water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

2030 NDP
NATIONAL DEVELOPMENT PLAN
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CLASSIFICATION OF SIGNIFICANT WATER RESOURCES AND DETERMINATION OF RESOURCE QUALITY OBJECTIVES FOR WATER RESOURCES IN THE USUTU TO MHLATHUZE CATCHMENTS (WP11387)

RQO Workshop, Mbombela, 24 August 2023

RESOURCE QUALITY OBJECTIVES: WATER QUALITY



WATER IS LIFE - SANITATION IS DIGNITY

Resource Quality Objectives: Water Quality

Patsy Scherman

BACKGROUND PREPARATION FOR RQO DEVELOPMENT

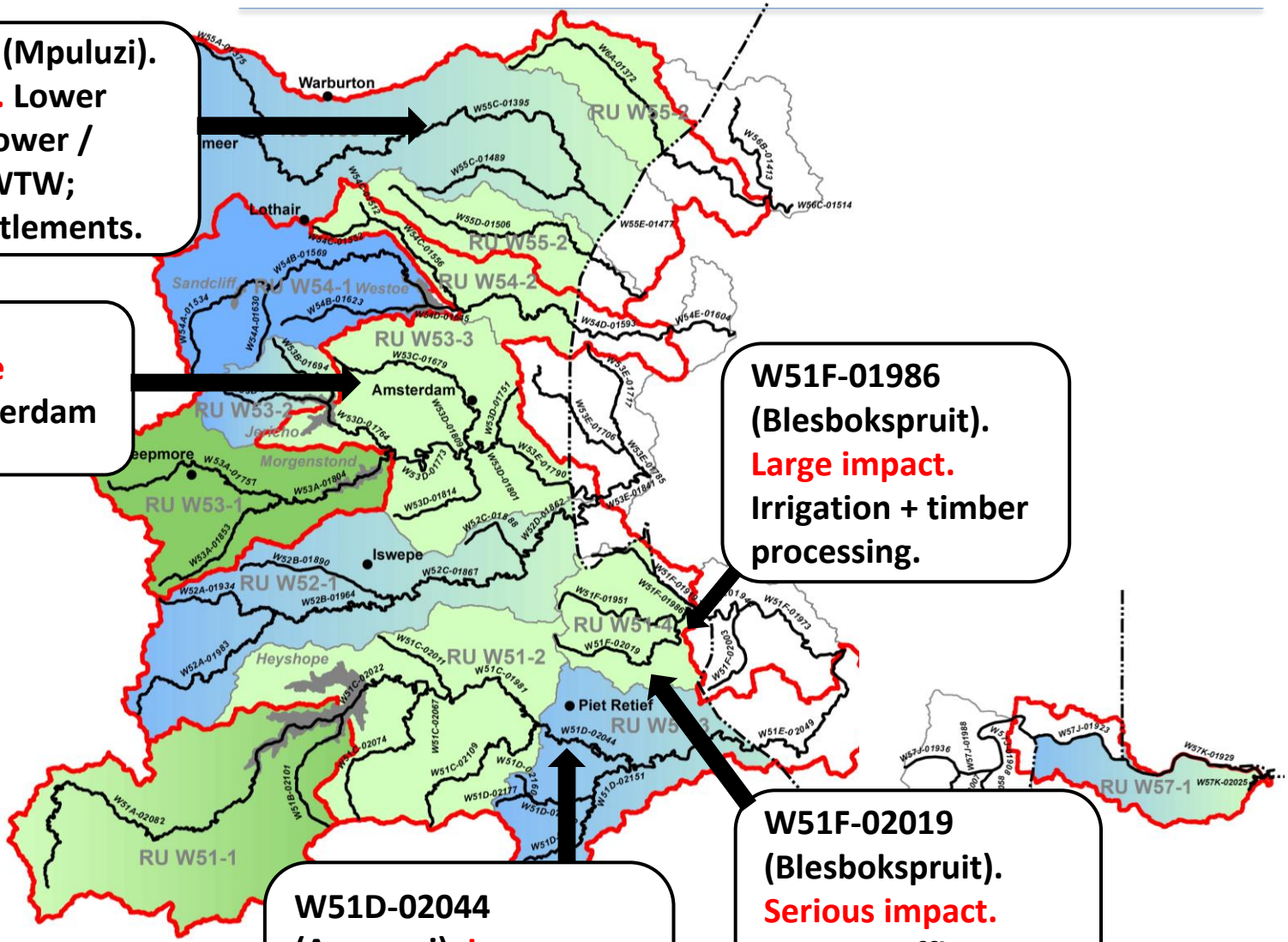
- **Water quality Status Quo**
- **Identify preliminary water quality hot spots**
- **Prepare for November 2022 TTG meeting**

