water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

2030 NDP
NATIONAL DEVELOPMENT PLAN
Our Future - make it work

The Determination Of Water Resource Classes, Reserve And Resource Quality Objectives For Secondary Catchments (A5-A9) Within The Limpopo WMA And Secondary Catchment B9 in the Olifants WMA

Project Steering Committee Meeting No 1

Presented by: Myra Consulting in association with Southern Waters and Anchor Research & Monitoring

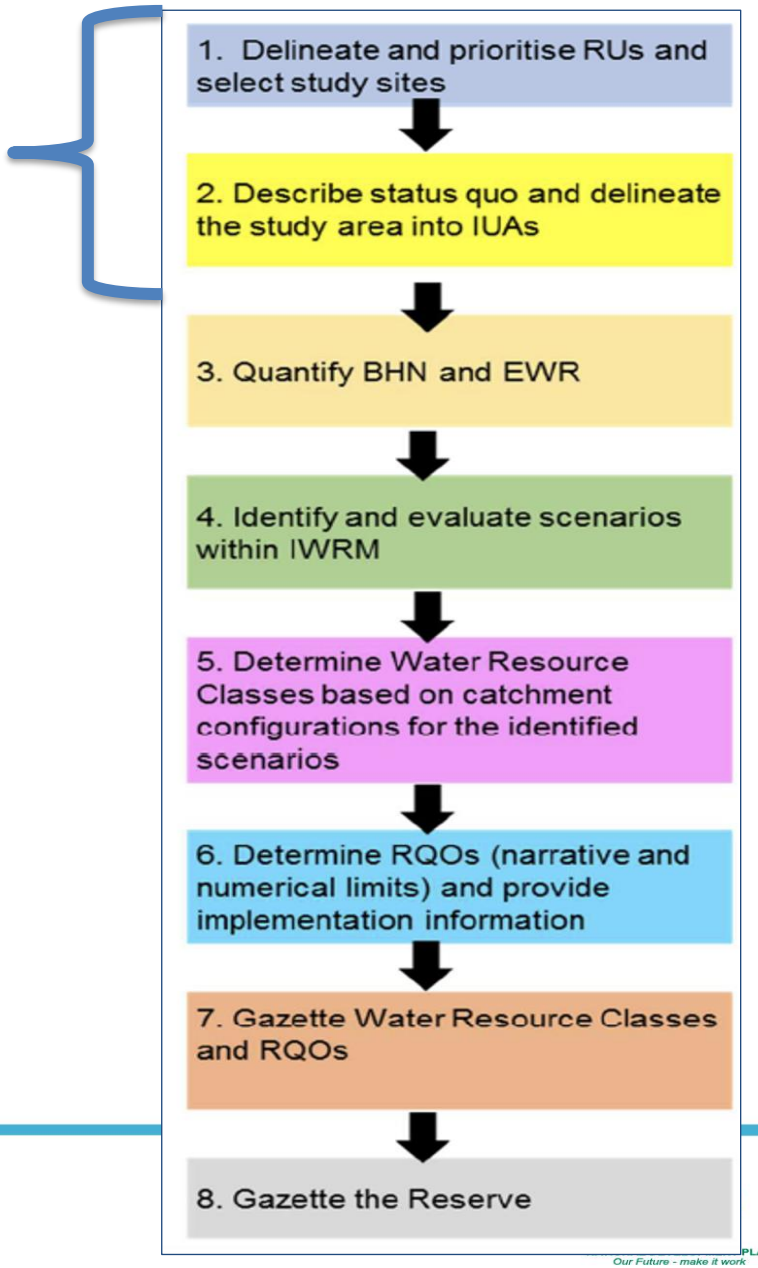
Date: 5 July 2022

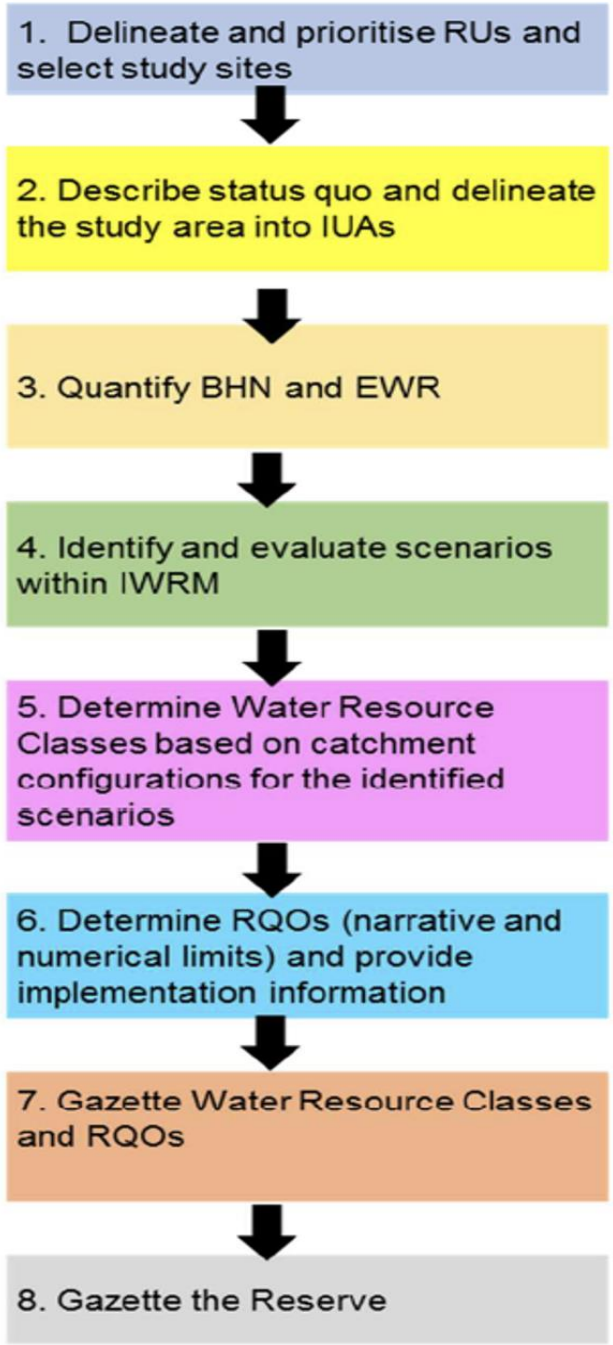
OUTLINE OF PRESENTATION

- Delineation and Status Quo of the Integrated Units of Analysis (IUAs)
- Approach and expected outcomes for linking the the value and condition of the water resource
- Approach to the visioning process

STUDY APPROACH

- Integrated framework for incorporating the gazetted steps for Classification, Reserve and RQOs will be used to guide the study.





STEP 1

Identified the river, wetland and groundwater resource units (RU) and selection of study sites.

Study sites – biophysical nodes – are locations at which flow requirements will be set.

STEP 2

Described the current condition and delineation of IUAs

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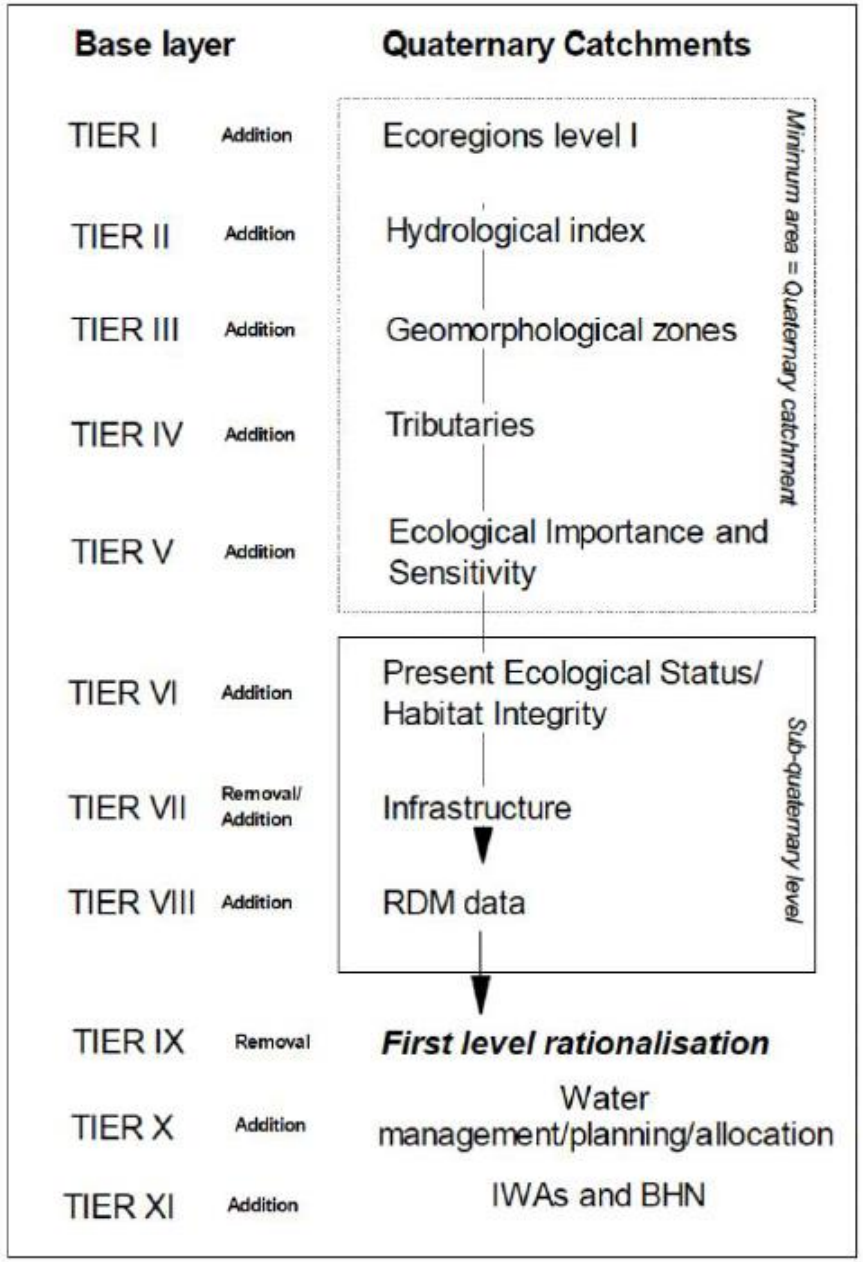
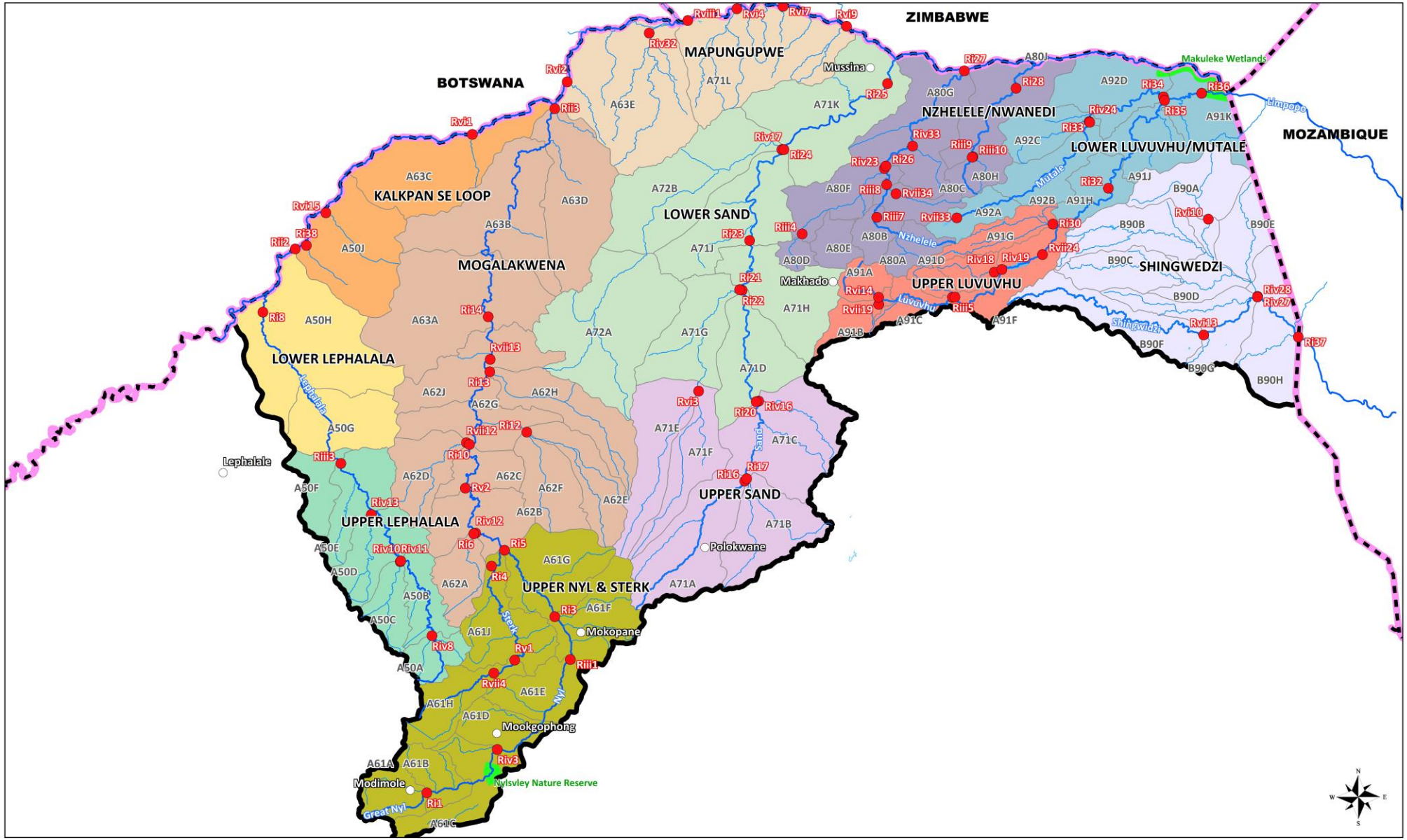
Development of the decision-analysis framework to link the economic and social value and ecological condition of the water resource

STEP 1: IDENTIFY AQUATIC RESOURCES, SELECT STUDY SITES

- Nodes = point of interest

- A series of steps to identify 1st points
  - Based on existing information
  - Decisions are ecological and infrastructure related

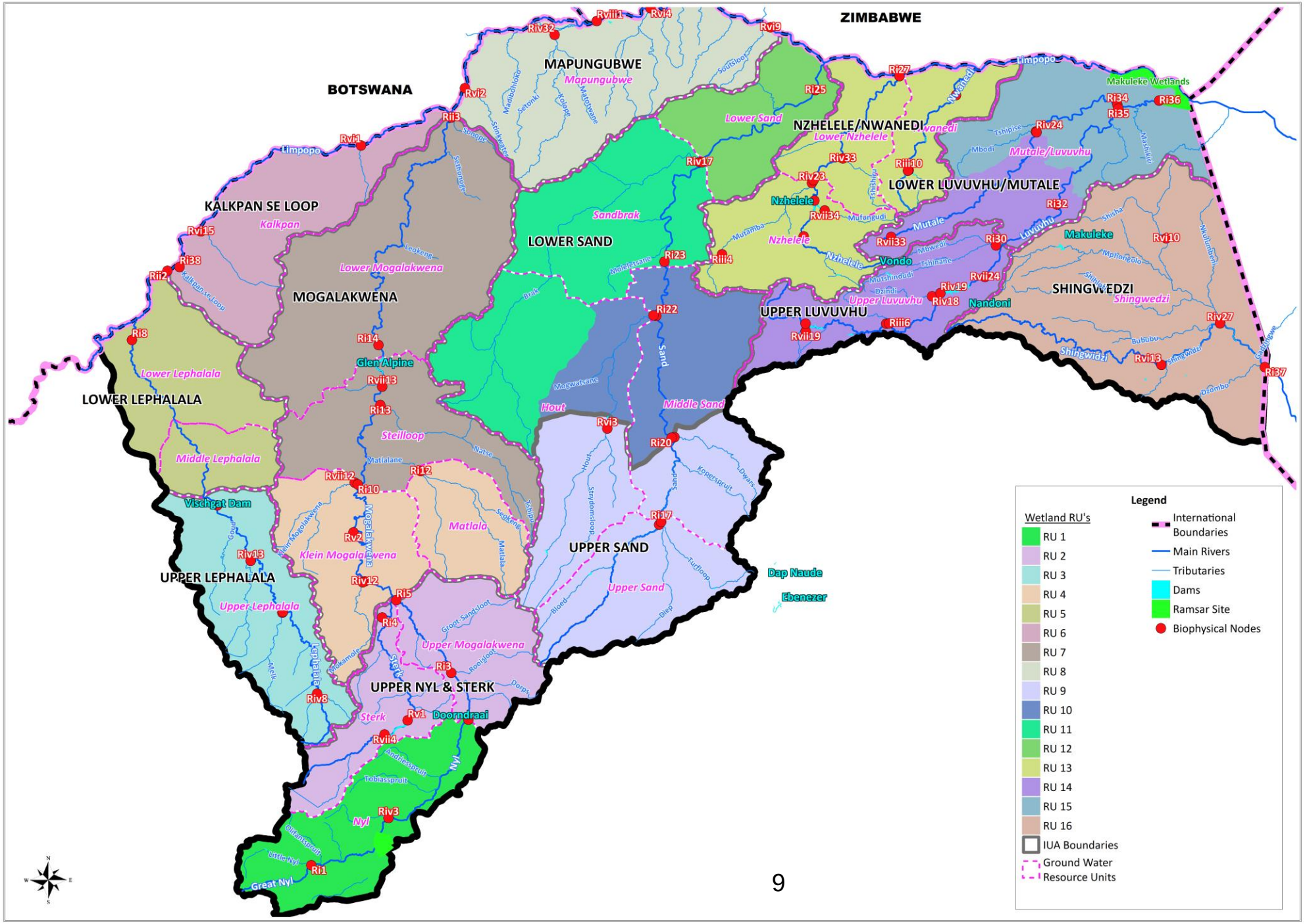



ZIMBABWE
BOTSWANA
MOZAMBIQUE
MAPUNGUPWE
NZHELELE/NWANEDI
LOWER LUVUVHU/MUTALE
KALKPAN SE LOOP
LOWER SAND
MOGALAKWENA
SHINGWEDZI
UPPER LUVUVHU
LOWER LEPHALALA
UPPER LEPHALALA
UPPER SAND
UPPER NYL & STERK
Mussina
Makuleke Wetlands
Makhado
Lephalale
Polokwane
Mokopane
Mookgophong
Modimole
Nylsvley Nature Reserve
Limpopo
Mutale
Nzhelele
Luvuvhu
Shingwedzi
Sand
Sterk
Nyl
Great Nyl
Lephalala

OVERVIEW OF DELINEATION PROCESS

STEP 2: DESCRIBE CURRENT CONDITION AND IDENTIFY IUAS

1. The delineation process was aimed at combining the river, wetland, and groundwater resource units; the infrastructure, landuse and socio-economic information into areas of interest.
2. Key considerations in the delineation process was to maintain separate river basins such that the IUAs are hydrologically independent.
3. Ecological zones aligned well with socio-economic zones.
4. Socio-economic zones formed the IUAs
5. 12 IUAs defined


ZIMBABWE
BOTSWANA
MAPUNGUBWE
Mapungubwe
NZHELELE/NWANEDI
Lower Nzhelele
Lower Sand
LOWER LUVUVHU/MUTALE
Mutale/Luvuvhu
KALKPAN SE LOOP
Kalkpan
LOWER SAND
Sandbrak
MOGALAKWENA
Lower Mogalakwena
Nzhelele
Vondo
Makuleke
SHINGWEDZI
Shingwedzi
UPPER LUVUVHU
Upper Luvuvhu
Nandoni
LOWER LEPHALALA
Lower Lephalala
Glen Alpine
Steilloop
Middle Lephalala
Hout
Middle Sand
UPPER SAND
Upper Sand
Matlala
Klein Mogalakwena
Vischgat Dam
UPPER LEPHALALA
Upper Lephalala
Upper Mogalakwena
UPPER NYL & STERK
Sterk
Nyl
Dap Naude
Ebenezer
Doorndraai
Limpopo
Makuleke Wetlands
Legend
Wetland RU's
RU 1
RU 2
RU 3
RU 4
RU 5
RU 6
RU 7
RU 8
RU 9
RU 10
RU 11
RU 12
RU 13
RU 14
RU 15
RU 16
IUA Boundaries
Ground Water Resource Units
International Boundaries
Main Rivers
Tributaries
Dams
Ramsar Site
Biophysical Nodes

SOCIO-ECONOMIC ZONE	RIVER RESOURCE UNITS	DAM RESOURCE UNIT	GROUNDWATER RESOURCE UNITS	WETLAND RESOURCE UNITS	IUA NAME	QUATERNARY CATCHMENTS
1. Upper Lephalala	Upper Lephalala	Vischgat	Upper Lephalala	RU 3	Upper Lephalala	A50A, A50B, A50C, A50D, A50E, A50F
2. Lower Lephalala	Lower Lephalala	Susandal	Middle Lephalala Lower Lephalala	RU 5	Lower Lephalala	A50G, A50H
3. Kalkpan se Loop	Kalkpan se Loop		Kalkpan / Maasstroom	RU 6	Kalkpan se Loop	A50J,A63C
4. Upper Nyl & Sterk	Upper Nyl/Sterk Middle Nyl Lower Nyl	Donkerpoort Doorndraai	Nyl River Valley, Sterk Upper Mogalakwena	RU1 RU 2	Upper Nyl & Sterk	A61A, A61B, A61C, A61D, A61E, A61F, A61G, A61H, A61J
5. Mogalakwena	Mogalakwena	Glen Alpine	Klein Mogalakwena Matlala Steilloop Lower Mogalakwena	RU 4 RU 7	Mogalakwena	A62A, A62B, A62C, A62D, A62E, A62F, A62G, A62H, A62J, A63A, A63B, A63D
6. Mapungubwe	Mapungubwe/Lower Sand		Kolope	RU 8	Mapungubwe	A63E, A71L
7. Upper Sand	Upper Sand	Turfloop Houtrivier	Upper Sand Middle Sand Hout	RU 9	Upper Sand	A71A, A71B, A71C, A71E, A71F

SOCIO-ECONOMIC ZONE	RIVER RESOURCE UNITS	DAM RESOURCE UNIT	GROUNDWATER RESOURCE UNITS	WETLAND RESOURCE UNITS	IUA NAME	QUATERNARY CATCHMENTS
8. Lower Sand	Lower Sand	Dr Neethling	Middle Sand Hout Lower Sand Sandbrak	RU 10 RU 11 RU 12	Lower Sand	A71D, A71G, A71H, A71J, A71K, A72A, A72B
9. Nzhelele/Nwanedi	Upper Nzhelele/Upper Nwanedi Lower Nzhelele/Upper Nwanedi	Mutshedzi Nzhelele Ṅwanedi Luphephe Cross	Nzhelele Lower Nzhelele Nwanedi	RU 13	Nzhelele/Nwanedi	A80A, A80B, A80C, A80D, A80E, A80F, A80G, A80H, A80J
10. Upper Luvuvhu	Luvuvhu Headwaters Upper Luvuvhu	Albasini Mambedi Tshakuma Vondo Phiphidi Damani/Mvuwe Nandoni Mukumbani	Upper Luvuvhu	RU 14	Upper Luvuvhu	A91A, A91B, A91C, A91D, A91E, A91F, A91G
11. Lower Luvuvhu/Mutale	Upper Mutale/Middle Luvuvhu Lower Mutale/Lower Luvuvhu Luvuvhu KNP	Lake Fundudzi	Mutale/Luvuvhu	RU 15	Lower Luvuvhu/Mutale	A91H, A91J, A91K, A92A, A92B, A92C, A92D
12. Shingwedzi	Shingwedzi	Makuleke Rooibosrand	Shingwedzi	RU 16	Shingwedzi	B90A, B90B, B90C, B90D, B90E, B90F, B90G, B90J

RIVERS

RIVER DESCRIPTION AND STATUS QUO CRITERIA

- Criteria used to describe rivers per IUA:
  - Ecoregion Level I
  - Geomorphological Zonation
  - Vegetation Bioregion
  - Main tributaries
  - Perenniality
  - Conservation/Protected Areas

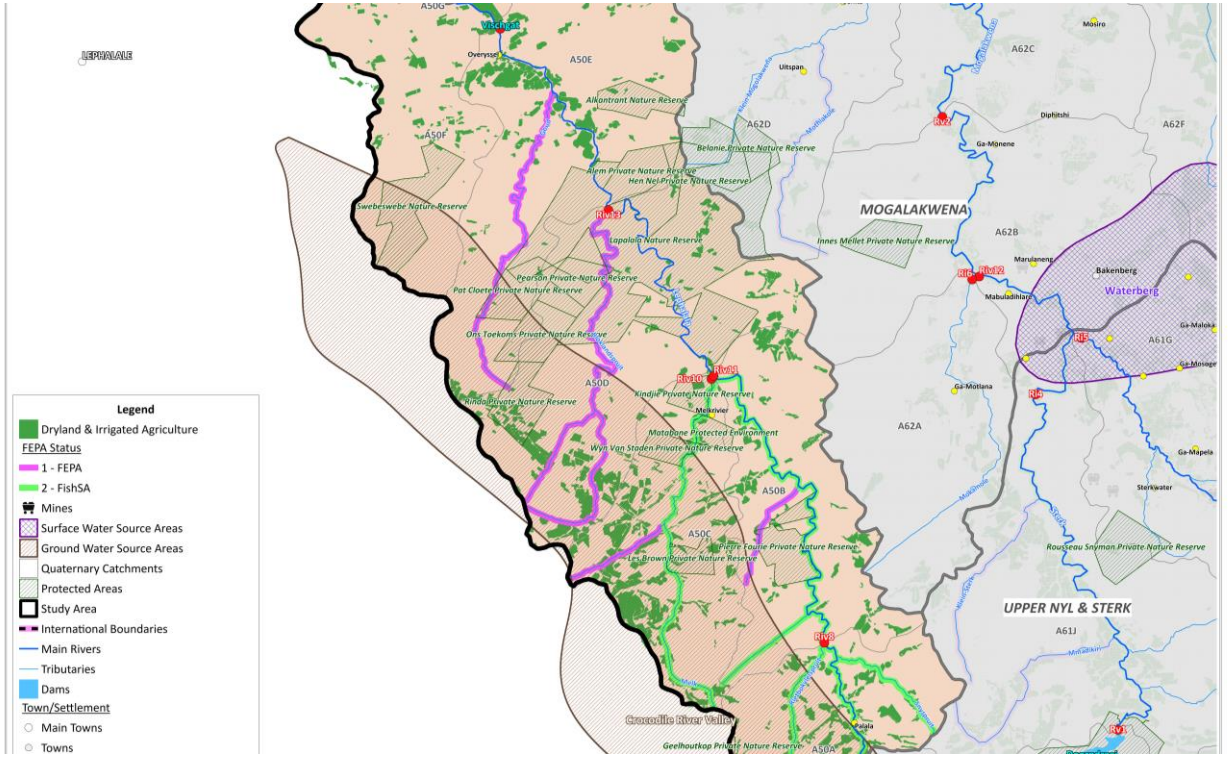
- River Ecological Status Quo per Sub-quaternary reach:
  - Present Ecological State (PES), 2014
  - Ecological Importance & Ecological Sensitivity (EI & ES), 2014
  - Freshwater Ecosystem Priority Areas (FEPAs)
  - Strategic Water Source Areas (SWSA)
  - Historic and recent ecological data – DWS, SANPARKS, LEDET, among others

FEPA Definitions

- Strategic spatial priorities are known as **Freshwater Ecosystem Priority Areas,** or **FEPAs.** Include river ecosystem types comprising unique combinations of landscape features, flow variability and channel slope. River ecosystem types which were used for representing natural examples of the diversity of river ecosystems across the country. River condition: A or B ecological category = FEPA;
- **Fish Support Area** = Fish sanctuaries in a good condition (A or B ecological category) were identified as FEPAs. The remaining fish sanctuaries in lower than an A or B ecological condition were identified as Fish Support Areas, also include sub-quaternary catchments that are important for migration of threatened or near-threatened fish species;
- **Phase 2 FEPA** = a river in a moderately modified condition (PES = C) and considered not possible to meet biodiversity targets for those rivers classified as an A or B PES;
- **Upstream Management Area** = rivers where human activities need to be managed carefully in order not to compromise downstream FEPAs and Fish Support Areas (Nel *et al.,* 2011).

STATUS QUO: Upper & Lower Lephalala IUAs

- Upper Lephalala River within the Waterberg Ecoregion: high conservation importance with regards to FEPA status;
- Mainstem Lephalala River and many of its associated tributaries in quaternary catchments A50A, A50B and A50C = FEPA fish support areas;
- Some of the tributaries in these three quaternaries = full FEPA status;
- Boklandspruit and Goud River in quaternary catchment A50D and A50E = full FEPA status;
- Boklandspruit and two sections of the Lephalala River, upstream of the confluence with the Boklandspruit = B PES;
- Lower Lephalala: no FEPA status, mainstem river in a D Ecological Category; high EI and ES.



STATUS QUO: Upper & Lower Lephalala IUAs

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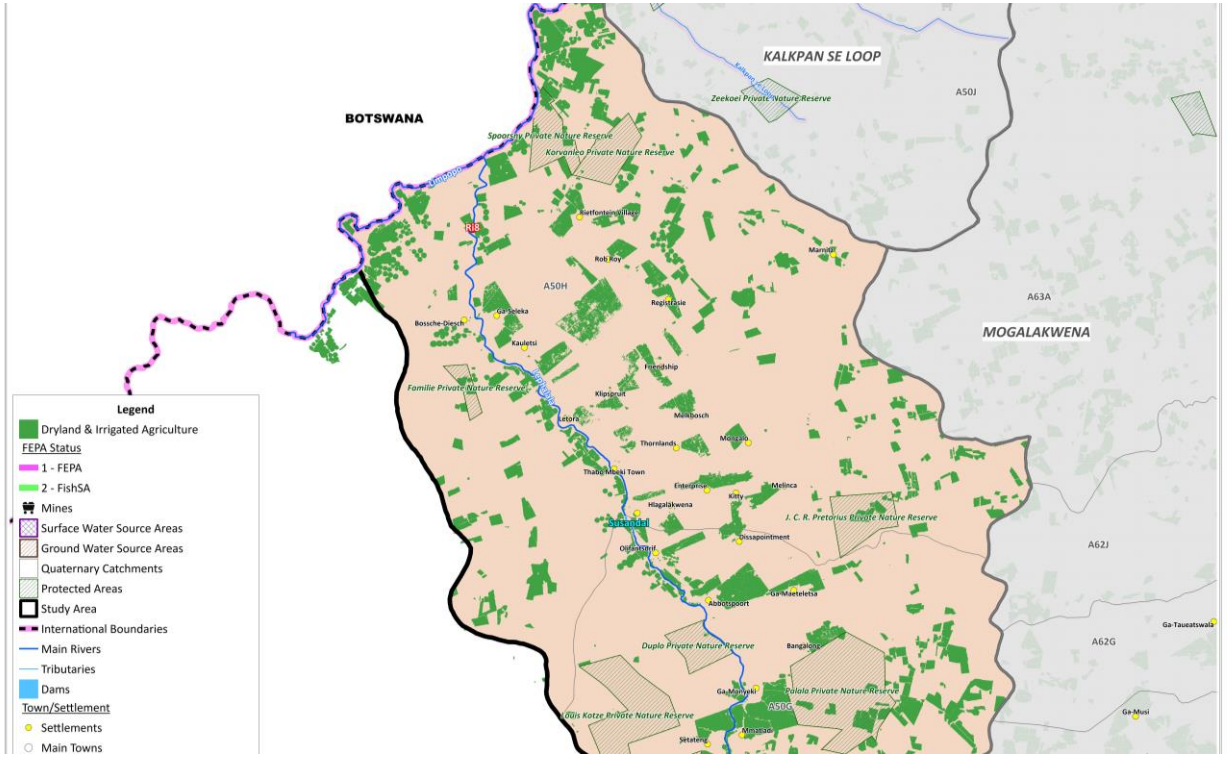
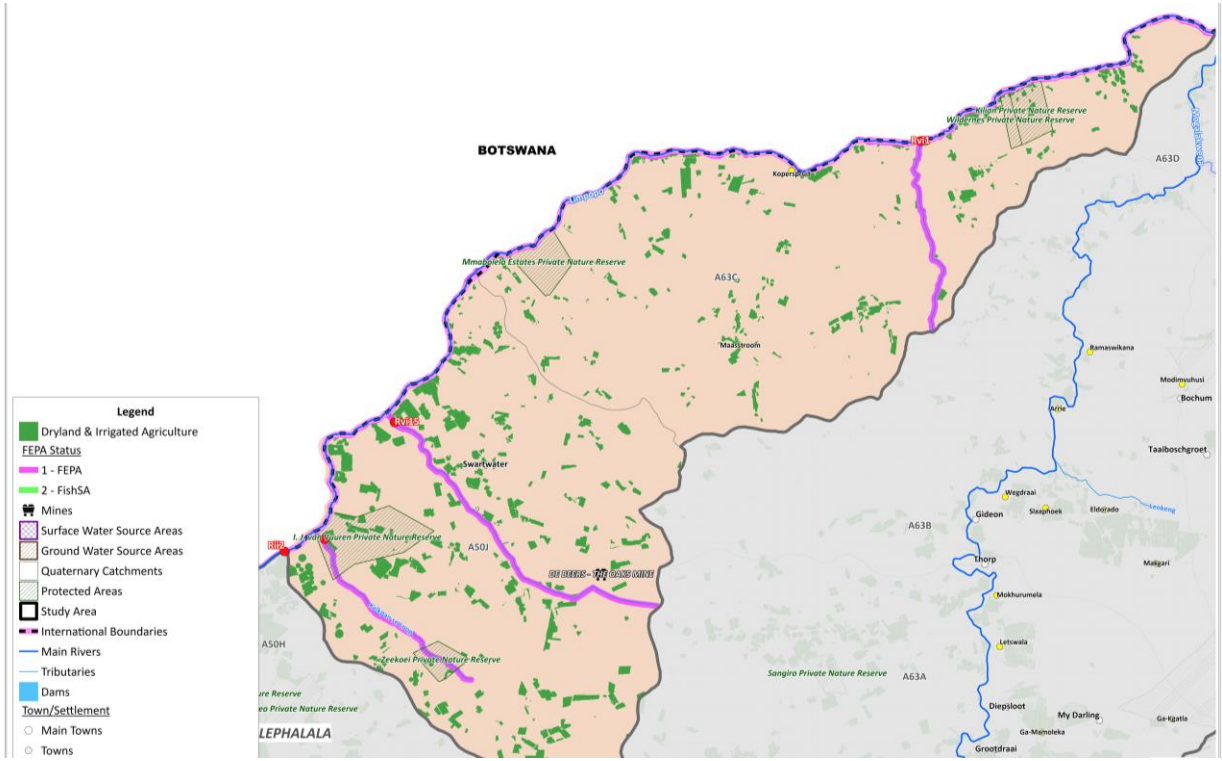
- Some of the tributaries in these three quaternaries = full FEPA status;
- Boklandspruit and Goud River in quaternary catchment A50D and A50E = full FEPA status;
- Boklandspruit and two sections of the Lephalala River, upstream of the confluence with the Boklandspruit = B PES;
- Lower Lephalala: no FEPA status, mainstem river in a D Ecological Category; high EI and ES.



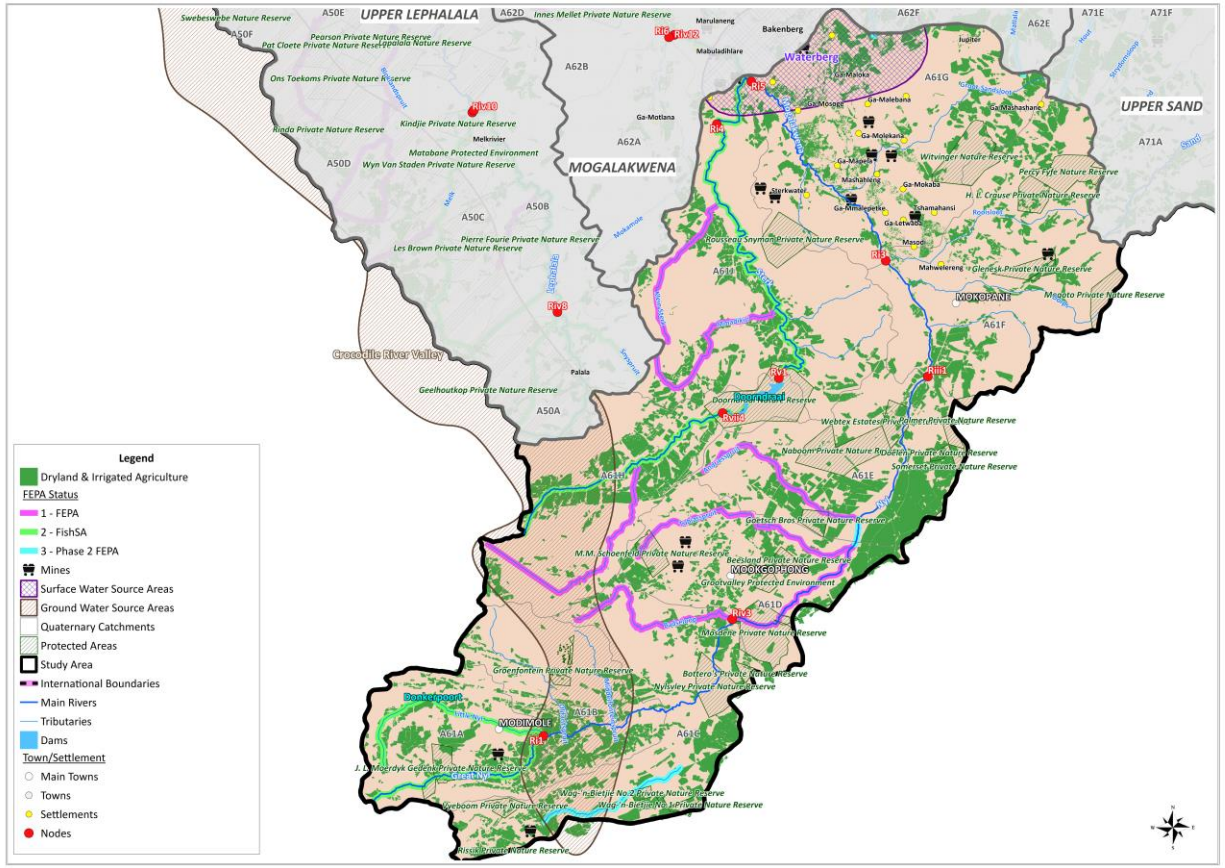
STATUS QUO: Kalkpan se Loop IUA

- The non-perennial tributaries, including the Kalkpan se Loop in quaternary catchment A50J = full FEPA status;
- B PES Category;
- Unnamed tributary assigned a high EI.



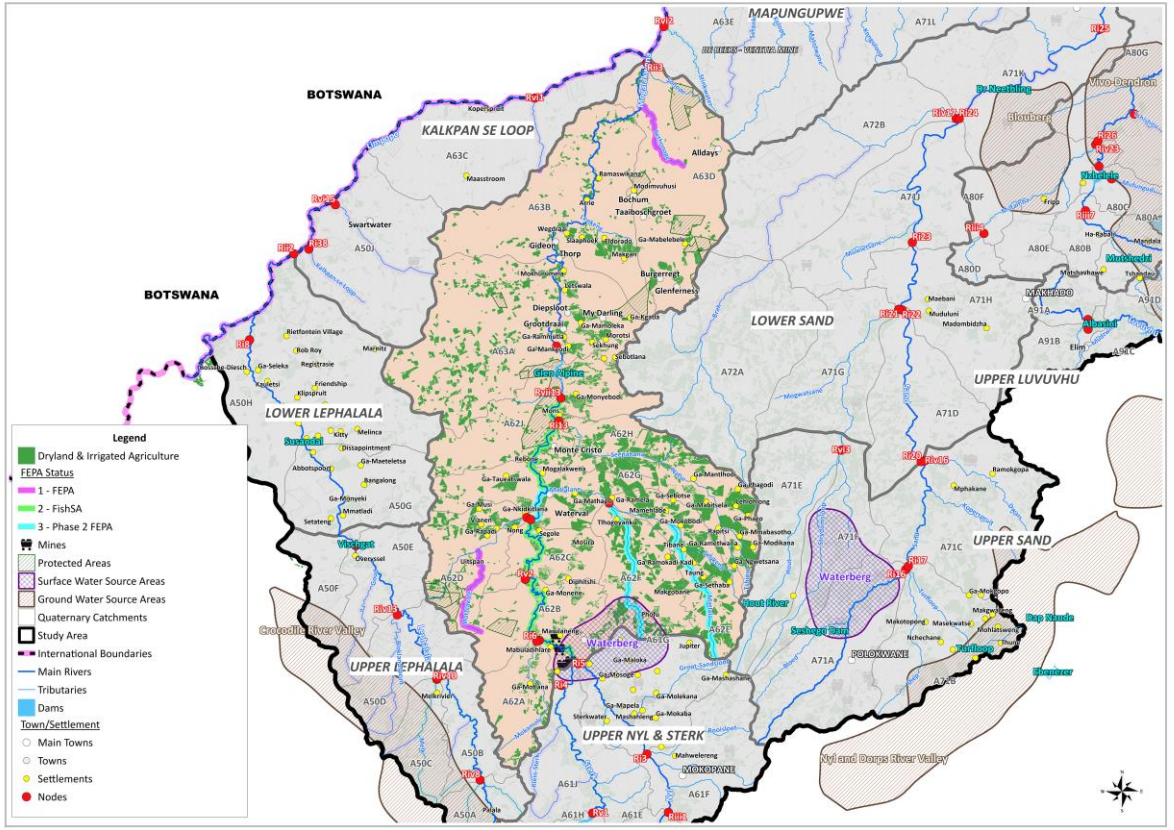
STATUS QUO: Upper Nyl & Sterk

- Sections of the upper Mogalakwena Catchment are of conservation importance re FEPA status;
- Badseloop, Tobiasspruit, Andriesspruit, Mmadikiri and Klein-Sterk Rivers = full FEPA status;
- Great Nyl, Little Nyl and Sterk Rivers = FEPA Fish Support Areas;
- Most of the rivers in quaternary catchments A61E, A61F and A61G = upstream FEPA areas;
- Ephemeral Nylsvley wetland situated in the Nyl River and has RAMSAR status;
- Most of the rivers in this IUA = C and D PES status, with two tributaries of the Sterk River = B PES status;
- Many of the rivers in the upper IUA = high EI and ES;
- Great Nyl, Olifantspruit and Klein Sterk River = very high ES;
- Section of the Mogalakwena River in the Waterberg with its confluence with the Sterk River, is considered a Strategic Water Source Area.



