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RESERVE DETERMINATION STUDIES FOR SELECTED SURFACE WATER, GROUNDWATER, ESTUARIES AND WETLANDS IN THE USUTU/MHLATUZE WATER MANAGEMENT AREA
WP 10544

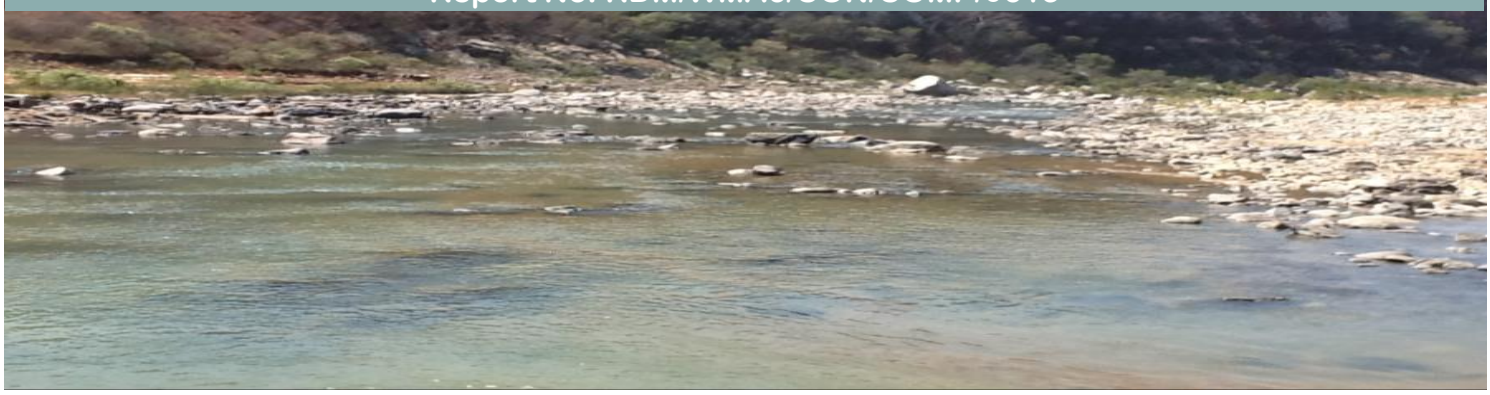
RIVER INTERMEDIATE EWR

VOLUME 1: ECOCLASSIFICATION

FINAL

MARCH 2015

Report No. RDM/WMA6/CON/COMP/0613



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Department:
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DEPARTMENT OF WATER & SANITATION

CHIEF DIRECTORATE: WATER ECOSYSTEMS

CONTRACT NO. WP 10544

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Report Title: River Intermediate EWR - Volume 1: EcoClassification

Compilers: K Reinecke and C Brown

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This report was compiled by Dr C. Brown and Dr K. Reinecke with specialist input from the following project members.

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ABBREVIATIONS AND ACRONYMS

AEC	Alternative Ecological Category
CD:RDM	Chief Directorate: Resource Directed Measures
DWA	Department of Water Affairs
EC	Ecological Category
EIS	Ecological Importance and Sensitivity
EWR	Ecological Water Requirement
NEMBA	National Environmental Management Biodiversity Act
NWRCS	National Water Resources Classification System
PES	Present Ecological Status
REC	Recommended Ecological Category
WMA	Water Management Area
PO4-P	Phosphate-P
EC	Electrical Conductivity
DO	Dissolved Oxygen
SASS	South African Scoring System
TIN	Total Inorganic Nitrogen
ASPT	Average Score Per Taxon
WWTW	Wastewater Treatment works
WMS	Water Management System

GLOSSARY OF TERMS

Ecological Category	Defines the ecological condition of a river in terms of the deviation of biophysical components from the reference condition. There are six Ecological Categories that range from A (natural) to F (critically modified).
EcoClassification	The determination and categorisation of the Present Ecological Status or various biophysical attributes of rivers relative to the natural and/or reference condition.
EcoStatus	The totality of features and characteristics of the river and its riparian areas that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services.
Ecological Water Requirements	The pattern (magnitude, timing and duration) and quality of flow needed to maintain an aquatic ecosystem in a particular condition (Ecological Category).
Ecological Reserve	The quantity and quality of water required to satisfy basic human needs by securing a basic water supply and in order to ensure ecologically sustainable development and use of water resources, as prescribed in the NWA.
EcoSpecs	Clear and measurable specifications of ecological attributes (e.g. water quality, flow, biological integrity) that defines the Ecological Category.
Present Ecological Status	The degree to which ecological conditions have been modified from reference conditions, based on water quality, biota and habitat information that is scored on a six point scale from A (natural) to F (critically modified).
Reference conditions	Natural ecological conditions prior to anthropogenic disturbance.

1 INTRODUCTION

1.1 Background to the study

The Chief Directorate: Resource Directed Measures issued an open tender invitation for the "Appointment of a Professional Service Provider to undertake Reserve Determinations for selected Surface water, Groundwater, Estuaries and Wetlands in the Usutu to Mhlatuze Basins". The focus on this area was a result of the high conservation status and importance of various water resources in the basin and the significant development pressures in the area affecting the availability of water.

Preliminary Reserve determinations are required to assist the DWS in making informed decisions regarding the authorisations of future water use and the magnitude of the impacts of the proposed developments on the water resources in the WMA, and to provide the input data for Classification of the area's water resources, and eventual gazetting of the Reserve (DWAF1999a).

DWS appointed Tlou Consulting to undertake the project in July 2013.

1.1.1 Study objectives

The objectives of the study are to:

- determine the Ecological Reserve (DWAF 1999a), at various levels of detail, for the Nyoni, Matigulu, Mlalazi, Mhlatuze, Mfolozi, Nyalazi, Hluhluwe, Mzinene, Mkuze, Assegaai and Pongola Rivers;
- determine the Ecological Reserve, at an Intermediate level for the Pongola floodplain;
- determine the Ecological Reserve, at an Intermediate level for the St Lucia/Mfolozi, Estuary System;
- determine the Ecological Reserve, at an Rapid level for the Mlalazi Estuary;
- determine the Ecological Reserve, at a Rapid level for the Amatikulu Estuary;
- determine the Ecological Reserve, at an Intermediate level for Lake Sibaya;
- determine the Ecological Reserve, at a Rapid level for Kozi Lake and Estuary;
- classify the causal links between water supply and condition of key wetlands
- incorporate existing EWR assessments on the Mhlatuze (river and estuary) and Nhlabane (lake and estuary) into study outputs;
- determine the groundwater contribution to the Ecological Reserve, with particular reference to the wetlands;
- determine the Basic Human Needs Reserve for the Usutu/Mhlatuze WMA;
- outline the socio-economic water use in the Usutu/Mhlatuze WMA;

- build the capacity of team members and stakeholders with respect to EWR determinations and the ecological Reserve.

1.2 This report

This report is Volume 1 of four volumes of the River Intermediate EWR Report:
Volume 1: EcoClassification
Volume 2: EWR Assessment – Results
Volume 3: Specialist reports
Volume 4: EcoSpecs and Monitoring Programme.

This report covers the activities required for Step 3 of the Reserve determination process as prescribed by the CD: RDM of DWS (DWAF 1999a; Kleynhans *et al.* 2007).

This report serves to document the results of the ecological classification (Step 3 in Figure 1-1) for the EWR sites in the Usuthu-Mhlatuze catchments for which Intermediate EWR determinations were undertaken.

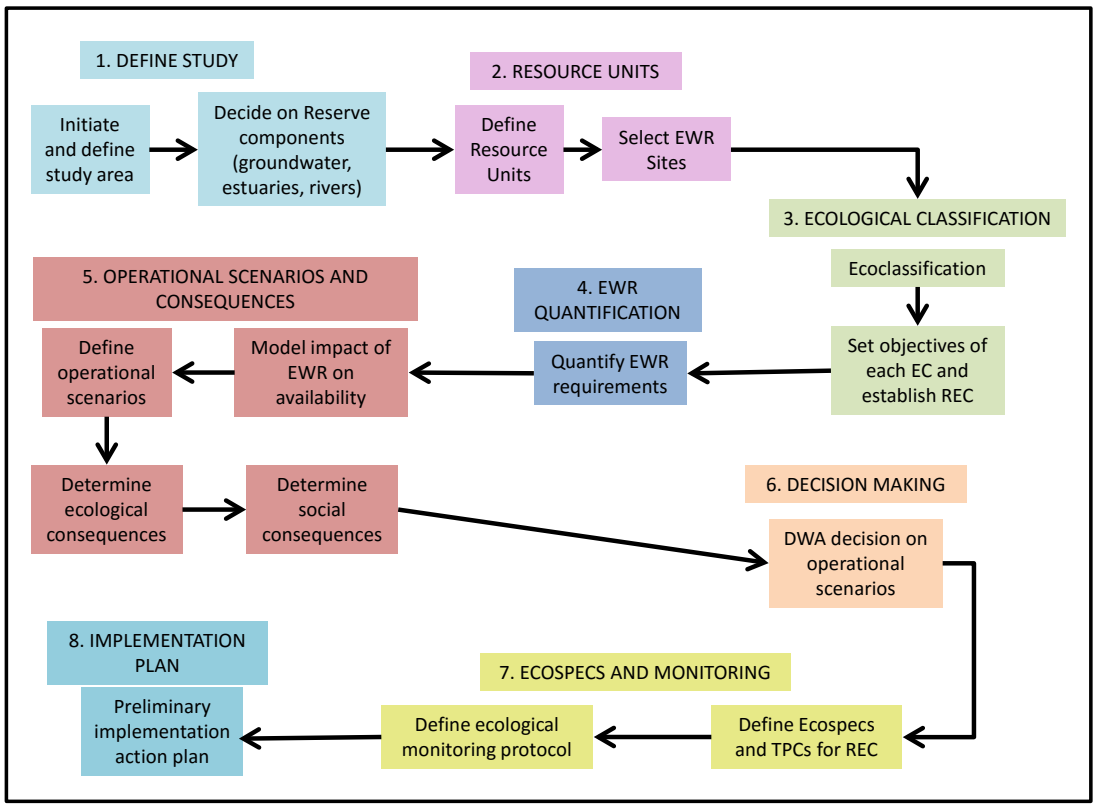

Figure 1-1 Generic procedure for the determination of the Ecological Reserve

The results are provided per EWR site and include the following:

- Data availability.
- Ecological Importance and Sensitivity (EIS)
- Reference conditions.
- Baseline ecological condition, including:
    - individual component EcoClassification;
    - cause and sources;
    - trends;
    - Ecostatus.
- Recommended Ecological category (REC) for each specialist component and EcoStatus.
- Alternative Ecological categories (AEC) for each specialist component and EcoStatus.
- Confidence in the results.

