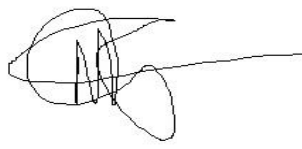




Aquatic Ecological Assessment of the stream at
Bluehills Midrand, Gauteng Province, South Africa
December 2024

This document contains information proprietary to Eco-Sentle (Pty) Ltd. and as such should be treated as confidential unless specifically identified as a public document by law. The document may not be copied, reproduced, or used for any manner without prior written consent from Eco-Sentle (Pty) Ltd. Copyright is specifically reserved.



Report Name	Aquatic Ecological Assessment of the stream at Bluehills Midrand, Gauteng Province, South Africa	
Report Writer	Musa Magala (M. Sc; Pr. Sci.Nat) <i>SACNASP Reg no: 013631</i>	
	Mthombeni Ndlangisa (Pr. Sci.Nat) <i>SACNASP Reg no: 115120</i>	
Report Reviewer		
Prepared for	Selahle Consulting and Projects	
Declaration	Eco-Sentle (Pty) Ltd and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Ecological Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time, and budget) based on the principals of science.	

Executive Summary

Eco-Sentle (Pty) Ltd was engaged by Selahle Consulting and Projects to conduct an Aquatic Ecological Assessment associated with the medium-density township development in Blue-Hills, Midrand, Gauteng Province. The purpose of this study is to provide input for the environmental authorisation process, specifically the water-use licence application, and to deliver a report addressing activities associated with the project. The findings and recommendations in this report are intended to guide the Environmental Assessment Practitioner (EAP) in making informed decisions regarding the ecological viability of the proposed project.

It is important to note that environmental authorisation (EA) for the development was granted in 2018, and construction activities associated with the development have occurred at the time of this study. However, the initial EA did not cover activities within a watercourse. As part of the condition of the EA it is stated that a WUL must be obtained regarding activities that will take place within a watercourse. This report therefore considers both the activities already undertaken in the study area and the outstanding activities, along with specialist studies conducted for the original EA application.

This assessment examined the watercourses within the Project Area of Influence (PAOI), defined as a 500m radius around the study area, in accordance with GN 4167 of December 2023. The study identified a single freshwater resource—a channelled valley bottom wetland. The assessment focused on evaluating the aquatic ecology of the Unnamed Stream, which flows from the wetland, and specifically investigated aquatic biota in this stream.

A Freshwater Resource Ecological Assessment, conducted by Scientific Terrestrial Services in November 2017 as part of the initial EA application, focused on wetland delineation and assessing the present ecological state of the wetland. This current study supplements the earlier assessment by concentrating on aquatic biota within the associated stream.

Results

Based on the Scientific Terrestrial Services Report (2017), the results of the ecological assessment of the wetland unit are presented below.

Freshwater ecosystem	Present Ecological State (PES)	Ecoservices Provision	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Category
Channelled valley bottom <i>wetland: A valley-bottom wetland with a river channel running through it</i>	D (Largely modified)	Intermediate	C (Moderate)	D (Largely modified)

This Aquatic ecological assessment focused on the stream employing various methodologies including SASS5 and Index of Habitat Integrity to determine the present ecological state of the unnamed stream. The results of this assessment are presented below.

River	PES	EIS	REC	RMO
Unnamed Stream	D/E	Low	C/D	Improve

The existing and historical human activities within the Project Area of Influence (PAOI) and the surrounding catchment have significantly altered the riparian and instream habitat integrity of this freshwater resource. These activities include the construction of Acacia Road, and the creation of an artificial dam located upstream of the feature, east of Acacia Road.

In addition to these physical impacts, the water quality within the stream was found to be poor, particularly for aquatic biota with moderate to low tolerance for pollution. This was reflected in the low diversity of aquatic macroinvertebrates observed. The poor water quality is likely linked to leakage from an on-site sewage system (French drain) situated in the central portion of the study area, immediately south of the medium-density housing development and upgradient of the freshwater resource.

Water sample analysis further revealed elevated levels of cyanide, faecal coliforms, phosphates, and chemical oxygen demand, all exceeding the general discharge limits for wastewater.

Impact Assessment

Following the Aquatic ecological site assessment, the Department of Water and Sanitation (DWS) Risk Assessment Matrix (2023) was applied to evaluate the significance of potential impacts from the outstanding works on the receiving freshwater environment. The risk assessment determined that activities during the construction and operational phases pose a "Low" risk to the wetland associated with the development.

To minimize further degradation of the freshwater resource, it is crucial to adhere to well-planned, ecologically sensitive site development strategies, implement the mitigation measures outlined in this report, and follow general good construction practices. Additionally, ongoing management, maintenance, and monitoring are essential to reduce the significance of perceived impacts and safeguard the freshwater ecosystem.

Specialist opinion

Based on the study's findings, the freshwater ecologist's professional opinion is that the remaining construction activities can be deemed acceptable, provided robust stormwater management designs are implemented and general good construction practices are adhered to.

Document Guide

The table below outlines the specialist report requirements for assessing and reporting impacts on aquatic biodiversity following Government Notice 320, published in Government Gazette 43110 on 20 March 2020. These requirements align with the Department of Environmental Affairs' screening tool guidelines and pertain to the National Environmental Management Act, 1998 (Act No. 107 of 1998).

No.	Requirements	Section in Report
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist	Annexure 2 and Annexure 2.1
2.2	Description of the preferred development site, including the following aspects-	N/A – Section 2
2.2.1	a. Aquatic ecosystem type b. Presence of aquatic species and composition of aquatic species communities, their habitat, distribution and movement patterns	Section 5 and Section 6
2.2.2	Threat status, according to the national web-based environmental screening tool of the species and ecosystems, including listed ecosystems as well as locally important habitat types identified	Section 5.2
2.2.3	National and Provincial priority status of the aquatic ecosystem (i.e. is this a wetland or river Freshwater Ecosystem Priority Area (FEPA), a FEPA sub- catchment, a Strategic Water Source Area (SWSA), a priority estuary, whether or not they are free-flowing rivers, wetland clusters, etc., a CBA or an ESA, including for all a description of the criteria for their given status	Section 5.2
2.2.4	A description of the Ecological Importance and Sensitivity of the aquatic ecosystem including: a. The description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.). b. The historic ecological condition (reference) as well as Present Ecological State (PES) of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel, flow regime (surface and groundwater)	Section 5.3 and section 6
2.3	Identify any alternative development footprints within the preferred development site which would be of a “low” sensitivity as identified by the national web based environmental screening tool and verified through the Initial Site Sensitivity Verification	N/A
2.4	Assessment of impacts - a detailed assessment of the potential impact(s) of the proposed development on the following very high sensitivity areas/ features:	Section 7
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Section 7
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	Section 6
2.4.3	How will the development impact on fixed and dynamic ecological processes that operate within or across the site, including:	Section 7

No.	Requirements	Section in Report
	a. Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes). b. Change in the sediment regime (e.g. sand movement, meandering river mouth/estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub-catchment. c. The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary/seasonal/permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.). d. Assessment of the risks associated with water use/s and related activities.	
2.4.4	How will the development impact on the functionality of the aquatic feature including: a. Base flows (e.g. too little/too much water in terms of characteristics and requirements of system). b. Quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river). c. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland). d. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); and e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal).	Section 7
2.4.5	How will the development impact on the functionality of the aquatic feature including: a. water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river) b. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland). c. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication). d. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal). e. The loss or degradation of all or part of any unique or important features (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soil, etc.) associated with or within the aquatic ecosystem.	Section 7
2.4.6	How will the development impact on key ecosystem regulating and supporting services especially Flood attenuation; Streamflow regulation; Sediment trapping; Phosphate assimilation; Nitrate assimilation; Toxicant assimilation; Erosion control; and Carbon storage.	Section 7
2.4.7	How will the development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	Section 7

No.	Requirements	Section in Report
2.4.9	A motivation must be provided if there were development footprints identified as per paragraph 2.3 above that were identified as having a “low” biodiversity sensitivity and were not considered appropriate.	N/A
3.	The report must contain as a minimum the following information:	
3.1	Contact details and curriculum vitae of the specialist including SACNASP registration number and field of expertise and their curriculum vitae	Annexure 1
3.2	A signed statement of independence by the specialist;	Declaration (Start of report)
3.3	The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 4
3.4	The methodology used to undertake the impact assessment and site inspection, including equipment and modelling used, where relevant;	Section 3
3.5	A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations	Section 4
3.6	Areas not suitable for development, to be avoided during construction and operation (where relevant)	N/A
3.7	Additional environmental impacts expected from the proposed development based on those already evident on the site and a discussion on the cumulative impacts;	Section 7
3.8	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted protocol;	N/A
3.9	Impact management actions and impact management outcomes proposed by the specialist for inclusion in the EMPr;	Section 7
3.10	A motivation where the development footprint identified as per 2.3 were not considered stating reasons why these were not being considered; and	N/A
3.11	A reasoned opinion, based on the finding of the specialist assessment, regarding the acceptability or not, of the development and if the development should receive approval, and any conditions to which the statement is subjected.	Section 8

Declaration

I, Musa Magala declare that:

- I act as the independent specialist in this application.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist work relevant to this application, including knowledge of the Act (NEMA), regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, regulations, and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan, or document to be prepared by myself for submission to the competent authority.
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



Musa Magala

Aquatic and Ecological Specialist

15 January 2025

Table of Contents

Executive Summary	3
Document Guide.....	5
Declaration	8
1. INTRODUCTION	11
1.1. Terms of Reference	11
1.2. Relevant Legislation.....	11
1.2.1. The National Water Act (NWA,1998)	12
1.2.2. National Environmental Mngement Act (NEMA, 1998)	12
2. METHODOLOGY.....	13
2.1. Water Quality	13
2.2. Aquatic Habitat integrity.....	13
2.3. Aquatic Macro-invertebrate Assessment.....	15
2.3.1. The South African Scoring System version 5	16
2.3.2. Macro-invertebrate Response Assessment Index	16
2.4. Present Ecological Status (PES).....	16
2.5. Determining the ecological Importance and sensitivy (EIS)	16
2.6. recommended Ecological Category	17
3. ASSUMPTIONS AND LIMITATIONS	17
4. DESKTOP ASSESSMENT	18
4.1. Project Location	18
4.2. Biophysical and Conservation Context of Project Site	18
4.3. Freshwater Resources in the Study Area	19
5. RESULTS: AQUATIC ASSESSMENT	26
5.1. Freshwater Resources Characterisation.....	26
5.2. Water Quality Assessment.....	26
5.3. Aquatic Macroinvertebrates assessment (SASS5)	28
5.3.1. South Africa Scoring System (Version 5)- SASS5	28
5.3.2. Macroinvertebrate Response INDEX	30
5.4. Habitat Assessment	31
5.4.1. Intermediate Habitat Integrity Assessment	31
5.5. Present Ecological State	34
5.6. Ecological Importance and Sensitivity	34
5.7. Recommended Ecological Category (REC)	34
6. IMPACT ASSESSMENT	36
6.1. Freshwater sensitivity verification	36
6.2. Risk assessment – Impact assessment.....	38
6.2.1. Previous Risk assessment- 2017.....	38

6.2.2. Aquatic Ecology Assessment	38
7. CONCLUSION	41
8. REFERENCES.....	42
9. ANNEXURE 1: WATER QUALITY CERTIFICATE.....	43
10. ANNEXURE 2: SPECIALIST DETAILS	44
11. ANNEXURE 2.1: SACNSP REGISTRATION	49

List of Figures

FIGURE 1: PROJECT LOCATION	18
FIGURE 2: GAUTENG C-PLAN IN RELATION TO THE DEVELOPMENT SITE	23
FIGURE 3: NFEPA FEATURES IN RELATION TO THE DEVELOPMENT SITE	24
FIGURE 4: IDENTIFIED CHanneled VALLEY BOTTOM WETLAND (SCIETIFIC, TERRESTRIAL SERVICES, 2017)	25
FIGURE 5; EXAMPLE OF SPECIES IDENTIED	30
FIGURE 6: DAM UPSTREAM OF WATERCOURSE	32
FIGURE 7: STREAM CHANNEL.....	32
FIGURE 8: AQUATIC BIODIVERSITY SENSITIVITY OF PROJECT AREA (DFFE, SCREENING TOOL).....	37

