water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

INKOMATI NWRCS

CONSEQUENCES OF SCENARIOS & RECOMMEND MANAGEMENT CLASSES: SAND (X_3) RIVER

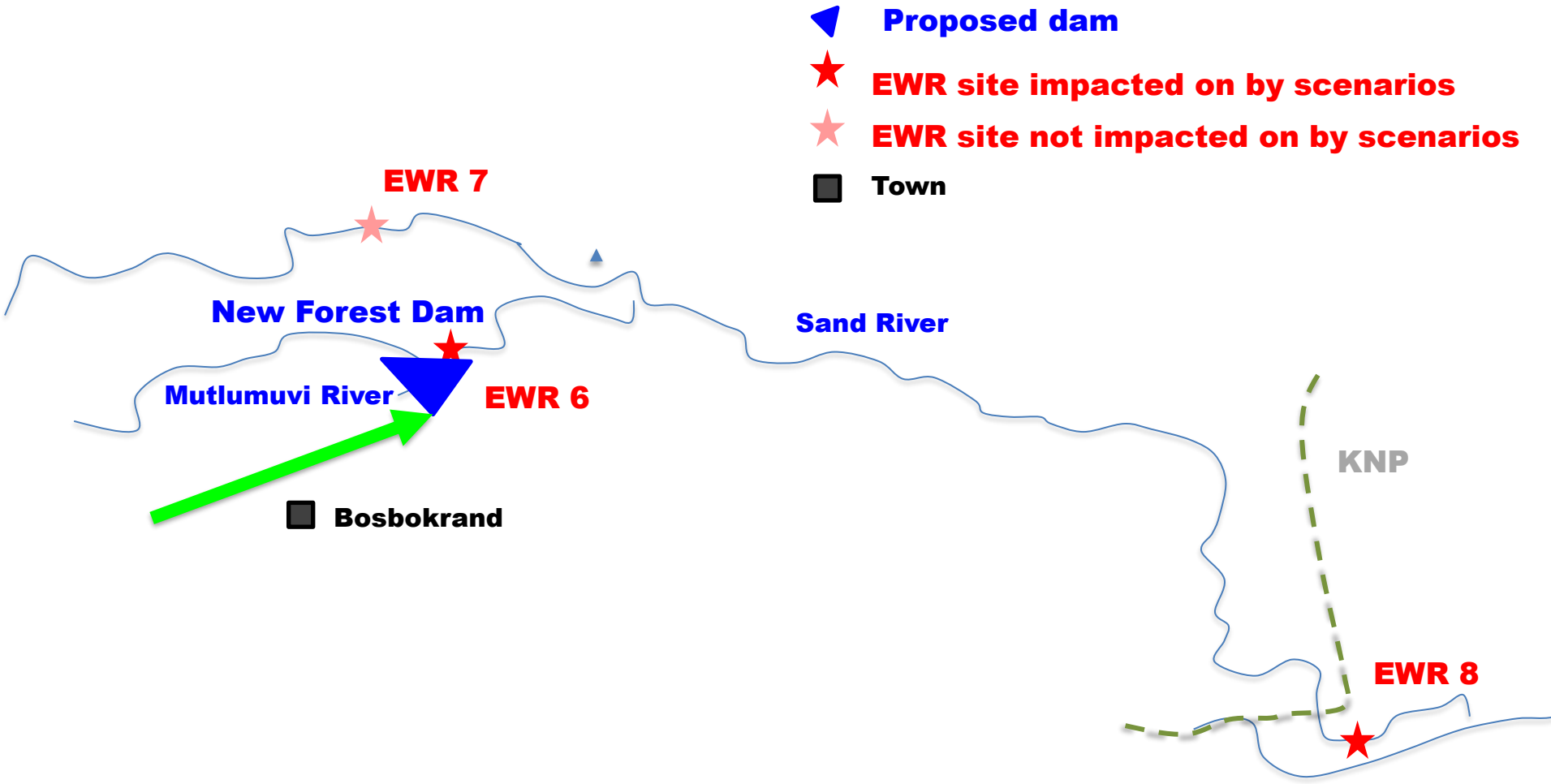
- Ecology
- Water quality
- Ecosystem Services
- Economics
- Management classes

