



water & sanitation

Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA



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

**SUMMARY OF RELEVANT EWR INFORMATION FOR MHLATUZE AND
NHLABANE ESTUARIES**

FINAL

AUGUST 2015

Report No. RDM/WMA6/CON/COMP/2013





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DEPARTMENT OF WATER & SANITATION

CHIEF DIRECTORATE: WATER ECOSYSTEMS

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Author: A Singh

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Consultants: Tlou Consulting (Pty) Ltd

Approved for the Consultants by:



.....
Ms A Singh
Project Manager

Client: Department of Water & Sanitation

Approved for the DWS:

.....
N Mohapi
Chief Director: Water Ecosystems

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

Contributors

A Singh

Tlou Consulting

Dr C Brown

Southern Waters

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ABBREVIATIONS AND ACRONYMS

CD:RDM	Chief Directorate: Resource Directed Measures
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EC	Ecological Category
EI	Ecological Importance
ES	Ecological Sensitivity
EWR	Ecological Water Requirement
NWRCS	National Water Resources Classification System
PES	Present Ecological Status
REC	Recommended Ecological Category
WMA	Water Management Area

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 DWA 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 gazettement of the Reserve (DWA1999a).

DWA 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 (DWA 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 a 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 Purpose of this Report

This report consolidates and reviews existing EWR assessments in the Mhlatuze River catchment with respect to the lakes and estuaries and where available and compatible these have been augmented with additional data.

The water resources considered include:

- Mhlatuze River (included in the **Rapid Rivers EWR report**)
- Mhlatuze estuary
- Nhlabane estuary and lake

2 REVIEW OF EXISTING STUDIES

2.1 NHLABANE ESTUARY AND LAKE

An EWR (previously known as EFR) for the Nhlabane estuary and lake was conducted in 1998, as part of the study undertaken by the then Department of Water Affairs and Forestry in association with Mhlathuze Water to re-assess the yield of the Mhlatuze Water Supply System. The study was known as the Mhlatuze Operating Rules and Future Phasing (MORFP) Study.

2.1.1 Description of the Nhlabane estuary and lake

The Nhlabane Lake and Estuary flow from a small and relatively undisturbed catchment, with the major anthropogenic disturbance being the mining activities of Richards Bay Minerals (RMB).

Prior to 1978, Lake Nhlabane had a direct connection to the sea through the Nhlabane estuary and consisted of two interconnected lakes, the north lake and the south lake. It was subsequently extensively modified with the construction of a 3.8 metre high concrete barrage across the outflow of the lake in 1978 to increase its storage for mining purposes. After barrage construction, the raising of the water level resulted in the merging of the two lakes into a single bi-lobed freshwater lake. The southern lobe then changed from estuarine to fresh with a resultant shift in the faunal communities from estuarine to freshwater-dominated. The barrage further prevented the migration of estuarine-associated fauna into and out of the lake, thus causing many estuarine organisms to disappear from the lake. The lake is, however, currently dominated by a relic estuarine faunal component. In 1984, the

barrage was raised a further 0.75 metres to 4.55m amsl and a further raising of the barrage is under construction, which will bring the overflow level to 6.05m amsl.

The current Nhlabane system consists of a bi-lobed lake of approximately 4,4km², which leads into a 3km estuary. The system is situated at 28°38'S; 32°16'E (Cyrus & Wepener, 2010).

A number of mining associated activities have had negative impacts on the system. These were related to the construction of a barrier between the estuary and the lake (the barrage); continued abstraction of water by Richards Bay Minerals (RBM) from the estuary itself and the effects of the RBM dredger and plant machinery crossing the estuary (Cyrus & Wepener, 2010). RBM have initiated and assisted with the attempted restoration of the estuarine functioning of Nhlabane, notably the breaching of the estuary to restore marine contact (Cyrus & Wepener, 2010).