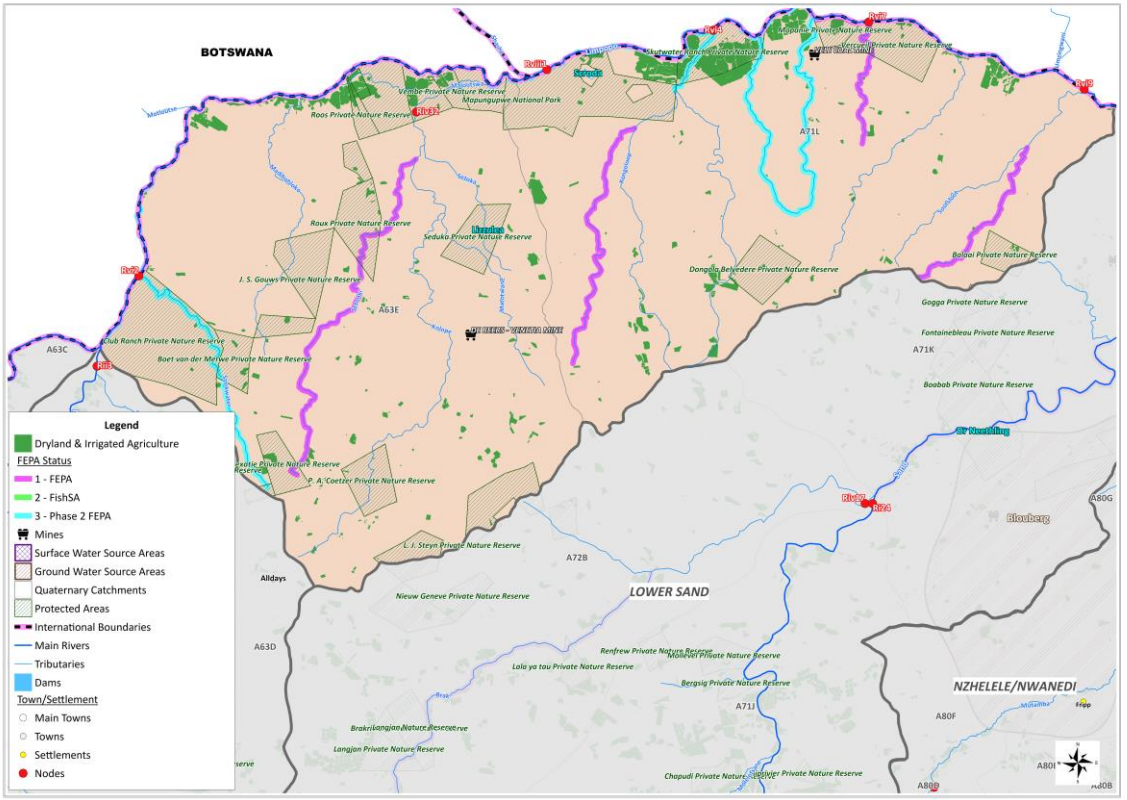
STATUS QUO: Mogalakwena IUA

- Mothlakole and Sethonoge Rivers = full FEPA status, with sections of the mainstem Mogalakwena River = fish support areas;
- Many tributaries in the upper IUA = FEPA support areas;
- The Mothlakole River is assigned an A PES Category;
- The lower Mogalakwena River = D PES Category, Sethonoge River and some of its unnamed tributaries = B PES Category;
- Upper Mogalakwena and mid-sections, some of the upper tributaries = high EI;
- Mokamole and Mothlakole and upper Mogalakwena Rivers = high ES.



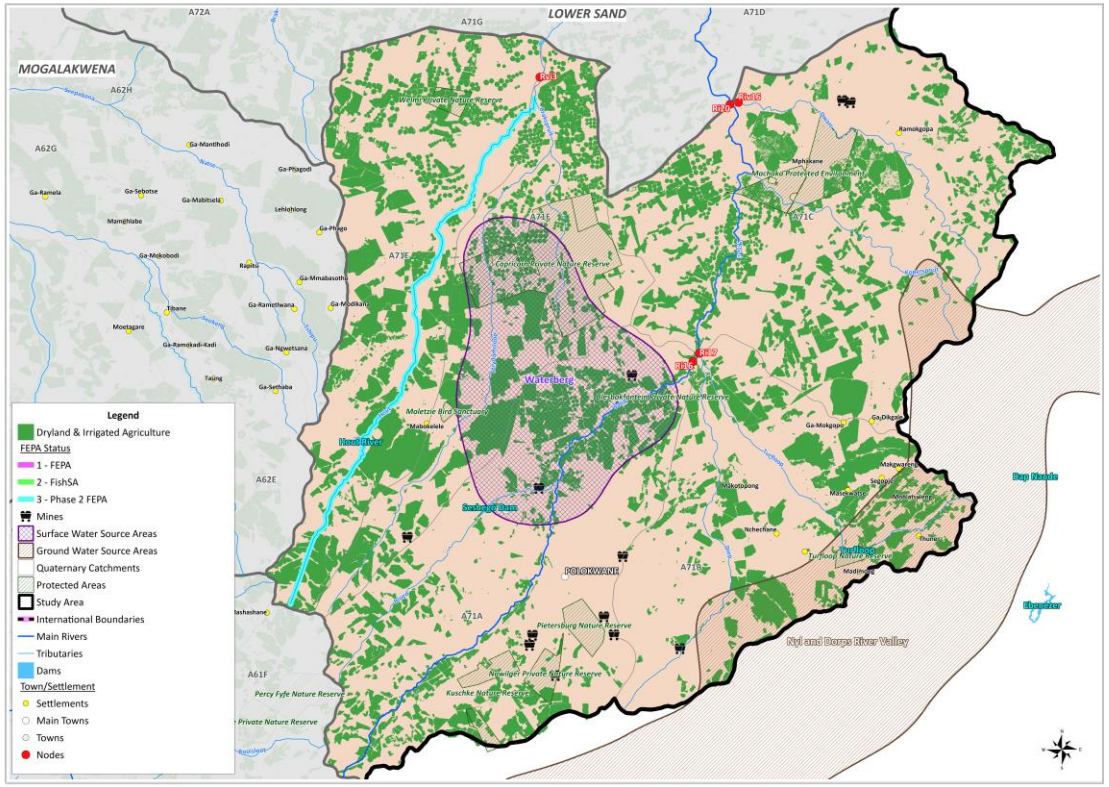
STATUS QUO: Mapungubwe IUA

- The Setongi, Kongoloop and Soutsloot = full FEPA status, with the Stinkwater and two unnamed tributaries = Phase 2 FEPA status;
- Kongoloop and Lower Soutsloot Rivers = A PES Category;
- Many of the tributaries including the Stinkwater, Setonki and Setoka Rivers = a B PES Category;
- Most of the rivers = high EI.

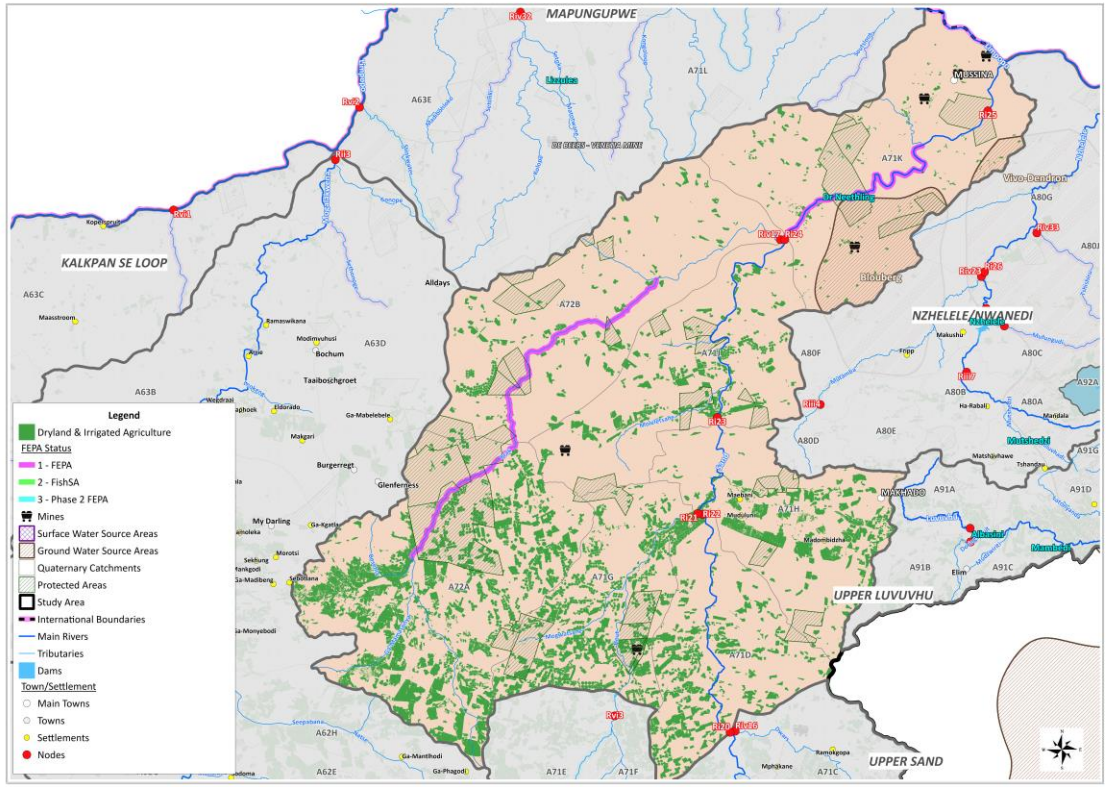


STATUS QUO: Upper Sand IUA

- Most of the Sand River catchment is considered an upstream FEPA, excluding the Hout River which is assigned Phase 2 FEPA status
- The Hout River is assigned a Phase 2 FEPA
- The Sand River and its tributaries in quaternary catchments A71A and A71F is classified as a Strategic Water Source Area
- The upper Sand River is assigned a high EI.



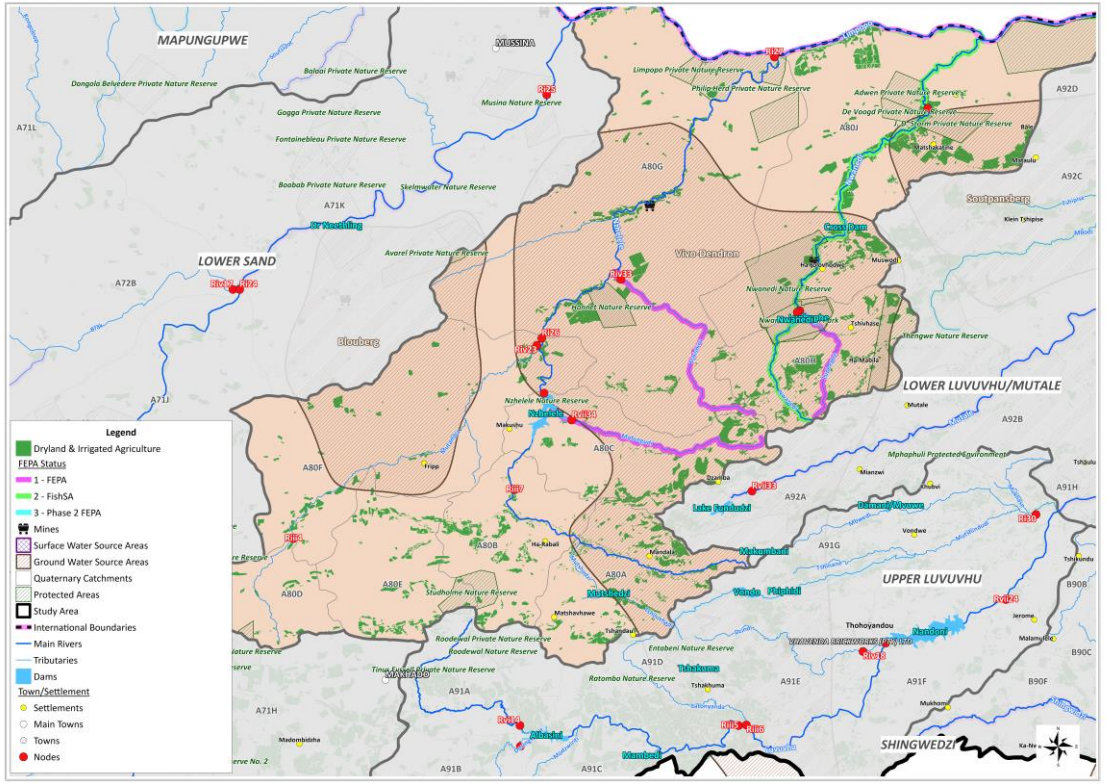
STATUS QUO: Lower Sand IUA



- Most of the rivers = upstream FEPA rivers;
- Only one section of the mainstem Sand River and a portion of the non-perennial Brakspruit = full FEPA status;
- Three non-perennial tributaries of the lower Sand River, including the Moleletsane River = B PES;
- Sections of the lower Sand River and a portion of the non-perennial Brak River tributary and the Moletsane River tributary = high EI.

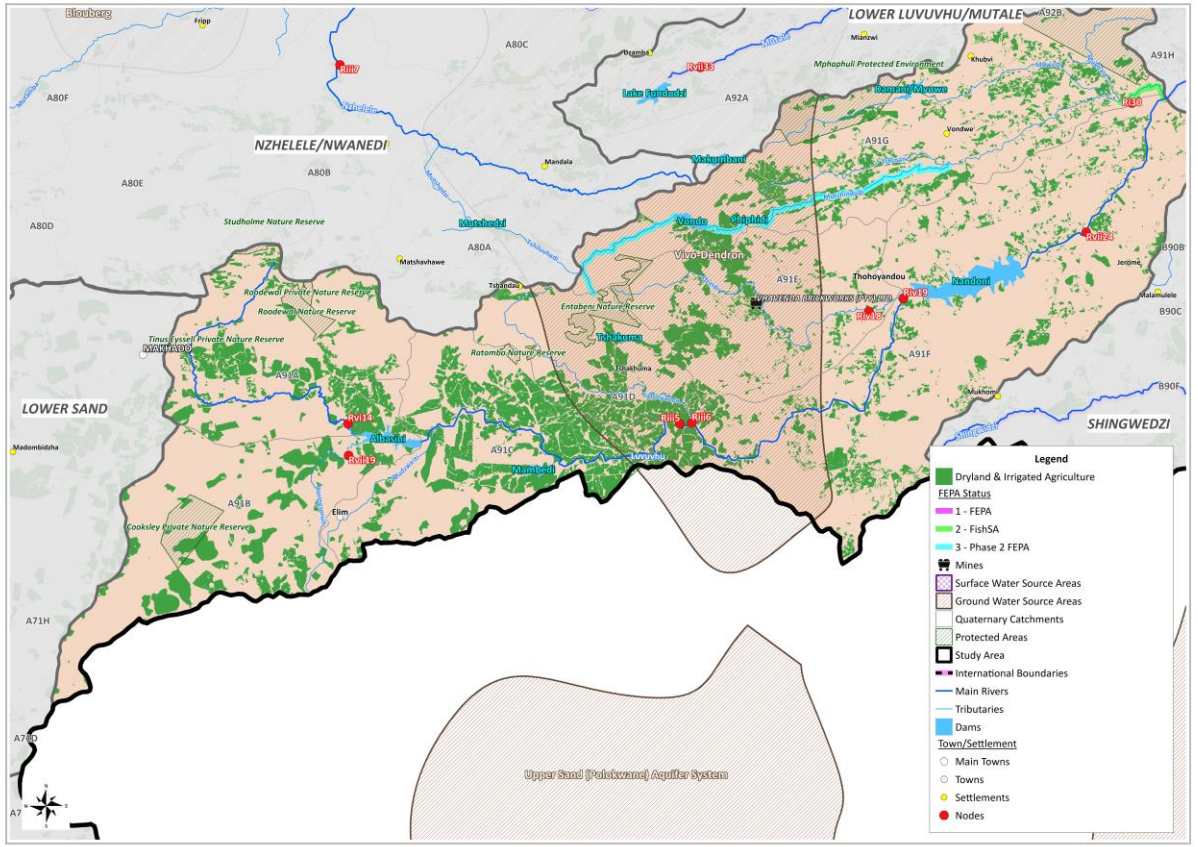
STATUS QUO: Nzhelele/Nwanedi IUA

- Non-perennial Mufungudi and Tshishiru Rivers, as well as the non-perennial Luphephe River in the Soutpansberg = full FEPA status;
- Nwanedi River = Fish Support Area;
- Sections of the catchment = high EI and high ES, with the upper Mutamba River = very high ES;
- A small tributary of the Mutamba River in quaternary catchment A80F and a tributary of the Nzhelele in quaternary catchment A80G = B PES Category, with the remainder of the catchment mostly = C and D PES Categories;
- REMP (River Ecostatus Monitoring Programme) sites A8LUPH-GUMEL on the Luphephe River and site A8NWAN-GORGE, on the Nwanedi River = B/C MIRAI Status.

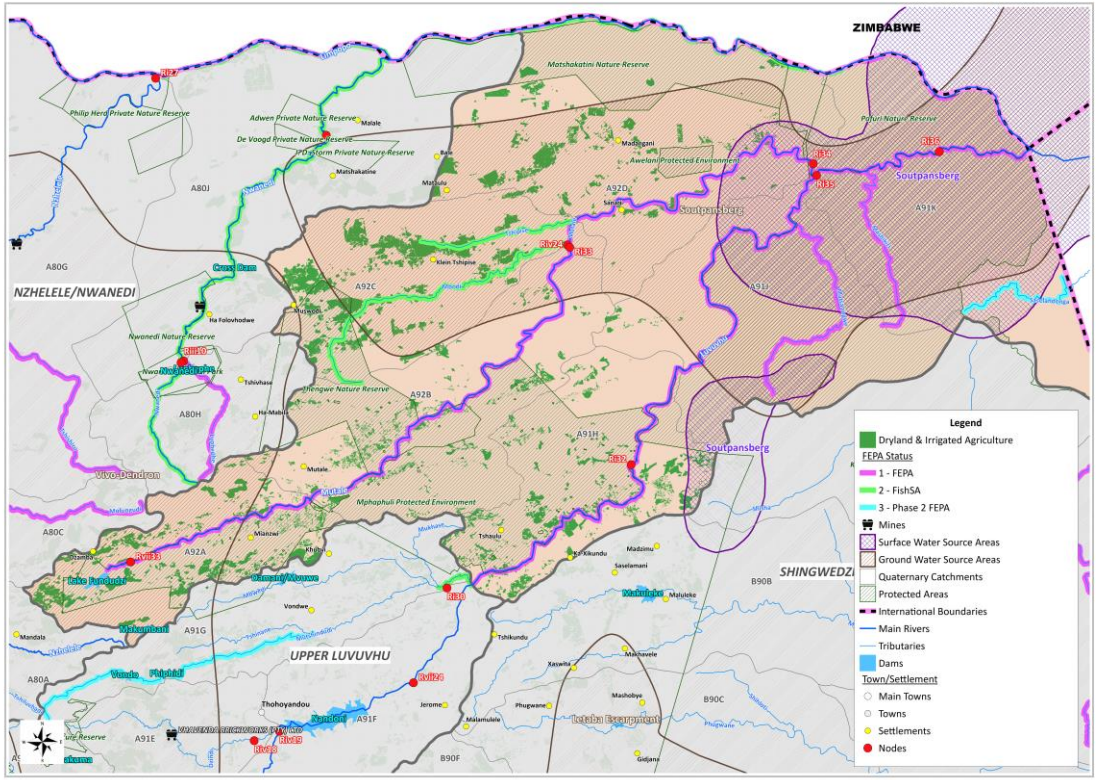


STATUS QUO: Upper Luvuvhu

- Upper Luvuvhu River = upstream FEPA;
- Upper Mutshinduḍi River = Phase 2 FEPA;
- Entire mainstem Luvuvhu River and lower Mutale River = high ES;
- Most of the rivers in the IUA are assigned a D PES Category, some = C PES Category;
- Upper Luvuvhu, Dzindi, upper Mutshinduḍi and Mbwedi Rivers = high ES, with the Dzindi, upper Mutshinduḍi, Tshinane and Mbwedi = very high ES;
- Mainstem Luvuvhu, including the Doringspruit tributary = high ES.



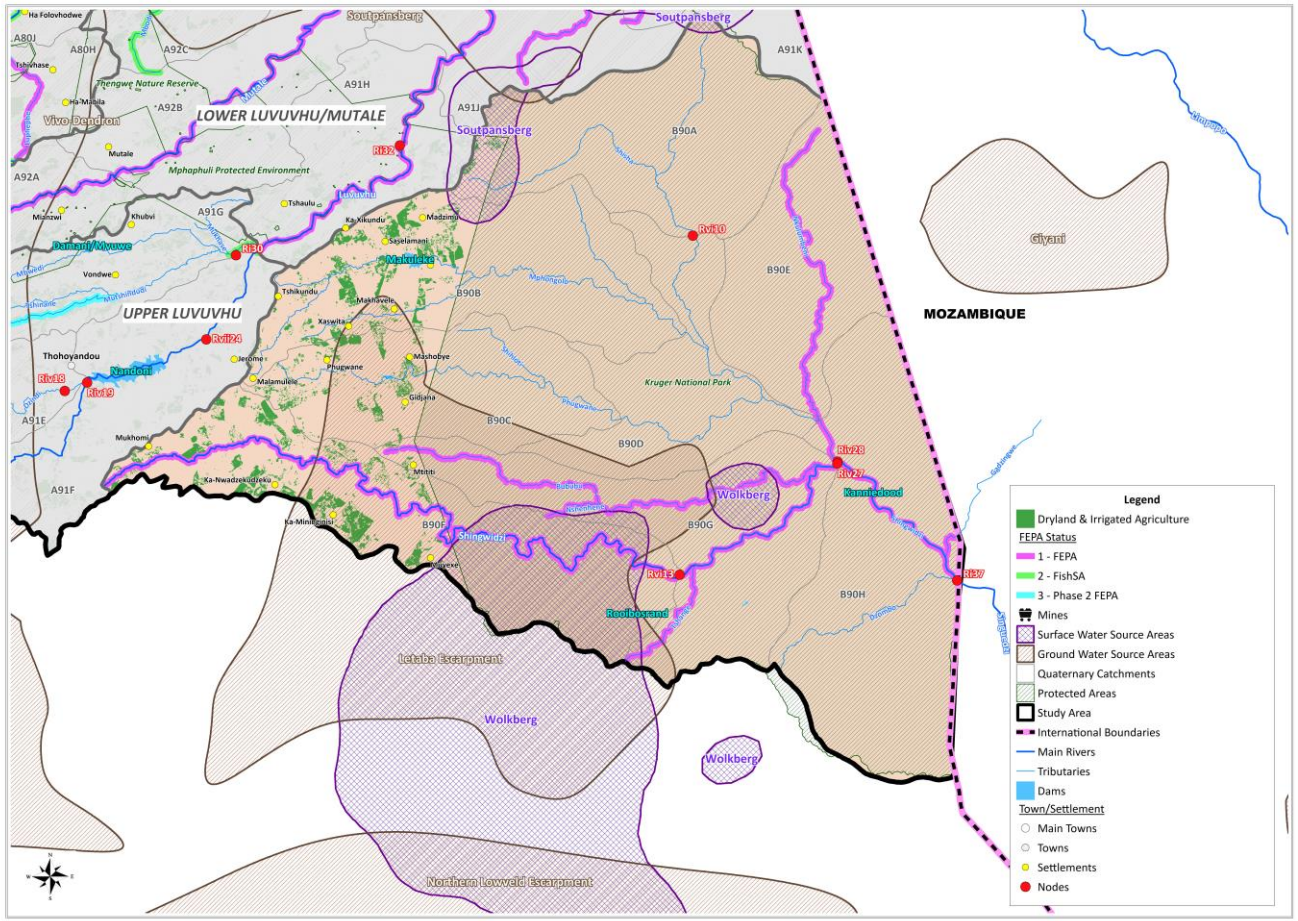
STATUS QUO: Lower Luvuvhu/Mutale



- Lower Luvuvhu and Mutale Rivers = full FEPA;
- Mbodi and Tshipise Rivers = Fish Support areas;
- Lower Luvuvhu River in quaternary A91J and A91K have unnamed tributaries in a B PES Category, lower Luvuvhu in an A PES Category before it enters the Limpopo River;
- Sections of the lower Luvuvhu catchment in quaternary catchments A91H, A91J and A91K comprise a Strategic Water Source Area;
- Lower Luvuvhu River, lower Mutale Rivers = high EI;
- Upper Mutale = very high ES.

STATUS QUO: Shingwedzi IUA

- Mainstem Shingwedzi River, Bububu and Nkulumbeni Rivers = full FEPA status, with unnamed tributaries in catchments B90A, B90B and B90C = Upstream FEPAs;
- Sections of the Shingwedzi and Bububu Rivers in quaternary catchments B90F and B90G are situated in Strategic Water Source Areas;
- Most of the Shingwedzi Catchment = high EI,
- Lower Shingwedzi River = high ES;
- Lower Shingwedzi River and many of its tributaries, including the Nkulumbeni, Shisha, Shihloti and Bububu Rivers = A or B PES.



WETLANDS

WETLANDS

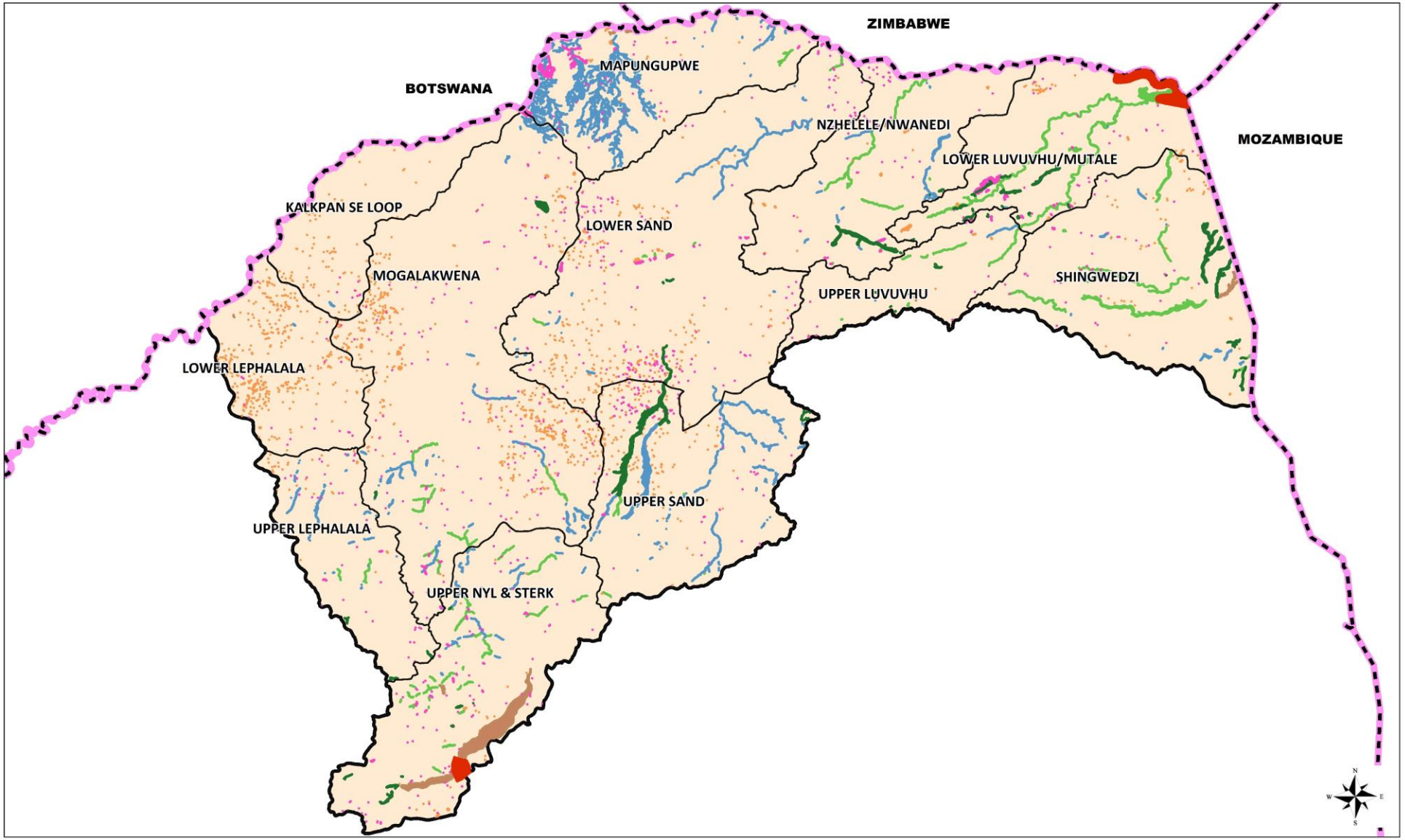
- Wetland distribution: Where do the different types of wetlands occur in the Study area, and some wetlands of interest
- Delineation of wetland Resource Units (RUs)
- Wetland status quo:
  - Dominant Type
  - Condition
  - Threat status
  - Protection level

WETLANDS

The information presented here is predominantly based on the following data sources:

- The wetland spatial distribution and metadata from the 2018 national biodiversity assessment (van Deventer *et al*., 2018).
- The wetland metadata from the National Freshwater Ecosystem Priority Areas study (NFEPA; Nel *et al.*, 2011).
- Wetland spatial and ecological data from the National Spatial Biodiversity Assessment (Driver *et al.*, 2005).

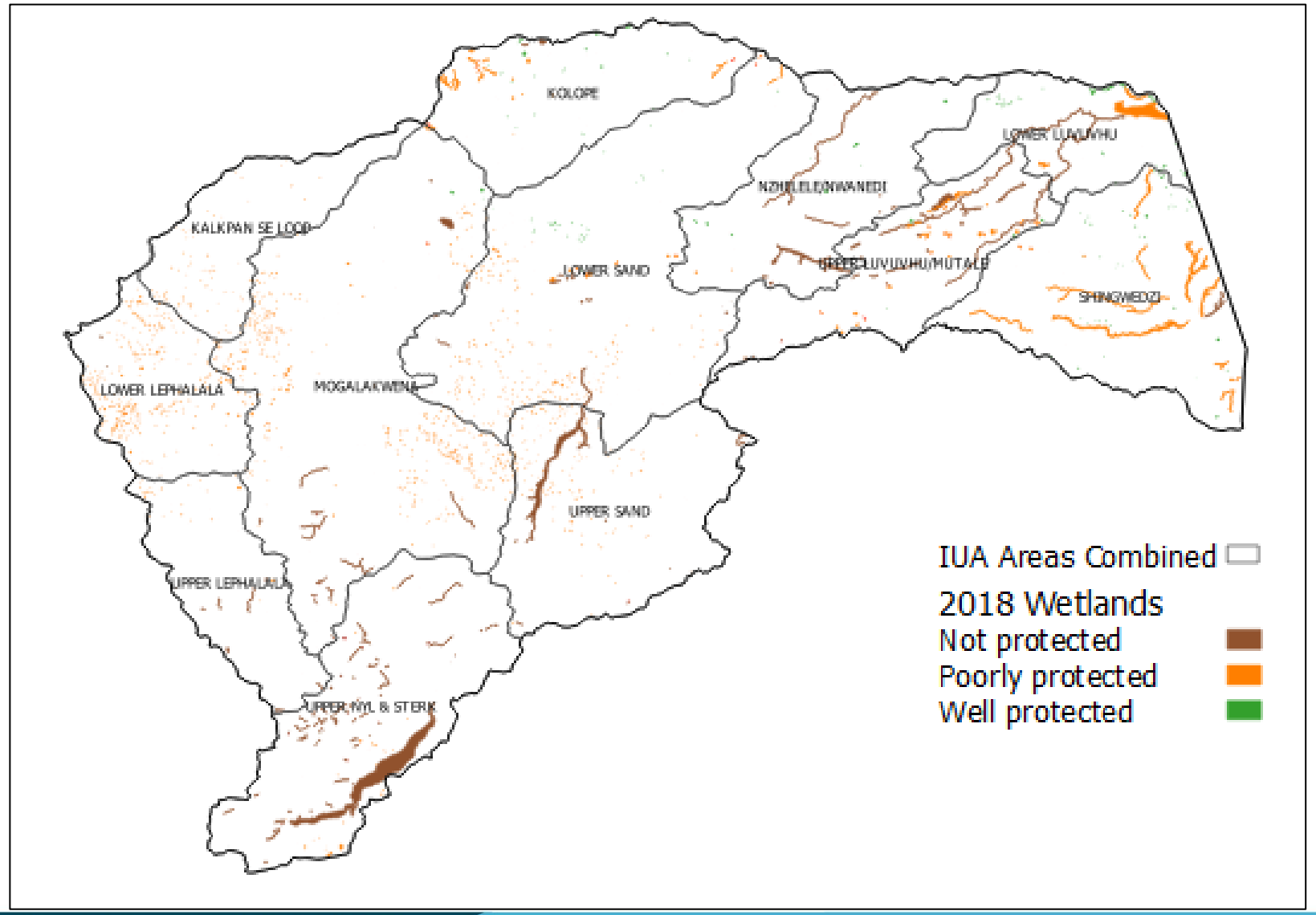
WETLANDS: Distribution of Different Types in the Study Area



Extent of wetlands (% area)

FLOOD	59.5
CVB	16.0
UVB	12.8
RIVER	10.5
DEPR	0.6
SEEP	0.6

WETLAND STATUS QUO: Protection Level



Extent of wetlands (% area)

Not protected	**82.6**
Poorly protected	**6.7**
Well protected	**0.2**
Not Assessed	**10.5**

WETLANDS: Ramsar wetlands

Nylsvley Nature Reserve

Ramsar site no. 952

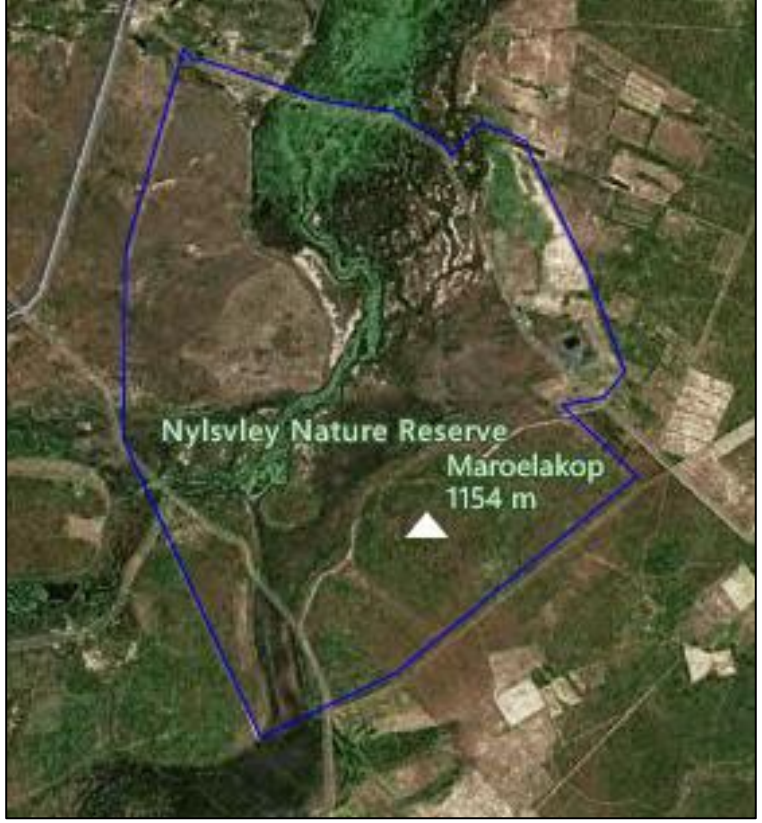
Date: 07/07/1998

Location: Limpopo Province, South Africa

Size: 3,970 ha

Coordinates: 24º39'S 028º42'E

Status/Type: Nature Reserve.



Description: The nature Reserve has riverine floodplains, flooded river basins, and seasonally flooded grassland, with the dominant wetland type being a seasonal river associated with a grassland floodplain. The wetland has the endangered roan antelope *Hippotragus equis*, and the area serves as a breeding ground for eight South African red-listed waterbirds and is the only site in South Africa which is a recorded locality for wild rice, *Oryza longistaminata*. The area is open to tourists, who usually come for birdwatching, and has high research value.