24 November 2014

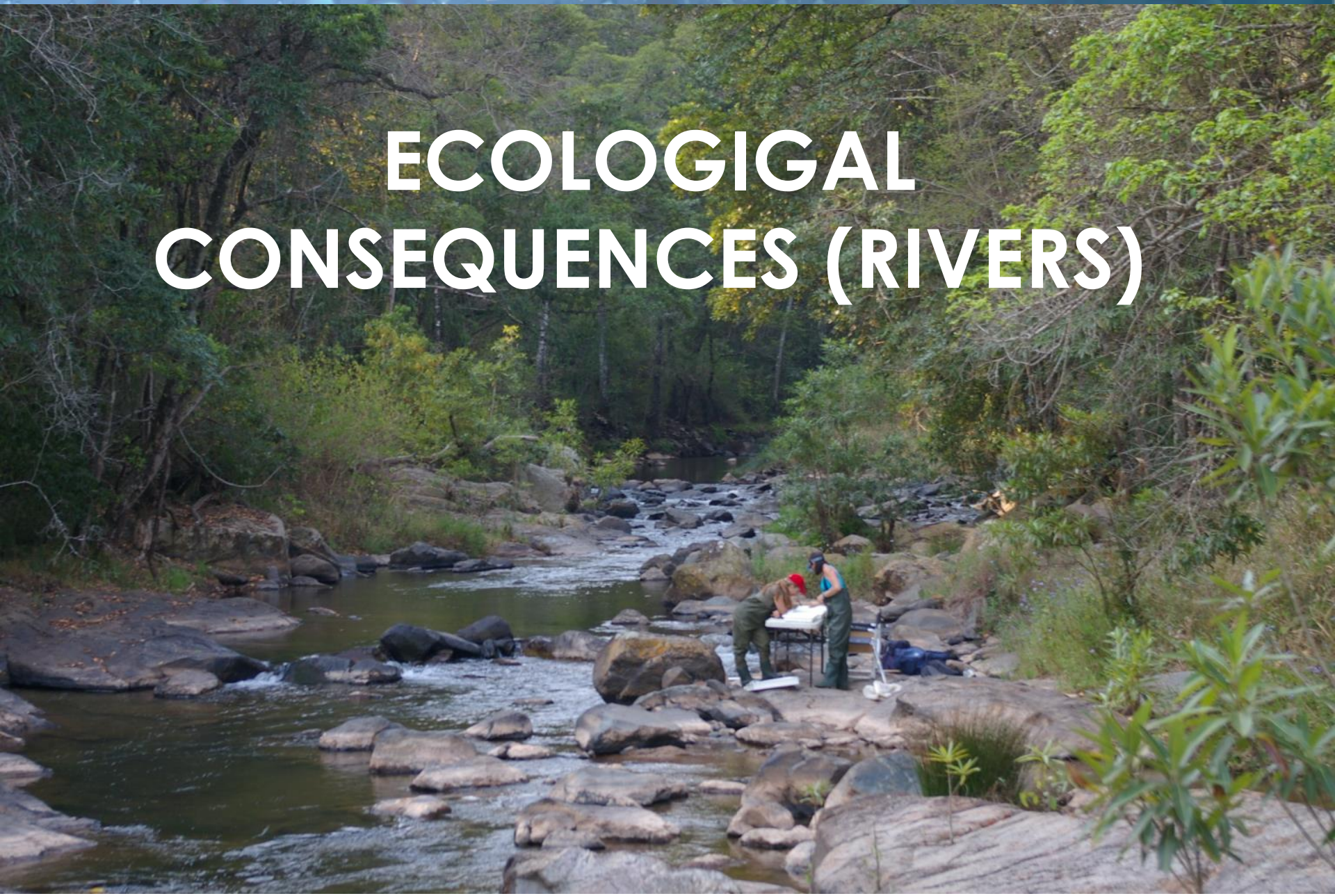
SAND RIVER (X3) RESULTS

SCENARIOS ONLY IMPACT ON SITES ON MUTLUMUVI AND DOWNSTREAM SAND:

- EWR S6 (Mutlumuvi DS of proposed New Forest Dam)
- EWR S8 (Sand River just before confluence with the Sabie River)


Proposed dam
EWR site impacted on by scenarios
EWR site not impacted on by scenarios
Town
EWR 7
New Forest Dam
Sand River
Mutlumuvi River
EWR 6
KNP
Bosbokrand
EWR 8

ECOLOGIGAL CONSEQUENCES (RIVERS)

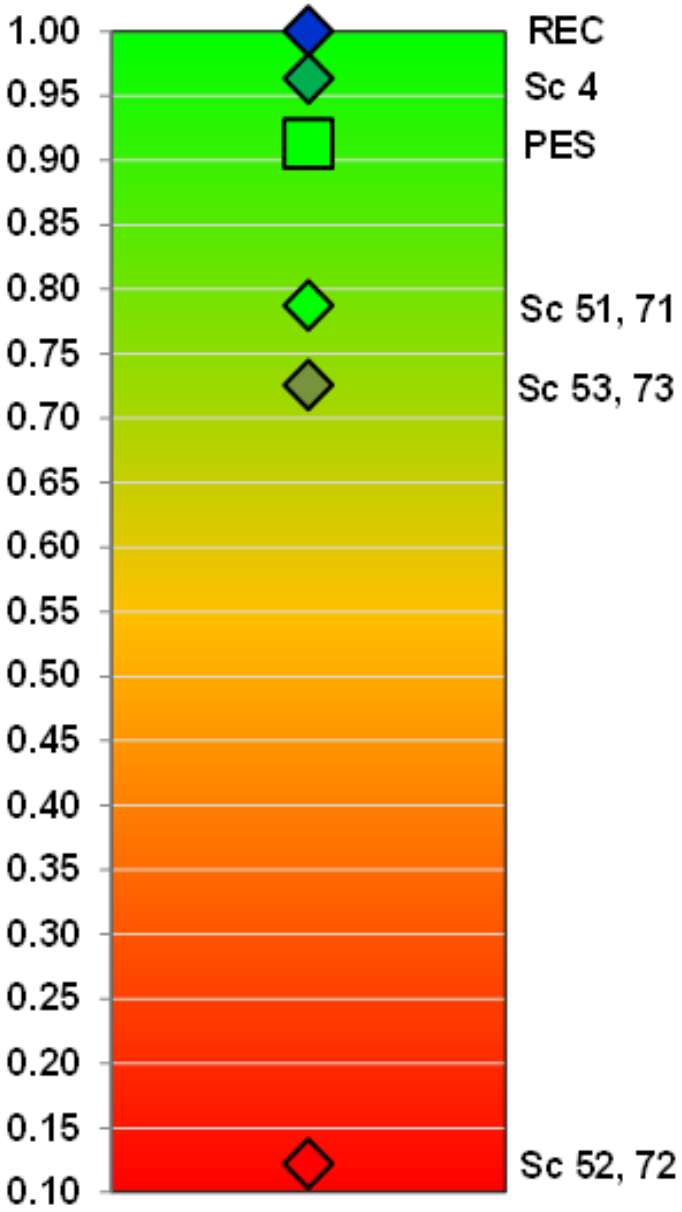


EWR S6: Scenario ranking

Component	PES	REC	Sc 4	Sc 51, 71	Sc 52, 72	Sc 53, 73
Physico chemical	B/C	B/C	B/C	C	F	C
Geomorphology	C	C	C	D	F	D
Fish	C	B	B/C	C/D	F	D
Invertebrates	B/C	B	B	C	F	C/D
Riparian vegetation	C	B	B/C	C	F	C/D
EcoStatus	C	B	B/C	C	F	C/D

- Sc 72 – worst case, river will barely ever flow.
- Low flows & floods decrease under Sc 71 & 73
- Results in degradation of geomorph & water quality and
- Degradation of instream habitat for fish and invertebrates.

