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DETERMINATION, REVIEW AND IMPLEMENTATION OF THE RESERVE IN THE OLIFANTS/LETABA SYSTEM

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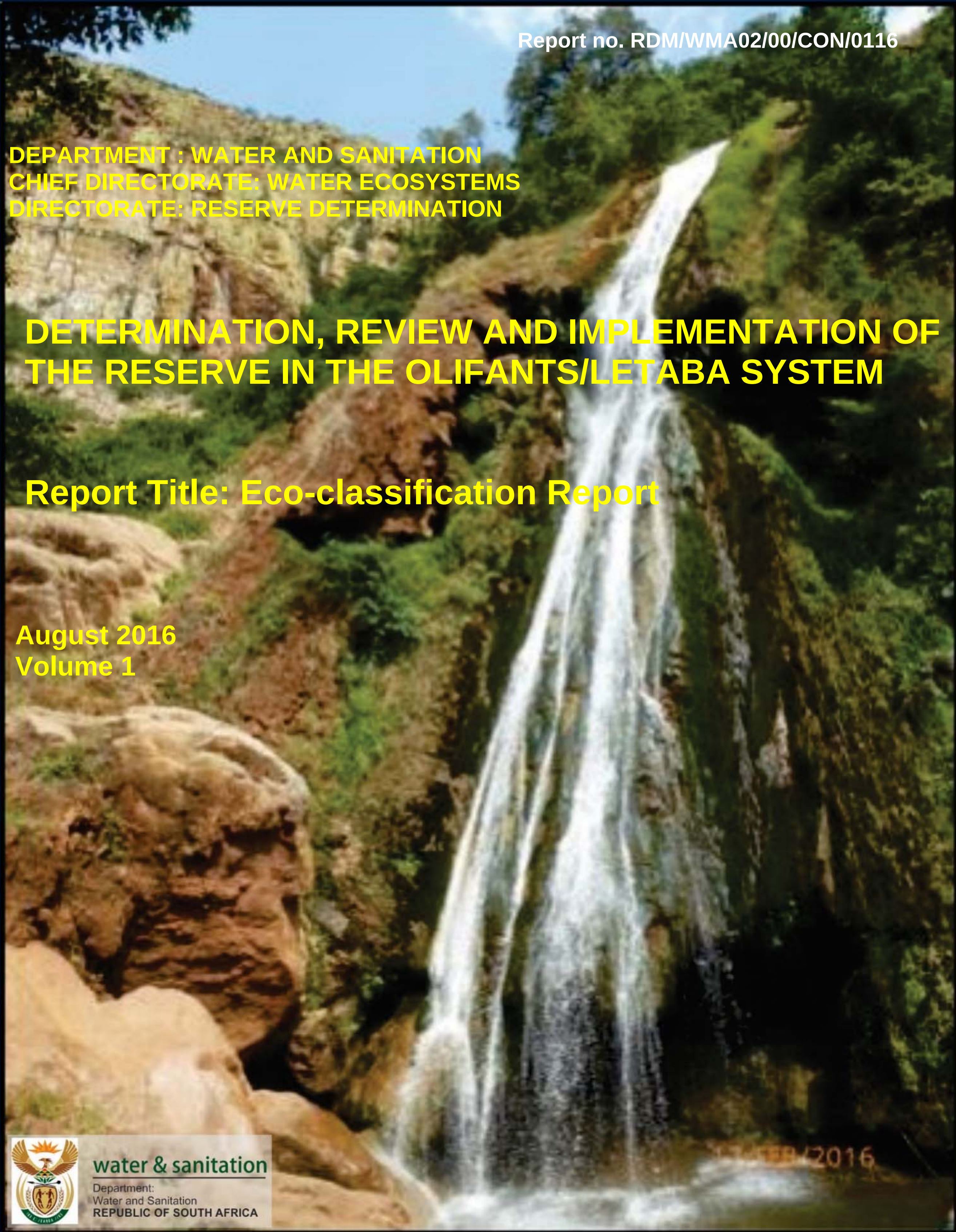

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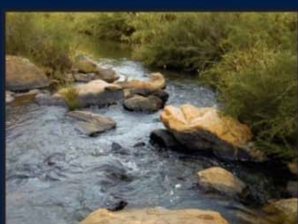

Directorate: Reserve Determination

DETERMINATION, REVIEW AND IMPLEMENTATION OF THE RESERVE IN THE OLIFANTS/LETABA SYSTEM

WP10940

ECO-CLASSIFICATION REPORT

AUGUST 2016

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DOCUMENT INDEX

Reports as part of this project:

***Bold** type indicates this report.*

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LIST OF ABBREVIATIONS

ASPT	Average Species per Taxon
CD: WE	Chief Directorate: Water Ecosystems
DO	Dissolved oxygen
DWS	Department of Water and Sanitation
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
EC	Electrical Conductivity
EI	Ecological Importance
EIS	Ecological importance and sensitivity
EWR	Ecological Water Requirements
ES	Ecological Sensitivity
FRAI	Fish Response Assessment Index
IEI	Integrated Ecological Index
IHI	Instream Habitat Assessment
IUA	Integrated Unit of Analysis
MC	Management Class
MIRAI	Macro-invetebrate Response Assessment Index
NWA	National Water Act
PES	Presentation Ecological State
REMP	Resource Eco-Status Monitoring Programme
RDM	Resource Directed Measures
RQO	Resource Quality Objectives
SIC	Stones-In-Current
SOOC	Stones-Out-Of-Current
SQ	Sub-Quaternary
VEGRAI	Vegetation Response Assessment Index
WET	Whole Effluent Toxicity
WQ	Water Quality
WRUI	Water Resource Use Index
WMA	Water Management Area
WWTW	Waste Water Treatment Works

EXECUTIVE SUMMARY

The Chief Directorate: Water Ecosystems in 2015 commissioned the study 'Determination, Review and Implementation of the Reserve in the Olifants/Letaba System'. With water resources in the Olifants Water Management Area (WMA 2) having been classified and Resource Quality Objectives determined (2011-2014), the preliminary Reserve determined in 2001 for the Olifants system and in 2006 for the Letaba system, is now required to be superseded by the Reserve. Due to the preliminary Reserve having been determined nine years prior to the water resource classification, a review and update is required to ensure that the Reserve is in accordance with the water resource classes and is applicable to the current system needs and demands. In addition there is a need to ensure that ecological important catchments outside the current framework are protected by additional ecological specifications.

The purpose of this study is thus to determine, review and implement the Reserve in the Olifants/Letaba System; with the aim of specifically addressing ecological gaps and reviewing the preliminary Reserves that have been determined.

Sites requiring the new or additional ecological information and Ecological Water Requiremnent (EWR) sites requiring update of the hydraulics of the preliminary Reserves were identified during the inception and information gap analysis tasks of the project. A prioritisation and selection of the sites was then undertaken based on review of previous Reserve studies, existing information, expert knowledge, water resources requiring protection, the Classification and resource quality objectives, the water reconciliation situation, conservation and protection areas and prevalent water quality issues. The filling in of the ecological gaps is being addressed through the undertaking of Rapid III Reserve determinations and biological surveys of the priority sites identified in the Olifants, Letaba and Shingwedzi catchments.

For the purpose of the Eco-Classification of the Olifants Catchment, a biological field survey was conducted from 5 – 16 October 2015 where the 16 identified EWR sites (on a Rapid III level of detail) and 20 biological sites were assessed. The biological field survey for the Letaba and Shingwedzi was conducted from 12 - 24 April 2016 where four (4) and one (1) identified EWR sites were assessed and 13 and nine (9) biological sites were assessed in the Letaba and Shingwedzi catchments respectively (Figure 3 and Table 1). Following the survey, the Eco-classification process was applied through a specialist workshop todetermine the Ecostatus of the priority sites.This report serves to document the results of the EcoClassification process for the rivers of the Olifants Water Management Area (WMA 2), for the Olifants, Letaba and Shingwedzi catchments. The results are provided per site and include an updated Present Ecological State (PES) of the EWR sites and recording information for all biological sites assessed.

The Eco-classification results will inform the refinement of ecological specifications for the preliminary Reserves where identified and development of ecological specifications for river reaches requiring additional protection beyond the current protection framework.

The results and findings of the process are summarised below for the Olifants and the Letaba/Shingwedzi catchments respectively. Based on the results of the survey and the observations noted, monitoring measures are also proposed at identified strategic sites.

Olifants

From the process outlined above, it was concluded that overall, owing to the drought and low flow conditions being abnormal at the time of the Olifants catchment field survey, this resulted in low water levels and flow velocities at majority of the sites surveyed. This subsequently had a negative impact on the *in situ* water quality, aquatic biota, as well as the riparian and instream habitat integrity. Cognisance was taken when reviewing the overall PES of each site assessed for the Olifants catchment.

However due to the increase in mining activities within some parts of the Olifants catchment, these activies are contributing to the utilisation of the natural resources. Mis-management of waste water treatment plants, primarily within the upper reaches of the catchment, are further posing a serious threat to various rivers within the system and ultimately to the lower Olifants River in the Kruger National Park (KNP).

The PES of the sites assessed were generally in a lower than expected state owing to the exceptional low flows, low velocities, poor water quality, low aquatic biota diversity and inadequate riparian and instream habitats available. Realistic management recommendations were therefore set to achieve the desired management classes. A summary of the PES from 1999 (comprehensive Reserve study), 2010 (re-visiting of selected EWR sites for the reconciliation strategy) and from this current survey for the Olfiants Catchment (2015) is tabulated below (Table A) and illustrated in the figure below (Figure A). The PES of site S8 was determined in 2011 by a Rapid III survey undertaken as part of the Olifants Classification study. Furthermore, Table B further provides a summary of the EWR sites surveyed within the Letaba and Shingwedzi Catchments and their associated impacts and proposed mitigation and monitoring measures.

Table A: Summary of the overall change in the PES for each EWR site in the Olifants catchment

Site Name	River Name	Quaternary Catchment	PES 1999	PES 2010/ 2011*	PES 2015	Changein PES
S1 (New Rapid II)	Elands	B31C	New Rapid II		C/D	**N/A**
S2 (Resurvey Olifants EWR 4)	Lower Wilge	B20J	C	C	C	=
S3 (New Rapid III)	Wilge	B20F	New Rapid III		C/D	**N/A**
S4 New Rapid III	Olifants	B11G	*This site was not surveyed during the October 2015 survey as there was no suitable hydraulic site present. However, the available*			***N/A***

Site Name	River Name	Quaternary Catchment	PES 1999	PES 2010/ 2011*	PES 2015	Changein PES
			information from a biological perspective will be evaluated.			
S5 (Resurvey Olifants EWR 1)	Olifants	B11J	D	D	D	=
S6 (Replacing Olifants EWR 3)	Klein Olifants	B12D	D	-	D/E	↓
S7 (Resurvey Olifants EWR 2)	Olifants	B32A	C	-	C	=
S8 (Resurvey of Olifants Rapid III site)	Kranspoortspruit	B32A	-	B*	C	↓
S9 (New Rapid III)	Selons	B32C	*New Rapid III site*		D	***N/A***
S10 (Resurvey Olifants EWR 8)	Olifants	B71D	C	C/D	C	↑
S11 (New Rapid III)	Spekboom	B42H	*New Rapid III site*		C	***N/A***
S12 (New Rapid III)	Upper Blyde	B60B	*New Rapid III site*		C	***N/A***
S13 (Resurvey Olifants EWR 11)	Olifants	B71J	E	-	C	↑
S14 (Resurvey Olifants EWR 12	Lower Blyde	B60J	B	B/C	C	↓

Site Name	River Name	Quaternary Catchment	PES 1999	PES 2010/ 2011*	PES 2015	Changei n PES
S15 (Resurvey Olifants EWR 13: Rapid II)	Olifants	B72D	C	C	C	=
S16 (Resurvey Olifants EWR 16)	Olifants	B73H	C	C	D	↓

Overall based on the Eco-classification undertaken and what has been observed, key sites have been identified by the specialists within the Olifants Catchmentas proposed strategic monitoring sites owing to their locality within the catchment, extensive upstream impacts and sensitivity around some of these sites. These sites are listed in the table below.

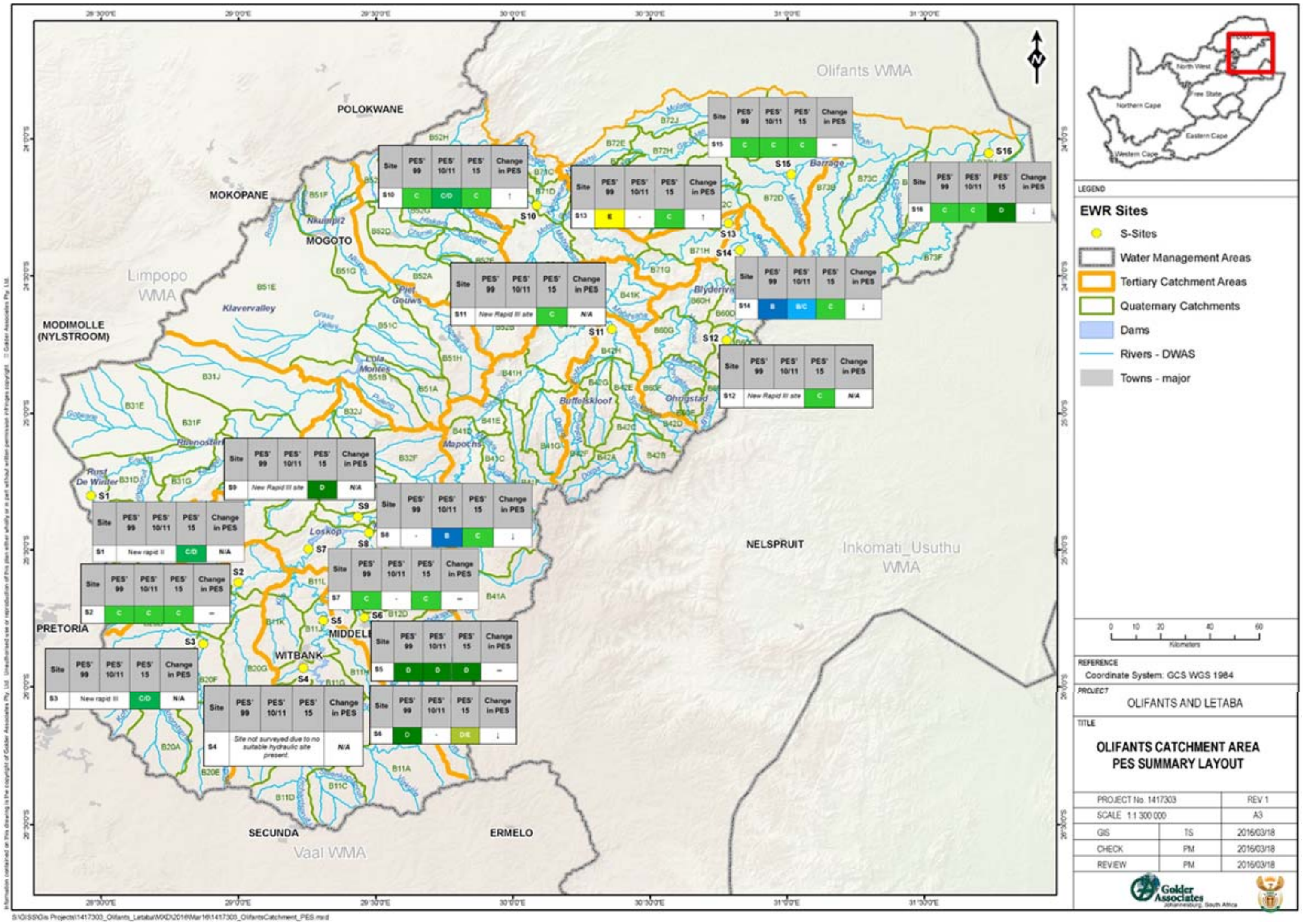

Figure A: Summary illustrating the overall change in the PES for each EWR site within the Olifants catchment (map created by Golder)

Table B: Summary of proposed strategic sites within the Olifants Catchment

<table>
<tr><th>Strategic Monitoring site Proposed</th><th>River</th><th>Impacts and Motivation</th><th>Monitoring Recommended</th></tr>
<tr><td>S2</td><td>Wilge</td><td>• Increased coal mining in the upper reaches of the Wilge, Saalboomspruit and Bronkhorstspruit
• Town developments with increased return flows from wastewater treatment works.</td><td>• Chemical and in situ water quality should be monitored bi-annually
• RQO's must be enforced
• Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet and dry season
• Riparian VEGRAI should be conducted every 5 years
• The IHI should be conducted annually</td></tr>
<tr><td>S4</td><td>Olifants</td><td>• Coal mining in the Witbank and Ogies areas
• Untreated or poorly treated sewerage impacting on water resources
• Extensive cultivation and grazing and cattle farming</td><td rowspan="3">• The recommended full Resource Eco-Status Monitoring Programme (REMP) protocol must include the following:
o Chemical, microbial and in situ water quality should be monitored quarterly;
o Diatom samples should be taken minimum annually;
o Whole Effluent Toxicity (WET) testing should be conducted quarterly until results are resolved;
o Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet and dry season;
o Riparian VEGRAI should be conducted every 5 years; and
o Index of habitat integrity (IHI) should be conducted annually.</td></tr>
<tr><td>S5</td><td>Olifants</td><td>• Extensive coal mining, acid mine drainage
• Town development and return flows from wastewater treatment works Witbank Dam and numerous small dams</td></tr>
<tr><td>S6</td><td>Klein-Olifants</td><td>• Middelburg Dam
• Mining in upper catchment near Pullen Hopes /Arnot /Hendrina
• Agricultural impacts
• Untreated or poorly treated sewerage impacting on water resources</td></tr>
</table>

Strategic Monitoring site Proposed	River	Impacts and Motivation	Monitoring Recommended
S7	Olifants	• Agricultural activities impacting, extensive settlements • Mining activities • Power Stations (Kendal and Kusile) • Industrial complex with Witbank	• The recommended full REMP protocol must include the following: o Chemical, microbial and *in situ* water quality should be monitored quarterly; o Diatom samples should be taken minimum annually; o Whole Effluent Toxicity (WET) testing should be conducted quarterly until results are resolved; o Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet and dry season; o Riparian VEGRAI should be conducted every 5 years; and o Index of habitat integrity (IHI) should be conducted annually.
X13	Elands	• Agriculture is intensive around Marble Hall • Villages, informal / poor infrastructure • Abstraction rate is high	
New De Hoop	Steelpoort	• Mining, proposed mining, forestry, dryland cultivation, informal settlements	
X16	Olifants	• Informal settlement, agriculture • Springbok flats draining in towards the resources • Erosion	
S10	Olifants	• Mining • Farming • Wolkburg, Legalametis reserve • Communities in Steelpoort vally	
H4	Steelpoort	• Mining, influx of people, Burgersfoort • Abstraction, de Hoop Dam	
S13	Olifants	• Intensive agriculture citrus • Game farming • Informal settlements • High erosion	
S14	Lower Blyde	• Extensive agriculture in Ohrigstad and Lower Blyde	

Strategic Monitoring site Proposed	River	Impacts and Motivation	Monitoring Recommended
		• Blyderivierpoort Dam • Pipeline from Lower Blyde for irrigation	
Ga-Selati	Ga-Selati	• Abstraction, farming, wastewater treatment works return flows, Phalaborwa industrial complex	
S16	Olifants	• Protected Area (Kruger National Park).	
X23	Olifants	• Located downstream of the Olifants and Letaba confluence and is the most downstream site of the greater catchment. • Takes into account all cumulative impacts sourced from the Olifants and Leteba catchments. • Located within a gorge in a protected reserve.	• Aquatic macroinvertebrates should be sampled annually. • Fish sampled every three years or should any changes or other indices are detected • Full chemical and *in situ* water quality is to be sampled annually. • Diatom sampling should be undertaken annually.

Letaba and Shingwedzi

The environmental stresses on the aquatic ecosystem as a result of the drought experienced by the country at the end of 2015 and beginning of 2016, were still visible within parts of the Letaba and Shingwedzi Catchments during the time of the survey (April 2016). Some sites were either dry or characterised by low water levels, low flow conditions and exposed habitats, all of which meant that the habitats were not ideal for biota or biological monitoring. Water quality impacts, as a result of the upstream mining, land use practices and urbanisation, within the Olifants catchment, continue to be reflected within parts of the Letaba Catchment with elevated Total Dissolved Solids (TDS) and observed algal blooms (nutrients). Sites within the Letaba catchment prior to entering the KNP were further impacted by alien invasive species, both aquatic and terrestrial, thus changing the indigenous biotic composition for that river reach and consequently lowering the PES. Additional impacts within the KNP borders included some trampling by mega herbivores which escalated the erosion during the drought period along the river reaches.

In terms of the Shingwedzi Catchment, limited work has been done in this catchment owing to its non-perennial nature. This was exacerbated by the effects of the drought, and as a result a number of sites were not flowing, thus automatically eliminating any flow dependent aquatic species.

As a result of the survey, selected sites within both catchments were red-flagged where conservation and protective measures will be put in place.

The PES of the sites assessed were generally in the same ecological category to previous studies undertaken. Realistic management recommendations were therefore set to maintain and achieve the desired management classes. A summary of the PES from 2006, 2013 and from this current survey for the Letaba and Shingwedzi Catchment (2016) is tabulated below (Table C) and illustrated in Figure Bbelow. Table D further provides a summary of the EWR sites surveyed within the Letaba and Shingwedzi Catchments and their associated impacts and proposed mitigation and monitoring measures.

Table C: Summary of the overall change in the PES for each EWR site in the Letaba and Shingwedzi Catchments

Site Name	River Name	Quaternary Catchment	PES 2006	PES 2013	PES 2016	Change in PES
Letaba						
LET2 (Resurvey Letaba EWR 7)	Letaba	B83D	C	C	C/D	↓
LET14 (Resurvey Letsitele EWR 2)	Letsitele	B81D	D	D	D	=
LET16	Letaba	B81B	C	C	C/D	↓

Site Name	River Name	Quaternary Catchment	PES 2006	PES 2013	PES 2016	Change in PES
(Resurvey Letaba EWR 1)						
LET18 (New Rapid III)	Broederstroom	B81A	**-**	**C**	**B/C**	↑
Shingwedzi						
SHI1 (survey)	Shingwedzi	B90H	**B/C**	**C**	**C**	=

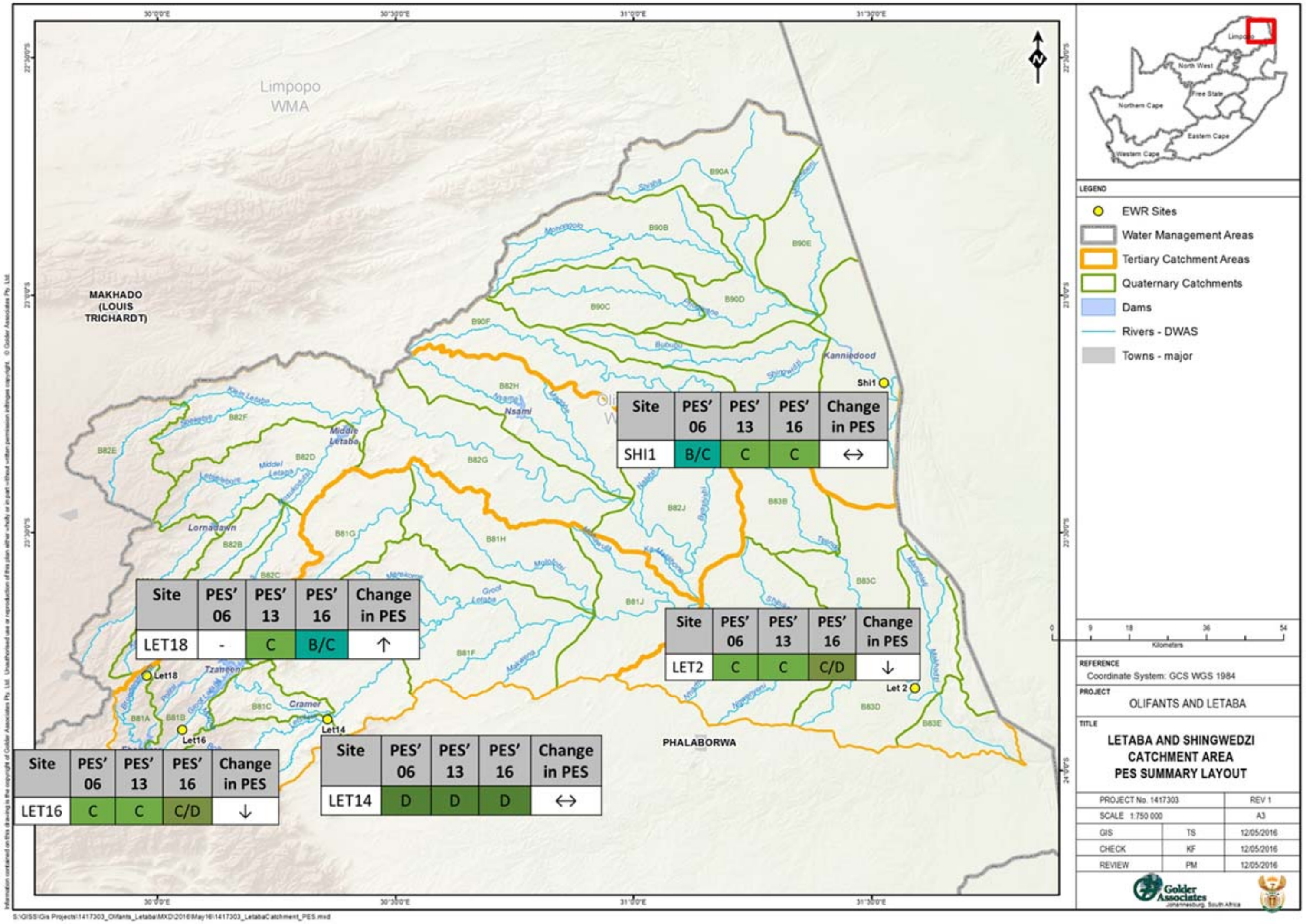

Figure B: Summary illustrating the overall change in the PES for each EWR site within the Letaba and Shingwedzi Catchments (map created by Golder)

Table D: Key sites within the Letaba and Shingwedzi Catchment

Strategic Monitoring site Proposed	River	Impacts and Motivation	Monitoring Recommended
Letaba			
LET2 (Survey of a site downstream existing Letaba EWR 7) Rapid III	Letaba	• Very little direct upstream impacts (in KNP) • No invasive vegetation observed • Large impacts on all flow components due to dams and extensive water use outside KNP • Some trampling by mega herbivores – increased erosion during the drought period • Some poor water quality related to impacts from outside the KNP (mainly nutrients)	• Owing to the proximity of this site, full comprehensive surveys should be conducted annually • Stringent management measures as per KNP protocols for this reach should be adhered to • Chemical and in situ water quality should be monitored quarterly • Diatom samples should be taken minimum annually • Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the low flow conditions • Continuous monitoring of flows at B8H018 • Riparian VEGRAI should be conducted every 5 years • The IHI should be conducted annually
LET14 (Resurvey Letsitele EWR 2) Rapid III	Letsitele	• Removal of riparian vegetation • Cultivation and some commercial farming • Water abstraction • Extensive forestry in the upper catchments • Poor sanitation and sewerage treatment • Alien invasive plants – aquatic and terrestrial	• Owing to the proximity of this site, full comprehensive surveys should be conducted annually • Stringent management measures for this reach should be revised and updated within the existing catchment management plan • REMP protocols must be conducted annually • Organic and inorganic water quality and in situ water quality should be monitored quarterly. • Diatom samples should be taken minimum annually • The WET testing should be conducted bi-annually until results are resolved. As this river reach is an important water source for the locals, this is an important protocol. • Continuous monitoring of flows at B8H010 • Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the low flow conditions

Strategic Monitoring site Proposed	River	Impacts and Motivation	Monitoring Recommended
			• Riparian VEGRAI should be conducted every 5 years The IHI should be conducted annually
LET16 (Resurvey Letaba EWR 1) Rapid III	Letaba	• Extensive forestry • Developments into the riparian zone • Alien invasive vegetation in the riparian zone • Limited erosion • Upstream informal settlements • Upstream impoundments (Dap Naude, Ebenezer)	• Owing to the proximity of this site, full comprehensive surveys should be conducted annually • Stringent management measures for this reach should be revised and updated within the existing catchment management plan • Chemical and in situ water quality should be monitored bi-annually • Diatom samples should be taken minimum annually • Continuous monitoring of flows at B8H014 • Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the low flow conditions • Riparian VEGRAI should be conducted every 3 years • The IHI should be conducted annually
LET18 (New Rapid III)	Broederstroom	• Extensive forestry • Deposition of silt (upstream forestry) • Invasive plants and fish	• Owing to the proximity of this site, full comprehensive surveys should be conducted annually • Stringent management measures for this reach should be revised and updated within the existing catchment management plan • In situ water quality should be monitored during the MIRAI assessments • Aquatic macroinvertebrates (MIRAI) should be monitored once a year • The IHI should be conducted annually

Strategic Monitoring site Proposed	**River**	**Impacts and Motivation**	**Monitoring Recommended**
		Shingwedzi	
SHI1 (Survey)	Shingwedzi	• Abstraction outside KNP and for rest camp/staff village • WQ pollution from outside KNP • Erosion and siltation – due to trampling	• Owing to the proximity of this site, full comprehensive surveys should be conducted annually • Stringent management measures as per KNP protocols for this reach should be adhered to • Chemical and in situ water quality should be monitored annually • Diatom samples should be taken minimum annually • Continuous monitoring of flows at B9H013 • Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the low flow conditions • Riparian VEGRAI should be conducted every 5 years • The IHI should be conducted annually

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APPENDICES

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1. INTRODUCTION

1.1 BACKGROUND AND CONTEXT

With the promulgation of The National Water Act (No. 36 of 1998) (NWA), water resources management in South Africa underwent a paradigm shift. The Department of Water and Sanitation (DWS) as custodian of the nation's water resources is mandated to protect, use, develop, conserve, manage and control the nation's water resources in a sustainable and equitable manner for the benefit of all South Africans. Sustainability encompasses both the long- and short-term protection of water resources to ensure that they can be developed and used effectively into the future.

An approach to managing water resources has been adopted that introduces measures to protect water resources by setting objectives for the desired condition of resources and putting measures in place to control water use to limit impacts to acceptable levels. Resource Directed Measures, together with Source Directed Controls are the key strategic approaches designed under the NWA to achieve equity, sustainability and efficiency in the management of water resources in South Africa

Resource Directed Measures (RDM) is enabled through Chapter 3 of the NWA which provides for the protection of water resources through the Classification of water resources, determination of Resource Quality Objectives (RQOs) and determination of the Reserve. These measures collectively aim to ensure that a balance is reached between the need to protect and sustain water resources on one hand and the need to develop and use them on the other. The Reserve (quantity and quality) which has priority over other water uses provides for two components; (1) basic human needs (BHN), ensuring that the essential needs of individuals served by the water resource in question are provided for; and (2) the ecological Reserve ensuring the water required to protect aquatic systems of the water resource are provided for. In terms of the NWA the preliminary determinations of Reserves may be made if a water resource has not been classified. However once water resources have been classified the preliminary Reserve must be superseded by the Reserve.

The Chief Directorate: Water Ecosystems in 2015 commissioned the study 'Determination, Review and Implementation of the Reserve in the Olifants/Letaba System. With water resources in the Olifants Water Management Area (WMA 4) having been classified and RQOs determined (2011-2014), the preliminary Reserve determined for the Olifants System in 2001, and for the Letaba system are now required to be superseded by the Reserve. Due to the preliminary Reserve having been determined nine years prior to the water resource classification, a review and update is required to ensure that the Reserve is in accordance with the water resource classes and is applicable to the current system needs and demands. In addition there is a need to ensure that ecological important catchments outside the current framework are protected by additional ecological specifications.

The purpose of this study is thus to determine, review and implement the Reserve in the Olifants\Letaba System; with the aim of specifically addressing ecological gaps and reviewing and refining the preliminary Reserves that have been determined.

Four main components are being addressed through the study technical process. These include the review and analysis of existing information; identification and filling in of the ecological gaps identified; evaluation of ecological consequences and operational considerations; and setting the Reserve, defining the ecological specifications and developing the resource management plan. The 8 step Reserve determination procedure is being adhered to in terms of addressing the ecological gaps.

The review and analysis of existing information and the identification of ecological gaps have been completed. The filling in of the ecological gaps is being addressed through Rapid III Reserve determinations and biological surveys of the priority sites identified in the Olifants, Letaba and Shingwedzi catchments.

This report provides the results of part of step 3 of the 8-step Reserve determination process, the Eco-classification, based on a Rapid III level of detail for the rivers of the Olifants Water Management Area.

1.2 STUDY AREA

The study area is the Olifants WMA (WMA 2) and includes the Olifants, Letaba and Shingwedzi systems. The spatial extent of the area includes tertiary drainage regions B11, B12, B20, B31, B32, B41, B42, B51, B52, B60, B71, B72 and B73 in the Olifants system, B81, B82 and B83 in the Letaba area, and B90, the Shingwedzi catchment.

The Olifants River originates at Trichardt, east of Johannesburg, and flows through the Kruger National Park. The Letaba River joins the Olifants River upstream of the border into Mozambique, where they join the Limpopo River before discharging into the Indian Ocean. The Shingwedzi River is located mostly in the Kruger National Park and then into Mozambique before it joins the Limpopo River.

The Olifants System falls within three provinces (Gauteng, Mpumalanga and the Limpopo Province). The main tributaries of the Olifants River are the Wilge, Elands and Ga-Selati Rivers on the left bank and the Klein-Olifants, Steelpoort, Blyde, Klasserie and Timbavati Rivers on the right bank.

The Letaba River catchment is drained by the Groot Letaba River and its major tributaries are the Klein-Letaba, Middle Letaba, Letsitele and Molototsi Rivers. The Shingwedzi River and its major tributaries the Shisha, Mphongolo and Phugwane drain the Shingwedzi River catchment.

The Olifants WMA is a highly utilised and regulated catchment and like many other WMAs in South Africa, its water resources are becoming more stressed due to an accelerated rate of development and the scarcity of water resources. There is an urgency to ensure that water resources in the Olifants WMA are able to sustain their level of uses and be maintained at their desired ecological states.

The overview map of the WMA is shown in **Figure *1***.

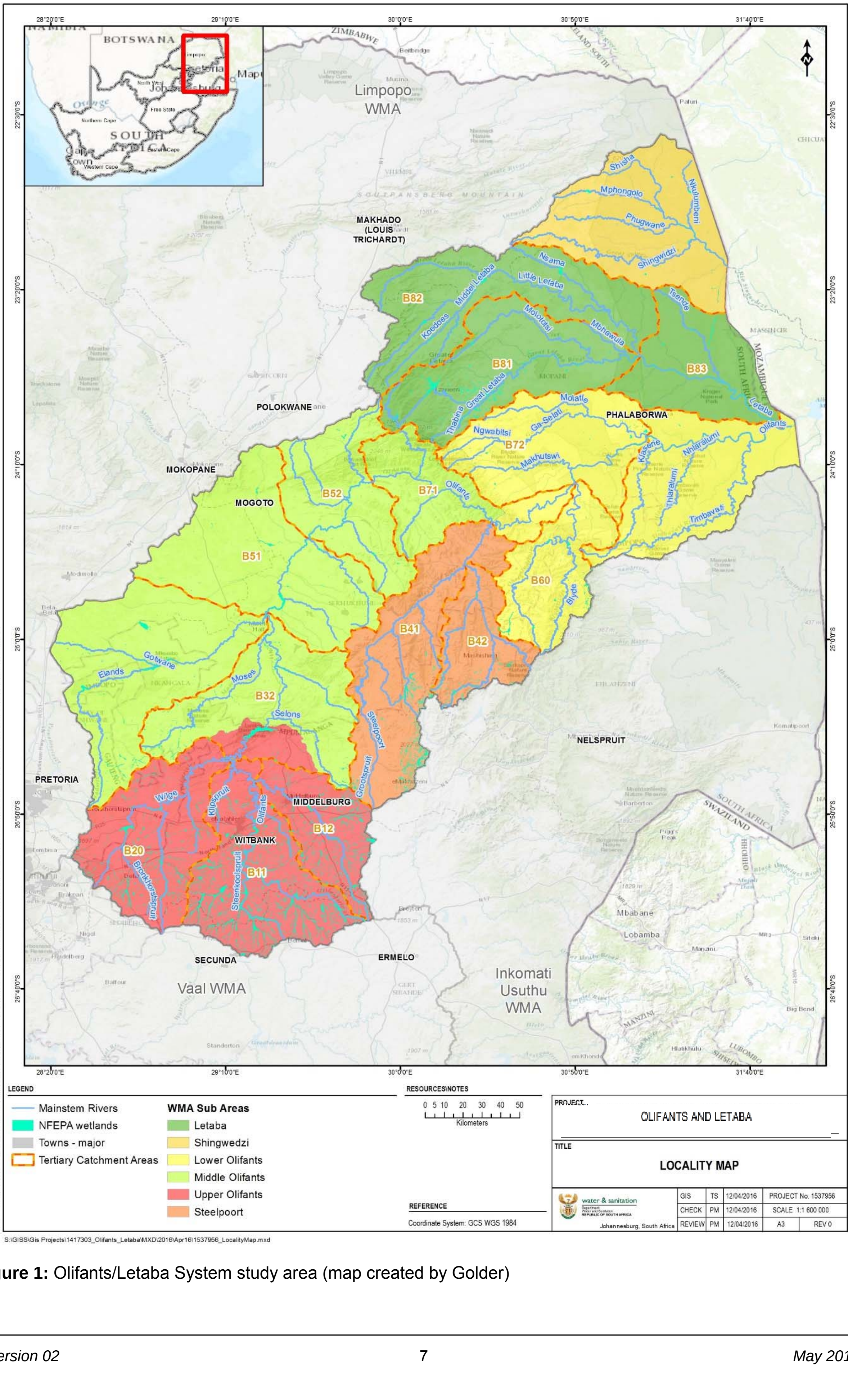

Figure 1: Olifants/Letaba System study area (map created by Golder)

1.3 PRIORITY SITES AND SURVEY APPROACH

An assessment of the system was undertaken during the inception and gap analysis phases of the project to identify and confirm the priority water resources, quaternary and sub-quaternary catchments, Ecological Water Requirement (EWR) sites, wetlands and groundwater driven systems where ecological gaps exist and needed to be addressed. These have been supported by the determination of hotspot areas based on an Integrated Ecological Index and Water Resource Use Index. The hotspot assessment identified the level of Reserve determination that was required (see gaps analysis report for more information).

A list of priority quaternary catchments (with associated river reaches) within the Olifants, Letaba and Shingwedzi catchmentswere identified. The purpose behind these particularly identified priority sub-catchments is that they are important from an ecological perspective or support the system to achieve the desired ecological condition, which require supplementary data, information or analysis to finalise the Reserve. In addition, river reaches in a better ecological condition than the water resource class target ecological catery were also prioritised. A prioritisation and selection of the sites was then undertaken based on review of previous Reserve studies, existing information, expert knowledge, water resources requiring protection, the Classification and resource quality objectives, the water reconciliation situation, conservation and protection areas and prevalent water quality issues.

Further to these, water quality, wetland surveys and groundwater assessments were undertaken as determined through the gap analysis steps. They were prioritised to the extent that the system will be adequately protected by the selection of sites that best serve the needs of the system.

The filling in of the ecological gaps is being addressed through the undertaking of Rapid III Reserve determinations and biological surveys of the priority sites identified in the Olifants, Letaba and Shingwedzi catchments.

The biological field survey for the Olifants Catchment was conducted from 5 – 16 October 2015 where the 16identified EWR sites and 20 biological sites were assessed (Figure 2and Table 1The EWR sites were assigned the letter S and the biological sites letters B, E, H and X, derived by the specialists in the field.

The biological field survey for the Letaba and Shingwedzi was conducted from 12 - 24 April 2016 where four (4) and one (1) identified EWR sites were assessed and 13 and nine (9) biological sites were assessed in the Letaba and Shingwedzi catchments respectively (Figure 3 and Table 1).

The aim of the surveys was to address gaps either through conducting Rapid III assessments, re-survey of hydraulics as well as the surveying the following components at the existing EWR sites:

- *In situ* water quality
- Fish;
- Aquatic macroinvertebrates;
- Riparian habitat; and
- In-stream habitat.

The assessments undertaken during the Olifants, Letaba and Shingwedzi catchment surveys included the following:

- The specialists assessed the present condition of their study component in relation to the considered reference condition, which allowed the determination of the Present Ecological State (PES) for the specific component;
- A cross-sectional profile of the river channel was surveyed using a total station by the hydraulic specialist. Hydraulic data for calibration purposes was collected and the river flow was determined with the aid of a flow meter at the EWR site or from a gauging weir close to the site;
- The fish specialist sampled fish in available aquatic habitats in the vicinity of the hydraulic cross-section using an electro-fish shocker. Any man-induced habitat modifications impacting on fish fauna were identified and considered in the assessment;
- The macroinvertebrate specialist surveyed aquatic macroinvertebrates occurring within the range of instream habitats at the site using the South African Scoring System Version 5 (SASS5) methodology (Dickens and Graham, 2002). A habitat assessment of the site pertaining to SASS5 was also conducted
- The riparian vegetation specialist assessed the condition of the marginal and non-marginal riparian vegetation zones by using the habitat and riparian integrity models to determine the instream and riparian conditions. These models were used as a surrogate for the VEGRAI in the ECOSTATUS model; and
- *In situ* water quality data samples were collected at the EWR sites.

During the Olifants catchment field survey, the specialist team were faced with several limitations.

- Owing to the drought period experienced by the country, low water levels and flow velocities were noted which had a considerable impact on the instream and riparian habitat integrity and availability. These low water levels resulted in many of the different habitats being exposed, hampering sampling effort thus resulting in a low diversity of the aquatic biota. The low water levels further resulted in poor water quality owing to stagnant pools and high algal growth. The adverse conditions were concluded when addressing the EcoStatus for each EWR site;
- Deep pools (e.g. sitesS12, S14, E4, X2, B1) made some sites inaccessible thus hampering sampling effort;
- Access limitations to some of the survey sites (incorrect contact details for private land owners); and
- Sites found not providing the necessary hydraulics and/or biological habitats for surveying. In these cases, desktop PES information and extrapolation will be used to determine the EWRs.

The only limitations experienced by the specialists during the Letaba/Shingwedzi catchment field survey were the drought conditions and limited flow conditions, similar to the conditions recorded during the Olifants survey.

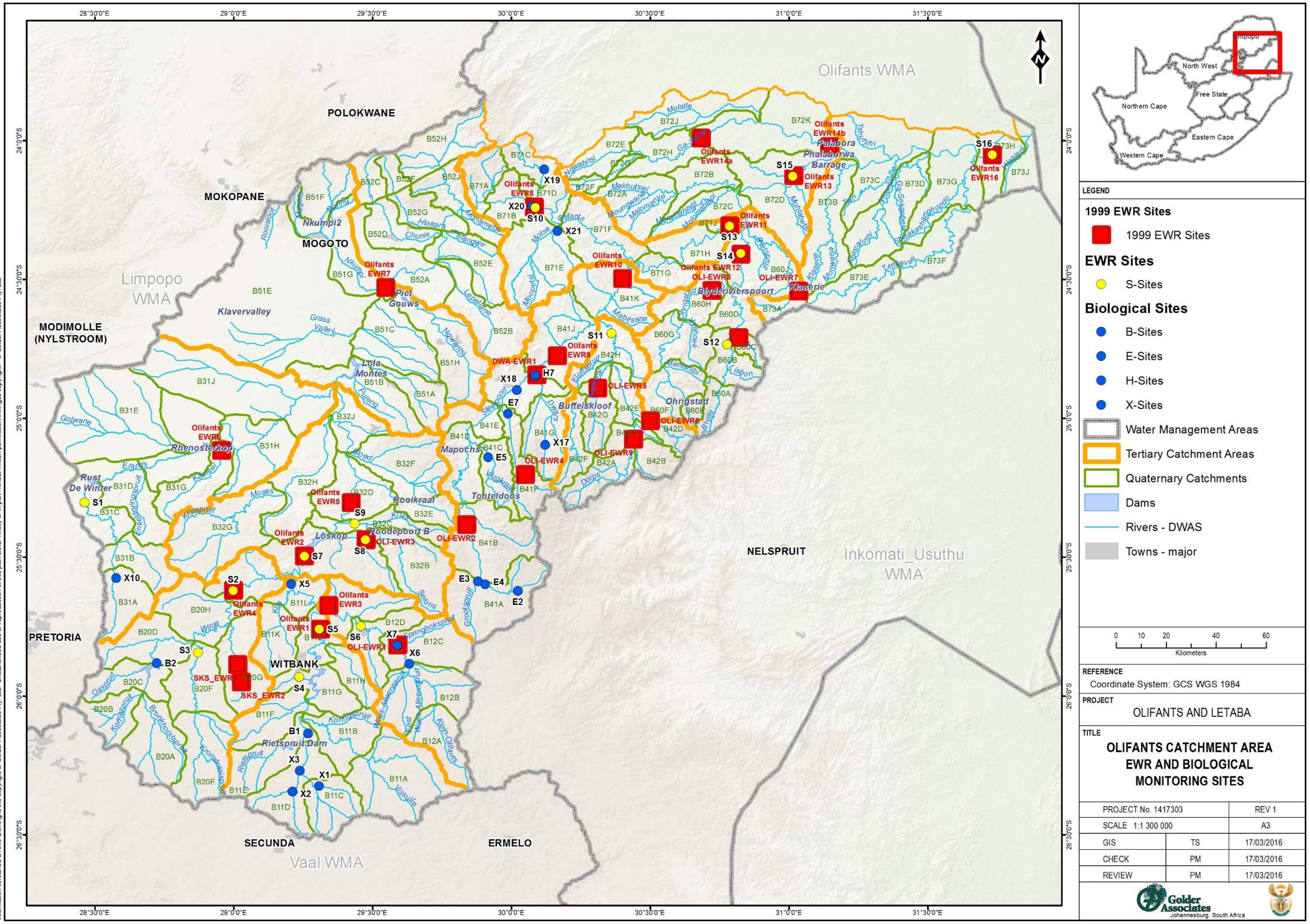

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Figure 2: Priority sites identified indicating type of survey required in the Olifants Catchment (map created by Golder)

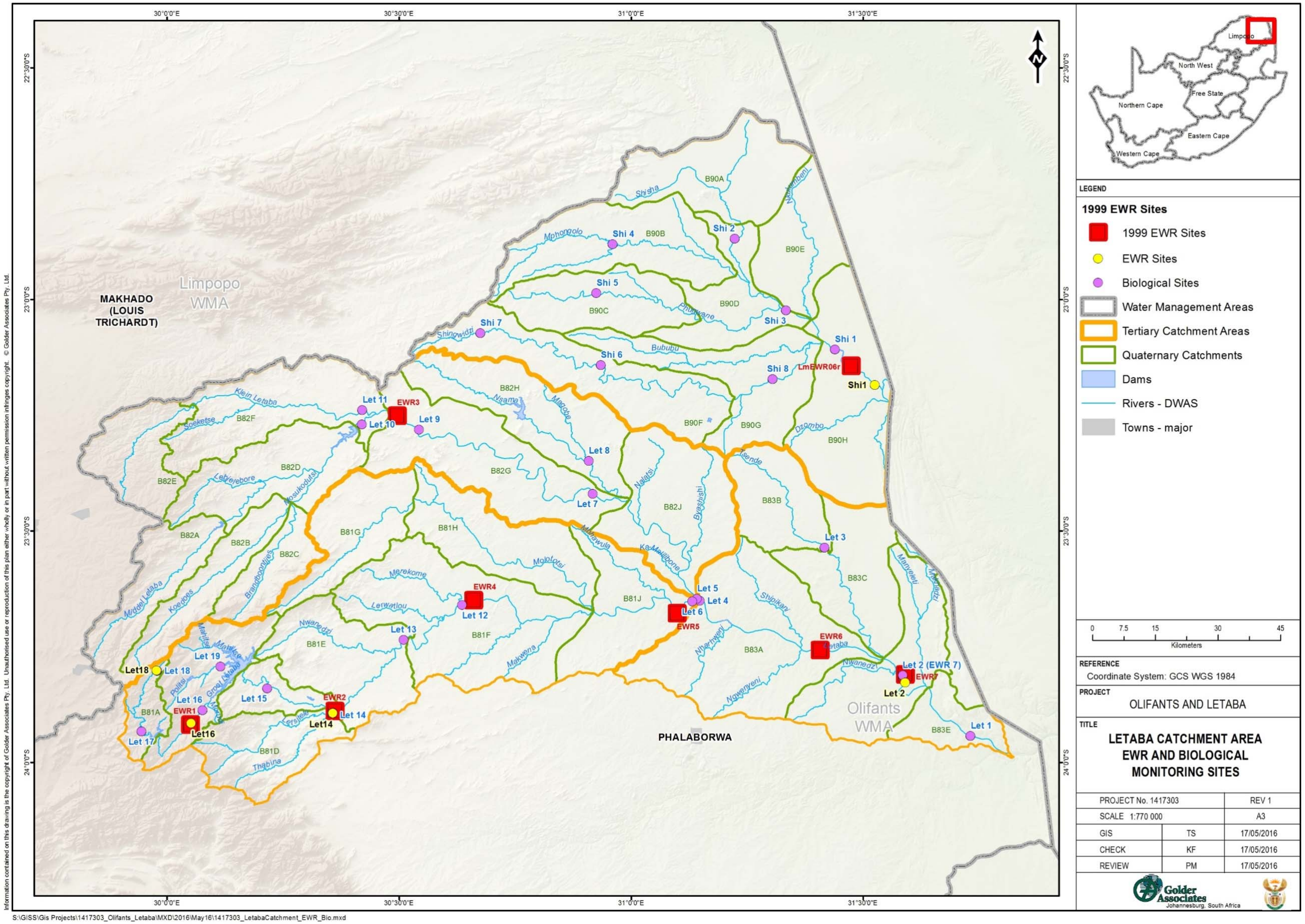


Figure 3: Priority sites identified indicating type of survey required in the Letaba/Shingwidzi Catchment (map created by Golder)

Table 1: Sites in the Olifants, Letaba and Shingwedzi Catchments surveyed during the Field Survey (5 - 16 October 2015 and 12 – 24 April 2016 respectively).

