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FRESHWATER HABITAT IMPACT ASSESSMENT

FOR THE

THE PROPOSED EXPANSION OF EXISTING CEMETERY ON ERF 566 AND ERF 141/480, IN MELKHOUTFONTEIN

PREPARED FOR: Hessequa Municipality

PREPARED BY: Sharples Environmental Services cc
Contact Person: Debbie Bekker
Email: debbie@sescc.net

DATE: 24 June 2020

DECLARATION OF INDEPENDENCE

I, Debbie Fordham, declare that I:

- Act as an independent specialist consultant, in this application, in the field of wetland ecology;
- Do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the amended EIA Regulations, 2014 (amended);
- Have, and will have, no vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the amended EIA Regulations, 2014; and
- Will provide the competent authority with access to all the information at my disposal regarding the application, whether such information is favourable to the applicant or not.

The following report has been prepared:

- As per the requirements of Section 32 (3) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Environmental Impact Assessment Regulations 2017 as per Government Notice No. 326 Government Gazette, 7 April 2017.
- In accordance with Section 13: General Requirements for Environmental Assessment Practitioners (EAPs) and Specialists as well as per Appendix 6 of GNR 982 - Environmental Impact Assessment 2014 Regulations and the National Environmental Management Act, 1998.
- With consideration to Cape Nature's standard requirements for biodiversity assessments.
- In accordance with DEA&DP's Guideline on Involving biodiversity specialists in the EIA process.
- Independently of influence or prejudice by any parties.

PROJECT TEAM

The authors of this report are in agreeance with the 'Declaration of Independence'.

SPECIALIST	QUALIFICATIONS	ROLE	DETAILS
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INDEMNITY AND COPYRIGHT

Report citation:

Sharples Environmental Services cc, 2020. Freshwater Habitat Impact Assessment for the proposed extension of the existing cemetery on Erf 566 and Erf 141/480, Melkhoutfontein.

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1 INTRODUCTION

Sharples Environmental Services cc (SES) has been appointed by *Aurecon,* on behalf of Hessequa Municipality, to conduct a Freshwater Specialist Impact Assessment for the proposed expansion cemetery on Erf 566 and Erf 141/480 in Melkhoutfontein.

1.1 Location

The proposed site is situated eastbound in the town of Melkhoutfontein, that lies in the Hessequa Municipal area. The graveyard site can be accessed via an existing tarred road, Rooipitjie Road turn-off from the Melkhoutfontein access road, turning off the R305 road about 5 kilometres from Stilbaai. Figure 1 shows the location of the study area in relation to the Stilbaai road and the Goukou River. Figure 2 indicates the proposed site location within Melkhoutfonein town and the 500m Regulated Area in terms of the National Water Act (Act 36 of 1998).

