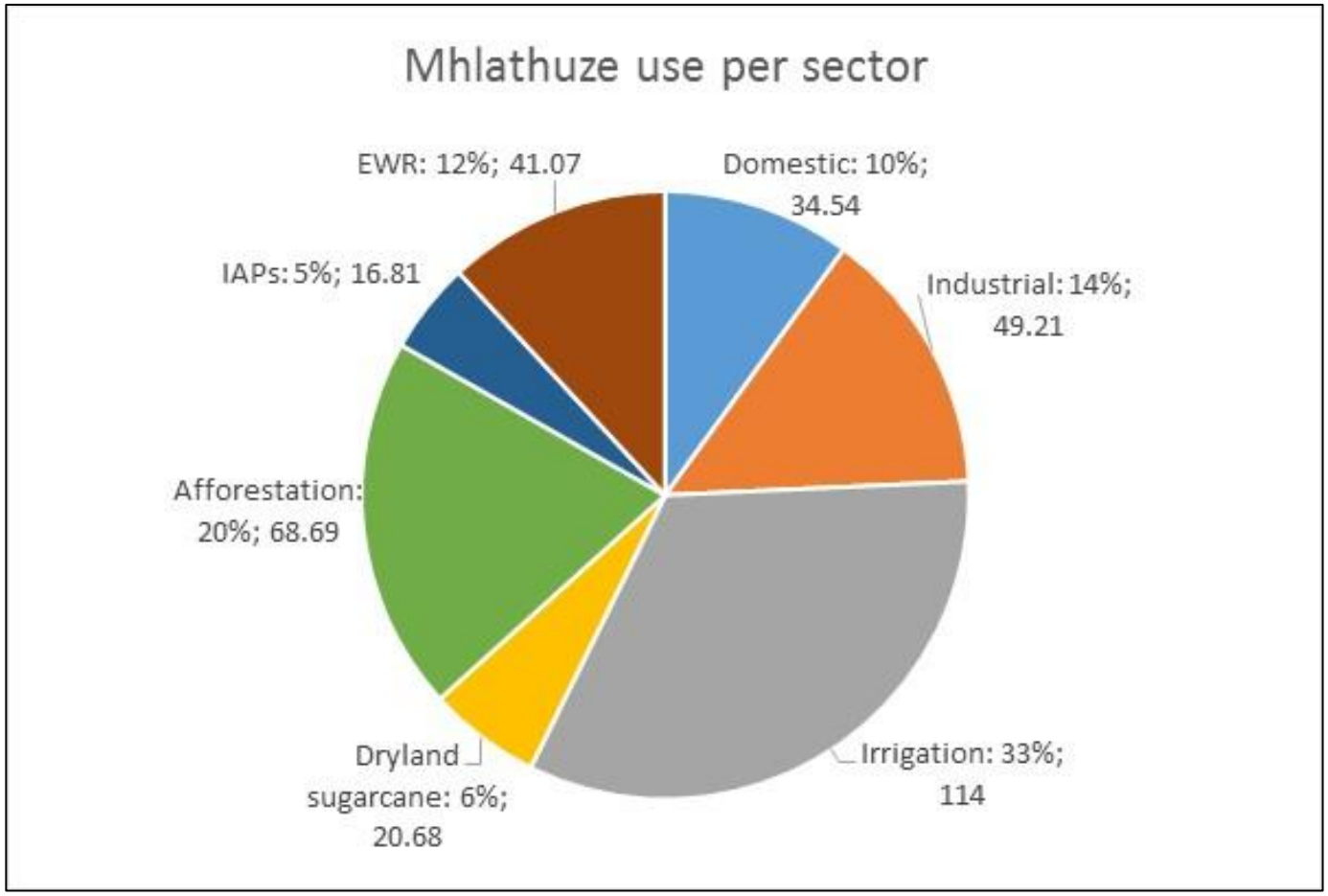
Units: million m^3/annum

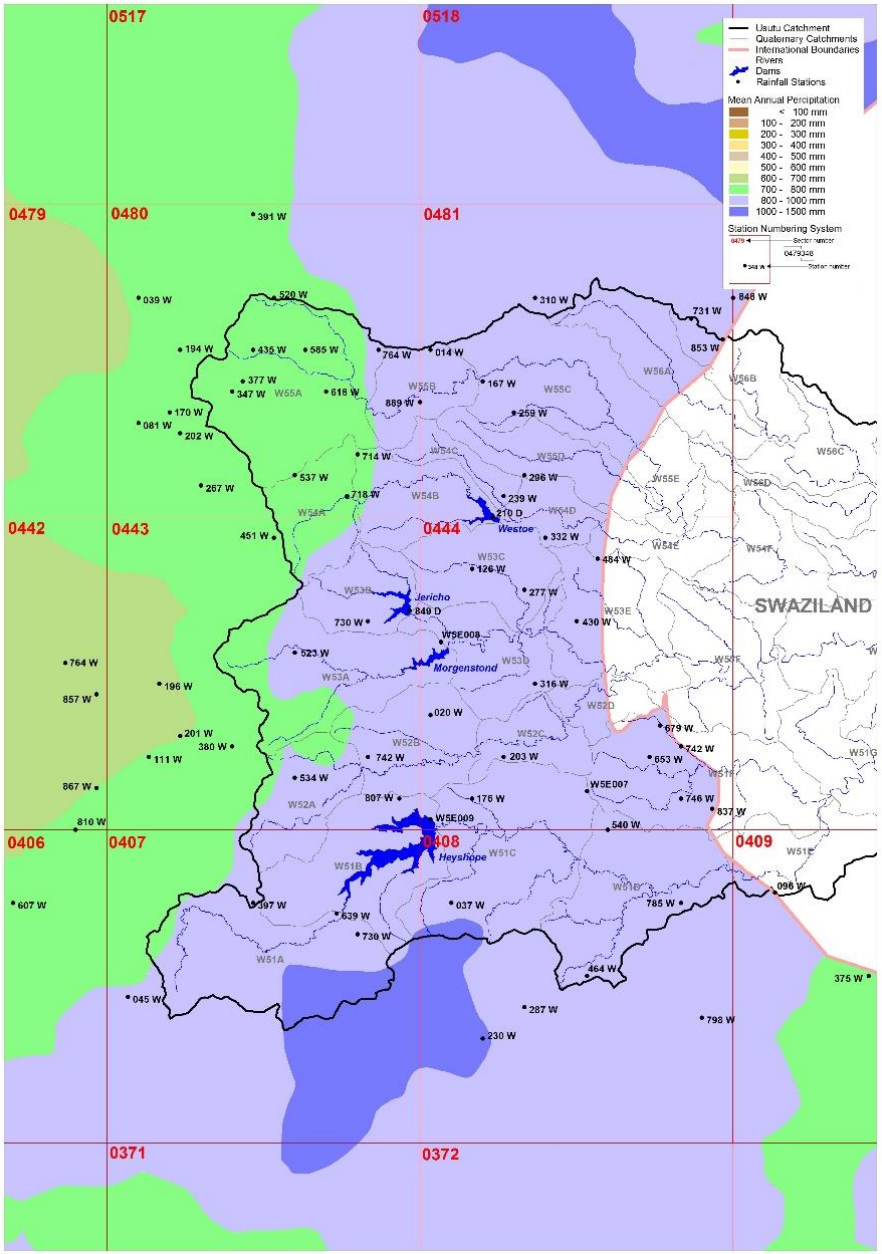
Sector	Umfolozi	Mkuze/Hluhluwe	Pongola	W7	Total
Domestic	33.52	20.69	24.10	4.03	82.34
Irrigation	43.64	58.31	272.79	0.11	374.85
Afforestation	47.27	14.44	75.21	11.86	148.78
Alien vegetation	7.98	11.02	20.85	0.52	40.37



WATER USE: MHLATHUZE

Units: million m^3/annum



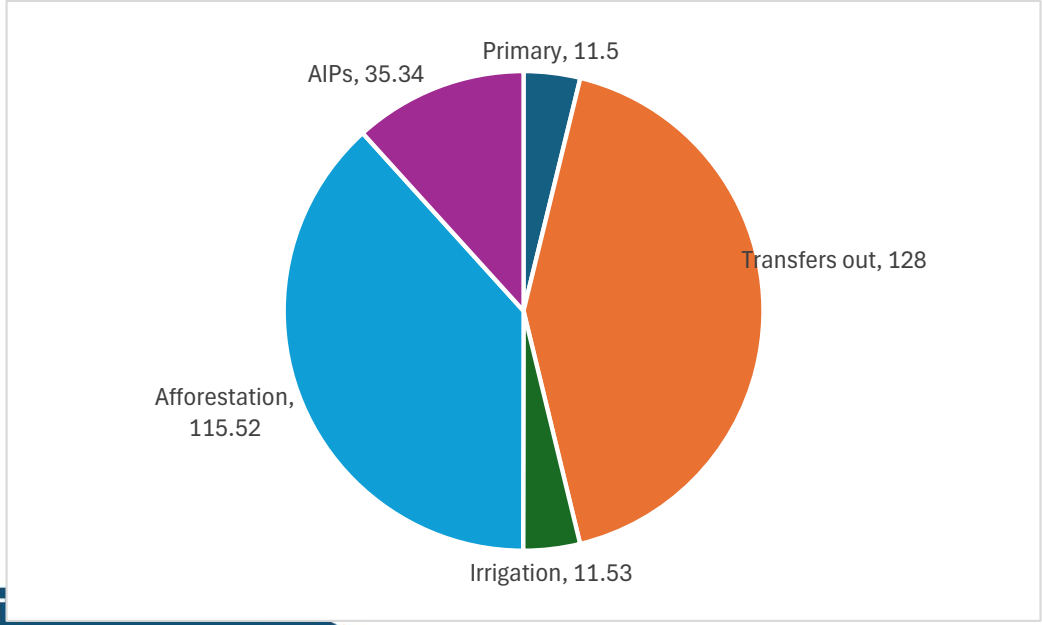

0517
0518
0479
0480
0481
0442
0443
0444
0406
0407
0408
0409
0371
0372
Usutu Catchment
Quaternary Catchments
International Boundaries
Rivers
Dams
Rainfall Stations
Mean Annual Precipitation
< 100 mm
100 - 200 mm
200 - 300 mm
300 - 400 mm
400 - 500 mm
500 - 600 mm
600 - 700 mm
700 - 800 mm
800 - 1000 mm
1000 - 1500 mm
Station Numbering System
SWAZILAND
Jericho
Westoe
Morgenstond
Heyshope

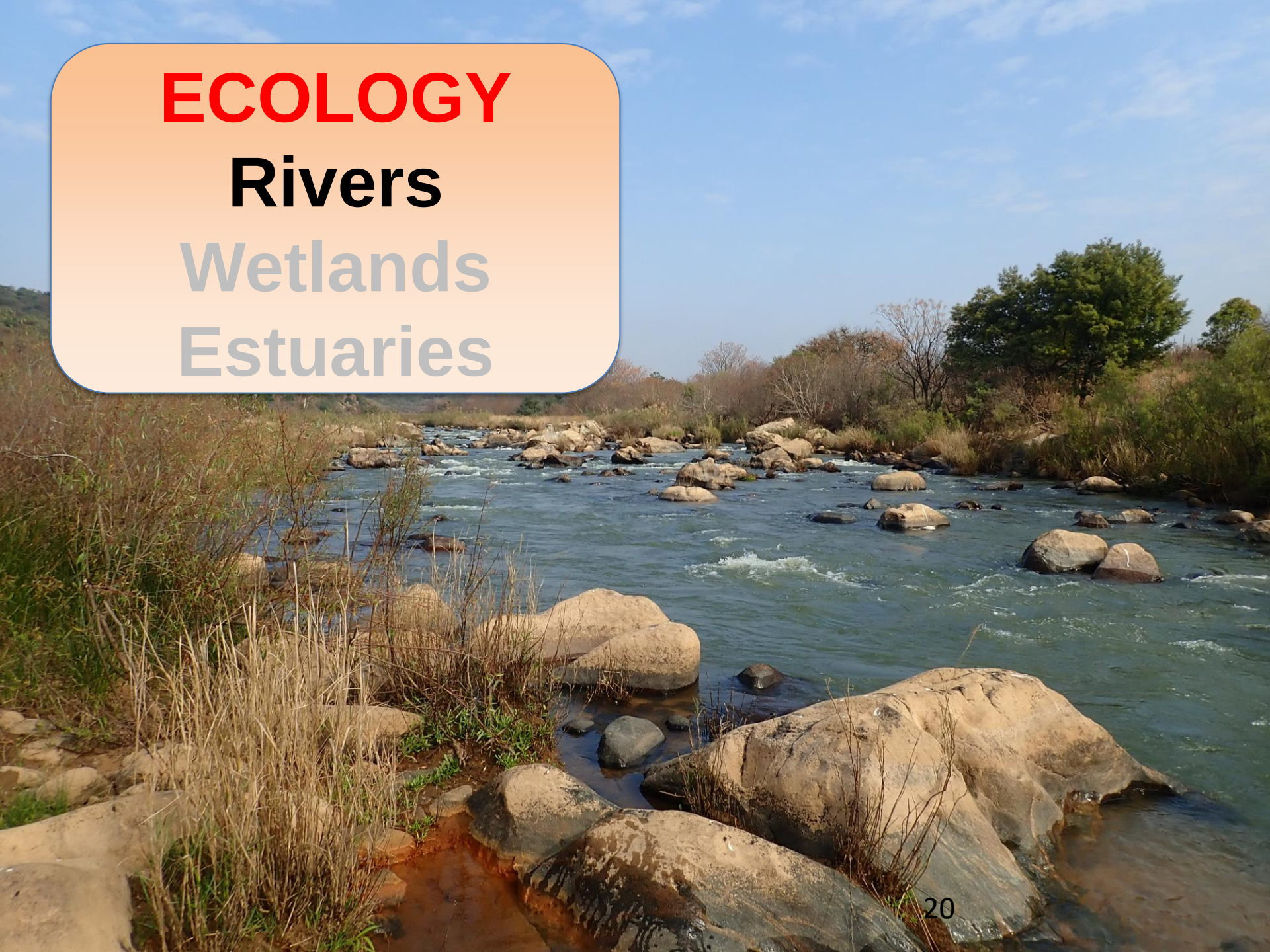

Usutu Catchment
Quaternary Catchments
International Boundaries
Rivers
Pipelines
Towns / Settlements
Dams
Gauging Stations
W5H022 Stations Used for Calibration
Lochiel
Warburton
Dundonald
Zwaluwnest
Glenmore
Lushushwane
Empuluzi
Chrissiesmeer
Breyten
KwaZanele
Lothair
Silindile
Fernie
Tinkhlulungwane
Sheepmoor
Amsterdam
Iswepe
Driefontein
Piet Retief
Ethandakukhanya
Dirkiesdorp
Mpuluzi
Lusushwana
Metula
uSuthu
Westoe
Jericho
Morgenstond
Heyshope
Hlelo
Ngwempisi
Ndlozane
Mkondvo
Asegaai
SWAZILAND
0 10 20 30 40 50 km