EWR S6: Component ecological consequences



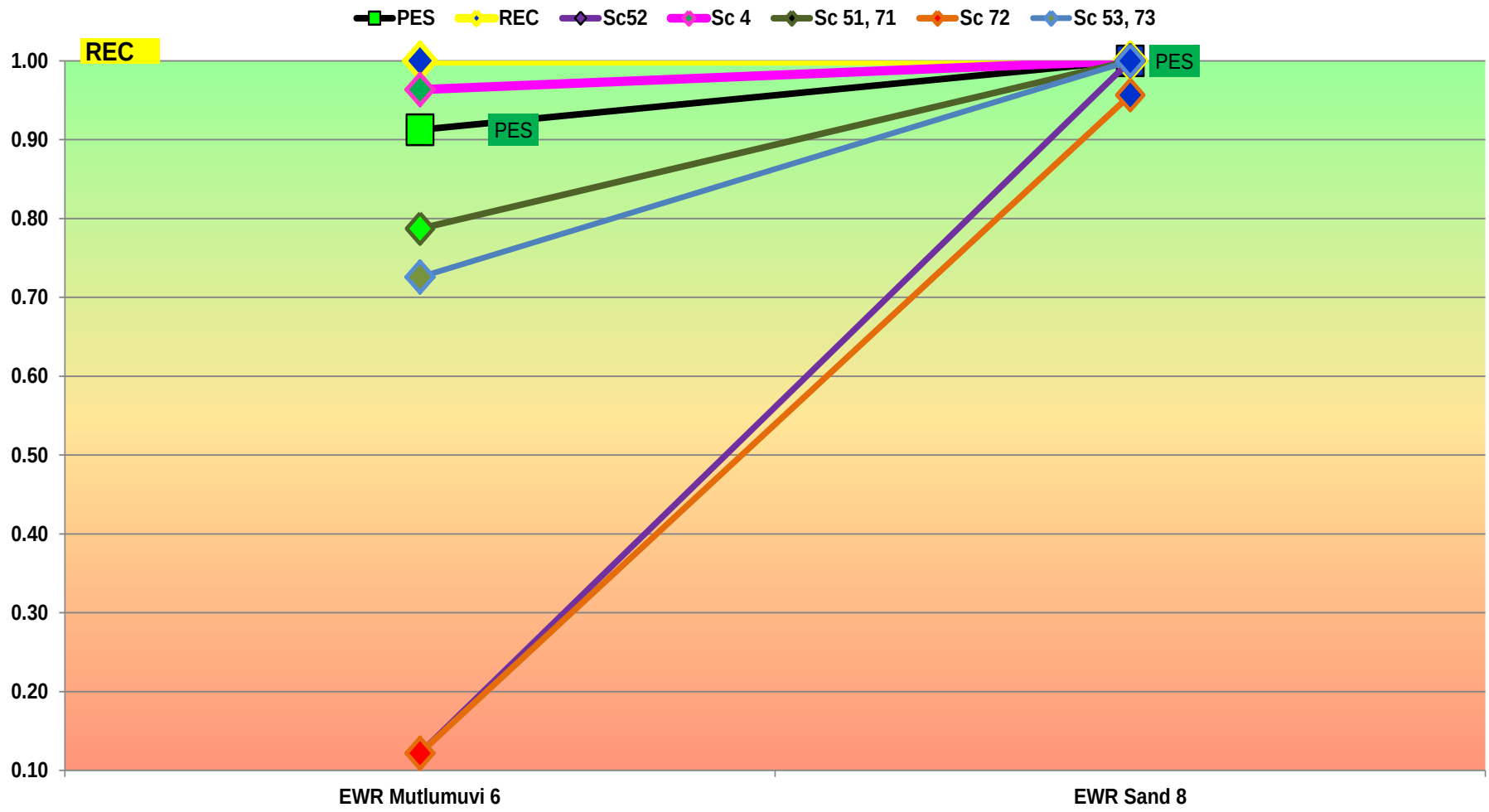
- None of scenarios meet REC.
- Sc 71(dam +REC) maintains PES, but geomorph and fish not.
- Sc 73 (dam +PES) – deterioration in the PES.
- Sc 72 – includes no EWR release, dry river, worst case.

EWR S8: Scenario ranking

Component	PES	REC	Sc 4, 51, 52, 53, 71, 73	Sc 72
Physico chemical	B	B	B	B/C
Geomorphology	C	C	C	C
Fish	B	B	B	B
Invertebrates	B	B	B	B/C
Riparian vegetation	B	B	B	B
EcoStatus	B	B	B	B

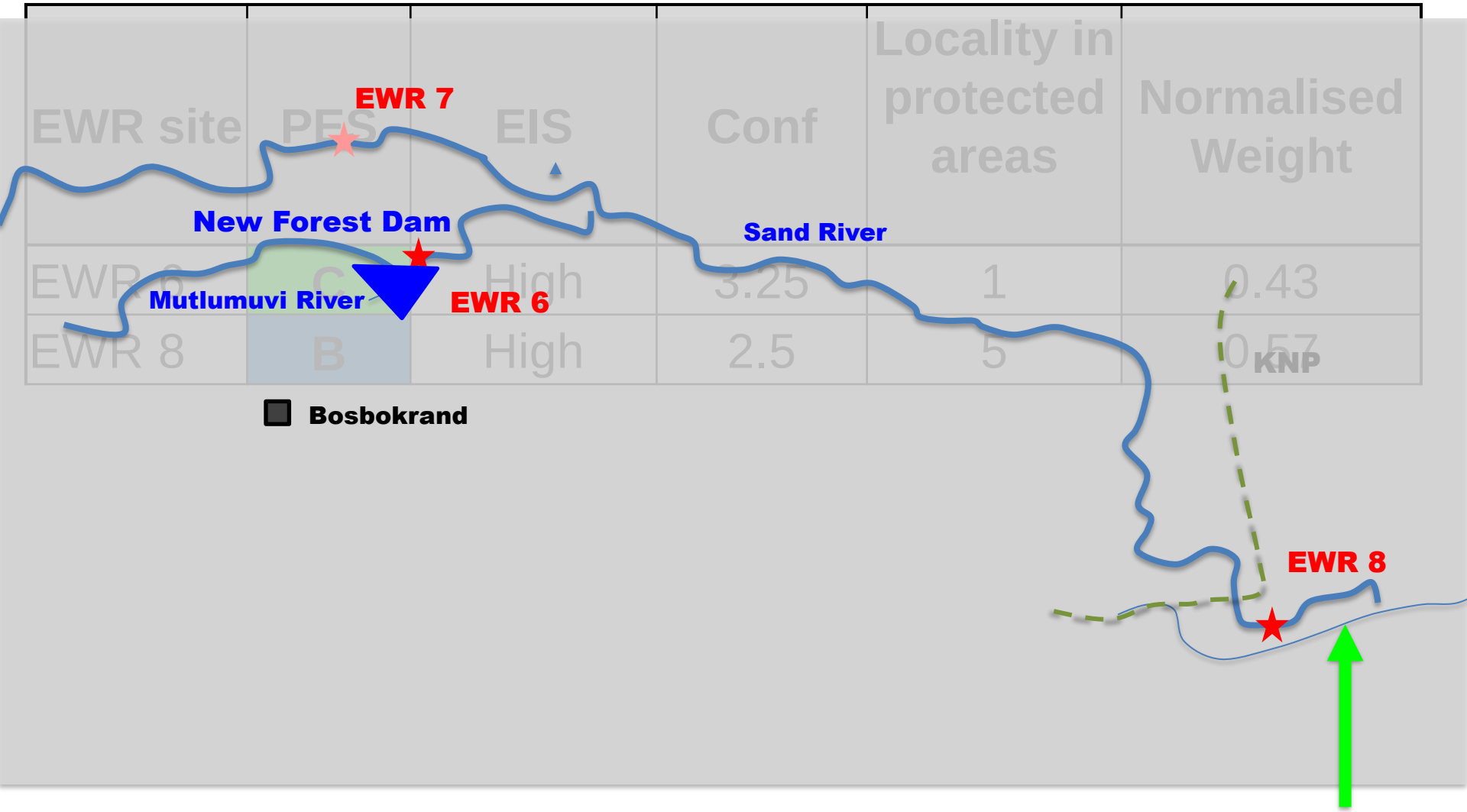
- No impact except for Sc 72.