2 STUDY AREA AND EWR SITES

2.1 Study area

The extent of the study area is shown in (Figure 2-1). It comprises the following catchment areas, and main rivers (rivers in bold denote locations of Intermediate EWR determinations):

- Mhlatuze (W1), including:
  - Mhlatuze River;
  - **Matigulu River;**
  - Mfule River;
  - **Nseleni River;**
  - Mlalazi River.
- Mfolozi (W2), including:
  - Mfolozi River;
  - **White Mfolozi River;**
  - **Black Mfolozi River;**
  - Mvunyane River;
  - Nondweni River;
  - Hlonyane River;
  - SikweBezi River;
  - Mona River;
  - Msunduzi River.
- Mkuze (W3), including:
  - **Mkuze River;**
  - Nkongolwana River;
  - Msunduzi River;
  - Mzinene River;
  - Nzimane River;
  - Hluhluwe River;
  - Nylalazi River.
- Pongola (W4), including:
  - **Pongola River;**
  - Bivane River;
  - Manzana River;
  - Mozana River;
  - Ngwavuma River.
- Upper Usutu (W5), including:
  - **Assegaai River;**
  - Ohlelo River;
  - Ngwempisi River;

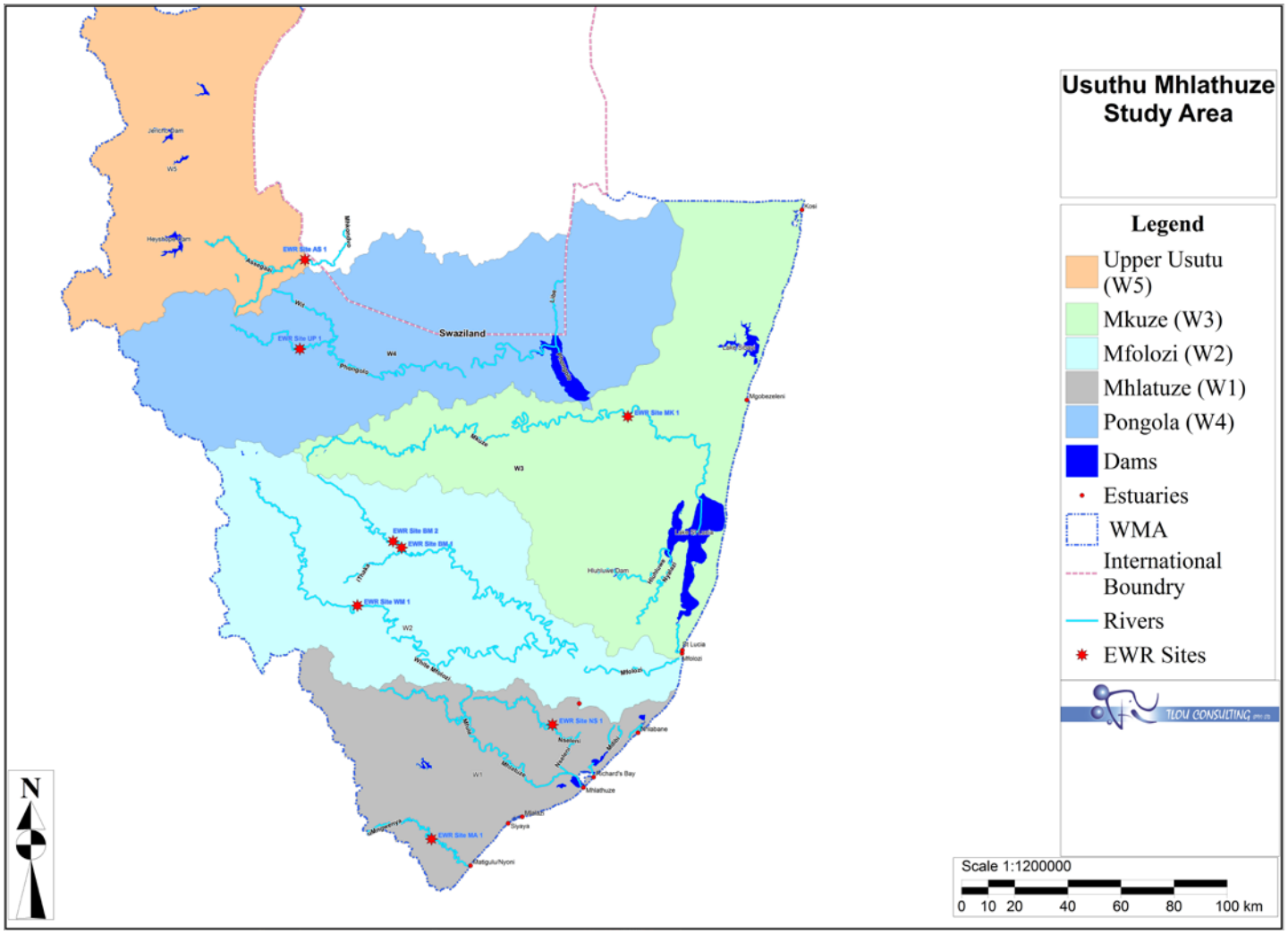

Figure 2-1 Map of the study area

  - Usuthu River;
  - Bonnie Brook River.
- Lake Sibaya / Kosi (W7).

2.2 EWR sites

The NWRCS node delineation process identified 49 river nodes for which EWR data will be required for Classification. In accordance with the Terms of Reference for the study, these data will be informed by intermediate assessments at eight sites that will be used to extrapolate results across the remainder of the area.

The locations of the eight EWR sites for which Intermediate assessments have been done are provided in Table 2-1.

Table 2-1 Locations of the eight EWR sites in the Intermediate EWR assessment

Quaternary	River name	Site Name	Location description	Latitude	Longitude
W51D	Assegaai	EWR Site AS1	Downstream of Heyshope Dam, near the Swaziland border.	27°3'44.28"S	30°59'19.68"E
W42E	Upper Pongola	EWR Site UP1	Near Frischgewaagd and Bilayoni Townships	27°21'50.88"S	30°58'10.62"E
W31J	Mkuze	EWR Site MK1	Adjacent to Mkuze National Park, almost opposite Mantuma Camp	27°35'31.56"S	32°13'4.80"E
W22C	Black Mfolozi	EWR Site BM1	Downstream of W2H028.	27°56'20.04"S	31°12'37.08"E
W22C	Black Mfolozi	EWR Site BM2	Near Basonhoek	28°0'50.04"S	31°19'27.48"E
W21H	White Mfolozi	EWR Site WM1		28°13'53.24"S	31°11'17.97"E
W12H	Nseleni	EWR Site NS1		28°38'2.76"S	31°55'51.24"E
W11B	Matigulu	EWR Site MA1	Downstream of old DWS gauging station.	29°1'12.36"S	31°28'13.44"E

3 EWR SITE AS1: ASSEGAAI RIVER

EWR Site AS1 is representative of the reach of the Assegaai River from Heyshope Dam to the RSA/Swaziland Border. It was also chosen to provide an extrapolation option for NWRCS nodes on the lower foothills of the Pongola River.

The relevant summary details are as follows:

Location:	Assegaai River, downstream of Heyshope Dam, close to the border between South Africa and Swaziland.
Coordinates:	27º3'44.28"S; 30º59'19.68"E.
Photograph:	See Figure 3-1.
.	
Comments:	EWR AS1 is the site of a previous EWR assessment (EWR site JMB2, Louw and Koekemoer 2008). It comprises a riffle, rapid and run section flanked by indigenous vegetation. There is a camp site and picnic area on the left bank.

Figure 3-1 EWR Site AS1: Assegaai River, September 2013

3.1 Data availability

The data available at EWR Site AS1 are summarised in Table 3-2.

The confidence rating used in the report is described in Table 3-1.

Table 3-1 Description of confidence ratings

Confidence rating	Description
1	Low confidence
2	Low to medium confidence
3	Medium confidence
4	Medium to high confidence
5	High confidence

Table 3-2 Data available at EWR Site AS1

Component	Data availability	Confidence
Hydrology	Measured data from Station W5H022 (Assegaai River at Zandbank (27.06519S; 30.99356E) situated just downstream of the EWR site. Plus data modelled using the Water Yield Model.	3
Hydraulics	Stage-discharge relationship calculated in 2014 for two cross-sections (one for high flow and one for low flows). Five observed discharges from 1.3 to 3.4m3/s.	3
Water quality	Long term water quality data from WMS at W5H022Q01 & W5H039QO1 (www.dwa.gov.za/iwqs/wms/data.html, accessed 30 June 2014); on site measurements (July 2014).	2
Geomorphology	Site survey data (July 2014); historical aerial photographs (1961, 1969, 1977, 1979, 1990); Google Earth imagery (2013) and hydrological summaries (Southern Waters 2014).	4
Vegetation	Species and vegetation type distributions (SANBI 2009; SIBIS, www.sanbi.org.za accessed 1 June 2009 and Mucina and Rutherfurd 2006); Google Earth imagery; historical aerial photographs; site specific hydraulics, vegetation data and hydrology.	5

Component	Data availability	Confidence
Macroinvertebrates	Rivers database for stations W5 ASSE-ZANDB, W5HLEL-WITKO, W5HLEL-VROEG, W5HLEL-EDENB, W5NGWE-NDLOV, W5NGWE-SKURW, W5ROBU-ROBUR; www.dwa.gov.za/iwqs/rhp/database.html accessed 30 June 2014.	2
Fish	Provincial (Kleynhans et al. 2007, DWA 2013) and national (SAIAB, www.saiaib.ac.za:8080/WebSearchSAIAB/advanced.jsp accessed June 2014; KZN-Wildlife, www.kznwildlife.com/index.php, accessed June 2014).	3

3.2 Ecological importance and sensitivity

The EIS of EWR Site AS1, with motivations, is provided in Table 3-3.

