SECTION F: APPENDICES

APPENDIX A. WETLAND HABITAT ASSESSMENT REPORT

APPENDIX A1. MOTIVATION FOR OTHER SPECIALIST ASSESSMENTS

APPENDIX B. COMMENTS AND RESPONSE TABLE

APPENDIX C. LAYOUT

APPENDIX D. SITE PHOTOS

APPENDIX E. PUBLIC PARTICIPATION

APPENDIX F. ENVIRONMENTAL MANAGEMENT PROGRAMME

APPENDIX G. STORM WATER MANAGEMENT PLAN

APPENDIX H. ENGINEERING PLANS, STORMWATER, SEWER AND ROADS

APPENDIX I. ENGINEERING PLANS, CROSS SECTION PLANS

APPENDIX J. DECLARATIONS AND CV'S OF EAP AND SPECIALISTS

APPENDIX A. WETLAND HABITAT ASSESSMENT REPORT

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DESKTOP WETLAND HABITAT ASSESSMENT

Proposed Establishment of Commercial Land Based Freshwater Fish Farm at Qhubu Lake, Eskhawini, Umhlathuze Local Municipality, KwaZulu-Natal

7 June 2019

Prepared by:
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SPECIALIST DECLARATION (LEAD AUTHOR)

I, **Brian Mafela,** declare that -

- I act as the independent specialist in this matter;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I performed the work relating to the application in an objective manner, even if it results in views and findings that are not favourable to the applicant;
- I declare that there were no circumstances that compromised my objectivity in performing such work;
- I have expertise in conducting the specialist assessment relevant to this application, including knowledge of the National Environmental Management Act (Act 107 of 1998) (NEMA), regulations and any guidelines that have relevance to the proposed activity;
- I comply with the NEMA Act, regulations and all other applicable legislation; and
- I disclosed 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 report are true and correct.
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub-regulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B (1) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Brian Mafela

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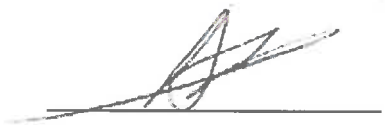
SPECIALIST DECLARATION (CO-AUTHOR)

I, **Andrew Briggs,** declare that -

- I act as the independent specialist in this matter;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I performed the work relating to the application in an objective manner, even if it results in views and findings that are not favourable to the applicant;
- I declare that there were no circumstances that compromised my objectivity in performing such work;
- I have expertise in conducting the specialist assessment relevant to this application, including knowledge of the National Environmental Management Act (Act 107 of 1998) (NEMA), regulations and any guidelines that have relevance to the proposed activity;
- I comply with the NEMA Act, regulations and all other applicable legislation; and
- I disclosed 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 report are true and correct.
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub-regulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B (1) of the National Environmental Management Act, 1998 (Act 107 of 1998).



Andrew Briggs

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SPECIALIST DECLARATION (INTERNAL REVIEWER)

I, **Leigh-Ann de Wet** declare that -

- I act as the independent specialist in this matter;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I performed the work relating to the application in an objective manner, even if it results in views and findings that are not favourable to the applicant;
- I declare that there were no circumstances that compromised my objectivity in performing such work;
- I have expertise in conducting the specialist assessment relevant to this application, including knowledge of the National Environmental Management Act (Act 107 of 1998) (NEMA), regulations and any guidelines that have relevance to the proposed activity;
- I comply with the NEMA Act, regulations and all other applicable legislation; and
- I disclosed 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 report are true and correct.
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub-regulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B (1) of the National Environmental Management Act, 1998 (Act 107 of 1998).

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EXECUTIVE SUMMARY

Afzelia Environmental Consultants was appointed by 18Phando Environmental Consulting on behalf of the Madlankala Primary Co-operative (Developer) to undertake a Desktop Wetland Habitat Assessment for a proposed commercial land based freshwater fish farm at Qhubu Lake situated about 10km south-west of Richards Bay, KwaZulu-Natal. The developer is planning to establish a Recirculating Aquaculture System (RAS) for the rearing of Mozambique Tilapia (*Oreochromis moccambicus*) for human consumption. The RAS is a common system for intensively farming aquatic species capable of producing optimal output on a small footprint. Three site alternatives (approx. 2100m^2 each) all located on the south-eastern shores of Qhubu Lake were considered.

The proposed site alternatives are located within Maputaland Coastal Belt vegetation type with provincial threat status of Endangered and some distance from an Alluvial Wetlands: Subtropical Alluvial Vegetation: Lowveld Floodplain Grassland which has a threat status of Critically Endangered.

Qhubu Lake likely habours four fish species considered Near Threatened. These include *Anguilla bengalensis, Anguilla bicolor, Aplocheilichthys myaposae* and *Oreochromis mossambicus*. Any impacts to Qhubu Lake are therefore undesirable.

In terms of the Environmental Services Management Plan (EMSP) for the uMhlathuze Local Municipality Site Alternative 1 and 3 fall within an area classified as "Development Zone" which means the area is not critical biodiversity support area and development of the site is permitted. Site Alternative 2 falls within an "Open Space Linkage Zone" which is an area that supplies key environmental / biodiversity services and therefore development within this area must be stringently controlled.

Through desktop delineation, the specialist identified a single wetland habitat (Unit S1) and a lake (Unit L1 – Qhubu Lake) within the regulated area for water use licensing (a 500m radius of the study area). The wetland occurs on the fringes of Qhubu Lake, on a gentle slope where subsurface flows break the surface. Water inputs are in the form of subsurface flows and water output is in the form of both subsurface and diffuse surface flows. According to the KZN Vegetation Type Map (EKZNW, 2012), the wetland is characterised by a grassland community that typically grows in alluvium found on lowland floodplains. Typical grasses include *Miscanthus sp, Leexia hexandra, Imperatea cylindrica* and *Paspalum sp*.

The most notable environmental impacts were identified as the production of sludge which requires disposal, discharge of wastewater containing nutrients such as nitrogen and phosphorus as well as diseases and pathogens into the aquatic environment, particularly the desktop delineated wetland and Qhubu Lake. Soil erosion from poor management of stormwater was also highlighted as a cause for concern. These impacts highlight the need for an

innovative and efficient wastewater treatment facility, reuse of sludge as fertiliser for example, and an effective stormwater management system.

Based on the risk posed by the development and sensitivity of the site, a final buffer width of 28m is recommended. It should be noted, however, that the recommended buffer cannot be used as a basis for authorising the proposed fish farm because the buffer is based on a desktop delineated wetland. A site-based delineation is required prior to authorising the development.

From an aquatic perspective, Site alternative 3 will likely have the least direct impact to the wetland and is therefore the most environmentally friendly. The unsuitability of site alternative 1 and 2 can only be confirmed once an infield wetland delineation is undertaken.

A suite of mitigation measures for consideration during the planning phase of the project have been provided in the report. Key mitigation measures are summarised as follows:

i. A high intensive rate of recirculation is recommended as it uses less new water and discharges less water through overflow which decreases discharge water quantities .
ii. Wastewater leaving the RAS will need to be treated.
iii. Only full waterborne sanitation must be provided.
iv. All buildings and structures must have rainwater harvesting infrastructure.
v. Stormwater must never be discharged into the sewer infrastructure.
vi. All stormwater collection, detention, attenuation, conveyance and outlet structures must be established outside delineated watercourses and their buffer zones.
vii. All stormwater generated by the development must be attenuated onsite and within the property boundary.

The following recommendations are made:

i. An infield wetland delineation and habitat impact assessment will need to be undertaken and this report updated. The report must include the assessment of the present ecological state, ecosystem services, ecological importance and assessment, DWS risk matrix as well as an impact significance assessment.
ii. An infield aquatic assessment will need to be undertaken. The assessment will need to include water quality assessment, macro-invertebrate assessment and a fish assessment.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

DWS	Department of Water and Sanitation
EIA:	Environmental Impact Assessment
EIS:	Ecological Importance & Sensitivity
EKZNW	Ezemvelo KZN Wildlife
FEPA	Freshwater Ecosystem Priority Area
GIS:	Geographic Information System
GPS	Global Positioning System
HGM:	Hydrogeomorphic
NFEPA:	National Freshwater Ecosystem Priority Areas
PES:	Present Ecological Status
RAS:	Recirculating Aquaculture System
WULA	Water Use Licence Application

INDEMNITY

Although Afzelia Environmental Consultants (Pty) Ltd exercises due care and diligence in rendering services and preparing documents, the Consultants do not accept any liability, and the Client by receiving this document, indemnifies the Consultants (directors, managers, agents and employees) against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered directly or indirectly by the Consultants and by the use of the information contained in this document.

1. INTRODUCTION

1.1. Project Locality and Description

Afzelia Environmental Consultants (Afzelia) was appointed by 18Phando Environmental Consulting on behalf of the Madlankala Primary Co-operative (Developer) to undertake a Desktop Wetland Habitat Assessment for a proposed commercial land based freshwater fish farm at Qhubu Lake. The proposed site is located in Esikhawini situated about 10km south-west of Richards Bay (Figure 1) within the Umhlathuze Local Municipality, KwaZulu-Natal.

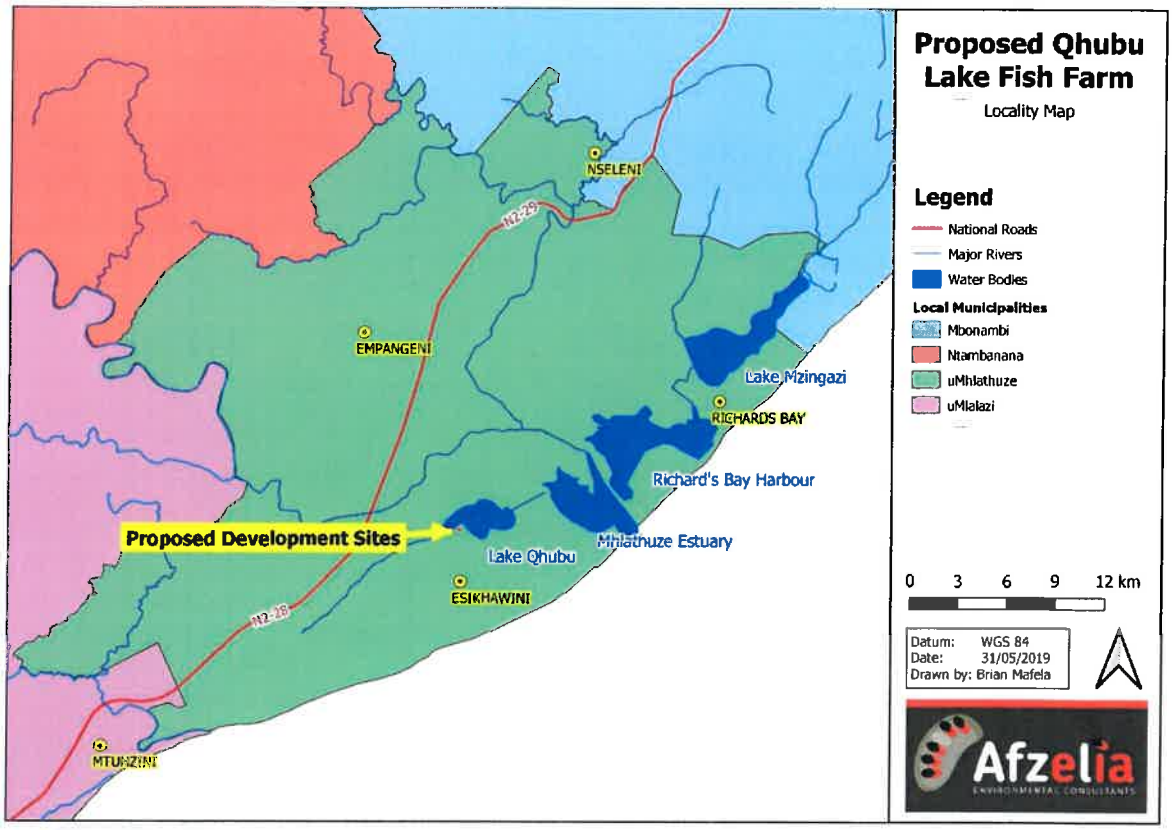

Figure 1: Location of the proposed development site within uMhlathuze Local Municipality.