SAND RIVER: INTEGRATED CONSEQUENCES

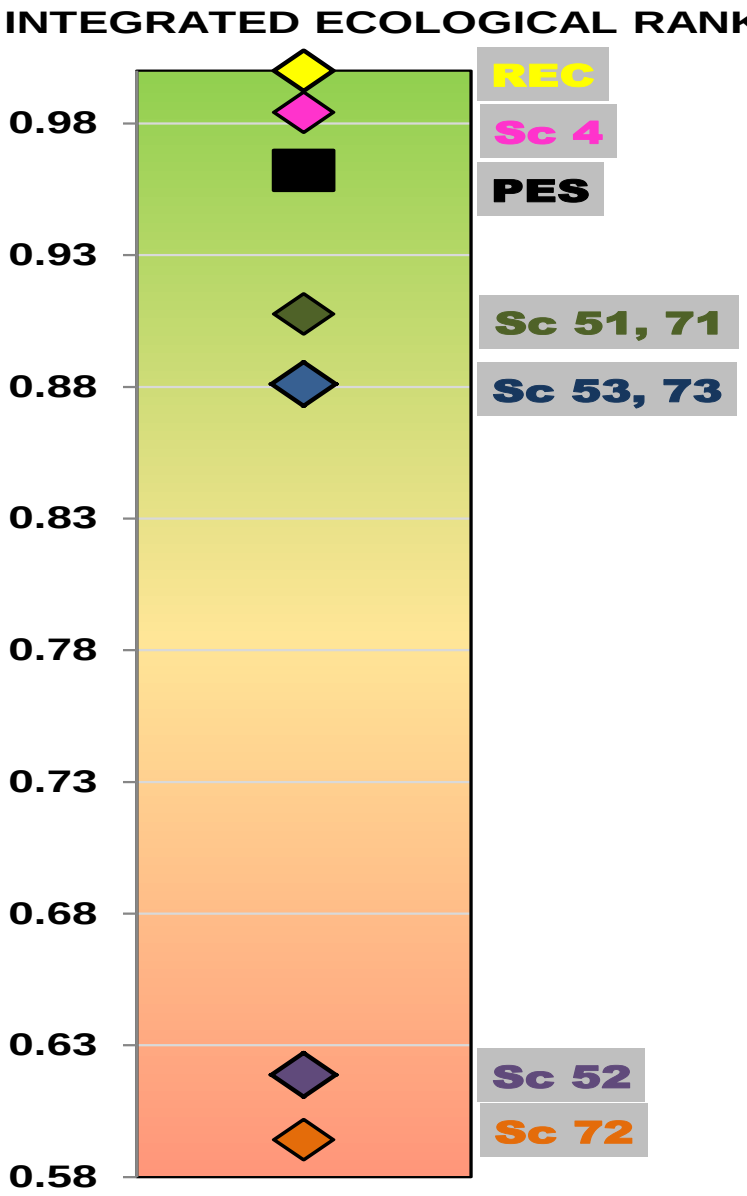


SAND RIVER: SITE WEIGHTING

EWR site	PES	EIS	Conf	Locality in protected areas	Normalised Weight
EWR 6	C	High	3.25	1	0.43
EWR 8	B	High	2.5	5	0.57



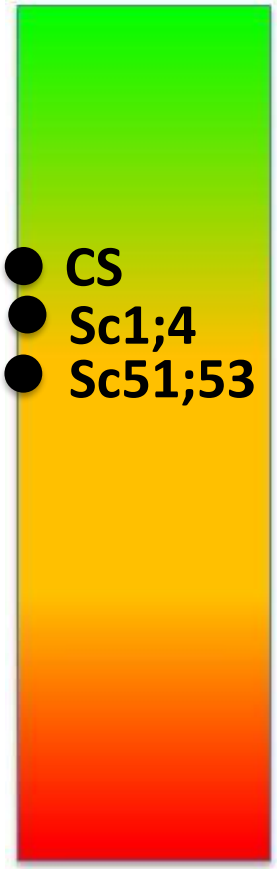
SAND RIVER: INTEGRATED RANKING



- Sc 72 not viable – change to seasonal system.
- Sc 4 best option but include unrealistic return flows.
- Sc 71 best option but biggest impact on yield.
- Sc 73 to be investigated further.

USER WATER QUALITY CONSEQUENCES (RIVERS)

SABIE-SAND SYSTEM



- CS
- Sc1;4
- Sc51;53

Site location

MRU Mut A, incl EWR 6 on the Mutlumuvi River

Primary role players

Settlements, irrigation return flows

Primary wq drivers

Nutrients, salts, toxics, *E. coli* / coliforms, turbidity

Site location

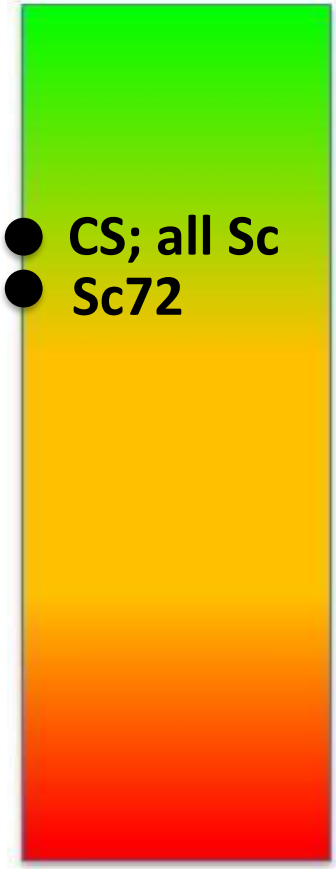
MRU Sand B, incl EWR 8 on the Sand River