Table 3-3 EIS of EWR Site AS1

Metrics	Baseline Rating	Comments
Biota (instream and riparian)		
Rare and endangered	1.00	*Crocodylus niloticus* is vulnerable and protected under NEMBA. *Crinum bulbispermum* is declining but was not observed on site.
Unique	2.00	Most fish species present are widespread but some have restricted ranges. There were three endemic plant taxa, 1 restricted to South Africa.
Intolerant (flow and/or WQ)	2.33	There were flow sensitive fish and invertebrate species present and plants of the marginal zone depend on perennially available flow.
Taxon richness	3.00	There was a diverse community of fish and riparian vegetation and there were approximately 31 invertebrate taxa present.
Instream and riparian habitats		
Diversity	2.67	There was a diverse array of aquatic habitat types as well as alluvial, bedrock and backwater habitats for riparian plant species.
Refugia	1.67	Some fish and invertebrates depend upon the interstitial refugia provided by inundated riffles.
Sensitivity to change in flows	2.67	Riffles are sensitive to flow related changes at all times.
Sensitivity to change in water quality	1.33	The aquatic habitats are sensitive to flow related changes in this narrow channel.
Migration	1.67	This river is an important migration corridor for large migratory

Metrics	Baseline Rating	Comments
route/corridor		rheophilic fish and the riparian corridor was distinct and well established.
Importance of conservation and natural areas	1.50	There were many riparian plant species present but alien invasion of the riparian area was high.
MEDIAN	1.83	
EIS	Moderate	

3.3 Reference condition

The expected Reference condition at EWR Site AS1 is described in Table 3-4.

Table 3-4 Reference condition at EWR Site AS1

Component	Reference condition	Confidence
Hydrology	See Hydrology report.	3
Water quality	Reference condition water quality parameters are: PO_4-P (x<0.005 mg/L), TIN (x<0.25 mg/L), EC (x<30 mS/m), pH (6.5 (5^{th}-95^{th} percentile) <x<8.0 (5^{th}-95^{th} percentile)), DO (x>8 mg/L) (DWAF 2008).	3
Geomorphology	The bed would have been more mobile under reference conditions, the marginal zone less vegetated and the active channel slightly wider than present day.	3
Vegetation	The reference condition would comprise less woody species and fewer reeds in the marginal and lower zones, a state maintained by the natural flooding disturbance regime. The upper zone would be dominated by woody riparian species with some terrestrial species present but there would be no alien species.	3
Macroinvertebrates	There would be approximately 67 taxa present with an associated SASS total score of 250 and an ASPT of 7.	3
Fish	18 Fish species are expected to occur in the Assegaai River including four species dependent on flow all year and five that are dependent of flow for part of the year. The other species are able to persist through no flow periods.	3

3.4 Baseline ecological condition (2014)

This section summarised the outcome of the discipline-specific EcoClassification assessments, which are provided in River Intermediate EWR Report (Volume 3- Specialist report).

3.4.1 Causes and sources

Causes and sources for the Present Ecological State are summarised in Table 3-5 below.

Table 3-5 Causes and sources of PES at EWR AS1

Component	Causes	Sources	Flow or non-flow related	Confidence
Water quality	There are elevated phosphate levels and possibly also nitrogen. There are few data to validate this.	Piet Retief WWTW.	Point source impact, worsened by reduced flow.	3
Geomorphology	Reduced flood incidence and flow volumes (MAR), trapping of sediments in upstream dam is somewhat offset by increased sediment supply from forests and their gravel roads between the dam and the EWR site.	Heyshope Dam, water abstraction, afforestation and catchment erosion.	Primarily flow related (due to the reduction of floods).	3.5
Vegetation	Increased cover and abundance of woody species.	Reduced floods.	Flow	4
	Change in species composition of plant community.	Invasion by alien species.	Non-flow	5
Macroinvertebrates	Nutrient enrichment.	Urban and agricultural runoff and afforestation.	Non-flow	3
	Less variability in flow regime	Heyshope Dam.	Flow	2
Fish	Reduced passage for migratory species.	The dam is a barrier.	Flow	4

3.4.2 Trends

Trends in the Present Ecological Status for all components of EWR AS1 are summarised below in Table 3-6.

Table 3-6 Trends in PES for EWR AS1

Component	Trend	Confidence
Water quality	Very slight worsening due to sulphate enrichment.	2
Geomorphology	Negative as the site is still adjusting to the reduced floods caused by Heyshope Dam that was closed in the mid-1980s.	3.5
Vegetation	Stable in terms of flow related changes, but overall negative due to alien species invasion.	4
Macroinvertebrates	Stable.	1
Fish	Stable.	2

3.4.3 EcoStatus (2014)

The Present Ecological Status of each component at EWR AS1 is summarised below in Table 3-7.

Table 3-7 Present Ecological Status of all components at EWR AS1

Component	Scores	EC	REC
Water Quality	82.8	B	B
Geomorphology	65.1	C	C
Vegetation	69.9	C	C
Macroinvertebrates	86.4	B	B
Fish	81.8	B/C	B/C
Instream	84.5	B	B
PES score	76.5		
PES category	C		
EIS	Moderate		
REC	C		
AECs	B and D		

4 EWR SITE UP1: UPPER PONGOLA RIVER

EWR Site UP1 is representative of the Pongola River from the R33 to Pongolapoort Dam. It was also chosen to provide an extrapolation option for NWRCS nodes on the Bivane, SikweBezi, upper Mkuze and Manzana Rivers.

The relevant summary details are as follows:

Location: Upper Pongola River, near Frischgewaagd and Bilayoni Townships, upstream of the confluence with the Wit River.

Coordinates: 27º21'50.88"S; 30º58'10.62"E

Photograph: See Figure 4-1.

.

Comments: This site has a range of habitats including riffles, pools and a variety of riparian vegetation while the area downstream is afforested.

Figure 4-1 EWR Site UP1: Upper Pongola River, September 2013

4.1 Data availability

The data available at EWR Site UP1 are summarised in Table 4-1.

Table 4-1 Data available at EWR Site UP1

Component	Data availability		Confidence
Hydrology	W4H002	Phongolo River @ Intulembi	3
	W4H003	Phongolo River @ The Bokfontein	
	W4H004	Bivane River @ Welgelegen	
	W4H006	Phongolo River @ M'Hlati	
	W4H008	Braksloot @ Pongola	
	W4H009	Phongolo River @ Ndumu Game Reserve	
	W4H010	Phongolo River @ Lake View	
	W4H013	Phongolo River @ Jozini	
	W4H016	Bivane River @ Paris Dam	
	Plus data modelled using the Water Yield Model.		
Hydraulics	Stage-discharge relationship calculated in 2014 for one cross-section. Two observed discharges at 3.4 and 6.7m3/s.		3
Water quality	Long term water quality data from WMS at W4H004Q01 (www.dwa.gov.za/iwqs/wms/data.html, accessed 30 June 2014); on site measurements (July 2014).		2
Geomorphology	Site survey data (July 2014); historical aerial photographs (1961, 1969, 1977, 1979, 1990); Google Earth imagery (2013); hydrological summaries (Southern Waters 2014) and cross-sections of the Pongolo River after Demoina (DWA 1984, Bracher and Kovacz1985).		4
Vegetation	Species and vegetation type distributions (SANBI 2009; SIBIS, www.sanbi.org.za accessed 1 June 2009 and Mucina and Rutherfurd 2006); Google Earth imagery; historical aerial photographs; site specific hydraulics, vegetation data and hydrology.		5
Macroinvertebrates	Rivers database for stations W4BIVN-NTLSP, W4PONG-BENDO, W2BMFU-CHRIS; www.dwa.gov.za/iwqs/rhp/database.html accessed 30 June 2014.		2
Fish	Provincial (Kleynhans et al. 2007, DWA 2013) and national (SAIAB, www.saiaib.ac.za:8080/WebSearchSAIAB/advanced.jsp accessed June 2014; KZN-Wildlife, www.kznwildlife.com/index.php, accessed June 2014).		3

4.2 Ecological importance and sensitivity

The EIS of EWR Site UP1, with motivations, is provided in Table 4-2.

Table 4-2 EIS of EWR Site UP1

Metrics	Baseline Rating	Comments
Biota (instream and riparian)		
Rare and endangered	1.00	*Crocodylus niloticus* is vulnerable and protected under NEMBA.
Unique	2.00	Most fish species present are widespread but some have restricted ranges. Two of the three expected plant endemic species were observed.
Intolerant (flow and/or WQ)	2.33	There were flow sensitive fish and invertebrate species present and plants of the marginal zone depend on perennially available flow.
Taxon richness	3.00	There was a diverse community of fish and riparian vegetation and there were approximately 30 invertebrate taxa present.
Instream and riparian habitats		
Diversity	2.67	There was a diverse array of aquatic habitat types as well as alluvial, bedrock and backwater habitats for riparian plant species.
Refugia	1.67	Some fish and invertebrates depend upon the interstitial refugia provided by inundated riffles.
Sensitivity to change in flows	2.67	Riffles are sensitive to flow related changes at all times.
Sensitivity to change in water quality	1.33	This channel is moderately sensitive to flow related water quality changes.
Migration route/corridor	1.67	This river is an important migration corridor for large migratory rheophilic fish and freshwater prawns (Palaemonidae). The riparian corridor was in a poor condition due to clearing for agriculture and forestry.
Importance of conservation and natural areas	1.50	There were many non-flow related anthropogenic sources of disturbance.
MEDIAN	1.83	
EIS	Moderate	

4.3 Reference condition

The expected Reference condition at EWR Site UP1 is described in Table 4-3.