WATER USE: USUTU

Units: million m^3/annum

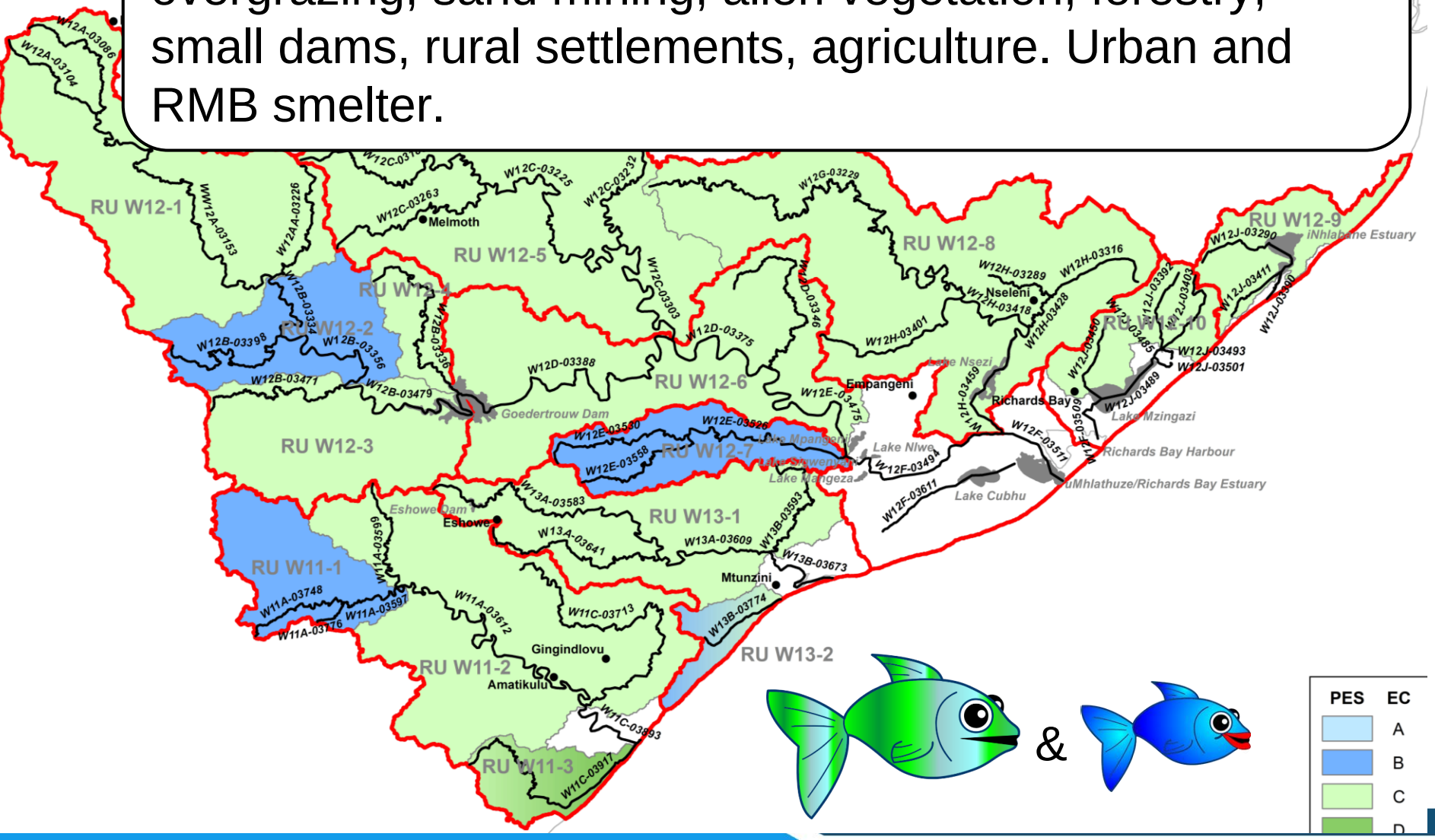
Reduction in runoff (million m^3/a)		Irrigation		Primary water users	Transfers
Afforestaion	IAP	(ha)	(million m^3/a)	(million m^3/a)	(million m^3/a)
115.52	35.34	4071	11.53	11.5	128
Sub-total	150.86		11.53	11.5	128
Percentage	50.0%		3.8%	3.8%	42.4%
Total	**301.89**				



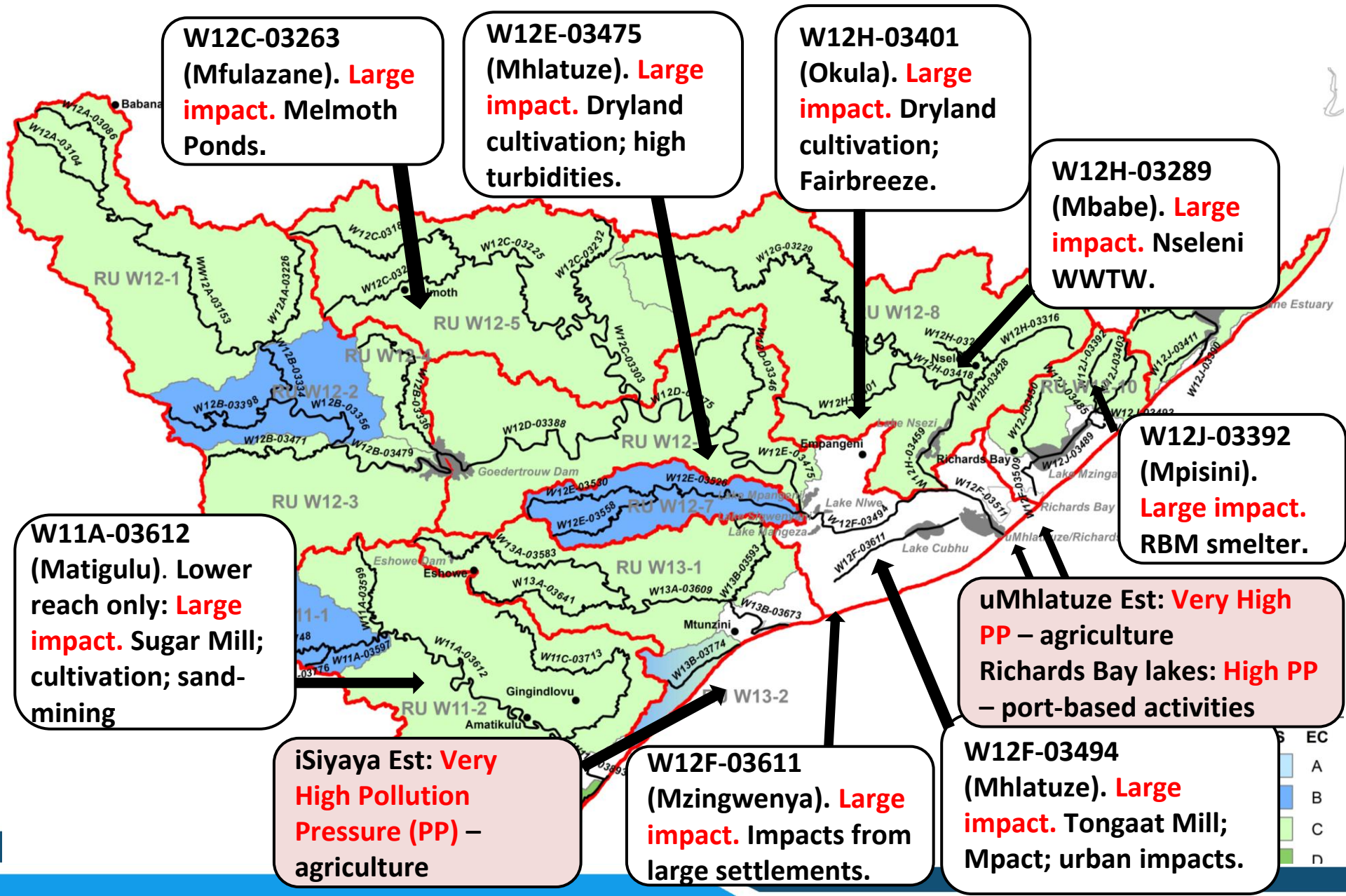

ECOLOGY
Rivers
Wetlands
Estuaries

W1 (Mhlathuze): STATUS QUO

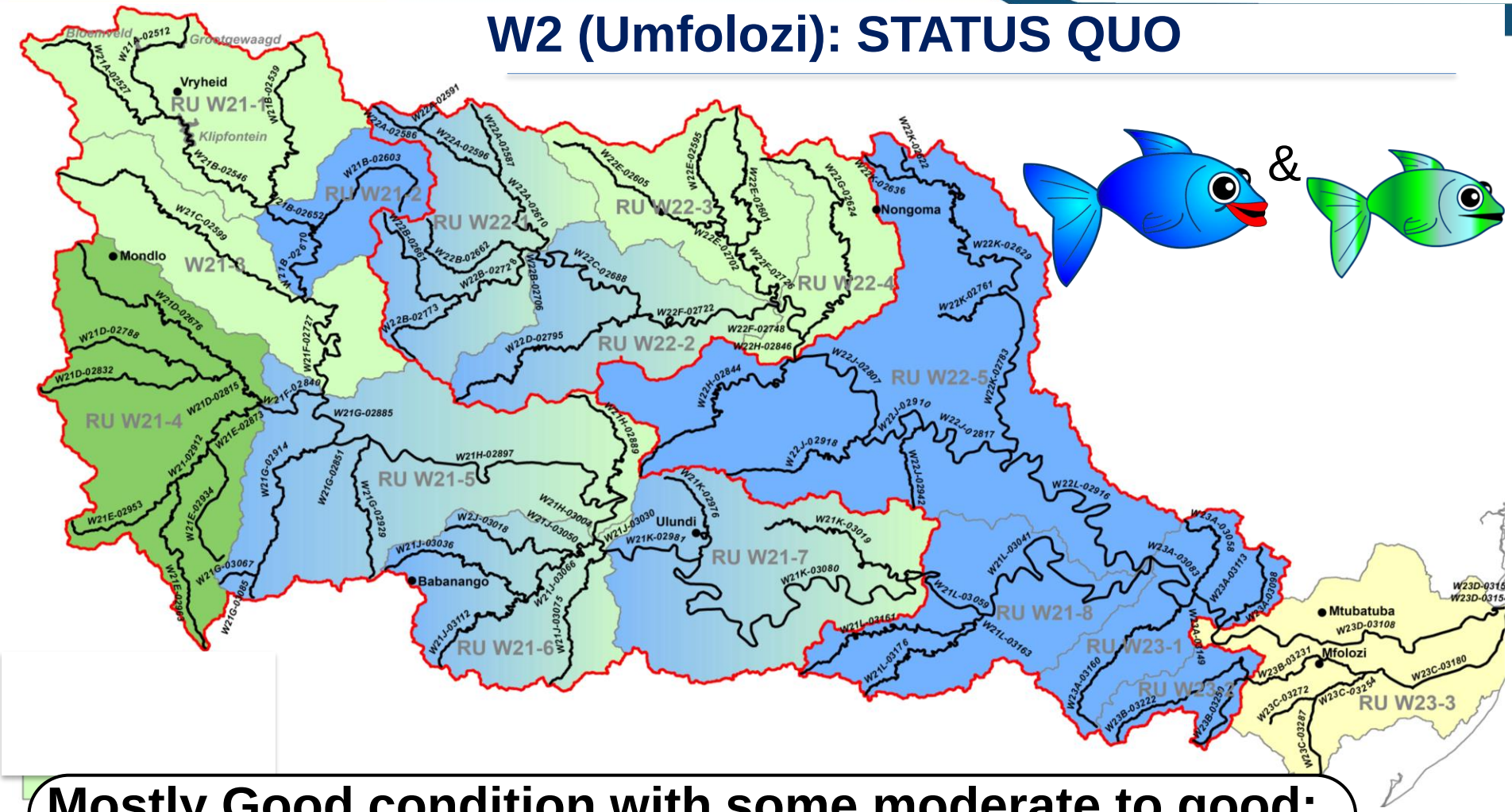
Mostly moderate condition: Roads, extensive overgrazing, sand mining, alien vegetation, forestry, small dams, rural settlements, agriculture. Urban and RMB smelter.



Example: W1 (Mhlathuze): WATER QUALITY STATUS QUO

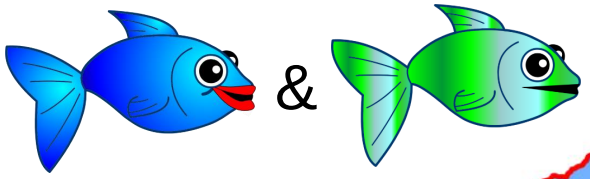


W2 (Umfolozi): STATUS QUO



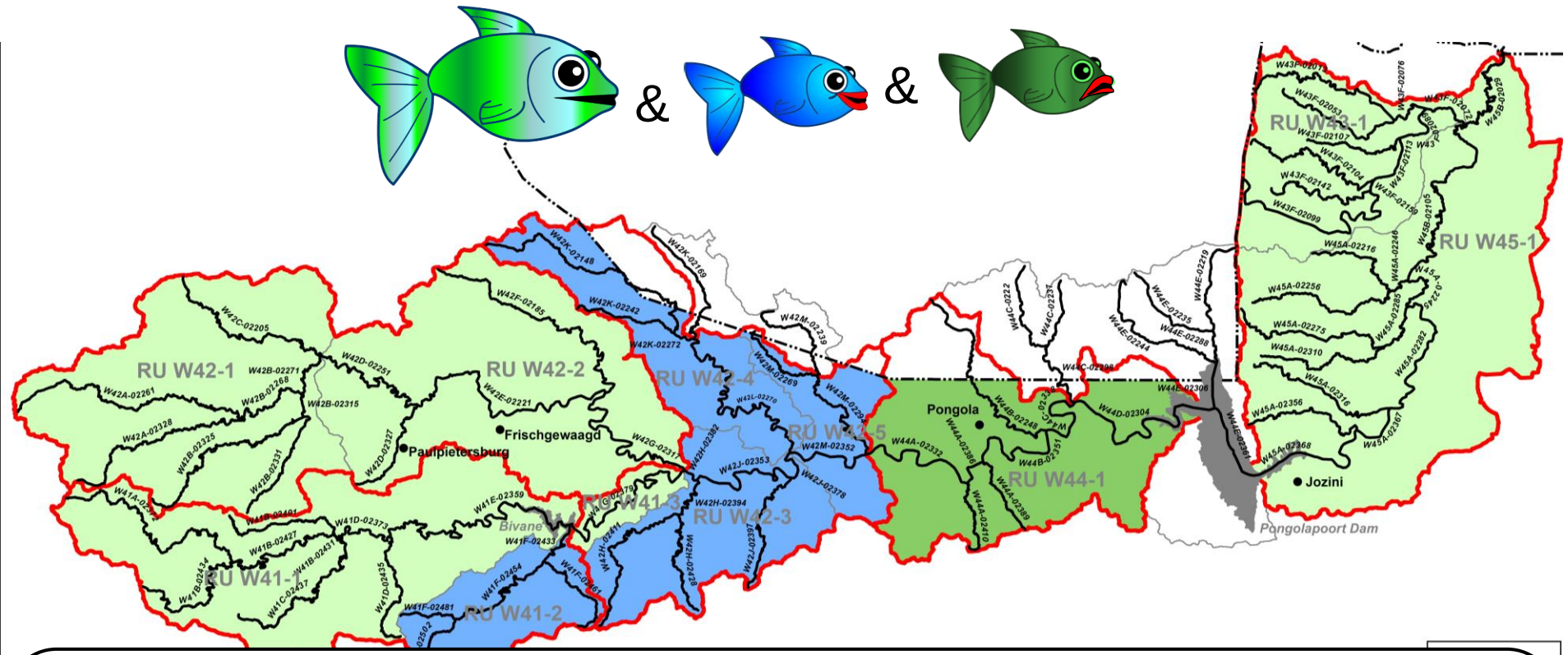
Mostly Good condition with some moderate to good: Outside Game Reserve: Forestry, dams, irrigation, erosion, sedimentation. In Game Reserve, good condition

W3 (Mkuze): STATUS QUO



Mostly Good condition with some moderate to good: Mkuze Game Park and Hluhluwe Game Reserve Good condition. Upper areas: forestry, coal mining, instream dams, rural areas, irrigation, alien vegetation erosion sedimentation. Lower areas, Sugarcane, levees, urban.