EWR site/ Biological site	Quaternary catchment	River	Coordinates	Sub-reach	Comments and level
Olifants Catchment					
S1	B31C	Elands	-25,303074; 28,46311	B31C-00770	New rapid 2 (no hydraulics)
S2	B20J	Wilge (Lower)	-25.619625; 28,999047	B20J-00998	Replace existing Olifants-EWR4, rapid 3
S3	B20F	Wilge	-25,843984; 28,871978	B20F-01150	New rapid 3
S4	B11G	Olifants	-	B11G-01225	Biological survey only, no suitable hydraulic site
S5	B11J	Olifants	-25,759183; 29,309564	B11J-01086	Replace existing Olifants-EWR1, rapid 3
S6	B12D	Klein Olifants	-25,748872; 29,458649	B12D-01118	Replace existing Olifants-EWR3, rapid 3
S7	B32A	Olifants	-25,496324; 29,254597	B32A-00937	Replace existing Olifants-EWR2, rapid 3
S8	B32A	Kranspoortspruit	-25,437714; 29,475619	B32A-00950	Resurvey existing OLI-EWR3
S9	B32C	Selons	-25,379969; 29,435557	B32C-00936	New rapid 3
S10	B71D	Olifants	-24.239917; 30.082457	B71D-00412	Replace existing Olifants-EWR8, rapid 3
S11	B42H	Spekboom	-24,694155; 30,361267	B42H-00553	New rapid 3
S12	B60B	Blyde (Upper)	-24,734412; 30,778321	B60B-00566	New rapid 3
S13	B71J	Olifants	-24,307563; 30,785695	B71G-00428	Replace existing Olifants-EWR11, rapid 3
S14	B60J	Blyde (Lower)	-24,407481; 30,827404	B60J-00444	Replace existing Olifants-EWR12, rapid 3
S15	B72D	Olifants	-24,12843; 31,01457	B72D-00326	Replace existing Olifants-EWR13, rapid 2 (no hydraulics)
S16	B73H	Olifants	-24,049426; 31,731751	B73H-00311	Replace existing Olifants-EWR16, rapid 3
B1	B11E	Steenkoolspruit	-26,0824.61; 29,1608.27	B11E-01297	Biological surveys only for revised ecostatus and extrapolation of EWR with DRM
B2	B20D	Bronkhorstspruit	-25,5304.5; 28,4325.7	B20D-01146	Biological surveys only for revised ecostatus and extrapolation of EWR with DRM
E2	B41A	Grootspruit	-25.62494, 29.99896	B41A-01002	Biological survey/ WQ only

EWR site/ Biological site	Quaternary catchment	River	Coordinates	Sub-reach	Comments and level
E3	B41A	Steelpoort	-25.58372, 29.87910	B41A-01025	Biological survey/ WQ only
E4	B41A	Langspruit	-25.592544, 29.898643	B41A-01047	Biological survey/ WQ only
E5	B41C	Masala	-25,0827.6; 29,5459.4	B41C-00766	Biological survey/ WQ only
E7	B41F	Klip	-24,5904.58; 29,5919.70	B41F-00699	Biological survey/ WQ only
H7	B41H	Dwars	-245038.33; 30,0530.24	B41H-00640	Updated biological data (using existing hydraulics)
X1	B11C	Steenkoolspruit	-26,1928.78; 29,1827.39	B11C-01449	Biological surveys/Water quality (WQ) only
X2	B11D	Dwars-in-die-wegspruit	-26,2040.27; 29,1244.90	B11D-01467	Biological surveys/WQ only
X3	B11D	Steenkoolspruit	-26,1608.94; 29,1417.73	B11D-01366	Biological surveys/WQ only
X5	B11L	Olifants	-25,3550.23; 29,1227.42	B11L-01024	Biological surveys/WQ only
X6	B12B	Klein Olifants	-25,5305.62; 29,3758.39	B12B-01192	Biological surveys/WQ only
X7	B12C	Klein Olifants	-25,4903.25; 29,3525.98	B12C-01153	Biological surveys/WQ only
X10	B31A	Elands	-25,3430.04; 28,3435.79	B31A-00963	Biological surveys/WQ only
X17	B41G	Groot Dwars	-25,0539.99; 30,0720.72	B41G-00721	Biological surveys/WQ only
X18	B41H	Steelpoort	-24,5339.71; 30,0101.67	B41H-00610	Biological surveys/WQ only
X19	B71C	Mohlapitse	-24,0613.01; 30.0706.47	B71C-00292	Biological surveys/WQ only
X20	B71B	Olifants	-24,1413.08; 30,0435.75	B71B-00335	Biological surveys/WQ only
X21	B71E	Motse	-24,1852.46; 30,1023.34	B71E-00429	Biological surveys/WQ only
X8	B20F	Wilge	-25,5039.16; 28,5218.40	B20F-01150	Biological surveys/WQ only

EWR site/ Biological site	Quaternary catchment	River	Coordinates	Sub-reach	Comments and level
Letaba Catchment					
Let 1	B83E	Letaba	-23.9422, 31.73159	B83E-00265	Biological surveys/WQ only
Let 2	B83D	Letaba	-23.8268, 31.59061	B83D-00255	Downstream existing EWR7, rapid 3
Let 3	B83C	Tsende	-23.5361, 31.41703	B83B-00161	Biological surveys/WQ only
Let 4	B83A	Letaba	-23.6505, 31.14846	B83A-00220	Biological surveys/WQ only
Let 5	B82J	Klein Letaba	-23.6459, 31.14202	B82J-00201	Biological surveys/WQ only
Let 6	B81J	Groot Letaba	-23.652, 31.13173	B81J-00219	Biological surveys/WQ only
Let 8	B82H	Nsama	-23.3488, 30.90899	B82H-00157	Biological surveys/WQ only
Let 9	B82G	Klein Letaba	-23.281, 30.54316	B82G-00135	No flows at existing Letaba EWR5
Let 11	B82F	Klein Letaba	-23.2387, 30.42083	B82F-00128	Dry
Let 12	B81F	Groot Letaba	-23.6596, 30.63574	B82G-00135	No hydraulics, rapid 2 at existing Letaba EWR4
Let 13	B81E	Groot Letaba	-23.735, 30.50999	B81F-00231	Biological surveys/WQ only
Let14	B81E	Letsitele	-23.8932, 30.35736	B81D-00271	Replace existing EWR2, rapid 3
Let 15	B81C	Groot Letaba	-23.8395, 30.21627	B81F-00231	Biological surveys/WQ only
Let16	B81B	Groot Letaba	-23.915, 30.05228	B81B-00264	Replace existing EWR1, rapid 3
Let 17	B81A	Broederstroom	-23.9328, 29.94485	B81A-00270	Biological surveys/WQ only
Let18	B81A	Broederstroom	-23.8007, 29.97741	B81A-00242	New EWR site, rapid 3
Let 19	B81	Politsi	-23.7923, 30.11532	B81B-00240	Biological surveys/WQ only
Shingwidzi catchment					
Shi1	B90H	Shingwedzi	-23.1849, 31.52508	B90H-00117	New rapid 3
Shi 2	B90D	Shisha	-22.8689, 31.22339	B90D-00067	Biological surveys/WQ only
Shi 3	B90D	Mphongolo	-23.0238, 31.33415	B90D-00112	Biological surveys/WQ only
Shi 4	B90B	Mphongolo	-22.8807, 30.96024	B90B-00082	Dry
Shi 5	B90C	Phugwane	-22.9862, 30.92536	B90C-00106	Biological surveys/WQ only

EWR site/ Biological site	Quaternary catchment	River	Coordinates	Sub-reach	Comments and level
Shi 6	B90F	Shingwidzi	-23.1417, 30.93512	B90F-00114	Dry
Shi 7	B90F	Shingwidzi	-23.0729, 30.67529	B90F-00114	Dry
Shi 8	B90G	Shingwidzi	-23.1724, 31.30491	B90G-00130	Biological surveys/WQ only

2 ECO-CLASSIFICATION

The Ecological Classification process (EcoClassification) is a tool used to determine and categorise the Present Ecological State (PES) and Recommended Ecological Category (REC) based on the health and integrity of the biophysical attributes of a river ecosystem, relative to the natural reference condition of that system (Kleynhans & Louw 2007). It forms an integral part of the Ecological Reservedetermination method and of any Environmental Flow Requirement method. Flowsand water quality conditions cannot be recommended without information on thepredicted resulting state, the Ecological Category (EC) (Kleynhans & Louw 2007).The primary objective of the EcoClassification process is to recognise the causes and sources of the deviation of the derived PES through the various models, in relation to the reference condition of that river's biophysical attributes. The end result is to ultimately gain information to derive future desirable and attainable ecological objectives for the river (Kleynhans & Louw 2007).

The various components required for the EcoClassification process to determine the integrated state or PES, the Ecostatus Level 4 model (Kleynhans & Louw 2007) include the following:

- Drivers:
    - Physical-chemical variables;
    - Geomorphology; and
    - Hydrology
- Biological Responses:
    - Fish;
    - Riparian vegetation; and
    - Aquatic macroinvertebrates

Varying procedures are followed for each component to assign an ECranging from A to F (where A represents a natural state and F a critically modified state)(**Table 2**). Ecologicalevaluation against the expected reference conditions, followed by integration of the categories of each component, provides a description of the Ecological Status or *EcoStatus* of a river. Consequently, the EcoStatus is defined as the integration of the river's features (instream and riparian zones) which influences its ability to support appropriate biota (Kleynhans & Louw 2007). This ability relates directly to the capacity of the system to provide a variety of goods and services.

Table 2: Ecological Categories and descriptions

Ecological Category	Description
A	Unmodified, natural.
A/B	Boundary category between A and B.
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
B/C	Boundary category between B and C.

Ecological Category	Description
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
C/D	Boundary category between C and D.
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
D/E	Boundary category between D and E.
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
E/F	Boundary category between E and F.
F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.

It must be noted that the ecological category scale represents a continuum whereby the boundaries between categories,along the continuum, are notional, artificially-defined points. Subsequently, there may be circumstances where there could be ambiguity as to which category a particular entity belongs to. This situation falls within the concept of a fuzzy boundary, where a particular entity may potentially have membership of both classes (Robertson *et al*., 2004). This is therefore referred to as boundary categories and assigned a B/C, C/D category etc (**Figure 4).**

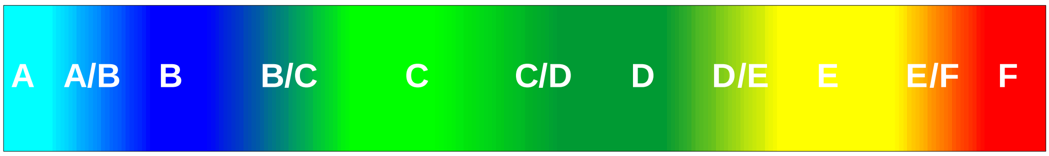


Figure 4: Illustration of the distribution of ecological categories on a continuum

The steps followed in the EcoClassification process for this study include the following:

- Determine the reference conditions for fish and macroinvertebrates;
- Determine the PES and explanation for fish, macroinvertebrates and instream and riparian habitat integrity using the Fish Response Assessment Index (FRAI), Macroinvertebrate Response Assessment Index (MIRAI) and Index of Habitat Integrity (IHI) models;
- Identify the trend for each component and whether there is movement towards or away from the reference state;
- Identify the overall change and reason for the potential deviation behind the PES and whether these are flow or non-flow related;
- Classify the overall EcoStatus for the site using the Ecostatus Level 4 model; and

- Verify the sub-reach desktop EI and ES (DWS, 2014) and adjust with site specific information for the biota and habitat.

Existing data was used where available from previous studies where the PES has already been determined following the Ecostatus Level 4 or similar models. Where data was limiting and which have been identified during the gap analysis phase, additional rapid III studies or biological surveys were undertaken. Only the fish and macroinvertebrates components were considered to determine the PES for this study. The habitat integrity for the riparian zone was used as a surrogate for the riparian vegetation component.

Ecoclassification Process

For ecoclassification of the water resourcesin the Olifants WMA, existing data was used where available from previous studies where the PES has already been determined following the Ecostatus Level 4 or similar models. Where data was limiting and which have been identified during the gap analysis phase, additional rapid III studies or biological surveys were undertaken, only the fish and macroinvertebrates components were considered to determine the PES. The habitat integrity for the riparian zone was used as a surrogate for the riparian vegetation component.

Following the survey undertaken in October 2015 in the Olifants catchment and in April 2016 in the Letaba/Shingwedzi catchments, specialist workshops were held in November 2015 and March 2016 to determine Ecostatus. The process included the following:

- Description of site localities within the catchment (EWR and biological sites);
- Type of historical and existing information availability for each site (EWR and biological sites);
- Characterisation and evaluation of each site in terms of both the drivers and responses identified (*i.e.* habitat availability, aquatic biota, water quality) and associated advantages and disadvantages of each component (EWR and biological sites);
- Reference conditions for the aquatic biota (EWR sites only);
- Description of both site and upstream impacts (EWR and biological sites);
- Completion of the EcoStatus 4 model resulting in an overall PES category and score coupled with an explanation for each component (EWR sites only);
- A comparison using the previous PES results from preceding Reserve studies (PES 1999 and PES 2010) was undertaken to compare the final selected PES identified during this study from the EcoStatus Model 4 and reasons for the potential deviations. However, owing to the drought and the low flow conditions being abnormal, this was taken into account when reviewing the PES state of the system. Subsequently a Recommended Ecological Category (REC) was provided (EWR sites only).
- Assessment of the PES ecological trends from 1999 for each component (aquatic biota and riparian and instream habitat integrity) (EWR sites only);
- The following 9 ecological importance and 8 ecological sensitivity criteria were assessed at a desktop level for each EWR sub-reach using the PES/EIS 2013 studies:
- Ecological Importance
  - Fish representivity and rarity
  - Macroinvertebrate representivity and rarity
  - Riparian-wetland-instream: vertebrates

  - Riparian-wetland-instream: natural vegetation
  - Habitat diversity
  - Habitat size
  - Habitat integrity
  - Riparian-wetland habitat integrity
  - Instream and riparian migration
- Ecological Sensitivity
  - Physico-chemical sensitivity:
  - Fish and macroinvertebrates
  - Fish: no flow
  - Macroinvertebrates: velocity
  - Riparian-wetland-instream – vertebrates: flow or water level changes
  - Riparian-wetland – vegetation:
  - water level changes
  - Stream size (flow/water level changes)

  However, as there were no perceived changes to the ecological importance and sensitivity for the EWR site itself, it was confirmed that these criteria will be reached during optimal/seasonal flow conditions. The desktop evaluation for each of these criteria for the EWR sub-reach can be viewed in **Appendix B**. Once the flows have returned to normal following the rain season, it is critical that the ecological importance and sensitivity is addressed during a workshop in order to evaluate the interaction between flows, habitat and biota; and
- An overall assessment and recommendations (EWR and biological sites).

3 OLIFANTS CATCHMENT: ECOLOGICAL STATUS - PRIORITY SITES

Please refer to Appendix C for the aquatic macroinvertebrate and fish inventories for each site

3.1 EWR SITES

3.1.1 SITE S1: ELANDS RIVER

SITE	DETAILS	VIEW
Site	S1	
River	Elands River	
Quaternary Catchment	B31C	
Co-ordinates	-25,303074; 28,46311	
Ecoregion	Bushveld Basin (8)	
IUA	4	
SQ Reach	B31C-00770	
IEI Rating	3	
WRUI Rating	2	
Survey Type	Rapid II (no hydraulics)	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	Very high	
Eco-Region Level II	8_5	
Geozone	E	
Gauging weirs	B3H003	
Discharge	0.0085 m3/s	

HABITAT AND BIOTA

- Good biological site
- Stones-In-Current (SIC), Stones-Out-Of-Current (SOOC), large boulders, small cobbles, and vegetation associated with the site. Limited marginal vegetation owing to very low flows.
- Aquatic macroinvertebrates: Average Score Per Taxa (ASPT): 6.5 (moderately tolerant taxa)

SITE	DETAILS	VIEW
• Fish Habitat: Good		
WATER QUALITY • pH: 8.7, EC: 16.0 mS/m, DO: 5.03mg/l		
SITE AND UPSTREAM IMPACTS • Very low flows • Exposed soils (erosion) • Agricultural activities • Several small dams • Artificial widening of river owing to a bridge • High organic material content observed namely algae and silt. This can be attributed largely to leaves from canopy		

S1: Site Evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	1	The site is easily accessible.	An upstream bridge (and remains of an old bridge) and downstream reed beds will influence the hydraulics under high flow conditions. The bridge pillars deflect flows towards the right hand bank. The wide site is not representative of the river.
Fish	4	Most of habitat present Good representation of velocity-depth classes Pools available serve as refuge areas	Upstream impacts – organic content
Macroinvertebrates	3	SIC, vegetation, SOOC present	Upstream impacts – organic content Silt limited spaces between cobbles
Habitat Integrity	3	Site provide good indication of present state of site	Exotic spreading from upstream

** Confidence scores: 0 = no confidence; 5 = high confidence*

S1: Information Availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	

Hydraulics						Only discharge and velocity readings
Fish						Only one survey
Macroinvertebrates						Historical surveys Present survey
Hydrology						Natural and present day monthly flow Gauging weir B3H003 downstream of site

* 0 (no information) to 4 (large amount of data available)

Reference Conditions	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Labeo cylindricus, labeo molybdinus, Micralestes acutidens, Mesobola brevianalis, Marcusenius macrolepidotus, Oreochromis mossambicus, Pseudocrenilabrus philander, Tilapia sparrmanii, Chiloglanis pretoriae*
Macroinvertebrates	Porifera, Turbellaria, Oligochaeta, Hirudinea, Potamonautidae, Atyidae, Hydracarina, Perlidae, Baetidae >2sp, Caenidae, Heptageniidae, Leptophlebiidae, Prosopistomatidae, Trichorythidae, Chlorocyphidae, Chlorolestidae, Coenagrionidae, Lestidae, Aeshnidae, Corduliidae, Gomphidae, Libellulidae, Pyralidael, Belostomatidae, Corixidae, Gerridae, Hydrometridae, Naucoridae, Nepidae, Notonectidae, Pleidae, Veliidae, Ecnomidae, Hydropsychidae 2spp, Hydropsychidae >2spp, Philopotamidae, Hydroptilidae, Leptoceridae, Dytiscidae, Elmidae, Gyrinidae, Haliplidae, Helodidae, Hydraenidae, Hydrophilidae, Psephenidae, Athericidae, Ceratopogonidae, Chironomidae, Culicidae, Dixidae, Muscidae, Simuliidae, Tabanidae, Tipulidae, Ancylidae, Bulinae, Lymnaeidae, Planorbinae, Thiaridae, Corbiculidae, Sphaeridae, Unionidae

S1: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	E (36.8)	F & NF	Very slow flow e.g lack of flow depth and velocity classes Some biotopes not accessible due to low flow e.g marginal vegetation (veg) and undercut banks
Macroinvertebrates	C/B (77.1)	F & NF	Very slow flow e.g lack of flow depth and velocity classes Some biotopes not accessible due to low flow e.g marginal veg Limited silt build-up due to low flow conditions

Habitat Integrity: Instream	C (69.0)	F & NF	Flow modification (numerous small dams upstream) Introduced aquatic fauna (bass in Rust de Winter Dam downstream of site)
Habitat Integrity: Riparian	B (87.0)	F & NF	Flow modification (some terrestrial encroachment – longer periods of low flows) Channel modification (bridges widening the stream)
ECOSTATUS	C/D (61.8)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S1: PES and causes	
Component	**Causes** **Present/Absent**
Fish	Present: *Pseudocrenilabrus philander, Tilapia sparrmanii*, *Chiloglanis pretoriae*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Trichorythidae and Simuliidae, fast flows: Gomphidae and Naucoridae, slow flows: Corixidae, Hydroptilidae and Tipulidae and very slow flows: the Lymnaeidae and Planorbinae. The taxa absent from the various habitat types were: bedrock: Porifera, cobbles: Hirudinea, Trichorythidae and Aeshnidae, marginal vegetation: Hydroptilidae, Hydrophilidae, Lymnaeidae and Planorbinae, from the GSM: Oligochaeta, Gomphidae and Tipulidae and from the water column: Corixidae, Naucoridae and Simuliidae. The taxa absent due to the water quality rating were those from moderate: Trichorythidae, Aeshnidae and Athericidae, low Gomphidae, Naucoridae, Hydroptilidae, Hydrophilidae, Simuliidae, Tipulidae and Ancylidae and those with the very low rating: Oligochaeta, Hirudinea, Corixidae, Lymnaeidae and Planorbinae.

S1: Overall change and reason for deviation				
COMPONENT	**PES 1999**	**PES 2010**	**PES 2015**	**REASON FOR DEVIATION**
ECOSTATUS	C	-	C/D	Flow modification Limited habitat diversity due to low flows Channel modification Undercut banks

S1: Ecological trends for the EWR site (include components that were assessed)			
Component	**Trend**	**Reason**	**Confidence (0-5)***
Fish	No previous data available		
Macro-invertebrates			
Habitat integrity: Instream	↓	Low water levels resulting in limited access to some biotopes for biota e.g. instream habitat dry and exposed	4
Habitat integrity: Riparian	↓	Increased water use upstream	2
ECOSTATUS	↓	Flow modification Limited habitat diversity due to low flows Channel modification Undercut banks Confidence low due to riparian veg (VEGRAI) survey not conducted	2

** 0 – no confidence to 5 – high confidence*

S1: OVERALL ASSESSMENT

This is a new rapid 2 site following the gap analysis. Limited access to biotopes as a result of the low and reduced water levels observed at the time of the survey (October 2015), resulted in a reduced ecostatus.

RECOMMENDATIONS

- Chemical and *in situ* water quality should be monitored bi-annually
- Diatom samples should be taken minimum every 2 years
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet season
- Riparian VEGRAI should be conducted every 5 years
- The IHI should be conducted every 2 years

3.1.2 SITE S2: LOWER WILGE RIVER*(old comprehensive Olifants-EWR4)*

SITE	DETAILS	VIEW
Site	S2	
River	Lower Wilge River	
Quaternary Catchment	B20J	
Co-ordinates	-25.619625 ; 28,999047	
Ecoregion	Eastern Bankenveld (9)	
IUA	2	
SQ Reach	B20J-00998	
IEI Rating	3	
WRUI Rating	2	
Survey Type	Rapid III	
PES2013 (reach)	C	
EI_ES 2013(reach)	High	
Eco-Region Level II	9_6	
Geozone	D	
Gauging weirs	B2H015	
Discharge	0.124 m3/s	

HABITAT AND BIOTA

- SIC, SOOC, small cobbles, and vegetation associated with the site. Limited marginal vegetation owing to very low flows.
- Aquatic macroinvertebrates: ASPT: 6.6 (moderately tolerant taxa)
- Fish Habitat: Good

WATER QUALITY

- pH 8.7; EC 54.0 mS/m; 7.38 mg/l

SITE AND UPSTREAM IMPACTS

- Flow velocity was very low

- Dense algae and fine sediments were observed
- Green algae dominate in fast flowing water
- Sediments noted out of channel and as a result less green algae
- Agricultural activities
- Upstream abstraction activities

S2: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	3	The site is easily accessible. The section and slope are even and the cross section is representative of the section of the river	Boulders will influence the roughness
Fish	4	Most of habitats present dominated by boulders Pools available serve as refuge areas	Low velocities due to low flows Upstream impacts – organic content
Macroinvertebrates	4	SIC, GSM, vegetation, SOOC habitats present dominated by large boulders with large interstitial spaces	Low velocities due to low flows Upstream impacts – organic content Silt limited spaces between cobbles
Riparian vegetation / Habitat Integrity	4	Representative of the site Good vegetation cover aided in bank stability	Cattle activity leading to trampling Limited alien invasive species

** Confidence scores: 0 = no confidence; 5 = high confidence*

S2: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics			■			Only one set of measured data available at the cross section
Fish				■		Historic data available from previous Reserve study (2001) and 2009/10 survey

						Present survey
Macroinvertebrates						Historic data available from previous Reserve study (2001) and 2009/10 survey Present survey
Hydrology						Natural and present day monthly flow Gauging weir B2H015 downstream of site
Physico-chemical						Data available from water quality monitoring site B2H015Q01 downstream of site. Historic data, DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

S2: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Amphilius uranoscopus, Enteromius (Barbus)anoplus, Enteromius (Barbus) eutaenia, Labeobarbus marequensis, Enteromius (Barbus)paludinosus, Labeobarbus polylepis, Enteromius (Barbus)trimaculatus, Enteromius (Barbus) unitaeniatus, Clarias gariepinus, Chiloglanis pretoriae, Labeo cylindricus, Labeo molybdinus, Pseudocrenilabrus philander, Tilapia sparrmanii*
Macroinvertebrates	Porifera, Turbellaria, Oligochaeta, Hirudinea, Potamonautidae, Atyidae, Hydracarina, Perlidae, Baetidae >2spp, Caenidae, Heptageniidae, Leptophlebiidae, Oligoneuridae, Polymitarcyidae, Prosopistomatidae, Trichorythidae, Chlorocyphidae, Coenagrionidae, Lestidae, Aeshnidae, Corduliidae, Gomphidae, Libellulidae, Pyralidae, Belostomatidae, Corixidae, Gerridae, Hydrometridae, Naucoridae, Nepidae, Notonectidae, Pleidae, Veliidae, Ecnomidae, Hydropsychidae 2spp, Hydropsychidae >2spp, Philopotamidae, Hydroptilidae, Leptoceridae, Dytiscidae, Elmidae, Gyrinidae, Haliplidae, Helodidae, Hydraenidae, Hydrophilidae, Psephenidae, Athericidae, Ceratopogonidae, Chironomidae, Culicidae, Dixidae, Muscidae, Simuliidae, Tabanidae, Tipulidae, Ancylidae, Bulinae, Lymnaeidae, Physidae, Planorbinae, Thiaridae, Corbiculidae, Sphaeridae

S2: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	C (72.4)	F & NF	Depth flow velocity Poor water quality, considerable algal growth
Macroinvertebrates	C (68.6)	F & NF	Flow velocity

			Limited habitat availability due to high algal growth Large boulders hampering sampling efficiency
Habitat Integrity: Instream	B (83)	F & NF	Flow velocity Limited habitat availability due to high algal growth Large boulders hampering sampling efficiency Upstream abstraction activities
Habitat Integrity: Riparian	A/B (89)	F & NF	Fair conditions
ECOSTATUS	C (76.6)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S2: PES and causes	
Component	**Causes** **Present/Absent**
Fish	Present: *Labeobarbus marequensis*, *Chiloglanis pretoriae, Amphilius uranoscopus*, *Enteromius (Barbus) trimaculatus*, *Pseudocrenilabrus philander*, *Enteromius (Barbus)unitaeniatus*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Trichorythidae, Hydropsychidae and Ceratopogonidae, fast flows: Leptoceridae, and very slow flows: Gerridae with the Lymnaeidae as a new record for this site. The taxa absent from the various habitat types were: bedrock: Ancylidae, cobbles: Trichorythidae, Aeshnidae, Hydropsychidae, Ceratopogonidae and Planorbinae, marginal vegetation: Hydrophilidae, from the GSM: Oligochaeta and from the water column: Tipulidae, Corduliidae and Oligochaeta. The taxa absent due to the water quality rating were those from moderate: Gerridae and Hydrometridae and those with the very low rating: Culicidae.

S2: Overall change and reason for deviation				
COMPONENT	**PES 1999**	**PES 2010**	**PES 2015**	**COMMENT**
ECOSTATUS	C	C	C	Stable

S2: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 1999	**PES 2010**	**PES 2015**		
Fish	B	C	C	The nature reserve upstream aids in the protection of the river reach Large area inaccessible to humans and limiting cultivation potential owing to step banks contributes to improvement to water quality	4
Macro-invertebrates	B	C/D	C	The nature reserve upstream aids in the protection of the river reach Large area inaccessible to humans and limiting cultivation potential owing to step banks contributes to improvement to water quality	4
Habitat integrity: Instream	-	C	B	Potential improvement in the water management upstream of this site. Current conditions observed resulted in a B category	3
Habitat integrity: Riparian	-	A/B	A/B	Good management by surrounding land owners	3
ECOSTATUS	B	C	C		

** 0 – no confidence to 5 – high confidence*

S2: OVERALL ASSESSMENT

The site is located on the Wilge River downstream of the confluence of Saalboomspruit and Bronkhorspruit river. Owing to the low water levels, marginal vegetation was not accessible and lack of GSM as a biotope for macroinvertebrates linked to the boulder/cobble nature of the streambed. Poor water quality,which is impacted by organic pollution from agricultural activity and further impacts from mining activities.

RECOMMENDATIONS

- Chemical and *in situ* water quality should be monitored bi-annually
- RQO's must be enforced
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet and dry season
- Riparian VEGRAI should be conducted every 5 years

- The IHI should be conducted annually
- It iis Important to set water quality objectives as water quality is an issue.

3.1.3 SITE S3 AND X8: WILGE RIVER*(NEW RAPID SITE)*

SITE	DETAILS	VIEW
Site	S3 and X8	
River	Wilge River	
Quaternary Catchment	B20F	
Co-ordinates	-25,843984; 28,871978	
Ecoregion	Highveld (11)	
IUA	2	
SQ Reach	B20F-01150	
IEI Rating	3	
WRUI Rating	3	
Survey Type	Rapid III and biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	11_3	
Geozone	E	
Gauging weirs	B2H014	
Discharge	0.0035 m3/s	

HABITAT AND BIOTA

- SIC,SOOC, bedrock, cobbles and boulders present
- Aquatic macroinvertebrates: ASPT: 5.4 (tolerant taxa)
- Fish Habitat: Fair
- Depth of 25-350mm for fish

WATER QUALITY

- pH: : pH 8.6; EC 44.0 mS/m; DO 4.85mg/l

SITE AND UPSTREAM IMPACTS

- Deeply incised banks that are collapsing.

• High abundance of algae and silt • Some embeddedness. • Low flow is restricted by undercut and root wads. • Agricultural activities • Open cast mining – lowering of baseflow capacties

S3 and X8: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	3	The site is easily accessible.	Bank vegetation will influence the hydraulics under high flow conditions.
Fish	4	Habitats present cobbles and boulders	Limited marginal vegetation and root wads Not good representation of flow-depth classes Limited pools available as refuge areas Upstream impacts – organic content
Macroinvertebrates	4	SIC and GSM habitats present, but limited	Limited SOOC and marginal vegetation Low velocities due to low flows Upstream impacts – organic content (discolouration) Silt limited spaces between cobbles
Riparian vegetation / Habitat Integrity	4	Representative of the site Some pockets of natural vegetation remain	Alien invasive present Removal of riparian vegetation observed Cattle activity leading to trampling Erosion and bank collapse

* *Confidence scores: 0 = no confidence; 5 = high confidence*

S3 and X8: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Only one set of measured data available at the cross section
Fish						Historic data available from previous surveys Present survey
Macroinvertebrates						Historic data available from previous surveys Present survey
Hydrology						Natural and present day monthly flow Gauging weir B2H014
Physico-chemical						Data available from water quality monitoring site B2H014Q01. Historic data, DWS Chemical monitoring programme

* 0 (no information) to 4 (large amount of data available)

S3 and X8: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Amphilius uranoscopus, Enteromius (Barbus)anoplus, Labeobarbus marequensis, Labeobarbus polylepis, Enteromius (Barbus)trimaculatus, Clarias gariepinus, Chiloglanis pretoriae, Pseudocrenilabrus philander, Tilapia sparrmanii*
Macroinvertebrates	Porifera, Turbellaria, Oligochaeta, Hirudinea, Potamonautidae, Atyidae, Hydracarina, Baetidae >2spp, Caenidae, Heptageniidae, Leptophlebiidae, Oligoneuridae, Polymitarcyidae, Prosopistomatidae, Trichorythidae, Chlorocyphidae, Chlorolestidae, Coenagrionidae, Lestidae, Aeshnidae, Corduliidae, Gomphidae, Libellulidae, Pyralidae, Belostomatidae, Corixidae, Gerridae, Hydrometridae, Naucoridae, Nepidae, Notonectidae, Pleidae, Veliidae, Ecnomidae, Hydropsychidae 2spp, Hydropsychidae >2spp, Philopotamidae, Hydroptilidae, Leptoceridae, Dytiscidae, Elmidae, Gyrinidae, Haliplidae, Hydraenidae, Hydrophilidae, Athericidae, Ceratopogonidae, Chironomidae, Culicidae, Dixidae, Empididae, Ephydridae, Muscidae, Psychodidae, Simuliidae, Syrphidae, Tabanidae, Tipulidae, Ancylidae, Bulinae, Lymnaeidae, Planorbinae, Thiaridae, Corbiculidae, Sphaeridae, Unionidae

S3 and X8: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	D (47.1)	F & NF	Low flow velocities Lack of biotope diversity Poor water quality owing to organic pollution High agricultural activities
Macroinvertebrates	C (76.6)	F & NF	Low flow velocities Lack of biotope diversity Poor water quality owing to organic pollution High agricultural activities
Habitat Integrity: Instream	D (54)	F & NF	Lack of scouring and thus silt build up Algal growth Smothering of habitats
Habitat Integrity: Riparian	D (55)	F & NF	Bank erosion and collapse due to the modified riparian vegetation regime Vegetation removal and trampling Alien invasive encroachment
ECOSTATUS	C/D (59)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S3 and X8: PES and causes	
Component	**Causes Present/Absent**
Fish	Present: *Enteromius (Barbus)anoplus*, *Clarias gariepinus*, *Chiloglanis pretoriae*, *Gambusia affinis*, Tilapia sparrmanii* **Exotic species*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Oligoneuridae, Simuliidae and Hydropsychidae, fast flows: Hydraenidae, slow flows: Haliplidae and Unionidae and very slow flows: Gerridae with Caenidae a new record. The taxa absent from the various habitat types were: cobbles: Oligoneuridae, Simuliidae and Hydropsychidae, marginal vegetation: Haliplidae, from the GSM: Unionidae and from the water column: Gerridae a new record (NR) and Dixidae. The taxa absent due to the

	water quality rating were those from high: Hydropsychidae, moderate: Gerridae and those with the low: Simuliidae, Haliplidae and Unionidae.

S3 and X8: Overall change and reason for deviation				
COMPONENT	**PES 1999**	**PES 2010**	**PES 2015**	**REASON FOR DEVIATION**
ECOSTATUS	C	-	C/D	Poor water quality Lack of flow velocity Instream habitat modification

S3 and X8: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 1999	**PES 2010**	**PES 2015**		
Fish	New site		D	Low flow velocities Lack of biotope diversity Poor water quality owing to organic pollution High agricultural activities	4
Macro-invertebrates			D	Low flow velocities Lack of biotope diversity Poor water quality owing to organic pollution High agricultural activities	4
Habitat integrity: Instream			D	Lack of scouring and thus silt build up Algal growth Smothering of habitats	4
Habitat integrity: Riparian			D	Bank erosion and collapse due to the modified riparian vegetation regime Vegetation removal and trampling Alien invasive encroachment	4

ECOSTATUS		C/D	

** 0 – no confidence to 5 – high confidence*

S3 and X8: OVERALL ASSESSMENT

This is a new rapid 3 site following the gap analysis. The site is located on the Wilge River. Owing to the low water levels, most of the biotopes were dry and exposed. Limited flow regimes due to upstream abstraction activities and dry season. Poor water quality due to organic pollution and agricultural activity.

RECOMMENDATIONS

- Chemical, microbial and *in situ* water quality should be monitored bi-annually
- Turbidity and deposition should be monitored monthly during the wet season and once during the dry season
- Diatom samples should be taken minimum every 2 years
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet and dry season
- Riparian VEGRAI should be conducted every 5 years
- The IHI should be conducted annually

3.1.4 SITE S4: OLIFANTS

SITE	DETAILS	COMMENT
Site	S4:	This site was not surveyed during the October 2015 survey due to no suitable hydraulic site present. However, the available information from a biological perspective will be evaluated.
River	Olifants	
Quaternary Catchment	B11G	
Co-ordinates	-	
IUA	1	
SQ Reach	B11G-01225	
IEI Rating	2	
WRUI Rating	4	
Survey type	Biological	
PES	D	

3.1.5 SITE S5: OLIFANTS*(old comprehensive Olifants-EWR1)*

SITE	DETAILS	VIEW
Site	S5	
River	Olifants	
Quaternary Catchment	B11J	
Co-ordinates	B11J-01086	
Ecoregion	Eastern Bankenveld (9)	
IUA	1	
SQ Reach	-25,759183; 29,309564	
IEI Rating	2	
WRUI Rating	4	
Survey type	Rapid III	
PES 2013 (reach)	B	
EI_ES 2013 (reach)	Moderate	
Eco-Region Level II	9_6	
Geozone	E	
Gauging weirs	None close by	
Discharge	0.163 m3/s	

HABITAT AND BIOTA

- SIC,SOOC, large and small cobbles, bedrock, and vegetation associated with the site.
- Aquatic macroinvertebrates: ASPT: 5.4 (tolerant taxa)
- Fish Habitat: Good
- Land owner says*Cyprinus carpio, Micropterus salmoides, Oreochromis mossambicus, Barbus marequensis*caught in large pools.
- Macro channel = 95m, Active = 50m, wet = 12m

WATER QUALITY

- pH: pH 8.6; EC 100 mS/m; DO 5.02 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flow rate
- Algae is dense

- Some silt present
- Water had a chemical smell
- Upstream cultivation
- Return flows from waste water treatment plants and inadequate treatment

S5: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	2	The site is easily accessible. The confidence will be limited to lower flows	High flows (in excess of 750mm higher than measured flows) will activate a channel on the left bank. Bank vegetation will influence the hydraulics under high flow conditions. The site is located just downstream of a confluence that wasn't active at the time.
Fish	3	Most of habitats present	Not good representation of flow-depth classes *Micropterus salmoides* (MSAL), *Cyprinus carpio* (CCAR) Gambusia affinis (GAFF) present in pools Limited marginal veg Upstream impacts – organic content
Macroinvertebrates	3	SIC, gravel and veg habitats present, but limited	Low velocities due to low flows SOOC, sand and mud absent Upstream impacts – organic content Silt limited spaces between cobbles
Riparian vegetation / Habitat Integrity	3	Some pockets of natural vegetation remain	Alien invasives present Channel modification due to town developments downstream

* *Confidence scores: 0 = no confidence; 5 = high confidence*

S5: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Only one set of measured data available at the cross section
Fish						Historic data available from previous Reserve study (2001) and possibly 2010 survey Present survey
Macroinvertebrates						Historic data available from previous Reserve study (2001) and possibly 2010 survey Present survey
Riparian vegetation						Present survey
Hydrology						Natural and present day monthly flow
Physico-chemical						Data available from gauging weir (B1H010Q01) Historic data, DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

S5: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Anguilla mossambica, Amphilius uranoscopus, Enteromius (Barbus)anoplus, Enteromius (Barbus)eutaenia, Labeobarbus marequensis, Enteromius (Barbus)mattozi, Enteromius (Barbus)paludinosus, Labeobarbus polylepis, Enteromius (Barbus)trimaculatus, Enteromius (Barbus)unitaeniatus, Clarias gariepinus, Chiloglanis pretoriae, Labeo cylindricus, Labeo molybdinus, Marcusenius macrolepidotus, Oreochromis mossambicus, Petrocephalus wesselsi, Pseudocrenilabrus philander, Tilapia rendalli, Tilapia sparrmanii*
Macroinvertebrates	Porifera, Turbellaria, Oligochaeta, Hirudinea, Potamonautidae, Atyidae, Hydracarina, Perlidae, Baetidae >2spp, Caenidae, Heptageniidae, Leptophlebiidae, Polymitarcyidae, Prosopistomatidae, Trichorythidae, Chlorocyphidae, Chlorolestidae, Coenagrionidae, Lestidae, Protoneuridae, Aeshnidae, Corduliidae, Gomphidae, Libellulidae, Pyralidae, Belostomatidae, Corixidae, Gerridae, Hydrometridae, Naucoridae, Nepidae, Notonectidae, Pleidae, Veliidae, Ecnomidae, Hydropsychidae 2spp, Hydropsychidae >2spp, Philopotamidae, Hydroptilidae, Leptoceridae, Dytiscidae, Elmidae, Gyrinidae, Haliplidae, Helodidae, Hydraenidae, Hydrophilidae, Psephenidae, Athericidae,

S5: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
	Ceratopogonidae, Chironomidae, Culicidae, Dixidae, Muscidae, Simuliidae, Tabanidae, Tipulidae, Ancylidae, Bulinae, Lymnaeidae, Physidae, Planorbinae, Thiaridae, Corbiculidae, Sphaeridae.

S5: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	D/E (39.1)	F & NF	Habitat impacted by exotic fish species (GAFF, MSAL, CCAR), poor water quality, organic pollution and excessive algal growth smothering the substrate Low flow Flow modifications due to surroundings dams and abstraction activities
Macroinvertebrates	C/D (60.2)	F & NF	Habitat impacted by poor water quality, organic pollution and excessive algal growth smothering the substrate Low flow Flow modifications due to surroundings dams and abstraction activities
Habitat Integrity: Instream	C/D (58)	F & NF	Flow modifications due to surroundings dams and abstraction activities Poor water quality, organic pollution and excessive algal growth smothering the substrate Growth of Water hyacinth (Eichhornia crassipes)
Habitat Integrity: Riparian	C (72)	F & NF	Flow modification owing to the downstream weir Alien invasive infestations Land use impacts
ECOSTATUS	D (56.7)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S5: PES and causes	
Component	**Causes**

	Present/Absent
Fish	Present: *Amphilius uranoscopus*, Gambusia affinis*, *Chiloglanis pretoriae*, *Clarias gariepinus*, *Micropterus salmoides**, *Labeobarbus marequensis*, *Oreochromis mossambicus* **Exotic species*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Perlidae, Ceratopogonidae, Trichorythidae and Philopotamidae, fast flows: Hydraenidae, Leptoceridae, Athericidae and Naucoridae, slow flows: Tipulidae, Chlorocyphidae and Tabanidae and very slow flows: Gerridae and Notonectidae. The taxa absent from the various habitat types were: cobbles: Perlidae, Ceratopogonidae, Trichorythidae, Philopotamidae, Athericidae and Chlorocyphidae, marginal vegetation: Hydraenidae and Hydrophilidae, from the GSM: Tipulidae and Tabanidae and from the water column: Naucoridae, Gerridae and Notonectidae. The taxa absent due to the water quality rating were those from high: Perlidae, Heptageniidae, Pyralidae and Helodidae, moderate: Trichorythidae, Philopotamidae, Hydraenidae, Athericidae, Protoneuridae, Chlorocyphidae, Chlorolestidae, Lestidae and Gerridae, low: Ceratopogonidae, Porifera, Leptoceridae, Haliplidae, Tipulidae, Tabanidae, Naucoridae, Hydrophilidae and Pleidae and those with the very low rating: Hirudinea, Sphaeridae and Bulinae.

S5: Overall change and reason for deviation				
COMPONENT	**PES 1999**	**PES 2010**	**PES 2015**	**REASON FOR DEVIATION**
ECOSTATUS	D	D	D	Retained. Continues to be impacted by exotic veg, reduced flows and poor water quality

S5: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 1999	**PES 2010**	**PES 2015**		
Fish	E	D/E	D/E	Low flow and lack of habitat diversity	4
Macro-invertebrates	C	D	C/D	Low flow and lack of habitat diversity	4

Habitat integrity: Instream					
Habitat integrity: Riparian	C	C	C	Considerable alien infestation will increase if not managed	4
ECOSTATUS	D	D	D		

** 0 – no confidence to 5 – high confidence*

S5: OVERALL ASSESSMENT

This is the existing comprehensive EWR1 site. Low flow, lack of habitat diversity, poor *in situ* water quality and considerable algal growth (completely smothered) as a result of eutrophic condition. Invasive fish species were recorded. The Ecostatus has remained a D ecological category. However, potential negative trajectory's need to be managed to prevent the system from degrading to a lower category.

RECOMMENDATIONS

- Chemical and *in situ* water quality should be monitored quarterly
- Setwater quality eco specs
- Diatom samples should be taken minimum every 2 years
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually towards the end of the wet season together with the IHI
- Riparian VEGRAI should be conducted in the near future to assess the current status, and every 3 years thereafter
- The RQO's set for the EWR1 must be stringently enforced
- It is important to set WQOs as water quality is an issue

3.1.6 SITE S6: KLEIN OLIFANTS*(replaced existing Olifants-EWR3)*

The original EWR3 site was inaccessible due to private land thus an alternate site (S6) was selected upstream of the existing site and is situated in Middelburg upstream of the WWTW.

SITE	DETAILS	VIEW
Site	S6	
River	Klein Olifants	
Quaternary Catchment	B12D	
Co-ordinates	-25,748872; 29,458649	
Ecoregion	Eastern Bankenveld (9)	
IUA	1	
SQ Reach	B12D-01118	
IEI Rating	2	
WRUI Rating	4	
Survey type	Rapid III	
PES 2013 (reach)	D	
EI_ES 2013 (reach)	High	
Eco-Region Level II	9_6	
Geozone	E	
Gauging weirs	None, only releases from Middelburg Dam	
Discharge	0.391 m3/s	

HABITAT AND BIOTA

- SIC, SOOC, large and small cobbles, bedrock and vegetation associated with the site.
- Aquatic macroinvertebrates: ASPT: 4.3 (tolerant taxa)
- Fish Habitat: Fair
- System under threat

WATER QUALITY

- pH: pH 8.9; EC 74 mS/m; DO 6.07 mg/l
- Important to set WQOs as water quality is an issue, especialy downstream of the WWTW.

SITE AND UPSTREAM IMPACTS

- Very low flows
- Algae present
- Solid waste was observed in the river channel. Invasive plants (riparian) present
- Town development
- Downstream Middleburg dam
- Mining activities
- Industrial activities
- Informal settlements

S6: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	3	The site is easily accessible. The confidence will be limited to lower flows	The cross section is just downstream of a confluence, boulders and vegetation on the left bank and a downstream pool will more than likely influence the hydraulics during high flows
Fish	4	Most of habitats present, but limited	Not good representation of flow-depth classes Pools with *Micropterus salmoides* and *gambusia affinis* present Limited marginal vegetation Upstream impacts – organic content Solid waste
Macroinvertebrates	4	SIC and vegetationhabitats present, but limited	Low velocities due to low flows SOOC and GSM absent Upstream impacts – organic content Solid waste
Riparian vegetation / Habitat Integrity	3	Representative of the reach	Exotic spreading from upstream Signs of current vegetation removal Cattle activity leading to trampling and erosion

* Confidence scores: 0 = no confidence; 5 = high confidence

S6: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Only one set of measured data available at the cross section
Fish						Historic data available from previous Reserve study (2001) downstream, 2009 and 2010 surveys (no fish caught), Three existing sites upstream in close proximity Present survey
Macroinvertebrates						Historic data available from previous Reserve study (2001) and 2010 survey. Four existing sites upstream in close proximity Present survey
Hydrology						Natural and present day monthly flow Only releases from Middelburg Dam
Physico-chemical						Data available from gauging weir (B1H012Q01) Historic data, DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

S6: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Amphilius uranoscopus, Enteromius (Barbus)anoplus, Labeobarbus marequensis, Enteromius (Barbus)paludinosus, Labeobarbus polylepis, Barbus trimaculatus, Clarias gariepinus, Chiloglanis pretoriae, Labeo cylindricus, Pseudocrenilabrus philander, Tilapia sparrmanii*
Macroinvertebrates	Perlidae, Turbellaria, Psephenidae, Hydropsychidae >2spp, Ceratopogonidae, Muscidae, Simuliidae, Trichorythidae, Polymitarcyidae, Prosopistomatidae, Philopotamidae, Gyrinidae, Elmidae, Potamonautidae, Heptageniidae, Pyralidae, Leptoceridae, Hydraenidae, Porifera, Baetidae 2spp, Baetidae >2spp, Aeshnidae, Hydroptilidae, Athericidae, Chironomidae, Coenagrionidae, Libellulidae, Oligochaeta, Leptophlebiidae, Helodidae, Ancylidae, Hirudinea, Caenidae, Protoneuridae, Haliplidae, Tipulidae, Gomphidae, Naucoridae, Hydracarina, Hydrophilidae, Dixidae, Chlorocyphidae, Chlorolestidae, Corduliidae, Corixidae, Veliidae, Dytiscidae, Tabanidae, Corbiculidae, Sphaeridae, Atyidae, Lestidae, Belostomatidae, Gerridae, Hydrometridae,

S6: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
	Nepidae,Notonectidae, Pleidae, Ecnomidae, Culicidae, Bulinae, Lymnaeidae, Physidae, Planorbinae, Thiaridae.

S6: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	D/E (38.6)	F & NF	Flow modification and low flow velocities Restricted habitat Several organic pollution and high algae content
Macroinvertebrates	D/E (38.5)	F & NF	Flow modification and low flow velocities Restricted habitat Several organic pollution and high algae content
Habitat Integrity: Instream	D (49)	F & NF	Restricted habitat Bed modification owing to algal growth and smothering of habitats Growth of hyacinth (Eichhornia crassipes)
Habitat Integrity: Riparian	D (48)	F & NF	Alien invasive vegetation Vegetation removal Cattle trampling Erosion Encroachment from adjacent development (i.e road bridges)
ECOSTATUS	D/E (41.7)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S6: PES and causes	
Component	**Causes** **Present/Absent**
Fish	Present: *Clarias gariepinus*, *Tilapia sparrmanii, Gambusia affinis*, Micropterus*

	*salmoides** **Exotic speices*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Perlidae, Psephenidae, Hydropsychidae, Ceratopogonidae, Trichorythidae, Polymitarcyidae, Philopotamidae and Gyrinidae, fast flows: Elmidae, Heptageniidae, Leptoceridae, Libellulidae and Gomphidae, slow flows: Hydroptilidae, Tipulidae, Chlorocyphidae, Tabanidae, Corbiculidae and Ecnomidae and very slow flows: Leptophlebiidae, Veliidae, Dytiscidae, Notonectidae, Lymnaeidae, Thiaridae, Physidae - new record. The taxa absent from the various habitat types were: cobbles: Perlidae, Psephenidae, Hydropsychidae, Ceratopogonidae, Simuliidae, Trichorythidae, Philopotamidae, Elmidae, Heptageniidae, Libellulidae, Chlorocyphidae, Ecnomidae and Leptophlebiidae, marginal vegetation: Hydroptilidae, Dytiscidae, Lymnaeidae and Thiaridae, from the GSM: Polymitarcyidae, Gomphidae, Tipulidae, Tabanidae and Corbiculidae and from the water column: Gyrinidae, Leptophlebiidae, Veliidae and Notonectidae. The taxa absent due to the water quality rating were those from high: Perlidae, Hydropsychidae and Heptageniidae, moderate: Psephenidae, Trichorythidae, Polymitarcyidae, Philopotamidae, Elmidae, Chlorocyphidae, Ecnomidae, Leptophlebiidae and Veliidae, low: Ceratopogonidae, Gyrinidae, Leptoceridae, Libellulidae, Gomphidae, Hydroptilidae, Tipulidae, Tabanidae, Corbiculidae and Dytiscidae and those with the very low rating: Notonectidae, Lymnaeidae, Physidae (NR) and Thiaridae.

S6: Overall change and reason for deviation				
COMPONENT	**PES 1999**	**PES 2010**	**PES 2015**	**REASON FOR DEVIATION**
ECOSTATUS	D	-	D/E	Poor water quality Nutrient loads Habitat modification Lack of flow Upstream abstraction activities

S6: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 1999	**PES 2010**	**PES 2015**		

Fish	D	D	D/E	Low fish diversity Lack of sensitive species (water quality and flow) High alien invasive composition Poor water quality Habitat modification Lack of flow regime	4
Macro-invertebrates	C	D/E	D/E	Diversity is constantly poor Macroinverterates tolerant to poor water quality are continually recorded	4
Habitat integrity: Instream	-	D/E	D	Improvement to a D as the site was moved further upstream from the original 1999 EWR3 site. However, site continues to be significantly impacted	4
Habitat integrity: Riparian	C	C/D	D	An increase in alien invasive species encroaching the riparian zone Cattle trampling and erosion	4
ECOSTATUS	D	D	D/E		

** 0 – no confidence to 5 – high confidence*

S6: OVERALL ASSESSMENT

It must be noted that this is an important site representative of the Klein-Olifants catchment. There is lack of management of surrounding land use impacts and severe degradation of the system owing to the upstream activities resulting in a high risk to the sustainability of the system. Intervention from the Department of Water and Sanitation is urgently required within this reach. The site is located on the Klein-Olifants downstream from the Middleburg Dam and upstream of the confluence with the Olifants River. Considerable upstream impacts include, stormwater runoff from informal settlements, town developments, mining, industrial activities and agricultural activities. Considerable alien invasive fish species and aquatic macrophytes were observed.

The flow at the site appears to be associated with return flows (wastewater), a lack of natural flow owing to the high number of impounds and weirs within the tributaries upstream, coupled with abstraction for farming activities.

RECOMMENDATIONS

- A task team urgently needs to address the issues surrounding the Steve Tshwete waste water treatment plant downstream of the EWR site.
- Stringent management measures for this reach and the broader Klein-Olifants should be revised and updated within the existing catchment management plan

- The proposed water quality RQOs for the nutrients are set for EWR3 should be stringently enforced
- Chemical and *in situ* water quality should be monitored quarterly
- Chemical and *in situ* water quality should be monitored quarterly downstream of the WWTW in addition to the monitoring at this EWR site
- Diatom samples should be taken minimum annually
- Whole Effluent Toxicity (WET) testing should be conducted quarterly until results are resolved
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet and dry season
- Riparian VEGRAI should be conducted every 5 years
- The IHI should be conducted annually

3.1.7 SITE S7: OLIFANTS *(old comprehensive Olifants-EWR2)*

SITE	DETAILS	VIEW
Site	S7	
River	Olifants	
Quaternary Catchment	B32A	
Co-ordinates	-25,496324; 29,254597	
Ecoregion	Eastern Bankenveld (9)	
IUA	3	
SQ Reach	B32A-00937	
IEI Rating	3	
WRUI Rating	3	
Survey Type	Rapid III	
PES 2013 (reach)	B	
EI_ES 1999 (reach)	High	
Eco-Region Level II	9_6	
Geozone	E	
Gauging weirs	B3H024	
Discharge	1.452 m3/s	

HABITAT AND BIOT

- SIC, SOOC,large and small cobbles. Limited marginal vegetation present.
- Aquatic macroinvertebrates: ASPT: 5.6 (moderately tolerant taxa)
- Fish Habitat: Good

WATER QUALITY

- pH 8.8; EC 81 mS/m; DO 6.75 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- High algae

S7: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	1	The site is located just above the full supply level from the dam and will only be suitable foe modelling low flows	Site is extremely remote and no critical cross section could be identified. A channel on the left bank will activate during high flows. Boulders and vegetation will affect the hydraulics during high flows
Fish	4	Most of habitats present Fair representation of flow-depth classes Pools present as refugia	Limited marginal vegetation Algae Shallower habitats not well represented Upstream impacts – organic content
Macroinvertebrates	4	SIC habitats present	Low velocities due to low flows SOOC absent GSM and marginal vegetation very limited Upstream impacts – organic content
Riparian vegetation / Habitat Integrity	4	Partially in a nature conservation but some impacts on the left hand bank from the local community	Small amount of riparian vegetation removal Trampling and erosion observed

* *Confidence scores: 0 = no confidence; 5 = high confidence*

S7: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Only one set of measured data available at the cross section
Fish						Historic data available from previous sruveys

						Present survey
Macroinvertebrates						Historic data available from previous Reserve study (2001) Present survey
Riparian vegetation						Historic data available from previous Reserve study (2001) Present survey
Hydrology						Natural and present day monthly flow Gauging weir B3H024
Physico-chemical						Data available from gauging weir (B1H010Q01) Historic data, DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

S7: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Anguilla mossambica, Enteromius (Barbus)anoplus, Labeobarbus marequensis, Enteromius (Barbus)mattozi, Enteromius (Barbus)paludinosus, Labeobarbus polylepis, Enteromius (Barbus)trimaculatus, Enteromius (Barbus)unitaeniatus, Clarias gariepinus, Chiloglanis pretoriae, Labeo cylindricus, Labeo molybdinus, Labeo rosae, Micralestes acutidens, Mesobola brevianalis, Marcusenius macrolepidotus, Oreochromis mossambicus, Pseudocrenilabrus philander, Schilbe intermedius, Synodontis zambezensis, Tilapia rendalli, Tilapia sparrmanii, Amphilius uranoscopus*
Macroinvertebrates	Perlidae, Oligoneuridae, Tricorythidae, Hydropsychidae 2 Sp, Hydropsychidae > 2 Sp, Ceratopogonidae, Empididae, Muscidae, Simuliidae, Turbellaria, Psephenidae, Polymitarcyidae, Prosopistomatidae, Philopotamidae, Gyrinidae, Porifera, Baetidae > 2 Sp, Aeshnidae, Hydroptilidae, Athericidae, Chironomidae, Potamonautidae, Heptageniidae, Crambidae (Pyralidae), Leptoceridae, Hydraenidae, Elmidae/Dryopidae, Hirudinea, Caenidae, Protoneuridae, Haliplidae, Tipulidae, Oligochaeta, Leptophlebiidae, Helodidae, Ancylidae, Coenagrionidae, Libellulidae, Atyidae, Lestidae, Belostomatidae, Gerridae, Hydrometridae, Nepidae, Notonectidae, Pleidae, Ecnomidae, Culicidae, Bulininae, Lymnaeidae, Physidae, Planorbinae, Thiaridae, Chlorocyphidae, Corduliidae, Corixidae, Veliidae/Mesoveliidae, Dytiscidae, Tabanidae, Corbiculidae, Sphaeriidae, Hydracarina, Hydrophilidae, Dixidae, Gomphidae, Naucoridae.