WETLANDS: Ramsar wetlands

Makuleke Wetlands

Ramsar site no. 1687

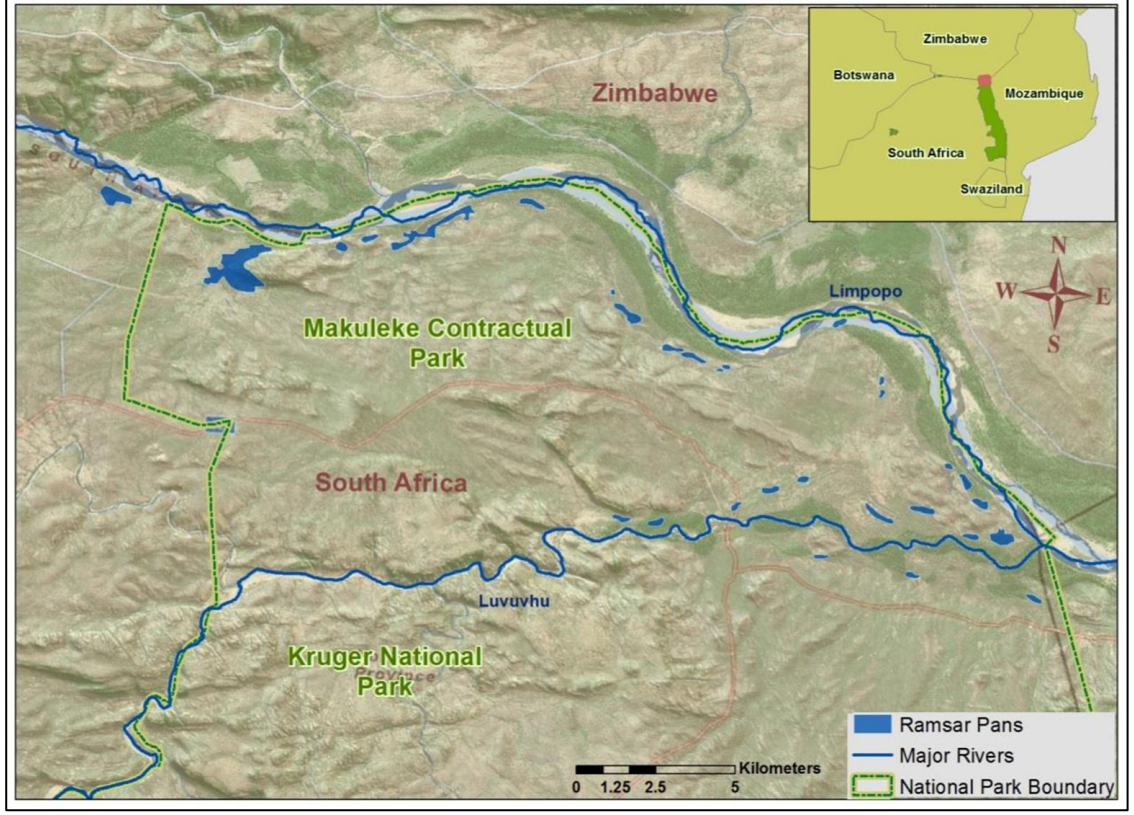
Date: 22/05/2007

Location: Limpopo, South Africa

Size: 7,757 ha

Coordinates: 22°23'S 031°11'E

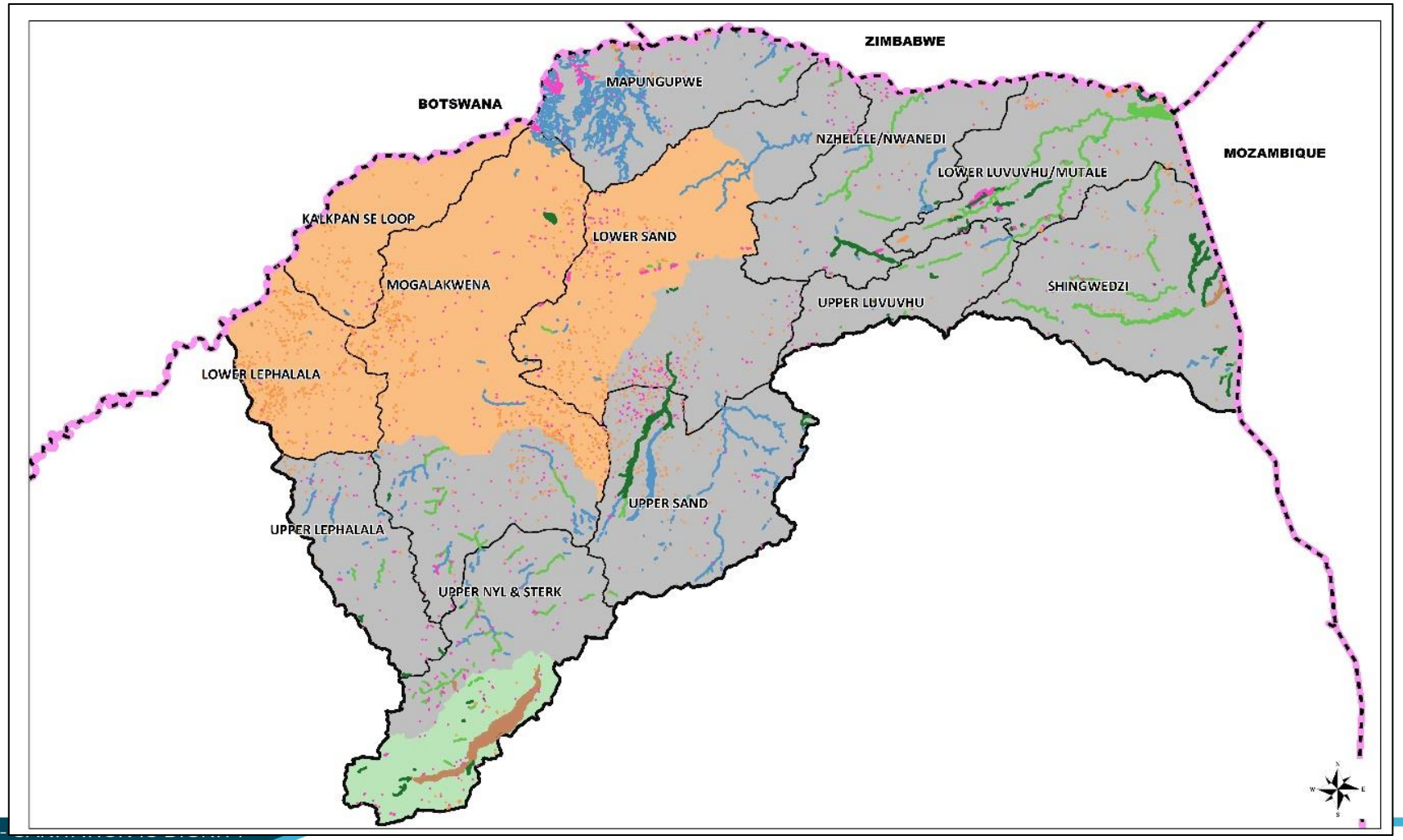
Status/Type: National Park



Description: An excellent example of a floodplain, most of which lies within the Kruger National Park, bordered by Zimbabwe and Mozambique to the north and east. Prominent features include riverine forests, riparian floodplain forests, floodplain grasslands, river channels and flood pans. Flood pans are of great importance in this ecosystem as they hold water right into the dry season. The floodplains are important for groundwater recharge, and maintain riparian and floodplain vegetation.

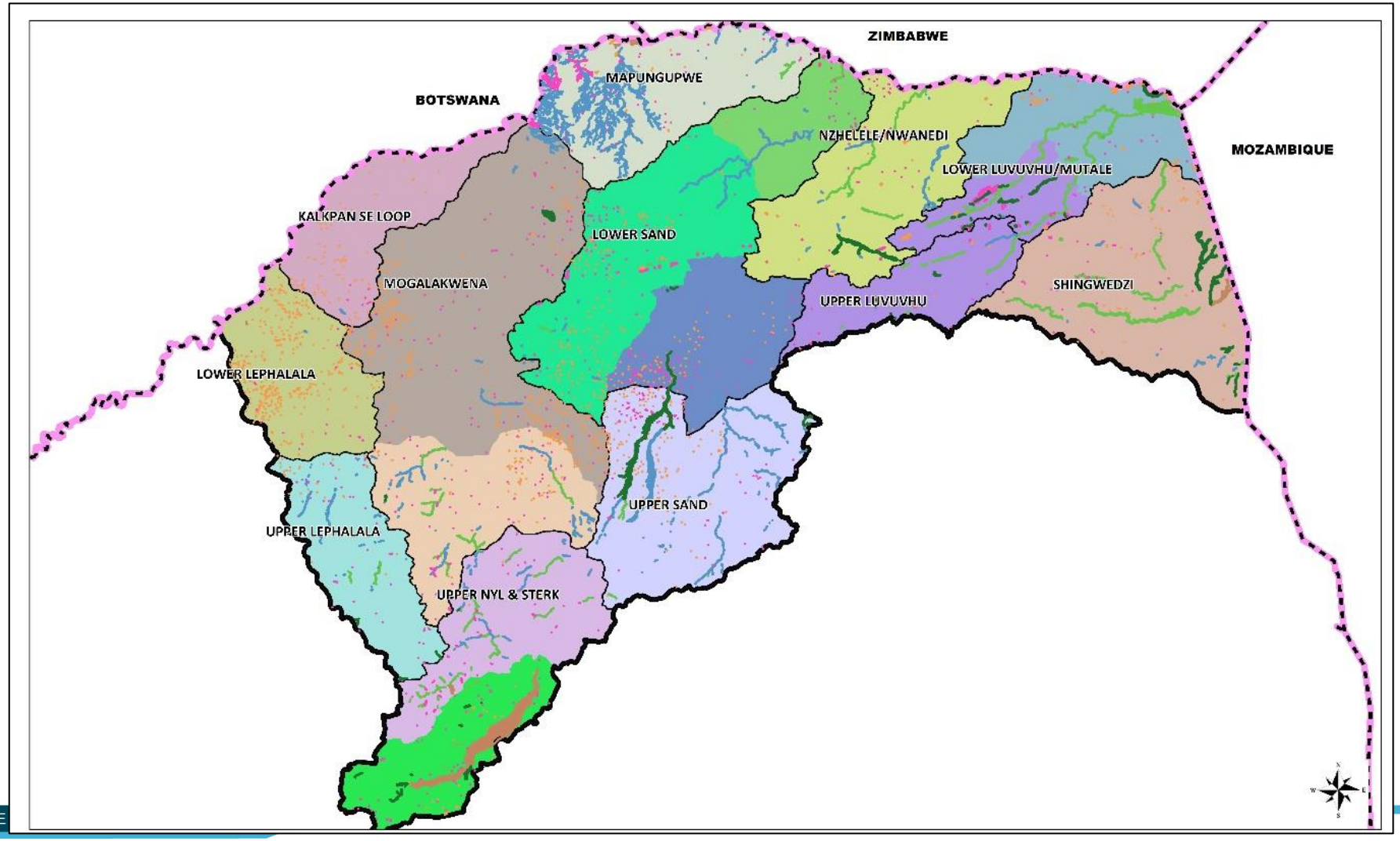
WETLANDS: Delineation of General Zones

3 General zones based on predominance of wetland type

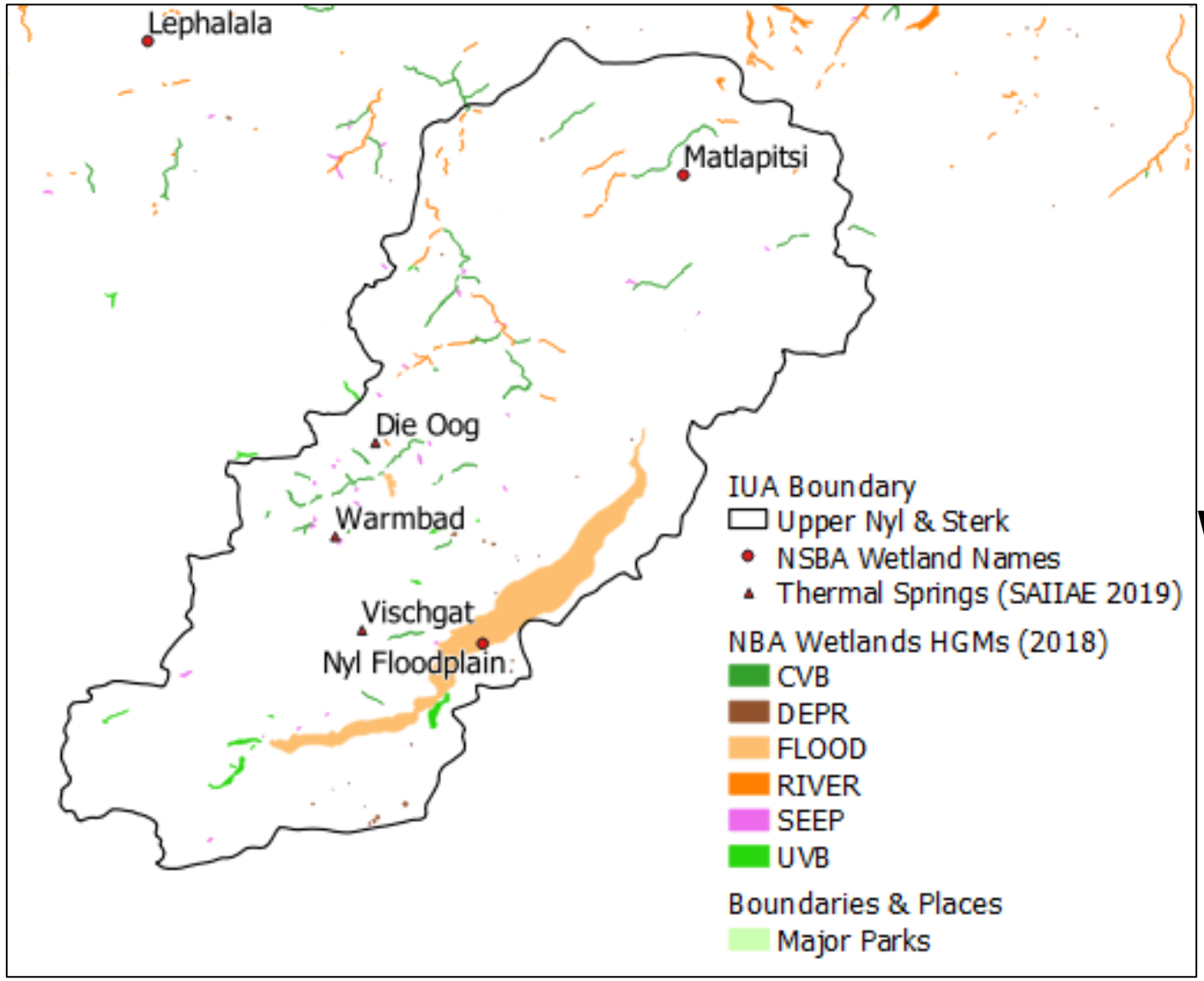


WETLANDS: Delineation of RUs

16 Wetland RUs shown in relation to IUAs



WETLAND STATUS QUO: 21805 Ha Wetlands



HGMs (% in IUA)

Channelled valley bottoms	5.8
Depressions	0.5
Floodplains	85.6
Riverine	2.1
Seeps	1.4
Unchannelled valley bottoms	4.7

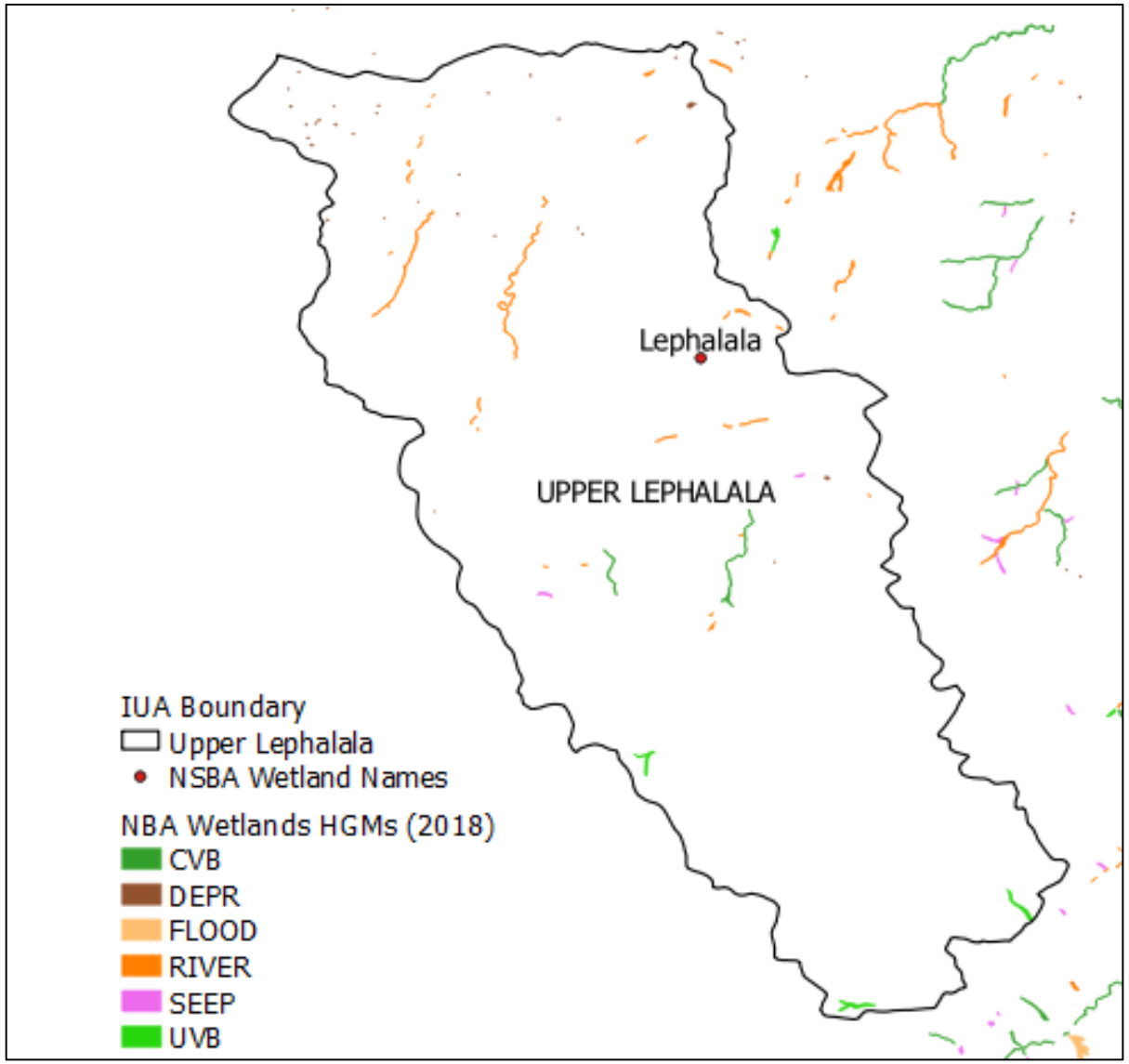
Wetland Condition (left) and Threat Status (right) (% in IUA)

A/B	1.0
C	0.9
D/E/F	96.0
N/A	2.1

CR	97.4
EN	0.0
LC	0.5
VU	0.0
N/A	2.1

WETLAND STATUS QUO:

729 Ha Wetlands



HGMs (% in IUA)

Channelled valley bottoms	15.8
Depressions	7.6
Floodplains	0.0
Riverine	44.8
Seeps	5.0
Unchannelled valley bottoms	26.9

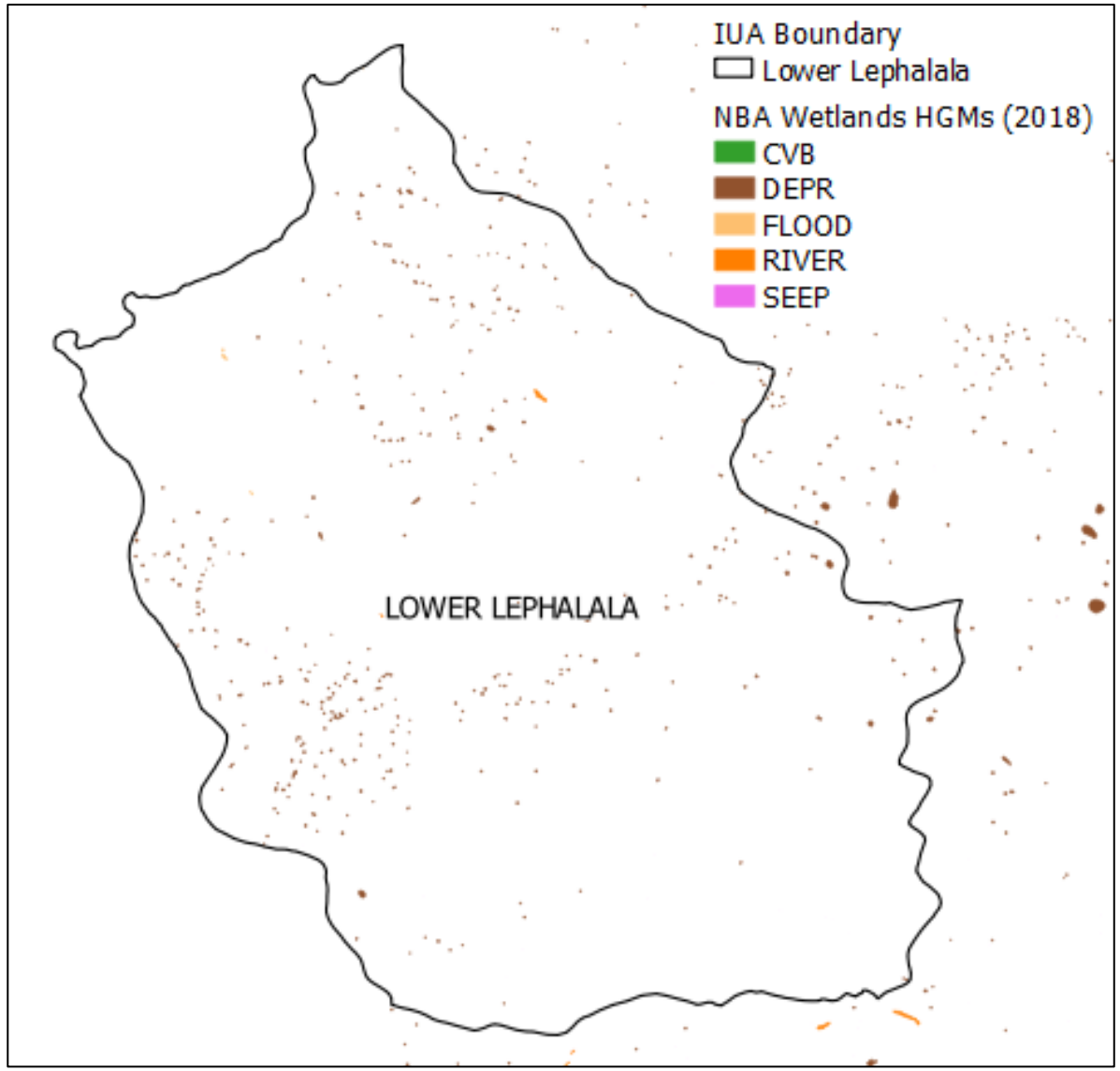
Wetland Condition (left) and Threat Status (right) (% in IUA)

A/B	5.6
C	3.6
D/E/F	46.1
N/A	44.8

CR	47.6
EN	0.0
LC	7.6
VU	0.0
N/A	44.8

WETLAND STATUS QUO:

529 Ha Wetlands



HGMs (% in IUA)

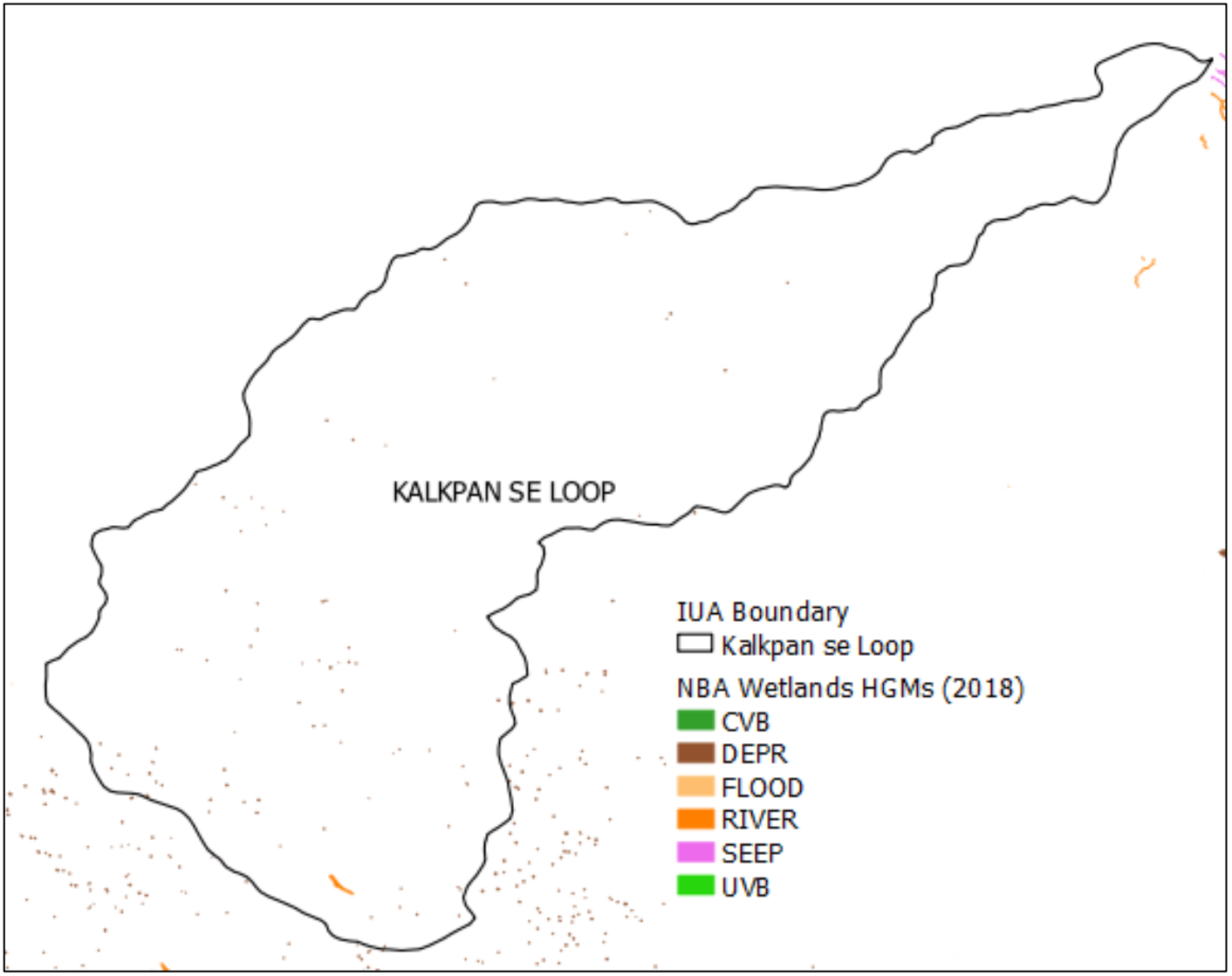
Channelled valley bottoms	0.0
Depressions	93.9
Floodplains	1.7
Riverine	4.4
Seeps	0.0
Unchannelled valley bottoms	0.0

Wetland Condition (left) and Threat Status (right) (% in IUA)

A/B	79.6
C	7.6
D/E/F	8.4
N/A	4.4

CR	1.7
EN	0.0
LC	93.9
VU	0.0
N/A	4.4

WETLAND STATUS QUO: 106 Ha Wetlands



HGMs (% in IUA)

Channelled valley bottoms	0.0
Depressions	49.5
Floodplains	0.0
Riverine	50.5
Seeps	0.0
Unchannelled valley bottoms	0.0

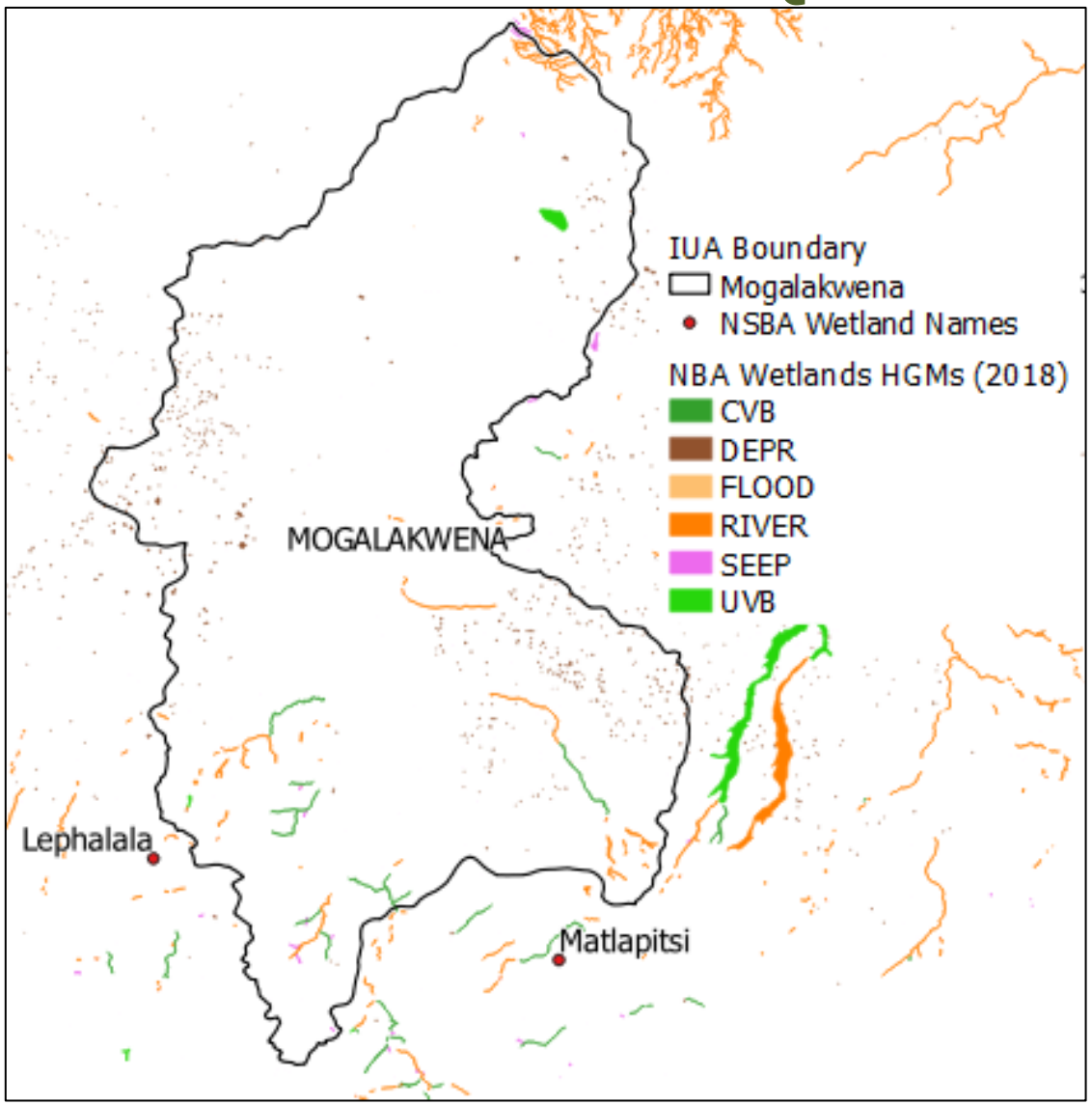
Wetland Condition (left) and Threat Status (right) (% in IUA)

A/B	42.2
C	3.7
D/E/F	3.6
N/A	50.5

CR	0.0
EN	0.0
LC	49.5
VU	0.0
N/A	50.5

WETLAND STATUS QUO:

4601 Ha Wetlands



HGMs (% in IUA)

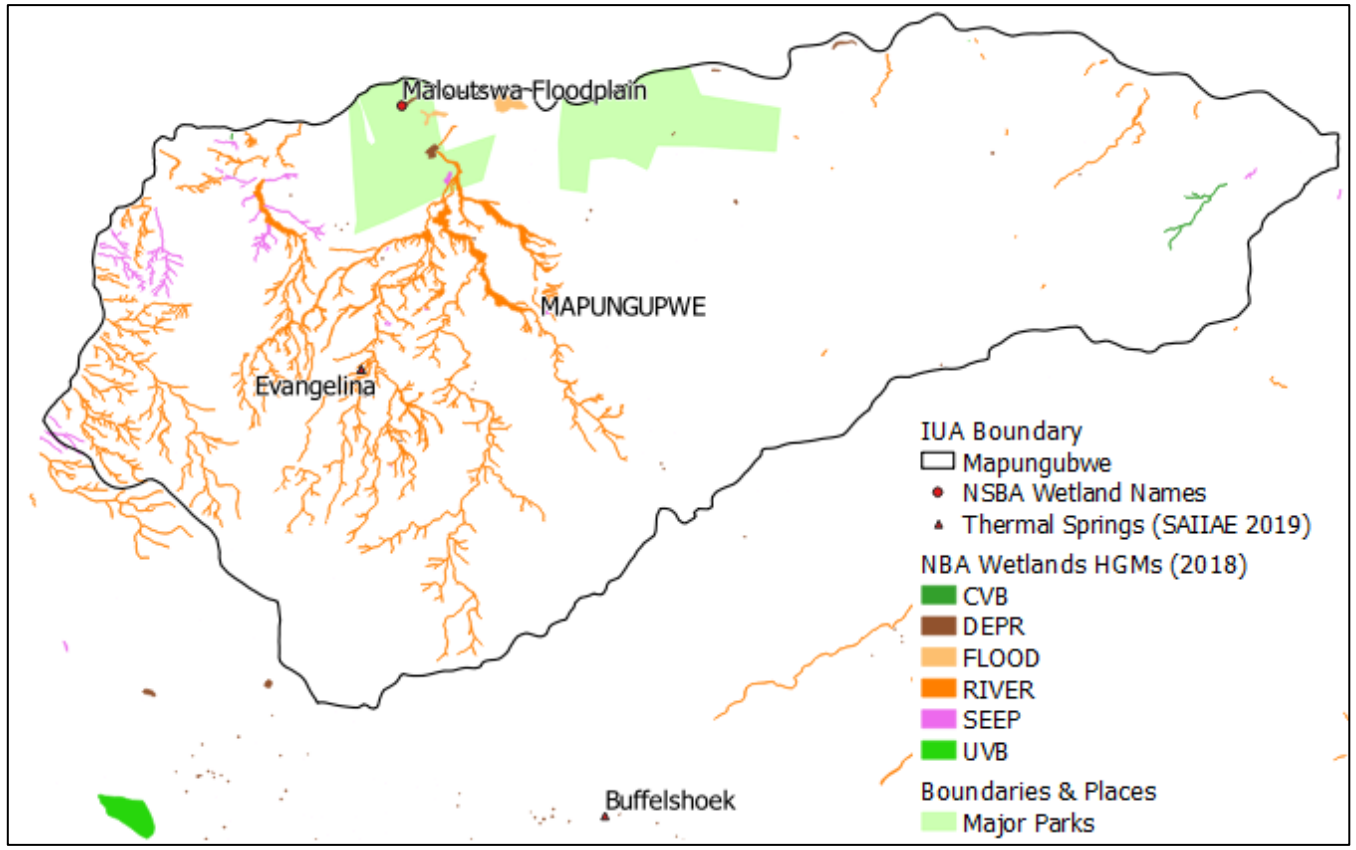
Channelled valley bottoms	14.5
Depressions	20.6
Floodplains	0.0
Riverine	39.1
Seeps	3.4
Unchannelled valley bottoms	22.4

Wetland Condition (left) and Threat Status (right) (% in IUA)

A/B	35.6
C	3.0
D/E/F	22.2
N/A	39.1

CR	39.2
EN	1.0
LC	19.1
VU	1.6
N/A	39.1

WETLAND STATUS QUO: 7299 Ha Wetlands



HGMs (% in IUA)

Channelled valley bottoms	0.9
Depressions	2.3
Floodplains	4.7
Riverine	87.1
Seeps	5.0
Unchannelled valley bottoms	0.0

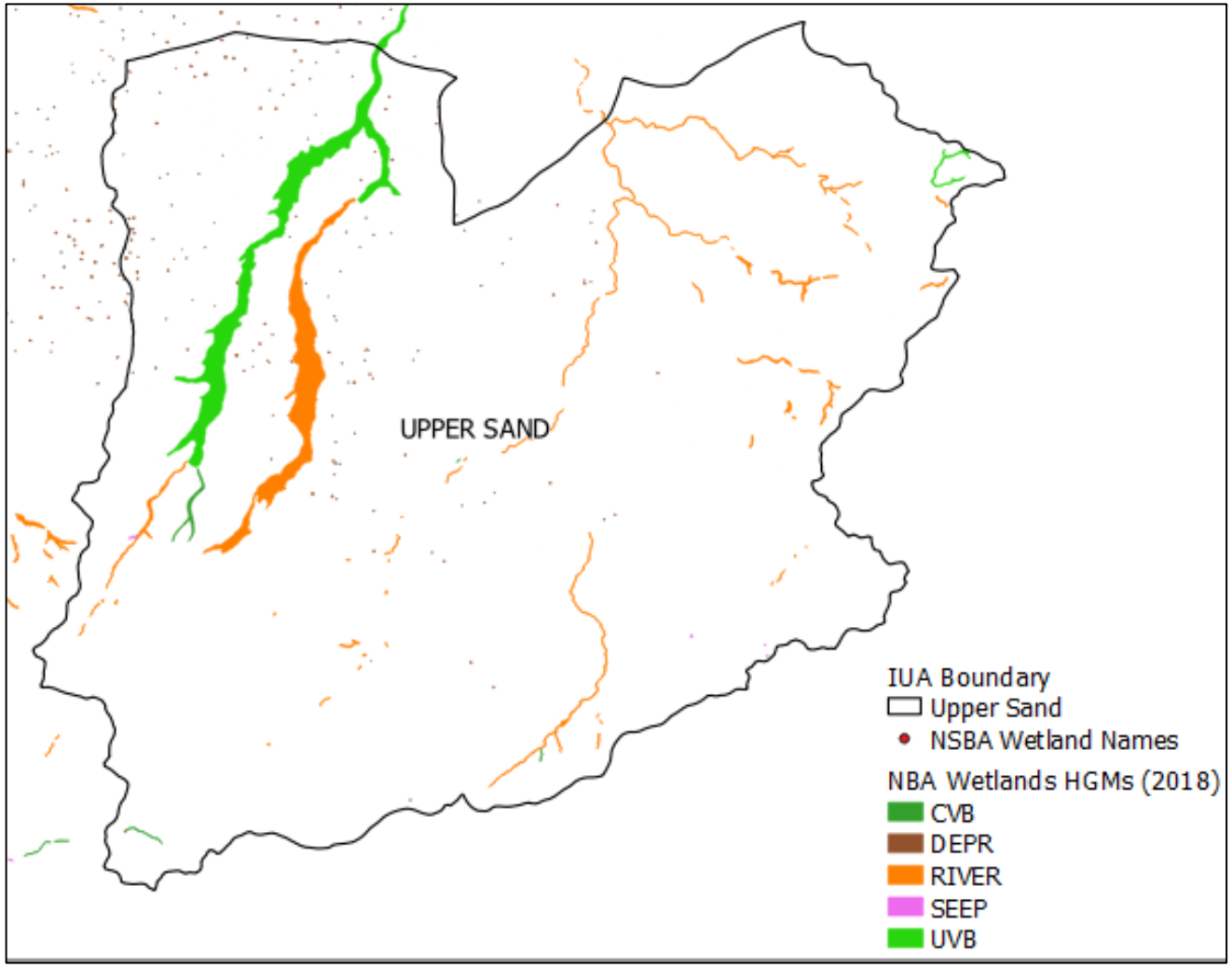
Wetland Condition (left) and Threat Status (right) (% in IUA)

A/B	2.7
C	4.5
D/E/F	5.8
N/A	87.1

CR	5.6
EN	5.0
LC	0.0
VU	2.3
N/A	87.1

WETLAND STATUS QUO:

13237 Ha Wetlands



HGMs (% in IUA)

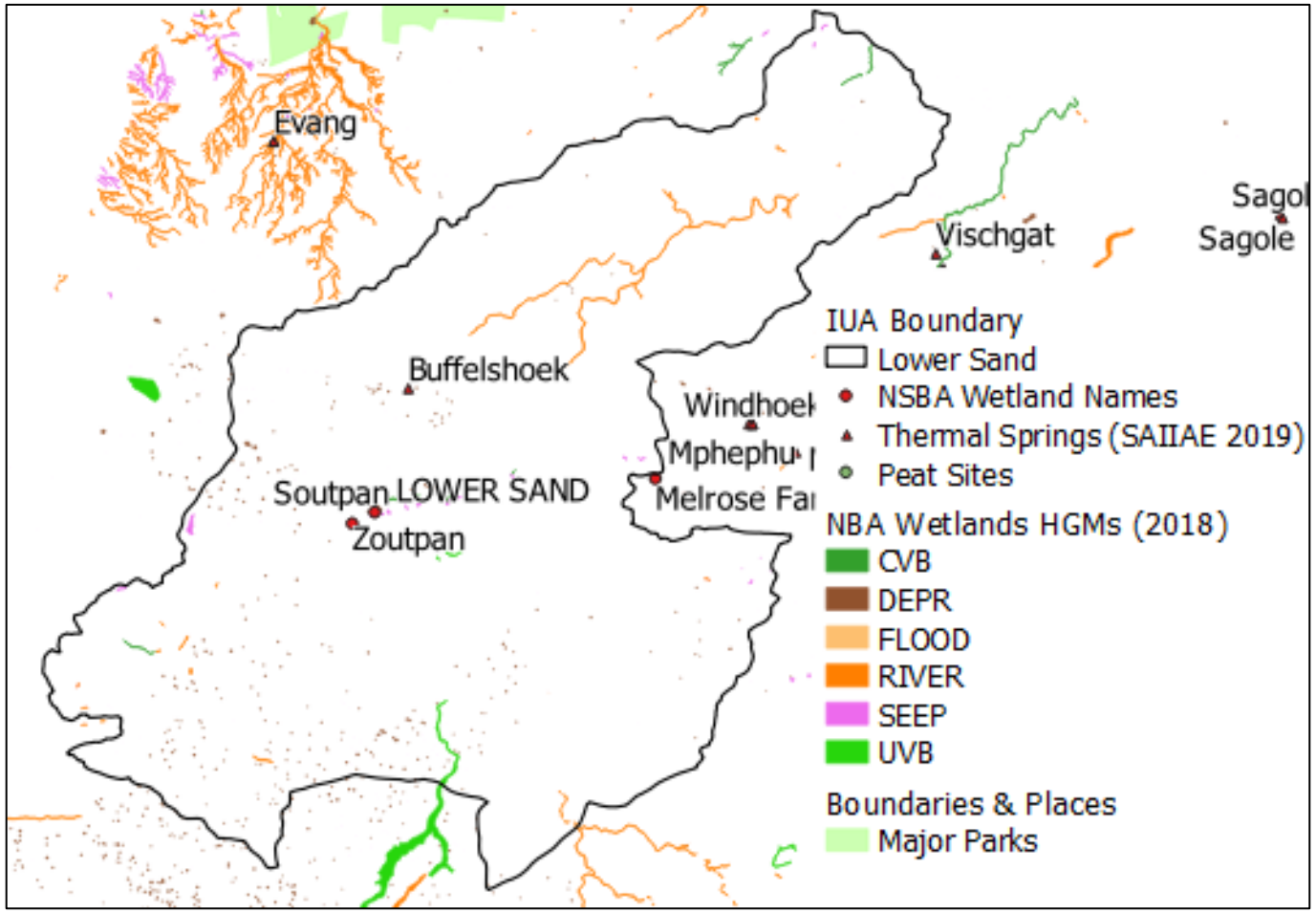
Channelled valley bottoms	1.5
Depressions	1.1
Floodplains	0.0
Riverine	45.3
Seeps	0.1
Unchannelled valley bottoms	52.0