The following project information was provided to Afzelia by 18Phando Environmental Consulting in the form of a Background Information Document:

"The developer is planning to establish a freshwater fish farm for the rearing of Mozambique Tilapia (*Oreochromis moccambicus*) for human consumption. The farm will be established on a 70m x 30m (2100m^2) footprint on the south-eastern shores of Qhubu Lake. Fish will be grown in a RAS (Recirculating Aquaculture System) which is a common system for intensively farming aquatic species capable of producing optimal output on a small footprint.

A 40-production pond system is proposed, which will be housed in 3 x (30m x 10m) agricultural type steel & plastic tunnels (Production Units) complete with extensive filtration and reticulation systems.

Total water in circulation during full operation will be 611,000 litres (611 kilolitres) including the reservoir. The farm will have an estimated water loss of 2,000 litres per day in mid-summer (less in winter) due to evaporation, mechanical loss and filtration related processes. Therefore, an estimated 60Kl per month in mid-summer and 15Kl in mid-winter will be drawn from Qhubu Lake to top up the system. This system will be capable of holding a total of approximately 40,000 fish (all ages) and expected to be producing a monthly harvest of 3500kg (3.5tons)."

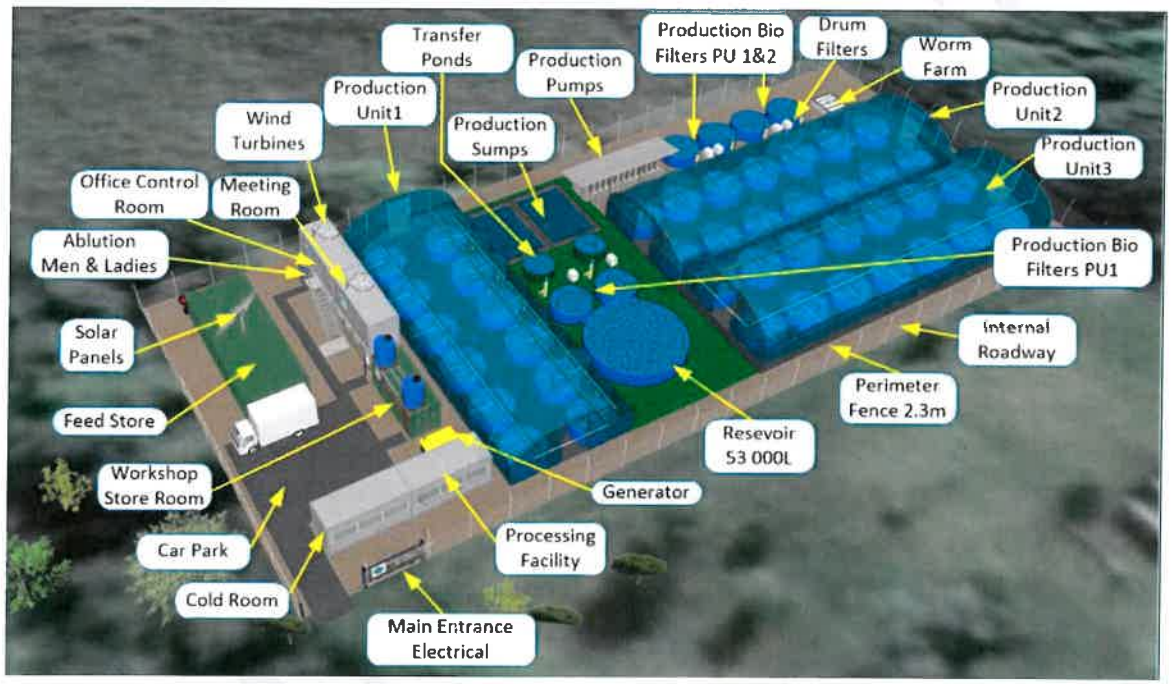

Figure 2: Example of the proposed fish farm.

Three potential sites located close to each other have been identified for development (Figure 3). Site Alternative 1, located closest (140m) to Qhubu Lake, has been flagged as the preferred site by the developer. Site Alternative 2 is located 160m away from the Lake and Site Alternative 3 is located furthest at 230m away from the Lake.

Figure 3: Site Alternatives Map.

1.2. Scope of Work

This assessment was undertaken as per the following Terms of Reference:

- Undertake a desktop review of the site's biophysical attributes using available literature and GIS information.
- Review conservation planning tools such as NFEPA datasets, KwaZulu-Natal Systematic Conservation Assessment and the uMhlathuze Environmental Services Management Plan and provide a discussion on how they impact the project.
- Undertake desktop delineation of wetlands within the study area using techniques detailed in the delineated guideline: A practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas – Edition 1 (DWAF 2005).
- Identify potential construction and operational phase impacts to watercourse.
- Provide planning-phase mitigation measures.
- Recommend development setbacks from all watercourses.

2. METHODOLOGY

2.1. Desktop Review

Prior to undertaking fieldwork, the specialist undertook a desktop review of the site and associated watercourses (wetlands, streams and rivers). This entailed reviewing available literature and GIS data on water resource conservation (e.g. NFEPA data, etc.), reviewing site details (climate, geology, soils, site relief, land use history, etc.) and undertaking desktop mapping of all watercourses within and around the study area. All desktop mapped watercourses were revised following fieldwork on site.

2.2. Wetland Assessments

For the purpose of this assessment, wetlands are considered as those ecosystems defined by the National Water Act as:

> *"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."*

2.2.1. Wetland Delineation

Onsite wetland delineation was undertaken as per procedures described in 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas – Edition 1' (Department of Water Affairs, 2005). This document requires the delineator to give consideration to the following 4 indicators in order to find the outer edge of the wetland zone:

i. The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur.
ii. The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation.
iii. The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation. Signs of wetness are characterised by a variety of aspects. These include marked variations in the colours of various soil components, known as mottling; a gleyed soil matrix or the presence of Fe/Mg concretions. It should be noted that the presence of signs of wetness within a soil profile is sufficient to classify an area as a wetland area despite the lack of other indicators.
iv. The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

2.2.2. Wetland Classification

All natural-occurring wetland units were classified according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al.*, 2013) which categorise wetlands into 6 distinct hydrogeomorphic (HGM) units. See Table 1 for a description of each HGM Unit.

Table 1: Description of wetland HGM units as classified by Ollis *et al.* (2013).

HGM Type	Description
Channelled valley bottom wetland	A mostly flat wetland area with a river channel running through it located along a valley floor, often connected to an upstream or adjoining river channel.
Unchanneled valley bottom wetland	A mostly flat wetland area without a river channel running through it located along a valley floor, often connected to an upstream or adjoining river channel.
Floodplain	A wetland area on the mostly flat or gently-sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by overtopping of the channel bank.
Seep	a wetland area located on gently to steeply sloping land and dominated by colluvial (i.e. gravity-driven), unidirectional movement of water and material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend onto a valley floor.
Flat	A level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat.
Depression	a wetland or aquatic ecosystem with closed (or near-closed1) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates.

Illustrations of the different wetland HGM types is provided Figure 4 below.

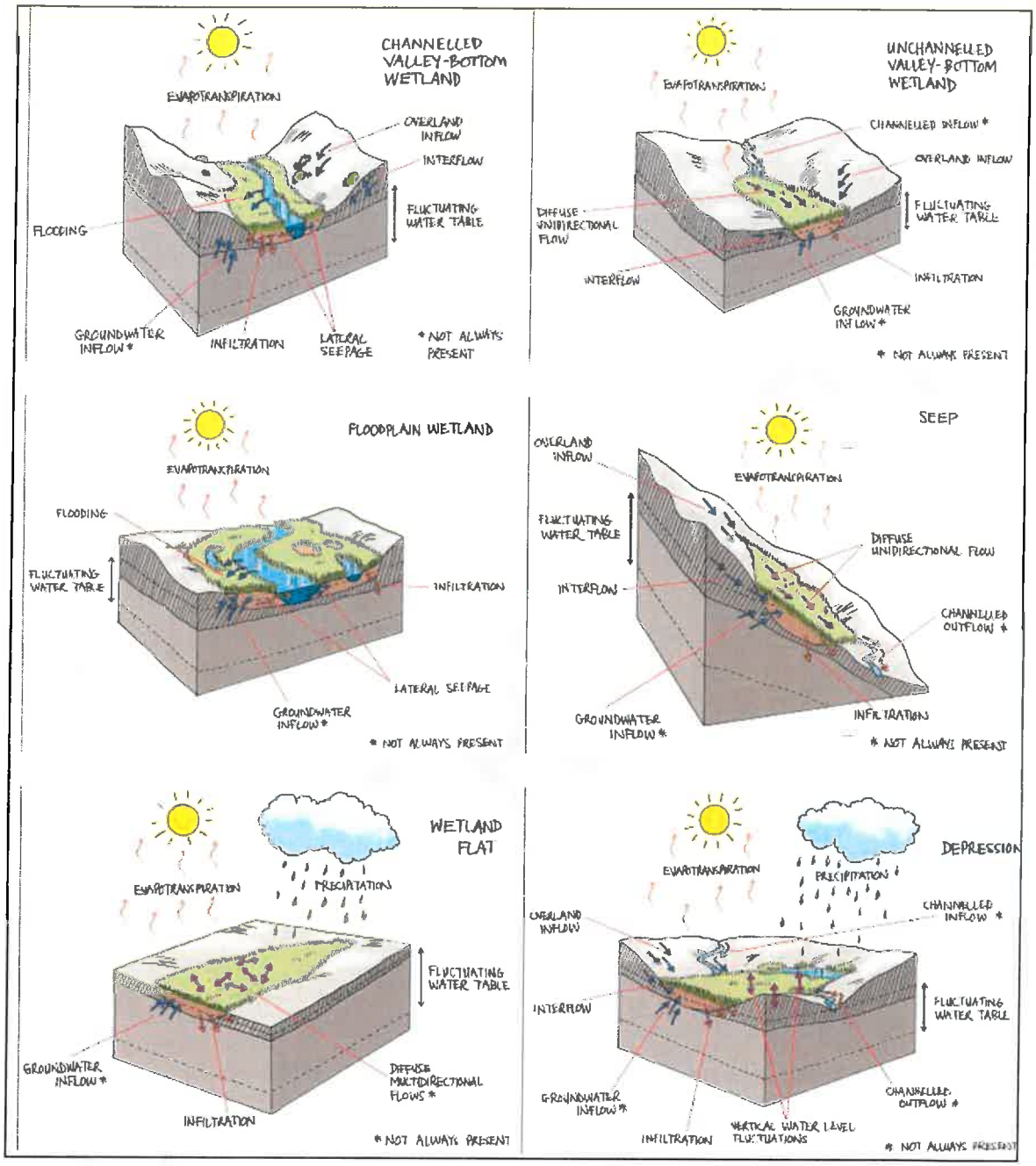

Figure 4: Site Alternatives Map.

