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

Public meeting – Polokwane

Results for the Ecological Reserve, Water Resource Classes and the Resource Quality Objectives

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WATER IS LIFE - SANITATION IS DIGNITY

water & sanitation

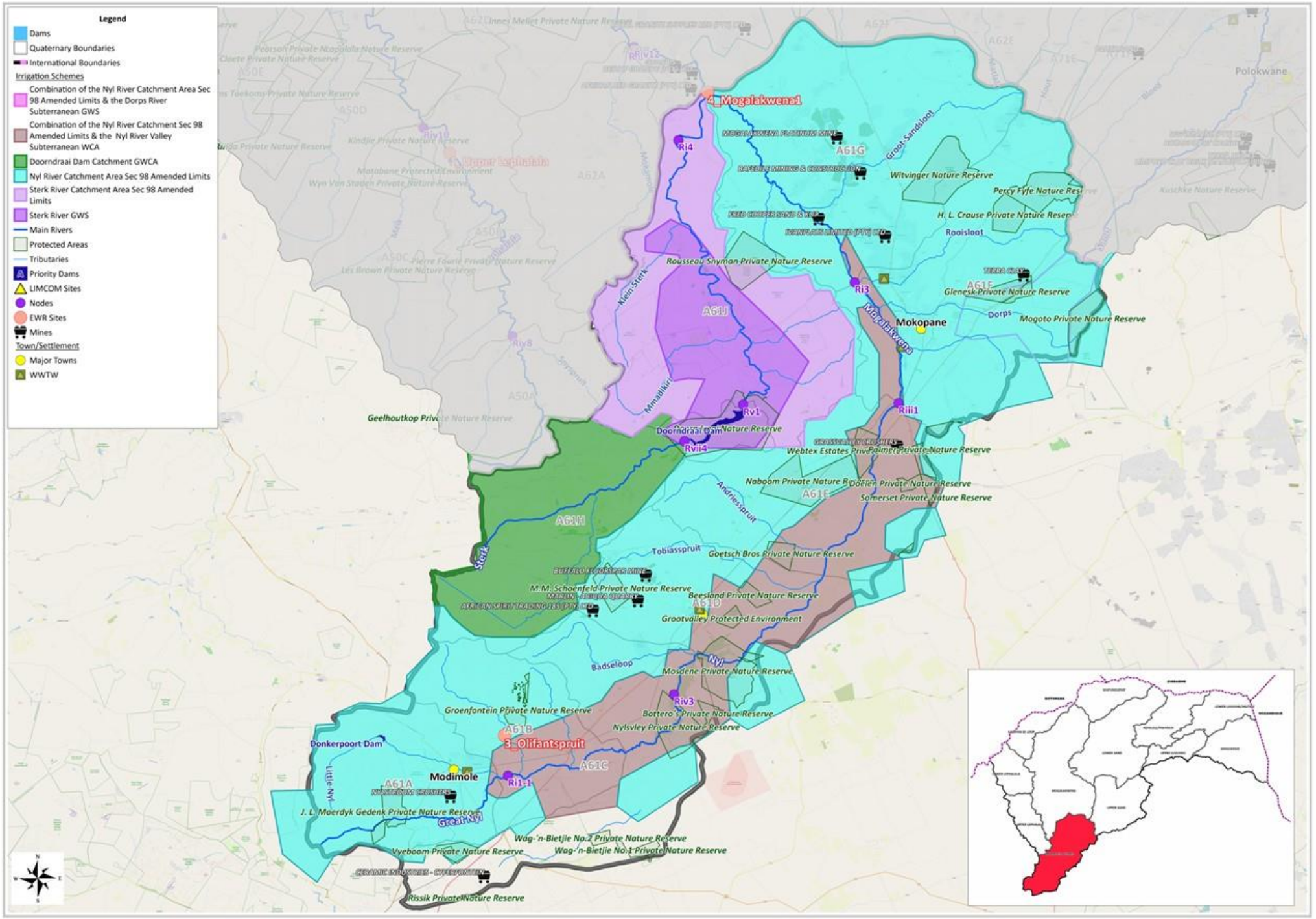
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

2030 NDP

30 YEARS OF FREEDOM
South Africa 1994 - 2024

OUTLINE – Nyl/Sterk IUA – Olifantspruit River site

1. Rivers – Karl Reinecke
2. Dams – Toriso Tlou
3. Wetlands – James MacKenzie
4. Groundwater – Martin Holland



NYL/ STERK \IUA

Outcomes of the Ecological Reserve process

Component	Score	Ecological Category	REC
Water quality	87.3	B	B
Geomorphology	76.0	C	C
Vegetation	57.3	D	C/D
Macroinvertebrates	79.7	B/C	B/C
Fish	76.9	C	B/C
PES score	75.4		
PES category	C		
EIS	MODERATE		
REC	B/C		
Mitigation to achieve REC	Intergovernmental co-operation to manage alien vegetation and sedimentation.		

