Freshwater Risk and Impact Assessment

Vegetation Clearing on Remainder (RE) of the Farm Schalkenbosch No. 229, Tulbagh, Western Cape

For: Enviro EAP

August 2026



Report Information

Document name	Freshwater Risk & Impact Assessment, Farm Schalkenbosch 229, Tulbagh V1.0		
Number of pages	**62**		
Author 1	Robyn Morton	SACNASP Reg. No.	Pending
Author 2	Faeeza Fortune	SACNASP Reg. No.	Pending
Author contact details	**Email:** kimberley@deltaecologists.com **| Phone:** 078 275 8815		
Reviewer	Kimberley van Zyl	SACNASP Reg. No.	117097

Citation

Morton, R., Fortune, F., & Van Zyl, K. 2026. Freshwater Risk & Impact Assessment, Farm Schalkenbosch 229, Tulbagh V1.0. Delta Ecology. RSA.

Executive Summary

Delta Ecology was appointed by Enviro EAP to undertake a Freshwater Risk and Impact Assessment for the proposed vegetation clearing on the Remainder of Farm Schalkenbosch 229, located near Tulbagh in the Western Cape. The proposed activity comprises the clearing of indigenous vegetation that has established within historically cultivated agricultural fields to facilitate the return of these areas to agricultural production. The assessment was undertaken in support of the Environmental Authorisation (EA) process following the identification of Very High Aquatic Biodiversity Theme Sensitivity by the National Web-based Environmental Screening Tool.

The assessment confirmed the presence of several non-perennial rivers, associated tributaries, one seep wetland and a highly modified agricultural flow path within or adjacent to the proposed vegetation clearing areas (**Figure i**). The non-perennial rivers were assessed as being in a largely natural to moderately modified ecological condition (PES Categories B/C), while the seep wetland was assessed as largely natural (PES Category B). These freshwater ecosystems provide important riparian habitat, maintain ecological connectivity within the upper Breede River catchment and contribute to local biodiversity.

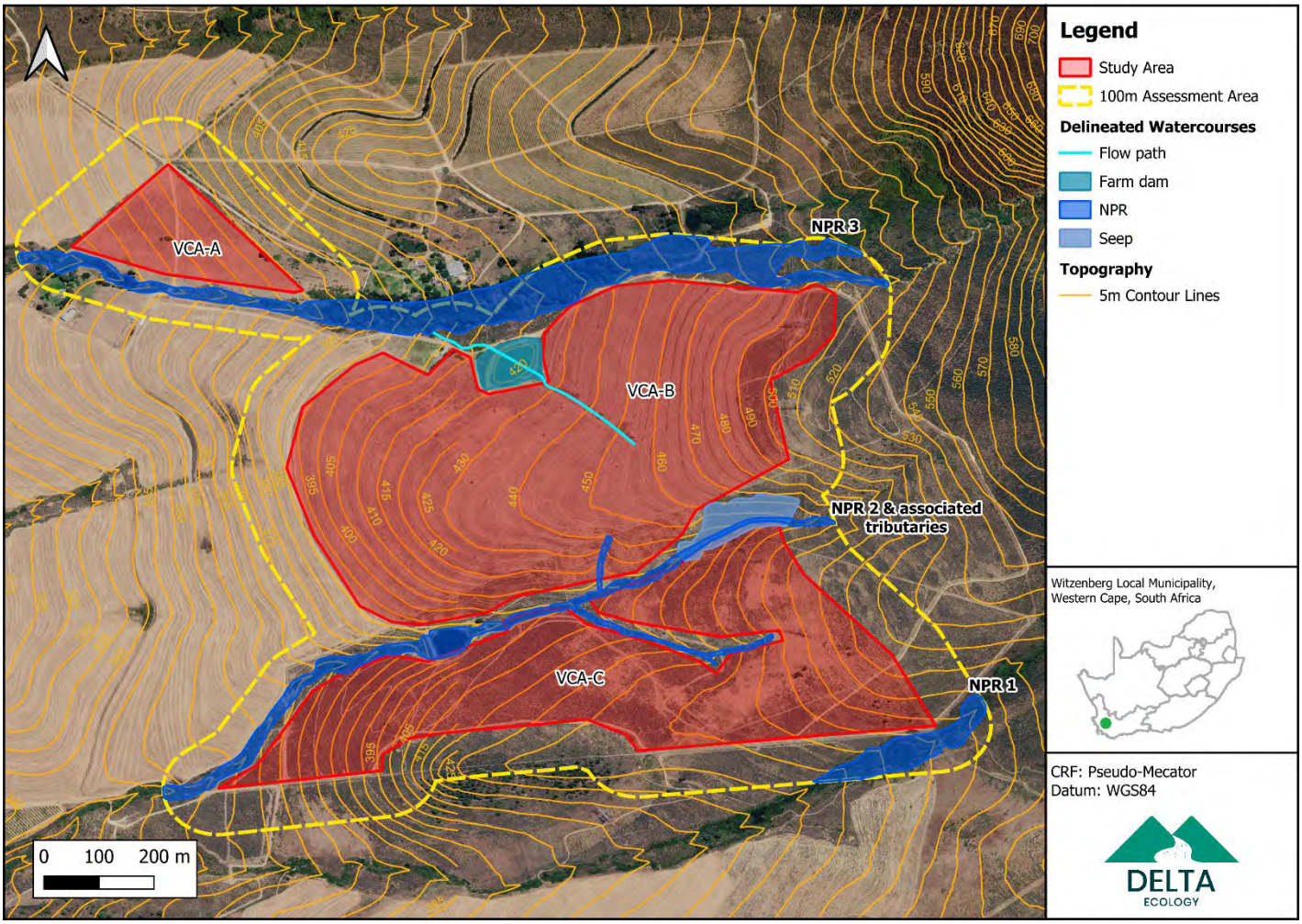


Figure i: Delineation of the at-risk watercourses.

The agricultural flow path was assessed as PES Category E/F (Critically Modified) and functions primarily as an agricultural drainage feature with negligible remaining aquatic habitat or ecological function. Consequently, from an aquatic biodiversity perspective, avoidance of this feature and the implementation of a freshwater buffer are not considered necessary, provided that vegetation clearing and subsequent agricultural activities do not result in concentrated runoff, erosion or sediment delivery into downstream freshwater ecosystems.

The proposed activity does not include new infrastructure or instream works. The principal freshwater risks are therefore indirect and relate to vegetation clearing in proximity to freshwater ecosystems, including disturbance of riparian habitat, altered surface water runoff, increased erosion and sedimentation, and deterioration of water quality. Four potential impacts were assessed, namely:

- Loss and degradation of freshwater and riparian habitat;
- Alteration of surface water runoff and hydrological processes;
- Increased sediment input and erosion; and
- Water quality impairment.

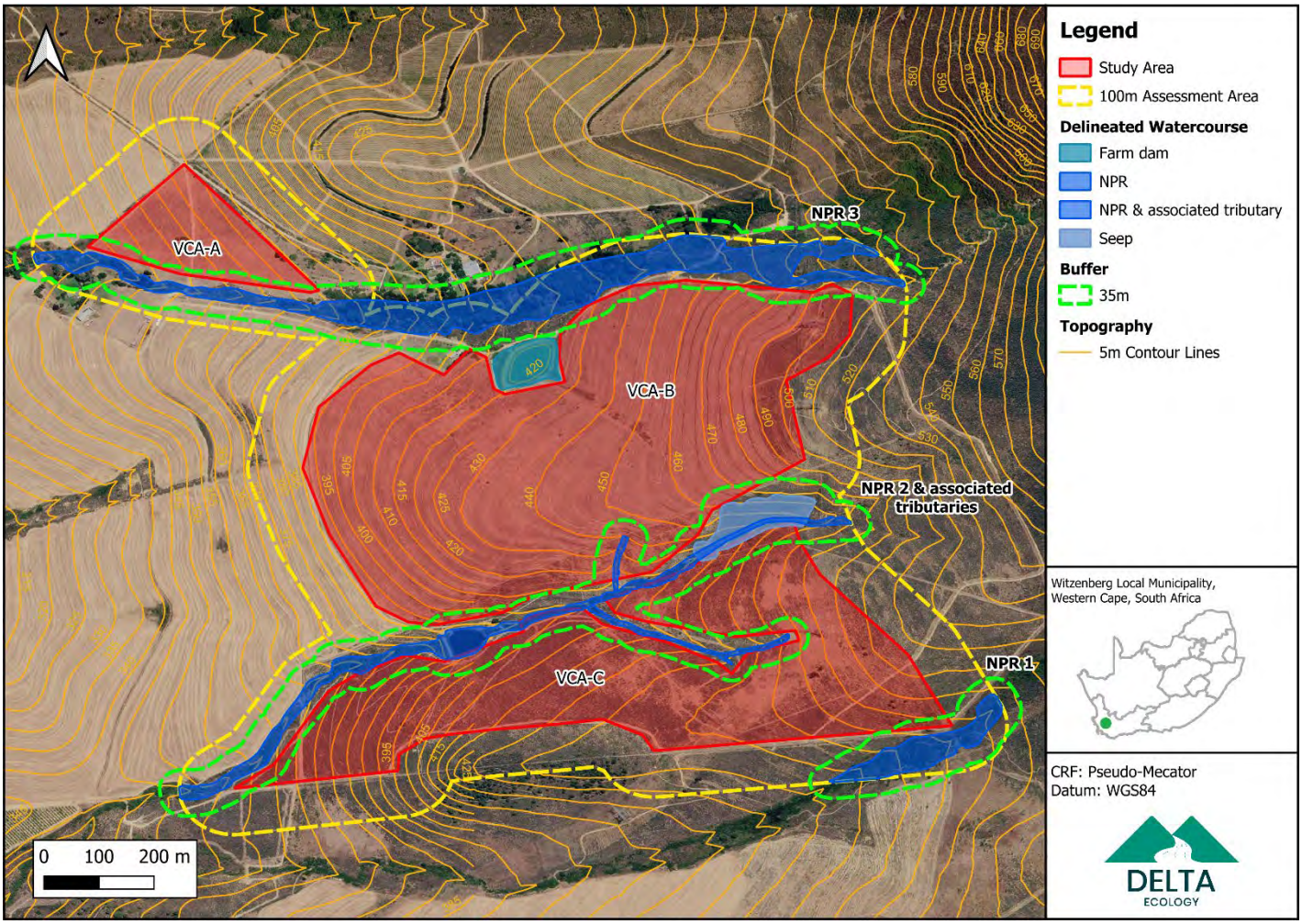


Figure ii: Recommended buffer.

The assessment identified the establishment and maintenance of a 35 m freshwater buffer around all delineated non-perennial rivers and the seep wetland as the primary mitigation measure (**Figure ii**). Additional mitigation includes maintaining existing drainage patterns and contour banks, implementing erosion and sediment control measures, protecting riparian vegetation, applying good agricultural management practices, and preventing contamination of freshwater ecosystems.

Following implementation of the recommended mitigation measures, all identified impacts are expected to reduce to Low significance. The Risk Assessment Matrix (RAM), undertaken in accordance with Government Notice 4167 of 2023, indicates that the anticipated Section 21(c) and (i) water uses fall within the Low Risk category. It is therefore considered that the proposed water uses may be authorised under the applicable General Authorisation (GA), subject to confirmation by the Department of Water and Sanitation (DWS).

From an aquatic biodiversity perspective, the proposed vegetation clearing is considered acceptable, provided that the recommended mitigation measures are implemented, the delineated 35 m freshwater buffers are maintained as permanent no-go areas, and good agricultural management practices are followed throughout vegetation clearing and subsequent agricultural activities.

Table of Contents

Executive Summary 3
Table of Contents 6
List of Figures 8
List of Tables 9
Specialist Details 10
1. Introduction 12
1.1. Terms of Reference 13
1.2. Limitations and Assumptions 14
1.3. Use of this report 15
2. Site Sensitivity Verification 15
3. Methodology 16
3.1. Desktop Assessment 16
3.2. Wetland Delineation 16
3.3. Riparian Area Delineation 16
3.4. Watercourse Classification 17
3.5. Present Ecological State Assessment 17
3.5.1. WET-Health PES Assessment 17
3.5.2. Habitat Integrity Assessment 18
3.6. Ecosystem Service Assessment 18
3.7. Ecological Importance and Sensitivity Assessment 19
3.8. Recommended Ecological Category 20
3.9. Desktop Buffer Tool 20
3.10. Impact and Risk Assessment 20
4. Desktop Assessment 21
4.1. Biophysical Context 21
4.2. Biodiversity Planning Context 23
5. Site Description 26
6. Status Quo Assessment 35
6.1. Habitat Integrity Assessment 35

6.2. Present Ecological State 37
6.3. Ecosystem Services 38
6.4. Ecological Importance and Sensitivity 38
6.5. Recommended Ecological Category 40
6.6. Buffer Determination 40
7. Aquatic Impact Identification 41
8. Impact Assessment 43
8.1. General Management Measures 43
9. Risk Assessment 48
10. Conclusion and Recommendation 49
11. References 50
ANNEXURE 1: DWS RISK ASSESSMENT 51
ANNEXURE 2: DETAILED METHODOLOGY 52
Wetland Delineation 52
Riparian Area Delineation 53
Wetland Classification 53
Present Ecological State Assessment (Wetlands) 55
Habitat Integrity Assessment (Rivers) 56
Ecosystem Service Assessment 59
Ecological Importance and Sensitivity Assessment 60
Recommended Ecological Category 60
Impact Assessment Methodology 61

List of Figures

Figure 1-1: Location of the project. 12

Figure 1-2: Overview of the study area. 13

Figure 4-1: Overview of study area in relation to the NFEPA Wetland Vegetation (CSIR, 2011). 23

Figure 4-2: Regional drainage overview in relation to the study area, indicating non-perennial rivers (NGI, 2019) and NFEPA wetlands (CSIR, 2011). 25

Figure 4-3: Regional drainage overview in relation to the study area, indicating non-perennial rivers (NGI, 2019) and NWM5 wetlands (SANBI, 2018). 25

Figure 4-4: Overview of the study area in relation to the 2023 WCBSP (CapeNature, 2024). 26

Figure 5-1: Delineation of the at-risk watercourses. 28

Figure 5-2: Overview of the study area. 29

Figure 5-3: Dense riparian vegetation within the non-perennial river 1. 29

Figure 5-4: Overview of the riparian zone of the non-perennial river 2. 30

Figure 5-5: Non-perennial river 2 with associated tributaries. 30

Figure 5-6: Farm dam within the non-perennial river 2. 31

Figure 5-7: Pine trees within the non-perennial river 2. 31

Figure 5-8: Dense riparian vegetation within the non-perennial river 2. 32

Figure 5-9: Dense riparian vegetation within the non-perennial river 3. 32

Figure 5-10: Road crossing the non-perennial river 3. 33

Figure 5-11: Disturbed agricultural landscape around the lower reaches of non-perennial river 3. 33

Figure 5-12: Overview of the seep wetland indicated by arrow. 34

Figure 6-1: Recommended 35 m buffer. 41

List of Tables

Table 3-1: PES Categories Scores as defined WET-Health Version 2 (Macfarlane *et al.*, 2020). 17

Table 3-2: IHI classes and their description 18

Table 3-3: Ecosystem Services Importance Categories Scores as defined in WET-Ecoservices' Version 2 (Kotze *et al.* 2020). 19

Table 3-4: Ecological Importance and Sensitivity Categories (DWAF, 1999). 20

Table 4-1: General characteristics of the study area. 21

Table 5-1: Classification of the watercourses within the study area. 34

Table 6-1: Instream IHI Score Rating Results for the non-perennial rivers and flow path 36

Table 6-2: Riparian IHI Score Rating Results for the non-perennial rivers and flow path. 37

Table 6-3: WET-Health Assessment for the seep wetland 37

Table 6-4: The outcome of the ecosystem services assessment for the seep wetland 38

Table 6-5: Score sheet for determining the EIS of the non-perennial rivers. 38

Table 6-6: Results of the EIS assessment for the onsite seep wetland. 39

Table 8-1: Assessment results for Impact 1 44

Table 8-2: Assessment results for Impact 2. 45

Table 8-3: Assessment results for Impact 3. 46

Table 8-4: Assessment results for Impact 4 47

Specialist Details

Author's Details | Robyn Morton	
Company Name	Delta Ecology
Physical address	41 Dreyersdal Rd, Bergvliet, Cape Town 7945
Email Address	robyn@deltaecologists.com
Telephone	082 779 7618
Highest Qualification	MSc. Nature Conservation
SACNASP Reg. No.	Pending
Area of Specialisation	Ecology

Robyn Morton has a MSc. degree in Conservation Sciences from the Cape Peninsula University of Technology. Throughout her studies, internships, and consultancy experience, she has gained valuable and informed insight into the functioning of natural and socio-ecological systems, as well as many key research and monitoring skills. Prior to her consulting career, Robyn worked for Zandvlei Estuary Nature Reserve for 4 years and gained experience in the field of urban wetland and estuary management. Robyn specialises in aquatic ecology and is currently working for Delta Ecology as a junior associate under the guidance of Kimberley van Zyl.