Wetland Condition (left) and Threat Status (right) (% in IUA)

A/B	0.7
C	0.2
D/E/F	53.9
N/A	45.3

CR	53.6
EN	0.0
LC	1.1
VU	0.0
N/A	45.3

WETLAND STATUS QUO: 9004 Ha Wetlands



HGMs (% in IUA)

Channelled valley bottoms	1.7
Depressions	5.9
Floodplains	0.0
Riverine	12.6
Seeps	4.4
Unchannelled valley bottoms	75.4

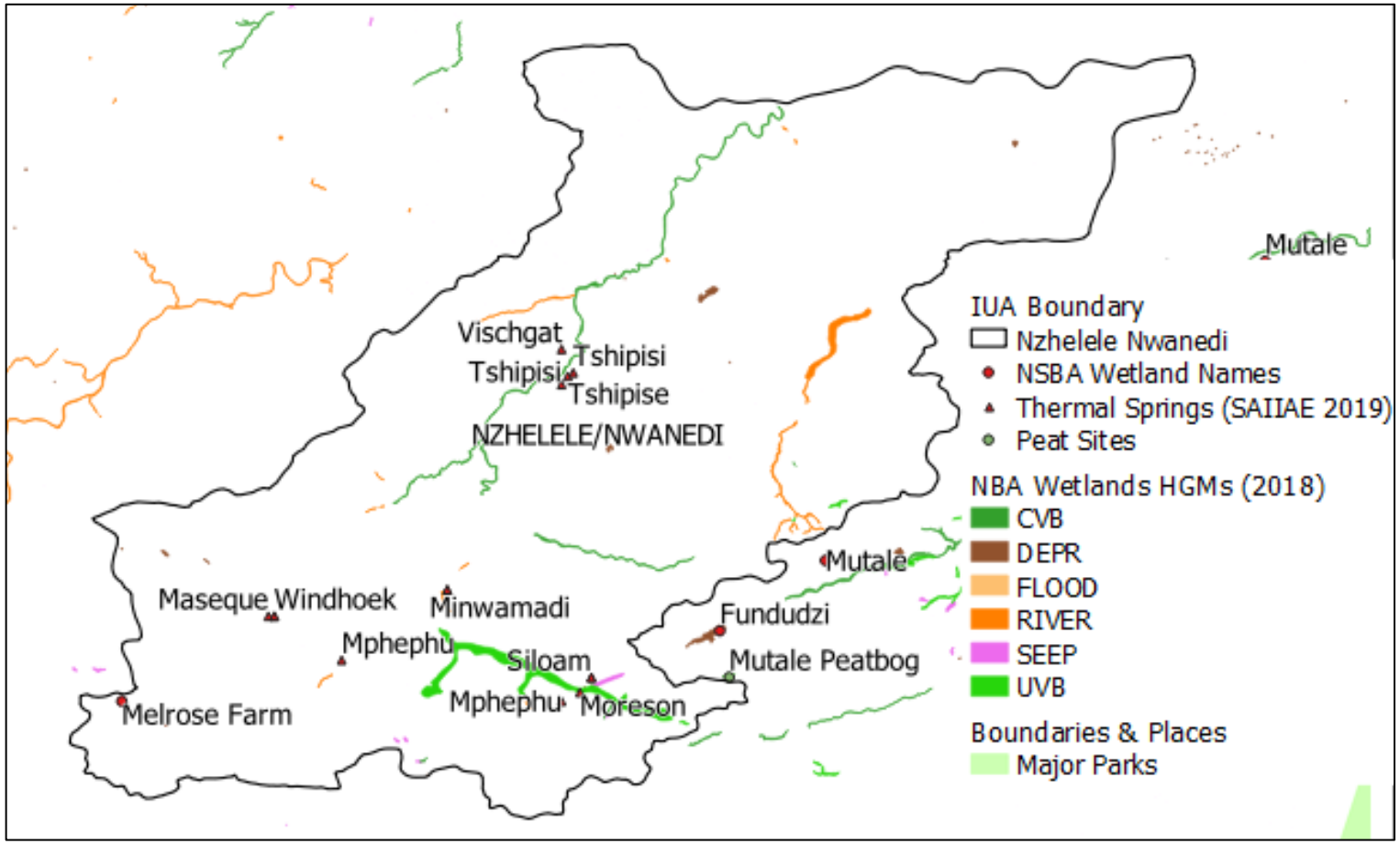
Wetland Condition (left) and Threat Status (right) (% in IUA)

A/B	3.7
C	1.8
D/E/F	81.9
N/A	12.6

CR	80.4
EN	1.1
LC	5.5
VU	0.3
N/A	12.6

WETLAND STATUS QUO:

4526 Ha Wetlands



HGMs (% in IUA)

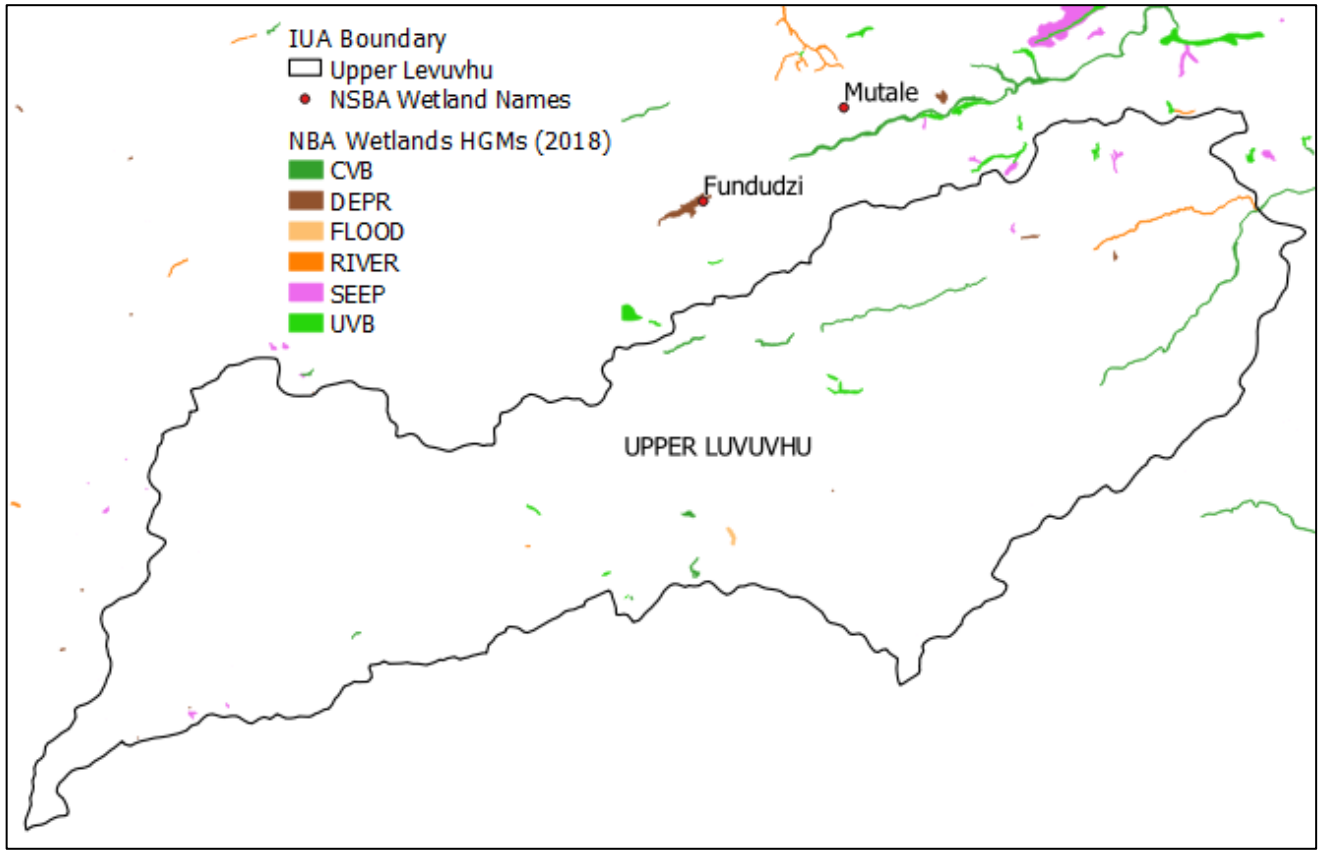
Channelled valley bottoms	21.4
Depressions	4.5
Floodplains	0.0
Riverine	19.6
Seeps	3.1
Unchannelled valley bottoms	51.3

Wetland Condition (left) and Threat Status (right) (% in IUA)

A/B	0.3
C	0.8
D/E/F	79.3
N/A	19.6

CR	75.9
EN	0.0
LC	0.2
VU	4.3
N/A	19.6

WETLAND STATUS QUO: 3313 Ha Wetlands



HGMs (% in IUA)

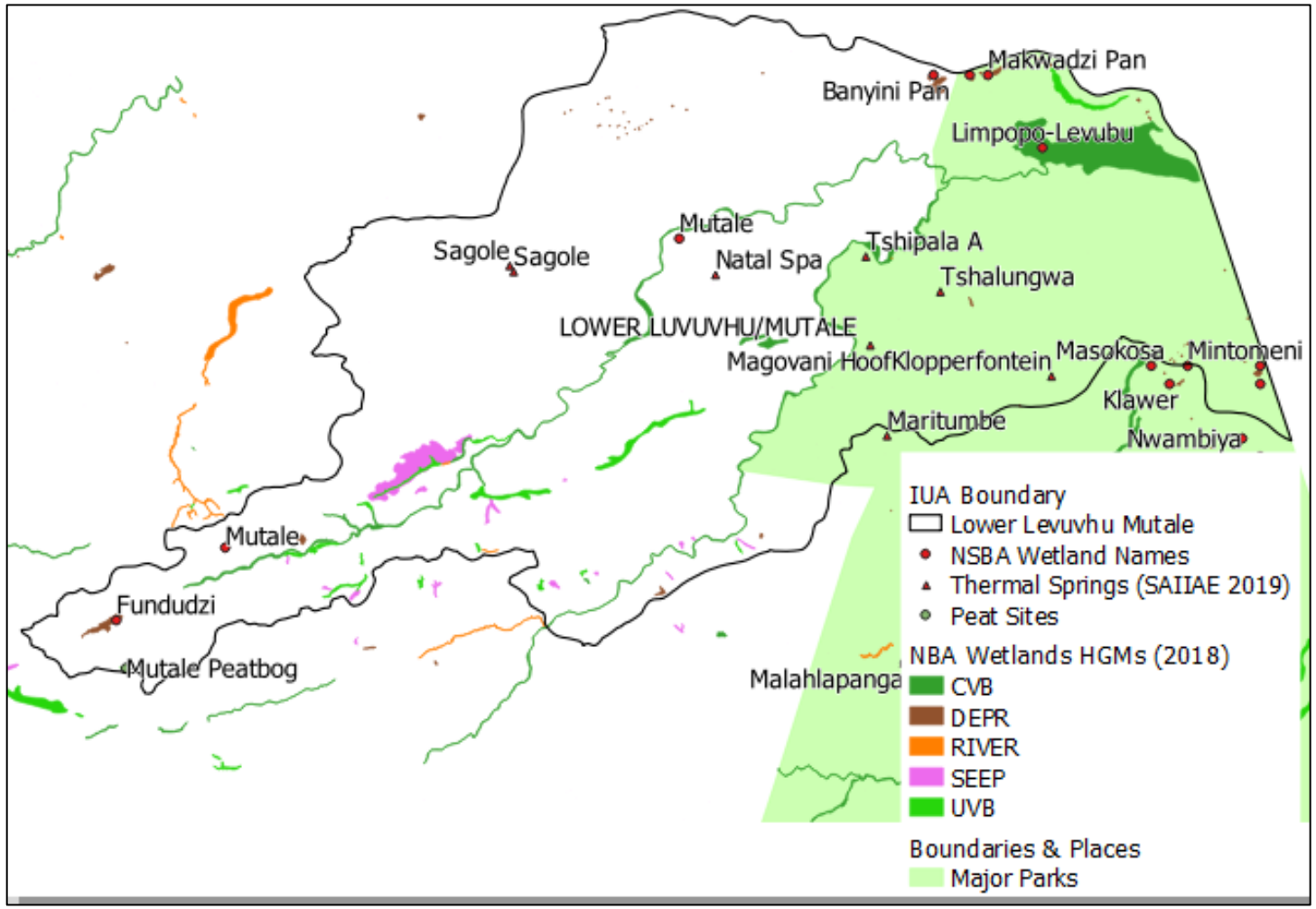
Channelled valley bottoms	90.5
Depressions	0.7
Floodplains	1.0
Riverine	2.7
Seeps	1.7
Unchannelled valley bottoms	3.5

Wetland Condition (left) and Threat Status (right) (% in IUA)

A/B	1.3
C	0.9
D/E/F	95.1
N/A	2.7

CR	95.8
EN	0.8
LC	0.7
VU	0.0
N/A	2.7

WETLAND STATUS QUO: 9617 Ha Wetlands



HGMs (% in IUA)

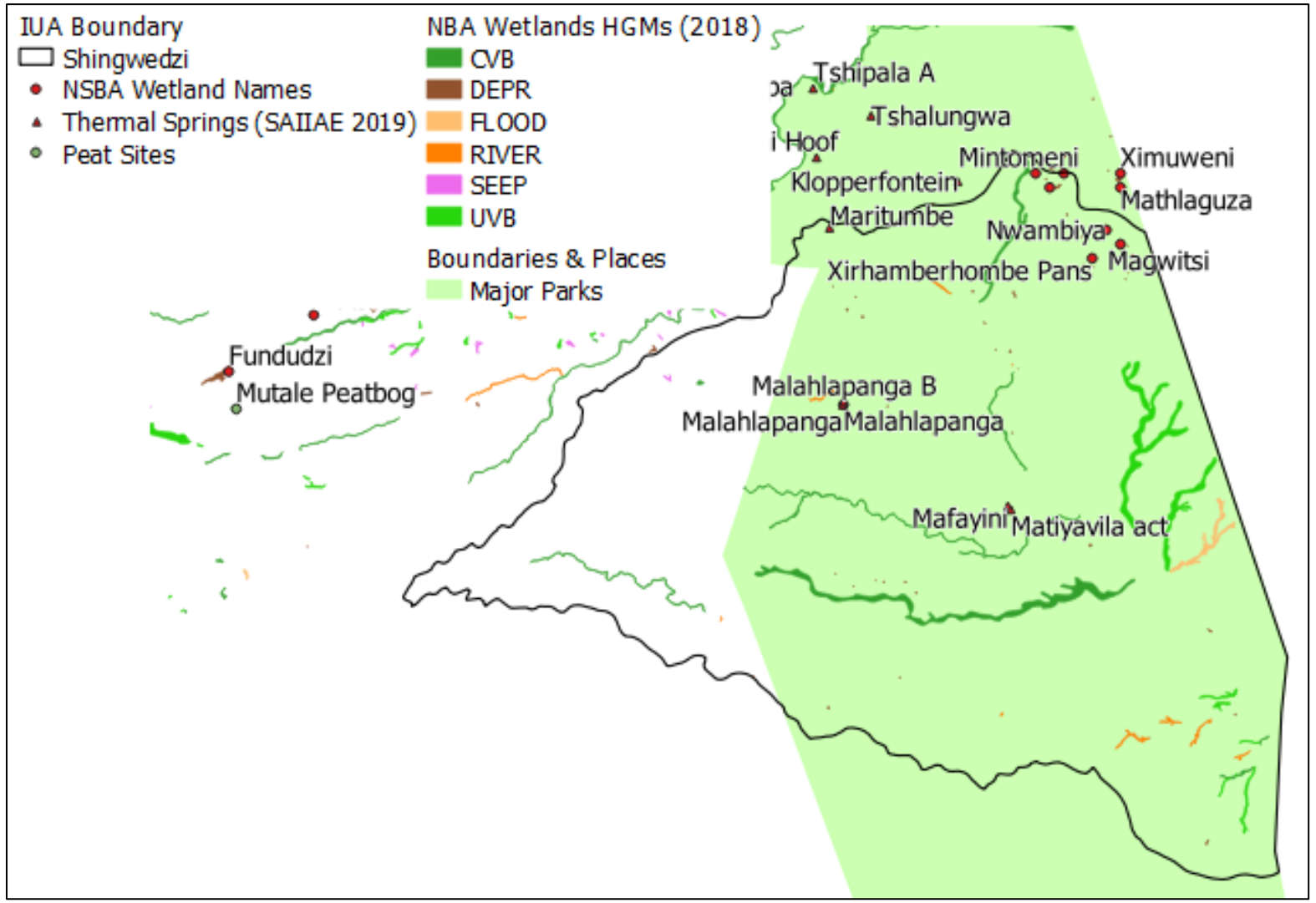
Channelled valley bottoms	66.1
Depressions	5.6
Floodplains	0.0
Riverine	0.2
Seeps	14.7
Unchannelled valley bottoms	13.5

Wetland Condition (left) and Threat Status (right) (% in IUA)

A/B	1.3
C	45.8
D/E/F	52.8
N/A	0.2

CR	93.4
EN	2.3
LC	0.0
VU	4.1
N/A	0.2

WETLAND STATUS QUO: 21805 Ha Wetlands



HGMs (% in IUA)

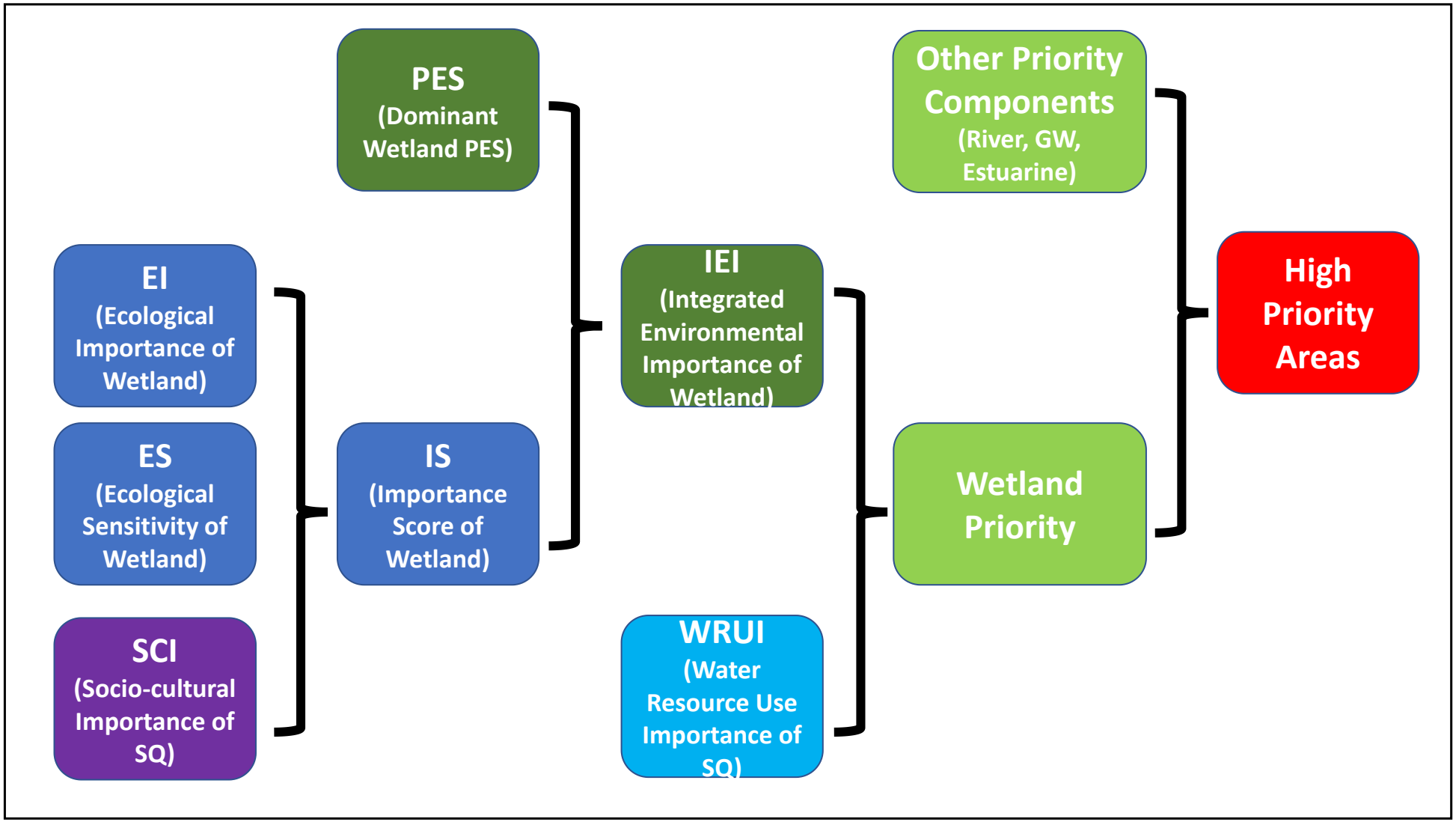
Channeled valley bottoms	51.5
Depressions	0.9
Floodplains	6.1
Riverine	4.0
Seeps	0.2
Unchanneled valley bottoms	37.3

Wetland Condition (left) and Threat Status (right) (% in IUA)

A/B	2.0
C	50.4
D/E/F	43.6
N/A	4.0

CR	94.9
EN	0.2
LC	0.0
VU	0.9
N/A	4.0

WETLANDS – NEXT STEP: Wetland Priority



WETLANDS – NEXT STEP: Wetland Importance

- NBA (2018) – Diversity and extent of wetlands
- NFEPA (2011) – Ramsar, FEPA, Cluster, habitats for threatened species
- Peatlands
- Important Birding Areas (2015)
- PES/EI/ES (DWS, 2014) – EI score (0 - 5) normalised to 4
- Regions / Centres of Plant Endemism (Van Wyk & Smith, 2001)
- Region Conservation Plans - LIMPOPO

WETLANDS – NEXT STEP: Wetland Sensitivity

- NBA (2018) – Protection level, threat status
- Threatened Ecosystems (SANBI, 2011)
- Threatened Plant Species (SANBI, 2009)
- PES/EI/ES (DWS, 2014) – ES score (0 - 5) normalised to 4

WATER QUALITY

Water quality assessment

- Water quality described the physical, chemical and microbiological properties of water
- Used the water quality data collected by DWS for quantitative status assessment
- Complemented with literature and , personal interview, and data collected for Limpopo EWR assessment study
- Used same fitness for use approach as was used in Vaal, Croc/Marico, Breede, and Berg RQO studies
- Calculated median, 75th and 95th percentile statistics for 2008-2018 period
- Categorised into

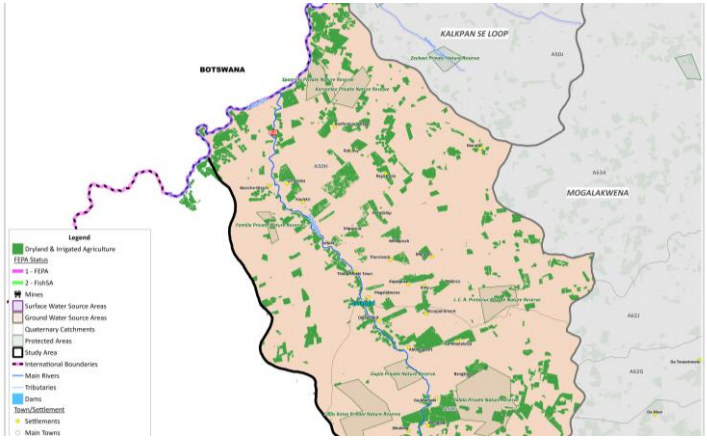
Water quality assessment

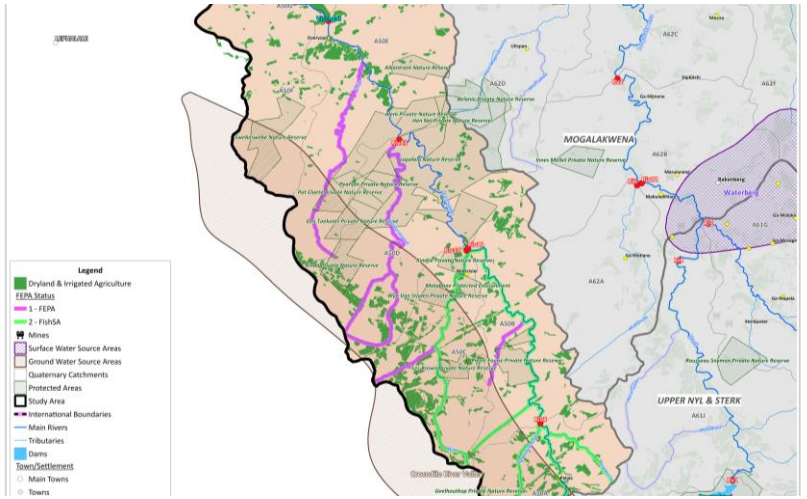
- Water quality criteria used to assess the present surface water quality status

Variable	Units	Bound	Ideal	Sensitive user	Acceptable	Sensitive user	Tolerable	Sensitive user
Alkalinity ($CaCO_3$)	mg/l	Upper	20	AAq	97.5	AAq	175	AAq
Ammonia (NH_3-N)	mg/l	Upper	0.015	Eco	0.044	Eco	0.073	Eco
Calcium (Ca)	mg/l	Upper	10	Dom	80	BHN	80	BHN
Chloride (Cl)	mg/l	Upper	40	In2	120	In2	175	In2
EC	mS/m	Upper	30	In2	50	In2	85	Eco
Fluoride (F)	mg/l	Upper	0.7	Dom	1	Dom	1.5	Dom
Magnesium (Mg)	mg/l	Upper	70	Dom	100	Dom	100	Dom
NO_3 (NO_3-N)	mg/l	Upper	6	Air	10	Air	20	Air
pH	units	Upper	≤ 8	In2	<8.4	In2		
		Lower	≥6.5	Air, Aaq, In2	>8.0	Air, Aaq, In2		
Potassium (K)	mg/l	Upper	25	Dom	50	Dom	100	Dom
PO_4-P (Rivers)	mg/l	Upper	0.025	Eco	0.075	Eco	0.125	Eco
PO_4-P (Dams)	mg/l	Upper	0.005	Eco	0.015	Eco	0.025	Eco
SAR	mmol/l	Upper	2	Air	8	Air	15	Air
Sodium (Na)	mg/l	Upper	70	Air	92.5	Air	115	Air
Sulphate (SO_4)	mg/l	Upper	80	In2	165	In2	250	In2
TDS	mg/l	Upper	200	In2	350	In2	800	In2

WQ STATUS QUO: Upper & Lower Lephalala IUAs

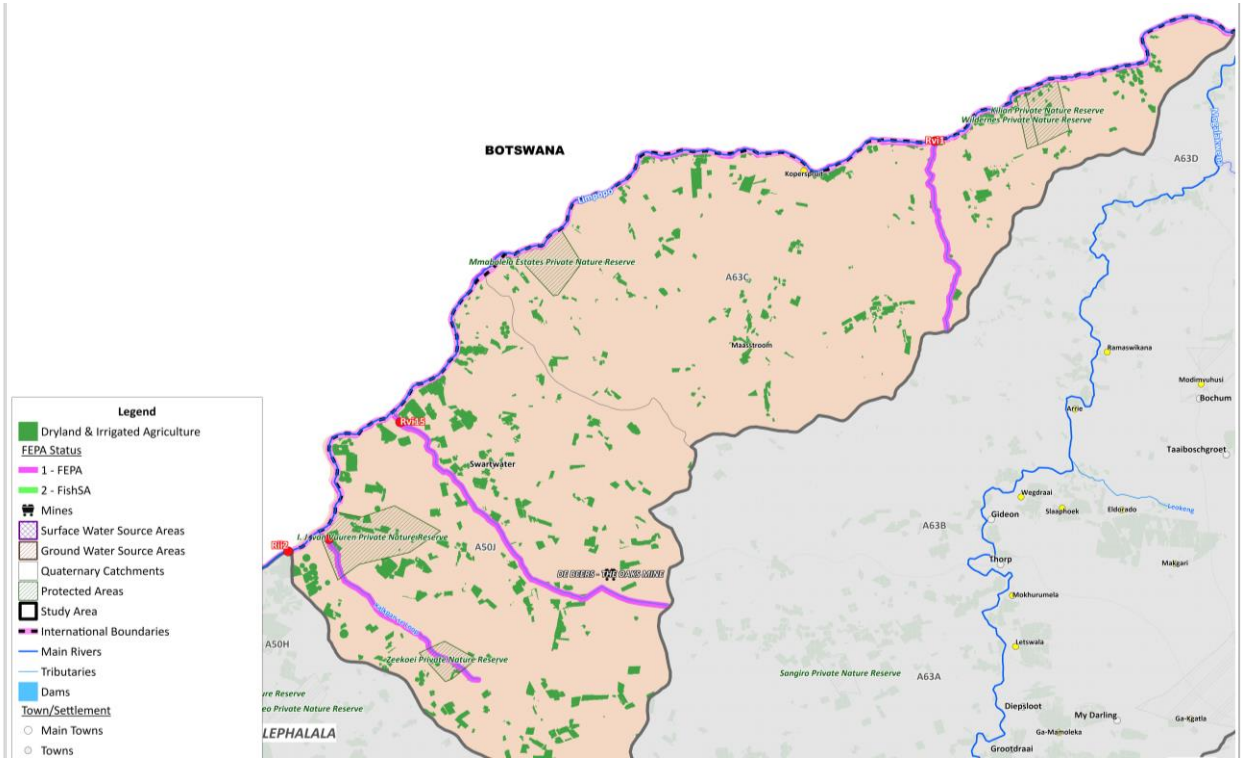
- Water quality in upper reaches is in Ideal category.
- Some concerns about irrigation impacts (agrochemicals, etc).
- In lower Lephalala water is still Ideal but elevated nutrients are observed, probably due to agricultural return flows, domestic wastewater discharges and/or urban runoff from villages near the river.





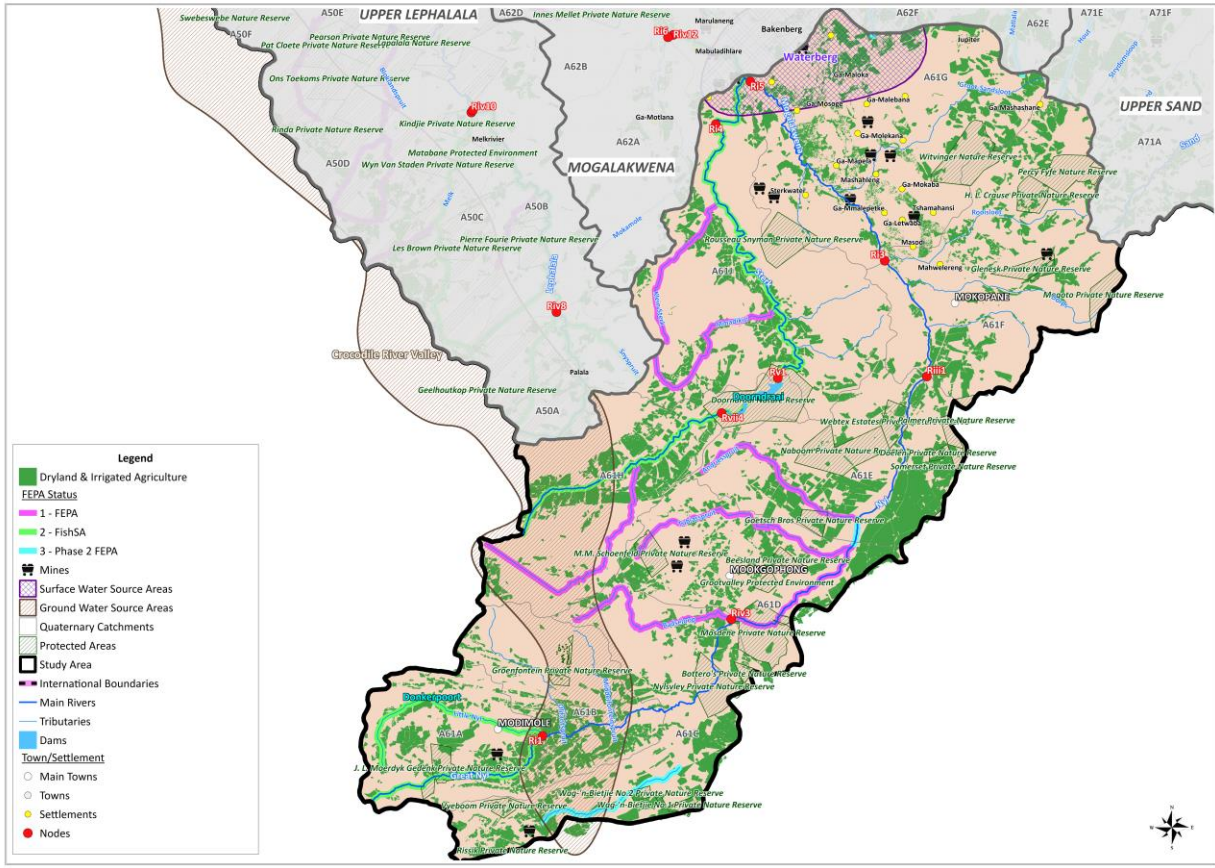
WQ STATUS QUO: Kalkpan se Loop IUA

- No water quality monitoring points in this IUA
- Quality probably characteristic of non perennial rivers
  - Highly variable salinity, fresh when there is runoff, brackish as pools form, saline as pools dry out
  - Pool water quality differ – not linear changes - affected by local groundwater inflows, geology and use (cattle and wildlife watering, abstractions, etc).



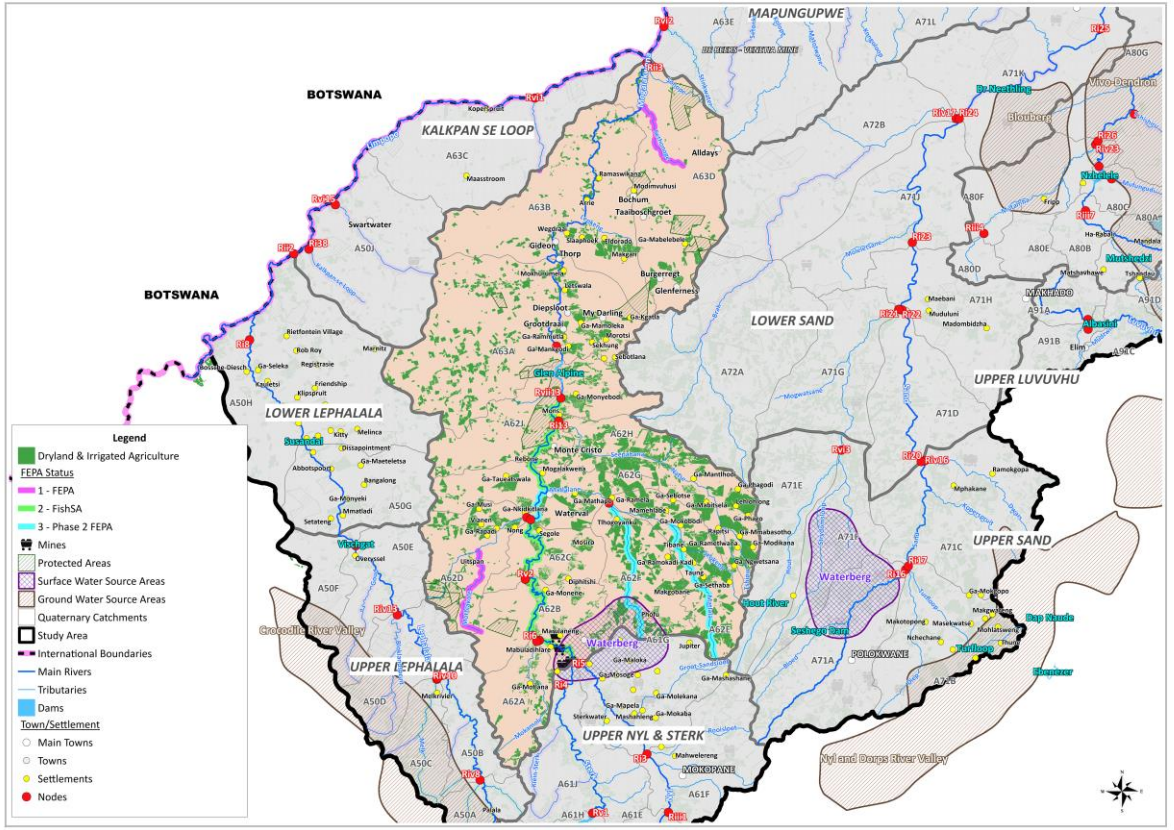
WQ STATUS QUO: Upper Nyl & Sterk

- Water quality in upper Nyl largely natural but affected by citrus and subtropical fruit cultivation (agrochemicals).
- The Modimolle WWTW a major source of pollution (nutrients, bacterial, COD, etc). Concerns about Mokopane WWTW.
- WQ improves in Nylsvley wetland although elevated salts, unionised ammonia and phosphates were measured.
- WQ at Mokopane affected by industries and platinum mining.
- Sterk River quality is Ideal/Acceptable & Doorndraai Dam is oligotrophic.



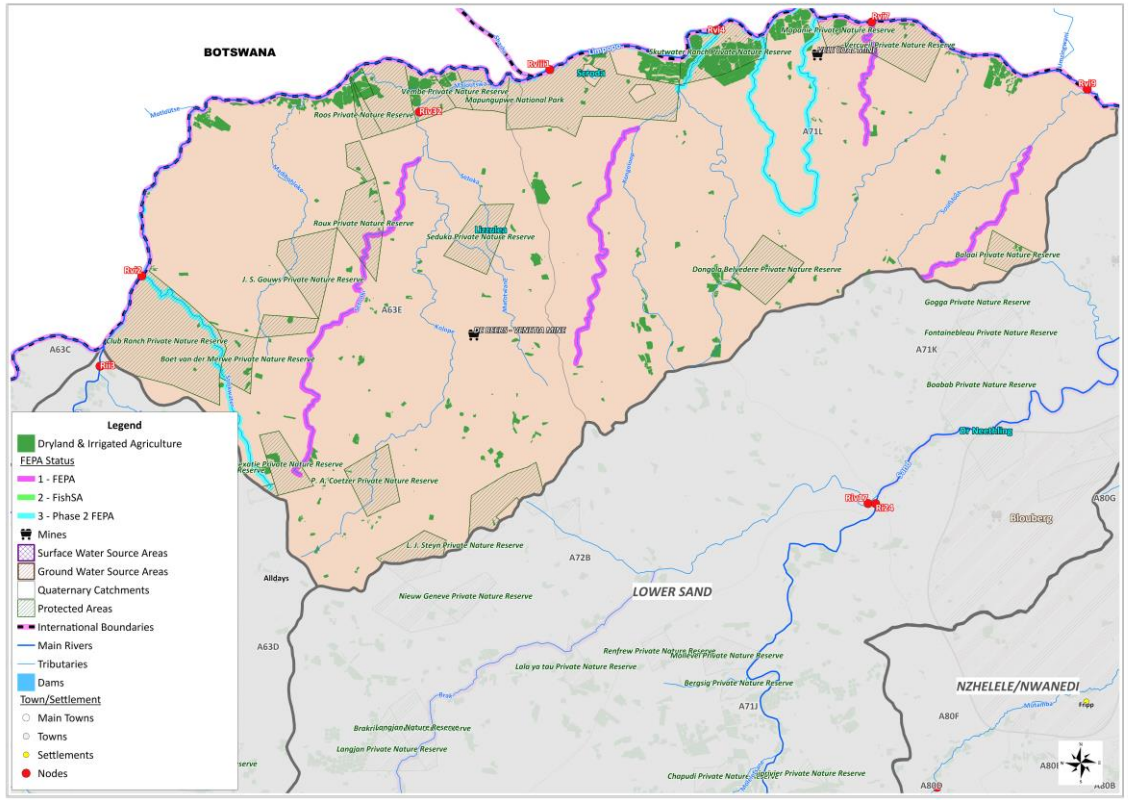
WQ STATUS QUO: Mogalakwena IUA

- Water quality in lower Mogalakwena affected by urban sprawl, some irrigation return flows.
- Water quality is mostly in an Acceptable category due to elevated salts, pH values and some elevated phosphate concentrations.
- In Glen Alpine Dam is, on average Ideal, but elevated salts & nutrients observed. Dam is in oligotrophic state for 75% of time, and 25% in mesotrophic state.