2.3. Buffer Zone Determination

Development set-backs / Buffer to watercourses were determined using the Buffer Zone tool which is part of the "*Buffer Zone Guideline for Wetlands, Rivers and Estuaries*" (Macfarlane *et al*, 2014). The tool works by accounting risk associated with specific land use activities, detailed site information (e.g. climate conditions), the sensitivity of the receiving environment and local buffer attributes. The tool then provides a recommended buffer zone width.

2.4. Assumptions and Limitations

The following assumptions and limitation are applicable to this study:

- Desktop delineation was undertaken using 5m contours, latest aerial imagery and the latest Google Earth Imagery. Any vegetation changes may have influenced the accuracy of the delineation.
- No fieldwork was undertaken for this project and therefore all information is based on available literature.
- Wetland habitat descriptions are based available literature and general knowledge of the area. It is probable that these may be inaccurate due to anthropogenic factors specific to the study area.
- Impact identification and provision of planning recommendations are based on the assumption that the RAS technology to be used will produce effluent to be discharged into the natural environment either untreated or partly treated.
- The recommended buffer cannot be used as a basis for authorising the proposed fish farm because the buffer is based on a desktop delineated wetland. A site-based delineation is required prior to authorising the development.

3. RESULTS AND DISCUSSION

3.1. Results of Desktop Investigations

3.1.1. Quaternary Catchment & Drainage Setting

The study area falls within quaternary catchment W12F which is drained by the Mhlathuze River supplemented by Nseleni River (a left bank tributary) prior to discharging into the Mhlathuze Estuary. The catchment is also drained by the Mzingwenya River which discharges into Qhubu Lake which feeds the Mhlathuze Estuary. The catchment has a low drainage density. At a site level, the proposed development is located along the southwestern edge of Qhubu Lake. The drainage network, water bodies and location of the proposed fish farm within the quaternary catchment is shown in Figure 5 below.

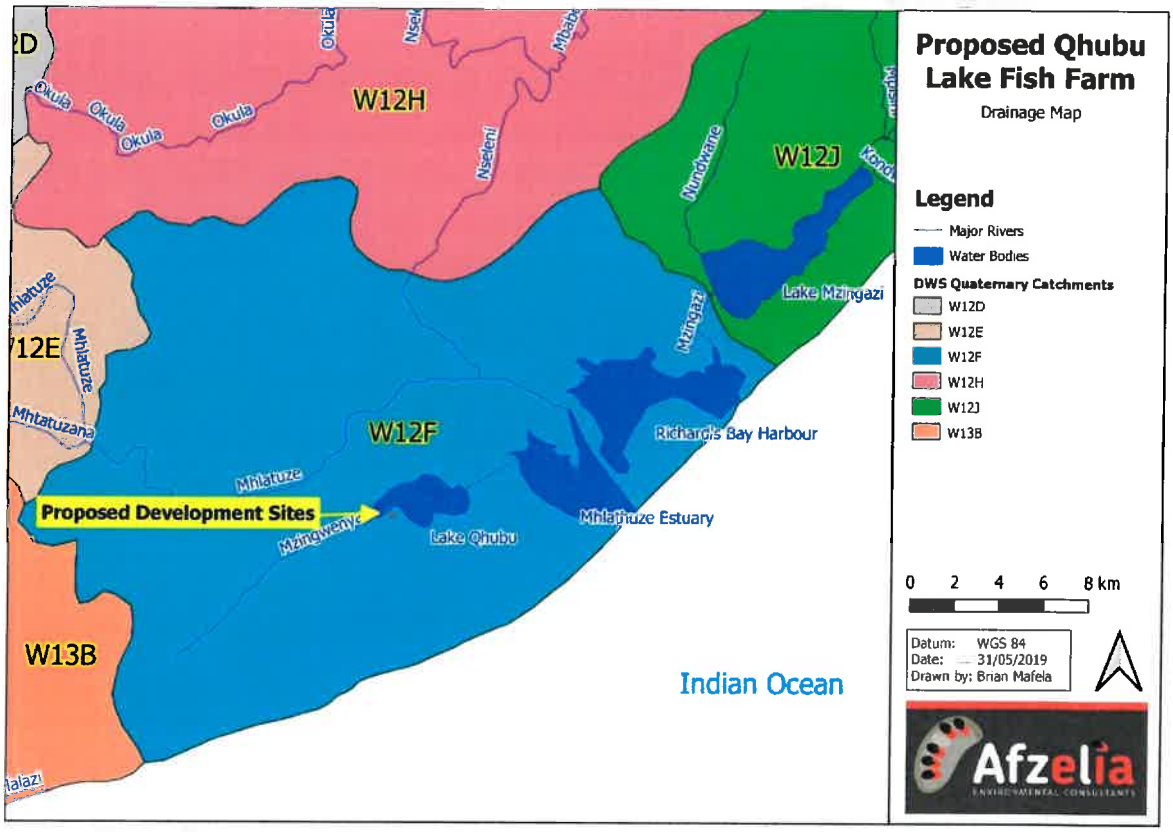

Figure 5: Quaternary catchment & drainage map.

3.1.2. Climate

Climate in the catchment is sub-tropical. Mean annual precipitation (MAP) is 1284.1 mm and is strongly summer dominant (mid to late summer), while annual potential evaporation is 97.0 mm (Schulze, 1997). Mean annual temperature (MAT) ranges between 20 and 22°C (Zone 5). Rainfall intensity is high.

3.1.3. Geology & Soil

The site is underlain by unconsolidated sand of oceanic origin. Given the loose nature of sand, the study area has a soil erodibility score (K-factor) of 0.66 which means it is highly erodible (Schulze, 2007).

3.1.4. NFEPA

According to the NFEPA GIS dataset the proposed development area is located on a non-prioritised sub-catchment (Catchment No. 3611) due to high transformation and lack of conservation important biota (CSIR, 2011). Furthermore, the NFEPA GIS dataset confirmed the presence of a non-prioritised wetland (non-FEPA) associated with Qhubu Lake (CSIR, 2011).

3.1.5. Vegetation

The terrestrial habitat within a 500m radius of the proposed development site is characterised by Maputaland Coastal Belt (with provincial threat status of Endangered) (EKZNW, 2010 & Jewitt 2014). The aquatic habitat which occurs on the fringes of Qhubu Lake is characterised by Alluvial Wetlands: Subtropical Alluvial Vegetation: Lowveld Floodplain Grassland which has a threat status of Critically Endangered (EKZNW, 2010 & Jewitt 2014). The spatial distribution of abovementioned vegetation types is shown in Figure 6. It should be noted that these are reference vegetation communities which have been somewhat impacted by anthropogenic activities.

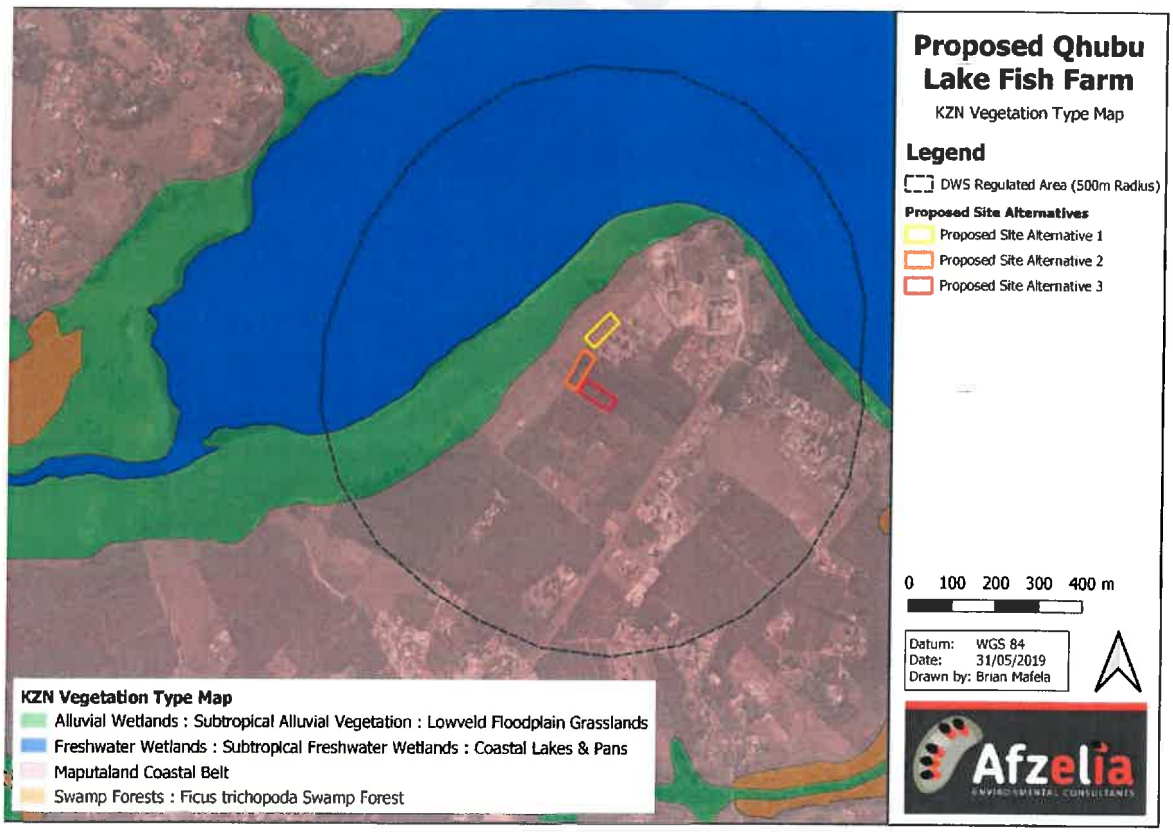

Figure 6: Terrestrial and aquatic vegetation according to the KZN Vegetation Type Map.

3.1.6. Desktop Macroinvertebrate Information

Information on the probability of occurrence and sensitivity of macroinvertebrate families within SQR W12F-03611 is provided in Table 2. below. The information indicates that of the 65 potential macroinvertebrate taxa in the SQR, sixteen have been identified as exhibiting high or very high sensitivity to changes physico-chemical conditions or no-flow conditions. These include Amphipoda, Athericidae, Calopterygidae, Chlorocyphidae, Crambidae (Pyralidae), Dixidae, Elmidae/Dryopidae, Helodidae, Heptageniidae, Hydropsychidae 2 spp, Lepidostomatidae, Oligoneuridae, Perlidae, Philopotamidae, Psephenidae and Tricorythidae. All other taxa exhibit very low to moderate sensitivity to changes in physico-chemical or no-flow conditions.