List of Tables

TABLE 1: CRITERIA USED IN THE ASSESSMENT OF HABITAT INTEGRITY (FROM KLEYNHANS, 1996).....	13
TABLE 2: DESCRIPTIVE CLASSES FOR THE ASSESSMENT OF MODIFICATIONS TO HABITAT INTEGRITY (FROM.....	14
TABLE 3: DATA OUTLINING THE CHARACTERISTICS OF FRESHWATER ECOSYSTEMS LINKED TO THE PROPOSED STUDY AND INVESTIGATION AREA.	20
TABLE 4: WATER QUALITY ASSESSMENT RESULTS	26
TABLE 5: SUMMARY OF SASS5 RESULTS.....	29
TABLE 6: LIST OF TAXA IDENTIFIED AND ASSOCIATED QUALITY VALUE.....	29
TABLE 7: KEY QUALITY VALUE SCORE.....	29
TABLE 8: MIRAI SCORE FOR THE PROJECT SITE	30
TABLE 9: INSTREAM INTEGRITY HABITAT ASSESSMENT RESULTS.....	33
TABLE 10: RIPARIAN INDEX OF HABITAT INTEGRITY	33
TABLE 11: PRESENT ECOLOGICAL STATE OF THE UNNAMED STREAM REACH.....	34
TABLE 12: MATRIX FOR THE DETERMINATION OF REC AND RMO FOR WATER RESOURCES (BASED ON KLEYNHANS & LOUW, 2007)	35
TABLE 13: SUMMARY REC FOR UNNAMED STREAM.....	35
TABLE 14: DWS RISK ASSESSMENT FOR OUTSTANDING WORKS.....	39

1. INTRODUCTION

Omeida Trading 426CC was granted an Environmental Authorisation (EA)—Ref#: GAUT oo2/18-19/E0036—by the Gauteng Department of Agriculture and Rural Development (GDARD) on 31 August 2018. The environmental authorisation granted the holder permission to undertake medium-density township development on holdings 105 and 106 of Bluehills agricultural holdings, City of Johannesburg metropolitan municipality.

The specific conditions of the environmental authorisation state that water authorisation must be obtained from the Department of Water and Sanitation regarding the activities that will take place within the watercourse.

With that context, Eco-Sentle (Pty) Ltd was engaged by Selahle Consulting and Projects to conduct an Aquatic Ecological Assessment associated with the medium-density township development. The purpose of this study is to provide input for the environmental authorisation process, specifically the water-use licence application, and to deliver a report addressing activities associated with the project.

This assessment was conducted following the amendments to the Environmental Impact Assessment Regulations, 2014 (No. 326, 7 April 2017) of the National Environmental Management Act, 1998 (Act No. 107 of 1998). The approach has taken cognisance of the recently published Government Notice 320 in terms of NEMA dated 20 March 2020: “Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation”.

This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the engineers and regulatory authorities, enabling informed decision-making with regard to the design to improve the ecological category.

1.1. TERMS OF REFERENCE

This report constitutes the baseline Aquatic Ecosystem Assessment. This was undertaken according to the following scope of work:

- Contextualization of the study area in terms of important biophysical characteristics and freshwater conservation planning through a review of available spatial datasets and relevant conservation plans.
- Assessment of the present ecological state (PES) of the delineated river units using the Qualitative Index of Habitat Integrity (Q-IHI) assessment tool (Kleynhans, 1996).
 - The river PES assessment was supplemented by water quality sampling and a SASS5 (Dickens & Graham, 2002) aquatic macroinvertebrate survey.
- Assessment of the Ecological Importance and Sensitivity (EIS) of the delineated river units using the EIS assessment method developed by Eco-Pulse adapted from the DWAF Resource Directed Measures EIS tools (Kleynhans, 1999 & Duthie, 1999).
- Apply the DWS Risk Assessment Matrix (2023) to evaluate potential impacts of the proposed development on freshwater ecosystems.

1.2. RELEVANT LEGISLATION

The importance of freshwater aquatic resources and the protection of wetlands and rivers has been campaigned at national and international levels. Relevant environmental legislation about the protection and use of wetland and aquatic ecosystems in South Africa is summarized below.

1.2.1. THE NATIONAL WATER ACT (NWA, 1998)

The Department of Water and Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (Act No. 36 of 1998 – NWA) allows for the protection of water resources, which includes the following:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way.
- The prevention of the degradation of the water resource
- The rehabilitation of the water resource.

The NWA recognises that the entire ecosystem and not just the water itself, and any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the DWS. Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

1.2.2. NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NEMA, 1998)

The National Environmental Management Act (Act No. 107 of 1998 – NEMA) and the associated Regulations as amended in April 2017, states that before any development taking place within a wetland or riparian area, an environmental authorisation application process needs to be followed. This could follow either the Basic Assessment (BA) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. In addition to the above, the assessment will also take cognisance of the following relevant national legislation, conventions, and regulations applicable to wetlands and riparian zones:

- Convention on Wetlands of International Importance - the Ramsar Convention and the South African Wetlands Conservation Programme (SAWCP)
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)
- National Environment Management Protected Areas Act, 2003 (Act 57 of 2003)
- Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983)
- South African Water Quality Guidelines under the NWA
- Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002)
- GN R267 (Regulations Regarding the Procedural Requirements for Water Use Licence Applications and Appeals)

2. METHODOLOGY

Standard methods used in the River Ecosystem Monitoring Programme were used to determine the PES of the considered watercourse. This was conducted in a single wet season survey. The various sections provided below elaborate on the various methods/indexes which were applied for this study.

2.1. WATER QUALITY

Water quality was measured using the water samples collected along the stream in proximity to the development area. The constituents considered that were measured included: pH, conductivity ($\mu\text{S}/\text{cm}$), temperature ($^{\circ}\text{C}$) and Dissolved Oxygen (DO) in mg/l as well as heavy metal and nutrients listed in the DWA wastewater discharge list.

2.2. AQUATIC HABITAT INTEGRITY

The Intermediate Habitat Assessment Index (IHIA) as described in the Procedure for Rapid Determination of Resource Directed Measures for River Ecosystems (Section D, 1999) was used to define the ecological status of the river reach. The IHIA model was used to assess the integrity of the habitats from a riparian and instream perspective. The habitat integrity of a river refers to the maintenance of a balanced composition of physico-chemical and habitat characteristics on a temporal and spatial scale that is comparable to the characteristics of natural habitats of the region (Kleynhans, 1996). The methodology is based on the qualitative assessment of several pre-weighted criteria which indicate the integrity of the in-stream and riparian habitats available for use by riverine biota.

The criteria considered indicative of the habitat integrity of the river were selected on the basis that anthropogenic modification of their characteristics can generally be regarded as the primary causes of degradation of the integrity of the river – see Table 1 (DWS, 1999). The study assessed over 200m of the unnamed stream.

The assessment of the severity of the impact of modifications is based on six descriptive categories which are described in Table 2.

TABLE 1: CRITERIA USED IN THE ASSESSMENT OF HABITAT INTEGRITY (FROM KLEYNHANS, 1996).

Criterion	Relevance
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Flow modification	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in the duration of low flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment (Gordon et al., 1993 in: DWS, 1999). Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation (Hilden & Rapport, 1993 in: DWS, 1999) is also included.

Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Water quality modification	Originates from point and diffuse point sources. Measured directly or agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments (Gordon <i>et al.</i> , 1992 in DWS, 1999)).
Exotic macrophytes	Alteration of habitat by obstruction of flow may influence water quality. Dependent upon the species involved and the scale of infestation.
Exotic aquatic fauna	The disturbance of the stream bottom during feeding may influence the water quality and increase turbidity. Dependent upon the species involved and their abundance.
Solid waste disposal	A direct anthropogenic impact which may alter habitat structurally. Also, a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the buffer the vegetation forms to the movement of sediment and other catchment runoff products into the river (Gordon <i>et al.</i> , 1992). Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Allochthonous organic matter input will also be changed. Riparian zone habitat diversity is also reduced.
Bank erosion	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 exotic vegetation encroachment.

TABLE 2: DESCRIPTIVE CLASSES FOR THE ASSESSMENT OF MODIFICATIONS TO HABITAT INTEGRITY (FROM

Impact Category	Description	Score
None	No discernible impact or the modification is located 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 are also very small.	1-5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.	6-10

Large	The modification is generally present with a detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are 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

The eventual total scores for the instream and riparian zone components are then used to place the habitat integrity in a specific intermediate habitat integrity category (DWS, 1999). These categories are indicated in

Category	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 ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-70
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level, and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances, the basic ecosystem functions have been destroyed, and the changes are irreversible.	0

2.3. AQUATIC MACRO-INVERTEBRATE ASSESSMENT

Macroinvertebrate assemblages are good indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are well-suited for assessing site-specific impacts (Barbour *et al.*, 1999).

Benthic macroinvertebrate assemblages consist of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour *et al.*, 1999).

Assessing and monitoring benthic macroinvertebrate communities forms an integral part of monitoring the health of an aquatic ecosystem.

2.3.1. THE SOUTH AFRICAN SCORING SYSTEM VERSION 5

The South African Scoring System version 5 (SASS5) is the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water quality changes of these families. Different families exhibit different sensitivities to pollution, these sensitivities range from highly tolerant families (e.g., Chironomidae) to highly sensitive families (e.g., Perlidae). SASS results are expressed both as an index score (SASS score) and the Average Score Per Recorded Taxon (ASPT value).

Sampled invertebrates are identified using the “Aquatic Invertebrates of South African Rivers” Illustrations book, by Gerber and Gabriel (2002). Identification of organisms is made to family level. Furthermore, all SASS5 and ASPT scores are compared with the SASS5 Data Interpretation Guidelines (Dallas, 2007) for the ecoregion. This method seeks to develop biological bands depicting the various ecological states and is derived from data contained within the Rivers Database and supplemented with other data not yet in the database.

2.3.2. MACRO-INVERTEBRATE RESPONSE ASSESSMENT INDEX

The Macroinvertebrate Response Assessment Index (MIRAI) is used to provide a habitat-based cause-and-effect foundation to interpret the deviation of the aquatic invertebrate community from the calculated reference conditions for the SQR. This does not preclude the calculation of SASS5 scores if required (Thirion, 2007). The four major components of a stream system that determine productivity for aquatic macroinvertebrates are as follows:

- Flow regime
- Physical habitat structure
- Water quality
- Energy inputs from the watershed

The results of the MIRAI indicate the current ecological category and therefore assist in the determination of the PES.

2.4. PRESENT ECOLOGICAL STATUS (PES)

Ecological classification refers to the determination and categorisation of the integrity of the various selected biophysical attributes of ecosystems compared to the natural or close to natural reference conditions (Kleynhans and Louw, 2007). For this study ecological classification is determined for biophysical attributes of the associated watercourse. This was completed using the river eco-classification manual by Kleynhans and Louw (2007).

2.5. DETERMINING THE ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)

The method used for the Ecological Importance and Sensitivity (EIS) determination is adapted from the method provided by DWS (1999) for floodplains. The method takes into consideration PES scores obtained for the watercourse as well as function and service provision to enable the assessor to determine the most representative EIS category for the watercourse feature or group being assessed. A series of determinants for EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category (Rountree, M. & Kotze, D. 2013).

2.6. RECOMMENDED ECOLOGICAL CATEGORY

The Recommended Ecological Category (REC) is determined by the PES of the water resource and the importance and/or sensitivity of the water resource. Water resources which have Present Ecological State categories in an E or F ecological category are deemed unsustainable by the DWA. In such cases the REC must automatically be increased to a D (Rountree et.al. 2013). Where the PES is in the A, B, C or D ecological category, then the EIS components must be checked to determine if any of the aspects of importance and sensitivity (Ecological Importance; Hydrological Functions and Direct Human Benefits) are high or very high. If this is the case, the feasibility of increasing the PES (particularly if the PES is in a low C or D category) should be evaluated. This is recommended to enable important and/or sensitive wetland water resources to maintain their functionality and continue to provide the goods and services for the environment and society.

The REC is determined as follows:

- If PES is in an E or F category, then the EIS is not important, and the REC is set to at least a D (since E and F ecological categories are considered unsustainable)
- If PES is in an A, B, C or D category, **AND** the EIS is Moderate to Low **OR** the EIS criteria is High or even Very High, **AND** It is **not feasible** or practicable for the PES to be improved THEN the REC is set to the current PES.
- If PES is in a B, C or D category, **AND** the EIS is High or Very High. **AND** it is **feasible** or practicable for the PES to be improved **THEN** the REC is set to at least one category higher than the current PES.

