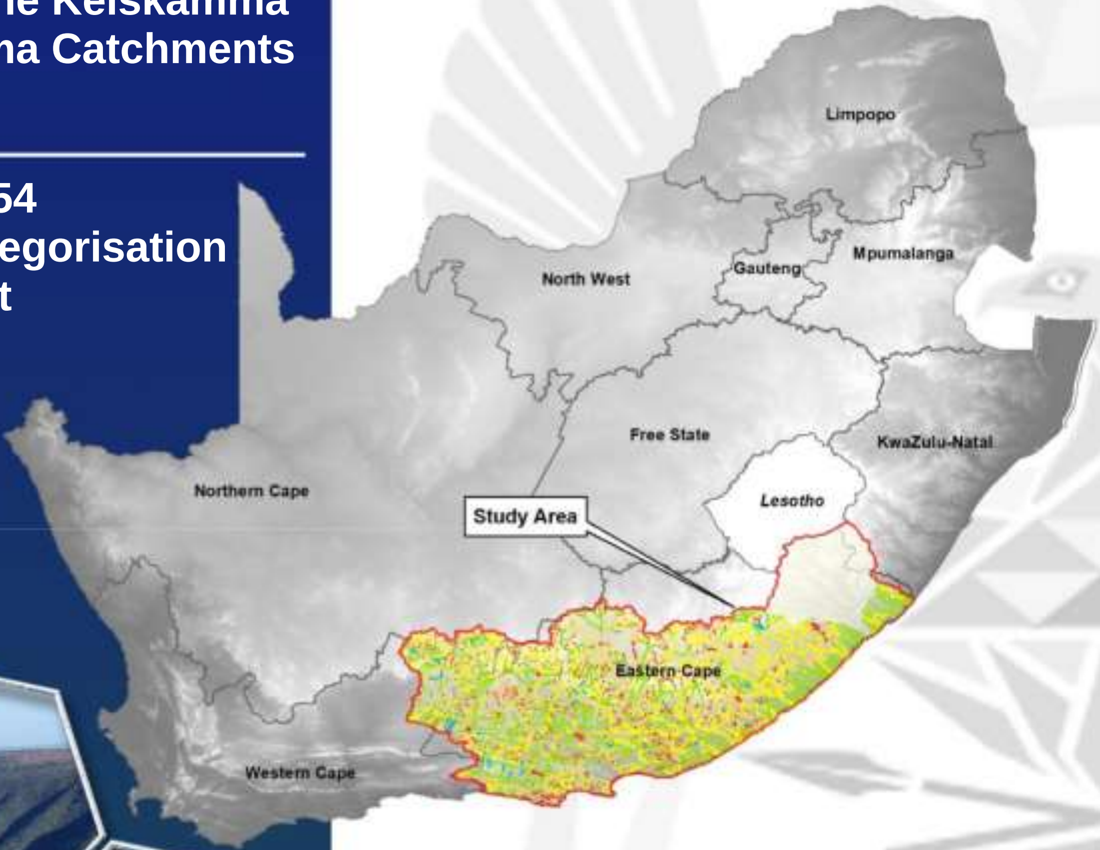
DEPARTMENT OF WATER AND SANITATION

Determination of Water Resource Classes, Reserve and the Resource Quality Objectives in the Keiskamma and Fish to Tsitsikamma Catchments

WP11354
Wetland Eco-Categorisation Report



REPORT NO.:
WEM/WMA7/00/CON/RDM/1223

November 2023

water & sanitation
Department:
Water and Sanitation
REPUBLIC OF SOUTH AFRICA

Published by

Department of Water and Sanitation
Private Bag X313
Pretoria, 0001
Republic of South Africa

Tel: (012) 336 7500/ +27 12 336 7500
Fax: (012) 336 6731/ +27 12 336 6731

This report is to be cited as:

Department of Water and Sanitation, South Africa. November 2023. Determination of Water Resource Classes, Reserve and RQOs in the Keiskamma and Fish to Tsitsikamma catchment: Wetland Eco-categorisation Report. Report No: WEM/WMA7/00/CON/RDM/1223.

Prepared by:

GroundTruth: Water, Wetlands and Environmental Engineering

3

Title:	*Wetland Eco-categorisation Report*
Authors:	*C. Cowden, S. Ellery, D. Kotze, F. Eggers*
Project Name:	*Determination of Water Resource Classes, Reserve and RQOs in the Keiskamma and Fish to Tsitsikamma catchment: WP11354*
DWS Report No.:	WEM/WMA7/00/CON/RDM/1223
Status of Report	*Final*
First Issue:	*April 2023*
Final Issue:	*29 November 2023*

Approved for GroundTruth: Water, Wetlands and Environmental Engineering

.... 29 November 2023

Dr Mark Graham *Date*

Director, GroundTruth

Supported by:

02/12/2023.. ....

Project Manager *Scientific Manager*

Rendani Mathwedzha

Approved for the Department of Water and Sanitation by:

....

Director: Reserve Determination

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Bold type indicates this report.

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ACKNOWLEDGEMENTS

The project team would like to acknowledge the following officials (in no particular order) for their contributions towards the overall project but especially during the various wetland resource unit site visits:

- Lwando Dayimani (Department of Water and Sanitation – DWS)
- Musa Nyambi (DWS)
- Ncamile Dweni (DWS)
- Rendani Mudzanani (DWS)
- Samkele Mnyango (DWS)
- Siyabonga Ngcobo (DWS)
- Zanele Nyamende (DWS)
- Nqabisa Gwentshe (DWS)
- Lawrence Mulangaphuma (DWS)
- Henry Maluleke (DWS)
- Yongama Mbanyeza (Eastern Cape Department of Economic Development, Environmental Affairs and Tourism – DEDEAT)
- Khanyisa Mpisane (DEDEAT)
- Eric Qonye (DEDEAT)
- Sinazo Songca (DEDEAT)
- Margaret Lowries (Department of Forestry, Fisheries and the Environment – DFFE)
- Andani Ndou (MTO Forestry Company – MTO)
- Buhlobo Grootboom (MTO)
- Elizabeth Mathebula (MTO)
- Enathi Puza (MTO)
- Delani Shongwe (MTO)
- Karen Kirkman (MTO)
- Desmond Pilasa (Amathole Forestry Company)

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LIST OF ACRONYMS

Acronym	Explanation
AFC	Amathole Forestry Company
BHN	Basic Human Needs
CR	Critically Endangered
CVB	Channelled Valley-bottom
DEDEAT	Department of Economic Development, Environmental Affairs and Tourism
DFFE	Department of Forestry, Fisheries and the Environment
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EIS	Ecological Importance and Sensitivity
EN	Endangered
EWR	Ecological Water Requirements
FP	Floodplain
HGM	Hydrogeomorphic Unit
IAP	Invasive Alien Plant
IBA	Important Bird Areas
IUA	Integrated Unit of Analysis
LT	Least Threatened
MAP	Mean Annual Precipitation
MCA	Multi-criteria Analysis
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
NWM5	National Wetland Map 5
PES	Present Ecological State
PET	Potential Evapotranspiration
RDM	Resource Directed Measures
REC	Recommended Ecological Category
RQO	Resource Quality Objectives
SWSAs	Strategic Water Source Area
UCVB	Unchannelled Valley-bottom
VB	Valley-bottom
WMA	Water Management Area
WRCS	Water Resource Classification System
WRU	Wetland Resource Unit

1. INTRODUCTION

The National Water Act, 1998 (No. 36 of 1998) (NWA) is founded on the principle that National Government has overall responsibility for and authority over water resource management for the benefit of the public without affecting the functioning of water resource systems. To achieve this objective, Chapter 3 of the NWA provides for the protection of water resources through the implementation of Resource Directed Measures (RDM). These measures are protection-based and include Water Resource Classification, determination of the Reserve and setting the associated Resource Quality Objectives (RQOs). These measures collectively aim to ensure that a balance is reached between the need to protect and sustain water resources, while allowing economic development.

The provision of water required for the maintenance of the natural functionality of the ecosystem and provision of Basic Human Needs (BHN) is the only right to water in the National Water Act (No. 36 of 1998) (NWA). The other water users from a strategic use, who are second in line to other water users, are subject to formal gazetted General Authorization and water use authorization as per Section 21 of the NWA.

The Chief Directorate: Water Ecosystems Management (CD: WEM) of the Department of Water and Sanitation (DWS), has initiated a study for the determination of Water Resource Classes, Reserve, and associated Resource Quality Objectives (RQOs) for the identified water resources in the Keiskamma, Fish to Tsitsikamma catchments.

The water resource components included in this report are **wetland ecosystems** (as per the Hydrogeomorphic (HGM) Units categorisation). The process of determining Reserves for designated wetlands involves establishing Ecological Water Requirements (EWRs) for those connected to rivers and/or groundwater resources, following the guidelines of the Decision Support System (DSS). In cases where wetlands lack such connections, the Reserve will be defined by specifying Ecological Specifications to align with the determined Resource Quality Objectives (RQOs). This will form part of Step 6 of the integrated steps for Classification, Reserve and RQOs will be guided by the “Development of Procedures to operationalise Resource Directed Measures (DWS, 2017). Furthermore, will be included within the RQO, numerical limits and confidence Report (Deliverable 4.3.34), developed for the identified water resources, in the subsequent phases of the project.

1.1 Study motivation

The Keiskamma and Fish to Tsitsikamma catchments within the Mzimvubu to Tsitsikamma Water Management Area (WMA7) are amongst the listed water-stressed catchments in South Africa. This study area is important for conservation and has recognised protected areas, natural heritage, cultural and historical sites that require protection. As several rivers and estuaries are within these catchments with no major impacts, it is vital that their ecological integrity is retained.

However, water use, from surface as well as groundwater resources, for agricultural and other land use activities are high, especially in the more arid catchments, impacting on the availability of water resources for the protection of the aquatic ecosystems. Industrial practices and domestic water use are on the rise in some of these catchments, especially around the major towns and cities. Water transfers from adjacent Water Management Areas (WMA) and within the study area and numerous storage dams changes the flow patterns, impacting on the aquatic biota. Furthermore, various water use license applications and increasing land use impacts in the catchments (forestry, farming, eradication of alien vegetation, wastewater treatment works) are increasing.

Therefore, measures including the classification of water resources, quantification of the Reserve for rivers and groundwater resources and setting of RQOs for all identified significant water resources is required to ensure ecological sustainability within these catchments. This will ultimately assist the DWS in managing and protecting of the water resources in the study area in an integrated manner, as well as making informed decisions regarding the authorisation of future water use and the magnitude of the impacts of proposed developments.

Overall, the goal of this study is to provide information that is legally defensible and that the Recommended Ecological Category (REC) is identified with RQOs being set for priority wetland ecosystems alongside the studies being undertaken for the river, estuary, and groundwater components, which will be gazetted and thus legally binding.

1.2 Overarching study objective

The main objectives of the overarching study are to determine, where applicable, (i) Water Resource Classes, (ii) the Reserve and (iii) associated Resource Quality Objectives (RQOs) and (iv) gazetting of these for the identified water resources in the Keiskamma and Fish to Tsitsikamma catchment area that would facilitate sustainable use of the water resources while maintaining the required ecological integrity. All the water resource components, including rivers, wetlands, estuaries, and groundwater will be considered during this study and where applicable, integration between these components will be undertaken. Furthermore, the determination of the Water Resource Classes, the Reserves and setting RQOs will depend on the integration of several disciplines in respect of water resources protection (i.e., instream and riparian health and Source Directed Control) that includes the needs of the water users present in the catchment area. This will be done through a consultative process with continual communication and liaison by involving the various stakeholders in the study area. Skills development and transfer through a number of workshops, training days, in-field surveys and day-to-day management of the study will be undertaken as part of the capacity building requirements of the DWS.

The key aims of this study are thus to (i) co-ordinate the implementation of the Water Resource Classification System (WRCS) through the published Regulation 810 (Department of Water Affairs, September 2010) and (ii) following the various methodologies for the determination of the relevant Reserves and setting the RQOs as prescribed by the DWS. The integrated procedure as developed to Operationalise Resource Directed Measures (DWS, 2017) will be used to guide the overall process for this study. The study team understands that this study is linked to previous Reserve determination studies and other water resource management initiatives within the study area. Linking and integration with current parallel studies, including the development of a reconciliation strategy for the management of the water resources in the study area will be undertaken as part of this study.

The Water Resource Classes and associated RQOs will assist as input information when assessing potential authorisation of future water uses, provide guidance on the operation and management of the system and the evaluation of the impacts of the present and proposed developments, in the form of operational scenario evaluation. Furthermore, taking the economic, social, and ecological goals to be attained, and considering and specifying the risks of non-compliance, with meeting of the Recommended Ecological Category (REC) and the potential loss of social and economic water use.

1.3 Purpose of this report

The purpose of this report is to summarise the data, information, approaches followed and results for the selected WRUs for the Keiskamma, Fish to Tsitsikamma project area to provide input for the determination of the Water Resource Classes and specification of RQOs. The approach for the WRUs incorporated Steps 3, 5 and 7 as shown in **Figure 1-1** below. The ecological specifications and Ecological Water Requirements (EWR) will be determined for priority rivers, estuaries, groundwater, and WRUs in subsequent phases of the project. As such, only selected aspects of Step 4 were included in the approach for the wetland component for this study. Where information from previous Reserve determinations for wetlands are available, these results will be used and the EWR will be quantified. However, recommendations for the need for quantification of the EWRs for specific priority wetlands and where integration between groundwater, rivers, estuaries and/or wetlands are crucial, will be made. Furthermore, preliminary ecological specifications have been provided for, which include the preliminary management and mitigation measures and monitoring recommendations for each priority wetland within this report. These will be summarised as ecological specifications in the RQO, numerical limits and confidence Report, as well as included within the gazette template (Deliverable 4.3.27).

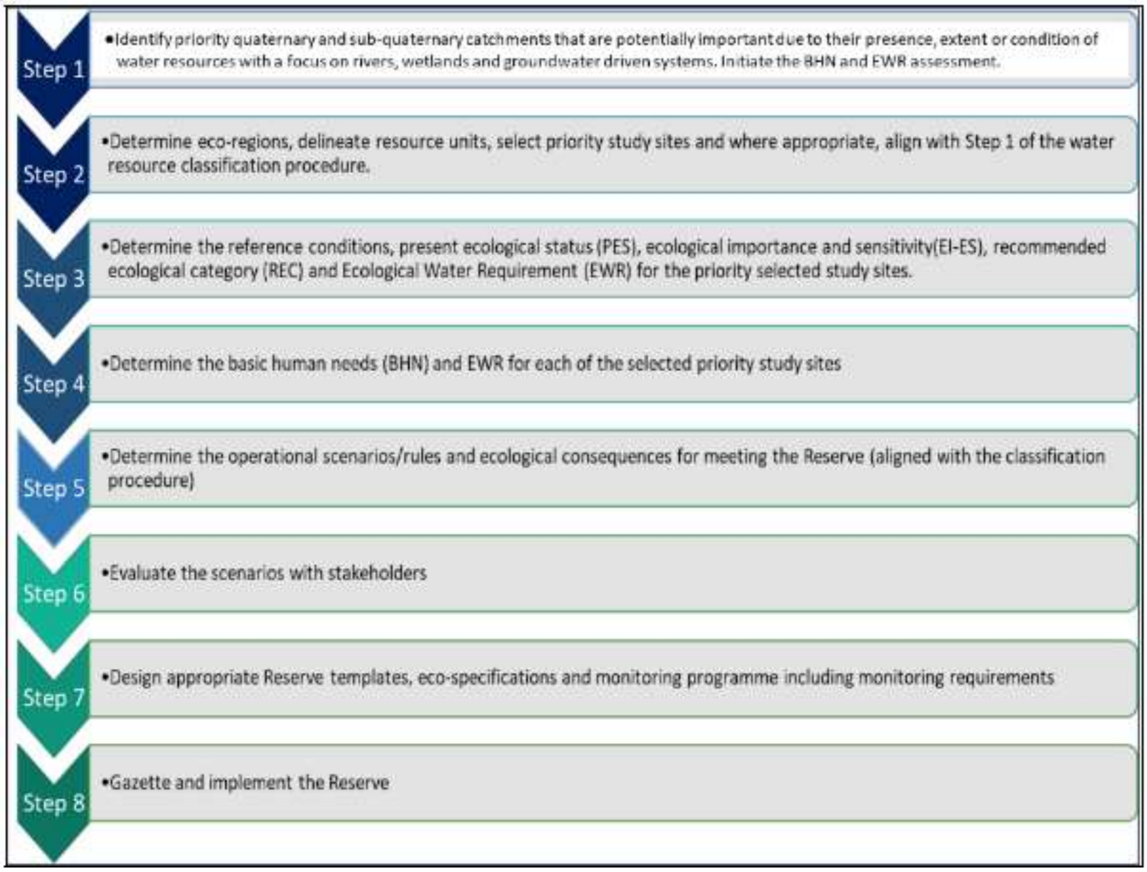

Figure 1-1: Integrated steps for the determination of the Reserve (DWS, 2017)

2. STUDY AREA

The study area forms part of the Mzimvubu to Tsitsikamma WMA (WMA7) as indicated in**.** The water resources of the Mzimvubu catchment (T31 – T36) were not included as part of the study area, as the catchments have been gazetted based on a reserve study undertaken in 2022. Secondary catchments T40 (Mtamvuna) and T50 (Mzimkhulu) form part of WMA4, and therefore were also excluded from this study.

Table 2-1 and **Figure 2-1**. The water resources of the Mzimvubu catchment (T31 – T36) were not included as part of the study area, as the catchments have been gazetted based on a reserve study undertaken in 2022. Secondary catchments T40 (Mtamvuna) and T50 (Mzimkhulu) form part of WMA4, and therefore were also excluded from this study.

Table 2-1 Main catchments and rivers in the study area

Catchment	Major Rivers
K80	Tsitsikamma and small coastal rivers
K90	Krom and small coastal rivers
L10 - L90	Gamtoos with main tributaries Groot, Baviaanskloof and Kouga
M10 - M30	Koega, Swartkops and small coastal rivers
N10 - N40	Sundays
P10 - P40	Kowie, Kariega, Boesmans and small coastal rivers
Q10 - Q90	Fish River with main tributaries of Little Fish, Koonap and Kat
R10 - R50	Keiskamma and small coastal rivers
S10 - S70	Great Kei River with main tributaries of Klipplaats, Indwe, White Kei, and Black Kei
T10	Mbashe
T20	Mthatha
T60	Small coastal rivers (Mtentu, Msikaba, and Mzintlava)
T70	Small coastal rivers (Mtakatye and Mngazi)
T80 & T90	Small coastal rivers

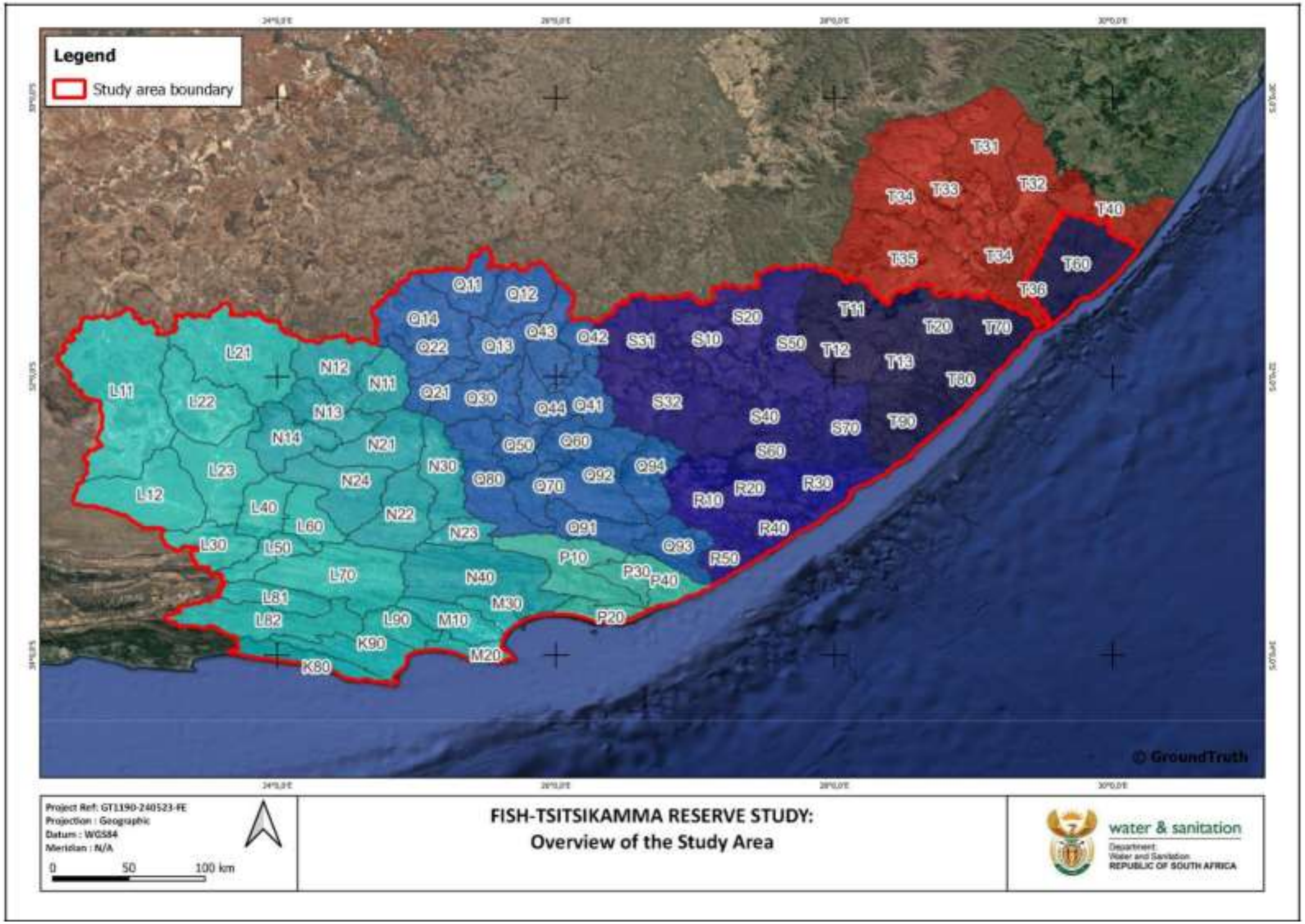

Figure 2-1 Overview of the greater study area

2.1 Wetlands

There are 12 sub-catchments within the overall study area, of which the Kei, Mbashe, Tsitsikamma and Fish hold the largest areas of known wetlands **(Table 2-2)**.

Table 2-2 Area[1] of wetland per sub-catchment

Catchment	Sub-catchment	Primary catchment	Hectares	%
Fish to Keiskamma	Gamtoos	L	1274	4.2
	Sundays	N	899	3.0
	Fish	Q	3,296	10.9
	Tsitsikamma	K	3,236	10.7
	Algoa	M	2,357	7.8
	Bushmans	P	634	2.1
Mzimvubu to Keiskamma	Kei	S	9,329	30.9
	Amathole	R	1,827	6.1
	Mbashe	T	4,304	14.3
	Mthatha	T	1,102	3.7
	Wild Coast	T	1,913	6.3
Grand Total			30,171	100

[1]Area of wetland was determined based on National Wetland Map 5 (NWM5), but supplemented with additional information for the Gamtoos, Sundays and Wild Coast, where a high level of under-mapping was confirmed.

2.2 A Few Key Trends Across the Sub-catchments

Wetland occurrence in relation to SWSAs: Strategic Water Source Areas (SWSAs): SWRA have been identified within all the relevant study area sub-areas, with the ground and surface water coverages within each sub-area differing quite substantially. Overall, surface SWSAs dominate the more eastern, coastal reaches of the study site, whilst the ground water SWSAs were noted more inland, along the north-western study area boundary, with scattered areas along the coastal sub-WMAs (**Figure 2-2**). Especially in the case of the surface water SWSAs, the occurrence of wetlands within these areas was notably higher than those areas that were not considered important SWSAs. As such, the presence of these SWSAs within the various sub-areas are good initial indicators for increased areas of wetland habitat.

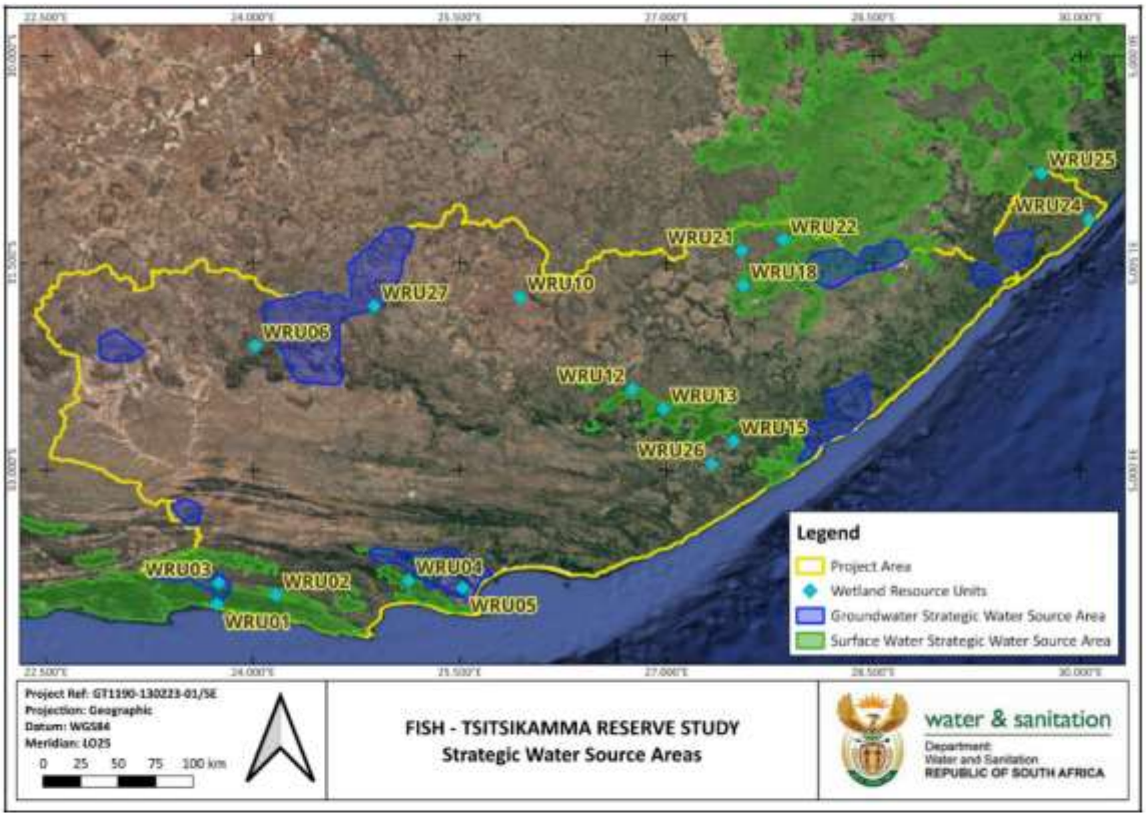

Figure 2-2 Distribution of SWSA's and WRUs across the studty area

Wetland occurrence in relation to Mean Annual Precipitation (MAP): In the hinterland of the overall study area, MAP increases greatly from west to east. In the extreme west, in the Gamtoos sub-catchment, the MAP is <400 mm for most of the area, with some portions even being < 200 mm MAP. This is followed by the Sunday's sub-catchment, where the MAP is also predominantly <400 mm, but areas where MAP is 400-600 mm are slightly more extensive than in the Gamtoos. The Fish, where the area has <400 mm MAP, are still extensive, with the Kei, predominantly 400-800 mm MAP. East of the Kei, the MAP is predominantly >800 mm, exceeding 1000 mm in extensive portions (**Figure 2-3**).

Such a wide range has important implications for wetland occurrence given that hydrology is a primary driver of wetlands. It is therefore not surprising that in the predominantly dry western sub-catchments (**Gamtoos and Sundays**) the total extent of wetlands is relatively low, but more to the east (i.e., in the **Fish sub-catchment**) it increases noticeably, further increasing in the next major sub-catchment (i.e., the **Kei**).

The coastal areas of the study area show a different pattern to the hinterland, with the MAP being relatively high in the west (**Tsitsikamma**), declining in the **Algoa and Bushmans** sub-catchments then increasing again thereafter. Thus, it is not surprising that **the Tsitsikamma sub-catchment, where, although confined to a narrow coastal strip, has a relatively high wetland extent** relatively to the overall small size of this area.

Some of the eastern sub-catchments, while having wetland extents that are higher than in the western hinterland, are lower than expected, given the high MAP and topography which is not very steep. Of note here are the Mthatha and Wild Coast sub-catchments. In a known verified field area in the Wild Coast sub-catchment of 4097 ha **inland of Mkambati Nature Reserve,**

53 wetlands (totalling 385 ha) were encountered with none of these wetlands mapped in NWM5, suggesting considerable under-mapping for this catchment. A similar level of under-mapping is suspected for the Mthatha sub-catchment, but this requires confirmation.

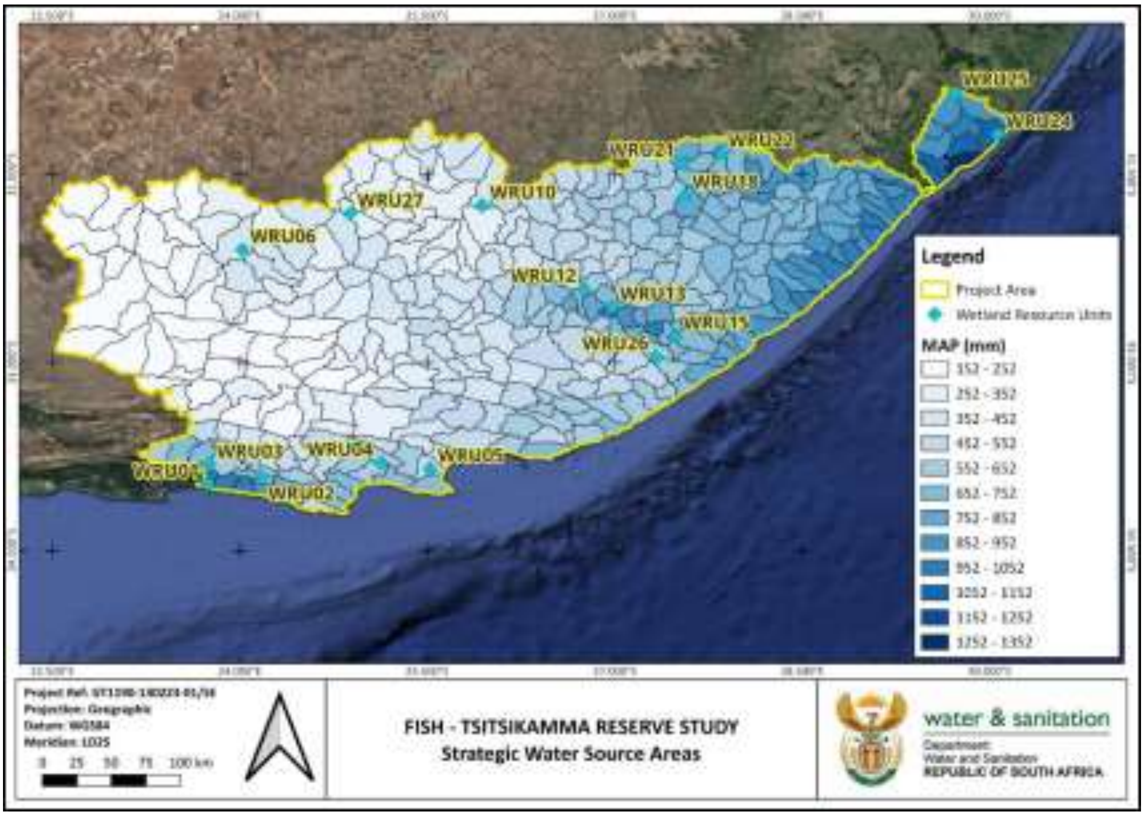

Figure 2-3 MAP distribution across the study area in relation to the final WRUs

Extent of wetlands compared with the Mzimvubu: It is interesting to note that the total extent of wetlands in the combined 12 sub-catchments (30,171ha) is considerably less than the 50,971 ha of wetlands in a single nearby sub-catchment, the gazetted Mzimvubu catchment. This is possibly owing to a lack of the very broad, gently sloped valley bottoms which are widespread in the Mzimvubu catchment and support some very large floodplain/valley bottom wetlands, largely absent from the study area. This is also a result of the MAP being substantially higher in the Mzimvubu sub-catchment than the average MAP across the 12 sub-catchments in the study area.

Present ecological state in relation to land-use and the aridity gradient: The greatest proportion of wetlands in a D, E and F category were found in the Tsitsikamma sub-catchment, where high impact, land-uses associated with cultivation and plantation forestry are extensive, followed by Algoa sub-catchment, where high impact urban/industrial land-uses are extensive. Field verified assessments such as Hugo (2011) and Tuswa (2016) suggest that the general land cover-based proxies used to derive the PES categories of wetlands in these sub-catchments are reasonable. The Tsitsikamma wetlands have a potentially important hydrological/ecological role connecting the mountain and coast. Although once in an E or F category, this link is severely compromised, there are some C and D category wetlands remaining which still perform a valuable ecological/hydrological connection value which needs to be sustained.

Wetlands least impacted in the three major arid to semi-arid sub-catchments (i.e., Gamtoos, Sundays and Fish), where most wetlands are placed in an A or B (natural to largely natural) Category. While this may be a reasonable approximation, it should be acknowledged that certain impacts are poorly represented in the land-cover map used for the assessment, particularly those within areas mapped as natural vegetation. Studies such as Todd (1999) and Boardman *et al.*, (2003) document widespread and extremely heavy livestock utilization of the natural vegetation in the Karoo from around 1900 through to the 1960s, leading to widespread degradation of the vegetation, in the valley bottoms, where most of the naturally vegetated wetlands are located. Therefore, it is anticipated that a field-based assessment of the Present Ecological State (PES), would reveal that some of the wetlands in the arid to semi-arid sub-catchments, which are mapped with predominantly natural vegetation in the wetland and catchment, would have a somewhat lower PES category than what was assigned based on desktop assessment alone. Site visits to the various WRUs was undertaken to verify this.

3. *WETLAND ECO-CATEGORISATION OBJECTIVE & METHODOLOGY*

The objective of the wetland eco-categorisation process is to determine the present status of the selected wetland resource units (WRUs) – the methods used for selecting the WRUs can be reviewed in the **resource unit report** (Department of Water and Sanitation, South Africa 2022a, Report number: WEM/WMA7/00/CON/RDM/0422). The eco-categorisation includes the determination of the PES and the Ecological Importance and Sensitivity (EIS) of each priority WRU, which produces a detailed picture of the present state of each wetland. The Recommended Ecological Category (REC) can then be derived from the PES and EIS.

Present Ecological State refers to the present ecological condition of the resource assessed relative to the deviation from the Reference State (Rountree et al. 2013). "The ecological importance of a water resource is an expression of its importance to the maintenance of biological diversity and ecological functioning on local and wider scales. Ecological sensitivity (or fragility) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience)...Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity (Kleynhans et al., 2005)" (Rountree et al. 2013: page 17).

The DWS Rapid Ecological Reserve Determination of Inland Wetlands (Rountree *et al.,* 2013) procedure has been slightly modified and implemented in this study to determine the Resource Quality Objectives for the selected WRUs in the Fish and Keiskamma to Tsitsikamma catchment. This includes the implementation of some steps to the procedural framework in **Figure 1-1**. **A** summary of the steps that were undertaken to determine the Resource Quality Objectives for the WRUs in this study include:

- **Step 1: Initiate the EWR and BHN assessment and identify priority quaternary and sub-quaternary catchments:** Priority catchments and priority systems within these catchments were identified at a desktop level as the study area spans a large part of the interior of South Africa. A team of specialists with a diverse range of experience were selected to undertake the study.
- **Step 2: Delineate wetland resource units and select priority wetland sites:** The identification of wetland RUs was focused on identifying systems at an ecosystem level and was strongly reliant on knowing where important and/or priority wetland systems were within the landscape, refer to the RU report for more information: DWS, 2022a). Therefore, the methods used to identify these priority RU areas were reliant on existing wetland coverages (Nel *et al.*, 2011 and Van Deventer *et al.,* 2019) and modification of previous approaches used to define strategically important wetland areas within the broader landscape (Van Deventer *et al.,* 2019). Additional spatial layers were considered and incorporated into a multi-criteria analysis (MCA) to broadly define those wetlands that were considered more important, based on a selected list of variables viewed as important from a wetland ecological, functioning, social and/or biodiversity perspective. The following information was sourced and used in the identification of priority wetlands for consideration in this study:
    - National Wetland Map 5 spatial dataset (Van Deventer *et al.* 2019);

    - National Freshwater Ecosystem Priority Areas (NFEPAs) wetland shapefile (Nel *et al.,* 2011);
    - Important Bird Areas (IBAs) (BirdLife South Africa, 2016);
    - Crane sightings and nest sites (Endangered Wildlife Trust, 2019);
    - Wetlands that interacted with the surface and groundwater SWSAs (Lötter and Maitre, 2021);
    - Wetlands with a Present Ecological State (PES) of A/B (Van Deventer *et al.* 2019);
    - Hydrogeomorphic (HGM) unit type, which was used to determine the level to which each system may provide services associated with (cf. Van Deventer *et al.* 2019):
        - Flood attenuation;
        - Stream flow regulation;
        - Erosion control;
        - Sediment trapping; and
        - Water quality enhancements (assimilation of nutrients).
    - Those systems categorised as Critically Endangered or Endangered (Nel *et al.*, 2012);
    - Wetlands located upstream of important water supply dams; and
    - Identified water-stressed catchments/basins from the river RU process.
        - Once the WRUs had been selected, the WRUs were prioritised in terms of their overall importance and the level of detail with which each WRU was to be assessed. Three 'tiers' were created with Tier 1 WRUs requiring the least amount of detail and Tier 3 WRUs requiring the most amount of detail (**see the Wetland Fieldwork Report for more details; DWS 2022b**). A site visit to each of the WRUs was undertaken in April 2022.
- **Step 3: Determine reference conditions; PES, EIS, and REC for the priority sites:** The reference conditions of each WRU were determined using a variety of appropriate assessment tools such as the WET-Health framework. The PES for each wetland was determined using the WET-Health v2 assessment tool (MacFarlane *et al.,* 2020) and either a Level 1B or a Level 2 WET-Health assessment was undertaken for each WRU depending on the pre-determined level of assessment (determined in Step 2). The hydrological, geomorphic, water quality and vegetation components of each WRU were assessed as part of the PES assessment. The EIS and the REC of each WRU were determined using the approach defined in Rountree *et al.* (2013).

An important aspect of the overall study is the integration of the separate ecological components (rivers, wetlands, and groundwater and estuaries) to ensure that their respective requirements interact in a way that works to satisfy the various water resource components. However, this integration process is not included in this report as the other components (groundwater, estuaries, and rivers) were only able to carry out fieldwork significantly later than the wetland team was. Therefore, the integration of these components, where appropriate, will be documented within the rivers EWR Quantification Report.

Table 3-1 and

Table 3-2 **provide** an overview of the priority 1[1] and 2[2] resource units for wetlands in the study area **(Figure 3-1** and **Figure 3-2)**. It should be noted that the systems listed in the table include only those that were assessed. Three (3) of the originally identified priority 2 systems were excluded from further consideration based on the following:

- WRU 07 and 08 (IUA_Q01): Based on their fairly similar climatic, topographic and land-use context, the wetlands of Sneeuberg East 1 and 2 (WRU 07 and 08) are assumed to be broadly similar to those of Sneeuberg West (WRU 06) in terms of type and management requirements, and this similarity was confirmed by field observations during a brief reconnaissance of three wetlands in Sneeuberg East 2 during a "mega-transect" survey in March 2022. Thus, given the considerable wetland heterogeneity needing to be covered within the overall assessment area, Sneeuberg East was not assessed any further, and the Sneeuberg West (WRU 06) site was taken to represent all the Sneeuberg.
- WRU 20 (IUA_S01): The infield verification of the system highlighted that the system is considered to in extremely poor ecological health, with issues such as major channel incision and extensive headcut erosion. These issues are not reversable without enormous investment, and the benefit of restoring this wetland is far outweighed by the projected cost. Additionally, the site visit confirmed that the wetland has entered an alternative stable state and is not likely to degrade further in future.

Table 3-1 Identified priority 1 resource units for wetlands in the study area?

IUA	IUA Description	RU No.	Quaternary catchment(s)
IUA_K01	Tsitsikamma and headwaters of Kromme-to-Kromme Dam	W_RU01	K80A
		W_RU02	K90A
IUA_KL01	Kromme from Kromme Dam to estuary and Gamtoos	No priority wetlands	
IUA_M01	M primary catchment	W_RU05	M10D
IUA_LN01	Groot to Kouga confluence, Upper Sundays to Darlington Dam	No priority wetlands	
IUA_N01	Sundays downstream Darlington Dam	No priority wetlands	
IUA_P01	P primary catchment	No priority wetlands	
IUA_Q01	Upper Fish	No priority wetlands	
IUA_Q02	Great Fish	No priority wetlands	
IUA_Q03	Koonap and Kat	No priority wetlands	
IUA_R01	Keiskamma	No priority wetlands	

[1] Priority 1, where rivers and estuaries will be assessed on an intermediate level and detailed considerations for wetlands and groundwater. RQOs will also be determined for the selected sub-components.

[2] Priority 2, with rapid assessments for rivers and estuaries and less detailed studies for the wetlands and groundwater (desktop with limited field verifications). Some of these will also be used as hydro and/ or biophisical nodes at the outlets of RUs or IUAs or where specific protection considerations are required.

IUA	IUA Description	RU No.	Quaternary catchment(s)
IUA_R02	Buffalo/ Nahoon	No priority wetlands	
IUA_S01	Upper Great Kei	No priority wetlands	
IUA_S02	Black Kei	W_RU13	S32D
IUA_S03	Lower Great Kei	No priority wetlands	
IUA_T01	Upper Mbashe, Upper Mthatha	W_RU22	T11A
IUA_T02	Lower Mbashe	No priority wetlands	
IUA_T03	Lower Mthatha	No priority wetlands	
IUA_T04	Pondoland coastal	W_RU24	T60D

Table 3-2 Identified priority 2 resource units for wetlands in the study area

IUA	IUA Description	RU No.	Quaternary catchment(s)
IUA_K01	Tsitsikamma and headwaters of Kromme-to-Kromme Dam	No priority wetlands	
IUA_KL01	Kromme from Kromme Dam to estuary and Gamtoos	No priority wetlands	
IUA_L01	Kouga to Kouga Dam, Baviaanskloof	W_RU03	L82D
IUA_M01	M primary catchment	W_RU04	M10B
IUA_LN01	Groot to Kouga confluence, Upper Sundays to Darlington Dam	W_RU06	L21D
IUA_N01	Sundays downstream Darlington Dam	No priority wetlands	
IUA_P01	P primary catchment	No priority wetlands	
IUA_Q01	Upper Fish	W_RU27	Q22A
IUA_Q02	Great Fish	W_RU10	Q43A, Q43B
IUA_Q03	Koonap and Kat	No priority wetlands	
IUA_R01	Keiskamma	No priority wetlands	
IUA_R02	Buffalo/ Nahoon	W_RU15	R20E
		W_RU26	R20D
IUA_S01	Upper Great Kei	W_RU18	S50E
		W_RU21	S50C
IUA_S02	Black Kei	W_RU12	S32E
IUA_S03	Lower Great Kei	No priority wetlands	

IUA	IUA Description	RU No.	Quaternary catchment(s)
IUA_T01	Upper Mbashe, Upper Mthatha	No priority wetlands	
IUA_T02	Lower Mbashe	No priority wetlands	
IUA_T03	Lower Mthatha	No priority wetlands	
IUA_T04	Pondoland coastal	W_RU25	T60B

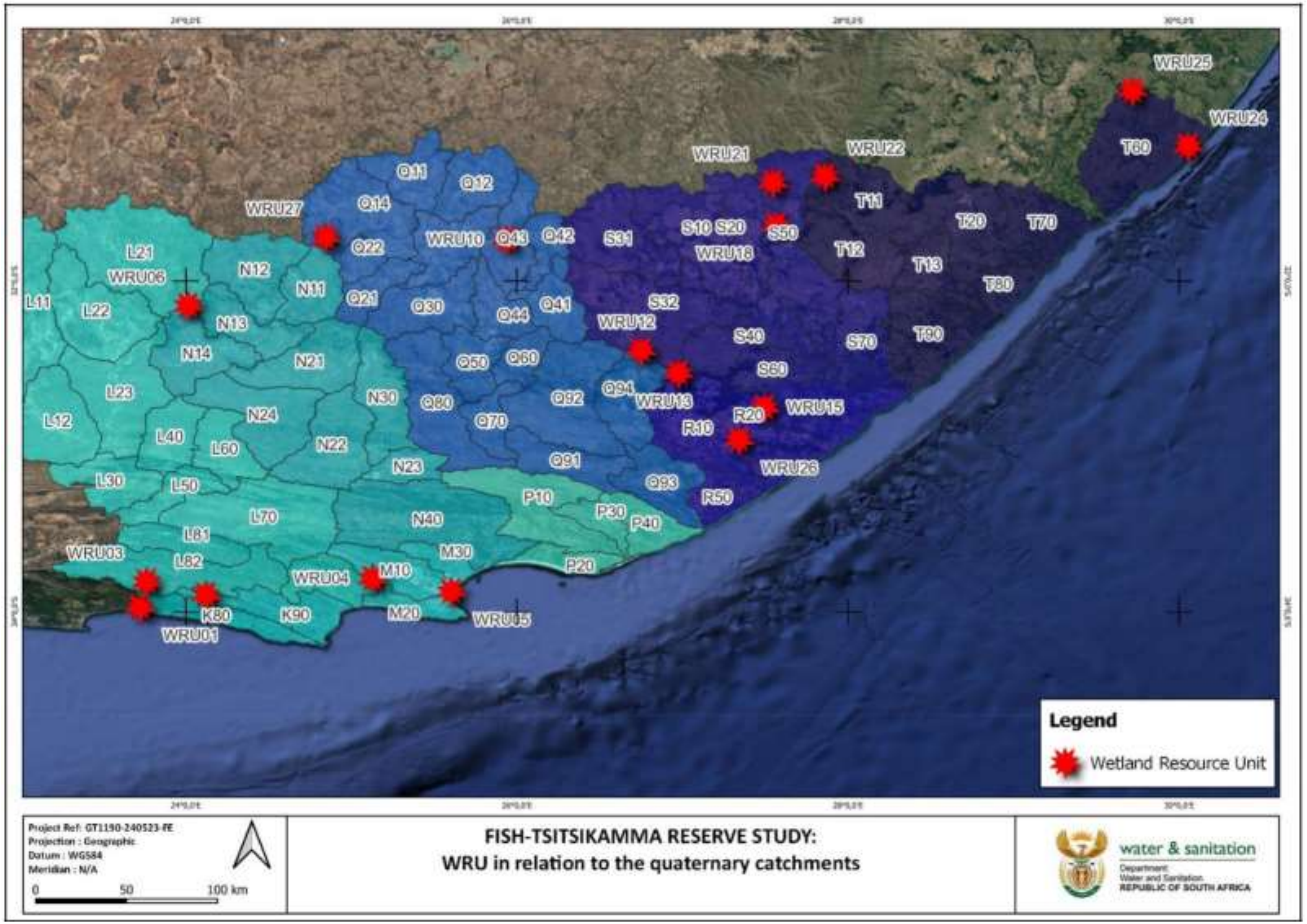

Figure 3-1 Overview of the selected priority wetlands in assoication with the quaternary catchments

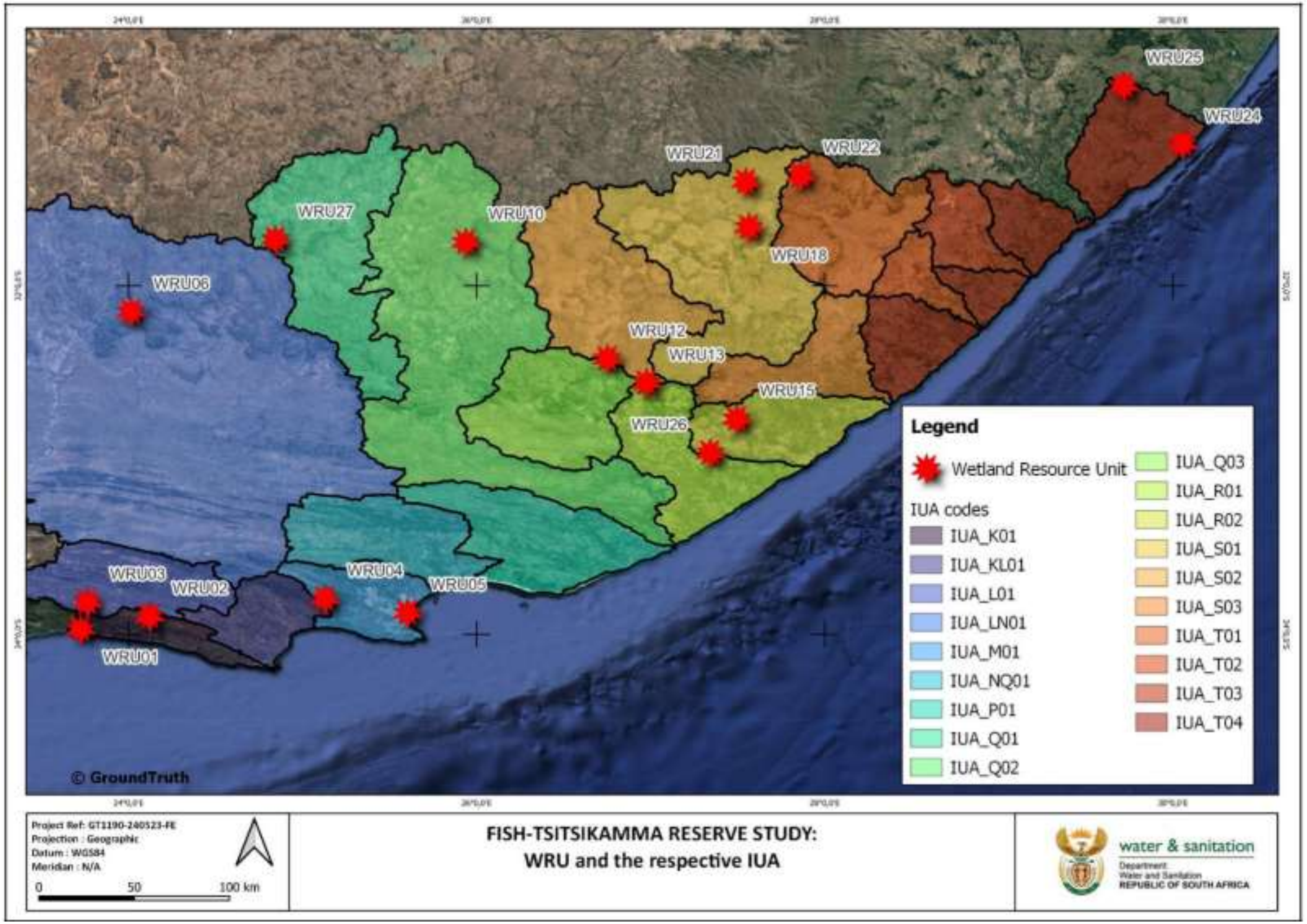

Figure 3-2 Overview of the wetland resource units selected in their respective

4. WETLAND ECO-CATEGORISATION PER INTERGRATED UNIT OF ANALYSIS (IUA)

The following sections provide a description and assessment results for all of the WRUs within the IUAs. The PES, EIS and REC results are based on the following categories and scores.