Table 2: Summarised desktop macroinvertebrate information for SQR W12F-03611. Important taxa are highlighted in orange and key results are highlighted in bold.

Macroinvertebrate Taxa	Confidence of Presence in SQR Reach	Physico-chemical Sensitivity	Sensitivity to No-flow Conditions
Aeshnidae	3.0 (Moderate)	2.7 (Moderate)	1.0 (Low/very low)
Amphipoda	3.0 (Moderate)	**4.3 (Very High)**	3.0 (Moderate)
Ancylidae	3.0 (Moderate)	2.0 (Low/very low)	1.0 (Low/very low)
Athericidae	1.0 (Very Low)	**3.3 (High)**	1.0 (Low/very low)
Atyidae	3.0 (Moderate)	2.7 (Moderate)	1.0 (Low/very low)
Baetidae 2 spp	3.0 (Moderate)	2.0 (Low/very low)	1.0 (Low/very low)
Belostomatidae	3.0 (Moderate)	1.0 (Low/very low)	2.0 (Low/very low)
Caenidae	3.0 (Moderate)	2.0 (Low/very low)	2.0 (Low/very low)
Calopterygidae	3.0 (Moderate)	**3.3 (High)**	3.0 (Moderate)
Ceratopogonidae	3.0 (Moderate)	1.7 (Low/very low)	2.0 (Low/very low)
Chironomidae	3.0 (Moderate)	0.7 (Low/very low)	1.0 (Low/very low)
Chlorocyphidae	3.0 (Moderate)	**3.3 (High)**	2.0 (Low/very low)
Coenagrionidae	3.0 (Moderate)	1.3 (Low/very low)	3.0 (Moderate)
Corbiculidae	3.0 (Moderate)	1.7 (Low/very low)	2.0 (Low/very low)
Corduliidae	3.0 (Moderate)	2.7 (Moderate)	2.0 (Low/very low)
Corixidae	3.0 (Moderate)	1.0 (Low/very low)	2.0 (Low/very low)
Crambidae (Pyralidae)	3.0 (Moderate)	**4.0 (High)**	**4.0 (High)**
Culicidae	3.0 (Moderate)	0.3 (Low/very low)	2.0 (Low/very low)
Dixidae	1.0 (Very Low)	**3.3 (High)**	2.0 (Low/very low)
Dytiscidae	3.0 (Moderate)	1.7 (Low/very low)	2.0 (Low/very low)
Ecnomidae	3.0 (Moderate)	2.7 (Moderate)	3.0 (Moderate)
Elmidae/Dryopidae	3.0 (Moderate)	2.7 (Moderate)	**4.0 (High)**
Gerridae	3.0 (Moderate)	1.7 (Low/very low)	2.0 (Low/very low)
Gomphidae	3.0 (Moderate)	2.0 (Low/very low)	3.0 (Moderate)
Gyrinidae	3.0 (Moderate)	1.7 (Low/very low)	3.0 (Moderate)
Haliplidae	3.0 (Moderate)	1.7 (Low/very low)	2.0 (Low/very low)
Helodidae	3.0 (Moderate)	**4.0 (High)**	1.0 (Low/very low)
Heptageniidae	3.0 (Moderate)	**4.3 (Very High)**	**4.0 (High)**
Hirudinea	3.0 (Moderate)	1.0 (Low/very low)	1.0 (Low/very low)
Hydracarina	3.0 (Moderate)	2.7 (Moderate)	1.0 (Low/very low)
Hydraenidae	3.0 (Moderate)	2.7 (Moderate)	2.0 (Low/very low)
Hydrometridae	3.0 (Moderate)	2.0 (Low/very low)	2.0 (Low/very low)
Hydrophilidae	3.0 (Moderate)	1.7 (Low/very low)	1.0 (Low/very low)

Hydropsychidae 2 spp	3.0 (Moderate)	2.0 (Low/very low)	**4.0 (High)**
Hydroptilidae	3.0 (Moderate)	2.0 (Low/very low)	3.0 (Moderate)
Lepidostomatidae	3.0 (Moderate)	**3.3 (High)**	3.0 (Moderate)
Leptoceridae	3.0 (Moderate)	2.0 (Low/very low)	3.0 (Moderate)
Leptophlebiidae	1.0 (Very Low)	3.0 (Moderate)	2.0 (Low/very low)
Lestidae	1.0 (Very Low)	2.7 (Moderate)	2.0 (Low/very low)
Libellulidae	3.0 (Moderate)	1.3 (Low/very low)	3.0 (Moderate)
Lymnaeidae	3.0 (Moderate)	1.0 (Low/very low)	2.0 (Low/very low)
Muscidae	3.0 (Moderate)	0.3 (Low/very low)	1.0 (Low/very low)
Naucoridae	3.0 (Moderate)	2.3 (Moderate)	3.0 (Moderate)
Nepidae	3.0 (Moderate)	1.0 (Low/very low)	2.0 (Low/very low)
Notonectidae	3.0 (Moderate)	1.0 (Low/very low)	2.0 (Low/very low)
Oligochaeta	3.0 (Moderate)	0.3 (Low/very low)	1.0 (Low/very low)
Oligoneuridae	3.0 (Moderate)	**5.0 (Very High)**	**5.0 (Very High)**
Perlidae	1.0 (Very Low)	**4.0 (High)**	**5.0 (Very High)**
Philopotamidae	3.0 (Moderate)	**3.3 (High)**	**4.0 (High)**
Physidae	3.0 (Moderate)	1.0 (Low/very low)	2.0 (Low/very low)
Planorbinae	3.0 (Moderate)	1.0 (Low/very low)	2.0 (Low/very low)
Pleidae	3.0 (Moderate)	1.3 (Low/very low)	2.0 (Low/very low)
Potamonautidae	3.0 (Moderate)	1.0 (Low/very low)	3.0 (Moderate)
Psephenidae	1.0 (Very Low)	**3.3 (High)**	**4.0 (High)**
Psychodidae	3.0 (Moderate)	0.3 (Low/very low)	2.0 (Low/very low)
Simuliidae	3.0 (Moderate)	1.7 (Low/very low)	3.0 (Moderate)
Sphaeriidae	1.0 (Very Low)	1.0 (Low/very low)	2.0 (Low/very low)
Synlestidae/Chlorolestidae	1.0 (Very Low)	2.7 (Moderate)	2.0 (Low/very low)
Syrphidae	3.0 (Moderate)	0.3 (Low/very low)	2.0 (Low/very low)
Tabanidae	3.0 (Moderate)	1.7 (Low/very low)	2.0 (Low/very low)
Thiaridae	3.0 (Moderate)	1.0 (Low/very low)	2.0 (Low/very low)
Tipulidae	3.0 (Moderate)	1.7 (Low/very low)	2.0 (Low/very low)
Tricorythidae	3.0 (Moderate)	3.0 (Moderate)	**5.0 (Very High)**
Turbellaria	1.0 (Very Low)	1.0 (Low/very low)	3.0 (Moderate)
Veliidae/Mesoveliidae	3.0 (Moderate)	1.7 (Low/very low)	2.0 (Low/very low)

3.1.7. Desktop Fish Information

Information on the conservation status, probability of occurrence and sensitivity of fish species within SQR W12F-03611 is provided in Table 3, below. The information indicates that of the 28 potential fish species in the SQR, four have been identified as "Near Threatened" whilst the remainder are of "Least Concern" or "Data Deficient" (IUCN, 2019). These include *Anguilla bengalensis, Anguilla bicolor, Aplocheilichthys myaposae* and *Oreochromis mossambicus.* Seven species are known to exhibit high to very high sensitivity to changes in physico-chemical or no-flow conditions, namely; *Aplocheilichthys myaposae, Barbus natalensis, Labeo cylindricus, Labeo molybdinus, Marcusenius pongolensis, Myxus capensis* and *Redigobius dewaali.* All other species exhibited very low to moderate sensitivity to changes in physico-chemical or no-flow conditions.

Table 3: Summarised desktop fish information for SQR W12F-03611.

Scientific Name	Conservation Status (IUCN, 2019)	Confidence of Presence in SQR Reach	Physico-chemical Sensitivity	Sensitivity to No-flow Conditions
Acanthopagrus berda	LC	1.0 (Very Low)	1.8 (Low/very low)	1.1 (Low/very low)
Anguilla bengalensis	NT	3.0 (Moderate)	2.7 (Moderate)	2.8 (Moderate)
Anguilla bicolor	NT	3.0 (Moderate)	2.7 (Moderate)	2.8 (Moderate)
Anguilla marmorata	LC	3.0 (Moderate)	2.5 (Moderate)	2.8 (Moderate)
Anguilla mossambica	LC	3.0 (Moderate)	2.5 (Moderate)	2.8 (Moderate)
Aplocheilichthys katangae	LC	3.0 (Moderate)	3.0 (Moderate)	1.2 (Low/very low)
Aplocheilichthys myaposae	NT	5.0 (High)	**4.0 (High)**	3.0 (Moderate)
Awaous aeneofuscus	LC	5.0 (High)	2.8 (Moderate)	2.0 (Low/very low)
Barbus natalensis	LC	3.0 (Moderate)	3.0 (Moderate)	**3.5 (High)**
Barbus paludinosus	LC	5.0 (High)	1.8 (Low/very low)	2.3 (Moderate)
Barbus trimaculatus	LC	3.0 (Moderate)	1.8 (Low/very low)	2.7 (Moderate)
Barbus viviparus	LC	5.0 (High)	3.0 (Moderate)	2.3 (Moderate)
Clarias gariepinus	LC	3.0 (Moderate)	1.0 (Low/very low)	1.7 (Low/very low)
Clarias theodorae	LC	5.0 (High)	2.0 (Low/very low)	1.0 (Low/very low)
Ctenopoma multispine	LC	5.0 (High)	2.0 (Low/very low)	2.0 (Low/very low)
Gilchristella aestuaria	LC	3.0 (Moderate)	3.0 (Moderate)	1.5 (Low/very low)
Glossogobius callidus	LC	5.0 (High)	2.3 (Moderate)	1.5 (Low/very low)
Glossogobius giuris	LC	3.0 (Moderate)	2.5 (Moderate)	1.7 (Low/very low)
Labeo cylindricus	LC	3.0 (Moderate)	**3.1 (High)**	**3.1 (High)**
Labeo molybdinus	LC	3.0 (Moderate)	**3.2 (High)**	**3.3 (High)**
Marcusenius pongolensis	LC	3.0 (Moderate)	**3.4 (High)**	3.0 (Moderate)
Megalops cyprinoides	Data Deficient	3.0 (Moderate)	2.5 (Moderate)	2.5 (Moderate)
Myxus capensis	LC	5.0 (High)	3.0 (Moderate)	**3.5 (High)**
Oreochromis mossambicus	NT	5.0 (High)	1.3 (Low/very low)	0.9 (Low/very low)
Pseudocrenilabrus philander	LC	5.0 (High)	1.4 (Low/very low)	1.0 (Low/very low)
Redigobius dewaali	LC	3.0 (Moderate)	**3.5 (High)**	1.0 (Low/very low)
Tilapia rendalli	LC	5.0 (High)	2.1 (Moderate)	1.8 (Low/very low)
Tilapia sparrmanii	LC	5.0 (High)	1.4 (Low/very low)	0.9 (Low/very low)

3.2. Provincial and Local Conservation Guidelines

3.2.1. KwaZulu-Natal Systematic Conservation Assessment

The KwaZulu-Natal Biodiversity Plan defines the areas of land in the form of Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) required to ensure the persistence and conservation of biodiversity within the province (EKZNW, 2016). The spatial plan then provides a tool to guide conservation and protected area expansion as well as informing economic sectors involved in alien plant control, conservation officer priorities and guiding the nature of development (EKZNW, 2016).