3. ASSUMPTIONS AND LIMITATIONS

The following limitations and assumptions apply to the baseline freshwater aquatic ecosystem assessment:

- This report deals exclusively with a defined area and the extent and nature of aquatic ecosystems in that area.
- Additional information used to inform the assessment was limited to data and GIS coverage available for the province at the time of the assessment.
- All field assessments were limited to daytime assessments.
- Sampling by its nature means that not all parts of the study area were visited. The assessment findings are thus only applicable to those areas sampled, which were extrapolated to the rest of the study area.
- The PES and EIS assessments make use of qualitative assessment tools and thus the results are open to professional opinion and interpretation. We have tried to substantiate all claims where applicable and necessary.
- The EIS assessment did not specifically address in detail all the finer-scale ecological aspects of the water resources such as a list of aquatic fauna likely to occur (i.e., amphibians and fish) within the onsite riverine system.
- Field survey was undertaken in December 2024 (summer), during the study area's wet season. One infield visit does not fully cover the seasonal variation in conditions at the site.
- Ecology is dynamic and complex; thus, some aspects, potentially significant, may have been inadvertently overlooked. Nonetheless, it is anticipated that all freshwater ecosystems potentially affected by the development within the study area have been thoroughly assessed and considered based on-site observations and ecological analysis.
- Access to certain parts of the site, particularly downstream areas, was limited due to the presence of numerous private properties and security restrictions in the area.

4. DESKTOP ASSESSMENT

4.1. PROJECT LOCATION

The study area (Development area) is bounded by Acacia Road to the east and Mimosa Road to the north, with Tamboti Road located about 290 meters to the south and the R55 (Main Road) approximately 520 meters to the west. The Carlswald Valley Residential Development lies directly southeast of the study area, while the Summerset development is situated around 300 meters to the east. Figure 1 shows a Satellite image depicting the location of the study area in relation to surrounding land uses.



FIGURE 1: PROJECT LOCATION

4.2. BIOPHYSICAL AND CONSERVATION CONTEXT OF PROJECT SITE

The following section presents data accessed as part of the desktop assessment, summarized in a “dashboard” format (TABLE 3). This dashboard is designed to provide concise summaries of the data on as few pages as possible,

enabling easy integration and interpretation by the reader. Additional discussion and interpretation are provided where necessary, with key information highlighted in bold for emphasis.

While the data sources utilized offer valuable, verifiable, and high-quality insights, the various databases may not always accurately reflect the specific site characteristics of the study area at the detailed scale required for EA/WUA processes. Nevertheless, the information serves as a critical background to the study, aiding in the legislative contextualization of risks and impacts. It also serves as a guideline to prioritize areas and aspects of greater conservation significance.

It is important to note that site assessments may occasionally contradict the data from these databases. In such cases, verified site information should take precedence in the decision-making process. The dashboard report aims to provide an overview of the study area's landscape; however, actual site conditions at the time of the assessment may differ from the database-provided background information. For further details on the site investigation, please refer to Section 6.

4.3. FRESHWATER RESOURCES IN THE STUDY AREA

We reviewed the Freshwater Ecological Assessment Report, 2017 which was undertaken by Scientific Terrestrial Services as part of the Environmental Authorisation prior to commencement of the project. The purpose of this report was to describe the ecology of the area where the proposed development was located, focusing on the characteristics of freshwater resources, mapping these resources, identifying areas of heightened Ecological Importance and Sensitivity (EIS), and determining the Present Ecological State (PES) of the freshwater resources associated with the proposed development.

Based on this study, one freshwater resource i.e., **a Channelled valley bottom wetland**: valley-bottom wetland with a river channel running through it was identified in the southern part of the study area. This resource was classified using the system outlined by Ollis *et al.* (2013) as an Inland System, situated within the Highveld Aquatic Ecoregion and the Mesic Highveld Grassland.

The study also identified several factors affecting the Present Ecological State (PES) of this system. These included the construction of Acacia Road (a gravel road), and an artificial dam located east of the road, upstream of the feature, as well as infilling through the creation of a berm in the western portion of the freshwater resource.

These anthropogenic impacts have led to changes in the system's hydrology and geomorphology. Additionally, leakage from an on-site sewage system (French Drain) in the central part of the study area, just south of the housing associated with the smallholding and upstream of the freshwater resource, was observed. This could have potentially altered the water quality of the freshwater resource. Please refer to Figure 4 for the location of the channelled valley bottom wetland, in relation to the project area and surrounding areas.

The unnamed stream (out-flow from the wetland) within the study area is a sub-tributary that eventually joins the main tributary of the Jukskei River. This connectivity underscores the importance of the stream in contributing to the broader hydrological and ecological functions of the Jukskei River system.

TABLE 3: DATA OUTLINING THE CHARACTERISTICS OF FRESHWATER ECOSYSTEMS LINKED TO THE PROPOSED STUDY AND INVESTIGATION AREA.

Aquatic ecoregion and sub-regions in which the study area is located		Detail of the study area terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database.	
Ecoregion	Highveld	FEPACODE	The study and investigation areas are located within a catchment classified as an upstream catchment area. Upstream Management Areas (FEPA code:4) are sub-quaternary catchments where human activities must be carefully managed to prevent the degradation of downstream river FEPAs and Fish Support Areas. However, these management areas do not encompass wetland FEPAs, which require assessment at a more detailed scale.
Catchment	Limpopo		
Quaternary Catchment	A21C		
WMA	Crocodile (West) and Marico		
Dominant characteristics of the Highveld Level 2 (11.01) (Kleynhans <i>et al.</i> , 2007)		NFEPA Wetlands	According to the NFEPA database, there is one Seep wetland within the study and investigation area. The Wetland is classified as an artificial wetland with an NFEPA rank of 6.
Dominant primary terrain morphology	Plains: low relief. Plains	Wetland Vegetation Type	The study area falls within the Mesic Highveld Grassland Group 3. This vegetation group is the least threatened according to Mbona <i>et al</i> (2015).
Dominant primary vegetation types	Rocky Highveld Grassland, Mixed Bushveld		
MAP (mm)	500 to 700	NFEPA Rivers – see Figure 3	According to the NFEPA database, there are no rivers within the study and investigation areas.
Coefficient of Variation (% of MAP)	20 to 34		The Jukskei River is located approximately 5 km west of the study area. According to the NFEPA Database, the river is largely modified (Class D)
Rainfall concentration index	55 to 64	Detail of the study area in terms of the Gauteng Conservation Plan (C-Plan V3.3, 2011)	
Rainfall seasonality	Early to mid-summer	Critical Biodiversity Area (CBA) – See Figure 2	A small section of the southern portion of the eastern boundary falls within a CBA, considered important for “Red” and “Orange” listed plant habitat and for primary vegetation. The southernmost portion of the study area falls within an area considered to be an ESA. Furthermore, according to the Gauteng C-Plan the southernmost portion of the of the project site traverses the wetland and falls within a wetland buffer. CBAs include natural or near-natural terrestrial and aquatic
Mean annual temp. (°C)	14 to 18		
Winter temperature (July)	0 to 20		
Summer temperature (Feb)	12 to 30		

Median annual simulated runoff (mm)	20 to 60		features that were selected based on an area's biodiversity characteristics, spatial configuration, and requirement for meeting both biodiversity pattern and ecological process targets
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014)		Ecological Support Area (ESA)	The southernmost section of the study area is classified as an Ecological Support Area (ESA). ESAs play a crucial role in maintaining connectivity and supporting key ecological processes between Critical Biodiversity Areas (CBAs), making them vital for habitat conservation.
Sub-quaternary reach	A21C-01167 (Jukskei)		
Proximity to study area	±5 km west of the study area		
Assessed by an expert?	Yes		
PES Category Median	Seriously Modified (Class E)	Wetland and River Buffers	According to the Gauteng C-Plan the southernmost portion of the study area falls within a wetland buffer.
Mean Ecological Importance (EI) Class	Moderate		
Mean Ecological Sensitivity (ES) Class	Moderate	Gauteng Environmental Management Framework (GEMF, 2014).	The study and investigation areas fall within the EMF Zone: Urban development zone Much of the study area and the investigation area is located within Zone 1. The intention with this zone is to streamline urban development activities in it and to promote development infill, densification, and concentration of urban development, in order to establish a more effective and efficient city region that will minimise urban sprawl into rural areas.
Stream Order	3		
Default Ecological Class (based on median PES and highest EI or ES mean)	Moderate (Class C)		