S7: PES per component for EWR site and Ecostatus

COMPONENT	PES category & score	Flow/ Non-flow	EXPLANATION
Fish	D (55.5)	F & NF	Low flows during this specific survey Organic pollution Velocity depth classes limited due to low flow Limited accessibility owing to the presence of hippos
Macroinvertebrates	C (65)	F & NF	Low flows during this specific survey Organic pollution Velocity depth classes limited due to low flow Limited accessibility owing to the presence of hippos Lack of marginal vegetation
Habitat Integrity: Instream	B (82)	F & NF	Instream reed beds and islands exposed Low flows during this specific survey High algal growth
Habitat Integrity: Riparian	A/B (89)	F	Limited riparian modification
ECOSTATUS	C (72.8)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S7: PES and causes	
Component	**Causes Absent/Present**
Fish	Present: *Clarias gariepinus*, *Cyprinus carpio**, *Labeobarbus marequensis*, *Pseudocrenilabrus philander*, *Amphilius uranoscopus*, *Labeo cylindricus*, *Chiloglanis pretoriae*, *Tilapia sparrmanii* **Exotic species*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Hydropsychidae, Ceratopogonidae and Philopotamidae, fast flows: Heptageniidae, Gomphidae and Naucoridae, slow flows: Hydroptilidae, Tipulidae, Chlorocyphidae and Sphaeridae and very slow flows: Notonectidae and Dytiscidae. The taxa absent from the various habitat types were: cobbles: Hydropsychidae, Ceratopogonidae, Simuliidae, Turbellaria, Philopotamidae, Heptageniidae, Elmidae, Libellulidae, Chlorocyphidae and Leptophlebiidae, marginal vegetation: Hydroptilidae and Dytiscidae, from the GSM: Gomphidae, Tipulidae, Tabanidae, Corbiculidae and

	Sphaeridae and from the water column: Naucoridae and Notonectidae. The taxa absent due to the water quality rating were those from high: Heptageniidae, moderate: Philopotamidae, Elmidae, Atyidae, Chlorocyphidae and Leptophlebiidae, low: Ceratopogonidae, Gomphidae, Naucoridae, Hydroptilidae, Tipulidae, Tabanidae, Corbiculidae and Dytiscidae and those with the very low rating: OLIGOCHAETA, Notonectidae and Sphaeridae.

S7: Overall change and reason for deviation				
COMPONENT	**PES 1999**	**PES 2010**	**PES 2015**	**REASON FOR DEVIATION**
ECOSTATUS	C	-	C	Lack of flow Poor water quality

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S7: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 1999	**PES 2010**	**PES 2015**		
Fish	C	-	D	Low flows during this specific survey Organic pollution Velocity depth classes limited due to low flow Limited accessibility owing to the presence of hippos	4
Macro-invertebrates	B	-	C	Low flows during this specific survey Organic pollution Velocity depth classes limited due to low flow Limited accessibility owing to the presence of hippos Lack of marginal vegetation	4
Habitat integrity: Instream	C	-	B	Improvement to the instream habitat integrity due to management intervention Less bed deposition as	4

S7: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 1999	**PES 2010**	**PES 2015**		
				characterised from the 1999 assessment	
Habitat integrity: Riparian	B	-	A/B	Improvement to the riparian habitat integrity due to management intervention	4
ECOSTATUS	C		C		

** 0 – no confidence to 5 – high confidence*

S7: OVERALL ASSESSMENT

The site is located on the Olifants River downstream from the confluence of the Wilge and Klein-Olifants River just upstream of Loskop Dam.Access to the site is problematic and time consuming. All impacts (mining, industrial, agricultural, WWTWs) from Emahaleni, Middleburg and Brokhorspruit are culminating at this site. Poor water quality with considerable algal growth and organic pollution owing to the upstream activities as stated above. High diversity of biotopes present at the site.

RECOMMENDATIONS

- Chemical and *in situ* water quality should be monitored bi-annually
- Diatom samples should be taken minimum annually
- Whole Effluent Toxicity (WET) testing should be conducted quarterly until results are resolved
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet and dry season
- Riparian VEGRAI should be conducted every 5 years
- The IHI should be conducted annually

3.1.8 SITE S8: KRANSPOORTSPRUIT*(RESURVEY at existing OLI-EWR3, Rapid III site)*

SITE	DETAILS	VIEW
Site	S8	
River	Kranspoortspruit	
Quaternary Catchment	B32A	
Co-ordinates	-25,437714; 29,475619	
Ecoregion	Eastern Bankenveld (9)	
IUA	3	
SQ Reach	B32A-00950	
IEI Rating	3	
WRUI Rating	2	
Survey type	Rapid III	
PES 2011 (site)	B	
EI_ES 2011 (site)	Very High	
Eco-Region Level II	9_6	
Geozone	D	
Gauging weirs	None	
Discharge	0.013 m3/s	

HABITAT AND BIOTA

- Habitat bedrock and boulder/cobbles with some sand and gravel. In stream vegetation was limited. When inundated there will be good overhanging vegetation and undercut banks.
- Aquatic macroinvertebrates: ASPT: 6.6 (moderately tolerant taxa)
- Fish Habitat: Fair

WATER QUALITY

- pH 8.6; EC 9.0 mS/m; 6.86 mg/l

SITE AND UPSTREAM IMPACTS

- Water was discoloured

- Algae and silt was observed covering cobbles.
- Limited agricultural activities

S8: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	1	The site is easily accessible. The confidence will be limited to lower flows	The site is located on a bend just downstream of a pipe culvert road crossing and just upstream of a vegetated island, all of which will affect the hydraulics during high flows
Fish	4	Most of habitats present Pools present as refugia	Limited representation of flow-depth classes Limited marginal vegetation Shallower habitats not well represented Solid waste
Macroinvertebrates	4	SIC and GSM habitats present, but limited	Low velocities due to low flows SOOC absent Marginal vegetation limited
Riparian vegetation / Habitat Integrity	4	In a fair condition	Some vegetation removal Trampling Erosion

* *Confidence scores: 0 = no confidence; 5 = high confidence*

S8: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Two sets of measured data available at the cross section
Fish						Historic data available from previous rapid Reserve study (2010) Olifants classification study rapid III assessment (2011)

						Present survey
Macroinvertebrates						Historic data available from previous rapid Reserve study (2010) Olifants classification study rapid III assessment (2011) Present survey
Hydrology						Olifants classification study rapid III assessment (2011) Monthly modelled natural and present day flows
Physico-chemical						No water qualiy site present. Data available from surveys only

** 0 (no information) to 4 (large amount of data available)*

S8: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Anguilla mossambica, Amphilius uranoscopus,Enteromius (Barbus)anoplus,Enteromius (Barbus)eutaenia, Labeobarbus marequensis,Enteromius (Barbus)lineomaculatus, Enteromius (Barbus)neefi,Enteromius (Barbus)paludinosus,Barbus trimaculatus, Barbus unitaeniatus,Clarias gariepinus,Chiloglanis pretoriae,Marcusenius macrolepidotus, Oreochromis mossambicus,Pseudocrenilabrus philander,Petrocephalus wesselsi, Tilapia rendalli,Tilapia sparrmanii*
Macroinvertebrates	Perlidae, Oligoneuridae, Ceratopogonidae, Muscidae, Turbellaria, Simuliidae, Psephenidae, Hydropsychidae 1sp, Hydropsychidae >2spp, Trichorythidae, Polymitarcyidae, Gyrinidae, Prosopistomatidae, Philopotamidae, Hydraenidae, Porifera, Baetidae 2spp, Baetidae >2spp, Chironomidae, Aeshnidae, Potamonautidae, Heptageniidae, Pyralidae, Hydroptilidae, Leptoceridae, Athericidae, Elmidae, Haliplidae, Tipulidae, Leptophlebiidae, Caenidae, Oligochaeta, Helodidae, Hirudinea, Coenagrionidae, Libellulidae, Ancylidae, Veliidae, Dytiscidae, Lestidae, Belostomatidae, Gerridae, Hydrometridae, Nepidae, Notonectidae, Pleidae, Dixidae, Bulinae, Physidae, Planorbinae, Thiaridae, Culicidae, Chlorocyphidae, Corduliidae, Corixidae, Tabanidae, Corbiculidae, Sphaeridae, Naucoridae, Atyidae, Ecnomidae, Gomphidae, Hydracarina, Hydrophilidae.

S8: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**

Fish	D (75.0)	F & NF	Low flow velocities Depth velocity class absent Relatively good water quality High siltation and erosion
Macroinvertebrates	B (82.0)	F & NF	Good biotope diversity Relatively good water quality Limited siltation
Habitat Integrity: Instream	B (83)	F & NF	Low flow velocities High siltation and erosion
Habitat Integrity: Riparian	C (75)	F & NF	Low flow velocities Trampling Erosion Alien invasive species
ECOSTATUS	C (77.2)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S8: PES and causes	
Component	**Causes** **Absent/Present**
Fish	Present: *Enteromius (Barbus)paludinosus*, *Clarias gariepinus*, *Pseudocrenilabrus philander*, *Enteromius (Barbus) eutaenia*, *Enteromius (Barbus) trimaculatus*, *Labeobarbus marequensis*, *Enteromius (Barbus) lineomaculatus*, *Amphilius uranoscopus*, *Enteromius (Barbus) unitaeniatus*, *Chiloglanis pretoriae*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in fast flows: Coenagrionidae, slow flows: Chlorocyphidae, Tabanidae, Corbiculidae and Sphaeridae and very slow flows: Belostomatidae and Planorbinae. The taxa absent from the various habitat types were: cobbles: Chlorocyphidae, marginal vegetation: Coenagrionidae and Belostomatidae, from the GSM: Tabanidae, Corbiculidae and Sphaeridae and from the water column: Muscidae. The taxa absent due to the water quality rating were those from moderate: Chlorocyphidae, low: Coenagrionidae, Tabanidae and Corbiculidae and those with the very low rating: Belostomatidae, Planorbinae and Sphaeridae.

S8: Overall change and reason for deviation			
COMPONENT	**PES 2011**	**PES 2015**	**REASON FOR DEVIATION**
ECOSTATUS	B	C	Low flow velocities due to poor rainfall conditions Riparian vegetation modification Erosion Limited incidents of siltation

S8: Ecological trends for the EWR site (include components that were assessed)				
Component	**Trend**		**Reason**	**Confidence (0-5)***
	PES 2011	**PES 2015**		
Fish	B	D	This site has been moved higher up in the system owing to impoundments. This resulted in less fish species being identified due to restricted movement due to the impoundment coupled with lower water depth classes.	4
Macro-invertebrates	B/C	B	This site is located above the impacts related to agricultural activities as well as a residential and golfing estate, ultimately improving the water quality slightly.	4
Habitat integrity: Instream	A/B	B	Low flow velocities Less flow velocity classes Slightly more erosion and siltation	4
Habitat integrity: Riparian	B	C	Removal of riparian vegetation Grazing and trampling Erosion	4
ECOSTATUS	B	C		

** 0 – no confidence to 5 – high confidence*

S8: OVERALL ASSESSMENT
This is a resurvey of and existing rapid III site (OLI-EWR3) following the gap analysis. The site is located on the Kraanspoortspruit below the confluence of the Klip River. Limited flow velocities but with good instream habitats, including a high proportion of bedrock. Marginal vegetation exposed. Moderate water quality owing to limited upstream impacts with minimal agricultural activities.

RECOMMENDATIONS

- Owing to limited upstream impacts, and the possible presence of the rare and endangered BLIN and unique BBIFthe status of the river needs to be improved
- Water resources is classified as a class II which must be maintained
- REMP protocols must be conducted every 2 years

3.1.9 SITE S9: SELONS (NEW RAPID III)

SITE	DETAILS	VIEW
Site	S9	
River	Selons	
Quaternary Catchment	B32C	
Co-ordinates	-25,379969; 29,435557	
Ecoregion	Eastern Bankenveld (9)	
IUA	3	
SQ Reach	B32C-00936	
IEI Rating	3	
WRUI Rating	4	
Survey type	Rapid III	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	Very High	
Eco-Region Level II	9_5	
Geozone	E	
Gauging weirs	B3H017	
Discharge	0.038 m3/s	

HABITAT AND BIOTA

- Cobble and boulders present. Riffles with limited algae. Pool had dense green algae bloom. Some vegetation observed, mainly root wads.
- Aquatic macroinvertebrates: ASPT: 5.9 (moderately tolerant taxa)
- Fish Habitat: Good
- Parasites observed on *Barbus paludinosus*

WATER QUALITY

- pH 8.8; EC 27.0 mS/m; DO 6.11mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- Exposed soils (erosion)
- Agricultural activities

- Several small dams
- Artificial widening of river due to incised and collapsing river banks
- High organic material content observed namely algae and silt. This can be attributed largely to bank collapse

S9: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	2	The site is easily accessible. The section and slope are even.	High flows will activate a channel on the right hand side. Bank vegetation will affect the hydraulics under high flow conditions
Fish	4	Most of habitats present Pools present as refugia	Limited representation of flow-depth classes Limited marginal vegetation Shallower habitats not well represented High algae content
Macroinvertebrates	4	SIC habitat present, but limited	Low velocities due to low flows SOOC absent GSM and marginal vegetation limited High algae content
Riparian vegetation / Habitat Integrity	3	-	Alien vegetation Vegetation removal Eroded and steep/collapsible banks Siltation present

* *Confidence scores: 0 = no confidence; 5 = high confidence*

S9: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics			■			Only one set of measured data available at the

						cross section
Fish						Present survey
Macroinvertebrates						Historic data available Present survey
Hydrology						Natural and present day monthly flow Gauging weir B3H017
Physico-chemical						No water quality site present

** 0 (no information) to 4 (large amount of data available)*

S9: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Enteromius (Barbus) anoplus, Labeobarbus marequensis, Enteromius (Barbus)paludinosus, Enteromius (Barbus)trimaculatus, Clarias gariepinus, Chiloglanis pretoriae, Labeo cylindricus, Labeo molybdinus, Labeo rosae, Oreochromis mossambicus, Pseudocrenilabrus philander, Tilapia sparrmanii*
Macroinvertebrates	Baetidae >2spp, Helodidae, Heptageniidae, Pyralidae, Prosopistomatidae, Perlidae, Hydropsychidae >2spp, Oligoneuridae, Dytiscidae, Pleidae, Haliplidae, Tipulidae, Caenidae, Tabanidae, Corbiculidae, Naucoridae, Ceratopogonidae, Porifera, Coenagrionidae, Libellulidae, Gyrinidae, Ancylidae, Hydroptilidae, Gomphidae, Simuliidae, Hydrophilidae, Leptoceridae, Hydropsychidae 1sp, Empididae, Veliidae, Lestidae, Gerridae, Hydrometridae, Leptophlebiidae, Dixidae, Protoneuridae, Chlorocyphidae, Corduliidae, Hydraenidae, Polymitarcyidae, Atyidae, Ecnomidae, Aeshnidae, Hydracarina, Psephenidae, Philopotamidae, Psychomyiidae, Athericidae, Trichorythidae, Elmidae, Belostomatidae, Nepidae, Notonectidae, Lymnaeidae, Planorbinae, Thiaridae, Culicidae, Corixidae, Sphaeridae, Muscidae, Oligochaeta, Hirudinea, Coelenterata, Chironomidae, Turbellaria, Potamonautidae.

S9: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	C (71.1)	F & NF	Low flow velocities Poor water quality Habitat modification Bank erosion and collapsible banks

			Siltation present
Macroinvertebrates	C (67.6)	F & NF	Low flow velocities Poor water quality Habitat modification Bank erosion and collapsible banks Siltation present
Habitat Integrity: Instream	D (55)	F & NF	Lack of instream vegetation Siltation present Modified habitat availability (i.e flow velocity classes) Several algae
Habitat Integrity: Riparian	D/E (38)	F & NF	Bank erosion and collapsible banks Alien invasive Vegetation harvesting Clearing of the riparian zone for use for agricultural activities
ECOSTATUS	D (56.7)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S9: PES and causes	
COMPONENT	**CAUSES** **Absent/Present**
Fish	Present: *Labeobarbus marequensis*, *Enteromius (Barbus) paludinosus*, *Chiloglanis pretoriae*, *Pseudocrenilabrus philander*, *Tilapia sparrmanii*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Trichorythidae, Philopotamidae and Gyrinidae, fast flows: Heptageniidae, Leptoceridae, Hydraenidae, Gomphidae and Naucoridae slow flows: Sphaeridae and very slow flows: Belostomatidae, Lymnaeidae, Planorbinae and Thiaridae. The taxa absent from the various habitat types were: cobbles: Trichorythidae, Philopotamidae and Heptageniidae, marginal vegetation:Leptoceridae, Belostomatidae,Lymnaeidae, Planorbinae and Thiaridae, from the GSM: Gomphidae and Sphaeridae and from the water column: Gyrinidae and Naucoridae. The taxa absent due to the water quality rating were those from high:Heptageniidae, moderate: Trichorythidae and Philopotamidae, low:Gyrinidae, Leptoceridae, Gomphidae and Naucoridae and those with the very low rating: Belostomatidae, Lymnaeidae, Planorbinae, Sphaeridae and

	Thiaridae.

S9: Overall change and reason for deviation		
COMPONENT	**PES 2015**	**REASON FOR DEVIATION**
ECOSTATUS	D	Severely modified catchment upstream High organic and inorganic loads Agricultural activities Low flow velocities Poor water quality Habitat modification Bank erosion and collapsible banks

S9: Ecological trends for the EWR site (include components that were assessed)			
Component	**Trend**	**Reason**	**Confidence (0-5)***
	PES 2015		
Fish	C	Low flow velocities Poor water quality Habitat modification Bank erosion and collapsible banks Siltation present	4
Macro-invertebrates	C	Low flow velocities Poor water quality Habitat modification Bank erosion and collapsible banks Siltation present	4
Habitat integrity: Instream	D	Lack of instream vegetation Siltation present Modified habitat availability (i.e flow velocity classes) Several algae	4

Habitat integrity: Riparian	D/E	Bank erosion and collapsible banks Alien invasive Vegetation harvesting Clearing of the riparian zone for use for agricultural activities	4
ECOSTATUS	D		

** 0 – no confidence to 5 – high confidence*

S9: OVERALL ASSESSMENT

The site is located on the Selons upstream of the confluence with the Olifants and includes the Bobbejaansdoom and the Kruis rivers. Low flow velocities and severely modified owing to upstream impoundments and abstraction activities. Upstream impacts include intensive cultivation and cattle farming, water abstraction and game farming. Due to low flow regimes, the GSM and marginal vegetation was limited. Upstream impacts, including eutrophication, were resulting in high nutrient enrichment within the system.

RECOMMENDATIONS

- REMP protocols must be conducted every 2 years
- Water quality needs to be improved with the buy-in from surrounding land owners

3.1.10 SITE S10: OLIFANTS *(OLD COMPREHENSIVE OLIFANTS-EWR8)*

SITE	DETAILS	VIEW
Site	S10	
River	Olifants	
Quaternary Catchment	B71D	
Co-ordinates	-24.239917; 30.082457	
Ecoregion	Eastern Bankenveld (9)	
IUA	10	
SQ Reach	B71D-00412	
IEI Rating	2	
WRUI Rating	4	
Survey type	Rapid III	
PES (site)	C/D	
EI_ES (site)	Moderate	
Eco-Region Level II	9.2	
Geozone	E	
Gauging weirs	None	
Discharge	2.343 m3/s	

HABITAT AND BIOTA

- SIC, SOOC,pool, cobbles, boulders and sand observed. Silt deposition. Vegetation and undercut banks limited due to low water level.
- Aquatic macroinvertebrates: ASPT: 6.3 (moderately tolerant taxa)
- Fish Habitat: Fair

WATER QUALITY

- pH 8.8; EC 63 mS/m; DO 7.6 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- High silt

S10: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	2	Cross sections are located on a straight section of the river.	Site is remote and surveying under higher flows will be problematic
Fish	4	Most of habitats present Pools present as refugia	Limited representation of flow-depth classes No marginal vegetation Shallower habitats not well represented
Macroinvertebrates	4	SIC and GSM habitats present, but limited	Low velocities due to low flows SOOC absent Marginal vegetation limited Silt deposition
Riparian vegetation / Habitat Integrity	4	Marginal vegetation stabilising the river banks	Cattle grazing Vegetation harvesting Limited alien invasive vegetation

* *Confidence scores: 0 = no confidence; 5 = high confidence*

S10: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Only one set of measured data available at the cross section
Fish						Historic data available from previous Reserve study (2001) and surveys in 2004 and 2010 re-survey Present survey
Macroinvertebrates						Historic data available from previous Reserve study (2001) and surveys in 2004 and 2010 re-survey Present survey

Hydrology						Natural and present day monthly flow
Physico-chemical						No water quality monitoring site in vicinity of reach

** 0 (no information) to 4 (large amount of data available)*

S10: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Anguilla bengalensis, Anguilla marmorata, Anguilla mossambica, Enteromius (Barbus)eutaenia, Labeobarbus marequensis, Enteromius (Barbus)mattozi, Enteromius (Barbus)paludinosus, Enteromius (Barbus)trimaculatus, Enteromius (Barbus)unitaeniatus, Enteromius (Barbus)viviparous, Clarias gariepinus, Chiloglanis paratus, Chiloglanis pretoriae, Chiloglanis swierstrai, Labeo cylindricus, Labeo molybdinus, Labeo rosae, Labeo ruddi, Micralestes acutidens, Marcusenius macrolepidotus, Oreochromis mossambicus, Opsaridium peringueyi, Pseudocrenilabrus philander, Schilbe intermedius, Synodontis zambezensis, Tilapia rendalli, Tilapia sparrmanii*
Macroinvertebrates	Nepidae, Lestidae, Protoneuridae, Atyidae, Haliplidae, Coenagrionidae, Belostomatidae, Pleidae, Hydrophilidae, Dytiscidae, Hydroptilidae, Hydraenidae, Lymnaeidae, Planorbinae, Thiaridae, Helodidae, Pyralidae, Hydracarina, Ceratopogonidae, Chironomidae, Leptoceridae, Baetidae >2spp, Leptophlebiidae, Ecnomidae, Aeshnidae, Simuliidae, Notonectidae, Hydrometridae, Corduliidae, Caenidae, Hirudinea, Philopotamidae, Athericidae, Empididae, Potamonautidae, Oligoneuridae, Corixidae, Muscidae, Naucoridae, Chlorocyphidae, Psephenidae, Trichorythidae, Elmidae, Heptageniidae, Prosopistomatidae, Perlidae, Hydropsychidae 2spp, Hydropsychidae >2spp, Coelenterata, Psychomyiidae, Porifera, Ancylidae, Gomphidae, Sphaeridae, Corbiculidae, Oligochaeta, Tipulidae, Tabanidae, Polymitarcyidae, Libellulidae, Turbellaria, Culicidae, Veliidae, Gerridae, Dixidae, Gyrinidae.

S10: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	C/D (60.6)	F & NF	Lack of habitat diversity Lack of marginal vegetation Low flow velocities Siltation present Poor water quality

Macroinvertebrates	C/D (60.2)	F & NF	Lack of habitat diversity Lack of marginal vegetation Low flow velocities Siltation present Poor water quality
Habitat Integrity: Instream	B (83)	F & NF	Siltation present Flow depth modification Lack of marginal vegetation Lack of instream vegetation
Habitat Integrity: Riparian	B/C (78)	F & NF	Cattle trampling Vegetation harvesting Alien invasive vegetation
ECOSTATUS	C (67.9)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S10: PES and causes	
COMPONENT	**CAUSES** **Absent/Present**
Fish	Present: *Labeobarbus marequensis*, *Enteromius (Barbus)viviparous*, *Clarias gariepinus*, *Chiloglanis paratus*, *Chiloglanis pretoriae*, *Labeo cylindricus*, *Labeo molybdinus*, *Micralestes acutidens*, *Oreochromis mossambicus*, *Pseudocrenilabrus philander*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Turbellaria, Psephenidae, Trichorythidae, Philopotamidae and Gyrinidae, fast flows: Potamonautidae and Heptageniidae, slow flows: Tipulidae, Hydroptilidae, Chironomidae, Chlorocyphidae, Corixidae, Corbiculidae and Sphaeridae and very slow flows: Dytiscidae, Gerridae, Lymnaeidae and Planorbinae. The taxa absent from the various habitat types were: cobbles: Turbellaria, Psephenidae, Philopotamidae, Potamonautidae, Heptageniidae and Chlorocyphidae, marginal vegetation: Hydroptilidae, Dytiscidae, Lymnaeidae and Planorbinae, from the GSM: Tipulidae, Corixidae, Corbiculidae and Sphaeridae and from the water column: Gyrinidae and Gerridae. The taxa absent due to the water quality rating were those from high: Heptageniidae, moderate: Psephenidae, Trichorythidae, Philopotamidae, Chlorocyphidae and Gerridae, low: Gyrinidae, Tipulidae, Hydroptilidae, Corbiculidae and Dytiscidae and those with the very low rating: Lymnaeidae, Planorbinae,

	Chironomidae, Potamonautidae, Corixidae, Sphaeridae, Oligochaeta and Turbellaria.

S10: Overall change and reason for deviation				
COMPONENT	**PES 1999**	**PES 2010**	**PES 2015**	**REASON FOR DEVIATION**
ECOSTATUS	E	C/D	C	Improved floods/flows since 2010 which has resulted in flushing the system to improve the habitat and water quality

S10: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 1999	**PES 2010**	**PES 2015**		
Fish	D	D	C/D	Lack of habitat diversity Lack of marginal vegetation Low flow velocities Siltation present Poor water quality	4
Macro-invertebrates	D	C/D	C/D	Lack of habitat diversity Lack of marginal vegetation Low flow velocities Siltation present Poor water quality	4
Habitat integrity: Instream	E	C/D	B	Siltation present Flow depth modification Lack of marginal vegetation Lack of instream vegetation	4
Habitat integrity: Riparian	D	C	B/C	Cattle trampling Vegetation harvesting Alien invasive vegetation	4

ECOSTATUS	E	C/D	C	

** 0 – no confidence to 5 – high confidence*

S10: OVERALL ASSESSMENT

The site is located on the Olifants downstream of the Flag Boshielo Dam below the confluence with the Mohlapitse River. Low flow velocities are severely modified owing to poor rainfall, abstraction and lack of release from the upstream dam. Return flows, upstream activities namely, waste water treatment works return flows, subsistence farming, agricultural activities all result in poor water quality.

RECOMMENDATIONS

- Owing to the proximity of this site, full comprehensive surveys should be conducted annually
- Stringent management measures for this reach should be revised and updated within the existing catchment management plan
- Chemical and *in situ* water quality should be monitored quarterly
- Diatom samples should be taken minimum annually
- The WET testing should be conducted quarterly until results are resolved
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet and dry season
- Riparian VEGRAI should be conducted every 5 years
- The IHI should be conducted annually

3.1.11 SITE S11: SPEKBOOM*(NEW RAPID III)*

SITE	DETAILS	VIEW
Site	S11	
River	Spekboom	
Quaternary Catchment	B42H	
Co-ordinates	-24,694155; 30,361267	
Ecoregion	Eastern Bankenveld (9)	
IUA	8	
SQ Reach	B42H-00553	
IEI Rating	3	
WRUI Rating	3	
Survey type	Rapid III	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	9_3	
Geozone	D	
Gauging weirs	None	
Discharge	0.028 m3/s	

HABITAT AND BIOTA

- Pool, cobbles, boulders present. Good rootwads present but exposed.
- Aquatic macroinvertebrates: ASPT: 7.6 (moderately tolerant taxa)
- Fish Habitat: Fair

WATER QUALITY

- pH 9.1; EC 61 mS/m; DO 7.29 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- Water discoloured green with some siltpresent.
- Agricultural activities

S11: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	3	The site is easily accessible. The section and slope are even.	Vegetation on the banks and downstream bridge will influence the site under high flows.
Fish	4	Most of habitats present Pools present as refugia Limited marginal vegetation	Rootwads present but exposed. Limited representation of flow-depth classes Shallower habitats not well represented Organics present
Macroinvertebrates	4	SIC and GSM habitats present, but limited	Low velocities due to low flows SOOC absent Marginal vegetation limited due to low flow levels Organics present
Riparian vegetation / Habitat Integrity	4	Limited impacts	Upstream sandbag weir for abstraction and cattle watering

* *Confidence scores: 0 = no confidence; 5 = high confidence*

S11: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Only one set of measured data available at the cross section
Fish						Historic data available upstream and downstream of site (R555) Present survey
Macroinvertebrates						Historic data available upstream and

						downstream of site (R555) Present survey
Hydrology						Natural and present day monthly flow
Physico-chemical						No water quality site present

** 0 (no information) to 4 (large amount of data available)*

S11: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Anguilla mossambica, Labeobarbus marequensis, Enteromius (Barbus)neefi, Enteromius (Barbus)paludinosus, Labeobarbus polylepis, Barbus trimaculatus, Enteromius (Barbus)unitaeniatus, Clarias gariepinus, Chiloglanis pretoriae, Labeo cylindricus, Labeo molybdinus, Marcusenius macrolepidotus, Oreochromis mossambicus, Opsaridium peringueyi, Pseudocrenilabrus philander, Tilapia sparrmanii, Barbus lineomaculatus*
Macroinvertebrates	Nepidae, Belostomatidae, Bulinae, Lymnaeidae, Planorbinae, Thiaridae, Chironomidae, Notonectidae, Hirudinea, Potamonautidae, Corixidae, Muscidae, Turbellaria, Sphaeridae, Oligochaeta, Culicidae, Lestidae, Chlorolestidae, Atyidae, Hydraenidae, Calopterygidae, Leptophlebiidae, Ecnomidae, Aeshnidae, Hydracarina, Hydrometridae, Chlorocyphidae, Psephenidae, Philopotamidae, Athericidae, Trichorythidae, Elmidae, Corduliidae, Polymitarcyidae, Veliidae, Gerridae, Dixidae, Haliplidae, Coenagrionidae, Pleidae, Dytiscidae, Hydroptilidae, Hydrophilidae, Ceratopogonidae, Simuliidae, Leptoceridae, Caenidae, Porifera, Ancylidae, Naucoridae, Libellulidae, Tipulidae, Tabanidae, Corbiculidae, Unionidae, Gomphidae, Gyrinidae, Helodidae, Pyralidae, Baetidae >2spp, Heptageniidae, Prosopistomatidae, Perlidae, Hydropsychidae >2spp, Oligoneuridae.

S11: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	C (76.7)	F & NF	High abundance of BMAR More than half of the expected fish species for the river reach recorded Good flow velocity classes Rootwads present but mostly exposed
Macroinvertebrates	C (63.8)	F & NF	SIC sample contributed majority of the SASS5 score however, due to low flow conditions, the

			marginal veg and GSM scored relatively low
Habitat Integrity: Instream	C (13)	F & NF	Upstream sandbag weir for abstraction and cattle watering Lack of instream vegetation Low flow velocities
Habitat Integrity: Riparian	B (85)	F & NF	Good riparian zone however, there is concern for wood harvesting and agricultural activity encroachment
ECOSTATUS	C (74.8)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S11: PES and causes	
COMPONENT	**CAUSES** **Present/Absent**
Fish	Present: *Labeobarbus marequensis*, *Enteromius (Barbus) unitaeniatus*, *Clarias gariepinus*, *Chiloglanis pretoriae*, *Labeo cylindricus*, *Labeo molybdinus*, *Marcusenius macrolepidotus*, *Pseudocrenilabrus philander*, *Barbus lineomaculatus* (New record)
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Turbellaria, Simuliidae, Trichorythidae, Philopotamidae and Gyrinidae, fast flows: Potamonautidae, Leptoceridae, Gomphidae and Naucoridae, slow flows: Hydroptilidae, Chlorocyphidae and Sphaeridae and very slow flows: Dytiscidae, Belostomatidae, Notonectidae, Lymnaeidae, Planorbinae and Thiaridae. The taxa absent from the various habitat types were: cobbles: Turbellaria, Simuliidae, Trichorythidae, Philopotamidae, Potamonautidae and Chlorocyphidae, marginal vegetation: Leptoceridae, Hydroptilidae, Dytiscidae, Belostomatidae, Lymnaeidae, Planorbinae and Thiaridae, from the GSM: Gomphidae and Sphaeridae and from the water column: Gyrinidae, Naucoridae and Notonectidae. The taxa absent due to the water quality rating were those from moderate: Turbellaria, Trichorythidae, Philopotamidae and Chlorocyphidae, low: Simuliidae, Gyrinidae, Leptoceridae, Gomphidae, Naucoridae, Hydroptilidae and Dytiscidae and those with the very low rating: Belostomatidae, Lymnaeidae, Planorbinae, Thiaridae, Notonectidae, Potamonautidae, Turbellaria, Sphaeridae and Oligochaeta.

S11: Overall change and reason for deviation		
COMPONENT	**PES**	**REASON FOR DEVIATION**

	2015	
ECOSTATUS	C	Root wads present but exposed. Limited representation of flow-depth classes Shallower habitats not well represented Adequate water quality

S11: Ecological trends for the EWR site (include components that were assessed)			
Component	**Trend**	**Reason**	**Confidence (0-5)***
	PES 2015		
Fish	C	High abundance of BMAR More than half of the expected fish species for the river reach recorded Good flow velocity classes Rootwads present but mostly exposed	
Macro-invertebrates	C	SIC sample contributed majority of the SASS5 score however, due to low flow conditions, the marginal veg and GSM scored relatively low	
Habitat integrity: Instream	C	Upstream sandbag weir for abstraction and cattle watering Lack of instream vegetation Low flow velocities	
Habitat integrity: Riparian	B	Good riparian zone however, there is concern for wood harvesting and agricultural activity encroachment	
ECOSTATUS	C		

** 0 – no confidence to 5 – high confidence*

S11: OVERALL ASSESSMENT

The site is located on the Spekboom and is a new rapid III site as identified during the gap analysis. The site is downstream from agricultural, mining, industrial and informal settlements. Upstream within the Spekboom valley, intensive cultivation and centre pivots contributing to these impacts.

Flow velocities are severely modified owing to poor rainfall and abstraction activities, return flows from the informal settlements as well as from the agricultural activities. The water quality was adequate.

RECOMMENDATIONS

- Due to the importance of the Spekboom River to the lower Steelpoort River, it is recommended that RHEM be conducted annually
- Chemical, microbial and *in situ* water quality must be monitored on a quarterly basis
- The site should be monitored to understand the health of the system and ensure the trajectory of change over time
- The instream monitoring should be in collaboration with the adjacent land use/s allocated water use license compliance monitoring program

3.1.12 SITE S12: UPPER BLYDE RIVER*(NEW RAPID III)*

SITE	DETAILS	VIEW
Site	S12	
River	Upper Blyde	
Quaternary Catchment	B60B	
Co-ordinates	-24,734412; 30,778321	
Ecoregion	Northern Escarpment Mountains (10)	
IUA	13	
SQ Reach	B60B-00566	
IEI Rating	4	
WRUI Rating	1	
Survey type	Rapid III	
PES 2013 (reach)	B	
EI_ES 2013 (reach)	High	
Eco-Region Level II	10_1	
Geozone	E	
Gauging weirs	B6H001	
Discharge	2.039 m3/s	

HABITAT AND BIOTA

- SIC, SOOC, pool, cobbles, boulders observed. Snag trees under bridge provided habitat. Limited overhanging vegetation.
- Aquatic macroinvertebrates: ASPT: 6.5 (moderately tolerant taxa)
- Fish Habitat: Good

WATER QUALITY

- pH 8.4; EC 19.0 mS/m; DO 11.95 mg/l

SITE AND UPSTREAM IMPACTS

- Low flows
- High silt loads observed.

- Extensive agricultural activities (grazing, cultivation, forestry)

S12: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	2	The site is easily accessible.	Debris on the bridge pillars will affect the cross section under high flows. The site is located on a bend and water levels are not entirely constant
Fish	4	Most of habitats present Pools present as refugia Most flow-depth classes present	Limited marginal vegetation Silt deposition high
Macroinvertebrates	4	SIC, SOOC and GSM habitats present, but limited	Marginal vegetation limited Silt deposition high
Riparian vegetation / Habitat Integrity	3	Pockets of riparian vegetation in a fair to good state	Alien invasive species present Erosion of stream banks due to alien infestation Trampling by cattle

* *Confidence scores: 0 = no confidence; 5 = high confidence*

S12: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Only one set of measured data available at the cross section
Fish						Historic data available Present survey
Macroinvertebrates						Historic data available Present survey
Hydrology						Natural and present day monthly flow Gauging weir B6H001

Physico-chemical						Data available at water quality monitoring site B6H001Q0. Historic data, DWS Chemical monitoring programme

* 0 (no information) to 4 (large amount of data available)

S12: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Amphilius natalensis, Labeobarbus marequensis, Enteromius (Barbus)motebensis, Enteromius (Barbus)neefi, Chiloglanis pretoriae, Tilapia sparrmanii*
Macroinvertebrates	Sphaeridae, Oligochaeta, Chironomidae, Hirudinea, Potamonautidae, Corixidae, Muscidae, Nepidae, Belostomatidae, Lymnaeidae, Planorbinae, Notonectidae, Turbellaria, Culicidae, Calamoceratidae, Hydracarina, Corduliidae, Polymitarcyidae, Pisuliidae, Lepidostomatidae, Lestidae, Protoneuridae, Atyidae, Hydraenidae, Philopotamidae, Athericidae, Chlorolestidae, Platycnemidae, Leptophlebiidae, Ecnomidae, Aeshnidae, Hydrometridae, Chlorocyphidae, Psephenidae, Trichorythidae, Elmidae, Veliidae, Gerridae, Dixidae, Gomphidae, Corbiculidae, Caenidae, Tipulidae, Tabanidae, Hydrophilidae, Ceratopogonidae, Leptoceridae, Haliplidae, Coenagrionidae, Dytiscidae, Hydroptilidae, Empididae, Naucoridae, Libellulidae, Pleidae, Simuliidae, Hydropsychidae 2spp, Porifera, Ancylidae, Gyrinidae, Baetidae >2spp, Helodidae, Pyralidae, Heptageniidae, Prosopistomatidae, Perlidae, Hydropsychidae >2spp.

S12: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	B/C (80.5)	F & NF	Varied flow conditions Erosion and siltation present in the system
Macroinvertebrates	C (71.0)	F & NF	Varied flow conditions Due to the low water levels, some of the biotopes are exposed
Habitat Integrity: Instream	B (84)	F & NF	Lack of instream vegetation Siltation
Habitat Integrity: Riparian	C (75)	F & NF	Wood harvesting Invasive alien infestation

			Erosion and trampling
ECOSTATUS	C (75.2)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S12: PES and causes	
COMPONENT	**CAUSES** **Present/Absent**
Fish	Present: *Amphilius natalensis*, *Labeobarbus marequensis*, *Enteromius (Barbus) neefi, Chiloglanis pretoriae*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Psephenidae and Gyrinidae, fast flows: Naucoridae, slow flows: Tipulidae and very slow flows: Belostomatidae, Notonectidae, Lymnaeidae and Planorbinae. The taxa absent from the various habitat types were: cobbles: Psephenidae, marginal vegetation: Belostomatidae, Lymnaeidae and Planorbinae, from the GSM: Tipulidae and from the water column: Naucoridae and Notonectidae. The taxa absent due to the water quality rating were those from moderate: Psephenidae, low: Tipulidae, Hydrophilidae, Naucoridae and Gyrinidae and those with the very low rating: Oligochaeta, Lymnaeidae, Planorbinae and Notonectidae.

S12: Overall change and reason for deviation		
COMPONENT	**PES 2015**	**COMMENT**
ECOSTATUS	C	Low flow condition Habitat modification (instream and riparian) Impact of forestry activities

S5: Ecological trends for the EWR site (include components that were assessed)			
Component	**Trend**	**Reason**	**Confidence (0-5)***
	PES 2015		
Fish	B/C	Varied flow conditions Erosion and siltation present in the system	4

Macro-invertebrates	C	Varied flow conditions Due to the low water levels, some of the biotopes are exposed	4
Habitat integrity: Instream	B	Lack of instream vegetation Siltation	4
Habitat integrity: Riparian	C	Wood harvesting Invasive alien infestation Erosion and trampling	4
ECOSTATUS	C		

** 0 – no confidence to 5 – high confidence*

S12: OVERALL ASSESSMENT

This is a new rapid III site following the gap analysis. The site is situated in the upper reaches of the Blyde River, upstream of the confluence with the Treur River and the Blyde River Canyon Reserve. Important tributaries are the Molototse and the Lisbon Rivers.

RECOMMENDATIONS

- Due to the importance of the upper Blyde River in maintaining the good condition of the lower Blyde, it is recommended that RHEM be conducted annually
- Chemical,*in situ* water quality and microbiological parameters should be monitored bi-annually
- Index of habitat integrity (IHI) should be conducted annually
- Land use activities should be managed to prevent degradation of the ecological health of the system and deterioration in water quality.

3.1.13 SITE S13: OLIFANTS*(OLD COMPREHENSIVE OLIFANTS-EWR11)*

SITE	DETAILS	VIEW
Site	S13	
River	Olifants	
Quaternary Catchment	B71J	
Co-ordinates	-24,307563; 30,785695	
Ecoregion	Northern Escarpment Mountains (10)	
IUA	10	
SQ Reach	B71J-00428	
IEI Rating	3	
WRUI Rating	4	
Survey type	Rapid III	
PES 1999 (site)	E	
EI_ES 1999 (site)	High	
Eco-Region Level II	10_1	
Geozone	E	
Gauging weirs	None	
Discharge	4.051 m3/s	

HABITAT AND BIOTA

- SIC, SOOC, little boulders and bedrock were present. Cobbles were embedded. Vegetation limited but under higher flow undercut banks and root wads will be present.
- Aquatic macroinvertebrates: ASPT: 6.5 (moderately tolerant taxa)
- Fish Habitat: Fair

WATER QUALITY

- pH 9.0; EC 55 mS/m; DO 11.63 mg/l

SITE AND UPSTREAM IMPACTS

- Water was silty and substrate was smothered in fine silt
- Return flows from agricultural activities
- Upstream weir for water absraction
- Abstraction is high
- Informal settlements
- Cattle grazing

S13: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	2	The site is easily accessible.	A critical section was difficult to find due to instream channels and deposition of rocks
Fish	4	Pools present as refugia Most of flow-depth classes present	Most of habitats present but exposed Limited marginal vegetation Silt deposition Poor water quality due to high nutrient loads
Macroinvertebrates	4	SIC and GSM habitats present, but limited	SOOC and bedrock absent Marginal vegetation limited dominated by *Phragmites sp.* Silt deposition Poor water quality due to high nutrient loads
Riparian vegetation / Habitat Integrity	4	Good condition at the site	Wood harvesting by local communities Siltation due to upstream impacts Marginal vegetation limited dominated by *Phragmites sp.*

** Confidence scores: 0 = no confidence; 5 = high confidence*

S13: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics			X			Only one set of measured data available at the cross section
Fish					X	Historic data available from previous Reserve study (2001) and survey in 2004 Present survey
Macroinvertebrates					X	Historic data available from previous Reserve study (2001) and survey in 2004 Present survey
Hydrology			X			Natural and present day monthly flow
Physico-chemical			X			Data available from gauging weir (B7H009Q01) Historic data, DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

S13: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Anguilla bengalensis, Anguilla marmorata, Anguilla mossambica, Enteromius (Barbus)eutaenia, Brycinus imberi, Labeobarbus marequensis, Enteromius (Barbus)mattozi, Enteromius (Barbus)paludinosus, Enteromius (Barbus)trimaculatus, Enteromius (Barbus)unitaeniatus, Enteromius (Barbus)viviparous, Clarias gariepinus, Chiloglanis paratus, Chiloglanis pretoriae, Chiloglanis swierstrai, Labeo cylindricus, Labeo molybdinus, Labeo rosae, Labeo ruddi, Micralestes acutidens, Mesobola brevianalis, Marcusenius macrolepidotus, Oreochromis mossambicus, Opsaridium peringueyi, Petrocephalus wesselsi, Pseudocrenilabrus philander, Schilbe intermedius, Synodontis zambezensis, Tilapia rendalli*
Macroinvertebrates	Perlidae, Oligoneuridae, Turbellari, , Psephenidae, Hydropsychidae 2spp, Hydropsychidae >2spp, Ceratopogonidae, Empididae, Muscidae, Simuliidae, Trichorythidae, Polymitarcyidae, Prosopistomatidae, Philopotamidae, Gyrinidae, Elmidae, Potamonautidae, Heptageniidae, Pyralidae, Leptoceridae, Hydraenidae, Baetidae >2spp, Aeshnidae, Hydroptilidae, Athericidae, Chironomidae, Coenagrionidae, Libellulidae, Oligochaeta, Leptophlebiidae, Lepidostomatidae, Pisuliidae, Helodidae, Ancylidae, Hirudinea, Caenidae, Haliplidae, Tipulidae, Unionidae, Gomphidae, Naucoridae, Hydracarina, Hydrophilidae, Dixidae, Calopterygidae, Chlorocyphidae, Chlorolestidae,

S13: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
	Corduliidae, Corixidae, Veliidae, Dytiscidae, Tabanidae, Corbiculidae, Sphaeridae, Atyidae, Lestidae, Belostomatidae, Gerridae, Hydrometridae, Nepidae, Notonectidae, Pleidae, Ecnomidae, Calamoceratidae, Culicidae, Ephydridae, Bulinae, Lymnaeidae, Planorbinae, Thiaridae.

S13: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	D (55.0)	F & NF	Most of habitats present but exposed Limited marginal vegetation thus eliminating vegetation dependent fish species Silt deposition Poor water quality due to high nutrient loads Low flow velocities Large system with a high number of expected species and thus rapid sampling protocol and limited habitat accessibility resulted in relatively low fish species observed (9 fish species recorded out of a possible 29 expected species)
Macroinvertebrates	D (48.8)	F & NF	SOOC and bedrock absent Marginal vegetation limited dominated by *Phragmites sp.* Silt deposition Poor water quality due to high nutrient loads Low flow velocities Large system with a high number of expected species and thus rapid sampling protocol and limited habitat accessibility resulted in relatively low fish species observed (23 fish species recorded out of a possible 88 expected species)
Habitat Integrity: Instream	C (68)	F & NF	Marginal vegetation limited dominated by *Phragmites sp.* Silt deposition
Habitat Integrity:	B (87)	F & NF	Fair to good conditions due to the site falling within a

Riparian			nature reserve Some pockets are exposed owing to bank erosion
ECOSTATUS	C (63.4)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S13: PES and causes	
COMPONENT	**CAUSES**
Fish	Present: *Labeobarbus marequensis*, *Enteromius (Barbus)trimaculatus*, *Enteromius (Barbus) viviparous*, *Clarias gariepinus*, *Chiloglanis paratus*, *Chiloglanis pretoriae*, *Labeo cylindricus*, *Labeo molybdinus*, *Oreochromis mossambicus*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Perlidae, Turbellaria, Psephenidae, Philopotamidae and Gyrinidae, fast flows: Potamonautidae, slow flows: Tipulidae and very slow flows: Dytiscidae, Belostomatidae, Gerridae, Notonectidae, Lymnaeidae, Planorbinae and Thiaridae. The taxa absent from the various habitat types were: cobbles: Perlidae, Turbellaria, Psephenidae, Philopotamidae and Potamonautidae, marginal vegetation: Dytiscidae, Belostomatidae, Lymnaeidae, Planorbinae and Thiaridae, from the GSM: Tipulidae and from the water column: Gyrinidae, Gerridae and Notonectidae. The taxa absent due to the water quality rating were those from high: Perlidae and Hydropsychidae, moderate: Psephenidae, Philopotamidae, Aeshnidae, Hydracarina, Atyidae and Gerridae, low: Gyrinidae, Ancylidae, Tipulidae, Hydrophilidae and Dytiscidae and those with the very low rating: Turbellaria, Potamonautidae, Belostomatidae, Notonectidae, Lymnaeidae, Planorbinae and Thiaridae.

S13: Overall change and reason for deviation				
COMPONENT	**PES 1999**	**PES 2010**	**PES 2015**	**REASON FOR DEVIATION**
ECOSTATUS	E	-	C	During the 1999 survey, the section of the river was dominated by sand deposition resulting in an overall category E PES. During subsequent flooding, the sand build up was scoured. Therefore, during the current survey, the instream habitat integrity improved ultimately contributing to an improved overall PES.

S13: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 1999	**PES 2010**	**PES 2015**		
Fish	E	-	D	During the 1999 survey, the section of the river was dominated by sand deposition resulting in an overall category E PES. During subsequent flooding, the sand build up was scoured. Therefore, during the current survey, the instream habitat integrity improved ultimately contributing to an improved overall PES.	4
Macro-invertebrates	D	-	D		4
Habitat integrity: Instream	E	-	C		4
Habitat integrity: Riparian	E	-	B		4
ECOSTATUS	E	-	C		

** 0 – no confidence to 5 – high confidence*

S13: OVERALL ASSESSMENT

This is the existing comprehensive EWR11 site located on the Olifants River upstream from the confluence of the Blyde River. Impacts in the lower section of the catchment include intensive citrus farming, game farming and subsistence grazing and cultivation and abstraction for commercial and subsistence farms. However, abstraction levels have reduced due to a newly constructed pipeline from the Blyde River routing water to the farmers ultimately contributing to less abstraction from the Olifants main stem. Furthermore, a high number of informal settlements and poor infrastructure coupled with high erosion from the immediate catchment as well as higher up from the middle Olifants River. Agricultural return flows contribute to the nutrient loading within the system as well as surface runoff sourced from cattle and human waste. An overall improvement in the ecological status of the site was observed primarily due to improved instream habitat integrity.

Due to this site being in the lowest part of the catchment prior to the confluence with the Blyde River, it is recommended that a comprehensive monitoring program is implemented. This is to ensure that the ecological status of the lower Olifants in the Kruger National Park can be improved.

RECOMMENDATIONS

- A full comprehensive monitoring programme for all drivers and response indicators to be implemented
- Chemical and *in situ* water quality should be monitored quarterly
- Flow monitoring
- Diatom samples should be taken minimum annually
- WET testing should be conducted quarterly until results are resolved
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet and dry season
- Riparian VEGRAI should be conducted every 5 years

- IHI should be conducted annually

3.1.14 SITE S14 AND E11: LOWER BLYDE RIVER *(OLD COMPREHENSIVE OLIFANTS-EWR12)*

SITE	DETAILS	VIEW
Site	S14 and E11	
River	Lower Blyde	
Quaternary Catchment	B60J	
Co-ordinates	-24,407481; 30,827404	
Ecoregion	Lowveld (3)	
IUA	10	
SQ Reach	B60J-00444	
IEI Rating	3	
WRUI Rating	3	
Survey type	Rapid III	
PES 2010 (site)	B/C	
EI_ES 2010 (site)	High	
Eco-Region Level II	3_7	
Geozone	E	
Gauging weirs	B6H005	
Discharge	0.653 m3/s	

HABITAT AND BIOTA

- Habitat consisted of cobbles with snags and root wads. Overhanging vegetation and some undercut banks present. Deep pools.
- Aquatic macroinvertebrates: ASPT: 5.6 (moderately tolerant taxa)
- Fish Habitat: Fair

WATER QUALITY

- pH 8.6; EC 20 mS/m; DO 10.92 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- Silt and algae present
- Intensive agricultural activities

- Excessive abstraction for agriculture
- Upstream weir
- Large upstream impoundment (Blyderivierpoort Dam)

S14 and E11: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	2	The cross section is fairly critical and on a straight section of river	Access to the site is fairly difficult. A channel will activate on the left bank during high flows. Trees and bank vegetation will influence the hydraulics at the site under high flows.
Fish	4	Root wads present but mostly exposed (as a result of water levels) Most habitats present Pools present as refugia Most of flow-depth classes present Good cobbles and boulders Good marginal vegeation	Alien species present (MSAL) Low flow levels
Macroinvertebrates	4	SIC, marginal vegetation and GSM habitats present, but limited	SOOC and bedrock absent
Riparian vegetation / Habitat Integrity	4	Instream habitat integrity is in a good condition	Encroachment of farming activities on the riparian vegetation

** Confidence scores: 0 = no confidence; 5 = high confidence*

S14 and E11: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Only one set of measured data available at the cross section

Fish						Historic data available from previous Reserve study (2001) and re-survey in 2010 Present survey
Macroinvertebrates						Historic data available from previous Reserve study (2001) and re-survey in 2010 Present survey
Hydrology						Natural and present day monthly flow Gauging weir B6H005
Physico-chemical						Data available from gauging weir (B6H004Q01) Historic data, DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

S14 AND E11: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Anguilla bengalensis, Anguilla marmorata, Anguilla mossambica, Enteromius (Barbus)eutaenia, Enteromius (Barbus)lineomaculatus, Labeobarbus marequensis, Enteromius (Barbus)mattozi, Labeobarbus polylepis, Enteromius (Barbus)trimaculatus, Enteromius (Barbus)unitaeniatus, Clarias gariepinus, Chiloglanis paratus, Chiloglanis pretoriae, Labeo cylindricus, Labeo molybdinus, Labeo rosae, Micralestes acutidens , Mesobola brevianalis, Marcusenius macrolepidotus, Oreochromis mossambicus, Opsaridium peringueyi, Petrocephalus wesselsi,Pseudocrenilabrus philander, Schilbe intermedius, Synodontis zambezensis, Tilapia rendalli, Tilapia sparrmanii*
Macroinvertebrates	Perlidae, Oligoneuridae, Turbellaria, Psephenidae, Hydropsychidae 2spp, Hydropsychidae >2spp, Ceratopogonidae, Empididae, Muscidae, Simuliidae, Trichorythidae, Polymitarcyidae, Prosopistomatidae, Philopotamidae, Gyrinidae, Elmidae, Potamonautidae, Heptageniidae, Pyralidae, Leptoceridae, Hydraenidae, Porifera, Baetidae 2spp, Baetidae >2spp, Aeshnidae, Hydroptilidae, Athericidae, Chironomidae, Coenagrionidae, Libellulidae, Oligochaeta, Leptophlebiidae, Lepidostomatidae, Pisuliidae, Helodidae, Ancylidae, Hirudinea, Caenidae, Platycnemidae, Haliplidae, Tipulidae, Unionidae, Gomphidae, Naucoridae, Hydracarina, Hydrophilidae, Dixidae, Calopterygidae, Chlorocyphidae, Chlorolestidae, Corduliidae, Corixidae, Veliidae, Dytiscidae, Tabanidae, Corbiculidae, Sphaeridae, Atyidae, Lestidae, Belostomatidae, Gerridae, Hydrometridae, Nepidae, Notonectidae, Pleidae, Ecnomidae, Calamoceratidae, Culicidae, Ephydridae, Bulinae, Lymnaeidae, Planorbinae, Thiaridae.