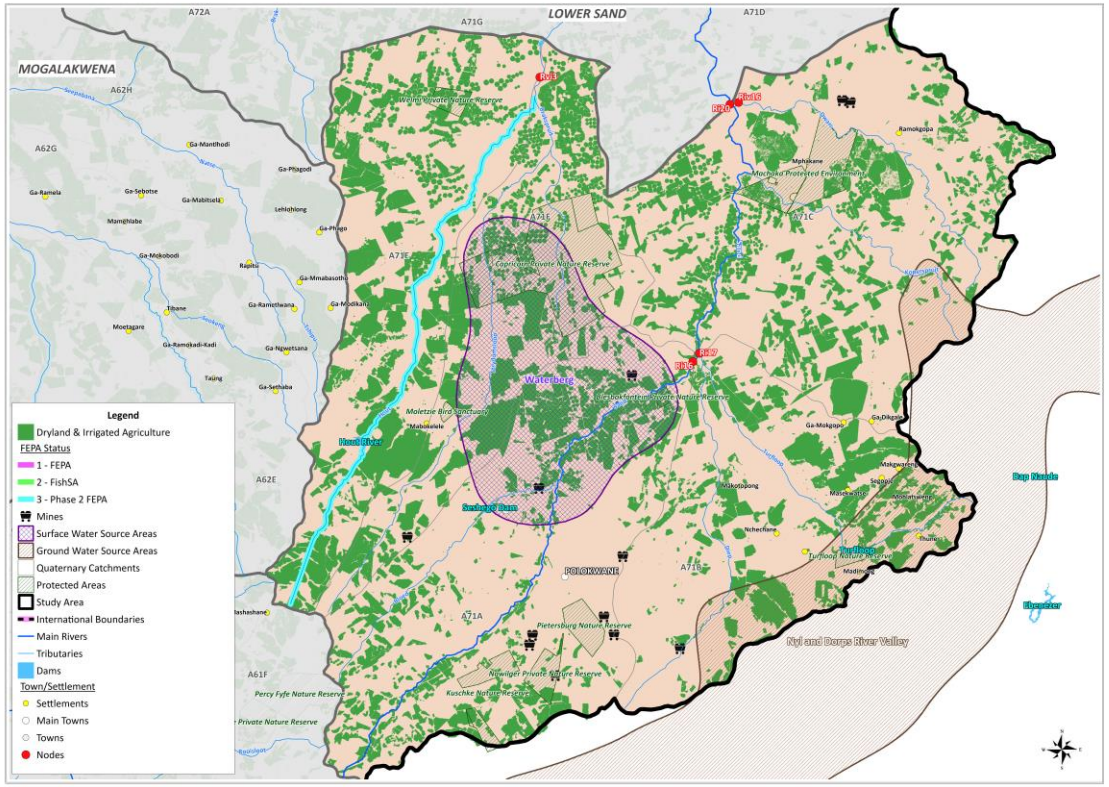
WQ STATUS QUO: Mapungubwe IUA

- No water quality monitoring points in this IUA
- Quality probably characteristic of non perennial rivers
  - Highly variable salinity, fresh when there is runoff, brackish as pools form, saline as pools dry out
  - Pool water quality differ – not linear changes - affected by local groundwater inflows and geology
- Lower reaches probably affected by localised irrigation return flows – elevated salinity and nutrients



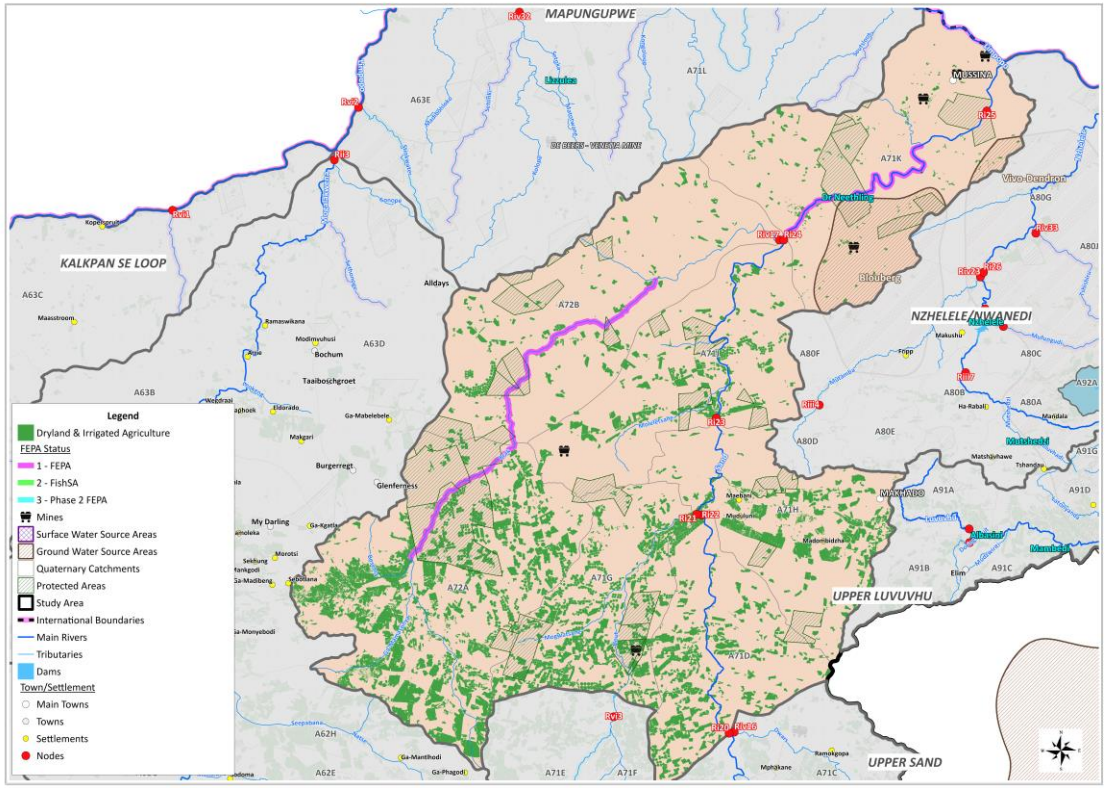
WQ STATUS QUO: Upper Sand IUA

- Water quality affected by effluents from WWTW, sand and aggregate mining and intensive agricultural activities.
- High salts, phosphates and pH and unionised ammonia recorded in Sand and Bloed d/s of WWTWs.
- Concerns about high coliform counts of WWTWs.



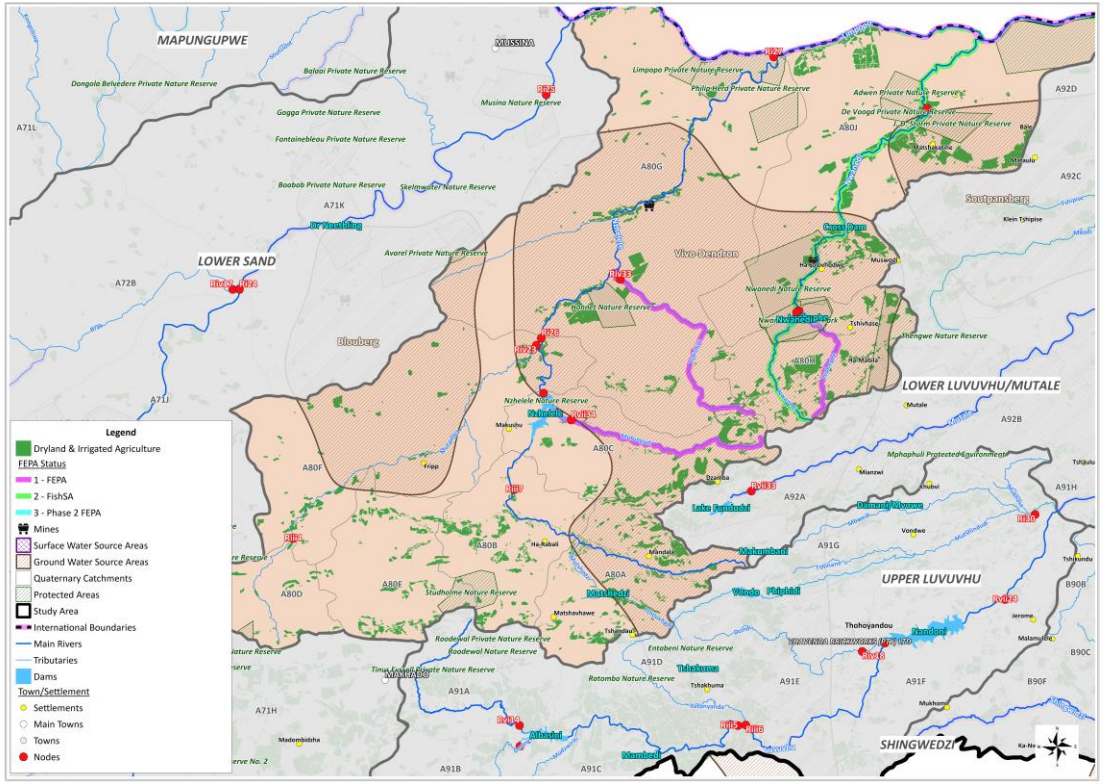
WQ STATUS QUO: Lower Sand IUA

- Monitoring in lower Sand poor with most monitoring points located d/s of WWTW for compliance testing.
- River is non perennial and quality probably similar in characteristics too nonperennial rivers.



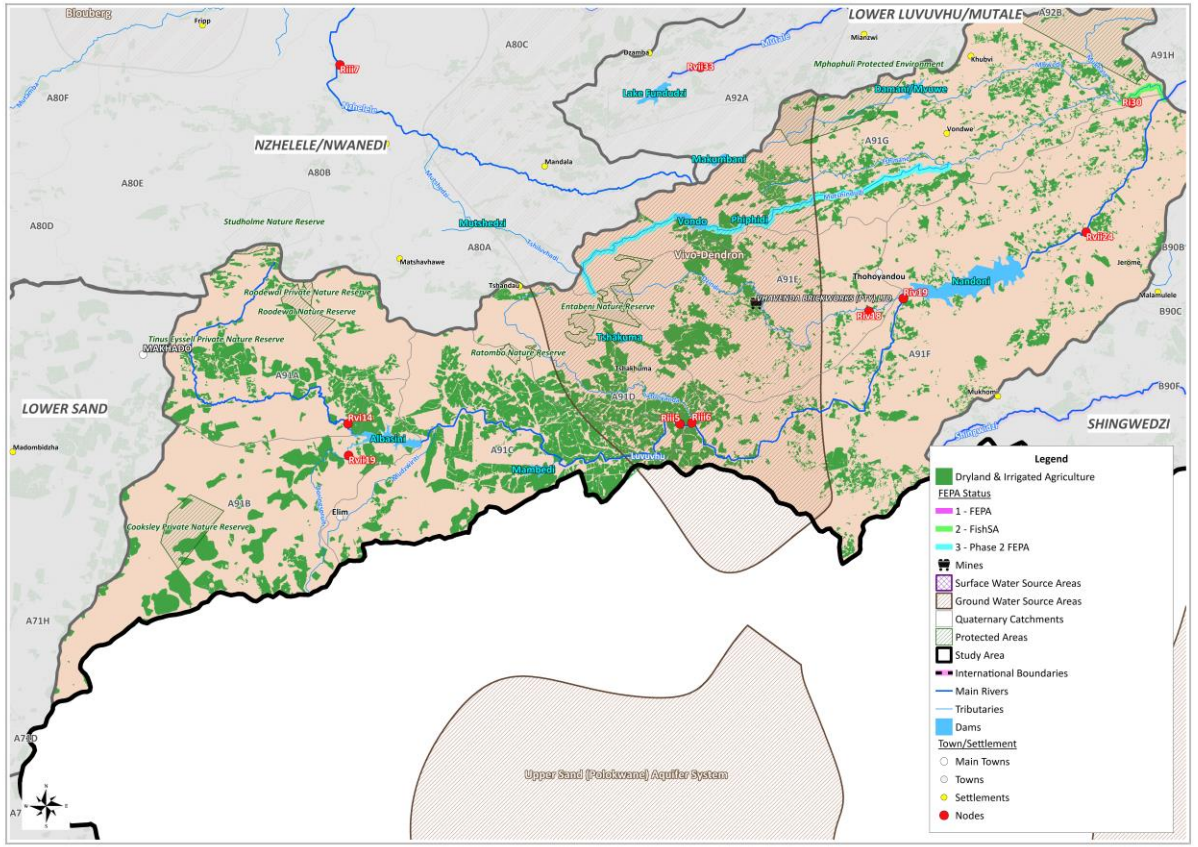
WQ STATUS QUO: Nzhelele/Nwanedi IUA

- Water quality in upper reaches affected by urban sprawl, subsistence agriculture in floodplains and sand mining.
- Quality in Mutshedzi River in Ideal state except for elevated phosphates.
- Further downstream (A80B) quality poorer with elevated salts (Acceptable/Tolerable), high pH (Unacceptable) and high phosphates.
- Quality in Nzhelele, Luphephe and Nwanedi dams good, and in oligotrophic/mesotrophic states.



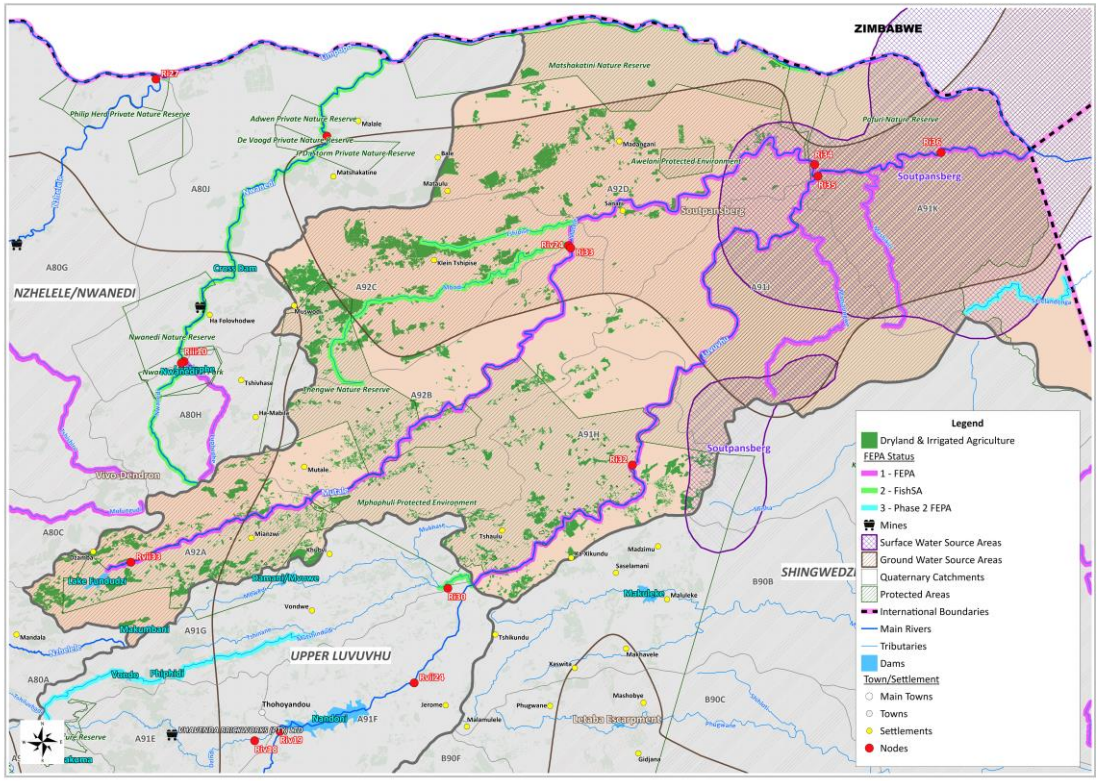
WQ STATUS QUO: Upper Luvuvhu IUA

- Water quality affected by intensive sub-tropical fruit cultivation and afforestation in upper catchment and urban sprawl of Thohoyandou.
- Concerns about nutrients from fertilizer use, agrochemicals at fruit orchards, poor quality effluent from WWTWs, and poor sanitation in dense settlements.
- DDT used for malaria control is a concern.
- Water quality in Ideal/Acceptable state except for PO4-P concentrations



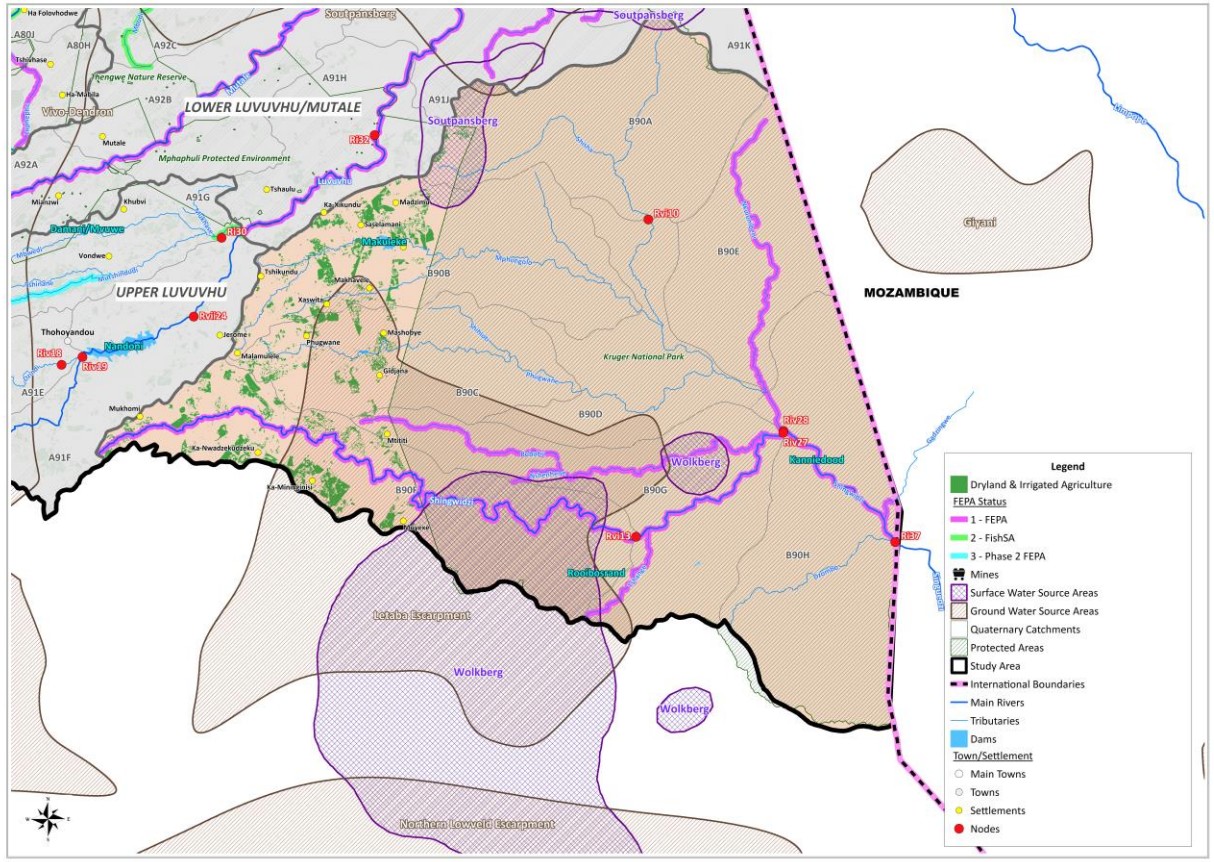
STATUS QUO: Lower Luvuvhu/Mutale IUAs

- Water quality affected agriculture and urban sprawl.
- However, in general water quality is in Ideal/Acceptable category in the Mutshindudi and Mutale catchments although elevated nutrients a concern.
- In lower Luvuvhu quality is in Ideal category with slightly elevated phosphates (Acceptable category)
- Water quality in Ideal/Acceptable state except for PO4-P concentrations



WQ STATUS QUO: Shingwedzi IUA

- Majority of catchment fall in KNP, upper reaches is subsistence agriculture and urban sprawl.
- Concerns high unionised ammonia, nutrients and poor bacteriological quality d/s of WWTW.
- Sand mining a concern.
- Acid mine drainage at abandoned Giants Reef mine near Shangoni.
- Fertilizers from large commercial irrigation farm near KNP border.



GROUNDWATER

GROUNDWATER

- Groundwater (GW) plays an important role

→ for water supply within the study area, and

→ to maintain river baseflow in the dry season (limited to specific settings)

- Groundwater is earmarked for further development in several catchments

→ but heavily used in some

Presentation (Status Quo)

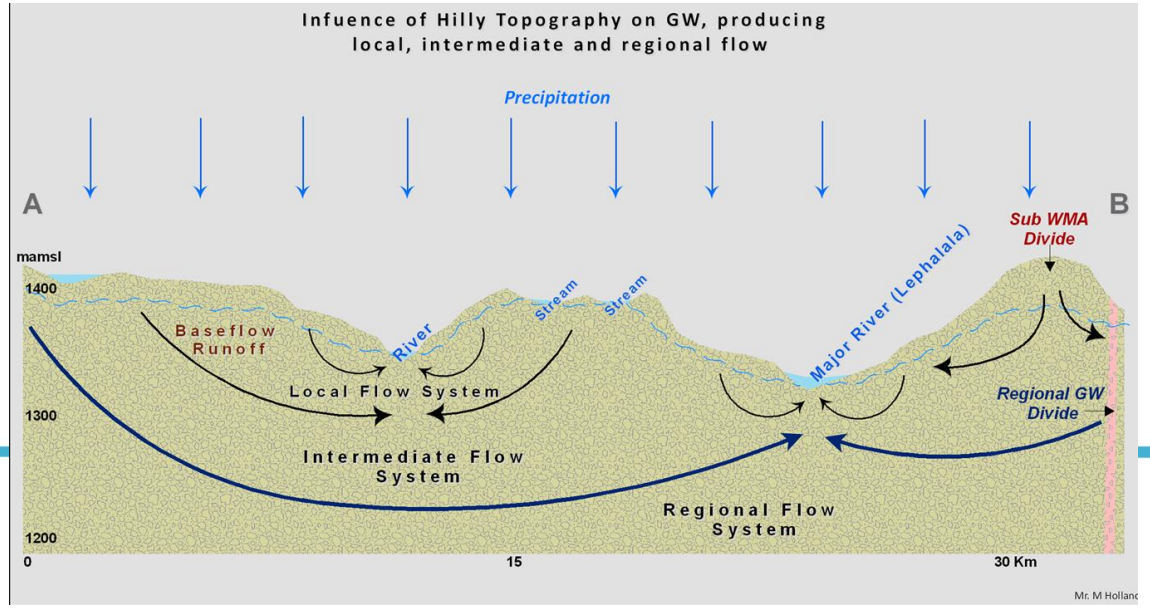
- Delineation of Groundwater Resource Units (GRUs)
- Brief overview of the hydrogeology (map)
- Groundwater Status Quo (for each IUA)
- Next step

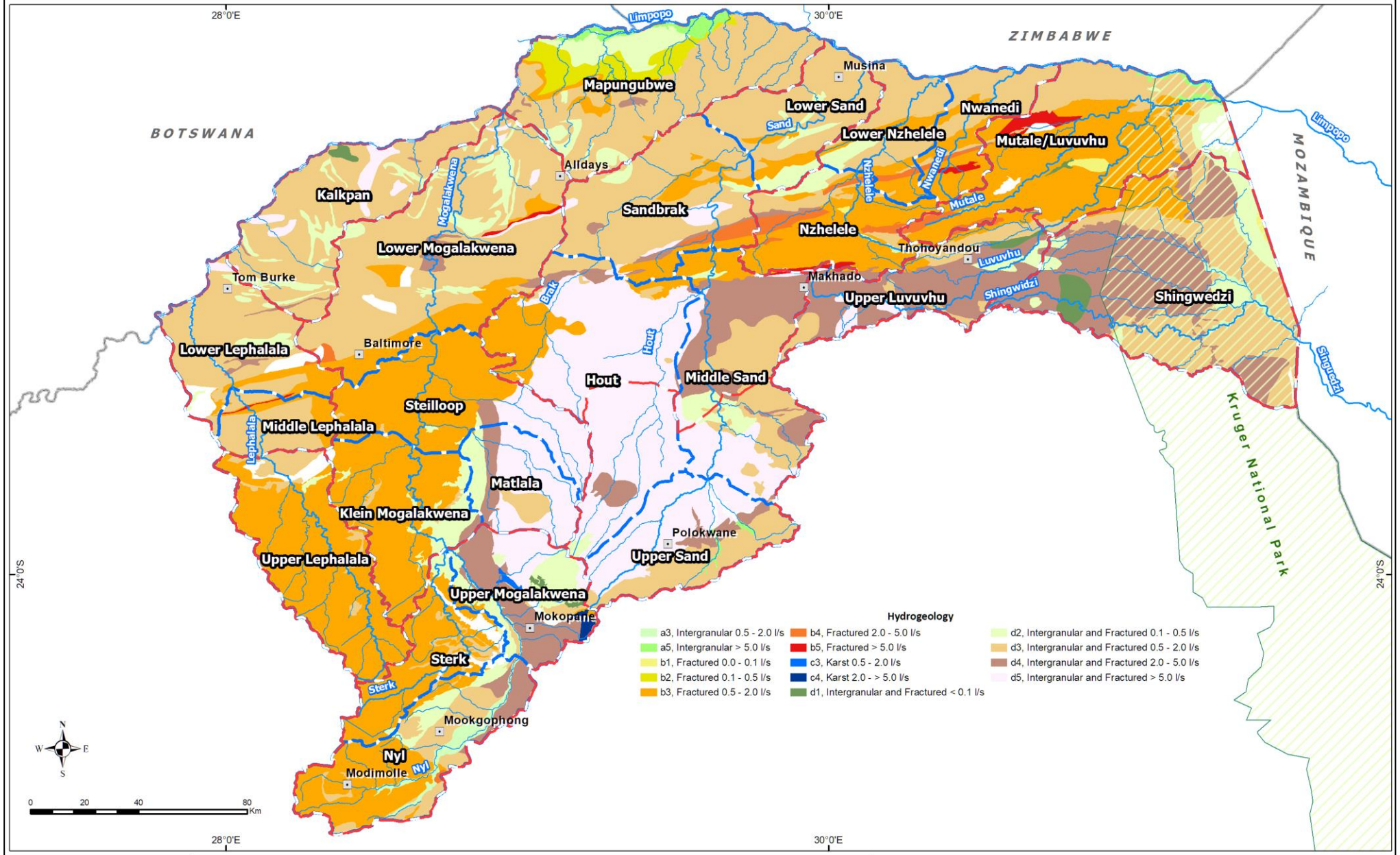
GROUNDWATER RESOURCE UNITS

- Basis for the delineation is similar geological rocks that has uniform water bearing properties →

GW must be considered in terms of an integrated water resource

- Groundwater table mimics the surface topography at the regional scale→ catchment boundaries act as groundwater divide
- Groundwater component of the (ecological) Reserve is determined by calculating the groundwater contribution to baseflow → hydrological approach





LOCALITY MAP

TITLE:

WATER RESOURCE CLASSES, RESERVE & RQO DETERMINATION IN THE A5-A9 & B9 SECONDARY CATHMENTS

Groundwater Resource Units

Legend

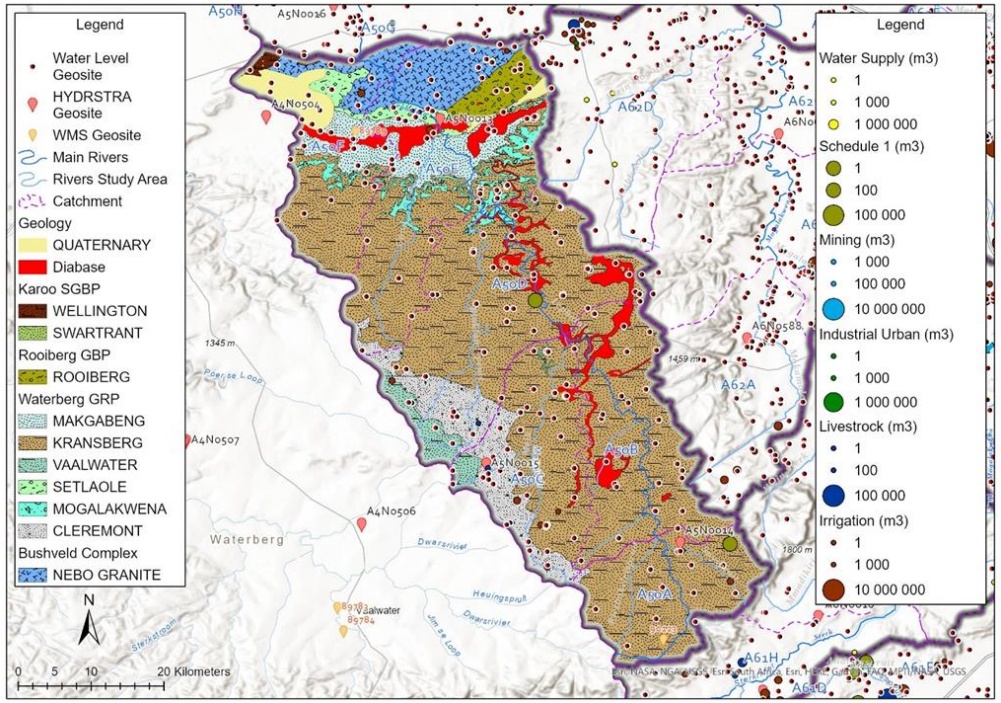
- Selected Towns
- International Boundary
- Main Rivers
- Tributaries
- Integrated Units of Analysis
- Groundwater Resource Units

2030 NDP
NATIONAL DEVELOPMENT PLAN
Our Future - make it work

GROUNDWATER STATUS QUO - Upper Lephalala IUAs

GRUs: A50-1

- Fractured Waterberg Group aquifers and Intergranular/Alluvial aquifers
  – lower groundwater potential
- Ave. depth 24 mbgl with yields of 1.6 L/s
- Acceptable groundwater quality
- Registered groundwater use is ~0.7 Mm^3/a
  → underutilised
- Limited GW water schemes

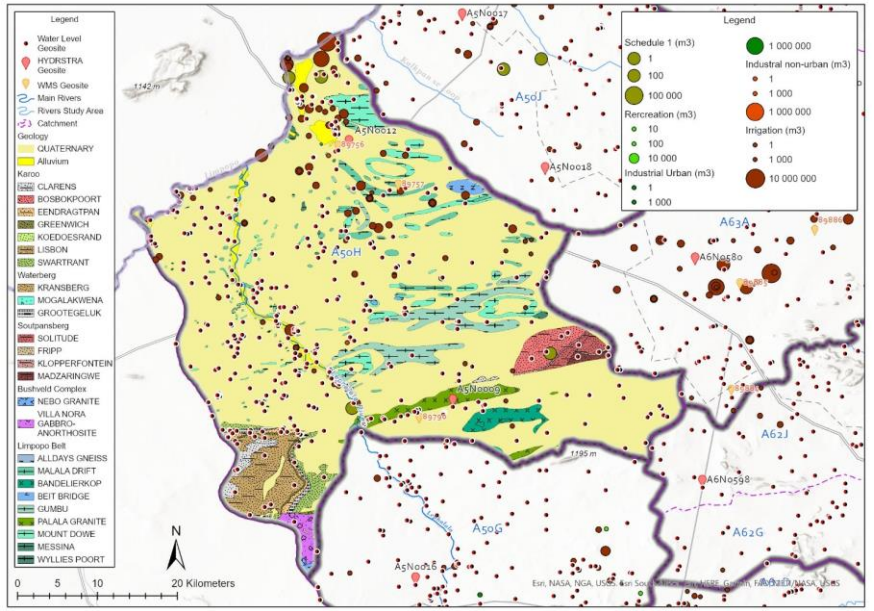


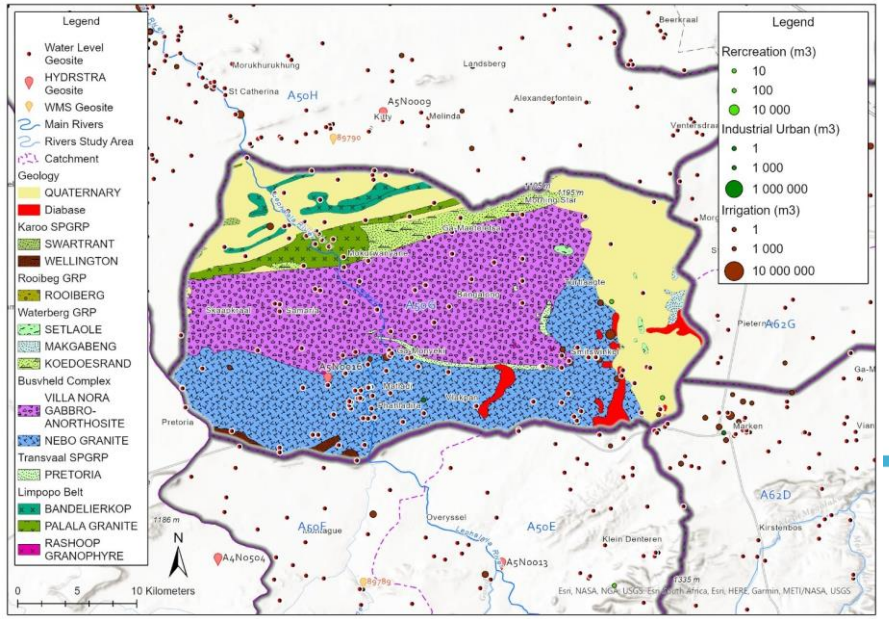
- High probability of GW contribution to Baseflow
- Groundwater levels show a strong response to significant recharge events with a decreasing trend during poor recharge seasons

GROUNDWATER STATUS QUO – Lower Lephalala IUAs

GRUs: A50-2 and A50-3

- Intergranular and fractured aquifer (with Alluvial) system – moderate to good groundwater potential
- Ave. depth 21 to 24 mbgl with yields of 2.0 L/s
- Moderate to poor quality (elements of concern = nitrate and fluoride)
- Registered groundwater use is ~15 Mm^3/a → moderately exploited (especially A50-3)
- Several GW water schemes (and GW dependent towns/villages)
- Low probability of GW contribution to Baseflow
- Groundwater levels show a decline of 3 to 5 m in groundwater levels since 2009, which can relate to a localised to regional impact

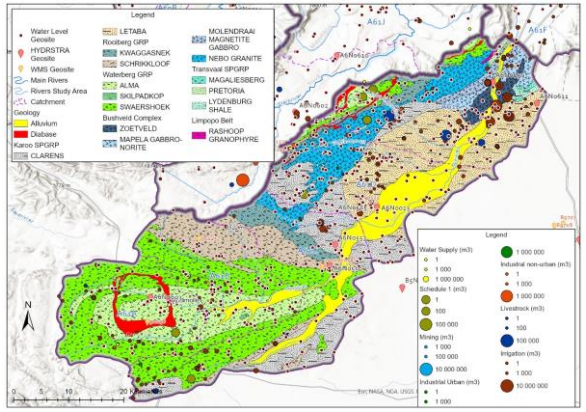


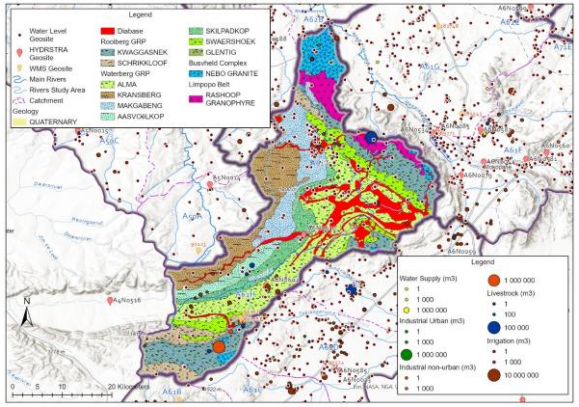


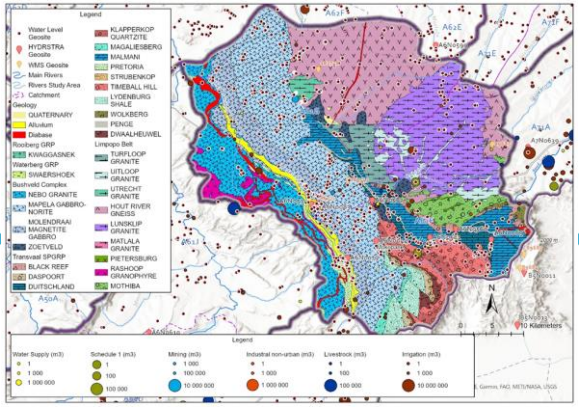
GROUNDWATER STATUS QUO - Upper Nyl and Sterk IUAs

GRUs: A61-1, A61-2, and A61-3

- Fractured Waterberg Group aquifers with Intergranular/Alluvial aquifers and hosts the Mokopane (karst) dolomite – low to high groundwater potential
- Strategic GW source (of National Importance)
- Ave. depth16 mbgl with yields of 1.8 to 4.3 L/s
- A61-1 and A61-2 is of acceptable groundwater quality
- A61-3 is of moderate to poor quality (notable elements of concern = nitrate)
- Registered groundwater use is ~30 Mm^3/a → low to moderately exploited (pit inflows and mine wellfields contributes to exploitation in A61-3)
- Some GW water schemes (and GW dependent towns/villages)
- High probability of GW contribution to Baseflow (to Sterk and Nyl river)
- Groundwater levels show show a neutral trend with a few stations showing a decline of around 20 m which can relate to a localised impact



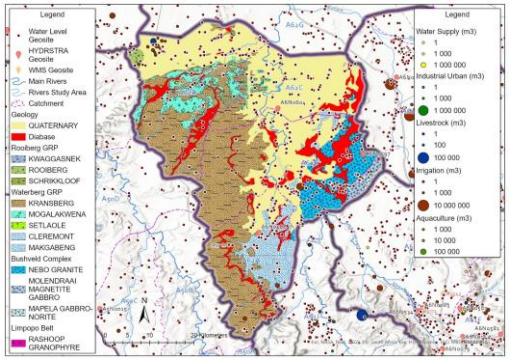


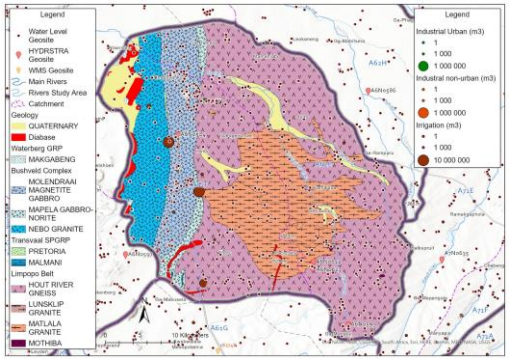


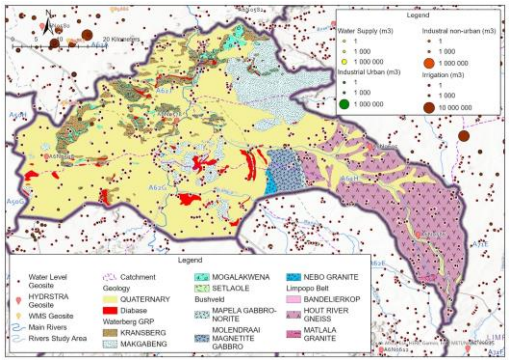
GROUNDWATER STATUS QUO – Lower Mogalakwena IUAs

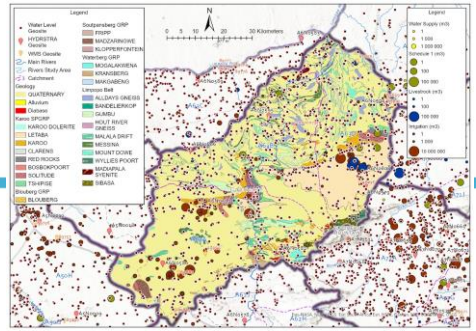
GRUs: A61-1, A61-2, A61-3, and A63-1

- Intergranular and fractured aquifer (with Alluvial) system – moderate to good groundwater potential
- Ave. depth 13 to 24 mbgl with yields of 1.4 to 2.9 L/s
- Moderate to poor quality (notable elements of concern = nitrate)
- Registered groundwater use is ~22 Mm^3/a → overall underutilized (large-scale abstraction for irrigation in GRU A63-1)
- Several GW water schemes (and GW dependent towns/villages)
- Probability of GW contribution to Baseflow (decreases downgradient)
- Groundwater levels show a strong response to significant recharge events with a decreasing trend during poor recharge seasons
- Significant decreases observed at selected mon. stations relate to a localised to regional impact (in A63-1)