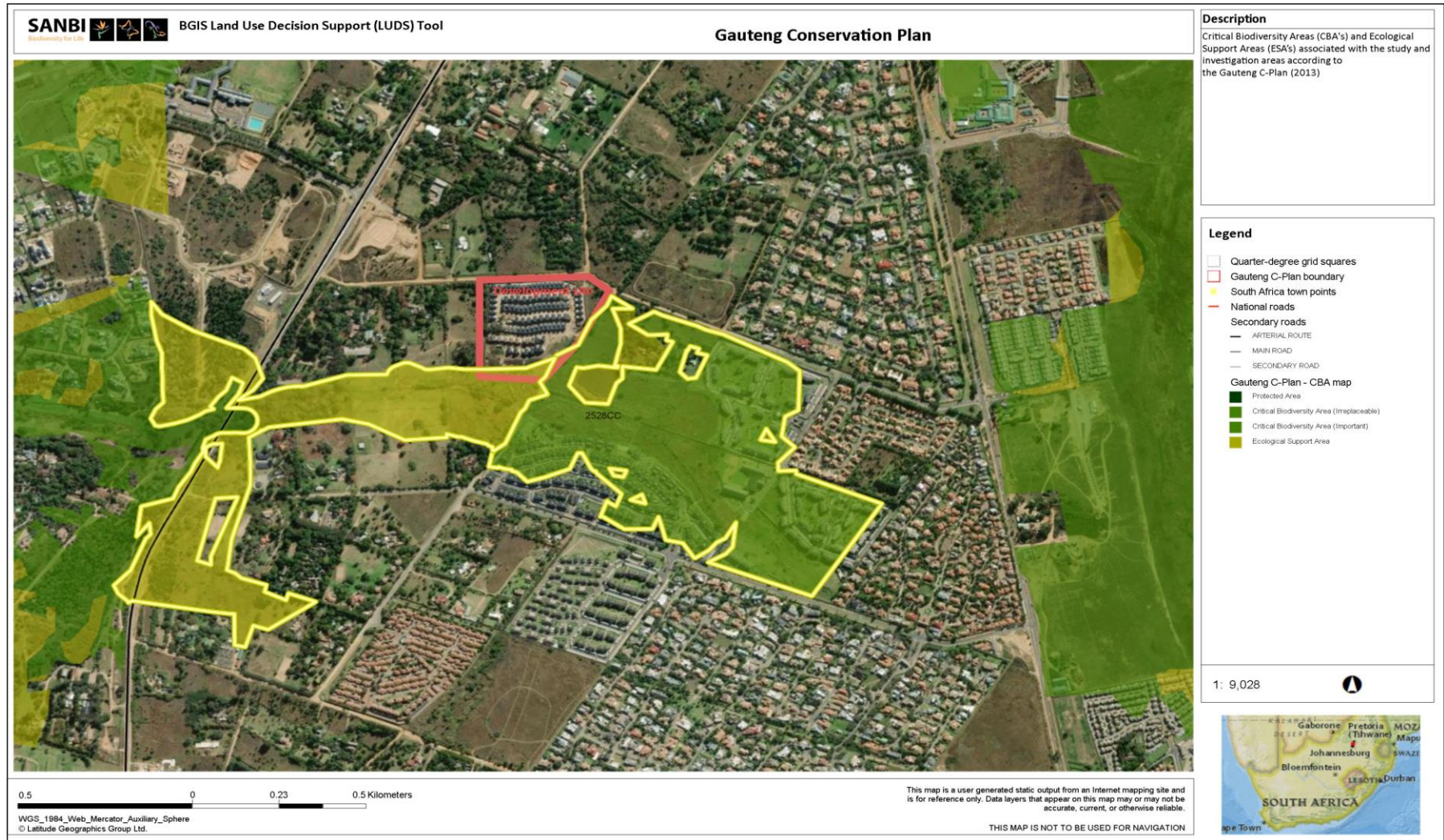


FIGURE 2: GAUTENG C-PLAN IN RELATION TO THE DEVELOPMENT SITE

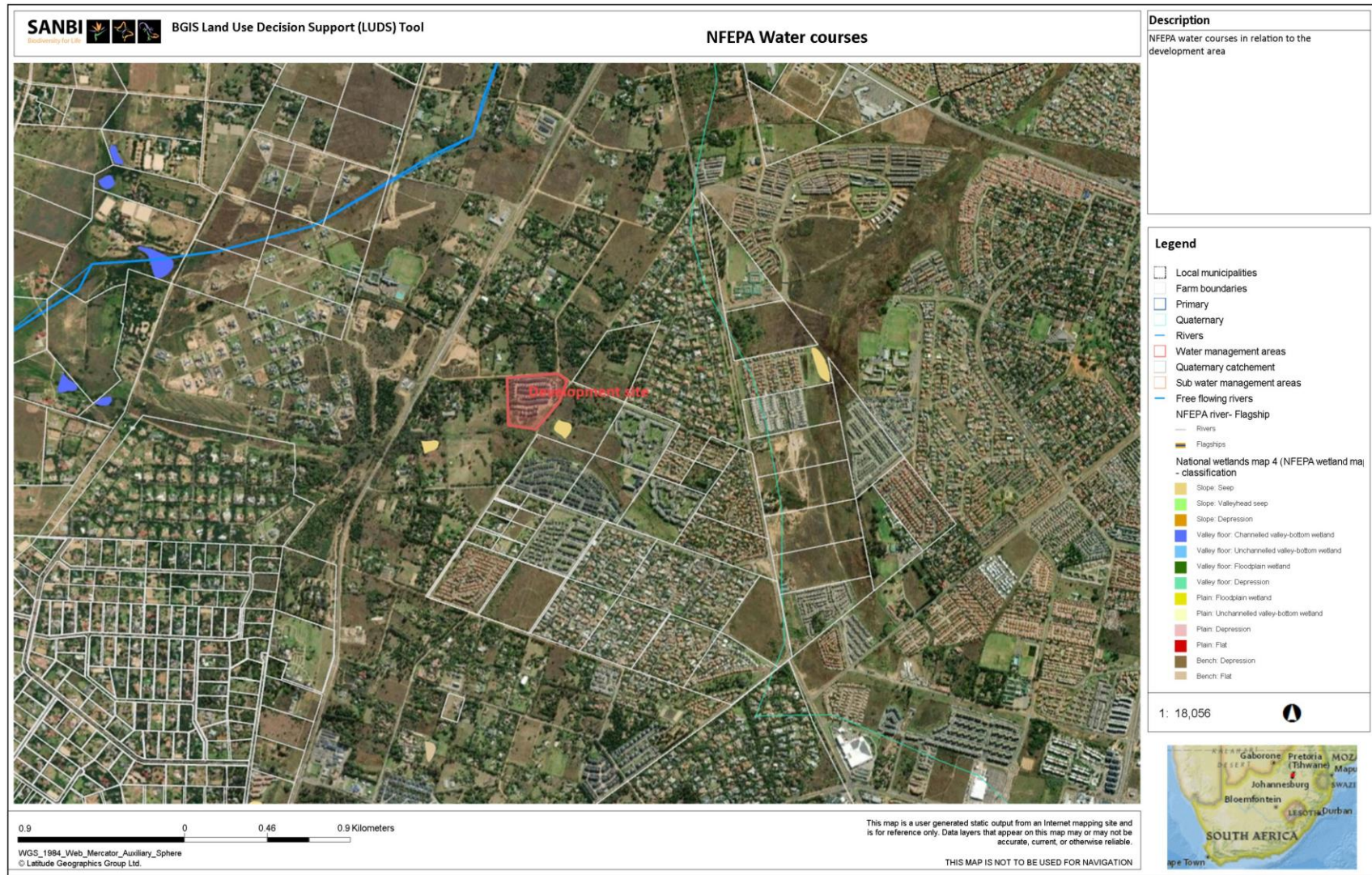


FIGURE 3: NFEPA FEATURES IN RELATION TO THE DEVELOPMENT SITE

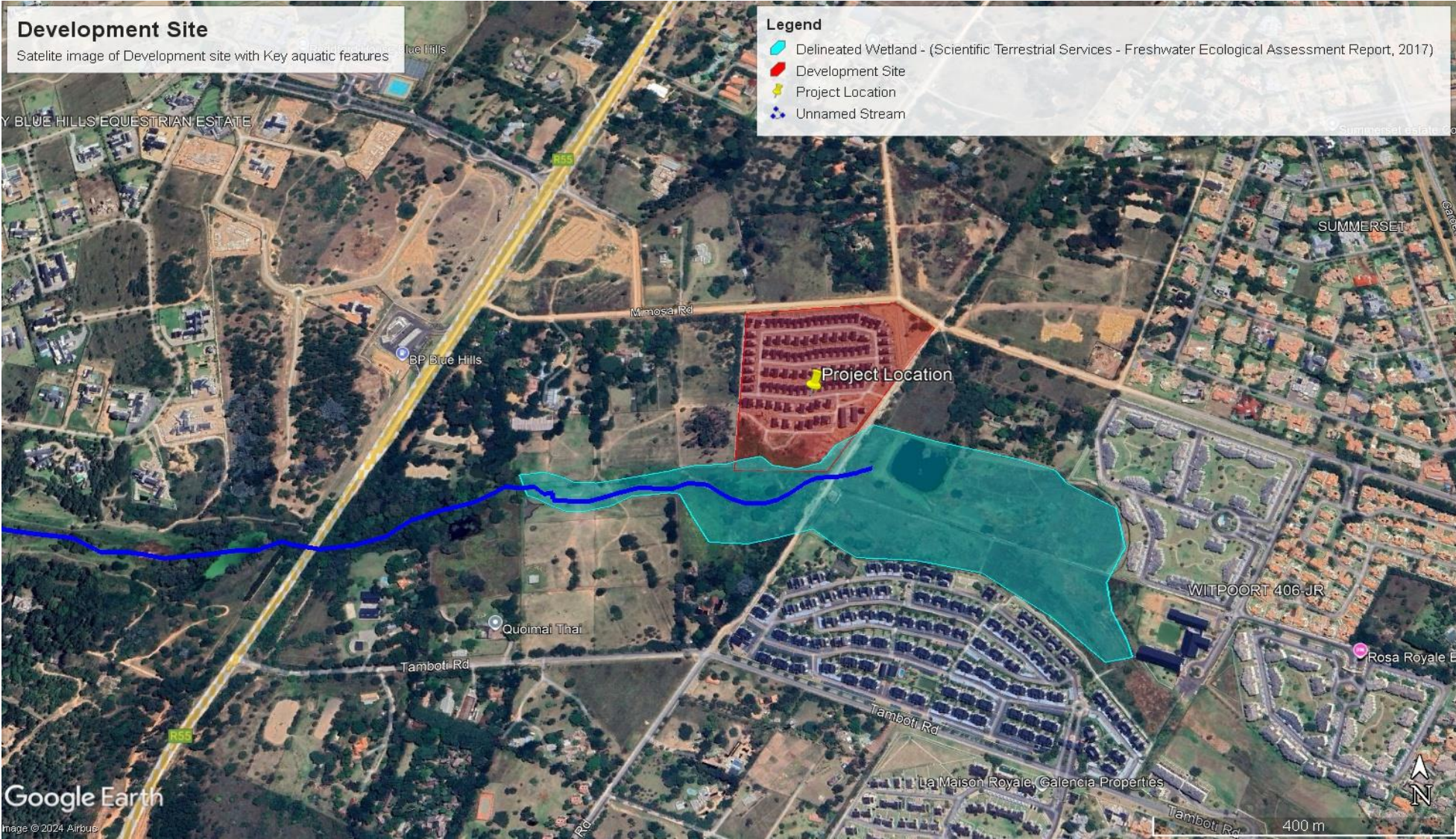


FIGURE 4: IDENTIFIED CHANNLED VALLEY BOTTOM WETLAND (SCIETIFIC, TERRESTRIAL SERVICES, 2017)

5. RESULTS: AQUATIC ASSESSMENT

5.1. FRESHWATER RESOURCES CHARACTERISATION

Ecological classification refers to the determination and categorisation of the integrity of the various selected biophysical attributes of ecosystems compared to the natural or close to natural reference conditions (Kleynhans and Louw, 2007). For this study, ecological classifications have been determined for biophysical attributes for the associated water course. This was completed using the river Eco-classification manual by Kleynhans and Louw (2007).

5.2. WATER QUALITY ASSESSMENT

A once-off water quality sample was taken at the sampling site. The sample was collected at the locations as it coincided with the reach of the stream that was sampled as part of the macroinvertebrate (SASS5) survey. It's important to note that the sample was collected downstream of the Sewage water pump station. The collected sample was analysed at a SANAS-accredited testing laboratory (WaterLab Pty Ltd) for several water quality determinants, including Electrical conductivity, Nitrate/Nitrite, Orthophosphate, pH and heavy metals. The results are presented in Table 4. Annexure 1 shows the original certificate from the lab. Water quality Parameters that are above the Wastewater regulation limits are highlighted in red.

TABLE 4: WATER QUALITY ASSESSMENT RESULTS

Parameters (mg/l unless specified)	Unnamed Stream Channel Results	Wastewater Discharge Limits	
		General Limits	Special Limits
	mg/l (Unless specified otherwise)		
pH - Value @ 25 °C	7.3	5.5-9.5	5.5 -7.5
Electrical Conductivity in mS/m @ 25°C	81.2	-	<-
Suspended Solids at 105°C	31	<25	<10
Free Residual Chlorine as Cl ₂	<0.1	<0.25	0
Fluoride as F	0.2	<1	<1
Nitrate as N	<0.1	-	-
Nitrite as N	0.1	-	-
Ortho Phosphate as P	3.9	<10	-
Free Cyanide as CN	0.049	<0.02	<0.01
Chemical Oxygen Demand as O ₂ (Total)	96	<75	<30
Oil & Grease	18	<2.5	0

Parameters (mg/l unless specified)	Unnamed Stream Channel Results	Wastewater Discharge Limits	
Faecal Coliform Bacteria	>100 000	<1000	0
Free and Saline Ammonia as N	33	<6	<2
Arsenic as As (Dissolved)	0.02	<0.02	<0.01
Boron as B	<0.025	<1	<0.5
Cadmium as Cd (Dissolved)	<0.001	<0.005	<0.001
Hexavalent Chromium as Cr	<0.010	<0.05	<0.02
Copper as Cu (Dissolved)	0.279	<0.01	<0.002
Iron as Fe (Dissolved)	0.271	<0.3	<0.3
Lead as Pb (Dissolved)	0.001	<0.01	<0.006
Manganese as Mn (Dissolved)	0.048	<0.1	<0.1
Mercury as Hg	<0.001	<0.005	<0.001
Selenium as Se (Dissolved)	0.001	<0.02	<0.02
Zinc as Zn (Dissolved)	<0.025	<0.01	<0.04

The assessment of water quality parameters in the sampled stream revealed several exceedances of South African wastewater discharge limits (highlighted in red). Each parameter is described below, along with its environmental impact on macroinvertebrate communities:

Total Suspended Salts (TSS): Total Suspended Salts refer to dissolved and suspended salts present in water, which can affect its ionic balance. Elevated levels of suspended salts increase water salinity, which may disrupt the osmoregulatory functions of aquatic organisms. For macroinvertebrates, high salinity can reduce species diversity as many are sensitive to changes in salinity, leading to the dominance of more tolerant species, (DWAF, 1996).

Ortho-phosphate: Ortho-phosphate is a nutrient that fuels algal growth. Excessive concentrations can lead to eutrophication, depleting dissolved oxygen levels and creating hypoxic conditions. This process poses significant threats to oxygen-dependent macroinvertebrates, often resulting in reduced species diversity and abundance. Phosphates in this stream may be attributed to the leaks from the raw sewage pump station located upstream of the site.

Free Cyanide: Free cyanide is a highly toxic compound that interferes with cellular respiration in aquatic organisms. Even at low concentrations, it can cause acute toxicity in macroinvertebrates, leading to population declines and disrupted food web dynamics (DWAF, 1996). No obvious sources of cyanide were noted on site however, raw sewage collected from various locations including industries upstream may leak into the stream.

Chemical Oxygen Demand (COD): COD measures the amount of oxygen required to oxidize organic and inorganic matter in water. High COD levels indicate organic pollution, which depletes oxygen essential for macroinvertebrate

survival. Oxygen stress can lead to a decline in sensitive species and a shift towards more pollution-tolerant organisms (DWAF, 1996). This exceedance is evidence of raw sewage entering into the stream from the pump station.