S14 and E11: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	C (70.3)	F & NF	Alien species present (MSAL) Low flow levels
Macroinvertebrates	D (52.4)	F & NF	Low flow velocity and flow depth (limited marginal vegetation) Poor water quality due to tolerant species present
Habitat Integrity: Instream	C (73)	F & NF	Lack of instream vegetation Silt deposition
Habitat Integrity: Riparian	B (88)	F & NF	Good riparian habitat integrity
ECOSTATUS	C (69.7)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S14 and E11: PES and causes	
COMPONENT	**CAUSES** **Absent/Present**
Fish	Present: *Enteromius (Barbus) lineomaculatus*, *Labeobarbus marequensis*, *Enteromius (Barbus) trimaculatus*, *Enteromius (Barbus) unitaeniatus*, *Clarias gariepinus*, *Chiloglanis pretoriae*, *Labeo cylindricus, Labeo molybdinus*, *Micralestes acutidens*, *Tilapia rendalli*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Ceratopogonidae, Simuliidae, Trichorythidae, Prosopistomatidae, Philopotamidae and Gyrinidae, fast flows: Elmidae, Aeshnidae, Gomphidae and Naucoridae, slow flows: Hydroptilidae and Tabanidae and very slow flows: Calamoceratidae and Lymnaeidae. The taxa absent from the various habitat types were: cobbles: Ceratopogonidae, Simuliidae, Trichorythidae, Philopotamidae, Elmidae and Aeshnidae, marginal vegetation:Hydroptilidae and Lymnaeidae, from the GSM: Gomphidae, Tabanidae and Calamoceratidae and from the water column: Gyrinidae, Naucoridae, Culicidae. The taxa absent due to the water quality rating were those from moderate: Trichorythidae, Philopotamidae, Elmidae, Aeshnidae and Calamoceratidae, low:Ceratopogonidae, Simuliidae, Gyrinidae, Gomphidae, Naucoridae, Hydroptilidae and

	Tabanidae and those with the very low rating:Lymnaeidae.

S14 and E11: Overall change and reason for deviation				
COMPONENT	**PES 1999**	**PES 2010**	**PES 2015**	**REASON FOR DEVIATION**
ECOSTATUS	B	B/C	C	Good management within the system is required Adequate flow regimes not available due to upstream dam

S14 and E11: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 1999	**PES 2010**	**PES 2015**		
Fish	B	C	C	Alien invasive fish species (MSAL) Poor water quality due to increased farming activities	
Macro-invertebrates	B	B	D	Poor water quality due to increased farming activities and pesticide utilisation within the catchment Habitat inaccessibility due to deep pools Flow modifications	
Habitat integrity: Instream	-	B/C	C	Silt deposition due to the low flows Limited instream vegetation due to the substrate dominated by cobbles and boulders	
Habitat integrity: Riparian	B	B	B	Maintained	
ECOSTATUS	B	B/C	C		

** 0 – no confidence to 5 – high confidence*

S14 AND E11: OVERALL ASSESSMENT

This is the existing EWR12 site on the Blyde River just upstream of the confluence with the Olifants River. The impacts include intensive agricultural activities primarily citrus, mangoes and vegetables. Furthermore, intensive abstraction as well as the pipeline routing water from the River to the surrounding famers. This is potentially reducing the volume and water quality entering into the lower Olifants River and thus into the Kruger National Park. In addition, this area was classified as a class II but is currently under threat due to the decrease in the ecological condition status for most components. Therefore stringent management measures for the flows land based activities need to be implemented.

Due to this site being in the lowest part of the Blyde catchment prior to the confluence with the Olifants River and the river being a Class II river, it is recommended that a comprehensive monitoring program is implemented. This is to ensure that the ecological status of the Blyde river does not deteriorate and to contribute to the improvement in water quality in the lower Olifants in the Kruger National Park.

RECOMMENDATIONS

- A full comprehensive monitoring programme for all drivers and response indicators to be implemented
- Chemical and *in situ* water quality should be monitored quarterly
- Flow monitoring
- Diatom samples should be taken minimum annually
- WET testing should be conducted quarterly until results are resolved
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet and dry season
- VEGRAI should be conducted every 5 years
- IHI should be conducted annually

3.1.15 SITE S15: OLIFANTS *(OLD COMPREHENSIVE OLIFANTS-EWR13)*

SITE	DETAILS	VIEW
Site	S15	
River	Olifants	
Quaternary Catchment	B72D	
Co-ordinates	-24,12843; 31,01457	
Ecoregion	Lowveld (3)	
IUA	12	
SQ Reach	B72D-00326	
IEI Rating	2	
WRUI Rating	4	
Survey type	Rapid II (no hydraulics)	
PES 2010 (site)	C	
EI_ES 2010 (site)	Moderate	
Eco-Region Level II	3_7	
Geozone	E	
Gauging weirs	B7H007	
Discharge	1.660 m^3/s from gauging weir B7H007	

HABITAT AND BIOTA

- Sand with limited cobbles. Limited root wads and undercut banks.
- Aquatic macroinvertebrates: ASPT: 5.8 (moderately tolerant taxa)
- Fish Habitat: Poor

WATER QUALITY

- pH 8.8; EC 56 mS/m; DO 10.68 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- Some silt
- Low algae growth

- Discharge at the gauging weir B7H007 was used
- No hydraulic surveys undertaken
- Agricultural activities
- Human and cattle waste

S15: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	0	There is access to the site	Crocodiles, deep channels and sand bars meant that a cross section and discharge could not be surveyed
Fish	4	Pools present as refugia	Flow-depth classes limited No marginal vegetation Poor water quality
Macroinvertebrates	4	GSM habitats present, but limited	SIC, SOOC and bedrock absent Marginal vegetation limited Opaque colour of water Poor water quality
Riparian vegetation / Habitat Integrity	4	None identified	Wildlife trampling Wildlife demolishing vegetation Erosion Private residential development into the riparian zone

* *Confidence scores: 0 = no confidence; 5 = high confidence*

S15: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
						No cross section surveyed due to risk of crocodiles and due to the fact the section is located on sand bars with channels Cross-section from previous study (1999) is avialable

Fish						Historic data available from previous Reserve study (2001), survey in 2004 and re-survey in 2010 Present survey
Macroinvertebrates						Historic data available from previous Reserve study (2001), survey in 2004 and re-survey in 2010 Present survey
Hydrology						Natural and present day monthly flow Gauging weir B7H007
Physico-chemical						Data available from gauging weir (B7H007Q01) Historic data, DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

S15: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Anguilla bengalensis, Anguilla marmorata, Anguilla mossambica, Enteromius (Barbus) annectens, Brycinus imberi, Labeobarbus marequensis, Enteromius (Barbus) mattozi, Enteromius (Barbus) paludinosus, Enteromius (Barbus) toppini, Enteromius (Barbus) trimaculatus, Barbus unitaeniatus, Enteromius (Barbus) viviparous, Clarias gariepinus, Chiloglanis paratus, Chiloglanis pretoriae, Chiloglanis swierstrai, Glossogobius callidus, Hydrocynus vittatus, Labeo congoro, Labeo cylindricus, Labeo molybdinus, Labeo rosae steindachner, Labeo ruddi, Micralestes acutidens, Mesobola brevianalis, Marcusenius macrolepidotus, Oreochromis mossambicus, Opsaridium peringueyi, Petrocephalus wesselsi, Pseudocrenilabrus philander, Schilbe intermedius, Synodontis zambezensis, Tilapia rendalli*
Macroinvertebrates	Perlidae, Oligoneuridae, Turbellaria, Psephenidae, Hydropsychidae 1sp, Hydropsychidae >2spp, Ceratopogonidae, Empididae, Muscidae, Simuliidae, Trichorythidae, Paleomonidae, Polymitarcyidae, Prosopistomatidae, Philopotamidae, Gyrinidae, Elmidae, Potamonautidae, Heptageniidae, Pyralidae, Leptoceridae, Hydraenidae, Porifera, Baetidae 2spp, Baetidae >2spp, Aeshnidae, Hydroptilidae, Athericidae, Chironomidae, Coenagrionidae, Libellulidae, Oligochaeta, Leptophlebiidae, Lepidostomatidae, Pisuliidae, Helodidae, Ancylidae, Hirudinea, Caenidae, Haliplidae, Tipulidae, Unionidae, Gomphidae, Naucoridae, Hydracarina, Hydrophilidae, Dixidae, Calopterygidae, Chlorocyphidae, Chlorolestidae, Corduliidae, Corixidae, Veliidae, Dytiscidae, Tabanidae, Corbiculidae, Sphaeridae, Atyidae, Lestidae, Belostomatidae, Gerridae, Hydrometridae, Nepidae, Notonectidae, Pleidae, Ecnomidae, Calamoceratidae, Culicidae, Bulinae, Lymnaeidae, Planorbinae, Thiaridae.

S15: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	C/D (61.8)	F & NF	Sensitive fish species recorded Marginal and instream vegetation limiting resulting in low fish species diversity associated with vegetation The system is dominated by sandbanks, although a natural feature of the lower Olifants River Lack of flow depth classes Poor water quality
Macroinvertebrates	D (57.1)	F & NF	Marginal and instream vegetation limiting The system is dominated by sandbanks, although a natural feature of the lower Olifants River Low flow regimes Poor water quality
Habitat Integrity: Instream	B/C (80)	F & NF	The system is dominated by sandbanks, although a natural feature of the lower Olifants River Low flow regimes Lack of SIC, SOOC Marginal and instream vegetation limiting
Habitat Integrity: Riparian	D (48)	F & NF	Wildlife trampling Wildlife demolishing vegetation Extensive erosion Flood damage Private residential development into the riparian zone
ECOSTATUS	C (68.5)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S15: PES and causes	
COMPONENT	**CAUSES**
Fish	Present: *Labeobarbus marequensis*, *Enteromius (Barbus)trimaculatus*, *Enteromius (Barbus) viviparous*, *Clarias gariepinus*, *Chiloglanis pretoriae*, *Chiloglanis swierstrai*, *Glossogobius callidus*, *Labeo cylindricus, Labeo molybdinus*, *Micralestes acutidens*, *Oreochromis mossambicus*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Perlidae, Turbellaria, Psephenidae, Simuliidae, Trichorythidae and Philopotamidae, fast flows: Elmidae and Potamonautidae, slow flows: Chironomidae, Tipulidae, Chlorocyphidae, Corixidae and Sphaeridae and very slow flows: Caenidae, Dytiscidae, Gerridae, Lymnaeidae, Planorbinae. The taxa absent from the various habitat types were: cobbles: Perlidae, Turbellaria, Psephenidae, Simuliidae, Trichorythidae, Philopotamidae, Elmidae, Potamonautidae and Chlorocyphidae, marginal vegetation: Dytiscidae, Lymnaeidae and Planorbinae, from the GSM: Chironomidae, Tipulidae, Sphaeridae and Caenidae and from the water column: Corixidae and Gerridae. The taxa absent due to the water quality rating were those from high: Perlidae, moderate: Psephenidae, Trichorythidae, Philopotamidae, Elmidae, Chlorocyphidae and Gerridae, low: Simuliidae, Tipulidae, Caenidae and Dytiscidae and those with the very low rating: Turbellaria, Potamonautidae, Chironomidae, Corixidae, Sphaeridae, Lymnaeidae and Planorbinae.

S15: Overall change and reason for deviation				
COMPONENT	**PES 1999**	**PES 2010**	**PES 2015**	**REASON FOR DEVIATION**
ECOSTATUS	C	C	C	Stable

S15: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 1999	**PES 2010**	**PES 2015**		
Fish	C	D	C/D	Stable and dependant on the flows at the time of the survey. Also influenced by scouring events during the season prior to the survey.	5

Macro-invertebrates	C	C	D	Marginal and instream vegetation limiting The system is dominated by sandbanks, although a natural feature of the lower Olifants River Low flow regimes Poor water quality	5
Habitat integrity: Instream	-	D	C/B	Linked to flow variation in prior wet seasons and natural fluctuations.	4
Habitat integrity: Riparian	C	B/C	D	Vegetation Removal Extensive erosion due to recent flooding Flood damage Development into the riparian zone	4
ECOSTATUS	C	C	C		

** 0 – no confidence to 5 – high confidence*

S15: OVERALL ASSESSMENT

This is the existing comprehensive EWR13 site located on the Olifants River 20km upstream from the Ga-Selati confluence, upstream of the Bulele Nature Reserve Complex and Phalaborwa impacts (Ga-selati River). Regular monitoring is therefore required to monitor the trajectory of change.

RECOMMENDATIONS

- Chemical and *in situ* water quality should be monitored bi-annually
- Diatom samples should be taken minimum every 2 years
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet season
- Riparian VEGRAI should be conducted every 5 years
- IHI should be conducted every 2 years

3.1.16 SITE S16: OLIFANTS *(OLD COMPREHENSIVE OLIFANTS-EWR16)*

SITE	DETAILS	VIEW
Site	S16	
River	Olifants	
Quaternary Catchment	B73H	
Co-ordinates	-24,049426; 31,731751	
Ecoregion	Lowveld (3)	
IUA	12	
SQ Reach	B73H-00311	
IEI Rating	3	
WRUI Rating	4	
Survey type	Rapid III	
PES 2010 (site)	C	
EI_ES 2010 (site)	High	
Eco-Region Level II	3.6	
Geozone	E	
Gauging weirs	B7H015	
Discharge	2.964 m^3/s from gauging weir B7H015	

HABITAT AND BIOTA

- Sand and bedrock habitat.
- Aquatic macroinvertebrates: ASPT: 5.8 (moderately tolerant taxa)
- Fish Habitat: Fair

WATER QUALITY

- pH 8.9; EC 65 mS/m; DO 12.55 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- Some stringy algae observed at site
- Discharge at the gauging weir B7H015 as the weir just upstream of the site (B7H026) was still under construction)
- Upstream weir

- Industrialactivities (Phalaborwa Industrial Complex)

S16: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	2	Site is easily accessible. Discharge can be obtained from an upstream gauging weir	The site is fairly braided and difficult to model under low flows. Crocodiles and hippos are a risk.
Fish	4	Falls within a protected area There are limited pools as refugia	Flow-depth classes limited (very shallow under currently flow conditions) No marginal or instream vegetation
Macroinvertebrates	4	Bedrock and GSM habitats present, but limited	SOOC absent SIC Limited Marginal vegetation limited Algae present
Riparian vegetation / Habitat Integrity	4	It is a protected area	Flood damage Herbivore damage

* *Confidence scores: 0 = no confidence; 5 = high confidence*

S16: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Only one set of measured data available at the cross section
Fish						Historic data available from previous Reserve study (2001), re-survey in 2010 and recent WRC project (2012) Present survey
Macroinvertebrates						Historic data available from previous Reserve study (2001), re-survey in 2010 and recent WRC project (2012)

						Present survey
Riparian vegetation						Historic data, previous survey data
Hydrology						Natural and present day monthly flow Gauging weir B7H015 and in future B7H026
Physico-chemical						Historic data B7H017Q01, DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

S16: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Anguilla bengalensis, Anguilla marmorata, Anguilla mossambica, Enteromius (Barbus)afrohamiltoni, Brycinus imberi, Labeobarbus marequensis, Enteromius (Barbus)mattozi, Enteromius (Barbus)paludinosus, Enteromius (Barbus)radiates, Enteromius (Barbus)toppini, Enteromius (Barbus)trimaculatus, Enteromius (Barbus)unitaeniatus, Enteromius (Barbus)viviparous, Clarias gariepinus, Chiloglanis paratus, Chiloglanis pretoriae, Chiloglanis swierstrai, Glossogobius callidus, Glossogobius giuris, Hydrocynus vittatus, Labeo congoro, Labeo cylindricus, Labeo molybdinus, Labeo rosae, Labeo ruddi, Micralestes acutidens, Mesobola brevianalis, Marcusenius macrolepidotus, Oreochromis mossambicus, Opsaridium peringueyi, Petrocephalus wesselsi, Pseudocrenilabrus philander, Schilbe intermedius, Synodontis zambezensis, Tilapia rendalli, Tilapia sparrmanii*
Macroinvertebrates	Perlidae, Oligoneuridae, Turbellaria, Ceratopogonidae, Muscidae, Simuliidae, Trichorythidae, Hydropsychidae >2spp, Psephenidae, Paleomonidae, Polymitarcyidae, Gyrinidae, Prosopistomatidae, Philopotamidae, Hydroptilidae, Chironomidae, Porifera, Baetidae 1sp, Baetidae >2spp, Aeshnidae, Hydraenidae, Potamonautidae, Heptageniidae, Pyralidae, Leptoceridae, Athericidae, Elmidae, Haliplidae, Tipulidae, Unionidae, Oligochaeta, Hirudinea, Caenidae, Leptophlebiidae, Coenagrionidae, Libellulidae, Helodidae, Ancylidae, Ecnomidae, Calopterygidae, Chlorocyphidae, Corduliidae, Corixidae, Tabanidae, Corbiculidae, Sphaeridae, Atyidae, Hydracarina, Gomphidae, Naucoridae, Dytiscidae, Hydrophilidae, Dixidae, Bulinae, Lymnaeidae, Physidae, Planorbinae, Thiaridae, Belostomatidae, Gerridae, Hydrometridae, Nepidae, Notonectidae, Pleidae, Veliidae, Culicidae, Psychodidae.

S16: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	D (54.66)	F & NF	Flow-depth classes limited (very shallow under currently flow conditions) No marginal or instream vegetation Limited substrate/cover diversity
Macroinvertebrates	D (44.46)	F & NF	SOOC absent SIC Limited Marginal vegetation limited Algae present
Habitat Integrity: Instream	B (85)	F & NF	Falls within a protected area – Kruger National Park
Habitat Integrity: Riparian	A/B (91)	F & NF	Falls within a protected area – Kruger National Park
ECOSTATUS	D (57.5)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

S16: PES and causes	
COMPONENT	**CAUSES**
Fish	Present: *Labeobarbus marequensis*, *Clarias gariepinus*, *Chiloglanis paratus*, *Chiloglanis swierstrai*, *Hydrocynus vittatus*, *Labeo cylindricus*, *Labeo molybdinus*, *Oreochromis mossambicus*, *Pseudocrenilabrus philander*, *Tilapia rendalli*, *Tilapia sparrmanii*
Macroinvertebrates	The following taxa were absent from the sample: those sensitive to flow modifications in very fast flows: Turbellaria, Muscidae, Simuliidae, Trichorythidae, Hydropsychidae and Philopotamidae, fast flows: Elmidae, Heptageniidae, Leptoceridae and Athericidae, slow flows: Hydroptilidae, Tipulidae, Chlorocyphidae, Corduliidae, Tabanidae and Sphaeridae and very slow flows: Leptophlebiidae, Notonectidae, Lymnaeidae and Planorbinae. The taxa absent from the various habitat types were: cobbles: Turbellaria, Simuliidae, Trichorythidae, Hydropsychidae, Philopotamidae, Elmidae, Heptageniidae, Leptoceridae, Athericidae, Chlorocyphidae and Leptophlebiidae, marginal

	vegetation: Hydroptilidae, Lymnaeidae, Planorbinae and Nepidae, from the GSM: Tipulidae, Corduliidae, Tabanidae and Sphaeridae and from the water column: Muscidae, Notonectidae. The taxa absent due to the water quality rating were those from high: Hydropsychidae, and Heptageniidae, moderate: Trichorythidae, Philopotamidae, Athericidae, Elmidae, Chlorocyphidae, Corduliidae and Leptophlebiidae, low: Simuliidae, Leptoceridae, Hydroptilidae, Tipulidae and Tabanidae and those with the very low rating: Turbellaria, Muscidae, Sphaeridae, Lymnaeidae, Planorbinae, Nepidae and Notonectidae.

	PES 1999	PES 2010	PES 2015	REASON FOR DEVIATION
ECOSTATUS	C	C	D	Low flow conditions and associated lack of habitat for biota

S16: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 1999	**PES 2010**	**PES 2015**		
Fish	C	C	D	Low flow conditions and associated lack of habitat for biota	5
Macro-invertebrates	C	C	D		
Habitat integrity: Instream	-	C	B	Floods scouring the system have removed some sand deposits, deepening pools and removing some off the nutrients in the silt	4
Habitat integrity: Riparian	C	B/C	A/B	Improving due to its location within a protected area	4
ECOSTATUS	C	C	D		

** 0 – no confidence to 5 – high confidence*

S16: OVERALL ASSESSMENT

This is the existing comprehensive EWR16 site located on the Olifants River, the furthest downstream EWR site in the system approximately 6km upstream from the confluence with the Letaba River at the Olifants River Gorge (KNP Eastern border with Mozambique). It is below the confluence with the Timbavati River in the Park. It is an important monitoring site for monitoring water quality and flow velocity to Mozambique in terms of international obligations. It also contributes to biodiversity protection in the Kruger National Park.

RECOMMENDATIONS

- A full comprehensive monitoring programme for all drivers and response indicators to be implemented

- Chemical and *in situ* water quality should be monitored quarterly
- Flow monitoring at gauge B7H026
- Diatom samples should be taken minimum annually
- WET testing should be conducted quarterly until results are resolved
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet and dry season
- Riparian VEGRAI should be conducted every 5 years
- IHI should be conducted annually
- RQOs to be implemented and audited

3.2. BIOLOGICAL SITES

3.2.1 SITE B1: STEENKOOLSPRUIT

SITE	DETAILS	VIEW
Site	B1	
River	Steenkoolspruit	
Quaternary Catchment	B11E	
Co-ordinates	-26,0824.61; 29,1608.27	
Ecoregion	Highveld (11)	
IUA	1	
SQ Reach	B11E-01297	
IEI Rating	2	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (reach)	D	
EI_ES 2013 (reach)	Moderate	
Eco-Region Level II	11_2	
Geozone	F	
Gauging weirs	B1H017	

HABITAT AND BIOTA

- Site had some bedrock with overhanging vegetation.
- Aquatic macroinvertebrates: ASPT: 3.4 (tolerant taxa)
- Fish Habitat: Poor
- Depth 50 – 650mm for fish

WATER QUALITY

- pH 8.0; EC 48 mS/m; DO 5.64 mg/l

SITE AND UPSTREAM IMPACTS

- Flow velocity very low.
- Azolla (red fern) abundant.

- High sediment
- High algae.

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

B1: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	3	Captures all the upstream sections of Steenkoolspruit, Dwars-In-Die-Wegspruit and Rietspruit, upstream from the Witbank complex (severely modified) as well as prior to the confluence with the Olifants River	Some sections of the river was too deep to sample Biotope diversity low
Macroinvertebrates	3		Some sections of the river was too deep to sample Biotope diversity low Dominated by bedrock

** Confidence scores: 0 = no confidence; 5 = high confidence*

B1: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						No historical data Present biological survey
Macroinvertebrates						No historical data Present biological survey
Physico-chemical						Historical data from gauging weir (B1H021Q01)

** 0 (no information) to 4 (large amount of data available)*

B1: OVERALL ASSESSMENT

This is a new biological site following the gap analysis. The site captures all the upstream sections of Steenkoolspruit, Dwars-In-Die-Wegspruit and Rietspruit, upstream from the Witbank complex (severely modified) as well as prior to the confluence with the Olifants River.

RECOMMENDATIONS

- Due to its proximity in the catchment, it is recommended that REMP be conducted annually

- The site should be monitored to understand the health of the system and ensure the trajectory of change over time
- The instream monitoring should be in collaboration with the adjacent land use/s allocated water use licence compliance monitoring program.

3.2.2 SITE B2: BRONKHORSPRUIT

SITE	DETAILS	VIEW
Site	B2	
River	Bronkhorspruit	
Quaternary Catchment	B20D	
Co-ordinates	-25,5304.5; 28,4325.7	
Ecoregion	Western Bankenvled (7)	
IUA	2	
SQ Reach	B20D-01146	
IEI Rating	3	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	7_5	
Geozone	B	
Gauging weirs	B2H010 B2H003	

HABITAT AND BIOTA

- Aquatic macroinvertebrates: ASPT: 3.9 (tolerant taxa)
- Fish Habitat: Good
- High parasite on observed fish.

WATER QUALITY

- pH 8.1; EC 37 mS/m; DO 7.52 mg/

SITE AND UPSTREAM IMPACTS

- Moderate flows as a result of release from the dam
- Floating debris
- Sedimentation and organics observed.

- Lots of algae and diatoms present (long stringy algae).
- Upstream Bronkhorstspruit dam
- High algae

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

B2: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Good habitat diversity and accessibility Represents upstream catchment activities	High organic pollution High algae growth Upstream impoundment (Bronkhorspruit Dam) Poor water quality Flow modifications (water return)
Macroinvertebrates	4	Good habitat diversity and accessibility Represents upstream catchment activities	High organic pollution High algae growth Upstream impoundment (Bronkhorspruit Dam) Poor water quality Alien aquatic veg Flow modifications (water return)

* *Confidence scores: 0 = no confidence; 5 = high confidence*

B2: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical data available both upstream and downstream of impoundment Present survey
Macroinvertebrates						Historical data available both upstream and downstream of impoundment Present survey

Physico-chemical						Historic data B2H003Q01, DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

B2: OVERALL ASSESSMENT

The site is located on the Bronkhortspruit River. The site provided a good representation of the reach from a habitat perspective. Cumulative impacts from upstream agricultural activities. The SASS score was low but represented the present habitat. Poor water quality and high nutrient loads eutrophication owing to the upstream agricultural activities.

RECOMMENDATIONS

- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Full chemical and *in situ* water quality is to be sampled quarterly.
- Diatom sampling should be undertaken quarterly.

3.2.4 SITE B4: TIMBAVATI

SITE	DETAILS	VIEW
Site	B4	 
River	Timbavati	
Quaternary Catchment	B73G	
Co-ordinates	-24.119665, 31.632990	
Ecoregion	3_Lowveld	
IUA	12	
SQ Reach	B73G-00339	
IEI Rating	3	
WRUI Rating	2	
Survey type	Biological	
PES 2013 (reach)	B	
EI_ES 2013 (reach)	High_Moderate	
Eco-Region Level II	3_6	
Geozone	E	
Gauging weirs	-	

HABITAT AND BIOTA

- Limited vegetation, bedrock and limited sand. Numerous pools
- Aquatic macroinvertebrates: ASPT: 4.7 (tolerant taxa)
- Fish Habitat: Fair and representative of the system
- Ephemeral system

WATER QUALITY

- pH 8.4; EC 165 mS/m; DO 5.8 mg/

SITE AND UPSTREAM IMPACTS

- Limited impacts due to being located within a protected area

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

B4: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	-	Low flows
Macroinvertebrates	4	-	Low flows Limited gravel and cobbles

* *Confidence scores: 0 = no confidence; 5 = high confidence*

B4: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical data available Present survey
Macroinvertebrates						Historical data available Present survey
Physico-chemical						Present survey

** 0 (no information) to 4 (large amount of data available)*

B4: OVERALL ASSESSMENT

The site is located on the Timbavati River within a protected reserve. The site is representative of the river reach and is an ephemeral nature. Limited vegetation, bedrock and limited sand. Numerous pools at the site.

RECOMMENDATIONS

- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- I*n situ* water quality is to be sampled annually.

3.2.3 SITE E2: LAKENVLEISPRUIT

SITE	DETAILS	VIEW
Site	E2	
River	Lakenvleispruit	
Quaternary Catchment	B41A	
Co-ordinates	-25.62494, 29.99896	
Ecoregion	Eastern Bankenveld (9)	
IUA	6	
SQ Reach	B41A-01005	
IEI Rating	2	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	9_6	
Geozone	E	
Gauging weirs	None	

HABITAT AND BIOTA

- Cobbles and boulders dominated.
- Aquatic macroinvertebrates: ASPT: 5.5 (moderately tolerant taxa)
- Fish Habitat: Good but high occurrence of MSAL

WATER QUALITY

- pH: 8.6 ; DO: 11.4 mg/l, EC: 8.0 ms/m

SITE AND UPSTREAM IMPACTS

- Plantations and forestry
- Grazing and trampling

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

E2: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics			
Fish	4	Suitable habitat availability Downstream of Lakenvlei Suitable flow	High occurrence of alien invasive fish species (MSAL)
Macroinvertebrates	4	Suitable habitat availability Downstream of Lakenvlei Suitable flow	-
Riparian vegetation / Habitat Integrity	4	The site is located within the grasslands and habitat is in a good condition	

* *Confidence scores: 0 = no confidence; 5 = high confidence*

E2: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						
Fish						Historical data RHP data Present survey
Macroinvertebrates						Historical data RHP data Present survey
Riparian vegetation						Present survey
Physico-chemical						Continual monitoring programme Historical data Present survey

** 0 (no information) to 4 (large amount of data available)*

E2: OVERALL ASSESSMENT

The site is located on the Lakenvleispruit downstream of Lakenvlei with limited upstream impacts with the exception of plantations and forestry. In accordance to DWS and GIS databases, this site is referred to the Lakenvleispruit however, the road signage on the bridge refer to the Grootspruit. Despite good habitat availability, high occurrence of the alien invasive fish species *M. salmoides* was observed which resulted in a low diversity of indigenous fish species. A high number of MSAL juveniles were observed, thus using this river reach as a breeding ground. The stomach content of the fish were assessed where it was identified that tadpoles were their primary food source.

RECOMMENDATIONS

- This site must be continually monitored from a biological perspective in order to gain information for the RQO's
- The instream monitoring should be in collaboration with the adjacent land use/s allocated water use license compliance monitoring program (i.e. current and proposed future mining and power generation activities in the area).
- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Full chemical, microbial and *in situ* water quality is to be sampled quarterly

3.2.4 SITE E3: GROOTSPRUIT

SITE	DETAILS	VIEW
Site	E3	
River	Grootspruit	
Quaternary Catchment	B41A	
Co-ordinates	-25.58372, 29.87910	
Ecoregion	Highveld	
IUA	6	
SQ Reach	B41A-01025	
IEI Rating	2	
WRUI Rating	3	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	11_2	
Geozone	E	
Gauging weirs	None	

HABITAT AND BIOTA

- Deep pools upstream and around the bridge, cobbled riffle zone downstream but was dry at the time of the survey
- Aquatic macroinvertebrates: ASPT: 4.2 (tolerant taxa)
- Fish Habitat: Limited due to low water levels, deep channels, overhanging vegetation and SOOC will provide improved habitat during higher flow conditions. High occurrence of MSAL

WATER QUALITY

- pH 8.0; EC:34 ms/m, DO 13.2 mg/l

SITE AND UPSTREAM IMPACTS

- Agricultural activities
- Cultivation
- Grazing
- Incised banks

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

E3: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics			
Fish	4	-	Low flow conditions Alien invasive fish species (MSAL)
Macroinvertebrates	4	-	Low flow conditions Deep pools with deposition
Riparian vegetation / Habitat Integrity	4	Representative of the river reach	Cultivation Exotic vegetation (*Salix sp.)* Eroded and incised banks

* *Confidence scores: 0 = no confidence; 5 = high confidence*

E3: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish		■				Historical data Present survey
Macroinvertebrates		■				Historical data Present survey
Riparian vegetation		■				Present survey
Physico-chemical		■				Present survey

** 0 (no information) to 4 (large amount of data available)*

E3: OVERALL ASSESSMENT

The site is located on the Grootspruit just before the confluence with the Steelpoort and the Langspruit. In accordance to DWS and GIS databases, this site is referred to the Grootspruit however, the road signage on the bridge already refers to the Steelpoort. The catchment is dominated by cultivation and centre pivots, grazing, water abstraction for farmers. The site was selected with future mining applications in mind to get baseline data for the site. Low water levels resulted in poor habitat availability and sampling effort. The impact of invasive fish (MSAL) and riparian vegetation was noted owing to the modified state.

RECOMMENDATIONS

- This site must be continually monitored from a biological perspective in order to gain information for the RQO's
- Full REMP protocols should be conducted under better flow conditions during the wet season in order to establish a representative baseline for the Grootvlei catchment and its role in the upper Steelpoort catchment
- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Full chemical, microbial and *in situ* water quality is to be sampled quarterly

3.2.5 SITE E4: LANGSPRUIT

SITE	DETAILS	VIEW
Site	E4	
River	Langspruit	
Quaternary Catchment	B41A	
Co-ordinates	-25.592544, 29.898643	
Ecoregion	Highveld (11)	
IUA	6	
SQ Reach	B41A-01047	
IEI Rating	3	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (reach)	D	
EI_ES 2013 (reach)	High	
Eco-Region Level II	11_2	
Geozone	D	
Gauging weirs	None	

HABITAT AND BIOTA

- Incised deep pools with small sections of riffle habitat, SIC, SOOC
- Aquatic macroinvertebrates: ASPT: 6.4 (moderately tolerant taxa)
- Fish habitat: Poor representivity of diverse habitats limited to deep pools hampering sampling effort

WATER QUALITY

- pH 8.9; DO 9.8 mg/l, EC:11 ms/m

SITE AND UPSTREAM IMPACTS

- Historical quarry upstream
- Cultivation
- Water abstraction
- Grazing
- Agricultural activities
- Collapsed banks and erosion

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

E4: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	-	Deep pools Collapsed banks
Macroinvertebrates	4	Suitable habitat availability, SIC dominated the overall sample	Deep pools resulting in inaccessibility Collapsed banks
Riparian vegetation / Habitat Integrity	4	Representative of the reach	Collapsed banks and erosion Cattle grazing and trampling

** Confidence scores: 0 = no confidence; 5 = high confidence*

E4: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical data Present survey
Macroinvertebrates						Historical data Present survey
Riparian vegetation						Present survey
Physico-chemical						Present survey

** 0 (no information) to 4 (large amount of data available)*

E4: OVERALL ASSESSMENT

The site is located on the Langspruit upstream with the confluence of the Grootspruit where it forms with Steelpoort River.The catchment is dominated by cultivation, agricultural activities and the historic quarry upstream.

RECOMMENDATIONS

- This site must be continually monitored from a biological perspective in order to gain information for the RQO's

- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Full chemical, microbial and *in situ* water quality is to be sampled quarterly

3.2.6 SITE E5: MASALA

SITE	DETAILS	VIEW
Site	E5	
River	Masala	
Quaternary Catchment	B41C	
Co-ordinates	-25, 109525 29.899051	
Ecoregion	Eastern Bankenveld (9)	
IUA	6	
SQ Reach	B41C-00766	
IEI Rating	2	
WRUI Rating	3	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	9.3	
Geozone	D	
Gauging weirs	None	

HABITAT AND BIOTA

- Limited roots, cobbles (mostly bedrock) observed. Some marginal vegetation.
- Aquatic macroinvertebrates: ASPT: 5.7 (moderately tolerant taxa)
- Fish Habitat: Good
- *M. salmoides* introduced at site

WATER QUALITY

- pH 8.72; DO 5.91 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- Mining activities
- Agricultural activities
- Dry land cultivation
- Informal settlements
- Stream diversions and modifications

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

E5: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Most biotopes present	Bedrock waterfalls Site located at a lodge resulting in recreational activities at the site potential impacting the site Introduction of MSAL into the river
Macroinvertebrates	4	Most biotopes present	Bedrock waterfalls Site located at a lodge resulting in recreational activities at the site potential impacting the site
Riparian vegetation / Habitat Integrity	4	Fair condition due to the site being in private property	Lodge developments are encroaching into the riparian zone

* *Confidence scores: 0 = no confidence; 5 = high confidence*

E5: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical data available Present survey
Macroinvertebrates						Historical data available Present survey
Riparian vegetation						No VEGRAI available Present survey
Physico-chemical						Present survey

** 0 (no information) to 4 (large amount of data available)*

E5: OVERALL ASSESSMENT

The site is located on the Masala River adjacent to a private lodge upstream of De Hoop Dam and the confluence of the Steelpoort River. Upstream impacts include open cast mining, agricultural activities, cultivation and grazing, influx of people in informal settlements. Introduced MSAL into the river for recreational purposes and local food source may lead to a threat to the system. Furthermore, illegal gill netting of fish in the upstream De Hoop Dam should be monitored. The general habitat degradation and erosion is relatively severe. The poor in situ water quality was influenced by the low flow conditions.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and *in situ* water quality should be conducted on a quarterly basis
- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Metal accumulation within the fish species to ensure that it is safe for human consumption
- RQO’s to be implemented

3.2.7 SITE E7: KLIP

SITE	DETAILS	VIEW
Site	E7	
River	Klip	
Quaternary Catchment	B41F	
Co-ordinates	-24,984961, 29.988771	
Ecoregion	Eastern Bankenveld (9)	
IUA	6	
SQ Reach	B41F-00699	
IEI Rating	4	
WRUI Rating	2	
Survey type	Biological	
PES 2013 (reach)	B	
EI_ES 2013 (reach)	High	
Eco-Region Level II	9.3	
Geozone	D	
Gauging weirs	None	

HABITAT AND BIOTA

- Cobble/boulders and bedrock with pool observed. Sand in stream with no marginal vegetation. Aquatic macroinvertebrates: ASPT: 6.6 (moderately tolerant taxa)
- Fish Habitat: Good however, no fish recorded during the survey although only approximately 4 expected fish species would occur at this site

WATER QUALITY

- pH 8.4; DO 6.08 mg/l, EC: 128 ms/m

SITE AND UPSTREAM IMPACTS

- Very low flows
- Silt higher than expected
- Some algae
- Detritus
- According to local information the DWS noted severe pollution from the mines during construction of Lake De Hoop.

- Off channel dams to pump and purify were constructed but not active after closure of the Mapochs Mine.
- Agricultural activities and extensive cattle grazing
- Cultivation
- Informal settlements

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

E7: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Good habitat availability	Low flow conditions Poor water quality
Macroinvertebrates	4	Good habitat availability	Low flow conditions Poor water quality
Riparian vegetation / Habitat Integrity	4	Inaccessibility due to the locality of the site due to mountainous terrain	Cattle grazing Trampling

** Confidence scores: 0 = no confidence; 5 = high confidence*

E7: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Present survey
Macroinvertebrates						Present survey
Riparian vegetation						Present survey
Physico-chemical						Present survey

** 0 (no information) to 4 (large amount of data available)*

E7: OVERALL ASSESSMENT

The site is located in the lower Klip River prior to the De Hoop Dam. The lower Klip River enters into the impoundment thus having potential impacts on the fish diversity within this river reach. Upstream impacts include agricultural activities including grazing and cultivation and adjacent minimal informal settlements.

The site is located within a mountainous terrain and thus the site is inaccessible therefore this river reach can be well managed. As the site is in between the Masala and Groot Dwars River with severe mining activities currently happening, this river reach is an important biodiversity refugia. From a water quality perspective, this is an important site owing to the site constantly routing water to the De Hoop Dam contributing to a dilution effect.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and *in situ* water quality should be conducted on a quarterly basis
- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Continual management to protect the ecological status of this river reach, especially the management of the larger landscape due to the steepness of the site with the aim to avoid further erosion and trampling from local agricultural activities.

3.2.8 SITE H7: DWARS

SITE	DETAILS	VIEW
Site	H7	
River	Dwars	
Quaternary Catchment	B41H	
Co-ordinates	-24,843539, 30.091469	
Ecoregion	Eastern Bankenveld (9)	
IUA	6	
SQ Reach	B41H-00640	
IEI Rating	2	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (reach)	D	
EI_ES 2013 (reach)	High	
Eco-Region Level II	9_3	
Geozone	D	
Gauging weirs	None	

HABITAT AND BIOTA

- Aquatic macroinvertebrates: ASPT: 6.5 (moderately tolerant taxa)
- Fish Habitat: Fair

WATER QUALITY

- pH 8.4; EC: 697 ms/m; DO 8.49 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- Silt
- Agricultural activities
- Impacts from grazing
- Wood harvesting (wood crafters)
- Mining activities
- Exposed soils

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

H7: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Good habitat availability and in a fair to good condition	Poor water quality Nutrient pollution Upstream catchment habitat modification due to grazing and trampling
Macroinvertebrates	4	Good habitat availability and in a fair to good condition	Poor water quality Nutrient pollution Upstream catchment habitat modification due to grazing and trampling
Riparian vegetation / Habitat Integrity	4	Good habitat availability and in a fair to good condition	Local wood harvesting

** Confidence scores: 0 = no confidence; 5 = high confidence*

H7: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Lion Extrata Smelter on-going monitoring programme as part of their water use license conditions Historical data Present survey
Macroinvertebrates						Lion Extrata Smelter on-going monitoring programme as part of their water use license conditions Historical data Present survey
Riparian vegetation						Historical data

						Present survey
Physico-chemical						Lion Extrata Smelter on-going monitoring programme as part of their water use license conditions Historical data Present survey

** 0 (no information) to 4 (large amount of data available)*

H7: OVERALL ASSESSMENT

The site is located in the Dwars, upstream of the confluence of the Steelpoort River. Upstream impacts from mining activities, informal settlements and agricultural activities is contributing to the degraded status of the water quality and riparian habitat integrity at this site. It is important that this site is continually monitored before it enters into the Steelpoort River. Reason being is that there is high pressure and increasing impacts on this system owing to further planned mining developments within the catchment and the Dwars River is an important refugia for juvenile fish species (e.g. BMAR).

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and *in situ* water quality should be conducted on a quarterly basis
- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Continual management to protect the ecological status of this river reach, due to the river being an important refugia for the above mentioned fish species and planned upstream mining activities.

3.2.9 SITE X1: STEENKOOLSPRUIT

SITE	DETAILS	VIEW
Site	X1	
River	Steenkoolspruit	
Quaternary Catchment	B11C	
Co-ordinates	-26,1928.78; 29,1827.39	
Ecoregion	Highveld (11)	
IUA	1	
SQ Reach	B11C-01449	
IEI Rating	2	
WRUI Rating	2	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	Moderate	
Eco-Region Level II	11_2	
Geozone	E	
Gauging weirs	B1H017	

HABITAT AND BIOTA

- Site located high up in the catchment
- Limited instream macrophytes and little overhanging vegetation. Pools
- Aquatic macroinvertebrates: ASPT: 4.5 (tolerant taxa)
- Fish Habitat: Poor
- Depth 10mm-500mm for fish.

WATER QUALITY

- pH pH 8.4; EC 89 mS/m; DO 5.63 mg/l

SITE AND UPSTREAM IMPACTS

- No flow
- Small dams

- High silt and algae observed.
- Mining
- Cultivation
- Trampling by cattle
- Erosion.
- High exotic invasive trees observed.
- Low gradient, deeply incised homogenous system.

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

X1: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Represents the system in the specific reach high up in the catchment Limited erosion Close to natural conditions owing to private land and conservation activities occurring	Homogenous nature of the river reach from a habitat perspective Stagnant pools and marginal veg
Macroinvertebrates	4	Represents the system in the specific reach high up in the catchment Limited erosion Close to natural conditions owing to private land and conservation activities occurring	Low Integrated Habitat Assessment System (IHAS) score due to the homogenous nature of the river reach Stagnant pools, marginal veg and GSM

* *Confidence scores: 0 = no confidence; 5 = high confidence*

X1: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Present survey
Macroinvertebrates						Present survey
Riparian vegetation						Present survey

Physico-chemical						Historical data available from DWS Chemical monitoring programme B1H017Q01

** 0 (no information) to 4 (large amount of data available)*

X1: OVERALL ASSESSMENT

This is a new biological site following the gap analysis. Impacts and inputs into the larger system has resulted in poor water quality, bed modification and erosion.

RECOMMENDATIONS

- Assess compliance to the conditions of the water use license criteria from surrounding land uses (current mining activities to the west of the sample site)
- The site should be monitored to understand the health of the system and ensure the trajectory of change over time
- The instream monitoring should be in collaboration with the adjacent land use/s allocated water use license compliance monitoring program.

3.2.10 SITE X2: DWARS-IN-DIE-WEGSPRUIT

SITE	DETAILS	VIEW
Site	X2	
River	Dwars-in-die-wegspruit	
Quaternary Catchment	B11D	
Co-ordinates	-26,2040.27; 29,1244.90	
Ecoregion	Highveld (11)	
IUA	1	
SQ Reach	B11D-01467	
IEI Rating	2	
WRUI Rating	2	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	Moderate	
Eco-Region Level II	11_5	
Geozone	E	
Gauging weirs	None	

HABITAT AND BIOTA

- Some stones in current if there is flow downstream of bridge and pools

WATER QUALITY

- pH 8.2; EC 85 mS/m; DO 5.49 mg/l

SITE AND UPSTREAM IMPACTS

- Water discoloured with organic sheen on surface.
- No flow
- Upstream Rietfontein dam
- Deeply incised channel.
- Dumping of solid waste (household) observed.
- Steep banks

- Potential excavation activities.
- Cultivation
- Cattle trampling
- Erosion
- Mining
- Two power stations are located in close proximity (6-10km)

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

X2:Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	N/A	Not sampled due to deep pools	
Macroinvertebrates			

* *Confidence scores: 0 = no confidence; 5 = high confidence*

X2: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						No historical data Present survey not conducted
Macroinvertebrates						
Riparian vegetation						No historical data Present survey not conducted
Physico-chemical						No historical data

** 0 (no information) to 4 (large amount of data available)*

X2: OVERALL ASSESSMENT

This is a new biological site following the gap analysis. However, although this site is not a good biological site, it is an important site for water quality.

RECOMMENDATIONS

- As the site was characterised by a deep pool, it hampered sampling effort and thus fish and aquatic macroinvertebrates could not be sampled. It is thus advised that this site is not surveyed owing to the poor site characteristics.
- Chemical and *in situ* water quality is to be sampled quarterly.

- The instream monitoring should be in collaboration with the adjacent land use/s allocated water use license compliance monitoring program (i.e. current mining activities to the west of the sample site).

3.2.11 SITE X3: STEENKOOLSPRUIT

SITE	DETAILS	VIEW
Site	X3	
River	Steenkoolspruit	
Quaternary Catchment	B11D	
Co-ordinates	-26,1608.94; 29,1417.73	
Ecoregion	Highveld (11)	
IUA	1	
SQ Reach	B11D-01366	
IEI Rating	2	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (reach)	D	
EI_ES 2013 (reach)	Moderate	
Eco-Region Level II	11_2	
Geozone	F	
Gauging weirs	B1H017	

HABITAT AND BIOTA

- Fish Habitat: Poor

WATER QUALITY

- pH 8.7; EC 35 mS/m; DO 6.56 mg/l

SITE AND UPSTREAM IMPACTS

- Mining
- Cattle
- Cultivation
- Site is located close to Kriel Power station.
- Informal settlement near site.
- Solid waste and faecal matter present.
- Erosion
- Incised channel

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

X3: site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	N/A	Not sampled due to deep pools	
Macroinvertebrates		N/A	

* *Confidence scores: 0 = no confidence; 5 = high confidence*

X3: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						No historical data Present survey not conducted
Macroinvertebrates						No historical data Present survey not conducted
Riparian Vegetation						No historical data Present survey not conducted
Physico-chemical						Historic data

** 0 (no information) to 4 (large amount of data available)*

X3: OVERALL ASSESSMENT

This is a new biological site following the gap analysis. The site was not surveyed due to deep pools and raw sewage. A different site within the reach should be identified to sample the biological components as the site visited was inadequate. This site will however provide a cumulative perspective of the Steenkoolspruit and Dwars-In-Die-Wegspruit as an input into the larger Witbank Catchment, as current no biological data is available for this upper part of the catchment.

RECOMMENDATIONS

- As the site was characterised by a deep pool and raw sewage, it hampered sampling effort and thus fish and aquatic macroinvertebrates could not be sampled.
- A different site should be identified to sample fish and macroinvertebrates.
- Chemical and *in situ* water quality is to be sampled quarterly.

- The instream monitoring should be in collaboration with the adjacent land use/s allocated water use license compliance monitoring program (i.e. current and proposed future mining and power generation activities in the area).

3.2.12 SITE X5: OLIFANTS

SITE	DETAILS	VIEW
Site	X5	
River	Olifants	
Quaternary Catchment	B11L	
Co-ordinates	-25,3550.23; 29,1227.42	
Ecoregion	Eastern Bankenveld (9)	
IUA	1	
SQ Reach	B11L-01024	
IEI Rating	3	
WRUI Rating	3	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	Very High	
Eco-Region Level II	9_6	
Geozone	E	
Gauging weirs	None	

HABITAT AND BIOTA

- Pool, cobbles, boulders present. Good rootwads present.
- Aquatic macroinvertebrates: ASPT: 5.1 (tolerant taxa)
- Fish Habitat: Fair
- Depth of 50-600mm for fish, 20min
-

WATER QUALITY

- pH 8.9; EC 87 mS/m; DO 7.85 mg/l

SITE AND UPSTREAM IMPACTS

- High algae observed.
- Encroachment of alien vegetation on bank and in water (macrophytes).
- Organic odour present.

- Sediments resulted in embeddedness of cobbles.

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

Important site below the Klipspruit and the Klein Olifants river confluences. It captures the impact and inputs into the system of the upper Olifants catchment area.

X5: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Good site, representative of all biotopes. Located in a well protected area thus excludes external drivers.	Water quality and high algal impact. Low flows limits biotope diversity (due to current flow regime).
Macroinvertebrates	4	In normal flow conditions all biotopes present representing reach diversity.	Low flow exposed biotopes, SIC, root wads and marginal vegetation.
Riparian vegetation / Habitat Integrity	2	Good site for riparian vegetation and fair for habitat integrity.	Some alien invasive present.

* *Confidence scores: 0 = no confidence; 5 = high confidence*

X5: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historic information, old river health programme site.
Macroinvertebrates						Historic information, old river health programme site.
Riparian vegetation						Historic site (1999)
Physico-chemical						No available information

** 0 (no information) to 4 (large amount of data available)*

X5: OVERALL ASSESSMENT

The site is well located on the Olifants River below the confluences of the Klein Olifants and Klipspruit but above the Wilge confluence. The site provides a sufficient habitat diversity for the REMP protocols.

It also captures the upstream perspective of the upper Olifants catchment area. The SASS score was low and that was driven by water quality and lack of diversity of habitat (due to low flows) present during this survey.

RECOMMENDATIONS

- Fish and macroinvertebrates should be sampled regularly.
- Full chemical and *in situ* water quality is to be sampled quarterly.
- Diatom sampling should be undertaken quarterly.

3.2.13 SITE X6: KLEIN OLIFANTS

SITE	DETAILS	VIEW
Site	X6	
River	Klein Olifants	
Quaternary Catchment	B12B	
Co-ordinates	-25,5305.62; 29,3758.39	
Ecoregion	Highveld (11)	
IUA	1	
SQ Reach	B12B-01192	
IEI Rating	2	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (reach)	D	
EI_ES 2013 (reach)	Moderate	
Eco-Region Level II	11_2	
Geozone	E	
Gauging weirs	B1H026	

HABITAT AND BIOTA

- Aquatic macroinvertebrates: ASPT: 4.7 (tolerant taxa)
- Fish Habitat: Poor

WATER QUALITY

- pH 8.9; EC 260 mS/m; DO 6.63 mg/l

SITE AND UPSTREAM IMPACTS

- Algae high and sediment observed.
- River had strong odour and faecal smell.
- Informal settlements located in close proximity of site.
- Cultivation centre pivots in area and cattle grazing and trampling observed.
- Two pump houses for extraction are observed close to site.

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

X6: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Represents the area	Land use impacts (agricultural and mining activities, dams and abstraction activities upstream) Low flow (also due to abstraction activities) Slight siltation
Macroinvertebrates	4		

** Confidence scores: 0 = no confidence; 5 = high confidence*

X6: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical surveys Present survey
Macroinvertebrates						Historical surveys Present survey
Physico-chemical						Historic data, DWS Chemical monitoring programme, downstream site B1H012Q01

** 0 (no information) to 4 (large amount of data available)*

X6: OVERALL ASSESSMENT

The site is located on the Klein-Olifants River upstream of Middleburg Dam. The site provided a good representation of the reach from a habitat perspective. Cumulative impacts from the surrounding land use will be picked up within this reach prior to entering Middleburg Dam. The SASS score was low but represented the present habitat. Poor water quality.

RECOMMENDATIONS

- As site X6 and X7 are in close proximity to each other, and site X7 is located in the upper reaches of Middleburg dam, it is recommended that a new site be selected on the Klein-Olifants to replace the two sites (X6 and X7) and provide a combined overview of upstream impacts from Klein-Olifants, Coetzerspruit, Bosmanspruit, Rietkuilsprit and Woes-Alleenspruit. This new site is proposed to be located at site co-ordinates -25.836943, 29.608087.

- Fish and macroinvertebrates should be sampled regularly.
- Full chemical and *in situ* water quality is to be sampled quarterly.
- Diatom sampling should be undertaken quarterly.