The spatial guidelines provided by the plan outline two main categories of areas that are required to meet conservation targets for the province (EKZNW, 2016). These two main categories include CBAs and ESAs, including corridors. These are further divided into smaller categories, which are outlined in Table 4.

Upon interrogation of KZN Biodiversity Plan, it was determined that no provincial CBAs or ESAs are located within the proposed development boundary, alternatives or immediate receiving environment.

Table 4: Description of subcategories of CBAs and ESAs.

Critical Biodiversity Areas (CBAs) – Crucial for supporting biodiversity features and ecosystem functioning and are required to meet biodiversity and/or process targets	
Critical Biodiversity Areas: Irreplaceable	Areas considered critical for meeting biodiversity targets and thresholds, and which are required to ensure the persistence of viable populations of species and the functionality of ecosystems.
Critical Biodiversity Areas: Optimal	Areas that represent an optimised solution to meet the required biodiversity conservation targets while avoiding high cost areas as much as possible (Category driven primarily by process, but is informed by expert input).
Ecological Support Areas (ESAs) – Functional but not necessarily entirely natural areas that are required to ensure the persistence and maintenance of biodiversity patterns and ecological processes within Critical Biodiversity Areas.	
Ecological Support Areas	Functional but not necessarily entirely natural terrestrial or aquatic areas that are required to ensure the persistence and maintenance of biodiversity patterns and ecological processes within the Critical Biodiversity Areas. The area also contributes significantly to the maintenance of Ecosystem Services.
Ecological Support Areas: Species Specific	Terrestrial modified areas that provide a critical support function to a threatened or protected species, for example agricultural land or dams associated with nesting/roosting sites.
Ecological Support Areas: Buffers	Terrestrial areas identified as requiring land-use management guidance not necessarily due to biodiversity prioritisation, but in order to address other legislation/ agreements which the biodiversity sector is mandated to address, e.g. WHS Convention, Triggers Listing Notice criteria, etc.

3.2.2. Environmental Services Management Plan for the uMhlathuze Local Municipality

The 2007 Environmental Services Management Plan (EMSP) for the uMhlathuze Local Municipality is a policy document for planning and management of natural assets within eight distinct hydrological catchments located in the uMhlathuze Local Municipality. The ESMP also classifies areas into four distinct environmental service supply and management zones which described as follows:

i. **Nature Reserves (Level 1):** These are areas of high biodiversity and environmental importance that require a high level of protection. These areas include habitats which are considered internationally, nationally or provincially important and comprise estuaries, lakes, wetlands, natural forests, coastal buffers and other critically endangered habitats. These areas should be proclaimed nature reserves.

ii. **Conservation Zone (Level 2):** These are areas of high biodiversity and environmental importance that cannot be proclaimed as nature reserves, but which still require some level of protection. This zone includes unique or regional important habitats such as wetlands, forest areas and areas within the 1:100 year flood line. No developments other than for conservation purposes may occur within this zone.

iii. **Open Space Linkage Zone (Level 3):** These are areas that provide a natural buffer for level 1 and 2 zones, areas that link level 1 and 2 zones as well as areas that supply key environmental services. Development within these areas should be stringently controlled.

iv. **Development Zone (Level 4):** These areas comprise any additional areas not included within level 1, 2 and 3 zones. These areas may already be developed or comprise "natural assets" that are not important

for environmental services. The further development of these areas should not adversely impact on the existing supply of environmental services.

According to the ESMP Site Alternative 1 and 3 fall within an area classified as "Development Zone" which means the area is not critical biodiversity support area. As such development of Site Alternative 1 and 3 is permitted. Site Alternative 2 falls within an "Open Space Linkage Zone" which is an area that supplies key environmental / biodiversity services and therefore development within this area must be stringently controlled. A map showing the location of the proposed development sites within the four distinct environmental service supply and management zones is provided in Figure 7.

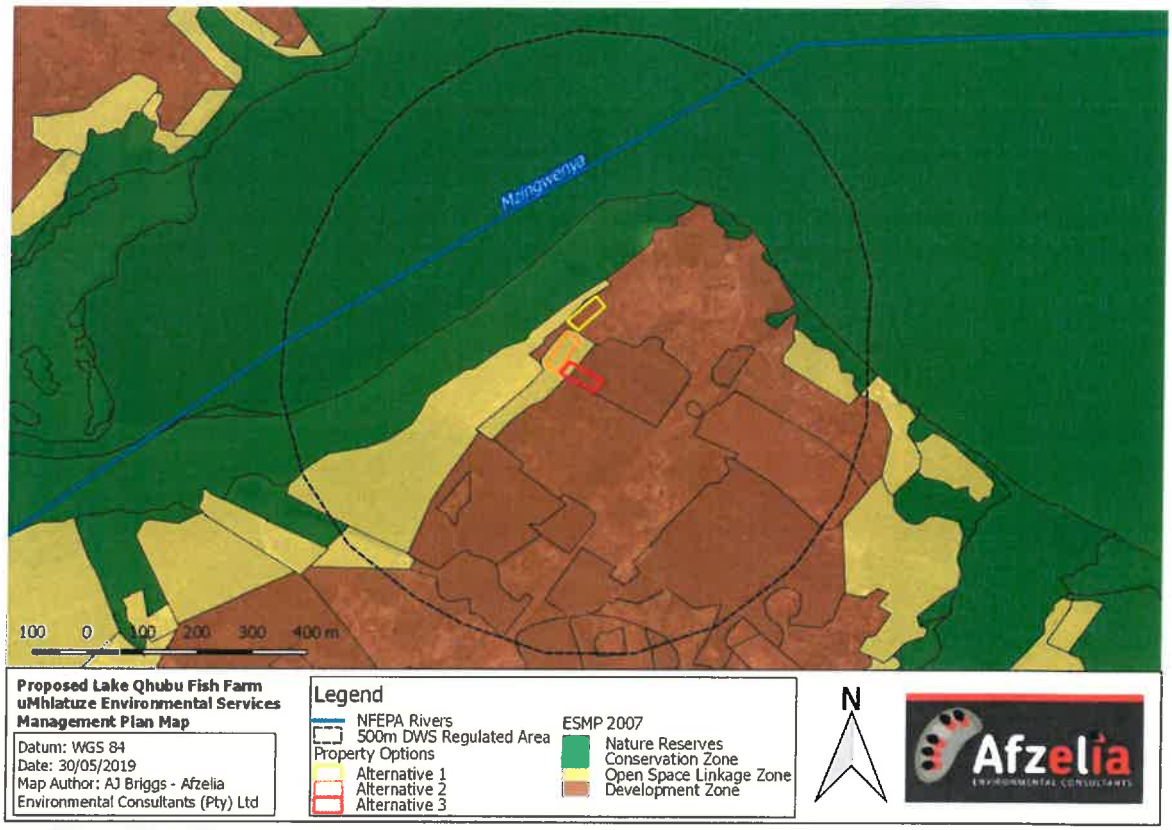

Figure 7: Desktop delineated wetland and lake within the study area.

3.3. Desktop Wetland Delineation & Classification

Through desktop delineation, the specialist identified a single wetland habitat (Unit S1) and a lake (Unit L1 – Qhubu Lake) within the regulated area for water use licensing (a 500m radius of the study area). The wetland occurs on the fringes of Qhubu Lake (Figure 8).

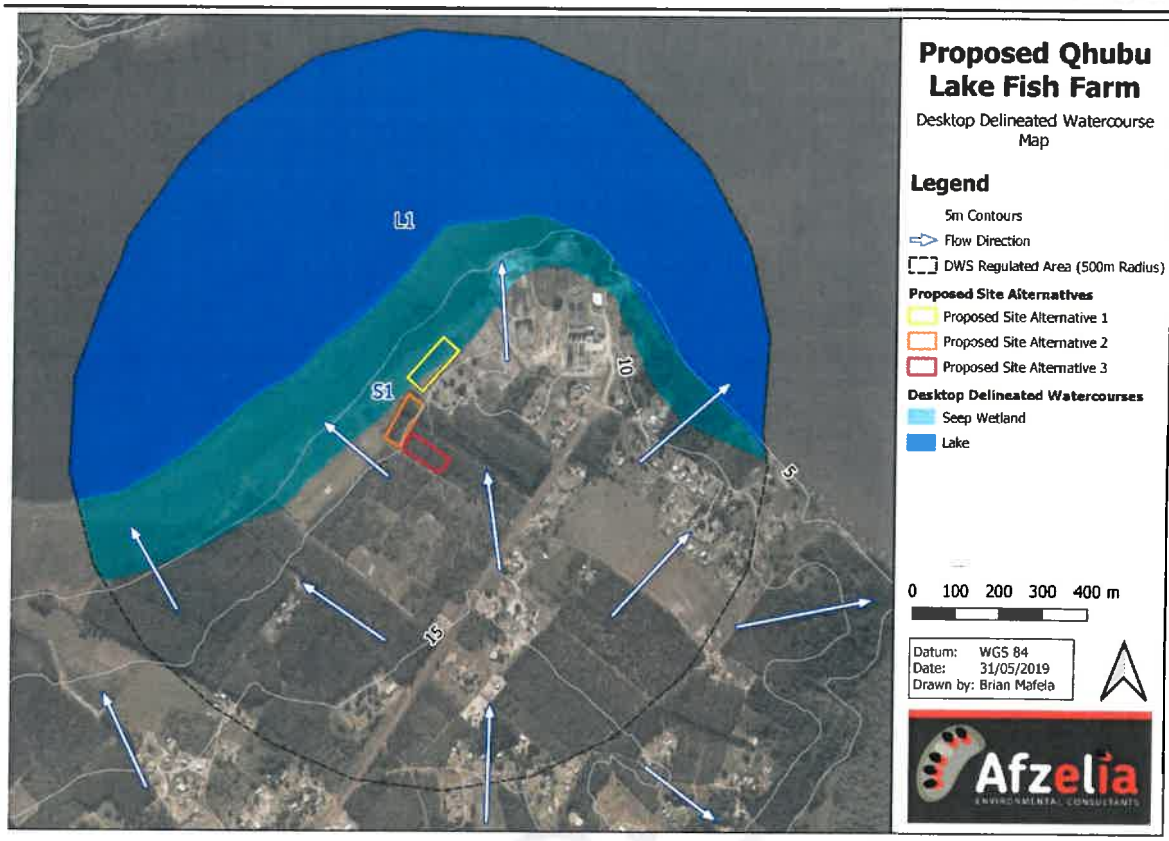

Figure 8: Desktop delineated wetland and lake within the study area.