- **<u>At TTG and follow up meetings:</u>**
  - **ID wq role players, including non-ecological e.g. irrigation, settlements**
  - **Identify indicators linked to driving variables associated with indicator wq role players, e.g. elevated *phosphate* associated with nutrients linked to stock-watering**
  - **Identify pollution priority areas and / or priority protection areas**

STATUS QUO: WATER QUALITY

- **Aim: Identify preliminary water quality priority areas per secondary catchment. NB: First step toward identifying driving water quality variables for which RQOs will be set.**
- **Rivers: Based on a water quality impact rating (0: no impact to 5: serious impact) on PES EIS spreadsheets.**
- **Based on desktop information and liaison with water quality managers.**
- **Following data sources used:**
  - **ISP 2004, Reserve 2014, PES/EIS review of Jan 2022, 2020 DWS Planning Review, DWS's IRIS, 2020 IUCMA Usuthu EcoStatus report, 2022 Green Drop report**

W5 (Usutu): Water quality status quo



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

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

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

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

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

WATER QUALITY HOTSPOTS: W5

SQR	River name	Water quality impact (rating)	Water quality issues
W51D-02044	Assegaai	Large (3)	Urban impacts from Piet Retief, including WWTW and Mpact.
W51F-01986	Blesbokspruit	Large (3)	Irrigation; impacts from upstream timber processing plants.
W51F-02019	Blesbokspruit	Serious (4)	Tannery effluent draining into the Farroloop and Blesbokspruit; Thuthuka Forestry.
W53C-01679	Thole	Large (3)	Amsterdam WWTW (medium risk).
W55C-01395	Mpuluzi	Large (3)	Lower reach only: Mayflower/Empuluzi WWTW; extensive settlements.

PRINCIPLES: WATER QUALITY RQOs (1)

- **If EcoSpecs not available from an EWR study, wq guidelines are used (linked to a level of protection, e.g. TWQR, rather than a TEC).**
- **WQ RQOs IMMEDIATELY applicable = ONLY where monitoring data are available.**
- **Monitoring recommendations and provisional RQOs are set for identified driving variables for which RQOs are *not immediately* applicable, but for which a database needs to be developed.**
- **Once an adequate dataset has been produced, evaluate the provisional RQOs provided and update the RQOs for the driving variables.**
- **Numerical and narrative RQOs are prepared using all existing data sources for identified monitoring points, and for *driving variables ONLY* for High Priority WQ sites, and for *ALL variables* for High Priority EWR sites.**

PRINCIPLES: WATER QUALITY RQOs (2)

- **Note that Reserve data available as A–F categories were converted to Ideal to Tolerable categories (required for water quality gazetting purposes), as follows:**

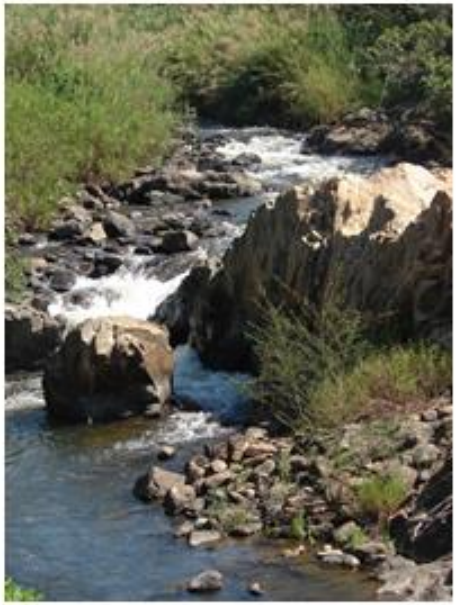
Categories A and A/B: Ideal
Categories B, B/C and C: Acceptable
Categories C/D and D: Tolerable