3.2.14 SITE X7: KLEIN OLIFANTS

SITE	DETAILS	VIEW
Site	X7	
River	Klein Olifants	
Quaternary Catchment	B12C	
Co-ordinates	-25,4903.25; 29,3525.98	
Ecoregion	Highveld (11)	
IUA	1	
SQ Reach	B12C-01153	
IEI Rating	2	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	Moderate	
Eco-Region Level II	11_2	
Geozone	E	
Gauging weirs	B1H012	

HABITAT AND BIOTA

- Fish and aquatic macroinvertebrates not surveyed owing to the upstream construction activities and no flow conditions

WATER QUALITY

- pH 8.8; EC 240 mS/m; DO 5.70 mg/l
- Water quality impacts noted

SITE AND UPSTREAM IMPACTS

- River reach was dry
- Bridge construction nearby.
- Grazing cultivation
- Solid waste.

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

X7: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	Not applicable as site was dry and fish and macroinvertebrates could not be surveyed		
Macroinvertebrates			

** Confidence scores: 0 = no confidence; 5 = high confidence*

X7: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical data upstream from the site
Macroinvertebrates						Historical data
Physico-chemical						Historic data, DWS Chemical monitoring programme, downstream site B1H012Q01

** 0 (no information) to 4 (large amount of data available)*

X7: OVERALL ASSESSMENT

The site is located on the Klein-Olifants River upstream of Middleburg Dam. The site provided a good representation of the reach from a habitat perspective. Cumulative impacts from the surrounding land use will be picked up within this reach prior to entering Middleburg Dam. The SASS score was low but represented the present habitat. Poor habitat diversity as a result of construction activities widening the N4. Poor water quality primarily owing to the adjacent construction activities which also lead to daming up of the system at this monitoring point.

RECOMMENDATIONS

- As above "*site X6 and X7 are in close proximity to each other, and site X7 is located in the upper reaches of Middleburg dam, it is recommended that a new site be selected on the Klein-Olifants to replace the two sites (X6 and X7) and provide a combined overview of upstream impacts from Klein-Olifants, Coetzerspruit, Bosmanspruit, Rietkuilsprit and Woes-Alleenspruit. This new site is proposed to be located at site co-ordinates -25.836943, 29.608087.*

3.2.15 SITE X10: ELANDS

SITE	DETAILS	VIEW
Site	X10	
River	Elands	
Quaternary Catchment	B31A	
Co-ordinates	-25,3430.04; 28,3435.79	
Ecoregion	Eastern Bankenveld (9)	
IUA	4	
SQ Reach	B31A-00963	
IEI Rating	3	
WRUI Rating	3	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	Very High	
Eco-Region Level II	9_3	
Geozone	D	
Gauging weirs	None	

HABITAT AND BIOTA

- Low flow velocities
- Fish Habitat: Good

WATER QUALITY

- pH 8.6; EC 25 mS/m; DO 6.85 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flow
- Substrate has fine silt.
- Detritus build up noted - linked to canopy cover.
- Upstream flow modifications
- Abstraction
- Weirs present

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined. **No macroinvertebrates were sampled due to the low flow. However, this site is regularly sampled for Gauteng's accreditation.**

X10: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Habitat diversity is representative of the reach	Poor water quality owing to upstream agricultural and abstraction activities Very low flow during the survey
Macroinvertebrates	Not applicable		

** Confidence scores: 0 = no confidence; 5 = high confidence*

X10: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical data for the river reach Present survey
Macroinvertebrates						Historical data from Gauteng SASS5 accreditation
Physico-chemical						Historic data, DWS Chemical monitoring programme, downstream site below dam B3H013Q01

** 0 (no information) to 4 (large amount of data available)*

X10: OVERALL ASSESSMENT The site is located on the Elands River high up in the catchment. Habitat diversity is representative of the reach. Poor water quality and abstraction is evident. However, impacts along the Elands River will be evaluated at site S1 upstream of Rust de winter Dam. **RECOMMENDATIONS** • Full chemical and *in situ* water quality is to be sampled quarterly. • Diatom sampling should be undertaken quarterly.

3.2.16 SITE X17: GROOT DWARS

SITE	DETAILS	VIEW
Site	X17	
River	Groot Dwars	
Quaternary Catchment	B41G	
Co-ordinates	-25,094453, 30.122450	
Ecoregion	Eastern Bankenveld (9)	
IUA	6	
SQ Reach	B41G-00721	
IEI Rating	3	
WRUI Rating	2	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	9_3	
Geozone	D	
Gauging weirs	B4H009	

HABITAT AND BIOTA

- Pool, cobbles, boulders present.
- Aquatic macroinvertebrates: ASPT: 6.2 (moderately tolerant taxa)
- Fish Habitat: Good but no fish recorded

WATER QUALITY

- pH 8.4; EC:120 ms/m; DO 6.52 mg/l

SITE AND UPSTREAM IMPACTS

- Extensive mining activities
- Grazing and cultivation activities

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

X17: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Suitable habitat availability	Poor water quality
Macroinvertebrates	4	Suitable habitat availability	Poor water quality
Riparian vegetation / Habitat Integrity	4	Representative of the reach	Poor planning of infrastructure (i.e roads and bridges) Upstream erosion Historical over grazing

** Confidence scores: 0 = no confidence; 5 = high confidence*

X17: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish					■	Continual monitoring programme Historical data Present survey
Macroinvertebrates					■	Continual monitoring programme Historical data Present survey
Riparian vegetation		■				Present survey
Physico-chemical					■	Continual monitoring programme Historical data Present survey

** 0 (no information) to 4 (large amount of data available)*

X17: OVERALL ASSESSMENT

The site is located in the Groot Dwars River upstream of the Der Brochen Dam. The site provided a good representation of the reach from a habitat perspective. Cumulative impacts from upstream agricultural and mining activities resulting in poor water quality at this site.

RECOMMENDATIONS

- REMP protocols to be conducted

- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Full chemical and *in situ* water quality is to be sampled quarterly.

3.2.17 SITE X18 AND H3: STEELPOORT

SITE	DETAILS	VIEW
Site	X18 and H3	
River	Steelpoort	
Quaternary Catchment	B41H	
Co-ordinates	-24,894400, 30.017083	
Ecoregion	Eastern Bankenveld (9)	
IUA	6	
SQ Reach	B41H-00610	
IEI Rating	2	
WRUI Rating	3	
Survey type	Biological	
PES 2013 (reach)	D	
EI_ES 2013 (reach)	High	
Eco-Region Level II	9_3	
Geozone	E	
Gauging weirs	B4H023	

HABITAT AND BIOTA

- Aquatic macroinvertebrates: ASPT: 5.7 (moderately tolerant taxa)
- Fish Habitat: Fair

WATER QUALITY

- pH 8.4; EC: 318 ms/m; DO 8.93 mg/l

SITE AND UPSTREAM IMPACTS

- Low/moderate flow present.
- Releases are made from De Hoop Dam
- Water abstraction present (use by construction vehicles and local communities for drinking)
- High cultivation upstream
- Informal settlements
- Erosion

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

X18 and H3: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Suitable habitat biotopes	Poor water quality (lower water temperatures and silt loads) Continual bottom releases from the De Hoop Dam
Macroinvertebrates	4	Suitable habitat biotopes	Poor water quality (lower water temperatures and silt loads) Continual bottom releases from the De Hoop Dam
Riparian vegetation / Habitat Integrity	4	-	Modified Infrastructural development within the riparian zone Agricultural activities encroaching the riparian zone Trampling Over grazing

** Confidence scores: 0 = no confidence; 5 = high confidence*

X18 and H3: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Lion Extrata Smelter on-going monitoring programme as part of their water use license conditions Historical data RHP monitoring site Present survey
Macroinvertebrates						Lion Extrata Smelter on-going monitoring programme as part of their water use license conditions

						Historical data RHP monitoring site Present survey
Riparian vegetation						Historical data RHP monitoring site Present survey
Physico-chemical						Lion Extrata Smelter on-going monitoring programme as part of their water use license conditions Historical data RHP monitoring site Present survey

** 0 (no information) to 4 (large amount of data available)*

X18: OVERALL ASSESSMENT

The site is located on the main stem of the Steelpoort River downstream of the De Hoop Dam. As the De Hoop Dam do bottom releases, this has an impact on the water quality of this river reach. Furthermore, bottom releases from the dam are resulting in temperature changes and increased silt loads downstream impacting fish and macroinvertebrate communities. Over time, this change in the temperature within the river reach can change the fish communities in the future. Further upstream impacts includes mining and agricultural activities and upstream erosion and high influx of people at informal settlements. Due to the dam being newly constructed coupled with its bottom releases and associated impacts, it is important to monitor this site on a continual basis.

RECOMMENDATIONS

- REMP protocols to be conducted
- Fish and macroinvertebrates should be sampled annually towards the end of the wet season and dry season.
- Full chemical, microbial and *in situ* water quality is to be sampled quarterly, taken careful note of temperature fluctuations.
- Turbidity should be monitored (owing to the silt loads from the dam)

3.2.18 SITE X19: MOHLAPITSE

SITE	DETAILS	VIEW
Site	X19	
River	Mohlapitse	
Quaternary Catchment	B71C	
Co-ordinates	-24,104101, 30.118140	
Ecoregion	Eastern Bankenveld (9)	
IUA	10	
SQ Reach	B71C-00292	
IEI Rating	4	
WRUI Rating	2	
Survey type	Biological	
PES 2013 (reach)	B	
EI_ES 2013 (reach)	High	
Eco-Region Level II	9_2	
Geozone	D	
Gauging weirs	B7H013	

HABITAT AND BIOTA

- Pooled SASS sample however difficult to see biotopes.
- Aquatic macroinvertebrates: ASPT: 7.3 (moderately tolerant taxa)
- Fish Habitat: Poor

WATER QUALITY

- pH 8.4; EC: 350 ms/m; DO 5.79 mg/l

SITE AND UPSTREAM IMPACTS

- Low flow
- High silt present following rain
- Wood harvesting
- Cattle grazing

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

X19: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	All biotopes present Downstream of a nature reserve	Limited flow conditions Siltation due to recent rains
Macroinvertebrates	4	All biotopes present Downstream of a nature reserve	Limited flow conditions Siltation due to recent rains
Riparian vegetation / Habitat Integrity	4	Habitat was good Downstream of a nature reserve	Siltation due to recent rains

** Confidence scores: 0 = no confidence; 5 = high confidence*

X19: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical information (upstream from this site)\ Present survey
Macroinvertebrates						Historical information (upstream from this site)\ Present survey
Riparian vegetation						Present survey
Physico-chemical						Present survey

** 0 (no information) to 4 (large amount of data available)*

X19: OVERALL ASSESSMENT

The site is located on the Mahlapitse River downstream of the Wolkberg Wilderness Trail and Lekgalameetse Nature Reserve. Consequently, water quality was relatively good, despite the silt loads however, this may have been caused from the recent rains. This is an important biodiversity site due to the expected *Aplocheilichthys katagae* (AKAT) and*Barbus bifrenatus* (BBIF) whose have isolated and limited ranges. Therefore, thus the mountainous terrain is a critical habitat characteristic for them.

RECOMMENDATIONS

- Full REMP protocol

- Fish and macroinvertebrates should be sampled annually towards the end of the wet season and dry season.
- *In situ* water quality is to be sampled quarterly.

3.2.19 SITE X20: MOHLAPITSE

SITE	DETAILS	VIEW
Site	X20	
River	Mohlapitse	
Quaternary Catchment	B71D	
Co-ordinates	-24,236967, 30.076572	
Ecoregion	Eastern Bankenveld (9)	
IUA	10	
SQ Reach (upstream)	B71C-00292	
IEI Rating	2	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (upstream reach)	B	
EI_ES 2013 (upstream reach)	High	
Eco-Region Level II	9_3	
Geozone	E	
Gauging weirs	None	

HABITAT AND BIOTA

- Aquatic macroinvertebrates: ASPT: 6.0 (moderately tolerant taxa)
- Fish Habitat: Good

WATER QUALITY

- pH 8.6; EC 34 mS/m; DO 8.42 mg/l

SITE AND UPSTREAM IMPACTS

- Low flow observed.
- Invasive vegetation within the riparian zone.
- High sedimentation.
- Water had a blue soapy feel and look to it.
- Agricultural activities
- Cattle grazing

- Cultivation

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

X20: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Good habitat availability (cobbles and riffles)	Limited instream vegetation
Macroinvertebrates	4	Good habitat availability (cobbles and riffles)	Limited instream vegetation
Riparian vegetation / Habitat Integrity	4	Indigenous vegetation fairly well intact	Cattle trampling Wood harvesting Erosion

** Confidence scores: 0 = no confidence; 5 = high confidence*

X20: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical data Present survey
Macroinvertebrates						Historical data Present survey
Riparian vegetation						Present survey
Physico-chemical						Present survey

** 0 (no information) to 4 (large amount of data available)*

X20: OVERALL ASSESSMENT

The site is located on the Mohlapiste upstream from the confluence of the Olifants River (Site S10). Upstream impacts include agricultural activities, cultivation and cattle grazing and trampling.

RECOMMENDATIONS

- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Full chemical, microbial and *in situ* water quality is to be sampled quarterly (based on the observed water having a cloudy blue colour at the time of the survey).

3.2.20 SITE X21: MOTSE

SITE	DETAILS	VIEW
Site	X21	
River	Motse	
Quaternary Catchment	B71E	
Co-ordinates	-24,314487, 30.173174	
Ecoregion	Eastern Bankenveld (9)	
IUA	10	
SQ Reach	B71E-00429	
IEI Rating	1	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (reach)	E	
EI_ES 2013 (reach)	Low	
Eco-Region Level II	9.3	
Geozone	E	
Gauging weirs	None	

HABITAT AND BIOTA

- Little cobble present, mostly sand and no marginal vegetation.
- Aquatic macroinvertebrates: ASPT: 6.0 (moderately tolerant taxa) as only GSM was sampled due to no other biotopes present. Therefore the ASPT is not a good indication of the aquatic macroinvertebrate community and tolerance thereof owing to the low number of taxa observed.
- Fish Habitat: Poor. Fish could not be sampled owing to very low water levels

WATER QUALITY

- pH 8.5; EC: 30 ms/s; DO 5.84 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows, mostly ephemeral
- Water discoloured green with some siltpresent.
- Informal settlement
- Grazing and trampling

- Cultivation
- Wood harvesting

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

X21: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	-	Lack of biotope diversity. No SIC or SOOC No marginal vegetation
Macroinvertebrates	4	-	Lack of biotope diversity. No SIC or SOOC No marginal vegetation
Riparian vegetation / Habitat Integrity	4	-	Severely modified Sand mining within the river bed

** Confidence scores: 0 = no confidence; 5 = high confidence*

X21: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Present survey
Macroinvertebrates						Present survey
Riparian vegetation						Present survey
Physico-chemical						Present survey

** 0 (no information) to 4 (large amount of data available)*

X21: OVERALL ASSESSMENT

The site is located on the Motse river just upstream with the confluence of the Olifnts River. This site represents all upstream impacts and influences associated with the Motse River. Consequently, this is an important site for monitoring purposes and thus an ongoing monitoring programme is essential for this river reach. Two upstream tributaries, namely the Moopeptsi and Mabogwane rivers, both drain extensive settlements, grazing cultivation and mining activities resulting in high silt loads and poor sanitation (i.e. sewage from human and cattle). The site is not important from an ecological perspective but rather from the influence it has on the Olifants River system in terms of water quality and siltation (concentrated silt and microbial issues).

RECOMMENDATIONS

- Full chemical, microbial and *in situ* water quality is to be sampled quarterly.

3.2.21 SITE X23: OLIFANTS

SITE	DETAILS	VIEW
Site	X23	 
River	Olifants	
Quaternary Catchment	B73J	
Co-ordinates	-23.98734, 31.828179	
Ecoregion	12_ Lebombo Upland	
IUA	12	
SQ Reach	B73J-00304	
IEI Rating	-	
WRUI Rating	2	
Survey type	Biological	
PES 2013 (reach)	System inundated and thus no assessment	
EI_ES 2013 (reach)	-	
Eco-Region Level II	12_1	
Geozone	E	
Gauging weirs	None	

HABITAT AND BIOTA

- Bedrock and cobbles and deep inaccessible pools.
- Aquatic macroinvertebrates: ASPT: 6.0 (moderately tolerant taxa)
- Fish Habitat: Fair and site is representative of the river reach

WATER QUALITY

- pH 9.3; EC 55 mS/m; DO 7.56 mg/l

SITE AND UPSTREAM IMPACTS

- Site is located within a protected area.
- Located within the gorge downstream of the Olifants and Letaba catchment
- Most downstream site of the greater catchment

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

X23: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Deep pools	Lack of diverse habitat types (within the gorge)
Macroinvertebrates	4	Presence of SIC	Deep pools Lack of diverse habitat types (within the gorge)
Riparian vegetation / Habitat Integrity	2	-	No riparian vegetation Steep marginal rock faces

** Confidence scores: 0 = no confidence; 5 = high confidence*

X23: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historic information Present survey
Macroinvertebrates						Historic information Present survey
Riparian vegetation						Historic site
Physico-chemical						Limited historic information

** 0 (no information) to 4 (large amount of data available)*

X23: OVERALL ASSESSMENT

The site is located downstream of the Olifants and Letaba confluence and is the most downstream site of the greater catchment. It is an important site as it is taking into account all cumulative impacts sourced from the Olifants and Leteba catchments. It is further located within a gorge in a protected reserve. The site is characterised by a lack of diverse habitat types and deep pools with sheer marginal rock faces.

RECOMMENDATIONS

- Aquatic macroinvertebrates should be sampled annually.

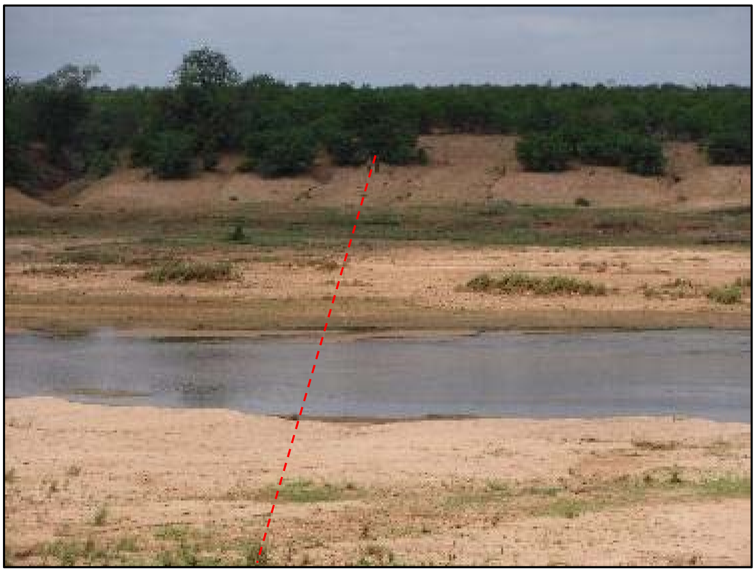
- Fish sampled every three years or should any changes or other indices are detected
- Full chemical and *in situ* water quality is to be sampled annually.
- Diatom sampling should be undertaken annually.

4 LETABA CATCHMENT: ECOLOGICAL STATUS - PRIORITY SITES

Please refer to Appendix D for the aquatic macroinvertebrate and fish inventories for each site

4.1 EWR SITES

4.1.1 SITE LET2: LETABA RIVER (DOWNSTREAM OLD LETEBA EWR7)

SITE	DETAILS	VIEW
Site	LET2 (EWR7a - Downstream old Letaba EWR7)	 
River	Letaba	
Quaternary Catchment	B83D	
Co-ordinates	23° 49' 36.5" S 31° 35' 26.2" E	
Ecoregion	3_Lowveld	
IUA	11	
SQ Reach	B83D-00255	
IEI Rating	3	
WRUI Rating	3	
Survey Type	Rapid 3	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_5	
Geozone	F	
Gauging weirs	B8H018	
Discharge	$0.53 m^3/s$	

HABITAT AND BIOTA

- Sand and gravel, limited marginal vegetation
- Aquatic macroinvertebrates: ASPT: 5.79 (tolerant taxa)
- Fish Habitat: poor (mainly SS and SD, low flow, homogeneous)

WATER QUALITY
• pH 9.0; EC 53 mS/m; DO 7.10 mg/l
SITE AND UPSTREAM IMPACTS • Very little upstream impacts • No invasive vegetation observed • Limited impacts from flow modifications • Some trampling by mega herbivores – increased erosion during the drought period • Some poor water quality related to anthropogenic impacts from outside the KNP

Let2: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	2	Straight section that is representative of the river. Easily accessible.	Sandy section that will change over time. The downstream pool will inundate the site and side channel will activate during high flows. The confidence in the results will be limited to lower flows
Fish	4	Within the protection of the KNP	Low flow, poor diversity of velocity-depth classes. Limited vegetation (instream and marginal) due to low flows.
Macroinvertebrates	4	Within the protection of the KNP	Low flow Limited vegetation (instream and marginal) due to low flows. Habitat dominated by sand and gravel bed, no SIC

** Confidence scores: 0 = no confidence; 5 = high confidence*

Let2: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Only 1 set of measured data available at the cross section Existing hydraulic information from the 2006 Letaba EWR7 site
Fish						Existing FROC Historical surveys (2006) Present survey
Macroinvertebrates						Existing MIRAI within the reach Historical surveys (2006) Present survey
Hydrology						Natural and present day monthly flows Gauging weir B8H018
Physico-chemical						Data available from water quality monitoring site B8H018Q01 downstream of site. Historic data, DWS Chemical monitoring programme

* 0 (no information) to 4 (large amount of data available)

Let2: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Labeobarbus marequensis, Enteromius (Barbus)paludinosus, Enteromius (Barbus)radiates, Enteromius (Barbus)toppini, Enteromius (Barbus)trimaculatus, Enteromius (Barbus)viviparous, Clarias gariepinus, Chiloglanis paratus, Glossogobius callidus, Glossogobius giuris, Hydrocynus vittatus, Labeo cylindricus, Labeo molybdinus, Micralestes acutidens, Mesobola brevianalis, Oreochromis mossambicus, Pseudocrenilabrus philander, Schilbe intermedius, Synodontis zambezensis, Tilapia rendalli, Chiloglanis pretoriae* Fish expected within the reach however with a low probability of being recorded: *Anguilla bengalensis, Anguilla marmorata, Anguilla mossambica,Brycinus imberi, Labeo rosae, Labeo ruddi, Marcusenius macrolepidotus, Petrocephalus wesselsi, Barbus unitaeniatus*
Macroinvertebrates	Turbellaria, Oligochaeta, Hirudinea, Potamonautidae, Atyidae, Paleomonidae, Hydracarina, Perlidae, Baetidae >2spp, Caenidae, Heptageniidae,

Let2: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
	Leptophlebiidae, Oligoneuridae, Polymitarcyidae, Prosopistomatidae, Trichorythidae, Calopterygidae, Chlorocyphidae, Chlorolestidae, Coenagrionidae, Lestidae, Platycnemidae, Protoneuridae, Aeshnidae, Corduliidae, Gomphidae, Libellulidae, Pyralidae, Belostomatidae, Corixidae, Gerridae, Hydrometridae, Naucoridae, Nepidae, Notonectidae, Pleidae, Veliidae, Dipseudopsidae, Ecnomidae, Hydropsychidae >2spp, Philopotamidae, Hydroptilidae, Leptoceridae, Dytiscidae, Elmidae, Gyrinidae, Haliplidae, Helodidae, Hydraenidae, Hydrophilidae, Psephenidae, Athericidae, Ceratopogonidae, Chironomidae, Culicidae, Dixidae, Empididae, Ephydridae, Muscidae, Simuliidae, Tabanidae, Tipulidae, Ancylidae, Bulinae, Lymnaeidae, Physidae, Planorbinae, Thiaridae, Corbiculidae, Sphaeridae and Unionidae

Let2: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	D (48.9)	F & NF	Very slow flow e.g. lack of velocity-depth classes Lack of habitat availability such as marginal vegetation (as a result of the low water level), SIC and substrate diversity
Macroinvertebrates	D (46.6)	F & NF	Very slow flow Flow modification Lack of habitat availability such as marginal vegetation (as a result of the low water level), SIC and substrate diversity
Habitat Integrity: Instream	D (42)	F & NF	Upstream impacts manifesting downstream at the site Directly related to drought conditions Limited available habitat
Habitat Integrity: Riparian	C (77)	F & NF	Flow modification (numerous upstream dams not releasing floods), exaggerated by drought conditions Trampling by wildlife, bank erosion and flood damage
ECOSTATUS	C/D (60.3)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

Let2: PES and causes	
Component	**Causes** **Present/Absent**
Fish	Most of the flow dependant species and deep water inhabitants were absent, related to very low flows currently experienced
Macroinvertebrates	Due to the low flow and limited access to available biotopes, only 12 of the expected 53 families (flow related) were present, 14 of the 62 families expected (habitat related) and 19 of the 53 families expected present when looking at those related to water as an indicator.

Let2: Overall change and reason for deviation				
COMPONENT	**PES 2006**	**PES 2013**	**PES 2016**	**REASON FOR DEVIATION**
ECOSTATUS	C	C	C/D	Low flows and flow modification resulting in exposed habitats. Poor water quality as a result of nutrient input owing to high algae blooms observed at the site

Let2: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 2006	**PES 2013**	**PES 2016**		
Fish	C	-	D	Very slow flow e.g. lack of velocity-depth classes Lack of habitat availability such as marginal vegetation (as a result of the low water level), SIC and substrate diversity	4
Macro-invertebrates	D	-	D	Very slow flow Flow modification Lack of habitat availability such as marginal vegetation (as a result of the low water level), SIC and substrate diversity	4

Let2: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
Habitat integrity: Instream	-	-	D	Upstream impacts manifesting downstream at the site Directly related to drought conditions Limited available habitat	4
Habitat integrity: Riparian	C *(VEGRAI)*	-	C	Flow modification (numerous upstream dams not releasing, irrigation), exaggerated by drought conditions Trampling by wildlife, bank erosion and flood damage	4
ECOSTATUS	C	C	C/D		

** 0 – no confidence to 5 – high confidence*

Let2: OVERALL ASSESSMENT

The site is located on the Letaba River in the Kruger National Park just upstream of Letaba Rest Camp and the Engelhard Dam/weir. Limited flow conditions owing to upstream impacts (numerous dams not releasing, irrigation) and drought conditions at the time of the survey. The habitat was dominated by sand and gravel beds and no SIC. Some impacts noted at the site include trampling by wild animals, bank erosion and flood damage. Adequate water quality.

RECOMMENDATIONS

- Owing to the proximity of this site, full comprehensive surveys should be conducted annually
- Stringent management measures as per KNP protocols for this reach should be adhered to
- Chemical and *in situ* water quality should be monitored quarterly
- Diatom samples should be taken minimum annually
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the low flow conditions
- Riparian VEGRAI should be conducted every 5 years
- The IHI should be conducted annually

4.1.2 SITE LET14: LETSITELE RIVER (UPSTREAM OLD EWR2 SITE)

SITE	DETAILS	VIEW
Site	LET14 (Upstream old Letaba EWR2)	
River	Letsitele	
Quaternary Catchment	B81D	
Co-ordinates	-23.893155 30.357356	
Ecoregion	3_Lowveld	
IUA	2	
SQ Reach	B81D-00271	
IEI Rating	3	
WRUI Rating	3	
Survey Type	Rapid 3	
PES 2013 (reach)	D	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_1	
Geozone	E	
Gauging weirs	B8H010	
Discharge	0.668m^3/s	

HABITAT AND BIOTA

- SIC, SOOC, cobbles and limited boulders and bedrock present
- Aquatic macroinvertebrates: ASPT: 5.4 (moderately tolerant taxa)
- Fish Habitat: Fairto good
- Moderate alien invasive vegetation (aquatic and terrestrial namely water Hyacinth, Kariba weeds)

WATER QUALITY

- pH 9.8; EC 20 mS/m; DO 4.44 mg/l

SITE AND UPSTREAM IMPACTS

- Large scale town developments and informal settlements
- Poor infrastructure planning
- Wood harvesting
- Over grazing and trampling
- Removal of riparian vegetation
- Cultivation and some commercial farming
- Water abstraction
- Forestry in the upper catchments
- Poor sanitation and sewerage treatment
- Alien invasive plants – aquatic and terrestrial

Let14: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	2	Straight section with an even slope Easily accessible	Upstream gauging weir may influence flows at the site The confidence in the results will be limited to lower flows
Fish	4	Good habitat diversity Variety of velocity-depth classes and substrate types	Poor water quality Upstream anthrogenic impacts
Macroinvertebrates	4	Good habitat diversity Variety substrate types	Poor water quality Upstream anthrogenic impacts

** Confidence scores: 0 = no confidence; 5 = high confidence*

Let14: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Existing hydraulic information from the 2006 Letaba EWR2 site One set of measured data for the cross section for the current survey (2016)
Fish						Historical surveys (2006) Present survey

Let14: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Macroinvertebrates						Historical surveys (2006) Present survey
Hydrology						Natural and present day monthly flow Gauging weir B8H010
Physico-chemical						Historic information, water quality site B8H010 DWS Chemical monitoring programme

* 0 (no information) to 4 (large amount of data available)

Let14: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Enteromius (Barbus) Eeutaenia, Labeobarbus marequensis, Enteromius (Barbus)paludinosus, Barbus Enteromius (Barbus)toppini, Enteromius (Barbus) trimaculatus, Enteromius (Barbus)unitaeniatus, Enteromius (Barbus)viviparous, Clarias gariepinus, Chiloglanis pretoriae, Labeo cylindricus, Labeo molybdinus, Micralestes acutidens, Mesobola brevianalis, Marcusenius macrolepidotus, Oreochromis mossambicus, Petrocephalus wesselsi, Pseudocrenilabrus philander, Tilapia rendalli, Tilapia sparrmanii*
Macroinvertebrates	Porifera, Coelenterata, Turbellaria, Oligochaeta, Hirudinea, Amphipoda, Potamonautidae, Atyidae, Paleomonidae, Hydracarina, Notonemouridae, Perlidae, Baetidae 1sp, Baetidae 2spp, Baetidae >2spp, Caenidae, Ephemeridae, Heptageniidae, Leptophlebiidae, Oligoneuridae, Polymitarcyidae, Prosopistomatidae, Telagonodidae, Trichorythidae, Calopterygidae, Chlorocyphidae, Chlorolestidae, Coenagrionidae, Lestidae, Platycnemidae, Protoneuridae, Aeshnidae, Corduliidae, Gomphidae, Libellulidae, Pyralidae, Belostomatidae, Corixidae, Gerridae, Hydrometridae, Naucoridae, Nepidae, Notonectidae, Pleidae, Veliidae, Corydalidae, Sialidae, Dipseudopsidae, Ecnomidae, Hydropsychidae 1sp, Hydropsychidae 2spp, Hydropsychidae >2spp, Philopotamidae, Polycentropodidae, Psychomyiidae, Barbarochthonidae, Calamoceratidae, Glossosomatidae, Hydroptilidae, Hydropsalpingidae, Lepidostomatidae, Leptoceridae, Petrothrincidae, Pisuliidae, Sericostomatidae, Dytiscidae, Elmidae, Gyrinidae, Haliplidae, Helodidae, Hydraenidae, Hydrophilidae, Limnichidae, Psephenidae, Athericidae, Blepharoceridae, Ceratopogonidae, Chironomidae, Culicidae, Dixidae, Empididae, Ephydridae, Muscidae, Psychodidae, Simuliidae, Syrphidae, Tabanidae, Tipulidae, Ancylidae, Bulinae, Hydrobiidae, Lymnaeidae, Physidae, Planorbinae, Thiaridae, Viviparidae, Corbiculidae,

Let14: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
	Sphaeridae and Unionidae

Let14: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	D (53.5)	F	Good habitat diversity Variety of velocity-depth classes and substrate types Poor water quality (return flows) Upstream anthropogenic impacts
Macroinvertebrates	E (31.4)	F	Good habitat diversity Variety of substrate types Poor water quality (return flows) Upstream anthropogenic impacts
Habitat Integrity: Instream	C (63)	F	Poor water quality Upstream anthropogenic impacts Siltation Upstream weir
Habitat Integrity: Riparian	D/E (39)	F	High vegetation removal Alien invasive vegetation Some bank erosion
ECOSTATUS	D (42.4)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

Let14: PES and causes	
Component	**Causes** **Present/Absent**
Fish	The species absent are related to low flow (velocity dependant species) and those associated with the special habitat requirements i.e. root wads and undercut banks. The low flows exposed the most critical habitat types and

	therefore lower the fish diversity dramatically.
Macroinvertebrates	The very poor flow conditions limited the quality and biotope availability and this is reflected in the low presence of families: only 9 of the 78 flow related families, 10 of the 85 habitat related families and 14 of the 96 water quality related families.

Let14: Overall change and reason for deviation				
COMPONENT	**PES 2006**	**PES 2013**	**PES 2016**	**REASON FOR DEVIATION**
ECOSTATUS	D	D	D	Poor water quality (return flows) Upstream anthropogenic impacts

Let14: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 2006	**PES 2013**	**PES 2016**		
Fish	C	-	D	Good habitat diversity Variety of velocity-depth classes and substrate types Poor water quality Upstream anthropogenic impacts	4
Macro-invertebrates	D	-	E	Good habitat diversity Variety of substrate types Poor water quality (return flows) Upstream anthropogenic impacts	4
Habitat integrity: Instream	D	-	C	Poor water quality Upstream anthropogenic impacts Siltation Upstream weir	4
Habitat integrity: Riparian	E (related to instream)	-	D/E	High vegetation removal Alien invasive vegetation	4

				Some bank erosion	
ECOSTATUS			D		

** 0 – no confidence to 5 – high confidence*

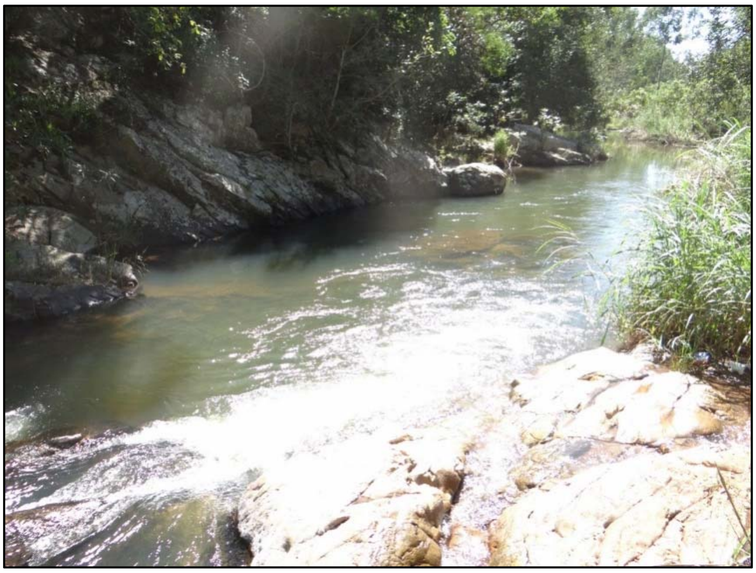
Let14: OVERALL ASSESSMENT

The site is located on the Letsitele River just downstream gauging weir B8H010 and upstream the Letaba River confluence. Varying flow conditions. The habitat availability was good comprising of most biotopes. The water quality was poor owing to upstream anthropogenic impacts.

RECOMMENDATIONS

- Owing to the proximity of this site, full comprehensive surveys should be conducted annually
- Stringent management measures for this reach should be revised and updated within the existing catchment management plan
- REMP protocols must be conducted annually
- Organic and inorganic water quality and *in situ* water quality should be monitored quarterly.
- Diatom samples should be taken minimum annually
- The WET testing should be conducted bi-annually until results are resolved. As this river reach is an important water source for the locals, this is an important protocol.
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the low flow conditions
- Riparian VEGRAI should be conducted every 5 years
- The IHI should be conducted annually

4.1.3 SITE LET16: LETABA RIVER (OLD LETABA EWR1 SITE)

SITE	DETAILS	VIEW
Site	LET16 (old Letaba EWR1)	
River	Letaba	
Quaternary Catchment	B81B	
Co-ordinates	S23 54 54.0 E30 03 08.2	
Ecoregion	9_Eastern Bankenveld	
IUA	1	
SQ Reach	B81B-00264	
IEI Rating	5	
WRUI Rating	4	
Survey Type	Rapid 3	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	Very High	
Eco-Region Level II	9_2	
Geozone	D	
Gauging weirs	B8H014	
Discharge	0.747m^3/s	

HABITAT AND BIOTA

- SIC, SOOC, high amount of bedrock, cobbles and boulders present. Limited vegetation and substrate types
- Aquatic macroinvertebrates: ASPT: 6.71 (tolerant taxa)
- Fish Habitat: Fair

WATER QUALITY

- pH 8.9; EC 5 mS/m; DO 6.93 mg/l

SITE AND UPSTREAM IMPACTS

- Extensive forestry

- Developments into the riparian zone
- Limited sewerage into river – poor infrastructure
- Alien invasive vegetation in the riparian zone
- Limited erosion
- Upstream informal settlements
- Upstream impoundments (Dap Naude, Ebenezer)

Let16: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	2	Straight section with an even slope Easily accessible	Access to the site will be limited under high flow conditions
Fish	4	Adequate water quality	Homogenous habitats (pools with boulders and bedrocks) Lower foothills Alien invasive fish species present (MSAL)
Macroinvertebrates	4	Habitat diversity Varying flow velocities Adequate water quality	Bedrock and boulders dominated sampling

** Confidence scores: 0 = no confidence; 5 = high confidence*

Let16: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Only 1 set of measured data available at the cross section Existing hydraulic information from the 2006 Letaba EWR1 site
Fish						Historical surveys (including 2006) Present survey
Macroinvertebrates						Historical surveys (including 2006)

Let16: Information availability						
COMPONENT	INFORMATION AVAILABILITY*					DESCRIPTION OF INFORMATION
	0	1	2	3	4	
						Present survey
Hydrology						Natural and present day monthly flow Gauging weir B8H014
Physico-chemical						Historic information, water quality site B8H014 DWS Chemical monitoring programme

* 0 (no information) to 4 (large amount of data available)

Let16: REFERENCE CONDITIONS	
COMPONENT	DESCRIPTION OF REFERENCE CONDITIONS
Fish	*Amphilius uranoscopus, Labeobarbus marequensis, Chiloglanis pretoriae, Labeo cylindricus, Labeo molybdinus, Marcusenius macrolepidotus, Opsaridium peringueyi* Fish expected within the reach however with a low probability of being recorded: *Anguilla marmorata, Anguilla mossambica, Enteromius (Barbus)eutaenia, Enteromius (Barbus)lineomaculatus, Enteromius (Barbus)neefi, vpaludinosus, Barbus trimaculatus, Barbus unitaeniatus, Pseudocrenilabrus philander, Tilapia rendalli, Tilapia sparrmanii, Micralestes acutidens, Mesobola brevianalis*
Macroinvertebrates	Porifera, Turbellaria, Oligochaeta, Hirudinea, Potamonautidae, Atyidae, Hydracarina, Perlidae, Baetidae >2spp, Caenidae, Heptageniidae, Leptophlebiidae, Oligoneuridae, Polymitarcyidae, Prosopistomatidae, Trichorythidae, Calopterygidae, Chlorocyphidae, Chlorolestidae, Coenagrionidae, Lestidae, Platycnemidae, Protoneuridae, Aeshnidae, Corduliidae, Gomphidae, Libellulidae, Pyralidae, Belostomatidae, Corixidae, Gerridae, Hydrometridae, Naucoridae, Nepidae, Notonectidae, Pleidae, Veliidae, Dipseudopsidae, Ecnomidae, Hydropsychidae >2spp, Philopotamidae, Polycentropodidae, Psychomyiidae, Hydroptilidae, Lepidostomatidae, Leptoceridae, Pisuliidae, Dytiscidae, Elmidae, Gyrinidae, Haliplidae, Helodidae, Hydraenidae, Hydrophilidae, Psephenidae, Athericidae, Ceratopogonidae, Chironomidae, Culicidae, Dixidae, Empididae, Ephydridae, Muscidae, Simuliidae, Tabanidae, Tipulidae, Ancylidae, Lymnaeidae, Planorbinae, Thiaridae, Corbiculidae, Sphaeridae and Unionidae

Let16: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	D (46.0)	F	Homogenous habitats (pools with boulders and bedrocks) Habitat at this specific site was not ideal for all fish species expected within the reach
Macroinvertebrates	D (44.0)	F	Homogenous habitats (pools with boulders and bedrocks). No marginal or instream vegetation. Varying flow velocities Adequate water quality
Habitat Integrity: Instream	C/B (78)	F	Flow modification Nutrient input from upstream informal settlements Extensive forestry Introduction of alien invasive fish species (MSAL)
Habitat Integrity: Riparian	C (75)	F	Infrastructure within the riparian zone Steep slopes Some alien vegetation impacts (Saringa spp., Eucalyptus and pine trees) Extensive forestry Siltation
ECOSTATUS	C/D (66)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

Let16: PES and causes	
Component	**Causes** **Present/Absent**
Fish	Of the seven (7) species expected, only three (3) were present with an additional exotic species recorded.
Macroinvertebrates	The modified flow and dry conditions resulted in poor habitat availability and therefore a large number of families were absent. Of the 56 families associated with flow, only 12 were recorded, only 14 of the 56 associated with the biotope

	diversity and only 17 of the 72 associated with the water quality conditions.

Let16: Overall change and reason for deviation				
COMPONENT	**PES 2006**	**PES 2013**	**PES 2016**	**REASON FOR DEVIATION**
ECOSTATUS	C	C	C/D	Homogenous habitats (pools with boulders and bedrocks) Habitat at this specific site was not ideal for all fish species expected within the reach

Let16: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 2006	**PES 2013**	**PES 2016**		
Fish	C	-	D	Homogenous habitats (pools with boulders and bedrocks) Habitat at this specific site was not ideal for all fish species expected within the reach Adequate water quality	4
Macroinvertebrates	C/D	-	D	Homogenous habitats (pools with boulders and bedrocks). No marginal or instream vegetation. Varying flow velocities Adequate water quality	4
Habitat integrity: Instream	-	-	C/B	Flow modification Nutrient input from upstream informal settlements Extensive forestry Introduction of alien invasive fish species (MSAL)	4
Habitat integrity: Riparian	C	-	C	Infrastructure within the riparian zone	4

				Steep slopes Some alien vegetation impacts (Saringa spp., Eucalyptus and pine trees) Extensive forestry Siltation	
ECOSTATUS	C	C	C/D		

** 0 – no confidence to 5 – high confidence*

Let16: OVERALL ASSESSMENT

The site is located on the Great Letaba River between Ebenezer and Tzaneen Dams in the upper foothills geozone. Homogenous habitats dominated by pools of bedrock and boulders which resulted in low fish diversity and relatively good aquatic macroinvertebrate diversity. Varying flow-depth velocities. The water quality was adequate.

RECOMMENDATIONS

- Owing to the proximity of this site, full comprehensive surveys should be conducted annually
- Stringent management measures for this reach should be revised and updated within the existing catchment management plan
- Chemical and *in situ* water quality should be monitored bi-annually
- Diatom samples should be taken minimum annually
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the low flow conditions
- Riparian VEGRAI should be conducted every 3 years
- The IHI should be conducted annually

4.1.4 SITE LET18: BROEDERSTROOM

SITE	DETAILS	VIEW
Site	LET18	 
River	Broederstroom (upper)	
Quaternary Catchment	B81A	
Co-ordinates	-23.80068, 29.97741	
Ecoregion	9_Eastern Bankenveld	
IUA	1	
SQ Reach	B81A-00242	
IEI Rating	3	
WRUI Rating	4	
Survey Type	Rapid 3	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	9_2	
Geozone	D	
Gauging weirs	None	
Discharge	0.192m^3/s	

HABITAT AND BIOTA

- SIC, SOOC, cobbles and GSM present
- Aquatic macroinvertebrates: ASPT: 6.48 (SASS:201/Taxa: 31)
- Fish Habitat: Fair

WATER QUALITY

- pH 8.5; EC 4 mS/m; DO 8.2 mg/l

SITE AND UPSTREAM IMPACTS

- Extensive forestry
- Deposition (upstream forestry)
- Invasive plants and fish

Let18: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	2	Straight section with an even slope Easily accessible	Site will be inundated during high flows (backwater from Dap naude Dam) Confidence will be limited to lower flows
Fish	4	Habitat diversity Water quality	Forestry Alien invasive fish species (OMYK) Poor vegetation availability
Macroinvertebrates	4	Habitat diversity Water quality	Poor vegetation availability Forestry Deposition

** Confidence scores: 0 = no confidence; 5 = high confidence*

Let18: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics						Only 1 set of measured data available at the cross section
Fish						Historical surveys Present survey
Macroinvertebrates						Present survey
Hydrology						Natural and present day monthly flow
Physico-chemical						Historic information, water quality site B8H053 DWS Chemical monitoring programme

* 0 (no information) to 4 (large amount of data available)

Let18: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Amphilius uranoscopus*
Macroinvertebrates	Turbellaria, Oligochaeta, Hirudinea, Potamonautidae, Hydracarina, Perlidae, Baetidae 2spp, Baetidae >2spp, Caenidae, Leptophlebiidae' Trichorythidae, Chlorocyphidae, Coenagrionidae, Lestidae, Aeshnidae, Gomphidae, Libellulidae, Belostomatidae, Corixidae, Gerridae, Hydrometridae, Naucoridae, Nepidae, Notonectidae, Pleidae, Veliidae, Hydropsychidae 1sp, Philopotamidae, Hydroptilidae, Leptoceridae, Dytiscidae, Elmidae, Gyrinidae, Hydrophilidae, Athericidae, Ceratopogonidae, Chironomidae, Culicidae, Dixidae, Muscidae, Simuliidae, Tabanidae, Tipulidae an Planorbinae

Let18: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	D (48.2)	F & NF	Low diversity of fish expected, due to location in the upper catchment. Long history of *Oncorhynchus mykiss* (OMYK)has resulted in the predation of indigenous species. As the FRAI model is based on a deviation of fish species expected to occur, to those observed, no result could be obtained due to no indigenous fish being present. The instream and riparian habitat proved to be sufficient for the expected *Enteromius (Barbus)Neefi* and *Linmaculatus*and *Amphiliusuranoscopus*species. The FRAI model has been adjusted to take into account the habitat which is present for the fish species despite the site only consisting of alien fish species. The class D is owing to the highly modified view that the alien fish species have reduced the indigenous fish species.
Macroinvertebrates	C (73.4)	F & NF	Some predatory impacts from OMYK on the aquatic macroinvertebrate communities Absent natural vegetation
Habitat Integrity: Instream	B (86)	F & NF	Flow modification due to forestry Siltation owing to the forestry and heavy truck activity Presence of alien invasive fish species (OMYK) have

			significantly reduced the indigenous fish species community at this site
Habitat Integrity: Riparian	A/B (88)	NF	Flow modification due to forestry Siltation Bank erosion
ECOSTATUS	C (74.4)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

Let18: PES and causes	
Component	**Causes** **Present/Absent**
Fish	The presence of exotic invasive has led to a total loss of indigenous fish species.
Macroinvertebrates	The presence of the exotic fish had a negative impact on the biota, but the most important change in the invertebrate diversity is related to the water quality related to the activities associated with the plantations – mostly siltation.

Let18: Overall change and reason for deviation				
COMPONENT	**PES 2006**	**PES 2013**	**PES 2016**	**REASON FOR DEVIATION**
ECOSTATUS	-	C	C	Some predatory impacts from OMYK on the aquatic macroinvertebrate communities Extensive forestry

Let18: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 2006	**PES 2013**	**PES 2016**		
Fish	**-**	**-**	C	Heavy predation from OMYK which has resulted in no indigenous fish species being sampled.	4

Let18: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 2006	**PES 2013**	**PES 2016**		
Macro-invertebrates	-	-	C	Some predatory impacts from OMYK on the aquatic macroinvertebrate communities Absent natural vegetation	4
Habitat integrity: Instream	-	-	B	Flow modification due to forestry Siltation owing to the forestry and heavy truck activity Presence of alien invasive fish species (OMYK) have significantly reduced the indigenous fish species community at this site	4
Habitat integrity: Riparian	-	-	A/B	Flow modification due to forestry Siltation Bank erosion	4
ECOSTATUS	-	C	C		

** 0 – no confidence to 5 – high confidence*

Let18: OVERALL ASSESSMENT

The site is located in the upper catchment on the Broederstroom just upstream of Dap Naude Dam. Good habitat diversity with the exception of limited vegetation. High predation impacts from alien invasive fish species (OMYK) resulting in no indigenous fish species being recorded. Varying flow-depth velocities and habitat types. The water quality was good.

RECOMMENDATIONS

- Owing to the proximity of this site, full comprehensive surveys should be conducted annually
- Stringent management measures for this reach should be revised and updated within the existing catchment management plan
- I*n situ* water quality should be monitored during the FRAI and MIRAI assessments
- Aquatic macroinvertebrates (MIRAI) should be monitored once a year
- The IHI should be conducted annually

4.2 BIOLOGICAL SITES

4.2.1 SITELET1: LETABA RIVER

SITELet: 1	DETAILS	VIEW
Site	Let 1	 
River	Letaba River	
Quaternary Catchment	B83E	
Co-ordinates	-23.942280; 31.731521	
Ecoregion	3_Lowveld	
IUA	11	
SQ Reach	B83E-00265	
IEI Rating	3	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_5	
Geozone	E_Lower Foothills	
Gauging weirs	B8H028	

HABITAT AND BIOTA

- Bedrock and sand dominated, some boulders with limited cobbles (mostly bedrock) – no root wads or marginal vegetation.
- Aquatic macroinvertebrates: ASPT: 6.0 (moderately tolerant taxa)
- Fish Habitat: Moderate (Lacking diversity under current flow conditions)

WATER QUALITY

- pH 8.7; EC: 50 ms/m; DO 10.6 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- Some siltation due to trampling in park – drought related
- Abstraction outside park – dams and weirs

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

LET 1: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Bedrock in this section of river provides good habitat and refugia for fish, as well as the physical structures for a variety of velocity-depth classes.	Low flow conditions. No marginal or instream vegetation
Macroinvertebrates	4	Bedrock provides shoots and backwaters for a variety of velocities and deposition patterns (Sand and Gravel).	Limited biotopes for sampling. Naturally poor SIC and VEG within the reach.
Riparian vegetation / Habitat Integrity	4	Represents the reach, yet low flows limited biotope diversity.	Low flows exposed some instream habitats (SIC/SOC) and marginal vegetation

** Confidence scores: 0 = no confidence; 5 = high confidence*

LET 1: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical surveys (B83E-00265) Present survey
Macroinvertebrates						Historical information Present survey
Riparian vegetation						Present survey
Physico-chemical						Historic information, upstream water quality site B8H018. DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

LET 1: OVERALL ASSESSMENT

The site is located in the lower section of the Letaba River before it joins the Olifants River. Located at the low water bridge the site is easily accessible and provides sufficient habitat to be representative of the reach. This site is the lowest site within the Letaba system and therefore should be monitored before it enters the Olifants proper.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical and *in situ* water quality should be conducted on a bi-annual basis
- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.

4.2.2 SITELET 3: TSENDE RIVER

SITE	DETAILS	VIEW
Site	Let 3	 
River	Tsende River	
Quaternary Catchment	B83B	
Co-ordinates	-23.55065; 31.43027	
Ecoregion	3_Lowveld	
IUA	12	
SQ Reach	B83B-00161	
IEI Rating	5	
WRUI Rating	1	
Survey type	Biological	
PES 2013 (reach)	-	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_3	
Geozone	E_Lower Foothills	
Gauging weirs	B8H011	

HABITAT AND BIOTA

- Most biotopes present, but under current flow conditions, most exposed.
- Trampling of riparian and marginal vegetation (wildlife).
- Aquatic macroinvertebrates: ASPT: 5.2 (moderately to highly tolerant taxa)
- Fish Habitat: Moderate - Good

WATER QUALITY

- pH 9.3; EC: 89 ms/m; DO 8.66 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- Impoundment (Pioneer dam) upstream

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

LET 3: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	3	SD and SS habitats available. Undercut banks and substrate heterogeneity. Some overhanging vegetation.	Low flow conditions have limited the extent of sampling in side channels and marginal vegetation.
Macroinvertebrates	3	Substrate heterogeneity and overhanging vegetation.	Some smothering of habitats due to low flow and wildlife activity (siltation).
Riparian vegetation / Habitat Integrity	4	Represent the river reach Vegetation in a good condition	Low flows exposed good SIC/SOC during current survey Limited impacts from mega herbivores related to drought conditions

** Confidence scores: 0 = no confidence; 5 = high confidence*

LET 3: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Limited historical information available. Present survey.
Macroinvertebrates						Limited historical information available
Riparian vegetation						Limited information available
Physico-chemical						Limited. Present survey

** 0 (no information) to 4 (large amount of data available)*

LET 3: OVERALL ASSESSMENT

The site is located in the Tsende River, downstream of Pioneer Dam (Mopani Rest Camp) and upstream of the Mooiplaas picnic area (Tsendze Rustic Camp Site). Upstream impacts are limited as the Tsende River originates within the Kruger National Park, and therefore future monitoring should be limited to annually.

RECOMMENDATIONS

- *In situ* water quality should be conducted with yearly chemical and microbial analysis – to determine any possible impacts from tourist facilities upstream.
- Aquatic macroinvertebrates should be sampled annually towards the end of the dry season.
- Continual management to protect the ecological status of this river reach, due to the river being an important refugia for the above mentioned fish species and planned upstream mining activities.

