AQUATIC RESOURCES MONITORING PROGRAM AND AUDITING PLAN

Strubensvalley Ext. 24

Proponent:
RENICO
Project Reference:
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Declaration of Independence

Specialist Name	Mr. P. Singh
Declaration of Independence	I declare, as a specialist appointed in terms of the National Environmental Management Act (Act No 108 of 1998) and the associated 2014 Environmental Impact Assessment (EIA) Regulations, 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 report relevant to this application, including knowledge of the Act, 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 48 and is punishable in terms of section 24F of the Act.
Signature	
Date	22 July 2021

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Executive Summary

Prism Environmental Management Services was requested by **RENICO** to develop an Aquatic Resources Monitoring and Auditing Plan. Monitoring programs can measure the success of mitigation measures, monitor unforeseen impacts, and can be used as a feedback system to adjust or correct management of the aquatic resource. This Monitoring Program aims to highlight environmental aspects that require monitoring based on findings from the specialist studies, and at the discretion of the aquatic specialist. This, to suggest the appropriate monitoring requirements by informing the Environmental Impact Assessment (EIA) and Water Use License Application (WULA) for the said development.

Southern Africa has freshwater biodiversity that is highly diverse and of great importance to livelihoods and economies. However, the conservation and importance of these aquatic ecosystems are often disregarded during the development planning process, and subsequently development is often not compatible with conservation of these resources. The value of the goods and services derived from freshwater ecosystems include essential products such as food and drinking water but many anthropogenic activities have led to the rapid decrease in the state of these resources (Darwall, et al., 2009). Due to the rapid population growth rate in Africa and the increased demand for safe drinking water and sanitation there is a potential large-scale impact to freshwater biodiversity. Action and mitigation are required to assess the status of freshwater ecosystems and to integrate that information into the water development planning process. This information is critical to minimise or mitigate significant impacts to freshwater biodiversity and the subsequent loss to livelihoods and economies which are dependent on these goods and services (Darwall, et al., 2009). Monitoring programs (including auditing plans) can measure the success of mitigation measures, monitor unforeseen impacts, and can be used as a feedback system to adjust or correct management of the aquatic resource.

Conclusion

This Monitoring Program aims to highlight environmental aspects that require monitoring based on findings from the specialist studies, at the discretion of the aquatic specialist. This, to suggest the appropriate monitoring requirements in the Water Use License. The recommended monitoring requirements are summarised in the Table 9 (Section 4: Recommended Monitoring Requirements). The aquatic resources to be monitored includes SV24_UCVB (unchanneled valley bottom wetland). The relevant monitoring tools mentioned in this document will provide the necessary information regarding the impacts associated with the proposed construction and with this information, it will be possible to monitor the extent of the impacts on various aspects of the associated wetland/aquatic ecosystems. The final monitoring requirements is subject to the discretion of the Department of Water and Sanitation. The necessary mitigation measures can be developed according to the information that will be gathered using the monitoring tools discussed in this document. Monitoring programs can measure the success of mitigation implementations, monitor unforeseen impacts, and can be used as a feedback system to adjust or correct management of the aquatic resource.

Table 10: Recommended Monitoring requirements for the development.

Monitoring Program		Monitoring Requirements and Deliverables
1.	**Wetland Assessment**	**Aspects**: Present Ecological State, Ecological Importance and Sensitivity, Recommended Ecological Category. Photographic record **Survey Point**: • Wetlands and buffer areas **Sampling Frequency**: • One (1) Post-construction/rehabilitation assessment. **Reporting Frequency**: • Once off **Submission to Client**: 30 days after Site assessment.
2.	**ECO Site Inspections**	**Aspects**: Site condition of sensitive areas; litter and pollution; storage of building material and waste; condition and functioning of bridge; site photographs; non-compliances with Environmental Authorisation and Water Use License/General Authorisation; threats to sensitive areas. Conditions of the EMPr. **Survey Point**: • Sensitive areas (wetland and buffer areas) • Storage and laydown areas (waste, building materials, etc.) **Survey Frequency**: • Preconstruction Phase – Once • Construction Phase – Weekly • Post construction - Once **Reporting Frequency:** • Phase dependent. Monthly reporting for weekly inspections. **Submission to Client**: 30 days after last survey.
3.	**Water Use License Compliance Audit**	**Aspects**: Dependent on Water Use License conditions. **Survey Point (s)**: • As required by the Water Use License. **Survey Frequency**: • As required by the Water Use License. • Recommended frequency – Annual Audit **Reporting Frequency:** • As required by the Water Use License. • Closure audit (within 6 months of construction completion) **Submission to Provincial Head**: 30 days after Audit.
4.	**Rehabilitation Audit**	**Aspects**: Site condition of sensitive and rehabilitated areas. Effect of the Rehabilitation effort before, during and after rehabilitation comparisons. **Survey Point (s)**: • Sensitive areas (Wetland and Buffer Areas)

		• Rehabilitated areas **Survey Frequency**: • Preconstruction Phase – Once • Construction Phase – Once • Post construction - Once **Reporting Frequency:** • Phase dependent. • Closure audit (within 6 months of rehabilitation completion) **Submission to Client**: 30 days after last survey.

Recommendations:

- Reference should be made to the Wetland Assessment Report (22040_WPES_1) (Botha, 2021), Ecological Habitat Assessment Report (22040_ECOL_1) (Van Wyk & Meintjes, 2021) and the Rehabilitation Plan (22040_REHAB_1) (Singh, 2021) for detailed/further mitigation measures.
- It should be attempted to preserve current wetland function:
  - Wetland drivers should be protected.
  - Water quality preservation is key.
- It is recommended that a silt curtain be used where possible to contain increased turbidity and limit the extent of the impact during construction. Silt curtains can be used to contain re-suspended sediment to a smaller area;
  - Particular attention must be paid to controlling soil erosion as siltation will impact on sensitive aquatic habitats downstream of the site;
- Adequate storm-water management which won't aggravate the erosion of the banks/slopes must be provided;
- An Environmental Control Officer (ECO) should be present to facilitate aquatic resource habitat rehabilitation efforts;
- The ECO should be experienced and qualified in general rehabilitation measures and how to identify current, emerging and potential problems;
- The footprint of the development during the construction phase should be kept as small as possible by limiting construction vehicles to designated roadways;
- The unnecessary removal of wetland and terrestrial vegetation must be avoided;
- The dumping of any excess building material or refuse must be prohibited within the wetland and buffer zones;
- Adequate ablution facilities must be provided in order to prevent construction crews defecating in the wetland and buffer zones, and must be placed outside the delineated buffer area.
- No fires are permitted in the wetland and buffer zones, or the use of vegetation thereof being used to make fires;
- No trapping, killing or poisoning of any wildlife should be allowed on site;
- All exotic vegetation identified must be managed and removed routinely and appropriately, in attempts to reduce the impacts of exotic species.

- Waste management must be a priority and all waste must be collected and stored adequately. It is recommended that all waste be removed from site on a weekly basis to prevent rodents and pests entering the site.
- Adequate signage should be erected that raises awareness about possible fauna, protected areas and delineations in the area.
- Staff should be educated about the sensitivity of floral and faunal species and measures should be put in place to deal with any species that are encountered during the construction process. The intentional killing of any animals including snakes, insects, lizards, birds or other animals should be strictly prohibited.

Follow-up surveys are recommended to potentially identify emerging impacts following post-construction within wetland areas. This is important to implement any further mitigatory measures required for emerging problems (e.g. soil erosion forming through poor storm-water management feature design, re-establishment and encroachment of exotic vegetation, impedances of wetland drivers, etc.). The appointed ECO should be well-versed in identifying potential emerging environmental concerns.

The relevant monitoring tools mentioned in this document will provide the necessary information regarding the associated impacts. The monitoring tools may be used to determine the baseline state of the different ecosystems. By doing this, the bio-monitoring data can be measured against the data obtained during the baseline state. Any changes can then be recorded. With this information it will be possible to monitor the extent of the impacts on various aspects of the associated aquatic ecosystems. The necessary mitigation measures can be developed according to the information that will be gathered using the monitoring tools discussed in this document.

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1. Introduction

Prism Environmental Management Services was requested by **RENICO** to develop an Aquatic Resources Monitoring and Auditing Plan. Monitoring programs can measure the success of mitigation measures, monitor unforeseen impacts, and can be used as a feedback system to adjust or correct management of the aquatic resource. This Monitoring Program aims to highlight environmental aspects that require monitoring based on findings from the specialist studies, and at the discretion of the aquatic specialist. This, to suggest the appropriate monitoring requirements by informing the Environmental Impact Assessment (EIA) and Water Use License Application (WULA) for the said development.