nMAR	7.815 MCM	
S.Dev.	0.784	
CV	0.100	
Q75	0.0111	
Ecological Category	C	
	MCM	% nMAR
Total EWR	6.002	76.792
Maint. Lowflows	3.385	43.318
Drought Lowflows	1.513	19.354
Maint. Highflows	2.616	33.474

Excludes floods with return period ≥1:2 years.

Monthly Distributions (MCM)

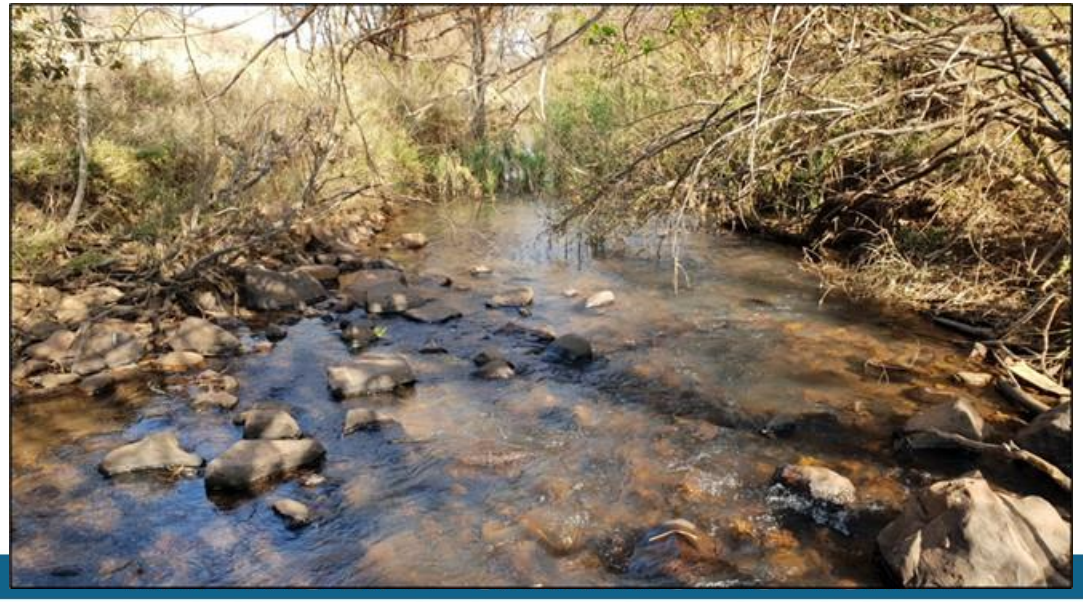
	Natural	Modified Flows (EWR)			
		Lowflows		HighFlows	Total EWR
Month	Mean	Maint.	Drought	Maint.	Maint.
Oct	0.147	0.089	0.059	0.012	0.101
Nov	0.605	0.259	0.130	0.215	0.475
Dec	1.171	0.399	0.194	0.485	0.884
Jan	1.407	0.494	0.222	0.570	1.064
Feb	1.641	0.578	0.235	0.588	1.166
Mar	1.355	0.549	0.219	0.475	1.024
Apr	0.686	0.392	0.158	0.237	0.629
May	0.297	0.229	0.096	0.032	0.261
Jun	0.154	0.132	0.058	0.001	0.133
Jul	0.125	0.103	0.049	0.001	0.103
Aug	0.116	0.087	0.046	0.000	0.087
Sep	0.111	0.075	0.048	0.000	0.075
Total	7.82	3.39	1.51	2.62	6.00