Primary role players

Thulamahashe WWTW

Primary wq drivers

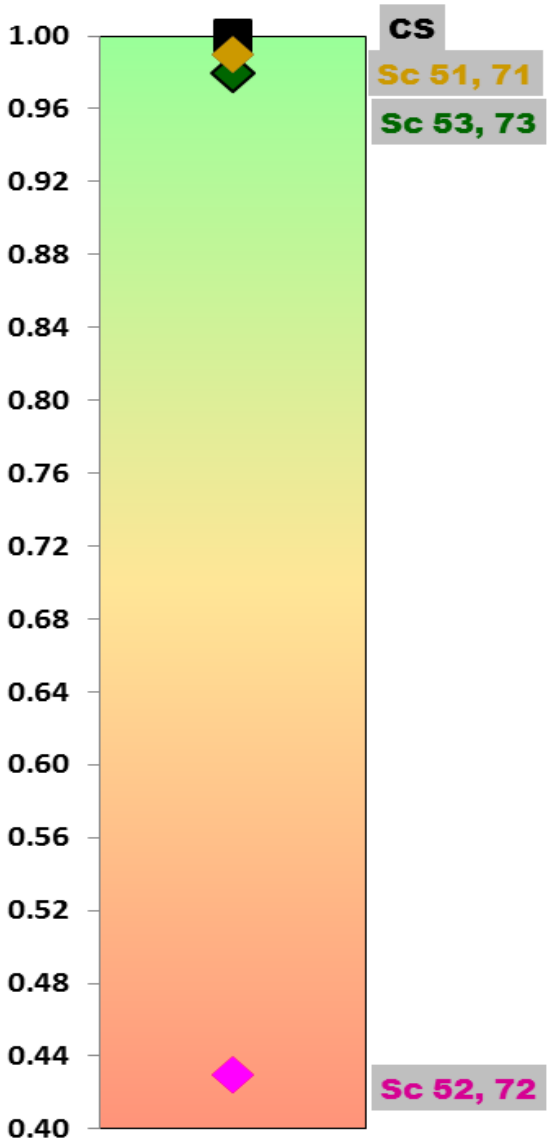
Nutrients, *E. coli* / coliforms



- CS; all Sc
- Sc72

ECOSYSTEM SERVICES CONSEQUENCES

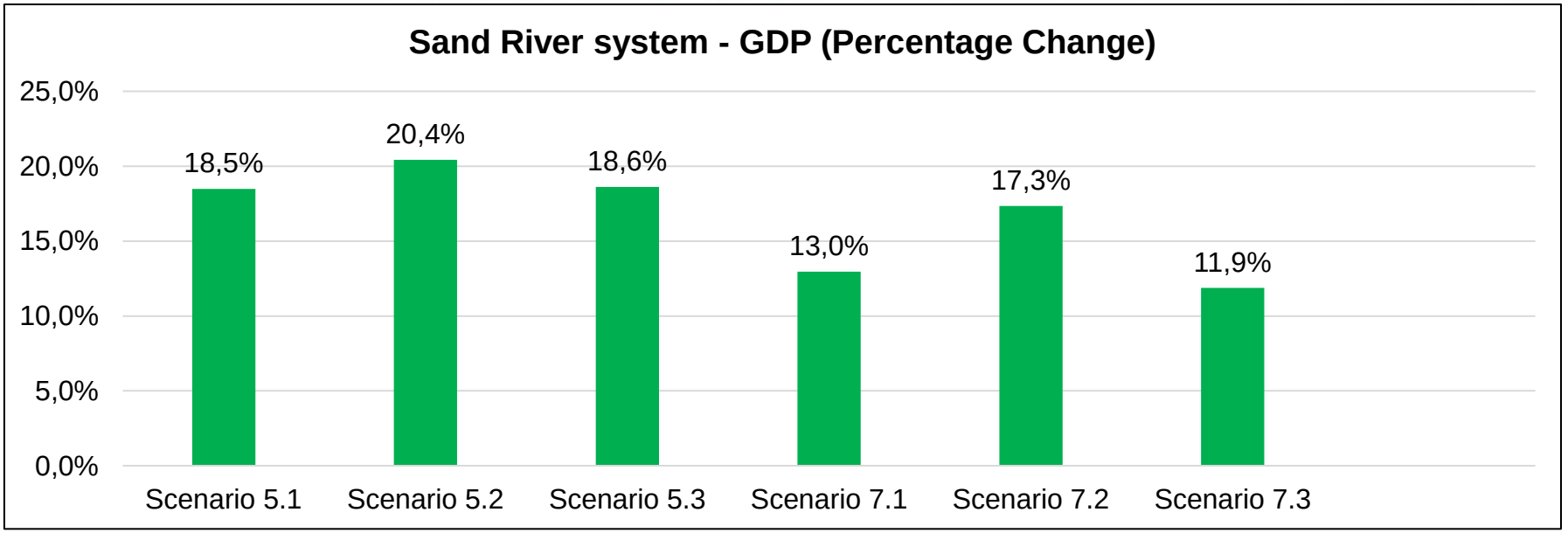
CONSEQUENCES - Sand

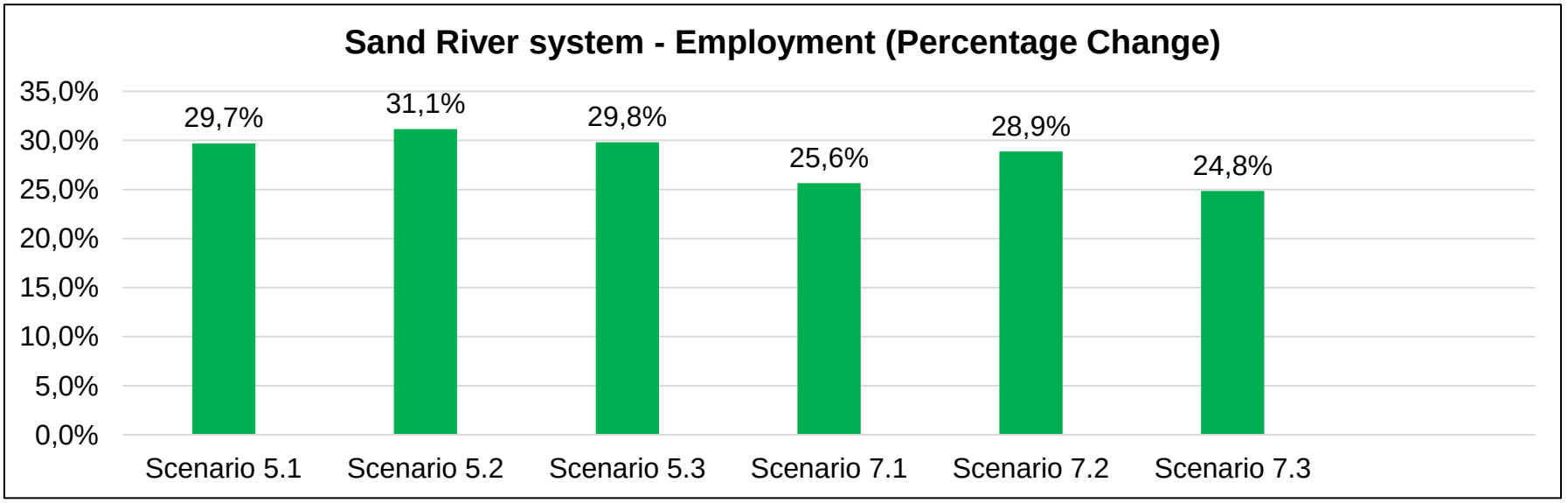


- For the Sand River system most scenarios were either neutral in impact or marginally positive.
- Scenarios 51 and 53 have some negative impact on water quality as well as some fish species and riparian vegetation. However some species were deemed to potentially react slightly positively. Geomoph was seen to react slightly –ve to these scenarios