Category	PES Description	PES Score (%)	EIS Description	Range of EIS[3] Score
A	Natural	90-100	Very High	≥3.5
B	Largely natural	80-89	High	>2.5 and <3.5
C	Moderate	60-79	Moderate	>1.5 and ≤2.5
D	Largely modified	40-59	Low/Marginal	>0.5 and ≤1.5
E	Seriously modified	20-39	None	≤0.5
F	Critically modified	0-20	-	-

Additionally, the projected trajectory of change over the next five (5) years linked to the PES assessment, is based on the following key:

- ↑↑= large improvement,
- ↑= slight improvement,
- →= remains the same,
- ↓= slight decline, and
- ↓↓= large decline.

[3] It should be noted that the EIS categories have been slightly modified for this study, in which all the categories now reflect a range of scores. This was considered to be a crucial amendment as only systems scoring a 4 and/or 100% could be classified as being of 'Very High' importance. This original approach excluded some very important systems from scoring in the 'Very Important' category despite their high importance. Allowing for range in this upper category meant that some systems that did not score a 4 on all indicators of the EI/ES rating system are now considered to be of 'Very High' importance. Additionally, including a range for the EIS scores is consistent with the PES scoring range.

4.1 IUA_K01: Tsitsikamma and Headwaters of Kromme and Kromme Dam

Table 4-1 Summary of wetland information for IUA_K01

IUA Description	Tsitsikamma and headwaters of Kromme-to-Kromme Dam
HGM unit type	Total of 189 wetlands mapped; Channelled Valley Bottom Wetlands: 50% Depression Wetlands: 8% Hillslope Seep Wetlands: 16% Unchannelled Valley Bottom Wetlands: 26%
PES per HGM unit type	Channelled Valley Bottom Wetlands - A/B: 16%; C: 40%; D/E/F: 44%. Depression Wetlands - A/B: 36%; C: 21%; D/E/F: 43%. Hillslope Seep Wetlands - A/B: 8%; C: 44%; D/E/F: 48%. Unchannelled Valley Bottom Wetlands - A/B: 15%; C: 20%; D/E/F: 65%.
FEPA Wetlands[4]	A single FEPA wetland is present in IUA_K01 – namely the Kromme wetland.
WRU	WRU01 and WRU02

4.1.1 WRU 01 – Tsitsikamma Plains Wetland Complex

Table 4-2 Summary of WRU 01

Factor	Comment	
WRU Number (Quat Catchment)	WRU 01 (K80A)	
Level of Assessment	Field-based	
Priority	01	
HGM Unit Type(s)	Hillslope seep, Channelled and Unchanneled valley-bottom wetlands	
Vegetation types	Eastern Fynbos-Renosterveld Sandstone Fynbos	
SWSA	Yes (Tsitsikamma SWSA)	
Threat Status	**UNCHANNELLED VALLEY-BOTTOM**: CRITICALLY ENDANGERED, **CHANNELLED VALLEY-BOTTOM**: CRITICALLY ENDANGERED, **SEEP**: ENDANGERED	
PES	**LOTTERING**: C (Moderate)	**SLANG**: B (Largely natural)
EIS	B (High)	A (Very High)
Contributors:	Donovan Kotze, Pumla Dlamini	

[4] It should be noted that only FEPA wetlands that overlap spatially with the National Wetland Map 5 will be recorded here as it is recognised that there are some inherent problems with the NFEPA wetland coverage. Therefore, only those FEPA wetlands that have been 'confirmed' by the National Wetland Map 5 will be recorded here.

4.1.1.1 Wetland Description

Natural features of the wetlands

Much of the wetlands on the Tsitsikamma plains are associated with low to medium order streams, either in valley bottoms which are unchannelled or which have a relatively shallow channel, both often associated with lateral seep areas. Where closest to the mountains, these valley bottom wetlands tend to have the highest level of wetness and support organic soils, while those further from the mountain tend to be more seasonal and generally lack organic soil. This may be because of greater inputs of groundwater to the wetlands closer to the mountains. The vegetation of the plains wetlands described above is characterized by several different species and growth-forms, including the short tree, *Leucodendron conicum* (the Garden Route conebush), often growing in association with the shorter-growing and sprawling grass-like shrub *Cliffortia graminae*, restios (notably *Platycaulis compressus* and *Elegia fistulosa*), sedges (notably *Carpha glomerata*), and erect shrubs, (notably *Berzelia intermedia*, which shows a preference for the drier wetland margins). The compositional and structural diversity of plant species described above are assumed to contribute positively to the habitat provided for fauna.

Impacts to the wetlands

Some wetland areas on the Tsitsikamma plains are planted through with timber plantations, mainly pines, or are dominated by dense infestations of Invasive Alien Plants (IAP), notably black wattle, while others have been converted to planted pastures for dairy production. However, the largest proportion of wetlands on the Tsitsikamma plains remain under natural or semi-natural vegetation flanked closely by pine plantations. Within this context, the narrower the wetlands, the greater the edge effect. The consequences of the adjacent pine trees include the following:

- Increased shading. These wetlands are subject to high shading effects from the trees, which has potentially severe impacts on the many herbaceous plant species not adapted to high levels of shading.
- Greatly reduced burning. Especially the narrowest wetlands are difficult to burn, with the result that fire is often excluded from these wetlands, which would naturally have been subject to periodic fires. This has potentially severe consequences for the fire-dependent native herbaceous vegetation, which in the long term is likely to be outcompeted by forest plants.
- Increased physical disturbance associated with plantation activities, especially at harvesting and planting times, resulting in secondary impacts such as increased opportunities for IAP, potential sedimentation issues and increased erosion in the wetlands.
- Increased drying out of the wetland due to the immediately adjacent tree plantations. Although requiring further investigation of wetland inflows (including baseflows) to confirm, it appears that in narrow wetlands (typically channelled valley bottoms, often associated with hillslope seep wetlands), the localized drying effect of the immediately adjacent tree plantations extend across the width of the wetlands.

The result of the above impacts is that many of the narrower wetlands are now extensively invaded by bracken fern (*Pteridium aquilinum*) and have lost much of their original vegetation and severely compromising their natural function and PES. This homogenization of the vegetation is likely to also impact on the fauna. In the dragonflies, for example, which represent one of faunal taxa associated with wetlands, this homogenization reduces species richness as dragonflies are favoured by heterogenous vegetation structure, which provides perches for feeding or mating and concealment from predators (Hugo 2011).

A further factor affecting the impacts is the proportion of the wetland's catchment occupied by tree plantations. Thus, narrow wetlands with catchments having a high proportion of plantation forestry would generally be the most impacted. In contrast, those wetlands which are broad, resulting in lower edge-effects, and which also have catchments with a low proportion of plantation forestry, are likely to be least impacted and make the greatest contribution to landscape-level biodiversity conservation. The best example of such wetlands is the Lottering wetland cluster, which formed the focus of the assessment and was flagged as having the highest priority for setting RQOs **(Figure 4-1)**.

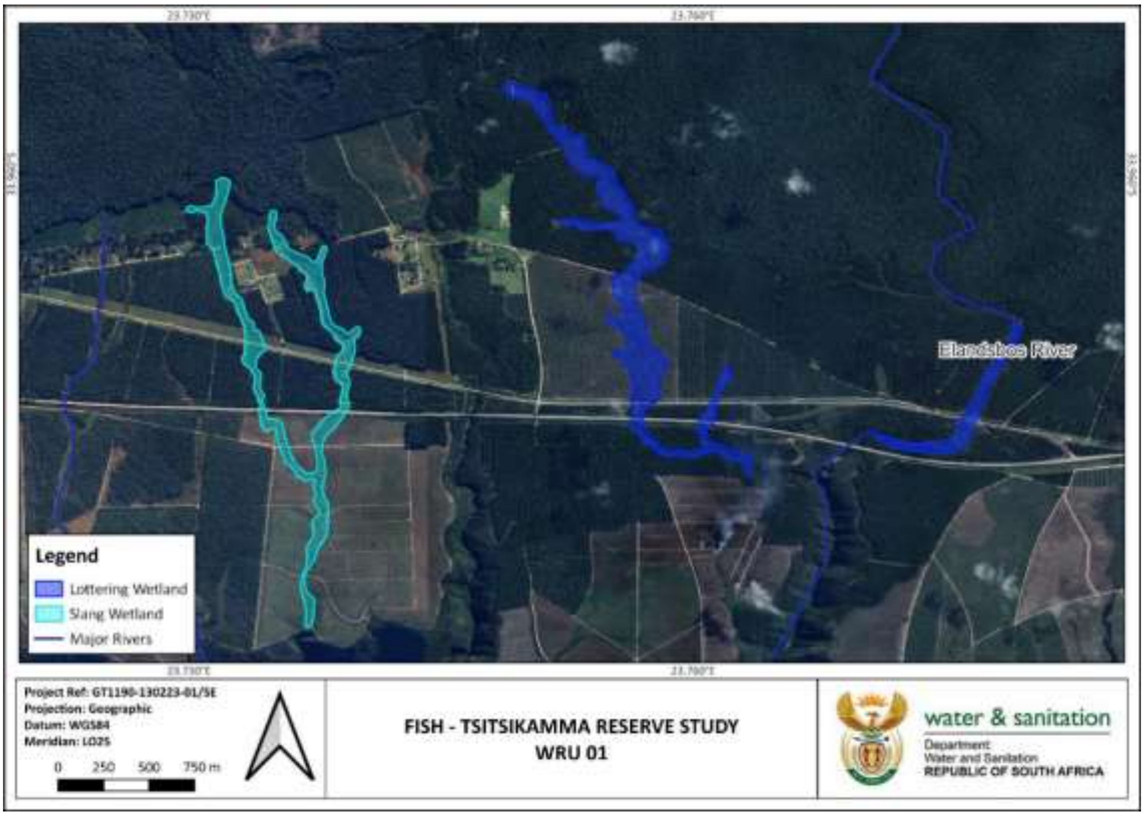

Figure 4-1 Overview of the Tsitsikamma wetland plains. The wetland on the left being the Slang wetland and the wetlands on the right forming the Lottering Wetland Complex.

4.1.1.2 Present Ecological State

Owing the high extent of tree plantations in the catchment of the Slang and especially the Lottering wetland, hydrology is the parameter that indicated to be the most impacted of the four components of the PES assessment for both wetlands, followed by vegetation and then geomorphology and water quality **(**

Table 4-3**)**. The water quality component is the least impacted for both wetlands given the minimal pollution sources identified in the wetlands' catchments. Also, while sedimentation in the wetlands is likely to have been increased as a result of forestry activities, this does not appear to be high.

Table 4-3 Present ecological state for WRU 01 – the Lottering and Slang Wetlands

Lottering Wetland

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	5.4	1.6	0.6	2.9
PES Score (%)	46%	84%	94%	71%
Ecological Category	**D→**	**B→**	**A→**	**C↓**
Combined Impact Score	2.9			
Combined PES Score (%)	71%			
Combined Present Ecological Category	**C→**			

Slang Wetland

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	3.3	0.9	0.4	1.6
PES Score (%)	67%	91%	96%	84%
Ecological Category	**C→**	**A→**	**A→**	**B↓**
Combined Impact Score	1.8			
Combined PES Score (%)	82%			
Combined Present Ecological Category	**B→**			

4.1.1.3 Ecological Importance and Sensitivity

Both the Lottering and the Slang wetlands have a **high** ecological importance, with ecological importance/ biodiversity support making the greatest contribution to the overall score. Of note is that these two wetlands, represent two of the largest remaining representative examples of their kind, both providing potentially important ecological links mountain and coastal area. Both wetlands support Red-listed data species such as the near-threatened Garden Route Conebush (*Leucadendrom conicum*) and habitat potentially suitable for the vulnerable dragonfly *Syncordulia venator*, and the vulnerable Grass Owl, *Tyto capensis*, which Hugo (2011) noted in similar wetlands nearby **(Table 4-4)**. Both wetlands also play an important role in providing wide and generally intact ecological linkages between the mountains and the Tsitsikamma plain and coast. However, the Slang wetland scored slightly higher because of its unusually high PES score compared with most other Tsitsikamma Plains valley bottom wetlands, which contributes positively to the value of the Slang wetland as a representative example of this wetland type.

Table 4-4 Rating of the ecological importance and sensitivity of the Lottering and Slang wetlands. Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Slang	Lottering	Motivation
1. Biodiversity support	**3.5**	**3.3**	Score taken as the average of the three scores below
Presence of Red Data species	3.5	3.5	The near-threatened Garden Route Conebush (*Leucadendrom conicum*) is recorded in the wetland. The wetland also supports habitat suitable for the vulnerable dragonfly *Syncordulia venator*, and the vulnerable Grass Owl, Tyto capensis, recorded by Hugo (2011) in similar wetlands nearby.
Populations of unique species	3.0	3.0	Given the broad and large intact area of the wetland in an overall landscape where the cumulative impacts and edge effects on wetlands are high, uncommonly large populations of wetland species are likely.
Migration/breeding/feeding sites	4.0	3.5	Given the broad, large intact wetland in an overall landscape where the cumulative loss of wetlands is very high, the wetland is likely to be important as a breeding and/or feeding site for wetland-dependent fauna. In addition, the wetland plays a major role in what appears to be possibly the widest and most intact corridor linking the mountains with the coast through the Tsitsikamma plains.
2. Landscape scale	**3.3**	**2.8**	Score taken as the average of the five scores below
Protection status of the wetland	4.0	4.0	Both wetlands are not formally protected but are included in the conservation management of MTO and fall within a SWSA.
Protection status of the vegetation type	3.0	1.5	For the Slang the main vegetation type of the wetland is least threatened Tsitsikamma Sandstone Fynbos and vulnerable Garden Route Shale Fynbos, while for the Lottering it is Tsitsikamma Sandstone Fynbos.
Regional context of the ecological integrity	3.0	3.0	Both wetlands contain large fragments of remaining intact wetland in a broader landscape where the cumulative loss of wetlands is high.
Size and rarity of the wetland type/s present	3.5	2.0	Given the vulnerable status one of the main overall vegetation types, the high cumulative loss of wetlands in the overall landscape and the large and intact state of the unit, some rare vegetation types are anticipated.
Diversity of habitat types	3.0	3.5	A relatively high diversity is assumed based on the high vegetation structural and compositional diversity and the hydrogeomorphic and hydrological diversity of the wetland and it is covering 3 vegetation types, Tsitsikamma Sandstone Fynbos, Garden Route Shale Fynbos, and Tsitsikamma Sandstone Fynbos (in the lower most portion of the wetland).
3. Sensitivity of the wetland	**3.2**	**3.2**	Score taken as the average of the three scores below
Sensitivity to changes in floods	3.0	3.0	Based on the wetlands being mainly a channelled valley bottom wetland
Sensitivity to changes in low flows/dry season	3.5	3.5	Based on the wetlands being mainly a channelled valley bottom wetland, as well as considering their peat deposits for which baseflows are assumed to be important As above

Ecological Importance	Slang	Lottering	Motivation
Sensitivity to changes in water quality	3.0	3.0	This is assumed based on wetland being supplied by naturally low-nutrient waters
TOTAL OVERALL SCORE:	**3.5**	**3.3**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-5 Rating of the Slang and Lottering wetland's hydrological/functional importance according to Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecosystem benefits	Slang	Lottering	Motivation
Flood attenuation	3.0	3.0	Low longitudinal slope and moderately high surface roughness - dominated by a mix of restios (*Restio paniculata*) and the grass-like shrub (*Cliffortia graminae*). Downstream floodable property includes the R102 and N2 road crossings.
Streamflow regulation	3.0	3.0	The hydrogeological setting Table Mountain group and fractured metasedimentary is likely associated with groundwater discharge. Also, invasive alien trees in the wetland (which would otherwise reduce outflows) are limited.
Sediment trapping	3.0	3.0	See flood attenuation. Also, pine plantation trees likely to slightly increase sediment delivery.
Phosphate assimilation	2.6	2.8	See sediment trapping. Also, sources of P in the wetland's catchment appear limited.
Nitrate assimilation	2.5	2.8	While the moderately confined longitudinal flows are not ideal in terms of nitrate assimilation, in the intact areas of wetland lateral flows are diffuse and likely to be important in assimilating N. However, nitrate sources are fairly limited in the wetland's catchment.
Toxicant assimilation	3.0	3.0	See above two items. Also, toxicant sources anticipated washing off the two main roads crossing the wetland.
Erosion control	3.0	3.0	Much of the wetland is maintained under permanent vegetation cover
Carbon storage	3.0	4.0	The wetland's relatively high level of wetness of the intact areas of wetland are assumed to support moderately high accumulation of soil organic matter.
TOTAL OVERALL SCORE:	**3.0**	**3.2**	Score taken as the average of the five highest scores above

Table 4-6 Rating of the Slang and Lottering wetland's importance for direct human benefits according to Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance))

Direct human benefits		Slang	Lottering	Motivation
Provisioningservices	Water for human use	1.0	1.0	No known water use
	Harvestable resources	1.0	1.0	No known harvesting
	Cultivated foods	1.0	1.0	No known cultivated foods
Cultura l services	Cultural heritage	1.0	1.0	No known cultural heritage features
	Tourism and recreation	2.5	2.5	Currently there appears to be limited direct contribution of the wetland to tourism and recreation. However, the wetland contributes indirectly to tourism insofar as the wetland buffers water quality in the Slang River, which is a notable tourist feature where it is crossed by the Otter Trail approximately 3 km downstream of the outlet of the wetland.
	Education and research	0.9	1.0	Currently there appears to be limited contribution of the wetland to education and research.
TOTAL OVERALL SCORE:		**1.3**	**1.2**	Score taken as the average of the five highest scores above

4.1.1.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) for the Lottering and Slang wetlands, the following were noted:

(1) the EIS of both wetlands is high;

(2) their PES is in a B and C category respectively; and

(3) the Lottering wetland has a catchment mostly converted with tree plantations and the Slang wetland has portions of its catchment covered with extensive tree plantations.

Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for both wetlands should be set at their current PES categories, or if practical, improved by a category. Given item (3) above, it is likely to be impractical to improve the PES for both wetlands, and therefore the REC is set at a C for Lottering and B for Slang, i.e. the current PES category is to be maintained (**Figure 4-7**). Further adding to the difficulty of improving the PES for both wetlands, and for wetlands generally in South Africa, are the projected increasing impacts to wetlands associated with climate change (**Box 1**).

Table 4-7 Recommended Ecological Category (REC) for the two priority wetlands in the Tsitsikamma WRU

	Slang Wetland	Lottering Wetland
REC	B	C

Box 1: **The effects of global climate change on wetlands in South Africa**

South Africa's climate is projected to continue changing in several key respects, including the following (Dallas and Rivers-Moore 2014; Snaddon *et al.* 2019).

- Temperatures, and associated evaporative demand, will continue to increase across all South Africa.
- The intensity and frequency of extreme events (both droughts and floods) will continue to increase across most of South Africa.
- Mean annual precipitation will likely shift depending on geographical location, with a decrease anticipated in the north, north-east and south-west of South Africa and an increase anticipated in the east.

All above factors influence a wetland's water availability, which is foundational to a wetland's existence and functionality, and would be altered given the close relationship between climate and water availability, both surface and sub-surface (Snaddon *et al.* 2019). Further effects of climate change include altered functioning, e.g., increased vulnerability to erosion because of the increased intensity of floods, and altered structure, e.g., wetland species composition, both directly as a result of altered temperatures and indirectly because of altered water availability (Dallas and Rivers-Moore 2014; Snaddon *et al.* 2019).

Given the above factors, wetlands are likely to vary according to their vulnerability to climate change, with the following identified by Dallas and Rivers-Moore (2014) and Snaddon *et al.* (2019) as having potentially high vulnerabilities.

- Wetlands in geographical areas where mean annual precipitation is projected to decline the most. In the study area this is likely in the western portions.
- Wetlands already impacted by land/water use. Such wetlands are more vulnerable given that land- and water-use impacts on a wetland interact with climate change impacts. For example, increased hardened surfaces in a wetland's catchment will amplify the stormflows that are projected to increase as a result of projected increased storm intensity, thereby amplifying the threat of erosion.
- Wetlands inherently vulnerable to altered water availability, e.g., wetlands supporting peat/organic sediments.
- Wetlands inherently vulnerable to erosion, e.g., as is often the case for unchanneled valley bottom wetlands.
- Wetlands supporting species with narrow ecological tolerances in terms of temperature and/or water availability.
- Wetlands with poor ecological connectivity. Part of resilience to climate change at a landscape level is, where possible, for species to shift geographically to more favourable conditions with changing climate, e.g., as temperatures increase, to shift to wetlands at higher altitudes. Such shifts would be more difficult where ecological connectivity is poor.

Box 2: The importance of Strategic Water Source Areas (SWSAs)

Strategic Water Source Areas are defined as areas of land that either: (a) supply disproportionately high volumes of mean annual surface runoff in relation to their size and are therefore considered nationally important; or (b) have higher groundwater recharge and where groundwater forms a nationally important resource; or (c) areas that meet both criteria (a) and (b). The above can be attributed to climatic conditions such as high rainfall or physical properties such as the ability of the lithology to store water as groundwater. Wetlands which fall within SWSAs are therefore elevated in their overall ecological importance given that they may be responsible for supplying ecosystem services which assist in maintaining the quantity and quality of the water produced within identified SWSAs.

4.1.2 WRU 02 – Kromme Wetland Complex

Table 4-8 Summary of WRU 02

Factor	Comment
WRU Number (Quat Catchment)	WRU 02 (K90A)
Level of Assessment	Field-based, possible integration/ interaction with Upper Kromme River RU and groundwater RU
Priority	01
HGM Unit Type(s)	Channelled and Unchanneled valley-bottom wetlands
Vegetation types	Eastern Fynbos-Renosterveld Shale Renosterveld
SWSA	Yes (Tsitsikamma SWSA)
Threat Status	**UNCHANNELLED VALLEY-BOTTOM**: CRITICALLY ENDANGERED
PES	A (Natural)
EIS	A (Very High)
Contributors	Donovan Kotze, Steven Ellery

4.1.2.1 Wetland Description

A wetland complex comprising a series of valley bottom wetlands is located along the Kromme River to the east of the town of Joubertina **(Figure 4-2)**. The entire length of the wetland complex is approximately 34 km, but the assessments were undertaken on a smaller subsection of the wetland complex in the north-western portion of the complex, namely on the adjacent Krugersland and Kompanjiesdrif wetlands (henceforth referred together as the

Kromme wetland). These are two large unchannelled valley-bottom wetlands which are dominated by *Prionium serratum* (popularly known as Palmiet). Palmiet wetlands in the Eastern and Western Capes are particularly threatened wetlands, which has potentially serious consequences for water security in many towns, and the Krugersland and Kompanjiesdrif wetlands represent the largest remaining palmiet wetlands in the Kromme River catchment. The Kromme River and associated wetlands lie upstream of the Churchill and Impofu Dams, which are both important water supply dams for downstream towns such as Gqeberha and St Francis Bay as well as for the important agricultural activities in this part of the Eastern Cape. In addition, lying downstream of the above is the Kromme River Estuary, dependent on the catchment for its freshwater inputs, which are presently severely diminished.

The Kromme River and the associated wetlands are situated on quarzitic sandstones and shales of the Cape Supergroup and are located within the folded and faulted Cape Fold Belt Mountains. Given the steep and often impermeable nature of much of the catchment, floods are common in the Kromme River which have resulted in the reworking (natural erosion and deposition) of the wetland sediments multiple times throughout recorded history. Much research has been conducted on the Kromme wetland as it represents a dynamic and relatively unique geomorphic landscape (McNamara, 2018; Pulley *et al.,* 2017; Lagesse, 2017). Much of the areas directly surrounding the wetlands have been converted to agriculture and/or pastureland which has exacerbated and, in some cases, accelerated the shifting of the geomorphic landscape in the Kromme Wetlands. Several rehabilitation interventions by the Working for Wetlands interventions program have been implemented within the Kromme Wetland, and these have successfully halted a major erosion headcut which was threatening the wetland, thereby contributing significantly to averting what would have otherwise been a significant decline in the ecological state of the wetland.

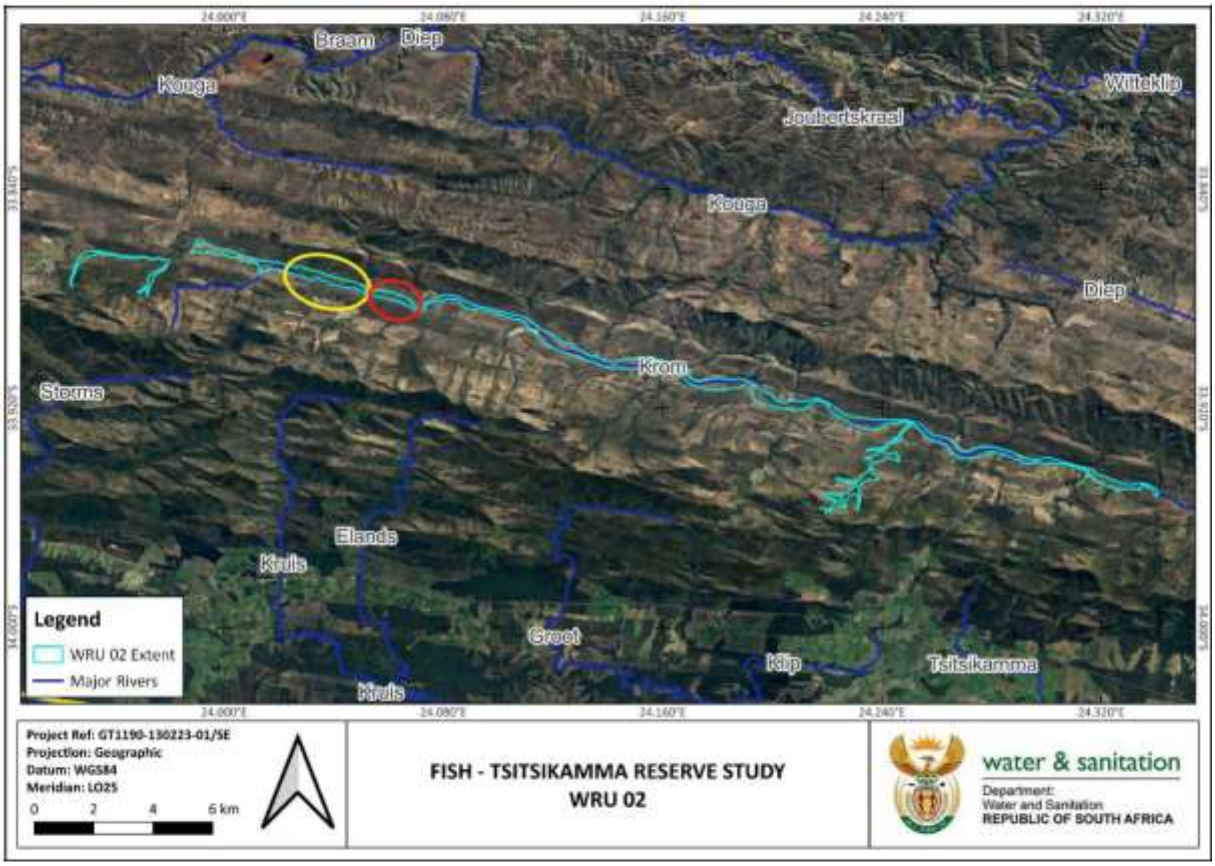

Figure 4-2 Overview of the Kromme wetland complex. The yellow oval indicates the Krugersland wetland and the red oval indicates the Kompanjiesdrif wetland.

4.1.2.2 Present Ecological State

The Kompanjiesdrif and Krugersland Wetlands are both in a pristine condition and both fall within an A category. These two portions of the wetland have predominantly been undisturbed aside from the disturbances associated with the construction of a Working for Wetlands rehabilitation intervention along the southern side of the wetland and a small farm road crossing at the head of the wetland. As can be seen from **Table 4-9** the most prolific impact to the integrity of the wetland is the impact on the vegetation. Several patches of the invader alien species, *Acacia mearnsii (Black wattle)* are located along the edge of the wetland, and it is thought that these invasive species have been favoured by the disturbance associated with the R62 road that runs along the outside of the wetland. In addition, small portions of the wetland have been infilled because of the construction of the road, which have in turn resulted in a slight decline in the hydrology and geomorphology scores of the wetland.

Table 4-9 Present ecological state of WRU 02 – the Kromme wetland complex

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	0.7	0.8	0.8	1.6
PES Score (%)	93%	92%	92%	84%
Ecological Category	**A→**	**A→**	**A→**	**B→**
Combined Impact Score	1.0			
Combined PES Score (%)	90%			
Combined Present Ecological Category	**A→**			

4.1.2.3 Ecological Importance and Sensitivity

The Kromme Wetland has a high EIS score due to the following factors:

- It is one of the largest intact Palmiet wetlands in the region, with major palmiet wetlands being a threatened wetland type well recognized for ecosystem services such as erosion control and water storage.
- The wetland falls within a SWSA (Strategic Water Source Area).
- It supports an endangered species of Redfin fish which is endemic to the Kromme River catchment (**Table 4-10**).
- The wetland type represented by the site, namely lowland fynbos wetland on alluvial deposits (in a broad valley bottom setting) has been subject to very high levels of cumulative loss, mainly through transformation to cultivated land, as well as typically having a high likelihood of supporting Red-listed plant species where sufficient intact habitat remains.
- The site has a high value in terms of ecosystem services, not only in terms of provisioning services for water storage and areas for cultivation but also in terms of regulating services, particularly with respect to the enhancement of water quality compromised by the high level of intensive agriculture in the wetland and its nearby catchment (**Table 4-11**). These services are particularly important for the downstream Churchill Dam, as it is a water supply dam that supplies water to a few surrounding towns and agricultural areas.

Table 4-10 Rating of the Kromme wetland's Ecological Importance and Sensitivity according to Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Score (0-4)	Motivation
1.Biodiversity support	**3.7**	Score taken as the average of the three scores below
Presence of Red Data species	3.5	The wetland supports an endangered species of Redfin, *Pseudobarbus sen-ticeps,* restricted to the Kromme River catchment (Chakona and Skelton 2017) although to note that this species occurs in stream habitats rather than wetlands specifically.
Populations of unique species	4.0	The wetland represents one of the largest intact palmiet peatlands in South Africa. In addition, given the large intact area of wetland in a broader landscape where the cumulative impacts on wetlands are high, uncommonly large populations of wetland species are likely.
Migration/breeding/feeding sites	3.5	Given the large intact area of wetland in a broader landscape where the cumulative impacts on wetlands are high, the wetland potentially has a high importance as a breeding and/or feeding site for wetland-dependent fauna, but specific information on this is lacking.
2. Landscape scale	**3.6**	Score taken as the average of the five scores below
Protection status of the wetland	3.0	The wetland is not formally protected but falls within a SWSA
Protection status of the vegetation type	4.0	The main vegetation type of the wetland, Langkloof Shale Renosterveld, which is **Endangered**
Regional context of the ecological integrity	4.0	The site comprises what appears to be the largest remaining intact wetland in a broader landscape where the cumulative impacts on wetlands is high, noting that both upstream and downstream of the Kromme wetland, the proportion of intact wetland remaining appears to be much lower than in the Kromme wetland.
Size and rarity of the wetland type/s present	3.5	As indicated, the site represents one of the largest remaining intact palmiet peat wetlands, but also noting that palmiet wetlands are not rare, but are widespread in the Fynbos Biome.
Diversity of habitat types	3.5	A high diversity is assumed based on the hydrogeomorphic and hydrological diversity of the wetland together with the diversity of vegetation types including extensive palmiet-dominated areas as well as mixed shrub/grass/restio areas.
3. Sensitivity of the wetland	**3.0**	Score taken as the average of the three scores below
Sensitivity to changes in floods	2.5	Based on the wetland being mainly a valley bottom wetland
Sensitivity to changes in low flows/dry season	3.5	The sensitivity is score is based on the wetlands being a valley bottom, but also considering that its extensive palmiet and peat deposits assumed to be dependent on baseflows.

Ecological Importance	Score (0-4)	Motivation
Sensitivity to changes in water quality	3.0	This is assumed based on wetland being supplied by naturally low-nutrient waters
TOTAL OVERALL SCORE:	**3.7**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-11 Rating of the Kromme wetland's hydrological/functional importance according to Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Regulating and supporting benefits		Score (0-4)	Motivation
Flood attenuation		3.5	Moderately low longitudinal slope and high surface roughness of the wetland contribute to flood attenuation; some floodable cultivated lands downstream of the wetland.
Streamflow regulation		3.5	The hydrogeological setting (Table Mountain Group Sandstone) is likely to be associated with groundwater discharge in the wetland, and this was confirmed by the study of Tanner *et al.* (2019); limited extent in the wetland of invasive trees potentially increasing atmospheric loss of water from the wetland.
Water ality	Sediment trapping	3.0	See flood attenuation. Further adding to the importance of the wetland for sediment trapping is the contribution that this will make to avoided sedimentation of the large water storage dam (Churchill Dam) downstream of the wetland, although located about 40 km downstream and with several other wetlands occurring along this route which could potentially act to trap this sediment before reaching Churchill Dam.
	Phosphate assimilation	2.5	See sediment trapping above. Also, to note that the effectiveness of the wetland is likely to be high for the assimilation of phosphates, nitrates and toxicants, given the moderately diffuse flows in portions of the wetland and the generally high level of wetness and vegetation cover across much of the wetland. However, typical sources of anthropogenically-derived phosphate such as cultivation in the wetland's catchment are limited given the absence of human settlements and the limited extent of cultivated lands relative to the overall catchment.
	assimilation Nitrate assimilation	2.5	See above.
	Toxicant	2.5	See above.
	Erosion control	3.0	major erosion control works constructed by Working for Wetlands at the wetland outflow have effectively halted major head-cut Much of the wetland is maintained under permanent vegetation cover, therefore promoting the control of erosion. In addition, erosion which was threatening the wetland. However, there has been localized increased erosion in the river reach downstream of major erosion control works.
Carbon storage		4.0	The wetland's hydrogeological setting and relatively high level of wetness support the accumulation of soil organic matter, and the presence of organic sediments across extensive areas of the wetland is confirmed by Haigh *et al.* (2009) and Lagesse (2017).
TOTAL OVERALL SCORE:		**3.4**	Score taken as the average of the five highest scores above

Table 4-12 Rating of the Kromme wetlands importance for direct human benefits according to Rountee and Kotze (2013) Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		**Score (0-4)**	**Limited extraction of water**
Provisioning services	Water for human use	2.5	Direct use of water from the wetland for irrigation and livestock watering purposes
	Harvestable resources	1.0	No known current harvesting
	Cultivated foods	0.0	No cultivation in the wetland, although other wetlands in the catchment are extensively cultivated
Cultural services	Cultural heritage	1.0	No known cultural heritage features
	Tourism and recreation	1.5	Currently there appears to be limited contribution of the wetland to tourism and recreation
	Education and research	1.0	Currently there appears to be limited contribution of the wetland to education and research.
TOTAL OVERALL SCORE:		**1.2**	Score taken as the average of the five highest scores above

4.1.2.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) for the Kromme Wetland, the following were noted:

(1) the EIS of the wetland is high;

(2) the PES is in an A category; and

(3) the catchment of the Kromme wetland is predominantly natural with concentrated agricultural activities near the wetland itself. Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for the wetland should be set at its current PES category, i.e., the current PES category is to be maintained (**Table 4-13**).

Table 4-13 Recommended Ecological Category (REC) for wetlands in the Kromme WRU

	Valley-bottom
REC	A

4.2 IUA_L01: Kouga to Kouga Dam, Baviaanskloof

Table 4-14 Summary of wetland information for IUA_L01

IUA Description	Kouga to Kouga Dam, Baviaanskloof
HGM unit type	Total of 38 wetlands mapped. Channelled Valley Bottom Wetlands: 65% Depression Wetlands: 26% Hillslope Seep Wetlands: 6% Unchannelled Valley Bottom Wetlands: 3%
PES per HGM unit type	Channelled Valley Bottom Wetlands - A/B: 80%; C: 4%; D/E/F: 16%. Depression Wetlands - A/B: 90%; D/E/F: 10%. Hillslope Seep Wetlands - A/B: 50%; C: 50%. Unchannelled Valley Bottom Wetlands - A/B: 100%.
FEPA Wetlands	N/A
WRU	WRU03

4.2.1 WRU 03 – Krakeel Wetland Complex

Table 4-15 Summary of information for the Krakeel Wetland Complex

Factor	Comment
WRU Number (Quat Catchment)	WRU 03 (L82D)
Level of Assessment	Field-based
Priority	02
HGM Unit Type(s)	Channelled and Unchanneled Valley-bottom Wetlands
Vegetation types	Eastern Fynbos-Renosterveld Sandstone Fynbos, Eastern Fynbos-Renosterveld Shale Renosterveld
SWSA	Yes (Tsitsikamma SWSA)
Threat Status	**UNCHANNELLED VALLEY-BOTTOM**: CRITICALLY ENDANGERED, **CHANNELLED VALLEY-BOTTOM**: ENDANGERED
PES	D (Largely modified)
EIS	A (Very High)
Contributors	Donovan Kotze

4.2.1.1 Wetland Description

The Krakeel wetland, 889 ha in extent and located immediately west of Joubertina, consists of two main portions, the first associated with the Krakeel River and the second with the Wabooms River. The confluence of the two river systems lies at the outflow of the wetland

(Figure 4-3). Both are predominantly channelled valley bottoms, but it would appear that prior to human modification there were also areas of unchanneled valley bottom which have subsequently become channelised.

The vegetation in the wetland comprises a mosaic of **palmiet** (*Prionium serratum*), common reed (*Phragmites australis*) and mixed shrub/restio/sedge/grass (including *Cliffortia strobolifera, Restio paniculata, Psoralia* spp., *Cyperus textilis* and *Pennisetum macrourum*) **(Figure 4-4 & Figure 4-5)** areas of which have become dominated by invasive plant species, particularly *Acacia mearnsii* (black wattle), now occupying approximately 6% of the overall wetland and 18% of the intact natural areas.

The wetland and its catchment are underlain by Table Mountain Group Sandstone with the MAP being 598mm per annum, but likely to be significantly higher than this in the mountain areas of the wetland's upper catchment. The hydroperiod of the wetland ranges from permanently saturated (mainly in the palmiet areas) through seasonally- to temporarily saturated. Given the hydrogeomorphic type, geology and climatic setting of the wetland, it is assumed to be hydrologically maintained by a combination of direct precipitation, inflows from its upstream catchment and, to a lesser extent, by lateral inflows. Nonetheless these lateral inflows may be critical for localized permanently saturated areas in the wetland, **although this requires further investigation to confirm**.

Only 29% of the wetland remains under natural vegetation, and the predominant land use in the wetland is associated with cultivation **(Table 4-16)** and in the areas immediately surrounding the wetland are fruit orchards, together with several farm dams and limited areas of light industry related to fruit production and a small human settlement in the catchment **(Figure 4-6).** The more distant areas of the wetland's catchment, which extend into the nearby mountains, are predominantly natural vegetation **(Figure 4-3)**.

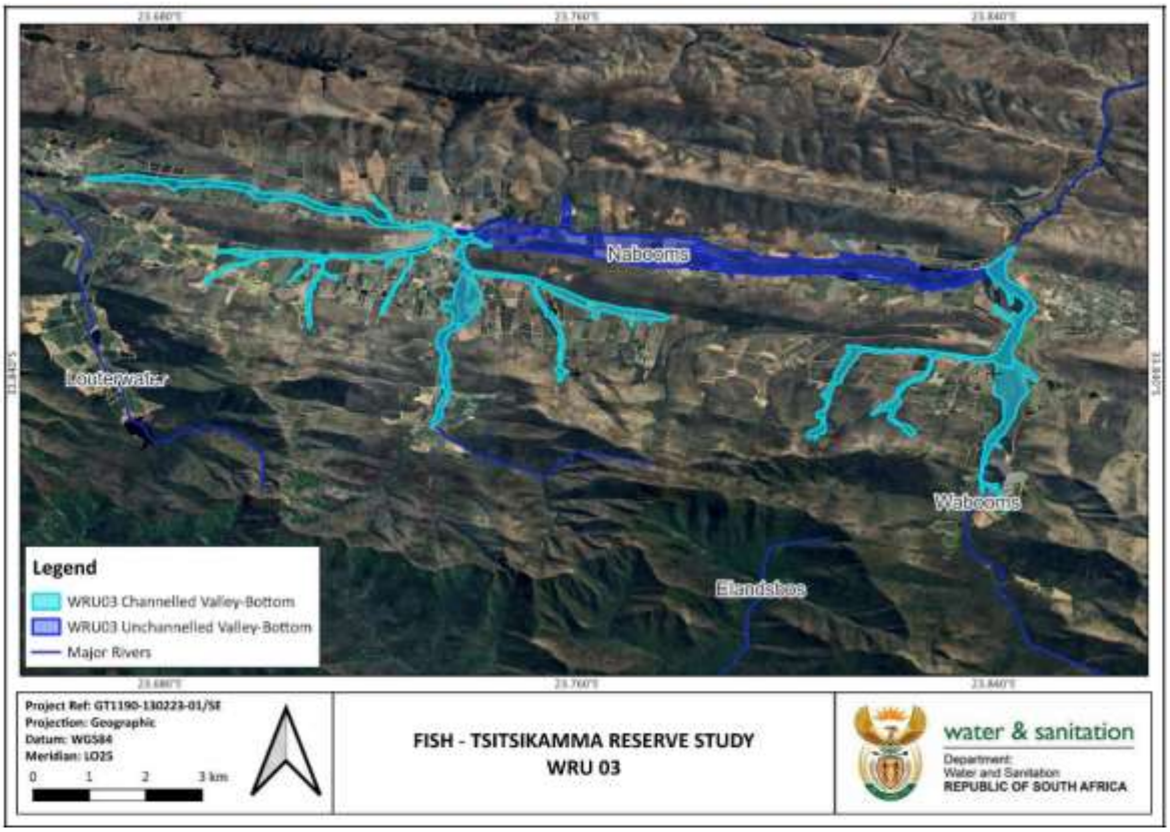

Figure 4-3 Overview of the Krakeel wetland complex.

Table 4-16 Landcover categorisation of the Krakeel wetland according to the WET-Health landcover classification

Level 1B Landcover Categories	Area (%)
Dams	5%
Natural / Minimally impacted	29%
Semi-natural (undrained)	10%
Semi-natural (drained)	5%
Orchards and vineyards	44%
Dense infestations of invasive alien plants	6%
TOTAL	**100%**

Figure 4-4 Mixed restio/sedge/grass/shrub vegetation in Krakeel portion of the wetland, with a clump of young black wattle trees visible to the extreme left

Figure 4-5 The Wabooms River with flanking palmiet (left) and mixed shrub/restio vegetation (right)

Figure 4-6 The wetland in the upper reaches of the Krakeel River visible in the foreground comprising a mosaic of orchards, dams and semi-natural wetland (with large clumps of the invasive alien Spanish reed, *Arundo donax*, while extensive orchards adjacent to the wetland can be seen in the middle ground and an area of natural vegetation in the catchment infested with IAPs.

4.2.1.2 Present Ecological State

Owing to the high level of loss of natural areas in the wetland, as described in the previous section, the impact scores on the vegetation component of PES is particularly high, followed by the hydrology component. The geomorphology component is least affected, but nonetheless still falls within a **C ecological category (Table 4-17). It is important to note that despite the highly altered state of the overall wetland, 261 ha of the wetland remains largely intact, although under threat by expanding IAP infestations.**

Table 4-17 Present ecological state for WRU 03 – the Krakeel wetland complex

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	5.1	2.7	3.6	6.5
PES Score (%)	49%	73%	64%	35%
Ecological Category	**D↓**	**C→**	**C↓**	**E↓**
Combined Impact Score	4.6			
Combined PES Score (%)	54%			
Combined Present Ecological Category	**D↓**			

4.2.1.3 Ecological Importance and Sensitivity

The Krakeel wetland has a high ecological importance given the following key features.

- It is one of the largest wetlands in the overall study area.
- The wetland type represented by the site, namely lowland fynbos wetland on alluvial deposits (in a broad valley bottom setting) has been subject to very high levels of cumulative loss, mainly through transformation to cultivated land, as well as typically having a high likelihood of supporting **Red-listed plant species** where sufficient intact habitat remains.
- While much of the wetland itself has been transformed and its overall PES is low, it still contains a few remaining reasonably intact natural areas, which currently serve as valuable representative examples of its type, **which are worthy of protection efforts**.
- The site has a high value in terms of ecosystem services, not only in terms of provisioning services for water storage and areas for cultivation but also in terms of regulating services, particularly with respect to the enhancement of water quality compromised by the high level of intensive agriculture in the wetland and its nearby catchment. Remaining natural and semi-natural areas, especially those strategically located shortly downstream/downslope of intensive land-use, have a potentially high value for regulating services.
- Most of the wetland is contained within a Strategic Water Source Area, which elevates its importance.

In a rating of the wetland's EIS **(Table 4-18)** the landscape-scale factors make the greatest contribution to the overall score. While from

Table 4-19 **and Table 4-20** it can be seen that the wetland's functional/ecosystem services contributions lies mainly in its regulating services contributing to the enhancement of water quality likely to be compromised by the intensive agricultural activity on its catchment **(**

Table 4-19**)**. In terms of provisioning services, it is primarily through its direct contribution of land and water for cultivation **(Table 4-20)**.

Table 4-18 Rating of the Krakeel wetland's Ecological Importance and Sensitivity according to Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Score (0-4)	Motivation
1.Biodiversity support	**2.8**	Score taken as the average of the three scores below
Presence of Red Data species	3.0	Very little information is available on the site, but given its location and the 46 ha of remaining intact vegetation it is likely to contain Red Data plant species
Populations of unique species	3.5	No known uncommonly large populations of wetland species, but given the large fragments of remaining intact wetlands in a broader landscape where the cumulative loss of wetlands is very high, an uncommonly large populations of wetland species is likely
Migration/breeding/feeding sites	2.0	Given the large fragments of remaining intact wetlands in a broader landscape where the cumulative loss of wetlands is very high, the wetland is likely to be at least moderately important as a breeding and/or feeding site for wetland-dependent fauna, but specific information on this is lacking
2. Landscape scale	**3.4**	Score taken as the average of the five scores below
Protection status of the wetland	3.0	The wetland is not formally protected but it is located in a SWSA
Protection status of the vegetation type	4.0	The main vegetation type of the wetland, Langkloof Shale Renosterveld, is Endangered
Regional context of the ecological integrity	3.0	The site contains large fragments of remaining intact wetland in a broader landscape where the cumulative loss of wetlands is very high
Size and rarity of the wetland type/s present	4.0	Given the endangered status of the main overall vegetation type, rare vegetation types are anticipated.
Diversity of habitat types	3.0	Although not assessed, a relatively high diversity is assumed based on the hydrogeomorphic diversity of the wetland and it is covering 3 vegetation types, Langkloof Shale Renosterveld, Tsitsikamma Sandstone Fynbos and Kouga Grassy Sandstone Fynbos
3. Sensitivity of the wetland	**2.8**	Score taken as the average of the three scores below
Sensitivity to changes in floods	2.5	Based on the wetland's HGM type being mainly a valley bottom wetland
Sensitivity to changes in low flows/dry season	3.0	Based on the wetland's HGM type being mainly a valley bottom wetland and the wetland and the wetland supporting permanently saturated areas assumed to be maintained at least in part by baseflows.

Ecological Importance	Score (0-4)	Motivation
Sensitivity to changes in water quality	3.0	This is assumed based on wetland being supplied by naturally low-nutrient waters
TOTAL OVERALL SCORE:	**3.4**	Score taken as the maximum of the three scores (1., 2. and 3.) above.

Table 4-19 Rating of the Krakeel wetland's hydrological/functional importance according to Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Regulating and supporting benefits	Score (0-4)	Motivation
Flood attenuation	3.0	Low longitudinal slope and high surface roughness of the wetland
Streamflow regulation	3.0	The hydrogeological setting (see Section 3.1.1) is likely to be associated with groundwater discharge in the wetland but the contribution is somewhat diminished by extensive IAPs.
Sediment trapping	3.0	See flood attenuation. Further adding to all water quality enhancement services is the fact that intact areas of the wetland are located in its downstream areas near the wetland's outlet, therefore being most strategically located for sediment/pollutant interception from the wetland's overall catchment
Phosphate assimilation	3.0	See sediment trapping. Also, the high extent of intensive agriculture, especially in the buffer surrounding the wetland, is likely to result in the wetland receiving elevated phosphates
Nitrate assimilation	3.5	While the moderately confined longitudinal flows are not ideal in terms of nitrate assimilation, in the intact areas of wetland, lateral flows are diffuse and likely to be important in assimilating nitrates.
Toxicant assimilation	3.5	See above two items
Erosion control	2.5	Much of the wetland is maintained under permanent vegetation cover, therefore promoting the control of erosion. However, human disturbance and concentration of water flows in some areas of the wetland have somewhat diminished the supply of this service.
Carbon storage	3.0	The wetland's hydrogeological setting (see Section 3.1.1) and the relatively high level of wetness of the intact areas of wetland are assumed to support moderately high accumulation of soil organic matter.
TOTAL OVERALL SCORE:	**3.2**	This is taken as the average of the five highest scores above

Table 4-20 Rating of the Krakeel wetland's importance for direct human benefits according to Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits	Score (0-4)	Motivation
Water for human use	4.0	Extensive abstraction of water from dams within the wetland occurs for irrigation purposes
Harvestable resources	1.0	No known harvesting
Cultivated foods	4.0	Extensive fruit production occurs within the wetland
Cultural heritage	1.0	No known cultural heritage features
Tourism and recreation	1.5	Currently there appears to be limited contribution of the wetland to tourism and recreation
Education and research	1.0	Currently there appears to be limited contribution of the wetland to education and research.
TOTAL OVERALL SCORE:	**3.5**	Score taken as the average of the five highest scores above

4.2.1.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) for the Krakeel wetland RU, the following were noted:

(1) the EIS of the wetland is high;

(2) the PES is in a D category; and

(3) the wetland is "hard-working", with extensive areas long converted to cultivated lands, and further intensification of land-use is anticipated in the wetland's catchment. Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC should be set at a C/D if practical, or it should be managed as a D with specific management action implemented to manage further disturbance of this wetland in the SWRA (**Table 4-21**). Given item (3) above, it is likely to be impractical to improve the PES from a D to a C/D category, and therefore the REC is set at a D, i.e., maintain the current category, with some specific terms and conditions to manage the prevention of further anthropogenic impact on this wetland Further adding to the difficulty of improving the wetland's PES is the decreased MAP to PET ratio predicted with projected climate change.