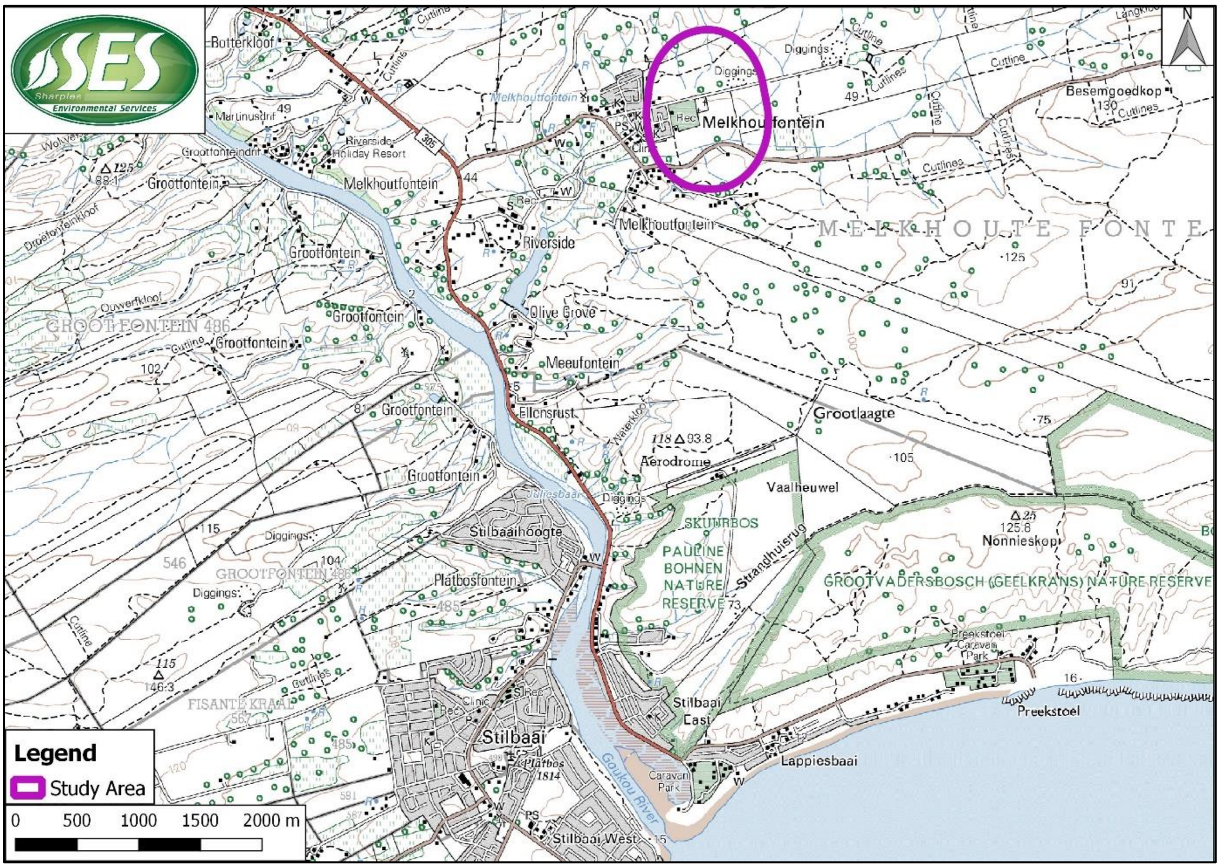


Figure 1: A cadastral map showing the location of the proposed expansion of the existing cemetery in relation to Beaufort West.