Co-author's Details | Faeeza Fortune	
Company Name	Delta Ecology
Physical address	59 Exmouth Rd, Plumstead, Cape Town 7801
Email Address	fortunefaeeza@gmail.com
Telephone	083 287 4098
Highest Qualification	MA Geography and Environmental Studies (UWC)
SACNASP Reg. No.	Pending
Area of Specialisation	Ecology

Faeeza Fortune is a freshwater specialist with a Masters in Geography and Environmental Studies from the University of the Western Cape. She is currently pursuing a PhD in wetland geomorphology at Stellenbosch University. During her academic and consultant career, Faeeza has worked in wetlands and rivers across some parts of South Africa. Some of the most notable sites include the depression wetlands in the Northern Cape, the variety of wetland types on the Agulhas coastal plain in the Western Cape, to grassland valley-bottom and floodplain wetlands in the Eastern Cape, and most recently, rivers and palmiet and fynbos valley-bottom wetlands in Western Cape. This experience has shaped her understanding of the drivers of wetland development, their degradation, and the challenges related to wetland rehabilitation, restoration, and management in South Africa. Faeeza is currently working for Delta Ecology as a junior associate under the guidance of Kimberley Van Zyl.

Specialist Details | Kimberley van Zyl	
Company Name	Delta Ecology
Physical address	59 Exmouth Rd, Plumstead, Cape Town 7801
Email Address	Kimberley@deltaecologists.com
Telephone	078 275 8815
Highest Qualification	MSc. Water Resource Management (University of Pretoria)
SACNASP Reg. No.	117097
Area of Specialisation	Freshwater Ecology

Kimberley van Zyl is an ecologist and environmental scientist with over 9 years' experience in the environmental management field. She holds a MSc. degree in Water Resource Management from the University of Pretoria and her professional affiliations include the South African Council for Natural Scientific Professions (SACNASP) and the South African Society for Aquatic Scientists. Kimberley's work experience has exposed her to a range of projects across various business sectors such as mining, agriculture, and construction, as well as the public sector.

A signed statement of independence will be provided as a separate document.

1. Introduction

Delta Ecology was appointed by Enviro EAP to undertake a Freshwater Risk and Impact Assessment for the proposed vegetation clearing on the Remainder of Farm Schalkenbosch 229, located approximately 5 km southeast of Tulbagh in the Western Cape Province (**Figure 1-1 & Figure 1-2**). The proposed activity entails the clearing of indigenous vegetation that has established on historically cultivated agricultural land to facilitate the return of these areas to agricultural production through ploughing. The proposed vegetation clearing areas comprise three discrete portions of the property, namely Driehoekkamp, Damkamp, and Agterstekamp, referred to as VCA-A, VCA-B, and VCA-C respectively (**Figure 1-2**).

The proposed activity is being undertaken as part of an Environmental Authorisation (EA) process in terms of the National Environmental Management Act (NEMA) (Act No. 107 of 1998) (NEMA). The National Department of Forestry, Fisheries, and the Environment (DFFE) Web-based Environmental Screening Tool identified the site as exhibiting Very High Aquatic Biodiversity Theme Sensitivity, thereby triggering the requirement for an aquatic specialist Site Sensitivity Verification (SSV) in accordance with the Protocol for the Specialist Assessment and Minimum Report Requirements for Environmental Impacts on Aquatic Biodiversity (Government Notice No. 320 of 2020).

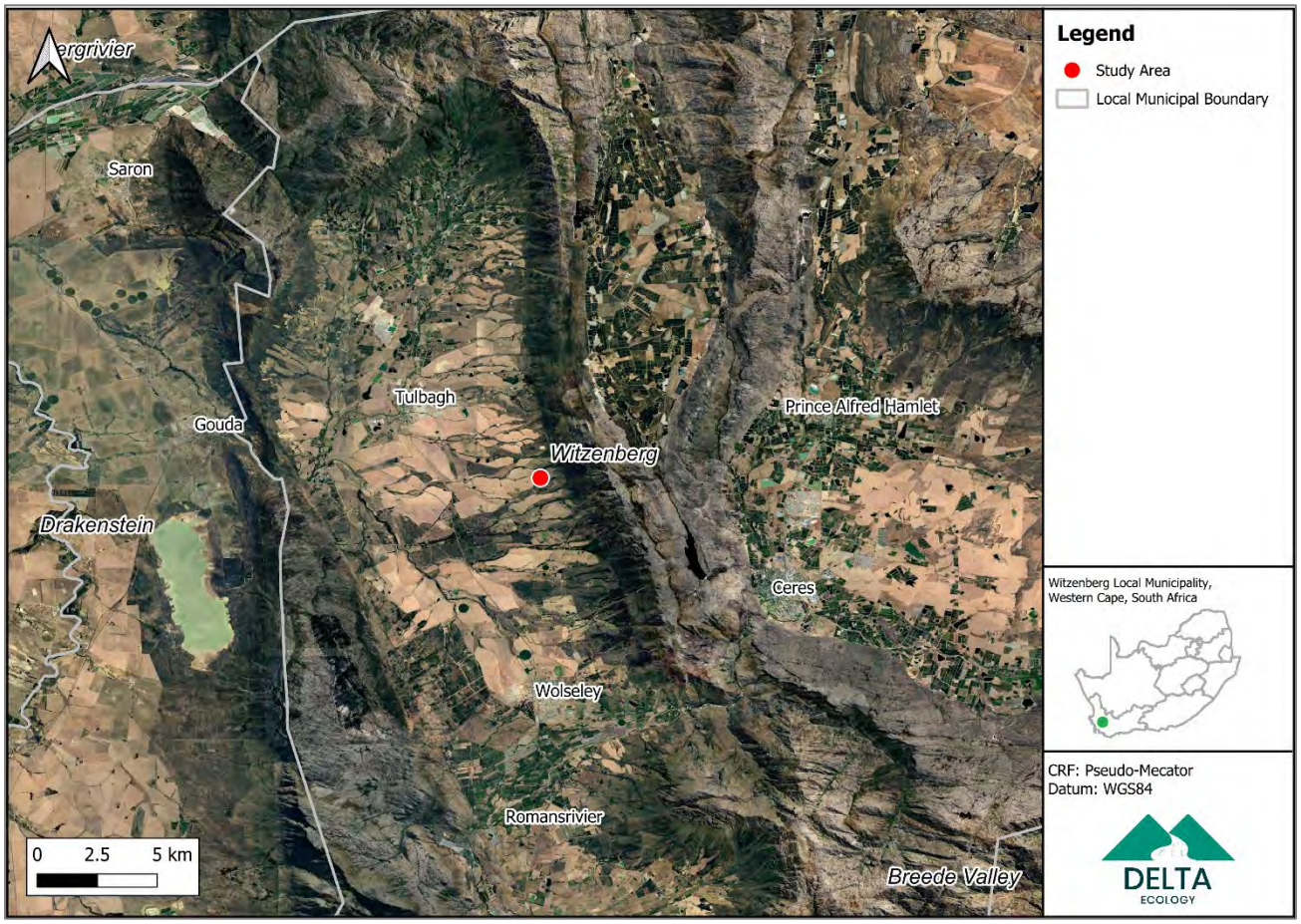


Figure 1-1: Location of the project.

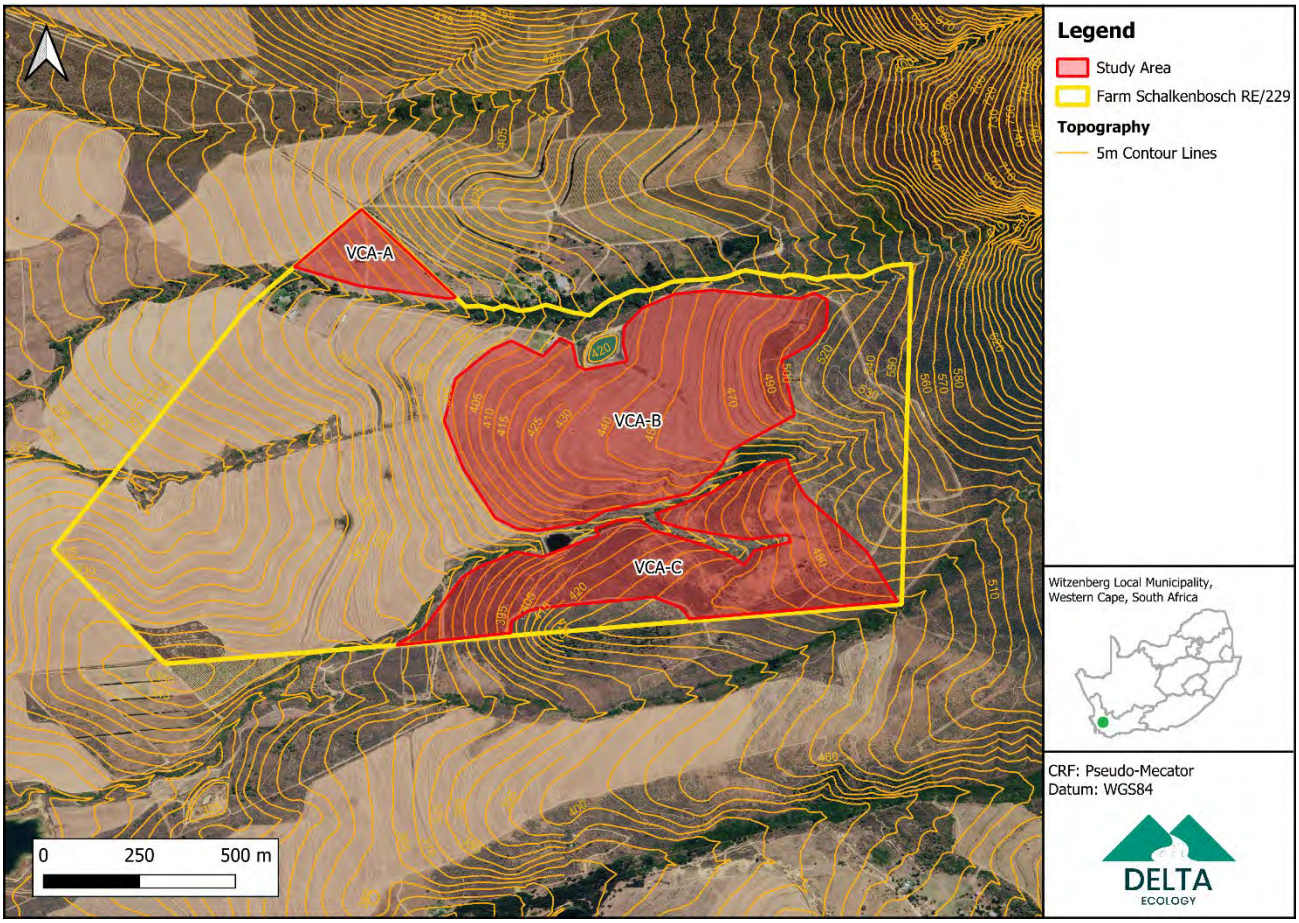


Figure 1-2: Overview of the study area.

1.1. Terms of Reference

The Terms of Reference (ToR) agreed upon for this Freshwater Risk and Impact Assessment include:

- A desktop background assessment and site assessment to identify and confirm potential aquatic biodiversity constraints associated with the proposed activities.
- Delineation of watercourse (s) likely to be at risk or impacted by the proposed activities, using a combination of site-based and desktop methodologies as appropriate.
- Verification of the aquatic sensitivity of the area as either "Very High" or "Low".
- Determination of the Present Ecological State (PES), Index of Habitat Integrity (IHI), Ecological Importance and Sensitivity (EIS), contribution to Wetland Ecosystem Services (WES) (where applicable), Recommended Ecological Category (REC), and buffer areas (if applicable).
- Assessment of potential aquatic biodiversity impacts of the vegetation clearing and agricultural production on the watercourse (s) present within the study area.
- Application of the Risk Assessment Matrix (RAM) stipulated by GN 4167 of 2023 promulgated in terms of the National Water Act (Act 36 of 1998); and
- Provision of mitigation measures to reduce aquatic biodiversity impacts / risks as far as possible.

1.2. Limitations and Assumptions

The following limitations and assumptions apply to this assessment:

- The site assessment was undertaken on 17 July 2026 during the winter (wet) season. Although the assessment was conducted during a single season, this is not considered to affect the reliability of the findings or conclusions. The timing of the survey was appropriate for identifying and delineating watercourses, as sufficient field indicators were present, including surface flow, landscape position, topographic indicators, hydromorphic soils, and characteristic wetland and riparian vegetation. These indicators provided an adequate basis to delineate watercourses and to assess their ecological condition, sensitivity and potential vulnerability to the proposed vegetation clearing activities.
- Only watercourse (s) that, in the opinion of the specialist, will be impacted by the development activities, given the information available at the time, were assessed.
- The watercourse edge was delineated using a Garmin handheld GPSMAP 66i with an expected accuracy of 3 m or less at the 95% confidence interval. In the opinion of the specialist, this limitation is of no material significance to the assessment and all aquatic biodiversity constraints have been adequately identified.
- Watercourse delineation plotted digitally may be offset by at least five meters to either side. Furthermore, it is important to note that, during converting spatial data to final drawings, several steps in the process may affect the accuracy of areas delineated in the current report. The scale at which maps and drawings are presented in the current report may become distorted should they be reproduced by, for example, photocopying and printing.
- Formal vegetation sampling was not undertaken by the specialist; however, general observations of vegetation were recorded based on onsite visual inspections. Only dominant and noteworthy plant species were noted. Consequently, the vegetation information presented has limitations for detailed botanical application, but this level of detail is considered appropriate and acceptable for the purposes of the aquatic biodiversity assessment, in line with the *Protocol for the Specialist Assessment and Minimum Report Requirements for Environmental Impacts on Aquatic Biodiversity* (GN No. 320 of 20 March 2020) and the *GN 4167 of 2023 promulgated in terms of the NWA (Act 36 of 1998).* A separate Plant Species and Terrestrial Biodiversity Impact Assessment has been undertaken by Dr Keet (Keet, 2025).
- A Species of Conservation Concern (SCC) scan, fauna and flora assessments were not included in the current study. Potential aquatic SCC were, however, considered and noted where relevant within the EIS assessment. This level of detail is considered appropriate and acceptable for the purposes of the aquatic biodiversity assessment, in line with the *Protocol for the Specialist Assessment and Minimum Report Requirements for Environmental Impacts on Aquatic Biodiversity* (GN No. 320 of 20 March 2020) and the *GN 4167 of 2023 promulgated in terms of the NWA (Act 36 of 1998).*
- Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions, species' seasonality, and migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage.
- Description of the depth of the regional water table, geohydrological and hydro pedological processes, as well as flood line calculations falls outside the scope of the current assessment and are not deemed necessary for the proposed development.

- The delineation does not consider climate change or future changes to watercourses resulting from increasing catchment transformation. The reason for this is because the accepted best practice method for delineating watercourses in South Africa, required by GN 509 [1], uses key indicators obtained in the field at the time of the assessment to determine the wetland's current edge. The applicant should be cognisant of the risk that the extent, ecological state, and function of the onsite watercourse (s) may change over time, due to altered land use in the catchment.

Notwithstanding the above limitations, the specialist is of the opinion that the aquatic biodiversity constraints for the study area have been adequately identified for the purposes of this assessment.

1.3. Use of this report

This report reflects the professional judgement of its author and, as such, the full and unedited contents of this should be presented in any application to relevant authorities. Any summary of the findings should only be produced with the approval of the author.

2. Site Sensitivity Verification

According to the National Web-based Environmental Screening Tool, the proposed vegetation clearing areas are classified as having Very High Aquatic Biodiversity Theme Sensitivity (DFFE, 2026). This sensitivity is primarily associated with the presence of mapped aquatic ecological features within and adjacent to the proposed vegetation clearing areas, including Critical Biodiversity Areas (CBAs) and watercourses. Additionally the areas are located within a Strategic Water Source Area (SWSA) for Surface Water (SW), specifically the Boland SWSAsw. In accordance with the NEMA (Act No. 107 of 1998) Environmental Impact Assessment Regulations, 2020 (as amended) (GN R. 320 of 2020), the environmental sensitivity identified by the National Web-based Environmental Screening Tool must be verified through an Initial SSV prior to undertaking the specialist assessment.

The Initial SSV comprised a desktop assessment (refer to **Section 4**) together with a field assessment undertaken on **17 July 2026** (refer to **Section 5**). The field assessment confirmed the presence of several watercourses associated with the upper Breede River catchment, including non-perennial drainage lines and associated riparian habitat; as well as one seep wetland. The watercourses are located within an agricultural landscape that has been historically cultivated for dryland agriculture and contains existing contour banks and contour-aligned planting rows constructed for soil and water conservation. While portions of the surrounding landscape have been transformed through historical cultivation, the delineated watercourses retain important freshwater habitat and ecological connectivity.

The proposed vegetation clearing areas occur near these watercourses and have the potential to result in indirect impacts through vegetation clearing, soil disturbance, erosion, sediment mobilisation and changes to surface runoff patterns if not appropriately managed. The presence

[1] Also refer to Section 3.2. for a detailed description of this methodology.

of aquatic ecological features within the study area, together with the potential for impacts associated with the proposed activities, confirms that the site is of Very High Aquatic Biodiversity Sensitivity.

In accordance with GN R. 320 of 2020, where the verified aquatic biodiversity sensitivity is confirmed as Very High, a full Aquatic Biodiversity Impact Assessment is required. Accordingly, the findings of the SSV support the need for the comprehensive freshwater assessment presented in this report.

3. Methodology

The detailed methodology used in this aquatic biodiversity assessment report, including a desktop background assessment, site assessment, and the delineation and classification of the onsite watercourse (s) associated with the proposed study area, is outlined in detail in **Annexure B**, and a summary is provided in the subsections below.