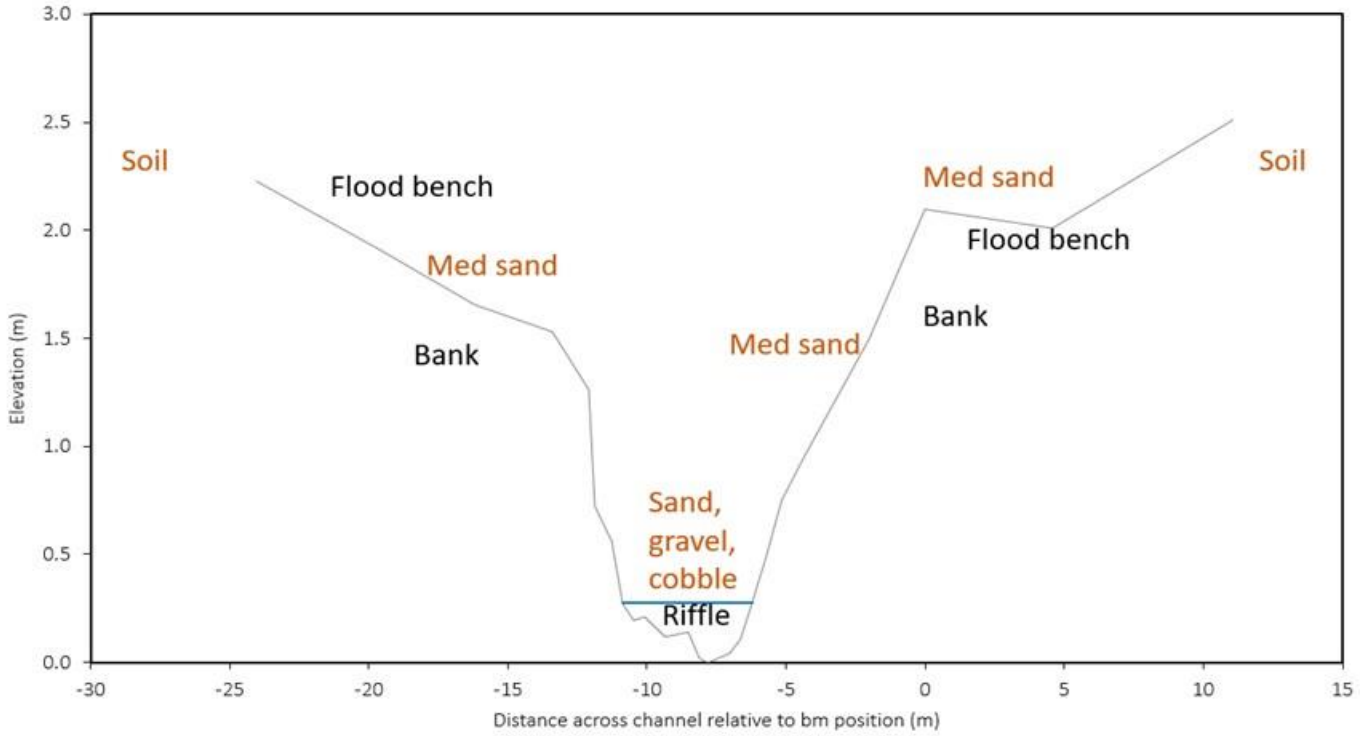
Outcomes of the Classification scenario analysis

- Water resource class II
- Clear invasive exotic plants, curtail further water use

Quat	Node	River	PES	REC	TEC	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Upper Nyl and Sterk IUA																		
A61H	Rvii4	Sterk	E		D	0.421	3.053	3.908	5.843	6.738	2.745	1.695	0.847	0.396	0.349	0.352	0.318	26.67
A61H	Rv1	Sterk	E		D/E	0.064	0.278	2.249	2.735	5.466	1.844	1.203	0.385	0.105	0.104	0.101	0.084	14.615
A61J	Ri4	Sterk	C		C	0.289	0.792	2.046	3.274	7.472	2.715	1.321	0.716	0.513	0.506	0.421	0.363	20.427
A61B	Ri1	Olifantspruit	C	B/C	C	0.143	0.581	1.103	1.359	1.601	1.376	0.745	0.29	0.138	0.106	0.091	0.079	7.607
A61A	Ri1-1	Nyl	C		C	0.478	1.211	1.845	2.473	3.389	2.868	2.077	1.51	1.133	0.889	0.663	0.492	19.032
A61C	Riv3	Nyl	C		C	0.376	1.536	3.002	3.721	4.909	3.985	2.041	0.762	0.362	0.278	0.238	0.206	21.419
A61E	Riii1	Nyl	D		C/D	0.018	1.225	2.97	5.74	8.506	4.15	1.641	0.332	0.023	0	0	0	24.602
A61F	Ri3	Mogalakwena	D		C/D	0.604	2.405	4.519	9.415	14.208	6.496	2.89	1.312	0.892	0.822	0.735	0.681	44.979
A61G	Ri5	Mogalakwena	C	C	C	1.009	3.979	7.893	16.529	27.543	11.28	5.057	2.579	1.819	1.689	1.425	1.229	82.032