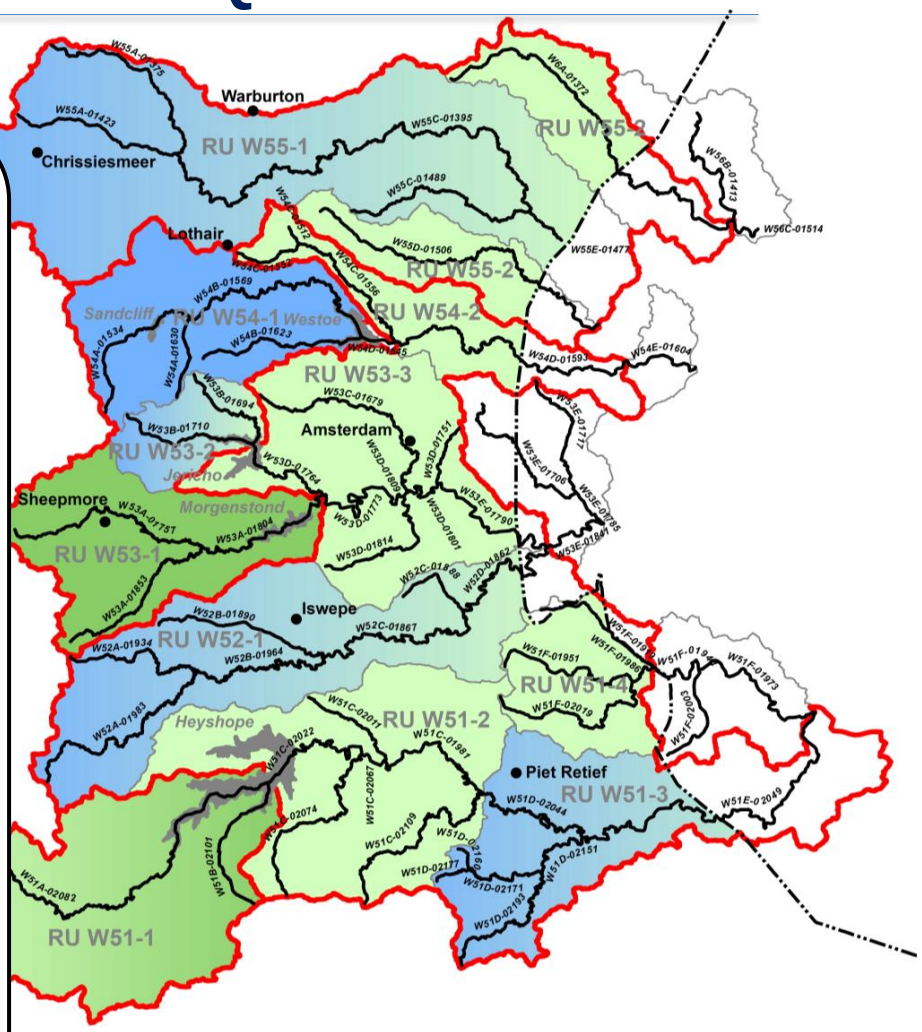
W4 (Pongola): STATUS QUO



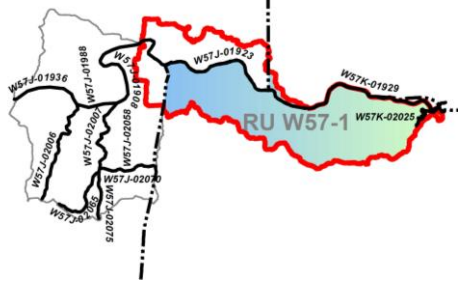
Mostly moderate condition: Alien vegetation, forestry, Paul Pietersburg (water quality), dams, overgrazing, Good condition in middle Pongola with Ithala Game Reserve. Lower Pongola Floodplain poor condition – flow changes etc.

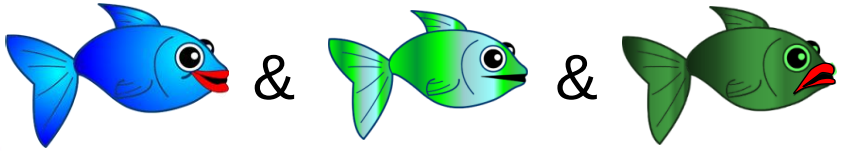
W5 (Usutu): STATUS QUO

Above large dams: Good to Moderate; Lower catchment: Moderate. Upper areas, small dams, forestry, agriculture, alien veg. Below dams, flow changes, forestry, alien veg, agriculture, mining.

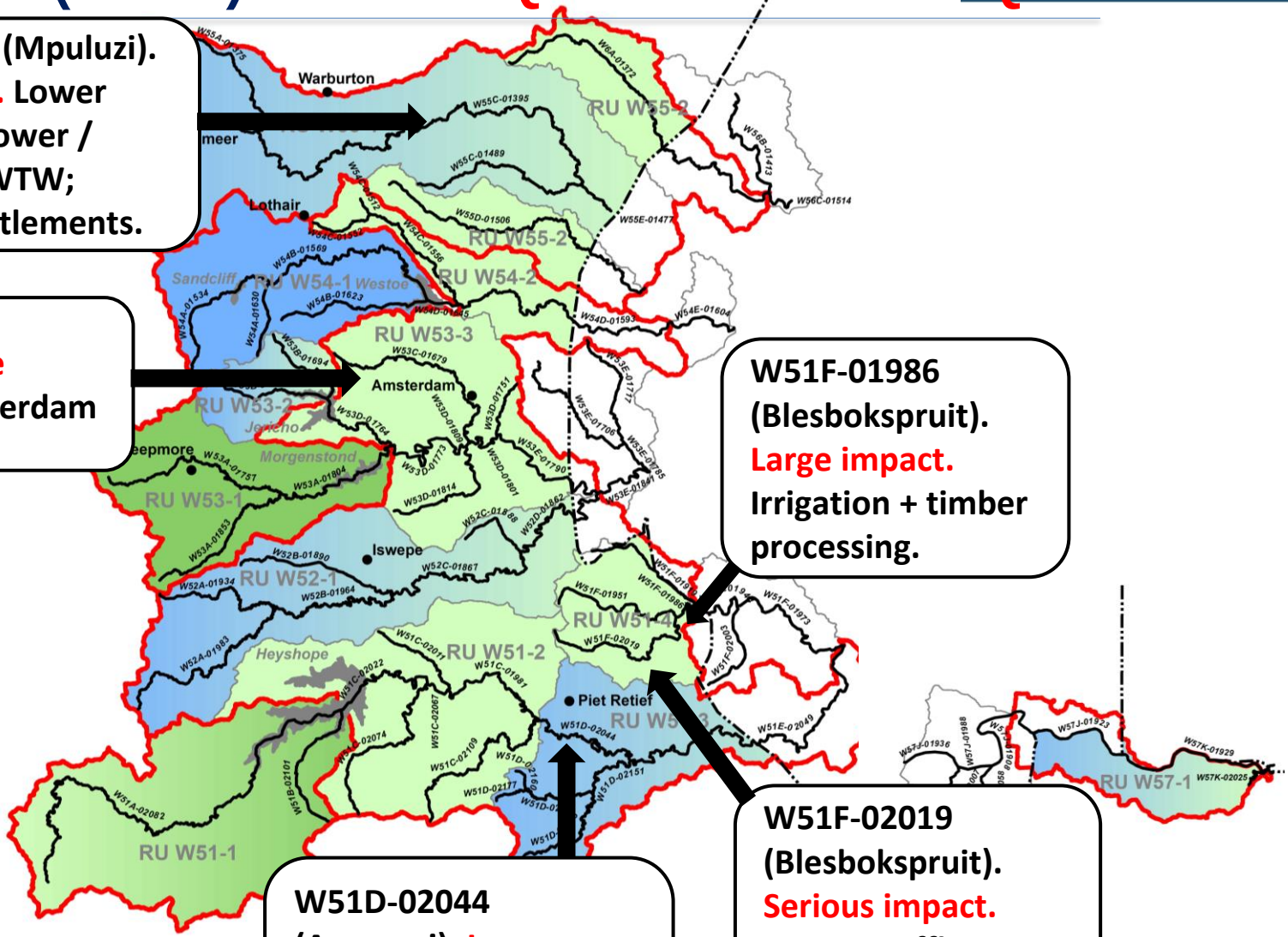


Moderate to Good: Borders Ndumo Game Reserve.





Example: W5 (Usutu) - WATER QUALITY STATUS QUO



W55C-01395 (Mpuluzi). Large impact. Lower reach: Mayflower / Empuluzi WWTW; extensive settlements.

W53C-01679 (Thole). Large impact. Amsterdam WWTW.

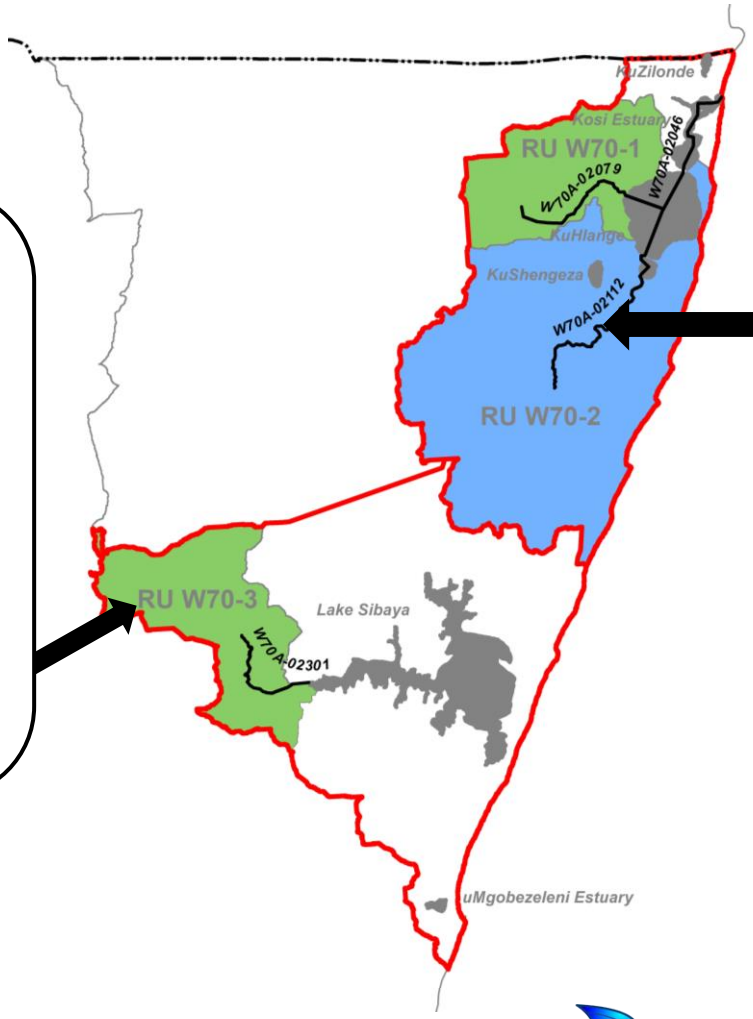
W51F-01986 (Blesbokspruit). Large impact. Irrigation + timber processing.

W51F-02019 (Blesbokspruit). Serious impact. Tannery effluent; Thuthuka Forestry.

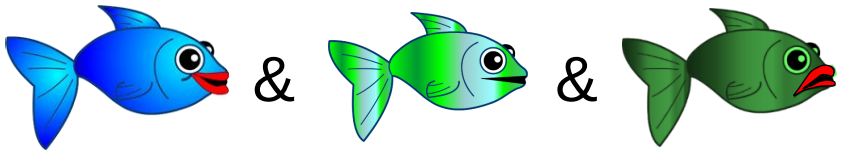
W51D-02044 (Assegaai). Large impact. Urban impacts from Piet Retief + Mpact.

W7 (Kosi & Sibaya): STATUS QUO

Poor Condition (Sibaya)
Water quality impacts from settlements and hospital.



Good to Moderate: Isimangaliso Wetland Park and **Moderate:** urban areas, WWTW, forestry.



IS IMPROVEMENT NECESSARY?

Improvement is necessary if:

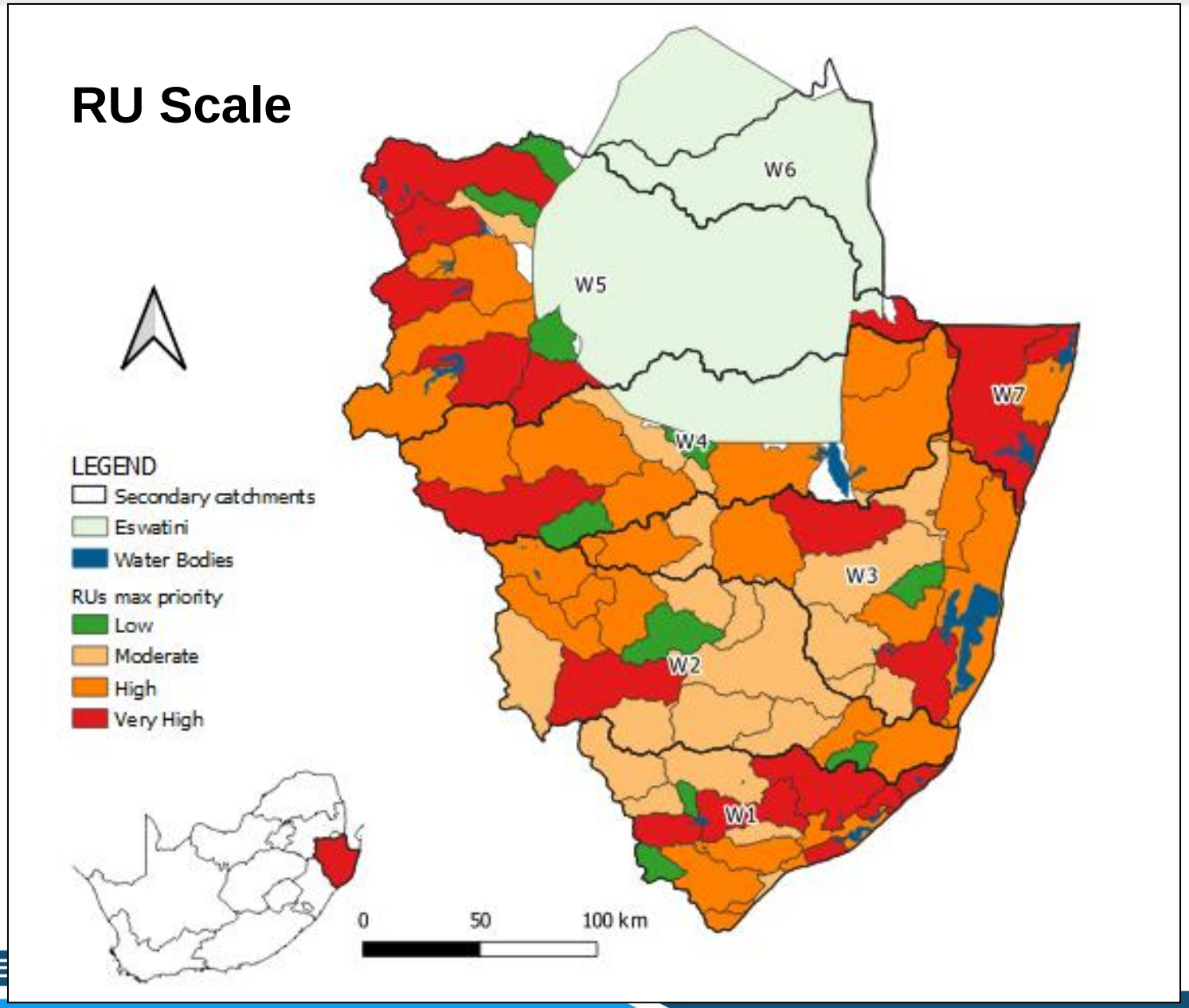
- **Ecological importance is High or Very High (apply a set of rules for rivers and estuaries)**
- **Rivers or estuaries are in a very poor condition – then potential and difficulties for improvement are assessed.**