3.1. Desktop Assessment

The following desktop resources were consulted:

- Topographical information from the National Geographical Information Service (NGI);
- The South African Atlas of Climatology and Agrohydrology (1997, 2007 and 2009);
- The South African National Biodiversity Institute (SANBI) (2018) National Vegetation Map (NVM) & National Wetland Map Version 5 (NWM5) (2018);
- The National Freshwater Ecosystem Priority Area (NFEPA) wetland, wetland vegetation group, river, and Freshwater Ecosystem Priority Area (FEPA) datasets (CSIR, 2011);
- The Western Cape Biodiversity Spatial Plan (WCBSP) (2023); and
- The Natural Agricultural Resource Atlas of South Africa: Version 1.2 (NAR, 2022).

3.2. Wetland Delineation

The wetland boundaries were delineated at the outer edge of the wetland temporary zone using the method described in the Department of Water Affairs and Forestry (DWAF[2]) Manual for the Identification and Delineation of Wetlands and Riparian Areas for field-based delineation (DWAF, 2008).

3.3. Riparian Area Delineation

Riparian areas were identified using the method described in the DWAF, (2008) Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas. This method is the accepted best practice method for identifying and delineating riparian areas in South Africa and its use is required by GN 509.

[2] Now Department of Water and Sanitation (DWS).

3.4. Watercourse Classification

The Ollis *et al* (2013) Classification System for Wetlands and Other Aquatic Ecosystems in South Africa, as used in this assessment, is a tiered structured classification system that provides a uniform description of wetland types based on their hydrogeomorphic characteristics.

3.5. Present Ecological State Assessment

3.5.1. WET-Health PES Assessment

WET-Health Version 2 (Macfarlane *et al*. 2020) is a modular tool designed to evaluate and assess the Present Ecological State (PES) of wetland hydrogeomorphic units based on the degree to which the wetland has deviated from its natural reference condition. The tool accounts for four inter-related components that influence wetland health. These consist of three core drivers of wetland change namely hydrology, geomorphology and water quality, along with vegetation as a responding variable. A separate PES score is derived for each of these components, which are then combined into a single PES score for the wetland hydrogeomorphic unit. The scores for each component and the overall score fall into one of six Ecological Categories defined in **Table 3-1** below.

Table 3-1: PES Categories Scores as defined WET-Health Version 2 (Macfarlane *et al*., 2020).

Ecological Category	Description	Impact Score	PES Score (%)
A	Unmodified, natural.	0-0.9	90-00
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible, and a small loss of natural habitats and biota may have taken place.	1-1.9	80-89
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	60-79
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	40-59
E	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	20-39
F	Critically modified. Modifications have reached a critical level, and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	0-19

3.5.2. Habitat Integrity Assessment

The Index of Habitat Integrity (IHI) assessment is a tool used to assess the habitat integrity of a river based on the intensity and extent of anthropogenic disturbances that impact both the instream and riparian habitat. The assessment of habitat integrity is based on an interpretation of the deviation from the reference condition (Kleynhans *et al.*, 2008).

The Index of Habitat Integrity scores (%) for the instream and riparian zone components are used to place these two components into a specific class. These classes are indicated in **Table 2-2**. The assessment method in determining the severity of modifications to habitat integrity is a largely field-based site assessment, supplemented with information from aerial photographs (google earth images).

Table 3-2: IHI classes and their description

CLASS	DESCRIPTION	SCORE (%)
A	Unmodified, natural.	90 – 100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place, but the assumption is that ecosystem functioning is essentially unchanged.	80 - 89
C	Moderately modified. A loss or change in natural habitat and biota has occurred, but basic ecosystem functioning appears predominately unchanged.	60 – 79
D	Largely modified. A loss of natural habitat and biota and a reduction in basic ecosystem functioning is assumed to have occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and ecosystem functioning is extensive.	20 – 39
F	Modifications have reached a critical level and there has been an almost complete loss of natural habitat and biota. In the worst cases, the basic ecosystem functioning has been destroyed.	0 - 19

3.6. Ecosystem Service Assessment

WET-EcoServices Version 2 (Kotze *et al.*, 2021) is a structured and rapid field-based evaluation tool designed to assess the wetlands and riparian areas ecosystem services based on their Hydrogeomorphic (HGM) unit. The tool offers two levels of assessment, namely Level 1 (a rapid desktop assessment) and Level 2 (a detailed field-based indicator assessment). Level 1 is designed for conducting rapid desktop assessments of many wetlands and riparian areas across provincial and national scales. Ratings are assigned based on the Hydrogeomorphic unit of the wetland. Level 2 is designed for conducting robust in-field assessments of ecosystem services for respective wetland types and/or riparian areas. The level 2 Ecosystem Service assessment was applied to the seep in this case.

Table 3-3: Ecosystem Services Importance Categories Scores as defined in WET-Ecoservices' Version 2 (Kotze *et al*. 2020).

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

3.7.Ecological Importance and Sensitivity Assessment

The EIS method (Rountree *et al*. 2013) is a rapid scoring system designed to identify the ecological importance and sensitivity of wetlands to disturbances across multiple scales (i.e., catchment to international scales). The full EIS method integrates three important components, namely, ecological importance and sensitivity, hydro-functional importance, and basic socio-economic importance. The hydro-functional and socio-cultural benefits were however assessed using the updated WET-EcoServices assessment methodology and these two components were therefore omitted from this EIS assessment. The EIS score ranges from 0-4, and it provides an index for prioritisation and management of water resources. The EIS categories are presented in **Table 2-3.**

Table 3-4: Ecological Importance and Sensitivity Categories (DWAF, 1999).

EIS Category	Description	Range of Median
Very high	Ecologically important and sensitive on a national or even international level. These river systems and their biota are usually very sensitive to flow and habitat modifications and provide only a small capacity for use.	>3 and <=4
High	Ecologically important and sensitive on a regional or national scale. These river systems may be sensitive to flow and habitat modifications.	>2 and <=3
Moderate	Watercourses that are considered to be ecologically important and sensitive on a provincial or local scale. The biota of these watercourses is not usually sensitive to flow and habitat modifications.	>1 and <=2
Low/marginal	Watercourses that are not ecologically important and sensitive at any scale. The biota within these watercourses is not sensitive to flow and habitat modifications.	>0 and <=1

3.8. Recommended Ecological Category

The method for determining the Recommended Ecological Category (REC) for water resources is described in Rountree *et al*. (2013). The objective of the REC is to define the management objective for wetlands and does so in accordance with the following rules:

- A wetland within PES Category A (unmodified) cannot be rehabilitated. The management objective will therefore always be to maintain the existing PES Category.
- A wetland within PES Category B, C or D with a "Low marginal" or "Moderate" EIS score must also be maintained in the pre-development PES category.
- A wetland within PES Category B, C or D with a "High" or "Very High" EIS score must, where practically possible, be rehabilitated to a PES category that is one higher than the pre-development category. E.g. a wetland with a pre-development PES score of C and a "High" EIS score must be rehabilitated to a PES category B. Where this is not practically possible, maintenance of the pre-development PES category will be the management objective.
- PES Categories E or F are considered unsuitable and always require rehabilitation to a PES Category D.

3.9. Desktop Buffer Tool

Desktop Buffer Tool (Macfarlane, 2016), a rapid, spreadsheet-based, scoring tool was used to determine an appropriate buffer around rivers, wetlands and estuaries.

3.10. Impact and Risk Assessment

The impact assessment utilised the Delta Ecology impact assessment methodology as specified in **Annexure B.** The risk assessment utilised the methodology and RAM stipulated by GN 4167 of 2023 promulgated in terms of the National Water Act (Act 36 of 1998).

4. Desktop Assessment

A review of desktop resources was undertaken. A summary of key desktop information relevant to this assessment is provided below.

4.1. Biophysical Context

The study area is situated on the western foothills of the Witsenberg Mountain, with elevation decreasing from approximately 510 m amsl in the east to approximately 345 m amsl toward the western extent of the site (**Figure 4-1**). The landscape is predominantly characterised by commercial annual crops, low Fynbos shrubland and dense forestry, particularly along the rivers (DFFE, 2020).

The dominant geology is mudstones, shales, and greywackes of the Porterville Formation (Malmesbury Group). In the western portion of the area, other lithologies are present from the Table Mountain Group, including quartz sandstone of the Peninsula Formation, diamictite and tillite of the Pakhuis Formation, and mudrock, siltstone, and shale of the Cedarberg Formation (Council for Geoscience, 2019). Soil formations are largely characterised by weathered rock with limited soil development, and where present, it is typically very shallow (ENPAT, 2021). Lime may be rare or absent in the landscape (ENPAT, 2021).

The study area falls within the temperate Csa class of the Köppen-Geiger Climate Classification, indicating a Mediterranean climate characterised by hot, dry summers and mild, wet winters (Beck et al., 2018). It is situated along an east–west rainfall gradient and receives a mean annual precipitation of 637 mm, with rainfall concentrated in the austral winter and peaking in June (Schulze, 2009). A similar east–west temperature gradient is also evident across the study area, with mean annual temperatures ranging from 12 °C to 16 °C (Schulze, 2009).

According to the latest SANBI (2018) Vegetation Map, the natural terrestrial vegetation of the surrounding landscape is characterised by the Endangered (EN) Breede Alluvium Fynbos (PP), Breede Shale Renosterveld (PP), and Breede Shale Fynbos (MP). These vegetation types have a Protection Status ranging from Poorly Protected (PP) to Moderately Protected (MP) in the Revised National List of Threatened Ecosystems (Government Gazette 47526 of 2022) in terms of Section 52 of the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004 – NEMBA).

According to the NFEPA wetland vegetation spatial dataset (CSIR, 2011), the study area is associated with the Critically Endangered (CR) vegetation types with Protected status that range from Zero Protection (ZP), Moderately Protected (MP) to Well-Protected (WP). This includes the Southwest Shale Fynbos (CR / ZP-WP), East Coast Shale Renosterveld (CR / ZP-MP) and Southwest Alluvium Fynbos (EN / ZP-WP) (**Figure 4-1**).

The general biophysical characteristics of the study area are summarised in **Table 4-1**.

Table 4-1: General characteristics of the study area.

Site attribute	Description	Data source
Eco-region	South Western Coastal Belt and Western Folded Mountains	Department of Water Affairs Level 1 Ecoregions (DWS, 2011)

Terrestrial Vegetation Type	Breede Alluvium Fynbos (EN / PP), Breede Shale Fynbos (EN / MP), and Breede Shale Renosterveld (EN / PP)	National Vegetation Map of South Africa, 2018 (SANBI, 2018)
Dominant Geology and Soils	Mudstones, shales, and greywackes of the Porterville Formation dominate the study area (Malmesbury Group), while the western areas include Table Mountain Group lithologies (Peninsula quartz sandstone, Pakhuis diamictite/tillite, Cedarberg mudrock, siltstone, shale). Soils are shallow, poorly developed, derived from weathered rock, with little to no lime present.	Council for Geoscience (2019) ENPAT (2021)
Soil Erodibility Factor (K)	0.53 (High Erodibility)	SA Atlas of Climatology and Agrohydrology (Schulze, 2009)
Soil Depth & Clay Percentage (%)	>= 450 mm and < 750 mm >= 15 % and < 35 %	Soil types and descriptions for the Western Cape, Department of Agriculture, Forestry and Fisheries (DAFF, 2021)
Mean Annual Precipitation (mm)	637 mm	SA Atlas of Climatology and Agrohydrology (Schulze, 2009)
Rainfall seasonality	Winter rainfall	
Mean Annual Temperature (°C)	12 - 16 °C	
Water Management Area (WMA)	Breede - Olifants	Water Management Areas (DWAF, 2023)
Quaternary Catchment	G10E	South African Quaternary Catchments Database (Schulze *et al*. 2007)
Wetland Vegetation Group (for wetlands within the applicable terrestrial vegetation type)	Southwest Shale Fynbos (CR / ZP-WP), East Coast Shale Renosterveld (CR / ZP-MP), and Southwest Alluvium Fynbos (EN / ZP-WP)	NFEPA Wetland Vegetation Types (CSIR, 2011)

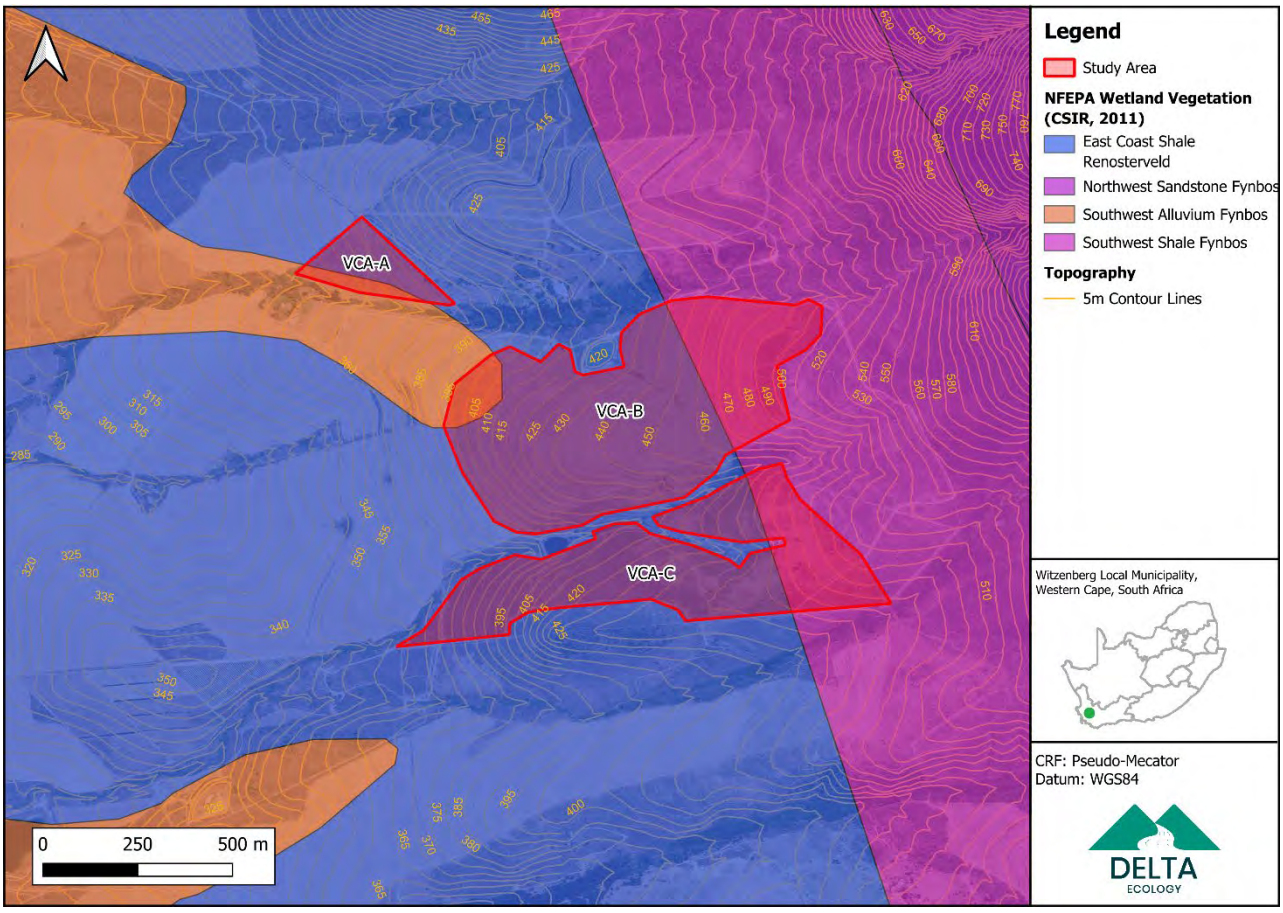


Figure 4-1: Overview of study area in relation to the NFEPA Wetland Vegetation (CSIR, 2011).

4.2. Biodiversity Planning Context

The site under evaluation is located within the Breede - Olifants Water Management Area (WMA), in quaternary catchment G10E. The applicable sub-quaternary reach is not demarcated as a FEPA sub-quaternary catchment. The regional setting, in terms of the Level 1 Department of Water Affairs (DWA) (now Department of Water and Sanitation) Ecoregions, is within the South Western Coastal Belt and Western Folded Mountains(**Table 4-1**).

The study area traverses several unnamed mapped non-perennial rivers (NGI, 2019) and occurs within the 100 m DWS Regulated Area for Rivers (**Figure 4-2** and **Figure 4-3**). These non-perennial rivers form a tributary system of the Boontjies River, which is classified as an NFEPA River (NBA, 2018). The Boontjies River is a southwest-flowing perennial tributary of the Klein Berg River. The Boontjies River has been assigned a PES category D (Largely Modified), with a 'Moderate' Ecological Importance (EI) and 'High' Ecological Sensitivity (ES) (DWS, 2014).

In addition, the study area transects and occurs within the 500 m DWS Regulated Area for wetlands, as indicated by the mapped NFEPA wetlands (CSIR, 2011) and mapped NWM5 wetlands (SANBI, 2018) (**Figure 4-2** and **Figure 4-3**). A detailed description of the study area comprising the Vegetation Clearing Areas (VCA) in relation to these mapped watercourses is provided in detail below:

VCA-A

VCA-A is located approximately 31 m west of a west-flowing non-perennial river (NGI, 2019) and falls within the river's 100 m DWS regulated area. A natural NFEPA wetland (CSIR, 2011) and a NWM5 seep wetland (SANBI, 2018) associated with the non-perennial river transect the southern portion of VCA-A. In addition, VCA-A is located approximately 387 m northwest of an artificial NFEPA wetland (CSIR, 2011) and therefore falls within the 500 m DWS Regulated Area for wetlands.

VCA-B

VCA-B is located approximately 44 m south of a west-flowing non-perennial river (NGI, 2019) and falls within the river's 100 m DWS regulated area, while its tributary transects the north portion of VCA-B. Another non-perennial river, flowing southwest, is located approximately 30 m south of VCA-B and also falls within the river's 100 m DWS Regulated Area.