RQOs for EWR site 3_Olifantspruit





RQOs Ri1– water quality

Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Salts	Electrical conductivity (EC)	Salt concentrations need to be maintained at levels that is do not adversely affect aquatic ecosystems (C category).	95th percentile EC ≤ 55 mS/m	95th percentile Electrical conductivity greater than 44 mS/m
Nutrients	Total Inorganic nitrogen (TIN)	River nutrient concentrations should be maintained in a mesotrophic state or better (Acceptable category).	Median TIN ≤ 1.75 mg/l	Median TIN greater than 1.40 mg/l
	Orthophosphate (PO_4-P)		Median PO_4-P ≤ 0.075 mg/l	Median PO_4-P greater than 0.060 mg/l
System variables	Dissolved oxygen	Dissolved oxygen concentrations should be such that some oxygen sensitive species are present in the river.	5th percentile Dissolved oxygen concentration ≥ 6 mg/l	Dissolved oxygen concentrations less than 7.2 mg/l
	pH	pH affects aquatic organisms and solubility of metals	6.5 ≤ pH ≤ 8.5	pH between 6.0 - 6.5 or pH between 8.5 - 9.0
	Water temperature	Water temperatures should fall within the reference thermograph (graph of the 95% band of seasonal pattern of minimum and maximum temperatures river).	Water temperature within the reference thermograph (95% band) plus or minus 1 standard deviation	Water temperatures outside of the reference thermograph (95% band) plus or minus 1 standard deviation
Toxins	Ammonia (NH_3-N) Atrazine Endosulfan	Toxicity levels should not pose a threat to river aquatic ecosystems.	Ammonia (NH_3-N) ≤ 44 µg/l (95th percentile) Atrazine ≤ 49 µg/l (95th percentile) Endosulfan ≤ 0.075 µg/l (95th percentile)	95th percentile Ammonia (NH_3-N) greater than 35 µg/l 95th percentile Atrazine greater than 39 µg/l 95th percentile Endosulfan greater than 0.06 µg/l
Pathogens	Escherichia coli (E coli) Faecal coliforms	Concentrations of waterborne pathogens should be maintained in an Acceptable category for contact recreation	E coli / Faecal coliforms ≤ 25 cfu/100ml (95th percentile)	95th percentile E coli / Faecal coliforms greater than 20 cfu/100ml

RQOs – Geomorphology

Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Habitat	Geomorphology	GAI score	Maintain or improve catchment drivers and site impacts. Maintain pool-riffle reach type.	Maintain a GAI PES score of at least a 'C' or > 63%	GAI PES score < 63%
		Bed erosion	Maintain bed elevation in relation to banks and benches	Maintain lowest point along riffle cross-section at < 0.5 m difference in elevation from previous cross-sectional surveys	Riffle bed aggradation or degradation of more than 0.5 m from reference/longer-term average
		Bank erosion	Maintain low to moderate proportion of bank length actively eroding	Maintain active bank erosion below 30% of riverbank length	Active bank erosion of more than 30% of bank length
		Bed sediment size	Maintain riffle sediment size to include largely gravel and cobble	Maintain riffle with mobile sediment in the range of a D50 of 27 mm, D16 of 14 mm and D84 of 55 mm	Riffle dominated by sand or only cobble
		Embeddedness	Maintain low to moderate embeddedness of riffle sediment	Maintain embeddedness of < 25% for riffle sediment	Embeddedness levels of > 25% for 25% of riffle area/sampling points
		Pool depth	Maintain downstream pool with deep open water	Maintain downstream pool with water > 0.5 m deep for > 60% of pool area	Downstream pool is > 60% filled with sediment and forming largely shallow habitat
		Flood bench	Maintain flood benches along one of the banks	Maintain flood bench of > 2 m wide along at least one bank with signs of recent fine sediment deposition	Channel erosion to the extent where there are no benches wider than ~ 2 m and no signs of recent fine sediment deposition on the benches

RQOs – Riparian Vegetation

Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Riparian vegetation	Marginal zone	Dominant vegetation	Non-woody vegetation should dominate the marginal zone	Non-woody cover >= 20% (aerial cover).	Non-woody cover less than 20%
		Key species	*Phragmites australis*, *Juncus dregeanus* and *Juncus oxycarpus*.	3 listed species present.	Absence of 1 or more listed species
		Alien plant species	The riparian vegetation structure and composition in the marginal zone should maintain desired dominance and non-dominance.	Perennial alien plant species <= 20% (aerial cover).	Presence of perennial alien plants
		Terrestrial woody cover		No terrestrial woody plants.	Presence of terrestrial woody species
		Indigenous woody cover		Woody cover <= 10% (aerial cover).	Woody cover more than 10%
		Non-woody cover		Non-woody cover >= 20% (aerial cover).	Non-woody cover less than 20%
		Reed cover		Reed cover <= 30% (aerial cover).	Reed cover more than 20%
	Non-marginal (upper - banks)	Dominant vegetation	Woody vegetation should dominate the macro-channel banks	Woody cover >= 40% (aerial cover).	Woody cover less than 40%
		Alien plant species	Alien invasive plant species should be kept low or absent on macro-channel banks	perennial alien plant species <= 50% (aerial cover).	Cover by alien plants more than 50%
	Riparian zone	PES	The PES category should be a D at least	VEGRAI score >= 42%	VEGRAI score < 42%
		Species richness	Indigenous plant species richness in the riparian zone should be maintained.	>= 20 indigenous species.	Less than 20 indigenous plant species present
		Endemic riparian species	*Combretum erythrophyllum* (southern African endemic) must be present.	1 listed species present.	Absence of 1 or more listed species