- **Values used for setting RQOs were linked to standard DWS methods and procedures, data format from WMS and DWAF (2008). Note data confidence.**
- **Monitoring data to be collected for measurement against RQOs that are immediately applicable and to be gazetted, should be collected from the monitoring sites as identified in the water quality Reserve documentation, if possible.**

METHODS FOR DETERMINING THE WATER QUALITY COMPONENT OF THE ECOLOGICAL RESERVE FOR RIVERS

SECOND DRAFT

March 2008



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PRINCIPLES: WATER QUALITY RQOs (3)

- **Microbial compliance targets: as in NMMP (risk guidelines) where full or partial recreation guidelines are not met), and set below each WWTW, town and large settlement.**

Narrative RQO	Numerical RQO		
Meet faecal coliform and *E. coli* targets for recreational / other (full or partial contact) use*.	Potential health risks in terms of counts / 100 ml (SA NMMP guidelines).		
	Low	Medium	High
	< 600	600 – 2 000	> 2 000

* Guidelines are provided in the absence of data or knowledge of recreational activities in the area.

It is assumed that run-of-river water is not used for domestic use UNLESS primary treatment has been undertaken. Objectives for domestic use, such as drinking untreated water from the river, are therefore not covered in the water quality RQOs.

- **Toxics: Broad numerical guidelines for *toxics* are not suitable for areas where specific information on toxics are not available, or where the identity of contaminants are not known. Where no data, biotic response and biological monitoring are used to indicate toxicity.**

DATA SELECTION

The general rule for data selection is the following:
*Select the RC (or Reference Condition/natural state) data as the **first** 3–5 yrs (**minimum of 60 data points for high confidence, 25 samples for moderate confidence and 12 samples for low confidence**) of the data record, and the PES as the **last** 3–5 years of data (again a minimum of 60, 25 or 12 data points for difference confidence levels). The monitoring point suitable for Reference Condition must therefore either be in an unimpacted tributary (this can be in an adjacent catchment, but in the same Level II EcoRegion) or a very early data record (e.g. from the 1960s – early 1980s). It is possible to use the same monitoring point for Reference Condition and PES data, if the appropriate data record is available.*

Note that although a low confidence desktop assessment can be run using 12 data points, these points should preferably be spread across the hydrological cycle. Alternatively, weekly monitoring over a 60 day period can be undertaken.

Note: If inadequate data exists for an assessment in a *High / Very High* EIS area **(i.e. n < 25)**, recommend that monitoring is initiated (preferably over one hydrological cycle) before a Reserve can be determined, including at the Desktop level. This constraint may be waived if sufficient biological monitoring and site-specific information is available.