Several natural NFEPA wetlands (CSIR, 2011) and NWM5 (SANBI, 2018) seep wetlands, both associated with the non-perennial river, are located adjacent to both the northern and southern boundary of VCA-B and therefore fall within the 500 m DWS Regulated Area for wetlands. In addition, two artificial NFEPA wetlands are located adjacent to the northern boundary and southwestern boundary, while another artificial wetland is located approximately 100 m northeast of VCA-B.

VCA-C

VCA-C is located approximately 60 m south of a west-flowing non-perennial river (NGI, 2019) and falls within the associated 100 m DWS regulated area. A tributary of this system transects the eastern portion of the study area. Another non-perennial river, flowing southwest, occurs to the south of VCA-C, particularly near its southeastern corner, and also falls within the 100 m DWS Regulated Area.

Two natural NFEPA wetlands (CSIR, 2011) and NWM5 (SANBI, 2018) seep wetlands, both associated with the non-perennial river, are located directly north of VCA-C, while another natural NFEPA wetland (CSIR, 2011) and NWM5 (SANBI, 2018) seep wetland are located south of VCA-C. In addition, an artificial NFEPA wetland (CSIR, 2011) is situated directly north of VCA-C, with another located approximately 490 m to the north. These artificial wetlands therefore fall within the 500 m DWS Regulated Area for wetlands.

The 2023 WCBSP (CapeNature, 2024) indicates that the study area does not intersect any aquatic CBAs or ESAs (**Figure 4-4**). However, Wetland CBA 1 features are associated with the non-perennial rivers adjacent to the study area (**Figure 4-4**). The study area does not fall within a Protected Area but is located adjacent to the Witzenberg Nature Reserve (**Figure 4-4**).

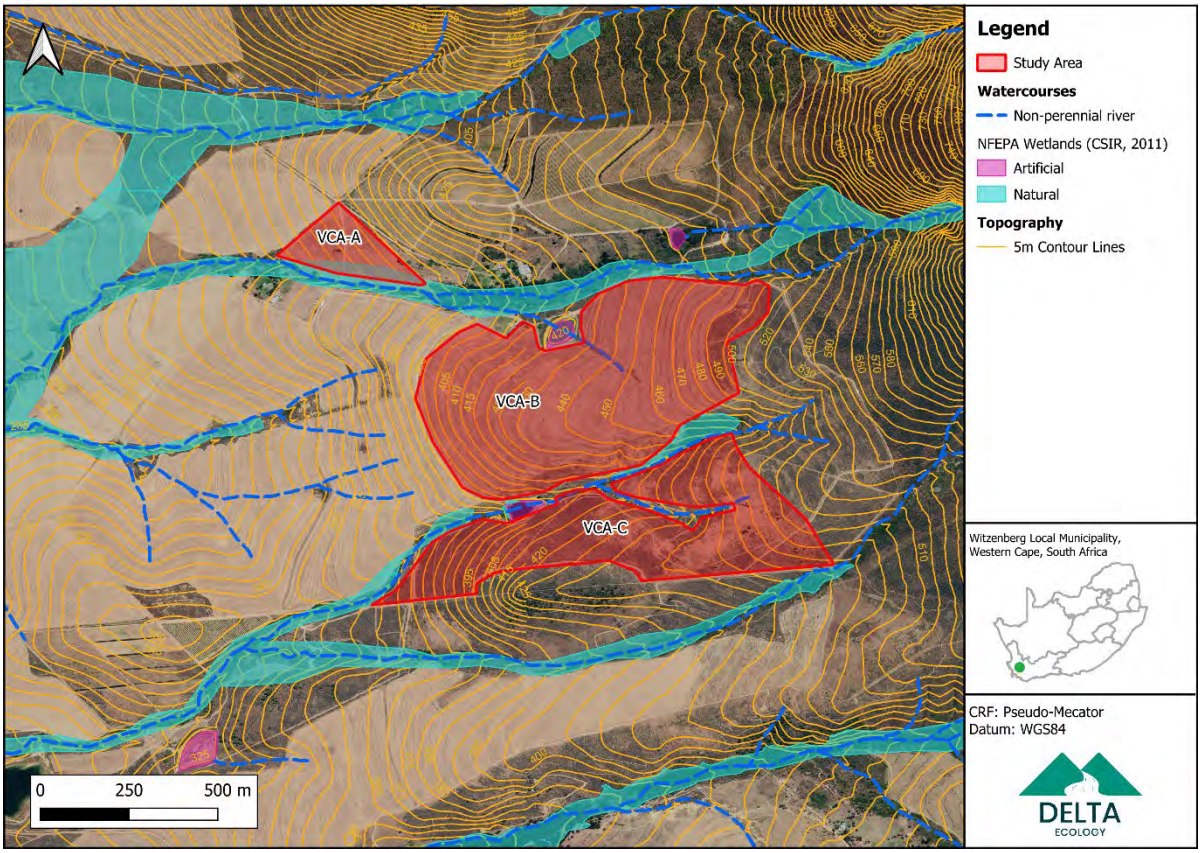


Figure 4-2: Regional drainage overview in relation to the study area, indicating non-perennial rivers (NGI, 2019) and NFEPA wetlands (CSIR, 2011).

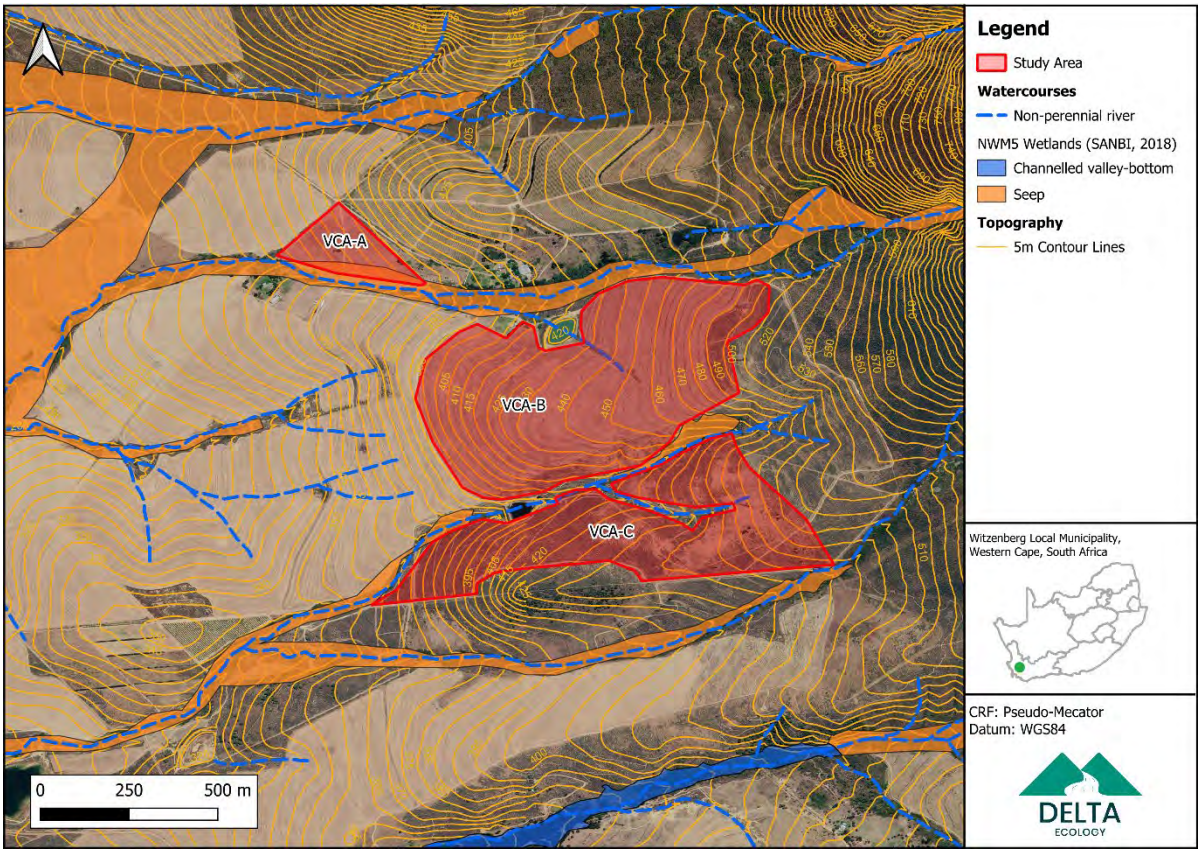


Figure 4-3: Regional drainage overview in relation to the study area, indicating non-perennial rivers (NGI, 2019) and NWM5 wetlands (SANBI, 2018).

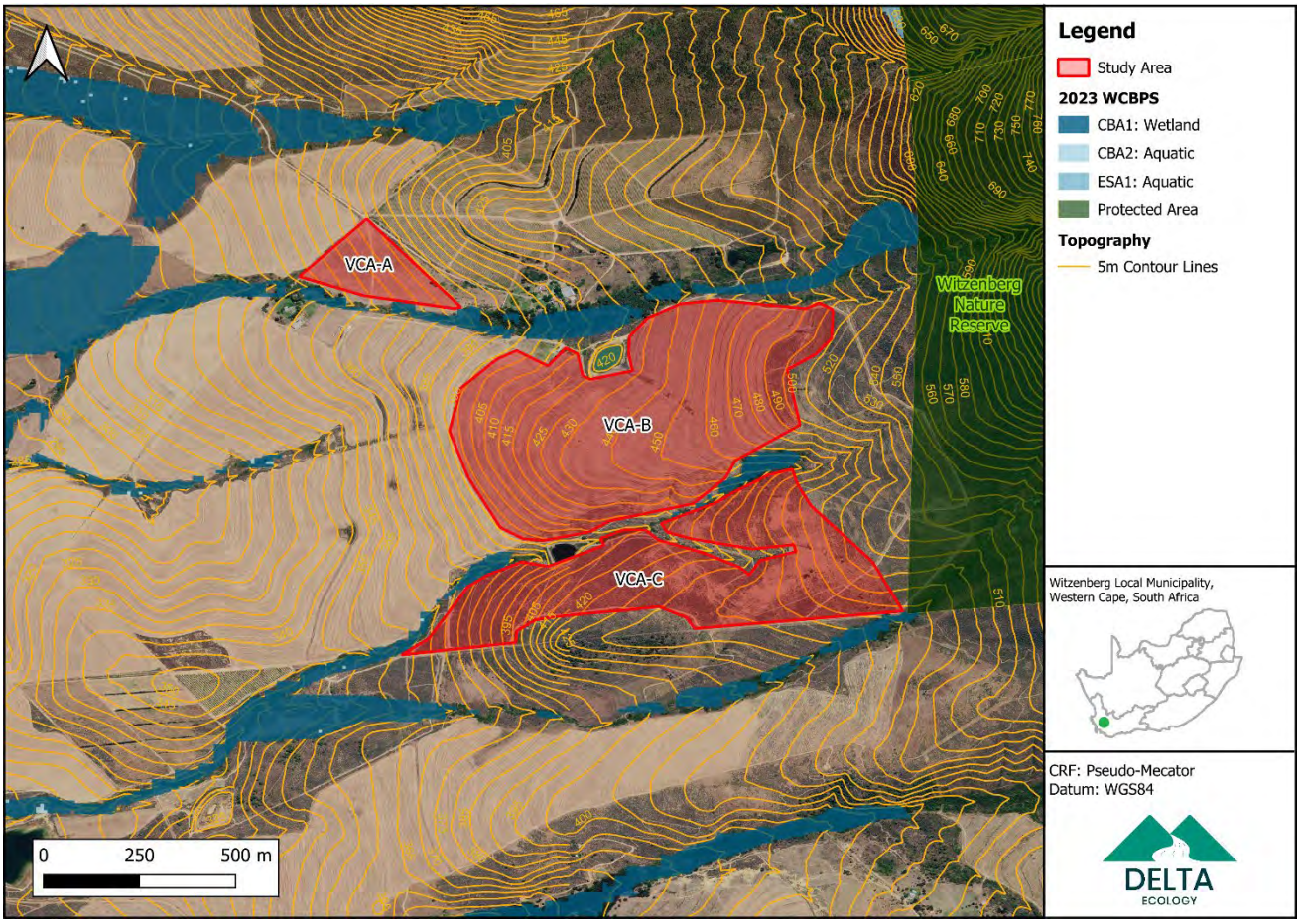


Figure 4-4: Overview of the study area in relation to the 2023 WCBSP (CapeNature, 2024).

5. Site Description

The study area is situated on the lower slopes of the Tulbagh Mountain Range and ranges in elevation from approximately 530 m above mean sea level (masl) in the east to 306 masl in the west. The topography generally slopes westward, resulting in several watercourses traversing the property.

Three non-perennial rivers and associated tributaries, one flow path and one seep wetland occur within the regulated proximity of the proposed vegetation clearing areas (**Figure 5-1**). The proposed development footprint is located predominantly within areas that have been historically disturbed by agricultural activities (**Figure 5-2**), resulting in varying degrees of modification to the aquatic ecosystems.

Non-perennial River 1 is in a relatively undisturbed condition and supports dense, well-developed indigenous riparian vegetation (**Figure 5-3**).

Non-perennial River 2 retains sections of dense riparian vegetation in fair ecological condition; however, the system has been altered by historical agricultural activities, including the construction of a farm dam within the channel (**Figure 5-5-Figure 5-8**). The tributaries of Non-perennial River 2 have been historically impacted by agricultural activities, resulting in modified channels to an extent and comparatively sparse riparian vegetation (**Figure 5-4 & Figure 5-5**).

Non-perennial River 3 supports dense riparian vegetation along much of its length, although sections are dominated by alien invasive tree species (**Figure 5-9**). The lower reaches have been substantially disturbed by historical agricultural activities, while the upper reaches remain comparatively less impacted (**Figure 5-10 & Figure 5-11**).

The seep wetland is situated between a cultivated area and fallow agricultural field but remains in a relatively natural ecological condition, as it continues to support the characteristics of a largely intact seep system with dense wetland vegetation (**Figure 5-12**).

The flow path has been almost entirely transformed by historical agricultural activities. Little riparian vegetation remains, and the feature now functions primarily as an agricultural furrow that conveys surface runoff into a downstream farm dam.

The riparian and wetland vegetation for the watercourses was mostly dominated by native shrubs such as *Freylinia lanceolata* (River Bellbush), *Asparagus rubicundus* (Redstem Asparagus), *Diospyros glabra* (Cape Starapple), *Dodonaea viscosa* ssp. *Angustifolia* (Sand Olive), *Kiggelaria Africana* (Wild Peach) and *Olea europaea* ssp. *Cuspidate* (Indian Olive) (Keet, 2025). Two procted planted species were recorded with the riparian habitat, namely *Ferraria crispa* (Black Spiderlily) and *Chasmanthe aethiopica* (Cobra Lily) (Keet, 2025).

Non-perennial river 2 had some occurrence of alien invasive species, namely *Pinus halepensis* (Aleppo Pine), limited to a few scattered individuals. Non-perennial river 3 had more occurrence of alien invasive species partially in the lower more disturbed reaches which predominately included *Acacia melanoxylon* (Australian Blackwood) with some occurrence of *Pinus halepensis* (Aleppo Pine) and *Fraxinus angustifolia* (Algerian Ash). Additionally, *Quercus robur* (English Oak) which is alien but not considered invasive was also present within non-perennial river 3.

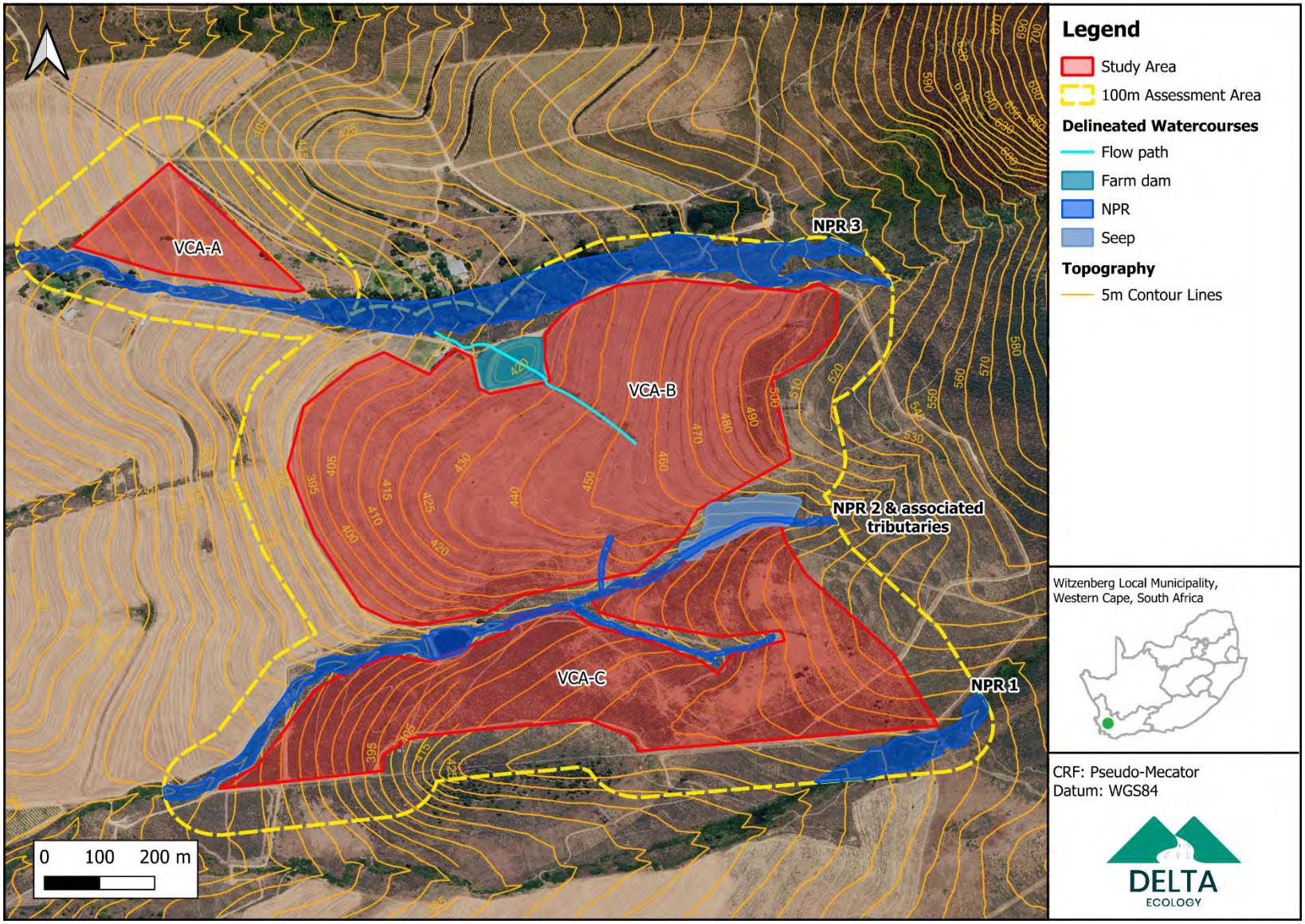


Figure 5-1: Delineation of the at-risk watercourses.