4.2.3 SITELET 4: LETABA RIVER

SITE	DETAILS	VIEW
Site	Let 4	 
River	Letaba River	
Quaternary Catchment	B83A	
Co-ordinates	-23.650558; 31.148384	
Ecoregion	3_Lowveld	
IUA	11	
SQ Reach	B83A-00220	
IEI Rating	5	
WRUI Rating	3	
Survey type	Biological	
PES 2013 (reach)	B	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_3	
Geozone	E_Lower Foothills	
Gauging weirs	B8H028	

HABITAT AND BIOTA

- Some marginal vegetation (homogenous: *Phragmites* clumps). Limited root wads and undercut banks.
- Bedrock and sand dominated, some boulders and cobbles.
- Aquatic macroinvertebrates: ASPT: 5.63 (moderately to highly tolerant taxa)
- Fish Habitat: Good

WATER QUALITY

- pH 8.9; EC: 47 ms/m; DO 7.1 mg/l

SITE AND UPSTREAM IMPACTS

- Siltation limited – outside influence
- Low flows related to excessive abstraction
- Fragmentation – numerous dams and weirs
- Exposed soils due to trampling – drought related

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

LET 4: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Good diversity of velocity-depth classes even under current flow conditions. Substrate heterogeneity (sand, cobbles, boulders and mud).	Low flow conditions meant banks and side channels were not activated.
Macroinvertebrates	4	Good SIC	Poor VEG biotope.
Riparian vegetation / Habitat Integrity	4	Represent reach First site in the KNP – gives full picture of cumulative impacts from the Groot and Klein Letaba rivers	Some trampling Low water bridge modify the channel to a small extent

** Confidence scores: 0 = no confidence; 5 = high confidence*

LET 4: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical information Present survey
Macroinvertebrates						Regular RHP and KNP surveys Present survey
Riparian vegetation						Regular RHP and KNP surveys Historic information from other Letaba River projects
Physico-chemical						Historic information, upstream water quality site B8H028. DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

LET 4: OVERALL ASSESSMENT

The site is located in the Letaba River, just below the confluence of the Groot and Klein Letaba tributaries. Upstream impacts from the catchment include agricultural activities, informal settlements and land degradation, all which are contributing to the degraded status of the water quality. It is important that this site is continually monitored as it is a benchmark for the rivers state as it enters the Kruger National Park.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and *in situ* water quality should be conducted on a bi-annual basis
- Fish and macroinvertebrates should be sampled annually during the wet season.
- Continual management to protect the ecological status of this river reach, due to the river being an important refugia – cumulative impacts from the Letsitele, Nsama, Middle, Klein and Groot Letaba and to a smaller extent the Nwanedzi and Molototsi rivers.

4.2.4 SITELET 5: KLEIN LETABA RIVER

SITE	DETAILS	VIEW
Site	Let5	 
River	Klein Letaba River	
Quaternary Catchment	B82J	
Co-ordinates	-23.645972; 31.142238	
Ecoregion	3_Lowveld	
IUA	9	
SQ Reach	B82J-00201	
IEI Rating	5	
WRUI Rating	3	
Survey type	Biological	
PES 2013 (reach)	B	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_3	
Geozone	E_Lower Foothills	
Gauging weirs	None	

HABITAT AND BIOTA

- Limited habitat diversity – dominated by GSM – some marginal vegetation available under normal flow conditions.
- Aquatic macroinvertebrates: (*no SASS5 conducted due to lack of habitat/flow, shallow puddles*)
- Fish Habitat: Poor (*fish not sampled*)

WATER QUALITY

- pH 8.5; EC: 47 ms/m; DO 8.77 mg/l

SITE AND UPSTREAM IMPACTS

- Abstraction
- Exposed soils
- Poor land-use practices
- Poor infrastructure
- Erosion and siltation

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

LET 5: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	N/A as per the above	-	No flow. Homogenous mud substrate
Macroinvertebrates	N/A as per the above	-	No flow. Homogenous mud substrate
Riparian vegetation / Habitat Integrity	4	Intact in the park, habitat in good condition	Outside impacts having a negative impact on the habitat – low flows and siltation

** Confidence scores: 0 = no confidence; 5 = high confidence*

LET 5: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish		■				Limited historical information
Macroinvertebrates		■				Limited historical information
Riparian vegetation			■			Some historical information
Physico-chemical		■				Limited.

** 0 (no information) to 4 (large amount of data available)*

LET 5: OVERALL ASSESSMENT

The site is located in the lower section of the Klein Letaba River before the confluence with the Groot Letaba (becoming Letaba River). Originating outside of the Park, the Klein Letaba flows through the Hlanganani and Giyani regions and as a result of land use practices and informal settlements, water quality is considered degraded with nutrients and high sediment loads present.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and *in situ* water quality should be conducted on a bi-annual basis
- Aquatic macroinvertebrates and diatoms should be sampled annually during the wet season.

However, communication with the KNP game ranger must first be conducted to confirm there is flow at the site for the benefit of the sampling event.

- Continual management to protect the ecological status of this river reach, due to upstream impacts on the Letaba River system.

4.2.5 SITELET 6: GROOT LETABA RIVER

SITE	DETAILS	VIEW
Site	Let 6	 
River	Groot Letaba River	
Quaternary Catchment	B81J	
Co-ordinates	-23.649779; 31.141140	
Ecoregion	3_Lowveld	
IUA	4	
SQ Reach	B81J-00219	
IEI Rating	4	
WRUI Rating	3	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_3	
Geozone	F_Lowland River	
Gauging weirs	B8H008	

HABITAT AND BIOTA

- Sand-dominated system with some in-stream and marginal vegetation under higher flow conditions
- Aquatic macroinvertebrates: ASPT: 5.44 (moderately to highly tolerant taxa)
- Fish Habitat: Moderate to Good

WATER QUALITY

- pH 9.4; EC: 42.0 ms/m; DO 8.61 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- Silt
- Agricultural activities
- Impacts from grazing
- Wood harvesting in the riparian zone
- Fragmentation due to dams and weirs
- Exposed soils

• Abstraction • Return/runoff flows – agricultural and sewerage

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

LET 6: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Bedrock in this section of river provides good habitat and refugia for fish, as well as the physical structures for a variety of velocity-depth classes.	Low flow conditions. No marginal or instream vegetation. Limited SIC.
Macroinvertebrates	4	Bedrock provides shoots and backwaters for a variety of velocities and deposition patterns (Sand and Gravel).	Limited biotopes for sampling. Naturally poor SIC and VEG within the reach.
Riparian vegetation / Habitat Integrity	4	Lowest point in the Groot Letaba – cumulative impacts related to the total catchment	Impacts related to commercial farming and poor land-use in rural areas

** Confidence scores: 0 = no confidence; 5 = high confidence*

LET 6: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical information Present survey
Macroinvertebrates						Historical information Present survey
Riparian vegetation						Historical information Present survey
Physico-chemical						Historic information, water quality site B8H008. DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

LET 6: OVERALL ASSESSMENT

The site is located in the Groot Letaba upstream before the confluence with the Klien Letaba (becoming Letaba River). Originating outside of the Park, the Groot Letaba flows through the intensive agricultural hubs Tzaneen and forestry of Haenesburg. Furthermore the Letsitele and Nwanedzi Rivers flow through highly populated regions and as a result of land use practices and informal settlements, water quality is considered degraded with nutrients and high sediment loads present.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and *in situ* water quality should be conducted on a quarterly basis
- Fish and macroinvertebrates should be sampled annually during the wet season or when there is flow at the site.
- Continual management to protect the ecological status of this river reach, due to the upstream impacts on the system to ensure good quality water into the KNP and Mozambique.

4.2.6 SITELET 8: NSAMA RIVER

SITE	DETAILS	VIEW
Site	Let 8	 
River	Nsama River	
Quaternary Catchment	B82H	
Co-ordinates	-23.349141; 30.909281	
Ecoregion	3_Lowveld	
IUA	10	
SQ Reach	B82H-00157	
IEI Rating	4	
WRUI Rating	3	
Survey type	Biological	
PES 2013 (reach)	B	
EI_ES 2013 (reach)	Moderate	
Eco-Region Level II	3_3	
Geozone	E_Lower Foothills	
Gauging weirs	B8R009 (upstream)	

HABITAT AND BIOTA

- System dominated by sand – high siltation, good marginal vegetation present under normal flow conditions with some dykes (bedrock, boulders, cobbles).
- Aquatic macroinvertebrates: (*no SASS5 conducted due to lack of habitat, no flow and shallow puddles*)
- Fish Habitat: Poor to Moderate (*fish not sampled*)

WATER QUALITY

- Stagnant pools only - pH 9.3; EC: 26.0 ms/m; DO 5.77 mg/l

SITE AND UPSTREAM IMPACTS

- No flow during survey
- Silt high
- Agricultural activities
- Impacts from grazing
- Wood harvesting
- Exposed soils

- Trampling

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

LET 8: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	n/a	-	No flow Muddy pool under bridge
Macroinvertebrates	n/a	-	No flow Muddy pool under bridge
Riparian vegetation / Habitat Integrity	4	Site representative of river, seasonal stream	High impacts from catchment – siltation, erosion, trampling

** Confidence scores: 0 = no confidence; 5 = high confidence*

LET 8: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Limited historical information
Macroinvertebrates						Some historical information
Riparian vegetation						Some historical sampling
Physico-chemical						Historic information, upstream water quality site B8R009. DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

LET 8: OVERALL ASSESSMENT

The site is located in the Nsama River, downstream of the Hudson Ntsanwisi Dam and before the confluence with the Klein Letaba. The catchment upstream of the dam is heavily populated with extensive portions of degraded land. These settlements and land use practices have resulted in a degraded system.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and *in situ* water quality should be conducted during the wet season
- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Continual management to protect the ecological status – important tributary of the Klein Letaba River – will reflect the impacts from the catchment and therefore loads on the Letaba River system.

4.2.7 SITELET 9: KLEIN LETABA RIVER

SITE	DETAILS	VIEW
Site	Let 9	 
River	Klein Letaba River	
Quaternary Catchment	B82G	
Co-ordinates	-23.281334; 30.542761	
Ecoregion	3_Lowveld	
IUA	9	
SQ Reach	B82G-00135	
IEI Rating	3	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (reach)	D	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_3	
Geozone	E_Lower Foothills	
Gauging weirs	B8H033	

HABITAT AND BIOTA

- Diverse habitat available, most dry due to very low flow during the survey, all present as pool with limited vegetation
- Aquatic macroinvertebrates: (*no SASS5 conducted due to lack of flow, deep pools*)
- Fish Habitat: Moderate to Good

WATER QUALITY

- pH 9.1; EC: 37 ms/m; DO 5.72 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- Silt
- Agricultural activities
- Impacts from grazing
- Wood harvesting (wood crafters)
- Weir
- Abstraction

- Exposed soils, trampling and erosion

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

LET 9: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Good substrate diversity.	Low flow conditions. No marginal or instream vegetation.
Macroinvertebrates	n/a	-	Lack of flow, deep pools
Riparian vegetation / Habitat Integrity	4	Diverse habitat available under normal flow conditions	Weir, abstraction

** Confidence scores: 0 = no confidence; 5 = high confidence*

LET 9: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						B82KLET-KREME EWR5 Present survey
Macroinvertebrates						EWR5
Riparian vegetation						Limited historic information
Physico-chemical						Historic information, upstream water quality site B8H033. DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

LET 9: OVERALL ASSESSMENT

The site is located in the Klein Letaba directly downstream of the weir located near Hlaneki. The site is located approximate halfway between the Middle Letaba Dam and town of Giyani. This site is an important site as the Middle Letaba Dam does not have the ability to release water. Land use within this region is contributing to the degraded status of the water quality and riparian habitat integrity at this site.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and *in situ* water quality should be conducted during the wet season and prior to the dry season
- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Continual management to protect the ecological status of this river reach.

4.2.8 SITELET 12: GROOT LETABA RIVER

SITE	DETAILS	VIEW
Site	Let 12	 
River	Groot Letaba River	
Quaternary Catchment	B81F	
Co-ordinates	-23.683598; 30.609765	
Ecoregion	3_Lowveld	
IUA	4	
SQ Reach	B81F-00200	
IEI Rating	4	
WRUI Rating	3	
Survey type	Biological	
PES 2013 (reach)	D	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_3	
Geozone	E_Lower Foothills	
Gauging weirs	B8H017	

HABITAT AND BIOTA

- Diverse habitat with good representation of all biotopes present under normal flow conditions. Limited root wads and undercut banks due to extensive bedrock areas.
- Aquatic macroinvertebrates: ASPT: 5.17 (moderately to highly tolerant taxa)
- Fish Habitat: Good
- *Micropterus salmoides* introduced at site

WATER QUALITY

- pH 9.1; EC: 23.0 ms/m; DO 5.83 mg/l

SITE AND UPSTREAM IMPACTS

- Low flows
- Fragmentation – weirs and dams
- Agricultural activities
- Rural activities
- Wood harvesting
- Removal of riparian vegetation

- Erosion

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

LET 12: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Good habitat diversity and velocity-depth classes Undercut banks and substrate heterogeneity.	Fragmentation – weirs and dams within reach Exotic MSAL
Macroinvertebrates	4	Substrate heterogeneity and overhanging vegetation. Good SIC	Some habitat smothering by siltation and algae on rocks
Riparian vegetation / Habitat Integrity	4	Representative of reach	Weir and bridge at site

** Confidence scores: 0 = no confidence; 5 = high confidence*

LET 12: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish				■		EWR3 B81GLET-GIYBR Present survey
Macroinvertebrates				■		Historical information Present survey
Riparian vegetation				■		Good historical information
Physico-chemical			■			Historic information, water quality site B8H017. DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

LET 12: OVERALL ASSESSMENT

The site is located in the Groot Letaba, upstream from the Hans Marensky Nature Reserve. The site is positioned where the D1597 Bridge links through to the R529.

RECOMMENDATIONS

- Monitoring only to be conducted at site LET13. A biological survey is not necessary at site LET12 and LET13.

4.2.9 SITELET 13: GROOT LETABA RIVER

SITE	DETAILS	VIEW
Site	Let 13	
River	Groot Letaba River	
Quaternary Catchment	B81E	
Co-ordinates	-23.73200; 30.55812	
Ecoregion	3_Lowveld	
IUA	4	
SQ Reach	B81F-00231	
IEI Rating	3	
WRUI Rating	3	
Survey type	Biological	
PES 2013 (reach)	D	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_3	
Geozone	E_Lower Foothills	
Gauging weirs	B8H009	

HABITAT AND BIOTA

- Good representative site of the reach. Limited roots and undercut banks. Some marginal vegetation.
- Aquatic macroinvertebrates: ASPT: 5.78 (moderately to highly tolerant taxa)
- Fish Habitat: Good
- *Micropterus salmoides* introduced at site

WATER QUALITY

- pH 9.5; EC: 20.0 ms/m; DO 4.96 mg/l

SITE AND UPSTREAM IMPACTS

- Low flows - controlled
- Fragmentation of river – weirs and dams
- Abstractions
- Agricultural activities
- Impacts from grazing
- Wood harvesting

- Erosion
- Exposed soils

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

LET 13: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Good habitat diversity and velocity-depth classes Substrate heterogeneity.	Fragmentation – weirs within reach Exotic MSAL
Macroinvertebrates	4	Substrate heterogeneity and overhanging vegetation. Good SIC	Fragmentation – weirs within reach
Riparian vegetation / Habitat Integrity	4	Site represent reach	High impacts: cultivation, rural impacts, abstraction, fragmentation of the river due to many weirs and dams

** Confidence scores: 0 = no confidence; 5 = high confidence*

LET 13: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical information within reach Present survey
Macroinvertebrates						Historical information within reach Present survey
Riparian vegetation						Some historical information
Physico-chemical						Good historic information, upstream water quality site B8H009. DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

LET 13: OVERALL ASSESSMENT

The site is located in the Groot Letaba, upstream from site Let 12. The site is positioned on a farm road that has a low water bridge across the river.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and *in situ* water quality should be conducted on a quarterly basis
- Fish and macroinvertebrates should be sampled annually towards the end of the dry season.
- Continual management to protect the ecological status of this river – severe impacts related to fragmentation, pollution and abstraction.

4.2.10 SITELET 15: GROOT LETABA RIVER

SITE	DETAILS	VIEW
Site	Let 15	 
River	Groot Letaba River	
Quaternary Catchment	B81C	
Co-ordinates	-23.839035; 30.216967	
Ecoregion	4_North Eastern Highlands	
IUA	3	
SQ Reach	B81C-00245	
IEI Rating	3	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (reach)	D	
EI_ES 2013 (reach)	High	
Eco-Region Level II	4_2	
Geozone	D_Upper Foothills	
Gauging weirs	B8H050	

HABITAT AND BIOTA

- Limited roots, cobbles (mostly bedrock) observed. Some marginal vegetation.
- Aquatic macroinvertebrates: ASPT: 5.78 (moderately to highly tolerant taxa)
- Fish Habitat: Good

WATER QUALITY

- pH 9.3; EC: 8.0 ms/m; DO 4.31 mg/l

SITE AND UPSTREAM IMPACTS

- Flow regime modified from Lake Tzaneen - low flows
- Abstraction, weirs and dams
- Fragmented river
- Agricultural activities
- Informal settlements
- Sewerage and chemical pollution

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

LET 15: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Good availability of velocity-depth classes	Bedrock dominated (homogenous) Upstream impoundment
Macroinvertebrates	4	Good availability of velocity-depth classes	Bedrock dominated (homogenous) Limited vegetation
Riparian vegetation / Habitat Integrity	4	Good representation of river Good habitat and biotopes present	Pollution Fragmentation Abstraction

** Confidence scores: 0 = no confidence; 5 = high confidence*

LET 15: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						B81GLET-YAMOR Present survey
Macroinvertebrates						Present survey
Riparian vegetation						Some historical information
Physico-chemical						Historic information, upstream water quality site B8H050Q01. DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

LET 15: OVERALL ASSESSMENT The site is located in the Groot Letaba just downstream of the town of Tzaneen, Tzaneen Dam and Yamorna Weir. The site was dominated by bedrock and was heavily shaded. This sites represents a division between the forestry of the upper catchment and the irrigated agriculture of the middle

Letaba. This site is also the last site in the Groot Letaba located in the North Eastern Highlands Ecoregion and Upper Foothills where a moderately steep channel that is bedrock controlled exists. It is important that this site is continually monitored before the river 'drops' into the lower foothills where extensive agriculture is practiced.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and*in situ* water quality should be conducted on a quarterly basis
- Fish and macroinvertebrates should be sampled bi-annually towards the end of the dry and wet season.
- Continual management to protect/improve the ecological status of this river reach. Highly impacted and must improve EC to ensure good water quality downstream.

4.2.11 SITELET 17: BROEDERSTROOM

SITE	DETAILS	VIEW
Site	Let 17	 
River	Broederstroom	
Quaternary Catchment	B81A	
Co-ordinates	-23.937309; 29.942791	
Ecoregion	9_Eastern Bankenveld	
IUA	1	
SQ Reach	B81A-00270	
IEI Rating	5	
WRUI Rating	4	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	Very High	
Eco-Region Level II	9_2	
Geozone	D_Upper Foothills	
Gauging weirs	B8H053	

HABITAT AND BIOTA

- Limited roots, cobbles (mostly bedrock) observed. Some marginal vegetation.
- Aquatic macroinvertebrates: ASPT: 6.48 (moderately tolerant taxa)
- Fish Habitat: Moderate to Good
- *Micropterus salmoides* introduced at site

WATER QUALITY

- pH 8.5; EC: 4.0 ms/m; DO 8.20 mg/l

SITE AND UPSTREAM IMPACTS

- Low flows
- Limited silt
- Plantations
- Exposed soils

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

LET 17: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	2	Pool and riffle habitat present Boulders and marginal vegetation provide good habitat	Exotic MSAL Siltation from forestry
Macroinvertebrates	2	Riffle habitat present Marginal vegetation provide good habitat	Boulders and deep pools inhibit sampling Siltation from forestry
Riparian vegetation / Habitat Integrity	4	Site with good habitat diversity	Plantations, erosion and siltation

* *Confidence scores: 0 = no confidence; 5 = high confidence*

LET 17: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Present survey
Macroinvertebrates						Present survey
Riparian vegetation						Some historical information
Physico-chemical						Some historic information, upstream water quality site B8H053Q01. DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

LET 17: OVERALL ASSESSMENT

The site is located in the Broederstroom River, upstream of the Ebenezer Dam, and is surrounded by forestry. As a result there was lots of silt deposition in the deeper pools. The exotic Largemouth Bass (MSAL) was captured.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical and *in situ* water quality should be conducted on a bi-annual basis
- Fish and macroinvertebrates should be sampled annually towards the end of the dry season.
- Continual management to protect the ecological status of this river.

4.2.12 SITELET 19: POLITSI RIVER

SITE	DETAILS	VIEW
Site	Let 19	 
River	Politsi River	
Quaternary Catchment	B81B	
Co-ordinates	-23.793284; 30.120468	
Ecoregion	4_North Eastern Highlands	
IUA	1	
SQ Reach	B81B-00240	
IEI Rating	3	
WRUI Rating	3	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	4_2	
Geozone	D_Upper Foothills	
Gauging weirs	B8R003	

HABITAT AND BIOTA

- Limited roots, cobbles (mostly bedrock) observed. Some marginal vegetation.
- Aquatic macroinvertebrates: ASPT: 8.46 (low to moderately tolerant taxa)
- Fish Habitat: Moderate

WATER QUALITY

- pH 9.3; EC: 6.0 ms/m; DO 6.28 mg/l

SITE AND UPSTREAM IMPACTS

- Low flows
- Silt
- Agricultural activities
- Informal settlements
- Wood harvesting (plantations)
- Some sewerage from informal areas
- Exposed soils

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

LET 19: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	2	Lowest point in Politsi Substrate heterogeneity	Downstream Tzaneen Dam Surrounding forestry
Macroinvertebrates	4	Substrate heterogeneity	-
Riparian vegetation / Habitat Integrity	4	Good representative site, lowest point in Politsi River	Plantations Erosion Siltation in rainy season

** Confidence scores: 0 = no confidence; 5 = high confidence*

LET 19: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Upstream information Present Survey
Macroinvertebrates						Present Survey
Riparian vegetation						Some historical information (Vlok 1996 – 1998)
Physico-chemical						Historic information, upstream water quality site B8R003Q01. DWS Chemical monitoring programme

** 0 (no information) to 4 (large amount of data available)*

LET 19: OVERALL ASSESSMENT

The site is located in the Politsi River, upstream of the Tzaneen Dam. The upper catchment is dominated by plantations (forestry).

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and *in situ* water quality should be conducted on a bi-annual basis
- Fish and macroinvertebrates should be sampled annually towards the end of the dry season.
- Continual management to protect the ecological status of this river.

5.0 SHINGWEDZI CATCHMENT: ECOLOGICAL STATUS - PRIORITY SITES SHINGWEDZI CATCHMENT

Please refer to Appendix D for the aquatic macroinvertebrate and fish inventories for each site

5.1 EWR SITES

5.1.1 SITE SHI1: SHINGWEDZI RIVER

SITE	DETAILS	VIEW
Site	SHI1	
River	Shingwedzi	
Quaternary Catchment	B90H	
Co-ordinates (steel peg on right bank)	23° 11’ 05.7” S 31° 31’ 30.3” E	
Ecoregion	3_Lowveld	
IUA	Not delineated	
SQ Reach	B90H-00117	
IEI Rating	2	
WRUI Rating	3	
Survey Type	Rapid 3	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_5	
Geozone	E	
Gauging weirs	B9H013	
Discharge	0.006m^3/s	

HABITAT AND BIOTA

- SIC, SOOC, Limited cobbles and boulders present

- Aquatic macroinvertebrates: ASPT: 5.22 (tolerant taxa)
- Fish Habitat: Fair (low flow)

WATER QUALITY

- pH 9.3; EC 55 mS/m; DO 8.21 mg/l

SITE AND UPSTREAM IMPACTS

- Abstraction outside KNP and for rest camp/staff village
- WQ pollution from outside KNP
- Erosion and siltation – due to trampling

Shi1: EWR site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Hydraulics	2	Straight section that is representative of the river. Easily accessible.	The downstream pool will inundate the site during high flows. The confidence in the results will be limited to lower flows.
Fish	4	Good diversity of substrates	Low flow (limited marginal vegetation) Water quality impacts from outside KNP landuse and activities
Macroinvertebrates	2	Good diversity of substrates, microhabitats	Low flow (limited marginal vegetation) Water quality impacts from outside KNP landuse and activities

** Confidence scores: 0 = no confidence; 5 = high confidence*

Shi1: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Hydraulics			■			Only 1 set of measured data available at the cross section

Shi1: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical surveys
Macroinvertebrates						LIMCOM survey 2012 System not well studied as rivers further south in KNP Current survey
Hydrology						Natural and present day monthly flow Gauging weir B9H013
Physico-chemical						Data available from water quality monitoring site B9H003 upstream of site (outflow from Dam). Historic data, DWS Chemical monitoring programme

* 0 (no information) to 4 (large amount of data available)

Shi1: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
Fish	*Enteromius (Barbus) afrohamiltoni, Enteromius (Barbus) annectens, Brycinus imberi, Labeobarbus marequensis, Enteromius (Barbus) mattozi, Enteromius (Barbus) paludinosus, Enteromius (Barbus)radiates, Enteromius (Barbus) toppini, Enteromius (Barbus) trimaculatus, Enteromius (Barbus) unitaeniatus, Enteromius (Barbus)viviparous, Clarias gariepinus, Chiloglanis paratus, Glossogobius giuris, Labeo cylindricus, Labeo molybdinus, Labeo ruddi, Micralestes acutidens, Mesobola brevianalis, Oreochromis mossambicus, Schilbe intermedius, Synodontis zambezensis, Tilapia rendalli, Glossogobius callidus* Fish expected within the reach however with a low probability of being recorded: *Anguilla marmorata, Anguilla mossambica*
Macroinvertebrates	Porifera, Coelenterata, Turbellaria, Oligochaeta, Hirudinea, Potamonautidae, Atyidae, Paleomonidae, Hydracarina, Perlidae, Baetidae 2spp, Baetidae , 2spp, Caenidae, Heptageniidae, Leptophlebiidae, Oligoneuridae, Polymitarcyidae, Trichorythidae, Calopterygidae, Chlorocyphidae, Coenagrionidae, Lestidae, Platycnemidae, Protoneuridae, Aeshnidae, Corduliidae, Gomphidae, Libellulidae, Pyralidae, Belostomatidae, Corixidae, Gerridae, Hydrometridae, Naucoridae, Nepidae, Notonectidae, Pleidae, Veliidae, Dipseudopsidae, Ecnomidae, Hydropsychidae >2spp, Philopotamidae, Hydroptilidae,

Shi1: REFERENCE CONDITIONS	
COMPONENT	**DESCRIPTION OF REFERENCE CONDITIONS**
	Leptoceridae, Dytiscidae, Elmidae, Gyrinidae, Haliplidae, Helodidae, Hydraenidae, Hydrophilidae, Athericidae, Ceratopogonidae, Chironomidae, Culicidae, Dixidae, Empididae, Muscidae, Simuliidae, Tabanidae, Tipulidae, Ancylidae, Bulinae, Lymnaeidae, Planorbinae, Thiaridae, Corbiculidae, Sphaeridae and Unionidae

Shi1: PES per component for EWR site and Ecostatus			
COMPONENT	**PES category & score**	**Flow/ Non-flow**	**EXPLANATION**
Fish	D (47.5)	F	Low flows as a result of current drought, and water use outside of KNP.
Macroinvertebrates	D (44.2)	F & NF	Low flows Pollution from outside the park Modified flow conditions (abstractions and sand mining)
Habitat Integrity: Instream	A/B (89)	F	Water abstraction outside of KNP, flow modification Recent flood and collapse of Kanniedood Dam has restored the natural flows, eliminating the artificial retention and no release that was previously experienced
Habitat Integrity: Riparian	A (93)	NF	Bank erosion Natural impacts through trampling from wildlife Impacts on the basal cover during the current drought
ECOSTATUS	C (69.4)		

Refer to Appendix A for the Habitat Integrity assessment scores for the riparian and instream zone

Shi1: PES and causes	
Component	**Causes** **Present/Absent**
Fish	Lack of flow dependant species due to the current low flow conditions. Additionally marginal habitats are not accessible as they are above the water line and dry.
Macroinvertebrates	The seasonal conditions and increased abstraction (related to sand mining) caused a poor diversity of the macroinvertebrates: of the 45 families associated with flow conditions, only 12 were recorded, only 17 of the 60 associated with habitat diversity and only 18 of the 68 associated with the water quality in the

	system.

Shi1: Overall change and reason for deviation				
COMPONENT	**PES 2012**	**PES 2013**	**PES 2016**	**REASON FOR DEVIATION**
ECOSTATUS	B/C	C	C	Low flows Pollution from outside the park Modified flow conditions (abstractions and sand mining)

Shi1: Ecological trends for the EWR site (include components that were assessed)					
Component	**Trend**			**Reason**	**Confidence (0-5)***
	PES 2012	**PES 2013**	**PES 2016**		
Fish	B/C	-	D	Low flows as a result of current drought, and water use outside of KNP.	4
Macro-invertebrates	D	-	D	Low flows Pollution from outside the park Modified flow conditions (abstractions and sand mining)	4
Habitat integrity: Instream	B/C	-	A/B	Water abstraction outside of KNP, flow modification Recent flood and collapse of Kanniedood Dam has restored the natural flows, eliminating the artificial retention and no release that was previously experienced	4
Habitat integrity: Riparian	A/B	-	A	Bank erosion Natural impacts through trampling from wildlife Impacts on the basal cover during the current drought	4
ECOSTATUS	B/C	C	C		

** 0 – no confidence to 5 – high confidence*

SHI1: OVERALL ASSESSMENT

The site is located on the lower reaches of the Shingwedzi River before it enters Mozambique downstream of the Kannidood Dam in the Kruger National Park. Good diversity of substrate types. Recent flood and collapse of Kanniedood Dam has restored the natural flows, eliminating the artificial retention and no release that was previously experienced. Excessive sand mining is currently taking place outside of the KNP which is resulting in loss of flow and volume flowing into the park. This has a large impact on the availability of water in the park which in turn has a knock on effect on wildlife during the dry seasons.

RECOMMENDATIONS

- Owing to the proximity of this site, full comprehensive surveys should be conducted annually
- Stringent management measures as per KNP protocols for this reach should be adhered to
- Chemical and *in situ* water quality should be monitored annually
- Diatom samples should be taken minimum annually
- Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the low flow conditions
- Riparian VEGRAI should be conducted every 5 years
- The IHI should be conducted annually

5.2 BIOLOGICAL SITES

5.2.1 SITESHI 2: SHISHA RIVER

SITE	DETAILS	VIEW
Site	Shi 2	 
River	Shisha River	
Quaternary Catchment	B90D	
Co-ordinates	-22.848415; 31.243093	
Ecoregion	3_Lowveld	
IUA	-	
SQ Reach	B90D-00067	
IEI Rating	4	
WRUI Rating	0	
Survey type	Biological	
PES 2013 (reach)	A	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_3	
Geozone	E_Lower Foothills	
Gauging weirs	B9H001	

HABITAT AND BIOTA

- Good diversity of biotopes under normal flow conditions.
- Aquatic macroinvertebrates: (*no SASS5 conducted due to lack of flow, shallow puddles*)
- Fish Habitat: moderate – good (*fish not sampled*)

WATER QUALITY

- pH 9.6; EC: 134.0 ms/m; DO 4.81 mg/l

SITE AND UPSTREAM IMPACTS

- No flow – pools only
- Some silt
- Site seasonal – part of large, flat catchment

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

SHI 2: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	n/a	-	Lack of flow, shallow puddles
Macroinvertebrates	n/a	-	Lack of flow, shallow puddles
Riparian vegetation / Habitat Integrity	4	Site not impacted due to seasonal nature – limited trampling	Weir upstream

** Confidence scores: 0 = no confidence; 5 = high confidence*

SHI 2: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Present survey
Macroinvertebrates						Present survey
Riparian vegetation						Historical information Fouché and Vlok (2009)
Physico-chemical						Limited information. Present survey

** 0 (no information) to 4 (large amount of data available)*

SHI 2: OVERALL ASSESSMENT

The site is located in the Shisha River which is predominantly within the Kruger National Park. Upstream impacts are limited as the Shisha River does not have a large discharge and only a small section drains from the Josefa community outside of the park. Therefore future monitoring should be limited to annually.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- *In situ* water quality should be conducted in the wet season
- Fish and macroinvertebrates should be sampled every 3 years towards the end of the wet season.
- Continual management to protect the ecological status of this river.

5.2.2 SITESHI3: MPHONGOLO RIVER

SITE	DETAILS	VIEW
Site	Shi 3	 
River	Mphongolo River	
Quaternary Catchment	B90D	
Co-ordinates	-23.02269; 31.33312	
Ecoregion	3_Lowveld	
IUA	-	
SQ Reach	B90D-00112	
IEI Rating	4	
WRUI Rating	2	
Survey type	Biological	
PES 2013 (reach)	A	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_5	
Geozone	F_Lowland River	
Gauging weirs	B9H004	

HABITAT AND BIOTA

- Limited roots, cobbles and boulder, sand dominated. Some marginal vegetation.
- Aquatic macroinvertebrates: (*no SASS5 conducted due to lack of habitat, shallow puddles*)
  Habitat: Poor to Moderate (*no fish sampled*)

WATER QUALITY

- pH 9.5; EC: 34.0 ms/m; DO 6.45 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- Trampling
- Some bank destabilisation

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

SHI 3: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	n/a	-	Lack of habitat, shallow puddles
Macroinvertebrates	n/a	-	Lack of habitat, shallow puddles
Riparian vegetation / Habitat Integrity	4	Good site, represent the reach Biotopes well represented under normal flow conditions	Lack of SIC, but that is the nature of the system

** Confidence scores: 0 = no confidence; 5 = high confidence*

SHI 3: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historical information Fouché and Vlok (2009)
Macroinvertebrates						Historical information Fouché and Vlok (2009)
Riparian vegetation						Historical information Fouché and Vlok (2009)
Physico-chemical						Limited historic nformation. Present survey

** 0 (no information) to 4 (large amount of data available)*

SHI 3: OVERALL ASSESSMENT

The site is located in the Mphongolo River, downstream of the confluence with the Phugwane and Shisha Rivers.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and *in situ* water quality should be conducted in the wet season
- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Continual management to protect the ecological status of this river reach – impacts from outside the KNP must be monitored.

5.2.3 SITESHI 4: MPHONGOLO RIVER

SITE	DETAILS	VIEW
Site	Shi 4	 
River	Mphogolo River	
Quaternary Catchment	B90B	
Co-ordinates	-22.880714; 30.960158	
Ecoregion	3_Lowveld	
IUA	-	
SQ Reach	B90B-00082	
IEI Rating	1	
WRUI Rating	3	
Survey type	Biological	
PES 2013 (reach)	D	
EI_ES 2013 (reach)	Moderate	
Eco-Region Level II	3_3	
Geozone	E_Lower Foothills	
Gauging weirs	-	

HABITAT AND BIOTA

- All biotopes present under normal flow conditions.
- Aquatic macroinvertebrates: (*no SASS5 conducted due to lack of flow*)
- Fish Habitat: Good (*no fish sampled*)

WATER QUALITY

- No flow – no measurements taken

SITE AND UPSTREAM IMPACTS

- No flow
- Silt
- Agricultural activities (upstream)
- Impacts from grazing(upstream)
- Wood harvesting (upstream)
- Exposed soils (upstream)
- Sewerage (upstream)

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

SHI 4: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	n/a	-	Lack of flow
Macroinvertebrates	n/a	-	Lack of flow
Riparian vegetation / Habitat Integrity	4	Site represent the reach Just inside the KNP Good habitat available under flow conditions	Severe impacts to the west

** Confidence scores: 0 = no confidence; 5 = high confidence*

SHI 4: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						None
Macroinvertebrates						Historical information Fouché and Vlok (2009) – not at the site but upstream
Riparian vegetation						Historical information Fouché and Vlok – not at the site, but upstream
Physico-chemical						Historical information Fouché and Vlok (2009) – not at the site but upstream

** 0 (no information) to 4 (large amount of data available)*

SHI 4: OVERALL ASSESSMENT

The site is located in the Mphogolo River where the river enters the Kruger National Park. This site is important as it provides an indication as to what is entering the Kruger National Park from outside the park. Settlements, centre pivots and cattle grazing have resulted in degradation of the water quality status and riparian habitat. Increases siltation has resulted in habitat smothering.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and *in situ* water quality should be conducted in the wet season.
- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Continual management to protect the ecological status of this river – severe impacts upstream.

5.2.4 SITESHI 5: PHUGWANE RIVER

SITE	DETAILS	VIEW
Site	Shi 5	 
River	Phugwane River	
Quaternary Catchment	B90C	
Co-ordinates	-22.986208; 30.925357	
Ecoregion	3_Lowveld	
IUA	-	
SQ Reach	B90C-00106	
IEI Rating	2	
WRUI Rating	2	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_3	
Geozone	E_Lower Foothills	
Gauging weirs	-	

HABITAT AND BIOTA

- Biotopes well represented during normal flows.
- Aquatic macroinvertebrates: *no flow, fairy shrimps sampled*
- Fish Habitat: Good

WATER QUALITY

- pH 9.3; EC: 29.0 ms/m; DO 6.88 mg/l

SITE AND UPSTREAM IMPACTS

- No flow during survey
- Silt
- Agricultural activities
- Impacts from grazing
- Wood harvesting
- Sewerage
- Exposed soils

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

SHI 5: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	1	Good habitat under higher flow conditions	No fish captured Elevated turbidity (cattle upstream)
Macroinvertebrates	1	Fairy shrimps captured	No flow Turbid water
Riparian vegetation / Habitat Integrity	4	Site represent river with diverse biotopes	High impact from outside KNP

** Confidence scores: 0 = no confidence; 5 = high confidence*

SHI 5: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Historic information Fouché and Vlok (2009) Present survey
Macroinvertebrates						Historic information Fouché and Vlok (2009) Present survey
Riparian vegetation						Historic information Fouché and Vlok (2009)
Physico-chemical						Historic information Fouché and Vlok (2009) Present survey

** 0 (no information) to 4 (large amount of data available)*

SHI 5: OVERALL ASSESSMENT

The site is located in the Phugwane River where the river enters the Kruger National Park. This site is important as it provides an indication as to what is entering the Kruger National Park from outside the park. Settlements (Malamulele) and cattle grazing have resulted in degradation of the water quality status and riparian habitat. Increases siltation has resulted in habitat smothering.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, microbial and *in situ* water quality should be conducted during the wet season
- Fish, diatoms and macroinvertebrates should be sampled annually towards the end of the wet season.
- Continual management to protect the ecological status of this river – impacts from outside KNP have negative results in lower Shingwedzi River.

5.2.5 SITESHI 6: SHINGWEDZI RIVER

SITE	DETAILS	VIEW
Site	Shi 6	 
River	Shingwedzi River	
Quaternary Catchment	B90F	
Co-ordinates	-23.141668; 30.935124	
Ecoregion	3_Lowveld	
IUA	-	
SQ Reach	B90F-00114	
IEI Rating	2	
WRUI Rating	2	
Survey type	Biological	
PES 2013 (reach)	C	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_3	
Geozone	E_Lower Foothills	
Gauging weirs	Downstream B9H002	

HABITAT AND BIOTA

- Dominated by GSM with sparse SIC/SOC under normal flow conditions, some marginal vegetation is present.
- Aquatic macroinvertebrates: (*no SASS5 conducted due to lack of flow*)
- Fish Habitat *(no fish sampled due to lack of flow)*

WATER QUALITY

- No water during the survey

SITE AND UPSTREAM IMPACTS

- Abstraction
- Silt
- Agricultural activities
- Impacts from grazing
- Wood harvesting (wood crafters)
- Mining activities (old discarded mines)

- Exposed soils
- Sewerage

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

SHI 6: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	n/a	-	Lack of flow
Macroinvertebrates	n/a	-	Lack of flow
Riparian vegetation / Habitat Integrity	4	Representative of the reach	Numerous impacts having negative impact of WQ and biota.

** Confidence scores: 0 = no confidence; 5 = high confidence*

SHI 6: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish						Present study
Macroinvertebrates						Present study
Riparian vegetation						Historical information Fouché and Vlok (2009)
Physico-chemical						Historical information. DWS Chemical monitoring programme, downstream site B9H002Q01

** 0 (no information) to 4 (large amount of data available)*

SHI 6: OVERALL ASSESSMENT

The site is located in the Shingwedzi River as it enters the Kruger National Park. Upstream impacts from informal settlements and agricultural activities are contributing to the degraded status of the water quality and riparian habitat integrity at this site. It is important that this site is continually monitored as it represents the quality of water entering the Kruger National Park.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical, diatom, microbial and *in situ* water quality should be conducted in the wet season
- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Continual management to protect the ecological status of this river system – impacts carried through the KNP.

5.2.6 SITESHI 8: SHINGWEDZI RIVER

SITE	DETAILS	VIEW
Site	Shi 8	 
River	Shingwedzi River	
Quaternary Catchment	B90G	
Co-ordinates	-23.172354; 31.304909	
Ecoregion	3_Lowveld	
IUA	-	
SQ Reach	B90G-00130	
IEI Rating	3	
WRUI Rating	2	
Survey type	Biological	
PES 2013 (reach)	B	
EI_ES 2013 (reach)	High	
Eco-Region Level II	3_5	
Geozone	E_Lower Foothills	
Gauging weirs	B9H002	

HABITAT AND BIOTA

- Most biotopes well represented during normal flow conditions.
- Aquatic macroinvertebrates: ASPT: 3.3 (highly tolerant taxa)
- Fish Habitat: Good (under higher flow conditions)

WATER QUALITY

- pH 8.5; EC: 103.0 ms/m; DO 2.67 mg/l

SITE AND UPSTREAM IMPACTS

- Very low flows
- Some pollution from outside KNP

This was a new biological site as identified from the gap analysis in order to support the biological tributary catchment. Therefore, no ecostatus was determined.

SHI 8: Site evaluation			
Component	**Confidence Score***	**Advantages**	**Disadvantages**
Fish	4	Most biotopes present	Low flow conditions Trampling of marginal vegetation
Macroinvertebrates	3	Substrate heterogenity	Low flow conditions Trampling of marginal vegetation
Riparian vegetation / Habitat Integrity	4	Good habitat available. Water mostly year round	Some trampling and erosion of river banks

** Confidence scores: 0 = no confidence; 5 = high confidence*

SHI 8: Information availability						
COMPONENT	**INFORMATION AVAILABILITY***					**DESCRIPTION OF INFORMATION**
	0	1	2	3	4	
Fish				■		B9SHIN-REDRO Present survey
Macroinvertebrates				■		B9SHIN-REDRO Present survey
Riparian vegetation			■			Historical information Fouché and Vlok (2009)
Physico-chemical				■		Historical information. DWS Chemical monitoring programme, upstream site B9H002Q01

** 0 (no information) to 4 (large amount of data available)*

SHI 8: OVERALL ASSESSMENT

The site is located in the Shingwedzi River downstream of the geological feature exposed by the river (sandstone slab) know as Red Rocks. This site is above the confluence of the Mphongolo (including: Shisha and Phugwane). Some upstream impacts from the Altein and Mphambo community areas. It will be important to monitor this site before the inputs from the more stressed Phugwane and Mphongolo systems are incorporated into the system.

RECOMMENDATIONS

- Annual REMP protocols should be conducted
- Chemical and *in situ* water quality should be conducted on a quarterly basis
- Fish and macroinvertebrates should be sampled annually towards the end of the wet season.
- Continual management to protect the ecological status of this river.

6 PRIORITY CATCHMENT AREAS AND PRELIMINARY PROPOSED HYDRONODES

Following theassessment of the EWR sites and the identified biological sites where Rapid III's were conducted to enhance the existing information and to enable the extrapolation of EWRs, catchment nodes were selected for priority river reaches based on protection measures identified. These were selected based on the results from the biological surveys conducted for this project, where it is considered important that flows be maintained to support the ecological integrity and health of the system. Through this process preliminary nodes within the Olifants, Letaba and Shingwedzi catchments have been identified for the setting of flows and may include additional ecological specfications.It is important to note that this forms part of the preliminary selection of the nodes and the finalrefinement and prioritisation will take place during the EWR refinement step of the project. The preliminary priority nodes best represent the upstream reach or area of the aquatic ecosystem requiring conservation and protection measures going forward. Information for the identified priority areain the Olifants, Letaba and Shingwedzi Catchments is indicated inTable 3 and the node location is illustrated in **Figure *5***. Furthermore, it is important to note that each node was evaluated in accordance to its requirmentes from a flow, biological or water quality perspective. This is indicated on the map below in **Figure *5***.

Table 3: Preliminary priority river reaches selected for protection in the Olifants, Letaba and Shingwedzi Catchments

(The grey indicates those priority sites which have a high priority for flow requirments. The red sites are the primarly key sites).

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
Olifants Catchment								
1	Piekespruit	Piekespruit	B11C	3			Protection, maintain PES	PES = B
	Blesbokspruit	Blesbokspruit	B11E	3			Protection, maintain PES	PES = B
	Steenkoolspruit at B1H021	Steenkoolspruit at B1H021	B11E	1			Maintain PES (possible improvement to C/D)	PES = D To capture upstream cumulative impacts and influences before the confluence with the olifants
	Olifants at B1H018	Olifants	B11A	1			Maintain PES	PES = C, EI=ES=High Upstream of most mining impacts, for protection of tributaries in B11A
	Olifants/Steenkool confluence	Olifants	B11B	2			Maintain in PES and improve lower section to D	PES=C for most of reaches, except last reach=E Assessing everything which occurs in the upper olifants before entering the larger olifants catchment
	Tweelingspruit	Tweefonteinspruit	B11F	3			Improve to a PES of D	PES = E To capture upstream cumulative impacts and influences before the confluence with the olifant. The outlet of B11B quat. The

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
								river is in an E therefore the PES needs to improve
	Olifants at B1H005	Olifants	B11G	1			Maintain PES (possible improvement to C/D)	PES = D Site is above the Witbank Dam and thus this site is very important as it takes into account the whole upper catchment. Captures all quats from B11A to B11F. Priority site!
	Noupoortspruit	Noupoort	B11G	2	NOU-EWR1		Maintain PES	Need to maintain PES to ensure dam and lower reaches in acceptable state Takes into account WWTW, mining, industrial and new mining applications (?) before entering the olifants system Set water quality specs (NB)
	Spookspruit	Spookspruit	B11H	1	SPK_EWR1	RU9 Witbank Dam & River	Maintain PES	PES = C Lots of mining development (pH=2) and receiving impacts and influences from quat B11H. Quality is a significant issue in addition to flow
	Olifants at EWR site	Olifants	B11J	Key site	Olifants_S5 (EWR1)	RU11 River	Maintain PES (possible	Currently a negative trend, need to improve for downstream reaches

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
							improvement to C/D)	Important to have this site in order to improve the system
	Klein Olifants/Woestalleen	Klein-Olifants	B12B	3			Improve to a PES of D	PES = E Identify what is coming in from Klein-Olifants
	Woestalleen	Woes-Alleenspruit	B12B	3			Improve to D	PES = E Identify what is coming in from Woestalleen
	Klein Olifants above Mburg Dam	Klein-Olifants	B12C	1	OLI-EWR1	RU18 Middelburg Dam	Improve to D	PES = E This site will identify whether the impacts are concentrated from the klein-Olifants or Woestalleen
	Klein Olifants below WWTW	Klein-Olifants	B12D	1	Olifants_S6		Maintain PES (possible improvement to C/D)	PES = D
	Klein Olifants at EWR site	Klein-Olifants	B12E	Key site	EWR3	RU34 River	Maintain PES	RQO set for Klein Olifants in RU35
	Keeromspruit	Keeromspruit	B12E	3			Maintain PES	Mining applications, to protect otherwise it will impact the lower Klein-Olifants and make it worse than its current state with inputs from the WWTW
	Klipspruit	Klip	B11L	2		RU12 River	Maintain PES (possible improvement to D)	PES = E Currently in a E with RQOs set
	Olifants above Wilge	Olifants	B11L	1		RU13 River		

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
							Maintain PES	For maintenance of Olifants into Loskop Dam
2	Upper Wilge at EWR site	Wilge	B20F	1	Olifants_S3	RU26 Wilge Dam	Maintain PES	To ensure lower reaches of Wilge can be improved to a B/C Sub-catchment before the Bronkhorstspruit Dam
	Bronkhorst above dam	Bronkhorstspruit	B20C	2			Maintain PES	To ensure lower reaches of Wilge can be improved to a B/C Sub-catchment before the Bronkhorstspruit Dam
	Osspruit	Osspruit	B20C	3			Maintain PES	To ensure lower reaches of Wilge can be improved to a B/C To ensure the upper reaches are retained to keep the B/C PES in the Wilger above the Bronkhorstruit Dam
	Bronkhorst above Wilge	Bronkhorstspruit	B20D	1		RU24 Bronkhorst Dam	Maintain PES	To ensure lower reaches of Wilge can be improved to a B/C Below all impacts of Bronkhorstspruit to maintain the PES
	Saalboomspruit	Saalboomspruit	B20G	1	SKS_EWR1		Maintain PES	To ensure lower reaches of Wilge can be improved to a B/C, intensified mining activities and developments
	Lower Wilge at EWR site	Wilge	B20J	Key site	Olifants_S2 (EWR4)	RU31 River	Improve to B	Provides some good quality and flows to Olifants currently under stress

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
								Cumulative effects to ensure a PES is improved to a B as per the ORRS
3	Kranspoortspruit at EWR site	Kranspoortspruit	B32A	1	Olifants_S8 (OLI-EWR3)		Maintain PES	Protection, rare fish (PWES and BLIN and flow related species). Site acts as a refugia above the Loskop dam Pressure for mining development in the upper catchment
	Selons at EWR site	Selons	B32C	1	Olifants_S9	RU38 Roodepoort Dam	Improve to C	Negative trend Agricultural pressure Site acts as a refugia below the Loskop dam
	Olifants at EWR site	Olifants	B32A	Key site	Olifants_S7 (EWR2)	RU37 River	Maintain PES B/C	For maintenance of river downstream to lower Olifants
4	Elands above RustdeWinter Dam	Elands	B31C	1	Olifants_S1	RU41 Rust de Winter Dam	Improve to C	Negative trend Takes into account impacts and influences from B31A, B and C quats
	Kameel above Elands	Kameel	B31G	3			Improve to C/D	Negative trend with developments (rural, towns) in upper reaches Takes into account impacts and influences from B31G
	Elands at EWR site	Elands	B31G	Key site	EWR6	RU45&46 River & Mkhombo Dam	Improve to C/D	Dam not releasing to maintain river

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
	Elands at B3H021	Elands	B31J	1		RU47 River	Improve to D	Return flows, water quality due to irrigation and high town developments and agriculture Taking into account the entire B31J quat
5	Olifants at EWR site	Olifants	B32D	Key site	EWR5	RU40 River & Loskop Dam	Maintain PES C	Maintenance of river downstream Loskop to Flag Boshielo. In accordance to the expected fish list for this site, there are a number of migratory fish species which require a migratory distance of 10-50km.
	Bloed above Olifants	Bloed	B32F	1		RU48 Rooikraal Dam	Improve to C	Extensive irrigation in lower reaches
	Moses at B3H005	Moses	B32H	1		RU49 River	Improve to C/D	Rural developments with negative trend and agriculture To ensure the quality going into the olifants
6	Grootspruit	Grootspruit	B41A	1		RU54 River & Belfast Dam	Improve to C	Mining and town developments, negative trend for Steelpoort downstream. RQO for the Belfast dam
	Langspruit	Langspruit	B41A	3			Improve to C	Mining and town developments, negative trend for Steelpoort downstream Important for the Langvlei wetlands and to ensure

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
								good water is coming in from the wetlands
	Tonteldoos & Vlugkraal	Tonteldoos & Vlugkraal	B41C	2		RU56 Vlugkraal & Tonteldoos Dams	Maintain PES	RQOs set for dams
	Steelpoort after Laersdrift	Steelpoort	B41D	1	OLI-EWR2	River	Maintain C	Inflows to De Hoop Dam Side channels coming in from the mining areas from the east. Ensure water quality into the De Hoop Dam is maintained
	Klip above De Hoop	Klip	B41F	3	OLI-EWR4		Improve to B	Rural developments and proposed mining impacts on river, unique fish (*Enteromius (Barbus) motabensus* BMOT – site E7) Site acts as a refugia above the De Hoop Dam
	Steelpport at De Hoop	Steelpoort	B41H	Key site	EWR9	RU64 De Hoop Dam	Maintain C/D	Releases for lower reaches of Steelpoort and middle reaches of Olifants
	Dwars at EWR site	Dwars	B41H	1	DWA-EWR1	RU62 River & Der Bruchen Dam	Maintain PES	Mining pressures and contributes to flows in lower Steelpoort Important fish refugia below De Hoop Dam The quality is decreasing and thus needs to be monitored
	Steelpoort at EWR site	Steelpoort	B41K	1	EWR10	RU66 River	Maintain PES	Releases for middle reaches of Olifants

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
7	Olifants below Flag Boshielo	Olifants	B51C	Key site	EWR7	RU52&53 River & Flag Boshielo Dam	Improve to D	PES=E due to limited releases, impacts on middle reaches of Olifants Important for social obligation and improvement for the site in the KNP (site - S16)
	Nkumpi	Nkumpi	B51G	3			Improve to D	PES=E, Development pressures (rural and agriculture and new mining applications) Taking into account all impacts and influences from quat B51G
	Olifants below Chunies	Olifants	B52E	3		RU72 River	Maintain PES (possible improvement to C/D)	PES = D High rural development Measuring all impacts and influences from B52E Needs to be monitored from a biological and flow perspective (no flow)
	Olifants at EWR site	Olifants	B71D	Key site	Olifants_S10 (EWR8)		Improve to C	PES=E On the Olifants to ensure it improves to a PES C at site and the B class for the KNP (site S16)
	Mohlapitse above Olifants	Mohlapitse	B71D	2			Maintain PES	Currently in a C, provide some flows to middle reaches of Olifants Taking into account impacts from Mohlapitse which brings in water from Wolkberg (good quality