This note also applies to EWR sites

HIGH PRIORITY EWR SITE: Assegaai River, AS1

EWR site: Assegaai River, AS1

River	Assegaai	Water Quality Monitoring Points	
		RC	Benchmark tables (DWAF, 2008). W5H006Q01, Swartwater River at Zwartwater: 1977-1981; n=145.
EWR Site	AS1	PES	IUCMA data, U-26: July 2016-Feb 2022; n=57-64. W5H022Q01: 2015-2019; n=49.
	Parameter / units	PES value	Rating for PAI / Comment
Inorganic salt ions (mg/L)	Sulphate as SO_4	-	No impacts expected. No method available. Electrical conductivity used as surrogate.
	Sodium as Na	-	
	Magnesium as Mg	-	
	Calcium as Ca	-	
	Chloride as Cl	-	
	Potassium as K	-	
Electrical conductivity	mS/m	21.63: IUCMA * 24.74: DWS	0
Nutrients (mg/L)	SRP-P	0.03: IUCMA 0.05: DWS	2.5
	TIN-N	0.6: IUCMA 0.3: DWS	1
Physical variables	pH (5th and 95th % tiles)	7.4 + 8.17: IUCMA 6.9 + 8.2: DWS	1
	Temperature (º C)	-	Although Heyshope Dam is upstream of the EWR site, little impact is expected due to the distance from the dam to the site. Impact is on trapped sediments in the dam. Ratings: 1
	Dissolved oxygen (mg/L)	-	
	Turbidity (NTU)	13.9: IUCMA (n=14; 2021-Feb 2022)	
Response variable	Chl-*a*: phytoplankton (ug/L)	-	
	Macroinvertebrate score (MIRAI) SASS score ASPT score	78.6%: 2020 IUCMA	B/C (2020 IUCMA report)
	Diatoms	SPI=15.3 (n=1)	B
	Fish score (FRAI)	69.2%	C
Toxics (mg/L)*	Ammonia (as N)	0.20: IUCMA * 0.22: DWS	4
	Fluoride (F)	-	
Overall site classification (from PAI table)			B/C (80.6%)

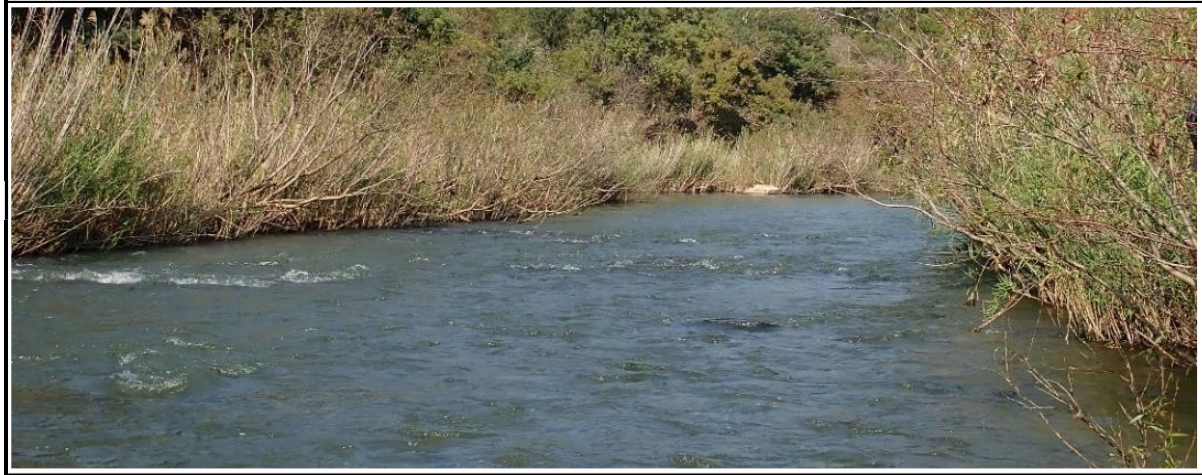
**** Data of July 2016-Feb 2017 seems problematic and inconsistent with other and historical data sources. Data from March 2017 to February 2022 used for the PES.***

-: no data

Upstream influences are Heyshope Dam, irrigation, afforestation and domestic water use. Commercial and subsistence agriculture takes place in the catchment around the Heyshope Dam with limited coal mining (DWAF, 2004). Piet Retief is located well upstream of the site, with an outlet from the Piet Retief and Uthiza WWTWs into the Ndhlozane tributary (in W51F) of the Assegaai River. Main water quality impactors are therefore in the lower reaches and the road network. Note that sediments are trapped in Heyshope Dam, resulting in the lack of fines at the boulder-dominated site.