42 River Resource Units with nodes were assessed:

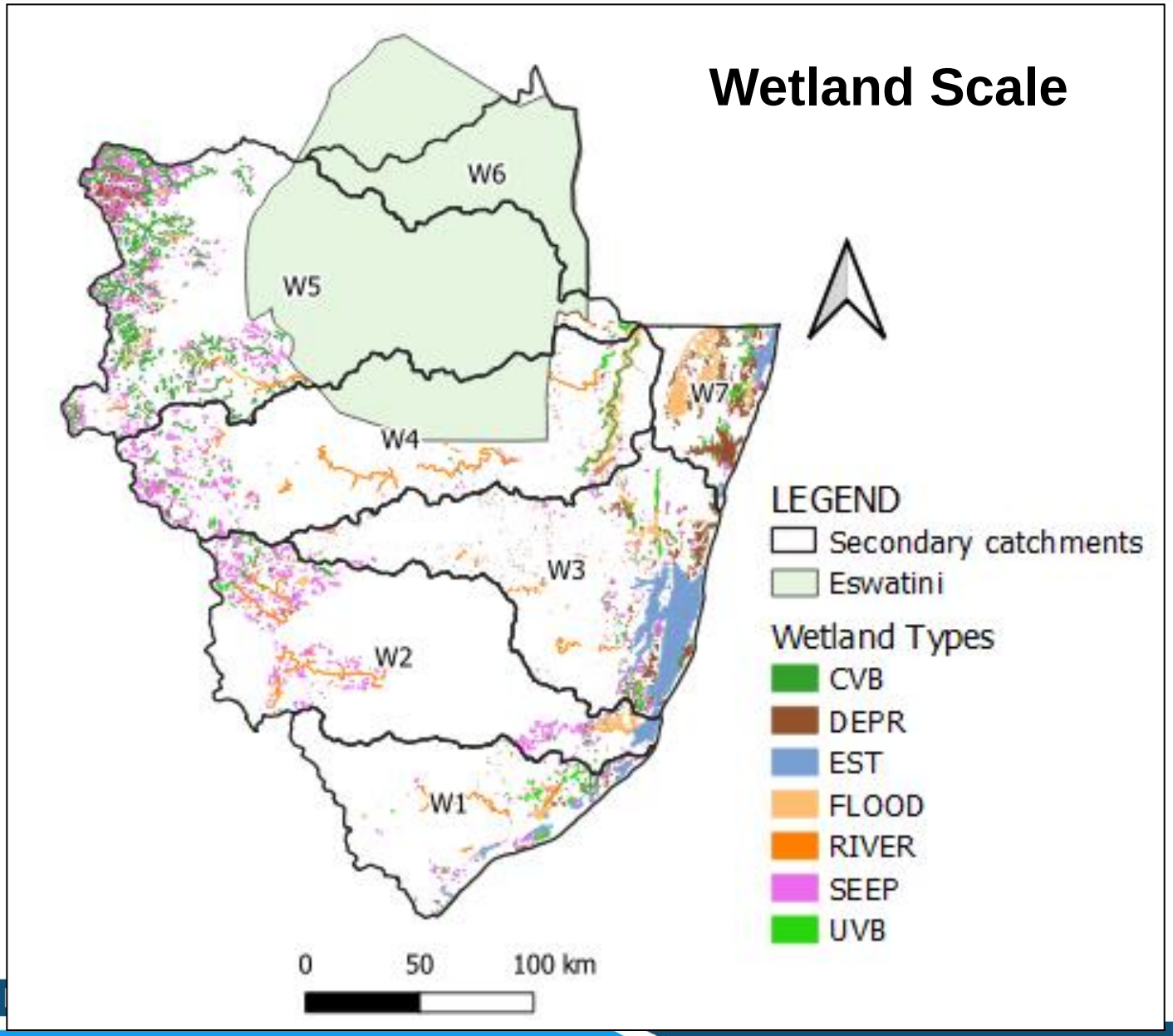
- **18 river reaches require improvement (i.e. the Recommended Ecological Category is > present state)**
- **7 river reaches must be improved through changes in the current flow regime.**
- **Other river reaches require improvement by addressing non-flow related problems.**


Rivers
Wetlands
Estuaries

WETLAND PRIORITISATION - OUTCOMES



WETLAND PRIORITISATION - OUTCOMES



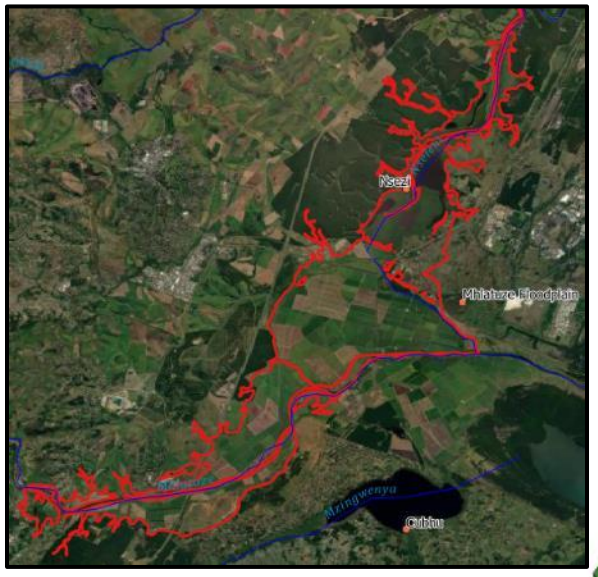
LIST OF HIGH PRIORITY WETLANDS

1) **W1 (Mhlathuze) – Four groups of wetlands including riverine wetlands along the Mhlathuze River leading into the Mhlathuze swamp system, lower reaches of Nseleni, including Nsezi and portions of the Mhlathuze floodplain, Nundwane, mainly Mzingazi, extensive channelled valley bottom wetlands leading into Richard's Bay Estuary, and depressions and seeps near the Nhlabane estuary.**
2) **W2 (Umfolozi) – Four groups of wetlands including riparian wetlands along the White Mfolozi River, Aloeboom vlei, Mvamanzi pan and the Mfolozi swamp.**
3) **W3 (Mkuze) – Five groups of wetlands including Mkuze and Nhlonhlela rivers including Nhlonhlela Pan, Hluhluwe, Nyalazi and Mpate, including Nyalazi, and the Mkuze River with swamps and floodplain before entering the estuary.**
4) **W4 (Pongola) – Two groups of wetlands including riparian wetlands along the Bivane River and the Pongola floodplain.**
5) **W5 (Usutu) – Six groups of wetlands including Boesmanspruit and Assegaai River, Sandspruit and Seganagana, Mpumalanga pan district around Chrissiesmeer, lower Usutu River including Banzi Pan and Ndumo.**
6) **W7 (Kosi & Sibaya) – Two groups of wetlands including Lake Sibaya and the Muzi swamps.**

High Priority Wetlands: W1 Mhlathuze as example

Group	SQ	SQ Name	Wetland description / note
1	W12E-03475	Mhlatuze	**Riverine wetlands** along the Mhlathuze River leading into the Mhlathze swamp system, including Lake Mpangeni.
2	W12H-03459	Nseleni	Floodplains along lower reaches of Nseleni, including Nsezi and portions of the **Mhlathuze floodplain**. For the sake of completeness, the remainder of the floodplain along the Mhlatuze (W12F-03494) was also included in the assessment. Wetland area of assessment was 4809 Ha.
3	W12J-03411		**Depressions and seeps surrounding the Nhlabane** estuary. Wetland area of assessment was 547 Ha.
4	W12J-03392 W12J-03403 W12J-03450	Mpisini Nundwane	Extensive channelled and unchannelled valley bottom wetlands leading into Richard's Bay Estuary, includes **Mzingazi**. Mzingazi was historically part of the Richard's Bay estuary, but a weir was built between the lake and the connection to the ocean which results in the lake currently being a freshwater system. Wetland area of assessment was 1689 Ha.

W1: Mhlathuze Floodplain



Main Impacts:

- Agriculture
- Mainly sugarcane

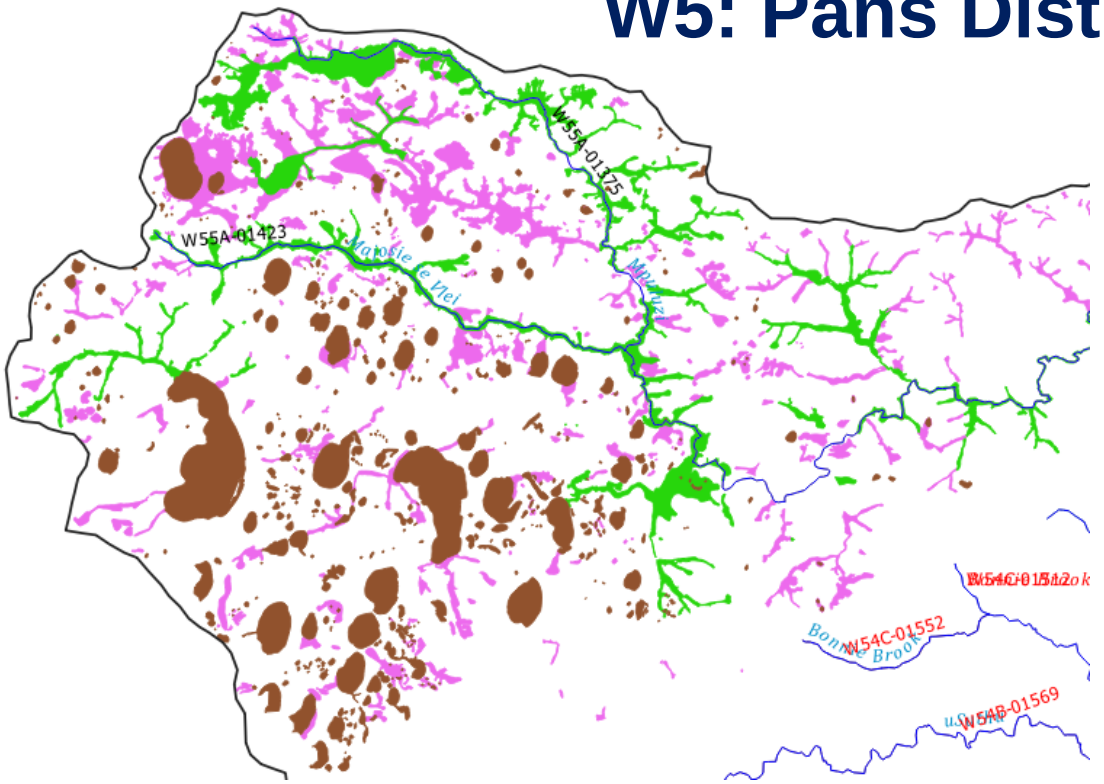
HGM 1: Floodplain	
Ecological Integrity Score:	43.5
Ecological Category:	D
Area (Ha):	3147.8
HGM 2: Floodplain	
Ecological Integrity Score:	21.8
Ecological Category:	E/F
Area (Ha):	1661.2
WETLAND PES	
Ecological Integrity Score:	36.0
Ecological Category:	E
Area (Ha):	4809.0
WETLAND REC	
Ecological Integrity Score:	42.0
Ecological Category:	D

RU	Wetland Name	Includes SQs	PES	EI	ES	Trajectory	REC	How to achieve the REC	TEC
W12-8	Mhlathuze Floodplain	W12H-03459 W12F-03494	E	VERY HIGH	VERY HIGH	↓	D	Prevent expansion of sugarcane from current; Reductions if possible	D

High Priority Wetlands: W5 Pans district as example

Group	SQ	SQ Name	Wetland description / note
5	W55A-01375 W55A-01423 W55C-01395	Mpuluzi Majosie se Vlei Mpuluzi	**Mpumalanga pan district** around Chrissiesmeer, Majosie se Vlei and Mpuluzi. Most of the pans are not directly associated with an official SQ. The area has high density of pans, extensive seepage wetlands and large areas of channelled valley-bottoms. These 3 HGM types were grouped to for amalgamated assessment. Wetland area of assessment was 21348 Ha.

W5: Pans District



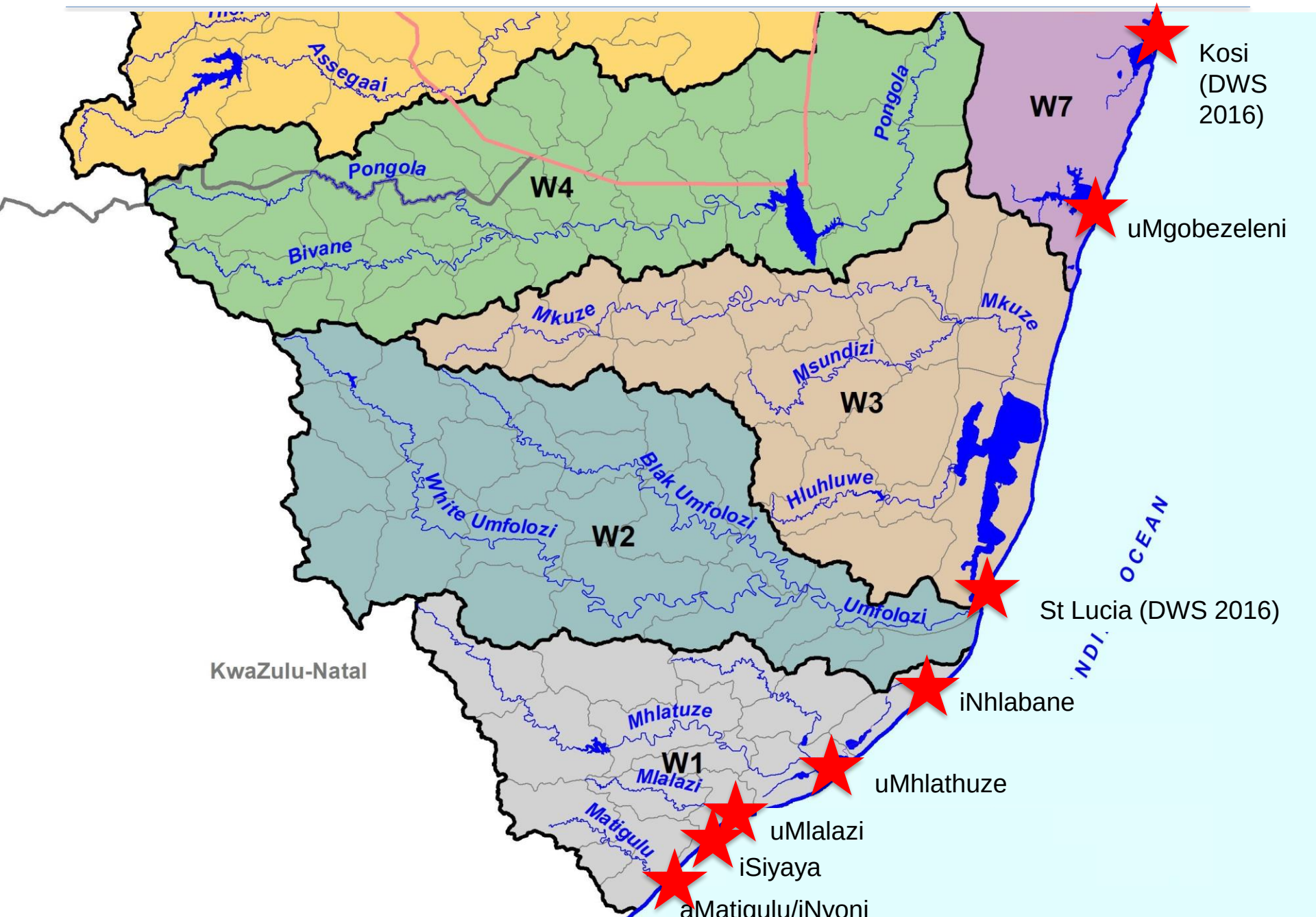
HGM 1: Depression (includes Pans)	
Ecological Integrity Score:	97.0
Ecological Category:	A
Area (Ha):	8347.7
HGM 2: Valley-bottom with a channel	
Ecological Integrity Score:	89.2
Ecological Category:	A/B
Area (Ha):	5843.0
HGM 3: Hillslope seepage linked to a stream channel	
Ecological Integrity Score:	85.3
Ecological Category:	B
Area (Ha):	7157.6
WETLAND PES	
Ecological Integrity Score:	90.9
Ecological Category:	A/B
Area (Ha):	21348.2
WETLAND REC	
Ecological Integrity Score:	90.9
Ecological Category:	A/B