Figure 5-2: Overview of the study area.



Figure 5-3: Dense riparian vegetation within the non-perennial river 1.



Figure 5-4: Overview of the riparian zone of the non-perennial river 2.



Figure 5-5: Non-perennial river 2 with associated tributaries.



Figure 5-6: Farm dam within the non-perennial river 2.



Figure 5-7: Pine trees within the non-perennial river 2.



Figure 5-8: Dense riparian vegetation within the non-perennial river 2.



Figure 5-9: Dense riparian vegetation within the non-perennial river 3.



Figure 5-10: Road crossing the non-perennial river 3.



Figure 5-11: Disturbed agricultural landscape around the lower reaches of non-perennial river 3.

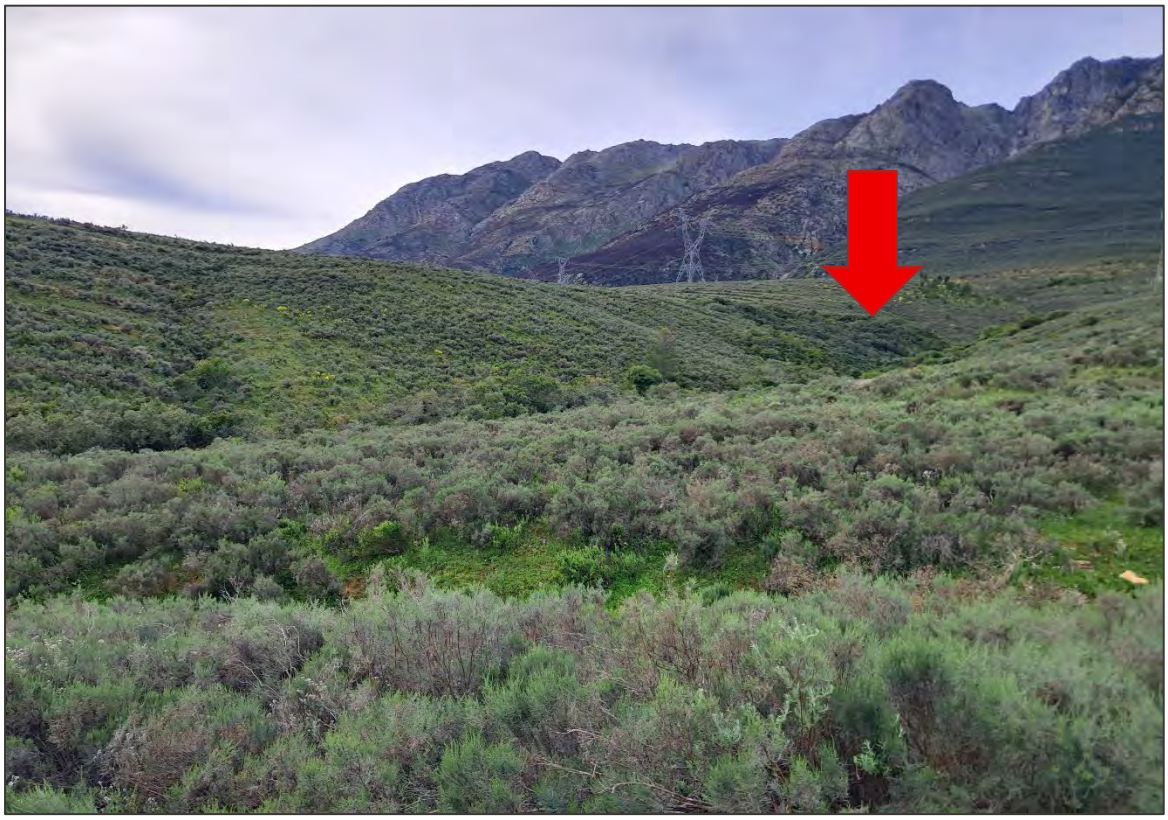


Figure 5-12: Overview of the seep wetland indicated by arrow.

Table 5-1: Classification of the watercourses within the study area.

Factor	Non-perennial rivers	Seep wetland
System	Inland	Inland
Ecoregion	South Western Coastal Belt in the west and Western Folded Mountains in the west	Western Folded Mountains
Landscape Setting	Valley	Valley
Hydrogeomorphic type	River	Seep
Drainage	Rainfall and interflow	Rainfall and interflow
Seasonality	Seasonal	Permanent
Anthropogenic influence	Road crossings, dams and agriculture	Agriculture
Vegetation	Southwest Shale Fynbos, East Coast Shale Renosterveld and Southwest Alluvium Fynbos	Southwest Shale Fynbos and East Coast Shale Renosterveld
Geology	Phyllite shale, schist and greywacke of the Porterville Formation,	Phyllite shale, schist and greywacke of the Porterville Formation,

	Malmesbury Group, partly covered by talus gravel	Malmesbury Group, partly covered by talus gravel
Substrate	Sand and stones	Sand and stones
Salinity	Fresh	Fresh
Natural V Artificial	Natural	Natural

6. Status Quo Assessment

In this study, the non-perennial rivers / flow path and seep wetland associated with the proposed activities were assessed to determine the IHI, PES, EIS, and contribution to WES. These metrics were used to determine the management objective expressed in terms of the REC.

6.1. Habitat Integrity Assessment

The habitat integrity of the non-perennial rivers and flow paths was assessed. The assessment for non-perennial river 1 produced an instream and riparian habitat integrity within category B (Largely Natural), while the results for non-perennial river 2, associated tributaries and non-perennial river 3 produced an instream and riparian habitat integrity within category C (Moderately Modified). The assessment for the flow path produced an instream and riparian habitat integrity within Category F (Critically Modified). The assessment results for the instream and riparian habitat are presented in **Table 6-1** and **Table 6-2** respectively.

Non-perennial River 1 is in a relatively undisturbed ecological condition and supports dense, well-developed indigenous riparian vegetation. The primary anthropogenic impacts on the system include a dirt road crossing, which has resulted in a localised modification of the channel and flow regime, and agricultural activities within the catchment that moderately affect water quality through increased sediment and nutrient inputs. Non-perennial River 2 retains sections of dense riparian vegetation in fair ecological condition; however, historical agricultural activities have moderately disturbed portions of the riparian zone. The construction of a farm dam within the channel has altered the natural flow regime, channel morphology and bed characteristics, while agricultural activities within the catchment negatively affect water quality. Tributaries associated with Non-perennial River 2 have been historically impacted by agricultural activities, resulting in a modified channel and comparatively sparse riparian vegetation. The river is also crossed by a dirt road, causing localised modifications to the channel morphology and flow regime.

Non-perennial River 3 supports dense riparian vegetation along much of its length, although sections are dominated by alien invasive tree species. The lower reaches have been substantially disturbed by historical agricultural activities, while the upper reaches remain comparatively less impacted. Multiple farm road crossings have resulted in localised modifications to the channel, bed and flow regime. Agricultural activities occurring in close proximity to the lower reaches contribute to a decline in water quality, while the presence of alien invasive vegetation has altered the composition and structure of the riparian habitat.

The flow path is entirely modified by agricultural activities and now functions primarily as a stormwater furrow conveying runoff to a downstream farm dam, with little remaining riparian vegetation and a substantially altered channel morphology and hydrological regime.

Table 6-1: Instream IHI Score Rating Results for the non-perennial rivers and flow path.

CRITERIA	River 1	River 2	Tributaries associated with NPR 2	River 3	Flow path
Water Abstraction	0	10	0	3	15
Flow Modification	5	9	8	10	20
Bed Modification	5	10	8	7	22
Channel Modification	5	10	8	7	20
Water Quality	9	11	7	13	20
Extent of Inundation	3	10	8	7	10
Alien Macrophytes	3	5	5	9	5
Presence of exotic fauna	0	0	0	0	0
Solid Wate Disposal	0	0	0	0	0
Instream Habitat Integrity Score	85	64	79	69	23
Instream Integrity Category	**B**	**C**	**C**	**C**	**F**

Table 6-2: Riparian IHI Score Rating Results for the non-perennial rivers and flow path.

CRITERIA	River 1	River 2	Tributaries associated with NPR 2	River 3	Flow path
Indigenous Vegetation Removal	5	7	10	10	24
Exotic Vegetation Encroachment	5	7	5	10	10
Bank Erosion	5	5	7	5	5
Channel Modification	5	9	7	10	20
Water Abstraction	0	10	0	0	10
Extent of Inundation	5	10	7	7	15
Flow Modification	5	9	7	7	20
Water Quality	9	11	7	14	20
Riparian Habitat Integrity Score	81	60	75	61	4
Riparian Integrity Category	**B**	**C**	**C**	**C**	**F**

6.2. Present Ecological State

The Macfarlane *et al.* (2020) WET-Health Version 2.0 assessment was completed for the seep wetland to determine PES. the seep wetland produced an overall PES score within lower category B (Largely Natural) with a combined PES score of 83%. The assessment results for the wetland are presented in **Table 6-3**.

The seep wetland is in a largely natural and supports dense indigenous wetland vegetation. However, agricultural activities within the upstream catchment have resulted in a moderate decline in water quality through increased sediment and nutrient inputs, while sediment deposition has also altered the wetland's hydrology, geomorphology and vegetation.

Table 6-3: WET-Health Assessment for the seep wetland.

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	1,8	1,0	2,6	1,5
PES Score (%)	82%	90%	74%	85%
Ecological Category	**B**	**B**	**C**	**B**
Trajectory of change	↓	↓	↓	↓
Confidence (revised results)	Not rated	Not rated	Not rated	Not rated
Combined Impact Score	1,7			
Combined PES Score (%)	83%			
Combined Ecological Category	**B**			
Hectare Equivalents	1,2 Ha			

6.3. Ecosystem Services

The seep wetland assessed for there contribution to ecosystem services using the WET-EcoServices Version 2 methodology. The assessment results are summarised in **Table 6-4.** The majority of ecosystem service importance scores fell within the "Moderately Low" to "Very Low" categories, indicating that these systems make a relatively limited contribution to the provision of most ecosystem services. The exception was the biodiversity maintenance service, which achieved "Very High" importance rating. The elevated biodiversity maintenance scores are likely attributable to several factors, including the watercourse being mapped as aquatic CBAs, hydrological connectivity to downstream aquatic CBAs, and its occurrence within a Critically Endangered vegetation types.

Table 6-4: The outcome of the ecosystem services assessment for the seep wetland.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1,1	0,5	0,0	Very Low
	Stream flow regulation	2,7	0,0	1,2	Low
	Sediment trapping	2,3	2,0	1,8	Moderate
	Erosion control	1,6	1,6	0,9	Low
	Phosphate assimilation	1,9	1,0	0,9	Low
	Nitrate assimilation	2,1	1,0	1,1	Low
	Toxicant assimilation	2,3	1,0	1,3	Low
	Carbon storage	2,1	2,0	1,6	Moderately Low
	Biodiversity maintenance	2,7	4,0	3,2	Very High
PROVISIONING SERVICES	Water for human use	3,0	0,7	1,8	Moderate
	Harvestable resources	2,0	0,3	0,7	Very Low
	Food for livestock	0,8	0,3	0,0	Very Low
	Cultivated foods	2,3	0,0	0,8	Very Low
CULTURAL SERVICES	Tourism and Recreation	1,3	0,0	0,0	Very Low
	Education and Research	1,0	0,0	0,0	Very Low
	Cultural and Spiritual	2,0	0,0	0,5	Very Low

6.4. Ecological Importance and Sensitivity

Non-perennial rivers 1, 2 and 3 achieved a median score which falls within the “Moderate” category, the tributaries of non-perennial river 2 fell within the “Low” category. The seep wetland achieved a score which falls within the “High” category. The results of the assessment are presented in **Table 6-5** and **Table 6-6.**

Table 6-5: Score sheet for determining the EIS of the non-perennial rivers.

Determinant	River 1	River 2 Tributaries	River 2	River 3	
PRIMARY DETERMINANTS	Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)	Confidence (1-4)
Rare and endangered Species	3	2	3	2	3
Populations of unique Species	2	1	2	2	3
Species/taxon richness*	3	1	2	2	3
Diversity of habitat types or features*	1	1	2	1	4

Determinant	River 1	River 2 Tributaries	River 2	River 3	
Migration route/breeding and feeding site for riverine species: Importance in terms of the link it provides for biological functioning.	3	2	3	3	4
Sensitivity to changes in the natural hydrological regime*: Determined by the size of the feature, available habitat types and frequency of flood events.	1	1	1	1	3
Sensitivity to water quality changes*: Determined by the size of the feature, available habitat types and frequency of flood events.	1	1	1	1	3
Energy dissipation and particulate/element removal: Roughness coefficient/Storage capacity and size.	2	1	2	2	3
Protected status: Ramsar Site, National Park, Wilderness area and Nature Reserve.	0	0	0	0	4
Ecological integrity: Degree of change of the flood regime, water quality and habitat from reference conditions.	3	1	1	1	4
TOTAL	19	11	19	15	34
MEDIAN	2	1	2	1.5	3
OVERALL EIS	**Moderate**	**Low**	**Moderate**	**Moderate**	**High**

Score guideline Very high = 4; High = 3, Moderate = 2; Marginal/Low = 1; None = 0
Confidence rating Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1
* a rating of zero is not appropriate in this context.

Table 6-6: Results of the EIS assessment for the onsite seep wetland.

Ecological Importance and Sensitivity	Seep wetland	Reason
Biodiversity Support (Median)	**2,00**	
Presence and status of Red Data species.	2	Possible habitat for SCC
Populations of unique species/uncommonly large populations of wetland species:	2	There was largely natural aquatic vegetation communities present on the site.
Migration/breeding/feeding sites.	2	Possible habitat for migration
Landscape Scale (Median)	**2,20**	
Protection status of the wetland/watercourse:	1	The property is private property, therefore offering some form of protection.

Ecological Importance and Sensitivity	Seep wetland	Reason
(National (4), Provincial/ Private (3), municipal (1 or 2), public area (0 or 1)		
Protection status of the vegetation type.	4	The wetland vegetation type is comprised of Southwest Shale Fynbos
Regional context of the ecological integrity: (Assessment of the PES)	3	PES within category B
Size and rarity of the wetland type/s present.	2	The threat status of the wetland vegetation indicates slight rarity.
Diversity of habitat types.	1	The wetland comprises a uniform habitat
Sensitivity of the Wetland (Median)	**1,33**	
Sensitivity to changes in floods	1	The seep wetland is not sensitive to changes in floods.
Sensitivity to changes in low flows/dry season.	1	The seep wetland is not sensitive to changes in flows
Sensitivity to changes in water quality.	2	The wetland is in a low-nutrient system and is therefore moderately sensitive to changes in water quality.
Ecological Importance and Sensitivity Score	**2,2**	
Ecological Importance and Sensitivity Category	**High**	

6.5. Recommended Ecological Category

According to the Rountree et al. (2013) methodology for determining the Recommended Ecological Category (REC), watercourses within PES Category B or C with either a "Moderate" or "Low" EIS score must be maintained in the pre-development PES category. A wetland within PES Category B with a "High" EIS score must, where practically possible, be rehabilitated to a PES category that is one higher than the pre-development category. Where this is not practically possible, maintenance of the pre-development PES category will be the management objective.

Therefore, the management objective for the watercourses is to ensure that non-perennial river 1 is maintained within PES Category B, and that non-perennial rivers 2 and associated tributaries and non-perennial river 3 are maintained within PES Category C, through the implementation of the necessary management measures to achieve and sustain this ecological condition. The management objective for the seep wetland is to maintain its current PES Category B. Rehabilitation to a higher PES category is not considered practically achievable, as the wetland is influenced by historical and ongoing catchment land uses.

6.6. Buffer Determination

A minimum 35 m buffer was delineated around the wetland and the non-perennial rivers and their associated riparian habitat to protect the systems from potential impacts associated with the proposed activities. This buffer is intended to minimise risks related to sedimentation, erosion, water quality deterioration, and disturbance to riparian and aquatic habitat by maintaining a vegetated separation zone between the watercourse and proposed activities.