Southern Africa has freshwater biodiversity that is highly diverse and of great importance to livelihoods and economies. However, the conservation and importance of these aquatic ecosystems are often disregarded during the development planning process, and subsequently development is often not compatible with conservation of these resources. The value of the goods and services derived from freshwater ecosystems include essential products such as food and drinking water but many anthropogenic activities have led to the rapid decrease in the state of these resources (Darwall, et al., 2009). Due to the rapid population growth rate in Africa and the increased demand for safe drinking water and sanitation there is a potential large-scale impact to freshwater biodiversity. Action and mitigation are required to assess the status of freshwater ecosystems and to integrate that information into the water development planning process. This information is critical to minimise or mitigate significant impacts to freshwater biodiversity and the subsequent loss to livelihoods and economies which are dependent on these goods and services (Darwall, et al., 2009).

1.1 Project Description

RENICO is intending to develop a residential township on Erf 1327 and 1328, **Strubensvallei Ext 24**. The development will be zoned for residential use. The site extends from North to South along Christiaan de Wet Road and falls under jurisdiction of City of Johannesburg (CoJ).

The proposed development involves the development of several Residential 3 units on approximately 1,97 hectares in extent, Erf 1327. In addition, the proposed development also involves the provision of all necessary services to the development including water, sanitation, stormwater and internal roads.
The site is also affected by the proposed development of the intersection with Christiaan de Wet Road and the Metro Boulevard. Same does not form part of the application for this development but, must be kept in mind as part of the development layout and aspects to be assessed.

1.2 Specialist Studies

The Wetland (Botha, 2021) and Ecological (Van Wyk & Meintjes, 2021) field investigations were undertaken during **November 2020** to assess and confirm the delineated Wetland zones and to better understand the potential sensitivities present on the survey area/study site. Conclusions from the specialist studies are presented in Table 1 below.

Table 1: Conclusions from specialist studies.

Findings and Conclusions from Specialist Studies
Wetland Assessment (Botha, 2021)
The field investigation concluded that one (1) natural wetland system. The following HGM units were observed: • SV24_UCVB – Unchanneled Valley Bottom Wetland - was found on the valley floor close to the head of the catchment, draining towards the West. The wetland attained a moderate overall PES (Present Ecological State). The overall wetland, ecological status was found to be moderately modified (**PES - C**). A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact. This wetland system is impacted by historical activities both in the catchment as well as directly on the wetland system where the impacts are continues. It forms part of a larger wetland system. The trajectory of change for the wetland ecological status is predicted that conditions are likely to deteriorate slightly over the next 5 years without major intervention. The wetland attained a Moderate Ecological Importance and Sensitivity (EIS) score (EIS - C). The Unchanneled Valley Bottom Wetland is considered ecologically important and sensitive on a local scale. The biodiversity of this wetland is generally not sensitive to flow and habitat modifications. It plays a small role in moderating the quantity and quality of water of major rivers. The system drains into further downstream wetland and streams before reaching major rivers. The Ecological Importance and Sensitivity (EIS) for this system is thus considered to be Moderate. The wetland Recommended Ecological Classification (REC) classification was rated as Category C. The wetland will be impacted to some extent by the proposed development activities, but a major impact is envisaged for the future road upgrades planned (Metro Boulevard Intersection). This impact will be localised and at the transitional point leading from the development and infrastructure installations into the wetland and buffer area. It will in all likelihood regress slightly in terms of its current Ecological Category if not managed in specific during the construction period. Stormwater management for the site is required in specific the construction phase. This will mitigate the impact on the wetlands. Rehabilitation of the impacts and maintenance of the system will further mitigate the impacts and could improve the sustainability of the system. Concluded from the results presented in this document, the construction activities will in all likelihood impact slightly on the wetland system but can be mitigated to satisfactory standards if all mitigatory actions are implemented with due care. It is key to preserve water quality and supply to the downstream aquatic resources. In respect of the construction phase, it is important to ensure that the required erosion protection measures linked to the wetland intersecting sections be carefully designed and installed. The project can be supported, should all the mitigation measures be implemented and monitored against to ensure compliance and protection of the aquatic resource.

Ecological Assessment (Van Wyk & Meintjes, 2021)
From a desktop perspective, the proposed development site occurs within the Egoli Granite Grassland (Endangered) vegetation type as depicted on the Geographic Information Systems (GIS) layers. In terms of the site assessment, the site was actively surveyed to determine the current status of the habitats on site. Two main habitat types were identified within the study site, namely, Disturbed Vegetation and Grassland Areas. The site assessment undertaken indicated that whilst from a desktop perspective, the site falls within this endangered vegetation type, the vegetation found on site is not representative of the Egoli Granite Grassland and therefore does not hold any conservational value. Further, due to the ongoing anthropogenic activities in and around the study area, lack of habitat and breeding ground and presence of feral animals, the possibility for any of these species to be found on site is low. The impacts on flora and fauna are considered as low-medium. Two Species of Conservation Concern were identified on site, namely *Hypoxis hemerocallidea* and *Boophone disticha*. Whilst these species are classified as “Least Concern” in terms of Red Data List, GDARD has confirmed that they should be considered as “Orange List” species in Gauteng due to provincial level pressures. Therefore, in order to mitigate impacts to these species, a Search and Rescue and Relocation Plan has been devised. Impacts to these species are expected to be low with the implementation of the necessary mitigation. The study area is regarded as **low-medium sensitivity**. The study area is disturbed in terms of aspects such as human activities in the study site, presence of alien invasive species on site and minimum habitat for most fauna species. The site does not constitute Egoli Granite Grassland and no additional terrestrial sensitivities were identified. It is recommended that no development or construction activities should occur within or within close proximity of the wetland area. It is therefore also recommended that the location for the attenuation dam should be outside of the wetland area as depicted in the proposed layout., With the implementation of the necessary mitigation measures contained in the Environmental Management Programme (EMPr) it is the professional opinion of the ecologist that the development should be supported.

1.3 Project Location

The proposed development is located on **Erf 1327**, **Strubensvallei Ext 24**, City of Johannesburg (CoJ), Gauteng Province (*here after referred to as the study site/s*) (Figure 1). The study site measures approximately 1,97 ha and is located in quaternary catchment A21E in the Limpopo Water Management Area (WMA 1) (Figure 2). The study area falls within the Grassland Biome (Biome 06), the Highveld Level-1 Ecoregion (Ecoregion 11) (Kleynhans, et al., 2005) (Figure 3). The wetland delineation in relation to the study site is presented in Figure 4.

1.4 Terms of Reference

Prism Environmental Management Services was requested by **RENICO** to develop an Aquatic Resources Monitoring Program and Auditing Plan to suggest the appropriate monitoring requirements by informing the Environmental Impact Assessment (EIA) and Water Use License Application (WULA) for the said development. Monitoring programs can measure the success of mitigation implementations, monitor unforeseen impacts, and can be used as a feedback system to adjust or correct management of the aquatic resource.

The aquatic resource monitoring program was developed in accordance with the requirements as per the Department of Water and Sanitation. The aquatic resource monitoring methods were based on previous experience on similar projects and developments.