RQOs – Fish

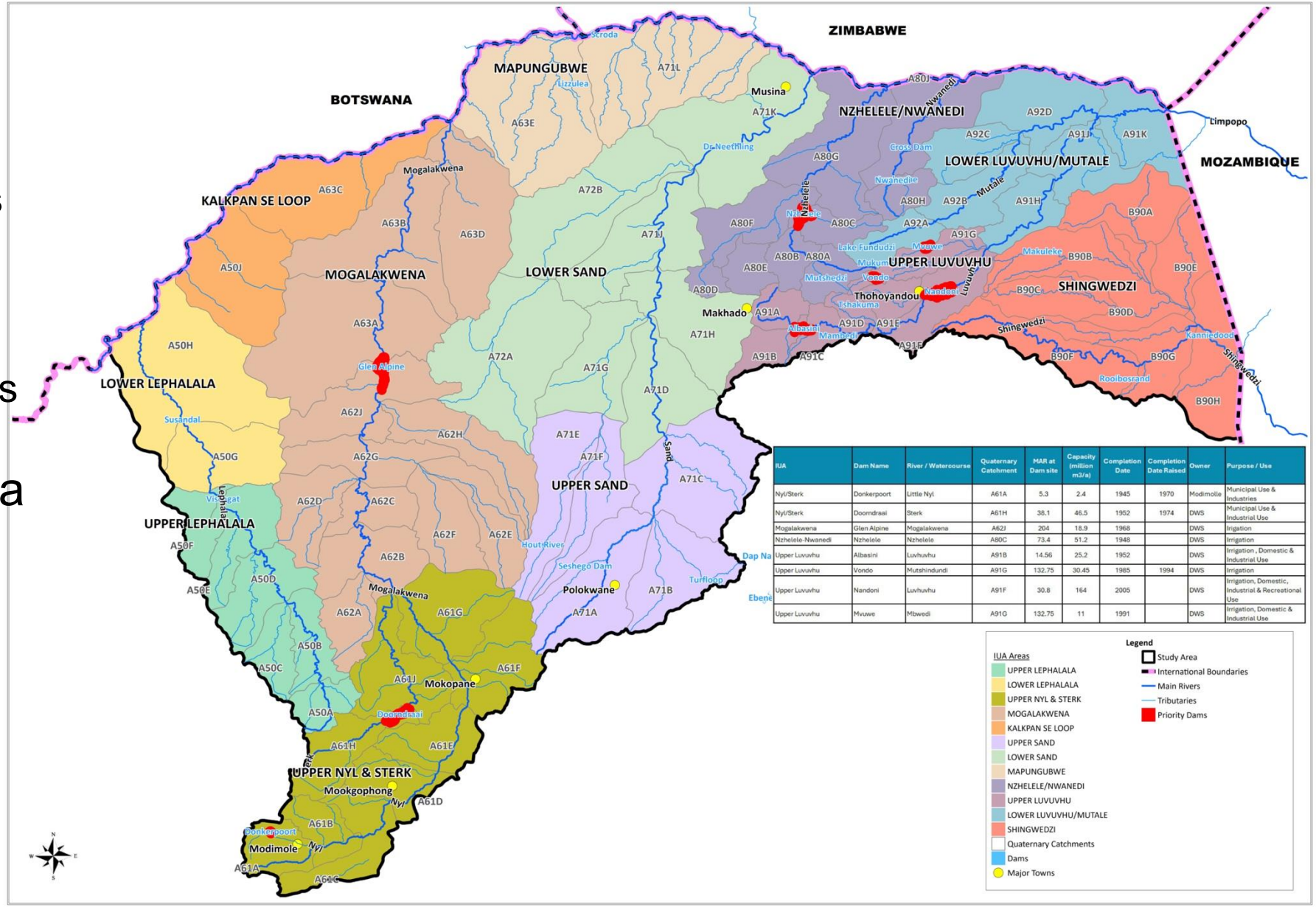
Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Biota	Fish	FRAI score	The Ecological Category should be maintained within a B/C Category, using reference data used for the EWR studies	FRAI to be maintained within the range of a B/C category (>77%)	A FRAI score that calculates to a PES category less than B/C for two or more consecutive surveys
		Overall fish health	Fish generally healthy (no ulcerative bacterial infections, and limited parasite burden)	Bacterial infections and/or parasitic burdens must impact <1% of the fish population	Bacterial infections and/or parasitic burdens impacting >1% of the fish population during any survey
		Species diversity	To maintain suitable habitat conditions that would support the key species.	Maintain the diversity of species as per EWR studies	Loss of species diversity that results in a drop in PES category
		Key species	To maintain suitable flow conditions to support the key species identified at the site.	Presence/absence records.	The absence of any of the target species for two or more consecutive surveys
				Relative abundance of species (values indicated in parenthesis):	
				Labeobarbus marequensis (2), Labeo cylindricus (1), Chiloglanis pretoriae (2), Enteromius bifrenatus (2)	