Table 4-3 Reference condition at EWR Site UP1

Component	Reference condition	Confidence
Hydrology	See Hydrology Report.	3
Water quality	Reference condition water quality parameters are: PO_{4}-P (x<0.005 mg/L), TIN (x<0.25 mg/L), EC (x<30 mS/m), pH (6.5 (5^{th}-95^{th} percentile) <x<8.0 (5^{th}-95^{th} percentile)), DO (x>8 mg/L) (DWAF 2008).	3
Geomorphology	The sediment (sand) load would have been lower than found at present, and there would be no minor impacts from small scale sand mining. The lateral bars and riparian area would be better vegetated and more stable. There would be slightly less sand present across the in-channel habitats.	3
Vegetation	The marginal and lower zones would be dominated by non-woody vegetation, mainly grasses and sedges. Cover of reeds would be lower in all zones and there would be no alien species. The banks would be dominated by a mixture of woody and non-woody species with some open areas.	3
Macroinvertebrates	There would be approximately 68 taxa present with an associated SASS total score of 220 and an ASPT of 7.	3
Fish	28 Fish species are expected to occur in the Pongola River at the EWR site including five species dependent on flow all year and five that are dependent of flow for part of the year. The other species are able to persist through no flow periods.	3

4.4 Baseline ecological condition (2014)

This section summarised the outcome of the discipline-specific EcoClassification assessments, which are provided in River Intermediate EWR Report (Volume 3 – Specialist report).

4.4.1 Causes and sources

Causes and sources for the Present Ecological State are summarised below in Table 4-4.

Table 4-4 Causes and sources of PES at EWR UP1

Component	Causes	Sources	Flow or non-flow related	Confidence
Water quality	There are possible nutrient contamination from nearby residential areas	Rural and agricultural runoff	Non flow	2
Geomorphology	Limited sand mining, catchment erosion and some invasive plant species.	Catchment degradation.	Non-flow	3.5
Vegetation	Reduced cover and abundance of woody species.	Wood harvesting.	Non-flow	4
	Increased cover of reeds.	Reduced competition.	Non-flow	
	Change in species composition of plant community.	Invasion by alien species.	Non-flow	5
Macroinvertebrates	Nutrient enrichment.	Rural and agricultural runoff.	Non-flow	3
	Sedimentation.	Cattle trampling.	Non-flow	2
Fish	Minor reduction in quality of interstitial habitat, reduced feeding opportunities.	Sand mining, grazing of marginal vegetation zone.	Non-flow	4

4.4.2 Trends

Trends in the Present Ecological State for all components of EWR UP1 are summarised below in Table 4-5.

Table 4-5 Trends in PES for EWR UP1

Component	Trend	Confidence
Water quality	Stable.	2
Geomorphology	Stable.	3.5
Vegetation	Stable in terms of flow related changes, but overall negative due to alien species invasion.	4
Macroinvertebrates	Stable.	1
Fish	Stable.	2

4.4.3 EcoStatus (2014)

The Present Ecological Status of each component at EWR UP1 is summarised below in Table 4-6.

Table 4-6 Present Ecological Status of all components at EWR UP1

Component	Scores	EC	REC
Water Quality	85.2	B	B
Geomorphology	87.1	B	B
Vegetation	70.0	C	C
Macroinvertebrates	79.5	B/C	B/C
Fish	70.4	C	C
Instream	75.3	C	C
PES score	72.6		
PES category	C		
EIS	Moderate		
REC	C		
AECs	B and D		

5 EWR SITE MK1: MKUZE RIVER

EWR Site MK1 is representative of the lower reach of the Mkuze River from the N2 to St Lucia. It was also chosen to provide an extrapolation option for NWRCS nodes on the Ngwavuma River (see Rivers Delineation Report).

The relevant summary details are as follows:

Location: Mkuze River, adjacent to Mkuze National Park, almost opposite Mantuma Camp.

Coordinates: 27º35'31.56"S; 32º13'4.80"E

Photograph: See Figure 5-1.

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Comments: The channel at this site was wide, the substratum sandy and there was well established riparian vegetation. This is also an existing River Health Monitoring site (W3MKZ-DNYDR).

Figure 5-1 EWR Site MK1: Mkuze River, September 2013

5.1 Data availability

The data available at EWR Site MK1 are summarised in Table 5-1.

Table 5-1 Data available at EWR Site MK1

Component	Data availability	Confidence
Hydrology	W3H001 Mkuze River @ Rietboklaagte W3H002 Mkuze River @ Morgenstond W3H008 Mkuze River @ Doornhoek W3H011 Mkuze River @ Morrisvale Plus data modelled using the ACRU.	3
Hydraulics	Stage-discharge relationship calculated in 2014 for one cross-section. Two observed at 0.7 and 1.4m3/s.	3
Water quality	Long term water quality data from WMS at W5H022Q01 & W5H039QO1 (www.dwa.gov.za/iwqs/wms/data.html, accessed 30 June 2014), on site measurements (July 2014).	2
Geomorphology	Site survey data (July 2014); historical aerial photographs (1961, 1969, 1977, 1979, 1990); Google Earth imagery (2013) and hydrological summaries (DWA 2014).	4
Vegetation	Species and vegetation type distributions (SANBI 2009; SIBIS, www.sanbi.org.za accessed 1 June 2009 and Mucina and Rutherfurd 2006); Google Earth imagery; historical aerial photographs; site specific hydraulics, vegetation data and hydrology.	5
Macroinvertebrates	Rivers database for stations W5 ASSE-ZANDB, W5HLEL-WITKO, W5HLEL-VROEG, W5HLEL-EDENB, W5NGWE-NDLOV, W5NGWE-SKURW, W5ROBU-ROBUR; www.dwa.gov.za/iwqs/rhp/database.html accessed 30 June 2014.	2
Fish	Provincial (Kleynhans et al. 2007, DWA 2013) and national (SAIAB, www.saiaib.ac.za:8080/WebSearchSAIAB/advanced.jsp accessed June 2014; KZN-Wildlife, www.kznwildlife.com/index.php, accessed June 2014).	3

5.2 Ecological importance and sensitivity

The EIS of EWR Site MK1, with motivations, is provided in Table 5-2.

Table 5-2 EIS of EWR Site MK1

Metrics	Baseline Rating	Comments
Biota (instream and riparian)		
Rare and endangered	1.00	*Crocodylus niloticus* is vulnerable and protected under NEMBA. *Balanites maughamii* is declining.
Unique	2.00	Most fish species present are widespread but some have restricted ranges. The Lowveld Riverine Forest community is critically endangered for the Maputaland centre of endemism. Palaemonidae prawns should be present.
Intolerant (flow and/or WQ)	2.33	There were flow sensitive fish and invertebrate species present and most plants present were phreatophytic, being reliant moist soil wetted from either ground or surface flow.
Taxon richness	3.00	There was a diverse community of fish and riparian vegetation and there were approximately 23 invertebrate taxa present.
Instream and riparian habitats		
Diversity	2.67	There was little riffle habitat present and bedrock was absent or uncommon but there were extensive floodplain areas. The channel was dominated by sand so the instream vegetation is very important for aquatic invertebrates.
Refugia	1.67	The floodplains and backwaters provide refugia for fish and invertebrates.
Sensitivity to change in flows	2.67	Some aquatic habitat is sensitive to reduced flows, particularly the instream vegetation.
Sensitivity to change in water quality	1.33	This channel is moderately sensitive to flow related water quality changes.
Migration route/corridor	1.67	This river is an important migration corridor for large migratory rheophilic fish and freshwater prawns (Palaemonidae) but the extent and connectivity of the riparian corridor was reduced due to clearing, especially on the floodplain.
Importance of conservation and natural areas	1.50	This river is important for fish conservation on a national scale and is part of the Mkhuze Nature Reserve area although it occurs outside of the fenced reserve.
MEDIAN	1.83	
EIS	Moderate	

5.3 Reference condition

The expected Reference condition at EWR Site MK1 is described in Table 5-3.

Table 5-3 Reference condition at EWR Site MK1

Component	Reference condition	Confidence
Hydrology	See Hydrology Report.	3
Water quality	Reference condition water quality parameters are: PO_4-P (x<0.005 mg/L), TIN (x<0.25 mg/L), EC (x<30 mS/m), pH (6.5 (5^{th}-95^{th} percentile) <x<8.0 (5^{th}-95^{th} percentile)), DO (x>8 mg/L) (DWAF 2008).	3
Geomorphology	The river is presently very close to the expected reference condition. There would be a slightly higher sediment yield and a greater abundance woody species on the floodplain if this site was pristine.	3
Vegetation	This site should be dominated by a diversity of tall woody species characteristic of Lowveld Riverine Forest with extensive floodplains.	3
Macroinvertebrates	There would be approximately 60 taxa present with an associated SASS total score of 150 and an ASPT of 7.	3
Fish	31 Fish species are expected to occur in the Mkuze River at the EWR site including one dependent on flow all year and four that are dependent of flow for part of the year. The other species are able to persist through no flow periods.	3

5.4 Baseline ecological condition (2014)

This section summarised the outcome of the discipline-specific EcoClassification assessments, which are provided in River Intermediate EWR Report (Volume 3 – specialist report).

5.4.1 Causes and sources

Causes and sources for the Present Ecological Status are summarised below in Table 5-4.

Table 5-4 Causes and sources of PES at EWR MK1

Component	Causes	Sources	Flow or non-flow related	Confidence
Water quality	High levels of nutrients, EC and sulphates.	Mining, worsened by irrigation return flows through cultivated fields.	Point source but worsened by reduced flow.	3

Component	Causes	Sources	Flow or non-flow related	Confidence
Geomorphology	Minor increase in sediment yield from the upper catchment.	Catchment degradation, clearing of woody floodplain vegetation.	Non-flow.	3.5
Vegetation	Reduced cover and abundance of woody species.	Clearing for firewood and agriculture.	Non-flow.	4
	Change in species composition of plant community.	Invasion by alien species.	Non-flow.	5
Macroinvertebrates	Changes in natural flow regime.	Inter-basin transfer from Pongolapoort Dam.	Flow.	3
	Sedimentation.	Cattle trampling.	Non-flow.	2
Fish	Reduced quality of aquatic and floodplain habitat.	Flow regulation, clearing of floodplain vegetation.	Non-flow.	4

5.4.2 Trends

Trends in the Present Ecological Status for all components of EWR MK1 are summarised below in Table 5-5.

Table 5-5 Trends in PES for EWR MK1

Component	Trend	Confidence
Water quality	Very slight worsening due to increased levels of EC and nutrients.	3
Geomorphology	Stable.	4
Vegetation	Stable in terms of flow related changes, but overall negative due to alien species invasion and especially so of the floodplain. The marginal and lower zones are more stable.	4
Macroinvertebrates	Stable.	1
Fish	Stable.	2

5.4.3 EcoStatus (2014)

The Present Ecological Status of each component at EWR MK1 is summarised below in Table 5-6.