ECONOMIC CONSEQUENCES

Scenario Evaluation – Sand River System





RECOMMENDED SCENARIO AND DRAFT MC

Integrated assessment and overall

(Score = weight x rating)

Nodes	River	Weights:		Normalisation:			Scenario Rating:				Scenario Score:			
		Importance	Length (km)	Importance 1	Length 0	Combined	53	71	72	73	53	71	72	73
a	*b*	*c*	*d*	*e*	*f*	*g*	*k*	*l*	*m*	*n*	*r*	*s*	*t*	*u*
X32B-00551	Motlamogatsana	1.0	27.1	0.0010	0.0933	0.0010	1.0000	1.0000	1.0000	1.0000	0.0010	0.0010	0.0010	0.0010
X32C-00558	Nwandlamuhari	1.0	15.1	0.0010	0.0518	0.0010	1.0000	1.0000	1.0000	1.0000	0.0010	0.0010	0.0010	0.0010
X32C-00564	Mphyanyana	1.0	11.9	0.0010	0.0408	0.0010	1.0000	1.0000	1.0000	1.0000	0.0010	0.0010	0.0010	0.0010
X32C-00606	Nwandlamuhari	1.0	1.2	0.0010	0.0042	0.0010	1.0000	1.0000	1.0000	1.0000	0.0010	0.0010	0.0010	0.0010
X32D-00605	Mutlumuvi	1.0	27.7	0.0010	0.0951	0.0010	0.7258	0.7873	0.1218	0.7258	0.0007	0.0008	0.0001	0.0007
X32E-00629	Nwarhele	1.0	18.0	0.0010	0.0618	0.0010	0.8571	0.8571	0.8571	0.8571	0.0008	0.0008	0.0008	0.0008
X32E-00639	Ndlobesuthu	1.0	6.8	0.0010	0.0234	0.0010	0.8000	0.8000	0.8000	0.8000	0.0008	0.0008	0.0008	0.0008
EWR6	Mutlumuvi	434.2	15.4	0.4282	0.0528	0.4282	0.7258	0.7873	0.1218	0.7258	0.3108	0.3371	0.0522	0.3108
X32F-00628	Nwarhele	1.0	6.5	0.0010	0.0223	0.0010	1.0000	1.0000	1.0000	1.0000	0.0010	0.0010	0.0010	0.0010
X32G-00549	Khokhovela	1.0	28.0	0.0010	0.0963	0.0010	1.0000	1.0000	1.0000	1.0000	0.0010	0.0010	0.0010	0.0010
X32G-00565	Sand	1.0	16.4	0.0010	0.0565	0.0010	1.0000	1.0000	0.9566	1.0000	0.0010	0.0010	0.0009	0.0010
X32H-00560	Phungwe	1.0	30.9	0.0010	0.1063	0.0010	1.0000	1.0000	1.0000	1.0000	0.0010	0.0010	0.0010	0.0010
X32H-00578	Sand	1.0	21.8	0.0010	0.0748	0.0010	1.0000	1.0000	0.9566	1.0000	0.0010	0.0010	0.0009	0.0010
EWR8	Sand	565.8	35.2	0.5580	0.1211	0.5580	1.0000	1.0000	0.9566	1.0000	0.5580	0.5580	0.5338	0.5580
X32J-00651	Mutlumuvi	1.0	24.8	0.0010	0.0853	0.0010	1.0000	1.0000	1.0000	1.0000	0.0010	0.0010	0.0010	0.0010
X32J-00730	Sand	1.0	4.2	0.0010	0.0143	0.0010	1.0000	1.0000	0.9566	1.0000	0.0010	0.0010	0.0009	0.0010
							Ecological Scores:				0.882	0.908	0.598	0.882

- 16 Biophysical Nodes including 2 EWR sites
- Scores summed for all nodes for each scenario then applied in integrated calculation with all four variables.

Variable Scores & Weights

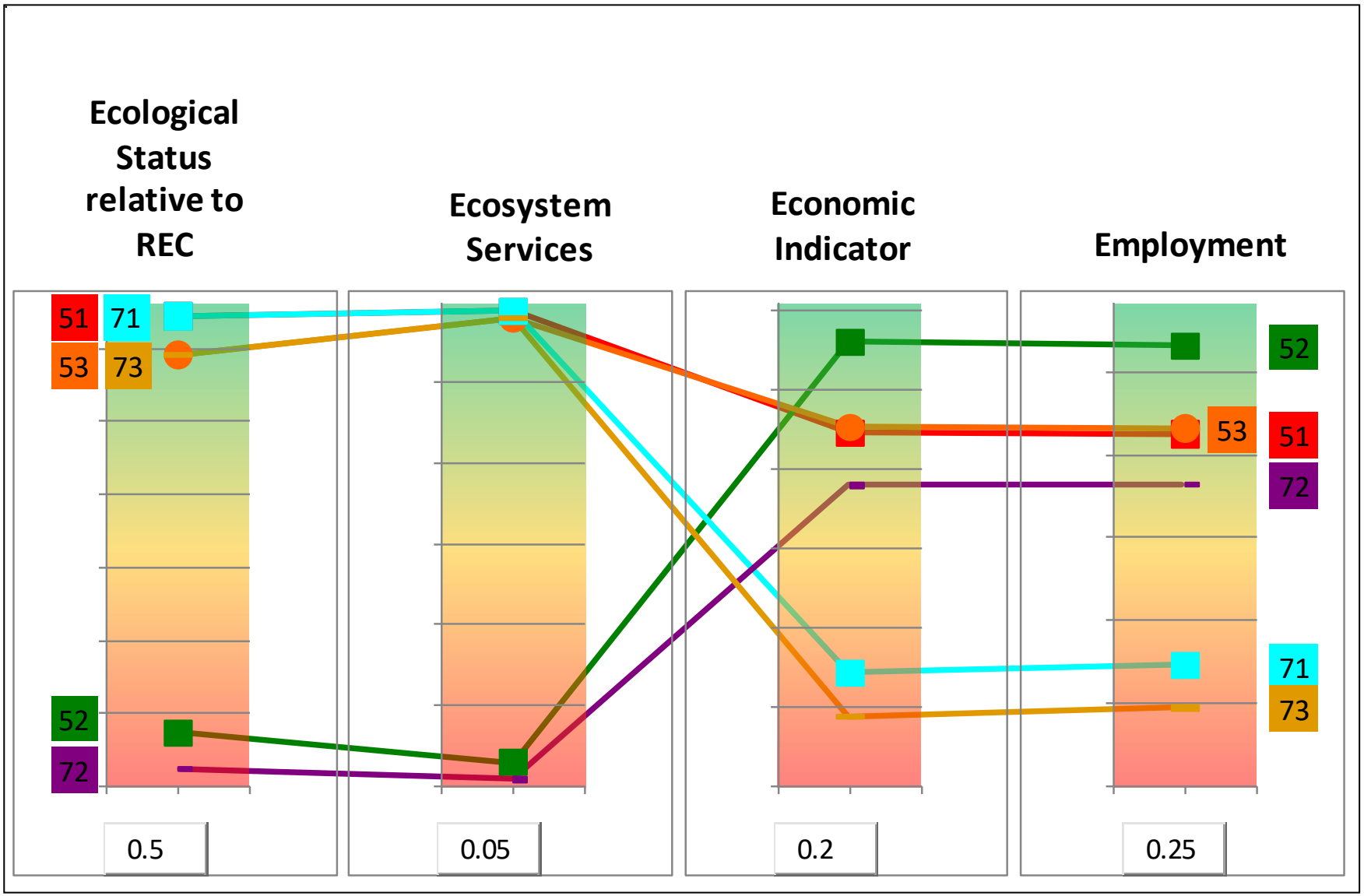
Variables	Scenarios					
	51	52	53	71	72	73
Ecological Status	0.91	0.62	0.88	0.91	0.60	0.88
Ecosystem Services	0.99	0.43	0.98	0.99	0.41	0.98
Economic Indicator (GDP) (R Millions)	237.9	243.7	238.3	222.8	234.6	220.1
Employment	2545	2598	2548	2405	2514	2380