Main Impacts:

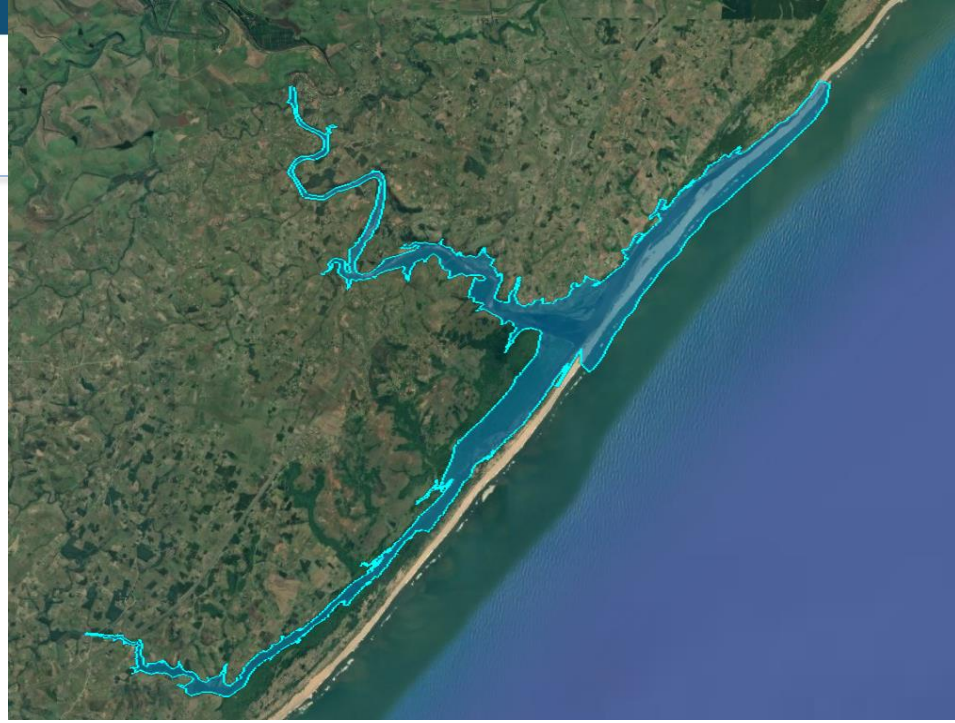
- Agriculture

Name	Includes SQs	Size (Ha)	PES	Trajectory	REC	How to achieve the REC
Pans District	W55A-01375 W55A-01423 W55C-01395	21348.2	A/B	→	A/B	Preventative conservation: Control expansion of forestry and commercial annual crops

Rivers
Wetlands
Estuaries


Assegaai
Pongola
Pongola
W7
W4
Bivane
Mkuze
Mkuze
Msundizi
W3
Hluhluwe
Black Umfolozi
White Umfolozi
W2
Umfolozi
KwaZulu-Natal
Mhlatuze
W1
Mlalazi
Matigulu
Kosi (DWS 2016)
uMgobezeleni
St Lucia (DWS 2016)
iNhlabane
uMhlathuze
uMlalazi
iSiyaya
aMatigulu/iNyoni

AMATIGULU/INYONI

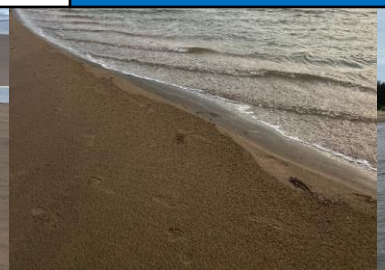


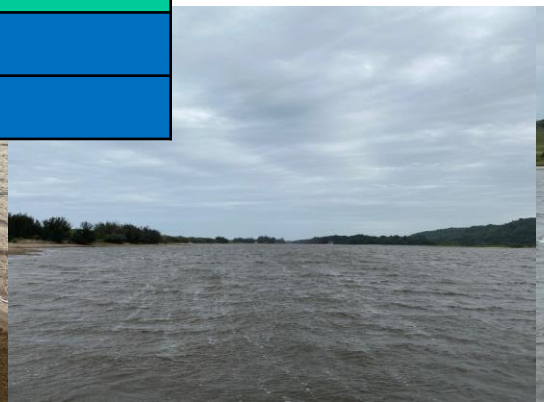
Key Pressures:

- Reduce flows (81% similar)
- Declining water quality (agricultural return flow & diffuse sources)
- Land-use change in the EFZ
- Very high fishing pressure (illegal gillnetting)
- Recreational disturbance of waterbirds

↓ Flow reduction & Nutrient enrichment

Component	Category
PES (trajectory)	**B/C ↓**
REC	**B**
TEC	**B**





UMHLATUZE

Key pressures

- Historical port development (separate mouth)
- Land-use change in EFZ (port & agriculture)
- Very high fishing pressure
- River and lakes water quality (agriculture & diffuse runoff)
- Flow reduction
- Loss of connectivity between part of the system (Lakes Mzingazi & Chubu, estuary and Richards Bay Port/Harbour)

Component	Category
PES (trajectory)	D🡻
REC	D
TEC	D

INHLABANE

Key Pressures:

- No flow to estuary – no EWR releases & nonfunctional fishway
- Physical habit alteration (build up of sediment)
- Build up of organic matter in estuary (forming a sludge)
- Poor water quality (pollution and *in situ* remineralization)
- No connectivity with lakes
- Bilharzia snail vectors & alien invasive *Terebia granifera* snails

Component	Category
PES (trajectory)	E🡻
REC	D
TEC	D




UMLALAZI

Key Pressures:

- Flow reduction (baseflows causing mouth closure)
- Declining water quality
- Land-use change and hard structures in the EFZ
- Very high fishing pressure
- Disturbance of birds (beach driving)
- Burning of mangroves
- Sand mining an emerging concern…

Component	Category
PES (trajectory)	B/C ↓
REC	B
TEC	B

- Will be very important to maintain its present baseflows (prevent mouth closure) & water quality state (no low oxygen levels) to ensure functionality and ecosystem services.




ISIYAYA

Key pressures:

- Flow reduction (abstraction & forestry)
- Poor water quality
- Impact of mining - very high turbidity in middle & upper reaches.
- Loss of habitat
- Direct disturbance

Component	Category
PES (trajectory)	D/E🡻
REC	C
TEC	D (short term)
	C (long term)




UMGOBEZELENI

Key pressures:

- Landuse change in catchment
- Pollution
- Very high fishing pressure (gillnetting)
- Forestry (groundwater level)
- Loss of connectivity

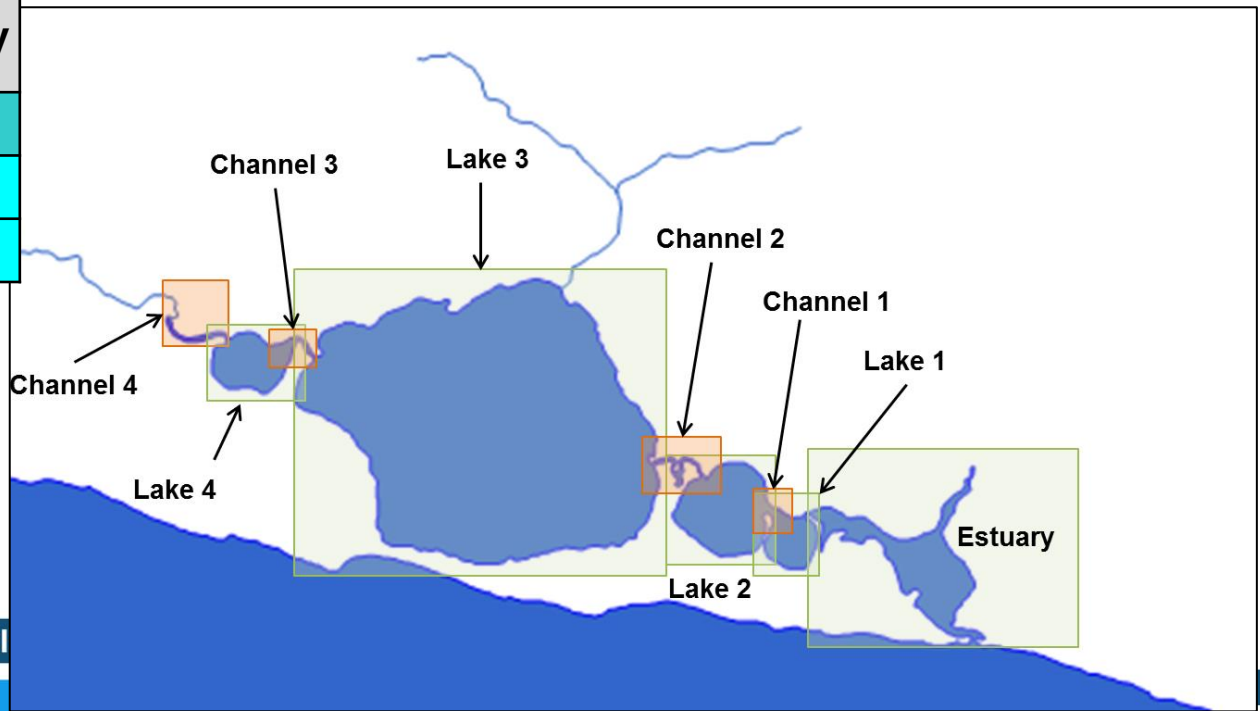
Component	Category
PES (trajectory)	B↓
REC	A
TEC	A/B

KOSI

Key pressures:

- Forestry (groundwater level)
- Very high fishing pressure (traps & gillnetting)
- Harvesting of mangroves
- Landuse change in catchment

Component	Category
PES (trajectory)	A/B↓
REC	A
TEC	A



ST LUCIA/ UMFOLOZI

Key pressures:

- Flow reduction
- Mouth manipulation
- Sediment input from catchment
- Land-use change in EFZ
- Water Quality (agricultural return flow)
- Over-exploitation (illegal gillnetting)
- Harvesting of mangroves

Component	Category
PES (trajectory)	D ↓↑
REC	B
TEC	C (short term)
	B (long term)

ASSESSMENT OF SCENARIOS AND CONSEQUENCE DETERMINATION

WHAT ARE SCENARIOS?

- **Scenarios, in context of water resource management and planning are plausible definitions (settings) of all the factors (variables) that influence the water balance and water quality in a catchment and the system as a whole.**

WHAT ARE SCENARIOS USED FOR?

- **Different levels of water use and protection are evaluated with the aim to find a balanced scenario**
- **Water Resource Classification is the process to evaluate and recommend what that balanced scenario entails**

CLASSIFICATION SELECTION PROCESS

- **Weigh up the level of ecological protection against the socio-economic benefits from water use.**
- **Scenario analysis (4 pillars):**
  - **Ecological status/health rating: relative to the desired ecological conditions**
  - **Ecosystem Services: rated relative to existing services**
  - **Economic activity: GDP in Rand**
  - **Employment: number of jobs supported**

EXAMPLES OF SCENARIOS EVALUATED

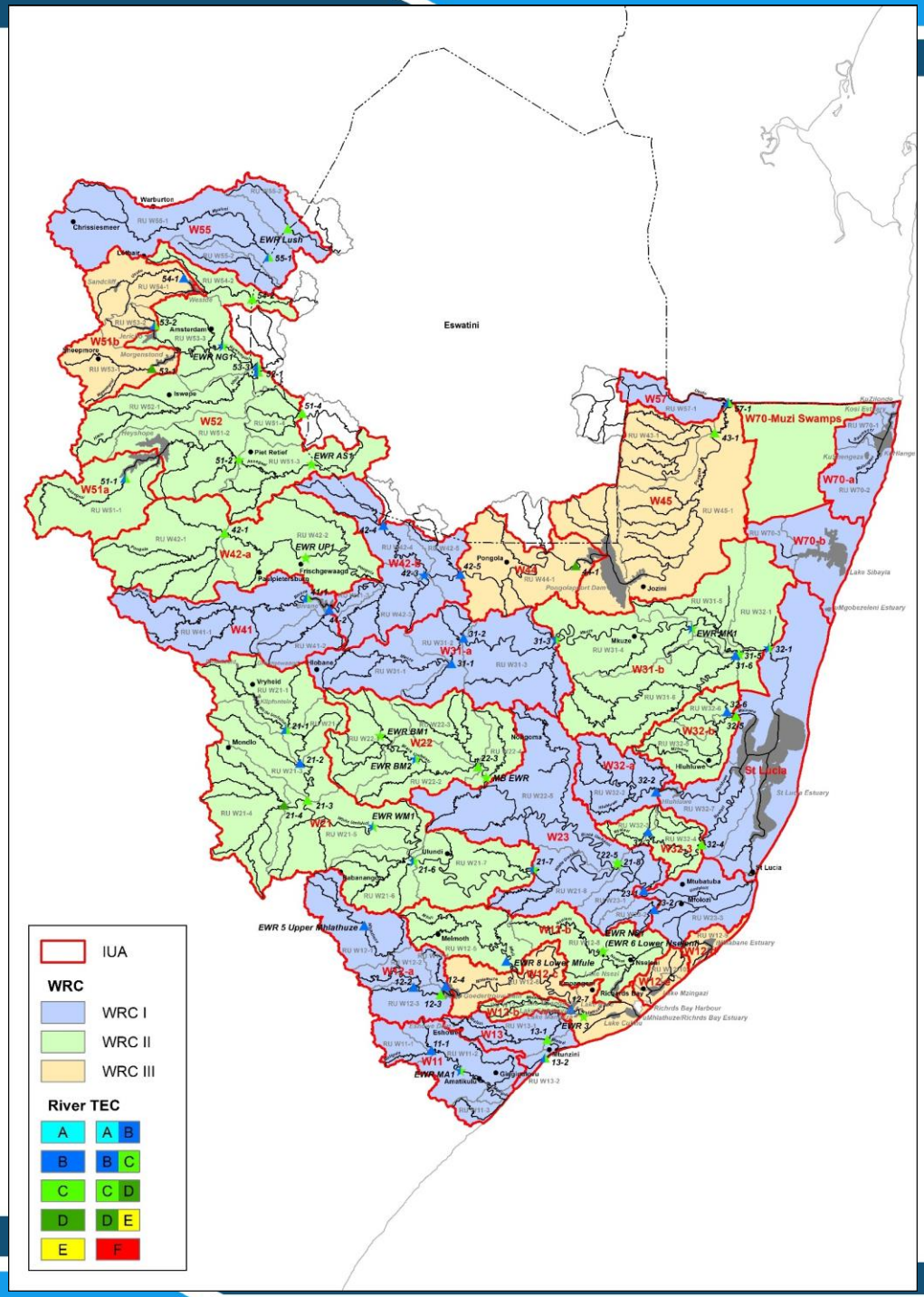
- Climate change
- Changes in present day flows
- Upgrading of WWTW
- Changes in dam operations
- Increased population
- Restoration