METRIC	RATING
pH	1.00
Salts	0.00
Nutrients	2.50
Water Temperature	1.00
Water clarity	1.00
Oxygen	1.00
Toxics	2.00
PC MODIFICATION RATING WITH THRESHOLD APPLIED (MAX)	1.33
CALCULATED PC MODIFICATION RATING WITHOUT THRESHOLD AND WITH DEFAULT WEIGHTS	1.33
CALCULATED P-C RATING WITHOUT THRESHOLD AND BASED ON ADJUSTED WEIGHTS	1.32
FINAL PC MODIFICATION RATING	1.36
P-C CATEGORY %	P-C CATEGORY
80.6	B/C

EWR AS1: Assegaai River



Coordinates	S27.06230 E30.98880
SQ code	W51E-02049
RU	RU W51-3
IUA	IUA W52
Level 2 EcoRegion	4.06
Geomorph Zone	lower/upper foothills

PRESENT ECOLOGICAL STATE: PES

I IHI	R IHI	PC	Geom	Rip Veg	Fish	Inverts	Instream	EcoStatus
C/D (59.1%)	C/D (58.7%)	B/C (80.6%)	C (70.84%)	C (69.9)%	C (69.2%)	B/C (78.6%)	C (77.8%)	C (74.16%)

ECOLOGICAL IMPORTANCE AND SENSITIVITY

MODERATE

RECOMMENDED ECOLOGICAL CATEGORY (REC) = PES

REC = C for ECOSTATUS

PROCESS: HIGH PRIORITY EWR SITES

- **RQOs and TPCs (Thresholds of Probable Concern, or 'red flags') must be set for all variables.**

- **Use PAI, WQ table summary table, and DWAF (2008) and WQ ecosystem guidelines to set RQOs and TPCs, e.g. for electrical conductivity.**
  - **Electrical conductivity summary statistic (95th %ile) is 58.8 mS/m.**
  - **Check assigned category in PAI, and boundary values in DWAF (2008).**
  - **Is electrical conductivity a driving variable?**
  - **Set associated EcoSpec, so 95th %ile of data must be ≤ xx mS/m.**
  - **Set associated TPC, so the 95th percentile of the data is xx – xx mS/m. A range between 80% and boundary of category generally used, e.g. so 8-10 mg/L: TPC if category is up to 10mg/L, for example.**
  - **Assign confidence and IMMEDIATELY APPLICABLE vs PROVISIONAL RQOs**

HIGH PRIORITY WQ SITES

Extract of points from W5

RU	SQ reach	River name	Impact rating	WQ role players	WQ driving variables	WQ notes
W51-3	W51D-02044	Assegaai	3.0	Urban impacts	Nutrients, salts, toxics, *E. coli* / coliforms	
W51-4	W51F-01986	Blesbokspruit	3.0	Cultivation; wood-processing	Toxics, nutrients, salts	Wood-processing plant
W51-4	W51F-02019	Blesbokspruit	4.0	Wood treatment + tannery effluents; settlements	Toxics, nutrients, salts, *E. coli* / coliforms	Tannery effluent draining into the Farroloop and into the Blesbokspruit
W53-3	W53C-01679	Thole	3.0	Urban impacts; WWTW; cultivation	Toxics, nutrients, salts, *E. coli* / coliforms	
W55-1	W55C-01395	Mpuluzi	3.0	Erosion (sand-mining); WWTW	Turbidity, toxics, nutrients, salts	

PROCESS: HIGH PRIORITY WQ SITES

- **Check if data are available for use**
- **If DATA, determine PES, check drivers and set RQOs + TPCs**
- **If NO DATA, check following steps:**
  - **Check position of site on GE**
  - **Is extrapolation from another EWR or EcoRegion level II site possible?**
  - **If so, determine PES, check drivers and set RQOs and TPCs**
  - **Set confidence and 'ímmediatly applicable' vs 'provisional'**
  - **If no, check drivers and set PROVISIONAL RQOs and TPCs**
  - **Prepare text: Flag for monitoring or notes for implementation**

GENERAL NOTES

- **Ecology is the main "user" at stretches containing EWR sites. Remember Chapter 3, NWA:**

SUSTAINABLE UTILISATION = LONG-TERM BALANCE BETWEEN USE AND PROTECTION OF WATER RESOURCES

- **Information on other users was "checked" at these river stretches.**
- **Driving user at sites = often ecological protection. Suitable if wq data is linked to the maintenance or reaching of a particular water quality category, which is part of a specific EC, catchment configuration and Water Resource Class.**
- **RQOs for driving variables set accordingly.**