Table 4-21 Recommended Ecological Category (REC) for wetlands in the Krakeel WRU

	Krakeel Wetlands	
REC	**C /**	**D**

4.3 IUA_M01: M Primary Catchment

Table 4-22 Summary of wetland information for IUA_M01

IUA Description	M primary catchment
HGM unit type	Total of 1337 wetlands mapped. Channelled Valley Bottom Wetlands: 8% Depression Wetlands: 40% Floodplain Wetlands: 1% Hillslope Seep Wetlands: 26% Unchanneled Valley Bottom Wetlands: 7% Wetland Flat Wetlands: 18%
PES per HGM unit type	Channelled Valley Bottom Wetlands - A/B: 21%; C: 43%; D/E/F: 36%. Depression Wetlands - A/B: 40%; C: 16%; D/E/F: 47%. Floodplain Wetlands - A/B: 17%; C: 8%; D/E/F: 75%. Hillslope Seep Wetlands - A/B: 21%; C: 24%; D/E/F: 55%. Unchannelled Valley Bottom Wetlands - A/B: 26%; C: 33%; D/E/F: 41%. Wetland Flat Wetlands - A/B: 29%; C: 16%; D/E/F: 55%.
FEPA Wetlands	A small number of FEPA wetlands have been mapped in IUA_M01, most of which are isolated depression wetlands which are considered important from a biodiversity conservation point of view.
WRU	WRU 04 (Longmore Wetlands) and WRU 05 (Chatty River Wetlands)

4.3.1 WRU 04 – Longmore Wetland Complex

Table 4-23 Summary of WRU 04

Factor	Comment
WRU Number (Quat Catchment)	WRU 04 (M10B)
Level of Assessment	Field-based
Priority	02
HGM Unit Type(s)	Channelled and Unchanneled Valley-bottom Wetlands
Vegetation types	Eastern Fynbos-Renosterveld Sandstone Fynbos
SWSA	Yes (Tsitsikamma)
Threat Status	**UNCHANNELLED VALLEY-BOTTOM**: CRITICALLY ENDANGERED, **CHANNELLED VALLEY-BOTTOM**: ENDANGERED
PES	C (Moderate)
EIS	A (Very High)
Contributors	Donovan Kotze

4.3.1.1 Wetland Description

The **Longmore wetland**, which occupies much of the drainage network of the upper Bulk River catchment, comprises predominantly valley bottom wetland fed laterally by hillslope seeps **(Figure 4-7)**. The wetland, which is underlain by Table Mountain Group Sandstone, Peninsular, Pakhuis and Cedarberg Formations, falls within Quaternary catchment M10B, for which the Mean Annual Precipitation is given as 557 mm. The vegetation in the wetland is a diverse mix of shrubs (*Cliffortia graminae*, *Leucadendron conicum*, *Psoralia spp*. and *Empleurum unicapsulare*), restios (*Elegia fistulosa* and *Platycaulos callistachyus*), sedges (*Carpha glomerata*), grass (*Miscanthus capensis*) and palmiet (*Prionium serratum*).

Although much of the wetland's catchment has been planted with pine trees, the wetland vegetation is still close to natural and the extent of IAP is limited, although some of the minor tributary arms of the wetland lying in steep-sided valleys have localized infestations, as well as being subject to an expanding extent of the indigenous Keurboom tree (*Virgilia divaricata*) which is a forest-pioneer species widely occurring in the southern Cape. Together with the invasive alien trees, this species poses a potential threat to the wetland's native vegetation, as well as likely having higher transpiration rates than the native vegetation described above, and therefore reducing water outflows from the wetland.

Natural vegetation **(Figure 4-8** to **Figure 4-10)** occupies most of the wetland **(Table 4-24)**. The next most extensive land-cover is semi-natural areas, which include historically disturbed (e.g., by timber planting and subsequent withdrawal) areas as well as areas recently invaded by Keurboom trees. Dense infestations of IAP, eroded areas and road crossings are currently very confined in their extent within the wetland **(Table 4-24)**.

Table 4-24 Landcover categorisation of the Longmore wetland according to the WET-Health landcover classification

Level 1B Landcover Categories	Percentage cover ion the wetland
Natural / Minimally impacted	84%
Semi-natural (undrained)	13%
Dense infestations of invasive alien plants	2%
Eroded areas	1%
Road crossings	<1%
Total	**100%**

In addition to the extremely **high biodiversity importance** of the wetland (owing to its condition, high diversity and threatened species) the wetland also makes an important contribution to streamflow regulation and limits sedimentation of the water supply dam located shortly downstream of the wetland's outlet.

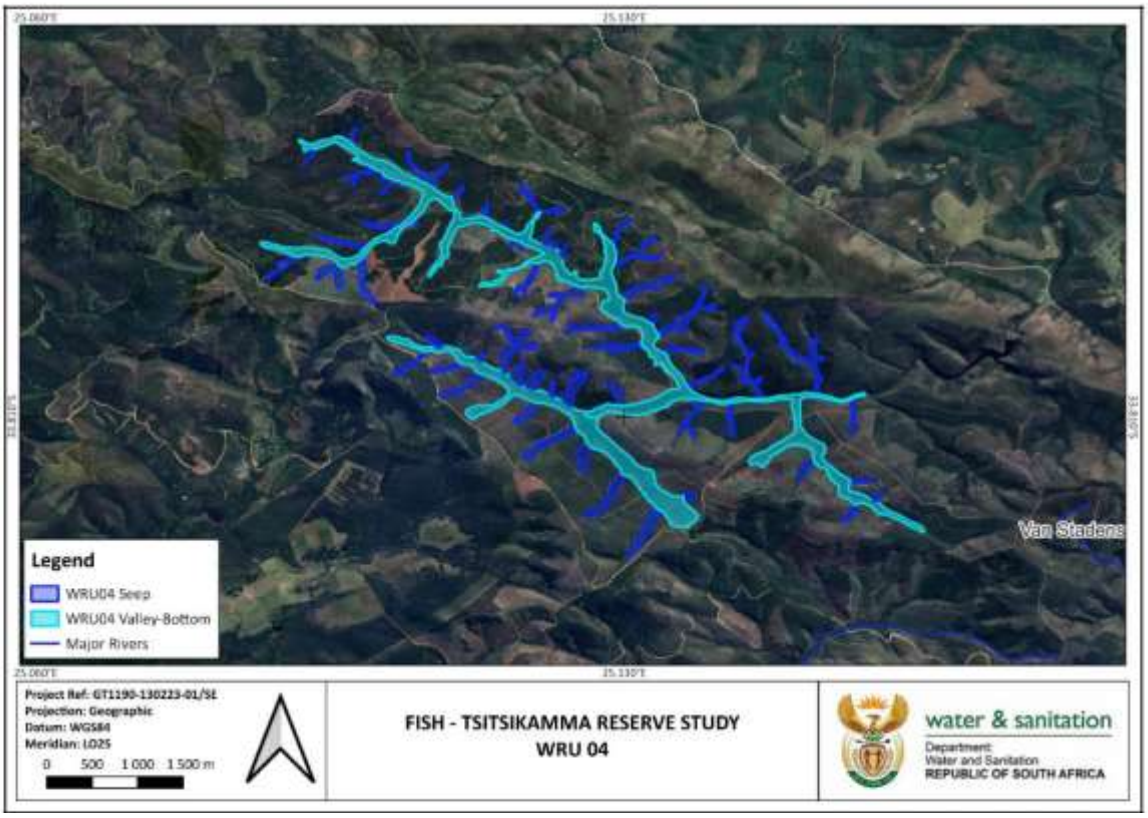

Figure 4-7 Overview of the Longmore wetland complex.

Figure 4-8 A valley bottom area with intact natural vegetation comprising a mix of restios (*Platycaulos callistachyus*), sedges (*Carpha glomerata*) and the grass-like shrub (*Cliffortia graminae*), and almost entirely free of IAP.

Figure 4-9 A hillslope seep area with intact natural vegetation comprising a diverse mix of shrubs (*Erica* spp., *Psoralia* spp. and the vlei boegoe, *Empleurum unicapsulare*), restios (*Elegia fistulosa*) and grass (*Miscanthus capensis*) and also almost entirely free of IAP.

Figure 4-10 A valley bottom wetland comprising intact natural vegetation with a low density of IAP and a relatively generous wetland buffer, which is mostly clear of IAP, especially to the right. The buffer was expanded greatly to its current position after the major fire of 2005 and when the tall pine trees in the buffer on the left are harvested they will not be replanted.

Figure 4-11 A narrow wetland area in a steep-sided valley. In the wetland buffer to the left are some mature pine trees (also visible in the previous photo) and in the wetland is a dense clump of the indigenous forest-pioneer tree the Keurboom (*Virgilia divaricata*), both of which escaped the 2017 fire. In the buffer to the right are scattered pine trees established after the 2017 fire.

Figure 4-12 The lowermost valley bottom portion of the wetland, with the wettest, central zone dominated by palmiet (*Prionium serratum*) and the <u>margins supporting the largest known sub-population of the critically endangered Vanstadensberg honeybush tea, *Cyclopia longifolia*</u>

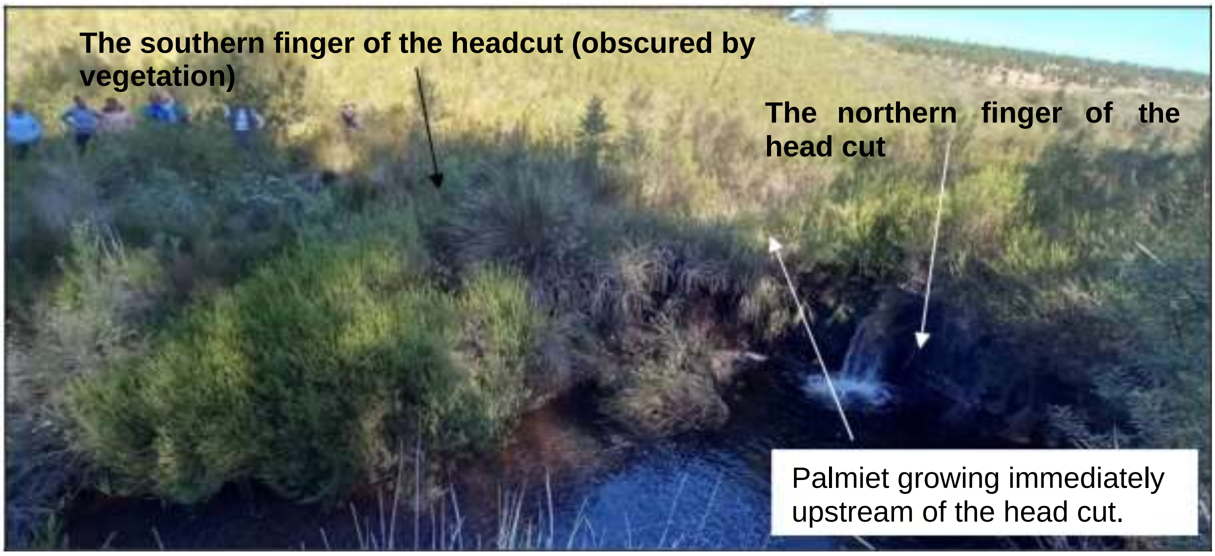

Figure 4-13 A major erosion headcut (with two main fingers) at the outflow of the lowermost valley bottom portion of the wetland. The progressive upstream advance of the headcut is likely to result in much of the habitat and sediment in the central zone being lost and the greatly incised channel having a draining and desiccating effect on the lateral areas favoured by the Vanstadensberg honeybush tea.

4.3.1.2 Present Ecological State

Owing to the high extent of tree plantations in the wetland's catchment, hydrology is the most impacted of the four components of the PES assessment, followed by vegetation and then geomorphology The water quality component is the least impacted given the minimal pollution sources identified in the wetland's catchment **(Table 4-25)**.

Table 4-25 Present ecological state

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	4.1	1.6	0.7	2.4
PES Score (%)	59%	84%	93%	76%
Ecological Category	**D→**	**B→**	**A→**	**C↓**
Combined Impact Score	2.4			
Combined PES Score (%)	76%			
Combined Present Ecological Category	**C→**			

It is noted that the unadjusted WET-Health Hydrology PES score was 55%, primarily as a result of plantation forestry-related catchment impacts. Given the key influence that hydrology has on vegetation and the fact that the vegetation PES was assessed directly at several locations across the wetland, the much higher vegetation PES (76%) suggests that the WET-Health assessment may have somewhat over-estimated the hydrology impact, although this difference may also potentially be attributed to a lag in the response of the vegetation. However, the fact that the wetland's catchment has been afforested for several decades would suggest that some of the lagged response of the vegetation to hydrological impacts would have already been manifest by now. Therefore, the difference between 55% and 76% is unlikely to be attributed to lag effects alone, and based on professional opinion is attributed to a combined overestimate of the magnitude of hydrology impacts and some lag impact effects on the vegetation which are yet to be manifest. Thus, considering the factors just described, the 55% was adjusted up to 59%.

The trajectory of change in the ecological state over the next five years is projected to generally remain the same, but with a slight decline in the vegetation component related to primarily the lag response described in the preceding paragraph.

4.3.1.3 Ecological Importance and Sensitivity

The Longmore wetland has a very high ecological importance, and in a rating of the wetland's EIS **(Table 4-26)** the biodiversity support factors make the greatest contribution to the overall score. While from

Table 4-27 **and Table 4-28** it can be seen that a key factor contributing to the wetland's functional/ecosystem services is its location shortly upstream of a water supply dam contributing to the Nelson Mandela Bay Metropole, while provisioning services are fairly limited.

Table 4-26 Rating (0-4) of the Longmore wetlands' Ecological Importance and Sensitivity according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Score (0-4)	Motivation
1. Biodiversity support	**3.8**	Score taken as the average of the three scores below
Presence of Red Data species	4.0	The wetland supports an important population of the Vanstadensberg honeybush tea (*Cyclopia longifolia*) (Figure 3-33), **which is a critically endangered wetland species with an extremely restricted geographical distribution**
Populations of unique species	4.0	The site represents the western limit of palmiet wetland in the fynbos biome. In addition, given the large intact area of wetland in a broader landscape where the cumulative impacts on wetlands are high, uncommonly large populations of wetland species are likely.
Migration/breeding/feeding sites	3.5	Given the large intact area of wetland in a broader landscape where the cumulative impacts on wetlands are high, the wetland is likely to be at least moderately important as a breeding and/or feeding site for wetland-dependent fauna, but specific information on this is lacking
2. Landscape scale	**3.4**	Score taken as the average of the five scores below
Protection status of the wetland	4.0	The wetland is not formally protected but has formally recognized management importance by MTO and falls within a SWSA
Protection status of the vegetation type	2.0	The main vegetation type of the wetland, Kouga Sandstone Fynbos is not threatened
Regional context of the ecological integrity	3.0	The site contains large fragments of remaining intact wetland in a broader landscape where the cumulative loss of wetlands is very high
Size and rarity of the wetland type/s present	4.0	As indicated, the site represents the western limit of palmiet wetland in the fynbos biome. In addition, given the presence of *Cyclopia longifolia*, rare vegetation types are anticipated.
Diversity of habitat types	4.0	A relatively high diversity is assumed based on the hydrogeomorphic and hydrological diversity of the wetland together with the diversity of vegetation types including a diverse mix of shrubs (*Cliffortia graminae, Leucadendron conicum, Psoralia* spp. and the vlei boegoe, *Empleurum unicapsulare*), restios (*Elegia fistulosa* and *Platycaulos callistachyus*), sedges (*Carpha glomerata*), grass (*Miscanthus capensis*) and palmiet.
3. Sensitivity of the wetland	**2.8**	Score taken as the average of the three scores below
Sensitivity to changes in floods	2.5	Based on the wetland being mainly a valley bottom wetland
Sensitivity to changes in low flows/dry season	3.0	As above but also considering that the permanently saturated areas in the wetland are likely maintained at least in part by baseflows

Ecological Importance	Score (0-4)	Motivation
Sensitivity to changes in water quality	3.0	This is assumed based on wetland being supplied by naturally low-nutrient waters
TOTAL OVERALL SCORE:	**3.5**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-27 Rating (0-4) of the Longmore wetland's hydrological/functional importance according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecosystem benefits	Score (0-4)	Motivation
Flood attenuation	2.5	Moderately low longitudinal slope and high surface roughness of the wetland; very limited floodable property downstream of the wetland before a major water storage dam
Streamflow regulation	3.5	The hydrogeological setting (Table Mountain Group Sandstone, Peninsular, Pakhuis and Cedarberg Formations) is likely to be associated with groundwater discharge in the wetland; very limited extent in the wetland of invasive trees potentially increasing atmospheric loss of water from the wetland. Further adding to the wetland's hydrological importance is its location shortly upstream of a water supply dam contributing to water supply in the water stressed Gqeberha metropolitan area.
Sediment trapping	3.5	See flood attenuation. Further adding to the importance of the wetland for sediment trapping is the contribution that this will make to avoided sedimentation of the large water storage dam shortly downstream of the wetland. As indicated above, this contributes positively to water supply of the Gqeberha metropolitan area.
Phosphate assimilation	2.5	See sediment trapping above. Also, to note that the effectiveness of the wetland is likely to be high for the assimilation of phosphates, nitrates and toxicants, given the moderately diffuse flows in portions of the wetland and the generally high level of wetness and vegetation cover across much of the wetland. However, typical sources of anthropogenically-derived phosphate such as cultivated lands are lacking in the wetland's catchment, but the widespread forestry in the wetland's catchment is likely to have some contribution. Given the water storage dam downstream, there is a current demand for phosphate assimilation.
Nitrate assimilation	3.5	See above.
Toxicant assimilation	3.5	See above two items
Erosion control	3.5	Much of the wetland is maintained under permanent vegetation cover, therefore promoting the control of erosion. However, a few areas of localized erosion are slightly diminishing the supply of this service.
Carbon storage	3.0	The wetland's hydrogeological setting (see Section 3.1.1) and the relatively high level of wetness of the intact areas of wetland are assumed to support moderately high accumulation of soil organic matter.

Ecosystem benefits	Score (0-4)	Motivation
TOTAL OVERALL SCORE:	**3.5**	Score taken as the average of the five highest scores above

Table 4-28 Rating (0-4) of the Longmore wetland's importance for direct human benefits according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits	Score (0-4)	Motivation
Water for human use	1.0	Very limited direct use of water from the wetland
Harvestable resources	3.0	No known current harvesting but the wetland supports a harvestable Honey Bush Tea species of potential economic importance
Cultivated foods	0.0	No cultivation in the wetland
Cultural heritage	1.0	No known cultural heritage features
Tourism and recreation	1.5	Currently there appears to be limited contribution of the wetland to tourism and recreation
Education and research	1.0	Currently there appears to be limited contribution of the wetland to education and research.
TOTAL OVERALL SCORE:	**1.3**	Score taken as the average of the five highest scores above

4.3.1.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) for the Longmore wetland, the following were noted:

(1) the wetland's EIS is very high and 84% of the wetland still comprises intact natural or near-natural vegetation;

(2) the PES is in a C category; and

(3) the wetland has a catchment mostly converted to tree plantations.

Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for the wetland should, if practical, be set at a B category (see note below).

The results of the cost-benefit analysis undertaken by Prime Africa (2023a) indicated three possible scenarios for the Longmore systems which are described in the Eco-Categorisation report (Department of Water and Sanitation 2023). Scenario 1 is the maintenance of the status quo and would not require any additional costs but would mean that the wetland systems will be maintained in their current C PES category. Scenario 2 would include the removal of approximately 200ha of planted trees to increase the PES to a B/C category which would result in a R39 – R46 million asset value loss to MTO. Scenario 3 would include the complete withdrawal of MTO from the management of the Longmore Wetland catchment, meaning that the local authorities would be responsible for the management of the land, which would include the need to clear the extensive IAPs likely to colonize the areas withdrawn from plantations. The appropriate maintenance of fire regimes and alien plants that are currently being well executed by MTO would fall to the local authorities. This would require that the local authority dedicate significant administrative and financial resources towards the management of the Longmore wetland. Given the estimated asset value loss to MTO in Scenario 2 and the anticipated financial and administrative burden to the local authority in Scenario 3, Scenario 1 was selected as the preferred approach. Hence a BAS of a C has been set for the Longmore wetlands, which would require MTO to continue their current management of the wetlands.

Table 4-29 Recommended Ecological Category (REC) for wetlands in the Longmore WRU

	Longmore
REC	**B / C**
BAS	**C**

4.3.2 WRU 05 – Chatty River Wetland Complex

Table 4-30 Summary of WRU 05

Factor	**Comment**
WRU Number (Quat Catchment)	WRU 05 (M10D)
Level of Assessment	Field-based, possible integration/ interaction with Swartkops Estuary RU
Priority	01
HGM Unit Type(s)	Floodplain and Channelled Valley-bottom Wetlands.
Vegetation types	Albany Thicket Valley
SWSA	Yes (Coega TMG Aquifer)
Threat Status	**FLOODPLAIN**: CRITICALLY ENDANGERED **CHANNELLED VALLEY-BOTTOM**: CRITICALLY ENDANGERED
PES	D (Largely modified)
EIS	A (Very High)
Contributors	Steven Ellery

4.3.2.1 Wetland Description

The **Chatty** River Wetlands are comprised of a series of floodplain, valley-bottom and seepage wetlands – forming a large wetland complex nested within the developed areas of Bethelsdorp, Ibhayi, Booysen Park and Kwadwesi in the city of Gqeberha **(Figure 4-14)**. A large, floodplain wetland (FP 1) that is associated with the Chatty River is the first order stream within the wetland complex and flows in an easterly direction between two large salt evaporation pans before it enters into the Swartkops Estuary – a recently declared Ramsar site. This 375ha floodplain wetland is the receiving system for the five additional valley-bottom wetlands that feed into the Chatty River floodplain wetland. These channelled valley-bottom wetlands are predominantly fed by inputs derived from their upstream topographically defined catchments. These wetlands fall within the M10D quaternary catchment which has a MAP of 471 mm/annum and an annual PET of 1550 mm/annum which makes **these systems vulnerable to changes in altered hydrological inputs.** The geology underlying the Chatty River Wetlands comprise of the Kirkwood and Quaternary formations which both form part of the Uitenhage group which is predominantly comprised of sand and mudstones.

Overall, the catchments of these wetlands have been severely altered with the development of the Bethelsdorp, Ibhayi, Booysen Park and Kwadwesi settlements which have expanded from the coast in a north westerly direction toward Uitenhage. These developments have drastically increased the impermeable surfaces within the wetlands' catchments which has increased the overall runoff and runoff velocity entering these wetlands especially at stormwater discharge points up the length of each wetland. Only the two western arms of the wetland complex (CVB 4 & 5) still have some undeveloped areas associated with their fringes and significant portions of their catchments. In addition, many of the inflowing streams flowing into these wetlands have been canalised and convey higher-than-natural velocity flows into the HGM units, along with large volumes of litter and debris. The combination of a highly urbanised catchment, canalisation of many of the inflowing streams, and the regularly surcharging sewer systems have resulted in the incision and erosion of many of the channelled portions of all of the Chatty River Wetlands.

The within wetland impacts to all wetlands include widespread accelerated channel incision and sediment deposition which is, in part, occurring because of the increasingly urbanised catchment. Channel incision was observed inside all the wetland units, with some large headcut erosion features within CVB 2 and CVB 3. Furthermore, the floodplain wetland has been moderately impacted by significant areas of infilling associated with roads, dumping of construction rubble and the expansion of informal settlements into the wetland boundary. According to a resident in Ibhayi, many of the informal settlements within the wetlands have recently been removed. It also appeared that a large portion of the channel within the floodplain has been modified and canalised as well, possibly to control water flows within the HGM unit to protect the encroaching developments. CVB 1 and CVB 5 **(Figure 4-14)** wetlands have been severely affected by large scale sediment deposition due to the clearing of land for development within their catchments. Recent rains have mobilised sediment into these wetlands, resulting in significant sediment deposits. At the time of the site visit, five surcharging sewer manholes were observed within CVB 2, and an additional two were observed, one each in CVB 1 and CVB 5. All sites were characterised predominantly by disturbance-tolerant plant species such as *Typha capensis*, *Phragmites australis*, *Juncus effuses*, *Cynodon dactylon*, *Pennisetum clandestinum*, *Cyperus textilis* and *Sarcocornia* cf *perennis* (confined to the floodplain). However, a number of other wetland species were identified throughout the wetlands including *Cyperus congestus*, *Cyperus laevigatus*, *Juncus lomatophylllus* and *Leersia hexandra*.

Despite the evident anthropogenic pressure within each of the HGM units and their associated catchments, the low turbidity, the absence of a strong odour and the absence of evidence of detergents and chemicals at the toe of the wetland was encouraging – showing the extent to which this wetland is providing water quality enhancing ecosystem services.

Table 4-31 Landcover percentage in the Chatty River wetland RU

Level 1B Landcover Categories	Percentage cover in the mainstem floodplain wetland	Percentage cover in the tributary channelled valley-bottom wetland
Semi-natural (undrained)	54%	48%
Moderately/heavily degraded land	25%	38%
Urban land covers	9%	2%
Infilling (infrastructure)	6%	3%
Flooded areas (due to roads or dams)	5%	1%
Sediment deposits[5]	0%	4%
Semi-natural (drained)	1%	3%
Subsistence crops	<1%	1%
Quarrying	2%	0%
Dense infestations of alien plans	<1%	<1%
Total	**100%**	**100%**

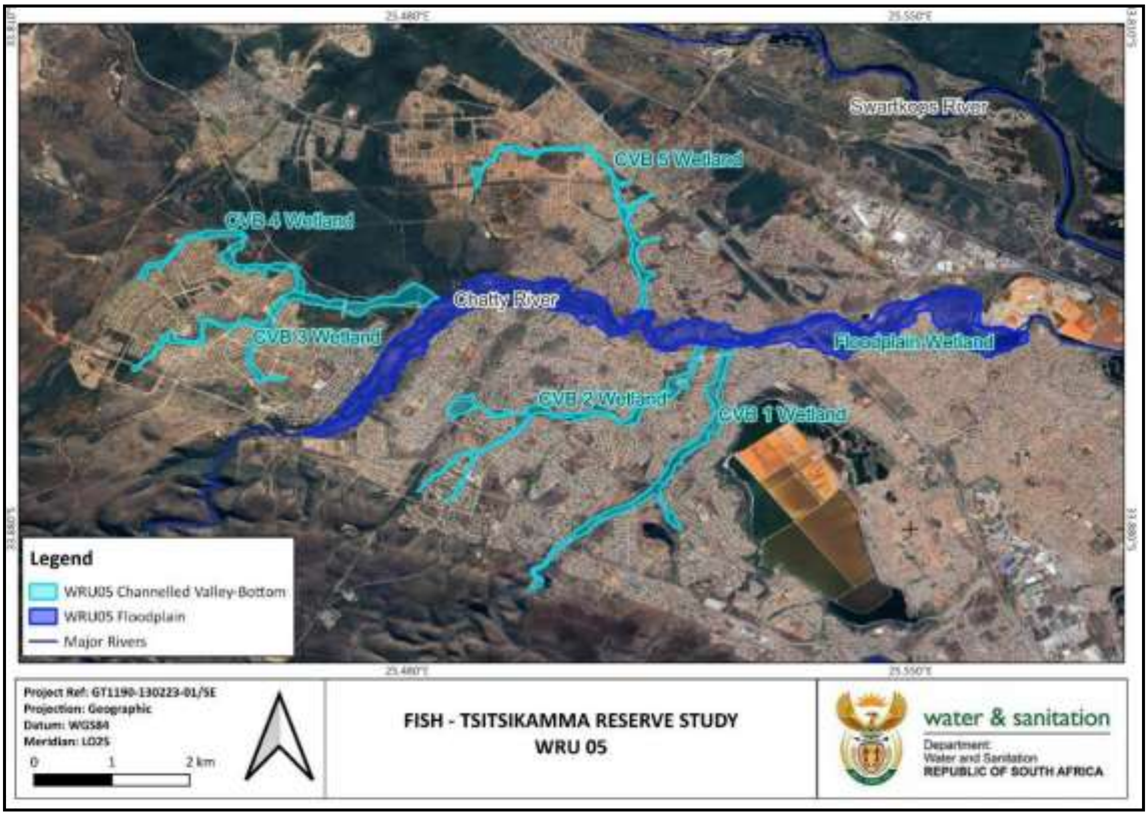

Figure 4-14 Overview of the Chatty River wetland systems

[5] The sediment deposits are extensive in one of the CVB wetlands. It should be noted that the areas that have been classified as Moderately degraded/heavily degraded lands may also include sediment deposits, but due to the coarse nature of this assessment, it was not possible to separate these land cover groups out.

Figure 4-15 One of the many stormwater canals that conveys stormflows into the Chatty River Wetlands. Many of these canals have been totally blocked by the litter and debris, causing them to overtop into inhabited areas, potentially posing a health risk to those living nearby. In addition, the canalised stormwater conduits that are not blocked were observed to, in some cases, have resulted in erosion and scour of the downstream wetland.

Figure 4-16 Photograph captured from one of the bridges crossing the CVB 1 wetland – with evidence of large scale canalisation of the channel as indicated by the large bank on the right hand-side of the photograph.

Figure 4-17 A surcharging sewer manhole pictured centrally, and a newly incising channel pictured to the right located in CVB 3. The lateral tongues of the incising channel (heading towards the manhole) and the proximity of the point of incision to this surcharging manhole indicate that this manhole has been a large causal factor in the incision of this channel.

Figure 4-18 Relatively clear and non-odourous water flowing through the toe of the wetland. In addition, this lower section of the system coincided with the most intact vegetation observed across the entire site.

4.3.2.2 Present Ecological State

Owing to the extensive urbanised nature of the catchment and the presence of multiple point source pollution discharges, the water quality module is the most impacted of the four components of the PES assessment **(Table 4-32)** for both the floodplain wetland and the channelled valley-bottom wetlands. The hydrology has been impacted upon in both the floodplain and channelled valley-bottom wetlands similarly due to the urbanisation of the catchment and the resulting increase in runoff generation and flood peaks. A large dry attenuation pond has been constructed in the upstream portions of the floodplain to mitigate possible flood damage to downstream areas owing to the largely urbanised catchment (Vromans, 2016). In addition, the extensive reworking of the floodplain due to increased runoff has resulted in the abandonment of the natural channel in favour for straightened portions of channel. Similarly, many of the channels within the channelled valley-bottom wetlands have been canalised or altered due to the unnatural deposition of sediment in many areas in the wetland. The vegetation component of the PES has similarly been disturbed by the proliferation of informal settlements within the wetlands along with extensive erosion at multiple points within the CVB and floodplain wetlands and an extensive sediment deposit in CVB 5.

Table 4-32 Present ecological state of WRU 05 – the Chatty River Floodplain and Channelled Valley-Bottom wetlands

Floodplain wetland

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	4.0	3.4	7.3	5.7
PES Score (%)	60%	66%	27%	43%
Ecological Category	**D** ↓	**C** →	**E** ↓	**D** ↓
Combined Impact Score	5.0			
Combined PES Score (%)	50%			
Combined Present Ecological Category	**D** ↓			

Channelled Valley-Bottom wetlands

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	4.0	3.5	7.3	6.2
PES Score (%)	60%	65%	27%	38%
Ecological Category	**D** ↓	**C** →	**E** ↓	**D** ↓
Combined Impact Score	5.1			
Combined PES Score (%)	49%			
Combined Present Ecological Category	**D** ↓			

Inspection of recent satellite imagery indicates that there are large tracts of land that are being cleared for further development in the catchment of the floodplain wetland and some of the channelled valley-bottom wetlands. These developments would further impact on the hydrology and water quality modules, hence these modules have trajectory of changes that indicate a slight decrease in condition within the next five years. Vegetative integrity is linked to hydrological integrity, and it can be assumed that a decrease in hydrological health within the wetlands will have a resultant impact on the vegetation PES within the wetland. As such, the trajectory of change in ecological state over the next five years is projected to decline. Further decline in the integrity and ability of the wetlands to provide ecosystem services will result in a possibly significant impact on the Swartkops Estuary downstream.

4.3.2.3 Ecological Importance and Sensitivity

The Chatty River wetlands have a very high ecological importance, and in the rating of the wetland's EIS (Table 4-33) it can be seen that the biodiversity support factors make the greatest contribution to the overall score. While from Table 4-34 and Table 4-35 it can be seen that a key factor contributing to the wetland's functional/ecosystem services is its location shortly upstream of the internationally important Swartkops Estuary, while provisioning services are fairly limited.

Table 4-33 Rating (0-4) of the Chatty River wetland complexes' Ecological Importance and Sensitivity according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	FP Wetland	CVB Wetlands	Motivation
1. Biodiversity support	**3.3**	**2.7**	Score taken as the average of the three scores below
Presence of Red Data species	3.0	3.0	While the wetlands do not directly support red data species, the Swartkops Estuary and the salt marshes downstream of the Chatty River wetlands support a red data species which are reliant on water from the Chatty River wetlands
Populations of unique species	3.0	2.5	Portions of the floodplain wetland support a salt marsh population comprising of *Sarcocornia species* as the main component of the unique population. While these are not necessarily unique features in the landscape, the salt pans in the landscape are thought to be providing the salt that allows these salt marshes to persist. **These salt pans are unique features in the landscape and this interaction is thought to be unique.**
Migration/breeding/feeding sites	4.0	2.5	Numerous birds were observed in the wetland, and it is well known that there is an IBA located downstream of the wetland floodplain, with the toe of this HGM unit being included in the IBA. Numerous migratory birds are known to use the Chatty River salt marshes.
2. Landscape scale	**3.3**	**3.1**	Score taken as the average of the five scores below
Protection status of the wetland	4.0	4.0	The wetlands are not formally protected; however, a critical biodiversity area (CBA) has been established over much of the wetland and therefore they technically receive municipal protection via the Nelson Mandela Bay Municipality (NMBM) Bioregional Plan. Additionally, these systems fall within the Coega TGM Aquifer groundwater SWSA and therefore should be protected to a greater degree.
Protection status of the vegetation type	3.0	3.0	Three vegetation types are found in this wetland (as per the NMBM Conservation Assessment and Plan, 2010). Albany Valley Thicket floodplain and channelled valley-bottom wetlands are **critically endangered**, the Motherwell Karroid Thicket is an **endangered** vegetation type and the Sunday's Valley Thicket is **vulnerable.** These receive little to no protection generally.
Regional context of the ecological integrity	3.0	2.5	PES category is D and is representative of the loss of wetlands in the area. There are other wetlands in the area which are in better condition and therefore this wetland does not represent an intact remaining wetland. However, the Chatty River Wetland systems support a Ramsar declared estuary system which increases its regional importance substantially.
Size and rarity of the wetland type/s present	3.5	3.5	Wetlands are 230-350 ha in size and floodplain and channelled valley bottom wetlands within the Albany Valley Thicket Biome are critically endangered.

Ecological Importance	FP Wetland	CVB Wetlands	Motivation
Diversity of habitat types	3.0	2.5	A variety of habitat types within the wetland including salt marshes dominated by *Sarcocornia species,* **ox bow lakes** which are characterised by open water and wetland dependant plants such as *Phragmites australis*, *Typha capensis*, *Eleocharis limosa*, *Schoenoplectus cf decipiens* and dense wetland vegetation along some of the channelled portions of the wetland which included *Juncus krausii*, *Schoenoplectus decipiens*, *Cyperus textilis.*
3. Sensitivity of the wetland	**3.5**	**3.2**	Score taken as the average of the three scores below
Sensitivity to changes in floods	4.0	3.0	Based on the wetland being floodplain and channelled valley-bottom wetlands.
Sensitivity to changes in low flows/dry season	2.5	2.5	Predominantly channelled with some flood out zones
Sensitivity to changes in water quality	4.0	4.0	Predominantly sandstone geology which has a higher nutrient loading than many other lithologies, so sensitivity may be lower.
TOTAL OVERALL SCORE:	**3.5**	**3.2**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-34 Rating (0-4) of the Chatty River wetlands' hydrological/functional importance according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecosystem benefits	FP Wetland	CVB Wetlands	Motivation
Flood attenuation	3.5	3.5	Flood attenuation is in high demand given the urban nature of the wetlands and the extensive infrastructure downstream of these wetlands. However, the channelised nature of many of the wetlands does not allow for the effective supply of this service and therefore the overall importance score is lowered for both the floodplain and channelled valley-bottom systems.
Streamflow regulation	3.5	3.5	The geology is predominantly comprised of sandstone and mudstone which do not typically have strong groundwater interactions. However, given the proximity of the wetlands to the coast and the presence of salt pans which are fed by groundwater to some degree, it is likely that there are additional flows from a groundwater source to all wetlands in the WRU.
Sediment trapping	3.5	3.5	See flood attenuation above. Further adding to the importance of the wetlands for sediment trapping is the contribution that this will make to avoided sedimentation of the very important Swartkops Estuary downstream of the wetlands. In addition, the low-income urban nature of the catchment means that there is a high level of sediment production. **Therefore, the demand for this service will be very high, but the ability of the wetlands to supply this service may be compromised due to the channelled nature of much of the wetlands.**
Phosphate assimilation	3.5	3.5	See sediment trapping above. Also, to note that the effectiveness of the wetlands is likely to be moderate for the assimilation of phosphates, nitrates and toxicants, given the somewhat limited diffuse flows in portions of the wetlands. However, typical sources of anthropogenically-derived phosphate, nitrates and toxicants such as stormwater outflows, leaking sewage infrastructure and industrial effluent are extremely high in the catchment and therefore the demand will be very high. Demand is increased due to important estuary downstream.
Nitrate assimilation	3.5	3.5	See above.
Toxicant assimilation	3.5	3.5	See above.
Erosion control	3.5	3.5	The vegetation cover in the wetlands is highly variable and is often removed or buried under sediment. There are multiple instances of erosion in the wetlands hence the effectiveness in providing erosion control is poor. However, the demand is extremely high.
Carbon storage	2.2	2.1	Demand for this is high given the urban setting of the wetlands, but the accumulation of organic sediment and the short nature of much of the vegetation is not favourable for carbon storage, therefore not high supply score.
TOTAL OVERALL SCORE	**3.5**	**3.5**	Score taken as the average of the five highest scores above

Table 4-35 Rating (0-4) of the Chatty River wetland's importance for direct human benefits according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		FP Wetland	CVB Wetlands	Motivation
Provisioningservices	Water for human use	1.8	1.8	Water quality issues preclude the use of this water by humans, although a number of instances of cars being washed in the wetlands were observed and a number of cattle were observed utilising the wetland as a watering place.
	Harvestable resources	1	1	No known current harvesting
	Cultivated foods	0.6	0.8	There were a small number of subsistence crops noted within the wetland - but limited in extent.
Cultural services	Cultural heritage	1.7	1.9	Two ceremonial areas were observed during the site visit.
	Tourism and recreation	0.7	0.5	Currently there appears to be limited contribution of the wetland to tourism and recreation, although the toe of the floodplain wetland forms part of the IBA which attracts bird watchers.
	Education and research	0.6	0.6	Currently there appears to be limited contribution of the wetland to education and research.
TOTAL OVERALL SCORE:		**1.2**	**1.1**	Score taken as the average of the five highest scores above

4.3.2.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) for the Chatty River wetlands, the following were noted:

(1) the EIS of the wetlands are high;

(2) the PES of the wetland complex is calculated as being on a serious negative trajectory and is already in a modified state;

(3) the land use/landcover context of the wetlands (with immediate catchments predominantly converted to urban residential areas wherein development and aging infrastructure are resulting in large impacts to water quality and hydrology in all wetlands); and

(4) the presence of the critically important Ramsar declared Swartkops Estuary directly downstream of the wetland systems which supports **critical several of endangered and migratory species**. Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for the wetland should be set at the current PES categories, or if practical, improved by a category.

The results of a qualitative cost benefit undertaken by Prime Africa (2023b) indicate that the costs associated with improving the PES category of the Chatty River wetlands will be prohibitive and may require that established communities are forcibly removed in order to open up parts of the catchments of these wetlands. However, according to Prime Africa (2023), it will be financially feasible to maintain the current PES category and perhaps marginally improve the PES, despite there being an assortment of costs associated with maintaining the status quo of the wetland. The management and mitigation measures included in the following section should be incorporated into a wetland management plan embedded in the open space planning mandate of the Nelson Mandela Bay Municipality. One of the main contributing factors to the current PES category is the presence of multiple overflowing manholes and raw sewage flowing into the wetlands. If these issues were dealt with, the PES of the Chatty River systems would improve. It is unlikely that the PES category will move into a C category, but it will approach a high D category. As such a BAS is set for the Chatty River wetland systems to be maintained at their current PES, but to be improved from the current low D category to a high D category. It should be noted that if none of the recommended management actions below are implemented, it is likely that the condition of the wetlands will deteriorate over time as indicated by the anticipated trajectory of change.

Table 4-36 Recommended Ecological Category (REC) for wetlands in the Chatty River WRU

	Floodplain	Channelled Valley-Bottom
REC	C	C
BAS	C / D	C / D

4.4 IUA_LN01: Groot to Kouga confluence, Upper Sundays to Darlington Dam

Table 4-37 Summary of wetland information for IUA_LN01

IUA Description	Groot to Kouga confluence, Upper Sundays to Darlington Dam
HGM unit type	Total of 524 wetlands mapped; Channelled Valley Bottom Wetlands: 43% Depression Wetlands: 29% Hillslope Seep Wetlands: 8% Unchannelled Valley Bottom Wetlands: 15% Wetland Flat Wetlands: 5%
PES per HGM unit type	Channelled Valley Bottom Wetlands - A/B: 66%; C: 14%; D/E/F: 20%. Depression Wetlands - A/B: 80%; C: 5%; D/E/F: 15%. Hillslope Seep Wetlands - A/B: 48%; C: 45% D/E/F: 7%. Unchanneled Valley Bottom Wetlands - A/B: 76%; C: 19% D/E/F: 5%. Wetland Flat Wetlands - A/B: 79%; C: 17%; D/E/F: 4%.
FEPA Wetlands	A small number of FEPA wetlands have been mapped in IUA_LN01 – most of which are valley bottom wetlands.
WRU	WRU 06

4.4.1 WRU 06 – Sneeuberg West

Table 4-38 Summary of WRU 06

Factor	Comment	
WRU Number (Quat Catchment)	WRU 06 (L21D)	
Level of Assessment	Field-based	
Priority	02	
HGM Unit Type(s)	Hillslope seeps, Channelled and Unchannelled Valley-bottom Wetlands	
Vegetation types	Upper Nama Karoo	
SWSA	N/A	
Threat Status	**SEEP:** CRITICALLY ENDANGERED, **CHANNELLED VALLEY-BOTTOM**: ENDANGERED, **UNCHANNELLED VALLEY-BOTTOM**: VULNERABLE	
PES	**SEEP**: B (Largely natural)	**VALLEY-BOTTOM:** C (Moderate)
EIS	B (High)	B (High)
Contributors	Donovan Kotze	

4.4.1.1 Wetland Description

It is important to note that the wetlands included in the **Sneeuberg West** RU are taken from a 3'000ha sample area (shown in **Figure 4-19)** which was drawn from the study of Kotze *et al.* (2022) and that these wetlands represent much larger set of wetlands extending across 31'000ha of the western Sneeuberg mountains and its foot hills.

The Sneeuberg West RU comprises a cluster of wetlands, with seeps in the higher altitude mountain slopes, with associated higher rainfall of 531 mm, and valley bottoms (channelled and unchannelled) on the plains, with lower MAP of 380mm (Kotze *et al.* 2022). The seep wetlands are undelain with Karoo dolerite, which appear to comprise inclined dolerite sills charactristic of the high mountains of the Sneeuberg (Clark *et al.* 2009). The valley bottom wetlands are underlain predominantly by the Balfour formation with Karoo dolerite intrusions, some of which appear to have an important hydrogeomorphological control over the largest wetlands in the Sneeuberg foothills (Kotze *et al.* 2022).

The vegetation in the seeps is dominated by the robust tufted grass *Mexmuellera macowanii*, while in the valley bottoms it is dominated by the sedge *Pseudoschoenus inanus* in association with grasses such as *Miscanthus capensis* **(Figure 4-19** to **Figure 4-23)**.

The hydroperiod of the seep and valley bottom wetlands are predominantly temporarily to seasonally saturated, with permanent areas being very limited in extent.

Almost all of the seep wetland areas remain under natural vegetation, while in the valley bottom wetland areas 56% of the area remains under natural vegetation, 14% under semi-natural vegetation, and the remaining area is under cultivation, dense alien invasive species infestations and dams. For both the seeps and valley bottoms, the catchment remains predominantly natural vegetation **(Table 4-39)**.

Table 4-39 Landcover in Sneeuberg West wetlands

Level 1B Landcover Categories	**Seep wetlands**	**Valley bottom wetlands**
	Area (%)	**Area (%)**
Deep flooding from impoundments		2%
Natural / Minimally impacted	97%	57%
Semi-natural (undrained)		11%
Semi-natural (drained)		3%
Moderately degraded land	3%	6%
Commercial annual crops (irrigated)		9%
Dense infestations of invasive alien plants		12%

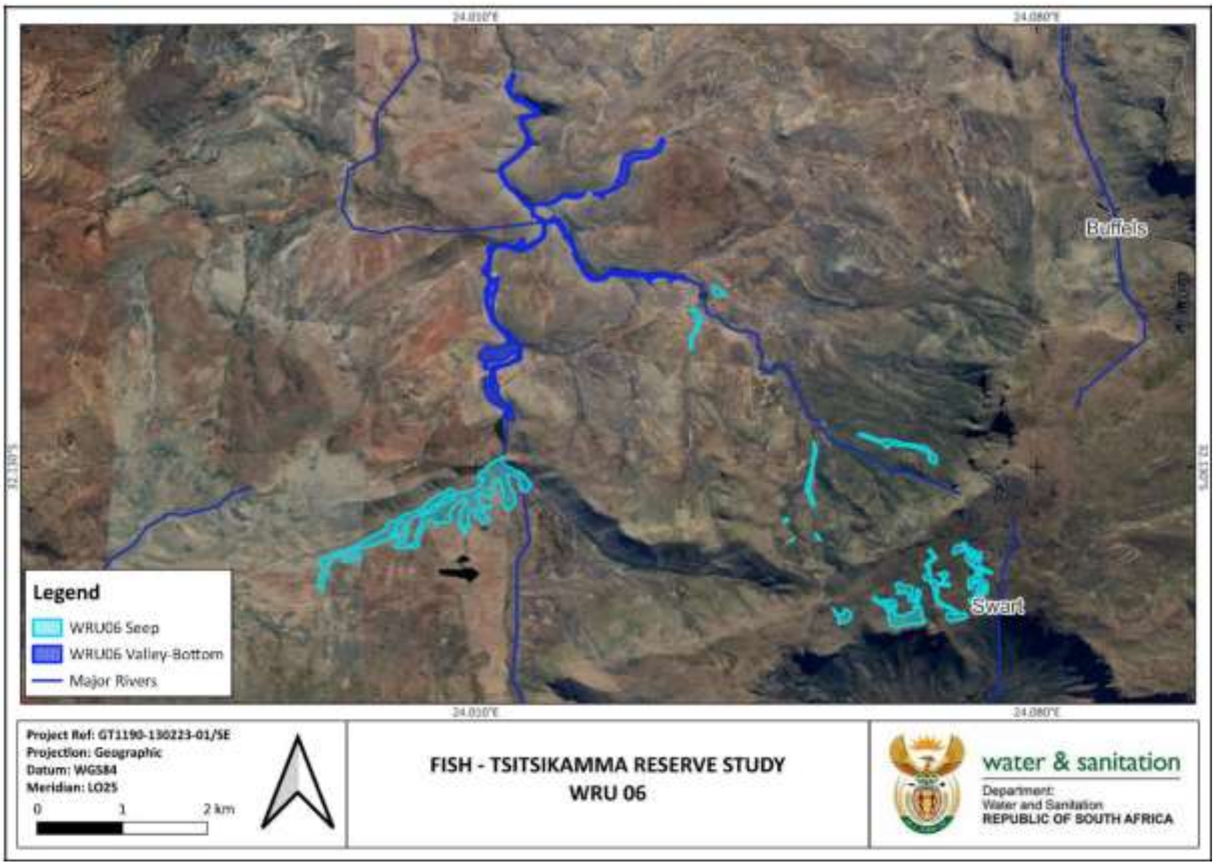

Figure 4-19 The Sneeuberg West wetland RU.

Figure 4-20 An extensive high altitude (1834-1933 m) seep wetland on the southern slopes of the Toorberg mountain, largely temporarily saturated and dominated by tall, robust grass *Merxmuellera macowanii*

Figure 4-21 A very localized area of the seep, seasonally to semi-permanently saturated area and with the River pumpkin (*Gunnera perpensa*)

Figure 4-22 A very narrow channeled valley-bottom wetland in a confined section of the valley in the Sneeuberg foothills, dominated by the sedge *Pseudoschoenus inanus,* and the tall grass *Miscanthus capensis*, with scattered trees of the invasive alien crack willow, *Salix fragilis*

The "poort", likely resulting from a dolerite dyke, where the wetland narrows considerably at its outlet, and which appears to act as a strong hydro geomorphological control on the extensive upstream wetland.

Figure 4-23 A broad, large (62 ha) unchanneled valley-bottom wetland in the Sneeuberge foothills, dominated by a mosaic of the sedge *Pseudoschoenus inanus*, the tall grass *Miscanthus capensis* and a shorter grasses and sedges.

4.4.1.2 Present Ecological State

The seep wetland area had noticably lower impact scores than the valley bottom wetland area **(Table 4-40)**, owing primarily to the preportionally much greater extent of natural areas in the seep wetland, as descrinbed in the previous section. For the valley bottom wetland area, the vegetation component had the highest impact score, but nonetheless was still a C Category, present ecological state owing to the still reasonably extensive remaining natural areas (an example of which can be seen in **Figure 4-22)**.