Table 5-6 Present Ecological Status of all components at EWR MK1

Component	Scores	EC	REC
Water Quality	58.1	C/D	C
Geomorphology	88.9	A/B	A/B
Vegetation	73.0	C	C
Macroinvertebrates	76.9	C	C
Fish	78.5	B/C	B/C
Instream	77.5	C	
PES score	75.0		
PES category	C		
EIS	Moderate		
REC	C		
AECs	B and D		

6 EWR SITE BM1: BLACK MFOLOZI RIVER

EWR Site BM1 is representative of the upper reaches of the Black Mfolozi River upstream of the confluence with the Kwabizankulu River. It was also chosen to provide an extrapolation option for NWRCS nodes on the Black Mfolozi, Bivane, Nondweni and Mvunyane Rivers (see Rivers Delineation Report).

The relevant summary details are as follows:

Location: Black Mfolozi River, downstream of DWS Gauge W2H028.

Coordinates: 27°56'20.04"S; 31°12'37.08"E.

Photograph: See Figure 6-1.

.

Comments: There is good access to this bedrock controlled site and a gauging weir is located upstream. There are distinct high and low-flow zones and a good range of aquatic habitat available.

Figure 6-1 EWR Site BM1: Black Mfolozi, September 2013

6.1 Data availability

The data available at EWR Site BM1 are summarised in Table 6-1.

Table 6-1 Data available at EWR Site BM1

Component	Data availability	Confidence
Hydrology	W2H002 Black Mfolozi River @ Umfolozi Game Res. W2H006 Black Mfolozi River @ Native Res 12 W2H008 Black Mfolozi River @ Ekuhlengeni W2H010 Mfolozi River @ Native Res 5 W2H028 Black Mfolozi River @ Ekuhlengeni W2H032 Umfolozi River @ State Land Plus data modelled using the ACRU.	3
Hydraulics	Stage-discharge relationship calculated in 2014 for one cross-section. Three discharges ranges from 0.25 to 2.76m3/s.	3
Water quality	Long term water quality data from WMS at W5H022Q01 & W5H039QO1 (www.dwa.gov.za/iwqs/wms/data.html, accessed 30 June 2014), on site measurements (July 2014).	2
Geomorphology	Site survey data (July 2014); historical aerial photographs (1961, 1969, 1977, 1979, 1990); Google Earth imagery (2013) and hydrological summaries (Southern Waters 2014). Data on sediment yield and sources of erosion in the catchment; cross-sectional changes at the Black and White Mfolozi rivers after the very large 1984 Domonia floods (DWA 1984, Bracher and Kovacz 1985, Watson et al 1996, Watson and Ramokgopa 1997). Hydrological summaries (Southern Waters 2014). Historical aerial photographs and Google Earth imagery was examined to identify morphological stability and trends.	4
Vegetation	Species and vegetation type distributions (SANBI 2009; SIBIS, www.sanbi.org.za accessed 1 June 2009 and Mucina and Rutherfurd 2006); Google Earth imagery; historical aerial photographs; site specific hydraulics, vegetation data and hydrology.	5
Macroinvertebrates	Rivers database for stations W5 ASSE-ZANDB, W5HLEL-WITKO, W5HLEL-VROEG, W5HLEL-EDENB, W5NGWE-NDLOV, W5NGWE-SKURW, W5ROBU-ROBUR; www.dwa.gov.za/iwqs/rhp/database.html accessed 30 June 2014.	2
Fish	Provincial (Kleynhans et al. 2007, DWA 2013) and national (SAIAB, www.saiaib.ac.za:8080/WebSearchSAIAB/advanced.jsp accessed June 2014; KZn-Wildlife, www.kznwildlife.com/index.php, accessed June 2014).	3

6.2 Ecological importance and sensitivity

The EIS of EWR Site BM1, with motivations, is provided in Table 6-2.

Table 6-2 EIS of EWR Site BM1

Metrics	Baseline Rating	Comments
Biota (instream and riparian)		
Rare and endangered	1.00	*Crocodylus niloticus* is vulnerable and protected under NEMBA. None of the 3 rare plant species expected were observed.
Unique	2.00	Most fish species present are widespread but some have restricted ranges. None of the 5 endemic plant species expected were found but freshwater prawns (Palaemonidae) were present.
Intolerant (flow and/or WQ)	2.33	There were flow sensitive fish and invertebrate species present and the marginal zone was rich in water-dependent sedges.
Taxon richness	3.00	There was a diverse community of fish and riparian vegetation and there were approximately 30 invertebrate taxa present.
Instream and riparian habitats		
Diversity	2.67	There was a diverse array of aquatic habitat types and both alluvial and bedrock riparian habitat but no backwaters or floodplains.
Refugia	1.67	Some fish and invertebrates depend upon the interstitial refugia provided by inundated riffles.
Sensitivity to change in flows	2.67	Riffles are sensitive to flow related changes at all times.
Sensitivity to change in water quality	1.33	This medium sized channel is moderately sensitive to flow related changes.
Migration route/corridor	1.67	This river is an important migration corridor for large migratory rheophilic fish and freshwater prawns (Palaemonidae) and there are no major impoundments. The riparian corridor was patchy due to clearing and overgrazing.
Importance of conservation and natural areas	1.50	There were many riparian plant species present but the riparian area was generally disturbed.
MEDIAN	1.83	
EIS	Moderate	

6.3 Reference condition

The expected Reference condition at EWR Site BM1 is described in Table 6-3.

Table 6-3 Reference condition at EWR Site BM1

Component	Reference condition	Confidence
Hydrology	See Hydrology Report.	3
Water quality	Reference condition water quality parameters are: PO_4-P (x<0.005 mg/L), TIN (x<0.25 mg/L), EC (x<30 mS/m), pH (6.5 (5^{th}-95^{th} percentile) <x<8.0 (5^{th}-95^{th} percentile)), DO (x>8 mg/L) (DWAF 2008).	3
Geomorphology	The PD condition of the river is close to the Reference condition.	4
Vegetation	The marginal and lower zone would be dominated by non-woody vegetation (grasses and sedges) and some scattered woody species, which are currently absent. The bank would be dominated riparian and terrestrial woody species and there would be no alien species.	3
Macroinvertebrates	There would be approximately 68 taxa present with an associated SASS total score of 220 and an ASPT of 7.	3
Fish	15 Fish species are expected to occur in the Black Mfolozi River at EWR site BM1 including two dependent on flow all year and two that are dependent of flow for part of the year. The other species are able to persist through no flow periods.	3

6.4 Baseline ecological condition (2014)

This section summarised the outcome of the discipline-specific EcoClassification assessments, which are provided in River Intermediate EWR Report (Volume 3 – Specialist report).

6.4.1 Causes and sources

Causes and sources of the Present Ecological Status are summarised below in Table 6-4.

Table 6-4 Causes and sources of the PES at EWR site BM1

Component	Causes	Sources	Flow or non-flow related	Confidence
Water quality	High levels of sulphates.	Coal mining.	Point source but worsened by reduced flow.	3
Geomorphology	Slightly reduced flows, elevated fines	Reduced flows and elevated fines from catchment degradation (afforestation)	Primarily non-flow related	3.5
Vegetation	Reduced cover and abundance of woody species.	Harvesting of wood and grazing of seedlings.	Non-flow.	4
	Change in species composition of plant community.	Invasion by alien species.	Non-flow.	5
Macroinvertebrates	Nutrient enrichment.	Rural settlements.	Non-flow.	3
	Migration barrier to freshwater prawns	Upstream weir.	Flow	3
	Sedimentation.	Cattle trampling, upper catchment afforestation	Non-flow.	2
Fish	Minor reduction in quality of interstitial habitat due to sedimentation.	Coal mining and rural settlements.	Non-flow.	4

6.4.2 Trends

Trends in PES for all components of EWR BM1 are summarised below in Table 6-5.

Table 6-5 Trends in PES for EWR BM1

Component	Trend	Confidence
Water quality	Positive, levels of EC, sulphate and phosphate decreasing.	4
Geomorphology	Stable	4
Vegetation	Stable in terms of flow related changes, but overall negative due to alien species invasion.	4
Macroinvertebrates	Stable	1
Fish	Stable	2

6.4.3 EcoStatus (2014)

The Present Ecological Status of each component at EWR BM1 is summarised below in Table 6-6.

Table 6-6 Present Ecological Status of all components at EWR BM1

Component	Scores	EC	REC
Water Quality	87.1	B	B
Geomorphology	88.9	A/B	A/B
Vegetation	74.9	C	C
Macroinvertebrates	81.3	B/C	B/C
Fish	75.9	C	C
Instream	79.1	B/C	B/C
PES score	77.3		
PES category	C		
EIS	Moderate		
REC	C		
AECs	B and D		

7 EWR SITE BM2: BLACK MFOLOZI RIVER

EWR Site BM2 is representative of the upper reaches of the Black Mfolozi River from the confluence with the Kwabizankulu River to the confluence with the White Umfolozi River. It was also chosen to provide an extrapolation option for NWRCS nodes on the Black Mfolozi, Bivane, Nondweni and Mvunyane Rivers (see Rivers Delineation Report).

The relevant summary details are as follows:

Location: Black Mfolozi River, near Basonhoek.

Coordinates: 28º0'50.04"S; 31º19'27.48"E.

Photograph: See Figure 7-1.

.

Comments: There are large boulders at this bedrock controlled site, which offers a good range of aquatic habitats to river organisms.

Figure 7-1 EWR Site BM2: Black Mfolozi River, September 2013

7.1 Data availability

The data available at EWR Site BM2 are summarised in Table 7-1.