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
								water) and in turn will aim to improve the PES to a C at Olifants at EWR8 and impacts from informal settlements Good habitat for both fish and inverts Good fish refugia
	Motse	Motse	B71E	3			Improve to C/D	Development pressures (town development and mining pressure)
	Olifants above Steelpoort	Olifants	B71F	1		RU95 River	Maintain D	To ensure adequate flows in Olifants in lower reaches
8	Dorpspruit below Lydenburg	Dorps	B42C	1	OLI-EWR9	RU74 Lydenburg Dam	Maintain PES	Water quality a considerable problem (High informal settlements), impacts on quality of Spekboom
	Watervals below Buffelskloof Dam	Waterval	B42G	1			Maintain PES	Releases required for EWR to contribute to flows in lower Spekboom. High irrigation which is contributing to lower Spekboom
	Rooiwalhoek-se-Loop	Rooiwalshoek se Loop	B42G	3			Protection, maintain PES	PES=B, only 'good' system left in this IUA Needs protection
	Watervals at EWR site	Waterval	B42G	1	OLI-EWR5	RU79 Bufelskloof Dam	Maintain PES	Contribute to flows in lower Spekboom
	Spekboom at EWR site	Spekboom	B42H	Key site	Olifants_S11	RU82 River	Maintain PES	Contribute to flows in lower Steelpoort

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
9	Ohrigstad below dam	Ohrigstad	B60F	1		RU83 River & Ohrigstad Dam	Maintain PES	River less impacted by irrigation developments No releases from the dam therefore low flows
	Vyehoek	Vyehoek	B60G	3			Improve to B/C	Development pressures (extensive irrigation in lower reaches). If the water quality deteriorates, will impact on the Blyderiverpoort Dam
	Ohrigstad above Blyderriver Dam	Ohrigstad	B60H	1	OLI-EWR8	RU86 River	Maintain PES	Almost no flows due to upstream use
10	Olifants at EWR site	Olifants	B71J	Key site	Olifants_S13 (EWR11)	RU96 River	Maintain PES C	PES=E (1999 study, currently in C), improvement to assist with flows in KNP.
	Lower Blyde at EWR site	Blyde	B60J	Key site	Olifants_S14 (EWR12)	RU88 Blyderivierpoort Dam	Improve to B	Currently on negative trend due to developments. Provides water to lower reaches of Olifants in the KNP.
	Makhutsi	Makhutswi	B72B	1		RU97 River	Protection, maintain PES	Small system with increasing pressures (rural settlements, commercial agriculture). Taking into account the whole sub-catchment
	Klaserie at B7R001	Klaserie	B73B	1	OLI-EWR7	RU106 Klaserie Dam	Maintain PES	PES=C, providing good habitats for biota Drains from an area with high forestry, agriculture and rural activities and an important contributor to the KNP. Needs to be

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
								maintained in order to obtain a PES B in the KNP
	Olifants at EWR site	Olifants	B72D	1	Olifants_S15 (EWR13)	RU98&105 River	Improve to PES B/C	PES=C, to provide adequate flows in KNP. An important contributor to the KNP. Needs to be maintained in order to obtain a PES B in the KNP
11	Ngwabitsi below Tours Dam	Ngwabitsi	B72E	1		RU99 Tours Dam	Protection, maintain PES	Still in a good state compared to lower reaches
	Upper Ga-Selati at EWR site	Ga-Selati	B72K	1	EWR14a		Maintain PES	Still in a good state compared to lower reaches To have an understanding of the water quality as the upper reaches of this river goes into the Palaborwe complex
	Ga-Selati at EWR site	Ga-Selati	B72K	Key site	EWR14b	RU103&104 River	Improve to D	PES=E mainly due to quality impacts from Phalaborwa and mining An important contributor to the KNP. Needs to be maintained in order to obtain a PES B in the KNP
12	Olifants at B7H015	Olifants	B73C	1		RU114 Phalaborwa Barrage	Improve to C	To provide adequate flows in KNP An important contributor to the KNP. Needs to be maintained in order to obtain a PES B in the KNP

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
	Timbavati outside KNP	Timbavati	B73E	2			Maintain PES	Development pressures and for protection of river in KNP An important contributor to the KNP. Needs to be maintained in order to obtain a PES B in the KNP
	Timbavati before Olifants	Timbavati	B73G	2			Maintain PES	KNP river Needs to be maintained in order to obtain a PES B in the KNP
	Olifants at EWR site	Olifants	B73H	Key site	Olifants_S16 (EWR16)		Improve to B/C with a final aim to a B	Negative trend and needs improvement, especially the flows Before the confluence of the Letaba
	Olifants after Letaba	Olifants	B73J	1		RU116 River	Improve to C	Negative trend and needs improvement, especially the flows. To ensure good water quality moving in to Mozambique (international obligation)
13	Upper Blyde at EWR site	Blyde	B60B	Key site	Olifants_S12		Improve to B	Provides good quality water for the lower Blyde
	Treur at B6H003	Treur	B60C	1	TRE-EWR1		Protection, maintain PES	Almost natural Needs protecton Red data fish species (Enteromies (Barbus) Treurensis)
	Blyde at B6H001	Blyde	B60D	1		RU121	Maintain PES	Provides good quality water for the lower Blyde

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
Letaba Catchment								
1	Upper Broederstroom	Broederstroom	B81A	1	LET18		Maintain PES	Extensive forestry and therefore water use and inflow into the Dap Naude Dam
	Lower Broederstroom	Broederstroom	B81A	2			Maintain PES	Between Dap Naude and Ebenezer Dams. To maintain water quality and maintain natural hydrological characteristics
	Politsi	Politsi	B81B	3			Maintain PES	Development pressures (forestry and agriculture) and ensure water quality for Tzaneen dam
	Great Letaba at Appel	Great Letaba	B81B	Key site	LET16 (EWR1)	River	Improve to B/C	Inflows to Tzaneen Dam an important for flows
2	Bobs before Letsitele	Bobs	B81D	3			Protection, maintain PES B	Extensive forestry Protection and maintenance for water quality. Important water source for Letsitele. Water quality issues (rural settlements)
	Thabina before Letsitele	Thabina	B81D	2			Improve to C/D	Development pressures (rural settlements and industrial activities)
	Letsitele at EWR site	Letsitele	B81E	1	LET14 (EWR2)	River	Improve to D	PES=E, development pressures and quality
3	Great Letaba above Letsitele	Great Letaba	B81C	1			Improve to C	Provision of flows to middle and lower reaches of Letaba River in KNP Commercial agriculture and informal settlements

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
4	Great Letaba at Hans Merensky	Great Letaba	B81F	1	EWR3	River	Improve to C	Provision of flows to middle and lower reaches of Letaba River in KNP
	Great Letaba at Letaba Ranch	Great Letaba	B81J	1	EWR4	River	Improve to C	Provision of flows to middle and lower reaches of Letaba River in KNP Final check with the confluence of the Klein Letaba
6	Nwanedzi before Great Letaba	Nwanedzi	B81E	3			Improve to C/D	Pressures from rural developments, water quality issues and want to improve to a C/D
	Molototsi before Great Letaba	Molototsi	B81H	3			Improve to C/D	Pressures from rural developments, water quality issues and want to improve to a C/D
7	Brandboontjies	Brandboontjies	B82C	1		River	PES=E, Improve to D	RQO study - hotspot
	Middle Letaba above dam	Middel Letaba	B82D	1		River	PES=E, Improve to D	RQO study - hotspot Taking into account Koedoes and Brandboonjies plus middle Letaba catchments (B82A, B, C and D)
8	Little Letaba above Middle Letaba	Little Letaba	B82F	2			Improve to B/C	Provision of flows to lower reaches of Little Letaba
9	Little Letaba at EWR site	Little Letaba	B82G	1	EWR5	River	Improve to B/C	Provision of flows to lower reaches of Little Letaba
	Little Letaba above Great Letaba	Little Letaba	B82J	3			Maintain PES	Provision of flows to lower reaches of Little Letaba

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
								Right at the bottom of the system
10	Nsama	Nsama	B82H	3			Maintain PES	Rural and development pressures Important trib to the Klein-Letaba
11	Letaba at EWR site	Letaba	B83A	1	EWR6	River	Improve to B/C	Negative trend and needs improvement, especially the flows Taking into account of the impacts from the Groot and Klein Letaba
	Letaba in KNP	Letaba	B83D	Key site	LET2 (EWR7)	River	Improve to C	Negative trend and needs improvement, especially the flows
12	Tsende	Tsende	B83C	2			Protection, maintain PES	Few rivers in good state Needs protection Good water quality for Letaba
Shingwedzi Catchment								
	Mphongolo at KNP border	Mphongolo	B90B	2			Maintain PES	Impacts from rural developments Abstraction at Makulek
	Shisha before Mphongolo	Shisha	B90D	2			Maintain PES	Wetland-pool system in KNP Provides good quality water into the Shingwedzi so needs to maintain the natural hydrology of this system
	Shingwedzi at KNP border	Shingwidzi	B90F	1			Maintain PES	Impacts from rural developments

IUA	Node Name and Brief Description	River	Quaternary	Priority (quantity)	EWR sites	RQO (quantity)	Reason	Motivation
								Site enters the KNP so need to monitor what is coming into the KNP
	Mphongolo before Shingwedzi	Mphongolo	B90H	2			Maintain PES	Impacts from rural developments Site enters the KNP so need to monitor what is coming into the KNP
	Shingwezi in KNP	Shingwidzi	B90H	Key site	SHI1		Maintain PES	Site is within the KNP

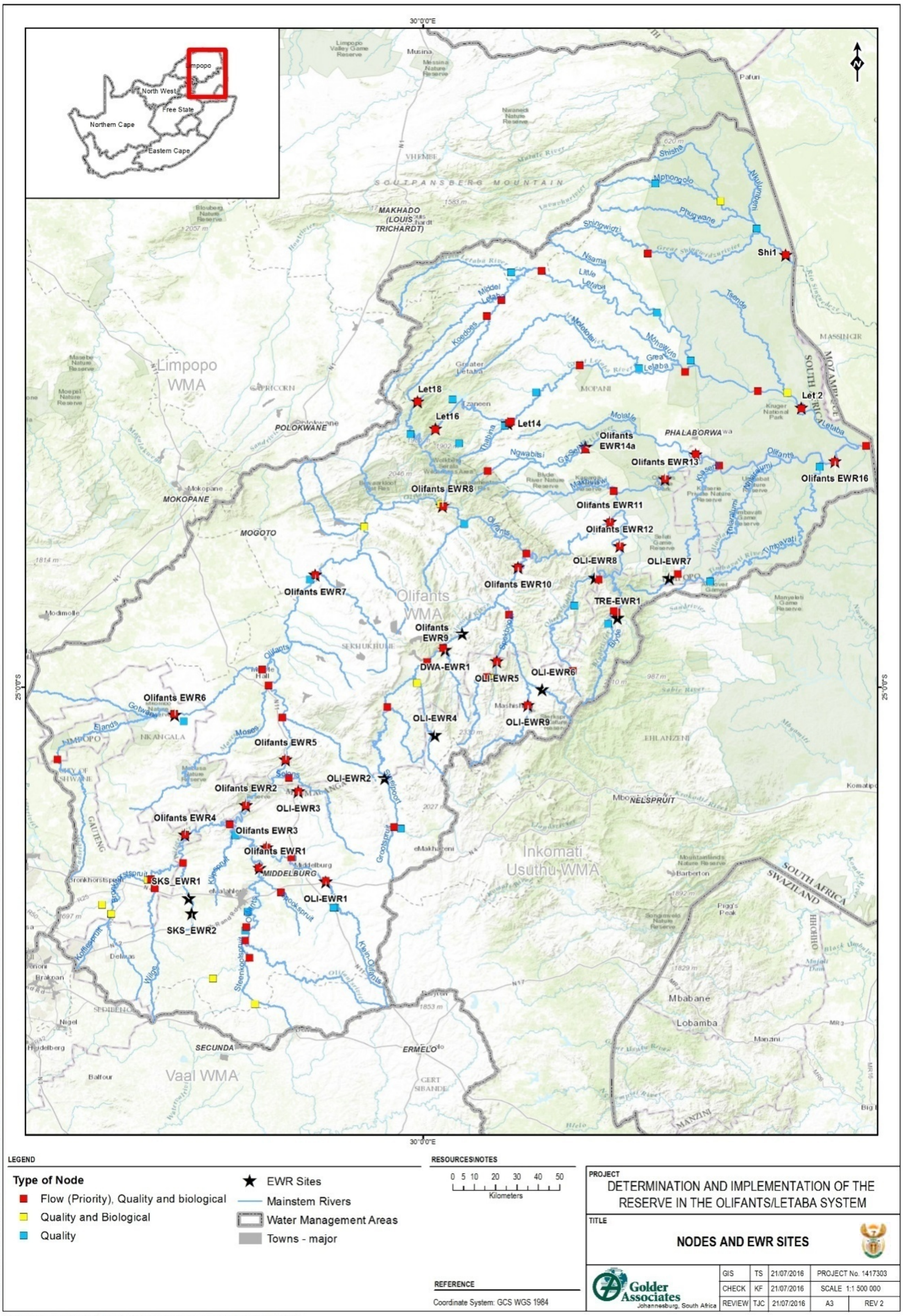


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Figure 5: Indicating IUAs with location of initial selection of hydronodes and EWR sites. *The black stars indicate the existing EWR sites. The red blocks show the priority sites where flow is a high priority, yellow blocks indicate a high priority for quality and biological and the blue blocks a high priority for water quality. (map created by Golder).*

7 CONCLUSION: CATCHMENT SUMMARY AND RECOMMENDATIONS FOR THE OLIFANTS SYSTEM SURVEY

Olifants

Owing to the drought and low flow conditions being abnormal at the time of the Olifants catchment field survey, this resulted in low water levels and low flow velocities at majority of the sites surveyed. This subsequently had a negative impact on the *in situ* water quality, aquatic biota, as well as the riparian and instream habitat integrity. This was taken into account when reviewing the overall Present Ecological State (PES) of each site assessed for the Olifants catchment.

However despite the above, an increase in mining activities within some parts of the Olifants catchment, is contributing to the utilisation of the natural resources. Mis-management of waste water treatment works, primarily within the upper reaches of the catchment, are further posing a serious threat to various rivers within the system and ultimately to the lower Olifants River in the Kruger National Park.

In terms of the PES of the sites assessed, they were generally in a lower than expected state owing to the exceptional low flows, poor water quality, low aquatic biota diversity and inadequate riparian and instream habitats available. Realistic management recommendations were therefore set to achieve the desired management classes. A summary of the PES from 1999 (comprehensive Reserve study), 2010 (re-visiting of selected Ecological Water Requirements (EWR) sites for the reconciliation strategy) and from this current survey for the Olfiants Catchment is tabulated below(**Table 4**) and illustrated in Figure 6 below. Based on the Eco-classification undertaken and what has been observed, key sites have been identified by the specialists (within the Olifants Catchment) as proposed strategic monitoring sites owing to their locality within the catchment, extensive upstream impacts and sensitivity around some of these sites. These sites are listed in **Table 5**.

Table 4: Summary of the overall change in the PES for each EWR site in the Olifants catchment

Site Name	River Name	Quaternary Catchment	PES 1999	PES 2010/ 2011*	PES 2015	Change in PES
S1 (New Rapid II)	Elands	B31C	New rapid II		**C/D**	**N/A**
S2 (Resurvey Olifants EWR 4)	Lower Wilge	B20J	**C**	**C**	**C**	=
S3 (New Rapid III)	Wilge	B20F	New rapid III		**C/D**	**N/A**
S4 New Rapid III	Olifants	B11G	*This site was not surveyed during the October 2015 survey as there was no suitable hydraulic site present. However, the available information from a biological perspective will be evaluated.*			***N/A***

Site Name	River Name	Quaternary Catchment	PES 1999	PES 2010/ 2011*	PES 2015	Change in PES
S5 (Resurvey Olifants EWR 1)	Olifants	B11J	D	D	D	=
S6 (Replacing Olifants EWR 3)	Klein Olifants	B12D	D	-	D/E	↓
S7 (Resurvey Olifants EWR 2)	Olifants	B32A	C	-	C	=
S8 (Resurvey of Olifants Rapid III site)	Kranspoortspruit	B32A	-	B*	C	↓
S9 (New Rapid III)	Selons	B32C	*New Rapid III site*		D	***N/A***
S10 (Resurvey Olifants EWR 8)	Olifants	B71D	C	C/D	C	↑
S11 (New Rapid III)	Spekboom	B42H	*New Rapid III site*		C	***N/A***
S12 (New Rapid III)	Upper Blyde	B60B	*New Rapid III site*		C	***N/A***
S13 (Resurvey Olifants EWR 11)	Olifants	B71J	E	-	C	↑
S14 (Resurvey Olifants EWR 12	Lower Blyde	B60J	B	B/C	C	↓
S15 (Resurvey Olifants EWR 13: Rapid II)	Olifants	B72D	C	C	C	=
S16 (Resurvey Olifants EWR 16)	Olifants	B73H	C	C	D	↓

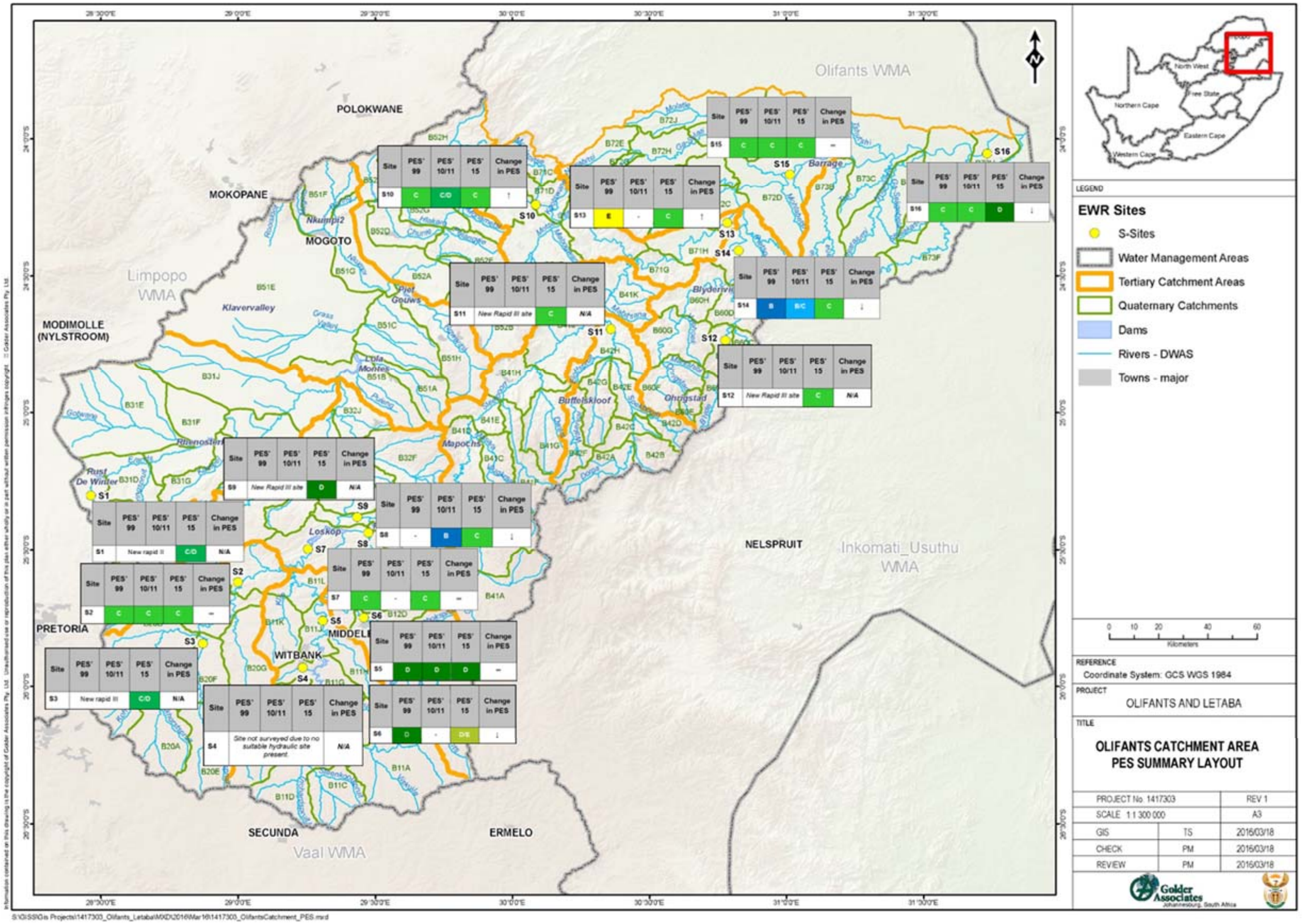

Figure 6: Summary illustrating the overall change in the PES for each EWR site within the Olifants catchment (map created by Golder)

Table 5: Summary of proposed strategicsites within the Olifants Catchment

Site	River	Co-ordinate	Catchment	Major Tributaries	Impacts and Motivation	Recommendations
S2	Wilge	-25.61962° 28,999047°	B20J	• Bronkhorstspruit • Saalboomspruit	• Increased coal mining in the upper reaches of the Wilge, Saalboomspruit and Bronkhorstspruit • Town developments with increased return flows from wastewater treatment works	• Chemical and *in situ* water quality should be monitored bi-annually • RQO's must be enforced • Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet and dry season • Riparian VEGRAI should be conducted every 5 years • The IHI should be conducted annually

S4	Olifants	-26.00225°
		29.292756°
			B11G	• Steenkoolspruit
				• Rietspruit
				• Viskuilespruit
				• Kilppoortjie
				• Tweeefontienspruit
					• Coal mining in the Witbank andOgies areas
					• Extensive cultivation and grazing and cattle farming
						• The recommended full REMP protocol must include the following:
						  • Chemical, microbial and *in situ* water quality should be monitored quarterly;
						  • Diatom samples should be taken minimum annually;
						  • Whole Effluent Toxicity (WET) testing should be conducted quarterly until results are resolved;

S5	Olifants	-25,75918° 29,309564°	B11J	Entire upstream catchment of Olifants before Klein Olifants confluence	• Extensive coal mining, AMD • Town development and return flows from WWTWs • Witbank Dam and numerous small dams	

Site	River	Co-ordinate	Catchment	Major Tributaries	Impacts and Motivation	Recommendations
S6	Klein-Olifants	-25.74878° 29.459030°	B12D	• Woes-Alleenspruit • Rietkuilspruit • Vaalbankspruit • Coetzerspruit • Boesmanspruit	• Middleburg Dam • Mining in upper catchment near Pullen Hopes /Arnot /Hendrina • Agriculture	• Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the wet and dry season; • Riparian VEGRAI should be conducted every 5 years; and • Index of habitat integrity (IHI) should be conducted annually.

S7	Olifants	-25.49685°
		29.255104°
			B32A	• Wilge
				  • Grootspruit
				  • Bronkhortspruit
				  • Saalboomspruit
				• Klein-Olifants
				  • Klip
					• Agriculture, extensive settlement
					• Mining
					• Power Stations (Kendal and Kusile)
					• Industrial complex withinWitbank	

X13	Elands	-24.92026° 29.318663°	B31J	• Kameel River • Gotwane River • Hartbeesspruit	• Agriculture intensive around Marble Hall • Villages, informal / poor infrastructure • abstraction	
New De Hoop	Steelpoort	-25.03274° 29.851941°	B41D	• Tronteldoos • Masala • Laersdrift • Lagspruit • Grootspruit • Laakinvlei	• Mining, proposed mining, forestry, dryland cultivation, informal settlements	
X16	Olifants	-24.52895° 29.546084°	B51G	• Nkumpi • Tributaries draining from the Mtlala area (B51A/B/C/H)	• Informal settlement, agriculture • Springbok flats draining in towards the water	

Site	River	Co-ordinate	Catchment	Major Tributaries	Impacts and Motivation	Recommendations
				• Elands	resources • Erosion	
S10	Olifants	-24.24109° 30.086578°	B71D	• Motlapits • Tongwane • Pelangwe • Chunies • Hlakaro	• Mining • Farming • Wolkburg, Legalametis Reserve • Communities in Steelpoort valley	
H4	Steelpoort	-24.50446° 30.398417°	B41K	• Tshwetlane • Mabitsana • Spekboom • Moopetsi • Dwars	• Mining, influx of people, Burgersfoort • Abstraction, de Hoop Dam	
S13	Olifants	-24.30782° 30.785832°	B71J	• Steelpoort	• Intensive agriculture - citrus • Game farming • Informal settlements • erosion	
S14	Lower Blyde	-24,40748° 30,827404°	B60J	• Upper Blyde • Treur • Ohrigstad	• Extensive agriculture in Ohrigstad and Lower Blyde • Blyderivierpoort Dam • Pipeline from Lower Blyde for irrigation	
Ga-	Ga-Selati	-24.03580°	B72K	• Molatle	• Abstraction, farming,	

Site	River	Co-ordinate	Catchment	Major Tributaries	Impacts and Motivation	Recommendations
Selati		31.167856°			WWTW return flow, Phalaborwa industrial complex	
S16	Olifants	-24.05150° 31.733259°	B73H	• Timbavati • Klaserie • Nhlaralumi • Blyde	• Protected Area (Kruger National Park)	
X23	Olifants	-23.98734, 31.828179	B73J	• Olifants	• Most downstream site in the system before flowing into Mozambique • Located downstream of the Olifants and Letaba confluence and is the most downstream site of the greater catchment. • Takes into account all cumulative impacts sourced from the Olifants and Leteba catchments.	• Aquatic macroinvertebrates should be sampled annually. • Fish sampled every three years or should any changes or other indices are detected • Full chemical and *in situ* water quality is to be sampled annually. • Diatom sampling should be undertaken annually.

Letaba and Shingwedzi

The environmental stresses on the aquatic ecosystem as a result of the drought experienced by the country at the end of 2015 and beginning of 2016, were still visible within parts of the Letaba and Shingwedzi Catchments during the time of the survey (April 2016). Some sites were either dry or characterised by low water levels, low flow conditions and exposed habitats, all of which meant that the habitats were not ideal for biota or biological monitoring. Water quality impacts, as a result of the upstream mining, land use practices and urbanisation, within the Olifants catchment, continue to be reflected within parts of the Letaba Catchment with elevated Total Dissolved Solids (TDS) and observed algal blooms (nutrients). Sites within the Letaba catchment prior to entering the Kruger National Park (KNP) were further impacted by alien invasive species, both aquatic and terrestrial, thus changing the indigenous biotic composition for that river reach and consequently lowering the PES. Additional impacts within the KNP borders included some trampling by mega herbivores which escalated the erosion during the drought period along the river reaches.

In terms of the Shingwedzi Catchment, limited work has been done in this catchment owing to its non-perennial nature. This was exacerbated by the effects of the drought, and as a result a number of sites were not flowing, thus automatically eliminating any flow dependent aquatic species.

As a result of the surveys, selected sites within both catchments were red-flagged where conservation and protective measures will be put in place.

The PES of the sites assessed were generally in the same ecological category as previous studies undertaken. Realistic management recommendations were therefore set to maintain and achieve the desired management classes. A summary of the PES from 2006, 2013 and from this current survey for the Letaba and Shingwedzi Catchment (2016) is tabulated below (
Table 6) and illustrated in the Error! Reference source not found.**below. (indicate which table)**

Table 7 further provides a summary of the EWR sites surveyed within the Letaba and Shingwedzi Catchments and their associated impacts and proposed mitigation and monitoring measures.

Table 6: Summary of the overall change in the PES for each EWR site in the Letaba and Shingwedzi Catchments

Site Name	River Name	Quaternary Catchment	PES 2006	PES 2013	PES 2016	Change in PES
Letaba						
LET2 (Resurvey Letaba EWR 7)	Letaba	B83D	C	C	C/D	↓
LET14 (Resurvey Letsitele EWR 2)	Letsitele	B81D	D	D	D	=

Site Name	River Name	Quaternary Catchment	PES 2006	PES 2013	PES 2016	Change in PES
LET16 (Resurvey Letaba EWR 1)	Letaba	B81B	C	C	C/D	↓
LET18 (New Rapid III)	Broederstroom	B81A	-	C	B/C	↑
Shingwedzi						
SHI1 (survey)	Shingwedzi	B90H	B/C	C	C	=

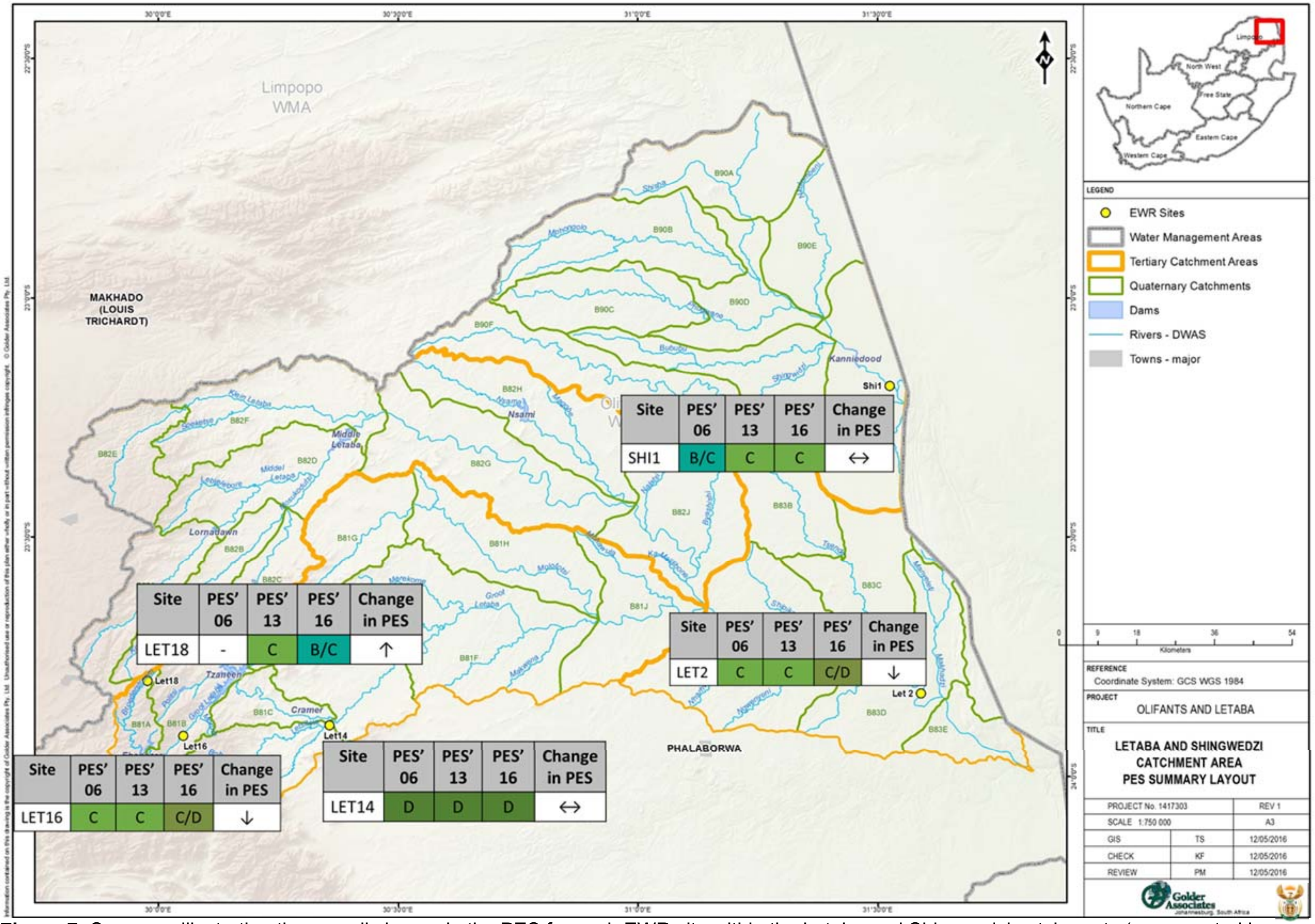

Figure 7: Summary illustrating the overall change in the PES for each EWR site within the Letaba and Shingwedzi catchments (map created by Golder)

Table 7: Key sites within the Letaba and Shingwedzi Catchment

<table>
<tr><th>Site</th><th>River</th><th>Co-ordinate</th><th>Catchment</th><th>Major Tributaries</th><th>Impacts and Motivation</th><th>Monitoring Recommended</th></tr>
<tr><td colspan="7">Letaba</td></tr>
<tr><td>LET2</td><td>Letaba</td><td>-23.8268, 31.59061</td><td>B83D</td><td>• Nwandedzi
• Manyeleti</td><td>• Flows
• Dams and extensive water use outside KNP
• Trampling
• Erosion
• Some poor water quality</td><td rowspan="4">• Owing to the proximity of this site, full comprehensive surveys should be conducted annually
• Stringent management measures as per KNP protocols for this reach should be adhered to
• Chemical and in situ water quality should be monitored quarterly
• Diatom samples should be taken minimum annually
• Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the low flow conditions
• Continuous monitoring of flows
• Riparian VEGRAI should be conducted every 5 years
• The IHI should be conducted annually</td></tr>
<tr><td>LET14</td><td>Letsitele</td><td>-23.8932, 30.35736</td><td>B81D</td><td>• Thabina</td><td>• Removal of riparian vegetation
• Cultivation
• Abstraction
• Extensive forestry
• Poor sanitation
• Alien invasive plants</td></tr>
<tr><td>LET16</td><td>Letaba</td><td>-23.915, 30.05228</td><td>B81B</td><td>• Morudi</td><td>• Extensive forestry
• Developments into the riparian zone
• Alien invasive vegetation
• Informal settlements
• Impoundments</td></tr>
<tr><td>LET18</td><td>Broeders troom</td><td>-23.8007, 29.97741</td><td>B81A</td><td></td><td>• Extensive forestry
• Forestry
• Invasive plants and fish</td></tr>
<tr><td colspan="7">Shingwedzi</td></tr>
<tr><td>SHI1</td><td>Shingwe dzi</td><td>-23.1849, 31.52508</td><td>B90H</td><td>• Bububu
• Nkulumbeni
• Phugwane</td><td>• Abstraction
• WQ pollution
• Erosion and siltation</td><td>• Owing to the proximity of this site, full comprehensive surveys should be conducted annually</td></tr>
</table>

Site	River	Co-ordinate	Catchment	Major Tributaries	Impacts and Motivation	Monitoring Recommended
						• Stringent management measures as per KNP protocols for this reach should be adhered to • Chemical and in situ water quality should be monitored annually • Diatom samples should be taken minimum annually • Continuous monitoring of flows • Fish (FRAI) and macroinvertebrates (MIRAI) should be monitored annually during the low flow conditions • Riparian VEGRAI should be conducted every 5 years • The IHI should be conducted annually

APPENDIX A

HABITAT INTEGRITY ASSESSEMENT SCORES FOR THE RIPARIAN ZONE AND INSTREAM ZONE

Habitat integrity scoring:					
None: 0	Small: 1-5	Moderate: 6-10	Large: 11-15	Serious: 16-20	Critical: 21-25

OLIFANTS CATCHMENT

Site S1

S1: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	2	Localised at site
EXOTIC VEGETATION (IMPACT 1-25)	5	Syringa
BANK EROSION (IMPACT 1-25)	3	Localised
CHANNEL MODIFICATION (IMPACT 1-25)	6	Bridge widening the river
WATER ABSTRACTION (IMPACT 1-25)	3	Some terrestrial encroachment, limited bank collapse
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	7	Some terrestrial encroachment – longer periods of low flows
PHYSICO-CHEMICAL (IMPACT 1-25)	0	
RIPARIAN VEGETATION INTEGRITY SCORE *	87	
RIPARIAN INTEGRITY CATEGORY	**B**	

* *Weighted riparian integrity score*

S1: Habitat Integrity Assessment Score for the Instream Zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	6	Small scale irrigation
FLOW MODIFICATION (IMPACT 1-25)	16	Large number of small dams upstream
BED MODIFICATION (IMPACT 1-25)	4	Increased silt in pools, between cobbles – cattle trampling in upper catchment Parts of old low water bridge
CHANNEL MODIFICATION (IMPACT 1-25)	5	Localised widening at the bridge
PHYSICO-CHEMICAL (IMPACT 1-25)	8	Organic material in pools, algae
INUNDATION (IMPACT 1-25)	0	None

ALIEN MACROPHYTES (IMPACT 1-25)	1	
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	10	Bass in Rust de Winter Dam might move up (not collected during survey)
RUBBISH DUMPING (IMPACT 1-25)	0	None
INSTREAM INTEGRITY SCORE *	69	
INSTREAM INTEGRITY CATEGORY	**C**	

* *Weighted instream integrity score*

Site S2

S2: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	2	Limited at site
EXOTIC VEGETATION (IMPACT 1-25)	5	Bugweed, mulberry, weeping willow
BANK EROSION (IMPACT 1-25)	3	Limited downstream of site
CHANNEL MODIFICATION (IMPACT 1-25)	1	
WATER ABSTRACTION (IMPACT 1-25)	1	
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	4	Possible terrestrial encroachment on right bank
WATER QUALITY (IMPACT 1-25)	6	Nutrient – reeds encroaching
RIPARIAN VEGETATION INTEGRITY SCORE *	89	
RIPARIAN INTEGRITY CATEGORY	**A/B**	

* *Weighted riparian integrity score*

S2: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	10	Extensive irrigation upstream
FLOW MODIFICATION (IMPACT 1-25)	6	Premier Mine and Bronkhorstspruit Dams in upper catchment
BED MODIFICATION (IMPACT 1-25)	6	Algae, some embeddedness
CHANNEL MODIFICATION (IMPACT 1-25)	1	
PHYSICO-CHEMICAL (IMPACT 1-25)	8	Nutrient enrichment, low %DO, algal growth
INUNDATION (IMPACT 1-25)	0	
ALIEN MACROPHYTES (IMPACT 1-25)	0	

INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	0	
RUBBISH DUMPING (IMPACT 1-25)	0	
INSTREAM INTEGRITY SCORE *	83	
INSTREAM INTEGRITY CATEGORY	**B**	

* *Weighted instream integrity score*

Site S3

S3: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	10	Agricultural activities
EXOTIC VEGETATION (IMPACT 1-25)	11	Weeping willow, mulberry, poplars
BANK EROSION (IMPACT 1-25)	15	Collapsing banks, incised
CHANNEL MODIFICATION (IMPACT 1-25)	8	Incision and straightening of channel
WATER ABSTRACTION (IMPACT 1-25)	3	Abstraction for irrigation use by pumps upstream of site
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	7	Drying of banks due to prolonged low flows
WATER QUALITY (IMPACT 1-25)	3	Nutrient enrichment
RIPARIAN VEGETATION INTEGRITY SCORE *	55	
RIPARIAN INTEGRITY CATEGORY	**D**	

* *Weighted riparian integrity score*

S3: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	14	Extensive irrigation in upper catchment
FLOW MODIFICATION (IMPACT 1-25)	12	Small dams and weirs and Premier Mine Dam
BED MODIFICATION (IMPACT 1-25)	8	Siltation, upstream land use, roads and bridges
CHANNEL MODIFICATION (IMPACT 1-25)	13	Collapsing banks, incision and widening of channel through land use activities
PHYSICO-CHEMICAL (IMPACT 1-25)	14	Algae, organic material

S3: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
INUNDATION (IMPACT 1-25)	0	
ALIEN MACROPHYTES (IMPACT 1-25)	0	
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	15	*Gambusia affinis*
RUBBISH DUMPING (IMPACT 1-25)	6	Localised
INSTREAM INTEGRITY SCORE *	54	
INSTREAM INTEGRITY CATEGORY	**D**	

* *Weighted instream integrity score*

<u>Site S5</u>

S5: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	2	Limited at site
EXOTIC VEGETATION (IMPACT 1-25)	4	Willows
BANK EROSION (IMPACT 1-25)	0	
CHANNEL MODIFICATION (IMPACT 1-25)	5	Downstream weir
WATER ABSTRACTION (IMPACT 1-25)	2	
INUNDATION (IMPACT 1-25)	1	Downstream inundation of old site due to weir
FLOW MODIFICATION (IMPACT 1-25)	2	Narrowing of channel
WATER QUALITY (IMPACT 1-25)	4	Nutrient enrichment
RIPARIAN VEGETATION INTEGRITY SCORE *	90	
RIPARIAN INTEGRITY CATEGORY	**A/B**	

* *Weighted riparian integrity score*

S5: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	6	Irrigation and domestic use
FLOW MODIFICATION (IMPACT 1-25)	16	Witbank and Doornpoort Dams upstream
BED MODIFICATION (IMPACT 1-25)	6	Algae in riffle area, silt in pools
CHANNEL MODIFICATION (IMPACT 1-25)	1	Reed built up on island
PHYSICO-CHEMICAL (IMPACT 1-25)	14	Nutrients, salts

INUNDATION (IMPACT 1-25)	0	
ALIEN MACROPHYTES (IMPACT 1-25)	7	Hyacinth, water fern, azolla
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	18	Bass, carb, Gambusia
RUBBISH DUMPING (IMPACT 1-25)	0	
INSTREAM INTEGRITY SCORE *	58	
INSTREAM INTEGRITY CATEGORY	**C/D**	

* *Weighted instream integrity score*

Site S6

S6: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	20	Clearing for picnic spot
EXOTIC VEGETATION (IMPACT 1-25)	12	Eucalyptus, wattles, willows
BANK EROSION (IMPACT 1-25)	4	Limited at site
CHANNEL MODIFICATION (IMPACT 1-25)	8	Upstream through town
WATER ABSTRACTION (IMPACT 1-25)	1	
INUNDATION (IMPACT 1-25)	1	
FLOW MODIFICATION (IMPACT 1-25)	10	Reduced flows from dam upstream, spiked flows from hardened surfaces
WATER QUALITY (IMPACT 1-25)	7	Nutrients
RIPARIAN VEGETATION INTEGRITY SCORE *	48	
RIPARIAN INTEGRITY CATEGORY	**D**	

* *Weighted riparian integrity score*

S6: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	5	Agricultural activities between Middelburg Dam and the town
FLOW MODIFICATION (IMPACT 1-25)	15	Middelburg Dam upstream, more spiked discharges from hardened surfaces
BED MODIFICATION (IMPACT 1-25)	12	Algae, solid waste
CHANNEL MODIFICATION (IMPACT 1-25)	11	Bridges and storm water runoff
PHYSICO-CHEMICAL (IMPACT 1-25)	18	Nutrients, possible toxins, low DO

INUNDATION (IMPACT 1-25)	0	
ALIEN MACROPHYTES (IMPACT 1-25)	6	
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	12	*Micropterus salmoides* *gambusia affinis*
RUBBISH DUMPING (IMPACT 1-25)	12	Extensive littering
INSTREAM INTEGRITY SCORE *	49	
INSTREAM INTEGRITY CATEGORY	**D**	

* *Weighted instream integrity score*

Site S7

S7: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	2	Limited upstream for historic land clearing
EXOTIC VEGETATION (IMPACT 1-25)	1	
BANK EROSION (IMPACT 1-25)	1	Limited due to animal movement
CHANNEL MODIFICATION (IMPACT 1-25)	4	Fence, low water bridges
WATER ABSTRACTION (IMPACT 1-25)	3	Limited for local use
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	5	Exposed banks with prolonged low flows due to upstream use
WATER QUALITY (IMPACT 1-25)	5	Nutrient enrichment
RIPARIAN VEGETATION INTEGRITY SCORE *	89	
RIPARIAN INTEGRITY CATEGORY	**A/B**	

* *Weighted riparian integrity score*

S7: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	3	Localised for farming activity
FLOW MODIFICATION (IMPACT 1-25)	11	Upstream dams (Witbank, Middelburg)
BED MODIFICATION (IMPACT 1-25)	2	Algae on rocks
CHANNEL MODIFICATION (IMPACT 1-25)	1	
PHYSICO-CHEMICAL (IMPACT 1-25)	8	Nutrients, low %DO

INUNDATION (IMPACT 1-25)	1	Possible backwater from Loskop Dam when full
ALIEN MACROPHYTES (IMPACT 1-25)	0	
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	12	Carb, possibly bass
RUBBISH DUMPING (IMPACT 1-25)	0	
INSTREAM INTEGRITY SCORE *	82	
INSTREAM INTEGRITY CATEGORY	**B**	

* *Weighted instream integrity score*

Site S8

S8: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	5	Wood harvesting
EXOTIC VEGETATION (IMPACT 1-25)	11	Sesbania, poplars
BANK EROSION (IMPACT 1-25)	7	Bank collapse at bridge, trampling
CHANNEL MODIFICATION (IMPACT 1-25)	6	Collapsing of banks, bridge
WATER ABSTRACTION (IMPACT 1-25)	1	
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	3	Prolonged low flow periods
WATER QUALITY (IMPACT 1-25)	1	
RIPARIAN VEGETATION INTEGRITY SCORE *	75	
RIPARIAN INTEGRITY CATEGORY	**C**	

* *Weighted riparian integrity score*

S8: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	6	Irrigation use in upper catchment
FLOW MODIFICATION (IMPACT 1-25)	6	Numerous small dams in upper catchment
BED MODIFICATION (IMPACT 1-25)	8	Embeddedness of cobbles
CHANNEL MODIFICATION (IMPACT 1-25)	9	Localised at bridge with erosion
PHYSICO-CHEMICAL (IMPACT 1-25)	1	
INUNDATION (IMPACT 1-25)	1	Localised upstream of bridge
ALIEN MACROPHYTES (IMPACT 1-25)	0	
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	0	

RUBBISH DUMPING (IMPACT 1-25)	2	Localised
INSTREAM INTEGRITY SCORE *	83	
INSTREAM INTEGRITY CATEGORY	**B**	

* *Weighted instream integrity score*

Site S9

S9: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	11	Burning regime, wood harvesting
EXOTIC VEGETATION (IMPACT 1-25)	6	Sesbania
BANK EROSION (IMPACT 1-25)	16	Large scale collapse of banks, especially right hand
CHANNEL MODIFICATION (IMPACT 1-25)	16	Widening of channel, encroachment of reeds
WATER ABSTRACTION (IMPACT 1-25)	2	
INUNDATION (IMPACT 1-25)	2	Reed beds blocking flows, inundating habitats
FLOW MODIFICATION (IMPACT 1-25)	10	Long periods of low flow, no high flows due to dam upstream and loss of lateral flows (incised channel)
WATER QUALITY (IMPACT 1-25)	1	
RIPARIAN VEGETATION INTEGRITY SCORE *	38	
RIPARIAN INTEGRITY CATEGORY	**D/E**	

* *Weighted riparian integrity score*

S9: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	15	Extensive irrigation
FLOW MODIFICATION (IMPACT 1-25)	12	Dam upstream, no releases
BED MODIFICATION (IMPACT 1-25)	4	Algae in pools, sand in riffle
CHANNEL MODIFICATION (IMPACT 1-25)	17	Bank collapse due to land use practices and clearing of vegetation
PHYSICO-CHEMICAL (IMPACT 1-25)	11	Nutrients, low %DO
INUNDATION (IMPACT 1-25)	0	

ALIEN MACROPHYTES (IMPACT 1-25)	0	
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	0	
RUBBISH DUMPING (IMPACT 1-25)	1	Localised
INSTREAM INTEGRITY SCORE *	55	
INSTREAM INTEGRITY CATEGORY	**D**	

* *Weighted instream integrity score*

Site S10

S10: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	5	Limited for wood harvesting
EXOTIC VEGETATION (IMPACT 1-25)	2	Limited sesbania
BANK EROSION (IMPACT 1-25)	6	Cattle trampling on right bank
CHANNEL MODIFICATION (IMPACT 1-25)	2	Limited erosion on right hand
WATER ABSTRACTION (IMPACT 1-25)	1	
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	11	Long period of low flows, less lateral water movement
WATER QUALITY (IMPACT 1-25)	1	
RIPARIAN VEGETATION INTEGRITY SCORE *	78	
RIPARIAN INTEGRITY CATEGORY	**B/C**	

* *Weighted riparian integrity score*

S10 (old IFR 8): Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	3	Limited to rural use
FLOW MODIFICATION (IMPACT 1-25)	15	All flow components impacted by Flag Boshielo Dam upstream
BED MODIFICATION (IMPACT 1-25)	3	Sand not moving through system less than natural
CHANNEL MODIFICATION (IMPACT 1-25)	4	Right side channel straightening due to trampling
PHYSICO-CHEMICAL (IMPACT 1-25)	3	Increased turbidity
INUNDATION (IMPACT 1-25)	0	

ALIEN MACROPHYTES (IMPACT 1-25)	0	
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	6	Possibly silver carb
RUBBISH DUMPING (IMPACT 1-25)	0	
INSTREAM INTEGRITY SCORE *	83	
INSTREAM INTEGRITY CATEGORY	**B**	

* Weighted instream integrity score

Site S11

S11: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	4	Limited
EXOTIC VEGETATION (IMPACT 1-25)	6	Chromolaena
BANK EROSION (IMPACT 1-25)	7	Upstream of site
CHANNEL MODIFICATION (IMPACT 1-25)	4	Bridge
WATER ABSTRACTION (IMPACT 1-25)	1	
INUNDATION (IMPACT 1-25)	1	Sand bag weirs
FLOW MODIFICATION (IMPACT 1-25)	2	
WATER QUALITY (IMPACT 1-25)	5	Nutrient enrichment
RIPARIAN VEGETATION INTEGRITY SCORE *	85	
RIPARIAN INTEGRITY CATEGORY	**B**	

* *Weighted riparian integrity score*

S11: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	13	Extensive irrigation
FLOW MODIFICATION (IMPACT 1-25)	4	Buffelskloof Dam in upper reaches of Watervals River
BED MODIFICATION (IMPACT 1-25)	9	Numerous small weirs for abstraction, reed encroachment, fenced areas
CHANNEL MODIFICATION (IMPACT 1-25)	4	Incised, low water bridge
PHYSICO-CHEMICAL (IMPACT 1-25)	6	Nutrients, algae, some silt
INUNDATION (IMPACT 1-25)	3	Limited due to small weirs (sand bags)
ALIEN MACROPHYTES (IMPACT 1-25)	0	

INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	0	
RUBBISH DUMPING (IMPACT 1-25)	2	Localised
INSTREAM INTEGRITY SCORE *	75	
INSTREAM INTEGRITY CATEGORY	**C**	
WATER ABSTRACTION (IMPACT 1-25)	13	Extensive irrigation

* *Weighted instream integrity score*

Site S12

S12 Blyde: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	9	Wood harvesting, land clearing
EXOTIC VEGETATION (IMPACT 1-25)	11	Wattle, non-woody
BANK EROSION (IMPACT 1-25)	5	Bank slip at bridge
CHANNEL MODIFICATION (IMPACT 1-25)	3	Localised due to bridge
WATER ABSTRACTION (IMPACT 1-25)	1	
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	5	Low flows impacts due to forestry and small dams in tributaries
WATER QUALITY (IMPACT 1-25)	1	
RIPARIAN VEGETATION INTEGRITY SCORE *	75	
RIPARIAN INTEGRITY CATEGORY	**C**	

* *Weighted riparian integrity score*

S12: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	4	Local use
FLOW MODIFICATION (IMPACT 1-25)	9	Forestry in upper catchment
BED MODIFICATION (IMPACT 1-25)	8	Limited siltation, silt in pools
CHANNEL MODIFICATION (IMPACT 1-25)	7	Bank collapse up- and downstream of bridge
PHYSICO-CHEMICAL (IMPACT 1-25)	3	Silt
INUNDATION (IMPACT 1-25)	1	
ALIEN MACROPHYTES (IMPACT 1-25)	0	

INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	0	
RUBBISH DUMPING (IMPACT 1-25)	1	Localised
INSTREAM INTEGRITY SCORE *	84	
INSTREAM INTEGRITY CATEGORY	**B**	

* *Weighted instream integrity score*

Site S13

S13 Olifants: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	3	Limited wood harvesting
EXOTIC VEGETATION (IMPACT 1-25)	2	
BANK EROSION (IMPACT 1-25)	6	Cattle trampling, mostly on right bank
CHANNEL MODIFICATION (IMPACT 1-25)	3	
WATER ABSTRACTION (IMPACT 1-25)	2	
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	7	Prolonged low flows due to upstream water use and dams
WATER QUALITY (IMPACT 1-25)	2	
RIPARIAN VEGETATION INTEGRITY SCORE *	87	
RIPARIAN INTEGRITY CATEGORY	**B**	

* *Weighted riparian integrity score*

S13 Olifants: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	17	Extensive irrigation along banks, water for local use
FLOW MODIFICATION (IMPACT 1-25)	15	All flow components impacted by dams upstream
BED MODIFICATION (IMPACT 1-25)	7	Embeddedness of cobbles, siltation
CHANNEL MODIFICATION (IMPACT 1-25)	2	
PHYSICO-CHEMICAL (IMPACT 1-25)	6	Nutrients from irrigation, possible toxins from mining
INUNDATION (IMPACT 1-25)	1	
ALIEN MACROPHYTES (IMPACT 1-25)	0	
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	0	

RUBBISH DUMPING (IMPACT 1-25)	0	
INSTREAM INTEGRITY SCORE *	68	
INSTREAM INTEGRITY CATEGORY	**C**	

* Weighted instream integrity score

Site S14

S14 Blyde: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	1	
EXOTIC VEGETATION (IMPACT 1-25)	2	Reeds, possible syringe and bugweed
BANK EROSION (IMPACT 1-25)	1	Limited
CHANNEL MODIFICATION (IMPACT 1-25)	6	Some scouring from fence and road, channel narrowing
WATER ABSTRACTION (IMPACT 1-25)	4	Prolonged low flows, less lateral flows
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	10	Narrowing of river channel, encroachment of terrestrial
WATER QUALITY (IMPACT 1-25)	1	
RIPARIAN VEGETATION INTEGRITY SCORE *	88	
RIPARIAN INTEGRITY CATEGORY	**B**	