Table 4-40 Present ecological state

Combined Seep wetland area

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	0.8	0.8	1.1	1.9
PES Score (%)	92%	92%	89%	81%
Ecological Category	**A→**	**A→**	**B→**	**B→**
Combined Impact Score	1.1			
Combined PES Score (%)	89%			
Combined Present Ecological Category	**B→**			

Combined Valley bottom wetland area

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	2.6	1.5	1.5	3.8
PES Score (%)	74%	85%	85%	62%
Ecological Category	**C→**	**B→**	**B→**	**C↓**
Combined Impact Score	2.4			
Combined PES Score (%)	76%			
Combined Present Ecological Category	**C→**			

4.4.1.3 Ecological Importance and Sensitivity

The Sneeuberg West wetlands have a **high ecological importance** given the following key features:

- A relatively high abundance of wetlands, the importance of which is amplified by the fact that in much of the surrounding lower-lying landscape, which is predominantly arid, wetlands are naturally scarce.
- The wetlands are still largely intact and in reasonable to good condition.
- Given the above two factors, wetlands provide potentially important ecological refuges, especially in dry periods and in the face of global climate change, with predicted increasing temperatures and decreasing water availability likely to heighten the importance of areas such as these which are the coolest and wettest parts of the overall landscape.
- The area overall lies close to the most westerly limits of Montane grassland wetlands.
- The wetlands are located in an important catchment area supplying the small town of Aberdeen located in the arid lowlands.

In a rating of the wetland's EIS **(Table 4-41)** it can be seen that the biodiversity support factors make the greatest contribution to the overall score. While from

Table 4-42 and

Table 4-43 it can be seen that the wetland's functional/ecosystem services contribution is somewhat limited, in part owing to the largely natural catchment where the demand for these services is relatively low be compromised by the intensive agricultural activity on its catchment (

Table 4-42**).** In terms of provisioning services, it is primarily through its direct contribution of livestock grazing and water provision and, in the case of some of the valley bottom wetlands, also as areas for cultivation (

Table 4-43**).**

Table 4-41 Rating of the Sneeuberg West wetlands' Ecological Importance and Sensitivity according to Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Score (0-4)	Motivation
1.Biodiversity support	**3.0**	Score is taken as the average of the three scores below
Presence of Red Data species	2.0	Very little information is available on the site
Populations of unique species	3.5	Given the relatively large extent of intact wetland at the site and the very low extent of wetlands in the broader Karoo landscape, the wetlands are likely to be at least moderately important for supporting populations of unique species. In addition, the Sneeuberg is **recognized as a centre of floristic endemism in the Great Escarpment** (Clarke *et al.* 2009).
Migration/breeding/feeding sites	3.5	As above, given the relatively large extent of intact wetland at the site and the very low extent of wetlands in the broader Karoo landscape, the wetlands are likely to be at least moderately important as a breeding and/or feeding site for wetland-dependent fauna, but specific information on this is lacking.
2. Landscape scale	**2.2**	Score is taken as the average of the five scores below
Protection status of the wetland	1.0	The wetland is not formally protected and is not in a SWSA
Protection status of the vegetation type	1.0	The main vegetation type of the wetland is not protected
Regional context of the ecological integrity	3.0	A relatively high abundance of intact wetland areas, the importance of which is amplified by the fact that in much of the surrounding lower-lying landscape, which is predominantly arid, wetlands are naturally scarce.
Size and rarity of the wetland type/s present	3.5	As described above, the wetlands constitute a large wetland area in the overall Great Karoo, which generally have limited very wetland extent, and any natural large wetland area is therefore a rare occurrence.
Diversity of habitat types	2.5	Although not assessed, a moderately high diversity is assumed based on the hydrogeomorphic diversity of the wetland and climatic and geological diversity encompassed in the group of wetlands.
3. Sensitivity of the wetland	**2.3**	Score is taken as the average of the three scores below
Sensitivity to changes in floods	2.0	Based on the wetlands being mainly seep and valley bottom wetlands

Ecological Importance	**Score (0-4)**	**Motivation**
Sensitivity to changes in low flows/dry season	2.5	As above
Sensitivity to changes in water quality	2.5	This is assumed based on wetland not being supplied by naturally very low-nutrient waters, as would be the case if their catchments were dominated by Table Mountain Group Sandstone.
TOTAL OVERALL SCORE:	**3.0**	Score taken as the maximum of the three scores (1., 2. and 3.) above

Table 4-42 Rating of the Sneeubrg West welands' hydrolgical/functional importance according to the critiria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Regulating and supporting benefits		**Score (0-4)**	**Motivation**
Flood attenuation		2.5	Low to moderate longitudinal slope and moderate to high surface roughness but limited downstream floodable property
Streamflow regulation		2	The hydrogeological setting (see Section 3.2.1) may potentially be associated with groundwater discharge, at least in localized areas
Water Quality Enhancement	Sediment trapping	2.5	See flood attenuation
	Phosphate assimilation	2.5	See sediment trapping. Also, the somewhat limited extent of intensive land use in the wetlands' catchments is likely to result in the wetland receiving only slightly to moderately elevated phosphates and nitrates
	Nitrate assimilation	2.0	See above. Also, the predominance of temporarily saturated areas in the wetlands over seasonally and permanently saturated areas somewhat limits the effectiveness of the wetland in assimilating nitrates.
	Toxicant assimilation	2.5	See above two items
	Erosion control	2.5	Much of the wetland is maintained under permanent vegetation cover, therefore promoting the control of erosion. However, human disturbance and concentration of water flows in some areas of the valley bottom wetland have somewhat diminished the supply of this service.
Carbon storage		2	The wetlands' relatively low level of wetness is assumed to somewhat limit the accumulation of soil organic matter.
TOTAL OVERALL SCORE:		**2.5**	Score taken as the average of the five highest scores above

Table 4-43 Rating of the Sneeuberg West wetlands' importance for direct human benefits according to Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		Score (0-4)	Motivation
Provisioning services	Water for human use	3.0	The wetlands are important for livestock watering; and abstraction of water from dams within the valley bottom wetland occurs for irrigation purposes
	Harvestable resources	4.0	The vegetation of the wetlands is very widely used for livestock grazing, and likely to provide a key grazing resource especially in dry periods
	Cultivated foods	3.0	Moderately extensive cultivation of the valley bottom wetlands
Cultural services	Cultural heritage	1.0	No known cultural heritage features
	Tourism and recreation	1.5	Currently there appears to be limited contribution of the wetlands to tourism and recreation
	Education and research	1.0	Currently there appears to be limited contribution of the wetland to education and research
TOTAL OVERALL SCORE:		**2.5**	The score is calculated based on the average of the five highest scores above

4.4.1.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) for the Sneeuberg West RU wetlands, the following were noted:

(1) the EIS of the wetlands are high;

(2) the PES is in a B category for the **seep wetlands** and a C category for the **valley bottom** wetlands; and

(3) the wetlands fall within a commercial livestock farm, including some areas long converted to cultivated lands. Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for the seeps should be set at a B, or if practical, improved to an A/B and for the valley bottoms be set at a C, or if practical, improved to a B/C. Given item (3) above, it is likely to be impractical to improve the PES. Further adding to the difficulty of improving the PES for the wetlands are the projected increasing impacts to wetlands associated with climate change. It is anticipated that several of the wetlands in the RU, especially the seep wetlands, may have a particularly high vulnerability to even a modest decrease in the MAP to PET ratio given that they appear close to the perceived threshold of occurrence in terms of minimum MAP to PET ratio (Kotze *et al.* 2022).

Table 4-44 Recommended Ecological Category (REC) for wetlands in the Sneeuberg West WRU

	Seep Wetlands	Valley Bottom Wetlands
REC	B	C

4.5 IUA_Q01: Upper Fish

Table 4-45 Summary of wetland information for IUA_Q01

IUA Description	Upper Fish
HGM unit type	Total of 88 wetlands mapped; Channelled Valley Bottom Wetlands: 69% Depression Wetlands: 21% Hillslope Seep Wetlands: 7% Unchanneled Valley Bottom Wetlands: 3%
PES per HGM unit type	Channelled Valley Bottom Wetlands - A/B: 57%; C: 6%; D/E/F: 37%. Depression Wetlands - A/B: 94%; D/E/F: 6%. Hillslope Seep Wetlands - A/B: 43%; C: 14%; D/E/F: 43%. Unchanneled Valley Bottom Wetlands - A/B: 33% D/E/F: 67%.
FEPA Wetlands	Several FEPA wetlands exist in IUA_Q01, many of them being small, isolated depression wetlands. However, a number of channelled and unchanneled valley-bottom FEPA wetlands have been mapped in both the Klein-Fish and Groot-Fish River catchments.
WRU	WRU27

4.5.1 WRU 27 – Loodsberg

Table 4-46 Summary of WRU 27

Factor	Comment	
WRU Number (Quad Catchment)	WRU 27 (Q22A)	
Level of Assessment	Field-based	
Priority	02	
HGM Unit Type(s)	Valley-bottom and seepage wetlands	
Vegetation types	Upper Nama Karoo	
SWSA	N/A	
Threat Status	**VALLEY-BOTTOM**: ENDANGERED **SEEP**: CRITICALLY ENDANGERED	
PES	**SEEP:** B (Largely Natural)	**VALLEY-BOTTOM:** C (Moderate)
EIS	B (High)	
Contributors	Donovan Kotze	

4.5.1.1 Wetland Description

It is important to note that the wetlands included in the Loodsberg RU **(Figure 4-24)** are taken from a 1’500 ha sample area which represents a much greater area (>10’000 ha) of the Loodsberg mountains and its foot hills which support a relatively high extent of wetlands.

The Loodsberg RU comprises a cluster of seep wetlands in higher altitude south-facing mountain slope, and a valley bottom in the foothills. The seep wetlands are underlain predominantly with Karoo dolerite, and the valley bottom wetland by the Takastad and Balfour formations and Karoo dolerite, which, as in the Sneeuberg mountains, may have an important hydrogeomorphological control over the associated wetlands (Kotze et al. 2022).

The vegetation in the seeps is dominated by mixed tufted and creeping grasses, while in the valley bottoms are dominated by the sedge *Pseudoschoenus inanus* in association with mixed grasses and, in the wettest locations, by *Phragmites australis*.

The hydroperiod of the seep and valley bottom wetlands are predominantly temporarily to seasonally saturated, with permanent areas being very limited in extent.

Almost all of the seep wetland areas remain under natural vegetation, while in the valley bottom wetland areas 65% of the area remains under natural vegetation (although much of it moderately degraded) **(Figure 4-26)** and 18% is eroded/severely degraded **(Figure 4-25)**. **Table 4-47** provides a summary of the landcover for the two wetland types. For both the seeps and valley bottoms, the catchment remains predominantly natural vegetation, but with some degradation.

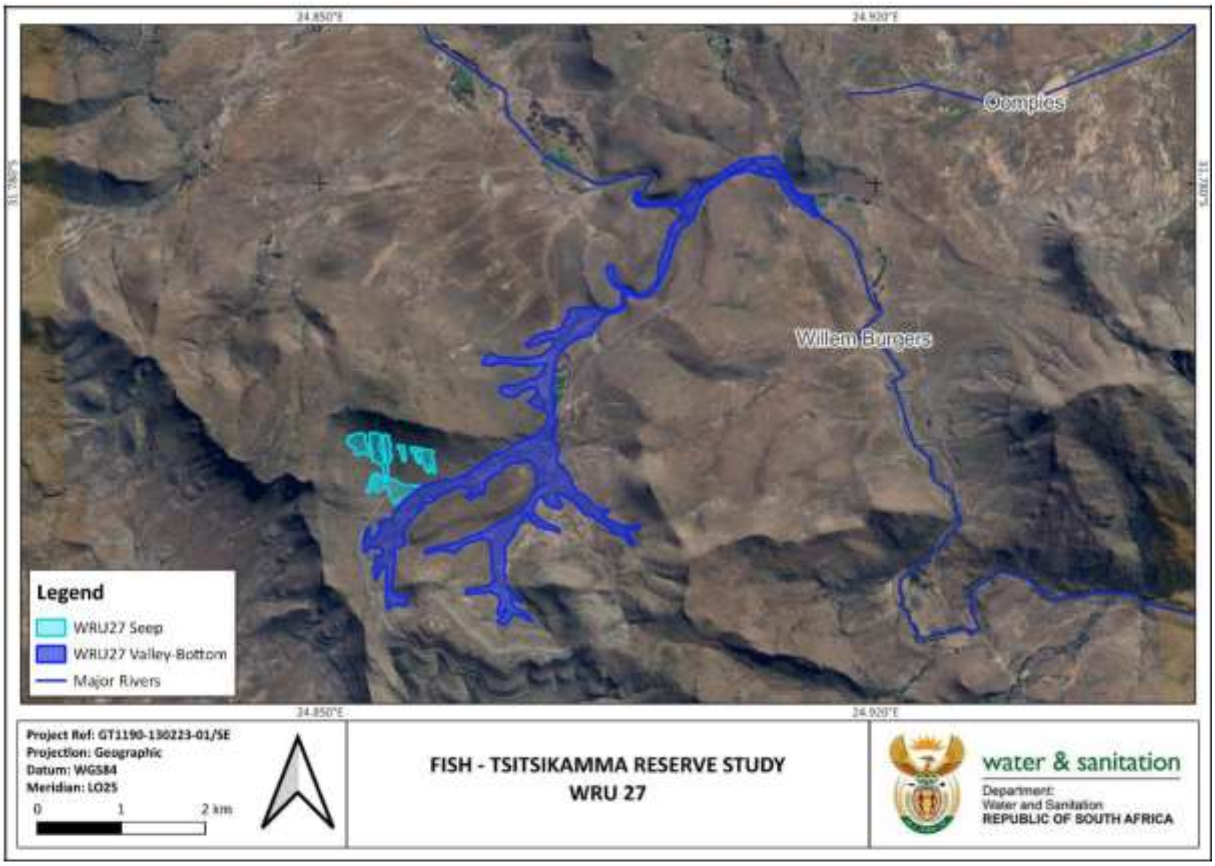

Figure 4-24 Overview of the Loodsberg wetland complexes

Table 4-47 Landcover percentage in the Loodsberg wetland complex wetland RU

Level 1B Landcover Categories	Percentage cover in the seep wetland	Percentage cover in the valley-bottom wetland
Deep flooding from impoundments		1%
Natural / Minimally impacted	79%	29%
Semi-natural (undrained)		9%
Semi-natural (drained)		2%
Moderately degraded natural	9%	36%
Eroded areas and heavily degraded lands	11%	18%
Commercial annual crops (irrigated)		4%
Roads	1%	1%
Total	**100%**	**100%**

Figure 4-25 The Loodsberg wetland RU, showing some of the eroded upper portions of the valley bottom area and cluster of seep wetlands on the lower south-facing slopes of the adjacent mountain, with one of the seep wetlands shown in the insert

Figure 4-26 The lower portions of the valley bottom wetland, still largely intact and dominated by the sedge *Pseudoschoenus inanus*, visible as the dark reed-like vegetation in the middle of the wetland.

4.5.1.2 Present Ecological State

The seep wetland area had lower impact scores than the valley bottom wetland **(Table 4-48),** owing primarily to the proportionally greater extent of natural areas in the seep wetland, as described in the previous section. For both the seep and valley bottom wetland areas, the vegetation component had the highest impact score and the water quality the lowest impact score.

The trajectory of change in ecological state over the next five years is projected to remain stable, but with a slight decline in the geomorphology component of the valley bottom wetland, primarily related to a projected extremely slight increase in gully erosion in the wetland.

Table 4-48 Present ecological state

Combined seep wetland area

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	1.5	1.9	0.8	2.3
PES Score (%)	85%	81%	92%	77%
Ecological Category	**B→**	**B→**	**A→**	**C→**
Combined Impact Score	1.6			
Combined PES Score (%)	84%			
Combined Present Ecological Category	**B→**			

Combined Valley-Bottom wetland area

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	3.8	3.9	1.5	5.0
PES Score (%)	62%	61%	85%	50%
Ecological Category	**C→**	**C↓**	**B→**	**D→**
Combined Impact Score	3.6			
Combined PES Score (%)	64%			
Combined Present Ecological Category	**C→**			

4.5.1.3 Ecological Importance and Sensitivity

The Loodsberg wetlands have a high ecological importance given the following key features:

- As for the Sneeuberg West wetlands, there is a relatively high abundance of intact wetlands in a surrounding area where wetlands are naturally scarce, thus providing potentially important ecological refuges, especially in dry periods and in the face of global climate change.
- The valley bottom wetlands in the area appear to be inherently very vulnerable to erosion, with many having eroded and some with major erosion-control works preventing further degradation. Although recent erosional advance is very slight, the threat remains of major erosion occurring as a result of a major future flood event.
- All of the wetlands fall within a Strategic Water Source Area.

In a rating of the wetland's EIS **(Table 4-49)** it can be seen that the biodiversity support factors make the greatest contribution to the overall score. While from Table 3.8 and 3.9 it can be seen that the wetland's functional/ecosystem services contribution is somewhat limited, in part owing to the largely natural catchment where the demand for these services is relatively low. In terms of provisioning services, it is primarily through its direct contribution to livestock grazing and water provision and, in the case of some of the valley bottom wetlands, also as areas for cultivation **(Table 4-51)**.

Table 4-49 Rating of the Loodsberg wetland complex Ecological Importance and Sensitivity according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Valley-bottom	Motivation
1. Biodiversity support	**2.8**	Score taken as the average of the three scores below
Presence of Red Data species	2.0	Very little information is available on the site
Populations of unique species	3.0	Given the relatively large extent of intact wetland at the site and the very low extent of wetlands in the broader Karoo landscape, the wetlands are likely to be at least moderately important for supporting populations of unique species.
Migration/breeding/feeding sites	3.5	As above, given the relatively large extent of intact wetland at the site and the very low extent of wetlands in the broader Karoo landscape, the wetlands are likely to be at least moderately important as a breeding and/or feeding site for wetland-dependent fauna, but specific information on this is lacking.
2. Landscape scale	**2.2**	Score is taken as the average of the five scores below
Protection status of the wetland	1.0	The wetland is not formally protected
Protection status of the vegetation type	1.0	The main vegetation type of the wetland is not protected
Regional context of the ecological integrity	3.0	A relatively high abundance of intact wetland areas, the importance of which is amplified by the fact that in much of the surrounding lower-lying landscape, which is predominantly arid, wetlands are naturally scarce.
Size and rarity of the wetland type/s present	3.5	As described above, the wetlands constitute a large wetland area in the overall Great Karoo, which generally has very limited wetland extent, and any natural large wetland area is therefore a rare occurrence.
Diversity of habitat types	2.5	Although not assessed, a moderately high diversity is assumed based on the hydrogeomorphic diversity of the wetland and climatic and geological diversity encompassed in the group of wetlands.
3. Sensitivity of the wetland	**2.3**	Score is taken as the average of the three scores below
Sensitivity to changes in floods	2.0	Based on the wetlands being mainly seep and valley bottom wetlands
Sensitivity to changes in low flows/dry season	2.5	As above

Ecological Importance	Valley-bottom	Motivation
Sensitivity to changes in water quality	2.5	This is assumed based on wetland not being supplied by naturally very low-nutrient waters, as would be the case if their catchments were dominated by Table Mountain Group Sandstone.
TOTAL OVERALL SCORE:	**2.8**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-50 Rating of the Loodsberg wetlands' hydrological/functional importance according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecosystem benefits	Valley-bottom	Motivation
Flood attenuation	3.0	Low to moderate longitudinal slope and moderate to high surface roughness, with some downstream floodable infrastructure
Streamflow regulation	2.0	The hydrogeological setting (see Section 3.2.1) may potentially be associated with groundwater discharge, at least in localized areas, but streamflow regulation is somewhat compromised by 5 ha of poplar trees in the wetland
Sediment trapping	2.5	See flood attenuation
Phosphate assimilation	2.5	See sediment trapping. Also, the somewhat limited extent of intensive land use in the wetlands' catchments is likely to result in the wetland receiving only slightly to moderately elevated phosphates and nitrates
Nitrate assimilation	2.0	See above. Also, the predominance of temporarily saturated areas in the wetlands over seasonally and permanently saturated areas somewhat limits the effectiveness of the wetland in assimilating nitrates.
Toxicant assimilation	2.5	See above two items
Erosion control	2.5	Much of the wetland is maintained under permanent vegetation cover, therefore promoting the control of erosion. However, human disturbance and concentration of water flows in some areas of the valley bottom wetland have somewhat diminished the supply of this service.
Carbon storage	2.0	The wetlands' relatively low level of wetness is assumed to somewhat limit the accumulation of soil organic matter.
TOTAL OVERALL SCORE:	**2.6**	Score taken as the average of the five highest scores above

Table 4-51 Rating of the Loodsberg wetland's importance for direct human benefits according to the criteria of Rountree and Kotze (2013) . Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		Valley-bottom	Motivation
Provisioningservices	Water for human use	2.5	The wetlands are important for livestock watering as well as some abstraction of water from dams within the valley bottom wetland occurs for irrigation purposes
	Harvestable resources	3.5	The vegetation of the wetlands is widely used for livestock grazing, and likely to provide a key grazing resource especially in dry periods
	Cultivated foods	2.5	Cultivation of the valley bottom wetlands, although somewhat limited in extent
Cultural services	Cultural heritage	1.0	No known cultural heritage features
	Tourism and recreation	1.5	Currently there appears to be limited contribution of the wetlands to tourism and recreation, although some of the wetland areas are well sighted from the main road running through the RU
	Education and research	1.0	Currently there appears to be limited contribution of the wetland to education and research
TOTAL OVERALL SCORE:		**2.0**	Score taken as the average of the five highest scores above

4.5.1.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) **(Table 4-52)** for the Loodsberg wetland complex, the following were noted: (1) the EIS of the wetlands; (2) the PES of the wetlands; and (3) the land use/landcover context of the wetlands (relatively unchanged catchment). Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for the wetland should be set at the current PES categories. Given item (3) above, the utilisation of the lands by livestock has to be managed, as it has the potential to do so in the future if not well managed, especially given that livestock grazing has been identified as an important contributor to historical degradation of the nearby Sneeuberg area more generally (Keay-Bright and Boardman 2007).

Table 4-52 Recommended Ecological Category (REC) for wetlands in the Loodsberg WRU

	Seep	**Valley-bottom**
REC	**B**	**C**

4.6 IUA_Q02: Great Fish

Table 4-53 Summary of wetland information for IUA_Q02

IUA Description	Great Fish
HGM unit type	Total of 262 wetlands mapped; Channelled Valley Bottom Wetlands: 36% Depression Wetlands: 45% Floodplain Wetlands: 0.5% Hillslope Seep Wetlands: 13% Unchannelled Valley Bottom Wetlands: 5.5%
PES per HGM unit type	Channelled Valley Bottom Wetlands - A/B: 61%; C: 18%; D/E/F: 21%. Depression Wetlands - A/B: 63%; C: 10%; D/E/F: 27%. Floodplain Wetlands - C: 100%. Hillslope Seep Wetlands - A/B: 54%; C: 33%; D/E/F: 23%. Unchannelled Valley Bottom Wetlands - A/B: 50%; C: 17%; D/E/F: 33%.
FEPA Wetlands	All of the FEPA wetlands that have been mapped in IUA_P01 are depression wetlands and have been mapped for their endangered threat status.
WRU	WRU10

4.6.1 WRU 10 – Dagbreek

Table 4-54 Summary of WRU 10

Factor	**Comment**
WRU Number (Quat Catchment)	WRU 10 (Q43A)
Level of Assessment	Field-based
Priority	02
HGM Unit Type(s)	Unchannelled valley-bottom wetlands (artificially created)
Vegetation types	Upper Nama Karoo
SWSA	N/A
Threat Status	**UNCHANNELLED VALLEY-BOTTOM**: VULNERABLE
PES	B (Largely natural)
EIS	A (Very High)
Contributors	Craig Cowden and Fiona Eggers

4.6.1.1 Wetland Description

The Dagbreek wetland complex **(Figure 4-27)** is a series of artificially created wetlands located along the Vlekpoort River and along the western edge of the Bamboesberg mountain range near the towns of Hofmeyr and Elandskop. The greater wetland complex is predominantly located within private farmlands, with the headwaters of the system being predominantly state-owned land and include the headwaters of the Vlekpoort River and upstream of the Kommandodrif dam. Generally, the wetland habitat associated with the Vlekpoort River have formed as a result of the suite of weirs/dams constructed along the length of the system. The interventions were implemented in the mid 1900's by the then Department of Agriculture as a component of a soil conservation programme. The objective of many of the interventions was to retain the soil within the landscape but also to initially provide a direct benefit to the landowners in terms of water for irrigation purposes. Although measures to retain the soil within the landscape were implemented, these did not necessarily focus on the adjacent management practices, and continuous overgrazing and the associated tree and alien invasive species encroachment continued due to the loss of the original system's biophysical drivers.

This complex of wetlands covers an area of approximately 616ha with additional areas of artificial wetland habitat within the catchment, however, these are mostly associated with the localised implementation of earthen structures versus those implemented by the Department of Agriculture. The wetlands fall within the Q43A quaternary catchment, characterised by an MAP of 391mm and a PET of 1750mm, which suggests that the wetlands would have a high sensitivity to hydrological impacts. The geology underlying the Dagbreek wetland complex is the Beaufort group which predominantly comprises of mudstone and arenite.

The general land use **(Table 4-55)** of the greater Dagbreek systems is livestock farming, with very few areas of cultivation. The cultivated areas are for the provision of fodder for the livestock during the dry winter months and are not linked to food production. The headwaters near Spitzkop, which is largely stated-owned land, is hugely degraded with large tracts of land being subjected to erosion – both gully and sheet erosion. Although the remaining catchment area is largely natural, historical and current land use practices[6], includes the continuous overgrazing by livestock and in some areas has led to bush encroachment[7]. The loss of sediment due to these land uses practices is evident upstream of the agricultural structures. With the continuous accumulation of sediment upstream of the interventions, many of the open water bodies are now either very shallow or have become extended grazing areas with the accumulation of water during the wetter months and/or years. These areas have become natural features within the landscape, especially since some of the interventions are in excess of 80-90 years old. These structures have allowed for the formation of wetland habitat in a landscape generally devoid of wetlands and is largely dominated by riparian habitat with some fringe wetlands. The wetland habitat upstream of some of the larger interventions extends for over 1.2km. In many instances, the upstream habitat is considered to be modified with

[6] Evidence within the landscape suggests that current land use practices also include overgrazing as recorded historically within the area.

[7] By the very nature of the Nama-Karoo, thorn trees generally only grow in water courses due to the availability of water within the landscape, while in this area trees are evident throughout the landscape in response to the overgrazing of the grassland areas.

secondary grassland however, for the purposes of this study was considered to be the natural state as the systems are artificial in nature and would have naturally established with disturbance tolerant and/or secondary vegetation dominating. Furthermore, these areas are subject to higher grazing pressures linked to the availability of water. In some areas of the wetlands, alien invasive species have been planted and/or have established e.g., *Populus* spp. Of the 87 systems assessed, approximately 10 interventions have failed and are no longer supporting wetland habitat, i.e., the structures have failed and are now characterised by a gully through the artificial wetland habitat.

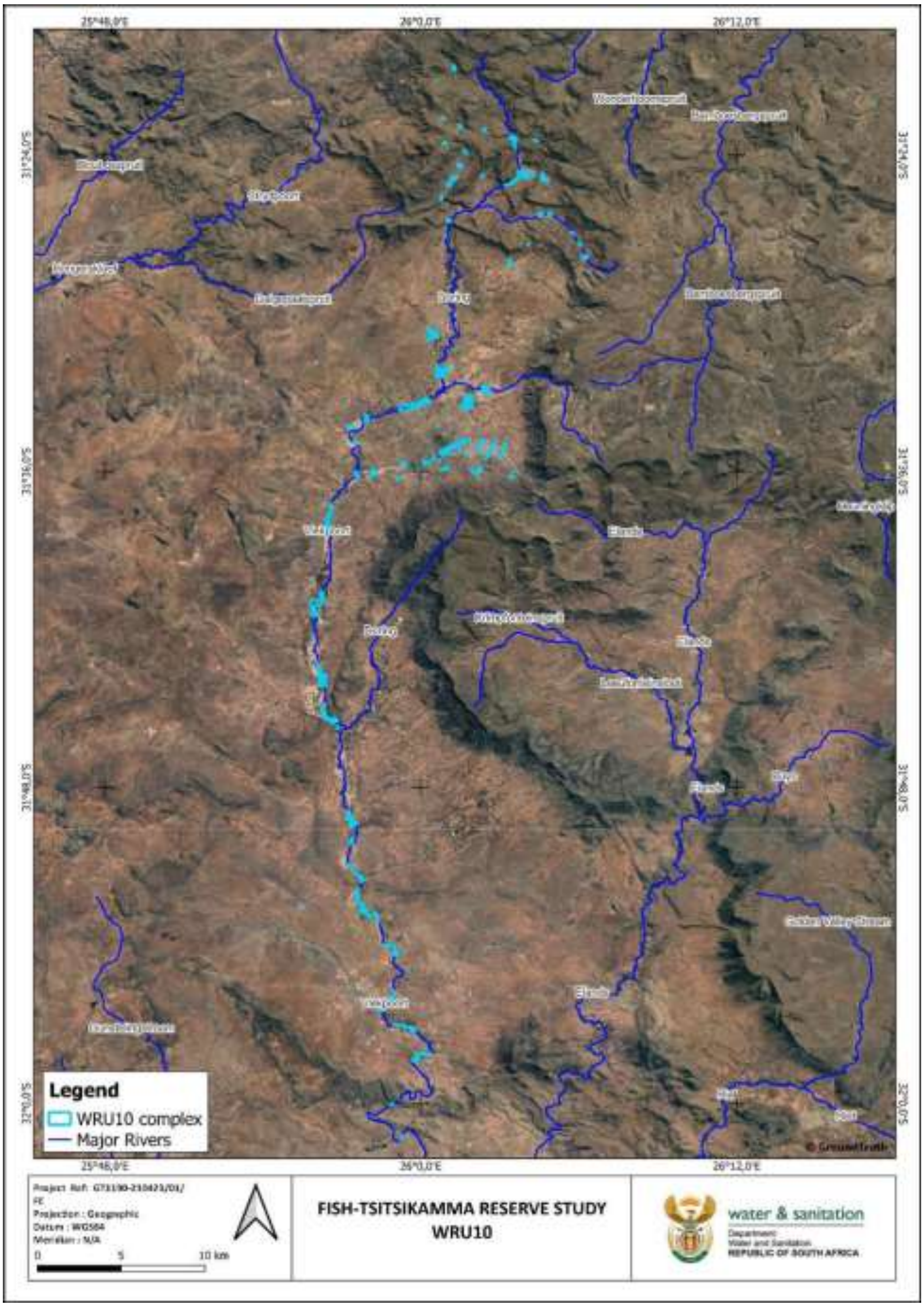

Figure 4-27 Overview of the Dagbreek wetland complexes along the Vlekpoort River

Although these systems are not considered to be true wetland habitat, they provide important ecosystem services within the landscape, including additional grazing lands and/or sources of water. **Figure 4-28** to **Figure 4-31** are photos of one of the artificial wetland systems that has formed as a result of an agricultural intervention. Additionally, the interventions have ensured that there has not been a mass export of sediment out of the greater catchment area, which would have otherwise been the case. Without intervention, the gully associated with the Vlekpoort River would have most likely been much larger in extent with further loss of the adjacent landscape to erosion. Overall, the greater river system has been classified as a D-category system (Nel *et al.* 2011) and is largely modified, which can be attributed to the interventions within the river and the degraded state of the system's catchment. However, the maintenance and management of these interventions and associated wetland systems are crucial in sustaining the habitat within the landscape and should one of the interventions fail, especially within the upper reaches, it can be assumed that the mass export of sediment may lead to the failure of the downstream interventions and as such loss of habitat within the landscape, and the formation of a large gully, similar to those present in the systems catchment. Additionally, all the mobilised sediment would accumulate in the Kommandodrif dam, which is utilised for irrigation purposes.

Table 4-55 Landcover percentage in the Dagbreek wetland complex wetland RU

Level 1B Landcover Categories	Percentage cover in the wetland complex
Open Water - Natural	7%
Natural / Minimally impacted	42%
Semi-natural (undrained)	31%
Semi-natural (drained)	5%
Moderately degraded land	12%
Dense infestation of invasive alien plants	1%
Eroded areas (& heavily degraded lands)	1%
Infilling (incl. infrastructure)	1%
Total	**100%**

Figure 4-28 Views of the sediment directly upstream of an intervention and the remaining open water

Figure 4-29 View of the accumulated sediment upstream of the weir and heavily grazed grassland

Figure 4-30 View of the erosion gully downstream of a weir

Figure 4-31 View of a buttress weir and the upstream wetland and grazing areas

4.6.1.2 Present Ecological State

Although the systems within the Dagbreek wetland complex are artificial in nature, they are important features within the landscape. The catchment related impacts are generally associated with the overutilisation of the lands resulting in the mobilisation of sediments into the freshwater ecosystems, resulting in the formation of the wetlands upstream of the interventions. Additional catchment related impacts include irrigated crops for livestock fodder, contributing to changes in the seasonality of flows. The in-system impacts include the small patch of alien invasive vegetation but are mostly linked with the portion of the system where the interventions have failed. These failed systems are dominated by gullies which are serving to desiccate the remaining wetland habitat adjacent to the channel. The geomorphology of the system has largely been influenced by the additional sediment inputs associated with some of the degraded catchment areas but also where some of the interventions have failed and are now no longer supporting wetland habitat but rather a large gully. Even though the vegetation is considered to be dominated by secondary vegetation, this was considered to be the benchmark status, as these systems are entirely artificial in nature. Nonetheless, impacts on the vegetative component are associated with overgrazing, alien invasive vegetation and portions of desiccated wetland linked to gully erosion. Due to the almost near-natural state of the catchment and very limited impacts, there a no real water quality related impacts excluding the mobilisation of sediments, that would detrimentally affect this component **(Table 4-56).**

Table 4-56 Present ecological state

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	1.6	1.3	0.6	2.9
PES Score (%)	84%	87%	94%	71%
Ecological Category	**B →**	**B →**	**A →**	**C →**
Combined Impact Score	1.6			
Combined PES Score (%)	84%			
Combined Present Ecological Category	**B →**			

4.6.1.3 Ecological Importance and Sensitivity

The Dagbreek Wetland Complex has a high ecological importance, and in a rating of the wetland's EIS **(Table 4-57)** it can be seen that the presence of cranes within some of the wetlands is contributing to the overall score. While from

Table 4-58 **it** can be seen that a key factor contributing to the wetlands functional/ecosystem services is the level of sediment trapping associated with these systems, whilst in **Table 4-59,** the provisioning services mainly contributing to the overall score are associated with the fact that these systems serve as a source of water within the dry landscape.

Table 4-57 Rating of the Dagbreek wetland complex Ecological Importance and Sensitivity according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Valley-bottom	Motivation
1. Biodiversity support	**3.5**	Score taken as the average of the three scores below
Presence of Red Data species	4.0	EWT have noted that some of the wetlands are utilised by cranes
Populations of unique species	4.0	As above
Migration/breeding/feeding sites	2.5	No breeding sites have been confirmed
2. Landscape scale	**1.7**	Score taken as the average of the five scores below
Protection status of the wetland	1.0	The wetlands are not formally protected
Protection status of the vegetation type	1.0	The Upper Nama Karoo vegetation type is classified as Least Threatened
Regional context of the ecological integrity	1.8	Wetlands are not uncommon in this landscape
Size and rarity of the wetland type/s present	3.0	Based on size
Diversity of habitat types	1.5	Habitat diversity is limited due to the artificial nature of the systems
3. Sensitivity of the wetland	**1.7**	Score taken as the average of the three scores below
Sensitivity to changes in floods	2.0	Based on the wetlands being valley-bottom wetlands
Sensitivity to changes in low flows/dry season	1.5	As above
Sensitivity to changes in water quality	1.5	Predominantly mudstone and arenite

Ecological Importance	Valley-bottom	Motivation
TOTAL OVERALL SCORE:	**3.5**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-58 Rating of the Dagbreek wetlands' hydrological/functional importance according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecosystem benefits	Valley-bottom	Motivation
Flood attenuation	2.5	The supply of this service is high based on the low longitudinal slops, and mostly being unchannelled systems
Streamflow regulation	0.8	The Nama Karoo is very dry with very limited natural wetland systems within the landscape. Thus, streamflow regulation in this landscape is very limited.
Sediment trapping	3.8	The original objective of the interventions was to assist in sediment trapping as part of the soil conservation initiative. These structures have been successful in accumulating sediments, which would have otherwise mobilised downstream leading to the formation of a large gully and further sedimentation of the Kommandodrif dam.
Phosphate assimilation	0.8	See sediment trapping above. However, typical sources of anthropogenically-derived phosphate such as cultivation in the wetland's catchment are limited
Nitrate assimilation	0.8	As above
Toxicant assimilation	0.8	As above
Erosion control	2.5	Refer to Sediment trapping
Carbon storage	0.5	The majority of the wetlands are characterised by a temporary level of wetness and therefore, the contribution to carbon storage is very limited.
TOTAL OVERALL SCORE:	**2.1**	Score taken as the average of the top five scores above

Table 4-59 Rating of the Dagbreek wetland's importance for direct human benefits according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		Valley-bottom	Motivation
Provisioningservices	Water for human use	2.2	The water from the wetlands in some instances is used for irrigation purposes but also as a source of water for livestock
	Harvestable resources	0.8	No known harvesting
	Cultivated foods	0.6	No cultivation within the wetland
Cultural services	Cultural heritage	0.6	No known cultural heritage features
	Tourism and recreation	0.3	There currently is a very limited contribution of the wetland to tourism and recreation
	Education and research	0.3	There appears to be a very limited contribution of the wetland to education and research
TOTAL OVERALL SCORE:		**0.9**	Score taken as the average of the top five scores above

4.6.1.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) **(Table 4-60)** for the Dagbreek wetland complex, the following were noted:

(1) the EIS of the wetlands;

(2) the PES of the wetlands; and

(3) the land use/landcover context of the wetlands (relatively unchanged catchment).

Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for the wetland should be set at an A/B category. Given item (3) above, the utilisation of the lands by livestock must be managed to ensure that further overgrazing does not continue. Furthermore, the old soil conservation structures should be monitored and maintained on a regular basis to ensure that these systems are not lost as result of intervention failure.

Table 4-60 Recommended Ecological Category (REC) for wetlands in the Dagbreek WRU

	Valley-bottom	
REC	**A /**	**B**

4.7 IUA_R02: Buffalo/ Nahoon

Table 4-61 Summary of wetland information for IUA_R02

IUA Description	Buffalo/ Nahoon
HGM unit type	Total of 200 wetlands mapped; Channelled Valley Bottom Wetlands: 18% Depression Wetlands: 50% Floodplain Wetlands: 0.5% Hillslope Seep Wetlands: 27.5% Unchannelled Valley Bottom Wetlands: 4%
PES per HGM unit type	Channelled Valley Bottom Wetlands - A/B: 50%; C: 8%; D/E/F: 42%. Depression Wetlands - A/B: 45%; C: 18%; D/E/F: 37%. Floodplain Wetlands - D/E/F: 100%. Hillslope Seep Wetlands - A/B: 25%; C: 26%; D/E/F: 49%. Unchannelled Valley Bottom Wetlands - A/B: 22%; C: 45%; D/E/F: 33%.
FEPA Wetlands	All of the FEPA wetlands that have been mapped in IUA_R02 are depression wetlands and have been mapped for their endangered threat status.
WRU	WRU 15 and WRU 26

4.7.1 WRU 15 – eDrayini Floodplain Wetland

Table 4-62 Summary of WRU 15

Factor	Comment
WRU Number (Quat Catchment)	WRU 15 (R20E)
Level of Assessment	Field-based
Priority	02
HGM Unit Type(s)	Floodplain
Vegetation types	Sub-Escarpment Savanna
SWSA	N/A
Threat Status	**FLOODPLAIN:** CRITICALLY ENDANGERED
PES	C (Moderate)
EIS	B (High)
Contributors	Steven Ellery and Donovan Kotze

4.7.1.1 Wetland Description

The eDrayini wetland, located north of Bisho in communal land, is a floodplain, with its upper portions comprising a western arm associated with the Kwagana River and an eastern arm associated the Incemerha River, and its lower portion continuing from the confluence of these two rivers and flowing in a southward direction towards Bisho **(Figure 4-32)**. The floodplain is predominantly temporarily saturated, but also includes localized seasonally saturated areas, particularly near the margins of the wetland, which appear to be either fed by lateral hillslope seepage and/or by small influent tributaries flooding out onto the floodplain. Non-wetland areas are also present within the floodplain, particularly associated with levees and other raised areas generally near the main river channel. Bank overspill from this channel occurs infrequently, and the main inflows maintaining the wetland appear to be predominantly from lateral sources. The wetland's vegetation has been relatively transformed and is largely dominated by grass species favoured by human disturbance, e.g., *Eragrostis plana,* together with disturbance-tolerant sedges, e.g., *Cyperus pulcher* **(Table 4-63)**.

Although historically about 60% of the floodplain was cultivated, in the last two decades this extent has been progressively declining to the current extent of <5% of the floodplain. The extent of *Vachellia karroo* and *Acacia mearnsii* trees have increased greatly along the stream channels, and *V. karroo* has also become well established on some of the abandoned cultivated lands, especially in the upper western arm of the floodplain. Currently, by far the greatest direct use made of the wetland is for livestock grazing. In terms of regulating services, flood attenuation is probably most important, given the floodplain's location upstream of Bisho and the extensive spatial extent within the wetland available for flood storage.

Table 4-63 Landcover percentage in the eDrayini wetland RU

Level 1B Landcover Categories	**Percentage cover in the wetland**
Semi-natural (undrained)	73%
Dense infestations of invasive alien plants	16%
Subsistence Crops	4%
Moderately/Heavily degraded areas	3%
Semi-natural (drained)	1%
Infilling	1%
Tree plantations	1%
Flooding from dams	1%
Total	**100%**

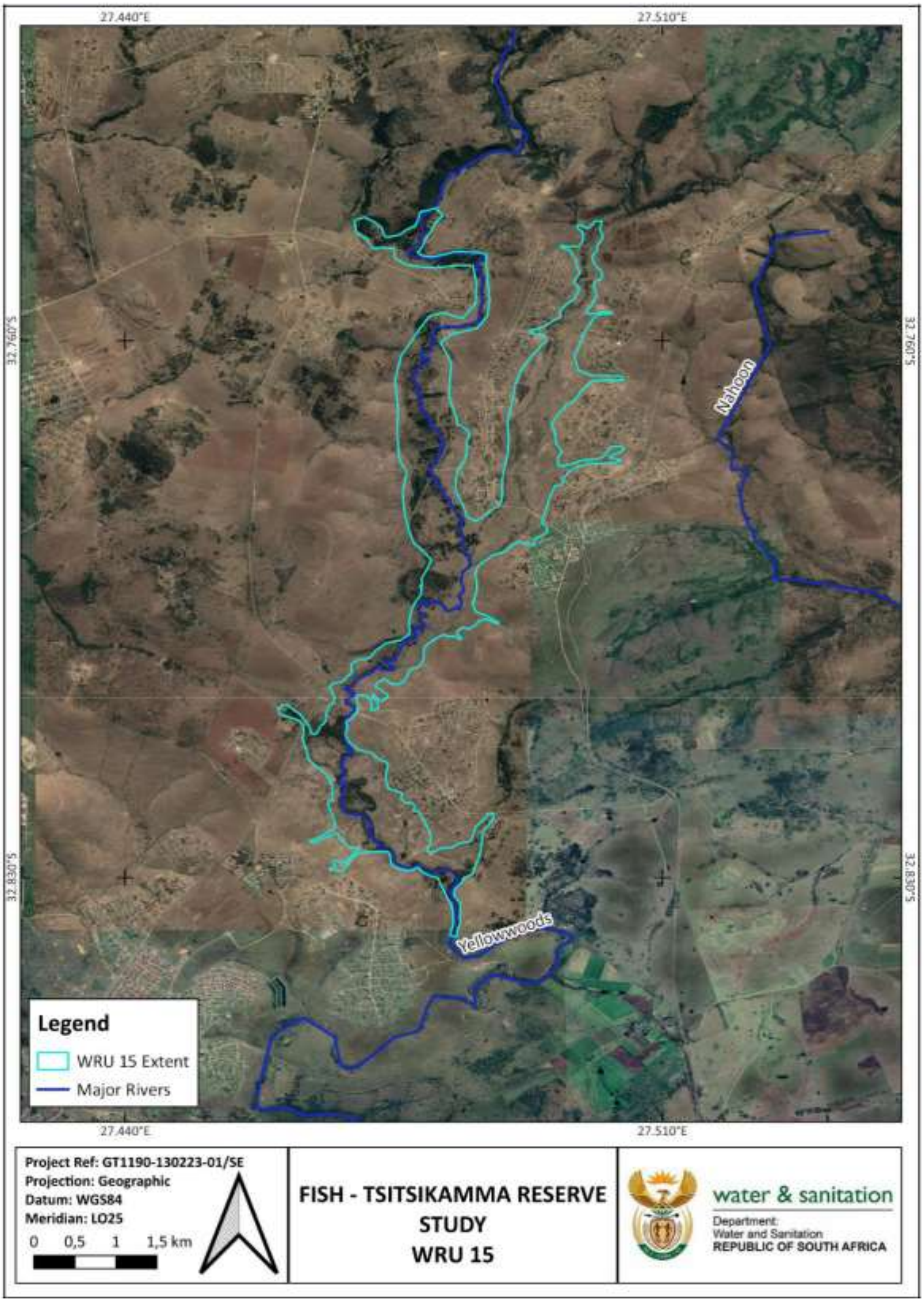

Figure 4-32 Overview of the eDrayini wetland resource unit

Figure 4-33 A historically-cultivated area in the eastern arm of the upper floodplain, with *Vachellia karroo* trees (visible in the background) dominating the stream channel.

Figure 4-34 One of the most extensive seasonally-saturated wetland areas in the floodplain, located in the eastern arm of the upper floodplain.

Figure 4-35 A minor headcut erosional feature currently subject to moderate levels of livestock trampling. Although currently the level of activity of the erosion is moderately low, it could potentially increase and threatens to advance into one of the naturally wettest portions of the wetland (shown in the previous photo) which, in turn, will likely have a significant draining effect on this area of the floodplain.

4.7.1.2 Present Ecological State

The vegetation PES is the most impacted component of the PES assessment for the eDrayini wetland which is a result of the historical cultivation within the floodplain wetland and the subsequent encroachment of *V karroo* and *A mearnsii* into the wetland. Additionally, current cultivation and currently eroding/eroded areas also contribute to the decline in the overall vegetation integrity of the wetland **(Table** 4-64 **4-64)**. Hydrology is the next most impacted component of wetland health which is predominantly a result of the alteration of water distribution and retention patterns within the wetland due to the presence of small drains and berms which remain in portions of the historically cultivated lands.

Table 4-64 Present ecological state

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	3.5	2.2	1.2	6.7
PES Score (%)	65%	78%	88%	33%
Ecological Category	**C →**	**C →**	**B →**	**E →**
Combined Impact Score	3.4			
Combined PES Score (%)	66%			
Combined Present Ecological Category	**C →**			

It is noted that the unadjusted WET-Health Hydrology PES score was 71%, with a hydrology impact score of 2.8 and a vegetation impact score of 5.3. These original scores were based on the fact that the majority of the wetland has been classified as the ‘Semi-Natural (undrained)’ land cover class, which has relatively low modelled impacts to hydrology and vegetation. While it is acknowledged that there are some areas within the old farmland where there are micro-drainage systems, classifying these areas as ‘Semi-Natural (drained)’ drastically increases the impact scores in both the hydrological and vegetation components of the PES. Based on professional opinion, the ‘Semi-Natural (drained)’ land cover class overestimates the impacts to hydrology and vegetation whereas the ‘Semi-Natural (undrained) underestimates these impacts. It is clear that these old agricultural areas have an impact on the hydrological and vegetative integrity of the wetland. As such, the modelled scores for both the impact to hydrology and vegetation have been modified such that the hydrology impact score is 3.5 and the vegetation impact score is 6.7.

The trajectory of change in ecological state over the next five years is projected to generally remain the same, but with a slight decline in the vegetation component related to primarily to the encroachment of IAPs and terrestrial species such as *V karroo.*

4.7.1.3 Ecological Importance and Sensitivity

The eDrayini wetland has a high ecological importance, and in a rating of the wetland’s EIS (**Table 4-55**) it can be seen that the biodiversity support factors make the greatest contribution to the overall score. While from **Table 4-56** and **Table 4-57** it can be seen that a key factor contributing to the wetland’s functional/ecosystem services is its location in rural communal lands where there is increased flood vulnerability of surrounding people and infrastructure as well as increased reliance on natural resources such as water and livestock grazing opportunities within the wetland.