Table 7-1 Data available at EWR Site BM2

Component	Data availability		Confidence
Hydrology	W2H002	Black Mfolozi River @ Umfolozi Game Res.	3
	W2H006	Black Mfolozi River @ Native Res 12	
	W2H008	Black Mfolozi River @ Ekuhlengeni	
	W2H010	Mfolozi River @ Native Res 5	
	W2H028	Black Mfolozi River @ Ekuhlengeni	
	W2H032	Umfolozi River @ State Land	
	Plus data modelled using the ACRU.		
Hydraulics	Stage-discharge relationship calculated in 2014 for one cross-section. One observed at 0.27m3/s.		3
Water quality	Long term water quality data from WMS at W5H022Q01 & W5H039QO1 (www.dwa.gov.za/iwqs/wms/data.html, accessed 30 June 2014), on site measurements (July 2014).		2
Geomorphology	Site survey data (July 2014); historical aerial photographs (1961, 1969, 1977, 1979, 1990); Google Earth imagery (2013) and hydrological summaries (Southern Waters 2014). Data on sediment yield and sources of erosion in the catchment; cross-sectional changes at the Black and White Mfolozi rivers after the very large 1984 Domonia floods (DWA 1984, Bracher and Kovacz 1985, Watson et al 1996, Watson and Ramokgopa 1997). Hydrological summaries (Southern Waters 2014). Historical aerial photographs and Google Earth imagery was examined to identify morphological stability and trends.		4
Vegetation	Species and vegetation type distributions (SANBI 2009; SIBIS, www.sanbi.org.za accessed 1 June 2009 and Mucina and Rutherfurd 2006); Google Earth imagery; historical aerial photographs; site specific hydraulics, vegetation data and hydrology.		5
Macroinvertebrates	Rivers database for stations W5 ASSE-ZANDB, W5HLEL-WITKO, W5HLEL-VROEG, W5HLEL-EDENB, W5NGWE-NDLOV, W5NGWE-SKURW, W5ROBU-ROBUR; www.dwa.gov.za/iwqs/rhp/database.html accessed 30 June 2014.		2
Fish	Provincial (Kleynhans et al. 2007, DWA 2013) and national (SAIAB, www.saiaib.ac.za:8080/WebSearchSAIAB/advanced.jsp accessed June 2014; KZn-Wildlife, www.kznwildlife.com/index.php, accessed June 2014).		3

7.2 Ecological importance and sensitivity

The EIS of EWR Site BM2, with motivations, is provided in Table 7-2.

Table 7-2 EIS of EWR Site BM2

Metrics	Baseline Rating	Comments
Biota (instream and riparian)		
Rare and endangered	1.00	*Crocodylus niloticus* is vulnerable and protected under NEMBA. None of the 3 rare plant species expected were observed.
Unique	2.00	Most fish species present are widespread but some have restricted ranges. None of the 5 endemic species expected were found but there were freshwater prawns (Palaemonidae).
Intolerant (flow and/or WQ)	2.33	There were flow sensitive fish and invertebrate species present and the abundant sedges in the marginal zone depend on perennially available flow.
Taxon richness	3.00	There was a diverse community of fish, the riparian vegetation was characteristic of the Maputaland Pondoland Region of endemism and there were approximately 29 invertebrate taxa present.
Instream and riparian habitats		
Diversity	2.67	There was a diverse array of aquatic habitat types as well as alluvial and bedrock for riparian plant species but there were no backwater habitats or floodplain present.
Refugia	1.67	Some fish and invertebrates depend upon the interstitial refugia provided by inundated riffles.
Sensitivity to change in flows	2.67	Riffles are sensitive to flow related changes at all times.
Sensitivity to change in water quality	1.33	This medium sized river is moderately sensitive to flow-related changes in water quality.
Migration route/corridor	1.67	This river is an important migration corridor for large migratory rheophilic fish and freshwater prawns (Palaemonidae) and there are no major impoundments. The riparian corridor was patchy due to clearing and overgrazing.
Importance of conservation and natural areas	1.50	The riparian area is severely impacted but there are some patches that are undisturbed.
MEDIAN	1.83	
EIS	Moderate	

7.3 Reference condition

The expected Reference condition at EWR Site BM2 is described in Table 3-3.

Table 7-3 Reference condition at EWR Site BM2

Component	Reference condition	Confidence
Hydrology	See Hydrology Report.	3
Water quality	Reference condition water quality parameters are: PO_{4}-P (x<0.005 mg/L), TIN (x<0.25 mg/L), EC (x<30 mS/m), pH (6.5 (5^{th}-95^{th} percentile) <x<8.0 (5^{th}-95^{th} percentile)), DO (x>8 mg/L) (DWAF 2008).	3
Geomorphology	The PD condition of the river is close to the Reference condition, but sediment loads are slightly elevated in the reach.	3.5
Vegetation	The marginal and lower zone would be dominated by non-woody vegetation (grasses and sedges) and some scattered woody species, which are currently absent. The bank would be dominated riparian and terrestrial woody species and there would be no alien species.	3
Macroinvertebrates	There would be approximately 68 taxa present with an associated SASS total score of 220 and an ASPT of 7.	3
Fish	18 Fish species are expected to occur in the Black Mfolozi River at EWR BM2 site including three dependent on flow all year and two that are dependent of flow for part of the year. The other species are able to persist through no flow periods.	3

7.4 Baseline ecological condition (2014)

This section summarised the outcome of the discipline-specific EcoClassification assessments, which are provided in River Intermediate EWR Report (Volume 3 – Specialist report).

7.4.1 Causes and sources

Causes and sources of the Present Ecological Status are summarised below in Table 7-4.

Table 7-4 Causes and sources of PES at EWR site BM2

Component	Causes	Sources	Flow or non-flow related	Confidence
Water quality	Turbidity expected to be high	Land-use such as subsistence agriculture	Non flow	3
Geomorphology	Reduced flows, slightly reduced floods, and elevated fines	Reduced flows from dams; elevated fines from catchment degradation.	Flow and non-flow related	3.5
Vegetation	Change in species composition of plant community.	Invasion by alien species, related to land use, such as overgrazing & vegetation clearing	Non-flow.	5
Macroinvertebrates	Nutrient enrichment.	Rural settlements.	Non-flow.	
	Sedimentation.	Cattle trampling.	Non-flow.	2
Fish	Minor reduction in quality of interstitial habitat due to sedimentation.	Grazing in marginal zone.	Non-flow.	4

7.4.2 Trends

Trends in the Present Ecological Status for all components of EWR BM2 are summarised below in Table 7-5.

Table 7-5 Trends in PES for EWR BM2

Component	Trend	Confidence
Water quality	Stable.	4
Geomorphology	Stable.	4
Vegetation	Stable in terms of flow related changes, but overall negative due to alien species invasion.	4
Macroinvertebrates	Stable.	1
Fish	Stable.	2

7.4.3 EcoStatus (2014)

The Present Ecological Status of each component at EWR BM2 is summarised below in Table 7-6.

Table 7-6 Present Ecological Status of all components at EWR BM2

Component	Scores	EC	REC
Water Quality	86.7	B	B
Geomorphology	83.1	B	B
Vegetation	76.7	C	C
Macroinvertebrates	79.8	B/C	B/C
Fish	75.2	C	C
Instream	77.9	B/C	B/C
PES score	77.3		
PES category	C		
EIS	Moderate		
REC	C		
AECs	B and D		

8 EWR SITE WM1: WHITE MFOLOZI RIVER

EWR Site WM1 is representative of the upper reaches of the White Mfolozi River from the confluence with the Mvunyane River to the confluence with the Black Mfolozi River. It was also chosen to provide an extrapolation option for NWRCS nodes on the White Mfolozi, Mona, Nzimane, Mozana, Pongola and Mkuze Rivers (see Rivers Delineation Report).

The relevant summary details are as follows:

Location: White Mfolozi River, just downstream of the R34 at the confluence with the Mvutshini River.

Coordinates: 28º13'53.24"S; 31º11'17.97"E.

Photograph: See Figure 8-1.

.

Comments: There is a gauging weir immediately upstream of the site that is located downstream of a road bridge with large culverts that do not impede flow. This site has distinct high and low flow zones and offers a large variety of habitat to river organisms.

Figure 8-1 EWR Site WM1: White Mfolozi River, September 2013

8.1 Data availability

The data available at EWR Site WM1 are summarised in Table 8-1.

Table 8-1 Data available at EWR Site WM1

Component	Data availability		Confidence
Hydrology	W2H003	White Mfolozi River @ Umfolozi Game Reserve	3
	W2H005	White Mfolozi River @ Overvloed	
	W2H009	White Mfolozi River @ Doornhoek	
	W2H010	Mfolozi River @ Native Res 5	
	W2H030	White Mfolozi River @ Klipfontein	
	W2H032	Umfolozi River @ State Land	
	Plus data modelled using the ACRU.		
Hydraulics	Stage-discharge relationship calculated in 2014 for one cross-section. Two observed records 0.7 and 6.4m3/s.		3
Water quality	Long term water quality data from WMS at W5H022Q01 & W5H039QO1 (www.dwa.gov.za/iwqs/wms/data.html, accessed 30 June 2014), on site measurements (July 2014).		2
Geomorphology	Site survey data (July 2014); historical aerial photographs (1961, 1969, 1977, 1979, 1990); Google Earth imagery (2013) and hydrological summaries (Southern Waters 2014). Data on sediment yield and sources of erosion in the catchment; cross-sectional changes at the Black and White Mfolozi rivers after the very large 1984 Domonia floods (DWA 1984, Bracher and Kovacz 1985, Watson et al 1996, Watson and Ramokgopa 1997). Hydrological summaries (Southern Waters 2014).		4
Vegetation	Species and vegetation type distributions (SANBI 2009; SIBIS, www.sanbi.org.za accessed 1 June 2009 and Mucina and Rutherfurd 2006); Google Earth imagery; historical aerial photographs; site specific hydraulics, vegetation data and hydrology.		5
Macroinvertebrates	Rivers database for stations W5 ASSE-ZANDB, W5HLEL-WITKO, W5HLEL-VROEG, W5HLEL-EDENB, W5NGWE-NDLOV, W5NGWE-SKURW, W5ROBU-ROBUR; www.dwa.gov.za/iwqs/rhp/database.html accessed 30 June 2014.		2
Fish	Provincial (Kleynhans et al. 2007, DWA 2013) and national (SAIAB, www.saiaib.ac.za:8080/WebSearchSAIAB/advanced.jsp accessed June 2014; KZn-Wildlife, www.kznwildlife.com/index.php, accessed June 2014).		3

8.2 Ecological importance and sensitivity

The EIS of EWR Site WM1, with motivations, is provided in Table 8-2.