RECOMMENDED SCENARIOS

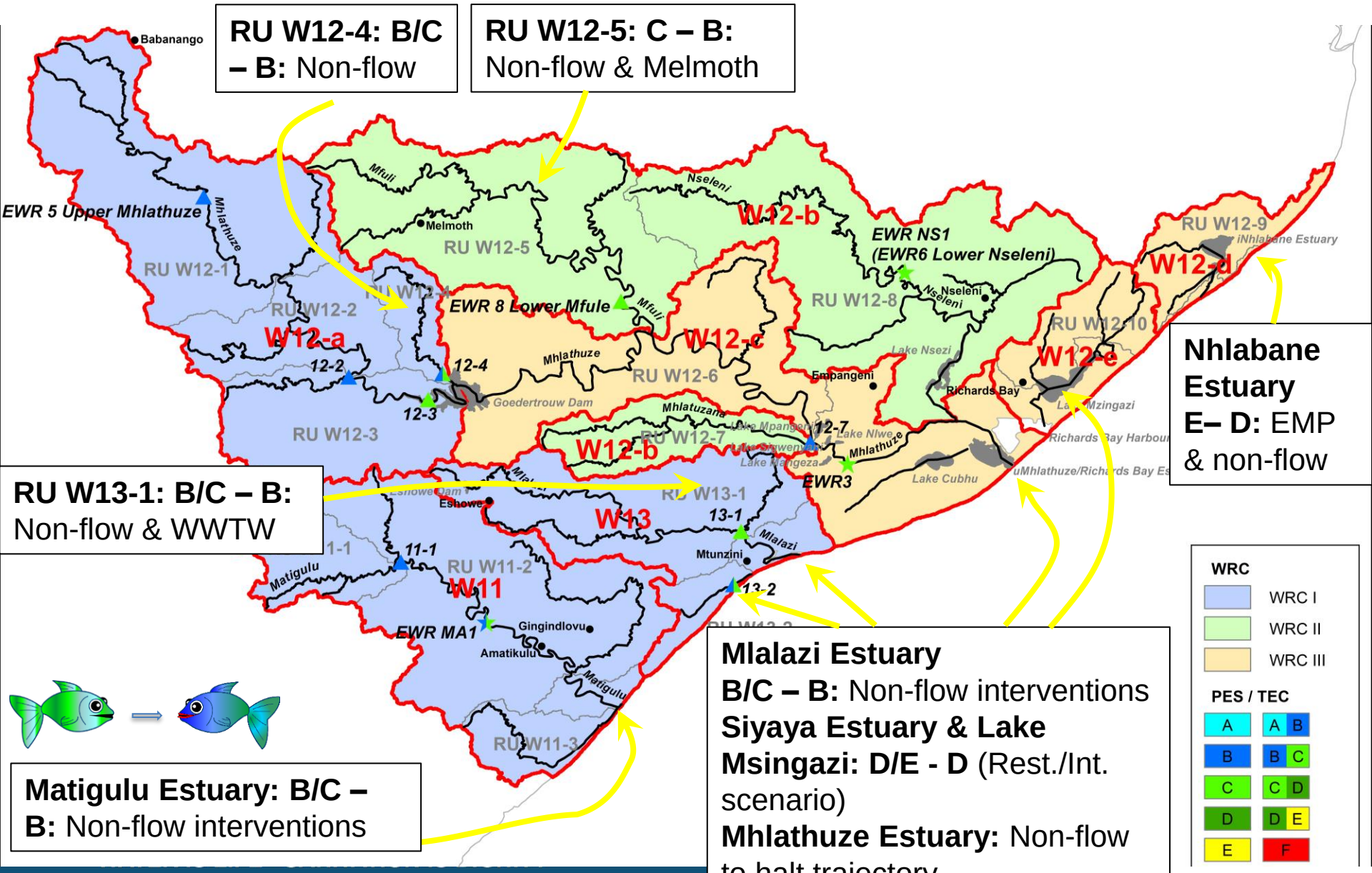
- **Scenarios were evaluated looking at implications on ecological status, economy, available yield and socio-economics.**
- **River scenarios resulted in most scenarios meeting the TEC so difficult trade-offs not required.**
- **Estuaries: Optimised scenarios selected which attempt to meet the TEC and do not compromise economic benefits to society to a major degree.**
- **The results of the recommended scenarios led to the recommended Classes for the IUAs.**

WATER RESOURCE CLASSES, CATCHMENT CONFIGURATION AND IMPLICATIONS

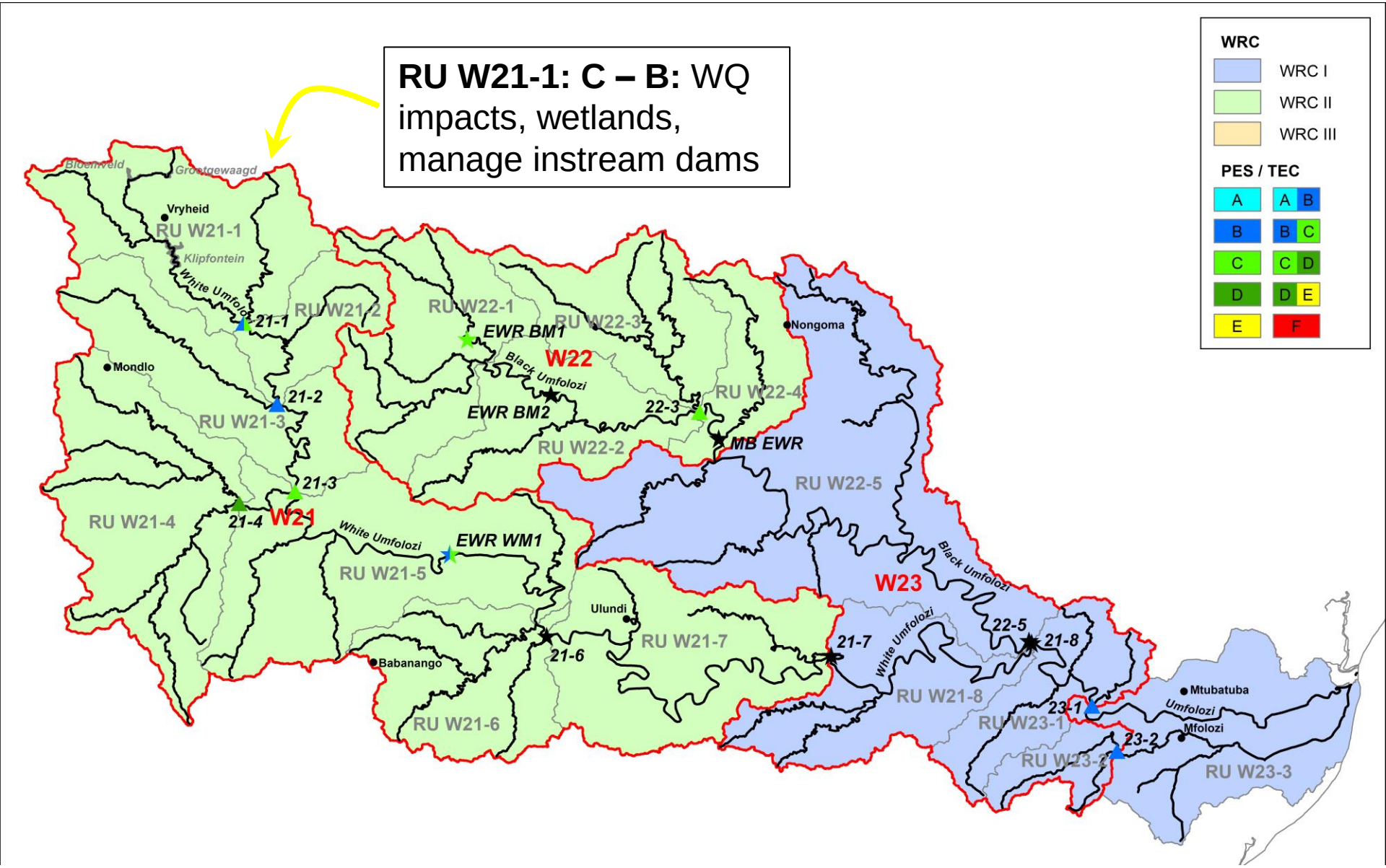
WATER RESOURCE CLASSES



W1 – Matigulu, Mhlathuze, Mlalazi



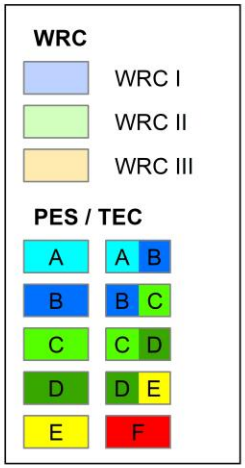
W2- Mfolozi


RU W21-1: C – B: WQ impacts, wetlands, manage instream dams
WRC
WRC I
WRC II
WRC III
PES / TEC
A
A B
B
B C
C
C D
D
D E
E
F
Bloemveld
Grootgewaagd
Vryheid
RU W21-1
Klipfontein
White Umfolozi
21-1
RU W21-2
RU W22-1
EWR BM1
RU W22-3
W22
Black Umfolozi
Nongoma
Mondlo
21-2
RU W21-3
EWR BM2
22-3
RU W22-4
MB EWR
RU W22-2
21-3
RU W22-5
RU W21-4
21-4
W21
White Umfolozi
EWR WM1
RU W21-5
W23
Black Umfolozi
Ulundi
RU W21-7
21-7
White Umfolozi
22-5
21-8
21-6
Babanango
RU W21-8
Mtubatuba
23-1
Umfolozi
RU W23-1
Mfolozi
23-2
RU W23-2
RU W23-3
RU W21-6