RQOs – Macroinvertebrates

Component	Sub-component	Indicator	RQO Narrative	RQO Numerical	TPC
Biota	Macroinvertebrates	MIRAI Category and Score	The Ecological Category should remain within a minimum of a B/C Category.	To ensure that the MIRAI score remains within the range of a B/C category (>78 - ≤82 %), using the same reference data used in the EWR study.	A MIRAI score of 80% or less.
		SASS5 Total Score and ASPT	To ensure that the SASS scores attained, support the specified Ecological Category.	To ensure that the SASS5 scores and ASPT values occur in the following range: SASS5 score: >140; ASPT value: >6.1.	SASS5 scores less than 145 and ASPT less than 6.2.
		Key taxa and abundance	To maintain suitable flow velocity (>0.6m/s) and to maintain clean, unembedded surface area (cobbles) to support the following flow-dependent taxa:	Minimum abundance of an A attained.	If Simuliidae is missing in two consecutive surveys or has a single individual present in two consecutive surveys.
			Simuliidae		
			To maintain sufficient quality and quantity of inundated vegetation to support the following vegetation-dwelling taxon:	Minimum abundance of an A attained.	Coenagrionidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.
			Coenagrionidae		
			To maintain sufficient quantity and quality of Gravel, sand and mud (GSM) habitat to support Gomphidae.	Minimum abundance of an A attained.	Gomphidae missing in two consecutive surveys or has a single individual present in two consecutive surveys.

PRIORITISATION OF DAMS

- Dams selection criteria
  - Water use sectors dependent on the dams
  - Impact of upstream use on inflows
  - Importance to downstream water users
  - Water quality
- Dams are operated as a system – 3 main systems
  - Mogalakwena
  - Nzhelele/Nwanedi
  - Luvuvhu system
-



IUA	Dam Name	River / Watercourse	Quaternary Catchment	MAR at Dam site	Capacity (million m3/a)	Completion Date	Completion Date Raised	Owner	Purpose / Use
Nyl/Sterk	Donkerpoort	Little Nyl	A61A	5.3	2.4	1945	1970	Modimolle	Municipal Use & Industries
Nyl/Sterk	Doorndraai	Sterk	A61H	38.1	46.5	1952	1974	DWS	Municipal Use & Industrial Use
Mogalakwena	Glen Alpine	Mogalakwena	A62J	204	18.9	1968		DWS	Irrigation
Nzhelele-Nwanedi	Nzhelele	Nzhelele	A80C	73.4	51.2	1948		DWS	Irrigation
Upper Luvuvhu	Albasini	Luvhuvhu	A91B	14.56	25.2	1952		DWS	Irrigation , Domestic & Industrial Use
Upper Luvuvhu	Vondo	Mutshindundi	A91G	132.75	30.45	1985	1994	DWS	Irrigation
Upper Luvuvhu	Nandoni	Luvhuvhu	A91F	30.8	164	2005		DWS	Irrigation, Domestic, Industrial & Recreational Use
Upper Luvuvhu	Mvuwe	Mbwedi	A91G	132.75	11	1991		DWS	Irrigation, Domestic & Industrial Use