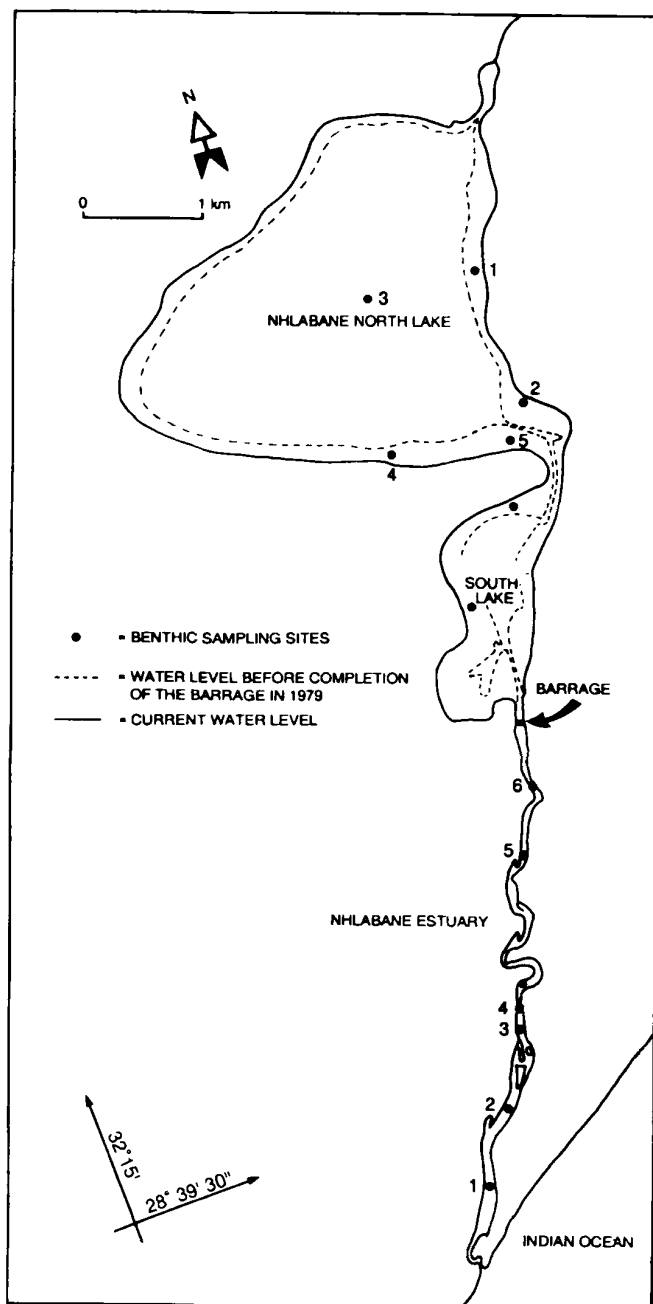


Figure 2-1. Nhlabane lake and estuary ((Cyrus & Wepener, 2010)

2.1.2 Ecoclassification of Nhlabane system

Results from the 1998 EWR study (DWAf in assoc with Mhlatuze Water, 2000b) (DWAf in association with Mhlatuze Water, 2000a) found the following:

Table 2-1. Ecological State of the Nhlabane system

Water Resource	PES		Importance		REC
	Water Body	Riparian	Ecological	Social	
Lake Nhlabane	C	D/E	High	Moderate	C
Nhlabane estuary	C/D		High importance locally		C

According to the 2011 National Biodiversity Estuary Plan for South Africa (Turpie, et.al. 2012), the current health category of the Nhlabane estuary is a D.

2.1.3 Recommended Ecological Water Requirements for the Nhlabane system

2.1.3.1 Nhlabane Estuary

The EWR set for the estuary was based on the assumption that water required to make the fishway operational, would be available. Establishing a partial link between the lake and estuary would result in an improvement of the functioning of the system and would be sufficient to raise the estuary to a ecological category C. Raising the ecological category to a B category would require continuous operation of the fishway, lowering of the barrage and rehabilitation of the riparian areas. Improvement to a ecological category A would require complete removal of all barriers and rehabilitation of the catchment (DWAF in assoc with Mhlatuze Water, 2000b).

The ecological flow requirements to improve the functioning of the system to a C category is provided in Table 2-2.

Table 2-2. Ecological Water Requirements to attain an Ecological Category C ((DWAf in assoc with Mhlatuze Water, 2000b)