Table 4-65 Rating of the eDrayini wetlands' Ecological Importance and Sensitivity according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Rating	Motivation
1. Biodiversity support	**3.2**	Score taken as the average of the three scores below
Presence of Red Data species	3.5	The main river flowing through the floodplain supports the threatened fish species *Sandillia bainsii*
Populations of unique species	3.0	Given that the wetland is a large reasonably intact area of wetland in a broader landscape where the cumulative impacts on wetlands are high, uncommonly large populations of wetland species are probable.
Migration/breeding/feeding sites	3.0	Given the large intact area of wetland in a broader landscape where the cumulative impacts on wetlands are high, the wetland is likely to be at least moderately important as a breeding and/or feeding site for wetland-dependent fauna, but specific information on this is lacking
2. Landscape scale	**2.9**	Score taken as the average of the five scores below
Protection status of the wetland	1.0	The wetland is not formally protected
Protection status of the vegetation type	4.0	The wetland's type, Sub-escarpment Savanna floodplain, has been subject to extremely high cumulative impacts and is recognized as a threatened type
Regional context of the ecological integrity	3.0	The site contains large fragments of remaining reasonably intact wetland in a broader landscape where the cumulative impact on wetlands is high
Size and rarity of the wetland type/s present	3.5	See above
Diversity of habitat types	3.5	A moderate diversity is assumed based on the hydrogeomorphic and hydrological diversity of the wetlands, together with the diversity of vegetation including disturbance tolerant grasses such as *Eragrostis plana*, together with sedges, e.g., Cyperus pulcher.
3. Sensitivity of the wetland	**2.8**	Score taken as the average of the three scores below
Sensitivity to changes in floods	3.0	Based on the wetland being mainly a floodplain with a relatively high level of lateral inputs from adjacent slopes and minor tributaries.
Sensitivity to changes in low flows/dry season	2.5	As above

Sensitivity to changes in water quality	3.0	The moderate sensitivity of the floodplain is assumed based on the existing moderately disturbed vegetation. A higher sensitivity in the channel is assumed especially given the presence of a threatened fish species.
TOTAL OVERALL SCORE:	**3.2**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-66 Rating of the eDrayini wetland's importance for direct human benefits according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecosystem benefits	Rating	Motivation
Flood attenuation	3.5	Low longitudinal slope and moderately high surface roughness of the wetland; floodable property (comprising extensive cultivated lands and some urban infrastructure) downstream of the wetland
Streamflow regulation	2.5	The hydrogeological setting (Balfour formation comprising predominantly mudstone with some subordinate sandstone, as well as Karoo dolerite in the upper reaches) is likely to be associated with possible groundwater discharge in the wetland; limited extent in the wetland of invasive trees potentially increasing atmospheric loss of water from the wetland
Sediment trapping	3.0	See flood attenuation.
Phosphate assimilation	3.0	See sediment trapping above. Also, to note that the effectiveness of the wetland is likely to be moderate for the assimilation of phosphates, nitrates, and toxicants, given the moderately diffuse flows in much of the wetland and the moderate level of wetness and high vegetation cover across much of the wetland. Anthropogenically-derived phosphate is likely from the relatively extensive human settlement in the wetland's catchment. Overspilling from the main channel through the floodplain is very infrequent and the primary contribution of the floodplain to assimilating P, N and toxicants appears likely to be those from lateral tributaries and runoff entering the floodplain.
Nitrate assimilation	2.5	See above.
Toxicant assimilation	3.0	See above two items
Erosion control	3.0	Much of the wetland is maintained under permanent vegetation cover, therefore promoting the control of erosion. However, a few areas of localized erosion are slightly diminishing the supply of this service.
Carbon storage	1.5	The wetland's hydrogeological setting and the generally low level of wetness are assumed to support a moderately low accumulation of soil organic matter.
TOTAL OVERALL SCORE:	**3.1**	Score taken as the average of the five highest scores above

Table 4-67 Rating of the eDrayini wetland's importance for direct human benefits according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		Rating	Motivation
ovisioning services	Water for human use	2.5	Water use occurs, particularly for livestock watering
	Harvestable resources	4.0	Mainly livestock grazing of much of the extensive wetland including the natural vegetation as well as the semi-natural secondary grasslands which have established on the old lands; also, some wood collection and limited fishing
	Cultivated foods	1.5	Although extensively cultivated up until about 15 years ago, cultivation of the floodplain is now very limited.
Cultural services	Cultural heritage	3.0	The river flowing through the wetland is used for traditional cultural practices
	Tourism and recreation	1.5	Currently there appears to be limited contribution of the wetland to tourism and recreation
	Education and research	1.5	Although the wetland was used in the past for a World Wetlands Day event, there currently appears to be a limited contribution of the wetland to education and research.
TOTAL OVERALL SCORE:		**2.3**	Score taken as the average of the five highest scores above

4.7.1.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) **Table 4-68**) for the eDrayini wetland, the following were noted: (1) the wetland's EIS is high; (2) the PES is in a C category (3) the wetland has a history of agricultural use catchment; and (4) it is located on rural communal land and receives no formal protection. Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for the wetland should be set at the current PES categories, or if practical, improved by a category. Given items (3) and (4) above, it is likely to be impractical to improve the PES of the wetland, and therefore the REC is set at a C. The projected increasing urban/residential growth around the eDrayini wetland may constrain efforts to sustain PES but this is anticipated to be balanced somewhat by the projected continuing declining intensity of agricultural use in the eDrayini wetland.

Table 4-68 Recommended Ecological Category (REC) for wetlands in the eDrayini WRU

	eDrayini Floodplain
REC	**C**

4.7.2 WRU 26 – KwaMasele Wetland Complex

Table 4-69 Summary of WRU 26

Factor	**Comment**
WRU Number (Quat Catchment)	WRU 26 (R20D)
Level of Assessment	Field-based
Priority	01
HGM Unit Type(s)	Hillslope seep, unchannelled and channelled valley-bottom wetlands
Vegetation types	Sub-Escarpment Savanna
SWSA	N/A
Threat Status	**SEEP**: ENDANGERED, **UNCHANNELLED VALLEY-BOTTOM**: CRITICALLY ENDANGERED, **CHANNELLED VALLEY-BOTTOM**: ENDANGERED
PES	C (Moderate)
EIS	B (High)
Contributors	Steven Ellery and Donovan Kotze

4.7.2.1 Wetland Description

The KwaMasele wetland, located in a headwaters position south-west of Qonce town on communal land, comprises extensive hillslope seeps feeding valley bottom wetland areas **(Figure 4-36**). Much of the hillslope portions of the wetland occur within the hollows of Kommetjievlakte terrain, which is a unique landscape feature marked by repeated small ridges/mounds and depressions that give the landscape a rippled appearance and which are largely confined to an area between Qonce and Pirie Forest. In the KwaMasele wetland, this adds to the hydrological and habitat diversity of the overall wetland, which is predominantly temporarily saturated. It appears that the valley-bottom areas were historically mainly unchannelled but advancing gully erosion has resulted in >50% of it now being channelled. Active erosion is continuing (exacerbated by heavy livestock trampling pressure) and threatens to erode through much of the remaining unchannelled area. Further adding to the risks of major erosion (and associated sediment release) is that the earthen dam wall in the wetland is in danger of overtopping, and ultimately breaching, where localized cattle trampling, etc. have reduced its height close to the dam's full supply level.

While some of the original vegetation has been lost to cultivation and the dam in the wetland, most of the wetland remains as natural/semi-natural used for livestock grazing. The wetland has been subject to sustained high grazing pressure (although currently the upper portion of the wetland, which is fenced off, appears to be grazed more leniently). The wetland is now dominated by grass species favoured by high grazing pressure, notably *Eragrostis plana,* but the wetter areas (some of which are contained in the kommetjies) support predominantly short-growing sedges such as *Fuirena pubescens* and *Eleocharis dregeana*, together with hydric grass species such as *Eragrostis planiculmis*. The vulnerable species *Arctotis debensis* occurs on some of the Kommetjie ridges in and adjacent to the wetland. The high biodiversity value of the KwaMasele wetland derives especially from the wetland representing a significant area of Kommetjievlakte terrain, which, despite its uniqueness, is not formally conserved anywhere within its range (**Table 4-70**).

Table 4-70 Landcover percentage in the KwaMasele WRU

Level 1B Landcover Categories	**Percentage cover in the wetland**
Semi-natural (undrained)	78%
Subsistence Crops	6%
Moderately/Heavily degraded areas	6%
Semi-natural (drained)	5%
Urban areas	2%
Flooding from dams	2%
Infilling & Sediment Deposits	1%
Total	**100%**

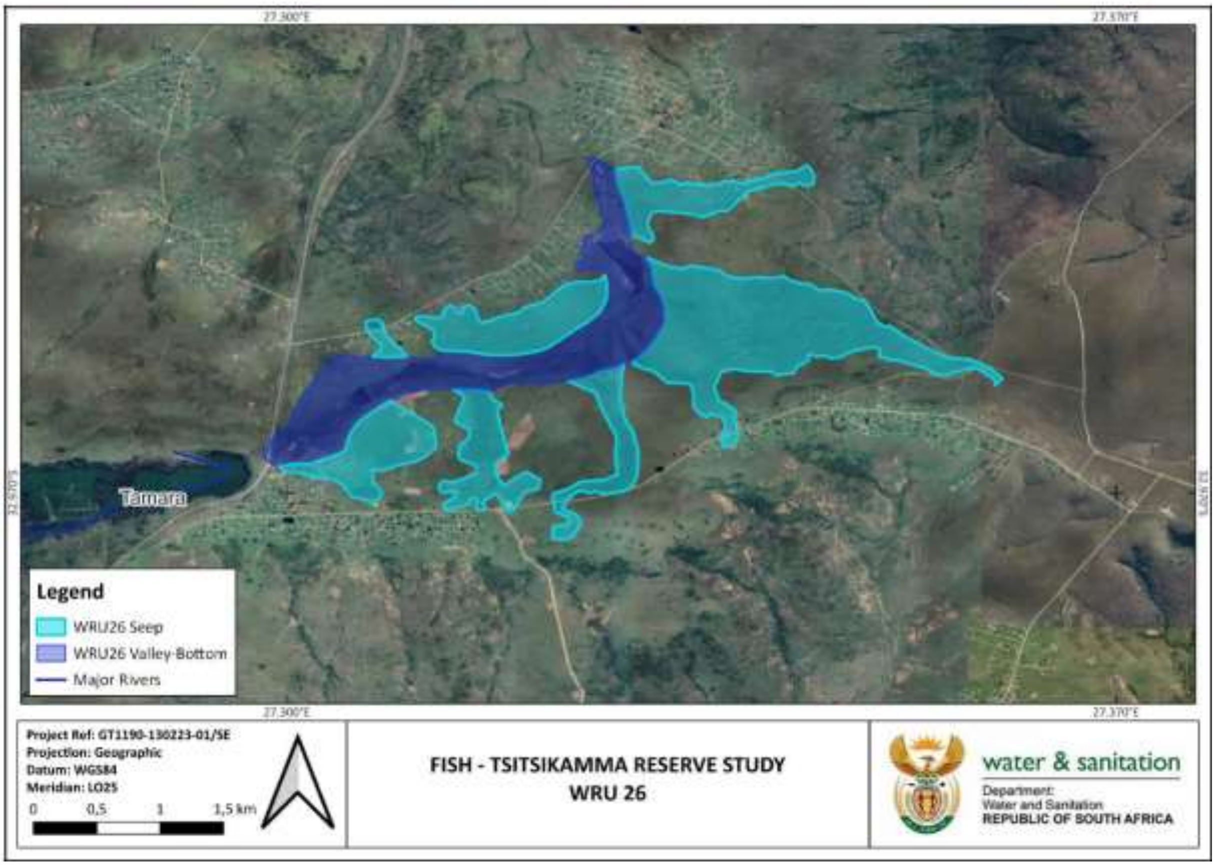

Figure 4-36 Overview of the KwaMasele wetland resource unit

Figure 4-37 A hillslope seep dominated by the sedge *Fuirena pubescence* near the western inflow to the wetland, located in an area which is fenced off and, recently at least, appears to have been more leniently grazed than the central and eastern portions of the wetland.

Figure 4-38 ***Arctotis debensis*** **growing in a kommetjievlakte area of the wetland amongst abundant earthworm casts. This is a vulnerable species known from only eight locations in a limited geographical area between Qonce and Perie Forest, and which appears well adapted to the extensive earthworm-mediated soil turnover characteristic of Kommetjievlakte (Dold *et al.* 2021).**

Figure 4-39 **The primary headcut at the head of the main gully (see the following four photos) which has advanced through an extensive area of unchannelled valley bottom and threatens a further large area of unchannelled valley bottom upstream. An active cattle path immediately upstream of the headcut can be seen, which is likely weakening the area under immediate threat of erosion.**

Figure 4-40 The primary livestock crossing point through the main erosion gully in the wetland, subject to intense localized trampling.

Figure 4-41 The main erosion gully in the wetland (downstream of the headcut shown in the previous photo) with (a.) located shortly downstream with incomplete vegetation cover and (b.) somewhat further downstream where vegetation cover is generally higher and more sediment has accumulated than above

but a cattle path has provided a focal point for localized incision and remobilization of some of the deposited sediment.

Figure 4-42 Three different locations where the hillslope component of KwaMasele wetland extends into adjacent Kommetjievlakte terrain, with (a.) on a midslope and the wetland areas confined to only a few of the deepest hollows such as that shown in the foreground; (b.) also on a footslope and

wetland areas present in most of the hollows; and (c.) located at the transition between the hillslope and valley bottom.

4.7.2.2 Present Ecological State

The vegetation PES is the most impacted component of the PES assessment for the KwaMasele wetland which is a result of the current grazing pressure within the wetland as well as the current cultivation within the seepage portions of the wetland **(Table 4-71)**. Grazing pressure within the wetland has resulted in a shift in species composition towards more disturbance tolerant species that respond well to grazing pressure such as *Eragrostis plana*. Hydrology is the next most impacted component of wetland health which is predominantly a result of the alteration of water distribution and retention patterns within the wetland due to the presence of a series of erosion gullies within the valley bottom portions of the wetlands. Additionally, the presence of multiple dams within the HGM units similarly impact the natural patterns of water retention and distribution.

The trajectory of change in ecological state over the next five years is projected to generally remain the same, given that all of the headcuts within the HGM unit appear to be relatively stable and have not advanced substantially in the last decade. It should be noted that should the grazing pressure on the wetland increase in the coming years, it is likely to cross a grazing threshold that would result in a decline in the present vegetation and hydrological health, which could potentially have knock on effects on the geomorphology and water quality components of the WRU.

Table 4-71 Present ecological state

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	3.1	1.9	1.1	5.2
PES Score (%)	69%	81%	89%	48%
Ecological Category	**C →**	**B →**	**B →**	**D →**
Combined Impact Score	2.9			
Combined PES Score (%)	71%			
Combined Present Ecological Category	**C →**			

4.7.2.3 Ecological Importance and Sensitivity

The KwaMasele wetland has a high ecological importance, and in a rating of the wetland's EIS **(Table 4-72)** it can be seen that the biodiversity support factors make the greatest contribution to the overall score. This contribution can, to a large degree, be attributed to the presence of the rare kommetjievlakte features that are extensively present within the HGM unit and the presence of the vulnerable *Arctotis debensis*. While from **Table 7-73** and **Table 4-74** it can be seen that a key factor contributing to the wetland's functional/ecosystem services is its location in rural communal lands where there is increased flood vulnerability of surrounding people and infrastructure as well as increased reliance on natural resources such as water and livestock grazing opportunities within the wetland.

Table 4-72 Rating of the KwaMasele wetlands' Ecological Importance and Sensitivity according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Rating	Motivation
1. Biodiversity support	**3.3**	Score taken as the average of the three scores below
Presence of Red Data species	3.5	The newly discovered and vulnerable species *Arctotis debensis* occurs on some of the Kommetjie ridges in and adjacent to the wetland (von Staden, 2008).
Populations of unique species	3.5	The KwaMasele wetland, which still comprises largely natural vegetation, provides a good representative example of wetland within Kommetjievlakte terrain, which, despite its uniqueness (see regional context), is not formally conserved anywhere within its range. Given this, and that the wetland is large and reasonably intact, uncommonly large populations of unique species in addition to *A. debensis* are probable but have not been confirmed.
Migration/breeding/feeding sites	3.0	Given the large intact area of wetland in a broader landscape where the cumulative impacts on wetlands are high, the wetland is likely to be at least moderately important as a breeding and/or feeding site for wetland-dependent fauna, but specific information on this is lacking.
2. Landscape scale	**3.0**	Score taken as the average of the five scores below
Protection status of the wetland	1.0	The wetland is not formally protected and does not fall in a SWSA
Protection status of the vegetation type	4.0	Sub-escarpment Savanna valley bottom wetlands have been subject to high cumulative impacts and are correspondingly threatened. Although not currently afforded specific protection, a strong case can be made for the protection of the kommetjievlaktes and their wetlands
Regional context of the ecological integrity	3.5	The wetland represents a large relatively intact area of wetland in kommetjie terrain, which is a unique landscape feature marked by repeated small ridges/mounds and depressions that give the landscape a rippled appearance and which are largely confined to an area between Qonce and Pirie Forest
Size and rarity of the wetland type/s present	3.5	See above two items
Diversity of habitat types	3.0	A moderate diversity is assumed based on the hydrogeomorphic diversity of the wetland together with the diversity of vegetation, including disturbance tolerant grasses such as Eragrostis plana on the drier areas, together with the wetter areas (much of which are contained in the kommetjies) supporting predominantly short-growing sedges such as *Fuirena pubescens* and *Eleocharis dregeana* and the hydric grass species such as *Eragrostis planiculmis*.
3. Sensitivity of the wetland	**2.7**	Score taken as the average of the three scores below

Sensitivity to changes in floods	2.5	Based on the wetland being mainly seep and valley bottom
Sensitivity to changes in low flows/dry season	3.0	As above
Sensitivity to changes in water quality	2.5	The moderate sensitivity is assumed for the wetter areas given that they are moderately diverse and short growing
TOTAL OVERALL SCORE:	**3.3**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-73 Rating of the KwaMasele wetland's importance for direct human benefits according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Regulating and supporting benefits		**Score (0-4)**	**Motivation**
Flood attenuation		3.0	Low longitudinal slope and moderately high surface roughness of the wetland resulting from the Kommetjievlakte terrain; limited floodable property downstream of the wetland.
Streamflow regulation		2.5	The hydrogeological setting (Middelton formation comprising predominantly mudstone with interspaced sandstone, as well as Karoo dolerite in the central portion) is likely to be associated with possible groundwater discharge in the wetland; very limited extent in the wetland of invasive trees which would otherwise increase atmospheric loss of water from the wetland
Water Quality Enhancement	Sediment trapping	2.5	See flood attenuation. Extensive erosion in the central portions of the wetland is detracting from its effectiveness in trapping sediment.
	Phosphate assimilation	2.5	See sediment trapping above. Also, to note that the effectiveness of the wetland is likely to be moderately low to moderate for the assimilation of phosphates, nitrates, and toxicants, given the moderately diffuse flows in much of the wetland (but much more concentrated where severely eroded) and the moderate level of wetness and high vegetation cover across much of the wetland. Anthropogenically-derived phosphate is likely from the very extensive human settlement and some cultivation in the wetland's catchment.
	Nitrate assimilation	2.5	See above.
	Toxicant assimilation	2.5	See above two items

Regulating and supporting benefits		Score (0-4)	Motivation
	Erosion control	2.5	Much of the wetland is maintained under permanent vegetation cover, therefore promoting the control of erosion. However, the effectiveness of the wetland in controlling erosion is compromised in that most of the wetland is subject to prolonged heavy grazing pressure and there is also extensive headcut and gully erosion active in the central portions of the wetland.
Carbon storage		1.5	The wetland's hydrogeological setting and the generally low level of wetness are assumed to support a moderately low accumulation of soil organic matter.
TOTAL OVERALL SCORE:		**2.6**	The score is taken as the average of the five highest scores above

Table 4-74 Rating of the KwaMasele wetland's importance for direct human benefits according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		Rating	Motivation
Provisioningservices	Water for human use	2.5	Water use particularly for livestock watering
	Harvestable resources	3.0	Mainly livestock grazing, but some fishing in the dam within the wetland
	Cultivated foods	1.5	Cultivation in a small portion of the wetland
Cultural services	Cultural heritage	3.0	Traditional beliefs and practices (associated mainly with open water areas in the wetland) persist
	Tourism and recreation	1.5	Currently there appears to be limited contribution of the wetland to tourism and recreation
	Education and research	1.0	Currently there appears to be limited contribution of the wetland to education and research.
TOTAL OVERALL SCORE:		**2.1**	Score taken as the average of the five highest scores above

4.7.2.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) for the KwaMasele wetland, the following were noted: (1) the wetland's EIS is high; (2) the PES is in a C category (3) the wetland is currently used extensively for grazing; and (4) it is located on rural communal land and receives no formal protection. Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for the wetland should be set at the current PES categories, or if practical, improved by a category. Given items (3) and (4) above, it is likely to be impractical to improve the PES of the wetland, and therefore the REC is set at a C. Given the importance of the vegetation integrity of the KwaMasele wetland to the high EIS of wetland and specifically to its value as a representative example of a kommetjievlakte terrain wetland, the REC for the vegetation component should be set above the vegetation PES of a D, currently the lowest scoring of the PES components in the wetland **(Table 4-75)**. Thus, a REC of a C/D for the vegetation component and a C for the overall wetland are set. However, given that the land tenure context of much of the wetland is communal and there are limited means of controlling the currently very heavy grazing pressure on extensive areas of the wetland, attaining the C/D set for the vegetation component will most likely not be practical, and therefore a slightly more attainable Likely Best Attainable State (LBAS) of a D category for the vegetation component and a C for the overall wetland are set.

Table 4-75 Recommended Ecological Category (REC) for wetlands in the KwaMasele WRU

	KwaMasele Wetlands
REC	**C**

4.8 IUA_S01: Upper Great Kei

Table 4-76 Summary of wetland information for IUA_S01

IUA Description	Upper Great Kei
HGM unit type	Total of 372 wetlands mapped; Channelled Valley Bottom Wetlands: 29% Depression Wetlands: 36% Floodplain Wetlands: 2% Hillslope Seep Wetlands: 28% Unchannelled Valley Bottom Wetlands: 5%
PES per HGM unit type	Channelled Valley Bottom Wetlands - A/B: 44%; C: 28%; D/E/F: 28%. Depression Wetlands - A/B: 67%; C: 11%; D/E/F: 22%. Floodplain Wetlands - A/B: 14%; C: 43%; D/E/F: 43%. Hillslope Seep Wetlands - A/B: 39%; C: 39%; D/E/F: 22%. Unchannelled Valley Bottom Wetlands - A/B: 30%; C: 45%; D/E/F: 25%.
FEPA Wetlands	A number of FEPA wetlands exist in IUA_KL01, many of them being small, isolated depression wetlands. However, several channelled and unchannelled valley bottom FEPA wetlands have been mapped in the Groot-Kei River catchment.
WRU	WRU 18 and WRU 21

4.8.1 WRU 18 – Cala wetland complex

Table 4-77 Summary of WRU 18

Factor	Comment	
WRU Number (Quat Catchment)	WRU 18 (S50E)	
Level of Assessment	Field-based	
Priority	02	
HGM Unit Type(s)	Hillslope seepage wetland and discontinuously channelled valley-bottom	
Vegetation types	Sub-Escarpment Grassland Group 5	
SWSA	Eastern Cape Drakensberg	
Threat Status	**VALLEY-BOTTOM**: Endangered, **SEEP**: Least Threatened	
PES	**VALLEY-BOTTOM**: C (Moderate)	**SEEP**: C (Moderate)
EIS	B (High)	B (High)
Contributors	Craig Cowden and Fiona Eggers	

4.8.1.1 Wetland Description

The Cala wetland complex **(Figure 4-43)** comprises of a number of hillslope seepage wetlands (+-109.7ha) which feed into a discontinuously channelled valley-bottom wetland (+-44.1ha). The wetlands are located in communal land upstream of the Lanqanci village and adjacent to the abandoned Cala state forests. The wetland complex feeds into the Tsomo River, which eventually drains into the Ncora dam. As the wetland complex forms part of the headwaters of the small stream, the system is an important feature within the landscape and supplier of ecosystem goods and services. The overall wetlands drain in an easterly direction and are defined by a geological control at the base of the system, from which point a small area of wetland habitat is associated with the stream before the descending into a steep riverine valley. These wetlands fall within the S50E quaternary catchment, characterised by a MAP of 783mm and a PET of 1500mm, which suggests that the wetlands would have a moderately low sensitivity to hydrological impacts. The geology underlying the Cala wetland complex is the Karoo Supergroup which predominantly comprises of arenite, mudstone, and shale.

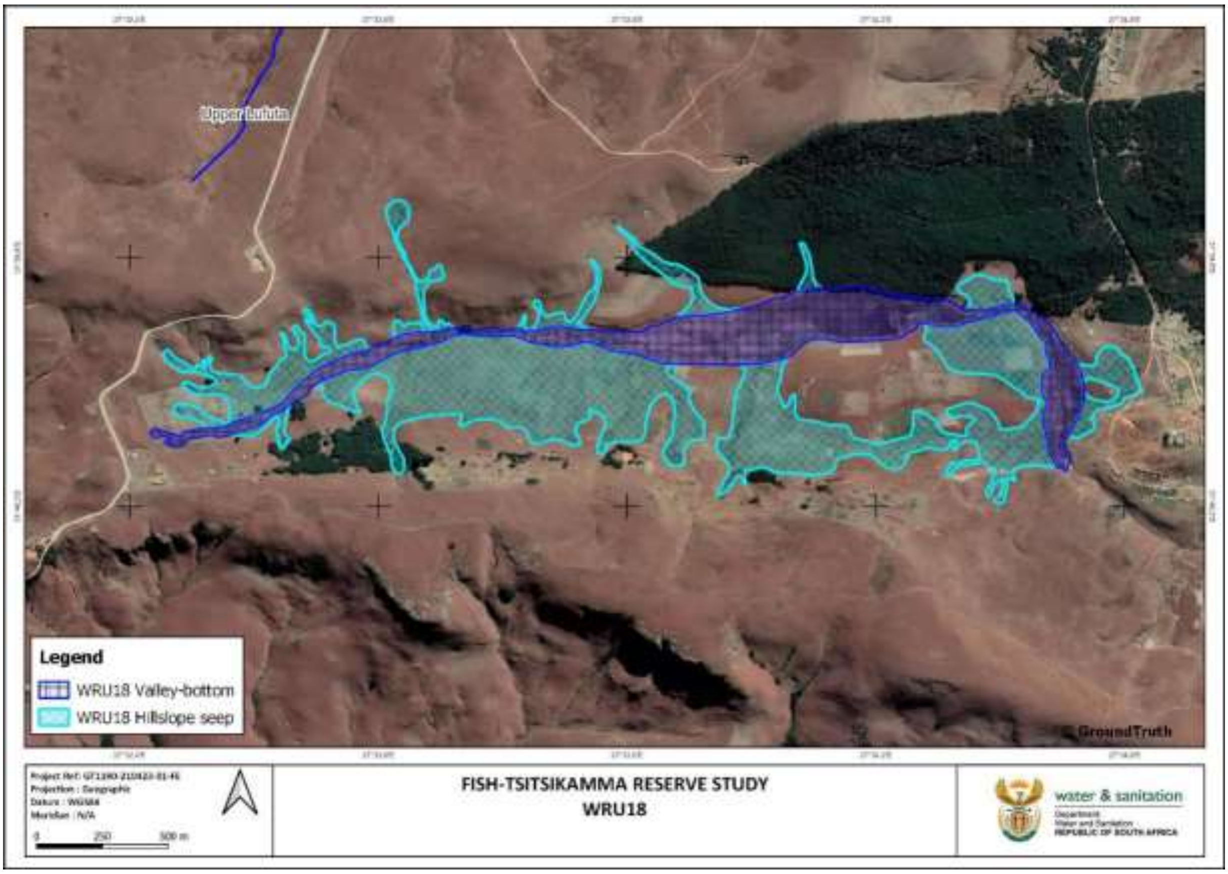

Figure 4-43 Overview of the Cala wetland complexes

The Cala wetland complex is located on communal lands, and the catchment of the wetland complex has not been extensively modified, unlike similar systems in the neighbouring catchments. The predominant catchment impacts include rotational cultivation, old-abandoned state plantations, clumps of black wattle, grazing and some houses.

Generally, the seepage wetlands along the northern boundary of the valley- bottom wetland are stepper in nature, with two of the systems having been substantially modified through the establishment of eucalyptus trees linked to the historic state forest areas, which are apparently no longer operational. Furthermore, a depression wetland was identified within this northern catchment area. The depression is perched quite high above the valley bottom wetland and decants via a small drainage feature into the downstream wetland. The depression is serving as a source of water for livestock and as such careful management of the system is essential. Additionally, the access road which bisects the drainage line should be reconsidered, to ensure that it does not alter the hydrology of the system or introduce erosion.

The seepage wetlands along the southern boundary of the valley-bottom wetland are generally more heavily impacted than the valley-bottom, as these areas have allowed for the establishment of some fields for cultivation, as the wetness regime of these systems varies between temporarily and seasonally saturated conditions. The valley-bottom system's wetness regime tends towards seasonally to permanently saturated conditions, which has excluded the system from the direct impacts of cultivation. In addition, within the flatter portions of the seepage systems, evidence of historical plough lines and/or ridge and furrow agricultural practices are still visible however, the vegetative cover within these areas has suitably recovered and is representative in terms of surface roughness but contains some disturbance tolerant wetland species, such as *Arundinella nepalensis*.

In-system modifications to the valley-bottom wetland are considered to be limited (Table 4-78). However, two drains were identified within the system, aimed at improving the hydraulic efficiency of the system from an anthropogenic perspective. However, based on the vegetative cover alongside and within the drains and the level of wetness in the adjacent habitat, the drains are relatively ineffective.

The fringe wetland habitat adjacent to the plantation forestry, has adapted to the increased shade within this area, with the vegetation comprising mostly of *Juncus effusus*, versus the *Carex* spp, *Pycreus* spp, *Eleocharis dregeana* etc., which dominates the valley-bottom system. *J. effusus* is a disturbance tolerant species and has thus encroached along the wetland/plantation interface.

A small cluster of *Pinus* spp. have established along the fringe of the valley-bottom wetland – about midway along the length of the system. Similarly, the wetland habitat in this small area has also adapted to the increased shade, with more disturbance tolerant species e.g., *J. effusus*, characterising the vegetation composition.

The lower portion of the valley-bottom wetland is the most impacted portion of the system, mainly as this portion is closest to the Lanqanci village located to the east of the system. A large portion of the catchment impacts associated with this portion is linked to livestock access paths which criss-cross the adjacent hillside, and the associated grazing pressure linked to the livestock.

Considering the location of the wetland and the integrity of the system in comparison to similar systems within the adjoining catchments, it is essential that the Cala WRU be considered to have a high importance in terms of both maintaining biodiversity and supplying important ecosystem services. The careful management of adjacent croplands, removal of the abandoned state forest (or at least the re-establishment of an appropriate buffer zone), and grazing areas will be an important consideration to ensure that the sediment loads into the system are managed. **Figure 4-43** to **Figure 4-47** is a series of photos of the Cala wetland complex for reference purposes.

Table 4-78 Landcover percentage in the Cala wetland RU

Level 1B Landcover Categories	Percentage cover in the valley-bottom wetland	Percentage cover in the seepage wetland complex
Open water - natural	0%	0.3%
Natural/minimally impacted	68.9%	10.9%
Semi-natural (undrained)	8.8%	17.1%
Semi-natural (drained)	4.6%	0%
Moderately degraded land	17.7%	63.0%
Subsistence crops	0%	6.5%
Tree plantations	0%	1.6%
Dense infestations of invasive alien plants	0.05%	0.7%
Total	**100%**	**100%**

Figure 4-44 View of the Cala wetland from the upper catchment area

Figure 4-45 View of the scrub wattle within a portion of the wetland's catchment

Figure 4-46 View of the depression wetland within the catchment of the system

Figure 4-47 View of the downstream portion of the valley-bottom wetland, which is characterised by permanent wetness. Note the plantation forestry along the right hand boundary of the system.

4.8.1.2 Present Ecological State

Even though the Cala wetland complex is located in one of the least disturbed catchments of the greater area, the localised impacts on the systems have contributed to impacts on the overall integrity of the systems, with one of the largest impacts on the system being the abandoned state forest plantation, which encroaches into the seepage wetlands and partially into the valley-bottom system. The hydrology has been impacted upon in both the valley-bottom and seepage wetlands, which is mostly attributed to the change in water inputs and slight modification to water distribution and retention. The increased runoff generation is mostly attributed to the changes in vegetation structure within the system and its associated catchments from a grassland dominated landscape, to portions being under subsistence agriculture and abandoned plantations. These changes in vegetation have also resulted in additional sediment inputs into the system, altering the geomorphology of the system. The additional sediment inputs are associated with the level of degradation of the catchment, i.e., areas of moderately degraded land. Water quality impacts are limited and are mainly attributed altered run-off within the catchment and within wetland land use e.g., subsistence agriculture. As described earlier, the seepage wetlands have undergone more extensive changes owing to the fact that these areas have been more accessible due to the level of wetness versus the valley-bottom wetland which tends to be more seasonally to permanently inundated. Consequently, the vegetation composition within the seepage wetlands is considered to be worse, as it is dominated by disturbance tolerant species and/or subsistence agriculture and/or plantation forestry **(Table 4-79)**.

Table 4-79 Present ecological state

Valley-bottom wetland

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	2.1	2.4	1.0	2.4
PES Score (%)	79%	76%	90%	76%
Ecological Category	**C →**	**C →**	**B →**	**C →**
Combined Impact Score	2.0			
Combined PES Score (%)	80%			
Combined Present Ecological Category	**C →**			

Hillslope seepage wetlands

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	3.7	3.7	1.4	5.4
PES Score (%)	63%	63%	86%	46%
Ecological Category	**C →**	**C →**	**B →**	**D →**
Combined Impact Score	3.6			
Combined PES Score (%)	64%			
Combined Present Ecological Category	**C →**			

4.8.1.3 Ecological Importance and Sensitivity

The Cala Wetland Complex has a moderate ecological importance, and in a rating of the wetland's EIS **(Table 4-80)** it can be seen that the landscape scale factors make the greatest contribution to the overall score. **Table 4-81** shows that a key factor contributing to the wetlands functional/ecosystem services is the nature and relative intactness of the systems, whilst in **Table 4-82**, the provisioning services mainly contributing to the overall score are associated with the utilisation of the seepage wetland for grazing and subsistence agricultural purposes.

Table 4-80 Rating of the Cala's wetland complexes' Ecological Importance and Sensitivity according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Valley-bottom	Hillslope seepage	Motivation
1. Biodiversity support	**0.3**	**0.3**	Score taken as the average of the three scores below
Presence of Red Data species	0.0	0.0	None of the available coverages contained any information relating to species of importance
Populations of unique species	1.0	1.0	The large portion of intact wetland habitat in a broader landscape where wetland degradation is not uncommon, wetland species populations are not unlikely
Migration/breeding/feeding sites	0.0	0.0	The available datasets do not highlight the site as being an important site for breeding species e.g., cranes.
2. Landscape scale	**3.3**	**3.1**	Score taken as the average of the five scores below
Protection status of the wetland	3.0	3.0	The wetland is not formally protected however, it falls within a Strategic Water Source Area
Protection status of the vegetation type	4.0	4.0	Sub-Escarpment Grassland Group 5 is classified as endangered
Regional context of the ecological integrity	3.5	3.5	The level of cumulative loss within the broader landscape is high, whilst this system is relatively intact
Size and rarity of the wetland type/s present	3.5	4.0	This site is one of the larger, intact remaining wetlands within the broader landscape
Diversity of habitat types	2.5	1.0	The discontinuously channelled valley-bottom wetland is characterised by a variety of habitats due to the change in the hydrological functioning of the system and thus habitat availability. The seepage wetlands are all dominated by grassland species.
3. Sensitivity of the wetland	**1.5**	**1.3**	Score taken as the average of the three scores below
Sensitivity to changes in floods	1.0	1.0	Based on the nature of the wetland system
Sensitivity to changes in low flows/dry season	1.5	1.0	As above

Ecological Importance	Valley-bottom	Hillslope seepage	Motivation
Sensitivity to changes in water quality	2.0	2.0	Predominantly mudstone geology which has a higher nutrient loading
TOTAL OVERALL SCORE:	**3.3**	**3.1**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-81 Rating of the Cala's wetland complexes' hydrological/functional importance according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecosystem benefits	Valley-bottom	Hillslope seepage	Motivation
Flood attenuation	2.0	1.8	VB: Even though the supply of this service is high based on the nature of the system, i.e., low longitudinal slope, surface roughness, discontinuously channelled; the demand for the service by downstream users is limited, thus reducing the overall score of the system. Seeps: Flood attenuation is not in high demand, based on the location of the wetland within a more rural landscape. Additionally, the ability of the wetlands to attenuate floods tends to be lower based on the nature of the systems.
Streamflow regulation	2.5	2.2	VB: The lateral inputs into the system, i.e., from the seepage wetlands, is fairly high and thereby sustain the streamflow during the drier winter periods. Seeps: The nature of the systems are normally associated with groundwater discharges (i.e., perched aquifers), and therefore, the contribution of flows into the dry season may be extended
Sediment trapping	2.5	2.2	VB: Refer to flood attenuation. Additionally, the water supply dam - Ncora dam, is located approximately 20km downstream of the wetland. Although the catchment associated with the wetland habitat is small, any additional sediment inputs prevented from entering the Ncora dam should be managed. Seeps: The importance of the wetlands for sediment trapping is the contribution that this will make to avoid sedimentation of the Ncora dam. Although the catchment associated with the wetland habitat is small, any additional sediment inputs prevented from entering the Ncora dam should be managed.

Ecosystem benefits	Valley-bottom	Hillslope seepage	Motivation
Phosphate assimilation	1.0	1.8	VB: See sediment trapping above. Also, to note that the effectiveness of the wetland is likely to be high for the assimilation of phosphates, nitrates, and toxicants, given the moderately diffuse flows in portions of the wetland and the generally high level of wetness and vegetation cover across much of the wetland. However, typical sources of anthropogenically-derived phosphate such as cultivation in the wetland's catchment are fairly limited. Seeps: See sediment trapping above. Also, to note that the effectiveness of the wetland is likely to be high for the assimilation of phosphates, nitrates, and toxicants, given the diffuse flows across the wetland and the generally high level of wetness and vegetation cover across much of the wetland. The cultivation of portions of the system, increases the importance of these systems in assimilating pollutants.
Nitrate assimilation	1.0	1.8	See above
Toxicant assimilation	1.0	1.8	See above
Erosion control	2.5	2.5	VB: Most of the wetland is characterised by an unchannelled valley-bottom with portions of the system being channelled. The limited disturbances within and adjacent to the system have ensured that the majority of the system is under permanent vegetation cover, thereby promoting the control of erosion. Seeps: Much of the wetlands are maintained under permanent vegetation cover, therefore promoting the control of erosion.
Carbon storage	3.0	1.7	VB: The hydrological setting of the wetland and level of saturation both favourably contribute towards the accumulation of organic matter. Seeps: The carbon storage abilities have been slightly reduced, as portions of the wetland have been cultivated. Additionally, the saturation level of these wetlands is not as high in comparison to the valley-bottom wetland.
OVERALL SCORE	**2.5**	**2.2**	Score taken as the average of the top five scores above

Table 4-82 Rating of the Cala's wetland complexes' importance for direct human benefits according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		Valley-bottom	Hillslope seepage	Motivation
Provisioning services	Water for human use	2.0	0.6	VB: Use of water from the wetland for the subsistence farming practices in the adjacent catchment, and livestock. Seeps: Limited available open water available for human use
	Harvestable resources	1.0	1.7	VB: No known current harvesting Seeps: Large portions of the wetlands are utilised for grazing purposes.
	Cultivated foods	0.6	1.5	VB: No cultivation within the wetland, however, within the adjacent catchment area. Seeps: Small portions of the wetland is utilised for subsistence agriculture
Cultural services	Cultural heritage	0.6	0.3	No known cultural heritage features
	Tourism and recreation	0.3	0.3	There currently is a very limited contribution of the wetland to tourism and recreation
	Education and research	0.4	0.4	There appears to be a very limited contribution of the wetland to education and research
TOTAL OVERALL SCORE:		**0.9**	**0.9**	Score taken as the average of the top five scores above

4.8.1.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) **(Table 4-83)** for the Cala wetland complex, the following were noted:

(1) the EIS of the wetlands;

(2) the PES of the wetlands; and

(3) the land use/landcover context of the wetlands (with a portion of the catchment including the abandoned state-owned forests).

Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for the wetland should be set at a B category. Given item (3) above, the removal of the state-owned forests and suitable revegetation and management of the newly cleared area, could greatly assist in achieving an improved PES and EIS score for the system. However, the management of the land following the clearing would be crucial, as the inappropriate management and subsequent encroachment of alien invasive species would potentially reduce both the PES and EIS of the overall system.

Table 4-83 Recommended Ecological Category (REC) for wetlands in the Cala WRU

	Valley-bottom	Seepage wetlands
REC	**B**	**B**

4.8.2 WRU 21 – Mbokotwa floodplain

Table 4-84 Summary of WRU 21

Factor	Comment
WRU Number (Quat Catchment)	WRU 21 (S50C)
Level of Assessment	Field-based
Priority	02
HGM Unit Type(s)	Floodplain
Vegetation types	Sub-Escarpment Grassland Group 7
SWSA	No
Threat Status	**FLOODPLAIN**: CRITICALLY ENDANGERED
PES	D (Largely modified)
EIS	A (Very High)
Contributors	Craig Cowden and Fiona Eggers

4.8.2.1 Wetland description

The Mbokotwa floodplain (+-802.5ha) **(Figure 4-48)** is located within the Ida precinct and flows through different types of land uses from commercial agricultural land use practices to subsistence farming. The system is a tributary to the Tsomo River which eventually flows into the Tsojana dam. The headwaters of the system originate from the nearby Geltschberg mountain range. The floodplain forms part of the headwaters, albeit slightly downstream of the actual headwaters, but nonetheless, the system is considered to be an important feature within the landscape and therefore, supplier of ecosystem goods and services. The floodplain generally drains in a northerly direction however, towards the base of the system the direction of flows changes into a southern direction. The base of the system has been artificially defined by the R56 regional road however, this road coincides with a change in topography and system characteristics. The floodplain falls within the S50C quaternary catchment, characterised by a MAP of 669mm and a PET of 1550mm, which suggests that the wetland would have moderate sensitivity to hydrological impacts. The geology underlying the Mbokotwa floodplain is the Karoo Supergroup which predominantly comprises of mudstone, and arenite.

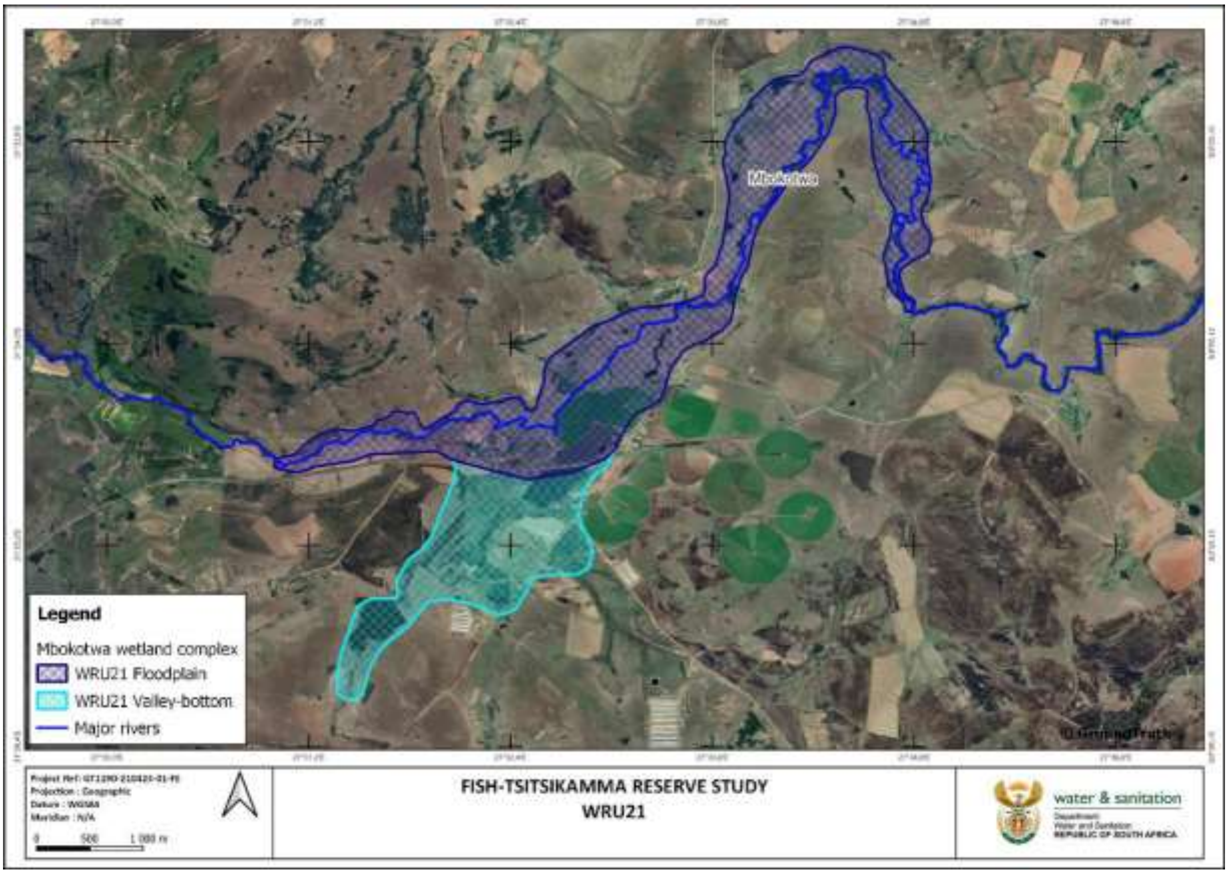

Figure 4-48 Overview of the Mbokotwa floodplain wetland

The catchment of the Mbokotwa floodplain is largely defined as semi-natural, due to the mountainous nature of the catchment and therefore, limiting accessibility to these areas. However, in the lower portions of the catchment, which is generally associated with a flatter topography, the impacts range from grazing lands to commercial crops (both irrigated and non-irrigated crops); to large water supply dams, piggery's/chicken hatcheries, dairy, and alien invasive vegetation. These catchment related impacts further extend into the Mbokotwa wetland.

The main impacts **(Table 4-85)** on the system are predominantly associated with in-system impacts and the commercial agricultural activities within the catchment. Large tracts of the wetland habitat have been modified through commercial agricultural activities including cultivation such as areas of rye grass but also centre pivots pastures for the adjacent dairy. The settling/effluent dams associated with the dairy are located just north of the R56. A drain has been directed around the dams towards the main channel of the floodplain for the discharge from these dams. It is further assumed that the water from these settling/effluent dams is utilised for the irrigation of the adjacent centre pivot pastures. The excess flows either flow laterally down towards the main channel, whilst some of the flows are collected in a small retention pond, which collects the excess runoff from this pivot and then decants into a drain which has been directed towards the floodplain channel. The flows from the other pivots located to the east but outside of the wetland boundary have also been directed towards this drain. Based on a review of the imagery in conjunction with the brief site visit, it is assumed that the discharge from the agricultural operations is within the legal limits.

The river channel associated with this central portion of the floodplain system (i.e., upstream of the dirt road which passes Ida diary); has become incised – up to 3m below ground level, thereby fundamentally changing the functioning of this portion of the system. Overbank topping from flood waters is an unlikely occurrence. In addition to the incised nature of the channel, potential impacts from the effluent/settling ponds and irrigation flows, the channel banks are dominated by alien invasive species such as *Populus* spp and *Acacia* spp. The northern side of this portion of the floodplain is characterised by small-scale agricultural practices which mostly include grazing by livestock. This portion of the wetland habitat is largely supported by lateral inputs from the adjacent seepage areas, and not by the overtopping from the channel due to sections of the channel being substantially incised. The wetness regime of the system ranges from extensive temporary wetness zones to areas of seasonal to permanent zones of wetness (often associated with flood channels and depressions/oxbow lakes). Natural vegetation was largely limited to these seasonal/permanent wetness zones with the sedge *Cyperus fastigiatus* often found in the depressions.

Directly downstream of the pivots is also characterised by what appears to be small scale agricultural practices. This portion of the system is characterised by old oxbow lakes and flood channels. Some of the old flood channels and oxbow lakes have been slightly modified with the construction of earthen berms on the downstream side of these systems, to serve as sources of water for livestock.

Another substantial in-system modification includes an off-take canal upstream of the effluent discharge point. The off-take is approximately 1.4km upstream. At the off-take, a small weir or similar has been constructed with a canal that directs flows from the main channel in an easterly direction towards a large freshwater dam. This dam is an off-channel dam and is sustained by the flows from the main river channel and not from the adjacent landscape. Based on a review of the imagery, the off-take canal and weir were all constructed towards the end of 2018 or early 2019. It is assumed that the main purpose of the dam is for the irrigation of the pivots to the east of the dam.

Upstream of this dam, the modifications are largely associated with agricultural land use practices, including inter alia, a water use dam, cultivated lands and the associated drainage networks and channel straightening, among others. Upstream of the offtake along the main river channel, the major modifications to the system include the adjacent pastures – non-irrigated, and alien invasive species along the channel banks.

The characteristics of the floodplain are fundamentally different within the lower portions of the system i.e., below the dirt road passing by Ida dairy. Downstream, the floodplain channel reverts back to a shallow channel thereby allowing for overbank topping. Much of the adjacent wetland habitat has been modified and is used as a source of fodder during the dry months. The channel is heavily infested with alien invasive trees, including *Populus* spp and *Acacia* spp. The catchment of this lower portion of the system has been cultivated and/or is utilised for grazing.

Although there are a number of impacts within and adjacent to the system, the floodplain is considered to be an important system in terms of supplying ecosystem services associated with regulating services especially water quality enhancement – due to the discharge from the commercial farming activities. Furthermore, this system is part of the headwaters for the Tsojana dam, and as such, to increase the longevity of water supply dams, the upstream areas should be well managed. **Figure 4-49** to **Figure 4-54** provide an overview of some of the impacts associated with the Mbokotwa floodplain wetland.

Table 4-85 Landcover percentage in the Mbokotwa floodplain wetland RU

Level 2 Landcover Categories	Percentage cover in the floodplain wetland
Deep flooding from impoundments	4.9%
Shallow flooding from impoundments	0.7%
Aquaculture dams/ponds	1.4%
Natural / Minimally impacted	3.6%
Semi-natural (undrained)	11.4%
Semi-natural (drained)	31.6%
Moderately degraded land	6.7%
Commercial annual crops (irrigated)	0.3%
Commercial annual crops (non-irrigated)	27.4%
Dense infestations of invasive alien plants	4.7%
Eroded areas (& heavily degraded lands)	0.8%
Urban Industrial/Commercial	0.5%
Urban Residential – low density	1.7%
Planted pastures (irrigated)	3.6%
Infilling (incl. infrastructure)	0.5%

Level 2 Landcover Categories	Percentage cover in the floodplain wetland
Artificially wetter areas (e.g., seepage below dams)	0.2%
Total	**100%**

Figure 4-49 View of a portion of the floodplain and the small artificially impounded areas on the adjacent floodplain terrace, and agricultural activities

Figure 4-50 Incised river channel within the floodplain, with the discharge point from the waste ponds slightly upstream from this point.

Figure 4-51 View of the flows along the diversion canal supplying the off-channel dam.

Figure 4-52 Debris below a large road culvert across the incised portion of the floodplain.

Figure 4-53 Artificially impounded area in the lower portion of the floodplain which is serving as a source of water for livestock

Figure 4-54 Grazing lands within the lower portion of the floodplain system

4.8.2.2 Present Ecological State

The Mbokotwa floodplain wetland has been substantially modified **(Table 4-86),** even though the broader catchment area is semi-natural. The in-system impacts and impacts within the 200m buffer of the wetland have greatly influenced the overall PES of the system. As highlighted above, the hydrology of the system has been substantially modified – D-category. This is mainly attributed to the agricultural land use changes and associated practices e.g., off-take channel and off-channel dam, additional water inputs associated with the irrigation practices, and channel incision, and transformation of the vegetation.

Although the main channel is incised for a portion of the system, the overall geomorphology for the remainder of the system has not been as severely impacted. The modifications to the vegetation composition of the system can mostly be attributed to the agricultural land use practices and therefore, large portions of intact wetland vegetation within the upper portion have largely been eliminated.