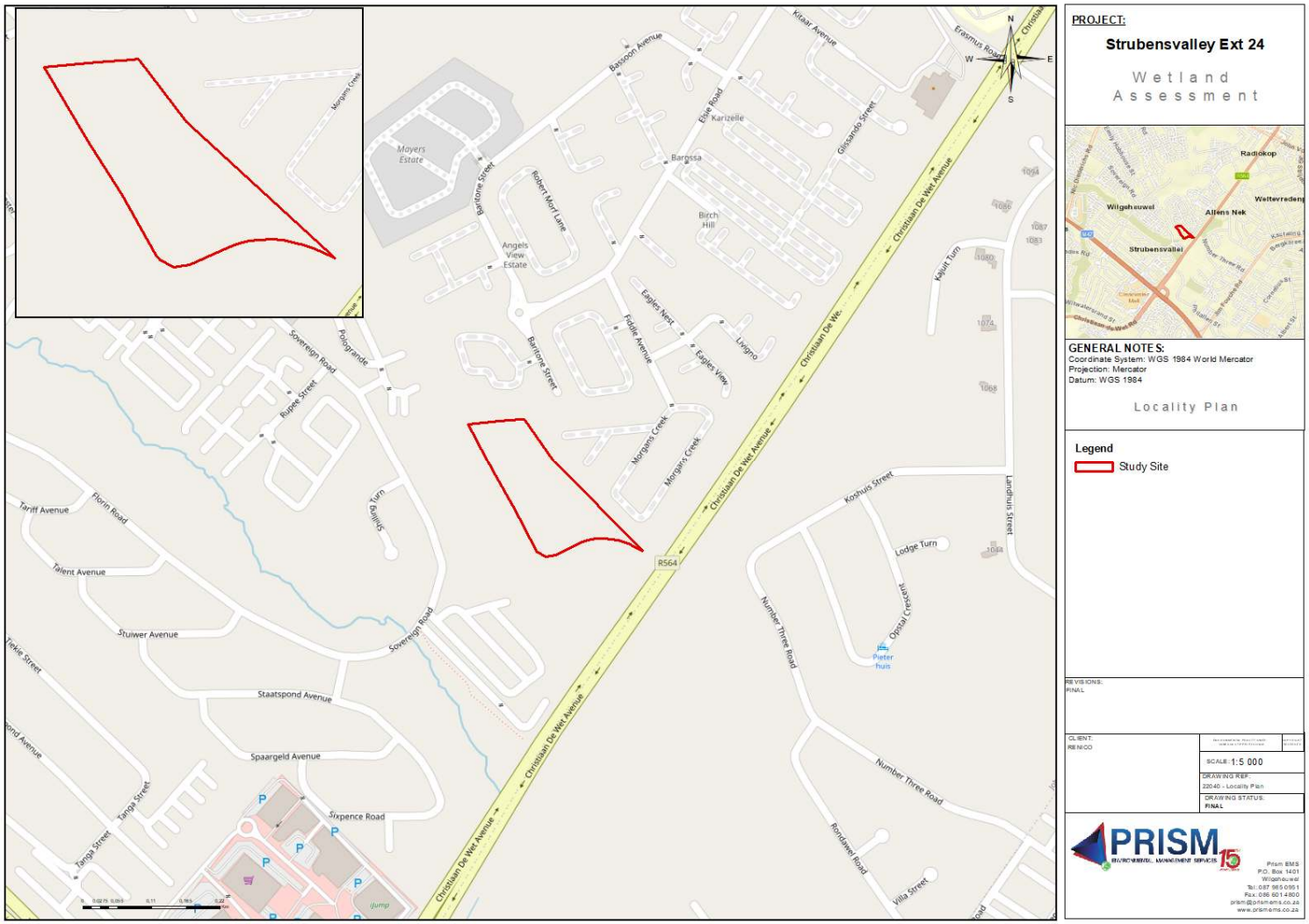

Figure 1: Locality map of the proposed development/study site.

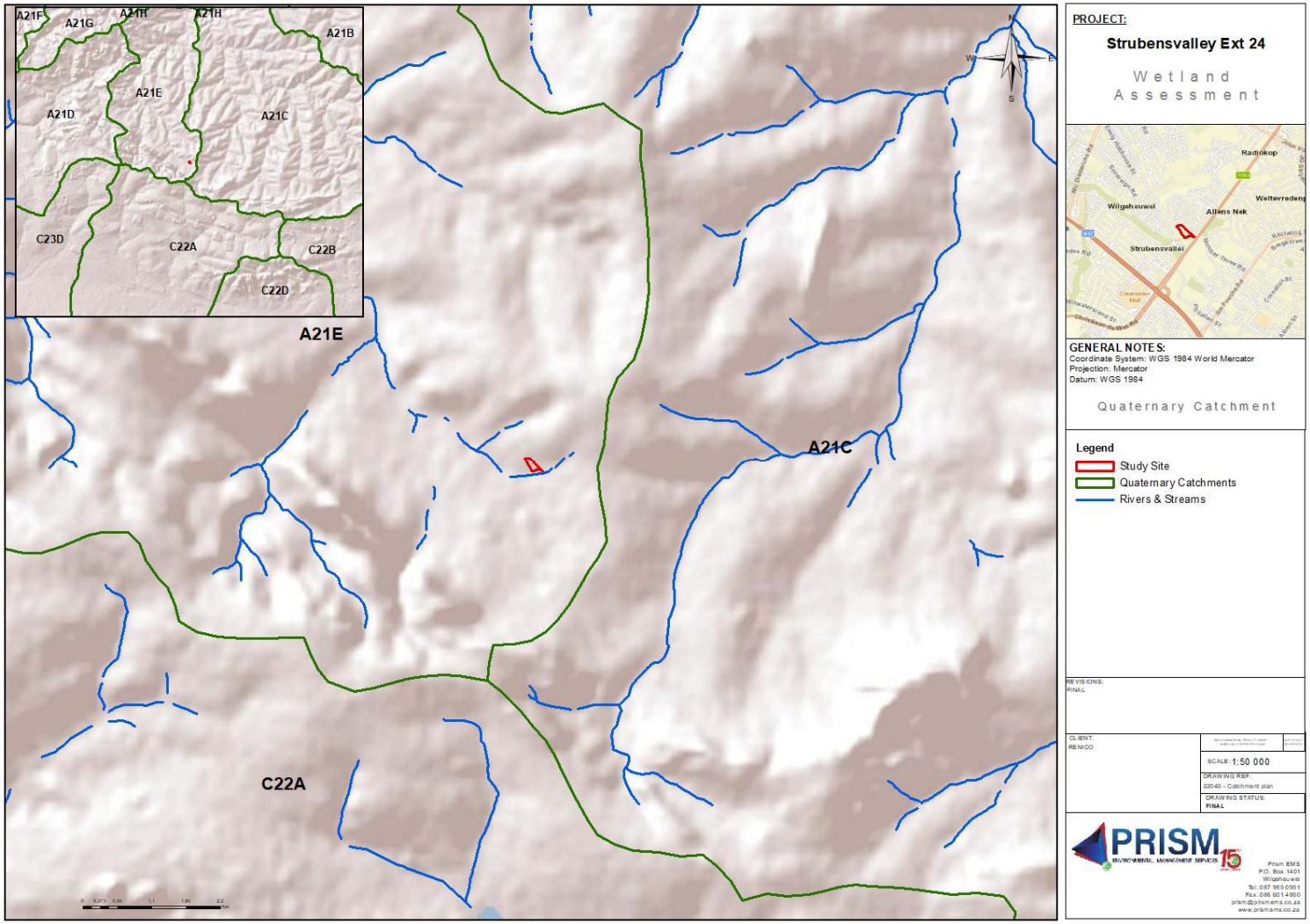

Figure 2: Map of the catchment areas.