MONT H	MAINTENANCE FLOWS				DROUGHT FLOWS		
	Baseflow (m ³ .s ⁻¹)	Freshets		Floods (m ³ .s ⁻¹)	Baseflo w (m ³ .s ⁻¹)	Freshets	
		(m ³ .s ⁻¹)	days			(m ³ .s ⁻¹)	days
Oct	V _{fishway} , Wks : 1 2 3 4	Sept / Oct 1 event	14	-	Closure for an entire year acceptable, but only 1 year in 3		
Nov	V _{fishway} , Wks : 1 2 3 4	2 events	14	-			
Dec	V _{fishway} , Wks : 1 2 3 4			-		-	
Jan	V _{fishway} , Wks : 1 2 3 4	-	-	-			
Feb	V _{fishway} , Wks : 1 2 3 4	-	-	33m ³ .s ⁻¹ , 9hrs			
Mar	V _{fishway} , Wks : 1 2 3 4	-	-	1 :2 yrs 375 m ³ .s ⁻¹			
Apr	V _{fishway} , Wks : 1 2 3 4	1 event	7	1 :50 yrs			
May	V _{fishway} , Wks : 1 2 3 4	-	-	-			
Jun	V _{fishway} , Wks : 1 2 3 4	-	-	-			
Jul	V _{fishway} , Wks : 1 2 3 4	-	-	-			
Aug	V _{fishway} , Wks : 1 2 3 4	-	-	-			
Sep	V _{fishway} , Wks : 1 2 3 4			-			

V_{fishway} = Volume required to maintain fishladder in operating condition (24h) (on the assumption that the fishladder works)

Wk = Week in which the flow is required

1 event = Total volume unknown, but should emulate natural conditions

Note 1 : • Apart from any flooding which may be required for specific ecological purposes, a release will be required in October if there has not been a flood event during the preceding 12 months
• A large flood occurring in any other month will count as the March flood

Note 2 : Macrobrachium information is required to finalise March and April baseflows and freshets

The above flow requirements are to raise the category of the estuary to a category C. However, if other non-flow related requirements including:

- Lowering the barrage to 3m; and
- Rehabilitation of the littoral zone of the estuary

are attended to, it would be possible to raise the category of the estuary to a B ((DWAf in assoc with Mhlatuze Water, 2000b).

2.1.3.2 Nhlabane Lake

The recommended Lake Water Level Requirements (LWR) made during the EWR assessment in 1999 (DWAf in assoc with Mhlatuze Water, 2000b) is provided in Table 2-3.

Table 2-3. Lake water level recommended for Lake Nhlabane compare with the current full supply levels (FSLs) ((DWAf in assoc with Mhlatuze Water, 2000b)

Water level	Lake Water level (m amsl)
Current FSL (1)	6.0
Drought minimum level (2)	3.5
Maintenance dry season minimum level	4.5
Management maximum level	6.0
Maximum drawdown rate	1 metre per month
Other recommendations	<p>The construction of a fishway on the lake overflow point with the provision of overflows during known migratory periods, to enable the spawning and migration of estuarine fish and crustaceans from the estuary to the lake during maintenance wet months and during the period from May to June.</p> <p>An investigation is required to determine the substrate conditions in the littoral areas of the new full supply level and whether these are conducive to the establishment of a new littoral zone on the periphery of the lake.</p>

Note: (1) FSLs are those provided by Richards Bay Minerals. (2) This level may be maintained for a maximum period of 12 months.

According to the DWS (2015b), this translates to an Ecological Water Requirement of 14,3 million m³/annum. They have noted that this figure is misleading, because the transfer from the Mfolozi River is included in the system modelling in support of the Reserve determination. They have stated that some of the Lake Reserves (for example, the Cubhu, Mzingazi, Nhlabane etc) are larger than the latest estimated sustainable yields of these lakes, and must be treated with caution.

The water levels were set for:

- . drought minimum level, which is the level achieved during drought periods only, and should not be maintained for extended periods of time unless indicated by the length of a period of actual drought;
- . maintenance minimum level, which is the level which should not be exceeded for lengthy periods during winter. If this level is exceeded for short periods during the dry season, maximum drawdown must never exceed the drought minimum level;
- . management maximum level, which is the maximum ecologically allowable level in the lake and which should never be exceeded for lengthy periods. This level is also the maximum maintenance level which would be experienced during summer; and

- drawdown rate. It must be noted that seasonal fluctuations in water levels are considered to be important in the long- term ecological maintenance of the lakes. Fluctuations must therefore take place between the maintenance dry season and management maximum levels.

2.1.4 Information that could be used to update the existing EWR for Nhlabane estuary and lake

Richards Bay Minerals has undertaken an evaluation of the sustainable yield of Lake Nhlabane (Nhalabane Sustainability Assessment), Richards Bay Minerals was requested to provide the team with a copy of the report, however at the time of writing this report, nothing had been forthcoming.

According to DWS (2015b), the report concludes that the sustainable abstraction from the lake has dropped to 30 000 m³/d as a result of land use changes, compared to RBM's demand of 29,000m³/day. This equates to a yield of 10.95 m³/a. Based on the increasing trend in streamflow reduction, it is estimated that this may within another 5 years drop to 20 000 m³/d, unless there is a substantial increase in rainfall or the land use trends change.