The general characteristics and classification of HGM units likely to be impacted by the proposed housing development are discussed in Table 5 below.

Table 5: General characteristics and classification of HGM units likely to be impacted by the proposed housing development

ID	Aspect	Description
S1	HGM Type	Seep Wetland
	General Description	Gentle sloping wetland along the edge of Qhubu Lake. The wetland occurs in an area where subsurface flows break the surface. Water inputs are in the form of subsurface flows and water output is the form of both subsurface and diffuse surface flows.
	Soil	Likely to be unconsolidated gray-brown sand with orange mottles.
	Vegetation	According to the KZN Vegetation Type Map (Scott-Shaw & Escott, 2011), the wetland is characterised by a grassland community that typical grows in alluvium found on lowland floodplains. Typical grasses include *Miscanthus sp, Leexia hexandra, Imperatea cylindrica* and *Paspalum sp.*
	Existing Impacts	• Vegetation trampling. • Limited vegetation removal. • Limited solid waste pollution. • Increased water usage driven by commercial tree plantations in the catchment of the wetland.
L1	HGM Type	Lake
	General Description	Natural occurring lake fed primarily by concentrated flows from upstream.

	Soil	N/A
	Vegetation	N/A
	Existing Impacts	• Limited water pollution from use of pit latrines within the catchment area.

4. IMPACT IDENTIFICATION

Although the RAS is generally considered as a most environmentally friendly way of producing fish at a commercially viable level. This is largely due to the limited amount of water used in recirculation and low discharge of wastewater which makes wastewater treatment easier and cheaper. Nevertheless, this farming technique, particularly its operational activity has impacts to the environment. Of notable concern is the discharge of waste into the environment (Boyd et al., 2005; Buschmann et al., 2006). A preliminary list of impacts to the aquatic habitat and biota is provided below:

Construction Phase Impacts:

i. Bulk earthworks will loosen the soil resulting in increased erosion and sedimentation of downslope aquatic environment

ii. Site alternative 1 (preferred) will likely lead to transformation / loss of wetland habitat as it is located within the desktop delineated wetland habitat.

Operational Phase Impacts:

i. Discharge of waste water into the wetland or Qhubu Lake will result in increased nutrification of the water. Dissolved nitrogen and phosphorus are key waste nutrients of concern (Bregnballe, 2015).

ii. Discharge of waste water into the wetland or Qhubu Lake may also introduce diseases and pathogens to indigenous aquatic fauna in Qhubu Lake. According to Bregnballe (2015) common diseases and pathogens include IPN (Infectious Pancreas Necrosis), BKD (Bacterial Kidney Disease), Ich (*Ichthyophthirius multifilis* or white spot disease), *Ichthyobodo necator* (Costia), *Trichodina sp.*, *Gyrodactylus sp., sessile ciliates*, VHS (Viral Hemorrhagic Septicemia), herpes virus and fungus (*Saprolegnia*).

iii. Improper discharge of waste water via a conduit may result in erosion and sedimentation of the downslope Wetland Unit S1 and Qhubu Lake.

iv. Improper handling of stormwater from hardened surfaces (parking lot, walkways etc.), buildings and other infrastructure (production units) may result in erosion and sedimentation of the downslope Wetland Unit S1 and Qhubu Lake.

5. PLANNING PHASE RECOMMENDATIONS

The specialists have provided planning recommendations aimed at guiding the proposed fish farm.

5.1. Preliminary Development Setbacks / Buffer Width Recommendations

A buffer zone is a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another (Macfarlane at al. 2014). According to Macfarlane *et al.* (2014) buffers surrounding water resources serve the following functions:

i. Maintaining basic aquatic process;
ii. Reducing impacts on water resources from upstream activities and adjoining land uses.
iii. Providing habitat for aquatic and semi-aquatic species.
iv. Providing habitat for terrestrial species.
v. Providing a range of ancillary societal benefits.

According to the Wetland Buffer tool for wetlands (Macfarlane *et al.* 2014), the highest aquatic environmental impact posed by aquaculture is rated as "Moderate." Threats posed by aquaculture are listed in Table 6. Key construction impacts were identified as "increase in sediment inputs & turbidity" linked with construction activities. The most notable operational impacts were identified as "alteration of flow volumes," "increased nutrient input" and "pathogen inputs" all linked with potential discharge of waste water.

Table 6: Threats posed by aquaculture (fish farming).

Impact Description	Construction Impact Threat Ratings	Operational Impact Threat Ratings
1. Alteration to flow volumes	Low	Medium
2. Alteration of patterns of flows (increased flood peaks)	Very Low	Very Low
3. Increase in sediment inputs & turbidity	Medium	Very Low
4. Increased nutrient inputs	Medium	Medium
5. Inputs of toxic organic contaminants	Very Low	Low
6. Inputs of toxic heavy metal contaminants	Low	Very Low
7. Alteration of acidity (pH)	N/A	Low
8. Increased inputs of salts (salinization)	N/A	Low
9. Change (elevation) of water temperature	N/A	Low
10. Pathogen inputs (i.e. disease-causing organisms)	Low	Medium

Based on the above-mentioned impact threat ratings and onsite characteristics (e.g. buffer slope, groundcover within the buffer, sensitivity of receiving watercourses etc.) a buffer width of 15m is recommended for the construction phase and 28m for the operational phase. A final buffer width of 28m is recommended (See Table 7 and Figure 9). It should be noted, however, that the recommended buffer cannot be used as a basis for authorising

the proposed fish farm because the buffer is based on a desktop delineated wetland. A site-based delineation is required prior to authorising the development.

Table 7: Recommended buffer widths.

Construction Phase Buffer Width	15
Operational Phase Buffer Width	28
Final Buffer Width	**28**

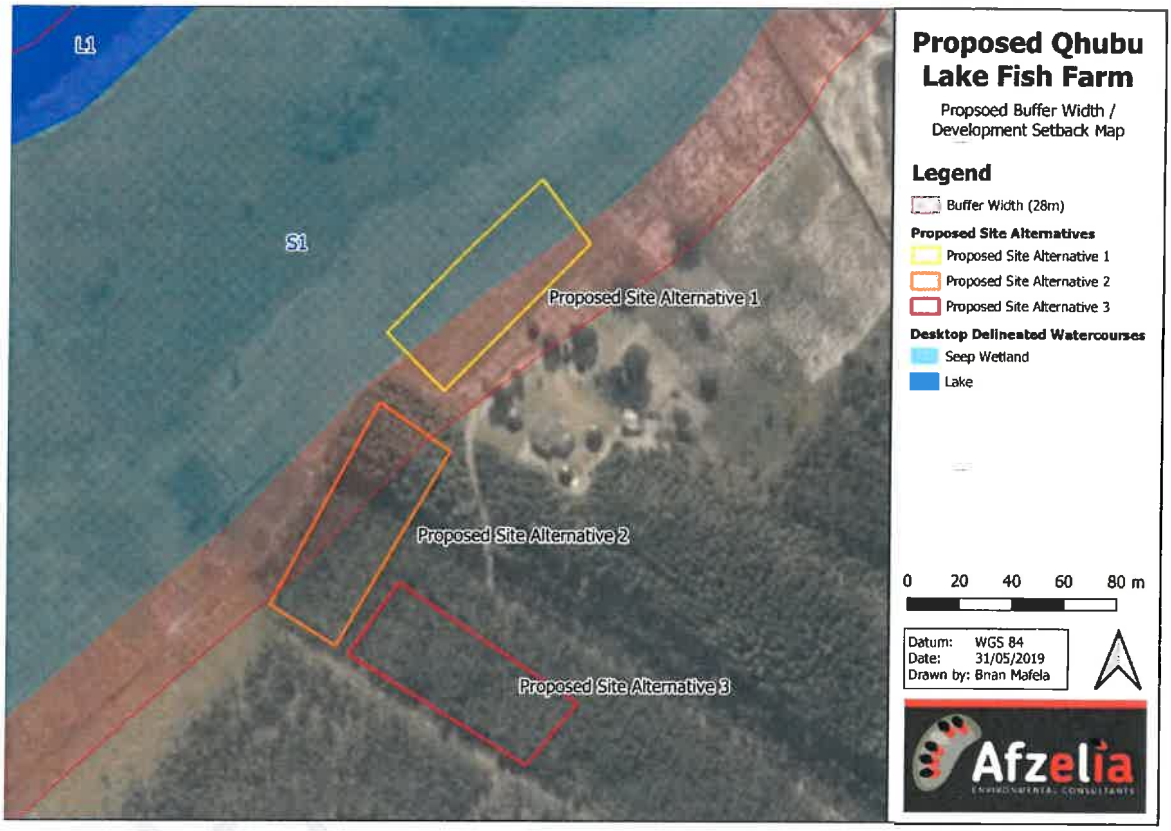

Figure 9: Map showing a composite development setback / buffer width.

It is worth noting that buffers do little to address impacts such as hydrological changes caused by stream flow reduction activities or changes in flow brought about by abstractions or upstream impoundments. Buffer zones are also not appropriate for militating against point-source discharges (such as sewage outflows), which can be managed more effectively by targeting these areas through specific source-directed controls. Contamination or use of groundwater is also not well addressed by buffer zones (Macfarlane *et al* 2014).

Despite clear limitations, buffer zones are well-suited for performing functions such as sediment trapping and nutrient retention that can significantly reduce the impact of activities taking place adjacent to water resources. Buffer zones are therefore proposed as a standard mitigation measure to reduce impacts linked with diffuse storm water run-off from land uses/activities planned adjacent to water resources (Macfarlane *et al* 2014).).

5.2. Site Alternative Recommendations

Based on the proposed location of the three sites relative to the desktop delineated wetland (Unit S1) and Qhubu Lake and proposed buffer, site alternative 3 will likely have the least direct impact to the wetland and is therefore the most environmentally friendly. Site alternative 1 (which is the preferred) will likely result in the loss of wetland habitat whilst site alternative 2 is partly located within the recommended 28m aquatic buffer width which is the development setback (See Figure 8 on previous page). Site alternative 3 should be treated as the preferred alternative. The unsuitability of site alternative 1 and 2 can only be confirmed once an infield wetland delineation is undertaken.

5.3. RAS Wastewater Treatment Recommendations

The RAS produces waste in the form of organic sludge and waste water. Such waste will need to be dealt with. Herewith recommended for consideration in treating such waste:

i. A high intensive rate of recirculation is recommended as it uses less new water and discharges less water through overflow which decreases discharge water quantities (Bregnballe, 2015). Overall, less discharge water will need to be treated which reduces the risk of environmental pollution and keeps the costs of treating water low.

ii. Wastewater leaving the RAS will need to be treated. This can be achieved through removal of organic sludge which can be taken to an accumulation facility for sedimentation or further mechanical dewatering and treatment of cleaned waste water (from the sludge treatment) as it usually contains a high concentration of nitrogen (Bregnballe, 2015). Organic sludge can be used for fertilizer and soil improvement on agricultural farms, or it can be used in biogas production for generating heat or electricity (Bregnballe, 2015).

iii. Reject water, which is cleaned waste water for discharge, will need to meet DWS requirements in terms of nutrient load prior to being discharged into the environment (water body). According to the DWS (1996) inorganic nitrogen concentrations should not be changed by more than 15% from that of the water body under local unimpacted conditions at any time of the year. In order to meet the DWS requirements, nitrogen in reject water will need to be removed to a low concentration of no more than 15% of unimpacted water bodies within the study area.

iv. Nitrogen in waste water can also be removed through a denitrification process (Rijn and Rivera, 1990; Barak, 1998; Rijn and Barak, 1998; van Rijn et al., 2006). Denitrification can also be used inside the recirculation system to reduce the amount of nitrate in the RAS process water in order to reduce the nitrate concentration, thus minimizing the need for new water in the system. An efficient denitrification system can reduce the nitrogen content in the effluent water significantly (Bregnballe, 2015).

v. An alternative to treating reject water would be to act as fertilizer in aquaponics systems. Aquaponics are systems where the waste water from the fish is used for growing vegetables, plants or herbs, typically inside greenhouses (Bregnballe, 2015).