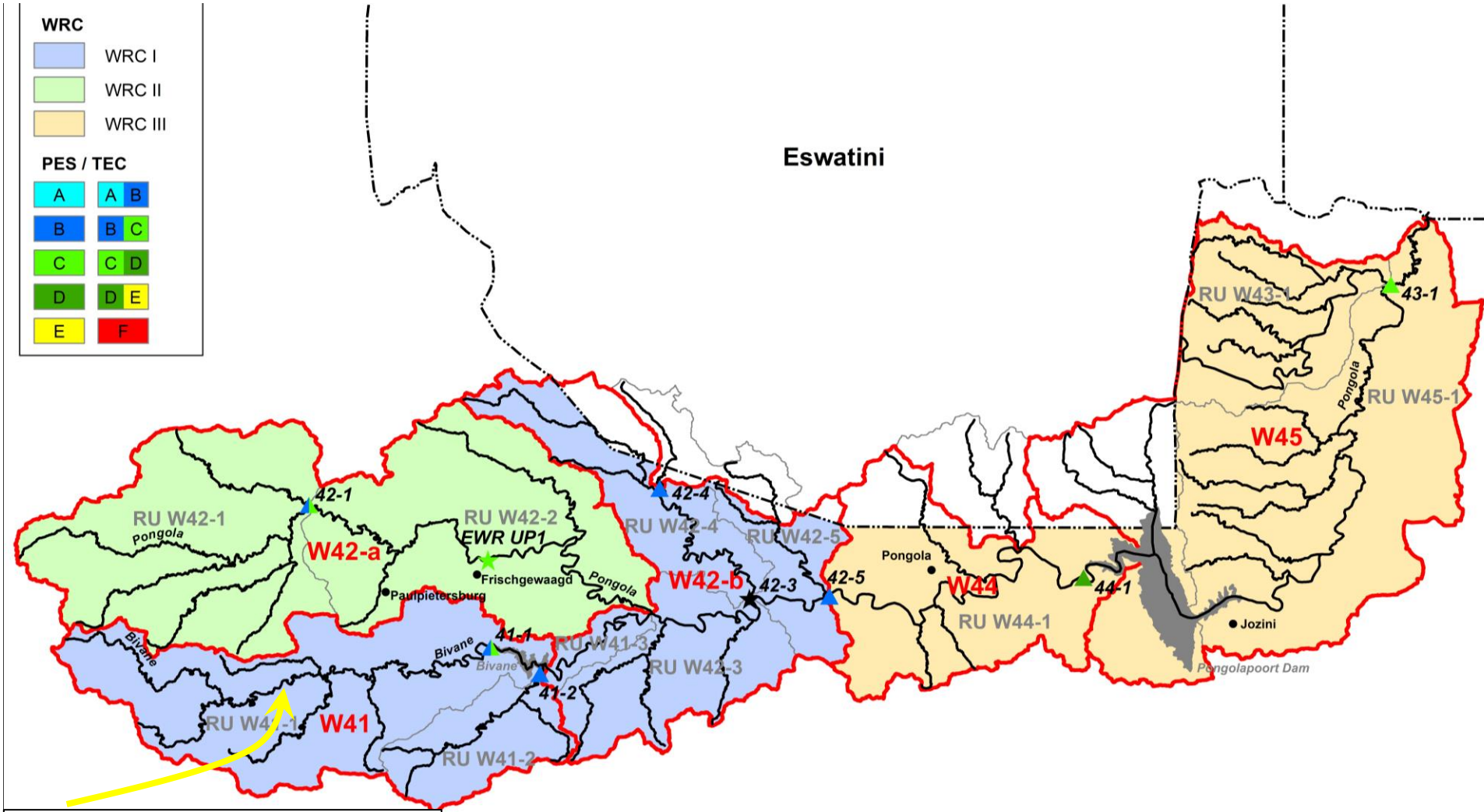
W3: Mkuze

RU W31-5: C – B/C: Non-flow

RU W31-1: C – B: Flow & Non-flow

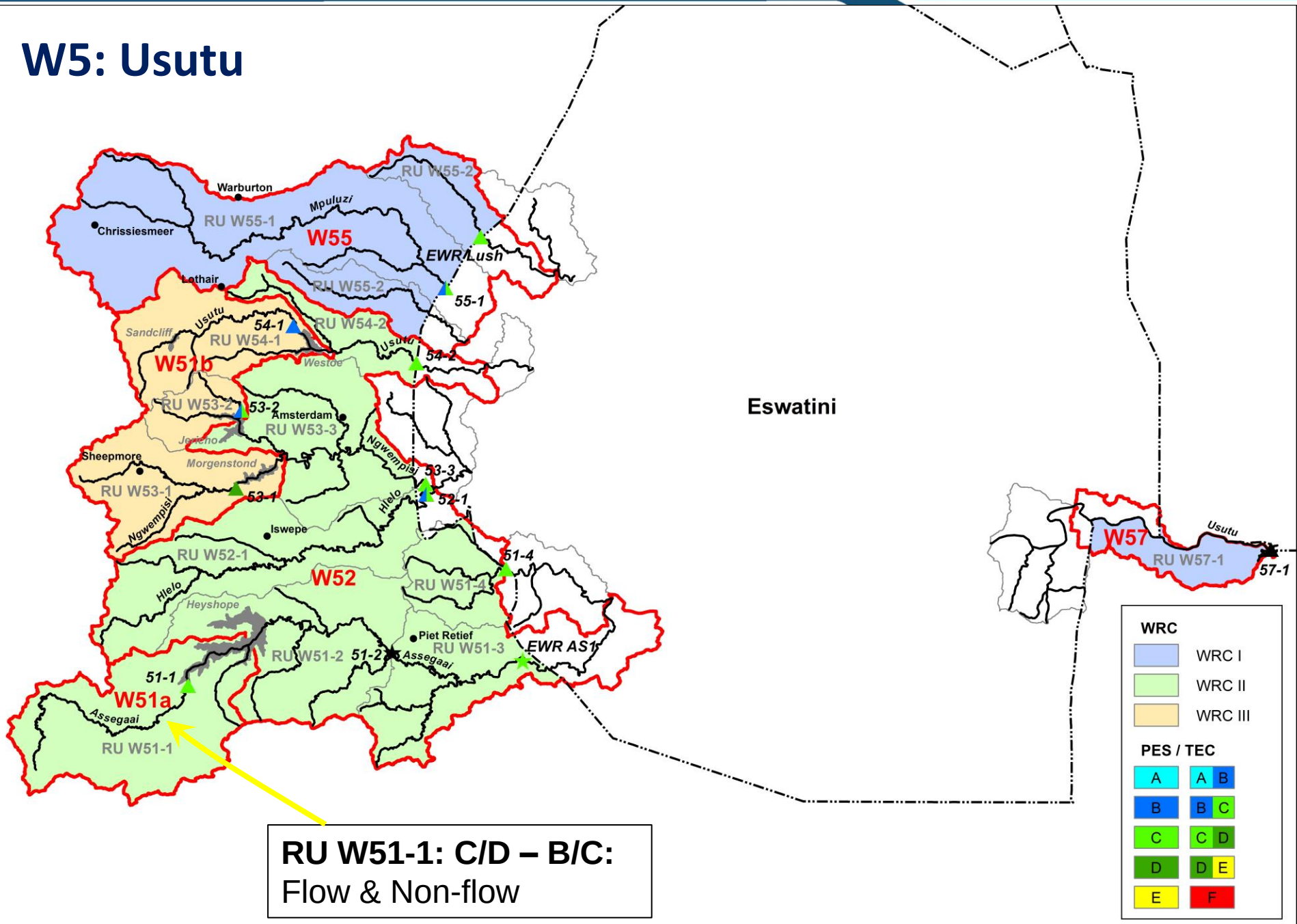


W4: Pongola



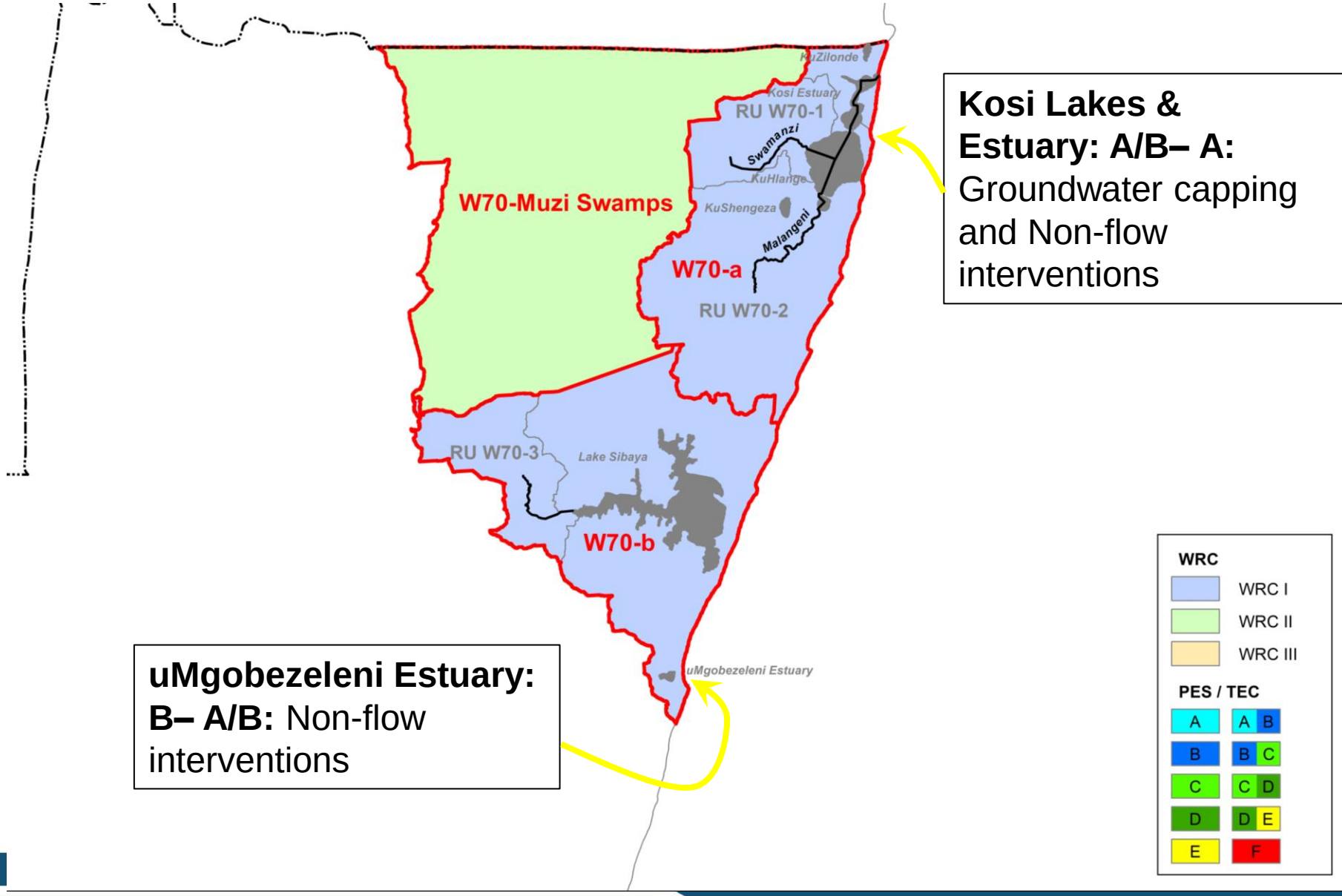
RU W41-1: C – B/C:
Flow & Non-flow

W5: Usutu



RU W51-1: C/D – B/C:
Flow & Non-flow

W7: Kosi Bay & Sibaya



Kosi Lakes & Estuary: A/B– A: Groundwater capping and Non-flow interventions

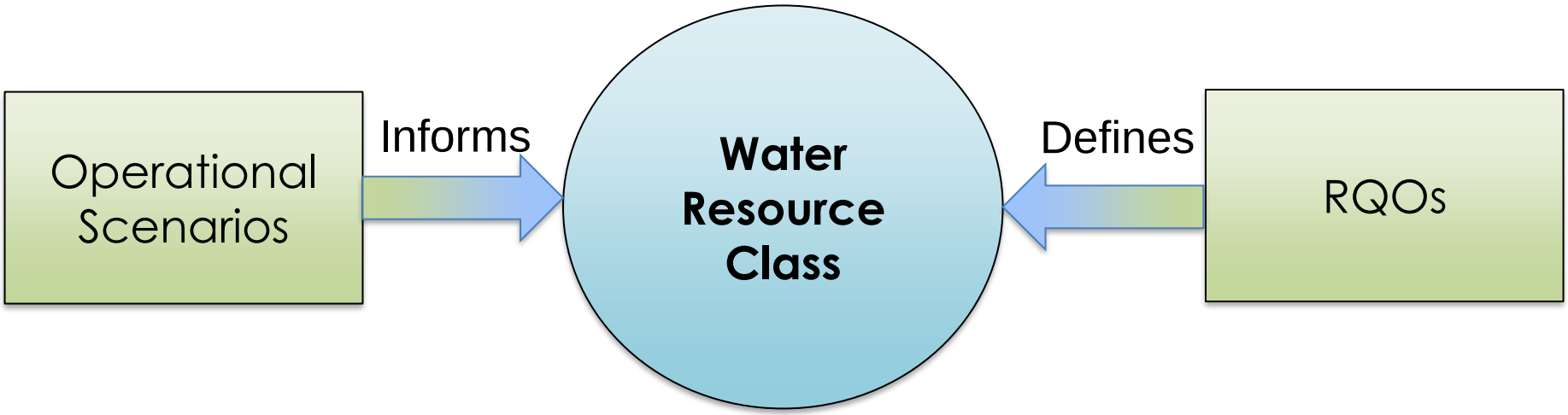
uMgobezeleni Estuary: B– A/B: Non-flow interventions

W2- Mfolozi & W3-Hluhluwe (St Lucia IUA)

RU St Lucia, W2&W3 feeder streams: D → C → B: Range of Non-flow interventions to, through a phased approach, achieve the TEC of a B

RESOURCE QUALITY OBJECTIVES

RQOs & WATER RESOURCE CLASSES



WHAT ARE RESOURCE QUALITY OBJECTIVES?

Resource Quality Objectives provide information to resource managers on how to manage the Integrated Units of Analysis to maintain or achieve the Water Resource Class and the ecological needs.

Resource Quality Objectives for a water resource are a numerical or narrative (descriptive) statement of the conditions which should be met to ensure that the water resource is protected.

FOR WHICH INDICATORS ARE RQOs SET?

- **Hydrology (flow): Quantity, pattern and timing of instream flow (repr. by time series, FDC). Defined by the recommended scenario.**
- **Water quality: Narrative + numerical values that define the fitness of use and/or ecological requirements for various variables.**
- **Characteristics and condition of riparian habitat and biota (% alien vegetation, cover, species).**
- **Characteristics and condition of instream habitat and biota (frequency of occurrence, species/taxa, abundance, habitat).**

NOTE: Not all RQOs are set for all RUs – depends on priority.


Rivers
Wetlands
Estuaries
Groundwater

EWR WM1 (WHITE MFOLOZI RIVER)

RU	RU W21-5
IUA	IUA W21
PES	B/C
EIS	Moderate
REC	B/C
TEC	B/C

BIOTA & HABITAT RQO

IIHI	B/C
RIHI	C
GEOM	B
VEG	B/C
FISH	C
INVER	B/C
ECOS	B/C

WATER QUALITY RQO

Nutrients	Orthophosphate	Acceptable	50th percentile of the data must be less than 0.015 mg/L PO_4-P (aquatic ecosystems: driver).
Salts	Electrical conductivity	Acceptable	95th percentile of the data must be less than or equal to 55 mS/m (aquatic ecosystems: driver).
Suspended sediments	Turbidity/clarity or TSS levels.	A moderate change from natural with unnaturally high sediment loads and turbidity during runoff events. Some sediment deposits evident (aquatic ecosystems: driver).	Not available

HYDROLOGICAL RQO

ECOLOGICAL WATER REQUIREMENTS (EWR)			
Natural MAR: 222.51 MCM		Present Day MAR: 191.8 MCM	
Low flow EWR		Total flow EWR	
MCM	% of nMAR	MCM	% of nMAR
54.74	24.6	89.31	40.1

EWR NG1 (NGWEMPISI RIVER)

RU	RU W53-3
IUA	IUA W52
PES	B/C
EIS	Moderate
REC (non flow-related)	B/C
TEC	B/C

BIOTA & HABITAT RQO

IIHI	C
RIHI	C/D
GEOM	B
VEG	C
FISH	C
INVER	B
ECOS	B/C

WATER QUALITY RQO

Nutrients	Orthophosphate	Tolerable	50th percentile of the data must be less than 0.125 mg/L PO_4-P (aquatic ecosystems: driver).
Nutrients	Total Inorganic Nitrogen (TIN: nitrate + nitrite + ammonium-N)	Acceptable	50th percentile of the data must be less than 1.0 mg/L TIN-N (aquatic ecosystems: driver).
Salts	Electrical conductivity	Ideal	95th percentile of the data must be less than or equal to 30 mS/m (aquatic ecosystems: driver).

ECOLOGICAL WATER REQUIREMENTS (EWR)

Natural MAR: 156.33 MCM		Present Day MAR: 79.15 MCM	
Low flow EWR		Total flow EWR	
MCM	% of nMAR	MCM	% of nMAR
30.46	19.5	50.82	32.5

HYDROLOGICAL RQO


Rivers
Wetlands
Estuaries
Groundwater

RQO PROCESS: Components & sub-components

Components	Sub-components
Quantity	Water inputs
	Water distribution and retention patterns
Quality	Nutrients
	Salts
	System variables
	Toxics
	Microbial determinands
Habitat	Present Ecological State (PES)
	Geomorphology
	Wetland Vegetation
Biota	Fish
	Plant species
	Mammals
	Birds
	Amphibians & reptiles
	Periphyton
	Aquatic Invertebrates
	Diatoms

Purpose is to describe (narrative RQO) and quantify (numeric RQO)

Example : RQOs - Mhlathuze Floodplains

Component	Subcomponent	Indicator	RQO	
			Narrative	Numerical
Water quantity	Water Inputs	Hydrology	Floods are necessary to inundate the floodplain thereby providing the wetting regime required for supporting the floodplain vegetation. The quantity and timing of inputs, and the distribution and retention patterns within the wetland must be maintained to avoid the loss of wetland hydrological function.	The EWR determined for the upstream Nseleni and Mlhathuze rivers should be implemented.
	Water distribution and retention patterns	Flooding by damming with the wetland	The current extent of damming within the wetland complex should not be permitted to increase.	The extent of damming within the delineated wetland area shall not exceed 51 Ha.

RQOs: Mhlathuze Floodplains

Component	Subcomponent	Indicator	RQO	
			Narrative	Numerical
Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland should not decline.	The current extent of natural grassland within the wetland should not decline 7% (335 Ha).
		Extent of natural wooded land within the wetland complex (land cover classes 1-4, 2020)	The current extent of natural wooded land within the wetland should not decline.	The current extent of natural wooded land within the wetland should not decline below 10% (508 Ha).
		Extent of herbaceous wetlands (land cover classes 22-23, 2020)	The current extent of herbaceous wetlands should not decline.	The current extent of herbaceous wetlands should not decline below 38% (98Ha).

RQOs: Mhlathuze Floodplains

Component	Subcomponent	Indicator	RQO	
			Narrative	Numerical
Biota	Endangered crane species	Counts of the number of breeding pairs of crane species.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any population decline.	The number of breeding crane pairs within the wetlands should be >0
	Waterbird species	Wetland is within 500m of a threatened waterbird point locality.	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline in waterbird population/s.	N/A
Water quality	River sub-components from the Nseleni and Mhlathuze rivers apply	River indicators from the Nseleni and Mhlathuze rivers apply	River RQOs from the Nseleni and Mhlathuze rivers apply	

Example: RQOs - Pans District

Component	Subcomponent	Indicator	RQO	
			Narrative	Numerical
Water quantity	Water Inputs	Hydrology	Water quantity (i.e. flow and inundation regime) must maintain wetlands in the present ecological state where practical.	N/A for pans and seepage wetlands. The EWR determined for the Mpuluzi River should be implemented.
	Water distribution and retention patterns	Flooding by damming with the wetland	Damming within the wetland complex should not be allowed to increase.	The extent of damming within the delineated wetland complex area shall not exceed 0.4% (86Ha).

RQOs: Pans District

Component	Sub-component	Indicator	RQO	
			Narrative	Numerical
Habitat	Wetland vegetation	Extent of natural grassland within the wetland complex (land cover classes 12-13; NLC, 2020)	The current extent of natural grassland within the wetland complex should not decline.	The current extent of natural grassland within the wetland complex should not decline below 40% (8621Ha).
		Extent of natural wooded land within the wetland complex (land cover classes 1-4, 2020)	The current extent of natural wooded land within the wetland complex should not decline.	The current extent of natural wooded land within the wetland complex should not decline below 0.7% (141Ha).
		Extent of herbaceous wetlands (land cover classes 22-23, 2020)	The current extent of herbaceous wetlands throughout the complex should not decline.	The current extent of herbaceous wetlands throughout the complex should not decline below 26% (5575Ha).