The buffer is considered appropriate given the site-specific conditions, including the confined valley-bottom setting of the watercourse and the absence of direct instream infrastructure.

No vegetation clearing shall occur within the 35 m buffer area, which must be maintained as a strict no-go zone throughout the construction and operational phases of the project. The buffer area must remain vegetated and intact, and compliance must be monitored by the Site Manager/Landowner.

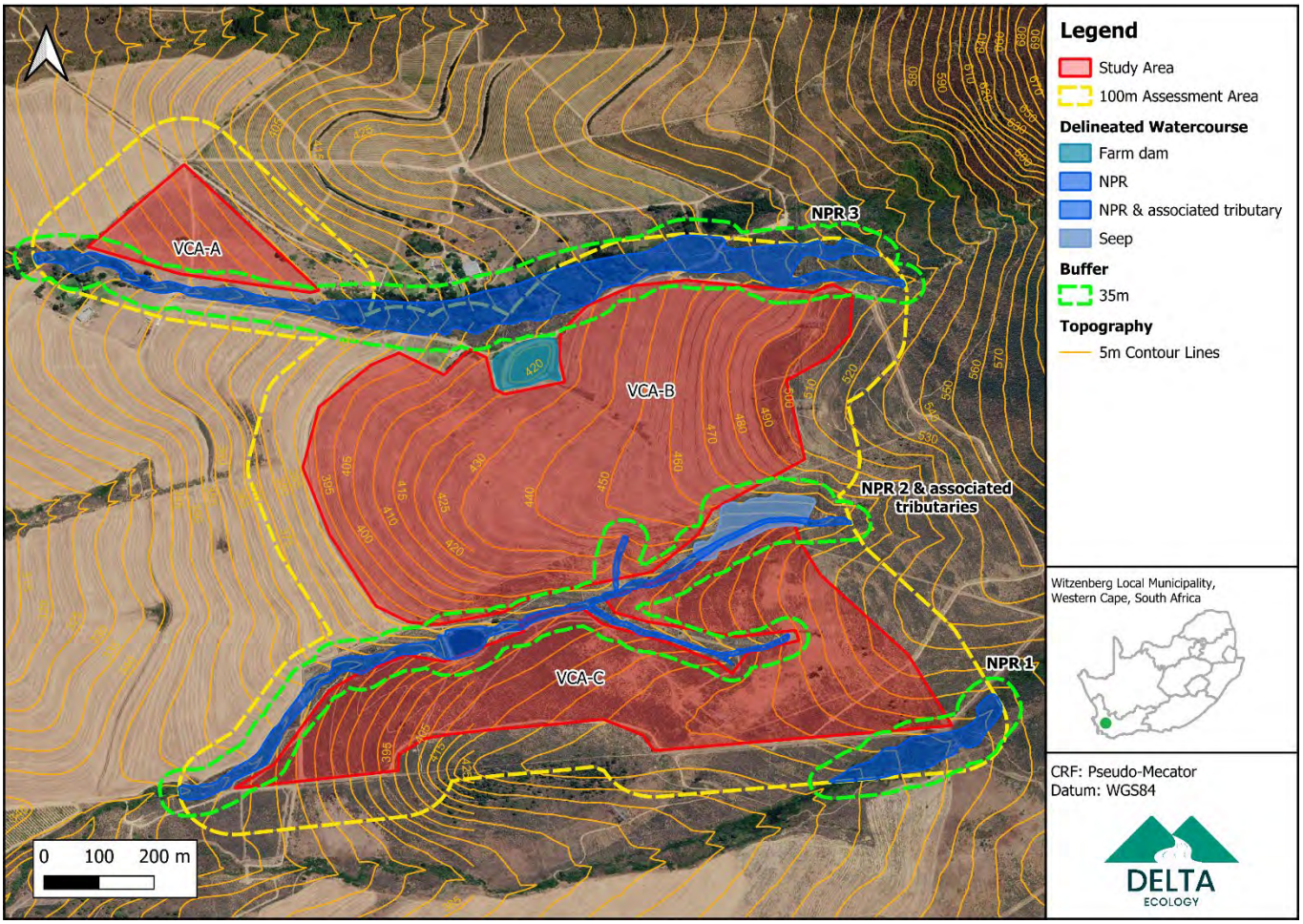


Figure 6-1: Recommended 35 m buffer.

7. Aquatic Impact Identification

The proposed activity involves the clearing of indigenous vegetation that has established within historically cultivated agricultural fields to facilitate the return of these areas to agricultural production. The proposed vegetation clearing will not directly modify the morphology of watercourses or involve any instream works (apart from within Flow Path 1). However, vegetation clearing and subsequent agricultural activities undertaken in close proximity to freshwater ecosystems have the potential to result in indirect impacts on adjacent watercourses if appropriate avoidance and mitigation measures are not implemented.

The freshwater features identified within and adjacent to the proposed vegetation clearing areas comprise several non-perennial streams, one flow path, and a seep wetland. The streams were assessed as being in a largely natural to moderately modified ecological condition (PES of B/C), while the seep wetland was assessed as PES C. All these systems were assigned a Moderate EIS, reflecting their role in maintaining local ecological processes and catchment connectivity. In contrast, the mapped flow path was assessed as PES E/F, with negligible instream and riparian habitat resulting from historical agricultural transformation and was therefore not assigned an Ecological Importance and Sensitivity rating.

The primary pathways through which the proposed activity could affect freshwater ecosystems include:

- Direct encroachment into watercourses and associated riparian habitat;
- Loss or degradation of riparian vegetation through vegetation clearing and the introduction or spread of invasive alien plant species following disturbance;
- Increased soil erosion and sediment delivery to adjacent watercourses;
- Changes to overland flow patterns resulting from vegetation clearing and agricultural operations; and
- Deterioration of surface water quality through increased sediment loads and the mobilisation of nutrients or agrochemicals during agricultural activities.

Given that the proposed activity is limited to vegetation clearing within an existing agricultural landscape and does not include the construction of new infrastructure or instream works, the most significant potential impacts are expected to arise where clearing occurs in close proximity to watercourses. These impacts can be effectively avoided through the retention of an appropriate buffer around freshwater ecosystems. Accordingly, this assessment recommends the establishment and maintenance of a **minimum 35 m buffer around all delineated non-perennial rivers and the seep wetland**, within which no vegetation clearing, ploughing or associated agricultural disturbance should occur. Owing to its highly modified ecological condition and negligible aquatic habitat, avoiding and implementing a buffer is not considered necessary for the degraded flow path from an aquatic biodiversity perspective.

The potential impacts associated with the proposed activity are assessed in the sections below.

8. Impact Assessment

The proposed activity comprises vegetation clearing followed by the continuation of agricultural land use. As the impact pathways, receptors and mitigation measures associated with the vegetation clearing and subsequent agricultural activities are largely the same, the construction and operational phase impacts have been assessed together to avoid unnecessary repetition.

The proposed vegetation clearing has the potential to result in indirect impacts on adjacent freshwater ecosystems, primarily through the loss of riparian habitat, alterations to surface water runoff, increased erosion and sedimentation, and deterioration of water quality. However, these impacts are largely avoidable through the implementation of the prescribed mitigation measures, particularly the maintenance of a 35 m freshwater buffer around all delineated non-perennial streams and the seep wetland. Following implementation of the recommended mitigation measures, all identified impacts are anticipated to be of Low significance, indicating that the proposed activity is considered acceptable from an aquatic biodiversity perspective, provided that the recommended mitigation measures are implemented throughout vegetation clearing and subsequent agricultural activities.

8.1. General Management Measures

All personnel involved in the vegetation clearing activities shall be made aware of the location and significance of freshwater no-go areas prior to the commencement of works.

The 35 m freshwater buffers shall remain clearly demarcated throughout the duration of the project. No waste disposal, vehicle parking, machinery servicing, stockpiling of materials or burning shall occur within the freshwater buffers.

Should previously unidentified freshwater features be encountered during vegetation clearing, work shall cease in the affected area until the feature has been assessed by the aquatic specialist and appropriate management measures have been implemented.

Machinery entering the site shall, where practicable, be free of excessive soil and plant material to reduce the risk of introducing alien invasive plant species.

Areas disturbed during vegetation clearing shall be monitored for the establishment of invasive alien vegetation, and any declared invasive species shall be removed in accordance with the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) Alien and Invasive Species Regulations.

Existing indigenous vegetation within the freshwater buffers shall be retained to improve ecological resilience and reduce opportunities for invasive species establishment.

Refuelling, servicing and maintenance of machinery shall only occur within designated areas located outside the freshwater buffers.

Existing contour banks, drainage structures and erosion-control measures shall be maintained in a functional condition throughout the duration of the project.

Table 8-1: Assessment results for Impact 1.

Impact 1: Loss and Degradation of Freshwater and Riparian Habitat				
Mitigation Measures		**A minimum 35 m buffer shall be maintained around all delineated non-perennial streams and the seep wetland throughout the duration of the proposed activities.** **No vegetation clearing, ploughing, cultivation, stockpiling, vehicle access, machinery movement or agricultural disturbance shall occur within the 35 m buffer.** **The delineated buffer shall be clearly demarcated in the field prior to commencement of vegetation clearing using danger tape, fencing or marker poles.** **Existing indigenous riparian and wetland vegetation within the buffer shall be retained and protected.** **Should any uncertainty arise regarding the location of the delineated watercourses or buffers, the aquatic specialist shall verify the boundaries prior to clearing.** **No buffer is required around the degraded agricultural flow path (PES E/F) from an aquatic biodiversity perspective, provided that no activities result in concentrated runoff or erosion into adjacent freshwater ecosystems.**			
	Impact Without Mitigation		**Impact With Mitigation**	
Consequence				
Intensity of Impact	3	Medium / Harmful	2	Low / Slightly Harmful
Duration of Impact	3	One year to 5 years	2	1 month to 1 year
Extent / spatial scale of impact	1	Limited to project site	1	Limited to project site
Reversibility	2	Moderate-cost rehabilitation / Moderate likelihood of success	2	Low-cost rehabilitation / Moderately high likelihood of success
Loss of irreplaceable resources	2	Low	2	Low
Cumulative Impact	3	Medium	2	Low
Probability				
Frequency of the Activity	4	Monthly to annually	4	Monthly to annually
Likelihood of the Incident / Impact occurring	3	Possible	2	Unlikely
Impact Significance				
Consequence	1,91	Low	1,73	Low
Probability	3.5	Medium	3,0	Medium
Impact Significance	**2,23**	**Low**	**1,98**	**Low**

Table 8-2: Assessment results for Impact 2.

Impact 2: Alteration of Surface Water Runoff and Hydrological Processes				
Mitigation Measures		**Existing natural drainage patterns shall be maintained during vegetation clearing and subsequent agricultural activities. Existing contour banks, drainage structures and agricultural runoff controls shall be retained and maintained, unless their modification is required to address an existing erosion or drainage problem.** **No berms, furrows, drains or other earthworks shall be constructed in a manner that obstructs natural drainage, diverts flow away from a watercourse, or concentrates runoff towards the delineated streams or seep wetland. New artificial drainage channels shall not discharge directly into a watercourse or its associated 35 m buffer.** **Vegetation clearing, ploughing and cultivation shall follow the existing contours of the land, where practicable, to reduce runoff velocities and maintain diffuse surface flow. Runoff from cultivated areas shall be dispersed before reaching the freshwater buffers and shall not be concentrated at individual discharge points.** **The 35 m buffers around the delineated streams and seep wetland shall be retained as naturally vegetated areas to assist in slowing, dispersing and infiltrating surface runoff. No drainage of the seep wetland or interception of its surface or shallow subsurface water supply shall be permitted.** **Any evidence of concentrated runoff, erosion, ponding or unintended diversion of flow resulting from the proposed activities shall be addressed promptly through suitable contouring, flow-dispersion or erosion-control measures.**		
	Impact Without Mitigation		**Impact With Mitigation**	
Consequence				
Intensity of Impact	3	Medium / Harmful	2	Low / Slightly Harmful
Duration of Impact	4	5 to 20 years	4	5 to 20 years
Extent / spatial scale of impact	1	Limited to project site	1	Limited to project site
Reversibility	3	Moderate-cost rehabilitation / Moderate likelihood of success	2	Low-cost rehabilitation / Moderately high likelihood of success
Loss of irreplaceable resources	2	Low	2	Low
Cumulative Impact	3	Medium	2	Low
Probability				
Frequency of the Activity	4	Monthly to annually	4	Monthly to annually

Likelihood of the Incident / Impact occurring	3	Possible	2	Unlikely
Impact Significance				
Consequence	2.45	Low	1.91	Low
Probability	3,5	Medium	3,0	Medium
Impact Significance	**2,66**	**Medium**	**2.12**	**Low**

Table 8-3: Assessment results for Impact 3.

Impact 3: Increased sediment input and erosion				
Mitigation Measures		**Vegetation clearing shall be undertaken progressively to minimise the extent of exposed soil at any one time.** **Existing contour banks and contour-aligned agricultural practices shall be retained and maintained to reduce runoff velocities and soil loss.** **Clearing activities shall follow existing contour alignments and avoid creating preferential flow paths towards watercourses.** **Disturbed areas shall be stabilised as soon as practicably possible following clearing.** **Soil stockpiles shall not be placed within the 35 m freshwater buffer or where runoff may enter watercourses.** **Should erosion features develop, appropriate erosion control measures (e.g. brush packing, mulch, erosion blankets or similar measures) shall be implemented immediately.** **Existing contour banks and erosion-control infrastructure shall be inspected following significant rainfall events and repaired where necessary to ensure their continued effectiveness.**		
	Impact Without Mitigation		**Impact With Mitigation**	
Consequence				
Intensity of Impact	3	Medium / Harmful	2	Low / Slightly Harmful
Duration of Impact	4	5 to 20 years	4	5 to 20 years
Extent / spatial scale of impact	1	Limited to project site	1	Limited to project site
Reversibility	3	Moderate-cost rehabilitation / Moderate likelihood of success	2	Low-cost rehabilitation / Moderately high likelihood of success

Loss of irreplaceable resources	2	Low	2	Low
Cumulative Impact	3	Medium	2	Low
Probability				
Frequency of the Activity	4	Monthly to annually	4	Monthly to annually
Likelihood of the Incident / Impact occurring	3	Possible	2	Unlikely
Impact Significance				
Consequence	2.45	Low	1.91	Low
Probability	3,5	Medium	3,0	Medium
Impact Significance	**2,66**	**Medium**	**2.12**	**Low**

Table 8-4: Assessment results for Impact 4.

Impact 4: Water quality impairment			
Mitigation Measures		**The 35 m freshwater buffer shall be maintained as a vegetated filter strip to intercept sediment, nutrients and other pollutants before they enter adjacent watercourses.** **Fertilisers, herbicides, pesticides and any other agricultural chemicals shall not be mixed, stored or applied within the freshwater buffer.** **All agricultural chemicals shall be applied in accordance with manufacturer specifications and recognised best agricultural practices.** **Refuelling and maintenance of machinery shall be undertaken outside the freshwater buffer in designated areas.** **Spill kits shall be available on site, and any hydrocarbon or chemical spills shall be contained and remediated immediately.** **No waste materials shall be disposed of within watercourses, drainage lines or freshwater buffers.** **Application of fertilisers, herbicides and pesticides should, where practicable, be avoided immediately prior to heavy rainfall events to minimise the potential for runoff into adjacent freshwater ecosystems.**	
	Impact Without Mitigation		**Impact With Mitigation**
Consequence			

Intensity of Impact	3	Medium / Harmful	2	Low / Slightly Harmful
Duration of Impact	4	5 to 20 years	4	5 to 20 years
Extent / spatial scale of impact	1	Limited to project site	1	Limited to project site
Reversibility	3	Moderate-cost rehabilitation / Moderate likelihood of success	2	Low-cost rehabilitation / Moderately high likelihood of success
Loss of irreplaceable resources	2	Low	2	Low
Cumulative Impact	3	Medium	2	Low
Probability				
Frequency of the Activity	4	Monthly to annually	4	Monthly to annually
Likelihood of the Incident / Impact occurring	3	Possible	2	Unlikely
Impact Significance				
Consequence	2.45	Low	1.91	Low
Probability	3,5	Medium	3,0	Medium
Impact Significance	**2,66**	**Medium**	**2.12**	**Low**

9. Risk Assessment

The proposed activities fall within the regulated area of a watercourse as defined in Government Notice (GN) 509 of 2016, as they are located within 100 m of delineated non-perennial rivers and within 500 m of a delineated wetland. Accordingly, the proposed activities trigger Section 21 (c) and (i) water uses in terms of the National Water Act (Act No. 36 of 1998), as they have the potential to impede or divert the flow of water in a watercourse and to alter the bed, banks, course or characteristics of a watercourse.

The RAM indicates that, following implementation of the recommended mitigation measures, including the establishment and maintenance of a 35 m buffer around the delineated non-perennial streams and seep wetland, retention of existing drainage patterns and contour banks, implementation of erosion control measures, and the application of good agricultural management practices, all identified impacts are expected to be of Low significance.

Based on the outcome of the RAM, the proposed Section 21 (c) and (i) water uses are anticipated to fall within the Low Risk category in accordance with GN 4167 of 2023. It is therefore considered that the proposed water uses may be authorised under the applicable General Authorisation (GA), subject to confirmation by the Department of Water and Sanitation (DWS).