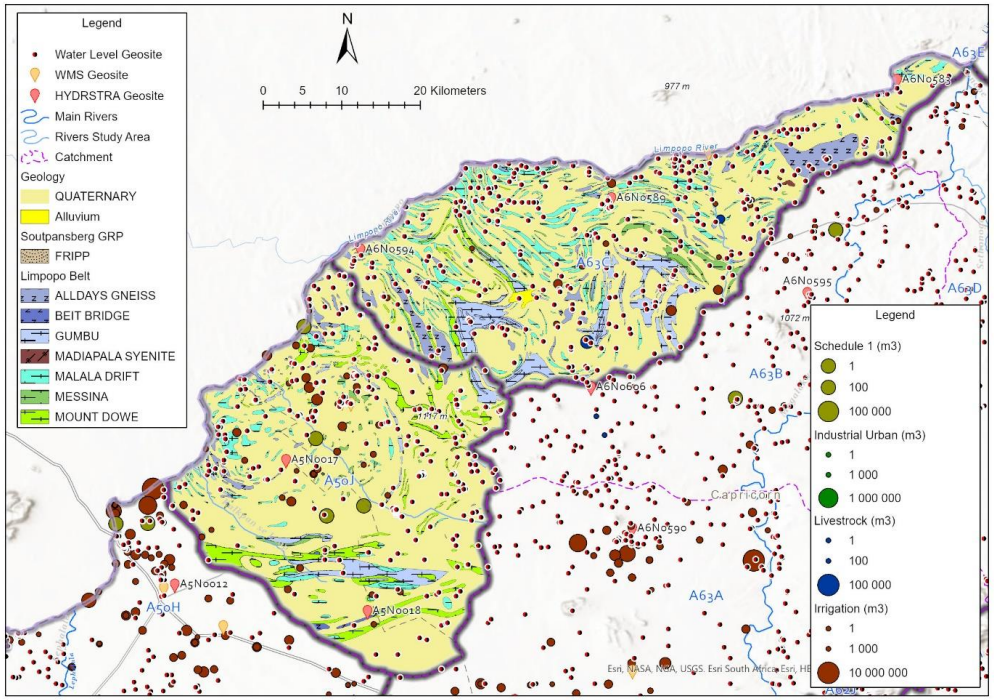




GROUNDWATER STATUS QUO – Kalkpan IUAs

GRUs: A50-4/A63-2

- Intergranular and fractured aquifer system from the Basement Complex and Alluvial aquifers – moderate groundwater potential
- Ave. depth 20 to 26 mbgl with yields of 1.5 to 2.0 L/s
- Moderate to poor quality (notable elements of concern = nitrate)
- Registered groundwater use is ~5 Mm^3/a



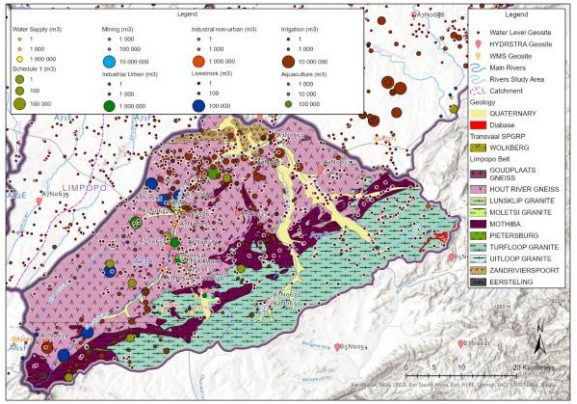
→ overall underutilized (more exploitation around Swartwater)

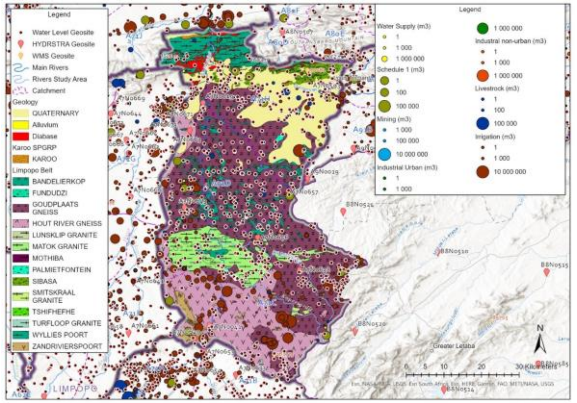
- Limited GW water schemes
- Moderate probability of GW contribution to Baseflow (higher along stretches of the Limpopo River)
- Groundwater levels show a decline of 3 to 5 m in groundwater levels since 2010, which can relate to a localised to regional impact

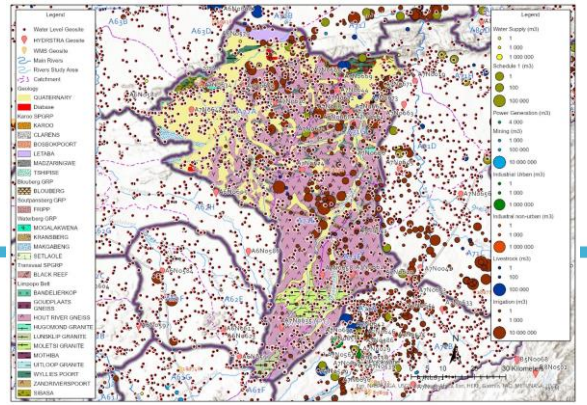
GROUNDWATER STATUS QUO – Upper Sand IUAs

GRUs: A71-1, A71-2, and A71-3 (The latter two straddles the Upper Sand and Lower Sand IUAs)

- Intergranular and fractured aquifer system from the Limpopo Mobile Belt and Alluvial aquifers – high groundwater potential
- Strategic GW source (of National Significance)
- Dendron-Vivo (Houdenbrak) Subterranean government water control areas
- Ave. depth 16 to 26 mbgl with yields of 2.4 to 4.9 L/s
- Moderate to poor quality (notable elements of concern = nitrate) (with elevated Cl)
- Registered groundwater use is ~72 Mm^3/a → heavily exploited
- Several GW water schemes (and GW dependent towns/villages)
- Low probability of GW contribution to Baseflow (anthropogenically altered) → artificial recharge schemes (to increase yields)
- Groundwater levels show a show a significant response to recharge events with variable (and seasonal) fluctuations. Most groundwater levels show a neutral to declining trend especially during poor recharge seasons



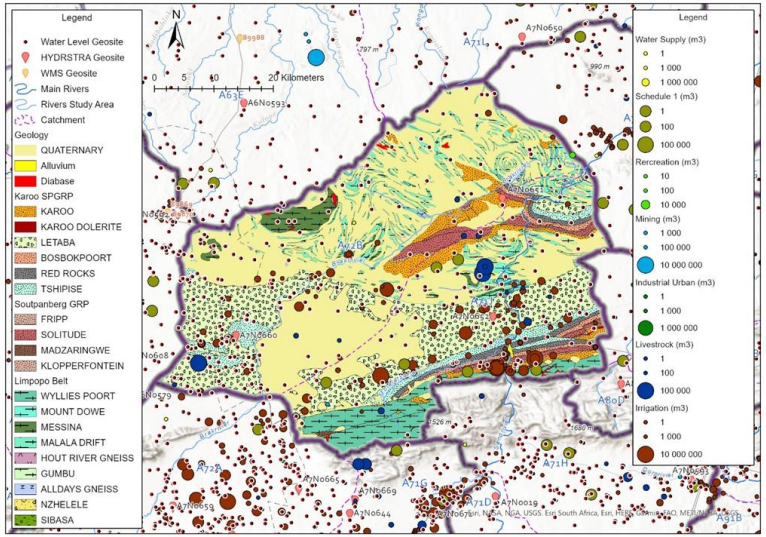


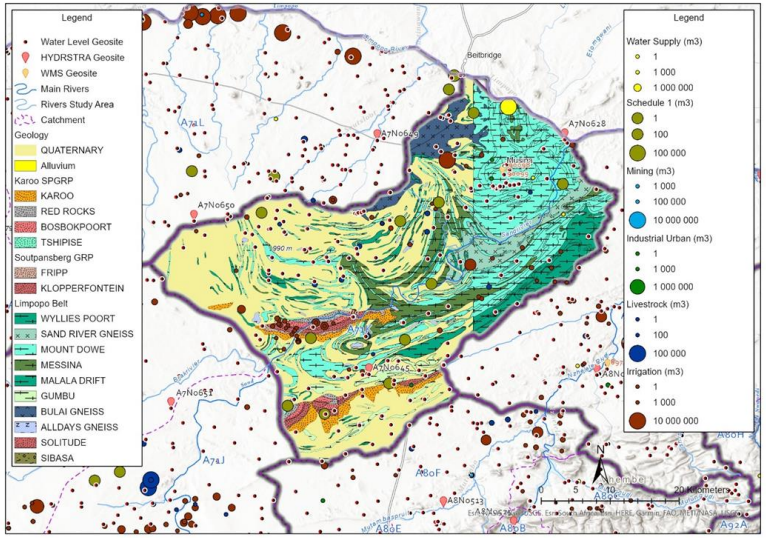


GROUNDWATER STATUS QUO – Lower Sand IUAs

GRUs: A71-2, A71-3, A71-4, and A71-5 (GRUs A71-2 and A71-3) straddles the Upper Sand and Lower Sand IUAs

- Intergranular and fractured aquifer system from the Limpopo Mobile Belt and Alluvial aquifers – high groundwater potential
- Fractured aquifers associated with the Soutpansberg Group and Karoo Supergroup – low groundwater potential
- Ave. depth 16 to 26 mbgl with yields of 1.3 to 4.9 L/s
- Moderate to poor quality (notable elements of concern = nitrate) (with elevated Cl)
- Registered groundwater use is ~83 Mm^3/a → heavily exploited
- Limited GW water schemes (in A71-4, and A71-5)
- Low probability of GW contribution to Baseflow
- Groundwater levels show a decreasing trend during poor recharge seasons
- High future water demand (Larger Musina Area) (SEZ)

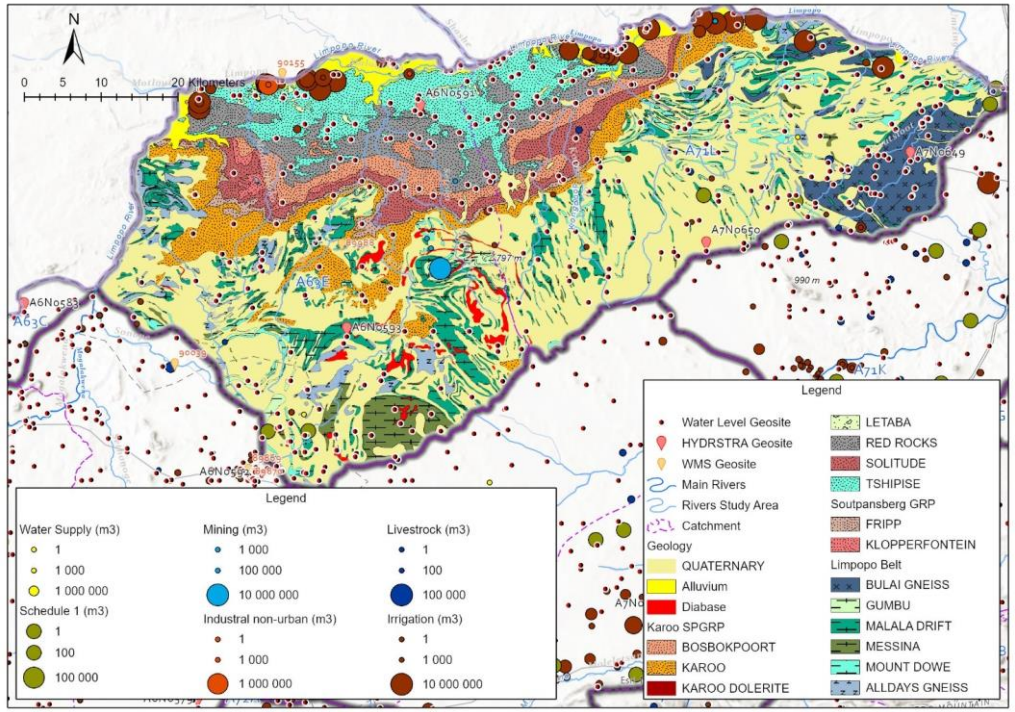




GROUNDWATER STATUS QUO – Mapungubwe IUAs

GRUs: A63-3/71-3

- Fractured aquifers associated with the Karoo Supergroup and Soutpansberg Group – low groundwater potential
- Alluvial aquifers from the Limpopo River are recharged during periods of high stream-flows as well as during the rainfall season and is associated with high yielding potential
- Ave. depth 19 mbgl with yields of 1.3 L/s
- Limited groundwater quality data is available for the GRU
- Registered groundwater use is ~46 Mm^3/a



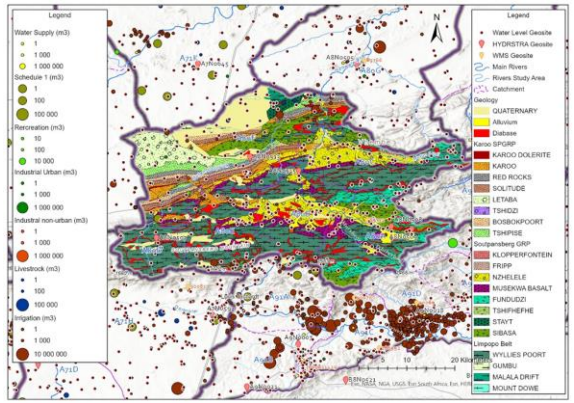
→ heavily exploited

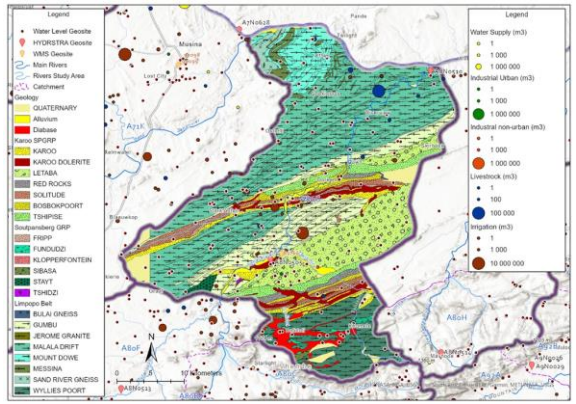
- Limited GW water schemes
- Higher probability of GW contribution to Baseflow (high SW/GW interaction along the Limpopo River)
- Groundwater levels show a strong response to significant recharge events with a decreasing trend during poor recharge seasons

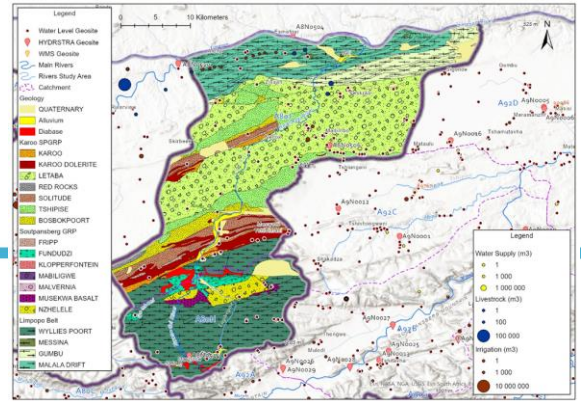
GROUNDWATER STATUS QUO – Nzhelele / Nwanedi IUAs

GRUs: A81-1, A81-2, and A81-3A71-1, A71-2

- Fractured aquifers associated with the Soutpansberg Group and Karoo Supergroup, the Basement Complex as well as local intergranular alluvial aquifers – low to moderate groundwater potential
- Ave. depth 15 to 20 mbgl with yields of 1.5 to 3.5 L/s
- Acceptable to moderate quality (notable elements of concern = chloride)
- Registered groundwater use is ~20 Mm^3/a → moderately exploited
- Some GW water schemes (and GW dependent towns/villages) (in A81-1)
- Probability of GW contribution to Baseflow (decreases downgradient)
- Higher probability of GW contribution to Baseflow (high SW/GW interaction along the Limpopo River) (A81-3)
- Groundwater levels show a show a significant response to recharge events with variable (and seasonal) fluctuations. Most groundwater levels show a neutral to declining trend with a few stations showing a decline of around 3 to 8 m which can relate to a localised impact
- Proposed mining activities may have a negative impact on GW quality





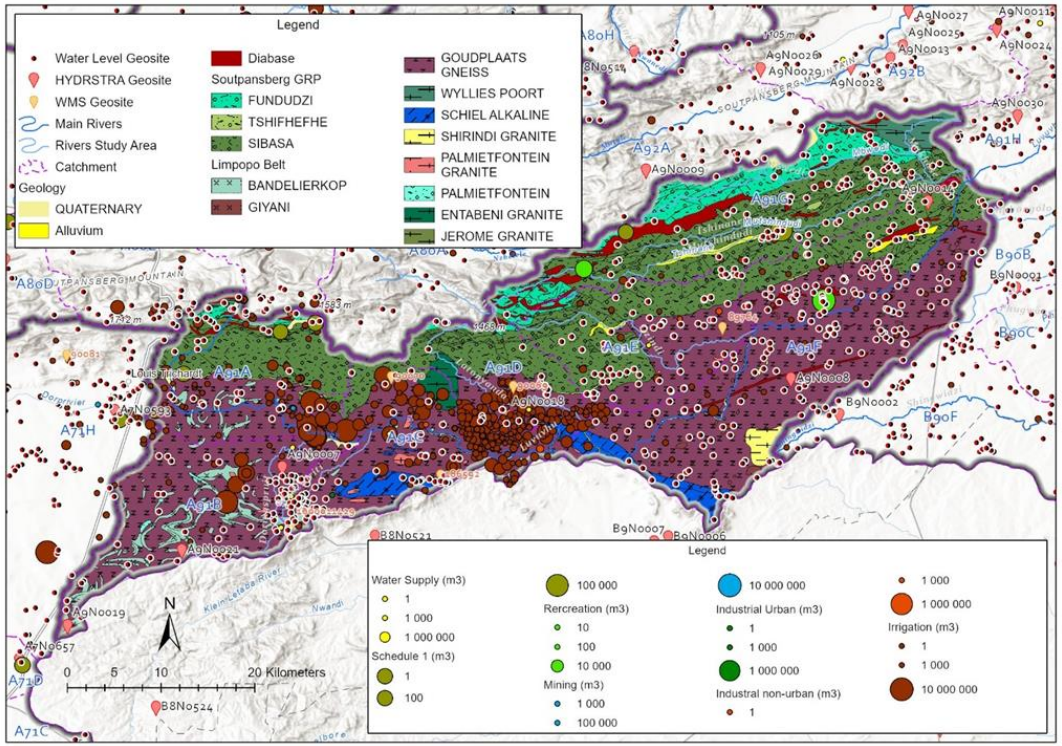


GROUNDWATER STATUS QUO – Upper Luvuvhu IUAs

GRUs: A91-1

- Fractured aquifers associated with the Karoo Supergroup, Soutpansberg Group and the Basement Complex (incl. local Intergranular/Alluvial aquifers) – moderate to high groundwater potential
- Strategic GW (and SW) source (of National Significance)
- Ave. depth 16 mbgl with yields of 2.9 L/s
- Acceptable groundwater quality
- Registered groundwater use is ~61 Mm^3/a

→ moderate to heavily exploited (large-scale irrigation)



- Limited GW water schemes
- High probability of GW contribution to Baseflow (groundwater contributes via sub surface seepage and springs)
- Groundwater levels show a strong response to significant recharge events with a decreasing trend during poor recharge seasons with a few stations showing declines which can relate to a localised to regional impact

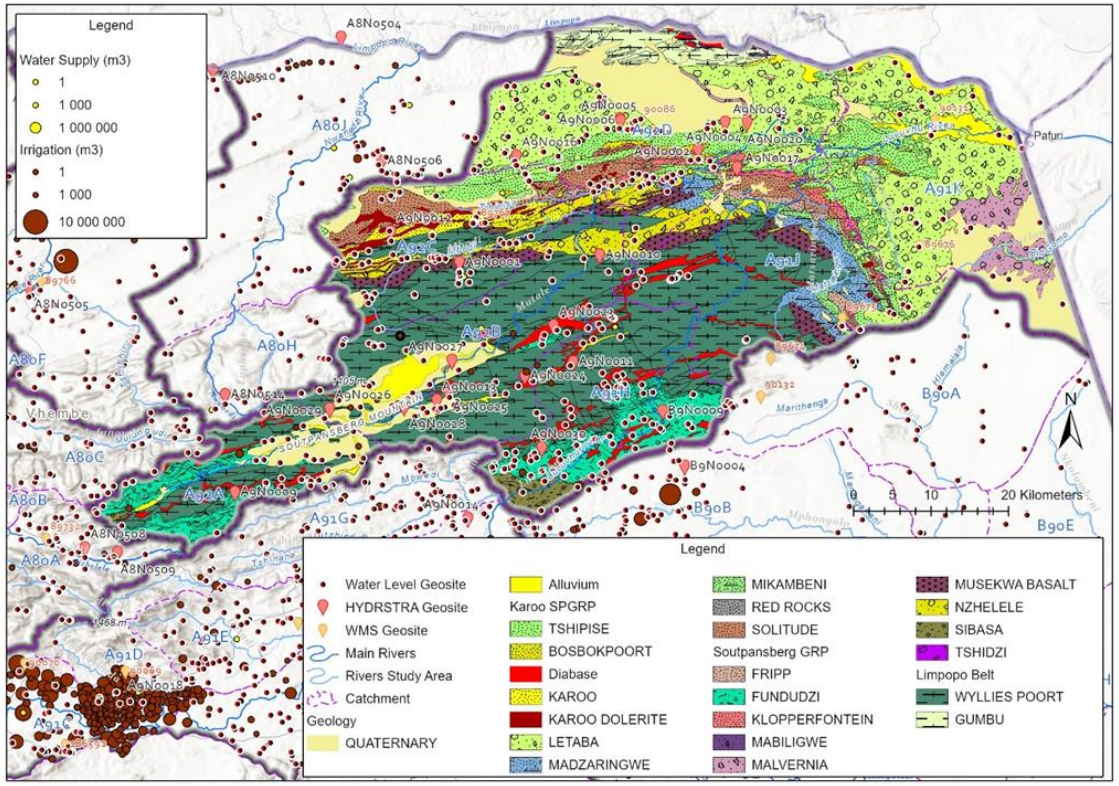
GROUNDWATER STATUS QUO – Lower Luvuvhu Mutale IUAs

GRUs: A91-2

- Fractured aquifers associated with the Karoo Supergroup, Soutpansberg Group (incl. local Intergranular/Alluvial aquifers) – low to moderate groundwater potential
- Ave. depth 14 mbgl with yields of 3.6 L/s
- Acceptable groundwater quality
- Registered groundwater use is ~61 Mm^3/a

→ underutilised

- Several GW water schemes (and GW dependent towns/villages)



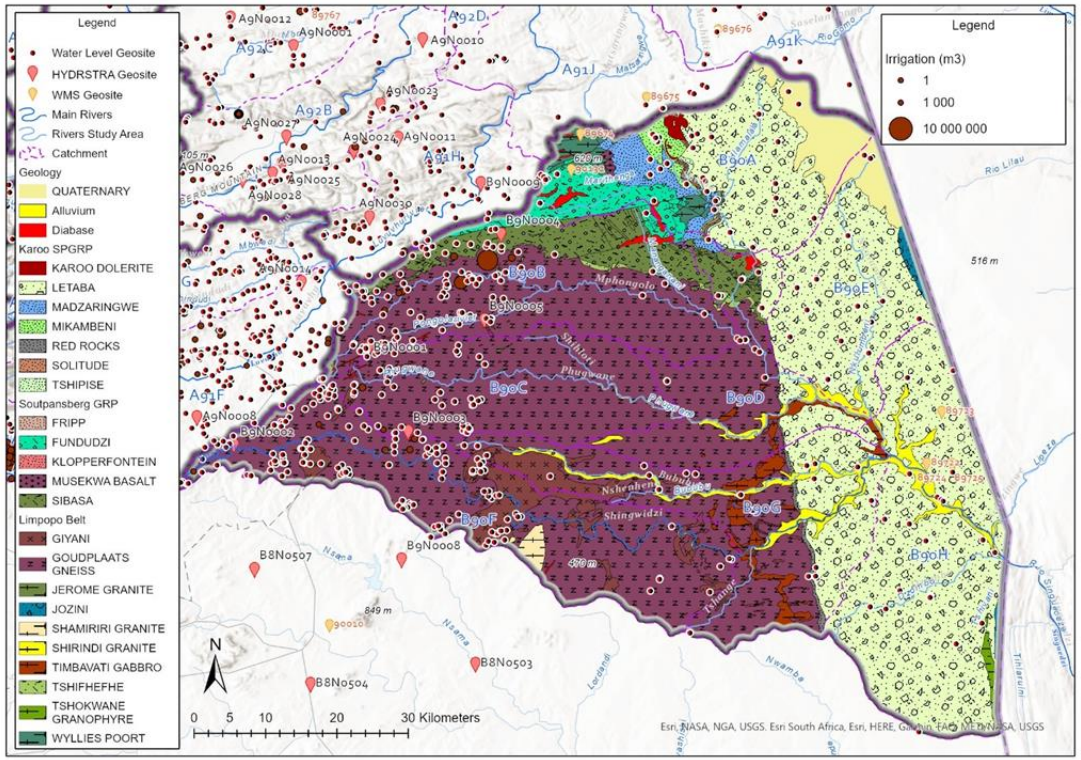
- High probability of GW contribution to Baseflow (in the upper reaches of the catchment)
- Groundwater levels show a strong response to significant recharge events with a decreasing trend during poor recharge seasons with a few stations showing declines which can relate to a localised to regional impact

GROUNDWATER STATUS QUO – Shingwedzi IUAs

GRUs: B90-1

- Intergranular and fractured aquifer systems from the Karoo Supergroup (Letaba Group) and fractured basement aquifer (incl. local Intergranular/Alluvial aquifers) – low to moderate groundwater potential
- Ave. depth 16 mbgl with yields of 1.6 L/s
- Moderate to poor quality (notable elements of concern = nitrate)
- Registered groundwater use is ~2.2 Mm^3/a

→ underutilised



- Limited GW water schemes
- Low probability of GW contribution to Baseflow (no sustainable yield is derived from surface flow)
- Groundwater levels show a strong response to significant recharge events with a decreasing trend during poor recharge seasons with a few stations showing declines which can relate to a localised to regional impact

GROUNDWATER (NEXT STEP)

- Development of Numerical Groundwater Flow Model for priority areas

→ Calibration against groundwater levels (and baseflow volumes)

- Establish wetlands (and potential GDPEs) of importance
- Field verification of selected groundwater schemes/wellfields and/or GDPEs

- Continuous [local] knowledge assimilation (if made available)

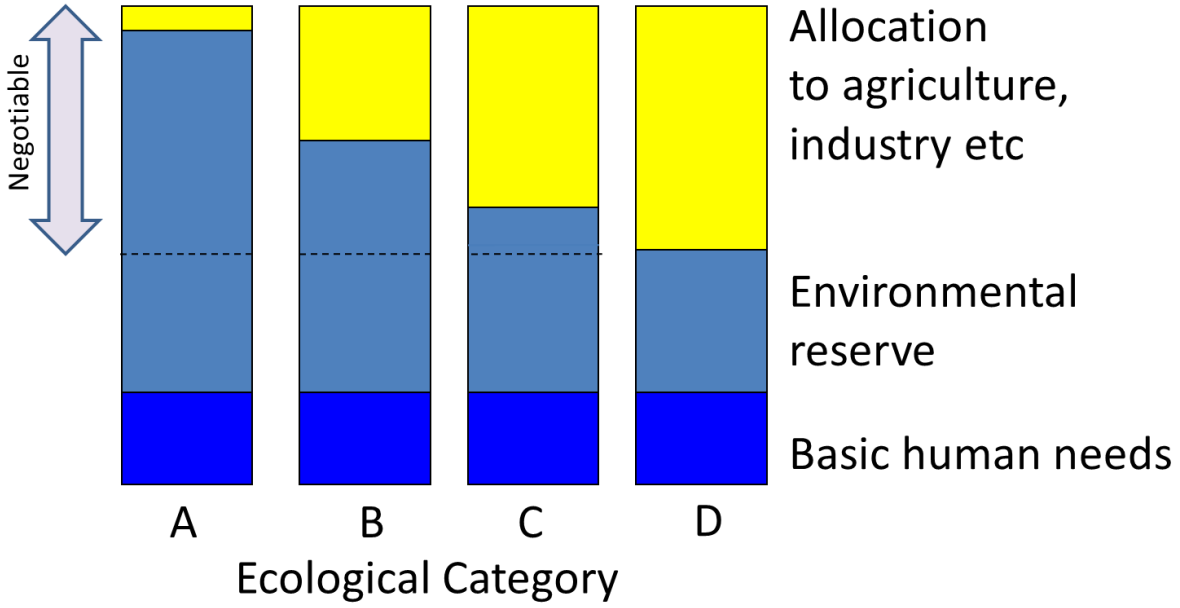
SOCIO-ECONOMICS & ECOSYSTEM SERVICES

SOCIO-ECONOMICS COMPONENT

- Review economic value of activities in the study area, with emphasis on water-dependent activities
- Estimate the value of aquatic ecosystem services
- Estimate the relationship between ecosystem health and ecosystem value
- Undertake scenario analysis to estimate costs and benefits of different levels of environmental protection (classification scenarios)

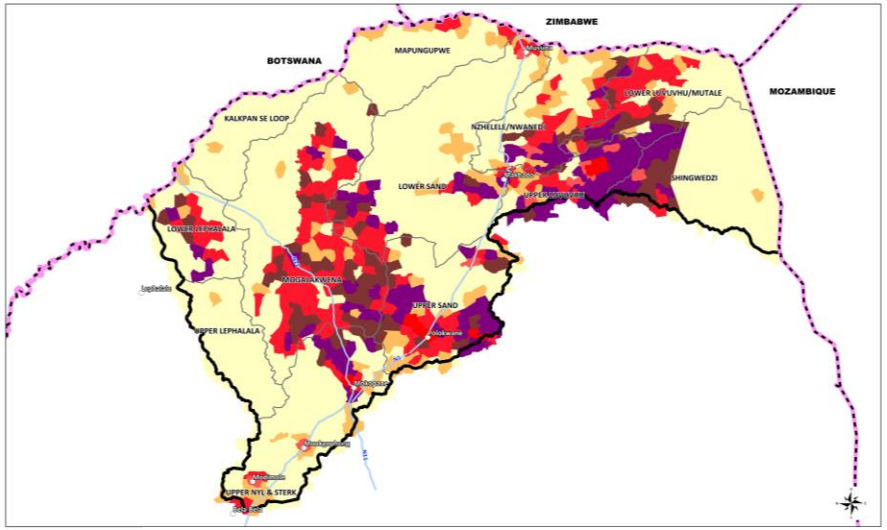
RATIONALE

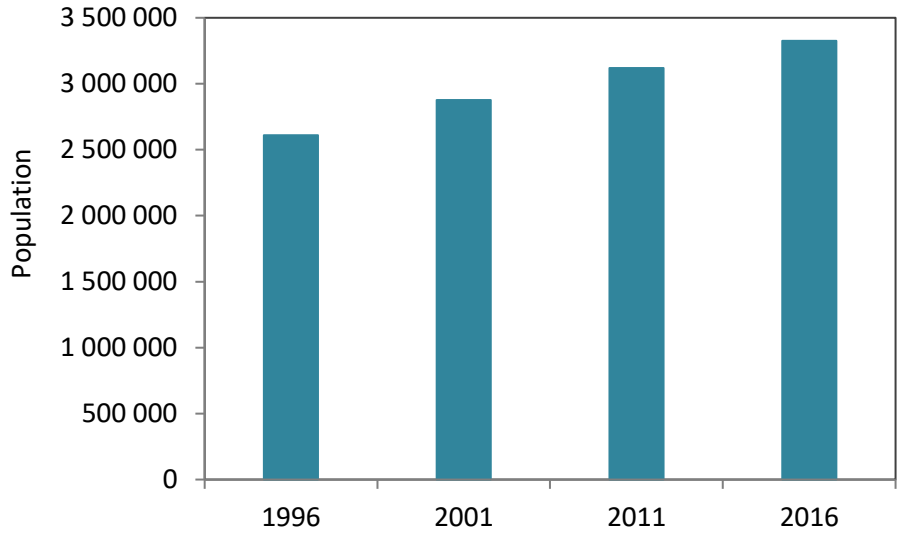
- In setting the Reserve for aquatic ecosystems,
  - Need to trade off economic value of allocating water to ecosystems versus to other uses
  - Need to take non-monetary factors into account, including meeting biodiversity conservation targets
- Increasing EC means have to either curtail water rights, or supply water from alternative sources (higher cost)



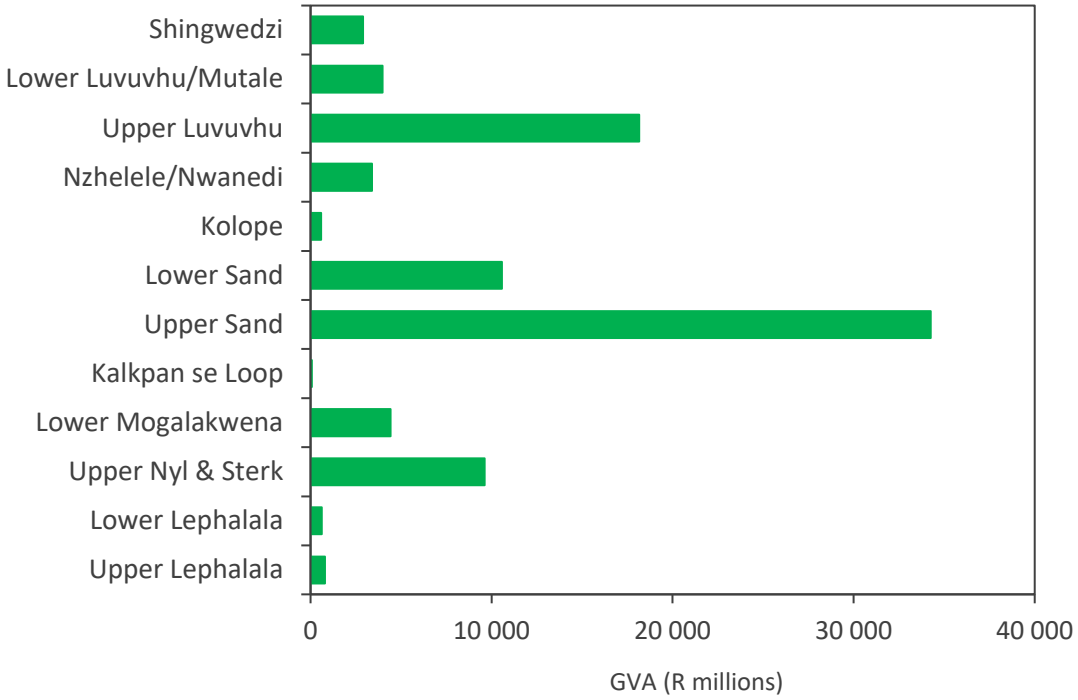
DESCRIPTION OF STATUS QUO: POPULATION OF THE STUDY AREA

- 3.3 million people
- Dense rural settlements
  - Upper Sand, Upper Luvuvhu, & Mogalakwena IUAs particularly densely populated
- Youthful population, high birth rates, high dependency ratios
- > a third of population considered poor or living in poverty
- Many households reliant on natural ecosystems for maintaining livelihoods and food security

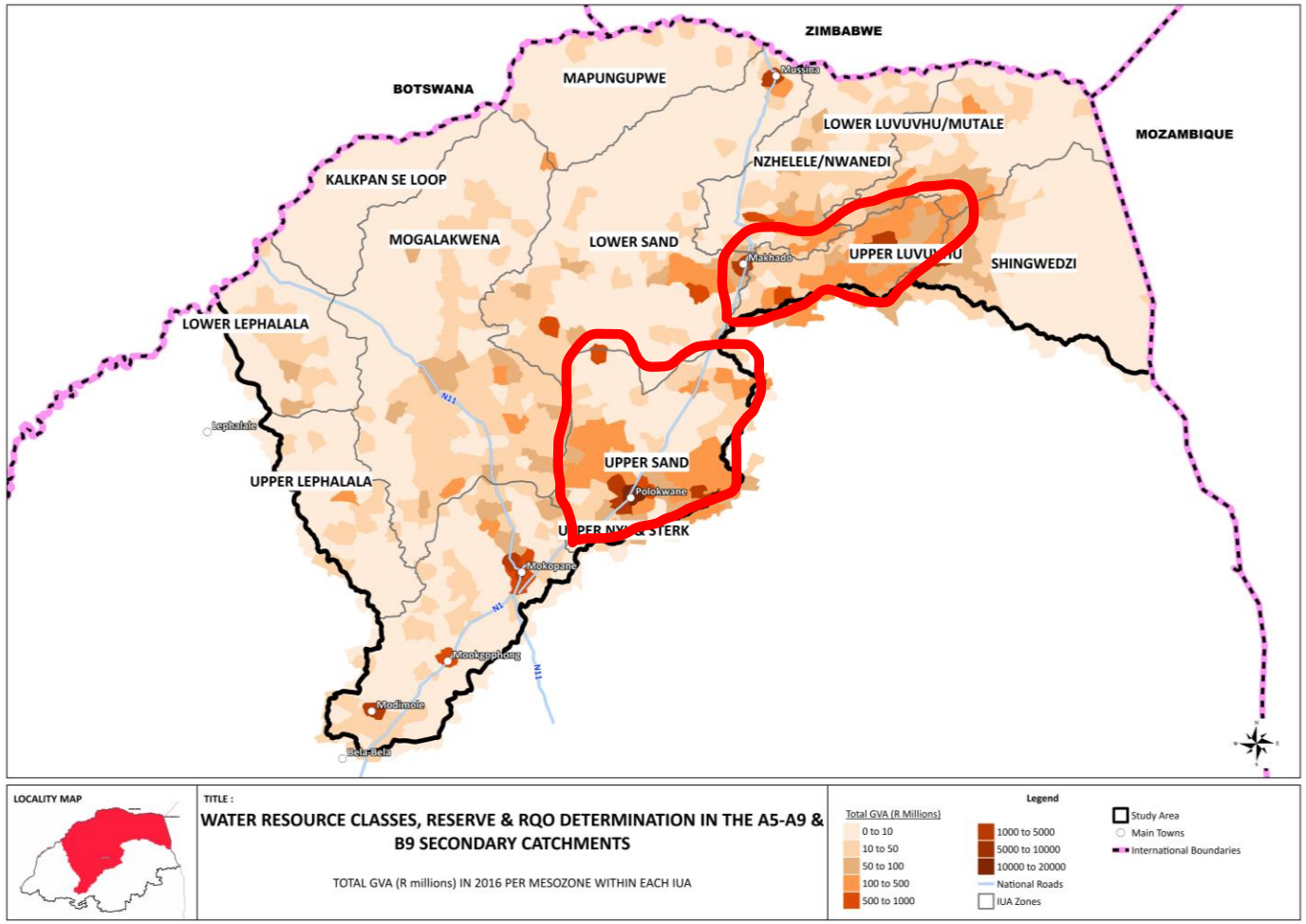




DESCRIPTION OF STATUS QUO: ECONOMIC CONTEXT

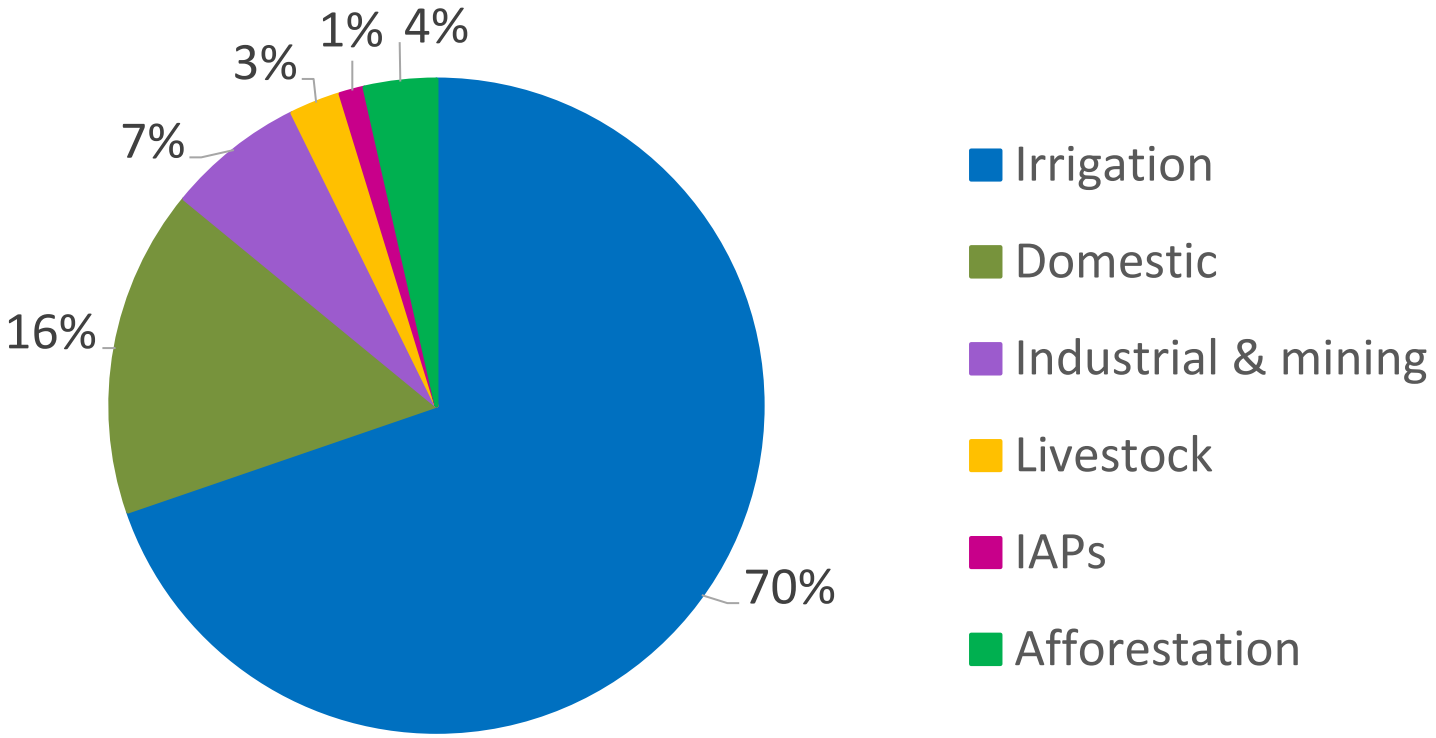


Total GVA (R million, all sectors)