RESULTS: EWR AS1 - ECOSPECS AND TPCs

Water quality metrics	EcoSpecs	TPC
Inorganic salts (*)		
$MgSO_4$	The 95th percentile of the data must be ≤ 16 mg/L.	The 95th percentile of the data is 13-16 mg/L.
Na_2SO_4	The 95th percentile of the data must be ≤ 20 mg/L.	The 95th percentile of the data is 16-20 mg/L.
$MgCl_2$	The 95th percentile of the data must be ≤ 15 mg/L.	The 95th percentile of the data is 12-15 mg/L.
$CaCl_2$	The 95th percentile of the data must be ≤ 21 mg/L.	The 95th percentile of the data is 17-21 mg/L.
NaCl	The 95th percentile of the data must be ≤ 45 mg/L.	The 95th percentile of the data is 36-45 mg/L.
$CaSO_4$	The 95th percentile of the data must be ≤ 351 mg/L.	The 95th percentile of the data is 280–351 mg/L.
Physical variables		
Electrical Conductivity	The 95th percentile of the data must be ≤ 30 mS/m.	The 95th percentile of the data is 24-30 mS/m.
pH	The 5th percentile of the data must range from 6.5 to 8.0, and the 95th percentile from 6.5 to 8.8.	The 5th percentile of the data is < 6.7 and > 7.8, and the 95th percentile is < 6.7 and > 8.6.
Temperature	Largely natural temperature range is expected.	Some temperature sensitive species at lower abundance and frequency of occurrence than expected for reference.
Dissolved oxygen	The 5th percentile of the data must be > 7.0 mg/L.	The 5th percentile of the data is ≤ 7.2 mg/L.
Turbidity	Small changes expected.	Maintain within current range (median: 14.0 NTU).
Nutrients		
Total Inorganic Nitrogen (TIN-N)	The 50th percentile of the data must be ≤ 0.7 mg/L.	The 50th percentile of the data is 0.6–0.7 mg/L
PO_4-P	The 50th percentile of the data must be ≤ 0.075 mg/L.	The 50th percentile of the data is 0.06–0.075 mg/L.
Response variables (#)		
Chl-*a* phytoplankton	The 50th percentile of the data must be ≤ 20 mg/L.	The 50th percentile of the data is 16–20 µg/L
Chl-*a* periphyton	The 50th percentile of the data must be ≤ 21 mg/m^2	The 50th percentile of the data is 17–21 mg/m^2
Toxics		
Ammonia (NH_3-N)	The 95th percentile of the data must be ≤ 0. 22 mg/L	The 95th percentile of the data is 0.018–0.22 mg/L
Other variables (#)	The 95th percentile of the data must be within the A (or 0) category in DWAF (2008), or within the Acute Effects Value (AEV) as stated in DWAF (1996a) for those variables not in DWAF (2008).	An impact is expected if the 95th percentile of the data exceeds the A category range in DWAF (2008), or the Target Water Quality Range (TWQR) as stated in DWAF (1996a).

(*) Inorganic salts only to be generated when the TPC for Electrical Conductivity is exceeded or salt pollution is expected, should a tool for generating salts be available.

(#) Low confidence. EcoSpec and TPC boundaries may need adjusting as data becomes available.

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Example of High Priority WQ site

Source: No detailed water quality assessment conducted. PESEIS data (DWS, 2014c) and literature sources (e.g. DWS, 2014a; DWAF, 1996a–e) were used.
Model: N/A
Users: Run-off from rural settlements.
Water quality issue: Nutrients, turbidity.

Narrative and numerical details are provided in **Table 4.6**.

Table 4.6 RU T31-4: Narrative and numerical water quality RQOs

Narrative RQO	Numerical RQO
Ensure that turbidity or clarity levels stay within Acceptable limits.	A moderate change from natural with temporary high sediment loads and turbidity during runoff events (Aquatic ecosystems: driver).
Ensure that nutrient levels are within Acceptable limits.	50th percentile of the data must be less than 0.025 mg/L PO_4-P (Aquatic ecosystems: driver).