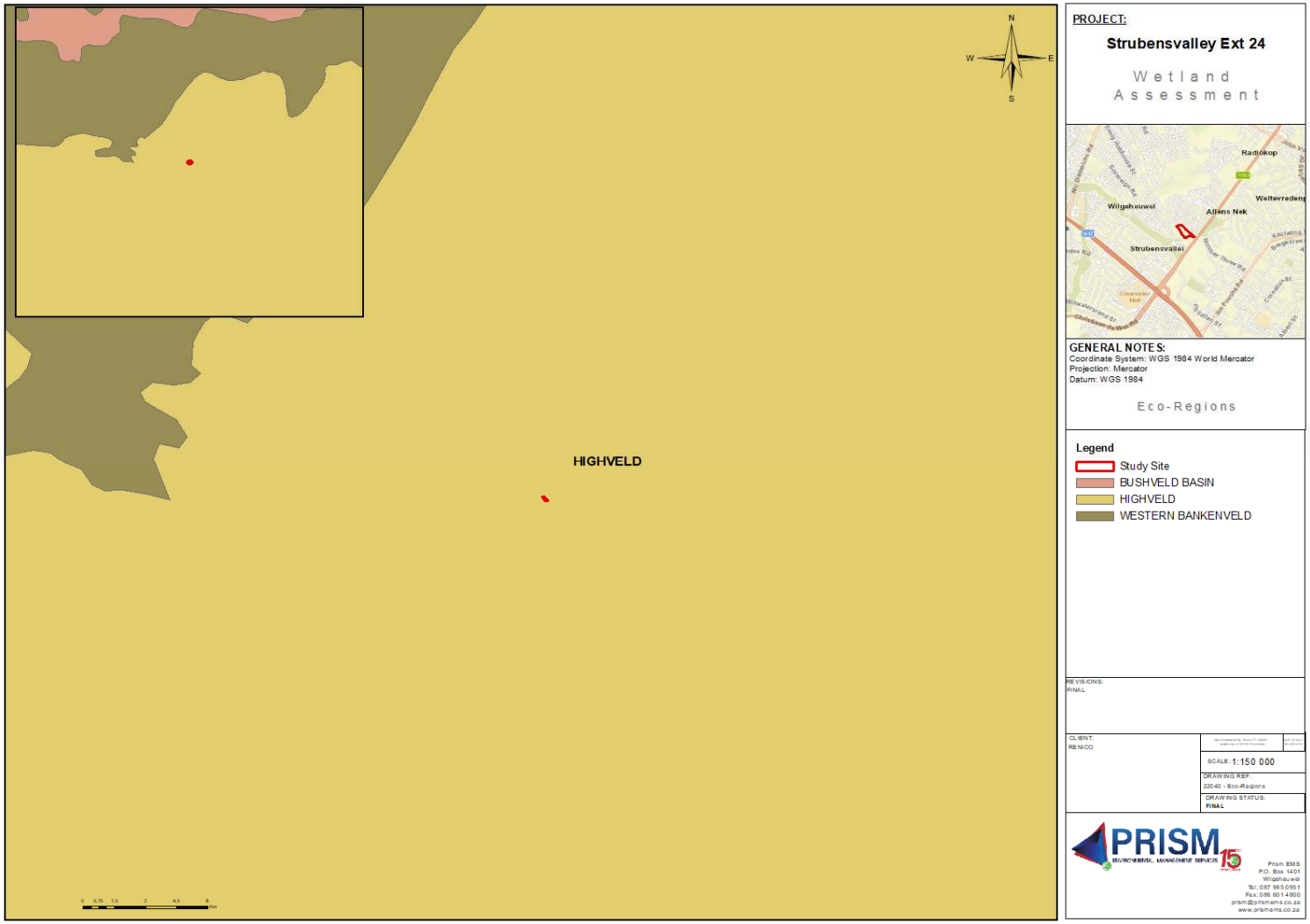

Figure 3: Map of Eco-regions.

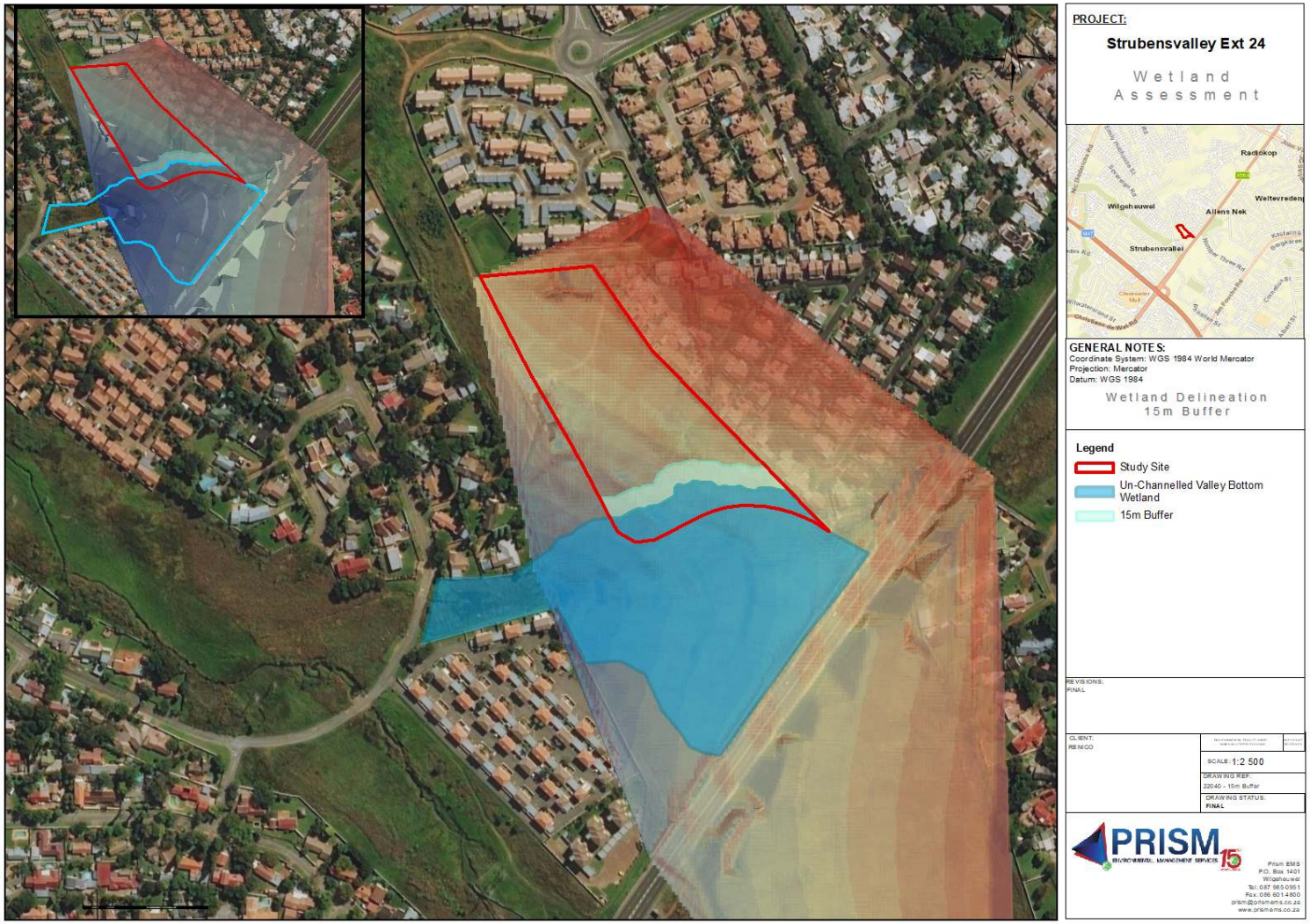

Figure 4: Locality map illustrating the site boundary, aquatic resources, and sensitivity buffers.

2. Literature Review

2.1 Legislation

2.1.1 National Water Act (Act 36, 1998)

2.1.1.1 *General:*

- Internationally regarded as the most advanced water legislation in the world, specifically in terms of environmental protection;
- Equity (water for everyone) and sustainability (long-term protection of resources) are its main principles; and
- Balance between use and protection (sustainability).

2.1.1.2 *Purpose and intent:*

To ensure that the nations natural resources are protected, used, developed, managed and controlled in a way that takes into account, amongst others – see section 2 of the Act -

- meeting basic human needs both present and future;
- promoting equitable access;
- facilitating social and economic development; and
- protecting ecosystems and biodiversity;
    - Balance between social development and equal access to water, economic growth and maintaining ecological integrity;
    - Focus on long term benefits for society;
    - Protection of the water resource to ensure sustainable use;
    - Does not aim to at all costs prevent impacts to the water environment (since this may inhibit much-needed economic development); but
    - Instead aims to achieve the right balance between use and protection of water resources (i.e. sustainable use).

DWS assumes public trusteeship of the nation's water resources. ***Water resource: includes a watercourse, surface water, estuary or aquifer***. ***Watercourse: means***-

a) ***a river or spring***;
b) ***a natural channel*** in which water flows regularly or intermittently;
c) ***a wetland, lake or dam*** into which, or from which, water flows, and
d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

Protection: in relation to a water resource, means—

a) ***maintenance of the quality*** of the water resource to the extent that the water resource may be used in an ecologically sustainable way;
b) ***prevention of the degradation*** of the water resource; and
c) the ***rehabilitation*** of the water resource.

2.1.1.3 *Section 21: Water Use*

For the purposes of this Act, ***water use includes***--

(a) taking water from a water resource;
(b) storing water;
(c) *impeding or diverting the flow of water in a watercourse*;
(d) engaging in a stream flow reduction activity contemplated in Section 36;
(e) engaging in a controlled activity identified as such in Section 37(1) or declared under Section 38(1);
(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
(g) disposing of waste in a manner which may detrimentally impact on a water resource;
(h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
(i) *altering the bed, banks, course or characteristics of a watercourse*;
(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
(k) using water for recreational purposes.

2.1.1.4 *Section 22: Permissible water use:*

(1) A person may only use water--
  a. without a license--
    (i) if that water use is permissible under Schedule 1;
    (ii) if that water use is permissible as a continuation of an existing lawful use; or
    (iii) if that water use is permissible in terms of a general authorisation issued under Section 39; ***(It is important to note that at the present time there are no General Authorisations*** [section 22(1) a (iii)] ***relating to any wetlands)***
  b. if the water use is authorised by a license under this Act; or
  c. if the responsible authority has dispensed with a license requirement under subsection (3).

(3) A responsible authority may dispense with the requirement for a license for water use if it is satisfied that the purpose of this Act will be met by the grant of a license, permit or other authorisation under any other law.

(4) In the interests of co-operative governance, a responsible authority may promote arrangements with other organs of state to combine their respective license requirements into a single license requirement.

Essentially then, **to utilise a water resource** (water, river channel, riparian area or wetland) **one needs a water license from DWA(DWS) unless:**

- the activity was existing and lawful prior to the act (i.e. before 1998);

- the activity is included in the Schedule 1 activities (domestic use, stock watering, emergencies, recreation, portage, discharge into a canal – refer below for more detail) or General Authorisations (there are none applicable to wetlands); or
- the need for a license has been dispensed with by the relevant authority (under section 22, subsection 3).