2.2 MHLATHUZE ESTUARY

2.2.1 Description of the Mhlathuze Estuary

The Mhlathuze River estuary (28.80°S, 32.05°E) is situated in the subtropical coastal zone of KwaZulu-Natal province, South Africa and could be regarded as a permanently open estuarine bay. The estuary covers an area of approximately 12 km² has an axial length of 6 km, a width of 3 km, and a total shoreline length of 30 km. With the development of a deep-water harbour at Richards Bay in the 1970s, the original Richards Bay estuary was divided into two distinct sections by means of a 4 km berm wall. This divided the original estuary into the new harbour area and a sanctuary area, which was intended to protect the estuarine character of the original system. The Mhlathuze River was canalized, diverting the natural flow of the river into the "sanctuary" or estuary. During 1975 a new mouth was dredged through the sandbar approximately 5 km to the south of the original mouth.

2.2.2 Ecoclassification of the Mhlathuze Estuary

According to 2011 National Biodiversity Estuary Plan for South Africa (Turpie, et.al. 2012), the current health category of the Mhlathuze estuary is a C. The Recommended Ecological Category proposed in the DWAF(2001c) was a C/D. There may be merit in reconsidering the Recommended Ecological Category of the Mhlathuze estuary, in light of the Turpie et.al. (2012) findings.

2.2.3 Ecological Water Requirements of the Mhlathuze Estuary

According to DWAF(2000c) Estuarine freshwater requirements normally describe baseflows to maintain an open mouth for certain periods of the year but in the case of the Mhlathuze estuary, tidal exchange and not baseflow is the primary mechanism for maintaining and open mouth. Therefore baseflows were set to maintain a reasonable salinity gradient for the necessary olfactory cues of migratory fish and invertebrates. Provisional estimates for flow rates of between 0.1 and 0.3 m³/s were used and were said to be updated after sufficient monitoring of vertical and longitudinal salinity gradients. Importance was attached to maintaining minimum flows, which ceased during winter at the time of the study, and installing fish ladders for migratory fish to surpass the weir.

Major floods are needed in January/February to reset the system by removing accumulated sediments. Also, the 1:2 year flood must move through in October in alternate years but it was acknowledged at the time that it was not possible to manage these floods. They were thus specified to avoid their being meaningfully removed through developments in the river basin upstream.

Table 2-4. Summary table of maintenance and drought flows for REC = C/D (DWAF 2000c).

MONTH	MAINTENANCE FLOWS				DROUGHT FLOWS		
	Baseflow (m ³ .s ⁻¹)	Freshets		Floods (m ³ .s ⁻¹)	Baseflow (m ³ .s ⁻¹)	Freshets	
		(m ³ .s ⁻¹)	days			(m ³ .s ⁻¹)	days
Oct	0.3	15	3	50 to 100	0.3	5	2
Nov	0.3	15	3	-	0.3	-	-
Dec	0.3	15	3	-	0.3	5	2
Jan	0.3	5	1	2 000	0.3	-	-
Feb	0.3	5	1		0.3	-	-
Mar	0.3	5	3	-	0.3	5	2
Apr	0.3	5	3	-	0.3	-	-
May	0.3	-	-	-	0.1 to 0.3	-	-
Jun	0.3	-	-	-	0.1 to 0.3	-	-
Jul	0.3	-	-	-	0.1 to 0.3	-	-
Aug	0.3	-	-	-	0.1 to 0.3	-	-
Sep	0.3	5	1	-	0.3	-	-

2.3 MHLATHUZE RIVER

2.3.1 Ecological Water Requirements of the Mhlathuze River

2.3.1.1 EWRs established in 2003

EWRs were determined at four sites but only comprehensively at two sites, 1 and 3, which were then used to extrapolate to sites 2 and 4 respectively (DWAF, 2003a; DWAF, 2003b; DWAF, 2003c; DWAF, 2003d). Site 3 is located upstream of the estuary weir and site 4 downstream of the weir to cater for the estuarine fish that can't move past the weir (DWAF 2000a). The river at site 4 was not considered in any great details as it is an artificial canal through what used to be a papyrus swamp that has no defined channel.

A summary of the results from the DWAF (2000a,b,c,d) is provided in Table 2-5.