The largest in-system impact on water quality of the systems is associated with the discharge of the effluent/settling pond flows located at the Ida diary and have been directed towards the main floodplain channel. Based on the assessment technique, the water quality scores are automatically populated, and a worst-case scenario is assumed but this needs to be considered against the fact that in situ water quality data for the discharge was unavailable. Should it be established that the discharge is within the national limits, the water quality component of the assessment could be suitably updated to reflect this. All of the other land use practices may be difficult to modify, but the management of water quality (which has been assumed to be a worst-case scenario) can potentially be managed.

Table 4-86 Present ecological state

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	4.6	1.3	5.9	7.7
PES Score (%)	54%	87%	41%	23%
Ecological Category	**D →**	**B →**	**D ↓**	**E →**
Combined Impact Score	4.9			
Combined PES Score (%)	51%			
Combined Present Ecological Category	**D →**			

4.8.2.3 Ecological Importance and Sensitivity

The Mbokotwa floodplain wetland has a high ecological importance EIS **(Table 4-87)**, which is derived from the size of the wetland but also the presence of cranes within the system.

Table 4-88 highlights that the hydro-functional importance of the system is associated with the demand for a number of ecological services particularly relating to water quality enhancement however, in some instances the efficacy is largely reduced due to the modifications of the system.

Table 4-89 – provisioning services, the main contributing factors includes water provisioning and harvestable resources. However, the score is reduced to limited contribution the overall system makes in terms of tourism and education.

Table 4-87 Rating of the Mbokotwa floodplain Ecological Importance and Sensitivity according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Floodplain	Motivation
1. Biodiversity support	**3.5**	Score taken as the average of the three scores below
Presence of Red Data species	4.0	EWT have noted that some of the wetlands are utilised by cranes
Populations of unique species	4.0	As above
Migration/breeding/feeding sites	2.5	No breeding sites have been confirmed but the presence within the catchment assumes that the cranes must be utilising the system for foraging,
2. Landscape scale	**2.4**	Score taken as the average of the five scores below
Protection status of the wetland	1.0	The wetland is not formally protected
Protection status of the vegetation type	4.0	The Sub-Escarpment Grassland Group 7 vegetation type has been classified as critically endangered
Regional context of the ecological integrity	1.5	PES category is D and is representative of the loss of wetlands in the area. There are other wetlands in the area which are in better condition and therefore this wetland does not represent an intact remaining wetland.
Size and rarity of the wetland type/s present	4.0	Based on the size of the system
Diversity of habitat types	1.5	Although the floodplain under natural circumstances offers a variety of habitats, the system has been substantially modified thereby the diversity has been reduced.
3. Sensitivity of the wetland	**2.8**	Score taken as the average of the three scores below
Sensitivity to changes in floods	4.0	Based on the nature of the system
Sensitivity to changes in low flows/dry season	3.0	The upper portion includes a relatively incised channel, whilst the lower portion includes more flood out zones
Sensitivity to changes in water quality	1.5	Largely mudstone geology

Ecological Importance	Floodplain	Motivation
TOTAL OVERALL SCORE:	**3.5**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-88 Rating of the Mbokotwa floodplain hydrological/functional importance according to the criteria of Rountree and Kotze (2013) . Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecosystem benefits	Floodplain	Motivation
Flood attenuation	2.5	Moderately low longitudinal slope and floodplain wetland. The incised nature of a portion of the system reduces the efficacy of the floodplain to supply these services, however, in the lower portion the efficacies are improved. However, the attenuation capacity of the system is reduced in comparison to its benchmark state.
Streamflow regulation	2.2	The lateral inputs into the wetland from the upstream and adjacent wetland habitat is relatively high, and therefore, would be able to sustain downstream habitat during the drier months. The adjacent wetland is largely sustained by these lateral inputs. the incised nature of a portion of the channel, greatly influences the efficacy of the system
Sediment trapping	1.8	Under natural conditions the efficacy of the system to provide this service would be higher, however, the incised nature of the system has significantly reduced the system ability to supply this service, even though the demand is relatively high by both downstream users and due to the fact that the adjacent land use practices contribute towards an increased yield of sediments entering the system.
Phosphate assimilation	2.3	The effectiveness of the wetland within the lower portion of the system is likely to be higher than the central portion for the assimilation of phosphates, nitrates and toxicants given the fact that the channel is not incised. However, due to the presence of a channel the efficacies are not as high was what the demand for the service is. The discharge of effluent into the main channel increases the demand for this service within the landscape.
Nitrate assimilation	2.0	Refer to the above
Toxicant assimilation	2.0	Refer to the above
Erosion control	2.3	The incised nature of the channel is reducing the efficacy of the system at supplying this service even though the demand for the service remains high.
Carbon storage	2.0	Portions of the system have a high level of wetness and thereby supporting the accumulation of organic latter; however, this is outweighed by the substantial modifications within the system.
OVERALL SCORE	**2.3**	Score taken as the average of the top five scores above

Table 4-89 Rating of the Mbokotwa floodplain importance for direct human benefits according to the criteria of Rountree and Kotze (2013) . Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		Floodplain	Motivation
Provisioning services	Water for human use	2.5	The off-take channel contributes towards the demand for the water from the main floodplain channel.
	Harvestable resources	1.8	Portions of the adjacent floodplain terraces are utilised by livestock for grazing purposes (non-commercial landowners)
	Cultivated foods	0.6	No know subsistence crops identified
Cultural services	Cultural heritage	1.0	No known cultural heritage features
	Tourism and recreation	0.3	Currently there appears to be limited contribution of the wetland to tourism and recreation
	Education and research	0.3	Currently there appears to be limited contribution of the wetland to education and research
TOTAL OVERALL SCORE:		**1.2**	Score taken as the average of the five scores above

4.8.2.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) **(Table 4-90)** for the Mbokotwa floodplain, the following were noted:

(1) the EIS of the wetlands;

(2) the PES of the wetlands; and

(3) the land use/landcover context of the wetlands (particularly relating to the discharge of effluent into the main floodplain channel).

Based on the guidelines of Rountree *et al.* (2013) given in the methods, the REC for the wetland should be set at the current PES categories, or if practical, improved to a C/D category[8]. Given item (3) above, the discharge of effluent should be continuously monitored to ensure that the practices continue within the DWS limits. Additionally, the removal and management of alien invasive plants within the wetland and associated buffer zone should be considered. In this context, eliminating agricultural activities would have significant socio-economic repercussions, but the adoption of good management practices can assist in lessening the existing impacts on the system. This may potentially be achieved through a partnership between government and the private landowners to reduce the impacts on the system.

It should be noted, that improving the integrity of the system by a full category was considered but deemed to be impractical/unfeasible considering current conditions within the system. Some of the major impacts within the system are linked to fundamental changes to the hydrology and geomorphology of the system, e.g., channel incision and reversing the hydrological modifications to the system through a suite of engineered rehabilitation interventions would require a significant financial investment from government, through programmes such as Working for Wetlands. Although possible, large-scale interventions, as would be required in this context, are low priorities in terms of the programme's current focus and would be unlikely to be implemented.

Furthermore, the outcomes of the Longmore Wetland Complex cost-benefit analysis highlighted (refer to Section 4.3.1) that the financial implications to either the private landowner and/or local authorities can be immense with the removal of the activities within the wetland and its associated buffer, and that the current utilisation of the system is considered to be the most appropriate way forward. However, this latter approach would nonetheless, the subject to the management of alien invasive plants within the wetland and within at least 200m of the wetland boundary. Furthermore, discharge of any wastewater must be regularly monitored ensuring that it is within the permissible discharge limits, and any additional modifications to the system should be prohibited. Further modifications to the hydrology and geomorphology beyond the existing off-take channels, storage dams, and discharge of flows, would only result

[8] While a REC has been derived for the wetland system based on management or mitigation practices that may address identified impacts, it does not incorporate an understanding of the socio-economic aspects of the system within the landscape. As such, the REC may be adjusted to a Best Attainable State (BAS) during subsequent phases of the project, based on the outcomes of a socio-economic cost-benefit analysis being undertaken for the Longmore and Chatty River wetland systems.

in additional degradation of an already substantially modified system. Thus, a REC of C/D has been set for the system, as appropriate management of the system e.g. alien invasive vegetation management, would result in an improvement of the systems overall integrity.

Table 4-90 Recommended Ecological Category (REC) for wetlands in the Mbokotwa floodplain WRU

	Floodplain	
REC	**C /**	**D**

4.9 IUA_S02: Black Kei

Table 4-91 Summary of wetland information for IUA_S02

IUA Description	Black Kei
HGM unit type	Total of 428 wetlands mapped; Channelled Valley Bottom Wetlands: 17% Depression Wetlands: 15% Floodplain Wetlands: 1% Hillslope Seep Wetlands: 52% Unchannelled Valley Bottom Wetlands: 15%
PES per HGM unit type	Channelled Valley Bottom Wetlands - A/B: 41%; C: 22%; D/E/F: 37%. Depression Wetlands - A/B: 75%; C: 10%; D/E/F: 15%. Floodplain Wetlands - C: 33%; D/E/F: 67%. Hillslope Seep Wetlands - A/B: 52%; C: 17%; D/E/F: 31%. Unchannelled Valley Bottom Wetlands - A/B: 43%; C: 40%; D/E/F: 17%.
FEPA Wetlands	There are a number of FEPA wetlands in the IUA_S02 that include channelled valley bottom, unchannelled valley bottom, hillslope seep and depression wetlands. Many of these have been identified as FEPA wetlands because they are known crane breeding/feeding sites or are located in key water supply areas in their catchment.
WRU	WRU 12 and WRU 13

4.9.1 WRU 12 – Cairns Wetland Complex

Table 4-92 Summary of WRU 12

Factor	Comment
WRU Number (Quat Catchment)	WRU 12 (S32E)
Level of Assessment	Desktop
Priority	02
HGM Unit Type(s)	Unchannelled Valley-bottom and Hillslope Seep Wetlands
Vegetation types	Drakensberg Grassland Group 1
SWSA	Yes (Amathole)
Threat Status	**UNCHANNELLED VALLEY-BOTTIM:** CRITICALLY ENDANGERED, **CHANNELLED VALLEY-BOTTOM:** LEAST THREATENED, **SEEP:** LEAST THREATENED
PES	B (Largely natural)
EIS	A (Very High)
Contributors	Steven Ellery

4.9.1.1 Wetland Description

The Cairns Wetland Complex is a large wetland complex comprising of large valley-bottom, floodplain and seepage wetlands located directly to the south of the settlement of Cairns in the Eastern Cape. Much of the wetland complex is characterised by similar kommetjievlakte features to those found in the KwaMasele Wetland. These features are located in the wide unchannelled valley-bottom wetlands. A single portion of the wetland complex was assessed for the purposes of this study, but it is recommended that further research is conducted within these rare and unique kommetjievlakte wetlands in order to protect and conserve them in a meaningful way. The wetland that was assessed is a large valley-bottom wetland system that moves between an unchannelled, to channelled system, with weakly-channelled sections in-between **(Figure 4-55)**. The upper reaches of the wetland is dominated by seasonal and permanent wetness zones, with large areas covered by the kommetjievlakte features which indicate wetlands that are largely natural. The catchment of this portion of the Cairns wetland is large (1808ha) and has minimal human disturbances. The encroachment of alien invasive vegetation and over-grazing are the two main impacts on the system and within the catchment.

The lower reaches of the system have eroded down to bedrock, as the system works to achieve a natural equilibrium following anthropogenic impacts. The upper reaches of the HGM unit were regarded as being fairly stable, but a large headcut was identified within the middle reaches of the HGM unit, however it appears as though the headcut has eroded down to bedrock and cannot erode further downward. A historical channel runs along the left-hand edge of the HGM unit, which was abandoned possibly as a result of the headcut advancement years ago.

According to local sources, the movement and presence of livestock within the wetland has led to a slight degradation of wetland features, such as trampling of wetland vegetation and informal stream crossings, however over-grazing of the vegetation within the wetland was not identified as a serious concern at this point in time (pers comms Qonye, 2022) (**Table 4-93**).

Table 4-93 Landcover percentage in the Cairns Wetland Complex WRU

Level 2 Landcover Categories	Percentage cover in the valley-bottom wetland
Natural/Minimally Impacted	83%
Semi-Natural (Undrained)	15%
Eroded Areas	1%
Infilling	1%
Total	**100%**

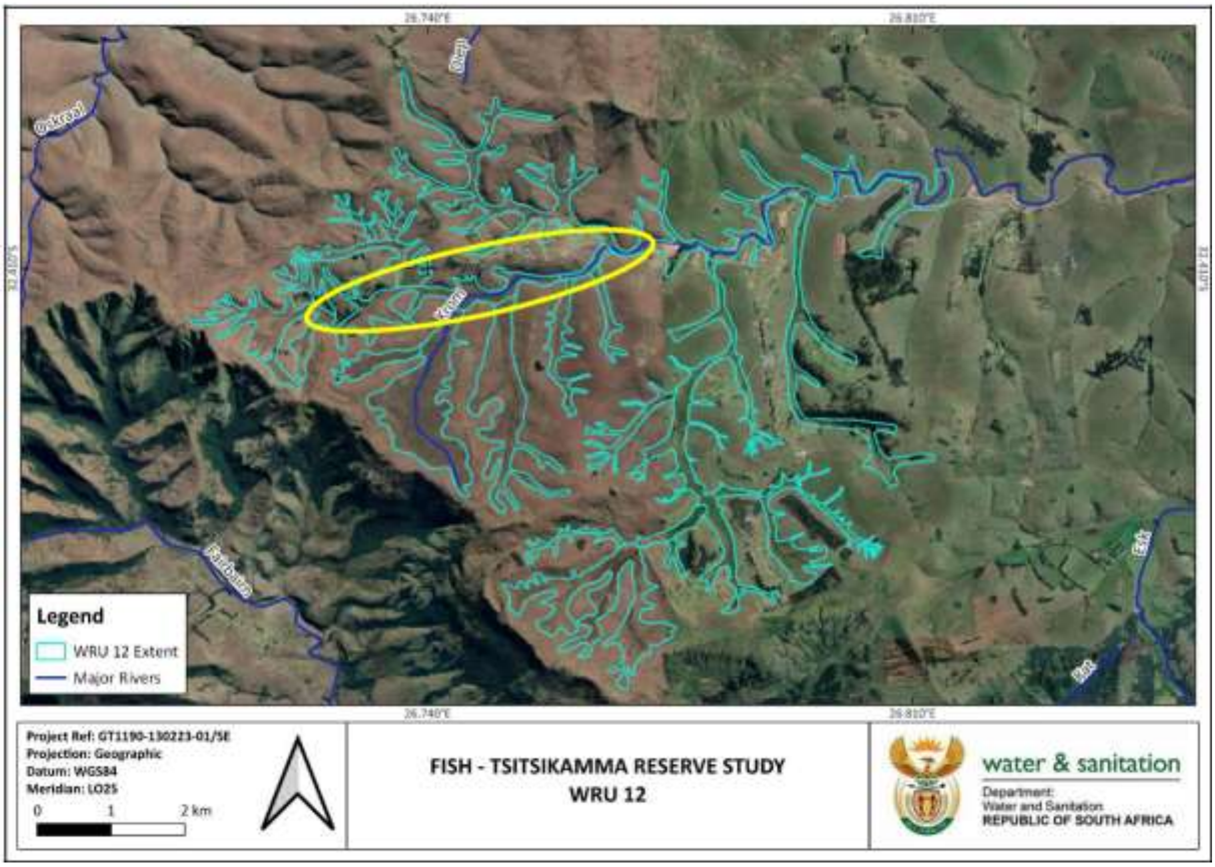

Figure 4-55 Overview of the Cairns wetland resource unit. The yellow oval indicates the HGM unit that was assessed.

4.9.1.2 Present Ecological State

The predominant impacts to the integrity of the Cairns wetland appear to be the presence of the eroded channels within the wetland which are affecting the natural patterns of water retention and distribution within the wetland. Additionally, given that there are cattle that move through and graze within the wetland, the vegetation has been impacted upon due to the preferential grazing of selected species by cattle. Otherwise, the catchment of the wetland is relatively intact and there are minor changes to water inputs which are a result of the presence of a small patch of gum trees within the immediate catchment of the wetland (**Table 4-94**).

Table 4-94 Present ecological state

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	1.0	0.5	0.7	1.8
PES Score (%)	90%	95%	93%	82%
Ecological Category	**B→**	**A →**	**A →**	**B →**
Combined Impact Score	1.1			
Combined PES Score (%)	89%			
Combined Present Ecological Category	**B →**			

4.9.1.3 Ecological Importance and Sensitivity

The Cairns wetland has a high ecological importance, and in a rating of the wetland's EIS it can be seen that the biodiversity support factors make the greatest contribution to the overall score (**Table 4-95**). This contribution can, to a large degree, be attributed to the presence of the rare kommetjievlakte features that are extensively present within the HGM unit and the presence of the vulnerable *Vandijkophrynus amatolicus* (Amathole Toad). While from **Table 4-96** and **Table 4-97** it can be seen that a key factor contributing to the wetland's functional/ecosystem services is its location in rural communal lands where there is increased flood vulnerability of surrounding people and infrastructure as well as increased reliance on natural resources such as water and livestock grazing opportunities within the wetland.

Table 4-95 Rating of the Cairns wetlands' Ecological Importance and Sensitivity according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Score (0-4)	Motivation
1. Biodiversity support	**3.3**	Score taken as the average of the three scores below
Presence of Red Data species	3.5	The intact wetlands provide potentially key ecological linkages for the critically endangered Amathole Toad (*Vandijkophrynus amatolicus*) which is restricted to the grasslands of the Amathole Mountains and favours hillslope seepage wetlands for breeding.
Populations of unique species	3.5	The Cairns wetland, which still comprises largely natural vegetation, provides a good representative example of wetland within Kommetjievlakte terrain, which, despite its uniqueness, is not formally conserved anywhere within its range. Given this, and that the wetland is large and reasonably intact, uncommonly large populations of unique species in addition to the presence of the Amathole Toad being probable but not confirmed.
Migration/breeding/feeding sites	3.0	Given the large intact area of wetland in a broader landscape where the cumulative impacts on wetlands are high, the wetland is likely to be at least moderately important as a breeding and/or feeding site for wetland-dependent fauna, but specific information on this is lacking.
2. Landscape scale	**3.0**	Score taken as the average of the five scores below
Protection status of the wetland	1.0	The wetland is not formally protected
Protection status of the vegetation type	4.0	Although the Drakensberg Grassland Bioregion in which the wetland falls is under relatively low threat, at a more local level, the Hogsback grasslands are somewhat more threatened. Although not currently afforded specific protection, a strong case can be made for the protection of the kommetjievlaktes and their wetlands.
Regional context of the ecological integrity	3.5	The wetland represents a large relatively intact area of wetland in kommetjie terrain, which is a unique landscape feature marked by repeated small ridges/mounds and depressions that give the landscape a rippled appearance and which are largely confined to an area between Qonce and Pirie Forest
Size and rarity of the wetland type/s present	3.5	See above two items
Diversity of habitat types	3.0	Excluding the degraded seeps, a relatively high diversity is assumed based on the hydrogeomorphic and hydrological diversity of the wetlands together with the diversity of vegetation including grasses (e.g., *Fingerhuthia sesleriiformis, Festuca caprina*) sedges (e.g., *Dracoscirpoides ficinioides*) and forbs (e.g., *Mentha aquatica*).
3. Sensitivity of the wetland	**2.5**	Score taken as the average of the three scores below
Sensitivity to changes in floods	2.0	Based on the wetland being mainly seep and valley bottom

Ecological Importance	**Score (0-4)**	**Motivation**
Sensitivity to changes in low flows/dry season	2.5	As above
Sensitivity to changes in water quality	3.0	The moderate sensitivity is assumed for the wetter areas given that they are moderately diverse and short growing
TOTAL OVERALL SCORE:	**3.3**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-96 Rating of the Cairns wetland's importance for direct human benefits according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecosystem benefits	**Score (0-4)**	**Motivation**
Flood attenuation	1.3	Low longitudinal slope and moderately high surface roughness of the wetland resulting from the Kommetjievlakte terrain; limited floodable property downstream of the wetland.
Streamflow regulation	2.7	The hydrogeological setting is likely to be associated with possible groundwater discharge in the wetland; very limited extent in the wetland of invasive trees which would otherwise increase atmospheric loss of water from the wetland
Sediment trapping	2.0	See flood attenuation. Extensive erosion in the central portions of the wetland is detracting from its effectiveness in trapping sediment.
Phosphate assimilation	2.0	See sediment trapping above. Also, to note that the effectiveness of the wetland is likely to be moderately low to moderate for the assimilation of phosphates, nitrates and toxicants, given the moderately diffuse flows in much of the wetland (but much more concentrated where severely eroded) and the moderate level of wetness and high vegetation cover across much of the wetland. Anthropogenically-derived phosphate is likely from the very extensive human settlement and some cultivation in the wetland's catchment.
Nitrate assimilation	2.8	See above.
Toxicant assimilation	2.1	See above two items
Erosion control	2.1	Much of the wetland is maintained under permanent vegetation cover, therefore promoting the control of erosion. However, the effectiveness of the wetland in controlling erosion is compromised in that most of the wetland is subject to prolonged heavy grazing pressure and there is also extensive headcut and gully erosion active in the central portions of the wetland.

Ecosystem benefits	Score (0-4)	Motivation
Carbon storage	2.3	The wetland’s hydrogeological setting and the generally low level of wetness are assumed to support a moderately low accumulation of soil organic matter.
OVERALL SCORE	**2.2**	Score taken as the average of the five highest scores above

Table 4-97 Rating (0-4) of the Cairns wetland’s importance for direct human benefits according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		Score (0-4)	Motivation
Provisioning services	Water for human use	1.1	Water use particularly for livestock watering
	Harvestable resources	2.4	Mainly livestock grazing, but some harvesting of vegetation within the wetland is assumed
	Cultivated foods	1.0	Cultivation in a small portion of the wetland
Cultural services	Cultural heritage	1.0	Traditional beliefs and practices (associated mainly with open water areas in the wetland) persist
	Tourism and recreation	0.3	Currently there appears to be limited contribution of the wetland to tourism and recreation
	Education and research	0.3	Currently there appears to be limited contribution of the wetland to education and research.
TOTAL OVERALL SCORE:		**1.0**	Score taken as the average of the five highest scores above

4.9.1.4 *Recommended Ecological Category*

In determining the Recommended Ecological Category (REC) for the Cairns wetland, the following were noted: (1) the wetland's EIS is high; (2) the PES is in a B category (3) the wetland is currently used extensively for grazing; and (4) it is located on rural communal land and receives no formal protection. Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for the wetland should be set at the current PES categories, or if practical, improved by a category. Given items (3) and (4) above, it is likely to be impractical to improve the PES of the wetland, and therefore the REC is set at the current PES of B. Given the relatively intact nature of much of the catchment of the wetland and the low-density populations surrounding the wetland, the maintenance of the PES at a B category is deemed to be an achievable REC **(Table 4-98**)

Table 4-98 Recommended Ecological Category (REC) for wetlands in the Cairns WRU

	Cairns Wetlands
REC	**B**

4.9.2 WRU 13 – Hogsback Wetland Complex

Table 4-99 Summary of WRU 13

Factor	**Comment**			
WRU Number (Quat Catchment)	WRU 13 (S32D)			
Level of Assessment	Field-based			
Priority	01			
HGM Unit Type(s)	Hillslope Seeps, Floodplain and Channelled Valley-Bottom Wetlands			
Vegetation types	Drakensberg Grassland Group 1			
SWSA	Yes (Amathole)			
Threat Status	**SEEP**:LEASTTHREATENED,**FLOODPLAIN**:CRITICALLY ENDANGERED, **CHANNELLED VALLEY-BOTTOM**: LEAST THREATENED, **UNCHANNELLED VALLEY-BOTTOM**: LEAST THREATENED			
PES	**SEEP**: C (Moderate)	**SEEP** (Degraded): D (Largely modified)	**CHANNELLED VALLEY-BOTTOM**: C (Moderate)	**FLOODPLAIN**: C (Moderate)
EIS	A (Very High)	B (High)	B (High)	B (High)
Contributors	Donovan Kotze and Steven Ellery			

4.9.2.1 Wetland Description

The Hogsback wetland RU, located north of Hogsback town, falls within the headwaters of the Great Kei River in the Klipplaat Rivier catchment (quaternary catchment **S32D**). The RU is part of a much more extensive wetland “mega-cluster” extending along the Amathole mountains into neighbouring catchments, particularly to the west, where the wetlands of the Elandsberg (described by Lubbe 2021) are encountered, followed by the Cairns wetland RU in the west and covering an overall area of ~18’000 ha.

The Hogsback wetland RU contains a high extent of wetland, including one of the largest unchanneled valley bottoms in the overall study area. The RU also represents a high diversity of HGM types (Eichhoff 2021). For the purposes of assessment, the diversity of HGM types have been grouped into the following three broad types: (1) **seeps** feeding into **channelled valley bottoms** (generally steep minor tributaries), and which are henceforth referred to simply as seeps, (2) **floodplains** and (3) **unchanneled** valley bottom. Wetness ranges from temporary through seasonal to permanent saturation/flooding. Grasses (e.g., *Festuca caprina* and *Fingerhuthia sesleriiformis*) dominate the temporary areas and sedges (notably *Carex acutiformis*) and, to a lesser extent, *Juncus lomatophylllus* and *Phragmites australis*, dominate the permanent areas, while a sedge/grass mix is characteristic of the seasonal areas. In the floodplain, *Cliffortia linearifolia* shrubs are often locally abundant, especially along the stream channel. Small *Leucosidea sericea* trees are also present, and most abundant where the historical fire frequency appears to have been reduced. Although requiring further investigation to confirm, the seep wetlands appear to contain a higher diversity than the floodplain and unchanneled valley bottom areas. Several of indigenous plant species encountered in the seeps (e.g., *Rhynchospora brownii*, *Juncus punctorius* and *Kyllinga* spp.) were absent in the floodplains/unchannelled valley bottoms, whereas much fewer were encountered in floodplains/unchannelled valley bottoms which were absent in the seeps.

Although fairly limited in extent, anthropogenically-induced erosional incision occurs in a few localized sites in the wetland, and several of these already have Working for Wetlands erosion-control structures in place.

The wetland RU falls predominantly within timber plantation areas but also extends into private farmland (livestock and cultivation), with these two mainland-uses varying according to which wetland types are most impacted. In the farmland, several wetland areas in the major valley bottoms and floodplains have been historically drained and transformed into cultivated lands. It appears that just north of the Hogsback wetland RU there was once extensive floodplain wetlands within the valley floor following the Klipplaats river, but almost all of this valley floor is now cultivated lands, e.g., as seen on Fenfield farm. However, the minor valley bottoms and seeps, which tend to be steeper and located in higher-lying areas, are much less transformed within the farmland areas. In contrast, in forestry areas, the major valley bottom wetlands, which are characteristically very broad, are largely intact, while many of the seeps and minor valley bottoms, which are characteristically narrow, are severely affected by the adjacent plantation’s edge effects (shading, desiccation and promoted American bramble infestation). However, some of the still-intact seeps in forestry areas have generous buffers, limited plantations in their catchments and are ecologically well connected, notably those on the south-western slopes of Gaika’s Kop. These provide potentially key ecological linkages for the critically endangered Amathole Toad (*Vandijkophrynus amatolicus*) which is restricted to the grasslands of the Amathole Mountains and favours seep wetlands for breeding.

The intact seeps on the south-eastern **slopes of the Geigerskop appear most important as potential ecological links for the Amathole toad**. These **seeps likely represent a critical link between the Elandsberg sub-population to the north-east of the wetland RU and sub-populations to the south-east**. Furthermore, as with the seeps generally, they contain several localized areas where water is discharging to the surface in what could probably be referred to as **springs** (**Figure 4-57**). While these are probably not entirely permanent, they appear to provide sustained surface water through the wet season at least and appear suitable as breeding sites for the Amatole toad (**Figure 4-58**). Aided by cattle hoof prints, these areas contain flooded micro-depressions within which the toads can breed (Bionerds 2021).

By far the greatest direct use made of the wetland, both in farmland and plantation areas, is for livestock grazing. Almost all the seep wetland areas remain under natural vegetation, while in the valley bottom wetland areas there has been some conversion to cultivated lands **(Table 4-100).**

Table 4-100 Landcover percentage in the Hogsback wetland RU

Level 1B Landcover Categories	Seeps intact	Seeps degraded	Floodplain	Unchannelled valley bottom
Natural / Minimally impacted	89%	11%	65%	66%
Semi-natural (undrained)	4%	59%	25%	19%
Dense infestations of invasive alien plants	7%	30%	10%	6%
Commercial annual crops	0%	0%	0%	9%
Total	**100%**	**100%**	**100%**	**100%**

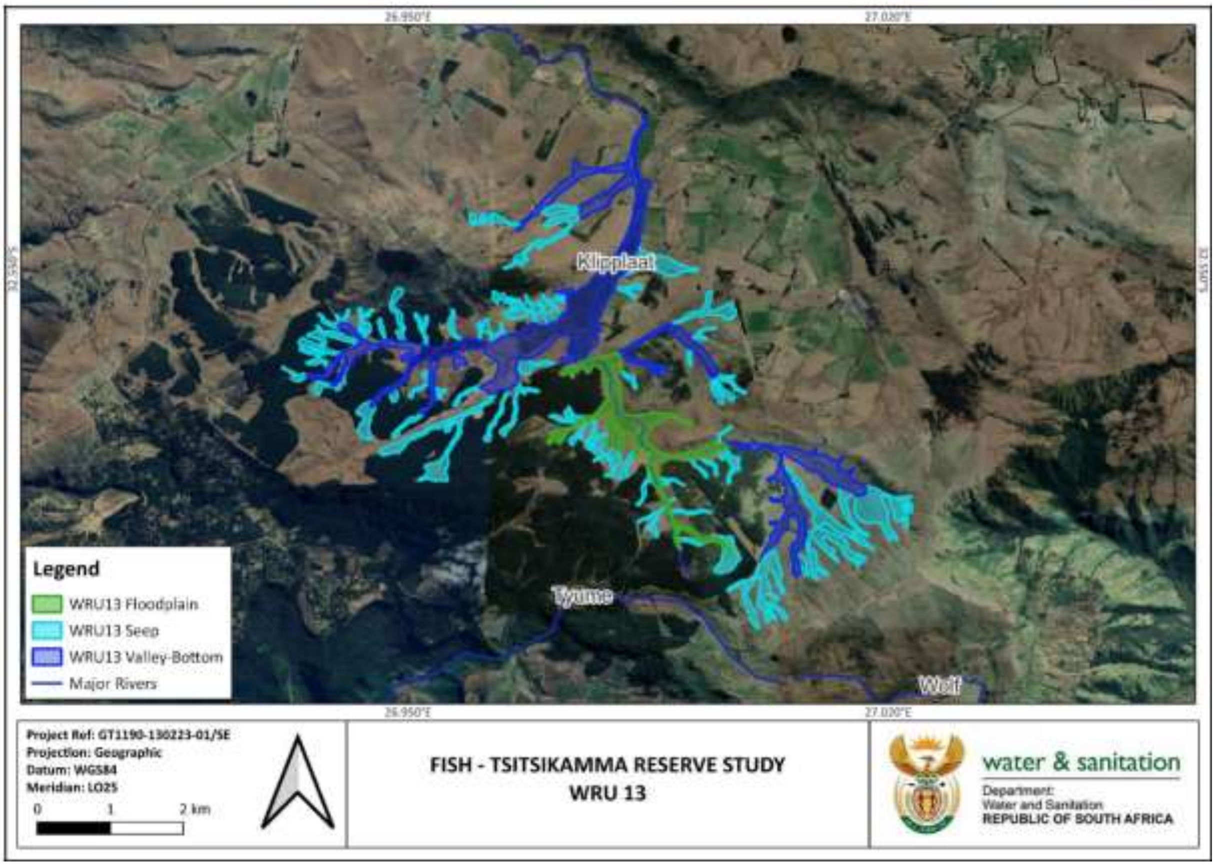

Figure 4-56 Overview of the Hogsback wetland resource unit

Figure 4-57: A wetland seep on the lower south-western slopes of Gaika's Kop, generously buffered by natural vegetation and without plantation trees in their upslope catchments. The insert photo shows one of several localized areas within the seep characterized by sustained seepage to the soil surface during the wet season, and potentially suitable for the Amathole Toad (*Vandijkophrynus amatolicus*)

Figure 4-58 A well-buffered wetland seep on the Gaika road, supporting a diversity of grasses (notably *Festuca caprina*) and sedge (e.g. *Pyreus* sp.) and with its wettest core dominated by the rush *Juncus puctorius.*

Figure 4-59 Left: A wetland seep heavily used by livestock. Right: One of Working for Wetlands rehabilitation interventions in a channelled valley bottom which was identified as incised.

Figure 4-60 A wetland seep area with extensive *Leucosidea sericea* trees, which are favoured by an absence/infrequency of fires.

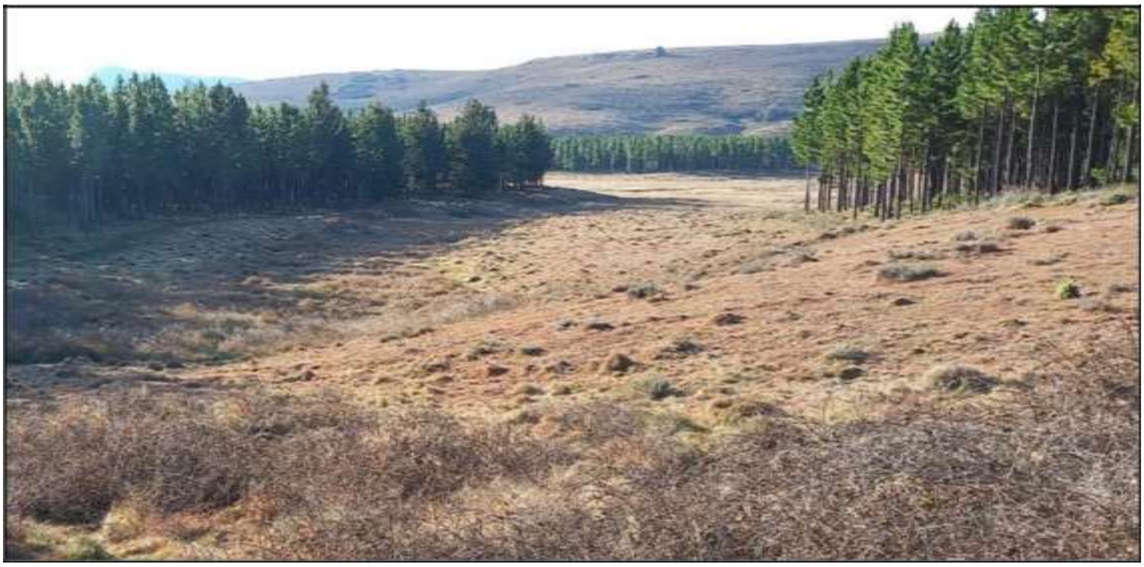

Figure 4-61 A wetland seep area infested with American bramble.

Figure 4-62 A floodplain wetland, showing the sinuous main stream channel and vigorous vegetation including the sedge *Carex acutiformis* and the short shrub *Clutia* sp.

Figure 4-63 The most extensive unchannelled valley bottom in the Hogsback area, dominated mainly by, the lesse pond sedge (*Carex acutiformis*) and seen here after a recent fire.

4.9.2.2 Present Ecological State

The intact seep wetlands had the lowest impact scores, followed by the floodplain, unchanneled valley bottom and lastly by the degraded seeps **(Table 4-101)**. This is owing primarily to the proportionally greater extent of natural areas in the seep wetland, as described in the previous section. Another key factor contributing to the much higher impacts in the degraded seeps compared with the intact seeps is the much greater extent of plantations in the wetlands' catchments and immediate buffers. For all the four wetland types assessed, the hydrology and vegetation components were generally the most impacted**.**

The trajectory of change in the ecological state over the next five years is projected to generally remain the same, but in some cases with a decline in the vegetation and hydrology components, primarily related to a projected continuing increase in IAP. This is mainly American bramble, but in the case of the UVB, it is the self-seeded pine trees which have increased dramatically in extent over the last 20 years in the catchment north-east of the wetland and are projected to continue increasing as such.

Table 4-101 Present ecological state

Seeps intact

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	3.6	1.4	0.7	1.7
PES Score (%)	64%	86%	93%	84%
Ecological Category	**C→**	**B→**	**A→**	**B↓**
Combined Impact Score	2.0			
Combined PES Score (%)	80%			
Combined Present Ecological Category	**C→**			

Seeps degraded

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	6.4	2.8	1.1	5.2
PES Score (%)	36%	72%	89%	48%
Ecological Category	**E→**	**C→**	**B→**	**D↓**
Combined Impact Score	4.7			
Combined PES Score (%)	53%			
Combined Present Ecological Category	**D→**			

Floodplain

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	5.3	2.1	0.8	2.6
PES Score (%)	47%	79%	92%	75%
Ecological Category	**D→**	**C→**	**A→**	**C↓**
Combined Impact Score	3.0			
Combined PES Score (%)	70%			
Combined Present Ecological Category	**C→**			

Unchannelled valley bottom

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	5.0	2.3	1.1	2.9
PES Score (%)	50%	77%	89%	71%
Ecological Category	**D↓**	**C→**	**B→**	**C↓**
Combined Impact Score	3.1			

Combined PES Score (%)	69%
Combined Present Ecological Category	**C↓**

4.9.2.3 Ecological Importance and Sensitivity

The Hogsback wetlands, in particular the intact seeps, have a high ecological importance given **(Table 4-102)**. In a rating of the wetland's EIS **(Table 4-102)** it can be seen that the biodiversity support factors make the greatest contribution to the overall score. While from **Table 4-103** and **Table 4-104** it can be seen that the wetland's functional/ecosystem services contribution is somewhat limited, in part owing to the limited intensive agricultural activity in the upstream/upslope catchment of most wetlands (**Table 4-103**). In terms of provisioning services, it is primarily through their direct contribution to livestock grazing (**Table 4-104).**

Table 4-102 Rating of the Hogsback wetlands' Ecological Importance and Sensitivity according to the criteria of Rountree and Kotze (2013) for intact seeps, degraded seeps, floodplain and unchannelled valley bottom (UVB). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Seeps, intact	Seeps, degraded	Flood-plain	UVB	Motivation
1. Biodiversity support	3.5	1.5	3.3	3.3	Score taken as the average of the three scores below
Presence of Red Data species	4.0	1.5	3.5	3.5	The intact seeps provide potentially key ecological linkages for the critically endangered Amathole **Toad** (*Vandijkophrynus amatolicus*) which is restricted to the grasslands of the Amathole Mountains and favours hillslope seepage wetlands for breeding.
Populations of unique species	3.5	1.5	3.5	3.5	Given the location of the wetlands near the southern limit of the Drakensberg Grassland Bioregion, together with being a large intact area of wetland in a broader landscape where the cumulative impacts on wetlands are high, uncommonly large populations of wetland species are likely where extensive intact wetland areas remain (i.e., excluding the degraded seeps).
Migration/breeding/feeding sites	3.0	1.5	3.0	3.0	Where large intact areas of wetland remain in a broader landscape where the cumulative impacts on wetlands are high, the wetland is likely to be at least moderately important as a breeding and/or feeding site for wetland-dependent fauna, but specific information on this is lacking
2. Landscape scale	3.1	2.0	3.1	3.1	Score taken as the average of the five scores below
Protection status of the wetland	4.0	4.0	4.0	4.0	The wetland is not formally protected but has formally recognized management importance by AFC and falls within a SWSA
Protection status of the vegetation type	2.0	2.0	2.0	2.0	Although the Drakensberg Grassland Bioregion in which the wetland falls is under relatively low threat, at a more local level, the **Hogsback grasslands are somewhat more threatened.**
Regional context of the ecological integrity	3.0	1.0	3.0	3.0	Excluding the degraded seeps, the wetlands contain large fragments of remaining intact wetland in a broader landscape where the cumulative loss of wetlands is high
Size and rarity of the wetland type/s present	3.5	1.5	3.5	3.5	See above
Diversity of habitat types	3.0	1.5	3.0	3.0	Excluding the degraded seeps, a relatively high diversity is assumed based on the hydrogeomorphic and hydrological diversity of the wetlands together with the diversity

Ecological Importance	**Seeps, intact**	**Seeps, degraded**	**Flood-plain**	**UVB**	**Motivation**
					of vegetation including grasses (e.g., *Fingerhuthia sesleriiformis, Festuca caprina*) sedges (e.g., *Dracoscirpoides ficinioides*) and forbs (e.g., *Mentha aquatica*).
3. Sensitivity of the wetland	2.5	2	2.7	2.8	Score taken as the average of the three scores below
Sensitivity to changes in floods	1.5	1.5	3.0	2.5	Based on the wetland's HGM type
Sensitivity to changes in low flows/dry season	3.0	3.0	2.5	3.5	Based on the wetland's HGM type, as well as noting that the areas of prolonged saturation in the wetland are likely to be at least partly maintained by low flows
Sensitivity to changes in water quality	3.0	1.5	2.5	2.5	This is assumed based on based on the generally diverse vegetation of moderate height in the seep (most sensitive) somewhat less diverse but taller vegetation in the floodplain and the already highly degraded vegetation in the degraded seeps
TOTAL OVERALL SCORE:	**3.5**	**2.0**	**3.3**	**3.3**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-103 Rating of the Hogsback wetlands' hydrological/functional importance according to the criteria of Rountree and Kotze (2013) for intact seeps, degraded seeps, floodplain and unchannelled valley bottom (UVB). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecosystem benefits	**Seeps, intact**	**Seeps, deg.**	**Flood-plain**	**UVB**	**Motivation**
Flood attenuation	1.5	1.5	3.0	3.0	Based on longitudinal slope and surface roughness of the HGM types; floodable property (comprising extensive cultivated lands and some farm buildings) downstream of the wetland
Streamflow regulation	3.0	3.0	3.0	3.0	The hydrogeological setting (Tarkastad subgroup, which contains sandstones and mudstones) is likely to be associated with possible groundwater discharge in the wetland; except for the degraded seeps, very limited extent in the wetland of invasive trees potentially increasing atmospheric loss of water from the wetland
Sediment trapping	1.5	1.5	3.0	3.0	See flood attenuation.

Ecosystem benefits	Seeps, intact	Seeps, deg.	Flood-plain	UVB	Motivation
Phosphate assimilation	2.5	2.5	3.0	3.0	See sediment trapping above. Also, to note that the effectiveness of the wetland is likely to be moderate for the assimilation of phosphates, nitrates, and toxicants, given the moderately diffuse flows in much of the wetland and the moderate level of wetness and high vegetation cover across much of the wetland. However, apart from the UVB, located lowest in the catchment, typical sources of anthropogenically-derived phosphate such as cultivated lands are lacking in the wetland's catchment, but the widespread forestry in the wetland's catchment is likely to have some contribution.
Nitrate assimilation	3.5	3.5	2.5	3.5	See above.
Toxicant assimilation	3.5	3.5	3.5	3.5	See above two items
Erosion control	3.5	3.5	3.5	3.5	Much of the wetland area is maintained under permanent vegetation cover, therefore promoting the control of erosion. However, a few areas of localized erosion are slightly diminishing the supply of this service.
Carbon storage	2.5	2.5	2.5	3.0	The wetland’s hydrogeological setting and the level of wetness are assumed to support a moderate accumulation of soil organic matter, but somewhat higher in the UVB, which has a higher level of wetness.
TOTAL OVERALL SCORE	**3.3**	**3.3**	**3.2**	**3.3**	Score taken as the average of the five highest scores above

Table 4-104 Rating of the Hogsback wetlands' importance for direct human benefits according to the criteria of Rountree and Kotze (2013) for intact seeps, degraded seeps, floodplain and unchannelled valley bottom (UVB). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		Seeps, intact	Seeps, degraded	Flood-plain	UVB	Motivation
Provisioning services	Water for human use	1.0	1.0	1.0	1.0	Very limited direct use of water from the wetland
	Harvestable resources	3.0	2.0	3.0	3.0	Livestock grazing, but no other known current harvesting
	Cultivated foods	0.0	0.0	0.0	0.0	No cultivation in the wetland
Cultural services	Cultural heritage	1.0	1.0	1.0	1.0	No known cultural heritage features
	Tourism and recreation	1.5	1.5	1.5	1.5	Currently there appears to be limited contribution of the wetland to tourism and recreation
	Education and research	1.0	1.0	1.0	1.0	Currently there appears to be limited contribution of the wetland to education and research.
TOTAL OVERALL SCORE:		**1.3**	**1.1**	**1.3**	**1.3**	Score taken as the average of the five highest scores above

4.9.2.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) for the Hogsback wetlands, the following were noted:

(1) the EIS of the different wetland types;

(2) the PES of the different wetland types; and

(3) the land-use/landcover context of the wetlands (with catchments mostly converted to tree plantations).

Based on the guidelines of Rountree *et al.* (2013) given in the Methods section, the REC for the wetlands should be set at their current PES categories if the importance is moderate or low, and if the importance scores is high or very high the category should be improved by half or a full category. Taking this into account, the REC for the intact seeps, floodplain and unchannelled valley bottom **(Table 4-105)** are all set at a half category higher than their PES, however pending what is identified as the Best Attainable State (BAS). Given item (3) above, and the fact that the tree plantations are largely within the legal limits of planting and there is also little that can be practically done within the wetlands to significantly improve PES, it is likely to be impractical to significantly improve the PES for the wetlands. Further adding to the difficulty of improving the PES of the wetlands, and for wetlands generally in South Africa, are the projected increasing impacts to wetlands associated with climate change (**Box 1**). Therefore, a Best Attainable State for these wetlands would be to maintain their respective current PES scores, which should be seen as a minimum management requirement.

Table 4-105 Recommended Ecological Category (REC) for wetlands in the Hogsback wetland RU

	Seeps intact	Seeps degraded	Floodplain	Unchannelled valley bottom
REC	B / C	D	B / C	B / C

4.10 IUA_T01: Upper Mbashe, Upper Mthatha

Table 4-106 Summary of wetland information for IUA_T01

IUA Description	Upper Mbashe, Upper Mthatha
HGM unit type	Total of 257 wetlands mapped; Channelled Valley Bottom Wetlands: 30% Depression Wetlands: 32% Floodplain Wetlands: 8% Hillslope Seep Wetlands: 19% Unchannelled Valley Bottom Wetlands: 11%
PES per HGM unit type	Channelled Valley Bottom Wetlands - A/B: 51%; C: 26%; D/E/F: 23%. Depression Wetlands - A/B: 46%; C: 31%; D/E/F: 33%. Floodplain Wetlands - A: 29%; C: 15%; D/E/F: 57%. Hillslope Seep Wetlands - A/B: 62%; C: 26%; D/E/F: 12%. Unchannelled Valley Bottom Wetlands - A/B: 67%; C: 18%; D/E/F: 15%.
FEPA Wetlands	There are several FEPA wetlands in the IUA_T01 that include channelled valley bottom, unchannelled valley bottom, hillslope seep, depression and floodplain wetlands. Many of these have been identified as FEPA wetlands because they are known crane breeding/feeding sites or are located in key water supply areas in their catchment. Several of the floodplain and unchannelled valley bottom wetlands have been identified by experts and have been included in the FEPA matrix.
WRU	WRU 22

4.10.1 WRU 22: Elliot/Khowa wetland complex

Table 4-107 Summary of WRU 22

Factor	Comment				
WRU Number (Quat Catchment)	WRU 22 (T11A)				
Level of Assessment	Field-based				
Priority	01				
HGM Unit Type(s)	Hillslope seepage wetlands, channelled valley-bottom, floodplain				
Vegetation types	Sub-Escarpment Grassland Group 5				
SWSA	No				
Threat Status	**FLOODPLAIN**: CRITICALLY ENDANGERED, **CHANNELLED VALLY-BOTTOM**: ENDANGERED, **UNCHANNELLED VALLY-BOTTOM**: ENDANGERED, **SEEP**: LEAST THREATENED				
PES	**Trib**: D (Largely modified)	**FLOODPLAIN (East)**: D (Largely modified)	**CHANNELLED VALLY-BOTTOM (West)**: D (Largely modified)	**FLOODPLAIN (Upper)**: E (Seriously modified)	**FLOODPLAIN (Lower):** C (Moderate)
EIS	(C) (Moderate)	A (Very High)	A (Very High)	A (Very High)	A (Very High)
Contributors	Craig Cowden, Fiona Eggers, Donovan Kotze, and Pumla Dlamini				

4.10.1.1 Wetland Description

The **Elliot/Khowa** wetland complex is a suite of wetlands which pass through the town of Elliot/Khowa in the Eastern Cape. For this study, the overall wetland was split into five (5) hydrogeomorphic (HGM) units namely two (2) floodplain systems, two (2) channelled valley-bottom systems, and one (1) seepage wetland complex. The splitting of the wetland into the various groups was undertaken to ensure that the value of the intact portions of wetland habitat are not lost in the greater system due to the extent of the impacts in other areas. This greater wetland complex forms part of the headwaters of one of the main tributaries of the Mbashe River and is located about 5km downstream of the southern Drakensberg Mountain range. Generally, the wetlands drain in a southernly direction, with the base of the system being characterised by a narrowing of the system and a geological control at the toe of the system. These wetlands fall within the **T11A** quaternary catchment, characterised by a MAP of 745mm and a PET of 1500mm, which suggests that the wetlands would have a moderate sensitivity to hydrological impacts. The geology underlying the wetland complex is the Karoo Supergroup which predominantly comprises of arenite, mudstone, and shale.

Although the Elliot/Khowa wetland complex is predominantly located within the town of Elliot/Khowa, the catchment related impacts are largely associated with agricultural activities, including *inter alia*, commercial annual crops both irrigated and non-irrigated, irrigated pastures, water supply dams, and feedlots/dairies; but also includes the encroachment of alien invasive vegetation, a quarry, and semi-natural habitat. Although these catchment related impacts influence the overall integrity of the various wetland complex units, the greatest impact to some of the systems is related to the in-system impacts.

For ease of interpretation **Figure 4-64** provides an overview of the various wetland complexes and the level at which the systems were assessed. Additionally, **Figure 4-65** to **Figure 4-77** provide a visual overview of some of the impacts within the Elliot/Khowa wetland complex.