RQOs: Pans District

Component	Subcomponent	Indicator	RQO	
			Narrative	Numerical
Biota	Endangered crane species	Counts of the number of breeding pairs of crane species.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any population decline.	The number of breeding crane pairs within the wetlands should be >0
		Number of crane species	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline in the number of crane species that occur in these wetlands.	The number of crane species found in the district should remain at 3. These are the Blue Crane *(Anthropoides paradiseus*), Grey Crowned Crane (*Balearica regulorum*) and Wattled Crane (*Bugeranus carunculatus*) (SANBI, 2014)
	Waterbird species	Wetland bird species	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	The number of wetland / waterbird species found in the district should remain >=83
		Wetland is within 500m of a threatened waterbird point locality.	Water quantity, quality, vegetation condition and land use practices must be maintained so as to not cause any decline in waterbird population/s.	N/A

RQOs: Pans District

Component	Subcomponent	Indicator	RQO	
			Narrative	Numerical
Biota	Mammals	Spotted-necked otter (*Lutra maculicollis)* – Near-Threatened	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline in the spotted-necked otter population.	The spotted-necked otter should remain within wetlands in the district.
	Taxon richness	Habitat condition is sufficient to maintain the current wetland species diversity.	Water quantity, vegetation condition and land use practices must be maintained so as to not cause any decline of diversity.	N/A


Rivers
Wetlands
Estuaries
Groundwater

AMATIGULU/INYONI

Component	Category
PES (trajectory)	**B/C ↓ (Class II)**
REC	**B (Class I)**
TEC	**B (Class I)**

Hydrology	**C**
Hydrodynamics	**B**
Physical habitat (sediments)	**B**
Water quality (salinity)	**A**
Water quality (general)	**C**
Microalgae	**B**
Macrophytes	**B**
Invertebrates	**B**
Fish	**B/C**
Birds	**B**

*The RQOs provided here include some numerical information. All narrative RQOs supported by numerical RQOs are in the technical reports.

AMATIGULU/INYONI ESTUARY

Example

Component/ indicator	TEC	RQO
Hydrology	C	Maintain TEC (>63%). Protect the flow regime to create the required habitat for birds, fish, macrophytes, microalgae and water quality: ▪ River inflow distribution patterns (flood components) should not differ by more than 10% (in terms of magnitude, timing and variability) from that of the Present State (DWS, 2023a). ▪ River inflow distribution patterns should not differ by more than 5% from that of the Present State (i.e. approved flow scenario for the aMatigulu/iNyoni). ▪ Monthly river inflow should not be < 0.75 m^3/s for more than 17% of the time. ▪ Monthly river inflow should not be < 10.0 m^3/s for more than 65% of the time.
Hydrodynamics	B	Maintain Target EC (>78%). Maintain mouth conditions to protect estuarine ecosystems and the associated habitat for birds, fish, macrophytes, microalgae and water quality (DWS, 2015a; 2023a): ▪ Mouth closure occurs less than 6 - 8 weeks in a year. ▪ Mouth closure occurs for less than3 - 4 years out of ten. ▪ Mouth closure occurs between September and March. ▪ Changes in tidal amplitude at the tidal amplitude should be <20% from Present State (DWS, 2015a) (mouth in the northern position, if mouth moves south the average tidal amplitude is expected to increase by 30 - 50%.
Water quality (salinity)	A	Maintain TEC (>93%). Salinity regime to maintain TEC for dependent biotic components (DWS 2015a, 2023a). ▪ Salinity values >5 in the upper reaches (End of Zone B/ beginning of Zone C) of the estuary. ▪ Salinity values >10 in middle reaches (Zone B) during the low flow season. ▪ Salinity values <5 in middle reaches (Zone B) and <15 in the lower reaches (Zone A) during closed mouth periods. ▪ Salinity values >5 in the iNyoni Arm about 1 km from the confluence. ▪ Salinities should not decrease by >20% in each of the reaches except during high flow freshwater dominated conditions. Salinities should not drop below 10 in the lower and middle reaches, except for short periods during the high flow freshwater state, to allow macrocrustacea larval development.

AMATIGULU/INYONI

Example

Macrophytes	B	Maintain the TEC (>78%) through: ▪ Maintain the distribution of macrophyte habitats to present baseline, particularly the large Swamp Forest stands (>300 ha) and presence of submerged macrophytes (refer see Appendix B and DWS, 2023a). ▪ <10% change in the area covered by different macrophyte habitats, especially swamp forest and submerged macrophytes. ▪ Invasive plants (e.g. syringa berry, Brazilian pepper tree, lantana, *Chromolaena*, *Opuntia*) should be largely absent from the riparian zone. ▪ No unvegetated, cleared areas along the banks. ▪ Floating invasive aquatics should not be observed in the upper estuary reaches. ▪ Macroalgae cover should be < 20% of estuarine water surface area. ▪ Sugarcane should not be present in the estuarine functional zone. ▪ There should not be extensive land cover change of natural land in the iNyoni and aMatigulu EFZ – less than 5% change from 2023.
Birds	B	Maintain the TEC (>78%). Maintaining avifaunal community that includes representatives of all original groups as per present baseline (refer to DWS, 2015; 2023a). ▪ Resident pair of African Fish Eagle present and breed successfully. ▪ Cormorants and/or herons/egrets: No significant reduction in numbers (<20%). ▪ Migratory waders, especially of estuarine-dependent species: No significant reduction in numbers (<20%). ▪ Waterfowl (ducks and geese): No significant reduction in numbers (<20%). ▪ Whole waterbird community: No significant reduction in numbers (<20%). ▪ Tern and gull roost at mouth: No significant reduction in numbers (<20%).

ST LUCIA/ UMFOLOZI

Component	Category
PES (trajectory)	D ↓↑ (Class III)
REC	B (Class I)
TEC	C (short term) (Class II)
	B (long term) (Class I)

Hydrology	C
Hydrodynamics	C
Physical habitat (sediments)	C
Water quality (salinity)	D ↑
Water quality (general)	D ↑
Microalgae	D ↑
Macrophytes	B
Invertebrates	D
Fish	C
Birds	C

Rivers

Wetlands

Estuaries

Groundwater

AIMS OF GW RESOURCE QUALITY OBJECTIVES

1) Maintain the required groundwater contribution to the EWR

2) Protect groundwater resources for the direct and indirect users

- RQOs may stipulate:
  - the volume of abstraction that would cause an undesirable reduction in baseflow or undue stress on aquifer
  - specific distances from a river
  - flow at gauging stations and maximum baseflow reduction
  - water quality conditions (linked to potable use)
  - GW levels with caution, as near rivers or in leaky aquifers abstraction may have large impact but water level remains stable

GROUNDWATER RQOs: W1

IUA	Class	GW RU	Quat	Comp-onent	Sub-component	Indicator	Narrative	Numeric
W12-d, W12-e	III	W12-5	W12J	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 19.22 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend.	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes.

GROUNDWATER RQOs: W5

Example: W55D

IUA	Class	GW RU	Quat	Com-ponent	Sub-com ponent	Indicator	Narrative	Numerical
W55	I	W55-2	W55D	Quantity	Abstraction	Water Allocations	All existing users to comply with existing allocation schedules, including GA and Schedule 1, and individual licence conditions. Allocations for new users is to remain within the allocable groundwater volume.	The remaining Allocable groundwater is 4.97 Mm^3/a.
					Baseflow	Dry season flows	Dry season flow in July shall not exhibit a declining trend for over 5 years.	
					Water level	Borehole water levels	Local monitoring of wellfields and background monitoring should be implemented. Water levels should not exhibit long term declining trends.	Static water levels should not exhibit a declining trend in July for over 5 years.
				Quality	Water Quality	Water quality analysis	Water quality should not exhibit a declining trend	Water quality to stay within the limits of Water Quality Class I.[1] in 100% of boreholes

Different set of RQOs for groundwater-fed lakes, i.e. Lake Sibaya, Mzingazi, Nhlabane, Cubhu.

GROUNDWATER RQOs: W1

Examples: Background information supporting RQOs – ***allocable groundwater***

Quat	Baseflow (Mm^3/a)	GW baseflow (Mm^3/a)	GW EWR (Mm^3/a)	GW % of Baseflow	Reserve (Mm^3/a)	Allocable Groundwater (Mm^3/a)
W11A	39.28	8.53	6.35	21.73	6.61	1.44
W11B	10.96	2.44	1.81	22.22	1.93	0.43
W11C	37.24	7.26	5.47	19.50	5.80	0.91
W12A	25.18	9.05	10.08	35.93	10.25	1.88
W12B	33.18	9.60	10.34	28.95	10.62	1.49
W12C	23.24	8.53	6.47	36.70	6.66	4.82
W12D	24.83	8.70	5.19	35.02	5.45	3.11
W12E	18.45	3.76	2.52	20.38	2.68	1.64
W12F	50.48	13.92	9.76	27.57	9.83	19.25
W12G	13.79	4.92	3.43	35.67	3.51	2.93
W12H	35.82	7.34	5.32	20.48	5.43	2.67
W12J	40.30	11.95	8.27	29.66	8.36	19.22
W13A	28.22	3.95	2.54	13.99	2.74	1.26
W13B	30.47	3.03	2.52	9.93	2.64	0.40

Water quality

Groundwater quality class was allocated according to the following criteria:

Class I: 95% of samples of water quality Class 0 and 1.

Class II: 75% of samples of water quality Class 0 – 2.

Class III: <75% of samples Class 0 – 2.

...ion		Drinking health effects
Class 0	Ideal water quality	No effects, suitable for many generations.
Class 1	Good water quality	Suitable for lifetime use. Rare instances of sub-clinical effects.
Class 2	Marginal water quality, water suitable for short-term use only	May be used without health effects by majority of users, but may cause effects in some sensitive groups. Some effects possible after lifetime use.
Class 3	Poor water quality	Poses a risk of chronic health effects, especially in babies, children and the elderly. May be used for short-term emergency supply with no alternative supplies available.
Class 4	Unacceptable water quality	Severe acute health effects, even with short-term use.

GROUNDWATER RQOs, W5: WATER QUANTITY

Examples: Background information supporting RQOs

Quaternary	Aquifer Recharge (Mm^3/a)	Groundwater baseflow (Mm^3/a)	BHN (Mm^3/a)	Use (Mm^3/a)	Stress Index	PES	Groundwater Component of Reserve (Mm^3/a)
W51A	10.39	8.27	0.04	0.2243	0.02	A	8.31
W51B	8.50	6.59	0.046	1.1142	0.13	B	6.63
W51C	12.53	9.99	0.076	0.4697	0.04	A	10.07
W51D	8.89	7.00	0.059	0.1635	0.02	A	7.06
W51E	6.11	4.20	0.002	0.0842	0.01	A	4.20
W51F	12.65	10.16	0.034	0.1683	0.01	A	10.20
W52A	5.03	3.85	0.027	0.1237	0.02	A	3.87
W52B	6.27	4.92	0.038	0.2076	0.03	A	4.96
W52C	3.35	2.59	0.02	0.0657	0.02	A	2.61
W52D	2.38	1.80	0.008	0.0148	0.01	A	1.81
W53A	10.25	7.95	0.044	0.4515	0.04	A	7.99
W53B	4.09	3.20	0.015	0.0199	0.00	A	3.21
W53C	5.82	4.66	0.035	0.0886	0.02	A	4.69
W53D	5.86	4.61	0.033	0.0559	0.01	A	4.65
W53E	8.96	7.20	0.02	0.0468	0.01	A	7.22
W53F	10.48	7.64	0	0.0002	0.00	A	7.64

GROUNDWATER RQOs, W5: WATER QUALITY

Analyses	Unit	Classification				
		Class 0 IDEAL	Class I GOOD	Class II MARGINAL	Class III POOR	Class IV UNACCEPTABLE
pH		5.5 - 9.5	4.5-5.5 and 9.5- 10	4-4.5 and 10-10.5	3-4 and 10.5-11	< 3 or > 11
Conductivity	mS/m	< 70	70 - 150	150 - 270	270 - 450	> 450
TDS	mg/l	< 450	450 - 1000	1000 - 2400	2400 - 3400	> 3400
Total Hardness	$CaCO_3$	< 200	200 - 300	300 - 600	> 600	
Calcium	mg/l	< 80	80 - 150	150 - 300	> 300	
Copper	mg/l	< 1	1 - 1.3	1.3 - 2	2 - 15	> 15
Iron	mg/l	< 0.5	0.5 - 1	1 - 5	5 - 10	> 10
Magnesium	mg/l	< 70	70 - 100	100 - 200	200 - 400	> 400
Manganese	mg/l	< 0.1	0.1 - 0.4	0.4 - 4	4 - 10	> 10
Potassium	mg/l	< 25	25 - 50	50 - 100	100 - 500	> 500
Sodium	mg/l	< 100	100 - 200	200 - 400	400 - 1000	> 1000
Chloride	mg/l	< 100	100 - 200	200 - 600	600 - 1200	> 1200
Fluoride	mg/l	< 0.7	0.7 - 1	1 - 1.5	1.5 - 3.5	> 3.5
Nitrate NO_3 - N	mg/l	< 6	6 - 10	10 - 20	20 - 40	> 40
Nitrite NO_2 - N	mg/l	< 6	6 - 10	10 - 20	20 - 40	> 40
Orthophosphate (PO_4 as P)	mg/l	< 0.1	0.1 - 0.25	0.25 - 1	> 1	
Sulphate (SO_4)	mg/l	< 200	200 - 400	400 - 600	600 - 1000	> 1000
MPN *E. coli*	/100ml	0	0 - 1	1 - 10	10 - 100	> 100

Groundwater quality class was allocated according to the following criteria:

Class I: 95% of samples of water quality Class 0 and 1.

Class II: 75% of samples of water quality Class 0 – 2.

Class III: <75% of samples Class 0 – 2.

SUMMARY: STRESS INDEX

Calculated from *total present use* and *aquifer recharge*:

- **W1 Mhlathuze Catchment: Groundwater is minimally used and the stress index is below 0.05.**
- **W2 Umfolozi Catchment: Groundwater is minimally used and the stress index is below 0.12.**
- **W3 Mkuze Catchment: Groundwater is minimally used and the stress index is below 0.05.**
- **W4 Pongola Catchment: Groundwater is minimally used and the stress index is below 0.05.**
- **W5 Usutu Catchment: Groundwater is minimally used and the stress index is below 0.13.**
- **W7 Catchment the stress index is 0.01. Groundwater is minimally used. Groundwater is critical to maintaining coastal lakes.**

CONCLUDING REMARKS

CONCLUDING REMARKS (1 OF 2)

- **The recommended Classes and RQOs provide for appropriate protection. Utilisation of water resources is possible to sustain current and future socio-economic imperatives.**
- **The study area is characterised and dominated by a high density of protected areas linked to rivers, estuaries and wetlands, e.g. Mfolozi-Hluhluwe Game Reserve, iSimangaliso, Lake St Lucia and wetland parks, Mkuze, Ndumo and Ithala Game Reserves, Kosi Bay Reserve etc). Classification and RQOs will provide additional measures to ensure the future protection of these areas.**

CONCLUDING REMARKS (2 OF 2)

- **Update on St Lucia/iMfolozi Estuary: Current activities 1) iSimangaliso Wetland Park Baseline Monitoring Programme, starting 2024; 2) Possible revision of related Estuary Management Plan; 3) DWS Water Resource Reconciliation study will highlight baseflow constraints; and 4) Ministerial in place.**

- **Implementation and monitoring of the RQOs will require intensifying the cooperation among institutions, for optimal use of resources and to aim higher towards achieving the goals of Integrated Water Resource Management.**

- **The Classification of water resources is a further step to realise Integrated Water Resource Management.**