2.1.2 Sustainable Utilisation of Agricultural Resources (draft legislation)

The objects of this Act are to provide for:

(a) the optimum productivity and sustainable utilisation of natural agricultural resources;
(b) the control of weeds or invader plants; and
(c) the control over the subdivision and change of utilisation of agricultural land.

Specifically related to wetlands and riparian areas:

Chapter 4: standards and control measures: Standards and control measures may relate to-

(a) the cultivation, utilisation and conservation of natural agricultural resources of agricultural land including State owned land;
(b) the irrigation of agricultural land;
(c) the prevention or control of the waterlogging or salinisation of agricultural land;
(d) the utilisation and conservation of wetlands, water sources and water courses;
(e) the regulation of the flow pattern of run-off water;
(f) the utilisation and conservation of vegetation;
(g) the restoration or reclamation of agricultural land;
(h) the protection of natural agricultural resources against pollution;
(i) the planning, design, construction, maintenance, alteration or removal of soil conservation works or other structures on agricultural land and the control of weeds and invader plants and bush encroachments.

2.1.3 CARA (Conservation of Agricultural Resources Act – 1983)

Regulation 7: Utilisation and protection of vlei, marshes, water sponges and watercourses

Subject to the provisions of the Water Act, 1956 (Act 54 of 1956) - repealed by the National Water Act, 1998 (Act 36 of 1998) - and sub-regulation (2) of this regulation,

- no land use shall utilise the vegetation in a vlei, marsh or water sponge or within the flood area of a watercourse or within 10 meters horizontally outside the flood area in a manner that causes or may cause the deterioration of or damage to the natural agricultural resources;

Except on authority of a written permission by the executive officer, no land user shall

- drain or cultivate any vlei, marsh or water sponge or a portion thereof on his farm unit; or
- cultivate any land on his farm unit within the flood area of a watercourse or within 10 meters horizontally outside the flood area of a watercourse.

The prohibition contained in sub-regulation (3) shall not apply in respect of:

- a vlei, marsh or water sponge or a portion thereof that has already been drained or is under cultivation on the date of commencement of these regulations, provided it is not done at the expense of the conservation of the natural agricultural resources; and
- land within the flood area of a watercourse or within 10 meters horizontally outside the flood area of a watercourse that is under cultivation on the date of commencement of these regulations, provided it is already protected effectively in terms of regulation (4) against excessive soil erosion through the action of water.

Regulation 8: Regulating the flow pattern run-off water

Subject to the provisions of the Water Act, 1956 (Act 54 of 1956) – repealed by the Water Act, 1998 (Act 36 of 1998), no land user shall in any manner whatsoever divert any run-off water from a water course on his farm unit to any other water course, except on authority of a written permission by the executive officer.

No land user shall effect an obstruction that will disturb the natural flow pattern of run-off water on his farm unit or permit the creation of such an obstruction unless the provision for the collection, passing through and flowing away of run-off water through, around or along that obstruction is sufficient to ensure that it will not be a cause for excessive soil loss due to erosion through the action of water or the deterioration of the natural agricultural resources.

2.1.4 NEMA (National Environmental Management Act, 1998)

The new NEMA regulations (Republic of South Africa, 1998b) have narrowed the spectrum of activities requiring an EIA application process and are more specific in describing the listed activities. The new regulations include activities previously omitted. The NEMA regulations also differentiate between a basic and a thorough assessment, the process allows for upfront decision making (e.g. fatal flaws, emergency circumstances and clearly no/very small impact situations) and it prescribes time frames for evaluation.

Specific listed activities in terms of this Act (Government Gazette of 18 June 2010, no. 544, 545 & 546), require authorisation and are related to the National Water Act, 1998 section 21 (c) and (i).

2.2 Wetlands

The generic term 'wetland' is used worldwide and includes specific ecosystems such as bogs, coastal lakes, estuaries, fens, floodplains, mangroves, marshes, mires, moors, pans, peatlands, seeps, sloughs, springs, swamps, vlei and wet meadows (Mays, 1996; DWAF, 2005). The main driving force of all wetlands is the interplay between land and water, and the consequent characteristics that reflect both (Cowan, 1999). Any part of the landscape where water accumulates for long enough and often enough to influence the plants, animals and soil occurring in that area, is referred to as a wetland (DWAF, 2005). Wetlands comprise approximately 6% of the world's land surface and are found in every climate from the tropics to the frozen tundra (Mays, 1996).

Several definitions for wetland and riparian areas exist. Two of the most common wetland definitions used in South Africa is the National Water Act (NWA) (Act 36 of 1998) (Republic of South Africa, 1998a) and the Ramsar Convention definition (Koester, 1989):

National Water Act, Act No 36 of 1998:

> *"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."*

South Africa, being a contracting party to Ramsar, also uses the definition accepted by the convention. Article 1.1 of the convention defines wetlands as (Koester, 1989; Cowan, 1999):

> *"areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters."*

Wetlands are defined as those areas that have water on the surface or within the root zone for long enough periods throughout the year to allow for the development of anaerobic conditions. These conditions create unique soil conditions (hydric soil) and support vegetation adapted to these flood conditions.

Hydric soil develops a grey or sometimes greenish or blue-grey colour, as a result of the chemical reduction of iron (gleying). Hydric soil that are seasonally flooded are characterised by the formation of mottles, which are relatively insoluble, enabling them to remain in the soil long after it has been drained. Consequently, it is possible to identify wetland areas on the basis of soil colour, using a standard colour chart, as matrix hue and chroma decrease, while mottle hue and chroma initially increase and then decrease the more saturated the soil become (Table 2).

Table 2: Relationship between degree of wetness (wetland zone), soil-physiochemistry and vegetation (Kotze, et al., 1994).

	Degree of wetness		
	Temporary	**Seasonal**	**Permanent / Semi-permanent**
Soil Depth (0cm – 10cm)	Matrix chroma: 1-3 Few / no mottles Low / intermediate OM Non-sulphuric	Matrix chroma: 0-2 Many mottles Intermediate OM Seldom sulphuric	Matrix chroma: 0-1 Few / no mottles High OM Often sulphuric
Soil Depth (40cm – 50cm)	Few / many mottles Matrix chroma: 0-2	Many mottles Matrix chroma: 0-2	No / few mottles Matrix chroma: 0-1
Vegetation	Predominantly grass species	Predominantly sedges and grasses	Predominantly reeds and sedges

Vegetation distribution within wetlands is related to the water regime. Terrestrial plants are not tolerant of water saturation within the root zone for periods long enough to cause anaerobic conditions, and are thus found on drier soil. The distribution of wetland plants is related to their tolerance of different flooding conditions, and their distribution within a system can be used as an indication of the wetness of an area.

Typically, indicators of soil wetness based on soil morphology correspond closely with vegetation distribution, since hydrology affects soil and vegetation in systematic and predictable ways. However, in systems where the hydrological regime has been modified due to human activities, vegetation distribution will not vary systematically with soil morphology. The response of vegetation to alteration of hydrological conditions is rapid (months/years), whereas the response of soil morphology to such alteration is slow (centuries). As an example, lowering of the water table or reduction of surface flows, may lead to rapid establishment of terrestrial vegetation, whereas the soil morphology will retain indicators of wetness for a lengthy period. Soil morphology forms the basis of wetland delineation nationally, following international protocols, mainly because it provides a long-term indication of the "natural" hydrological regime. However, soil morphology cannot be considered to necessarily reflect the current hydrological conditions of the site where the hydrological regime has been altered, and in such circumstances vegetation provides the best indication of the distribution of wetlands as it best reflects current hydrological conditions (Figure 5).

Wetland vegetation is adapted to shallow water table conditions. Due to water availability and rich alluvial soil, riparian areas are usually very productive. Tree growth rate is high and the vegetation under the trees is usually lush and includes a wide variety of shrubs, grasses and wildflowers.