Table 2-5. Summary of Ecological Water Requirements for Mhlathuze River (DWAF, 2003a; 2003b; 2003c; 2003d)

Quaternary Catchment	Water Resource	Ecological Reserve (%NMAR)	Ecological Reserve Volume (Mm3)	Basic Human Needs (%NMAR)	Total Reserve	NMAR (Mm3)
W12D	Mhlathuze IFR 1	30,51	54.286	0.15	30.66	177.9
W12D	Mhlathuze IFR 2	26.32	70.387	0.1	26.42	267.4
W12F	Mhlathuze IFR 3	26.56	81.820	0.24	26.80	308.1
W12F	Mhlathuze IFR 4	11.43	40.266	0.21	11.64	352.2

2.3.1.2 EWRs established in 2012

According to DWA (2015b), DWS RDM produced a new set of River Quantity ecological water requirements (EWRs) in 2012 which superseded all previous EWRs that had been used. This preliminary Reserve has been approved by DWS and therefore has a legal status. From this report it is not certain at what level of confidence the new set of EWRs have been determined and whether these new EWRs are based on Desktop assessments or extrapolated from higher confidence studies.

Table 2-6 presents a summary of the EWR information contained in DWS (2015b) and which was incorporated into the WRYM configuration for the Richards Bay Reconciliation Strategy.

Table 2-6. Preliminary determination of the Reserve for Water Quantity (from DWA, 2015b)

Quaternary Catchment	Water resource	Ecological Reserve (%) NMAR	Ecological Reserve Volume (Mm3)	Basic Human Needs (%NAMR)	*Total Reserve (%)	NMAR (Mm3)
W12A	***Mhlatuze River: Estimated from IFR site 1	38.1	24.7	0.40	38.5	64.8
W12B	**Mhlatuze River: IFR site 1	30.5	54.3	0.06	30.6	156.7
W12C	***Mhlatuze River: Estimated from IFR site 2	26.3	13.4	0.16	26.4	50.8
W12D	**Mhlatuze River: IFR site 3	26.3	70.8	0.14	26.4	195.2
W12D	**Mhlatuze River: IFR site 2	26.6	81.8	0.10	26.7	265.8
W12E	**Mhlatuze River: IFR site 4	11.4	40.3	0.11	11.5	278.1
W12F	**Mhlatuze River: IFR site 4	11.4	40.3	0.23	11.6	332.4
W12G	***Nseleni River: Estimated from IFR site 1	38.0	10.2	0.34	38.3	26.8
W12H	***Nseleni River: Estimated from IFR site 4	26.1	22.7	0.63	26.7	87.2

*This amount is the sum of ecological reserve and basic human needs.

**Indicates the Original 2001 IFR Sites.

***New Hydrological Nodes to which IFR results estimated to.

According to DWA (2015b), the WRYM for the Mhlatuze catchment has been configured such that all EWRs are satisfied as a priority. The ecological component of the Reserve is given the second-highest priority, after the Basic Human Needs Reserve component, which is estimated as 25l/capita/day for all inhabitants of the catchment⁴.

During final modelling undertaken to support compulsory licensing, some cases were found where the revised river EWRs required more water than was naturally available. These cases were adjusted such that the requirement was decreased to be equal to the natural flow.

2.3.2 Extrapolation of Ecological Water Requirements in the Mhlathuze River

Cognisance must be taken that during the extrapolation exercise undertaken as part of this study DWS (2015a), the team utilised the EWRs established in 2003 and not the 2012 version, as we were not aware of these results, together with other high confidence results in order to extrapolate to nodes identified in the Mhlathuze River catchment. There could be some mismatch between this newly generated results and the results generated in 2012 and used in the Reconciliation Study. An evaluation of the discrepancies need to be undertaken before further decisions are made.

3 RECOMMENDATIONS

Nhlabane estuary & Lake

It is recommended that a copy of the Nhlabane Sustainability Report prepared for Richards Bay Minerals, is obtained, to ascertain the current health of the system, with current operation. This can be compared to the previous EWR that was set for the system. Only once further information, including monitoring results are evaluated can any further discussions around revising of the EWR and operation of the system take place.

Mhlathuze estuary

No new data is available on which review of the EWR results can take place. However, there may be merit in reconsidering the EWR recommended in 1999, as according to Turpie et al (2012), the ecological category of the estuary is a C and not a C/D as prescribed in 1999. However, a monitoring programme needs to be established on the system, before this can be done.

Mhlathuze River

A 2012 version of EWRs was found to be the latest issued by the DWS. It may be necessary to compare this to the newly generated EWRs (during this study) for the Mhlathuze River catchment, especially if the 2012 EWR was based on a high confidence assessment.

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