5.4. Human Wastewater Disposal Recommendations

With regards to treatment of human waste from ablution facilities at the farm, we recommend the following:

i. Only full waterborne sanitation must be provided to each unit.
ii. Linking to an existing sewer infrastructure must be given priority over setting up an onsite treatment plant.
iii. In the event that a link cannot be made to an existing sewer infrastructure, we recommend use of an onsite package treatment plant such as (i) activated sludge /extended aeration plant; (ii) trickling filter; (iii) submerged bio-contactors; and (iv) rotating bio-contactors.

5.5. Stormwater Management Recommendations

Stormwater is generally a major problem with hardened surfaces which restrict infiltration but promote increased runoff. It is therefore of paramount importance that sustainable stormwater management methods are implemented. The general principle for stormwater management is to reduce the rate of runoff to a pre-development state and ensure that runoff is not concentrated onto adjacent neighbouring sites or other infrastructure. In this regard we recommend the following mitigation measures:

Point-Source Mitigation Measures

i. Hardened surfaces such as driveways, paved walkways, paved yards etc. must be kept to a minimum. If required, porous paving such as block paving must be used.
ii. All buildings and structures must have rainwater harvesting infrastructure. A common and acceptable technology is diverting stormwater from the gutter into Jo-jo tanks for storage. Harvested water can then be used in the RAS. The acceptable storage ratio for rainwater tanks is 60% of the volume of the tank. In other words, when calculating the volume of storage required (on the 1 m^3 to 40 m^2 area) then 60% of the rainwater tank volume may be claimed on the assumption that the tank is 40% full at any given time.
iii. Stormwater must never be discharged into the sewer infrastructure. The two must always be kept separate.

End-point Mitigation Measures

In the event that point-source mitigation measures are not adequate to handle stormwater end-point mitigation measures will need to be implemented. These include:

iv. All stormwater collection, detention, attenuation, conveyance and outlet structures must be established outside delineated watercourses and their buffer zones. This is necessary to allow the buffer zone to dissipate and filter stormwater before it reaches downstream watercourses.

v. A series of smaller stormwater outlets should be considered over a few large outlets. For example, a stormwater discharge point can be constructed for each unit rather than one outlet serving many units.

vi. All stormwater generated by the development must be attenuated onsite and within the property boundary.

vii. Where feasible, all grey water must be reused.

6. CONCLUSION

The desktop assessment has flagged the potential presence of a seep wetland associated with the fringe of Qhubu Lake. The desktop delineated wetland habitat occurs within Site Alternative 1 (preferred by the Developer), 8m away from Site Alternative 2 and 60m away from Site Alternative 3 (most environmentally friendly site). A preliminary buffer width / development setback of 28m has been recommended based on the potential environmental risks associated with the development. Please note that the buffer width did not take into account point source impacts such as direct discharge of wastewater into the environment. Site Alternatives 1 and 2 are considered less desirable alternatives from an aquatic point of view to due Site Alternative 1 likely to result in wetland habitat loss whilst Site Alternative 2 occurs within the recommended buffer width. Should the developer wish to pursue development of Site Alternatives 1 or 2, he will need to demonstrate how he can manage identified impacts. As it stands, Site Alternative 3 is the most environmentally friendly from an aquatic stand point and therefore ideal for development.

Despite being considered environmentally sustainable, the RAS produces waste in the form of organic sludge and wastewater. The nutrient concentration and wastewater quantities are largely dependent on the technology used. More advanced and generally expensive technologies produce low quantities and improved quality of wastewater. The most notable environmental impacts were identified as:

- the production of sludge which requires disposal,
- discharge of wastewater containing nutrients such as nitrogen and phosphorus as well as diseases and pathogens into the aquatic environment, particularly the desktop delineated wetland and Qhubu Lake.
- Soil erosion from poor management of stormwater was also highlighted as a cause for concern.

These impacts highlight the need for an innovative and efficient wastewater treatment facility, reuse of sludge as fertiliser for example, and an effective stormwater management system. A suite of planning mitigation measures have been recommended for informing the planning phase of the proposed freshwater fish farm.

7. REFERENCES

Barak, Y., 1998. Denitrification in recirculating aquaculture systems: from biochemistry to biofilters. In: Proceedings of the Second International Conference on Recirculating Aquaculture, Virginia, USA, Virginia Sea Grant.

Boyd, C.E., McNevin, A.A., Clay, J., Johnson, H.M., 2005. Certification issues for some common aquaculture species. Rev. Fish. Sci. 13, 231–279.

Bregnballe, J. 2015. A Guide to Recirculation Aquaculture An introduction to the new environmentally friendly and highly productive closed fish farming systems. the Food and Agriculture Organization of the United Nations (FAO) and EUROFISH International Organisation

Buschmann, A.H., Riquelme, V.A., Hernández-González, M.C., Varela, D., Jiménez, J.E., Henríquez, L.A., Vergara, P.A., Guí˜nez, R., Filún, L., 2006. A review of the impacts of salmonid farming on marine coastal ecosystems in the southeast Pacific. ICES J. Mar. Sci. 63, 1338–1345.

CSIR (Council for Scientific and Industrial Research). 2011. National Freshwater Ecosystem Priority Areas (NFEPA). Council for Scientific and Industrial Research, Pretoria, South Africa.

Department of Water Affairs and Forestry, 1996. South African Water Quality Guidelines. Volume 7: Aquatic Ecosystems.

Driver, A., Nel, J.L., Snaddon, K., Murray, K., Roux, D.J., Hill, L., Swartz, E.R., Manuel, J. and Funke, N. 2011. Implementation Manual for Freshwater Ecosystem Priority Areas. Report to the Water Research Commission. WRC Report No. XXXX. June 2011.

DWAF (Department of Water affairs and Forestry). 2005. A practical field procedure for identification and delineation of wetland and riparian areas. Edition 1, September 2005. DWAF, Pretoria.

Jewitt, D. 2014. KZN Vegetation Types: targets, statistics and conservation status (December 2014). Unpublished report, Biodiversity Research and Assessment, Ezemvelo KZN Wildlife

Macfarlane, D.M., Bredin, I.P., Adams, J.B., Zungu, M.M., Bate, G.C. & Dickens, C.W.S. 2014. Preliminary Guideline for the determination of buffer zones for rivers, wetlands and estuaries. Final Consolidated Report. WRC Report No TT 610/14, Water Research Commission, Pretoria.

Mucina, L. & Rutherford, M.C. 2006. Vegetation Map of South Africa, Lesotho and Swaziland, edn 2, 1:1 000 000 scale sheet maps. South African National Biodiversity Institute, Pretoria. ISBN 978-1-919976-42-6.

Ollis, D.J., Snaddon, C.D., Job, N.M. & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria.

Republic of South Africa, 1998. National Water Act (Act No. 36 of 1998). (As amended).

Rijn, J., Rivera, G., 1990. Aerobic and anaerobic biofiltration in an aquaculture unitnitrite accumulation as a result of nitrification and denitrification. Aquacult. Eng. 9, 217–234.

Rijn, J., Barak, Y., 1998. Denitrification in Recirculating Aquaculture Systems: From Biochemistry to Biofilters. Recirculating Aquaculture, Roanoke, Virginia, Virginia-Tech.

van Rijn, J., Tal, Y., Schreier, H.J., 2006. Denitrification in recirculating systems: theory and applications. Aquacult. Eng. 34, 364–376.

Scott-Shaw, C.R and Escott, B.J. (Eds) (2011) KwaZulu-Natal Provincial Pre-Transformation Vegetation Type Map – 2011. Biodiversity Conservation Planning Division, Ezemvelo KZN Wildlife, P. O. Box 13053, Cascades, Pietermaritzburg, 3202.

Schulze, R. 1997. South African atlas of agrohydrology and climatology. WRC Report No TT82/96. Pretoria: Water Research Commission.

Schulze, R. 2007. South African atlas of climatology and agrohydrology. WRC Report No. 1489/06. Water Research Commision. Pretoria. RSA.

APPENDIX A1. MOTIVATION FOR OTHER SPECIALIST ASSESSMENTS

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TO ALL STAKEHOLDERS AND INTERESTED & AFFECTED PARTIES

05 June 2019

Motivation as to why identified specialist assessment were not conducted as per the screening report for an environmental authorization as required by the 2014 EIA Regulations – proposed development footprint environmental sensitivity.

Date screening report generated: 24/04/2019 16:37:21

Project name: Establishment of a commercial land based freshwater fish farm (Lake Qhubu Fish Farm)

It is the responsibility of the EAP to confirm the list of the identified specialist assessments and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the footprint situation.

Identified Specialists assessments:

1. Agricultural Impact Assessment

The site is fully degraded and comprises of gum tree plantation.

2. Archaeological and Cultural Heritage Impact Assessment

A Heritage Specialist was involved during project initiation, the specialist highlighted that due to the size of the site being small (2100m^2) a Heritage Assessment is not triggered in terms of the KwaZulu-Natal Heritage Act (Act No. 4 of 2008) and National Heritage Resources Act (No. 25 of 1999).

3. Palaeontology Impact Assessment

A Heritage Specialist was involved during project initiation, the specialist highlighted that due to the size of the site being small (2100m^2) a Heritage Impact Assessment is not triggered by this development in terms of the KwaZulu-Natal Heritage Act (Act No. 4 of 2008) and National Heritage Resources Act (No. 25 of 1999).

4. Terrestrial Biodiversity Impact Assessment

The site is fully degraded and comprises of gum tree plantation.

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5. Aquatic Biodiversity Impact Assessment

According to the EIA Screening Report Aquatic Biodiversity theme came out a Low Sensitivity. The Aquatic Biodiversity Impact Assessment was therefore replaced by the Wetland Habitat Assessment (attached as appendix in the Draft Basic Assessment Report).

6. Marine Impact Assessment

The site is inland and surrounded by human settlement. There are no marine activities within the 500m radius.

7. Defense Assessment

The site is fully degraded and comprises of gum tree plantation.

8. Health Impact Assessment

The site is fully degraded and comprises of gum tree plantation.

9. Socio-Economic Assessment

Socio-Economic activities of the project were assessed as part of the Basic Assessment Report.