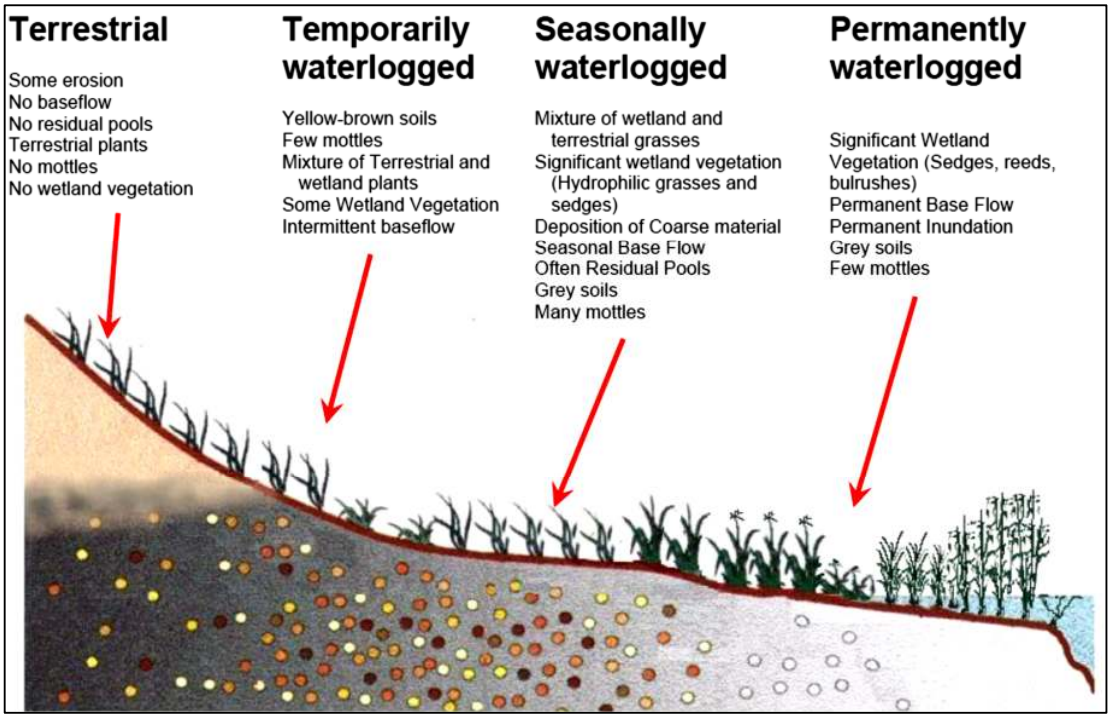

Figure 5: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change along a gradient of decreasing wetness, from the middle to the edge of the wetland. (Reproduced by Sivest from Kotze (1996), DWAF Guidelines in wetland delineation).

3. Methods

The methods listed below are the standard methods for monitoring aquatic ecosystems that will/may be impacted on by the proposed project. If the methods that are mentioned below are followed, the changes taking place within the aquatic resource can be monitored. The relevant mitigations for the associated impacts can then be developed according to the results that will be obtained, using the described methods. The results obtained will be repeatable and comparable, and the studies can be performed by different wetland and aquatic specialists. The methods described below should be performed by qualified specialists. The aquatic resource monitoring as per the methods described in this document should be conducted following the schedule listed in Section 4 (Recommended Monitoring Requirements). The final monitoring requirements is subject to the discretion of the Department of Water and Sanitation (competent authority). The site assessments should be performed as indicated in the same table, unless stated otherwise by the competent authority.

3.1 Wetland Assessment

3.1.1 WET-Health

WET-Health Version 2 consists of a series of three tools developed to assess the Present Ecological State (PES) or “ecological health” of wetland ecosystems of different hydrogeomorphic types at three different levels of detail/resolution. These tools build on previous assessment methods, including WET-Health Version 1 (Macfarlane, et al., 2008) and Wetland-IHI (DWAF, 2007), in response to the need that was identified to develop a refined and more robust suite of tools for the assessment of the PES of wetland ecosystems in South Africa. (Macfarlane, et al., 2020).

Three different levels of assessment have been developed to account for a broad range of user requirements, ranging from regional assessments involving thousands of wetlands through to detailed site-based assessments used to identify specific stressors and impacts on a single wetland for management and rehabilitation planning. In each instance, the assessment is based initially on a landcover assessment that seeks to provide an initial indication of wetland condition based on a generic understanding of the impacts of different land uses on catchment and wetland processes and characteristics. The assessment is refined for more detailed assessments by integrating finer-scale mapping, and a combination of additional desktop and site-based indicators to refine and improve the accuracy of the assessments. The following three levels of assessment are catered for in the method:

- ***Level 1A (desktop-based, low resolution)***, is an entirely desktop-based assessment and uses only pre- existing landcover data (i.e. no interpretation of aerial imagery by an assessor is required) and for which default impact intensity scores have been allocated for each component of wetland PES. In many cases, particularly when applied at a national level, it is not possible to delineate the upslope catchment of each of the individual wetlands. Instead, the landcover types in a GIS buffer around a wetland and within a “pseudo-catchment” selected to represent the true catchment (such as a sub-quaternary catchment) is used as a coarse proxy of the impacts on the wetland arising

from its upslope catchment. Impacts arising from the wetland and catchment are then integrated through structured algorithms to provide a coarse indication of wetland health.

- ***Level 1B (desktop-based, high resolution)***, is also largely desktop-based using pre-existing landcover data but makes a few finer distinctions than Level 1A in terms of landcover types and usually requires interpretation of the best available aerial imagery in order to do so. This also allows the pre-defined land- cover types to be mapped more accurately. Furthermore, the upslope catchment of each wetland can be individually delineated at this level, and landcover in this area is used as a proxy of the impacts on a wetland arising from its upslope catchment. As for Level 1A, impacts arising from within individual wetlands are inferred from landcover types occurring within the delineated wetlands.
- ***Level 2 (rapid field-based assessment)***, starts with landcover mapping, but is refined by assessing a range of catchment and wetland-related indicators that are known to affect wetland health. Impacts arising from the upslope catchment of a wetland are inferred from landcover mapping but are refined based on additional information (e.g. for plantations, the user must indicate whether the trees making up the plantations are eucalypts or pines and/or wattle). Landcover types occurring within the wetland are used as the starting point for assessing human impacts arising from within the wetland. However, this initial assessment is refined considerably by sub-dividing the wetland into relatively homogenous "disturbance units" and answering a suite of site-based wetland questions which provide a more direct assessment of change (e.g. the density, depth and orientation of artificial drainage channels, and the texture of the soil in the wetland) (Macfarlane, et al., 2020).

For the WET-Health section of the monitoring program, a **Level 2 assessment** (Macfarlane, et al., 2020) of the wetlands within the project area should be conducted. The procedure for conducting a Level 2 assessment is summarised in Figure 6.

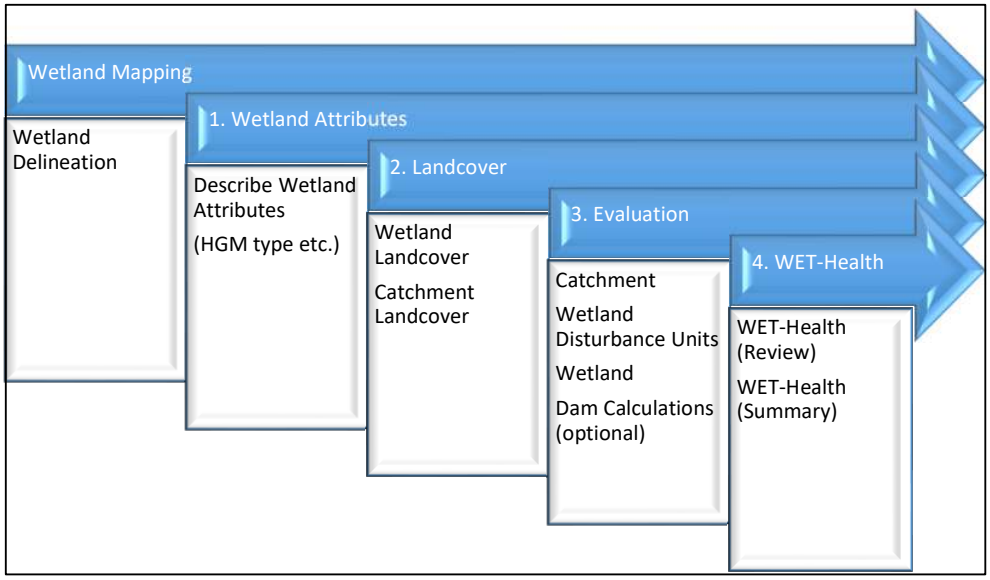

Figure 6: A stepwise outline of a Level 2 assessment (Macfarlane, et al., 2020).

3.1.1 Quantification of the Present State of the wetland

WET-Health is designed to assess the PES of a wetland by scoring the perceived deviation from a theoretical reference condition, where the reference condition is defined as the un-impacted condition in which ecosystems show little or no influence of human actions. In thinking about wetland health or PES, it is thus appropriate to consider 'deviation' from the natural or reference condition, with the ecological state of a wetland taken as a measure of the extent to which human impacts have caused the wetland to differ from the natural reference condition (Macfarlane, et al., 2020).