Variables	Weights
Ecological Status	0.5
Ecosystem Services	0.05
Economic Indicator	0.2
Employment	0.25

50% Ecology

50% Socio-Economic

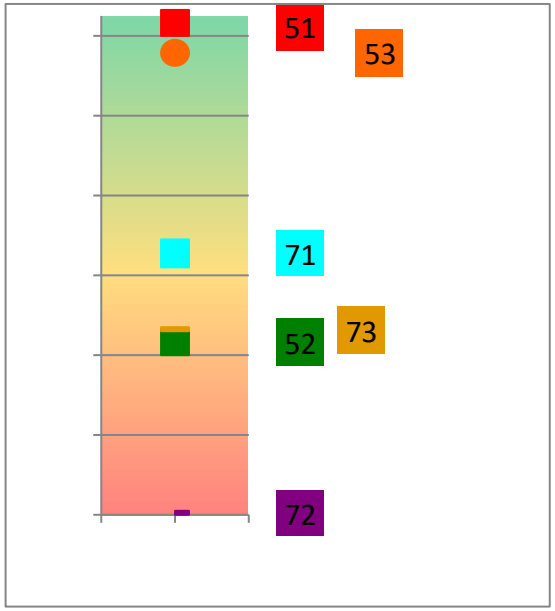
Visualisation of Variables Scores



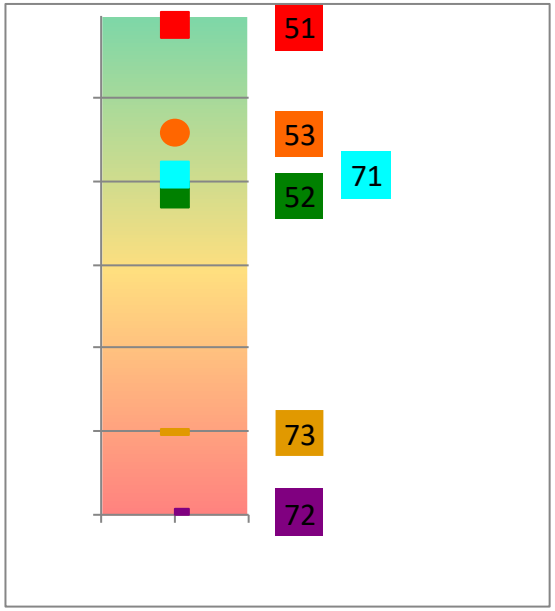
Overall Ranking (Two Rank Methods)

Method	Scenarios					
	51	52	53	71	72	73
Overall Score (Rank Order method)	4.825	3.8	4.175	3.925	1.9	2.375
Rank (1 = best, 6 = worse)	1	4	2	3	6	5
Overall Score (Normalisation Method)	0.890	0.491	0.854	0.602	0.277	0.507
Rank (1 = best, 6 = worse)	1	5	2	3	6	4

Overall Ranking (Normalised Scores)



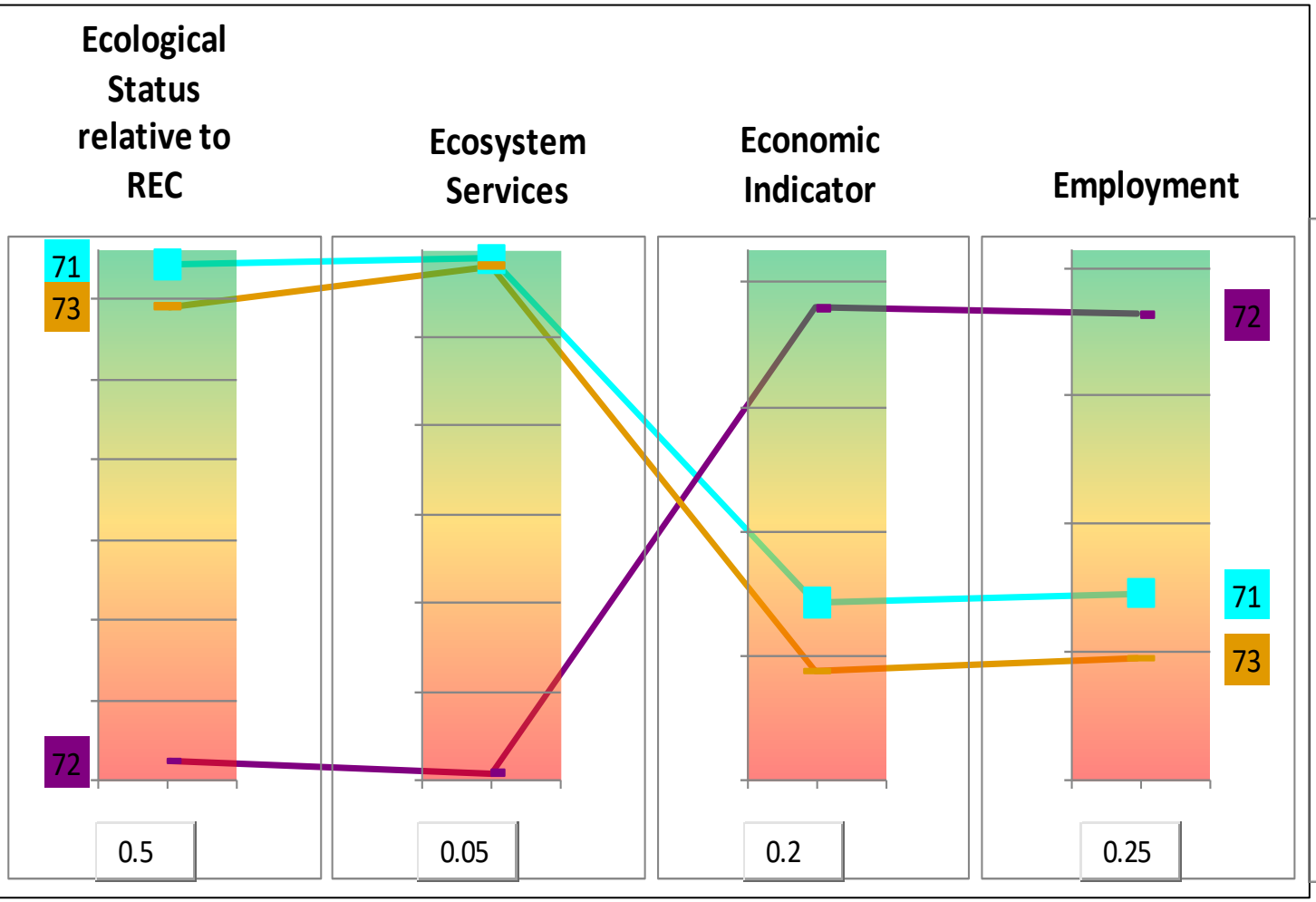
Overall Ranking (Rank Order)