10. Conclusion and Recommendation

Delta Ecology was appointed by Enviro EAP to undertake a Freshwater Risk and Impact Assessment for the proposed vegetation clearing on the Remainder of Farm Schalkenbosch 229, near Tulbagh, Western Cape. The assessment was undertaken in support of the EA process, following the identification of Very High Aquatic Biodiversity Theme Sensitivity by the National Web-based Environmental Screening Tool.

The assessment confirmed the presence of several non-perennial rivers, associated tributaries, one seep wetland and a highly modified agricultural flow path within or adjacent to the proposed vegetation clearing areas. The rivers were assessed as being in a largely natural to moderately modified ecological condition (PES B/C), while the seep wetland was assessed as largely natural (PES B). These freshwater ecosystems provide important riparian habitat, contribute to local ecological connectivity and support biodiversity within the upper Breede River catchment.

The proposed activity is limited to vegetation clearing within historically cultivated agricultural fields and does not include new infrastructure or instream works. Consequently, the primary risks relate to indirect impacts on adjacent freshwater ecosystems through vegetation clearing, disturbance of riparian habitat, altered runoff patterns, erosion, sedimentation and potential deterioration of water quality. These impacts can largely be avoided through appropriate planning and implementation of the recommended mitigation measures. In particular, maintaining a 35 m buffer around all delineated non-perennial rivers and the seep wetland is considered the primary measure to protect freshwater habitat and ecological functioning.

The agricultural flow path was assessed as PES Category E/F (Critically Modified) and functions primarily as an agricultural drainage feature with negligible remaining aquatic habitat or ecological function. Consequently, from an aquatic biodiversity perspective, avoidance of this feature and an associated freshwater buffer is not considered necessary, provided that vegetation clearing and subsequent agricultural activities do not result in concentrated runoff, erosion or sediment delivery into downstream rivers.

Following implementation of the recommended mitigation measures, all identified impacts are expected to be of Low significance, and the proposed activity is therefore considered acceptable from an aquatic biodiversity perspective. Furthermore, the Risk Assessment Matrix (RAM) indicates that the anticipated Section 21 (c) and (i) water uses are expected to fall within the Low Risk category in terms of Government Notice 4167 of 2023. It is therefore considered that the proposed water uses may be authorised under the applicable GA, subject to confirmation by the DWS.

Provided that the recommended mitigation measures are implemented, the delineated freshwater buffers are maintained as permanent no-go areas, and good agricultural management practices are adhered to throughout vegetation clearing and subsequent agricultural activities, the proposed development is not expected to result in unacceptable impacts on the freshwater ecosystems associated with the study area.

11. References

Beck HE, Zimmermann NE, McVicar TR, Vergopolan N, Berg A, Wood EF. 2018. Data Descriptor: Present and future Koppen-Geiger climate classification maps at 1-km resolution. Scientific Data.

CapeNature. 2023. 2023 Western Cape Biodiversity Spatial Plan Spatial Informants. Biodiversity Capabilities, CapeNature.CSIR. 2011. Freshwater Priority Areas.

CSIR. 2011. Freshwater Priority Areas.

Council for Geoscience. (2019). RSA Geology - 1 million.

DAFF. 2021. Soil Clay & Depth. CapeFarmMapper Ver.3.4.1.

DFFE. 2026. National Web based Environmental Screening Tool.

DFFE. 2022. Land Cover 9-classes.

DWAF. 2008. Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas:75.

DWAF. 2011. Water Management Areas. CapeFarmMapper Ver.3.4.1.

Department of Water and Sanitation. 2014. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa.

Department of Water and Sanitation. 2011. Ecoregions (Level 1) for South Africa [Data set]. Department of Water and Sanitation.

ENPAT. 2021. Soils & Geology (ENPAT). Cape Farm Mapper Ver 3.4.1.

Keet, J.-H., 2025. *Plant Species and Terrestrial Biodiversity Impact Assessment for Vegetation Clearing on Farm Schalkenbosch 229, Tulbagh, Western Cape.* Final Report, Version 1.0, Reference PR.25.038. Prepared for Enviro EAP on behalf of the Karla en Anke Trust. EcoFloristix Specialist Botanical Surveys, Somerset West.

Macfarlane D, M. 2016. Desktop tool for the determination of preliminary aquatic impact buffer zone requirements. Version 1.0. Prepared for the Water Research Commission, Pretoria.

Macfarlane D, Ollis D, Kotze D. 2020. WET-Health (Version 2.0) A Refined Suite of Tools for Assessing the Present Ecological State of Wetland Ecosystems.

NFEPA. 2011. National Freshwater Priority Area. CSIR.

NWM5. 2018. National Wetlands Map 5.

Rountree MW, Malan HL, Weston BC. 2013. Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). Available from www.wrc.org.za.

SANBI. 2011. NFEPA Wetland Vegetation. Available from https://bgis.sanbi.org.

SANBI. 2018. VegMap. Available from https://gis.elsenburg.com/apps/cfm/.

Schulze R. 2009. South African Atlas of Agrohydrology and Climatology. Water Research Commission, WRC (TT82-96).

Schulze R, Hallowes L, Horan M, Lumsden T, Pike A, Thornton-Dibb S, Warburton M. 2007. South African Quaternary Catchments Database. Page South African Atlas of Climatology and Agrohydrology. WRC Report 1489/1/06, Section 2.3. Pretoria.

Van Ginkel CE, Glen RP, Gordon-Gray KD, Cilliers CJ, Muasya M, van Deventer PP. 2011. Easy identification of some South African wetland plants (Grasses, Restios, Sedges, Rushes, Bulrushes, Eriocaulons and Yellow-eyed grasses). Page Water Research Commission.

ANNEXURE 1: DWS RISK ASSESSMENT

PROJECT: Schalkenbosch

RISK ASSESSMENT MATRIX for Section 21 (c) and (i) Water Use activities - Version 2.1.1

Name of Assessor: Kimberley van Zyl — Signature:

SACNASP Registration Number: Pr. Nat. Sci. Reg. No. 117097 (Ecological Science)

Date of assessment: 20-Jul-26

Risk to be scored for all relevant phases of the project (factoring in specified control measures) MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of Impact	Significance (max = 100)	Risk Rating	Confidence level
			Name/s	PES	Overall Watercourse Importance	Abiotic Habitat (Drivers)			Biota (Responses)											
						Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
CONSTRUCTION & OPERATION	The primary pathways through which the proposed activity could affect freshwater ecosystems include: •Direct encroachment into watercourses and associated riparian habitat; •Loss or degradation of riparian vegetation through vegetation clearing and the introduction or spread of invasive alien plant species following disturbance; •Increased soil erosion and sediment delivery to adjacent watercourses; •Changes to overland flow patterns resulting from vegetation clearing and agricultural operations; and •Deterioration of surface water quality through increased sediment loads and the mobilisation of nutrients or agrochemicals during agricultural activities.	*1b1>Watercourse Habitat disturbance	Seep Wetland	B	Very high	1	1	1	2	1	4	4	2	10	5	80	40%	28	L	High
		*1b1>Watercourse Habitat disturbance	Non-perennial River 1	B	Moderate	1	1	1	2	1	4	3	2	9	3	27	40%	10.8	L	High
		*1b1>Watercourse Habitat disturbance	Non-perennial River 2 and 3	C	Moderate	1	1	1	2	1	4	3	2	9	3	27	40%	10.8	L	High
		*1b1>Watercourse Habitat disturbance	Non-perennial River Tributaries	C	Low / Very low	1	1	1	2	1	4	3	2	9	2	18	40%	7.2	L	High
		*1b1>Watercourse Habitat disturbance	Flow Path	F	Low / Very low	1	1	1	2	1	4	4	4	12	2	24	40%	9.6	L	High
		*1b1>Alteration of flow	Seep Wetland	B	Very high	2	1	1	1	1	4	4	4	12	5	60	40%	24	L	High
		*1b1>Alteration of flow	Non-perennial River 1	B	Moderate	2	1	1	1	1	4	3	4	11	3	33	40%	13.2	L	High
		*1b1>Alteration of flow	Non-perennial River 2 and 3	C	Moderate	2	1	1	1	1	4	3	4	11	3	33	40%	13.2	L	High
		*1b1>Alteration of flow	Non-perennial River Tributaries	C	Low / Very low	2	1	1	1	1	4	3	4	11	2	22	40%	8.8	L	High
		*1b1>Alteration of flow	Flow Path	F	Low / Very low	2	1	1	1	1	4	4	4	12	2	24	40%	9.6	L	High
		*1b1>Sedimentation & Erosion	Seep Wetland	B	Very high	1	2	2	1	1	4	4	4	12	5	60	40%	24	L	High
		*1b1>Sedimentation & Erosion	Non-perennial River 1	B	Moderate	1	2	2	1	1	4	3	4	11	3	33	40%	13.2	L	High
		*1b1>Sedimentation & Erosion	Non-perennial River 2 and 3	C	Moderate	1	2	2	1	1	4	3	4	11	3	33	40%	13.2	L	High
		*1b1>Sedimentation & Erosion	Non-perennial River Tributaries	C	Low / Very low	1	2	2	1	1	4	3	4	11	2	22	40%	8.8	L	High
		*1b1>Sedimentation & Erosion	Flow Path	F	Low / Very low	1	2	2	1	1	4	4	4	12	2	24	40%	9.6	L	High
		*1b1>Water quality impairment	Seep Wetland	B	Very high	1	2	1	1	1	4	4	4	12	5	60	40%	24	L	High
		*1b1>Water quality impairment	Non-perennial River 1	B	Moderate	1	2	1	1	1	4	3	4	11	3	33	40%	13.2	L	High
		*1b1>Water quality impairment	Non-perennial River 2 and 3	C	Moderate	1	2	1	1	1	4	3	4	11	3	33	40%	13.2	L	High
		*1b1>Water quality impairment	Non-perennial River Tributaries	C	Low / Very low	1	2	1	1	1	4	3	4	11	2	22	40%	8.8	L	High
		*1b1>Water quality impairment	Flow Path	F	Low / Very low	1	2	1	1	1	4	4	4	12	2	24	40%	9.6	L	High

ANNEXURE 2: DETAILED METHODOLOGY

Wetland Delineation

The wetland boundaries were delineated at the outer edge of the wetland temporary zone using the method described in the Department of Water Affairs and Forestry (DWAF) Manual for the Identification and Delineation of Wetlands and Riparian Areas for field-based delineation (DWAF, 2008).

This method is the accepted best practice method for delineating wetlands in South Africa, and its use is required by GN 509 of 2016 for wetland assessments related to National Water Act section 21 (c) and (i) water uses. The method makes use of three key field indicators to guide the delineation process (refer to **Box 1**):

Box 1. Three indicators of wetland presence as described in DWAF (2008):

1. The **position in the landscape** – Identifies parts of the landscape where wetlands are more likely to occur;
2. The presence of **aquatic vegetation communities**;
3. The presence of **hydromorphic soil features**, which are morphological signatures that appear in soils with prolonged periods of saturation (associated with anaerobic conditions). Key hydromorphic features include:
    a. Mottling – Formation of clumps of iron oxide within the soil matrix in the form of orange, yellow, black or reddish-brown speckling. Mottling occurs in most soils and reaches maximum density in the centre of the seasonal zone with sparse mottling in the temporary zone and no mottling in the permanent zone.
    b. Gleying – Shift in soil colour from the terrestrial baseline towards a blue, green or grey colour and an overall reduction in soil chroma. This phenomenon is normally difficult to identify in the temporary zone, noticeable in the seasonal zone and most significant in the permanent zone.
    c. Organic Surface Layers – surface layers with very high organic content that typically occur in the wetland seasonal and permanent zones.
    d. Organic Streaking – Streaks of organic matter within the soil column which may be present in all zones, but particularly the temporary and seasonal zones.

Soil samples were taken for inspection by hand augering to determine soil form and presence of redoximorphic and other hydromorphic soil features. Aquatic vegetation communities were identified using the (DWAF, 2008) classification of wetland plant species and descriptions of communities, along with auxiliary information from (Van Ginkel *et al.*, 2011). Wetland plant species classification categories are as follows:

- Obligate species (occurring in wetlands >99% of the time – usually in the permanent or seasonal zone);
- Facultative Positive species (67 to 99% of the population occurs within wetlands – typically in the seasonal and temporary zones with the remaining 1 to 33% in the adjacent area on the wetland periphery);
- Facultative Species (33 – 67% of the population occurs within wetlands – usually in seasonal or temporary zones with the remaining 67 – 33% in the adjacent area on the wetland periphery);

- Facultative Negative Species (1 – 33% of the population occurs within wetlands – usually in the temporary zone with the remaining 99 to 67% in the adjacent area on the wetland periphery);
- Wetland Cosmopolitan Species (No specific affinity for wetlands and colonise wetland and terrestrial areas).

The soil composition at the proposed site allowed for wetland indicators such as periodic mottling indicative of the temporary and seasonal zones to be detected, such that the outer edge of the temporary zone could be confirmed for delineation.

Riparian Area Delineation

Riparian areas were identified using the method described in the DWAF, (2008) Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas. This method is the accepted best practice method for identifying and delineating riparian areas in South Africa and its use is required by GN 509. The method makes use of four key field indicators (refer to **Box 1**):

Four indicators of riparian areas as described in DWAF (2008)

1. The **position in the landscape** – riparian areas are only likely to develop on valley bottom landscape units.
2. The **soil form** – Riparian areas are often (but not always) associated with alluvial soils and recently deposited material.
3. **Topography** associated with riparian areas – riparian areas may have clearly identifiable banks associated with alluvial deposited material adjacent to the active channel.
4. The presence of **aquatic vegetation communities.**

The identification of riparian areas relies heavily on vegetative indicators. Using vegetation, the outer boundary of a riparian area can be defined as the point where a distinctive change occurs in the:

- species composition relative to the adjacent terrestrial area; and
- physical structure, such as vigour or robustness of growth forms of species like that of adjacent terrestrial areas. Growth form refers to the health, compactness, crowding, size, structure and/or numbers of individual plants.

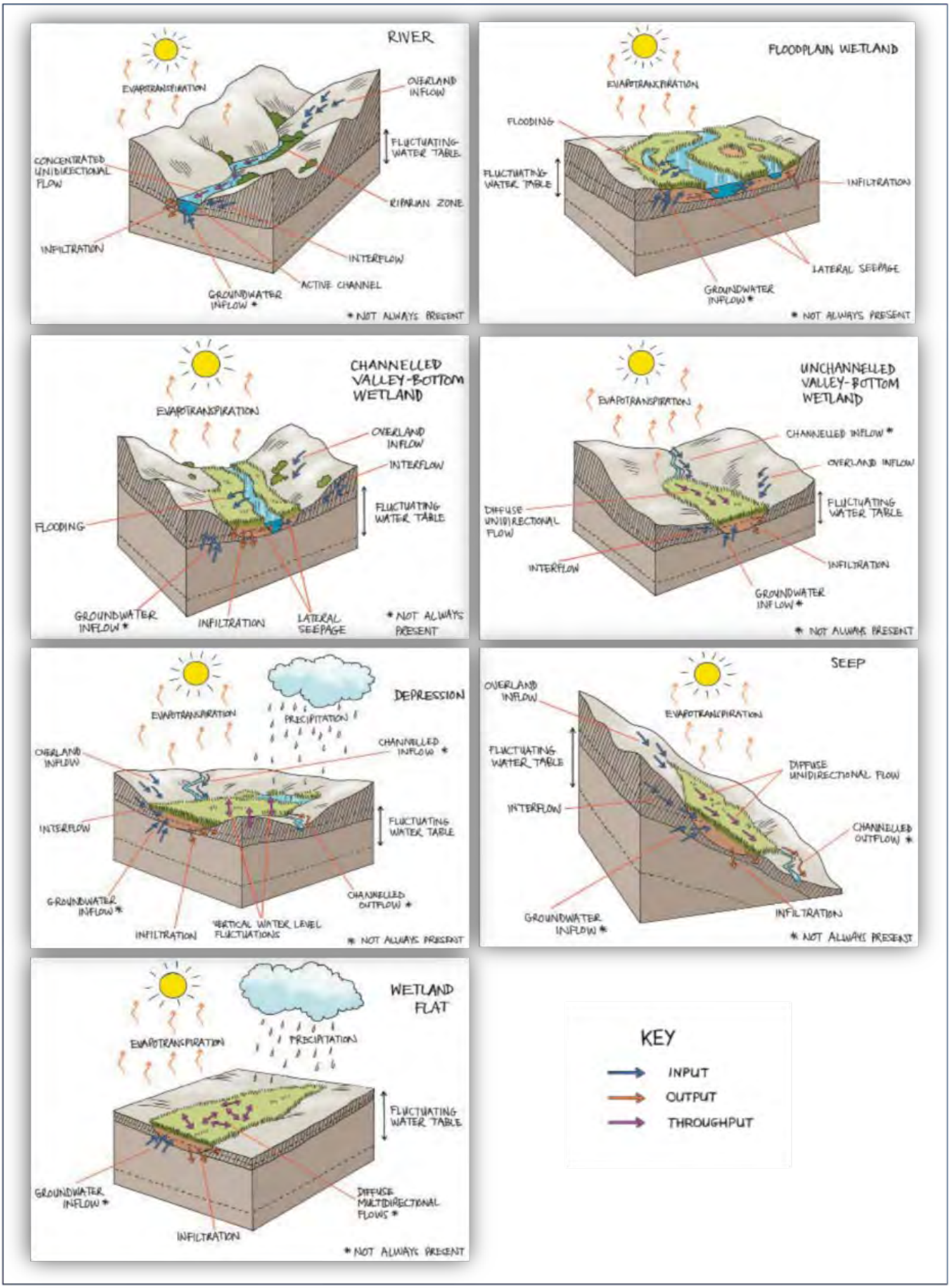
In addition to indicators of structural differences in vegetation, indicator species themselves can be used to denote riparian areas. Riparian plant species classification categories are as follows:

- Obligate riparian species occur almost exclusively in the riparian zone (> 90% probability)

  Preferential riparian species are preferentially, but not exclusively, found in the riparian zone (>75% probability). Preferential riparian species may harden to drought conditions but will always indicate sites with increased moisture availability.