Whilst wetland features vary considerably from one wetland to the next, wetlands are all broadly influenced by their climatic and geological setting and by three core inter-related drivers, namely hydrology, geomorphology and water quality. The biology of the wetland (in which vegetation generally plays a central role) responds to changes in these drivers, and to activities within and around the wetland. The interrelatedness of these four components is illustrated schematically in Figure 6 below and forms the basis of the modular-based approach adopted in WET-Health Version 2 (Macfarlane, et al., 2020).

Figure 7: Diagram representing the four key components of Wetland PES considered in WET-Health Version 2 (Macfarlane, et al., 2020).

In WET-Health, the natural reference condition of a wetland is inferred from conceptual models relating to the selected hydro-geomorphic (HGM) wetland type, the selected hydro-geological type setting and knowledge of vegetation attributes of similar wetlands in the region. PES is then assessed by evaluating the extent to which anthropogenic activities have altered wetland characteristics across the four inter-related components of wetland health, as follows (Macfarlane, et al., 2020):

- **Geomorphology** in this context is assessed by assessing changes to (i) geomorphic processes and (ii) the geomorphic structure of the wetland. Geomorphic processes in this context, refers to those physical processes that are currently shaping and modifying wetland form and evolution, whilst geomorphic structure refers to the three-dimensional shape of sediment deposits on which

wetland habitat is established. Whilst catchment drivers (similar to those assessed in the hydrology module) are integrated as part of the assessment, impacts are ultimately assessed based on an understanding of the degree to which within-wetland geomorphic processes and the associated structure of the wetland have been altered by anthropogenic activities. The module also accounts for differences in geomorphic processes in wetlands characterised by clastic (minerogenic) sedimentation and those characterised by organic sediment accumulation (peat).

- **Water quality** is defined as the physico-chemical attributes of the water in a wetland. It is assessed based on considering both potential diffuse runoff from land uses within the wetland and from the areas surrounding the wetland, together with point-source discharges of pollution entering directly into the wetland and/or into streams that flow into that wetland.
- **Vegetation** is defined in this context as the structural and compositional state of the vegetation within a wetland. This module evaluates changes in vegetation composition and structure as a consequence of current and historic on-site transformation and/or disturbance. Whilst the assessor needs to have some knowledge of vegetation in a particular region, the method does not require the assessor to be able to identify all wetland plant species. The emphasis is rather on identifying alien and ruderal (weedy) species that indicate disturbance, and assessing their occurrence relative to common naturally occurring indigenous species, including those that are naturally dominant in the wetland.

The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial *extent* of impact of individual activities and then separately assessing the *intensity* of impact of each activity in the affected area (Macfarlane, et al., 2008). The extent and intensity are then combined to determine an overall *magnitude* of impact. The impact scores and Present State categories are presented in Table 3.

Table 3: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands

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

3.1.2 Trajectory of Change

The determination of the appropriate Trajectory of Change symbol for the wetland entails assigning each HGM unit a change score. Future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change. Table 4 below should be used to assess the trajectory of change (Macfarlane, et al., 2020).

Table 4: Trajectory of Change classes, scores and symbols used to represent anticipated changes to the present state of the wetland.

Trajectory class	Description	Symbol
Improve markedly	Likely to improve substantially over the next 5 years	↑↑
Improve	Likely to improve slightly over the next 5 years	↑
Remain stable	Likely to remain stable over the next 5 years	→
Deteriorate slightly	Likely to deteriorate slightly over the next 5 years	↓
Deteriorate markedly	Likely to deteriorate substantially	↓↓

3.1.3 Overall health of the wetland

Once trajectory of change has been scored, the overall health score should presented for each of the four components of “wetland health” by jointly representing the PES and likely trajectory of change. This provides a useful overall picture of the health of the wetland assessment unit. For all levels of assessment, the summaries present the final Impact Score, PES Score and Ecological Category for each of the four components of wetland PES, as well as the combined Impact Score, PES Score and Ecological Category derived by integrating the component scores. Finally, for all levels of assessment, an automatically generated confidence rating for the PES results that has been derived for each wetland assessment unit should be presented. In addition, in the case of a Level 1B and Level 2 assessment, both the unadjusted (modelled) results and the final (adjusted) results should be presented, together with the confidence ratings for the revised results and the anticipated trajectory of change symbol derived for each of the four components of wetland PES. A hypothetical example of the overall health of the wetland(s) is given in Table 5 below.

Table 5: Summary of the overall health of the wetland based on impact score and change score using a hypothetical example (Macfarlane, et al., 2020).

WET-Health Level 2 assessment: PES Summary

This worksheet provides an overall summary of the WET-Health Assessment that can be used for reporting purposes

	Wetland PES Summary
Wetland name	HYPOTHETICAL EXAMPLE
Assessment Unit	UNIT A
HGM type	Depression without flushing
Areal extent (Ha)	6.0 Ha

Unadjusted (modelled) Scores

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	5.5	1.0	7.3	4.0
PES Score (%)	45%	90%	27%	60%
Ecological Category	D	A	E	D
Combined Impact Score	4.5			
Combined PES Score (%)	55%			
Combined Ecological Category	D			
Hectare Equivalents	3.3 Ha			
Confidence (modelled results)	MODERATE-TO-HIGH: Field-based assessment including information about the regional aquifer			

Final (adjusted) Scores

PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	6.2	1.0	7.3	4.0
PES Score (%)	38%	90%	27%	60%
Ecological Category	E	A	E	D
Trajectory of change	↓	→	↑	↓↓
Confidence (revised results)	Medium	High	Low	High
Combined Impact Score	5.2			
Combined PES Score (%)	48%			
Combined Ecological Category	D			
Hectare Equivalents	2.9 Ha			

3.1.4 Wetland Ecological Importance and Sensitivity (EIS)

The ecological importance and sensitivity assessment must be conducted according to the guidelines as discussed by (DWAF, 1999). DWAF defines "ecological importance" of a water resource as an expression of its importance to the maintenance of ecological diversity and function on local and wider scales. "Ecological sensitivity", according to DWAF (1999), refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The Ecological Importance and Sensitivity (EIS) analysis provides a guideline for the determination of the Ecological Management Class (EMC).

In the method outlined by DWAF a series of determinants for EIS are assessed for the wetlands on a scale of 0 to 4 (Table 6), where 0 indicates no importance and 4 indicates very high importance. The median of the determinants is used to determine the EIS and EMC of the wetland unit (Table 7).

Table 6: Score sheet for the determination of ecological importance and sensitivity (EIS) (DWAF, 1999).

Determinant	Score*	Confidence
Primary determinants		
Rare and endangered species		
Species/taxon richness		
Diversity of Habitat types or features		
Migration route/breeding and feeding site for wetland species		
Sensitivity to changes in the natural hydrological regime		
Sensitivity to water quality changes		
Flood storage, energy dissipation and particulate/element removal		
Modifying determinants		
Protected status		
Ecological integrity		

*Score guideline: 4 = Very High; 3 = High; 2 = Moderate; 1 = Marginal/Low; 0 = None. Confidence rating: 4 = Very High Confidence; 3 = High Confidence; 2 = Moderate Confidence; 1 = Marginal/Low Confidence.

Table 7: **Ecological Importance and Sensitivity (EIS) categories and the interpretation of median scores for biotic and habitat determinants (DWAF, 1999).**

Range of Median	EIS Category	Category Description	Recommended Ecological Management Class
>3 and <=4	**Very High**	Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	**A**
>2 and <=3	**High**	Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water in major rivers.	**B**
>1 and <=2	**Moderate**	Wetlands that are to be considered ecologically important and sensitive on a provincial or local scale. The biodiversity of these floodplains is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	**C**
>0 and <=1	**Low/ Marginal**	Wetlands that is not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	**D**

3.1.5 Recommended Ecological Category

A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability, but carries a higher risk of ecosystem failure." (DWAF, 1999).

The Recommended Ecological Category (REC) is determined based on the results obtained from the Present Ecological State (PES), reference conditions and Ecological Importance and Sensitivity (EIS) of the aquatic resource. This is then followed by realistic recommendations, mitigation, and rehabilitation measures to achieve the desired REC.

A system may receive the same class for the PES, as the REC if the system is deemed to be in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as to enhance the PES of the aquatic system. The REC of the wetland must also be determined and monitored according to Table 8 below.

Table 8: Recommended Ecological Category (REC) classes.

Class (% of total)	Description
A	Unmodified, natural.
B	Largely natural with few modifications.
C	Moderately modified.
D	Largely modified.