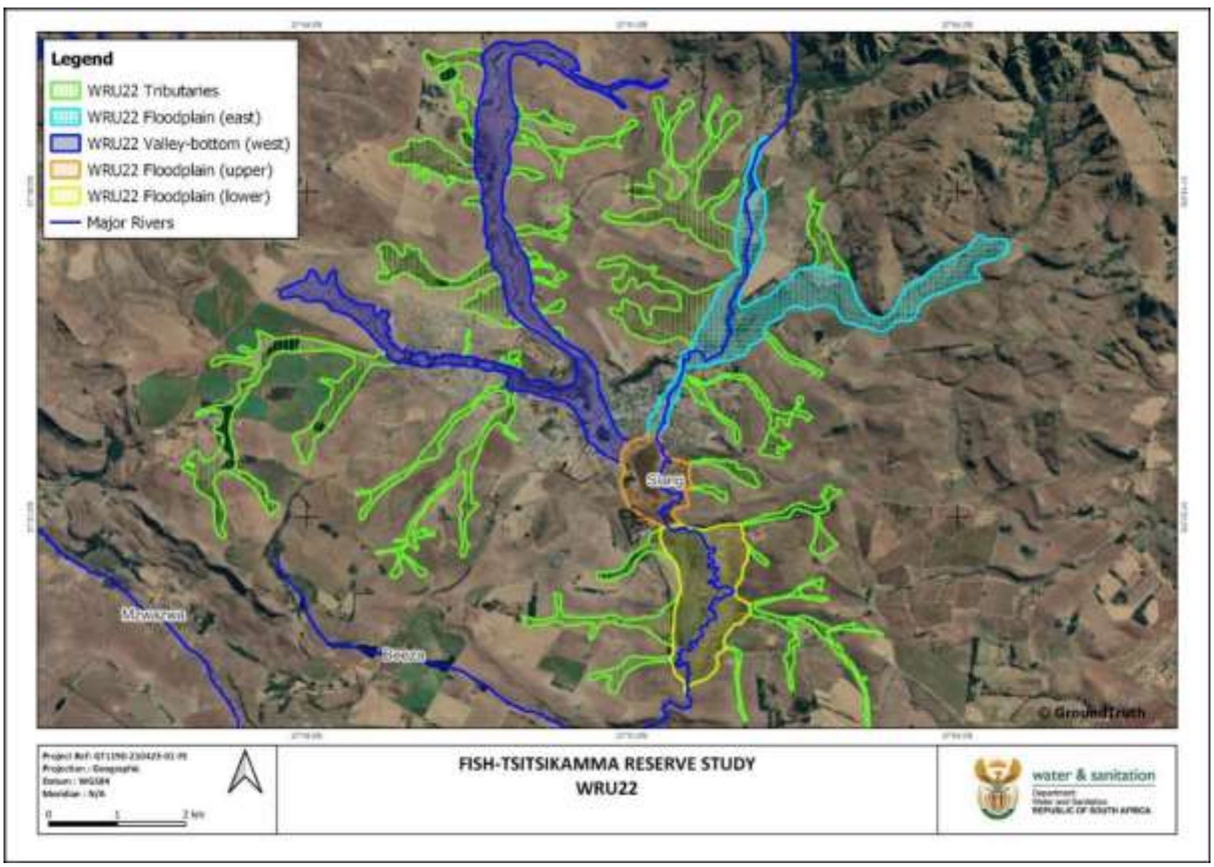

Figure 4-64 Overview of the identified wetland complexes and the level at which the complex was assessed

Tributaries

The tributaries are largely all hillslope-valley-bottom seepage wetlands associated with the Elliot/Khowa wetland complex and cover an area of approximately 1,027.5ha. Most of these wetlands have remained unchanged and thus have been classified as semi-natural. However, based on the catchment being largely dominated by agricultural activities, some of the impacts on the systems include non-irrigated commercial crops, impoundment of flows, the infestation of alien invasive species, and some low-density housing **(Table 4-108)**.

Floodplain (eastern arm)

This unit includes the upper floodplain portion of the Elliot/Khowa wetland complex. The eastern arm originates from the southern Drakensberg Mountain range and flows in a southerly direction towards Elliot/Khowa and covers an area of approximately 363.3ha. The lowest portion of the system extends below the R56 regional road to where the houses along the western edge end.

The impacts on this floodplain system vary from the upper portion being dominated by semi-natural conditions, through to a large water supply dam having been constructed across the majority of the one tributary. Localised dense infestations of silver wattle (*Acacia dealbata*) occur within these upper portions of the wetland.

Downstream therefore, the impacts intensify in the sense that the system runs through the eastern side of Elliot/Khowa. There are varying impacts in this lower portion from there being informal housing along the eastern boundary and low-density housing and some industries/commercial developments along the western boundary. Several drains have been dug along this lower portion, directing flows from the housing and commercial property towards the main channel. It is assumed that this would greatly influence the water quality of this portion of the system but particularly the floodplain directly downstream **(Table 4-108)**.

Channelled valley-bottom (western arm)

This channelled valley-bottom wetland extends through the western side of Elliot/Khowa and covers an area of approximately 445.6ha. The impacts within this system vary significantly with portions of the system being influenced by the agricultural land use practices, whilst the western and lower portion being affected by urbanisation.

Although large portions of the eastern arm of the valley-bottom are semi-natural (up to 45% of the system), some of the in-system impacts to this arm include the impoundment of flows through a series of small agricultural dams, cultivated lands, modifications to the channel itself with portions of the system having been straightened, and the R58 regional road bisecting the system.

The more significant impacts on the system are along the western arm. The upper portion of this arm is dominated by agricultural activities and includes portions of the system having been transformed to cultivated lands. However, downstream of this section and from which point the catchment of the system becomes urbanised, the real impacts on the system begin. A large part of the catchment associated with this lower section of the wetland has been classified as urban residential. In the not-so-distant past, a wastewater treatment works (WWTW) and its associated infrastructure i.e., sewage pipeline, was constructed for this urban residential area, however, due to political discrepancies within the community, the WWTW has never been operational. All the sewage from the connected houses is being discharged into the pipes but due to the WWTW not being operational does not decant into the WWTW, but rather has resulted in several of manholes from overflowing. The raw sewage from the discharging manholes generally decants into the valley-bottom wetland habitat, resulting in large area of the wetland being hydrologically wetter than under normal circumstances but also the water quality of the system has substantially deteriorated, which is regrettable, as it is not only a health hazard to the adjacent community but also in that the livestock are dependent on the wetland as a source of water.

Additional modifications within this lower portion of the wetland include the impoundment of flows and overgrazing of the wetland by livestock. At the confluence of the two arms associated with this valley-bottom wetland, flows have been directed towards the straightened channel. The channel straightening is because of flows being directed away from the town and housing, alongside a large earthen berm, thereby protecting this infrastructure from any flood waters. Downstream of the R56, much of the wetland has been developed by industrial/commercial development, which in turn have suitably directed flows around any of the developments and towards the main straightened channel. The base of this system is the start of the floodplain wetland system **(Table 4-109).**

Floodplain (upper portion)

The Elliot/Khowa floodplain has been separated into two systems for this study, namely the upper and lower portions. The split of the system is at an old railway crossing which bisects the system but also separates the impacts on the system. This upper portion covers an area of approximately 113.1ha.

This upper floodplain habitat has been substantially modified through a suite of historical land use practices. The two valley-bottom system described above, decant into this upper floodplain portion. Historically, this portion of wetland has been dominated by two meandering channels and its associated oxbow lakes and old flood channels. Evidence of this still exists along the eastern boundary of the floodplain, where the meandering channel has been largely maintained. However, this meandering channel has become incised based on the adjacent land use practices. Parts of the old meandering channel has been impounded with two large dams located off-channel from the main channel. Along the western banks of this channel, a large earthen berm and drain has been created, which serve to divert flows off the adjacent crop lands. This berm has resulted in this eastern meandering channel being confined in its current flow path, and resultantly the channel has become incised, as the energy within the channel is utilised in a vertical manner instead of horizontally across the floodplain.

As described above, the channel associated with the western channel valley-bottom has been straightened, which continues into the downstream floodplain system. The flows from the western channel have been canalised and flows between industrial developments and treatment/settling ponds, and the cultivated land on the east, i.e., the central portion of the floodplain is the cultivated lands. The flows from the western channel flow in a southerly direction to the confluence of the two channels.

Below the confluence of the two channels, the channel again is confined in its flow path with the second impoundment along the eastern banks and cultivated lands along the western banks. The base of this portion of the floodplain is defined by the old railway line **(Table 4-109).**

Floodplain (lower portion)

This lower portion of the Elliot/Khowa wetland complex is considered to be the most intact portion of the entire wetland complex (+-240.7ha), with the least number of impacts on the system. However, it is nonetheless not exempt from some impacts. The largest impact steaming from the upstream wetland complexes is associated with water quality, mainly linked to the raw sewage entering the western valley-bottom wetland and the flows which have been directed off the informal housing along the eastern valley-bottom. However, within the upper section of this floodplain is a local abattoir, which may potentially also be influencing the water quality within this lower portion. Below the abattoir are several fields which are utilised for grazing purposes and are also mowed.

A small section of the main channel has historically been straightened however, the area of influence is limited, as below this straightened section, the channel is allowed to maintain its natural course i.e., evidence of old flood channels and oxbow lakes, and is generally very shallow. Wetness ranges from temporary through to seasonal to permanent saturation/flooding, and the floodplain wetland area appears to be maintained by a combination of bank overspill from the main channel (mostly in the downstream portions) and by lateral inflows. Grasses (e.g., *Themeda triandra* and *Eragrostis* spp.) dominate the temporary areas and sedges (e.g., *Carex acutiformis* and *Cyperus fastigiatus*) and reeds, Phragmites australis the permanent areas, while a sedge/grass mix is characteristic of the seasonal areas. Scattered *Salix babylonica* and *Salix fragilis* trees occur along much the length of the Slang River flowing through the floodplain.

The **wetland supports breeding Crowned Crane** as well as hosting large numbers of **foraging Crowned Cranes**. In a field visit to the floodplain in March 2022, a pair of Crowned Cranes were observed with an unfledged chick adjacent to the permanently flooded back marsh area, together with a flock of 63 Crowned Cranes in an area lower in the floodplain which was shallowly flooded.
Owing to its importance for cranes and the fact that floodplains are a highly impacted wetland type generally, the site has a high biodiversity importance. The site also has a high ecosystem services importance, both in terms of provisioning services for livestock grazing, water supply and areas for cultivation. Further as well as in terms of regulating services, particularly with respect to flood attenuation and the enhancement of water quality compromised by Elliot's/Khowa's wastewater treatment works which discharges into the floodplain and from runoff from adjacent urban areas and intensive agricultural production, notably a livestock feedlot and abattoir immediately adjacent to the floodplain. Most of Elliot/Khowa town lies close to the floodplain and some of the town extends into the floodplain itself and into several of the wetland tributary arms feeding the floodplain, thus **highlighting the great need for effective ecological planning and management of the greater floodplain wetland complex** **(Table 4-109).**

Table 4-108 Landcover percentage in the Elliot/Khowa wetland complex wetland RU[9]

Level 1B assessment		
Landcover Categories	**Percentage cover in the tributaries**	**Percentage cover in the FP (east)**
Open Water – Natural	0,6%	-
Deep flooding from impoundments	4,2%	6,0%
Shallow flooding from impoundments	0,4%	0,0%
Aquaculture dams/ponds	0,01%	0,0%
Natural / Minimally impacted	17.9%	0,0%
Semi-natural (undrained)	35.8%	28,7%
Semi-natural (drained)	7,7%	0,1%
Moderately degraded land	18,9%	23.3%
Commercial annual crops (non-irrigated)	7,5%	31,5%
Dense infestations of invasive alien plants	0,8%	8,1%
Quarrying (sand, stone, diamonds)	0,01%	0,3%
Eroded areas (& heavily degraded lands)	0,5%	0,0%
Urban Industrial/Commercial	0,0	0,4%
Urban Informal	0,1%	0,8%
Urban Residential – low density	0,3%	0,5%
Planted pastures (irrigated)	4,2%	0,0%
Infilling (incl. infrastructure)	0,3%	0,4%
Artificially wetter areas	0,7%	0,0%
Total	**100%**	**100%**

[9] It should be noted that the percentage cover may exceed 100% due to the rounding of numbers.

Table 4-109 Landcover percentage in the Elliot/Khowa wetland complex wetland RU

Level 2 assessment			
Landcover Categories	**Percentage cover in the CVB (west)**	**Percentage cover in the upper floodplain**	**Percentage cover in the lower floodplain**
Open Water – Natural	-	-	0,2%
Deep flooding from impoundments	1,4%	4,1%	-
Shallow flooding from impoundments	1,0%	8,6%	-
Aquaculture dams/ponds	-	4,6%	-
Natural / Minimally impacted	-	-	68,2%
Semi-natural (undrained)	45,9%	-	24,6%
Semi-natural (drained)	12,5%	39,6%	5,9%
Moderately degraded land	17,6%	7,6%	-
Commercial annual crops (non-irrigated)	7,7%	30,4%	1,1%
Dense infestations of invasive alien plants	0,1%	-	-
Quarrying (sand, stone, diamonds)	0,7%	-	-
Eroded areas (& heavily degraded lands)	1,0%	-	-
Urban Industrial/Commercial	2,8%	1,5%	-
Urban Residential – high density	3,7%	-	-
Urban Residential – low density	0,4%	1,9%	-
Urban Open Space	0,1%	-	-
Infilling (incl. infrastructure)	2,9%	1,6%	-
Artificially wetter areas	2,3%	-	-
Total	**100%**	**100%**	**100%**

Figure 4-65 View of one of the tributaries flowing into the floodplain. This portion of the system has a series of dams to assist with the commercial agricultural practices which include crop cultivation and livestock grazing

Figure 4-66 View of an intact portion of the channelled valley-bottom wetland associated with the floodplain wetland.

Figure 4-67 Solid waste and die - back of wetland vegetation due to sewage contamination.

Figure 4-68 View of the die - back of vegetation due to the accumulation of sewage within the wetland as a result of the surchraging sewerage infrastructure.

Figure 4-69 Surcharging manhole with the sewage being directed towards the wetland.

Figure 4-70 Downstream portion of the floodplain, which is directly upstream of the geological control. This portion of the wetland resembles the most intact portion of the system and is also home to breeding cranes

Figure 4-71 Incised floodplain channel (in the background), which has been restricted in its movements due to a geological control along its northern boundary and a flood protection berm along its southern boundary.

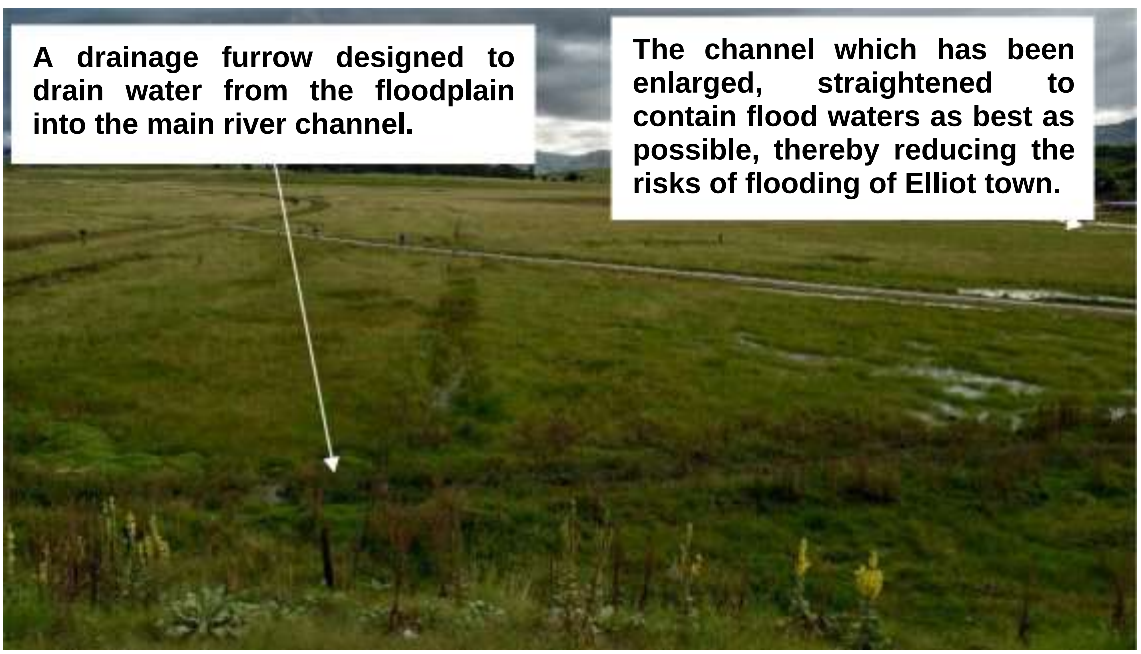

Figure 4-72 The lowermost portions of the main western wetland arm feeding the Elliot/Khowa floodplain

Figure 4-73 Flood-prone houses situated adjacent to the enlarged and straightened channel shown in the previous photo.

Figure 4-74 A low-lying flood-prone area of Elliot/Khowa town located within the wetland complex.

Figure 4-75 The Slang River at the inflow to the upper portions of the Elliot/Khowa floodplain, showing the vegetation dominated by kikuyu (*Pennistem clandestinum*) an alien pasture grass species.

Figure 4-76 Some of the upper portions of the Elliot/Khowa floodplain, with the indigenous shrub *Leucosidea sericea* and predominantly indigenous pioneer grasses, including *Eragrostis* and *Sporobolus* spp.

Figure 4-77 Some of the upper portion of the Elliot/Khowa floodplain, with the higher-lying areas dominated by grasses and the lower-lying areas by sedges.

4.10.1.2 Present Ecological State

The Elliot/Khowa wetland complex comprises of a variety of HGM unit types. For the purpose of this study and based on the 200m buffer and in-system impacts, the five (5) complexes have been assessed separately and at differing levels. The level of assessment adopted for each is as follows:

Level 1B assessment (Table 4-110):
  - Tributaries
  - Floodplain (eastern arm)
- **Level 2 assessment (Table 4-111)**:
  - Channelled valley-bottom (western arm)
  - Floodplain (upper portion)
  - Floodplain (lower portion).

As highlighted in the above section, the overall wetland complex has undergone several changes linked to changes in the hydrological and geomorphological functioning of the system, and thus in return the vegetative component. However, the **largest impact on all the assessment units is linked to water quality**. The modified nature of the systems greatly reduces the efficacy of the systems to provide any water quality enhancement services, which is further exacerbated by the inputs into the system e.g., raw sewage. Some of the impacts on the system are irreversible e.g., the large drains and impoundments within the upper floodplain wetland, however, raw sewage discharge into the wetlands e.g., due to the lack of an operational WWTW, can be mitigated and addressed, thereby contributing to the improved of all the systems' ecological integrity.

Table 4-110 Present ecological state

Tributaries

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	3.3	3.2	5.3	5.1
PES Score (%)	67%	68%	47%	52%
Ecological Category	**C ↓**	**C →**	**D ↓**	**D →**
Combined Impact Score	4.1			
Combined PES Score (%)	59%			
Combined Present Ecological Category	**D →**			

Floodplain (eastern arm)

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	4.5	3.6	5.1	7.2
PES Score (%)	55%	64%	49%	28%
Ecological Category	**D →**	**C →**	**D ↓**	**E →**
Combined Impact Score	5.0			
Combined PES Score (%)	50%			
Combined Present Ecological Category	**D →**			

Table 4-111 Present ecological state

Channelled valley-bottom (west)

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	4.3	2.1	6.1	5.9
PES Score (%)	57%	79%	6%	41%
Ecological Category	**D →**	**C →**	**E ↓**	**D →**
Combined Impact Score	4.5			
Combined PES Score (%)	55%			
Combined Ecological Category	**D →**			

Upper Floodplain portion

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	6.8	2.9	6.8	7.8
PES Score (%)	32%	71%	32%	22%
Ecological Category	**E →**	**C →**	**E ↓**	**E →**
Combined Impact Score	6.3			
Combined PES Score (%)	37%			
Combined Ecological Category	**E →**			

Lower Floodplain portion

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	3.5	1.6	5.3	1.8
PES Score (%)	65%	84%	47%	82%
Ecological Category	**C →**	**B →**	**D ↓**	**B →**
Combined Impact Score	3.1			
Combined PES Score (%)	69%			
Combined Ecological Category	**C →**			

4.10.1.3 Ecological Importance and Sensitivity

The Elliot/Khowa wetland complex was split into five (5) different assessment units, and were assessed separately for their ecological importance, due to the varying impacts on the various portions of the systems and the ecological integrity associated with these assessment units. These scores will only be described separately, should there be a significant difference in the scores/categories, however, should the scores just vary within a category, these will be described together.

Table 4-112 highlights that four (4) of the five (5) systems are considered to have high ecological importance, which is due to the landscape factors but also due to **the presence of crowned cranes within the system. Table 4-113** highlights that the key contributing factor to the wetlands functional/ecosystem services is the nature of the systems, and the demand for these services, particularly relating to water quality enhancement. The services were Identified as moderate, except for the eastern channelled valley-bottom wetland which has been identified as having a marginal contribution. **Table 4-114**, which is linked to the provision services is generally limited due to the modified nature of the system, however, water source and utilisation of the system for livestock grazing did feature.

Table 4-112 Rating of the Elliot/Khowa wetland complexes' Ecological Importance and Sensitivity according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Tributaries	FP (east)	CVB (west)	Upper Floodplain	Lower Floodplain	Motivation
1. Biodiversity support	**2.0**	**3.5**	**3.7**	**3.7**	**3.7**	Score taken as the average of the three scores below
Presence of Red Data species	2.5	4.0	4.0	4.0	4.0	This greater system supports crowned cranes
Populations of unique species	2.0	2.5	3.2	3.2	3.2	Crowned cranes in the lower floodplain wetland
Migration/breeding/feeding sites	1.5	4.0	4.0	4.0	4.0	This greater system supports crowned cranes (breeding. foraging. etc.)
2. Landscape scale	**2.5**	**2.9**	**2.7**	**2.8**	**3.2**	Score taken as the average of the five scores below
Protection status of the wetland	1.0	1.0	1.0	1.0	1.0	These wetlands are not formally protected
Protection status of the vegetation type	4.0	4.0	4.0	4.0	4.0	Sub-Escarpment Grassland Group 5 has been categorised as endangered
Regional context of the ecological integrity	2.5	3.5	3.0	3.5	3.5	**Trib & CVB**: The level of cumulative loss within the broader landscape is high. including these systems **Floodplains:** The level of cumulative loss within the broader landscape is high. however. this lower habitat is considered to still be relatively intact
Size and rarity of the wetland type/s present	4.0	4.0	4.0	4.0	4.0	Linked to the size of the systems
Diversity of habitat types	1.0	2.0	1.5	1.5	3.5	**Trib:** The seepage valley-bottom wetlands have been modified but also would generally be dominated by grassland species. **FP east:** The modified nature of the system limits the variety of habitat available. **CVB west:** The modified nature of the system limits the variety of habitat available.

Ecological Importance	Tributaries	FP (east)	CVB (west)	Upper Floodplain	Lower Floodplain	Motivation
						Floodplain upper: The modified nature of the system limits the variety of habitat available. **Floodplain lower:** The variety of saturation across the system allows for a variety of habitats
3. Sensitivity of the wetland	**1.3**	**3.0**	**1.8**	**3.0**	**3.0**	Score taken as the average of the three scores below
Sensitivity to changes in floods	1.0	4.0	2.0	4.0	4.0	Based on the HGM unit type, and/or sensitive/unique features within the system that are sensitive to changes
Sensitivity to changes in low flows/dry season	1.0	3.0	2.0	3.0	3.0	As above
Sensitivity to changes in water quality	2.0	2.0	2.0	2.0	2.0	Predominantly mudstone geology
TOTAL OVERALL SCORE:	**2.5**	**3.5**	**3.7**	**3.7**	**3.7**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-113 Rating of the Elliot/Khowa wetlands' hydrological/functional importance according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecosystem benefits	Tributaries	FP (east)	CVB (west)	Upper Floodplain	Lower Floodplain	Motivation
Flood attenuation	2.0	2.5	2.8	2.5	3.0	**Trib**: Flood attenuation is in high demand, as a large portion of the Elliot/Khowa town is located within the lower lying areas. **FP** east: The demand for this service is high, based on the town of Elliot/Khowa being located downstream of most of the the wetland habitat. The dams along the length of the system provide some level of flood attenuation, however, the remaining degraded nature of the system limits the efficacy of the system at supplying this service. **CVB** west: The demand for this service is high, as portions of the system flow through a large part of Elliot/Khowa. However, portions of the system have been modified to include channel straightening and earthen berms, limiting the efficacy of the system to supply this service. **Floodplain upper**: Moderately low longitudinal slope and floodplain wetland. The more incised nature of the one channel and canalisation of the other inflowing stream limits the efficacy with limited attenuation capacity. the urban nature of the surrounding landscape increased the demand for flood attenuation. **Floodplain lower**: Moderately low longitudinal slope and floodplain wetland. The depth of the channel is largely reduced from the central portion of the system thereby increasing the efficacy of this system at supplying this service.
Streamflow regulation	2.2	2.5	1.8	2.0	2.0	**Trib:** The nature of the systems is normally associated with groundwater discharges, and therefore, the contribution of flows into the dry season may be extended. **CVB west:** The lateral inputs from the adjacent seepage wetlands contribute towards the systems streamflow regulation. **Floodplains:** The geology is predominantly comprised of sandstone and mudstone which do not typically have strong groundwater interactions. However, the upstream system and seepage wetlands within the landscape would contribute to this.

Ecosystem benefits	Tributaries	FP (east)	CVB (west)	Upper Floodplain	Lower Floodplain	Motivation
Sediment trapping	2.1	2.0	1.8	2.8	3.3	**Trib:** the importance of the wetlands for sediment trapping is the contribution that it will make to avoid delivering additional sediments into the largely modified downstream systems. **FP east**: The nature of the system limits the ability of the system at supplying his service. Additionally, overbank topping and flows spreading across the adjacent terraces is limited to portions of the system. **CVB west**: Portions - mostly the upper sections - of the wetland can supply this service, however the more degraded nature of the system downstream reduces the efficacy. **Floodplain upper**: See flood attenuation. Further adding to the importance of the wetland for sediment trapping is the contribution that this will make to avoided sedimentation of the downstream floodplain. In addition, the nature of surrounding land uses e.g., informal housing; means that there is a high level of sediment production. Therefore, the demand for this service will be very high, but the ability of the wetland to supply this service may be compromised due to the channelled and incised nature of some of the wetland. **Floodplain lower**: See flood attenuation
Phosphate assimilation	2.2	2.5	2.8	2.8	3.2	**Trib**: As above. Also, to note that the effectiveness of the wetland is likely to be high for the assimilation of phosphates, nitrates and toxicants, given the diffuse flows across the wetland and the generally high level of wetness and vegetation cover across much of the wetland. In addition, the agricultural dominated landscape would increase the demand for this service. **FP east:** Based on the nature of the system being channelled. Based on the land use of the catchment, the demand for this service is likely to be high **CVB west:** The effectiveness of the wetland within the upper portion of the system is likely to be high for the assimilation of phosphates, nitrates and toxicants, given the moderately diffuse flows in portions of the wetland and the generally high level of wetness and vegetation cover across much of the wetland. However, the lower portion of the system the overall integrity of the system decreases with portions of the channel having been

Ecosystem benefits	Tributaries	FP (east)	CVB (west)	Upper Floodplain	Lower Floodplain	Motivation
						modified. The demand for water quality enhancement within the system is particularly high based on the discharge of raw sewage into the wetland and the use of the wetland by the community surrounding it. Furthermore, based on the nature of the catchment land use activities, the demand for this service is high. **Floodplain upper:** See sediment trapping above. Also, to note that the effectiveness of the wetland is likely to be moderate for the assimilation of phosphates, nitrates and toxicants, given the limited diffuse flows in portions of the wetland. However, typical sources of anthropogenically-derived phosphate, nitrates and toxicants such as stormwater outflows, leaking sewage infrastructure and industrial effluent are extremely high in the catchment and therefore the demand will be very high. Demand is increased due to important floodplain downstream. **Floodplain lower:** See above. The relatively intact nature of the system including the overbank topping into the adjacent oxbows and old flood channels increases the efficacy of this system at supplying this service. Typical sources of anthropogenically-derived phosphate, nitrates and toxicants such as stormwater outflows, leaking sewage infrastructure and industrial effluent are extremely high in the catchment and therefore the demand will be very high.
Nitrate assimilation	2.2	2.5	2.8	2.8	2.8	As above
Toxicant assimilation	2.2	2.5	2.8	2.8	2.8	As above
Erosion control	2.1	2.5	2.0	2.5	2.5	**Trib:** Much of the wetlands are maintained under permanent vegetation cover, therefore promoting the control of erosion. **FP east:** The steep nature of the system, and the lower portion becoming more incised, reduces the ability of this system at supplying this service. **CVB west:** Large portions of the wetland are dominated by permanent vegetation cover, and therefore promoting the control of erosion. The efficacies within the lower portion are largely reduced due to the channel modifications. **Floodplain upper:** The vegetation cover in the wetland is highly variable, and the incised nature and channel modifications have reduced the

Ecosystem benefits	Tributaries	FP (east)	CVB (west)	Upper Floodplain	Lower Floodplain	Motivation
						effectiveness of the system to supply this service. However, the demand is high. **Floodplain lower:** The high level of vegetative cover within the system, therefore promoting the control of erosion
Carbon storage	1.8	2.2	1.8	2.2	3.2	**Trib:** The carbon storage abilities have been slightly reduced, as portions of the wetland have been cultivated. Additionally, the saturation level of these wetlands is not as high in comparison to other HGM unit types. **CVB west:** The carbon storage abilities have been slightly reduced, as portions of the wetland have been cultivated and/or has become incised, with the saturation levels within these portions of the system being less than the more intact portions. **Floodplains:** The wetland’s hydrogeological setting and relatively high level of wetness support the accumulation of soil organic matter, and the presence of organic sediments across extensive areas of the wetland
TOTAL OVERALL SCORE	**2.2**	**2.5**	**2.6**	**2.7**	**3.1**	Score taken as the average of the top five scores above

Table 4-114 Rating of the Elliot/Khowa wetland's importance for direct human benefits according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		Tributaries	FP (east)	CVB (west)	Upper Floodplain	Lower Floodplain	Motivation
Provisioning services	Water for human use	1.6	2.8	1.8	1.8	1.8	**Trib:** Water storage dams have been created along some of the tributaries for agricultural purposes. **FP east:** The large dam which extends across a large portion of the system is likely to be a water supply dam to the town of Elliot/Khowa. Based on the nature of the systems in the broader area, and the water quality related issues, this system cannot be easily substituted **CVB west:** there are limited areas of open water, and in these areas the use of the water is predominantly for livestock and not human consumption. **Floodplain upper:** Water quality issues preclude the use of this water by humans, although the adjacent informal housing may be reliant on the system for domestic purposes. Along with the livestock associated in these areas. **Floodplain lower:** Water quality issues preclude the use of this water by humans.
	Harvestable resources	0.8	1.0	2.5	1.0	1.0	**Trib:** Although portions of the wetlands are used for grazing purposes, large other areas are available for grazing. **FP east:** Although portions of the system are under cultivation, the cultivation is associated with more commercial growers and not subsistence. **CVB west:** A large portion of the wetland, which is not privately owned, is utilised by the adjacent community's livestock for grazing and as a water source. **Floodplain upper:** No known current harvesting **Floodplain lower:** No known current harvesting
	Cultivated foods	0.6	1.0	1.0	1.0	1.0	No subsistence practices were observed.
Cultural services	Cultural heritage	0.3	1.0	1.0	1.0	1.0	No known cultural heritage features.
	Tourism and recreation	0.3	0.3	0.3	0.3	0.3	There currently is a very limited contribution of the wetland to tourism and recreation

Direct human benefits		Tributaries	FP (east)	CVB (west)	Upper Floodplain	Lower Floodplain	Motivation
	Education and research	0.4	0.3	0.3	0.3	0.3	There appears to be a very limited contribution of the wetland to education and research
TOTAL OVERALL SCORE:		**0.7**	**1.2**	**1.3**	**1.0**	**1.0**	Score taken as the average of the top five scores above

4.10.1.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) **(Table 4-115)** for the Elliot/Khowa wetlands, the following were noted:

(1) the EIS of the various wetland types;

(2) the PES of the various wetland types; and

(3) the land use/landcover context of the wetlands – with all the wetlands being detrimentally affected by water quality related issues e.g., raw sewage discharge.

Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for the wetland should be set at a level above the current PES categories. Given item (3) above, the integrity of the systems could be improved through the management of contaminated water inputs such as, raw sewage from the overflowing manholes and lack of a functioning WWTW. The PES water quality component for all the systems was not higher than a D-category, with some being as low as an E-category. Upon addressing the issues associated with water quality particularly relating to the overflowing manholes and raw sewage flowing into the wetland, the overall integrity is likely to improve. However, it is nonetheless, imperative that additional management and maintenance practices are assessed and adopted across the greater system, as highlighted in the results of the cost-benefit analysis undertaken for the Chatty River Wetland Complex (refer to Section 4.3.2).

In addition, practices linked to management of AIP and the nature and extent of the agricultural practices[10], particularly in the floodplain systems, can result in an improvement of the overall PES of the systems. For the lower floodplain system, it is essential that the dynamics of the system functioning are maintained, i.e., the encroachment of AIP and agricultural practices (i.e. cultivation and/or intensive grazing) into the lower portion should be prohibited.

Table 4-115 Recommended Ecological Category (REC) for wetlands in the Elliot/Khowa wetland complex WRU

	Level 1B: Tributaries	Level 1B: Floodplain (eastern arm)	Level 2: Channelled Valley-Bottom (west)	Level 2: Floodplain (upper)	Level 2: Floodplain (lower)
REC	C / D	C / D	C	D	B

[10] It should be noted that the legality of some of the agricultural practices may require verification based on the modifications being within the floodplain wetland

4.11 IUA_T04: Pondoland Coastal

Table 4-116 Summary of wetland information for IUA_T04

IUA Description	Pondoland Coastal
HGM unit type	Total of 562 wetlands mapped; Channelled Valley Bottom Wetlands: 36% Depression Wetlands: 28% Floodplain Wetlands: 1% Hillslope Seep Wetlands: 23% Unchannelled Valley Bottom Wetlands: 12%
PES per HGM unit type	Channelled Valley Bottom Wetlands - A/B: 31%; C: 41%; D/E/F: 28%. Depression Wetlands - A/B: 13%; C: 11%; D/E/F: 76%. Floodplain Wetlands - A/B: 57%; C: 29%; D/E/F: 14%. Hillslope Seep Wetlands - A/B: 37%; C: 25%; D/E/F: 38%. Unchannelled Valley Bottom Wetlands - A/B: 42%; C: 33%; D/E/F: 24%.
FEPA Wetlands	Multiple wetlands have been given FEPA status in IUA_T04 – predominantly for the fact that they are important crane breeding for feeding wetlands.
WRU	WRU 24 and WRU 25

4.11.1 WRU 24 – Sikombe and Xolobeni

Table 4-117 Summary of WRU 24

Factor	**Comment**	
WRU Number (Quat Catchment)	WRU 24 (T60D)	
Level of Assessment	Field-based	
Priority	02	
HGM Unit Type(s)	Channelled Valley-bottom Wetlands	
Vegetation types	Indian Ocean Coastal Belt Group 3	
SWSA	No	
Threat Status	**CHANNELLED VALLEY-BOTTOM**: LEAST THREATHENED	
PES	**Sikombe**: B (Largely natural)	**Xolobeni**: C (Moderate)
EIS	B (High)	B (High)
Contributors	Craig Cowden and Fiona Eggers	

4.11.1.1 Wetland description

The Wetland Resource Unit comprises of two **palmiet (*Prionium serratum*) wetland complexes**, namely the **Sikombe wetlands** (+-16.8ha) and the **Xolobeni wetlands** (+-9.8ha) **(Figure 4-78).** These wetlands fall within the **T60D quaternary catchment**, characterised by a MAP of 1072mm and a PET of 1150mm, which suggests that the wetlands would have a low sensitivity to hydrological impacts. The geology underlying these wetlands is the Cape Supergroup which predominantly comprises of arenite and shale. These wetlands have been typed as channelled valley-bottom wetlands and are between 4.5km and 6.5km upstream of the coastline, known as the Wild Coast of South Africa.

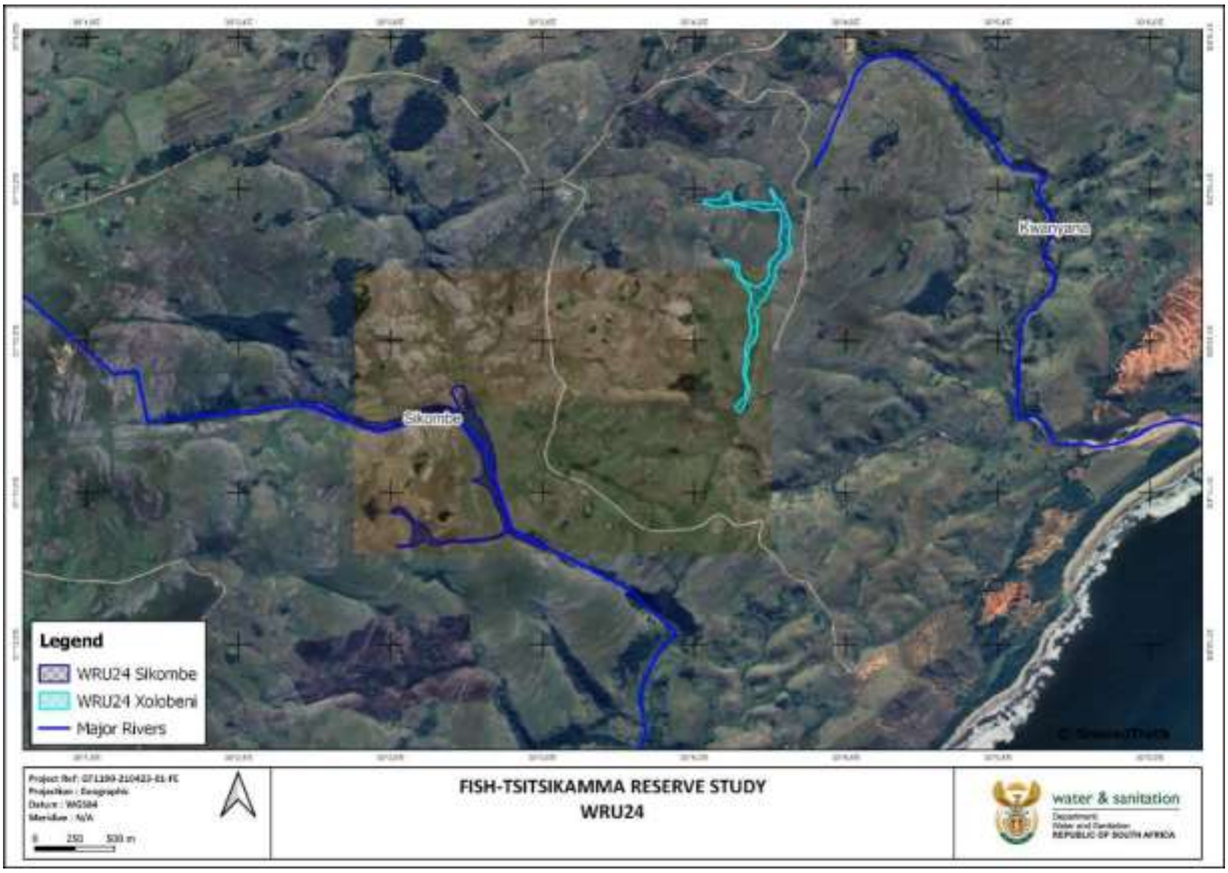

Figure 4-78 Overview of the Sikombe and Xolobeni WRUs

These wetlands comprise of valley-bottom and seepage palmiet-dominated wetlands and are defined by a geological control at the base of each system. The Sikombe wetland is located along the Sikombe River, whilst the Xolobeni wetland is a tributary of the Kwanyana River. Both of these wetlands and rivers drain into the Sikombe and Kwanyana estuaries, which have been classified as natural systems, i.e., a PES category of A/B. This is based on the limited upstream impacts and/or modifications to the systems catchments.

Although both systems are palmiet dominated systems and in close proximity to one another, the catchment related, and in-system impacts on the systems differ across the catchments **(Table 4-118).** The Sikombe catchment has mostly been identified as semi-natural (63% of the catchment), with livestock grazing of these open areas being the main use. Within proximity to the rural houses, subsistence agricultural activities persist but are very limited in extent (13.5%). There are some pockets of alien invasive vegetation (5.5%), but are generally near the houses, which covers an area of approximately 4.6%.

The catchment of the Xolobeni system has been substantially more modified than the Sikombe catchment due to the higher density of people within the catchment. This is evident in that approximately 43.9% of the catchment has been identified as semi-natural, subsistence crops at 22.9%, alien invasive vegetation at 5.8%, and houses/urban infrastructure at approximately 9%. The increased number of persons within the localised catchment, therefore, increases the pressures placed on the wetland habitat and the benefits derived from the system. In addition, sand mining practices were identified within the 200m buffer of the wetland, creating an additional source of sediments entering the system.

The vegetation of these systems is predominantly dominated by palmiet, with the drier patches seeing the establishment of woody species such as *Syzygium* spp. The tributaries are generally heavily eroded systems, which in some instances is attributed to the encroachment of alien invasive species, such as Gum tress (*Eucalyptus* spp), and Black Wattle (*Acacia mearnsii*), into the headwaters of these systems. Of the two systems, the Xolobeni is more heavily infested with alien invasive species at 9.2% whilst Sikombe is at 0.6%. In addition, Woodlots have been established within the upper portions of the Xolobeni system.

For the Sikombe wetland complex, the erosion of the upstream tributaries has likely been a continuous (possibly natural) process based on the degree of alluvial mounds within the wetland. The most recent rainfall of April 2022 has seen a large amount of sediment being mobilised and deposited within the upper reaches of the wetland habitat. The process of scour/erosion and sedimentation within the system has resulted in the formation of obviously over-steepened areas within the system. This over-steepening in the lower portion of the wetland has resulted in the formation of a headcut erosional feature, however, the headcut is onto bedrock and well-vegetated with palmiet, and as such the risk of aggressive advancement of the erosion is limited. It is anticipated that the headcut will slowly migrate upstream and will allow for a new stable state of the system to develop. The process of scour/erosion and sedimentation isa natural cycle within these systems. Downstream of the headcut along the open channel banks, a number of orchid species were identified, contributing to the ***uniqueness*** of the system.

Erosional features were also identified within the Xolobeni wetland complex. However, the erosion of the system coincides with anthropogenic disturbances linked to the installation of a water supply pipeline across the system. The water supply pipeline and the associated pump station are critically important to the adjacent community who rely on the water for **basic human needs**. The placement of the pipeline across the wetland, however, coincides with an over-steepened portion of the system, which has triggered erosion in the system, threatening both the integrity of the wetland and the supply of water to the adjacent communities.

Both the Sikombe and Xolobeni wetland complexes should be considered as **important systems** within the landscape, although for differing reasons. The Sikombe complex is relatively intact and as such should be maintained as such within the landscape, as it is providing a high level of regulating and supporting services to the adjacent community members. The Xolobeni complex is moderately degraded with the possibility of becoming severely degraded if suitable mitigation interventions are not implemented. The wetland is an important system particularly as a supply of potable water to the adjacent communities. Should the erosion within the system not be stabilised, it is likely the communities will lose their source of potable water. The management of the catchment and in-system impacts, such as brick making and the adjacent crop lands/woodlots, must be carefully considered to protect the systems from further degradation.

Figure 4-79 to **Figure 4-89** provide an overview of some of the impacts within the Sikombe and Xolobeni palmiet wetlands.

Table 4-118 Landcover percentage in the Sikombe and Xolobeni wetland RU

Level 1B Landcover Categories	Percentage cover in the Sikombe wetland	Percentage cover in the Xolobeni wetland
Open water - natural	0,2%	0.0%
Natural/minimally impacted	58,2%	28,6%
Semi-natural (undrained)	23,2%	6,1%
Semi-natural (drained)	0.0%	33,7%
Moderately degraded land	8,3%	4,1%
Subsistence crops	0.0%	3,1%
Tree plantations	0.0%	0.0%
Dense infestations of invasive alien plants	0,6%	9,2%
Eroded areas (& heavily degraded lands)	9,5%	12,1%
Sediment deposits	0.0%	3,1%
Total	**100%**	**100%**

Figure 4-79 Sikombe wetland: View of the upstream habitat of one of the major tributaries, which has been recently burnt

Figure 4-80 Sikombe wetland: View of the Palmiet wetland and the establishment of some woody species within the drier portions of the system

Figure 4-81 Sikombe wetland: Rotational madumbe/taro crop field adjacent to the valley bottom wetland in the seepage zones.

Figure 4-82 Sikombe wetland: Headcut erosion within the lower portion of the system.

Figure 4-83 Sikombe wetland: View of the geological control at the base of the palmiet wetland

Figure 4-84 Sikombe wetland: Palmiet wetland below the geological control

Figure 4-85 Xolobeni wetland: View of the upstream portion of the palmiet wetland and the woodlots within the wetland habitat

Figure 4-86 Xolobeni wetland: cultivation within the temporary zones of wetness associated with the seepage zones adjacent to the vallye bottom wetland habitat

Figure 4-87 Xolobeni wetland: View of some of the catchment impacts, and the channel which has eroded onto bedrock (lighter areas)

Figure 4-88 Xolobeni wetland: Headcut erosion upstream of the water abstraction point

Figure 4-89 Xolobeni wetland: Eroded palmiet wetland upstream of the water supply pipeline crossing point. Portions of the pipeline has been encased in concrete, however the channel has bypassed the concrete and has exposed portions of the pipeline

4.11.1.2 Present Ecological State

As described above, the Sikombe and Xolobeni systems are located within close proximity to one another, but with vastly different impacts affecting the overall integrity of the wetlands **(Table 4-119)**. The Sikombe wetland has been categorised as a B-category system, whilst the Xolobeni complex is a **C-category.**

Although the Sikombe wetland has been categorised as a B, the upper portion of the system is considered to be more impacted upon than the lower portion, mainly associated with the deposition of sediments within these areas and slightly more eroded channels, thereby allowing for the establishment of other species other than palmiet. More than half of the system is considered to be natural with limited overall impacts on the hydrology, geomorphology and vegetation components. Due to the limited impacts within the catchment, the water quality of the system is considered to be natural. It is anticipated, that with no changes in the adjacent land uses and/or in-system demands, the wetland would remain unchanged over the next 5 years.

The Xolobeni wetland has been categorised as a low C and is likely to see a large decline in its integrity over the next 5-years mainly attributed to the erosional headcut feature which was initiated as a result of the installation of the water pipeline. The steep gradient of the system and multiple headcuts features are likely to further erode the system, particularly should more heavy rainfall events occur. These erosional features affect not only the geomorphology of the system but also the hydrology and in return the vegetation composition, as more portions of the wetland become desiccated and thereby allowing the encroachment of non-desirable species. Additional degradational features within the wetland include the utilisation of the system for crops and woodlots.

Table 4-119 Present ecological state

Sikombe wetland

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	18.	2.3	0.9	2.9
PES Score (%)	82%	77%	91%	71%
Ecological Category	**B →**	**C →**	**A →**	**C →**
Combined Impact Score	1.9			
Combined PES Score (%)	80%			
Combined Present Ecological Category	**B →**			

Xolobeni wetland

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	4.2	3.7	1.3	5.5
PES Score (%)	58%	63%	87%	45%
Ecological Category	**D ↓↓**	**C ↓↓**	**B →**	**D ↓**
Combined Impact Score	3.7			
Combined PES Score (%)	63%			
Combined Present Ecological Category	**C ↓↓**			

4.11.1.3 Ecological Importance and Sensitivity

The Sikombe and Xolobeni Wetland Complex have a moderate ecological importance, and in a rating of the wetland's EIS **(Table 4-120)** it can be seen that the landscape scale factors make the greatest contribution to the overall score. While from

Table 4-121 it can be seen that for the Sikombe wetland, the relative intactness of the system is contributing towards the high ecological importance category, whilst for the Xolobeni wetland it is the demand for these services that is driving the moderate importance category as this system is more degraded than the Sikombe system. **Table 4-122** depicts that direct human benefits (BHN) received from the Sikombe and Xolobeni wetlands is low, which is largely reduced by the fact that these systems are largely are not used for tourism and educational purposes. However, the Xolobeni system is particularly important from a water provisioning perspective as the catchment is hugely reliant on the system as its source of water.

Table 4-120 Rating of the Sikombe and Xolobeni wetland complexes' Ecological Importance and Sensitivity according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Sikombe	Xolobeni	Motivation
1. Biodiversity support	**3.3**	**1.5**	Score taken as the average of the three scores below
Presence of Red Data species	4.0	1.8	**Sikombe**: Based on discussions with a vegetation specialist who was undertaking work within the area, these wetlands and surrounding landscape contain an amazing array of species which are rare. In addition, the wetland falls within a CBA area. **Xolobeni**: Other systems within the broader landscape have found to contain unusual species - this system likely historically did too
Populations of unique species	3.0	1.8	**Sikombe**: Refer to the above **Xolobeni**: Refer to the above
Migration/breeding/feeding sites	3.0	1.0	**Sikombe**: Uncertain but likely to be important habitat **Xolobeni**: Uncertain but likely to be important habitat
2. Landscape scale	**2.9**	**1.8**	Score taken as the average of the five scores below
Protection status of the wetland	1.0	1.0	Not formally protected
Protection status of the vegetation type	4.0	4.0	The Indian Ocean Coastal Belt Group 3 vegetation type is considered to be endangered
Regional context of the ecological integrity	3.5	1.5	**Sikombe**: The cumulative loss of wetland habitat within the broader landscape is considered to be high **Xolobeni**: PES category is a low C and is representative of the loss of wetlands in the area. There are other wetlands in the area which are in better condition and therefore this wetland does not represent an intact remaining wetland.
Size and rarity of the wetland type/s present	3.0	1.0	Based on the size of the system. For the Sikombe wetland, the level of intactness further contributes to the score.
Diversity of habitat types	3.0	1.5	**Sikombe:** A moderately high diversity is assumed based on the hydrogeomorphic and hydrological diversity of the wetland together with some of the vegetation identified. **Xolobeni:** The system has been substantially modified and thus diversity of the system has largely been reduced
3. Sensitivity of the wetland	**3.0**	**3.0**	Score taken as the average of the three scores below

Ecological Importance	Sikombe	Xolobeni	Motivation
Sensitivity to changes in floods	3.0	3.0	Based on the wetland being a valley-bottom wetland, and that palmiet is sensitive to changes in floods
Sensitivity to changes in low flows/dry season	3.0	3.0	As above
Sensitivity to changes in water quality	3.0	3.0	This is assumed based on the wetland being supplied by naturally low-nutrient waters
TOTAL OVERALL SCORE:	**3.3**	**3.0**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-121 Rating of the Sikombe and Xolobeni wetlands' hydrological/functional importance according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecosystem benefits	Sikombe	Xolobeni	Motivation
Flood attenuation	2.4	2.8	**Sikombe**: The high surface roughness of the system will assist in attenuating flows. However, the lack of floodable property downstream, i.e., low demand for the service, has reduced the overall score for this regulating service. **Xolobeni**: The high surface roughness of the system will assist in attenuating flows. Although the downstream portion of the system is not heavily utilised, there is cultivation etc. within the wetland habitat and thus would be in demand of this regulating service.
Streamflow regulation	3.5	2.1	**Sikombe**: The setting of the system is likely to be associated with groundwater discharge in the wetland, and the limited extent in the wetland of invasive trees potentially increasing atmospheric loss of water from the wetland. **Xolobeni:** Under natural conditions the services supplied by the system would be greatly improved however, due to the erosive features and thus desiccation of the system, and the presence of woodlots and alien invasive species, diminished the systems capabilities at supplying this service
Sediment trapping	2.8	2.0	**Sikombe**: See flood attenuation. However, due to the low demand for this service, the overall score was reduced. **Xolobeni**: See flood attenuation. However, due to the low demand for this service, the overall score was reduced.