Table 8-2 EIS of EWR Site WM1

Metrics	Baseline Rating	Comments
Biota (instream and riparian)		
Rare and endangered	1.00	*Crocodylus niloticus* is vulnerable and protected under NEMBA. One rare plant species was observed at the site.
Unique	2.00	Most fish species present are widespread but some have restricted ranges. One of the seven endemic species expected to occur was observed at the site and freshwater prawns (Palaemonidae) were present.
Intolerant (flow and/or WQ)	2.33	There were flow sensitive fish and invertebrate species present while the riparian area was characterised by open bedrock in the marginal area and comprised species tolerant to flow reductions.
Taxon richness	3.00	There was a diverse community of fish and riparian vegetation (of the Maputaland Pondoland region of endemism) and there were approximately 27 invertebrate taxa present.
Instream and riparian habitats		
Diversity	2.67	The diversity of aquatic habitat types was fair due to excessive sedimentation while the riparian area was dominated by bedrock with alluvial deposits present in the gorge.
Refugia	1.67	Some fish and invertebrates depend upon the interstitial refugia provided by inundated riffles.
Sensitivity to change in flows	2.67	Riffles are sensitive to flow-related changes at all times.
Sensitivity to change in water quality	1.33	This medium sized river is moderately sensitive to flow-related changes in water quality.
Migration route/corridor	1.67	This river is an important migration corridor for large migratory rheophilic fish and freshwater prawns (Palaemonidae). The riparian corridor is protected in the gorge and was well established.
Importance of conservation and natural areas	1.50	The gorge affords protection to the diversity of riparian plant species present.
MEDIAN	1.83	
EIS	Moderate	

8.3 Reference condition

The expected Reference condition at EWR Site WM1 is described in Table 8-3.

Table 8-3 Reference condition at EWR Site WM1

Component	Reference condition	Confidence
Hydrology	See Hydrology Report.	3
Water quality	Reference condition water quality parameters are: PO_{4}-P (x<0.005 mg/L), TIN (x<0.25 mg/L), EC (x<30 mS/m), pH (6.5 (5^{th}-95^{th} percentile) <x<8.0 (5^{th}-95^{th} percentile)), DO (x>8 mg/L) (DWAF 2008).	3
Geomorphology	The river bed would have had slightly less fines under the Reference condition, and possibly less encroachment of vegetation.	3
Vegetation	The riparian area is dominated by open bedrock habitat and there would be scattered non-woody marginal and lower zone species. The upper zone would be dominated by woody vegetation and some ravine species.	3
Macroinvertebrates	There would be approximately 69 taxa present with an associated SASS total score of 220 and an ASPT of 7.	3
Fish	19 Fish species are expected to occur in the White Mfolozi River at the EWR site including one dependent on flow all year and five that are dependent of flow for part of the year. The other species are able to persist through no flow periods.	3

8.4 Baseline ecological condition (2014)

This section summarised the outcome of the discipline-specific EcoClassification assessments, which are provided in River Intermediate EWR Report (Volume 3 – Specialist reports).

8.4.1 Causes and sources

Causes and sources of the Present Ecological Status are summarised below in Table 8-4.

Table 8-4 Causes and sources of PES at EWR site WM1

Component	Causes	Sources	Flow or non-flow related	Confidence
Water quality	May be elevated suspended sediments.	Subsistence agriculture.	Non flow	3
Geomorphology	Reduced flows, slightly reduced floods, and elevated fines	Reduced flows from dams; elevated fines from catchment degradation.	Both flow and non-flow related	3.5
Vegetation	Change in species composition of plant community.	Invasion by alien species due to land use	Non-flow.	5
Macroinvertebrates	Changes in natural flow regime	Klipfontein Dam in upper catchment	Flow	3
	Nutrient enrichment.	Animal husbandry.	Non-flow.	
	Sedimentation.	Erosion in upper catchment.	Non-flow.	
Fish	Minor reduction in quality of interstitial habitat due to sedimentation.	Grazing in marginal zone.	Non-flow.	4

8.4.2 Trends

Trends in the Present Ecological Status for all components of EWR WM1 are summarised below in Table 8-5.

Table 8-5 Trends in PES for EWR WM1

Component	Trend	Confidence
Water quality	Stable.	4
Geomorphology	Stable.	4
Vegetation	Stable.	4
Macroinvertebrates	Stable.	1
Fish	Stable.	2

8.4.3 EcoStatus (2014)

The Present Ecological Status of each component at EWR WM1 is summarised below in Table 8-6.

Table 8-6 Present Ecological Status of all components at EWR WM1

Component	Scores	EC	REC
Water Quality	87.3	B	B
Geomorphology	77.3	C	C
Vegetation	81.3	B/C	B/C
Macroinvertebrates	81.1	B/C	B/C
Fish	72.6	C	C
Instream	77.7	B/C	B/C
PES score	79.7		
PES category	B/C		
EIS	High		
REC	B/C		
AECs	B and C		

9 EWR SITE NS1: NSELENI RIVER

EWR Site NS1 is representative of the middle reaches of the Nseleni River upstream of its confluence with the Okula River. It was also chosen to provide an extrapolation option for NWRCS nodes on the Nseleni, Msunduzi, Mkuze, Mhlatuze, Mzinene, Nylalazi and Hluhluwe Rivers (see Rivers Delineation Report).

The relevant summary details are as follows:

Location: Nseleni River, near Cwaka.

Coordinates: 28°38'2.76"S; 31°55'51.24"E.

Photograph: See Figure 9-1.

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Comments: EWR Site NS1 is the site of a previous EWR assessment (EWR 6 –: Louw and Koekemoer 2008).

Figure 9-1 EWR Site NS1: Nseleni River, September 2013

9.1 Data availability

The data available at EWR Site NS1 are summarised in Table 9-1.

Table 9-1 Data available at EWR Site NS1

Component	Data availability	Confidence
Hydrology	Data modelled using ACRU.	3
Hydraulics	Stage-discharge relationship calculated in 2014 for one cross-section. Two observed 0.04 and 0.08m3/s.	3
Water quality	Long term water quality data from WMS at W5H022Q01 & W5H039QO1 (www.dwa.gov.za/iwqs/wms/data.html, accessed 30 June 2014), on site measurements (July 2014).	2
Geomorphology	Site survey data (July 2014); historical aerial photographs (1961, 1969, 1977, 1979, 1990); Google Earth imagery (2013) and hydrological summaries (Southern Waters 2014).	4
Vegetation	Species and vegetation type distributions (SANBI 2009; SIBIS, www.sanbi.org.za accessed 1 June 2009 and Mucina and Rutherfurd 2006); Google Earth imagery; historical aerial photographs; site specific hydraulics, vegetation data and hydrology.	5
Macroinvertebrates	Rivers database for stations W5 ASSE-ZANDB, W5HLEL-WITKO, W5HLEL-VROEG, W5HLEL-EDENB, W5NGWE-NDLOV, W5NGWE-SKURW, W5ROBU-ROBUR; www.dwa.gov.za/iwqs/rhp/database.html accessed 30 June 2014.	2
Fish	Provincial (Kleynhans et al. 2007, DWA 2013) and national (SAIAB, www.saiaib.ac.za:8080/WebSearchSAIAB/advanced.jsp accessed June 2014; KZn-Wildlife, www.kznwildlife.com/index.php, accessed June 2014).	3

9.2 Ecological importance and sensitivity

The EIS of EWR Site NS1, with motivations, is provided in Table 9-2.

Table 9-2 EIS of EWR Site NS1

Metrics	Baseline Rating	Comments
Biota (instream and riparian)		
Rare and endangered	1.00	*Crocodylus niloticus* is vulnerable and protected under NEMBA.
Unique	2.00	Most fish species present are widespread but some have restricted ranges. None of the three endemic plant taxa expected to occur nor freshwater prawns (Palaemonidae) were found.
Intolerant (flow and/or WQ)	2.33	There were flow sensitive fish and invertebrate species present while the riparian area lacked well-established marginal zones of graminoids, being dominated by forest (woody) species.
Taxon richness	3.00	There was a diverse community of fish and riparian vegetation and there were approximately 26 invertebrate taxa present.
Instream and riparian habitats		
Diversity	2.67	There was a diverse array of aquatic habitat types across the pools and riffles present while the riparian area comprised mostly steep banks with few boulders.
Refugia	1.67	Some fish and invertebrates depend upon the interstitial refugia provided by inundated riffles.
Sensitivity to change in flows	2.67	Riffles are sensitive to flow related changes at all times.
Sensitivity to change in water quality	1.33	This small river is sensitive to flow-related changes in water quality.
Migration route/corridor	1.67	This river is an important migration corridor for large migratory rheophilic fish may also be for remnant populations of freshwater prawns (Palaemonidae). The riparian corridor is in good condition but some clearing has taken place.
Importance of conservation and natural areas	1.50	This site is fairly isolated, has many large trees and abundant natural areas.
MEDIAN	1.83	
EIS	Moderate	

9.3 Reference condition

The expected Reference condition at EWR Site NS1 is described in Table 9-3.

Table 9-3 Reference condition at EWR Site NS1

Component	Reference condition	Confidence
Hydrology	See Hydrology Report.	3
Water quality	Reference condition water quality parameters are: PO_4-P (x<0.005 mg/L), TIN (x<0.25 mg/L), EC (x<30 mS/m), pH (6.5 (5^{th}-95^{th} percentile) <x<8.0 (5^{th}-95^{th} percentile)), DO (x>8 mg/L) (DWAF 2008).	3
Geomorphology	This riffle site is characterised by a cobble/boulder bed with well sorted fines, silt and organic matter and is close to what would be expected under reference conditions.	3
Vegetation	The marginal and lower zones are close to what would be expected under reference conditions and are well shaded by a dense canopy of tall trees. The upper zone would comprise a similarly closed canopy of taller woody species.	3
Macroinvertebrates	There would be approximately 70 taxa present with an associated SASS total score of 220 and an ASPT of 7.	3
Fish	20 Fish species are expected to occur in the Nseleni River at the EWR site including one dependent on flow all year and five that are dependent on flow for part of the year. The other species are able to persist through no flow periods.	3

9.4 Baseline ecological condition (2014)

This section summarised the outcome of the discipline-specific EcoClassification assessments, which are provided in River Intermediate EWR Report (Volume 3 – Specialist reports).

9.4.1 Causes and sources

The causes and sources of the PES are summarised below in Table 9-4.