Oil and Grease: These contaminants create surface films that inhibit gas exchange between water and air. They can also coat macroinvertebrates, impairing mobility, respiration, and feeding. Prolonged exposure often results in mortality or sub-lethal effects, reducing population resilience.

Faecal Coliform Bacteria: These bacteria indicate contamination by faecal matter i.e., sewage leaking from the pump station observed on site and potential pathogens. While they primarily signify health risks to humans, their presence also indicates poor water quality conditions that may indirectly affect macroinvertebrate communities by altering microbial dynamics and increasing disease prevalence (DWAF, 1996).

Free and Saline Ammonia: Ammonia, particularly in its un-ionized form, is highly toxic to aquatic organisms. Elevated levels disrupt nitrogen cycling and can cause physiological stress, gill damage, and mortality in macroinvertebrates, especially in sensitive species.

Copper: Copper is a heavy metal that bioaccumulates in aquatic organisms. It disrupts enzymatic and physiological processes in macroinvertebrates, leading to stress, reduced reproductive success, and mortality. Copper toxicity is particularly harmful to sensitive species, resulting in reduced biodiversity and ecosystem functionality (DWAF, 1996).

5.3. AQUATIC MACROINVERTEBRATES ASSESSMENT (SASS5)

5.3.1. SOUTH AFRICA SCORING SYSTEM (VERSION 5)- SASS5

Due to the shallow and narrow nature of the stream, it was not possible to assign a biotope rating. The available biotopes were limited to sand, gravel, and mud, alongside vegetation biotopes, which could only be sampled concurrently. As a result, a single sample was taken to encompass both biotope types. The stone biotope was notably absent, as this stream serves as an outflow channel from a channelled valley-bottom wetland. Additionally, stone biotopes typically do not occur in the upper reaches of streams, further explaining their absence in this habitat.

SASS5 results can be used to place a river unit into an Ecological Category using the South Africa Scoring System (SASS) Data Interpretation Guidelines (Dallas, 2007). These guidelines use SASS5 Scores and the Average Scores per Taxon (ASPT) to place a sampled river reach into an Ecological Category. The Interpretation Guidelines (Dallas, 2007) use the DWAF (2005) level 1 eco-regions and simplified longitudinal zones as spatial groups for interpreting SASS5 survey outcomes.

The SASS5 spatial group for the assessed reach of the Unnamed Stream (Tributary) is 'Crocodile (west)-Marico. SASS5 results are a function of both instream water conditions and the availability and quality of instream biotopes (biological habitat types). The SASS5 results were therefore interpreted considering both water quality and biotopes available for sampling during the site visit. A site visit was undertaken in December 2024 representing the wet season of the study area. The aquatic macroinvertebrate results for the study are presented in Table 5.

The SASS5 survey results place the assessed reach of the Unnamed Stream (Tributary) into the 'E/F' Ecological Category, which indicates that the instream component of the tributary unit is 'Seriously Modified' (Dallas, 2007). The primary instream river health modification driver can be attributed to water quality at the time of the assessment. This hypothesis is supported by the water quality analysis results in Table 4 which indicates a significant degree of nutrient enrichment. Furthermore, onsite observation of the sewage pump station that leaks into this water resource supports the hypothesis.

The low diversity of species was expected for a water resource this size and type of system. Based on the water quality results and the sampled habitat, the water resources support a low diversity of biota with a low portion of moderately sensitive taxa present. Examples of macroinvertebrates noted during sampling are presented in figure x. Table 6 shows macroinvertebrate families collected during the survey.

TABLE 5: SUMMARY OF SASS5 RESULTS

SASS5 Indices	SASS Score	33
	No. of Taxa	9
	ASPT*	3.67
	SASS5 Derived Ecological Category (Dallas, 2007)	E/F: Seriously Modified

TABLE 6: LIST OF TAXA IDENTIFIED AND ASSOCIATED QUALITY VALUE

Taxon	Quality Value (Sensitivity) (out of 15)
Turbellaria (Flatworms)	3
Annelida: Oligochaeta (Earthworms)	1
Annelida: Hirudinea (Leeches)	3
Megaloptera: Corydalidae	3
Tripchoptera: Hydropsychidae	6
Diptera: Chironomidae	9
Diptera: Ephydriidae	4
Gastropoda: Planorbinae	8
Coleoptera: Psephenidae	10

TABLE 7: KEY QUALITY VALUE SCORE

Quality Value Score Key	
1-5	Highly tolerant to pollution (Low/Very Low Sensitivity taxa)
6-10	Moderately tolerate to pollution (Moderate Sensitivity taxa)
11-15	Intolerant to pollution (High Sensitivity taxa)

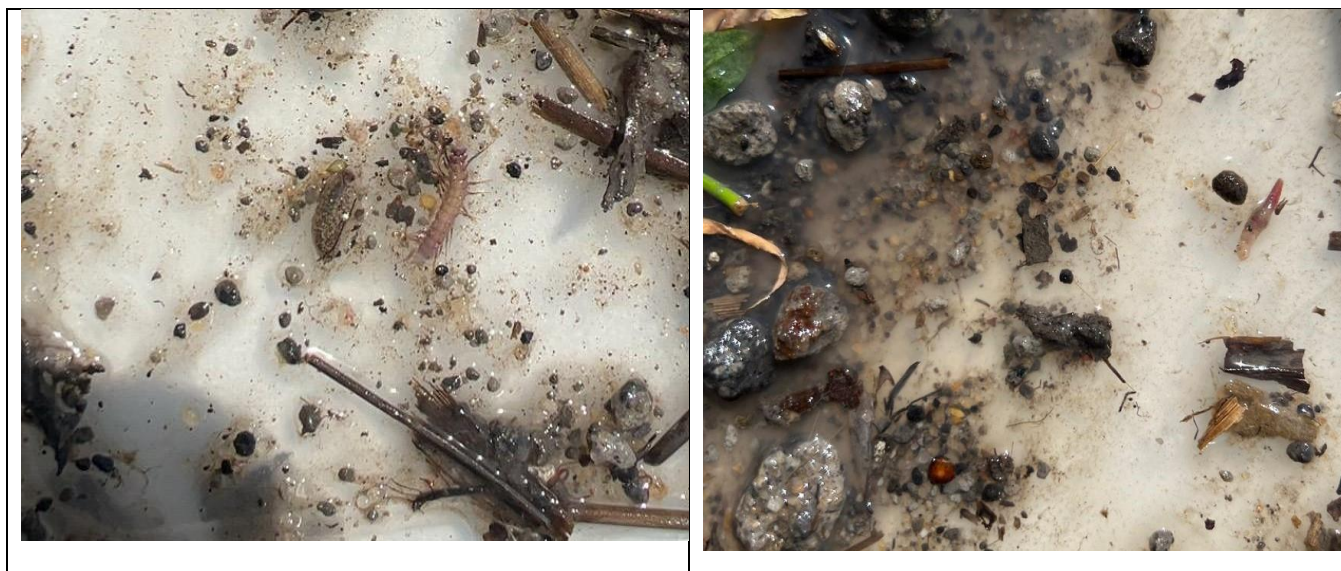


FIGURE 5; EXAMPLE OF SPECIES IDENTIED

5.3.2. MACROINVERTEBRATE RESPONSE INDEX

The Macroinvertebrate Response Assessment Index (MIRAI) methodology was conducted according to Thirion, (2007). Data collected from the SASS5 method was applied to the MIRAI model. The MIRAI model provides a habitat-based cause-and-effect foundation to interpret the deviation of the aquatic invertebrate community (assemblage) from the reference condition (unmodified river).

Results for the site assessed are presented in Table 8.

TABLE 8: MIRAI SCORE FOR THE PROJECT SITE

Invertebrate metric Group	Score
Flow Modification	63.2
Habitat	73
Water quality	29
Ecological score	50
Category	E: Largely Modified

The MIRAI results for the Unnamed Stream (Tributary) reach indicate the reach is Seriously modified (Class E). The main drivers predominantly contributing to the modified state are flow modification and water quality within the reach.

5.4. HABITAT ASSESSMENT

5.4.1. INTERMEDIATE HABITAT INTEGRITY ASSESSMENT

The assessed watercourse is a narrow channel originating from a wetland, characterised by shallow and very low flow conditions. This is attributed to the wetland's natural water retention capacity, compounded by several anthropogenic impacts observed during the onsite assessment. Notable disturbances include the Acacia Road (a gravel road), and an artificial dam located upstream to the east of Acacia Road (see Figure 6). Additionally, infilling activities, particularly creating a berm within the western portion of the freshwater resource, have further contributed to the reduced flow.

The riparian area of the stream has undergone significant modifications due to various developments and the broader urbanization of the surrounding region. Despite these alterations, the stream channel exhibited sections with canopy cover, offering intermittent shading, while other areas remained open. These factors collectively reflect the challenges affecting the habitat integrity of this watercourse. See Figure 7.

We utilized the Index of Habitat Integrity (IHI) model, updated in 2012, in conjunction with the technical manual developed by Kleynhans et al. (2008). The results for the instream and riparian habitat integrity assessment for the Unnamed Stream (tributary) in close proximity to the residential development Project site are presented in Table 9 and Table 10.



FIGURE 6: DAM UPSTREAM OF WATERCOURSE



FIGURE 7: STREAM CHANNEL

TABLE 9: INSTREAM INTEGRITY HABITAT ASSESSMENT RESULTS

Instream IHI		Justification
METRIC GROUP	RATING	
Hydrology modification	1,1	A single artificial dam upstream and road influence the hydrology of the stream
Physico-chemical modification	2	A sewage pump station exists and leaks into the stream. Flow obstruction influences water quality.
Bed modification	1,2	Low instream sedimentation due to upstream activities.
Bank modification	1	Urban developments
Connectivity modification	0	No connectivity modifications
INSTREAM IHI%	77,1	
CATEGORY	C	

TABLE 10: RIPARIAN INDEX OF HABITAT INTEGRITY

Riparian IHI		
METRIC GROUP	RATING	Justification
Hydrology	1	Largely impacted by urban developments and agricultural activities in the area.
Bank structure modification	0,6	Low I large parts of the stream with modifications near road crossing only
Connectivity modification	0,5	-
Riparian habitat integrity (%)	85	
CATEGORY	B	

According to the Instream Habitat Index as shown in Table 9, the unnamed stream assessed was classed as **Moderately Modified** (class C): which indicates loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.

Table 10 shows the results the riparian habitat integrity in the reach was rated as class B, or **Largely Natural**. A small change in natural habitats may have taken place. This is attributable to the urbanisation of the area. However, the ecosystem functions are essentially unchanged.

5.5. PRESENT ECOLOGICAL STATE

The Present Ecological State of the assessed tributary reach is presented in Table 11. The findings of the study were based on a single survey, and therefore the confidence of the findings is moderate. The results indicate that the unnamed stream (Tributary) reach was in a seriously modified state during the survey. This is attributed to the water quality and flow modifications within the reach and modifications to the riparian zone due to urbanisation inputs.

TABLE 11: PRESENT ECOLOGICAL STATE OF THE UNNAMED STREAM REACH

Category	Ecological Category
Habitat integrity Riparian	B
Habitat integrity Instream	C
Macroinvertebrate	E
Eco-Status	D/E: Largely Modified

5.6. ECOLOGICAL IMPORTANCE AND SENSITIVITY

The Ecological Importance of rivers is an expression of the importance of the water resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a watercourse's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007).

For this assessment, river EIS was based on rating the importance and sensitivity of riparian and in-stream biota (including fauna & flora) and habitat using both desktop and on-site indicators. The unnamed stream reach assessed can be classified as Low EIS. The main factors determining the EIS ratings include the following:

- The perennial flow that characterises this stream means that it likely plays host to a range of aquatic fauna that rely on the year-round presence of water for them to survive and breed.
- This stream is tributary to an NFEPA river Jukskei River.
- Due to its prevailing changes during the wet season flow regime, the stream is likely to be moderately sensitive to flow-related changes and changes in water quality.
- Moderate levels of anthropogenic disturbance; and despite disturbances, habitat maintains much of the same functional attributes as areas in a natural/sustainable state.
- No or low probability of Red List and/or protected species as determined by critical habitat assessments.

5.7. RECOMMENDED ECOLOGICAL CATEGORY (REC)

The recommended ecological category (REC) is the target or desired state of resource units that is required to meet water resource management objectives and quality targets. It is determined through the consideration of the PES, EIS and realistic opportunities to improve the PES, driven by context and setting.