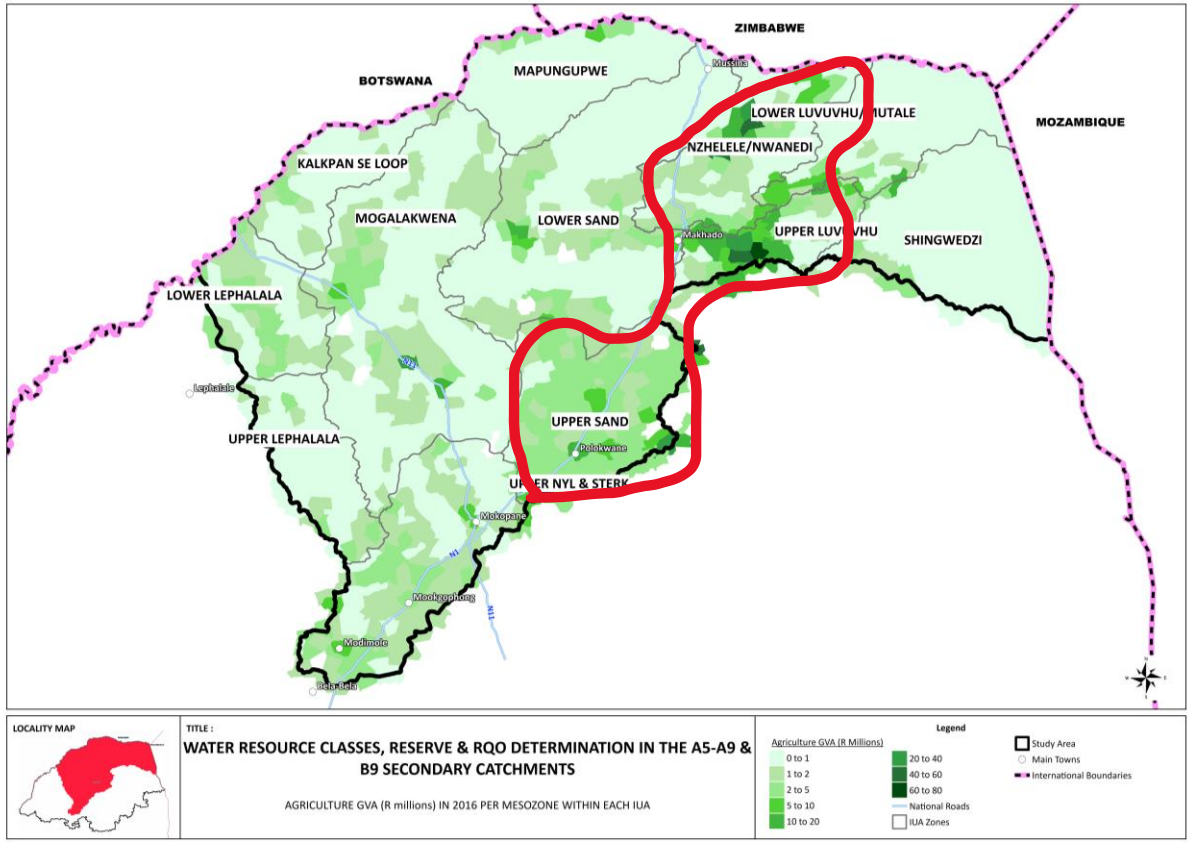
DESCRIPTION OF STATUS QUO: CURRENT WATER USE

- Bulk of water requirements in study area is for **irrigation agriculture**, followed by domestic use, industry and mining, and livestock watering



DESCRIPTION OF STATUS QUO: AGRICULTURE

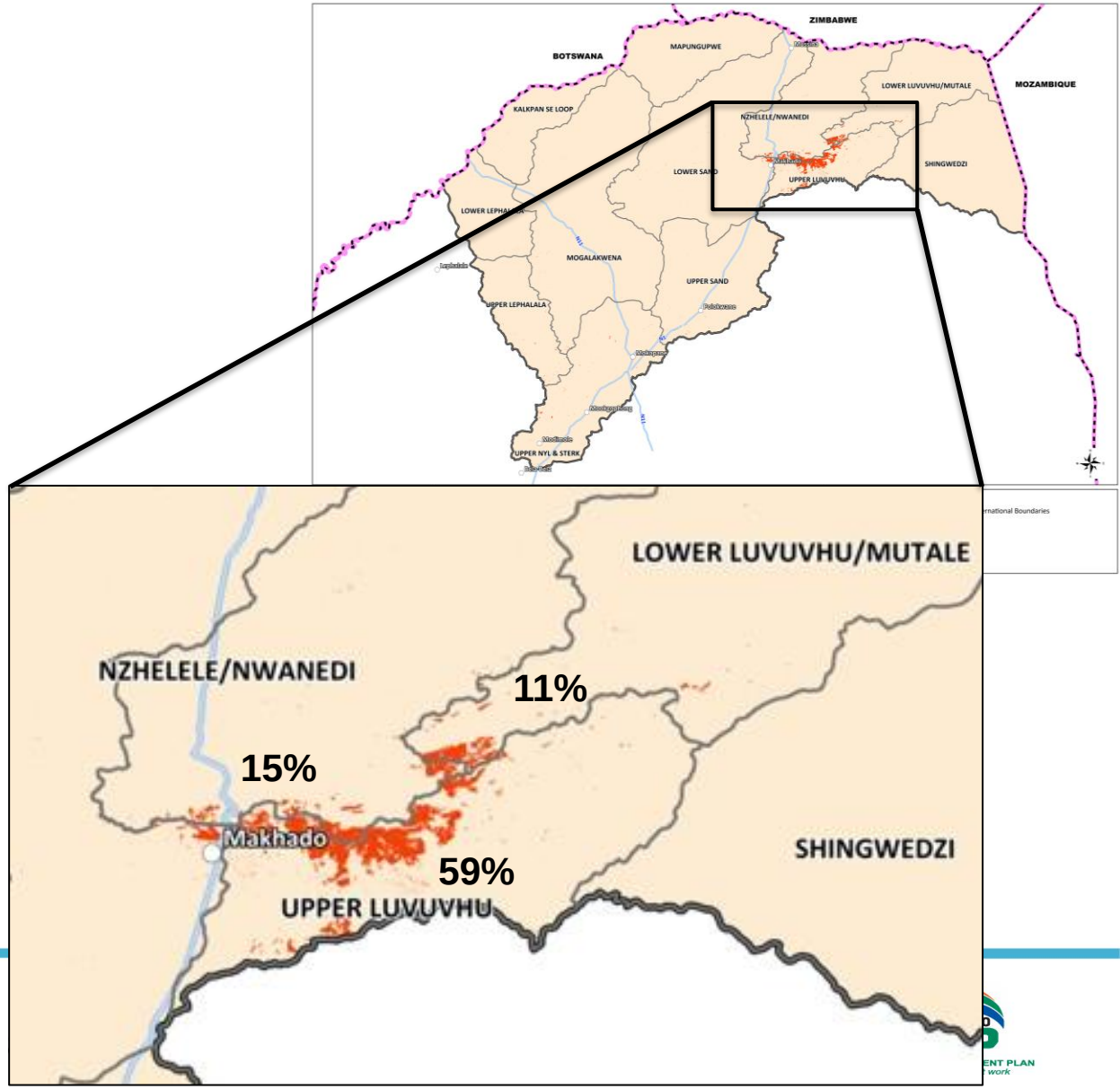
- Diverse agric. sector
  - Fruit & vegetables, cereal and oil seed products
- 74% of irrigated crops in Upper Sand, Lower Sand, Nzhelele/Nwanedi and Upper Luvuvhu IUAs
- 32 000 jobs
- Irrigated crops gross output estimated to be R5 billion in 2017



Agriculture GVA (R million)

DESCRIPTION OF STATUS QUO: FORESTRY

- 33 200 ha (68%) of commercial plantations in Limpopo are found in the study area
- Most of this is in the Upper Luvuvhu, Nzhelele/Nwanedi & Lower Luvuvhu/Mutale IUAs
- 1500 jobs
- Total gross output estimated to be R221 million in 2017



DESCRIPTION OF STATUS QUO: MINING

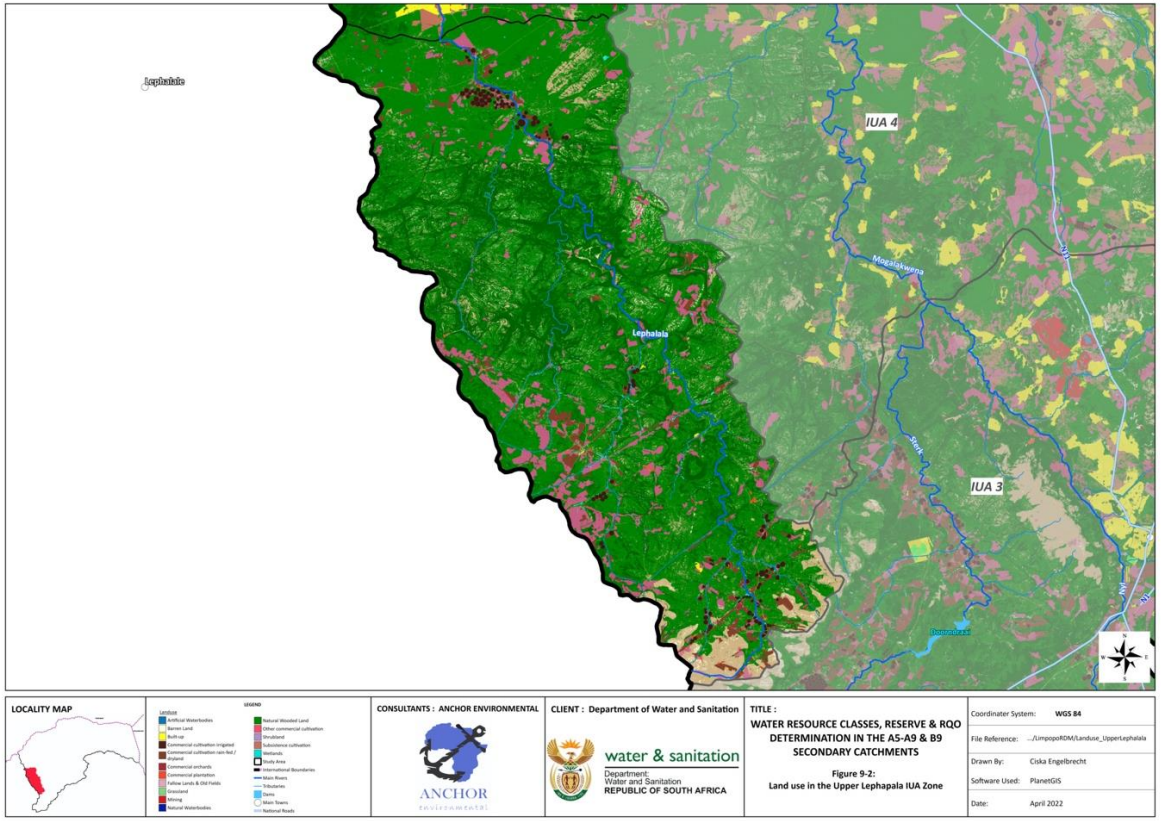
- Rich in mineral resources, mining an important economic activity
- Mining operations expanding in the study area
- Covers just over 7600 ha of land within study area
  - Mostly in Upper Nyl & Sterk, Upper Sand and Mapungubwe IUAs
- No mineral production data available

IUA	% of total mining area
Upper Lephalala	0%
Lower Lephalala	1%
Upper Nyl & Sterk	44%
Lower Mogalakwena	6%
Kalkpan se Loop	0%
Upper Sand	11%
Lower Sand	4%
Mapungubwe	23%
Nzhelele/Nwanedi	4%
Upper Luvuvhu	1%
Lower Luvuvhu/Mutale	4%
Shingwedzi	1%

DESCRIPTION OF STATUS QUO BY IUA: Upper Lephalala

- Sparsely populated
- No former homeland areas
- Low GVA (<1% of study area)
- 714 ha irrigated crops
- Nature-based tourism important

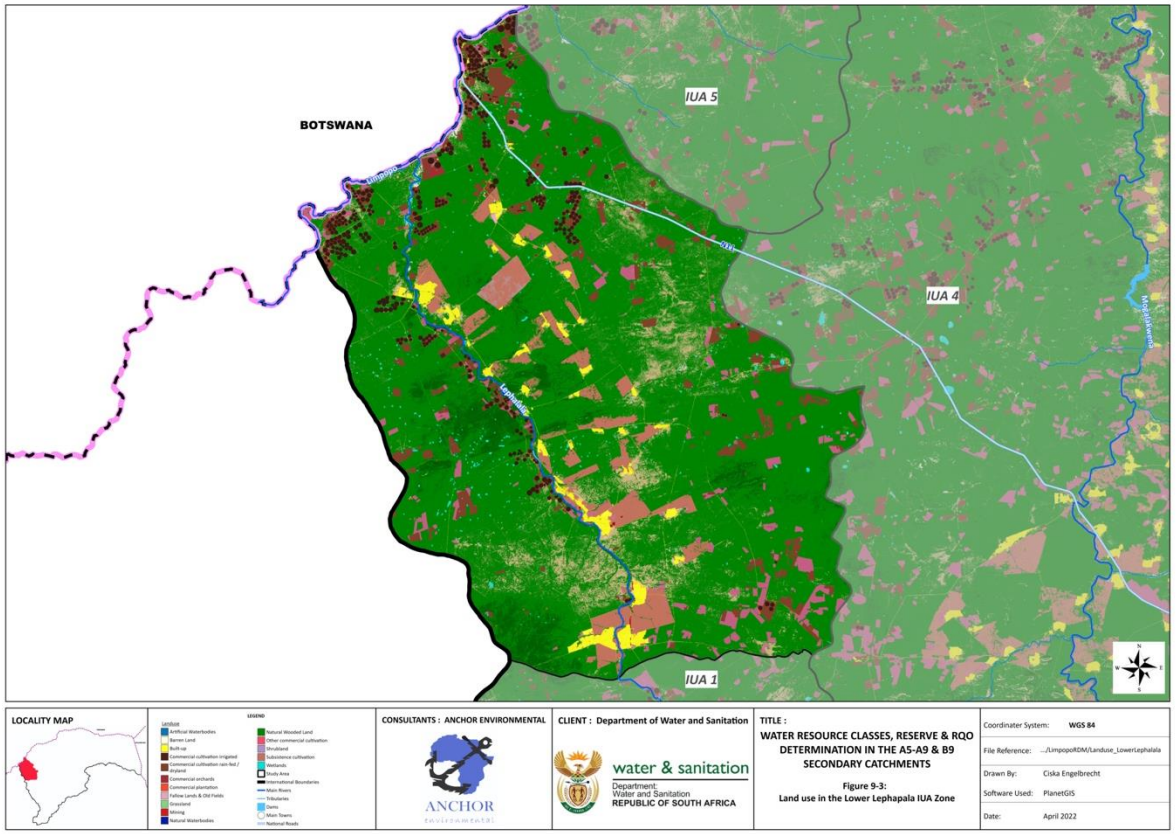
	Upper Lephalala	Study area
Total population (2016)	15 899	0.5%
Average annual hh income (2011)	R78 268	R70 996
% poor hh in IUA (2011)	15%	21%
% unemployed in IUA (2016)	23%	33%
% hh with good access to piped water (2011)	85%	59%
% hh dependent on river water in IUA (2011)	4%	4%



DESCRIPTION OF STATUS QUO BY IUA: Lower Lephalala

- 22% dense rural settlement (Lebowa)
- Agriculture dominant activity
- Low GVA (<1% of study area)
- 1000 ha irrigated crops

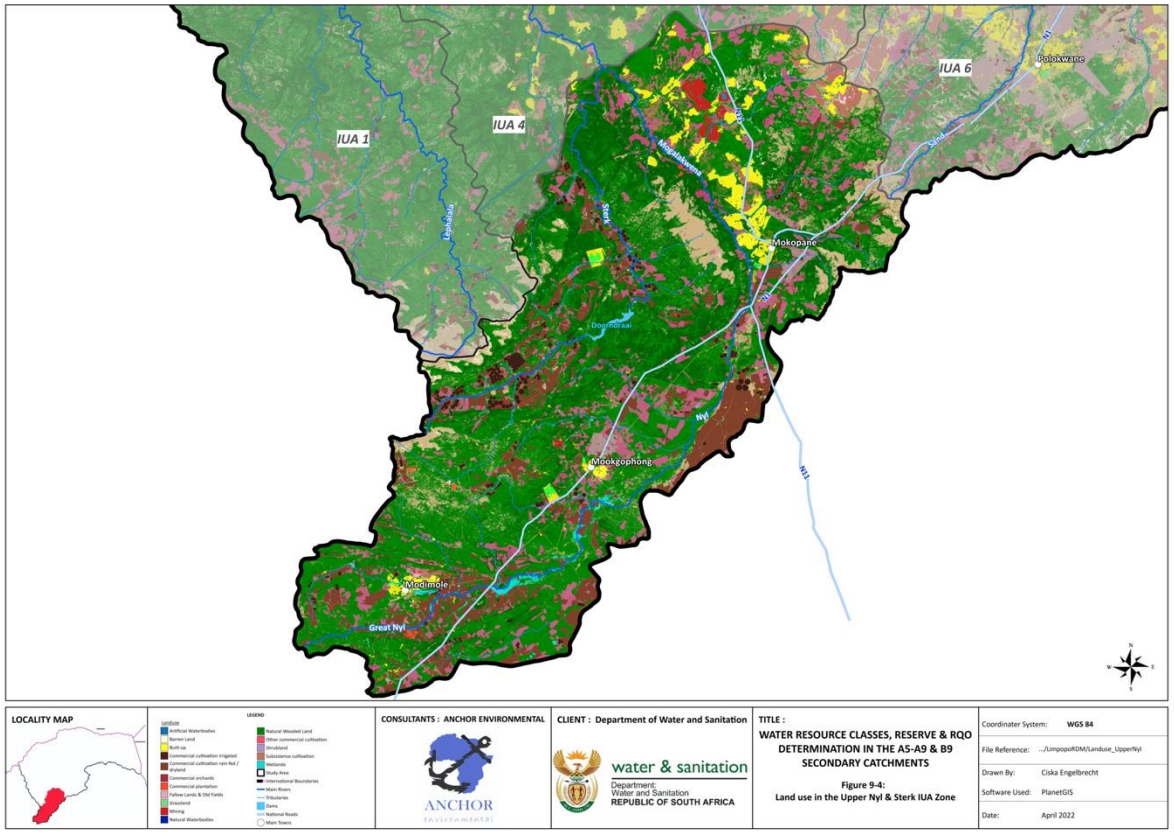
	Lower Lephalala	Study area
Total population (2016)	67 675	2%
Average annual hh income (2011)	R60 709	R70 996
% poor hh in IUA (2011)	18%	21%
% unemployed in IUA (2016)	21%	33%
% hh with good access to piped water (2011)	57%	59%
% hh dependent on river water in IUA (2011)	3%	4%



DESCRIPTION OF STATUS QUO BY IUA: Upper Nyl and Sterk

- Three major towns: Modimole, Mokopane, Mookgophong
- 47% of all commercial cultivation
- Mining important
- Contributes 11% of study area GVA
- Nature-based tourism important

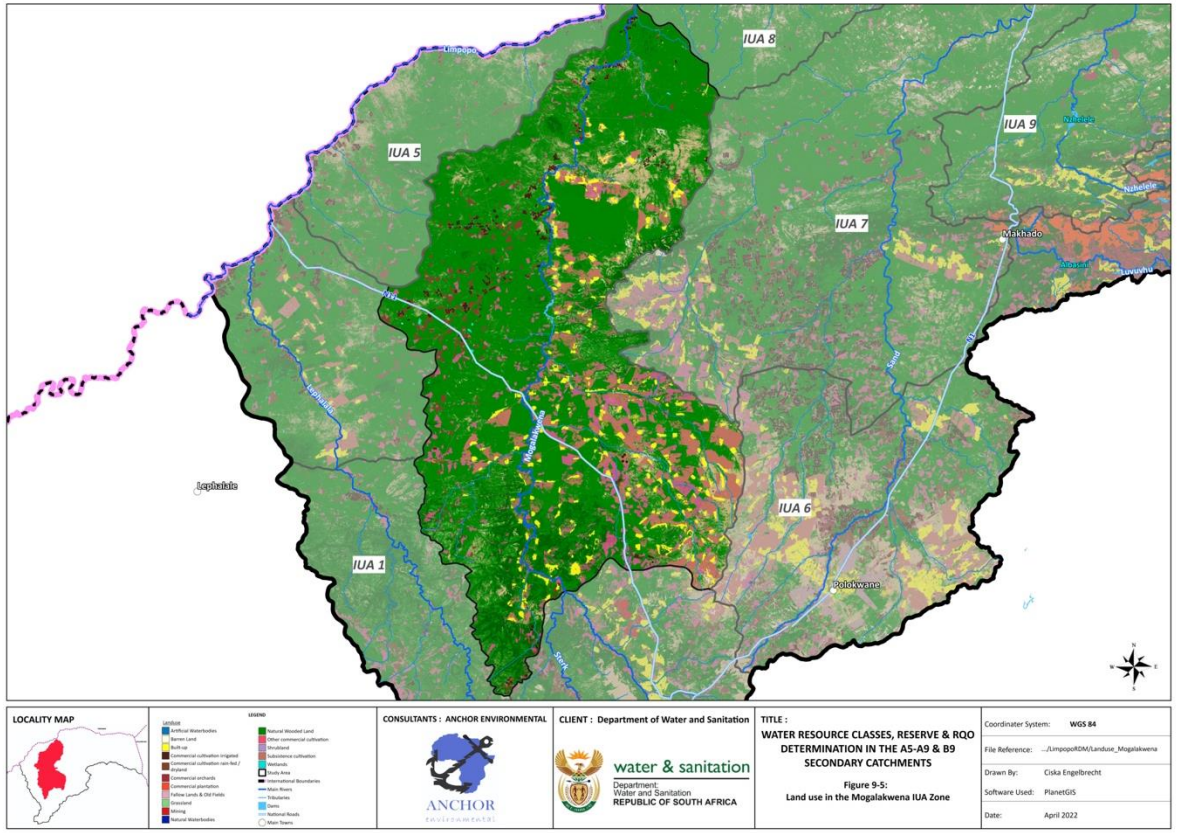
	Upper Nyl & Sterk	Study area
Total population (2016)	332 663	10%
Average annual hh income (2011)	R77 134	R70 996
% poor hh in IUA (2011)	19%	21%
% unemployed in IUA (2016)	31%	33%
% hh with good access to piped water (2011)	72%	59%
% hh dependent on river water in IUA (2011)	0%	4%



DESCRIPTION OF STATUS QUO BY IUA:
Lower Mogalakwena

- Largest IUA, covers 18% of study area
- Large dense rural settlements
- Subsistence cultivation more extensive than commercial cultivation
- Contributes 5% of study area GVA

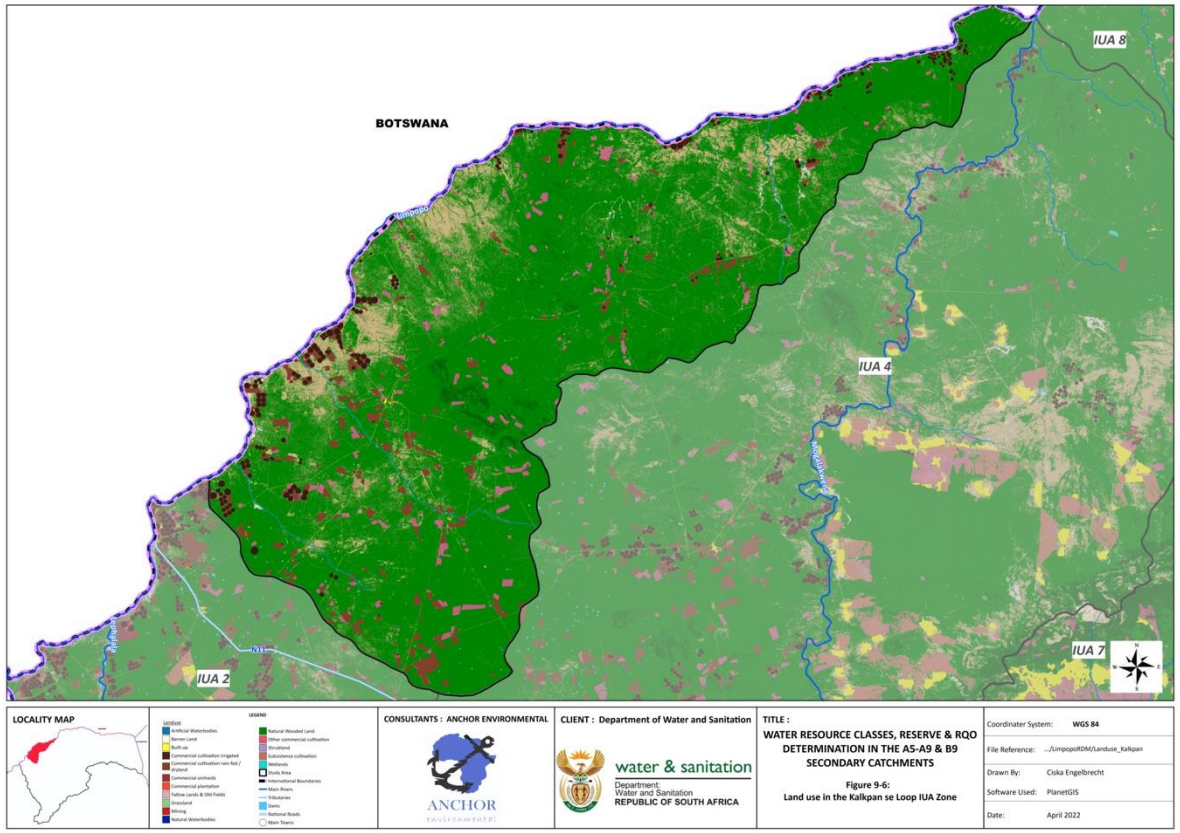
	Mogalakwena	Study area
Total population (2016)	330 280	10%
Average annual hh income (2011)	R50 078	R70 996
% poor hh in IUA (2011)	22%	21%
% unemployed in IUA (2016)	39%	33%
% hh with good access to piped water (2011)	60%	59%
% hh dependent on river water in IUA (2011)	4%	4%



DESCRIPTION OF STATUS QUO BY IUA: Kalkpan se Loop

- Sparsely populated
- Smallest contributor to study area GVA (0.1%)
- Agriculture most important activity
- Private game reserves / ranches

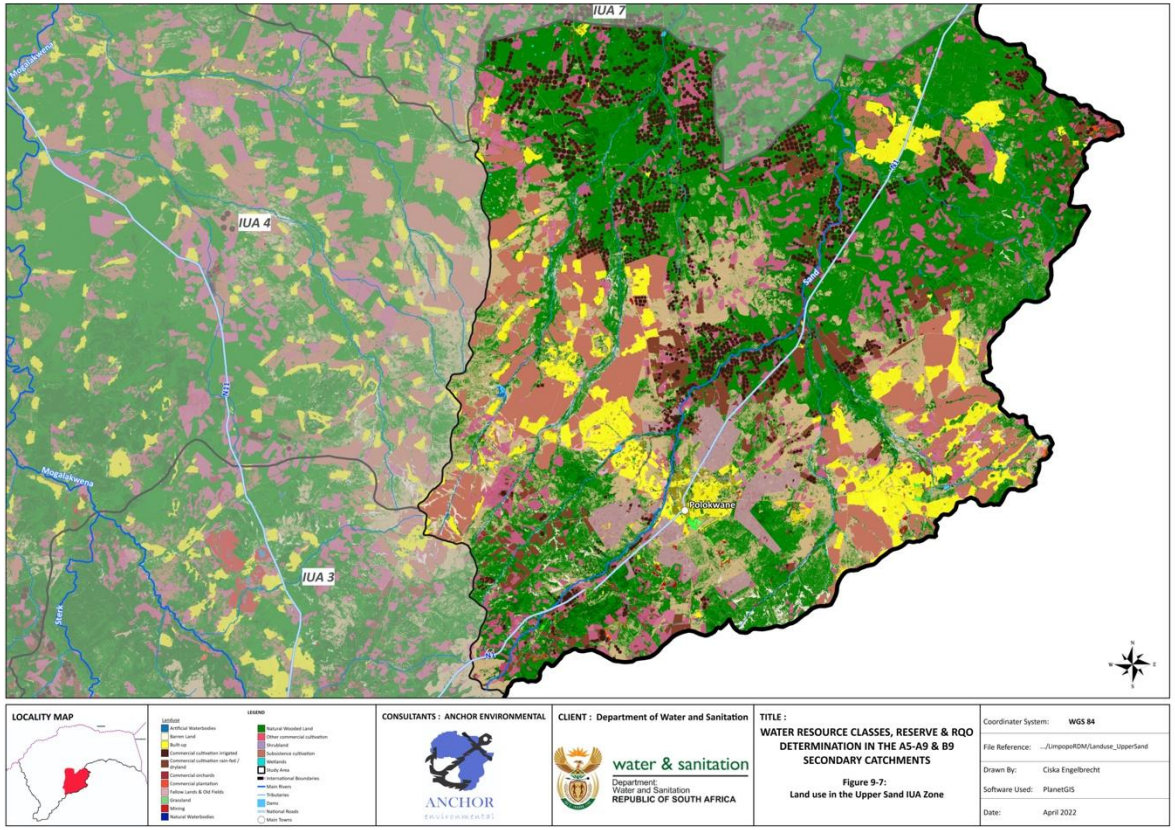
	Kalkpan	Study area
Total population (2016)	3 421	0.1%
Average annual hh income (2011)	R71 219	R70 996
% poor hh in IUA (2011)	8%	21%
% unemployed in IUA (2016)	27%	33%
% hh with good access to piped water (2011)	84%	59%
% hh dependent on river water in IUA (2011)	5%	4%



DESCRIPTION OF STATUS QUO BY IUA: Upper Sand

- Relatively densely populated, main city of Polokwane
- Highest contributor to study area GVA (38%)
- Economically diverse
- Highest number of employed persons
- >6000 ha irrigated crops

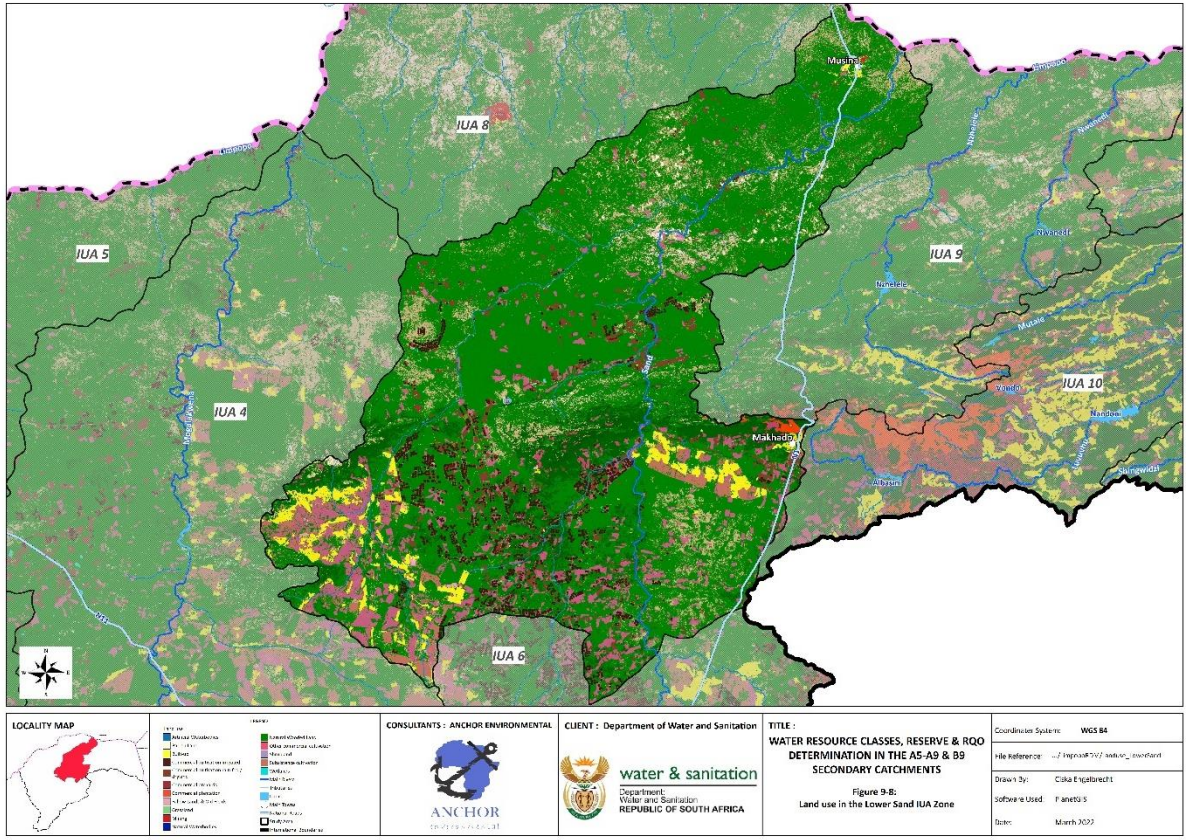
	Upper Sand	Study area
Total population (2016)	752 613	22.6%
Average annual hh income (2011)	R98 014	R70 996
% poor hh in IUA (2011)	20%	21%
% unemployed in IUA (2016)	30%	33%
% hh with good access to piped water (2011)	73%	59%
% hh dependent on river water in IUA (2011)	1%	4%



DESCRIPTION OF STATUS QUO BY IUA: Lower Sand

- Two main towns, Makhado and Musina
- Mostly sparsely populated outside of these
- 3rd highest contributor to study area GVA
- Most extensive area of commercial irrigated crops
- Nature-based tourism important

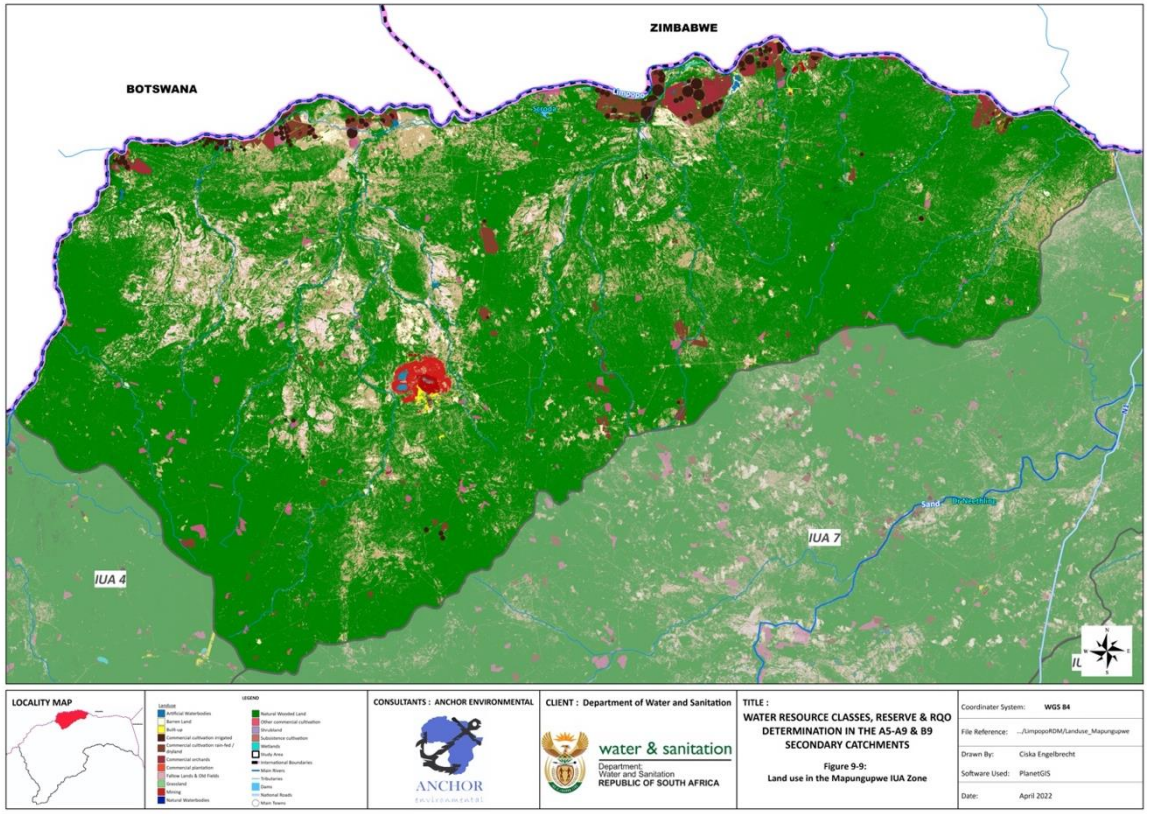
	Lower Sand	Study area
Total population (2016)	317 503	9%
Average annual hh income (2011)	R70 107	R70 996
% poor hh in IUA (2011)	20%	21%
% unemployed in IUA (2016)	28%	33%
% hh with good access to piped water (2011)	60%	59%
% hh dependent on river water in IUA (2011)	3.1%	4%



DESCRIPTION OF STATUS QUO BY IUA: Mapungubwe

- Mostly natural land cover (>90%)
- Sparsely populated
- Commercial irrigated agric along Limpopo River
- Venitia Diamond Mine in the centre of IUA
- Only 0.6% contribution to the study area GVA
- Mapungubwe National Park & other nature reserves

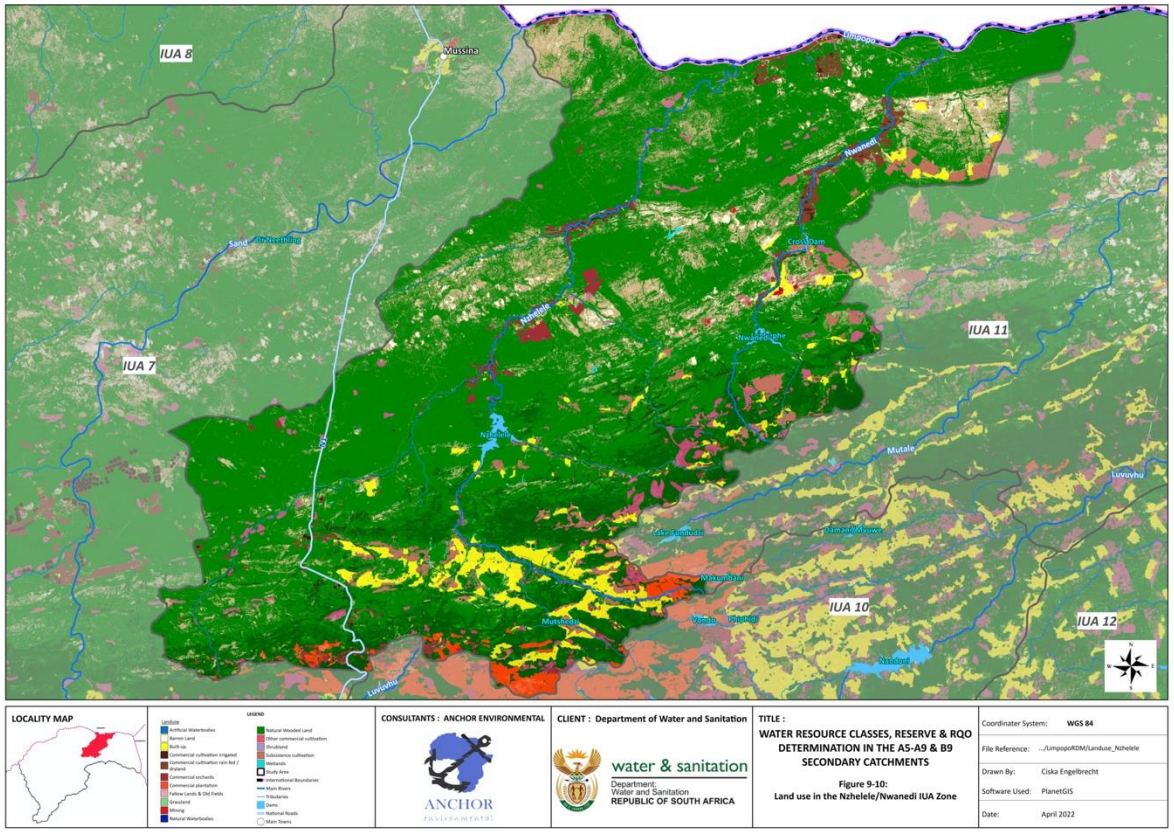
	Mapungubwe	Study area
Total population (2016)	14 625	0.4%
Average annual hh income (2011)	R66 612	R70 996
% poor hh in IUA (2011)	13%	21%
% unemployed in IUA (2016)	19%	33%
% hh with good access to piped water (2011)	69%	59%
% hh dependent on river water in IUA (2011)	12%	4%