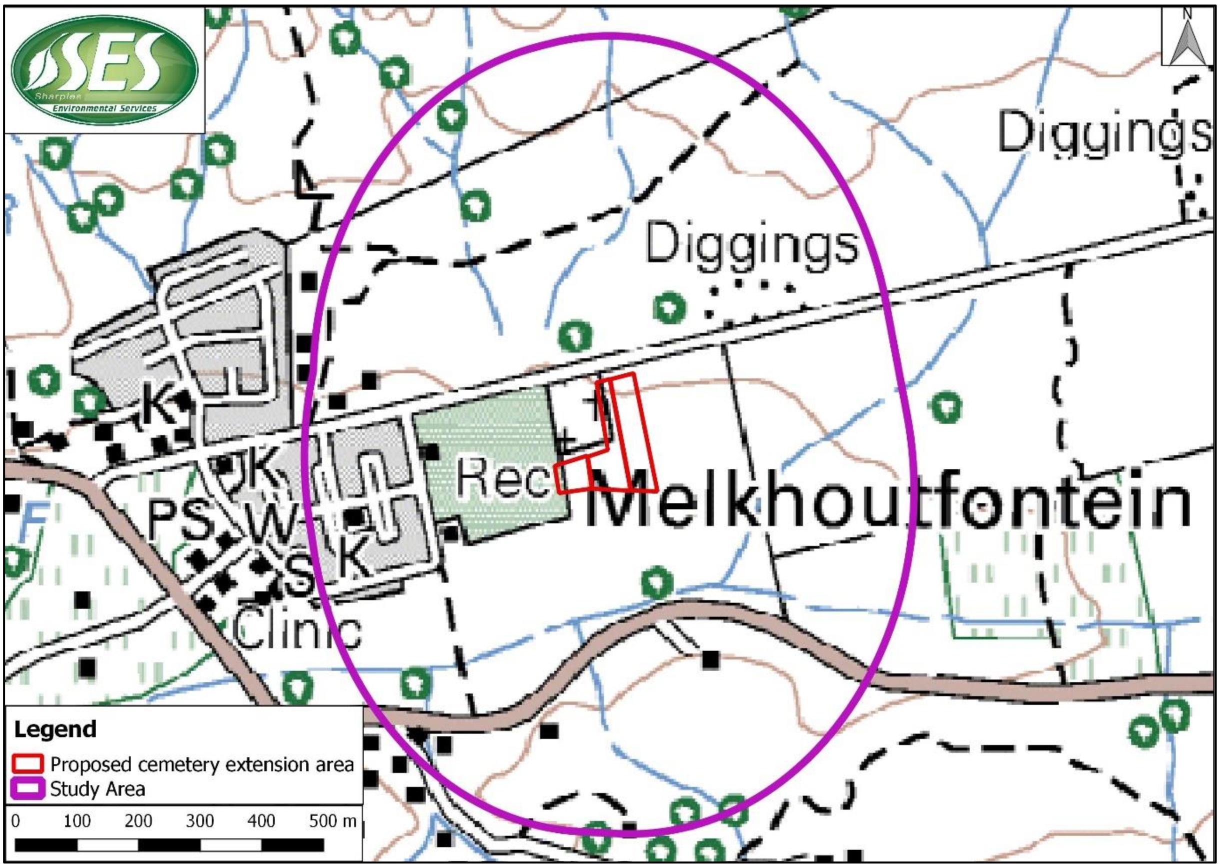


Figure 2: A cadastral map showing the location of the proposed expansion of the existing cemetery in relation to the existing cemetery, sports fields, and roads of the town of Melkhoutfontein

1.2 Background

The existing Melkhoutfontein Cemetery is located on Municipal property. The existing walled cemetery is overlapping part of Erf 566 and part of Erf 141/480. Site investigations conducted by the appointed engineers indicated that the existing cemetery has roughly 45 vacant burial plots available, which should allow for approximately 18 months of cemetery life, at more or less 25 funerals per year.

The intention of the Hessequa Municipality is to extend the existing cemetery to the east and south on a vacant part of Erf 141/480 (approximate area 5,843.50m2) and to the south on a part of Erf 566 (approximate area 2,495.50 m2) – a total expansion of 8,339.00m2. According to preliminary engineering investigations, the current expansion proposal will be a solution sufficient for the next 5 years. Figure 3 is a photograph showing the existing cemetery sharing a boundary with the sport fields along Rooipytjie Road.

Figure 3: Aerial photograph of the existing cemetery, boundary wall, and proposed expansion area

Figure 4 below shows the site layout plan for the expansion of the cemetery produced by Element Consulting Engineers (2018). It is proposed to demolish the existing boundary wall for expansion of the cemetery to the east and south on the remaining vacant part of Erf 141/480 (labelled 'B' in layout below), and to the south on an additional part of Erf 566 (labelled as 'A' below), before erecting a new boundary wall.