3.2 ECO Monitoring Audits

The ECO monitoring audits form the Auditing Plan as required by the Procedural Requirements of the Department of Water and Sanitation, and should focus on the sensitive areas and the conditions of the Environmental Authorisation, EMPr and Water Use License.

The sensitive areas include the wetland and associated buffer areas. During the site visits and audits site-specific photographs should form the photographic record of the condition of the sensitive areas and potential threats to same. The photographic record should also show any risks and issues that impacted the sensitive areas, and how the risks/issues were mitigated. During the site visits and audits the ECO must alert the contractor(s) verbally and with a written Site Instruction form when non-compliance(s) with the Environmental Authorisation, EMPr and/or Water Use License conditions are observed, as well as when events of pollution or risks to the sensitive areas are observed. This will also form the record of evidence and compliance.

The ECO monitoring audits should comprise 1) ECO site inspections, 2) Water Use License Compliance Audits, and 3) Rehabilitation Audits.

4. Recommended Monitoring Requirements

The monitoring requirements for this project are based on the findings of the specialist studies and site/project-specific information, at the discretion of the author(s) of this monitoring program. The aspects to be monitored, as well as frequencies and submissions are presented in the Table 9 below. This, to a) summarise the monitoring activities for the applicant, ensuring ease of compliance, and b) aid the Department Official in structuring the monitoring requirements of the water use license being applied for.

Table 9: Recommended Monitoring requirements for the development.

Monitoring Program		Monitoring Requirements and Deliverables
1.	**Wetland Assessment**	**Aspects**: Present Ecological State, Ecological Importance and Sensitivity, Recommended Ecological Category. Photographic record **Survey Point**: • Wetlands and buffer areas **Sampling Frequency**: • One (1) Post-construction/rehabilitation assessment. **Reporting Frequency**: • Once off **Submission to Client**: 30 days after Site assessment.
2.	**ECO Site Inspections**	**Aspects**: Site condition of sensitive areas; litter and pollution; storage of building material and waste; condition and functioning of bridge; site photographs; non-compliances with Environmental Authorisation and Water Use License/General Authorisation; threats to sensitive areas. Conditions of the EMPr. **Survey Point**: • Sensitive areas (wetland and buffer areas) • Storage and laydown areas (waste, building materials, etc.) **Survey Frequency**: • Preconstruction Phase – Once • Construction Phase – Weekly • Post construction - Once **Reporting Frequency:** • Phase dependent. Monthly reporting for weekly inspections. **Submission to Client**: 30 days after last survey.
3.	**Water Use License Compliance Audit**	**Aspects**: Dependent on Water Use License conditions. **Survey Point (s)**: • As required by the Water Use License. **Survey Frequency**:

		• As required by the Water Use License. • Recommended frequency – Annual Audit **Reporting Frequency:** • As required by the Water Use License. • Closure audit (within 6 months of construction completion) **Submission to Provincial Head**: 30 days after Audit.
4.	**Rehabilitation Audit**	**Aspects**: Site condition of sensitive and rehabilitated areas. Effect of the Rehabilitation effort before, during and after rehabilitation comparisons. **Survey Point (s)**: • Sensitive areas (Wetland and Buffer Areas) • Rehabilitated areas **Survey Frequency**: • Preconstruction Phase – Once • Construction Phase – Once • Post construction - Once **Reporting Frequency:** • Phase dependent. • Closure audit (within 6 months of rehabilitation completion) **Submission to Client**: 30 days after last survey.

5. Conclusions and Recommendations

This Monitoring Program aims to highlight environmental aspects that require monitoring based on findings from the specialist studies, at the discretion of the aquatic specialist. This, to suggest the appropriate monitoring requirements in the Water Use License. The recommended monitoring requirements are summarised in the Table 9 (Section 4: Recommended Monitoring Requirements). The aquatic resources to be monitored includes SV24_UCVB (unchanneled valley bottom wetland). The relevant monitoring tools mentioned in this document will provide the necessary information regarding the impacts associated with the proposed construction and with this information, it will be possible to monitor the extent of the impacts on various aspects of the associated wetland/aquatic ecosystems. The final monitoring requirements is subject to the discretion of the Department of Water and Sanitation. The necessary mitigation measures can be developed according to the information that will be gathered using the monitoring tools discussed in this document. Monitoring programs can measure the success of mitigation implementations, monitor unforeseen impacts, and can be used as a feedback system to adjust or correct management of the aquatic resource.

Recommendations:

- Reference should be made to the Wetland Assessment Report (22040_WPES_1) (Botha, 2021), Ecological Habitat Assessment Report (22040_ECOL_1) (Van Wyk & Meintjes, 2021) and the Rehabilitation Plan (22040_REHAB_1) (Singh, 2021) for detailed/further mitigation measures.
- It should be attempted to preserve current wetland function:

  - Wetland drivers should be protected.
  - Water quality preservation is key.
- It is recommended that a silt curtain be used where possible to contain increased turbidity and limit the extent of the impact during construction. Silt curtains can be used to contain re-suspended sediment to a smaller area;
  - Particular attention must be paid to controlling soil erosion as siltation will impact on sensitive aquatic habitats downstream of the site;
- Adequate storm-water management which won't aggravate the erosion of the banks/slopes must be provided;
- An Environmental Control Officer (ECO) should be present to facilitate aquatic resource habitat rehabilitation efforts;
- The ECO should be experienced and qualified in general rehabilitation measures and how to identify current, emerging and potential problems;
- The footprint of the development during the construction phase should be kept as small as possible by limiting construction vehicles to designated roadways;
- The unnecessary removal of wetland and terrestrial vegetation must be avoided;
- The dumping of any excess building material or refuse must be prohibited within the wetland and buffer zones;
- Adequate ablution facilities must be provided in order to prevent construction crews defecating in the wetland and buffer zones, and must be placed outside the delineated buffer area.
- No fires are permitted in the wetland and buffer zones, or the use of vegetation thereof being used to make fires;
- No trapping, killing or poisoning of any wildlife should be allowed on site;
- All exotic vegetation identified must be managed and removed routinely and appropriately, in attempts to reduce the impacts of exotic species.
- Waste management must be a priority and all waste must be collected and stored adequately. It is recommended that all waste be removed from site on a weekly basis to prevent rodents and pests entering the site.
- Adequate signage should be erected that raises awareness about possible fauna, protected areas and delineations in the area.
- Staff should be educated about the sensitivity of floral and faunal species and measures should be put in place to deal with any species that are encountered during the construction process. The intentional killing of any animals including snakes, insects, lizards, birds or other animals should be strictly prohibited.

Follow-up surveys are recommended to potentially identify emerging impacts following post-construction within wetland areas. This is important to implement any further mitigatory measures required for emerging problems (e.g. soil erosion forming through poor storm-water management feature design, re-establishment and encroachment of exotic vegetation, impedances of wetland

drivers, etc.). The appointed ECO should be well-versed in identifying potential emerging environmental concerns.

The relevant monitoring tools mentioned in this document will provide the necessary information regarding the associated impacts. The monitoring tools may be used to determine the baseline state of the different ecosystems. By doing this, the bio-monitoring data can be measured against the data obtained during the baseline state. Any changes can then be recorded. With this information it will be possible to monitor the extent of the impacts on various aspects of the associated aquatic ecosystems. The necessary mitigation measures can be developed according to the information that will be gathered using the monitoring tools discussed in this document.

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Appendix A – Specialist Qualifications

Table A1: Specialists consulted for this aquatic monitoring program and their qualifications

ASPECT INVESTIGATED	SPECIALIST	QUALIFICATION	REPORT DATE
Aquatic Resources Monitoring Program Compilation	P. Singh Senior Aquatic Specialist Pr.Sci.Nat	MSc *Cum Laude*: Aquatic Health BSc Hons. Biodiversity and Conservation BSc Life and Environmental Sciences SASS5 Accredited Practitioner (*DWS and WRC)* Wetland Management Course: Ecology, Hydrology, Biodiversity, Legislation, Delineation and Management (*University of the Free State*) Hydropedology and Wetland Functioning (*Water Business Academy / Terra Soil Science*) SACNASP 116822 (Aquatic Science)	July 2021
Mapping and Peer Review	D. Botha Principle EAP Pr.Sci.Nat Reg. EAP	M.A. Environmental Management B.A. Hons. Geography & Environmental Management, B.A. Humanities Post Higher Education Diploma Wetland and Riparian Delineation *(DWAF Accredited Short Course)* Soil Classification and Wetland Delineation - Short Course – *Terrasoil Science* Tools for Wetland Assessment – *Rhodes University* Hydropedology and Wetland Functioning (*Water Business Academy / Terra Soil Science*) SACNASP 119979 (Env. Science)	July 2021