The modus operandi followed by DWAF's Directorate: Resource Directed Measures (RDM) is that if the EIS is high or very high, the ecological management objective should be to improve the condition of the river (Kleynhans & Louw, 2007). However, the causes related to PES should also be considered to determine if improvement is realistic

and attainable (Kleynhans & Louw, 2007). This relates to whether the problems in the catchment can be addressed and mitigated (Kleynhans & Louw, 2007).

If the EIS is evaluated as moderate or low, the ecological aim should be to maintain the river in its PES (Kleynhans & Louw, 2007). Within the Ecological Reserve context, Ecological Categories A to D can be recommended as future states depending on the EIS and PES (Kleynhans & Louw, 2007). Ecological Categories E and F PES are regarded as ecologically unacceptable, and remediation is needed if possible (Kleynhans & Louw, 2007). A generic matrix for the determination of RECs and RMOs for water resources is shown in Table 12 below.

TABLE 12: MATRIX FOR THE DETERMINATION OF REC AND RMO FOR WATER RESOURCES (BASED ON KLEYNHANS & LOUW, 2007)

PES		EIS			
		Very High	High	Moderate	Low
A	Pristine/Natural	A: Maintain	A: Maintain	A: Maintain	A: Maintain
B	Largely Natural	A: Improve	A/B: Improve	B: Maintain	B: Maintain
C	Fair	B: Improve	B/C: Improve	C: Maintain	C: Maintain
D	Poor	C: Improve	C/D: Improve	D: Maintain	D: Maintain
E/F	Very Poor	D: Improve	E/F: Improve	E/F: Improve	E/F: Improve

Based on the matrix in Table 12, the minimum recommended management objective (RMO) for the Unnamed Stream tributary is to Improve its PES. This would need to be achieved through the management of localised activities to improve water quality and to prevent both direct and indirect impacts to riparian and instream habitat associated with the system. An important part of achieving this is to incorporate environmentally sustainable design principles into all future developments within the stream catchment. Table 13 summarises the REC for the river reach assessed.

TABLE 13: SUMMARY REC FOR UNNAMED STREAM

River	PES	EIS	REC	RMO
Unnamed Stream	D/E	Low	C/D	Improve

6. IMPACT ASSESSMENT

6.1. FRESHWATER SENSITIVITY VERIFICATION

The protocol for assessing freshwater and aquatic biodiversity, developed to support the Department of Forestry, Fisheries, and Environment (DFFE) (formerly the Department of Environmental Affairs), as part of the National Web-based Environmental Screening Tool (2020), outlines the criteria for assessing and reporting impacts on aquatic and freshwater biodiversity for activities requiring Environmental Authorisation (EA). For the aquatic/freshwater biodiversity theme, these requirements apply to sites with varying levels of biodiversity. The relevant theme in the National Web-based Environmental Screening Tool (2020) is provided by the South African National Biodiversity Institute (SANBI). Based on the site's sensitivity rating, a suitably qualified specialist must prepare the appropriate report or opinion memorandum to be included in the EA application.

According to the guidelines, applicants planning activities on a site identified as having "very high sensitivity" for an aquatic biodiversity theme must submit an Aquatic Biodiversity Impact Assessment. Conversely, if the site is identified as having "low sensitivity," an Aquatic Biodiversity Compliance Statement must be prepared and submitted to the competent authority. However, if a site survey conducted by a qualified freshwater ecologist reveals a sensitivity level different from that assigned by the screening tool—such as identifying a high risk to regional aquatic biodiversity or freshwater ecosystems despite a "low sensitivity" rating, or determining low risks for a site rated as "high sensitivity"—the assessment approach must align with the site survey findings rather than the screening tool's initial classification.

As part of the background information gathering process, the screening tool was utilized to assess the study and investigation areas. The screening tool indicates that the mixed-use development (already constructed) is situated in an area with a **very high aquatic sensitivity**, See Figure 8. This is attributable to the channelled Velly bottom wetland and the fact that the channel is a tributary to the Jukskei River.

Following the site verification conducted by Eco-Sentle, as well as a review of the report by Scientific Terrestrial Services in 2017, the classification of the wetlands as having very high sensitivity, as indicated by the DFFE Screening Tool, is supported and upheld thus not disputed.

Under the Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity, (GN320 of March 2020), for areas of very high aquatic biodiversity sensitivity an Aquatic Biodiversity Assessment must be produced. This report therefore fulfils this requirement.

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	Wetlands_Mesic Highveld Grassland Bioregion (Valley-bottom)

FIGURE 8: AQUATIC BIODIVERSITY SENSITIVITY OF PROJECT AREA (DFFE, SCREENING TOOL)

6.2. RISK ASSESSMENT – IMPACT ASSESSMENT

It is important to note that this report was compiled after construction activities related to the housing project had already taken place. As a result, its focus is limited to assessing the impacts associated with the remaining work required for the development. This primarily pertains to the installation of a stormwater drainage system that encroaches into a watercourse.

6.2.1. PREVIOUS RISK ASSESSMENT- 2017

In 2017, Scientific Terrestrial Services conducted a Freshwater Resource Ecological Assessment as part of the environmental assessment and authorization process for this development. This assessment included a risk analysis of various potential impacts on the identified watercourse (wetland and unnamed stream on-site) associated with the proposed development. All impacts were evaluated as **low** after mitigation measures were implemented. While environmental authorization for the development was obtained, it is important to highlight that this authorization did not include a water use license authorisation (it is stated that WUL must be obtained) for activities within the watercourse. The assessment anticipated four key ecological impacts on freshwater resource:

- Loss of freshwater habitat and ecological structure,
- Changes to sociocultural values and service provision,
- Impacts on hydrology and sediment balance, and
- Impacts on water quality

6.2.2. AQUATIC ECOLOGY ASSESSMENT

As part of this assessment, following assessment of the aquatic ecology of the freshwater resource (i.e., the Unnamed stream – tributary) and the wetland associated with the housing project, the DWS Prescribed Risk Assessment Matrix (2023) was utilized to evaluate the significance of anticipated impacts (of the outstanding works) on the primary drivers and receptors of this freshwater ecosystem, including hydrology, water quality, geomorphology, habitat, and biota.

Three key ecological impacts on the wetlands are anticipated, namely:

- Loss of wetland habitat and ecological structure,
- Disruptions to the hydrology and sediment balance of freshwater ecosystems, and
- Degradation of water quality.

A summary of the DWS Risk Assessment Matrix applied to the outstanding works of the project activities, is provided in Table 14 below. The following considerations undertaken when applying the DWS Risk Assessment Matrix (2023):

- The outstanding activities fall within the GN 4167 500m Zone of Regulation (ZoR) as per the National Water Act, 1998 (Act No. 36 of 1998), for freshwater ecosystems. Consequently, all legal aspects related to activities impacting freshwater ecosystems were assigned a score of “5.”
- The DWS Risk Assessment Matrix (2023) was applied under the assumption that a high level of mitigation would be implemented. Therefore, the results presented in this report reflect the perceived significance of impacts after mitigation.
- While the operation of the proposed development will be a permanent activity, construction is expected to take only a few months to a year. However, construction impacts may occur daily during this period.

TABLE 14: DWS RISK ASSESSMENT FOR OUTSTANDING WORKS

Phase	Activity	Impact	Severity	Consequence	Likelihood	Significance	Overall Risk Rating	Mitigation
Construction	The use of construction vehicles and heavy equipment onsite during the construction phase	Compaction of soils within sensitive habitat leading to loss of biodiversity and altered hydrological functioning.	7	15	40	6	L	Exposed soil, including topsoil, must be safeguarded throughout the construction phase using an appropriate geotextile material (e.g., Geojute or hessian sheeting) to prevent erosion and sedimentation of the freshwater ecosystem.
		Water quality impacts resulting from fluid leaks from poorly serviced vehicles.	7	15	40	6	L	
	Construction of stormwater pond, swales and other stormwater infrastructure Within the wetlands and the 30m GDARD	Disturbance and exposure of soil leading to increased runoff and erosion, and thus increased sedimentation of the Unchanneled Stream - tributary Increased sedimentation of the wetland, leading to smothering of vegetation associated with the wetlands.	7	15	40	6	L	The proponent is encouraged to incorporate Sustainable Drainage Systems (SuDS) principles into the design of the proposed development to manage stormwater during the operational phase. Implementing SuDS features, such as bioswales alongside attenuation ponds, will help mitigate significant impacts on the wetlands' hydrological functioning, reduce the risk of flooding during periods of high flow, and minimize the potential for increased erosion. Additionally, vegetated swales planted with indigenous wetland or riparian species can aid in water polishing, trapping hydrocarbons from road runoff before the water is discharged into the wetlands. Incorporating swales or similar attenuation features to ensure a diffuse outflow of stormwater into GDARD setback areas is critical. These measures replicate the natural subsurface and surface inflows that will be altered by the proposed development, thereby helping to maintain the hydrology of

		The proliferation of alien and/or invasive vegetation as a result of disturbances; and Ground disturbances and dust pollution during construction which may impact on water quality.	7	14	40	6	L	the downgradient seep wetland. The following considerations are essential for constructing the development in alignment with SuDS principles.
Operation	Operation of the stormwater infrastructure and service infrastructure	Flow concentration and potentially erosion at concentration points i.e. swales and other stormwater infrastructure; and Altered runoff patterns and increased water inputs to the wetlands, resulting in altered flow regime and subsequent impacts on the wetland vegetation.	10	20	40	8	L	Conduct regular maintenance to prevent system failures. Develop and implement an emergency response plan for potential emergencies. Restrict vehicle movement during maintenance and repairs to existing roadways only, avoiding any unnecessary disturbance within the freshwater ecosystem.
	Increased impermeable surfaces in the vicinity of the watercourse and the catchment.	Decreased infiltration and increased surface runoff from impervious surfaces, Increased water inputs to the freshwater environment at unnatural rates. Impacted soil and water quality condition within the wetland; Potential change in wetland hydrograph due to modified surrounding landscape.	10	20	60	12	L	A stormwater management plan must be integrated into the design of the development. The discharge of stormwater into the freshwater environment must be managed to prevent further bank incision or erosion and should be released in a diffused manner. It is strongly recommended that the principles of Sustainable Urban Drainage Systems (SUDs) be incorporated into the stormwater management plan for the development.

The outstanding construction and operational activities related to the Housing development are assessed as having a **"Low"** risk significance to the Channelled valley bottom wetland as well as the aquatic ecology of the associated unnamed stream (tributary), provided that all mitigation measures outlined in the table above are implemented. These measures are essential to prevent edge effects and cumulative impacts on the freshwater ecosystems within the proposed development and the investigation area.

7. CONCLUSION

A desktop and field assessment were undertaken for the Unnamed Stream. Based on the field assessment and PES attributes assessed the PES of the Stream reach was category D/E: Largely Modified. The dominant impacts to the onsite watercourse were instream water quality and riparian vegetation impacts.

Based on the current integrity and functional importance/sensitivity of the river reach, the recommended management objectives for this resource should be to improve the present condition and ecological functioning of the system with limited to no further biodiversity loss because of this proposed upgrade. The Recommended Ecological Category was identified as C/D improvement.

Following the Aquatic ecological site assessment, the Department of Water and Sanitation (DWS) Risk Assessment Matrix (2023) was applied to evaluate the significance of potential impacts from the outstanding works on the receiving freshwater environment. The risk assessment determined that activities during the construction and operational phases pose a "Low" risk to the wetland associated with the development.

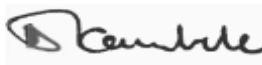
To minimize further degradation of the freshwater resource, it is crucial to adhere to well-planned, ecologically sensitive site development strategies, implement the mitigation measures outlined in this report, and follow general good construction practices. Additionally, ongoing management, maintenance, and monitoring are essential to reduce the significance of perceived impacts and safeguard the freshwater ecosystem.

Based on the study's findings, the freshwater ecologist's professional opinion is that the remaining construction activities can be deemed acceptable, provided robust stormwater management designs are implemented and general good construction practices are adhered to.