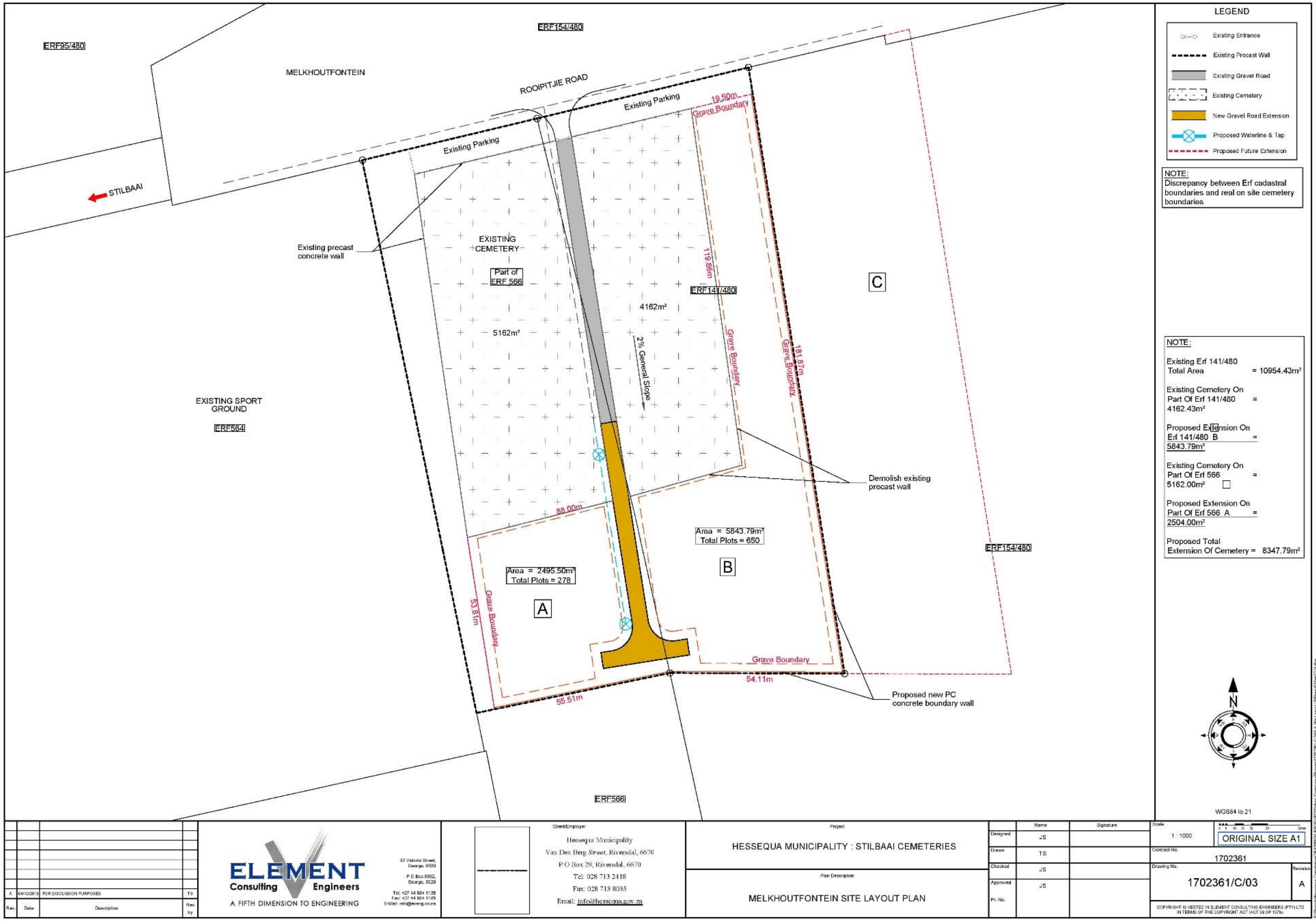


Figure 4: Proposed 2018 layout of the Melkhoutfontein cemetery expansion showing area A, B, and C in relation to the existing cemetery.

1.3 Relevant Legislation

The protection of water resources is essential for sustainable development and therefore many policies and plans have been developed, and legislation promulgated, to protect these sensitive ecosystems. The proposed project must abide by the relevant legislative requirements. Table 1 below shows an outline of the environmental legislation relevant to the project.

Table 1: Relevant environmental legislation

Legislation	Relevance
South African Constitution 108 of 1996	The constitution includes the right to have the environment protected
National Environmental Management Act 107 of 1998	Outlines principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for coordinating environmental functions exercised by organs of state.
Environmental Impact Assessment (EIA) Regulations	The 2014 regulations have been promulgated in terms of Chapter 5 of NEMA and were amended on 7 April 2017 in Government Notice No. R. 326. In addition, listing notices (GN 324-327) lists activities which are subject to an environmental assessment.
The National Water Act 36 of 1998	Chapter 4 of the National Water Act addresses the use of water and stipulates the various types of licensed and unlicensed entitlements to the use of water. The water uses under Section 21 (NWA) that are associated with the proposed development are most likely section 21 (c) and (i). Also, according to the Department of Water and Sanitation (DWS), any structures within a 500-metre radius from the boundary of a wetland constitutes a Section 21(c) and (i) water use and as such requires a water use licence.
General Authorisations (GAs)	Any uses of water which do not meet the requirements of Schedule 1 or the GAs, require a license which should be obtained from the Department of Water and Sanitation (DWS). The project will require a Water Use Authorisation or General Authorisation in terms of Section 21 (c) and (i) of the National Water Act (NWA), Act 36 of 1998, as the development will impact watercourses. Government Notice R509 of 2016 was issued as a revision of the General Authorisations (No. 1191 of 1999) for section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks or characteristics of a watercourse) as defined under the NWA. Determining if a water use licence is required is associated with the risk of impacting on that watercourse. A low risk of impact could be authorised in terms of a General Authorisations (GA).
National Environmental Management: Biodiversity Act No. 10 of 2004	This is to provide for the management and conservation of South Africa's biodiversity through the protection of species and ecosystems; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; and the establishment of a South African National Biodiversity Institute.

Conservation of Agricultural Resources Act 43 of 1967	To provide for control over the utilization of the natural agricultural resources of the Republic in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants; and for matters connected therewith.