RQOS FOR DAMS – WATER QUANTITY

- Water Quantity / availability and requirements
  - Determined by undertaking an Annual Operating Analysis of the system provided by the dam
  - AOA determines the amount of water that can be
    - released for the EWR to meet the base flows
    - supplied sustainably & equitably to the water use sector dependent over the coming hydrological year being considered
  - Water Restrictions
    - Where the water available to carry over to the next hydrological cycle
    - Restrictions will be implemented based on priority classification approved at the system operating forum
- Directorate: System Analysis
  - Responsible for determining the releases required in each hydrological year depending on the starting storage level of each dam
  - Monthly monitoring of projected releases for the EWR

RQOS FOR MOGALAKWENA SYSTEM– WATER QUANTITY

Objective	Task ID	Task	Description of Task	Unit of Measure	Data Source
Maintain theDam storage capacity to meet the releases to meet Base Flows	1	**Starting Storages at beginning of hydrological year (1 April)**	Establish the starting storage of the dam level	% of storage capacity	Use of SAWS data and SARCOF for weather outlook prediction & application
	2	**Short term Characteristic Curve of Dam**	Determine the short-term characteristic curves (STCCs) -	Volume of water available at different assurance levels for a given starting period	Water Resource Yield Model
	3	**User priority classification of the dam incl. EWR releases**	Review and Update the User categories for each system to include the EWR & International Obligations	Priority classification table	Annual Operating Analysis
	4	**Curtailment Curve**	Apply the STCCs to the starting storage to determine the water allocations that can be supplied to each user sector with EWR a priority user	Graphical plot of starting storage level vs factor of water allocation to be supplied for the hydrological year	Hydrological Drought Analysis Model (HDAM)
	5	**Stakeholder Participations**	Engage with the System Operating Forum (SOF) on the proposed releases for the hydrological year (including releases for the EWR)	Avoid dam storage level going down below the percentage to carryover to the next hydrological cycle. Review at 1 Nov- projected runoff	N/A

RQOS FOR MOGALAKWENA SYSTEM– Priority Classification

User Category	Portion of water supply within indicated priority class and associated recurrence interval of failure (years) and annual assurance of supply				
	High 1:100 (99%)	Medium High 1:50 (98%)	Medium Low 1:20 (95%)	Low 1:10 (90%)	Total
Domestic	60%	0%	30%	10%	100%
Irrigation	0%	30%	30%	10%	100%
Industry	80%	0%	10%	10%	100%
Curtailment Level	4	3	2	1	-

Current priority classification

Category /Water User	Priority Classification				
	Low	Medium Low	Medium	High	
	90% Assurance (1 in 10 years)	95% Assurance (1 in 20 years)	98% Assurance (1 in 50 years)	99% Assurance (1 in 100 years)	To
Domestic & Urban	10%	30%	0%	60%	
Irrigation	10%	30%	30%	30%	
Mining, Industries & Power Generation	10%	10%	0%	80%	
EWR	20%	0%	0%	80%	
Return Flows					
Curtailment Level	**0**	**1**	**2**	**3**	**4**

- Preliminary EWR determined in the LNRS
  - Not included in the priority classifications of the dams in Mogalakwena
  - Currently not being implemented
- For the gazetted EWR maintenance flows
  - Need to determine RI
  - Include into the priority classification
- System operating forum should include the EWR in the operation of the two dams

RQOS FOR MOGALAKWENA SYSTEM– Recommended EWRs

	10	20	30	40	50	60	70	80	90	99
Oct	1.023	0.932	0.787	0.694	0.612	0.491	0.414	0.338	0.285	0.278
Nov	5.365	1.494	0.804	0.686	0.602	0.497	0.402	0.333	0.332	0.332
Dec	6.616	3.084	1.849	0.759	0.631	0.514	0.416	0.347	0.3	0.265
Jan	9.232	4.167	2.216	1.92	0.729	0.531	0.426	0.351	0.304	0.275
Feb	7.72	3.405	2.1	1.108	0.603	0.461	0.374	0.319	0.283	0.261
Mar	3.745	2.479	1.29	0.855	0.669	0.52	0.427	0.354	0.339	0.338
Apr	1.957	1.255	0.936	0.753	0.624	0.498	0.411	0.341	0.328	0.328
May	1.378	1.074	0.839	0.717	0.626	0.514	0.416	0.352	0.302	0.271
Jun	1.071	0.939	0.78	0.686	0.603	0.497	0.402	0.339	0.292	0.256
Jul	1.051	0.946	0.803	0.705	0.623	0.514	0.416	0.351	0.302	0.26
Aug	1.025	0.936	0.794	0.701	0.621	0.513	0.416	0.346	0.295	0.253
Sep	0.986	0.904	0.758	0.67	0.598	0.495	0.4	0.327	0.265	0.22
Total	**41.169**	**21.615**	**13.956**	**10.254**	**7.541**	**6.045**	**4.92**	**4.098**	**3.627**	**3.337**