* *Weighted riparian integrity score*

S14: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	12	Extensive irrigation
FLOW MODIFICATION (IMPACT 1-25)	15	Blyderivierspoort Dam upstream
BED MODIFICATION (IMPACT 1-25)	3	Silt, algae
CHANNEL MODIFICATION (IMPACT 1-25)	2	
PHYSICO-CHEMICAL (IMPACT 1-25)	5	Nutrients – return flows
INUNDATION (IMPACT 1-25)	0	
ALIEN MACROPHYTES (IMPACT 1-25)	0	
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	11	Bass

RUBBISH DUMPING (IMPACT 1-25)	0	
INSTREAM INTEGRITY SCORE *	73	
INSTREAM INTEGRITY CATEGORY	**C**	

* *Weighted instream integrity score*

Site S15

S15: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	3	Clearing for building (right bank)
EXOTIC VEGETATION (IMPACT 1-25)	2	
BANK EROSION (IMPACT 1-25)	6	Scouring of upstream banks, trampling
CHANNEL MODIFICATION (IMPACT 1-25)	4	Channel widening due to bank collapse
WATER ABSTRACTION (IMPACT 1-25)	2	
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	7	Prolonged low flows due to upstream water use and dams
WATER QUALITY (IMPACT 1-25)	2	
RIPARIAN VEGETATION INTEGRITY SCORE *	87	
RIPARIAN INTEGRITY CATEGORY	**B**	

* *Weighted riparian integrity score*

S15: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	9	Local abstractions
FLOW MODIFICATION (IMPACT 1-25)	15	All flow components impacted by dams upstream
BED MODIFICATION (IMPACT 1-25)	2	Silt
CHANNEL MODIFICATION (IMPACT 1-25)	4	Scouring of upstream banks
WATER QUALITY (IMPACT 1-25)	6	Nutrients from irrigation, possible toxins from mining
INUNDATION (IMPACT 1-25)	0	
SECONDARY	0	

EXOTIC MACROPHYTES (IMPACT 1-25)	0	
EXOTIC FAUNA (IMPACT 1-25)	1	
SOLID WASTE DISPOSAL (IMPACT 1-25)	80	
INSTREAM INTEGRITY SCORE *	**B/C**	

* *Weighted instream integrity score*

Site S16

S16: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	1	Clearing for weir construction upstream
EXOTIC VEGETATION (IMPACT 1-25)	1	
BANK EROSION (IMPACT 1-25)	2	Trampling
CHANNEL MODIFICATION (IMPACT 1-25)	2	Upstream low water bridge and weir
WATER ABSTRACTION (IMPACT 1-25)	1	
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	7	Prolonged low flows due to upstream water use and dams
WATER QUALITY (IMPACT 1-25)	2	
RIPARIAN VEGETATION INTEGRITY SCORE *	91	
RIPARIAN INTEGRITY CATEGORY	**A/B**	

* *Weighted riparian integrity score*

S16: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	3	Local abstractions
FLOW MODIFICATION (IMPACT 1-25)	15	All flow components impacted by dams upstream
BED MODIFICATION (IMPACT 1-25)	2	Silt in pools
CHANNEL MODIFICATION (IMPACT 1-25)	2	Destabilised banks
PHYSICO-CHEMICAL (IMPACT 1-25)	5	Nutrients and possible toxins from mining outside KNP
INUNDATION (IMPACT 1-25)	0	
ALIEN MACROPHYTES (IMPACT 1-25)	0	

INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	0	
RUBBISH DUMPING (IMPACT 1-25)	1	
INSTREAM INTEGRITY SCORE *	85	
INSTREAM INTEGRITY CATEGORY	**B**	

* *Weighted instream integrity score*

LETABA CATCHMENT

SITE LET2

LET2: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	2	Localised
EXOTIC VEGETATION (IMPACT 1-25)	1	
BANK EROSION (IMPACT 1-25)	5	Trampling by animals, changing due to drought, basal cover disturbed
CHANNEL MODIFICATION (IMPACT 1-25)	2	
WATER ABSTRACTION (IMPACT 1-25)	7	Exposed banks for longer periods
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	12	Narrowing of channel and vegetation changes due to prolonged low flows and fewer floods
PHYSICO-CHEMICAL (IMPACT 1-25)	1	
RIPARIAN VEGETATION INTEGRITY SCORE *	77	
RIPARIAN INTEGRITY CATEGORY	**C**	

* Weighted riparian integrity score

LET2: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	20	Reduced flows due to extensive abstractions outside KNP
FLOW MODIFICATION (IMPACT 1-25)	20	All flow components modified due to large dams in upper catchment outside KNP
BED MODIFICATION (IMPACT 1-25)	15	Increased sedimentation
CHANNEL MODIFICATION (IMPACT 1-25)	15	Infilling of pools, lack of sediment flushing
PHYSICO-CHEMICAL (IMPACT 1-25)	8	Increased nutrients due to lack of flushing
INUNDATION (IMPACT 1-25)	0	None at site

ALIEN MACROPHYTES (IMPACT 1-25)	3	Possibility of import during high flows (water hyacinths, water lettuce, Kariba weed)
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	2	Bass, blue gill, Nile tilapia in system but not caught
RUBBISH DUMPING (IMPACT 1-25)	0	
INSTREAM INTEGRITY SCORE *	42	
INSTREAM INTEGRITY CATEGORY	**D**	

* Weighted instream integrity score

SITE LET14

LET14: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	13	Cultivation, infrastructure developments, trampling
EXOTIC VEGETATION (IMPACT 1-25)	13	Extensive infestation
BANK EROSION (IMPACT 1-25)	12	Cattle trampling, clearing of vegetation
CHANNEL MODIFICATION (IMPACT 1-25)	12	Bridge and weir upstream and downstream
WATER ABSTRACTION (IMPACT 1-25)	5	Limited water abstraction by settlements
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	4	Possible lower flows due to upstream forestry
PHYSICO-CHEMICAL (IMPACT 1-25)	3	
RIPARIAN VEGETATION INTEGRITY SCORE *	39	
RIPARIAN INTEGRITY CATEGORY	**D/E**	

* Weighted riparian integrity score

LET14: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	3	Abstractions by settlements and stock watering
FLOW MODIFICATION (IMPACT 1-25)	3	Extensive forestry in upper catchments
BED MODIFICATION (IMPACT 1-25)	10	Cattle crossing
CHANNEL MODIFICATION (IMPACT 1-25)	10	Weir upstream and bridge downstream of site
PHYSICO-CHEMICAL (IMPACT 1-25)	20	Organic pollution, return flows from households, car washing, dumping of rubbish

INUNDATION (IMPACT 1-25)	0	
ALIEN MACROPHYTES (IMPACT 1-25)	8	Hyacinths, Kariba weed
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	2	Bass, carb in the system
RUBBISH DUMPING (IMPACT 1-25)	12	Localised with car washing, other rubbish dumping
INSTREAM INTEGRITY SCORE *	63	
INSTREAM INTEGRITY CATEGORY	**C**	

* Weighted instream integrity score

SITE LET16

LET16: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	8	Some on right bank
EXOTIC VEGETATION (IMPACT 1-25)	12	Melia (seringa), bugweed, escapees from forestry (eucalyptus, pines)
BANK EROSION (IMPACT 1-25)	5	Limited on right bank
CHANNEL MODIFICATION (IMPACT 1-25)	5	Reed encroachment
WATER ABSTRACTION (IMPACT 1-25)	6	Irrigation along the river
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	10	Reduced flows, narrowing of channel with Dap Naude and Ebenezer Dams upstream and extensive forestry
PHYSICO-CHEMICAL (IMPACT 1-25)	5	Nutrient enrichment and siltation during forestry harvesting
RIPARIAN VEGETATION INTEGRITY SCORE *	75	
RIPARIAN INTEGRITY CATEGORY	**C**	

* Weighted riparian integrity score

LET16: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	3	Limited abstractions for local use
FLOW MODIFICATION (IMPACT 1-25)	14	Extensive forestry and releases from dams impacts on all flow components
BED MODIFICATION (IMPACT 1-25)	3	Bedrock system
CHANNEL MODIFICATION (IMPACT 1-25)	8	Reeds due to clearing and no large floods, narrowing of channel due to prolonged low flows

PHYSICO-CHEMICAL (IMPACT 1-25)	4	Some nutrient enrichment – informal settlements
INUNDATION (IMPACT 1-25)	0	
ALIEN MACROPHYTES (IMPACT 1-25)	2	
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	12	Bass
RUBBISH DUMPING (IMPACT 1-25)	3	Localised
INSTREAM INTEGRITY SCORE *	B/C	
INSTREAM INTEGRITY CATEGORY	**78**	

* Weighted instream integrity score

SITE LET18

LET18: Habitat Integrity assessment scores for the riparian zone		
RIPARIAN ZONE HABITAT INTEGRITY	**EWR site**	**COMMENT**
VEGETATION REMOVAL (IMPACT 1-25)	3	Clearing for forestry upstream
EXOTIC VEGETATION (IMPACT 1-25)	4	Oaks
BANK EROSION (IMPACT 1-25)	5	Truck activity
CHANNEL MODIFICATION (IMPACT 1-25)	2	Localised at bridge
WATER ABSTRACTION (IMPACT 1-25)	4	Localised for forestry use
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	4	Low flows impacted by extensive forestry in upper catchment
PHYSICO-CHEMICAL (IMPACT 1-25)	1	
RIPARIAN VEGETATION INTEGRITY SCORE *	88	
RIPARIAN INTEGRITY CATEGORY	**A/B**	

* Weighted riparian integrity score

LET18: Habitat Integrity assessment scores for the instream zone		
IN STREAM HABITAT INTEGRITY	**EWR site**	**COMMENT**
WATER ABSTRACTION (IMPACT 1-25)	1	Localised
FLOW MODIFICATION (IMPACT 1-25)	12	Extensive forestry in upper catchment
BED MODIFICATION (IMPACT 1-25)	5	Siltation
CHANNEL MODIFICATION (IMPACT 1-25)	4	Low water crossings and low water bridge upstream
PHYSICO-CHEMICAL (IMPACT 1-25)	1	
INUNDATION (IMPACT 1-25)	0	

ALIEN MACROPHYTES (IMPACT 1-25)	0	
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	5	Rainbow trout
RUBBISH DUMPING (IMPACT 1-25)	0	
INSTREAM INTEGRITY SCORE *	86	
INSTREAM INTEGRITY CATEGORY	**B**	

* Weighted instream integrity score

SHINGWEDZI CATCHMENT

SHI1: Habitat Integrity assessment scores for the riparian zone

RIPARIAN ZONE HABITAT INTEGRITY	EWR site	COMMENT
VEGETATION REMOVAL (IMPACT 1-25)	2	Limited
EXOTIC VEGETATION (IMPACT 1-25)	1	
BANK EROSION (IMPACT 1-25)	4	Localised at left bank, trampling by animals, basal cover impacted
CHANNEL MODIFICATION (IMPACT 1-25)	2	
WATER ABSTRACTION (IMPACT 1-25)	0	
INUNDATION (IMPACT 1-25)	0	
FLOW MODIFICATION (IMPACT 1-25)	3	Existing Kanniedood Dam upstream of site limited impact after part of wall was washed away in 2013
PHYSICO-CHEMICAL (IMPACT 1-25)	1	
RIPARIAN VEGETATION INTEGRITY SCORE *	93	
RIPARIAN INTEGRITY CATEGORY	**A**	

* Weighted riparian integrity score

SHI1: Habitat Integrity assessment scores for the instream zone

IN STREAM HABITAT INTEGRITY	EWR site	COMMENT
WATER ABSTRACTION (IMPACT 1-25)	6	Outside KNP and localised for use in KNP
FLOW MODIFICATION (IMPACT 1-25)	5	Limited after part of Kanniedood Dam washed away in 2013
BED MODIFICATION (IMPACT 1-25)	2	
CHANNEL MODIFICATION (IMPACT 1-25)	4	Trampling
PHYSICO-CHEMICAL (IMPACT 1-25)	2	Algae present (limited)

INUNDATION (IMPACT 1-25)	0	
ALIEN MACROPHYTES (IMPACT 1-25)	1	
INTRODUCED AQUATIC FAUNA (IMPACT 1-25)	0	
RUBBISH DUMPING (IMPACT 1-25)	0	
INSTREAM INTEGRITY SCORE *	89	
INSTREAM INTEGRITY CATEGORY	**A/B**	

* Weighted instream integrity score

APPENDIX B
ECOLOGICAL IMPORTANCE AND ECOLOGICAL SENSITIVITY

SITE S1

S1: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	
Fish representivity and rarity	High
Macroinvertebrate representivity and rarity	High-very high
Riparian-wetland-instream: vertebrates	Very high
Riparian-wetland-instream: natural vegetation	High
Habitat diversity	Low
Habitat size	Very high
Habitat integrity	High
Riparian-wetland habitat integrity	Very high
Instream and riparian migration	High-very high
Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very high
Fish: no flow	Very high
Macroinvertebrates: velocity	Very high
Riparian-wetland-instream – vertebrates: flow or water level changes	Very high
Riparian-wetland – vegetation: water level changes	Low
Stream size (flow/water level changes)	High

SITE S2

S2: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	
Fish representivity and rarity	Very High
Macroinvertebrate representivity and rarity	Very High

Riparian-wetland-instream: vertebrates	Very High
Riparian-wetland-instream: natural vegetation	Low to High
Habitat diversity	Low
Habitat size	High
Habitat integrity	High
Riparian-wetland habitat integrity	Very High
Instream and riparian migration	Very High
Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very High
Fish: no flow	Very High
Macroinvertebrates: velocity	Very High
Riparian-wetland-instream – vertebrates: flow or water level changes	Very High
Riparian-wetland – vegetation: water level changes	Low
Stream size (flow/water level changes)	High

SITE S3

S3 and X8: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	
Fish representivity and rarity	High
Macroinvertebrate representivity and rarity	Very High
Riparian-wetland-instream: vertebrates	High
Riparian-wetland-instream: natural vegetation	Moderate to High
Habitat diversity	Moderate
Habitat size	Very High

Habitat integrity	High
Riparian-wetland habitat integrity	High
Instream and riparian migration	High to Very High
Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very High
Fish: no flow	Very High
Macroinvertebrates: velocity	Very High
Riparian-wetland-instream – vertebrates: flow or water level changes	High
Riparian-wetland – vegetation: water level changes	High
Stream size (flow/water level changes)	High

SITE S4

This site was not surveyed during the October 2015 survey due to no suitable hydraulic site present. However, the available information from a biological perspective will be evaluated.

SITE S5

S5: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	
Fish representivity and rarity	Very High
Macroinvertebrate representivity and rarity	Very High
Riparian-wetland-instream: vertebrates	Very High
Riparian-wetland-instream: natural vegetation	Very High
Habitat diversity	Moderate
Habitat size	High
Habitat integrity	Very High
Riparian-wetland habitat integrity	Very High
Instream and riparian migration	Very High

Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very High
Fish: no flow	Very High
Macroinvertebrates: velocity	Very High
Riparian-wetland-instream – vertebrates: flow or water level changes	Very High
Riparian-wetland – vegetation: water level changes	Low
Stream size (flow/water level changes)	High

SITE S6

S6: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	
Fish representivity and rarity	High and Very High
Macroinvertebrate representivity and rarity	High and Very High
Riparian-wetland-instream: vertebrates	High
Riparian-wetland-instream: natural vegetation	High and Very High
Habitat diversity	Moderate
Habitat size	Low
Habitat integrity	Moderate
Riparian-wetland habitat integrity	Moderate
Instream and riparian migration	Moderate
Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very High
Fish: no flow	Very High
Macroinvertebrates: velocity	Very High

Riparian-wetland-instream – vertebrates: flow or water level changes	High
Riparian-wetland – vegetation: water level changes	Low
Stream size (flow/water level changes)	High

SITE S7

S7: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	
Fish representivity and rarity	Very High and High
Macroinvertebrate representivity and rarity	Very High and High
Riparian-wetland-instream: vertebrates	Very High
Riparian-wetland-instream: natural vegetation	High
Habitat diversity	Low
Habitat size	High
Habitat integrity	Very High
Riparian-wetland habitat integrity	Very High
Instream and riparian migration	Very High
Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very High
Fish: no flow	Very High
Macroinvertebrates: velocity	Very High
Riparian-wetland-instream – vertebrates: flow or water level changes	Very High
Riparian-wetland – vegetation: water level changes	Low
Stream size (flow/water level changes)	Low

SITE S8

S8: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	
Fish representivity and rarity	Very High
Macroinvertebrate representivity and rarity	Very High and High
Riparian-wetland-instream: vertebrates	Very High
Riparian-wetland-instream: natural vegetation	High
Habitat diversity	Very High
Habitat size	Moderate
Habitat integrity	Moderate
Riparian-wetland habitat integrity	Very High
Instream and riparian migration	Moderate to Very High
Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very High
Fish: no flow	Very High
Macroinvertebrates: velocity	Very High
Riparian-wetland-instream – vertebrates: flow or water level changes	Very High
Riparian-wetland – vegetation: water level changes	Low
Stream size (flow/water level changes)	Very High

SITE S9

S9: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	

Fish representivity and rarity	High
Macroinvertebrate representivity and rarity	Very High and High
Riparian-wetland-instream: vertebrates	Very High
Riparian-wetland-instream: natural vegetation	High
Habitat diversity	Moderate
Habitat size	Very Low
Habitat integrity	Moderate
Riparian-wetland habitat integrity	High
Instream and riparian migration	High and Very High
Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very High
Fish: no flow	Very High
Macroinvertebrates: velocity	Very High
Riparian-wetland-instream – vertebrates: flow or water level changes	Very High
Riparian-wetland – vegetation: water level changes	Low
Stream size (flow/water level changes)	High

SITE S10

S10: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	
Fish representivity and rarity	High
Macroinvertebrate representivity and rarity	Very High
Riparian-wetland-instream: vertebrates	Very High
Riparian-wetland-instream: natural vegetation	Very High to High

Habitat diversity	Low
Habitat size	Very Low
Habitat integrity	Moderate
Riparian-wetland habitat integrity	High
Instream and riparian migration	Very High
Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very High
Fish: no flow	Very High
Macroinvertebrates: velocity	Very High
Riparian-wetland-instream – vertebrates: flow or water level changes	High
Riparian-wetland – vegetation: water level changes	Low
Stream size (flow/water level changes)	Low

SITE S11

S11: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	
Fish representivity and rarity	High and Very High
Macroinvertebrate representivity and rarity	Very High
Riparian-wetland-instream: vertebrates	Very High
Riparian-wetland-instream: natural vegetation	Very High to High
Habitat diversity	Low
Habitat size	Moderate
Habitat integrity	Moderate
Riparian-wetland habitat integrity	High
Instream and riparian migration	High to Very High
Ecological Sensitivity	
Physico-chemical sensitivity:	Very High

Fish and macroinvertebrates	
Fish: no flow	Very High
Macroinvertebrates: velocity	Very High
Riparian-wetland-instream – vertebrates: flow or water level changes	Very High
Riparian-wetland – vegetation: water level changes	Low
Stream size (flow/water level changes)	High

SITE S12

S12: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	
Fish representivity and rarity	Low to high
Macroinvertebrate representivity and rarity	Very high
Riparian-wetland-instream: vertebrates	Very high
Riparian-wetland-instream: natural vegetation	High to very high
Habitat diversity	Low
Habitat size	High
Habitat integrity	Very high
Riparian-wetland habitat integrity	Very high
Instream and riparian migration	Very high
Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very high
Fish: no flow	Very high
Macroinvertebrates: velocity	Very high
Riparian-wetland-instream – vertebrates: flow or water level changes	Very high
Riparian-wetland – vegetation:	Low

water level changes	
Stream size (flow/water level changes)	High

SITE S13

S13: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	
Fish representivity and rarity	Very high to high
Macroinvertebrate representivity and rarity	Very high to high
Riparian-wetland-instream: vertebrates	Very high
Riparian-wetland-instream: natural vegetation	Very high to high
Habitat diversity	High
Habitat size	High
Habitat integrity	High
Riparian-wetland habitat integrity	Very high
Instream and riparian migration	High to very high
Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very high
Fish: no flow	Very high
Macroinvertebrates: velocity	Very high
Riparian-wetland-instream – vertebrates: flow or water level changes	Very high
Riparian-wetland – vegetation: water level changes	Low
Stream size (flow/water level changes)	High

SITE S14

S14 and E11: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**

Ecological Importance	
Fish representivity and rarity	Very High
Macroinvertebrate representivity and rarity	Very High
Riparian-wetland-instream: vertebrates	Very High
Riparian-wetland-instream: natural vegetation	High
Habitat diversity	Moderate
Habitat size	Very High
Habitat integrity	High
Riparian-wetland habitat integrity	Very High
Instream and riparian migration	Very High
Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very High
Fish: no flow	Very High
Macroinvertebrates: velocity	Very High
Riparian-wetland-instream – vertebrates: flow or water level changes	Very High
Riparian-wetland – vegetation: water level changes	Low
Stream size (flow/water level changes)	High

SITE S15

S15: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	
Fish representivity and rarity	Very high to high
Macroinvertebrate representivity and rarity	Very high to high
Riparian-wetland-instream: vertebrates	Very high

Riparian-wetland-instream: natural vegetation	Very high to low
Habitat diversity	Low
Habitat size	Very low
Habitat integrity	Moderate
Riparian-wetland habitat integrity	Very high
Instream and riparian migration	Very high
Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very high
Fish: no flow	Very high
Macroinvertebrates: velocity	Very high
Riparian-wetland-instream – vertebrates: flow or water level changes	Very high
Riparian-wetland – vegetation: water level changes	Low
Stream size (flow/water level changes)	Low

SITE S16

S16: Ecological Importance and Ecological Sensitivity	
Criteria	**Sub-reach**
Ecological Importance	
Fish representivity and rarity	Very high
Macroinvertebrate representivity and rarity	Very high
Riparian-wetland-instream: vertebrates	Very high
Riparian-wetland-instream: natural vegetation	High to low
Habitat diversity	Low
Habitat size	Low
Habitat integrity	High
Riparian-wetland habitat integrity	Very high
Instream and riparian migration	High to very high

Ecological Sensitivity	
Physico-chemical sensitivity: Fish and macroinvertebrates	Very high
Fish: no flow	Very high
Macroinvertebrates: velocity	Very high
Riparian-wetland-instream – vertebrates: flow or water level changes	Very high
Riparian-wetland – vegetation: water level changes	Low
Stream size (flow/water level changes)	High

LETABA AND SHINGWEDZI CATCHMENT

It was decided during the specialist workshop that the EIES for the Letaba and Shingwedzi catchments would be conducted using the desktop literature.

APPENDIX C
AQUATIC MACROINVERTEBRATE AND FISH INVENTORY – OLIFANTS CATCHMENT

RHP Site Code																																					
Site	X10	B2	B1	B4	E2	E3	E4	E5	E7	H7	X1	X2	X3	X5	X17	X18/H3	X19	X21	S1	S2	S3	S5	S6	S7	S8	S9	S10	S11	S12	S13	S14	S15	S16	X6	X7	X23	X20
Date		05/10/2015	06/10/2015	13/04/2016	28/01/2016	27/01/206	27/01/2016	28/10/2015	28/10/2015	27/10/2015	06/10/2015	06/10/2015	06/10/2015	06/10/2015	30/10/2015	28/10/2015	29/10/2015	29/10/2015	07/10/2015	08/10/2015	08/10/2015	09/10/2015	09/10/2015	10/10/2015	11/10/2015	11/10/2015	12/10/2015	12/10/2015	13/10/2015	15/10/2015	13/10/2015	14/10/2015	15/10/2015	10/10/2015	11/10/2015	17/04/2016	12/10/2015
LatitudeGIS																																					
LongitudeGIS																																					
Site Visit Owner								Awie 013-246 1533																													
River Name		Bronkhostpruit		Timbivati	Grootspruit	Steelpoort		Masala	Klip	Dwars					Groot Dwars	Steelpoort	Mohlapitse	Motse																		Olifants Gorge	
Tributary Of																																					
Drainage Region																																					
Longitudinal Zone																																					
Altitude																																					
Water Management Area		B	B								B	B	B	B					B	B	B	B	B	B	B	B							B	B			
Ecoregion 1																																					
Ecoregion 2																																					
Secondary Catchment		B2																																			
Quartenary Catchment		B20D																																			
SASSDataVersion		5	5		5			5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5							5	5			
PORIFERA								A												A	A		A	A		A								A			
COELENTERATA																																					
TURBELLARIA		C			A	B	A	B								1			A	A	1	B	A	B	A	A			B		A			A			1
OLIGOCHAETA		B	D		A	A				A	A					1					A	1	A		1	1				B	A		A			A	
HIRUDINEA		1																																			
AMPHIPODA																																					
POTAMONAUTIDAE		A	A		A		A		A		A				A	A	B		1	A	A	A	A	A	A	A			A		A		A	A			A
ATYIDAE											B								A	1	B	A		B		A	A	A				A					B
PALAEMONIDAE																																					
HYDRACARINA		A		A				1		1				A		B			A	A	B	A	A	B	B	A			A								1
NOTONEMOURIDAE																																					
PERLIDAE															1	1			A	B				A	1	A	A	B	B		A						A
BAETIDAE 1 SP		1	1																														A				
BAETIDAE 2 SP				A	B	B		B	A		A						B						B		B						A	B					
BAETIDAE > 2 SP							C			A				B	B	B			B	C	C	B				B	B	C	B	B						B	B
CAENIDAE		B			B	B	A	B		B	A			A		A			A	B	B	B	B	B	B	A	A	B	A	A	A		A	B			B
EPHEMERIDAE																																					
HEPTAGENIIDAE						B	B	B	1	A					B	A	B		A	A					1			B	B	B	B	A					
OLIGONEURIDAE																																				A	
LEPTOPHLEBIIDAE					A		B	A	A	A					A	B	A		C	B	B	C		A	B	B	A	C	B	B	A	B				1	A
POLYMITARCYIDAE																																					
PROSOPISTOMATIDAE										A															A	A		B									
TELOGANODIDAE																																					
TRICORYTHIDAE					C	A	B	B							A		B				B			A	A				B	A						B	
CALOPTERYGIDAE																																					
CHLOROCYPHIDAE															A				B	B	B					A			1	A	A						B
SYNLESTIDAE/CHLOROLESTIDAE								A																													
COENAGRIONIDAE			A		A	A	A	B		A	B			A	A	B			B	A	B	B	A	A		A	A	A	B	A	1	A	A	A			B
LESTIDAE										1	A								1	A																	
PLATYCNEMIDAE																																					
PROTONEURIDAE																																					
AESHNIDAE					A		A	A	1	A	1										1	1		1			A		1				1	1			A
CORDULIIDAE															A																						
GOMPHIDAE				A				B	B	A				1	B	1	B	1			A	1			B		B		A	A		B	A			1	A
LIBELLULIDAE				B				A		1	A			1	B				B	B	A	A		A	B	A	A	A	A	A	A	B	1	1		A	A
CRAMBIDAE (PYRALIDAE)																																					
BELOSTOMATIDAE			B	A		1		A		A	1			A	A	1			1	A	A	A	A	A			A		1		A	A	1	A			A
CORIXIDAE			D	C	B	C	C			A	C			B		A					B	B	A	A	A	A		A	A	B	A		A	B		B	
GERRIDAE				A			A	A		A	A				A				A				A	A	A	A		A	A		A		1	1			1
HYDROMETRIDAE								A											1						1												
NAUCORIDAE			A		B	1	B	1	A									A					A		1		A			1		B	B	B			1
NEPIDAE										A					A				A		1	1			1		1										A
NOTONECTIDAE			B	A		A	A	1		A	B			A					A		A				A	A					A	A		A			
PLEIDAE						A	A	A			A				1				A		A													A			
VELIIDAE/MESOVELIIDAE			B			A		A	A	A					1	A			A	A	A	A		A	A	A	B	A	A	A	B	A	A	A			B
CORYDALIDAE																																					
SIALIDAE																																					
DIPSEUDOPSIDAE																																					
ECNOMIDAE							A																					1									
HYDROPSYCHIDAE 1 SP					A									1		A									A	1						A				A	
HYDROPSYCHIDAE 2 SP		A				B	B	B		A					B		A		B	A	B	B		B			A		B	B	B			A			B
HYDROPSYCHIDAE > 2 SP																												B									
PHILOPOTAMIDAE					1		A												B						1				1								1
POLYCENTROPODIDAE																																					
PSYCHOMYIIDAE/XIPHOCENTRONIDAE																																					
BARBAROCHTHONIDAE																																					
CALAMOCERATIDAE																																					
GLOSSOSOMATIDAE																																					
HYDROPTILIDAE															1					B		A			A	1			1	A		A		1			
HYDROSALPINGIDAE																																					
LEPIDOSTOMATIDAE																																					
LEPTOCERIDAE							A	1		A					A				A		1			1	1		1		A	A	B	1					1
PETROTHRINCIDAE																																					
PISULIIDAE																																					
SERICOSTOMATIDAE																																					
DYTISCIDAE		1	B			1		B	A		A				A			1	A	1	A	A			1	A			1		1		B	1			
ELMIDAE/DRYOPIDAE					A	A	A	A		A				A	A		A		A	A	A	B		B	A	1	1	B	B	B				B			A
GYRINIDAE				OBS	A	A	A	B	1		1			1	A	B			A	A	A	A		A	A							A	A	A			1
HALIPLIDAE																																					
HELODIDAE				1																																	
HYDRAENIDAE				1																																	
HYDROPHILIDAE			A	A	1					1					1																						
LIMNICHIDAE																																					
PSEPHENIDAE					OBS		B			1					A		A		A	A		B		A	A	A		B			A						
ATHERICIDAE									1								A			A					A	1		A	A	1	A						
BLEPHARICERIDAE																																					
CERATOPOGONIDAE								A		A	B				1	A	1		B		B				1	A	1	1	A	A		A	A	A			
CHIRONOMIDAE		D	C	1	B	B	A	A	A		B			B	A	A			B	B	A	B	B	B	B	B		B	A	B	1		A	B		A	A
CULICIDAE				1							1				1						1			A		1								A			
DIXIDAE															1						1								1					1			
EMPIDIDAE																																					
EPHYDRIDAE			A		1																																
MUSCIDAE		A						1			A				A														1								
PSYCHODIDAE																																					
SIMULIIDAE					1	B	B	1												A		B	A	A	A	A	1		A	A						A	
SYRPHIDAE																																					
TABANIDAE							A	1											A	A	A			1		A	A	A	A	A		1					A
TIPULIDAE							A			A											A				1	A		A			1						1
ANCYLIDAE		B			A	A	A															A	A						B		B						
BULININAE																																					
HYDROBIIDAE																																					
LYMNAEIDAE				1																1																	A
PHYSIDAE		A												A								B	B	A									B	B			
PLANORBINAE				1	1	1											A			1		A	A								1						B
THIARIDAE				C																							A				C	C	C			B	
VIVIPARIDAE																																					
CORBICULIDAE			A			A													B	A	B			B		1		A		A	A	A	B	B		A	
SPHAERIIDAE																																					
UNIONIDAE																																					
SASS Score		51	48	80	120	108	165	170	79	175	89	NO	NO	71	180	109	88	18	200	192	179	145	73	151	216	184	125	166	208	149	151	111	87	118	NO	78	167
No of Families		13	14	17	22	22	26	30	12	27	20	NO	NO	14	29	19	12	3	31	29	33	27	17	27	33	31	20	22	32	23	27	19	20	25	NO	13	28
ASPT	#DIV/0!	3.92	3.43	4.71	5.45	4.91	6.35	5.67	6.58	6.48	4.45	NO	NO	5.07	6.21	5.74	7.33	6.00	6.45	6.62	5.42	5.37	4.29	5.59	6.55	5.94	6.25	7.55	6.50	6.48	5.59	5.84	4.35	4.72	NO	6.00	5.96
		13	14								20	0	0	14					31	29	33	27	17	27	33	31	20	22	32	23	27	19	20	25	0		28

	Amphilius uranoscopes	*Barbus anoplus*	*Barbus eutaenia*		*Barbus lineomaculatus*	*Labeobarbus marequensis*	*Barbus neefi*	*Barbus paludinosus*	*Barbus trimaculatus*	*Barbus unitaeniatus*	*Barbus viviparus*	*Chiloglanis paratus*	*Chiloglanis pretoriae*	*Chiloglanis swierstrai*	*Clarias gariepinus*	*Cyprinus carpio*	*Gambusia affinis*	*Glossogobius callidus*	*Hydrocynus vittatus*	*Labeo cylindricus*	*Labeo molybdinus*		*Labeo umbratus*	*Marcusenius macrolepidotus*	*Micropterus salmoides*	*Micralestes acutidens*	*Oreochromis mossambicus*	*Pseudocrenilabrus philander*	*Coptedon rendalli*	*Tilapia sparrmanii*	
	stargazer (mountain catfish)	chubbyhead barb	orangefin barb		line-spotted barb	Lowveld largescale yellow	sidespot barb	Straightfin barb	Threespot barb	Longbeard barb	Bowstripe barb	Sawfin suckermouth	Shortspine suckermouth	Lowveld suckermouth	Sharptooth catfish	Carp	mosquitofish (ex)	River goby	tigerfish	Redeye labeo	Leaden labeo		moggel	Bulldog	Largemouth bass	Silver robber	Mozambique tilapia	Southern mouthbrooder	Redbreast tilapia	Banded tilapia	**DIVERSITY**
						FS/SD		SD/SS	SD	SD	SS	FS	FS	FS	SD	SD		SS		FS	FS			SD	SD	SD/SS	SD	SS	SD	SS	
						Flowing water of larger rivers		Wide variety of habitats	Wide variety of habitats	Wide variety of habitats	Occurs in vegetated pools in rivers	Flowing water over cobbles and in shoots	Flowing water over cobbles and in shoots	Flowing water over sandy substrate	Wide variety of habitats	Wide variety of habitats		Rocks and vegetation at the bottom of pools		Prefers clear flowing water in rocky habitat	Deep pools			Well vegetated habitat with muddy substrate	Clear standing or slow flowing water	Clear flowing water	Wide variety of habitats except fast flowing water	Wide variety of habitats	Quiet well vegetated banks	Wide variety of habitats	
						Least Concern		Least Concern	Least Concern	Least Concern	Least Concern	Least Concern	Least Concern	Least Concern	Unlisted	Vulnerable		Least Concern		Least Concern	Least Concern			Least Concern	Unlisted	Least Concern	Near Threatened	Unlisted	Least Concern	Least Concern	
	4.8	2.6	4.3		4.1	2.6	3.4	1.8	2.2	1.7	2.4	3.5	4.6	4.4	1.2	1.4	2	2.3	3.2	3.1	3.2		2.3	3.6	2.2	2.3	1.3	1.3	1.8	1.3	
Site	**AURA**	**BANO**	**BEUT**	**BIMB**	**BLIN**	**BMAR**	**BNEE**	**BPAU**	**BTRI**	**BUNI**	**BVIV**	**CPAR**	**CPRE**	**CSWI**	**CGAR**	**CCAR**	**GAFF**	**GCAL**	**HVIT**	**LCYL**	**LMOL**	**LROS**	**LUMB**	**MMAC**	**MSAL**	**MACU**	**OMOS**	**PPHI**	**TREN**	**TSPA**	**30**
B1		3													1		9						1					12		5	6
B2						1									4													9		3	4
B4															1												20				2
E2																									31					1	2
E3																									11					1	2
E4		17					7								1																3
E5	1	7					1																		x						4
E7	2												3																		2
H7						44	4					3	22		1						3							9		2	8
S1													17															3		5	3
S2	9					16			3	1			37															5			6
S3		17											17		1		27													5	5
S5	1					X							5			X	1								X		X				7
S6															4		3								1					5	4
S7	1					51							33		3	2				31								5		4	8
S8	2		22		2	32		11	5	1			18		4													13			10
S9						40		15					20															1		8	5
S10						31					1	8	15		1					7	12					7	1	4			10
S11			51		10	300							23		3					15	29			1				4			9
S12	6					24	9						20																		4
S13						19			5		2	5	14		3					13	8						7				9
S14					2	25			5	14			75		3					33	1				5	22			1		11
S15						10			8		2		2	5	3			6		4	2					1	16				11
S16						77						6		6	5	1			X	11	13						10	1	2	1	12
X1		2																										22		7	3
X2																															0
X3																															0
X5															6		1											7		8	4
X5															6		1											7		8	4
X6																												7			1

X7																															0
X10		38																												4	2
X17																															0
X18/H3							3						26								2		2				19	62		3	7
X19	3		12			7					2		29								1			1		1	1	2			10
X20													7							31	5							7			4
X23				1		2							2		obs			7	obs		8	2									8
X21																															0
Abundance	25	84	85		14	679	24	26	26	16	7	22	385	11	50	3	42	13	0	145	84		3	2	48	31	74	180	3	70	2152

APPENDIX D
AQUATIC MACROINVERTEBRATE AND FISH INVENTORY – LETABA AND SHINGWEDZI CATCHMENT

RHP Site Code																				
Site		LET1	LET2	LET3	LET4	LET5	LET6	LET7	LET8	LET9	LET10	LET11	LET12	LET13	LET14	LET15	LET16	LET17	LET18	LET19
Date		18/04/2016	18/04/2016	19/04/2016	14/04/2016		13/04/2016						21/04/2016	21/04/2016	21/04/2016	21/04/2016	22/04/2016	22/04/2016	22/04/2016	20/04/2016
LatitudeGIS																				
LongitudeGIS																				
Site Visit Owner																				
River Name		Letaba		Tzende																Politsi
Tributary Of																				
Drainage Region																				
Longitudinal Zone																				
Altitude																				
Water Management Area																				
Ecoregion 1																				
Ecoregion 2																				
Secondary Catchment																				
Quartenary Catchment																				
SASSDataVersion																				
PORIFERA																				
COELENTERATA																				
TURBELLARIA																A		A	A	
OLIGOCHAETA		B	A		A		A						A	A	A	A		1		
HIRUDINEA			1										B		B					
AMPHIPODA																				
POTAMONAUTIDAE			A		OBS								A	A	OBS	A	OBS	A	B	
ATYIDAE				1			B						B	B						
PALAEMONIDAE																				
HYDRACARINA		1	1	D										A			1			
NOTONEMOURIDAE																				
PERLIDAE																		B	A	
BAETIDAE 1 SP													A							
BAETIDAE 2 SP				A			1										B			
BAETIDAE > 2 SP		B	B		B									B	B	C		B	B	B
CAENIDAE		1		C	A		A						A	A	A	B	A	B		
EPHEMERIDAE																				
HEPTAGENIIDAE														A		1	B	A		A
OLIGONEURIDAE		B	A		B		A						OBS							A
LEPTOPHLEBIIDAE		A	A		A								B	B	B		B	A	A	A
POLYMITARCYIDAE																				
PROSOPISTOMATIDAE																		1		
TELOGANODIDAE																				
TRICORYTHIDAE		A	B		B									A	A	B	B	A	B	
CALOPTERYGIDAE																				
CHLOROCYPHIDAE																A		A	A	
SYNLESTIDAE/CHLOROLESTIDAE																				
COENAGRIONIDAE			1	A			OBS						A	A	1	B	A	A	C	1
LESTIDAE																			A	
PLATYCNEMIDAE																				
PROTONEURIDAE																				
AESHNIDAE																		1	B	
CORDULIIDAE														A						
GOMPHIDAE		B	B	B	B													A	A	
LIBELLULIDAE			1	A										A		B	A	A	1	1
CRAMBIDAE (PYRALIDAE)																				
BELOSTOMATIDAE				A									A	A	A	A		A		
CORIXIDAE		B		A											A					
GERRIDAE				A												B		OBS	B	
HYDROMETRIDAE																				
NAUCORIDAE		1		OBS																
NEPIDAE																				
NOTONECTIDAE				A														A		
PLEIDAE				A										A						
VELIIDAE/MESOVELIIDAE					1									A		A		A		1
CORYDALIDAE																				
SIALIDAE																				
DIPSEUDOPSIDAE																				
ECNOMIDAE																		1		
HYDROPSYCHIDAE 1 SP					1														A	1
HYDROPSYCHIDAE 2 SP													A	B		B	A	A		
HYDROPSYCHIDAE > 2 SP																				

PHILOPOTAMIDAE														B		B			1	1
POLYCENTROPODIDAE																				
PSYCHOMYIIDAE/XIPHOCENTRONIDAE																				
BARBAROCHTHONIDAE																				
CALAMOCERATIDAE																				
GLOSSOSOMATIDAE																				
HYDROPTILIDAE																				
HYDROSALPINGIDAE																				
LEPIDOSTOMATIDAE																				
LEPTOCERIDAE														A			A	B	B	A
PETROTHRINCIDAE																				
PISULIIDAE																				
SERICOSTOMATIDAE																				
DYTISCIDAE		A	A	A									A					B	B	
ELMIDAE/DRYOPIDAE			B		1								A	B	A	A	1	A	1	1
GYRINIDAE		A		OBS														A		
HALIPLIDAE																				
HELODIDAE				A											1					
HYDRAENIDAE																				
HYDROPHILIDAE													A		A					
LIMNICHIDAE																				
PSEPHENIDAE																	A			
ATHERICIDAE																1	A	1	A	
BLEPHARICERIDAE																				
CERATOPOGONIDAE		A	A	A	A													A	A	
CHIRONOMIDAE		B	B	B	B								B	B	B	A	A	A	A	1
CULICIDAE															A	1			1	
DIXIDAE																			1	
EMPIDIDAE																				
EPHYDRIDAE																				
MUSCIDAE																				
PSYCHODIDAE																				
SIMULIIDAE		B		A	B									B	B	B	A	B	A	A
SYRPHIDAE																				
TABANIDAE			B											A		A	A	1		
TIPULIDAE																		A	A	
ANCYLIDAE																				
BULININAE																				
HYDROBIIDAE																				
LYMNAEIDAE				A										A						
PHYSIDAE		1	A				1							A						
PLANORBINAE													1	A						
THIARIDAE		B	C		B		B						B	B		A				
VIVIPARIDAE																				
CORBICULIDAE			A		B		OBS						B	B		A				
SPHAERIIDAE																				
UNIONIDAE																				
SASS Score		114	110	104	90		49						93	156	86	133	114	201	162	110
No of Families		19	19	20	16		9						18	27	16	23	17	31	25	13
ASPT		6.00	5.79	5.20	5.63		5.44						5.17	5.78	5.38	5.78	6.71	6.48	6.48	8.46
		17	19								0	0	18	27					25	13

RHP Site Code									
Site		SHI1	SHI2	SHI3	SHI4	SHI5	SHI6	SHI7	SHI8
Date		19/04/2016				Phungwne			14/04/2016
LatitudeGIS									
LongitudeGIS									
Site Visit Owner									
River Name									
Tributary Of									
Drainage Region									
Longitudinal Zone									
Altitude									
Water Management Area									
Ecoregion 1									
Ecoregion 2									
Secondary Catchment									
Quartenary Catchment									
SASSDataVersion									
PORIFERA									
COELENTERATA									
TURBELLARIA									
OLIGOCHAETA									C
HIRUDINEA									
AMPHIPODA									
POTAMONAUTIDAE									
ATYIDAE									
PALAEMONIDAE									
HYDRACARINA		A				OBS			
NOTONEMOURIDAE									
PERLIDAE									
BAETIDAE 1 SP									
BAETIDAE 2 SP		B							
BAETIDAE > 2 SP									
CAENIDAE		C							
EPHEMERIDAE									
HEPTAGENIIDAE									
OLIGONEURIDAE									
LEPTOPHLEBIIDAE		A							
POLYMITARCYIDAE									
PROSOPISTOMATIDAE									
TELOGANODIDAE									
TRICORYTHIDAE									
CALOPTERYGIDAE									
CHLOROCYPHIDAE									
SYNLESTIDAE/CHLOROLESTIDAE									
COENAGRIONIDAE		B							A
LESTIDAE									
PLATYCNEMIDAE									
PROTONEURIDAE									
AESHNIDAE									
CORDULIIDAE									
GOMPHIDAE		A							
LIBELLULIDAE		B							1

	Amphilius uranoscopes	*Bafr*	*Barbus eutaenia*	*Btop*	*Labeobarbus marequensis*	*Brad*	*Barbus trimaculatus*	*Barbus viviparus*	*Chiloglanis paratus*	*Chiloglanis pretoriae*	*Chiloglanis swierstrai*	*Clarias gariepinus*	*Glossogobius callidus*	*Hydrocynus vittatus*	*Labeo cylindricus*	*Labeo molybdinus*		*Marcusenius macrolepidotus*	*Micopterus salmoides*	*Micralestes acutidens*		*Oreochromis mossambicus*			*Pseudocrenilabrus philander*		*Coptedon rendalli*	*Tilapia sparrmanii*		
	stargazer (mountain catfish)		orangefin barb		Lowveld largescale yellow		Threespot barb	Bowstripe barb	Sawfin suckermouth	Shortspine suckermouth	Lowveld suckermouth	Sharptooth catfish	River goby	tigerfish	Redeye labeo	Leaden labeo	Sardine	Bulldog	Largemouth bass	Silver robber		Mozambique tilapia			Southern mouthbrooder		Redbreast tilapia	Banded tilapia	DIVERSITY	
					FS/SD		SD	SS	FS	FS	FS	SD	SS		FS	FS		SD	SD	SD/SS		SD			SS		SD	SS		
					Flowing water of larger rivers		Wide variety of habitats	Occurs in vegetated pools in rivers	Flowing water over cobbles and in shoots	Flowing water over cobbles and in shoots	Flowing water over sandy substrate	Wide variety of habitats	Rocks and vegetation at the bottom of pools		Prefers clear flowing water in rocky habitat	Deep pools		Well vegetated habitat with muddy substrate	Clear standing or slow flowing water	Clear flowing water		Wide variety of habitats except fast flowing water			Wide variety of habitats		Quiet well vegetated banks	Wide variety of habitats		
					Least Concern		Least Concern	Least Concern	Least Concern	Least Concern	Least Concern	Unlisted	Least Concern		Least Concern	Least Concern		Least Concern	Unlisted	Least Concern		Near Threatened			Unlisted		Least Concern	Least Concern		
	4.8		4.3		2.6		2.2	2.4	3.5	4.6	4.4	1.2	2.3	3.2	3.1	3.2		3.6	2.2	2.3		1.3			1.3		1.8	1.3		
Site	**AURA**	**BFRI**	**BEUT**	**BTOP**	**BMAR**	**BRAD**	**BTRI**	**BVIV**	**CPAR**	**CPRE**	**CSWI**	**CGAR**	**GCAL**	**HVIT**	**LCYL**	**LMOL**	**MBRE**	**MMAC**	**MSAL**	**MACU**	**ONIL**	**OMOS**	**OMYK**	**PCAT**	**PPHI**	**SINT**	**TREN**	**TSPA**	**28**	
Let1					2		1	6	10			3	4		35	2					1	29					3		11	
Let2							11	11	4	2		15	5		1							28							8	
Let3							6					29										164					15		4	
Let4				6	125	2	19	2	3	18		7	1			40				3		43			1		1		14	
Let5																													0	no fiding
Let6				?6?	26	1	11		2	10	10		1		4	2						13							11	
Let8																													0	
Let9						1	4	16				10	1				4					144			2				8	
Let12				1	8		3	17		59		6	2		7	13		7	2	20		1			2	1			15	
Let13				9	1			12		24		8			16	24		25	1	39		1		1	13	2	3		15	
Let14				79	2		1	27		6		20						37											7	
Let15			10		44		2	1				5								8		2			7		2		9	
Let16	13				16					46									1										4	
Let17																			6						1				2	
Let18																							2						1	
Let19					21					9					13					1									4	
																													0	
																													0	
Abundance	13	0	10	95	245	4	58	92	19	174	10	103	14	0	76	81	4	69	10	71	1	425	2	1	26	3	24	0	1630	

CRAMBIDAE (PYRALIDAE)									
BELOSTOMATIDAE		A							B
CORIXIDAE									A
GERRIDAE		A				OBS			
HYDROMETRIDAE									
NAUCORIDAE									
NEPIDAE									
NOTONECTIDAE		1				OBS			
PLEIDAE		A							
VELIIDAE/MESOVELIIDAE									B
CORYDALIDAE									
SIALIDAE									
DIPSEUDOPSIDAE									
ECNOMIDAE									
HYDROPSYCHIDAE 1 SP									
HYDROPSYCHIDAE 2 SP									
HYDROPSYCHIDAE > 2 SP									
PHILOPOTAMIDAE									
POLYCENTROPODIDAE									
PSYCHOMYIIDAE/XIPHOCENTRONIDAE									
BARBAROCHTHONIDAE									
CALAMOCERATIDAE									
GLOSSOSOMATIDAE									
HYDROPTILIDAE									
HYDROSALPINGIDAE									
LEPIDOSTOMATIDAE									
LEPTOCERIDAE									
PETROTHRINCIDAE									
PISULIIDAE									
SERICOSTOMATIDAE									
DYTISCIDAE						OBS			A
ELMIDAE/DRYOPIDAE									
GYRINIDAE		A				OBS			
HALIPLIDAE									
HELODIDAE		1							
HYDRAENIDAE									
HYDROPHILIDAE		1							
LIMNICHIDAE									
PSEPHENIDAE									
ATHERICIDAE									
BLEPHARICERIDAE									
CERATOPOGONIDAE									
CHIRONOMIDAE									1
CULICIDAE									
DIXIDAE									
EMPIDIDAE									
EPHYDRIDAE									
MUSCIDAE									
PSYCHODIDAE									
SIMULIIDAE		A							
SYRPHIDAE									
TABANIDAE									

TIPULIDAE									
ANCYLIDAE									
BULININAE									
HYDROBIIDAE									
LYMNAEIDAE		1							
PHYSIDAE									
PLANORBINAE		1							
THIARIDAE		A							B
VIVIPARIDAE									
CORBICULIDAE									
SPHAERIIDAE									
UNIONIDAE									
SASS Score		94				fairy shrimp			30
No of Families		18				5			9
ASPT	#DIV/0!	5.22							3.33
		18	0	0	0	5	0	0	9

	Amphilius uranoscopes	*Bafr*	*Barbus anoplus*	*Barbus eutaenia*	*Barbus lineomaculatus*	*Btop*	*Labeobarbus marequensis*	*Barbus neefi*	*Barbus paludinosus*	*Barbus trimaculatus*	*Barbus unitaeniatus*	*Barbus viviparus*	*Chiloglanis paratus*	*Chiloglanis pretoriae*	*Chiloglanis swierstrai*	*Clarias gariepinus*	*Cyprinus carpio*	*Gambusia affinis*	*Glossogobius callidus*	*Hydrocynus vittatus*	*Labeo cylindricus*	*Labeo molybdinus*	*Labeo umbratus*	*Marcusenius macrolepidotus*	*Micropterus salmoides*	*Micralestes acutidens*	*Oreochromis mossambicus*	*Pseudocrenilabrus philander*	*Coptedon rendalli*	*Tilapia sparrmanii*		
	stargazer (mountain catfish)		chubbyhead barb	orangefin barb	line-spotted barb		Lowveld largescale yellow	sidespot barb	Straightfin barb	Threespot barb	Longbeard barb	Bowstripe barb	Sawfin suckermouth	Shortspine suckermouth	Lowveld suckermouth	Sharptooth catfish	Carp	mosquitofish (ex)	River goby	tigerfish	Redeye labeo	Leaden labeo	moggel	Bulldog	Largemouth bass	Silver robber	Mozambique tilapia	Southern mouthbrooder	Redbreast tilapia	Banded tilapia	DIVERSITY	
							FS/SD		SD/SS	SD	SD	SS	FS	FS	FS	SD	SD		SS		FS	FS		SD	SD	SD/SS	SD	SS	SD	SS		
							Flowing water of larger rivers		Wide variety of habitats	Wide variety of habitats	Wide variety of habitats	Occurs in vegetated pools in rivers	Flowing water over cobbles and in shoots	Flowing water over cobbles and in shoots	Flowing water over sandy substrate	Wide variety of habitats	Wide variety of habitats		Rocks and vegetation at the bottom of pools		Prefers clear flowing water in rocky habitat	Deep pools		Well vegetated habitat with muddy subsrate	Clear standing or slow flowing water	Clear flowing water	Wide variety of habitats except fast flowing water	Wide variety of habitats	Quiet well vegetated banks	Wide variety of habitats		
							Least Concern		Least Concern	Least Concern	Least Concern	Least Concern	Least Concern	Least Concern	Least Concern	Unlisted	Vulnerable		Least Concern		Least Concern	Least Concern		Least Concern	Unlisted	Least Concern	Near Threatened	Unlisted	Least Concern	Least Concern		
	4.8		2.6	4.3	4.1		2.6	3.4	1.8	2.2	1.7	2.4	3.5	4.6	4.4	1.2	1.4	2	2.3	3.2	3.1	3.2	2.3	3.6	2.2	2.3	1.3	1.3	1.8	1.3		
Site	**AURA**		**BANO**	**BEUT**	**BLIN**		**BMAR**	**BNEE**	**BPAU**	**BTRI**	**BUNI**	**BVIV**	**CPAR**	**CPRE**	**CSWI**	**CGAR**	**CCAR**	**GAFF**	**GCAL**	**HVIT**	**LCYL**	**LMOL**	**LUMB**	**MMAC**	**MSAL**	**MACU**	**OMOS**	**PPHI**	**TREN**	**TSPA**	**28**	
Shi5																															**0**	no fish
Shi8		2				7				5						15						1					200		2		**7**	
																															0	
																															0	
																															0	
																															0	
																															0	
Abundance	0		0	0	0		0	0	0	5	0	0	0	0	0	15	0	0	0	0	0	1	0	0	0	0	200	0	2	0	223	