8. REFERENCES

- Council for Scientific and Industrial Research. NFEPA river FEPAs, 2011. Available from the Biodiversity GIS website, downloaded on 23 February 2023
- CSIR (Council for Scientific and Industrial Research). 2010. National Freshwater Ecosystem Priority Areas (NFEPA). Council for Scientific and Industrial Research, Pretoria, South Africa
- Dallas, H.F. 2007. River Health Programme: South African Scoring System (SASS) Data Interpretation Guidelines. Report produced for the Department of Water Affairs and Forestry (Resource Quality Services) and the Institute of Natural Resources.
- Department of Water and Sanitation (DWS). 1996. South African Water Quality Guidelines. Volume 7: Aquatic Ecosystems. Department of Water Affairs and Forestry, Pretoria.
- Department of Water and Sanitation (DWS). 2005. River Ecoclassification: Manual for Ecstatus Determination. First Draft for Training Purposes. Department of Water Affairs and Forestry.
- Dickens, C. W. S. and Graham, P.M. 2002. The South African Scoring System (SASS) Version 5: Rapid bioassessment method for rivers. *African Journal of Aquatic Science*. 27 (1): 1 -10.
- Kleynhans, C. J. 1996. A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River (Limpopo System, South Africa). *Journal of Aquatic Ecosystem Health* 5:41-54.
- Kleynhans CJ, Louw MD, Graham M, 2008. Module G: EcoClassification and EcoStatus determination in River EcoClassification: Index of Habitat Integrity (Section 1, Technical manual) Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 377-08
- Kleynhans CJ, Louw MD, Graham M, 2008. Module G: EcoClassification and EcoStatus determination in River EcoClassification: Index of Habitat Integrity (Section 1, Technical manual) Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 377-08
- Thirion, C. 2007. Module E: Macroinvertebrate Response Assessment Index in River EcoClassification: Manual for EcoStatus Determination (version 2). Joint Water Research Commission and Department of Water Affairs and Forestry report. WRC Report No. TT 332/08

9. ANNEXURE 1: WATER QUALITY CERTIFICATE

		WATERLAB (Pty) Ltd Reg. No.: 1983/0010507 V.A.T. No.: 4130107891		 T0391																																																																																																																																																																																														
23B De Havilland Crescent Perseus Techno Park Meiring Naudé Drive Pretoria		P.O. Box 283, Perseus Park, 0020 Tel: +2712 - 349 - 1066 Fax: +2786 - 654 - 2570 e-mail: admin@waterlab.co.za																																																																																																																																																																																																
CERTIFICATE OF ANALYSES																																																																																																																																																																																																		
GENERAL WATER QUALITY PARAMETERS																																																																																																																																																																																																		
Date received: 2024-12-09 Project number: 1000		Report number: 139077		Date completed: 2025-01-09 Order number:																																																																																																																																																																																														
Client name: Eco Sentle Address: 49 Birchwood Village, Chartwell, Fourways 2055 Telephone: 083 537 0424		Contact person: Mr. M. Magala e-mail: musa@ecosentle.co.za Mobile: 083 537 0424																																																																																																																																																																																																
<table border="1"><thead><tr><th rowspan="2">Analysis in mg/l (Unless specified otherwise)</th><th rowspan="2">UOM %</th><th rowspan="2">Method ID</th><th colspan="2">Wastewater Discharge Limits *</th><th>Sample Identification</th></tr><tr><th>General Limits*</th><th>Special Limits*</th><th>Blue Hills</th></tr></thead><tbody><tr><td>Sample Number</td><td></td><td></td><td></td><td></td><td>24-30335</td></tr><tr><td>Date/Time Sampled</td><td></td><td></td><td></td><td></td><td>N/A</td></tr><tr><td>pH - Value @ 25 °C</td><td>A</td><td>7.7</td><td>WLAB065</td><td>5.5-9.5</td><td>5.5-7.5</td><td>7.3</td></tr><tr><td>Electrical Conductivity in mS/m @ 25°C</td><td>A</td><td>7.0</td><td>WLAB065</td><td>---</td><td>---</td><td>81.2</td></tr><tr><td>Suspended Solids at 105°C</td><td>A</td><td>8.6</td><td>WLAB054</td><td><25</td><td><10</td><td>31</td></tr><tr><td>Free Residual Chlorine as Cl₂</td><td>N</td><td>---</td><td>WLAB036</td><td><0.25</td><td>0</td><td><0.1</td></tr><tr><td>Fluoride as F</td><td>A</td><td>6.7</td><td>WLAB014</td><td><1</td><td><1</td><td>0.2</td></tr><tr><td>Nitrate as N</td><td>A</td><td>4.8</td><td>WLAB046</td><td>#</td><td>#</td><td><0.1</td></tr><tr><td>Nitrite as N</td><td>A</td><td>3.0</td><td>WLAB046</td><td>#</td><td>#</td><td>0.1</td></tr><tr><td>Ortho Phosphate as P</td><td>A</td><td>14</td><td>WLAB046</td><td><10</td><td>---</td><td>3.9</td></tr><tr><td>Free Cyanide as CN</td><td>S</td><td>---</td><td>---</td><td><0.02</td><td><0.01</td><td>0.049</td></tr><tr><td>Chemical Oxygen Demand as O₂ (Total)</td><td>A</td><td>5.6</td><td>WLAB018</td><td><75</td><td><30</td><td>96</td></tr><tr><td>Oil & Grease</td><td>A</td><td>---</td><td>WLAB034</td><td><2.5</td><td>0</td><td>18</td></tr><tr><td>Faecal Coliform Bacteria (MPN/100 ml)</td><td>A</td><td>5.3</td><td>WLAB021</td><td><1000</td><td>0</td><td>>100000</td></tr><tr><td>Free and Saline Ammonia as N</td><td>A</td><td>10</td><td>WLAB046</td><td><6</td><td><2</td><td>33</td></tr><tr><td>Arsenic as As (Dissolved)</td><td>A</td><td>9.6</td><td>WLAB050</td><td><0.02</td><td><0.01</td><td>0.002</td></tr><tr><td>Boron as B</td><td>A</td><td>9.7</td><td>WLAB015</td><td><1</td><td><0.5</td><td><0.025</td></tr><tr><td>Cadmium as Cd (Dissolved)</td><td>A</td><td>8.5</td><td>WLAB050</td><td><0.005</td><td><0.001</td><td><0.001</td></tr><tr><td>Hexavalent Chromium as Cr</td><td>A</td><td>3.2</td><td>WLAB032</td><td><0.05</td><td><0.02</td><td><0.010</td></tr><tr><td>Copper as Cu (Dissolved)</td><td>N</td><td>---</td><td>WLAB050</td><td><0.01</td><td><0.002</td><td>0.029</td></tr><tr><td>Iron as Fe (Dissolved)</td><td>A</td><td>8.1</td><td>WLAB015</td><td><0.3</td><td><0.3</td><td>0.271</td></tr><tr><td>Lead as Pb (Dissolved)</td><td>A</td><td>9.7</td><td>WLAB050</td><td><0.01</td><td><0.006</td><td>0.001</td></tr><tr><td>Manganese as Mn (Dissolved)</td><td>A</td><td>8.3</td><td>WLAB015</td><td><0.1</td><td><0.1</td><td>0.048</td></tr><tr><td>Mercury as Hg</td><td>A</td><td>16</td><td>WLAB050</td><td><0.005</td><td><0.001</td><td><0.001</td></tr><tr><td>Selenium as Se (Dissolved)</td><td>A</td><td>9.4</td><td>WLAB050</td><td><0.02</td><td><0.02</td><td><0.001</td></tr><tr><td>Zinc as Zn (Dissolved)</td><td>A</td><td>8.0</td><td>WLAB015</td><td><0.1</td><td><0.04</td><td><0.025</td></tr></tbody></table>						Analysis in mg/l (Unless specified otherwise)	UOM %	Method ID	Wastewater Discharge Limits *		Sample Identification	General Limits*	Special Limits*	Blue Hills	Sample Number					24-30335	Date/Time Sampled					N/A	pH - Value @ 25 °C	A	7.7	WLAB065	5.5-9.5	5.5-7.5	7.3	Electrical Conductivity in mS/m @ 25°C	A	7.0	WLAB065	---	---	81.2	Suspended Solids at 105°C	A	8.6	WLAB054	<25	<10	31	Free Residual Chlorine as Cl ₂	N	---	WLAB036	<0.25	0	<0.1	Fluoride as F	A	6.7	WLAB014	<1	<1	0.2	Nitrate as N	A	4.8	WLAB046	#	#	<0.1	Nitrite as N	A	3.0	WLAB046	#	#	0.1	Ortho Phosphate as P	A	14	WLAB046	<10	---	3.9	Free Cyanide as CN	S	---	---	<0.02	<0.01	0.049	Chemical Oxygen Demand as O ₂ (Total)	A	5.6	WLAB018	<75	<30	96	Oil & Grease	A	---	WLAB034	<2.5	0	18	Faecal Coliform Bacteria (MPN/100 ml)	A	5.3	WLAB021	<1000	0	>100000	Free and Saline Ammonia as N	A	10	WLAB046	<6	<2	33	Arsenic as As (Dissolved)	A	9.6	WLAB050	<0.02	<0.01	0.002	Boron as B	A	9.7	WLAB015	<1	<0.5	<0.025	Cadmium as Cd (Dissolved)	A	8.5	WLAB050	<0.005	<0.001	<0.001	Hexavalent Chromium as Cr	A	3.2	WLAB032	<0.05	<0.02	<0.010	Copper as Cu (Dissolved)	N	---	WLAB050	<0.01	<0.002	0.029	Iron as Fe (Dissolved)	A	8.1	WLAB015	<0.3	<0.3	0.271	Lead as Pb (Dissolved)	A	9.7	WLAB050	<0.01	<0.006	0.001	Manganese as Mn (Dissolved)	A	8.3	WLAB015	<0.1	<0.1	0.048	Mercury as Hg	A	16	WLAB050	<0.005	<0.001	<0.001	Selenium as Se (Dissolved)	A	9.4	WLAB050	<0.02	<0.02	<0.001	Zinc as Zn (Dissolved)	A	8.0	WLAB015	<0.1	<0.04	<0.025
Analysis in mg/l (Unless specified otherwise)	UOM %	Method ID	Wastewater Discharge Limits *		Sample Identification																																																																																																																																																																																													
			General Limits*	Special Limits*	Blue Hills																																																																																																																																																																																													
Sample Number					24-30335																																																																																																																																																																																													
Date/Time Sampled					N/A																																																																																																																																																																																													
pH - Value @ 25 °C	A	7.7	WLAB065	5.5-9.5	5.5-7.5	7.3																																																																																																																																																																																												
Electrical Conductivity in mS/m @ 25°C	A	7.0	WLAB065	---	---	81.2																																																																																																																																																																																												
Suspended Solids at 105°C	A	8.6	WLAB054	<25	<10	31																																																																																																																																																																																												
Free Residual Chlorine as Cl ₂	N	---	WLAB036	<0.25	0	<0.1																																																																																																																																																																																												
Fluoride as F	A	6.7	WLAB014	<1	<1	0.2																																																																																																																																																																																												
Nitrate as N	A	4.8	WLAB046	#	#	<0.1																																																																																																																																																																																												
Nitrite as N	A	3.0	WLAB046	#	#	0.1																																																																																																																																																																																												
Ortho Phosphate as P	A	14	WLAB046	<10	---	3.9																																																																																																																																																																																												
Free Cyanide as CN	S	---	---	<0.02	<0.01	0.049																																																																																																																																																																																												
Chemical Oxygen Demand as O ₂ (Total)	A	5.6	WLAB018	<75	<30	96																																																																																																																																																																																												
Oil & Grease	A	---	WLAB034	<2.5	0	18																																																																																																																																																																																												
Faecal Coliform Bacteria (MPN/100 ml)	A	5.3	WLAB021	<1000	0	>100000																																																																																																																																																																																												
Free and Saline Ammonia as N	A	10	WLAB046	<6	<2	33																																																																																																																																																																																												
Arsenic as As (Dissolved)	A	9.6	WLAB050	<0.02	<0.01	0.002																																																																																																																																																																																												
Boron as B	A	9.7	WLAB015	<1	<0.5	<0.025																																																																																																																																																																																												
Cadmium as Cd (Dissolved)	A	8.5	WLAB050	<0.005	<0.001	<0.001																																																																																																																																																																																												
Hexavalent Chromium as Cr	A	3.2	WLAB032	<0.05	<0.02	<0.010																																																																																																																																																																																												
Copper as Cu (Dissolved)	N	---	WLAB050	<0.01	<0.002	0.029																																																																																																																																																																																												
Iron as Fe (Dissolved)	A	8.1	WLAB015	<0.3	<0.3	0.271																																																																																																																																																																																												
Lead as Pb (Dissolved)	A	9.7	WLAB050	<0.01	<0.006	0.001																																																																																																																																																																																												
Manganese as Mn (Dissolved)	A	8.3	WLAB015	<0.1	<0.1	0.048																																																																																																																																																																																												
Mercury as Hg	A	16	WLAB050	<0.005	<0.001	<0.001																																																																																																																																																																																												
Selenium as Se (Dissolved)	A	9.4	WLAB050	<0.02	<0.02	<0.001																																																																																																																																																																																												
Zinc as Zn (Dissolved)	A	8.0	WLAB015	<0.1	<0.04	<0.025																																																																																																																																																																																												
 A. van de Wetering - Chemical Technical Signatory			 M. Nkambule - Microbiological Technical Signatory																																																																																																																																																																																															
Start date of analysis: 2024/12/10 Date of Issue: 2025/01/10																																																																																																																																																																																																		
A = Accredited N = Not Accredited S = Subcontracted UMP = Uncertainty Of Measurement Tests marked "Not SANAS Accredited" in this report are not included in the SANAS Scope of Accreditation for this Laboratory. Results marked "Subcontracted Test" in this report are not included in the SANAS Scope of Accreditation for this Laboratory. Sample condition acceptable unless specified on the report. Microbiological standards dictate that zero cannot be reported in cases where no growth is observed. The requirement is to then report as <1cfu/g or ml. A result of <1 implies the absence of the specific test organism and is the lowest reportable result where no growth was detected. The information contained in this report is relevant only to the sample/sample supplied to WATERLAB (Pty) Ltd. This report, or any parts of this report, shall not be reproduced by any means, except with the written approval of the Board of WATERLAB (Pty) Ltd. Details of sample conducted by Waterlab (PTY) Ltd according to WLAB/Sampling Plan and Procedure/SOP are available on request.																																																																																																																																																																																																		
Bact. analyses analysed on: 2024-12-09		Sampled by: Client		Page 1 of 2																																																																																																																																																																																														