Wetland Classification

The Ollis *et al* (2013) Classification System for Wetlands and Other Aquatic Ecosystems in South Africa, as used in this assessment, is a tiered structured classification system that provides a uniform description of wetland types based on their hydrogeomorphic characteristics:


RIVER
EVAPOTRANSPIRATION
OVERLAND INFLOW
FLUCTUATING WATER TABLE
CONCENTRATED UNIDIRECTIONAL FLOW
RIPARIAN ZONE
INFILTRATION
INTERFLOW
ACTIVE CHANNEL
GROUNDWATER INFLOW *
* NOT ALWAYS PRESENT
FLOODPLAIN WETLAND
EVAPOTRANSPIRATION
FLOODING
FLUCTUATING WATER TABLE
INFILTRATION
LATERAL SEEPAGE
GROUNDWATER INFLOW *
* NOT ALWAYS PRESENT
CHANNELLED VALLEY-BOTTOM WETLAND
EVAPOTRANSPIRATION
OVERLAND INFLOW
INTERFLOW
FLUCTUATING WATER TABLE
FLOODING
GROUNDWATER INFLOW *
INFILTRATION
LATERAL SEEPAGE
* NOT ALWAYS PRESENT
UNCHANNELLED VALLEY-BOTTOM WETLAND
EVAPOTRANSPIRATION
CHANNELLED INFLOW *
OVERLAND INFLOW
FLUCTUATING WATER TABLE
DIFFUSE UNIDIRECTIONAL FLOW
INTERFLOW
INFILTRATION
GROUNDWATER INFLOW *
* NOT ALWAYS PRESENT
DEPRESSION
EVAPOTRANSPIRATION
PRECIPITATION
OVERLAND INFLOW
CHANNELLED INFLOW *
INTERFLOW
FLUCTUATING WATER TABLE
GROUNDWATER INFLOW *
CHANNELLED OUTFLOW *
INFILTRATION
VERTICAL WATER LEVEL FLUCTUATIONS
* NOT ALWAYS PRESENT
SEEP
OVERLAND INFLOW
EVAPOTRANSPIRATION
FLUCTUATING WATER TABLE
DIFFUSE UNIDIRECTIONAL FLOW
INTERFLOW
CHANNELLED OUTFLOW *
GROUNDWATER INFLOW *
INFILTRATION
* NOT ALWAYS PRESENT
WETLAND FLAT
EVAPOTRANSPIRATION
PRECIPITATION
FLUCTUATING WATER TABLE
GROUNDWATER INFLOW *
DIFFUSE MULTIDIRECTIONAL FLOWS *
INFILTRATION
* NOT ALWAYS PRESENT
KEY
INPUT
OUTPUT
THROUGHPUT

Present Ecological State Assessment (Wetlands)

WET-Health Version 2 (Macfarlane *et al.* 2020) is a modular tool designed to evaluate and assess the Present Ecological State (PES) of wetland hydrogeomorphic units based on the degree to which the wetland has deviated from its natural reference condition. The tool accounts for four inter-related components that influence wetland health. These consist of three core drivers of wetland change namely hydrology, geomorphology and water quality, along with vegetation as a responding variable. A separate PES score is derived for each of these components, which are then combined into a single PES score for the wetland hydrogeomorphic unit. The scores for each component and the overall score fall into one of six Ecological Categories defined in **Table A** below.

The tool offers three levels of assessment:

1. Level 1A, a low-resolution desktop-based assessment;
2. Level 1B, a high-resolution desktop-based assessment; and
3. Level 2, a detailed rapid field-based assessment.

Level 1A is applied to provincial and national scale assessments of many wetlands, while Level 1B is applied to catchment scale assessments or to rapid individual assessments. The Level 2 assessment incorporates information from a direct onsite assessment of the wetland and its catchment and adds detail by separately assessing the various disturbance units within the wetland. The level 2 assessment was applied in this case.

Table A: PES Categories Scores as defined WET-Health Version 2 (Macfarlane *et al.*, 2020).

Ecological Category	Description	Impact Score	PES Score (%)
A	Unmodified, natural.	0-0.9	90-00
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible, and a small loss of natural habitats and biota may have taken place.	1-1.9	80-89
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	60-79
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	40-59
E	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	20-39
F	Critically modified. Modifications have reached a critical level, and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	0-19

Habitat Integrity Assessment (Rivers)

The Index of Habitat Integrity (IHI) assessment is a tool used to assess the habitat integrity of a river based on the intensity and extent of anthropogenic disturbances that impact both the instream and riparian habitat. The assessment of habitat integrity is based on an interpretation of the deviation from the reference condition (Kleynhans *et al*., 2008). The disturbances assessed include abiotic factors such as water abstraction, weirs, dams, pollution and the dumping or rubble and biotic factors such as the presence of alien plants and aquatic animals which modify habitat (Kleynhans, 1996). These changes are all related and interpreted in terms of modification of the drivers of the system, namely hydrology, geomorphology, and physico-chemical conditions and how these changes would impact on the natural riverine habitats. The severity of each of these impacts is assessed, using scores as a measure of impact (**Table B**). Descriptions of each criterion are provided to assist with the assessment (**Table C**).

Table B: Scoring procedures used to determine the Index of Habitat Integrity.

IMPACT CLASS	DESCRIPTION	SCORE
None	No discernible impact or the modification is in such a way that it has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size, and variability is limited.	1 – 5
Moderate	The modification is present at a small number of localities and the impact on habitat quality, diversity, size, and variability are limited.	6 - 10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size, and variability. Large areas are, however, not affected.	11 -15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area affected. Only small areas are not influenced.	16 – 20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21 – 25

Table C: Descriptions of criteria used in the IHI assessments (Kleynhans, 1996).

CRITERION	DESCRIPTION
Water abstraction	Direct abstraction from within the specified river/river reach as well as upstream (including tributaries) must be considered (excludes indirect abstraction by for example exotic vegetation). The presence of any of the following can be used as an indication of abstraction: cultivated lands, water pumps, canals, pipelines, cities, towns, settlements, mines, impoundments, weirs, industries. Water abstraction has a direct impact on habitat type, abundance, and size; is implicated in flow, bed, channel and water quality characteristics; and riparian vegetation may be influenced by a decrease in water quantity.
Extent of inundation	Destruction of instream habitat (e.g. riffle, rapid) and riparian zone habitat through submerging with water by, for example, construction of an in-channel impoundment such as a dam or weir. Leads to a reduction in habitat available to aquatic fauna and may obstruct movement of aquatic fauna; influences water quality and sediment transport.

CRITERION	DESCRIPTION
Water quality	The following aspects should be considered: untreated sewage, urban and industrial runoff, agricultural runoff, mining effluent, effects of impoundments. Ranking may be based on direct measurements or indirectly via observation of agricultural activities, human settlements, and industrial activities in the area. Water quality is aggravated by a decrease in the volume of water during low or no flow conditions.
Flow modification	This relates to the consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow such as an increase in duration of low flow season can have an impact on habitat attributes, resulting in low availability of certain habitat types or water at the start of the breeding, flowering, or growing season.
Bed modification	This is regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment. The effect is a reduction in the quality of habitat for biota. Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation is also included. Extensive algal growth is also considered to be bed modification.
Channel modification	This may be the result of a change in flow which alters channel characteristics causing a change in instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Presence of exotic aquatic fauna	The disturbance of the stream bottom during exotic fish feeding may influence, for example, the water quality and lead to increased turbidity. This leads to a change in habitat quality.
Presence of exotic macrophytes	Exotic macrophytes may alter habitat by obstruction of flow and may influence water quality. Consider the extent of infestation over instream area by exotic macrophytes, the species involved and its invasive abilities.
Solid Waste disposal	The amount and type of waste present in and on the banks of a river (e.g. litter, building rubble) is an obvious indicator of external influences on stream and a general indication of the misuse and mismanagement of the river.
Decrease of indigenous vegetation from the riparian zone	This refers to physical removal of indigenous vegetation for farming, firewood, and overgrazing. Impairment of the riparian buffer zone may lead to movement of sediment and other catchment runoff products (e.g. nutrients) into the river.
Exotic vegetation encroachment	This excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Encroachment of exotic vegetation leads to changes in the quality and proportion of natural allochthonous organic matter input and diversity of the riparian zone habitat is reduced.
Bank erosion	A decrease in bank stability will cause sedimentation and possible collapse of the riverbank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or encroachment of exotic vegetation.

The score that has been allocated to an impact is then moderated by a weighting system, devised by Kleynhans (1996). Assignment of weights is based on the perceived relative threat of the impact to the habitat integrity of a riverine ecosystem. The total score for each impact is equal to the assigned score multiplied by the weight of that impact (**Table D**).

Table D: Weights assigned to each criterion

INSTREAM CRITERION	WGT	RIPARIAN ZONE CRITERION	WGT
Water abstraction	14	Water abstraction	13
Extent of inundation	10	Extent of inundation	11
Water quality	14	Water quality	13
Flow modification	7	Flow modification	7
Bed modification	13	Channel modification	12
Channel modification	13	Indigenous vegetation removal	13
Presence of exotic macrophytes	9	Exotic vegetation encroachment	12
Presence of exotic fauna	8	Bank erosion	14
Solid waste disposal	6		

Based on the relative weights of the criteria, the impacts of each criterion are estimated as follows:

Rating for the criterion /maximum value (25) x the weight (percent).

The estimated impacts of all criteria calculated in this way are summed, expressed as a percentage, and subtracted from 100 to arrive at a present status score for the instream and riparian components, respectively. The Index of Habitat Integrity scores (%) for the instream and riparian zone components are then used to place these two components into a specific class. These classes are indicated in **Table E**. The assessment method in determining the severity of modifications to habitat integrity is a largely field-based site assessment, supplemented with information from aerial photographs (google earth images).

Table E: IHI classes and their description

CLASS	DESCRIPTION	SCORE (%)
A	Unmodified, natural.	90 – 100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place, but the assumption is that ecosystem functioning is essentially unchanged.	80 - 89
C	Moderately modified. A loss or change in natural habitat and biota has occurred, but basic ecosystem functioning appears predominately unchanged.	60 – 79
D	Largely modified. A loss of natural habitat and biota and a reduction in basic ecosystem functioning is assumed to have occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and ecosystem functioning is extensive.	20 – 39
F	Modifications have reached a critical level and there has been an almost complete loss of natural habitat and biota. In the worst cases, the basic ecosystem functioning has been destroyed.	0 - 19

Ecosystem Service Assessment

WET-EcoServices Version 2 (Kotze *et al.*, 2021) is a structured and rapid field-based evaluation tool designed to assess the wetlands and riparian areas ecosystem services based on their Hydrogeomorphic (HGM) unit. The tool accounts for 16 ecosystem services which are derived from regulating (e.g., flood attenuation), provisioning (e.g., water supply), supporting (e.g., biodiversity maintenance), and cultural (e.g., tourism and recreation) services. The tool evaluates the scale of ecosystem services supplied (in terms of a score out of 4 per service) relative to other wetlands and riparian areas and furthermore compares the scale of service supply to the demand for each service. The scores are divided into seven categories as per **Table F**. The tool offers two levels of assessment, namely Level 1 (a rapid desktop assessment) and Level 2 (a detailed field-based indicator assessment). Level 1 is designed for conducting rapid desktop assessments of many wetlands and riparian areas across provincial and national scales. Ratings are assigned based on the Hydrogeomorphic unit of the wetland. Level 2 is designed for conducting robust in-field assessments of ecosystem services for respective wetland types and/or riparian areas. The level 2 Ecosystem Service assessment was applied to a riparian area in this case.

Table F: Ecosystem Services Importance Categories Scores as defined in WET-EcoServices Version 2 (Kotze *et al.* 2020).

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

Ecological Importance and Sensitivity Assessment

The EIS method (Rountree *et al.* 2013) is a rapid scoring system designed to identify the ecological importance and sensitivity of wetlands to disturbances across multiple scales (i.e., catchment to international scales). The full EIS method integrates three important components, namely, ecological importance and sensitivity, hydro-functional importance, and basic socio-economic importance. The hydro-functional and socio-cultural benefits were however assessed using the updated WET-EcoServices assessment methodology and these two components were therefore omitted from this EIS assessment. The EIS score ranges from 0-4, and it provides an index for prioritisation and management of water resources.

Table G: Ecological Importance and Sensitivity Categories (DWAF, 1999).

EIS Category	Description	Range of Median
Very high	Ecologically important and sensitive on a national or even international level. These river systems and their biota are usually very sensitive to flow and habitat modifications and provide only a small capacity for use.	>3 and <=4
High	Ecologically important and sensitive on a regional or national scale. These river systems may be sensitive to flow and habitat modifications.	>2 and <=3
Moderate	Watercourses that are ecologically important and sensitive on a provincial or local scale. The biota of these watercourses is not usually sensitive to flow and habitat modifications.	>1 and <=2
Low/marginal	Watercourses that are not ecologically important and sensitive at any scale. The biota within these watercourses is not sensitive to flow and habitat modifications.	>0 and <=1

Recommended Ecological Category

The method for determining the Recommended Ecological Category (REC) for water resources is described in Rountree *et al.* (2013):

- A wetland within PES Category A (unmodified) cannot be rehabilitated. The management objective will therefore always be to maintain the existing PES Category.
- A wetland within PES Category B, C or D with a "Low-marginal" or "Moderate" EIS score must also be maintained in the pre-development PES category.
- A wetland within PES Category B, C or D with a "High" or "Very High" EIS score must, where practically possible, be rehabilitated to a PES category that is one higher than the pre-development category. E.g. a wetland with a pre-development PES score of C and a "High" EIS score must be rehabilitated to a PES category B. Where this is not practically possible, maintenance of the pre-development PES category will be the management objective.
- PES Categories E or F are considered unsuitable and always require rehabilitation to a PES Category D.

Impact Assessment Methodology

Impact assessment methodologies are based on qualitative ratings of the various factors and represent a standardised method for presenting a substantiated specialist opinion regarding the significance of a particular class of impact. Delta Ecology has developed a rapid numerical impact assessment methodology, applied in this report, that incorporates a range of factors commonly assessed to which numerical values from 1 to 5 are assigned to each rating category. Six primary factors are used to determine Consequence, and two primary factors are used to determine Probability. These two secondary factors are used to determine Impact Significance for each identified impact. Consequence, Probability and Impact Significance are determined by a set of formulae which incorporate weightings for each primary and secondary factor.

The weightings for each factor were determined by application of the formulae to over 50 pre-existing ecological impact assessments. These assessments employed other methodologies and were accepted by the relevant environmental authorities. These assessments were primarily from reports drafted by Delta Ecology staff during previous employment but also included unrelated ecological impact assessments freely available on the internet. The weighting system has therefore been derived as a means of real-world formula calibration rather than by logic alone. The final methodology achieves impact significance ratings that are consistently in line with industry standards.

Key elements of the approach include a detailed description of the nature of the impact and of the proposed mitigation measures, assessment of each factor for both the "with mitigation" and "without mitigation" scenarios and includes the provision of a rationale for each rating where appropriate. The resulting impact significance ratings may be adjusted, if necessary, in accordance with specialist opinion, given adequate motivation for the deviation from the standard methodology.

The various factors, formulae and weightings are provided in the **Table H** below:

Scoring of impacts			
Factor	**Weighting**	**Score**	**Description/Rating**
Consequence	**8**		
Intensity	4	1	Very Low / Non-harmful
		2	Low / Slightly Harmful
		3	Medium / Harmful
		4	High / Very Harmful
		5	Very High / Disastrous
Duration	1	1	Up to 1 month
		2	1 month to 1 year
		3	One year to 5 years
		4	5 to 20 years
		5	Beyond 20 years / Permanent
Spatial scale/extent	3	1	Limited to project site
		2	Limited to local catchment
		3	Multiple local catchments
		4	Limited to quaternary catchment
		5	Regional, National, International
Reversibility	1	1	Passive restoration / High likelihood of success
		2	Low-cost rehabilitation / Moderately high likelihood of success
		3	Moderate cost / Moderate likelihood of success
		4	High cost / Low likelihood of success

		5	Very high cost / Very low likelihood of success
Loss of irreplaceable resources	1	1	None
		2	Low
		3	Medium
		4	High
		5	Very High
Cumulative Impact	1	1	Very Low
		2	Low
		3	Medium
		4	High
		5	Very High
Probability	**2**		
Frequency of the activity	1	1	Once off activity / less than once in 20 years
		2	5 to 20 years
		3	1 to 5 years
		4	Monthly to annually
		5	Weekly to Monthly
Likelihood of the Incident / Impact occurring	1	1	Highly unlikely
		2	Unlikely
		3	Possible
		4	Likely
		5	Definite
Consequence = (Intensity x 4) + Duration + (Extent x 3) + Reversibility + Loss of Irreplaceable Resources + Cumulative Impact) / 11			
Probability = (Frequency + Probability) / 2 OR = 5 where likelihood is definite			
Impact Significance = (Consequence x 8) + (Likelihood x 2) / 10			
Impact Significance Categories			
0 - 1.5			Very Low
1.6 - 2.5			Low
2.6 - 3.5			Medium
3.6 - 4.5			High
4.5 and above			Very High