DESCRIPTION OF STATUS QUO BY IUA:
Nzhelele / Nwanedi

- Agriculture important activity
- >5000 ha irrigated crops along main rivers, citrus dominant
- 3.8% of the study area GVA
- Higher dependence on natural resources by mostly rural population

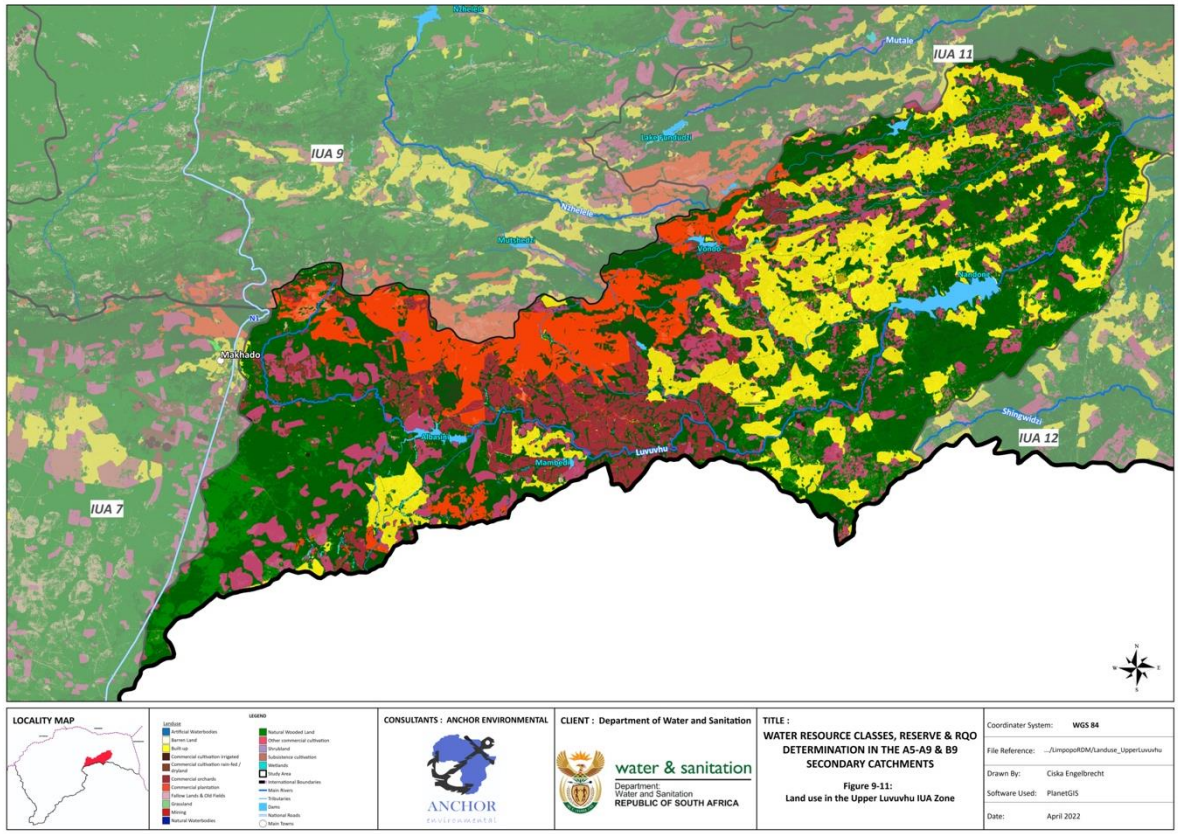
	Nzhelele/Nwanedi	Study area
Total population (2016)	224 066	6.7%
Average annual hh income (2011)	R54 562	R70 996
% poor hh in IUA (2011)	21%	21%
% unemployed in IUA (2016)	34%	33%
% hh with good access to piped water (2011)	41%	59%
% hh dependent on river water in IUA (2011)	8%	4%



DESCRIPTION OF STATUS QUO BY IUA: Upper Luvuvhu

- Densely populated
- Smallest extent of natural cover (47.9%), largest extent of commercial cultivation (14.8%) and forestry (8.7%) in the study area
- Permanent orchards and irrigated crops dominate
- 2nd largest contributor (20.3%) to study area GVA

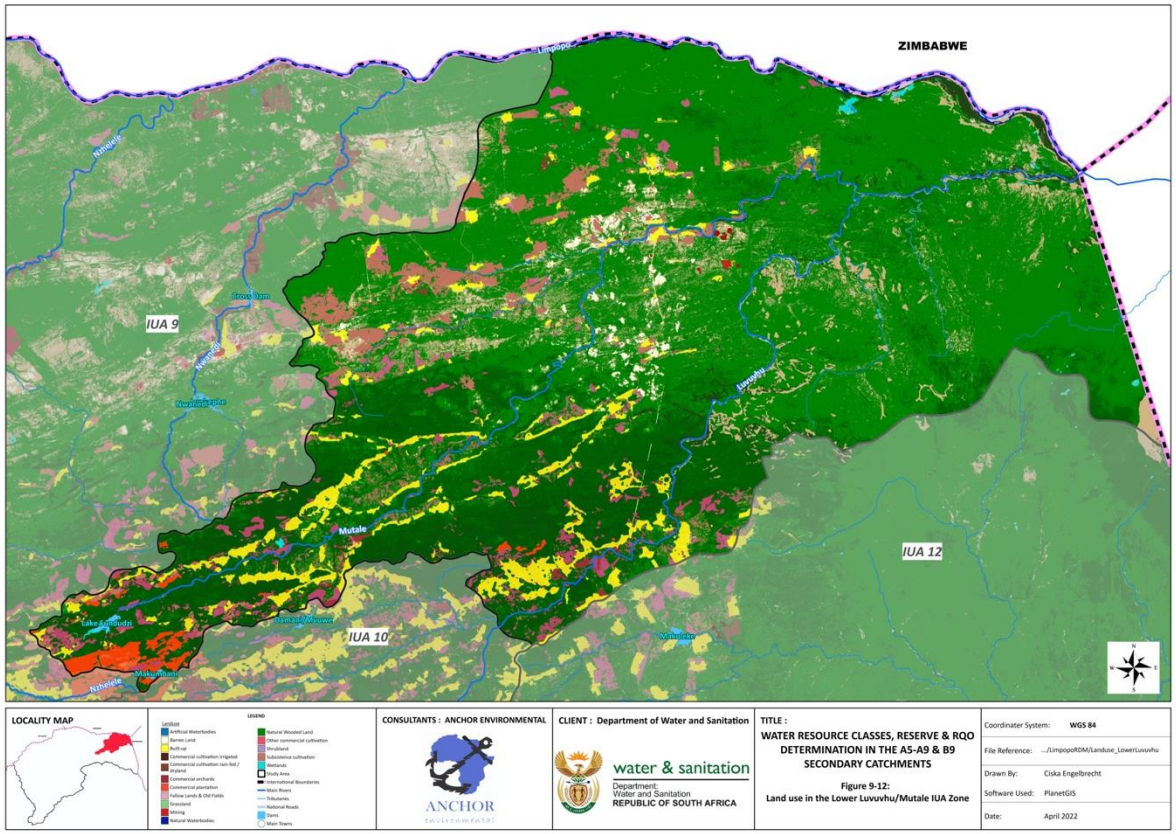
	Upper Luvuvhu	Study area
Total population (2016)	748 968	23%
Average annual hh income (2011)	R67 098	R70 996
% poor hh in IUA (2011)	21%	21%
% unemployed in IUA (2016)	37%	33%
% hh with good access to piped water (2011)	50%	59%
% hh dependent on river water in IUA (2011)	4%	4%



DESCRIPTION OF STATUS QUO BY IUA: Lower Luvuvhu/Mutale

- Sparsely populated in north, more dense in south
- Natural land cover >85%
- Subsistence agriculture important , minimal commercial agriculture
- High dependency on natural resources
- Nature-based tourism important (Pafuri tourism node, adjacent to KNP, private & community lodges)

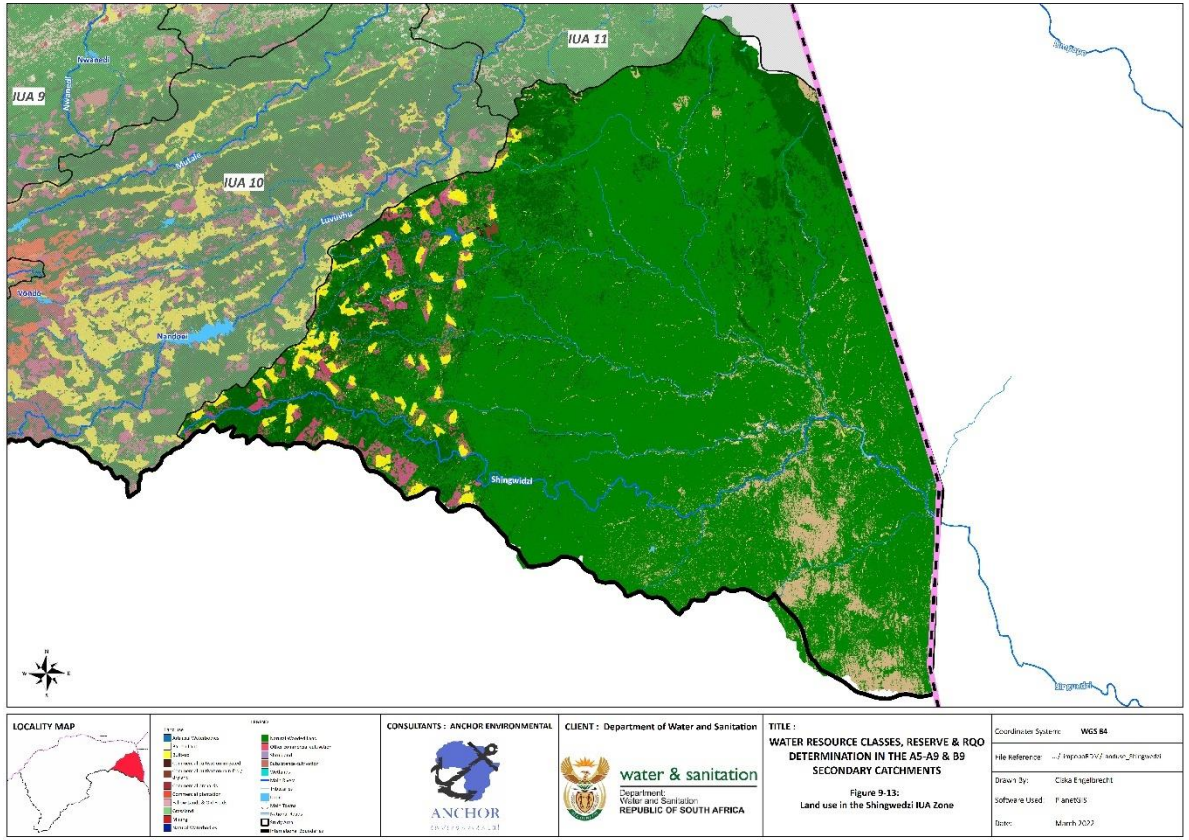
	Lower Luvuvhu	Study area
Total population (2016)	298 930	9%
Average annual hh income (2011)	R47 648	R70 996
% poor hh in IUA (2011)	26%	21%
% unemployed in IUA (2016)	41%	33%
% hh with good access to piped water (2011)	28%	59%
% hh dependent on river water in IUA (2011)	14%	4%



DESCRIPTION OF STATUS QUO BY IUA: Shingwedzi

- Almost entirely natural land cover (>95%), mostly within KNP, the largest and most significant protected area in the study area
- Relatively densely populated outside of KNP
- High unemployment, poor hh
- Very little commercial agriculture
- Contributes 3% to study area GVA

	Shingwedzi	Study area
Total population (2016)	227 565	6.8%
Average annual hh income (2011)	R44 468	R70 996
% poor hh in IUA (2011)	27%	21%
% unemployed in IUA (2016)	40%	33%
% hh with good access to piped water (2011)	38%	59%
% hh dependent on river water in IUA (2011)	0.6%	4%



LINKING VALUE AND CONDITION OF WATER RESOURCE

HOW TO LINK VALUE AND CONDITION OF THE WATER RESOURCE?

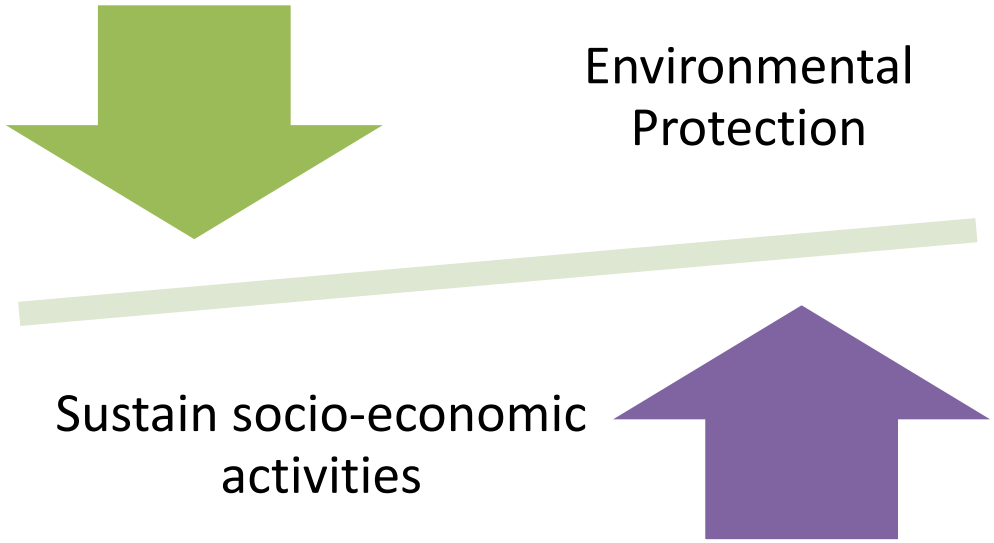
- **Value**:
  - Social
  - Economic
- **Condition**:
  - State of the water resource
  - Water quantity and quality
  - Aquatic ecosystem
- Need to estimate the **relationships** between water use and economic outputs as a result of production in water user sectors, stream flow reducing sectors and sectors relying on ecosystem services
- Scenario-based approach

OBJECTIVES

- Identification of Classification Scenarios
- Defining relationships and consequences of:
  - Water quality
  - River (ecological) at key biophysical nodes:
    - *determining impact on the Ecological Category (EC) and capacity to supply ecosystem services*
  - Economic:
    - *determining sectoral impacts of scenarios on yield and ecosystem services*
  - Socio-economic:
    - *determining impacts of any water allocation changes*
- Describe how to integrate and evaluate the consequences to provide preliminary Water Resources Classes for evaluation

SCENARIO EVALUATION PROCESS

- Aim of the scenario evaluation process:
  - An appropriate balance between the level of environmental protection and the use of the water to sustain socio-economic activities

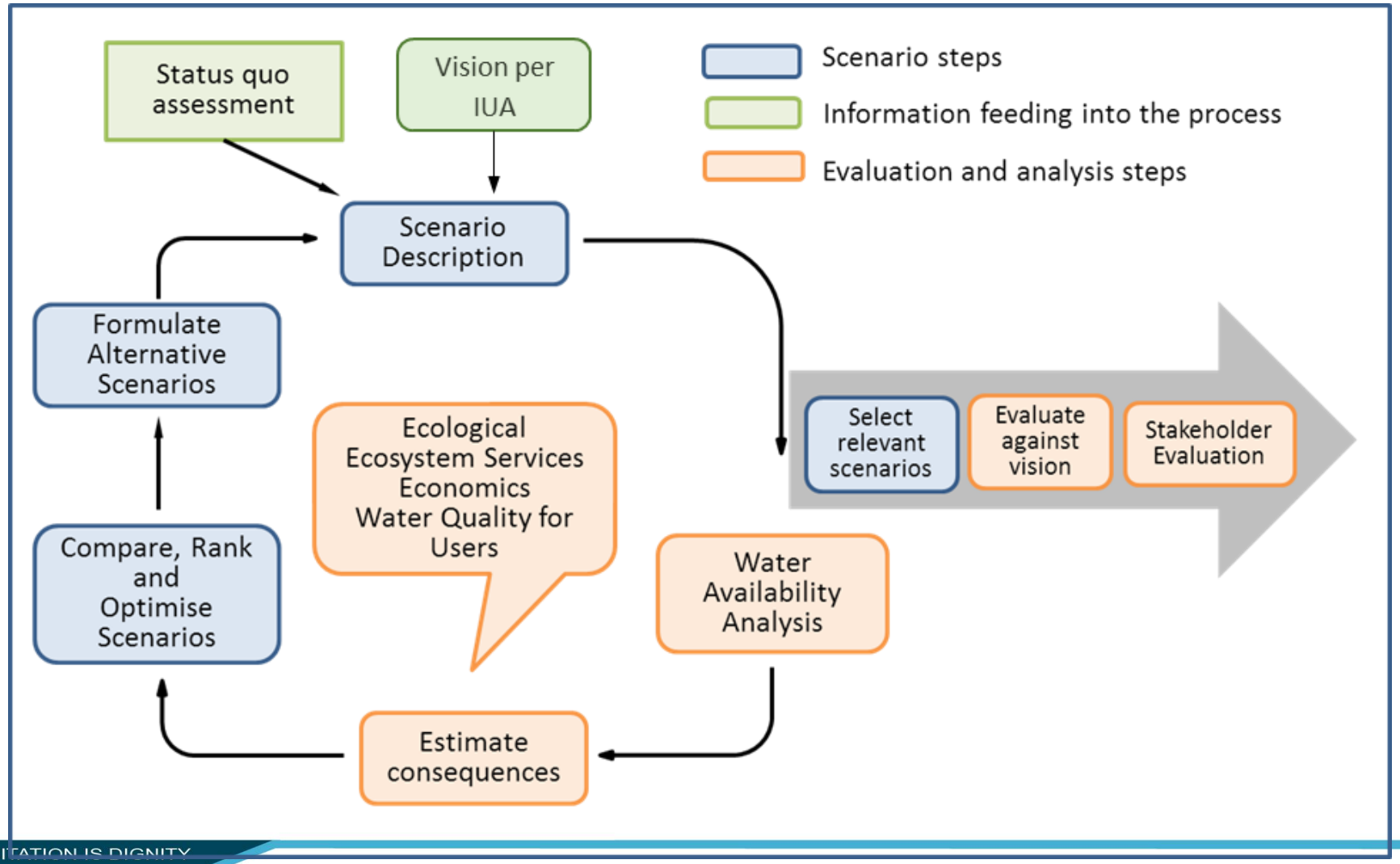


Balance must consider 3 main elements:

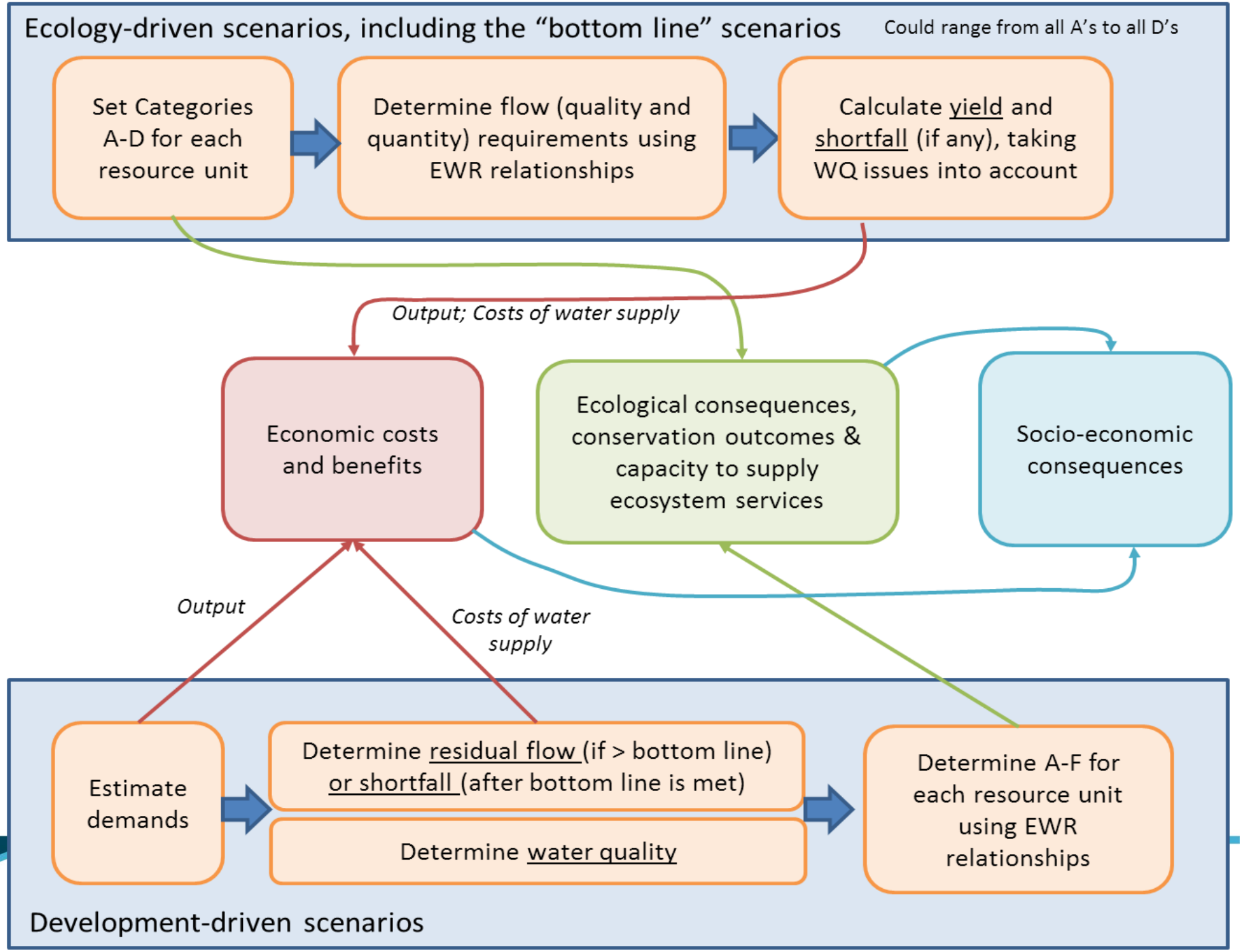
1. Ecology
2. Economic benefits
3. Societal benefits

- Scenario evaluation process estimates consequences of the scenarios on these three main elements

SCENARIO EVALUATION PROCESS



The technical process for assessment of the classification scenario framework involve both ecology-driven and development-driven scenarios



VARIABLES CONSIDERED IN SCENARIO EVALUATION

Variable	Components
Ecological	• Overall state of aquatic ecosystem health • % of freshwater conservation targets met
Water Quality for Users	• Empirical impacts on salinity and nutrient enrichment • Qualitative impacts on constituents of concern in a particular IUA
Economic	• Losses / gains in Total Value Added + Costs saved/incurred • Losses/gains in Total Employment
Society	• Impact on livelihoods, • Income to poor households • Intangible benefits to society

DEFINING THE CLASSIFICATION SCENARIOS

	#	Scenario	Description
1	1A	Maintain PES + low growth (=Baseline)	River and wetland systems are maintained in their present condition.
	1B	Maintain PES + high growth	
2	2A	Bottom line + low growth	The maximum volume of water made available for abstraction for economic activities, with the proviso that all water resources are maintained in a D class
	2B	Bottom line + high growth	
3	3A	RECs + low growth	RECs determined for rivers & wetlands based on present health & conservation importance (without consideration of socio-economic effects)
	3B	RECs + high growth	
4	4A	Targeted conservation + low growth	High ECs are given to areas of high conservation importance, but for other areas, the ECs can be below REC.
	4B	Targeted conservation + high growth	
5	5A	High conservation + low growth	Conservation targets are met, with an emphasis on an eco-tourism-based economy, with most resources in a good condition (in Classes A or B).
	5B	High conservation + high growth	

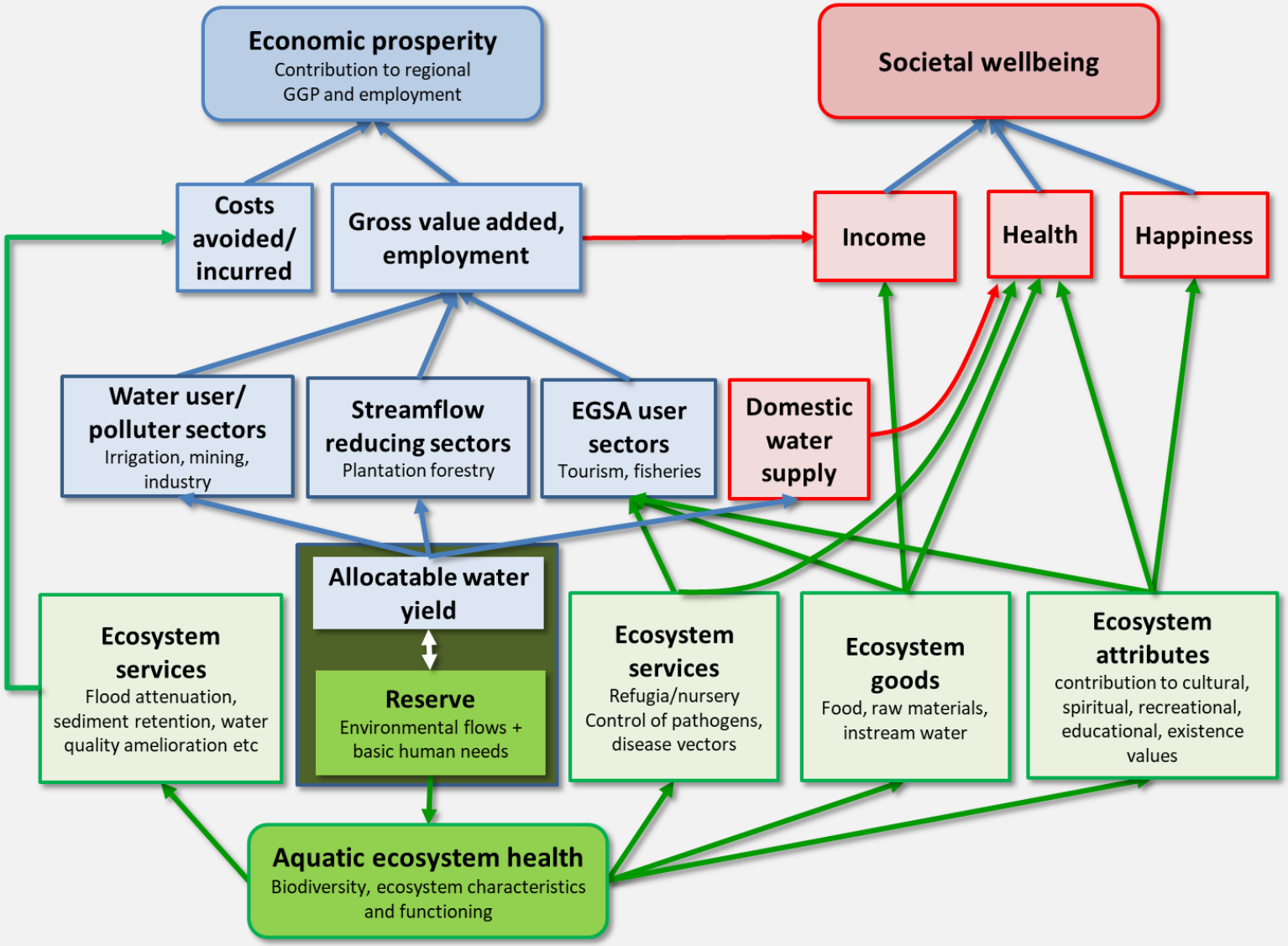
DETERMINING FLOWS & WATER FOR USE

- Models set up to determine how the ecological condition of rivers are predicted to change with changes made to flow in the scenarios
  - Model current day and natural flows
  - Flows required to achieve particular ecological state defined at selected river nodes
  - Includes groundwater and surface water contribution to flow
- Report surpluses and deficit in flow relative to current day

IMPACTS ON WATER QUALITY

- Qualitative assessment
- Based on the relationship between flow and water quality concentrations
- Envisaged changes in flow (Scenarios)
- Continued impacts of point sources and non-point sources

ASSESSING SOCIO-ECONOMIC CONSEQUENCES



- Linkages arising from the trade-off between water abstracted for use and water retained for the ecological Reserve.
- Determine relationship that links change in ecosystem health to a resulting economic value and social wellbeing across the study area.

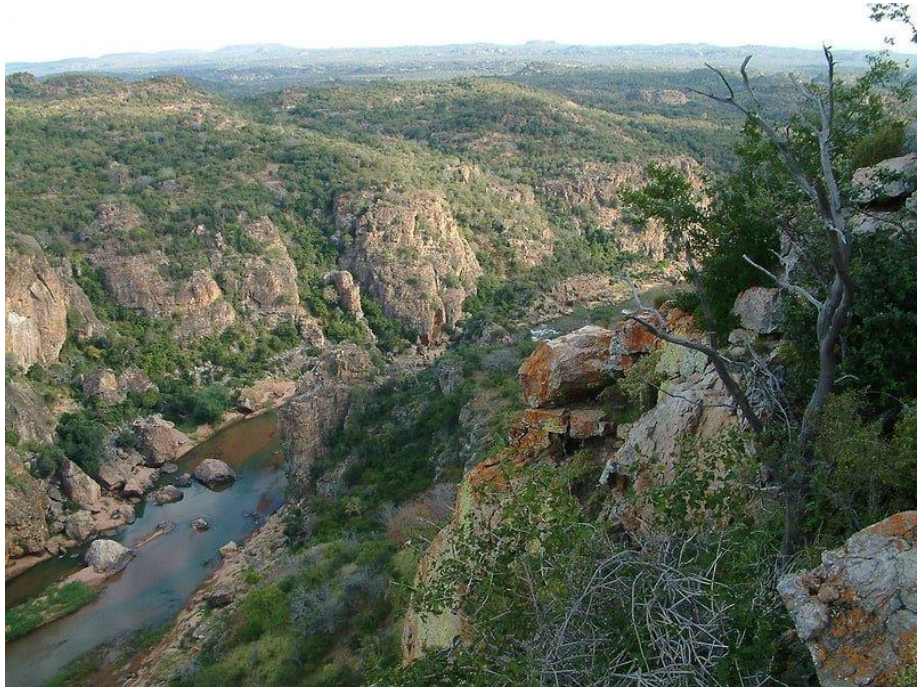
ASSESSING ECOLOGICAL CONSEQUENCES & CAPACITY TO SUPPLY ECOSYSTEM SERVICES

- 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 – will produce simple models
- Models will be used to estimate changes under each scenario, at the level of IUAs.

ASSESSING CHANGE IN ES

These are benefits obtained by people from ecosystems

- Provisioning services:
  - River water for domestic use, wild aquatic resources, wetland contribution to livestock production
- Cultural services:
  - Nature-based tourism
- Regulating services:
  - Carbon, flood attenuation, WQ improvement



BASELINE VALUATION OF ECOSYSTEM SERVICES

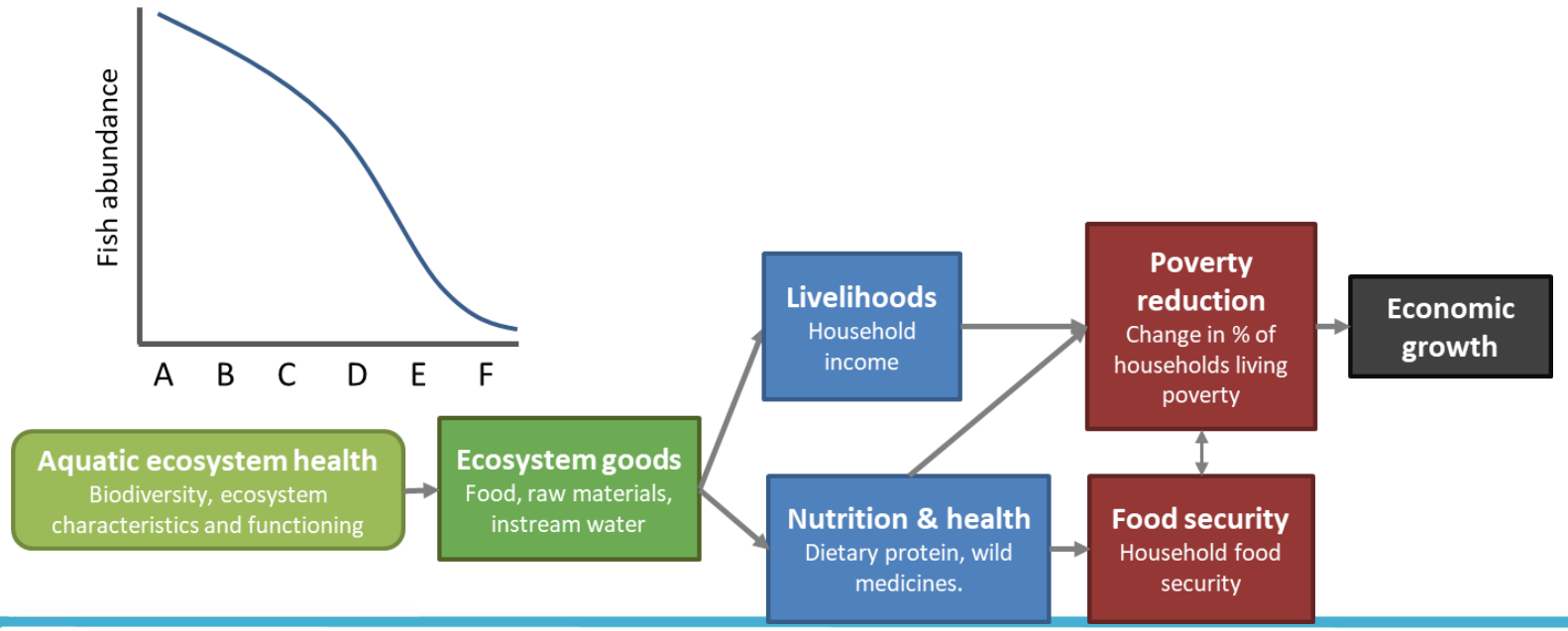
- Tourism important in the north-eastern parts of study area (Kruger & surrounds)
- Provisioning services important in Lower Luvuvhu/Mutale, Upper Sand, Lower Mogalakwena IUAs
- Flood retention service highest in Upper Nyl & Sterk, Lower Luvuvhu/Mutale IUAs

Ecosystem service	Value (R million)
Harvested wild aquatic resources	45.6
Livestock production	96.5
Water for domestic use	37.5
Contribution of rivers to tourism value	203.2
Flood retention	8.5
Carbon storage	18.5
Total	**R411.0**

Nature-based tourism, carbon and provision of aquatic resources likely the most sensitive to changes in ecosystem condition.

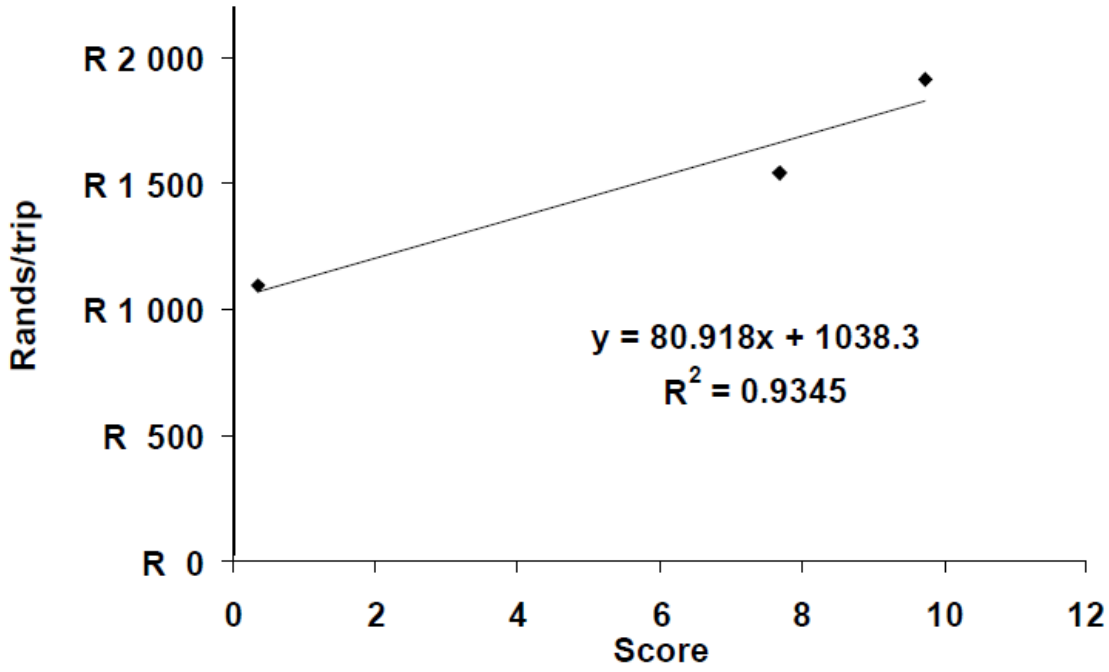
RELATIONSHIP BETWEEN ECOSYSTEM CONDITION AND ECOSYSTEM VALUE

- Changes in capacity to deliver ES estimated based on change in abundance of certain variables that result from a change in EC, e.g., the proportional change in the size of fish populations with a change in ecological condition, linked to flows



RELATIONSHIP BETWEEN ECOSYSTEM CONDITION AND ECOSYSTEM VALUE

- For tourism value, based on Turpie & Joubert (2001) who developed a model to estimate impacts of change in river quality on tourism value
- Here, a change in EC will be related to a change four river attributes (aquatic megafauna, abundance of water birds, riverscape, abundance of riparian trees) to generate a utility score which will be related to a change in visitor expenditure.
- The proportional change between scenarios will be used to generate changes in the overall tourism value of the study area.



ASSESSING ECONOMIC COSTS AND BENEFITS

- Increases or decreases in the costs of meeting water demands over 20-year period
  - Based on deficit/surplus at each node
  - When shortfall identified water supplied from next best, available option
  - Costs based on average costs per m3 of water supplied
- All costs/benefits are summarised as a discounted net present value ($\partial = 6\%$)
- The economic impacts are described in terms of value added to the economy (= contribution to GDP) and employment.

ASSESSING CHANGE IN SOCIETAL WELLBEING

- Particularly difficult to describe and quantify changes in societal wellbeing
- Social impacts of water allocation will come from changes in:
  - employment
  - abundance of harvested resources
  - human health risks as a result of water quality
  - intangible amenity values associated with natural systems.
- Changes to these benefits described mostly in qualitative terms, those that can be quantified in monetary terms (e.g. river water for domestic use) will be.

PROJECT CONTACTS

DWS STUDY MANAGERS

Ms Esther Lekalake
Project Manager: Water Resources Classification
Tel: 012 336 8671
Email: Lekalakee@dws.gov.za

Ms Vuledzani Thenga
Project Manager: Surface Water Reserve Determination
Tel: 012 336 6735
Email: thengav@dws.gov.za

Mr Tichatonga Gonah
Project Manager: Groundwater Reserve Determination
Tel: 012 336 7191
Email: gonaht@dwa.gov.za

STAKEHOLDER ENGAGEMENT OFFICE

Mr Rajesh Manilall
Tel: 012 336 9800
Email:
limpopoolifantswrcs@myraconsulting.co.za

TECHNICAL ENQUIRIES

Ms Adhishri Singh
Project Leader
Myra Consulting (Pty) Ltd
Email: adhishri@myraconsulting.co.za