10. ANNEXURE 2: SPECIALIST DETAILS

Eco-Sentle (PTY)LTD Specialist Details

Curriculum Vitae of Musa Magala

Cell: +27 83 537 0424 | Email: musa@ecosentle.co.za

Address: 29 Swallowtail St, Little falls, Johannesburg, South Africa

PROFESSIONAL PROFILE

I am a positive and hardworking individual with a proven track record of delivering on commitments to the highest standard possible. With over 8 years of experience in undertaking aquatic ecological assessments and terrestrial biodiversity assessments, I have developed a deep understanding of the complexities and nuances involved in environmental impact assessments. I hold a B.Sc. and B.Sc. Honours degree in Natural Sciences from the University of Limpopo and an M.Sc. in Aquatic Health from the University of Johannesburg.

As a specialist in Aquatic Ecology, I conduct comprehensive evaluations of freshwater ecosystems, assessing water quality, habitat conditions, and the health of aquatic organisms. This involves the identification and analysis of biological and chemical indicators to determine the ecological status and potential impacts of environmental changes or human activities. In the realm of Terrestrial Biodiversity and Ecology, my work focuses on assessing the variety and abundance of species in terrestrial habitats, evaluating the impacts of developments on these ecosystems, and devising strategies for biodiversity conservation and management. This includes conducting field surveys, habitat mapping, and ecological modeling to predict and mitigate the effects of land-use changes, infrastructure projects, and other anthropogenic activities.

SKILLS & COMPETENCES

- **Species Identification:** Ability to accurately identify various species of plants, animals, and microorganisms in both aquatic and terrestrial environments.
- **Ecological Surveying:** Proficiency in conducting field surveys to assess biodiversity, including methods like transects, quadrats, and remote sensing.
- **Data Analysis:** Skilled in analysing ecological data using statistical software to interpret biodiversity trends and patterns.
- **GIS and Mapping:** Competence in Geographic Information Systems (GIS) to create and interpret maps that display ecological data and biodiversity distributions.
- **Habitat Assessment:** Expertise in evaluating the quality and health of different habitats to determine their suitability for various species.
- **Aquatic Assessment:** Expertise in assessing the health and quality of aquatic ecosystems, including water quality testing and aquatic species monitoring.

- Understanding of South Africa's National Environmental Regulations: Knowledge of South Africa's environmental laws and regulations related to terrestrial biodiversity, including the National Environmental Management: Biodiversity Act (NEMBA).
- Knowledge of the South African Water Act: Familiarity with the National Water Act of South Africa, including regulations on water resource management, protection, and sustainable use.
- **Conservation Planning:** Ability to develop and implement conservation strategies aimed at protecting and restoring biodiversity.
- **Field Sampling Techniques:** Knowledge of various sampling techniques for collecting biological, chemical, and physical data from different environments.
- **Environmental Impact Assessment:** Skilled in assessing the potential impacts of development projects on biodiversity and recommending mitigation measures.

WORK EXPERIENCE

Eco-Sentle (Pty) Ltd

1. Biodiversity Assessments

- Conduct comprehensive field surveys and ecological assessments for various aquatic and terrestrial habitats.
- Identify, classify, and map species, communities, and ecosystems.
- Monitor biodiversity and ecosystem health through regular sampling and data collection.

2. Impact Assessments

- Perform Environmental Impact Assessments (EIA) and Biodiversity Impact Assessments (BIA) for development projects.
- Evaluate potential impacts of proposed developments on local biodiversity and ecosystems.
- Prepare detailed reports and recommendations to mitigate negative impacts on biodiversity.

3. Data Analysis and Reporting

- Analyze ecological data using statistical tools and geographic information systems (GIS).
- Produce high-quality technical reports, maps, and presentations to communicate findings to clients, stakeholders, and regulatory authorities.
- Ensure data integrity and maintain comprehensive records of all assessments.

4. Regulatory Compliance

- Stay updated with local, national, and international biodiversity regulations and guidelines.
- Ensure all projects comply with relevant environmental laws and policies.
- Liaise with regulatory bodies to obtain necessary permits and approvals.

5. Client and Stakeholder Engagement

- Collaborate with clients to understand their needs and project goals.
- Communicate findings and recommendations to clients, stakeholders, and the public.
- Develop and maintain strong relationships with key stakeholders, including government agencies, non-governmental organizations, and community groups.

6. Project Management

- Plan, coordinate, and manage biodiversity assessment projects from inception to completion.
- Develop project scopes, timelines, and budgets.

- Oversee field teams and subcontractors to ensure high-quality and timely delivery of services.

7. Mitigation and Conservation Planning

- Develop and implement biodiversity management and conservation plans.
- Design and recommend mitigation measures to minimize project impacts on biodiversity.
- Monitor the effectiveness of mitigation measures and adapt them as necessary.

The Biodiversity Consultancy (United Kingdom)

In this role, my duties were to support clients identify, measure, and manage their biodiversity footprint and risks to the business as well as integrate biodiversity strategies to existing carbon reduction and ESG programmes as they transit their organizations in response to changing sustainability environment and new trends in sustainability management and Reporting.

Core responsibilities and skills include the following:

- Supported clients in identifying, measuring, and managing their biodiversity footprint and risks.
- Integrated biodiversity strategies with existing carbon reduction and ESG programmes.
- Conducted biodiversity footprinting using tools like the Global Biodiversity Score (GBS).
- Performed biodiversity footprint assessments, policy reviews, KPI development, and action planning.
- Benchmarked client positioning against ESG & biodiversity standards.
- Developed biodiversity strategies and set carbon and biodiversity targets using SBTN & SBTI.
- Assisted clients in understanding TCFD & TNFD requirements.
- Conducted biodiversity impact assessments and ESG due diligence.
- Supported clients in understanding responsible sourcing and certifications.

Environmental Impact Management Services (PTY) LTD – Environmental Consultant

2013 – 2017 In this role I provided expert assessment and advisory services on matters pertaining to the management of Environmental and Social issues.

Core responsibilities and skills include the following:

- Provided expert assessment and advisory services on environmental and social issues.
- Executed both field and desk-based scientific research.
- Produced detailed scientific reports for non-technical audiences.
- Conducted Environmental Assessments to identify risks and monitored compliance.
- Liaised with regulatory bodies regarding environmental issues.
- Conducted Specialist Aquatic Assessments including ecological and water quality assessments.
- Applied environmental legislation across various sectors such as mining, construction, and infrastructure development.

University of Limpopo – Junior Laboratory Assistant

2011 –2012 Core responsibilities and skills include the following:

- Guiding undergraduate students through their practical modules, ensuring they adhere to lab procedures.

- Providing academic assistance.
- Performing basic chemical and biological experiments and following laboratory procedures. Preparing and cleaning of apparatus and glassware.
- Trained and mentored undergraduate students applying strong listening and the ability to provide clear instructions.

Key Projects

Basil Read

Role: Lead Environmental Monitoring Officer

Project: Olifants River Water Resources Development Project

Details: Managed the bulk water transfer scheme in Steelpoort, ensuring compliance with environmental regulations and conducting regular environmental monitoring to assess the impact of the project on local ecosystems.

Tetra 4 (PTY) LTD

Role: Senior Environmental Consultant

Project: Helium and Methane Gas Exploration

Location: Virginia, Free State Province

Details: Conducted comprehensive baseline assessments of surface water and groundwater quality to support the exploration project, providing critical data for environmental impact evaluations.

Mooiplaats

Role: Senior Environmental Consultant

Project: Environmental Due Diligence for Underground Coal Mine

Location: Near Ermelo, Mpumalanga Province

Details: Led the environmental due diligence process for the Mooiplaats underground coal mine, assessing potential environmental impacts and ensuring regulatory compliance.

Uniper & Fortum

Role: Senior Consultant

Project: Biodiversity Footprint Assessment and Strategy Development

Details: Evaluated existing governance processes for managing biodiversity, defined the biodiversity footprint, and established prioritization and target-setting protocols to enhance biodiversity conservation efforts.

Ørsted

Role: Senior Consultant

Project: Materiality and Upstream Value Chain Assessment

Details: Conducted materiality assessments and upstream value chain assessments, supporting the Global Biodiversity Score (GBS) assessment for biodiversity footprinting.

Richemont

Role: Consultant

Project: Biodiversity Impact Assessment and Target Setting

Details: Assisted the luxury fashion brand in understanding its biodiversity impact and developing actionable biodiversity targets to promote sustainable practices.

Philip Morris

Role: Consultant

Project: Biodiversity Impact Assessment, Strategy, and Target Development

Details: Conducted assessments to identify the biodiversity impact of operations and developed strategic initiatives and targets for biodiversity conservation.

Princess Housing Development

Role: Consultant

Project: Wetland Ecological and Impact Assessment

Details: Performed wetland ecological assessments and impact evaluations to secure environmental authorization for the housing development project.

Moreleta River, Pretoria

Role: Consultant

Project: Aquatic Ecological Assessment

Details: Conducted an aquatic ecological assessment to guide the rehabilitation of a bulk water pipeline, ensuring minimal environmental disruption.

PRASA Moses Mabida Station

Role: Consultant

Project: Terrestrial Biodiversity Assessment

Details: Conducted a terrestrial biodiversity assessment to facilitate the re-installation of a boundary fence, ensuring compliance with environmental standards.

Clayville	Housing	Development
Role:		Consultant

Project:	Wetland Delineation and Impact Assessment
-----------------	--

Details: Conducted wetland delineation and impact assessments to support the housing

development project, ensuring adherence to environmental regulations.

EDUCATION

- **Master of Science (M.Sc.): Aquatic Health** - University of Johannesburg.
- **Bachelor of Science Honours: Environmental Management** - University of Limpopo.
- **Bachelor of Science: Environmental Science** - University of Limpopo.

Other Training

- **IFC:** Environmental and Social Risk Management
- **IFC:** ESG Due Diligence for Private Equity – Performance Standards
- **TCFD:** Understanding the recommendations of Task Force on Climate Disclosures
- **EY:** Long-term Value Framework
- **EY:** ESG and Investing
-

Relevant Coursework of Qualifications

- Functional Freshwater and Wetland Ecology
- Water Quality Assessment and Management (Biological and Chemical) - Eco-Classification
- Integrated Water Resources Management
- Wetlands Assessment and Delineations
- Estuaries and Marine Environment Ecology
- Environmental Law Related to Water (NEMA & NWA)
- Wetland and River Management
- Biodiversity Management
- Environmental Ecology
- Parasitology
- Wildlife Management
- Freshwater Ecology & Management

11. ANNEXURE 2.1: SACNSP REGISTRATION