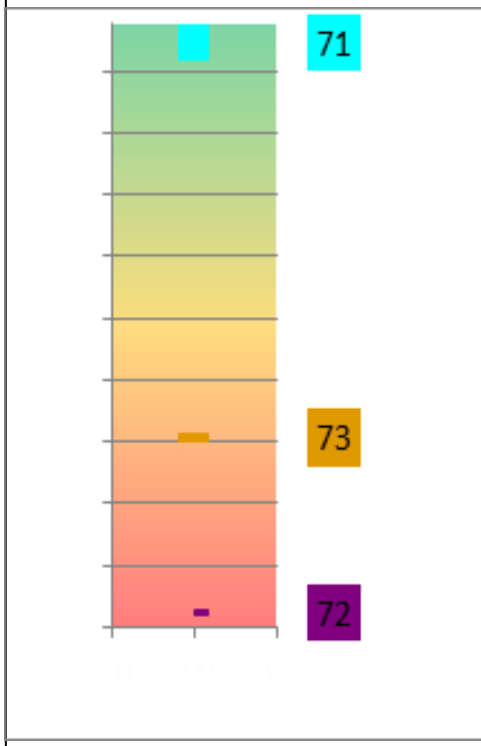


Probability of Scenarios Materialising

- A further aspect to consider is the probability of the underlying settings of the scenario variables materialising.
- The probability of achieving a 50% return flow factor (assumed for Scenarios 51, 52 and 53) is considered low.
- Therefore Scenarios 71, 72 and 73 is more likely to be achieved in the medium term future.
- See results next slide.

Integrated Ranking – 3 Scenarios





Sensitivity analysis and synthesis of results

Weights					Rank Position of Scenario (Normalisation Ranking Method)					
Alternative	**Ecology**	**EcoSystem Services**	**GDP**	**Jobs**	**51**	**52**	**53**	**71**	**72**	**73**
1	0.50	0.05	0.20	0.25	1.0	5.0	2.0	3.0	6.0	4.0
2	0.50	0.10	0.20	0.20	1.0	5.0	2.0	3.0	6.0	4.0
3	0.50	0.15	0.15	0.20	1.0	5.0	2.0	3.0	6.0	4.0
4	0.50	0.05	0.15	0.30	1.0	5.0	2.0	3.0	6.0	4.0
5	0.50	0.05	0.30	0.15	1.0	5.0	2.0	3.0	6.0	4.0
6	0.25	0.25	0.25	0.25	1.0	4.0	2.0	3.0	6.0	5.0
7	0.20	0.10	0.40	0.30	1.0	3.0	2.0	5.0	4.0	6.0
8	0.15	0.10	0.45	0.30	1.0	3.0	2.0	5.0	4.0	6.0

Rank: 1 = best, 6 = worse.

Derivation of the Water Resource Class for each IUA

Recommended Management Class Criteria Table

		% EC representation at units represented by biophysical nodes in an IUA					Prominent Ecological Categories
		≥ A/B	≥ B	≥C	≥ D	< D	
Class I		0	60	80	95	5	A & B
Class II			0	70	90	10	C
Class III	Either			0	80	20	D
	Or				100		

Unit Percentages:

Length of river in a given Ecological Category divided by the total river length in an IUA .

SAND RIVER SYSTEM RESULTS

IUA	Scenarios and Management Class							
	PES/ PD/SC1	REC	51	52	53	71	72	73
X3-7	III	III	III	XXX	III	III	XXX	III
X3-8	II	II	II	II	II	II	II	II
X3-9	I	I	I	I	I	I	I	I

"XXX" – Scenario did not achieve Class III criteria

- Short and Medium term: Maintain current operation
- Long term if New Forest Dam is built: MC associated with Sc 71

Proposed Ecological Categories for Scenario 71

IUA	MC	Nodes	River	PES	Target Sc 71
X3-7	III	X32D-00605	Mutlumuvi	D	D
		X32E-00629	Nwarhele	C/D	C/D
		X32E-00639	Ndlobesuthu	D/E	D/E
		EWR6	Mutlumuvi	C	C
		X32F-00628	Nwarhele	C/D	C/D
X3-8	II	X32B-00551	Motlamogatsana	C	C
		X32C-00558	Nwandlamuhari	C	C
		X32C-00564	Mphyanyana	C	C
		X32C-00606	Nwandlamuhari	C	C
		X32G-00549	Khokhovela	C	C
		X32G-00565	Sand	C	B
X3-9	I	X32H-00560	Phungwe	A	A
		X32H-00578	Sand	C	C
		EWR8	Sand	B	B
		X32J-00651	Mutlumuvi	A	A
		X32J-00730	Sand	B	B

SAND SCENARIO MATRIX

Scenario	SCENARIO VARIABLES				
	Update water demands	Growth in water demands	Reinstate Sand Forestry	New Forest Dam (Mutlumuvi River)	EWR
S1	Yes	No, no return flows	No	No	No
S51	Yes	Yes, 50% return flows	Yes	Yes	Yes, REC
S52	Yes	Yes, 50% return flows	Yes	Yes	No
S53	Yes	Yes, 50% return flows	Yes	Yes	Yes, PES
S71	**Yes**	**Yes, 25% return flows**	**Yes**	**Yes**	**Yes, REC**
S72	**Yes**	**Yes, 25% return flows**	**Yes**	**Yes**	**No**
S73	**Yes**	**Yes, 25% return flows**	**Yes**	**Yes**	**Yes, PES**