Ecosystem benefits	Sikombe	Xolobeni	Motivation
Phosphate assimilation	2.1	2.5	**Sikombe**: See sediment trapping above. Also, to note that the effectiveness of the wetland is likely to be high for the assimilation of phosphates, nitrates and toxicants, given the moderately diffuse flows in portions of the wetland and the generally high level of wetness and vegetation cover across much of the wetland. However, typical sources of anthropogenically-derived phosphate such as cultivation in the wetland's catchment are fairly limited. **Xolobeni**: See sediment trapping above. Also, to note that the effectiveness of this type of wetland would under natural circumstances be high for the assimilation of phosphates, nitrates and toxicants, given the moderately diffuse flows in portions of the wetland and the generally high level of wetness and vegetation cover across much of the wetland. However, the degradation of the system greatly reduces the effectiveness of the system to supply these services. Based on the nature of the catchment, and the fact that there are downstream users, would increase the demand for these services.
Nitrate assimilation	2.1	2.4	**Sikombe:** As above **Xolobeni:** As above
Toxicant assimilation	2.1	2.1	**Sikombe:** As above **Xolobeni:** As above
Erosion control	3.0	2.0	**Sikombe:** Much of the wetland is maintained under permanent vegetation cover, therefore promoting the control of erosion. **Xolobeni:** Large portion of the system is maintained under permanent vegetation, however, with the erosional features within the system, the ability of the system to provide these services is largely reduced.
Carbon storage	3.2	2.5	**Sikombe:** The wetland’s hydrogeological setting and relatively high level of wetness support the accumulation of soil organic matter, and the presence of organic sediments across extensive areas of the wetland is anticipated. **Xolobeni:** The wetland’s hydrogeological setting and relatively high level of wetness support the accumulation of soil organic matter, and the presence of organic sediments across extensive areas of the wetland is anticipated
OVERALL SCORE	**3.0**	**2.4**	Score taken as the average of the top five scores above

Table 4-122 Rating of the Sikombe and Xolobeni wetland's importance for direct human benefits according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		Sikombe	Xolobeni	Motivation
Provisioning services	Water for human use	2.8	3.5	**Sikombe**: The houses near the wetland and which have cultivated fields within the wetland buffer would be utilising the water for human use, and likely as a source of water for livestock. **Xolobeni:** The pump house and water pipeline across the wetland is evidence that the wetland is an important source of water for the catchment. In addition, the persons residing near the wetland are largely dependent on the wetland for water along with the livestock
	Harvestable resources	1.4	1.4	**Sikombe:** No known harvesting practices - but likely to be utilising the wetland vegetation for something based on the rural nature of the landscape. **Xolobeni:** No known harvesting practices - but likely to be utilising the wetland vegetation for something based on the rural nature of the landscape
	Cultivated foods	1.2	1.8	**Sikombe:** No crops cultivated within the wetland. **Xolobeni**: Small areas of subsistence agriculture persist in additional to the establishment of a woodlot
Cultural services	Cultural heritage	1.5	1.5	Unknown practices but likely to be utilised for something based on the rural nature of the landscape
	Tourism and recreation	0.3	0.3	Currently there appears to be limited contribution of the wetland to tourism and recreation
	Education and research	0.3	0.3	Currently there appears to be limited contribution of the wetland to education and research
TOTAL OVERALL SCORE:		**1.4**	**1.8**	Score taken as the average of the top five scores above

4.11.1.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) **(Table 4-123)** for the Sikombe and Xolobeni wetland complexes, the following were noted:

(1) the EIS of the wetlands;

(2) the PES of the wetlands; and

(3) the land use/landcover context of the wetlands i.e. 1) Sikombe being largely intact and 2) Xolobeni being an important water resource for the catchment.

Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for the wetland should be set at the current PES categories, or if practical, improved by half a category. Given item (3) above for both systems, the land use practices directly surrounding the Sikombe wetland should be maintained at the current level and any additional land use changes should be carefully implemented. For the Xolobeni wetland, halting the erosional feature associated with the water pipeline is crucial. The implementation of rehabilitation activities within the system should be implemented as a matter of urgency, to ensure that the community maintains their source of water.

Table 4-123 Recommended Ecological Category (REC) for wetlands in the Sikombe and Xolobeni WRU

	Sikombe	Xolobeni
REC	B	B

4.11.2 WRU 25 – Ludeke Halt

Table 4-124 Summary of WRU 25

Factor	Comment
WRU Number (Quat Catchment)	WRU 25 (T60B)
Level of Assessment	Field-based
HGM Unit Type(s)	Hillslope seepage and channelled valley-bottom wetlands
Vegetation types	Sub-Escarpment Grassland Group 3
SWSA	No
Threat Status	**SEEP**: CRITICAL, **CHANNELLED VALLEY-BOTTOM**: CRITICAL
PES	D (Largely modified)
EIS	B (High)
Contributors	Craig Cowden and Fiona Eggers

4.11.2.1 Wetland description

The Ludeke Halt wetland complex **(Figure 4-90)** is one of the tributaries of the Nqabeni River and comprises of hillslope seepage and channelled valley-bottom wetlands, covering an area of approximately 50.9ha. The wetlands are located within rural /semi-urban landscape, with Ludeke Halt located to the east, Ludeke to the north and KuSiwisa Halt to the west. The wetland complex drains into a tributary of the Nqabeni River, which is a tributary of the Mtentu River. The wetland complex is one of the headwaters of the Nqabeni River, and thus **should be considered as an important ecological feature within the landscape**. Generally, the system drains in a southerly direction and is defined at the base by a geological control. This wetland complex falls within the **T60B** quaternary catchment characterised by a MAP of 896mm and a PET of 1150mm, which suggests that the wetlands would have a low sensitivity to hydrological impacts. The geology underlying the complex is the Karoo Supergroup, with the predominant lithology being shale.

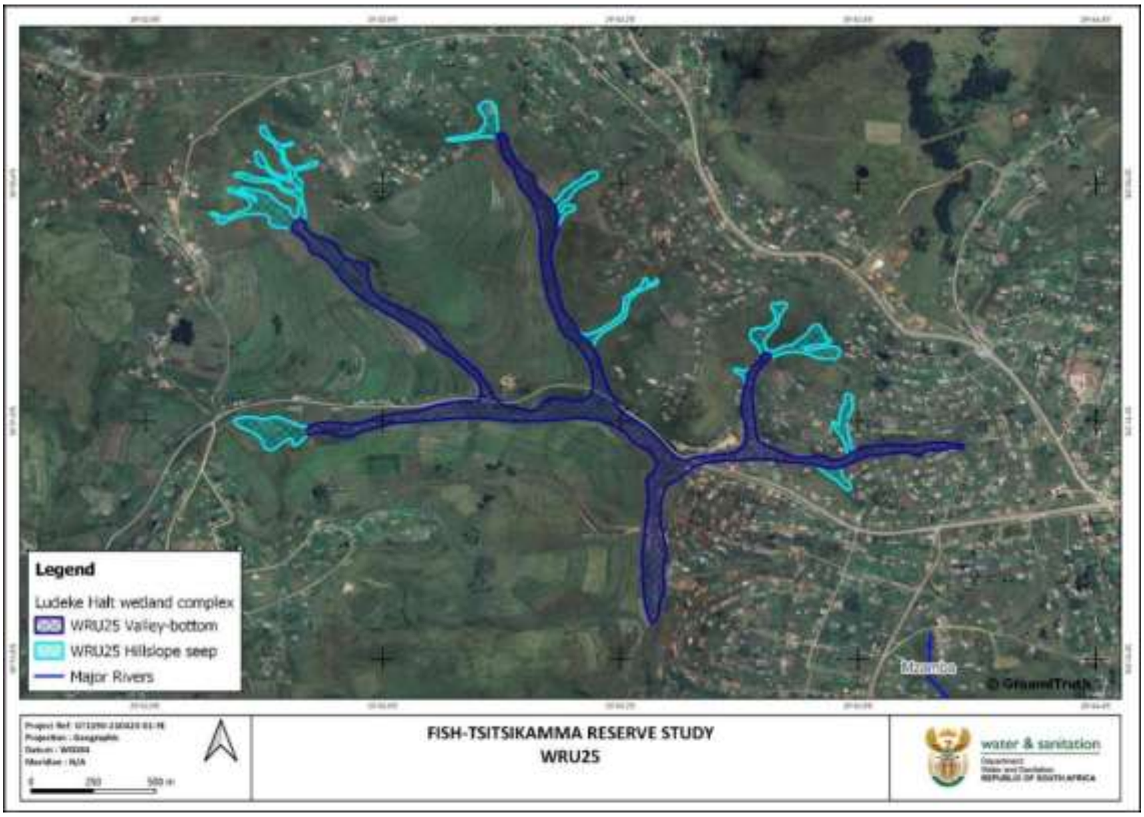

Figure 4-90 Overview of the Ludeke Halt wetland complex

The **Ludeke Halt** wetland complex is located within a rural to peri-urban landscape, with a variety of land uses within the catchment and wetland systems **(Table 4-125).** The north-eastern and eastern portions of the catchment are dominated by rural residential houses and therefore, is generally more heavily populated, whilst the north-west and western portions of the catchment are dominated by commercially cultivated crops, i.e., mass crop production. The variety of land uses within the catchment area also comes with a variety of additional impacts and associated intensities. Generally, the intensity of the impacts associated with the more heavily populated is greater than the impacts linked to the more sparsely populated areas.

Open space areas in amongst the houses is often utilised for livestock grazing and/or subsistence agricultural activities, leading to portions of the catchment being moderately degraded with portions of barren land and/or erosion. The more cultivated portions of the catchment have resulted in the encroachment of alien invasive species, predominantly eucalyptus trees. The more rural nature of the surrounding area has resulted in the harvesting of clay material for brick making in portions of the wetland and the associated buffer.

Although the wetland complex was assessed as a single unit, for the purposes of the description the wetland can be divided into two sections, namely above the R61 and downstream of the R61. The wetland habitat directly upstream of the R61 is in many instances the most degraded portion of the upstream system and has been subject to the formation of headcut erosional features. The western arm of the wetland is the most intact wetland habitat with the majority of the system being identified as semi-natural. The upper portion of the central arm of the wetland has some clay-harvesting activities with a degraded portion of wetland habitat directly downstream thereof. The more central portions of this system have generally been classified as semi-natural. The eastern arm is probably the most degraded of the three upstream systems. This can mainly be attributed to the fact that the surrounding catchment is dominated by peri-urban development, and thus the remaining open space is heavily used for subsistence agriculture and/or livestock grazing. This in turn has greatly impacted portions of the system, with erosional features being evident.

The wetland habitat downstream of the R61 is generally, considered to be the most degraded portion of the wetland complex. The western arm of this portion of the system, which runs parallel with the R61, has been subject to cultivation and a number of clay-harvesting sites. Within the lower portion of this arm, several drains have been created, obviously with the intention of lowering the water table of the system.

The lowest portion of the system is the most severely impacted portion of the wetland complex. The tributary associated with this portion of the wetland has been entirely eroded, which has led to a large deposition of sediments within the valley-bottom and is assumed to have initiated the erosion further upstream in the main valley. An upstream dam has breached, which is assumed to have contributed to the erosion and incision of the main channel.

The channel is approximately 2-3m below ground level. Alongside the channel a natural levee has formed, isolating some of the inputs from the adjacent seepage areas from the impacts of the channel and thus, these areas are relatively functional in comparison to the remaining portions of the valley-bottom wetland habitat.

Largely, the wetland complex vegetation within the seasonal/permanent wetness zones is dominated by common name first, *Cyperus latifolius*, with the adjacent temporary wetness areas characterised by hygrophilous grassland areas. These intact temporary zones of wetness are generally more heavily utilised for grazing.

Even though portions of the wetland complex are severely degraded, large portions of the upstream areas are still considered to be intact. Those systems, which have been slightly degraded, **should ideally be identified as a priority for sensitive management to secure the level of ecosystem functioning. Figure 4-91** to **Figure 4-100** provide a visual overview of some of the impacts within the Ludeke Halt wetland.

Table 4-125 Landcover percentage in the Ludeke Halt wetland RU

Level 1B Landcover Categories	Percentage cover in the wetland
Shallow flooding from impoundments	0.7%
Natural / Minimally impacted	4.3%
Semi-natural (undrained)	42.0%
Semi-natural (drained)	38.1%
Moderately degraded land	0.6%
Commercial annual crops (non-irrigated)	2.6%
Subsistence crops	1.6%
Quarrying (sand, stone, diamonds)	1.8%
Eroded areas (& heavily degraded lands)	6.3%
Urban Residential – low density	1.8%
Infilling (incl. infrastructure)	0.2%
Total	**100%**

Figure 4-91 Eroded main channel with the seepage wetland maintained on the adjacent valley bottom terrace. The seepage wetland is entirely independent of the valley-bottom sysytem and is still considered to provide some ecosystem services within the modified landscape.

Figure 4-92 An old flood channel associated with the valley-bottom wetland. A drain has been excavated from this pool of water towards the main channel, assisting with the desiccation of this feature and thereby, making the adjacent habitat more easily accessible for grazing purposes.

Figure 4-93 Seepage wetland adjacent to the valley-bottom wetland, however, erosional feastures are present upstream thereof, threatening the integrity of the seepage wetland.

Figure 4-94 Incised channel associated with the main valley-bottom wetland.

Figure 4-95 Breached dam wall within the valley-bottom wetland. The breach is most likely as a result of the advancing head cut erosional feature.

Figure 4-96 Evidence of brick making along the main portion of the Ludeke Halt wetland.

Figure 4-97 This tributary is more heavily impacted than some of the adjacent tribuatries. The density of houses and anthropogenic impacts on the wetlands are greater than the areas of the wetland. The seepage wetlands have in some instances been transformed to croplands. Additional impacts include grazing by livestock and over utilisation of the system resulting in the formation of head cut erosional features.

Figure 4-98 This tributary of the Ludeke Halt wetland is considered to be relatively intact with limited catchment and in-system impacts. The major impact on the system is associated with grazing by livestock, however, the limited number of livestock seen in the catchment area were not posing a threat to the seepage and valley-bottom wetland habitat

Figure 4-99 A tributary of the Ludeke Halt wetland, which has been encroached into agricultural fields. Soils are also being harvested for brick making. Within the downstream portion of the tribuatry there is evidence of an old drain, which served as a cut-off drain along the edge of the system

Figure 4-100 View of the road culvert associated with the R61 which has led to the formation of a small headcut erosional feature upstream of the culvert. The headcut has not progressed too far due to the shallow bedrock layer within the system.

4.11.2.2 Present Ecological State

The Ludeke Halt wetland complex is located within a largely transformed landscape, with limited areas that have not been transformed through either peri-urbanisation and/or cultivation. Nonetheless, the upstream portions of the wetland are generally considered to have substantial portions of wetland habitat which is still intact and providing the relevant ecological services within the landscape. The modifications **(Table 4-126)** to the wetland's hydrology are largely associated with the transformed nature of both the catchment, i.e. peri-urban landscape and commercial cultivation; and the in-system impacts, which include *inter alia*, head cut erosional features, channel incision, subsistence agriculture, clay harvesting, etc. These impacts are serving to not only change the water inputs into the system, but the manner in which the flows are distributed throughout the wetland e.g., flood attenuation is reduced due to the incised channel. The geomorphological changes to the system have been attributed to the erosional features within the system but also the additional sediment inputs associated with the adjacent land uses. The impacts associated with the water quality component is mostly linked to the land uses within the catchment. Some portions of the wetland have undergone substantial changes associated with subsistence agriculture but mostly, with the change in hydrology and therefore, the desiccation of portions of the wetland. These changes have altered the vegetation characteristics.

Table 4-126 Present ecological state

Channelled Valley-bottom wetland – laterally maintained.

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	5.4	3.7	2.3	5.7
PES Score (%)	46%	63%	77%	43%
Ecological Category	**D →**	**C →**	**C →**	**D →**
Combined Impact Score	4.4			
Combined PES Score (%)	56%			
Combined Present Ecological Category	**D →**			

4.11.2.3 Ecological Importance and Sensitivity

The Ludeke Halt Wetland Complex have a moderate ecological importance, and in a rating of the wetland's EIS **(Table 4-127)** it can be seen that the landscape scale factors make the greatest contribution to the overall score. While from **Table 4-128** it can be seen that a key factor contributing to the wetlands functional/ecosystem services are the sediment trapping and water quality enhancement services, which is mostly linked to the demand of the services based on the landscape in which the wetland is located. **Table 4-129** the provisioning services mainly contributing to the overall score are associated with the utilisation of the wetland for water and cultivated foods.

Table 4-127 Rating of the Ludeke Halt's Ecological Importance and Sensitivity according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecological Importance	Score (0-4)	Motivation
1. Biodiversity support	**0.5**	Score taken as the average of the three scores below
Presence of Red Data species	0.7	No known red data species
Populations of unique species	0.7	No known unique species
Migration/breeding/feeding sites	0.0	No known sites
2. Landscape scale	**2.6**	Score taken as the average of the five scores below
Protection status of the wetland	2.0	The wetland is not formally protected
Protection status of the vegetation type	4.0	The Sub-Escarpment Grassland Group 3 vegetation type is classified as critically endangered.
Regional context of the ecological integrity	3.0	The upper portion of the site comprises of relatively intact wetland habitat in a landscape where the cumulative loss of wetlands is high
Size and rarity of the wetland type/s present	2.0	Based on the size of the system
Diversity of habitat types	1.8	Varying types of habitats based on varying zones of wetness found along the length of the wetland
3. Sensitivity of the wetland	**1.7**	Score taken as the average of the three scores below
Sensitivity to changes in floods	2.0	Based on the nature of the system
Sensitivity to changes in low flows/dry season	2.0	Predominantly channelled in the lower portion, however, flood out zones in the upper portions
Sensitivity to changes in water quality	1.0	Predominantly shale geology

Ecological Importance	Score (0-4)	Motivation
TOTAL OVERALL SCORE:	**2.6**	Score taken as the maximum of the three scores for 1., 2. and 3. above

Table 4-128 Rating (0-4) of the Ludeke Halt's hydrological/functional importance according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Ecosystem benefits	Score (0-4)	Motivation
Flood attenuation	1.8	The upper portion of the system has greater attenuation capacity than the downstream portion of the system, which is dominated by an incised channel. The demand for flood attenuation would likely de high for domestic use and a source of water for livestock
Streamflow regulation	2.2	The lateral inputs into the wetland from the upstream wetland habitat is relatively high, and therefore, would be able to sustain downstream habitat during the drier months, however, this portion of the habitat has become desiccated due to the incised channel
Sediment trapping	2.3	The importance of the wetlands for sediment trapping is mostly associated with the adjacent land use activities i.e., cultivated lands and areas for over utilisation, and therefore, potentially a higher sediment yield entering the system.
Phosphate assimilation	2.5	The effectiveness of the wetland within the upper portion of the system is likely to be high for the assimilation of phosphates, nitrates and toxicants, given the moderately diffuse flows in portions of the wetland and the generally high level of wetness and vegetation cover across much of the wetland. However, due to the incised channel within the lower portion this is unlikely to assimilate any phosphates, nitrates or toxicants. Based on the nature of the catchment land use activities, the demand for this service is considered to be high.
Nitrate assimilation	2.5	Refer to Phosphate assimilation
Toxicant assimilation	2.5	Refer to Phosphate assimilation
Erosion control	1.3	The majority of the upstream wetland habitat is dominated by permanent vegetation cover and therefore, promoting the control of erosion. However, the lower portion is incised with the capabilities greatly reduced
Carbon storage	1.2	The carbon storage abilities have been slightly reduced, as portions of the wetland have been cultivated and/or has become incised, with the saturation levels within these portions of the system being less than the more intact portions.
OVERALL SCORE	**2.4**	Score taken as the average of the top five scores above

Table 4-129 Rating (0-4) of the Ludeke Halt's importance for direct human benefits according to the criteria of Rountree and Kotze (2013). Scores range from 0 to 4. (<0.5 = negligible importance to >3.5 = very high importance)

Direct human benefits		Score (0-4)	Motivation
Provisioning services	Water for human use	2.2	Although there are limited areas available with open water, water for both domestic and livestock use would be considered to be relatively high.
	Harvestable resources	1.0	No known current harvesting
	Cultivated foods	2.6	Portions of the system are being utilised as subsistence crops, which is an important source of food within the households.
Cultural services	Cultural heritage	1.0	No known cultural heritage features
	Tourism and recreation	0.3	Currently there appears to be limited contribution of the wetland to tourism and recreation
	Education and research	0.3	Currently there appears to be limited contribution of the wetland to tourism and recreation
TOTAL OVERALL SCORE:		**1.4**	Score taken as the average of the top five scores above

4.11.2.4 Recommended Ecological Category

In determining the Recommended Ecological Category (REC) **(Table 4-130)** for the Ludeke Halt wetland complex, the following were noted:

(1) the EIS of the wetlands;

(2) the PES of the wetlands; and

(3) the land use/landcover context of the wetlands (subsistence agricultural practises and clay-material mining).

Based on the guidelines of Rountree *et al.* (2013) given in the Methods, the REC for the wetland should be set at a PES category higher. Given item (3) above, the implementation of sustainable subsistence practices and the management of clay-material mining, could assist in achieving an improved PES and EIS score for the system. Further considerations in maintaining the system at the current PES or aiming for a slight improvement, would include managing the expansion of the peri-urban area and potentially, encouraging the adoption of a 15m buffer around portions of the wetland to assist in protecting it from the catchment related impacts.

Table 4-130 Recommended Ecological Category (REC) for wetlands in the Ludeke Halt WRU

	Wetland Complex	
REC	**C /**	**D**

5. WETLAND ECO-CATEGORISATION SUMMARY AND CONCLUSION

Seventeen (17) wetland resource units were selected for the Keiskamma and Fish to Tsitsikamma catchments and were visited as part of the field survey by the project team and assessed for their PES, EIS, and REC. These wetlands were selected based on a number of variables that highlighted these wetlands as being among the most ecologically and socially important wetlands in the study area. It is acknowledged that the available wetland coverage used to select these wetlands has a number of gaps in it, but the available wetland data was supplemented with local knowledge.

Table 5-1 provides the summary scores for each of the WRUs identified within the IUAs (also refer to **Figure 5-1** and **Figure 5-3**). In many instances the EIS score reflected is better than the PES, which is often related to the demand for a specific service e.g., water quality enhancement, and/or due to the presence of a red data species, whilst the integrity of the system is greatly reduced to the suite of catchment and in-system related impacts. Examples of such systems are the **Elliot/Khowa and Chatty River systems. In both cases, raw sewage flows from surcharging manholes into portions of the systems which are generally utilised by the adjacent community's livestock for grazing and a source of water**. Downstream of the surcharging sewage manhole in the Elliot/Khowa system, near the East Cape fuels depot and the WWTW, a pair of crowned cranes with a fledging was sighted in the flooded marshy area immediately downstream of the WWTW. In this instance the EIS rating is a B (High), however, the wetland integrity ranges between a D (largely modified) and E (seriously modified). Similarly, the Chatty River Wetlands are located upstream of the Swartkops Estuary with is an Important Bird Area (IBA) and provides habitat for many endangered local bird species as well as many migratory bird species. The EIS rating for the Chatty River systems are B and C, but both systems have been assessed as D category systems in terms of their PES.

The REC (**Figure 5-4** and **Figure 5-5**), which have been proposed for the various systems, is generally based on attainable management activities that can be adopted within the system and/or associated 200m buffer zone. It should be noted though that for two (2) of the systems, i.e., WRU04 Longmore and WRU05 Chatty River, a detailed socio-economic cost-benefit analysis is being undertaken. This analysis will allow for a realistic REC for the systems to be set. Furthermore, the project team are currently considering undertaking a socio-economic cost-benefit analysis for both WRU21 Mbokotwa and WRU22 Elliot/Khowa, to determine an informed and realistic REC. Both of these systems have been substantially modified through historical activities and which cannot be feasibly reversed e.g., channelisation of flows; and thus, the systems are largely locked in their current state of integrity. Although REC scores have been presented for these systems, these may potentially be unattainable due to the nature of these systems.

Intensive management and/or rehabilitation measures have generally not been prescribed for any of the systems, as in many instances it can be onerous on the landowners/users and therefore, are not adopted. The proposed management, maintenance and monitoring activities will be described in the subsequent implementation plan. However, for systems such as the Xolobeni wetland (WRU24) intensive rehabilitation activities have been proposed, as the erosional feature within the system is threatening the water supply to the surrounding community. A substantial number of persons are reliant on this particular system for water, and should the system become further degraded, water supply will be a massive problem.

Although in many instances, the greater wetland complexes were assessed for this study, there are some systems, such as the Cairns wetland complex (WRU12), which would benefit from additional research, as only a single portion of the wetland complex was assessed, and these systems are rare and unique kommetjievlakte wetlands. Additional research would assist in their protection and conservation.

Nonetheless, all of the systems presented in this report are considered to be important features within the landscape, and in many cases, are located within largely modified landscape. The protection and management of these systems is considered to be essential due to the number of benefits and services that are both directly and indirectly derived from these systems.

Table 5-1 Summary of the respective WRU identified within the IUAs

IUA	WRU	Wetland Name	HGM Type	SWSA (Y/N)	PES	EIS	Key ecosystem services provided	REC
K01	WRU01	Lottering	Valley-bottom/Seep	Y	C (Moderate)	B (High)	Carbon (C) storage, Biodiversity, Streamflow regulation	C
		Slang	Valley-bottom/Seep	Y	B (Largely natural)	A (Very High)	Biodiversity,Carbon storage, Streamflow regulation	B
	WRU02	Kromme	Unchannelled valley-bottom	Y	A (Natural)	A (Very High)	Biodiversity, C storage, Streamflow regulation, flood attenuation	A
L01	WRU03	Krakeel	Valley-bottom	Y	D (Largely modified)	A (Very High)	Water quality enhancement, Biodiversity, Water supply	C / D
M01	WRU04	Longmore	Valley-bottom	Y	C (Moderate)	A (Very High)	Biodiversity, Streamflow regulation, Sediment trapping	B / C[11]
	WRU05	Chatty River	Floodplain	Y	D (Largely modified)	A (Very High)	Biodiversity, water quality enhancement, sediment trapping	C
			Channelled valley-bottom	Y	D (Largely modified)	A (Very High)	Biodiversity, water quality enhancement, sediment trapping	C
LN01	WRU06	Sneeuberg West	Seep	N	B (Largely natural)	B (High)	Grazing, Water supply, Biodiversity	B
			Valley-bottom	N	C (Moderate)	B (High)	Grazing, Water supply, Biodiversity	C
LN01	WRU27	Loodsberg	Hillslope Seep	Y	B (Largely natural)	B (High)	Grazing, Water supply, Biodiversity	B

[11] It should be noted that the method to define the REC described in Rountree *et al.* (2013) was applied to the Longmore and Chatty River systems. However, depending on the outcome of a cost-benefit analysis currently being undertaken for these systems to meet these REC's, a BAS may need to be set for these systems.

IUA	WRU	Wetland Name	HGM Type	SWSA (Y/N)	PES	EIS	Key ecosystem services provided	REC
			Valley-bottom	Y	C (Moderate)	B (High)	Grazing, Water supply, Flood attenuation, Biodiversity	C
Q02	WRU10	Dagbreek	Valley-bottom	N	B (Largely natural)	A (Very High)	Sediment trapping, Erosion control, Biodiversity,	A / B
R02	WRU15	eDrayini	Floodplain	N	C (Moderate)	B (High)	Grazing, Flood attenuation, Biodiversity	C
	WRU26	KwaMasele	Valley-bottom/Seep	N	C (Moderate)	B (High)	Biodiversity, Grazing, Flood attenuation	C
S01	WRU18	Cala	Valley-bottom	Y	C (Moderate)	B (High)	Streamflow regulation, Water supply, Sediment trapping	B
			Hillslope Seep	Y	C (Moderate)	B (High)	Streamflow regulation, Sediment trapping, Harvestable resources	B
	WRU21	Mbokotwa	Floodplain	N	D (Largely modified)	A (Very High)	Water quality enhancement, Water supply, Biodiversity	C / D[12]
S02	WRU12	Cairns	Unchannelled valley-bottom /Seep	Y	B (Largely natural)	A (Very High)	Biodiversity, Grazing, Streamflow regulation	B
	WRU13	Hogsback	Hillslope Seep	Y	C (Moderate)	A (Very High)	Biodiversity, Streamflow regulation, Grazing, Erosion control	B / C
			Hillslope Seep (degraded)	Y	D (Largely modified)	B (High)	Grazing, Erosion control, Water quality enhancement	D

[12] Depending on the outcome of the analyses for the Longmore and Chatty River systems, the approach taken may need to be applied to the Mbokotwa system and a BAS may need to be set for it.

IUA	WRU	Wetland Name	HGM Type	SWSA (Y/N)	PES	EIS	Key ecosystem services provided	REC
			Channelled valley-bottom	Y	C (Moderate)	B (High)	Biodiversity, Flood attenuation, Grazing, Erosion control	B / C
			Floodplain	Y	C (Moderate)	B (High)	Biodiversity, Erosion control, Sediment trapping, Grazing	B / C
T01	WRU22	Elliot/Khowa	Hillslope Seep (Tributaries))	N	D (Largely modified)	C (Moderate)	Streamflow regulation, Grazing	C / D
			Floodplain (east)	N	D (Largely modified)	A (Very High)	Flood attenuation, Streamflow regulation, Biodiversity	C / D
			Channelled valley-bottom (west)	N	D (Largely modified)	A (Very High)	Water quality enhancement, Grazing, Flood attenuation	C
			Floodplain (upper)	N	E (Seriously modified)	A (Very High)	Biodiversity, Water quality enhancement, flood attenuation	D
			Floodplain (lower)	N	C (Moderate)	A (Very High)	Biodiversity, Flood attenuation, Water quality enhancement	B
T04	WRU24	Sikombe	Channelled valley-bottom	Y	B (Largely natural)	B (High)	Biodiversity, C storage, Streamflow regulation	B
		Xolobeni	Channelled valley-bottom	Y	C (Moderate)	B (High)	Water supply, C storage, Streamflow regulation	B
	WRU25	Ludeke Halt	Seep/Valley-bottom	Y	D (Largely modified)	B (High)	Subsistence use, Grazing, Streamflow regulation	C / D

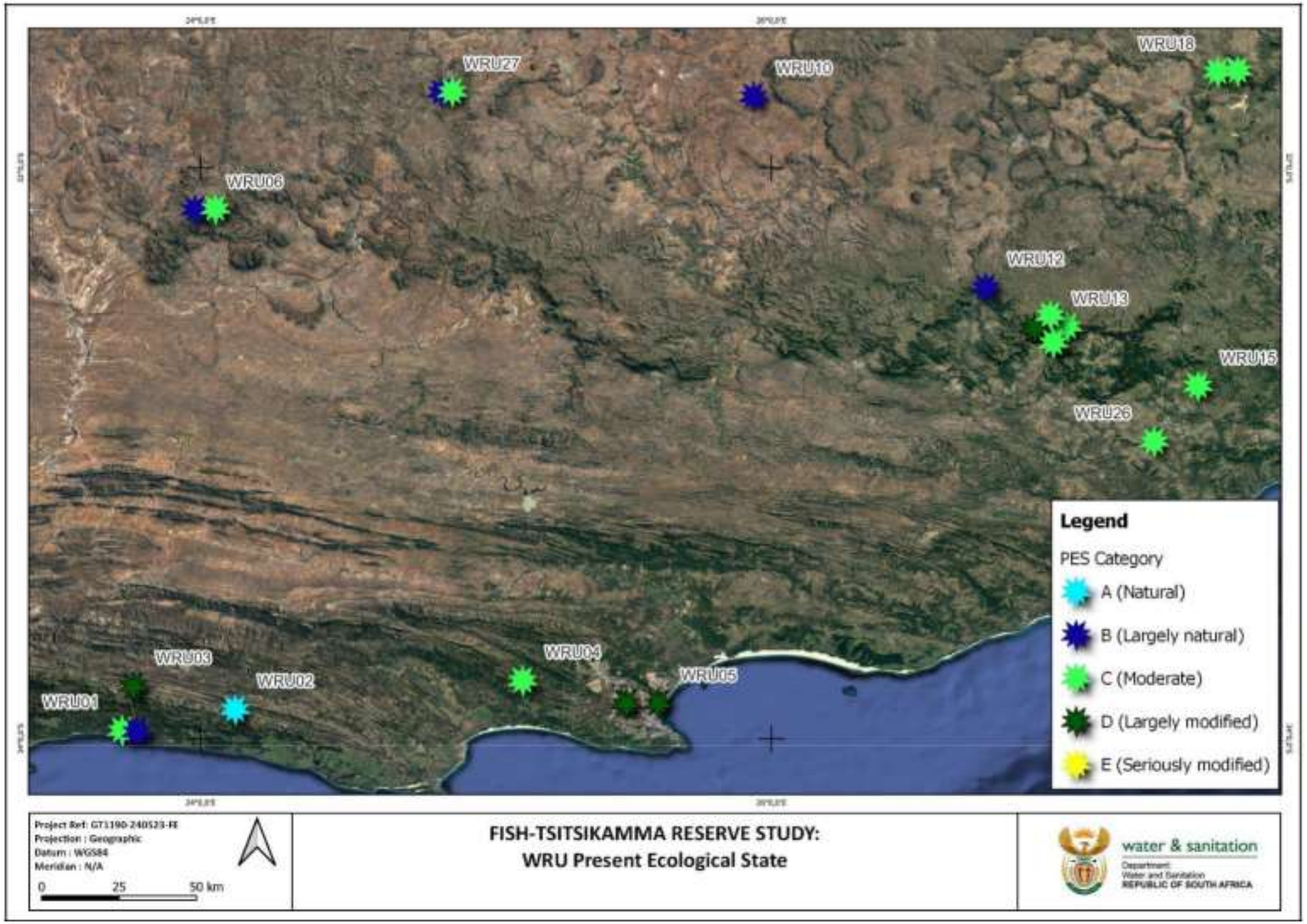

Figure 5-1 Overview of the Present Ecological State categories for WRU01, WRU02, WRU03, WRU04, WRU05, WRU06, WRU10, WRU12, WRU13, WRU15, WRU18, WRU26, WRU27

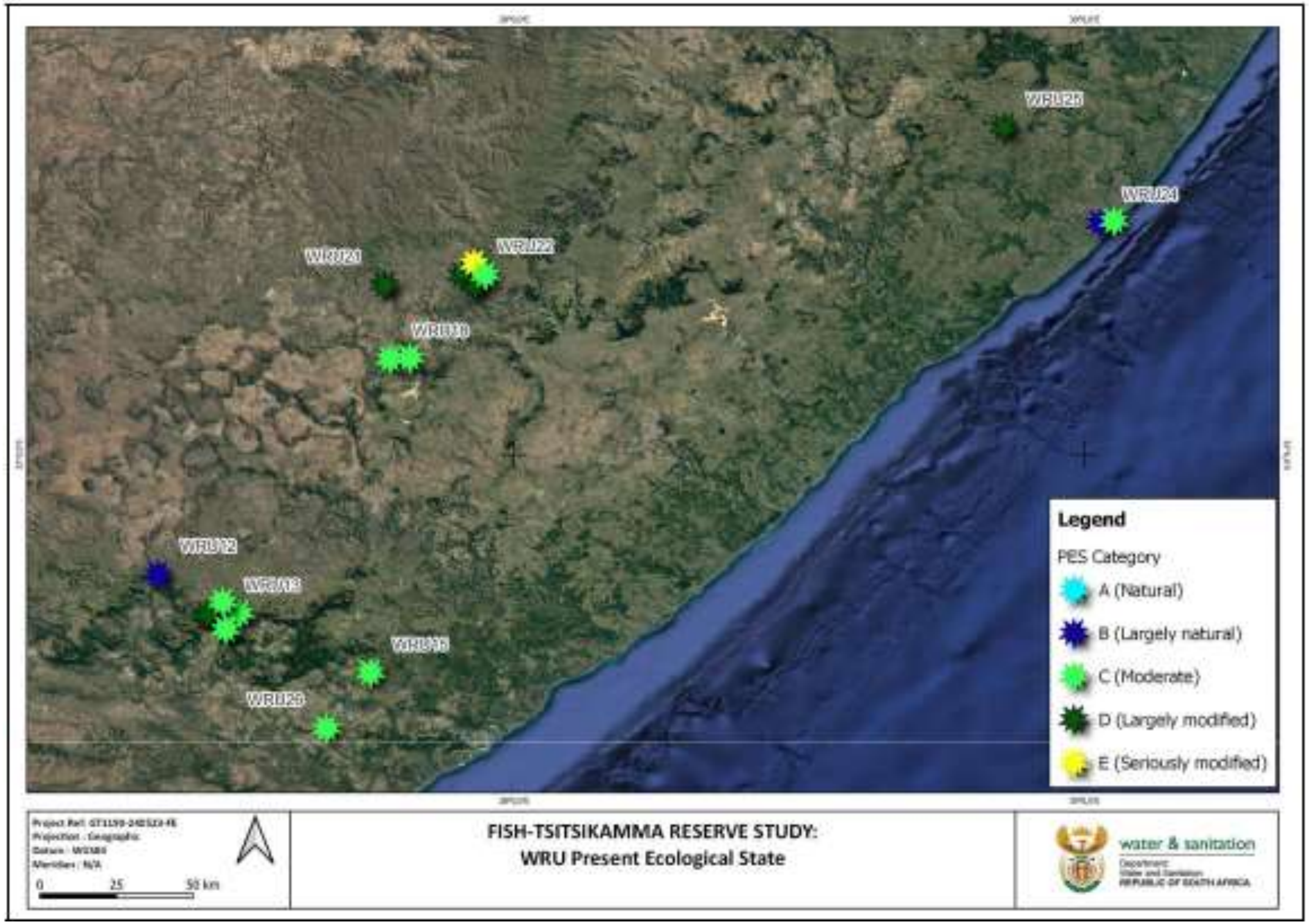

Figure 5-2 Overview of the Present Ecological State categories for WRU12, WRU13, WRU15, WRU18, WRU21, WRU22, WRU24, WRU25, WRU26

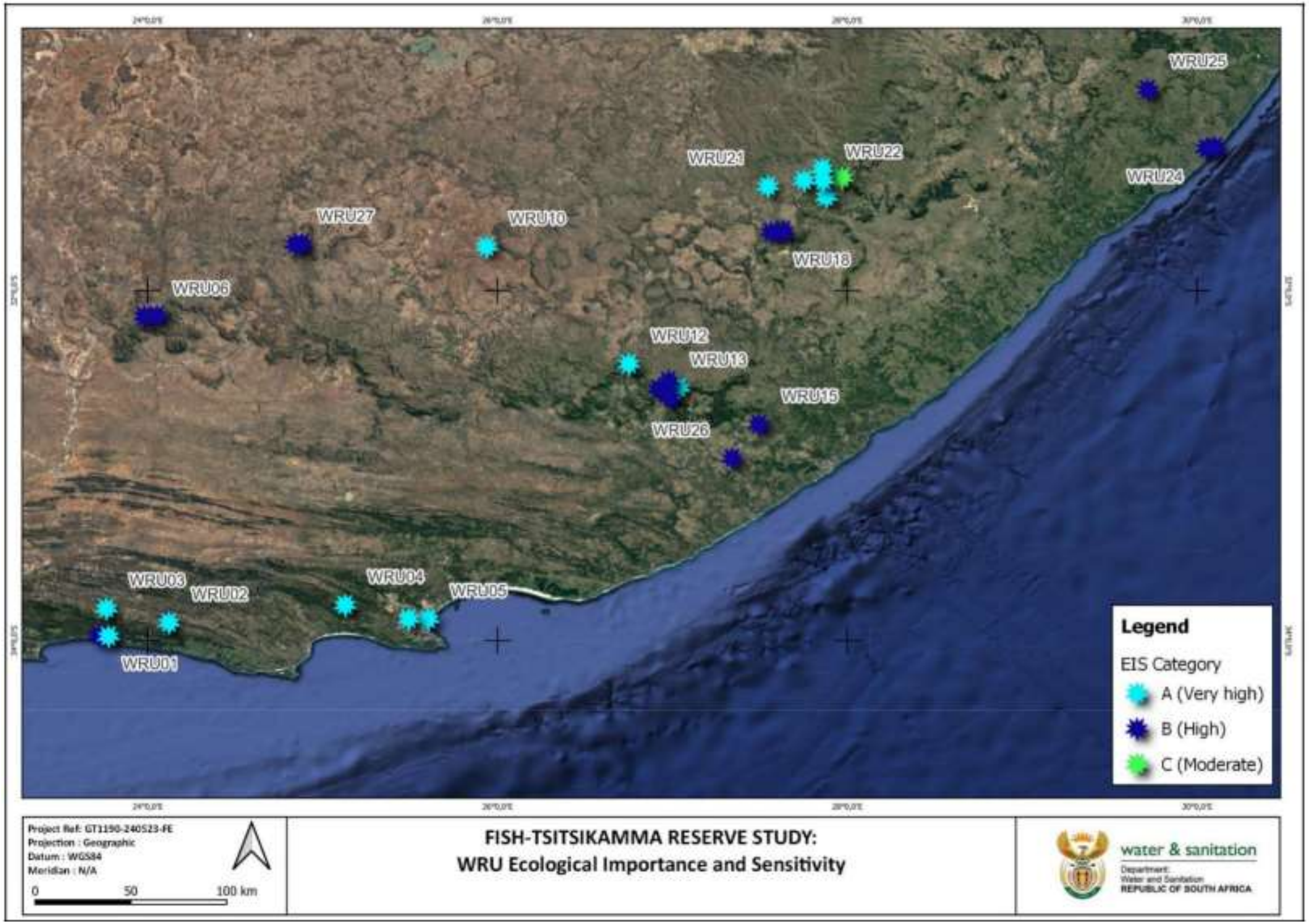

Figure 5-3 Overview of the Ecological Importance and Sensitivity categories for the various WRUs

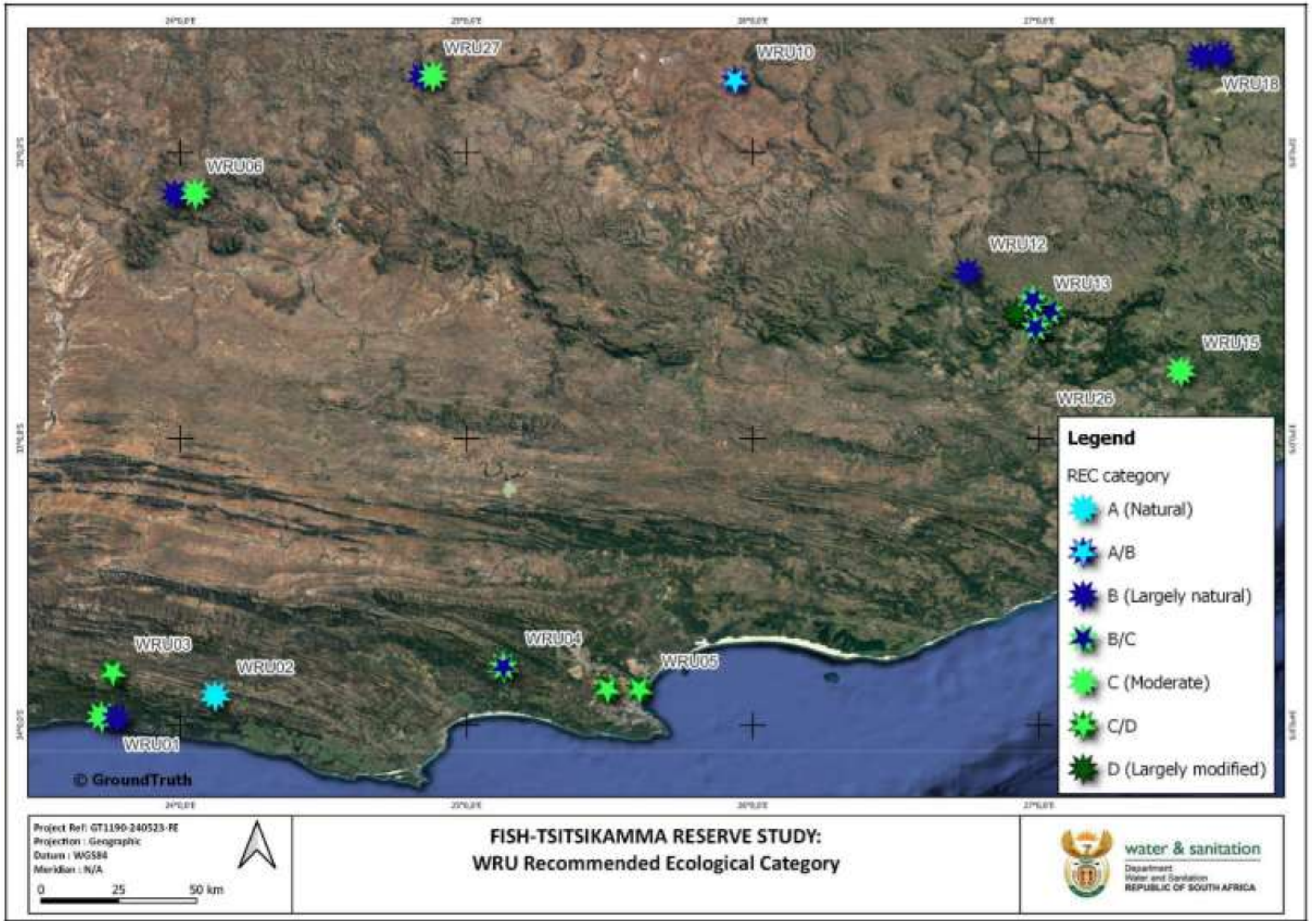

Figure 5-4 Overview of the Recommended Ecological Categories for WRU01, WRU02, WRU03, WRU04, WRU05, WRU06, WRU10, WRU12, WRU13, WRU15, WRU18, WRU26, WRU27

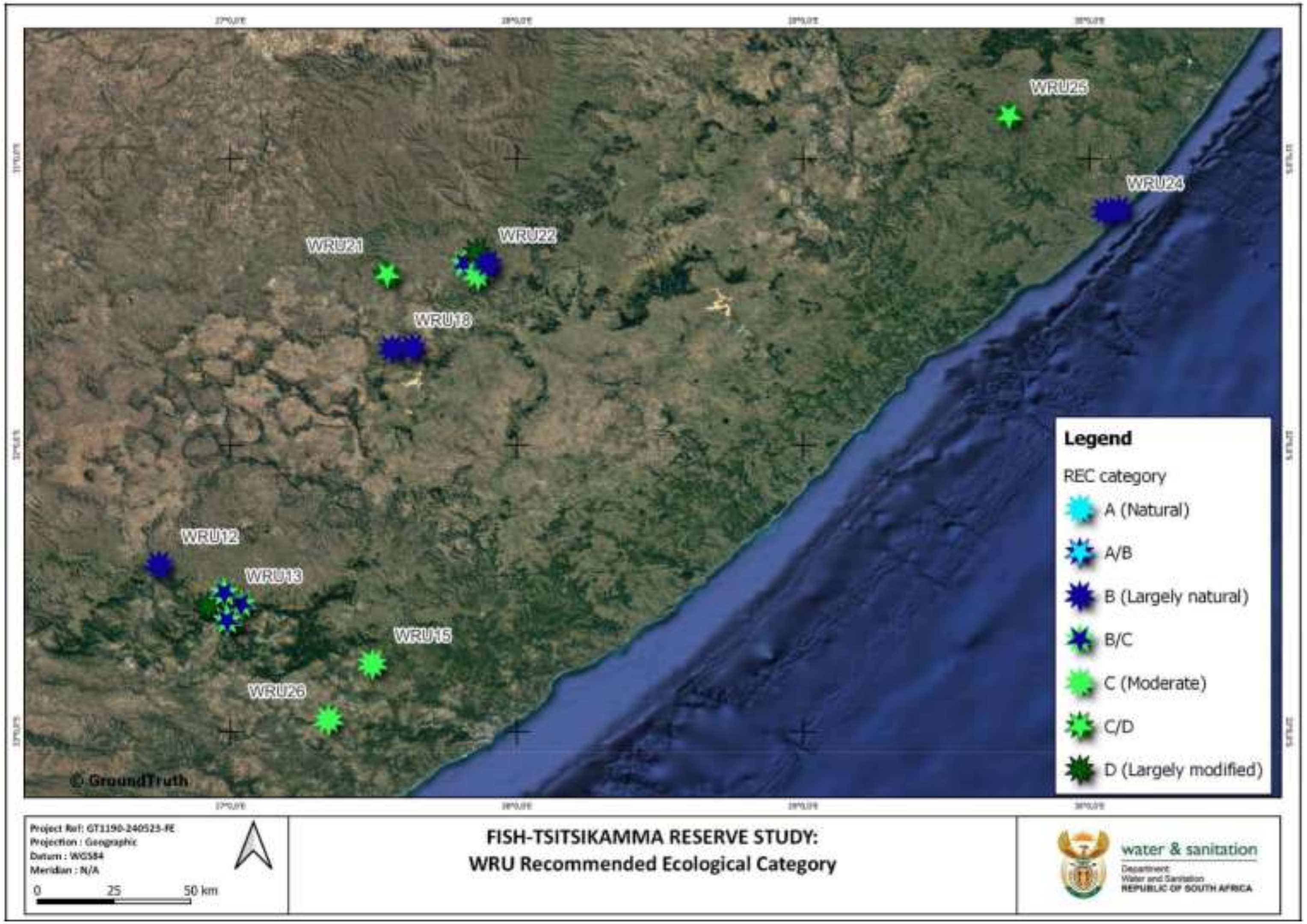

Figure 5-5 Overview of the Recommended Ecological Categories for WRU12, WRU13, WRU15, WRU18, WRU21, WRU22, WRU24, WRU25, WRU26

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