Table 9-4 Causes and sources of PES at EWR NS1

Component	Causes	Sources	Flow or non-flow related	Confidence
Water quality	Salinity is naturally high.	Underlying geology.	Non-flow.	3
Geomorphology	Limited catchment erosion, minor bank disturbance and invasive plant species.	Catchment degradation.	Non-flow	3.5
Vegetation	Reduced cover and abundance of woody species.	Clearing for road crossings and security fences.	Non-flow	4
	Increased cover of reeds.	Reduced competition, by woody species for light sources Reduced woody species causes conditions suitable for reed growth. Only in area affected by clearing of woody vegetation.	Non-flow	4
	Change in species composition of plant community.	Invasion by alien species, in areas cleared for roads and security fences.	Non-flow	5
Macroinvertebrates	Nutrient enrichment.	Rural and agricultural runoff.	Non-flow	3
	Sedimentation.	Cattle trampling.	Non-flow	2
Fish	Minor reduction in quality of interstitial habitat, reduced feeding opportunities.	Grazing of marginal vegetation zone.	Non-flow	4

9.4.2 Trends

Trends in the Present Ecological Status for all components of EWR NS1 are summarised below in Table 9-5.

Table 9-5 Trends in PES for EWR NS1

Component	Trend	Confidence
Water quality	Positive.	1
Geomorphology	Stable.	4
Vegetation	Stable in terms of flow related changes, but overall negative due to alien species invasion.	4
Macroinvertebrates	Stable.	1
Fish	Stable.	2

9.4.3 EcoStatus (2014)

The Present Ecological Status of each component at EWR NS1 is summarised below in Table 9-6.

Table 9-6 Present Ecological Status of all components at EWR NS1

Component	Scores	EC	REC
Water Quality	83.8	B	B
Geomorphology	81.7	B/C	B/C
Vegetation	64.4	C	C
Macroinvertebrates	79.5	B/C	B/C
Fish	68.1	C	C
Instream	75.5	C	
PES score	68.9	C	
PES category	C		
EIS	Moderate		
REC	C		
AECs	B and D		

10 EWR SITE MA1: MATIGULU RIVER

EWR Site MA1 is representative of the Matigulu River from the confluence with the Honothi River to the N2, near the head of the Amatikulu estuary.

The relevant summary details are as follows:

Location: Matigulu River, near Izimpohlo.

Coordinates: 29º1'12.36"S; 31º28'13.44"E.

Photograph: See Figure 10-1.

Comments: The channel is bedrock controlled and fairly straight and comprises a variety of aquatic habitats, controlled bedrock section of the river with a variety of habitats. Water is abstracted at the gauging weir upstream of the EWR site while cattle are grazed and domestic washing takes place downstream.

Figure 10-1 EWR Site MA1: Matigulu River, September 2013

10.1 Data availability

The data available at EWR Site MA1 are summarised in Table 10-1.

Table 10-1 Data available at EWR Site MA1

Component	Data availability	Confidence
Hydrology	W1H007 Matigulu River @ Amatikulu W1H010 Matigulu River @ Reserve 21 Plus data modelled using the Water Yield Model.	3
Hydraulics	Stage-discharge relationship calculated in 2014 for one cross-section. Two observed flows 0.15 and 1.78m3/s.	3
Water quality	Long term water quality data from WMS at W5H022Q01 & W5H039QO1 (www.dwa.gov.za/iwqs/wms/data.html, accessed 30 June 2014), on site measurements (July 2014).	2
Geomorphology	Site survey data (July 2014); historical aerial photographs (1961, 1969, 1977, 1979, 1990); Google Earth imagery (2013) and hydrological summaries (Southern Waters 2014).	4
Vegetation	Species and vegetation type distributions (SANBI 2009; SIBIS, www.sanbi.org.za accessed 1 June 2009 and Mucina and Rutherfurd 2006); Google Earth imagery; historical aerial photographs; site specific hydraulics, vegetation data and hydrology.	5
Macroinvertebrate	Rivers database for stations W5 ASSE-ZANDB, W5HLEL-WITKO, W5HLEL-VROEG, W5HLEL-EDENB, W5NGWE-NDLOV, W5NGWE-SKURW, W5ROBU-ROBUR; www.dwa.gov.za/iwqs/rhp/database.html accessed 30 June 2014.	2
Fish	Provincial (Kleynhans et al. 2007, DWA 2013) and national (SAIAB, www.saiaib.ac.za:8080/WebSearchSAIAB/advanced.jsp accessed June 2014; KZn-Wildlife, www.kznwildlife.com/index.php, accessed June 2014).	3

10.2 Ecological importance and sensitivity

The EIS of EWR Site MA1, with motivations, is provided in Table 10-2.

Table 10-2 EIS of EWR Site MA1

Metrics	Baseline Rating	Comments
Biota (instream and riparian)		
Rare and endangered	1.00	*Crocodylus niloticus* is vulnerable and protected under NEMBA. One of the two rare plant species expected to occur were present.
Unique	2.00	Most fish species present are widespread but some have restricted ranges. One of the seven endemic plant species expected to occur was found and freshwater prawns (Palaemonidae) were present.
Intolerant (flow and/or WQ)	2.33	There were flow sensitive fish and invertebrate species present while the riparian area was dominated by open bedrock and flow-tolerant species.
Taxon richness	3.00	There was a diverse community of fish and riparian vegetation, characteristic of the Maputaland Pondoland centre of endemism, and there were approximately 34 invertebrate taxa present.
Instream and riparian habitats		
Diversity	2.67	There was a diverse array of aquatic habitat types as well as alluvial, -bedrock and backwater and high-flow habitats for riparian plant species.
Refugia	1.67	Some fish and invertebrates depend upon the interstitial refugia provided by inundated riffles.
Sensitivity to change in flows	2.67	Riffles are sensitive to flow-related changes at all times.
Sensitivity to change in water quality	1.33	This medium sized river is moderately sensitive to flow-related changes in water quality.
Migration route/corridor	1.67	This river is an important migration corridor for euryhaline fish species and freshwater prawns (Palaemonidae). The riparian corridor well established.
Importance of conservation and natural areas	1.50	This natural site is protected within the gorge.
MEDIAN	1.83	
EIS	Moderate	

10.3 Reference condition

The expected Reference condition at EWR Site MA1 is described in Table 10-3.

Table 10-3 Reference condition at EWR Site MA1

Component	Reference condition	Confidence
Hydrology	See Hydrology Report.	3
Water quality	Reference condition water quality parameters are: PO_4-P (x<0.005 mg/L), TIN (x<0.25 mg/L), EC (x<30 mS/m), pH (6.5 (5^{th}-95^{th} percentile) <x<8.0 (5^{th}-95^{th} percentile)), DO (x>8 mg/L) (DWAF 2008).	3
Geomorphology	The present condition of the river is close to what would be expected under reference conditions.	3
Vegetation	The marginal (and backwaters) and lower zones would be dominated by non-woody species (sedges and grasses) with a few isolated woody species present. The upper zone would be dominated by woody riparian species interspersed with some terrestrial species. There would be aquatic species in the backwaters. Cattle and donkeys here mimic natural levels of herbivory.	3
Macroinvertebrates	There would be approximately 65 taxa present with an associated SASS total score of 220 and an ASPT of 7.	3
Fish	23 Fish species are expected to occur in the Matigulu River at the EWR site including two that are dependent of flow for part of the year. The other species are able to persist through no flow periods.	3

10.4 Baseline ecological condition (2014)

10.4.1 Individual components

This section summarised the outcome of the discipline-specific EcoClassification assessments, which are provided in River Intermediate EWR Report (Volume 3 – Specialist reports).

10.4.2 Causes and sources

The causes and sources of the PES are summarised below in Table 10-4.

Table 10-4 Causes and sources of PES at EWR sites MA1

Component	Causes	Sources	Flow or non-flow related	Confidence
Water quality	Slightly elevated nutrients and turbidity.	Commercial and subsistence agriculture.	Point impact, worsened by reduced flow.	3
Geomorphology	Slightly elevated fines	Elevated fines from catchment degradation (catchment erosion, agriculture, woodlots/afforestation).	Non-flow related	3.5
Vegetation	Change in species composition of plant community.	Invasion by alien species, due to land-use practices such as clearing of indigenous vegetation.	Non-flow.	5
	Reduced cover of woody species.	Harvesting of wood, grazing of seedlings.	Non-flow.	
Macroinvertebrates	Nutrient enrichment.	Animal husbandry.	Non-flow.	2
	Changes to the natural flow regime due to abstraction	Upstream weir.	Flow	
	Sedimentation.	Cattle trampling.	Non-flow.	
Fish	Minor reduction in quality of interstitial habitat due to sedimentation.	Grazing in marginal zone, harvesting of wood.	Non-flow.	4

10.4.3 Trends

Trends in the Present Ecological Status for all components of EWR MA1 are summarised below in Table 10-5.

Table 10-5 Trends in PES for EWR MA1

Component	Trend	Confidence
Water quality	Stable	1
Geomorphology	Stable	4
Vegetation	Stable.	3
Macroinvertebrates	Stable.	1
Fish	Stable.	2

10.4.4 Ecostatus (2014)

The Present Ecological Status of each component at EWR MA1 is summarised below in Table 10-6.

Table 10-6 Present Ecological Status of all components at EWR MA1

Component	Scores	EC	REC
Water Quality	82.4	B	B
Geomorphology	86.5	B	B
Vegetation	79.4	B/C	B/C
Macroinvertebrates	80.9	B/C	B/C
Fish	86.7	B	B
Instream	82.7	B	B
PES score	81.2		
PES category	B/C		
EIS	Moderate		
REC	B/C		
AECs	B, C and D		

11 RECOMMENDED AND ALTERNATIVE ECOLOGICAL CATEGORIES

The recommended and alternative ecological categories for each of the EWR sites are provided in Table 11-1. These are based solely on ecological considerations.

Table 11-1 The recommended and alternative ecological categories for the EWR sites

River	Site	REC	AEC1	AEC2	AEC3
Assegaai	AS1	C	B	D	-
Upper Pongola	UP1	C	B	D	-
Mkuze	MK1	C	B	D	-
Black Mfolozi	BM1	C	B	D	-
Black Mfolozi	BM2	C	B	D	-
White Mfolozi	WM1	B/C	B	C	-
Nseleni	NS1	C	B	D	-
Matigulu	MA1	B/C	B	C	D

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