EWR Monthly Rule curve – Doorndraai

EWR Monthly Rule curve – Glen Alpine

nMAR	188.946	MCM			
S.Dev.	15.804				
CV	0.084				
Q75	0.2848				
Ecological Category	**C**				
	MCM	% nMAR	Excludes floods with return period ≥1:2 years.		
Total EWR	43.439	22.99			
Maint. Lowflows	39.096	20.692			
Drought Lowflows	26.707	14.135			
Maint. Highflows	4.343	2.299			

Monthly Distributions (MCM)

	Natural	Modified Flows (EWR)			
		Low flows		High flows	Total EWR
Month	Mean	Maint.	Drought	Maint.	Maint.
Oct	3.417	0.487	0.741	0.107	0.594
Nov	13.305	2.12	1.02	0.135	2.255
Dec	18.652	2.557	1.951	0.313	2.87
Jan	31.569	3.906	3.485	0.758	4.663
Feb	52.951	10.47	4.785	0.495	10.965
Mar	26.374	9.273	4.619	0.606	9.879
Apr	15.229	4.486	2.522	0.658	5.143
May	8.955	2.496	2.082	0.629	3.125
Jun	5.898	1.351	1.632	0.367	1.717
Jul	4.964	1.104	1.552	0.183	1.287
Aug	4.168	0.546	1.266	0.057	0.603
Sep	3.464	0.3	1.054	0.038	0.338
Total	**188.95**	**39.1**	**26.71**	**4.34**	**43.44**

Doorndraai Dam – RQOs for quality

Sub-component	Indicator/Measure	RQO Narrative	RQO Numerical	TPC
Nutrients	Total Phosphates (mg/l) Chlorophyll a (µg/l)	Maintain Doorndraai Dam in a mesotrophic state or better (intermediate levels of nutrients, fairly productive in terms of aquatic animal and plant life and showing emerging signs of water quality problems) in order to protect bulk water provision (municipal and industrial water supply) and mitigate drinking water treatment costs.	Median annual Total Phosphates ≤ 0.047 mg/l Median annual Chlorophyll a ≤ 20 µg/l	Median annual Total Phosphates greater than 0.038 mg/l Median annual Chlorophyll a greater than 16 µg/l
Salts	Electrical Conductivity (EC) (mS/m) Total dissolved salts (TDS) (mg/l)	Salt concentrations must be maintained at a level that is not harmful to aquatic ecosystems in the dam and is in an Acceptable fitness for use state for domestic and industrial water supply, and for irrigation water supply.	95th percentile EC ≤ 90 mS/m 95th percentile TDS ≤ 585 mg/l	95th percentile EC greater than 72 mS/m 95th percentile TDS greater than 468 mg/l
Pathogens	Escherichia coli, Faecal coliforms	Doorndraai Dam must be maintained in an Acceptable microbiological state that is safe for contact recreational user.	95th percentile E coli / Faecal coliforms ≤ 15 cfu/100ml	95th percentile E coli / Faecal coliforms greater than 20 cfu/100ml

Doorndraai Dam – RQOs for biota

Componer	Sub-component	Indicator/Measure	RQO Narrative	RQO Numerical	TPC
Biota	Fish	Maintenance of fish species diversity	Maintain fish abundance at a level that fulfils ecosystem services roles of recreational angling and subsistence harvesting	Balanced relative abundance and diversity between Cichlidae, Cyprinidae and Clariidae	A notable dominance of one family of fish over two or more consecutive assessments
		Fish health	Fish health to be maintained in a state that is safe for consumption and suitable for recreational angling	Ulcers, bacterial infections and parasite burdens limited to <1% of fish population	>1% of the catch being impacted by bacterial infections or overburden of parasites
		Fish abundance	Maintaining fish abundance to support subsistence and recreational fishing	Maintain a stable catch per unit effort relative to previous surveys	A notable decline in fish population abundance over more than two assessments
	Alien aquatic plant species	Water Quality (Nutrients)	Maintain Doorndraai Dam in a mesotrophic state or better	Median annual Total Phosphates ≤ 0.047 mg/l	Median annual Total Phosphates greater than 0.038 mg/l
				Median annual Chlorophyll a ≤ 20 µg/l	Median annual Chlorophyll a greater than 16 µg/l
		Aerial extent	Maintain low % aerial cover of AIP (Water Hyacinth, Water Lettuce, Water Fern, Kariba Weed, Parrot's Feather) on dam surface and fringe	Maintain aerial cover of AIP on dam surface below 10%	The presence of AIP species on the dam surface or along the fringe