Kind Regards

Jeffrey Maivha (EAP for the Project)
18Phando Environmental Consulting (PTY) Ltd

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PHOTO EVIDENCE OF THE FOOTPRINT

APPENDIX B. COMMENTS AND RESPONSE TABLE

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COMMENTS AND RESPONSE TABLE

Project: Lake Qhubu Intensive Land-Based Aquaculture (Fish farm), Eskhaleni, Richards Bay, uMhlathuze Local Municipality, KwaZulu-Natal

Applicant: Madlankala Primary Cooperative

Date: 28 May 2019

Ref No.: V01 (Comments on the Background Information Document and Public Meetings)

NO.	NAME & SURNAME (DATE OF COMMENT)	FORMAT OF COMMENT	ORGANISATION/I&AP	COMMENT	RESPONSE FROM EAP/SPECIALIST/APPLICANT
COMMENTS FROM AUTHORITIES					
1.0	Thembalake Sibozana (14 November 2018)	email letter	DAFF	**Concern:** information provided in the document is not sufficient for the Department to make recommendations and cannot determine how natural / protected trees will be affected by the development. The Department hereby request that ecological study should be undertaken to determine how protected trees or natural forests will be impacted upon by the proposed development.	Draft Basic Assessment Report will be compiled and forwarded to DAFF which will include all relevant information. The site is completely transformed and comprises of Gum Tree Plantation.

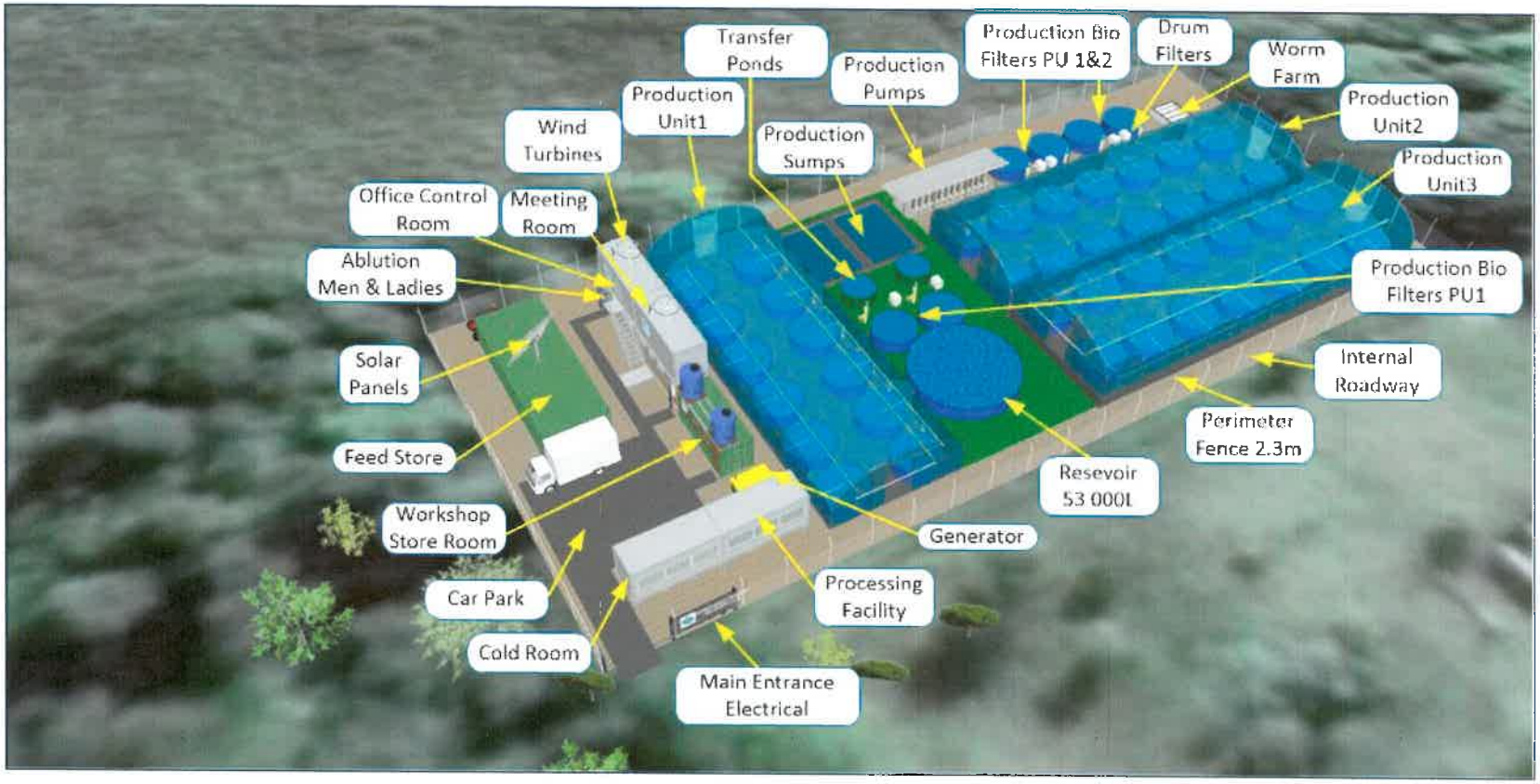
				Further the department will comment upon the receipt of the Draft Basic Assessment Report.	Draft Basic Assessment Report will be compiled and forwarded to DAFF which will include all relevant information.
2.0	Ayanda Goba (27 November 2018)	email letter	DAFF	**Concern:** referring to the satellite imagery (page 3), the proposed development would be located in close proximity to a natural watercourse. The areas bordering the proposed site seem to be utilized for agriculture and forestry with a slope range of 5% to 25%. The proposed activity may require construction of access roads and related infrastructure (i.e. bridges). Operations linked to this development may have land disturbances that may promote new infestations and further distribution of Declared Weeds and Invader Plants (DWIP). Aspects listed in 1 to 4 above may have impacts that may result to soil erosion, weakening and destruction of natural watercourses, establishment and distribution of declared weeds and invader plants. Therefore, the applicant is advised to undertake the following studies: a. Current zoning of an area earmarked for the proposed development.	The proposed development is located on the south-eastern shores of Lake Qhubu. The site is located within a Gum Tree Plantation. Access road is already available, bridge will not be required. Provisions are made in the EMPr to mitigate alien plant spp infestation. In terms of the Environmental Services Management Plan (EMSP) for the uMhlathuze Local Municipality site fall within an area classified as "Development Zone" which means the area is not critical biodiversity support area and development of the site is permitted.

				b. Soil survey (soil form, type, depth and slopes) c. Hydrology assessment (wetland and other natural watercourses) d. Vegetation Assessment (declared Weeds and Invader Plants). The studies listed in 5b, 5c and 4d above must prescribe mitigation measures to be implemented for conformity to requirements 7, 8, 14 and 15 of the Conservation of Agricultural Resources Act, 43 of 1983.	Wetland Assessment will form part of Basic Assessment Report. Re: Vegetation Assessment, the site is completely transformed and comprises of Gum tree plantation.
3.0	Induna M.T Ngwenya (01 March 2019)	Letter	Dube Traditional Council	**Concern:** The views of the Dube Traditional Council concerning the project is that the project is accepted for farming of fish at the Dube area and to bring growth in the region.	Noted
4.0	Induna K.J Dube (01 March 2019)	Letter	Dube Traditional Council	**Concern:** it is important to have variety of projects within the area so as to empower the community with skills and job creation.	Noted
5.0	Ezemvelo KZN Wildlife			No Comments received	Background Information Document was sent on the 25th October 2018
6.0	City of uMhlathuze			No Comments received	Background Information Document was sent on the 25th October 2018
7.0	uMhlathuze Water			No Comments received	Background Information Document was sent on the 25th October 2018
8.0	King Cetshwayo District Municipality			No Comments received	Background Information Document was sent on the 25th October 2018
9.0	Department of Waters & Sanitation			No Comments received	Background Information Document was sent on the 25th October 2018

10.0	Department of Transport			No Comments received	Background Information Document was sent on the 25th October 2018
11.0	Mrs J Hadebe (30 May 2019)	Cellphone call	Ward 13 Councillor	No Comments formal received yet, however via telephone call: ward councillor supports the project and the project should ensure that community receives skills and jobs.	Noted
COMMENTS FROM COMMUNITY MEMBERS					
12.0	Tata Shozi (11 May 2019)	Public meeting	Community member	**Concern:** You say there will be a reserve tank for water, does that mean you will be discarding used water or do you have a plan to clean used water?	Tank will be for temporary water storage that will be extracted from Lake Qhubu. This project will utilize the RAS system, meaning water will circulate in the system and no used water will be disposed.
12.1	Tata Shozi (11 May 2019)	Public meeting	Community member	**Concern:** You also spoke about have approximately 40 000 fish in the farm, will you be taking that directly from the Cubhu Lake or will you bring your own from somewhere?	Initial or start-up fish will be obtained from fish suppliers, as the project progresses initial fish will breed more fish.
12.2	Nosimilo Mbhense (11 May 2019)	Public meeting	Community member	**Concern:** There are people who are already fishing in the lake, does this project mean that they will be stopped? Will you be arresting them now?	The people currently fish in the lake are contravening the law (i.e. illegal fishing). This project will bring relief hence community will be able to buy fish from this project and no longer have to illegally fish in the lake.
12.3	Dudu Nala (11 May 2019)	Public meeting	Community member	**Concern:** When operations start will the project be looking to employ only people with qualifications in fisheries and agricultural sector or do we as normal citizens also stand a chance to be employed.	Surrounding communities will be prioritized for employment. The project will employee both skilled and non-skilled personnel. Training on aquaculture will be provided to non-skilled personnel.

				The reason I'm asking is, as we are here as members of the community we might give the project a go ahead only for it to benefit people from other areas more than us in terms of employment.	Nearby community will be prioritized for employment.
12.4	Tata Shozi (11 May 2019)	Public meeting	Community member	**Concern:** I have no objections, I want to see the project go forward with great success	Noted
12.5	Nosimilo Mbhense (11 May 2019)	Public meeting	Community member	**Concern:** I also say let the project go forward as it looks like it will assist in fighting unemployment in the area	Noted
12.6	Mr Lindani (11 May 2019)	Public meeting	Community member	**Concern:** I would like to see the project go forward	Noted
12.7	Sboh Shozi (11 May 2019)	Public meeting	Community member	**Concern:** I have no objections to this project, if I had powers the project would be up and running already	Noted
COMMENTS FROM I&AP					
13.0	WESSA			No Comments received	Background Information Document was sent on the 25th October 2018
14.0	RBCAA			No Comments received	Background Information Document was sent on the 25th October 2018
15.0	uMhlathuze Water Stewardship Partnership (uWASP)			No Comments received	Background Information Document was sent on the 25th October 2018

APPENDIX C. LAYOUT


Transfer Ponds
Production Bio Filters PU 1&2
Drum Filters
Worm Farm
Production Pumps
Production Unit1
Production Unit2
Wind Turbines
Production Sumps
Production Unit3
Office Control Room
Meeting Room
Ablution Men & Ladies
Production Bio Filters PU1
Solar Panels
Internal Roadway
Perimeter Fence 2.3m
Feed Store
Resevoir 53 000L
Workshop Store Room
Generator
Car Park
Processing Facility
Cold Room
Main Entrance Electrical

APPENDIX D. SITE PHOTOS

PHOTOS OF THE SITE