1.4 Scope of Work

The Scope of Work in accordance with the specific Terms of Reference are described below:

Phase 1 (Contextualisation of study area)

- ✓ Contextualization of the study area in terms of important biophysical characteristics and the latest available aquatic conservation planning information (including but not limited to vegetation, CBAs, Threatened ecosystems, any Red data book information, NFEPA data, broader catchment drainage and protected areas).
- ✓ Desktop delineation and illustration of all watercourses within and surrounding the study area utilising available site-specific data such as aerial photography, contour data and water resource data.
- ✓ A risk/screening assessment of the identified aquatic ecosystems to determine which ones will be impacted upon by the proposed development and therefore require groundtruthing and detailed assessment.

Phase 2 (Delineation and classification)

- ✓ Ground truthing, infield identification, delineation and mapping of any potentially affected aquatic ecosystems in terms of the Department of Water and Sanitation (DWAF 2008) Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas.
- ✓ Field delineation must follow the accepted national protocol and should result in a map that includes the identified boundary and the field data collection points (which should include at least one point outside the wetland or riparian area), and a report that explains how and when the boundary was determined.
- ✓ Classification of the identified aquatic ecosystems in accordance with the, 'National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa' (Ollis et al. 2013) and WET-Ecoservices (Kotze et al. 2009).
- ✓ Description of the identified watercourses with photographic evidence.

Phase 3 (Aquatic Assessment)

- ✓ Conduct a Present Ecological State (PES), functional importance assessment and Ecological Importance and Sensitivity (EIS) assessment of the delineated wetland habitats, utilising the latest tools, such as:

  - → Level 2 WET-Health tool (Macfarlane et al., 2009/2018) – PES
  - → WET-Ecoservices (Kotze et al., 2009/2018) and/or the Wetland EIS assessment tool of Roundtree and Kotze (2013). - Functional assessment
- ✓ Conduct a Present Ecological State (PES) and Present Ecological Importance and Sensitivity (EIS) assessment of the delineated river/riparian habitats, utilising:
  - → Qualitative Index of Habitat Integrity (IHI) tool adapted from (Kleynhans, 1996) – PES
  - → DWAF (DWS) River EIS tool (Kleynhans, 1999) - EIS
- ✓ Indicate the Recommended Ecological Category (REC) of the potentially impacted aquatic ecosystems.

Phase 4 (Impact Assessment)

- ✓ Identification, prediction and description of potential impacts on aquatic habitat during the construction and operational phases of the project. Impacts are described in terms of their extent, intensity, and duration. The other aspects that must be included in the evaluation are probability, reversibility, irreplaceability, mitigation potential, and confidence in the evaluation.
- ✓ All direct, indirect, and cumulative impacts for each alternative must be rated with and without mitigation to determine the significance of the impacts.

Phase 5 (Mitigation and monitoring)

- ✓ Recommend actions that should be taken to avoid impacts on aquatic habitat, in alignment with the mitigation hierarchy, and any measures necessary to restore disturbed areas or ecological processes.
- ✓ Determination and mapping of any necessary buffer zones with consideration to the *Buffer zone guidelines for rivers, wetlands and estuaries* (Macfarlane & Bredin, 2016).
- ✓ Rehabilitation guidelines for disturbed areas associated with the proposed project and monitoring.

2 STUDY AREA

2.1 Biophysical characteristics

The site is located within quaternary catchment H90E of the Gouritz Water Management Area. The Goukou River is the largest river within this area and is located west of the site. The mean annual evaporation rate is more than double the precipitation rate for the area, 1115.5mm and 489.62 mm per annum, respectively. The mean annual runoff rate is 34.9 mm per annum. It is situated at an elevation of approximately 35 m above sea level and surface runoff flows in a southern direction (2% slope) towards a shallow valley bottom. The unnamed watercourse within the valley bottom flows in a westerly direction to join the Goukou River estuary. The lithology of the landscape consists mainly of calcified dune sand of the Bredasdorp Group, partly covered by younger sand and calcrete.

Mapping the locality of aquatic habitat is essential for classification into the different wetland and river ecosystem types across the country, which in turn can be used with other data to identify aquatic systems of conservation significance. The national river data indicates a non perennial river south of the site within the valley bottom and a tributary non perennial river line to the east of the site (Figure 5). However, no river features were identified in the areas nearest to the site. Groundtruthing found no evidence of confined surface flows. These areas have lost definition in this reach and are disconnected from the surface drainage network.

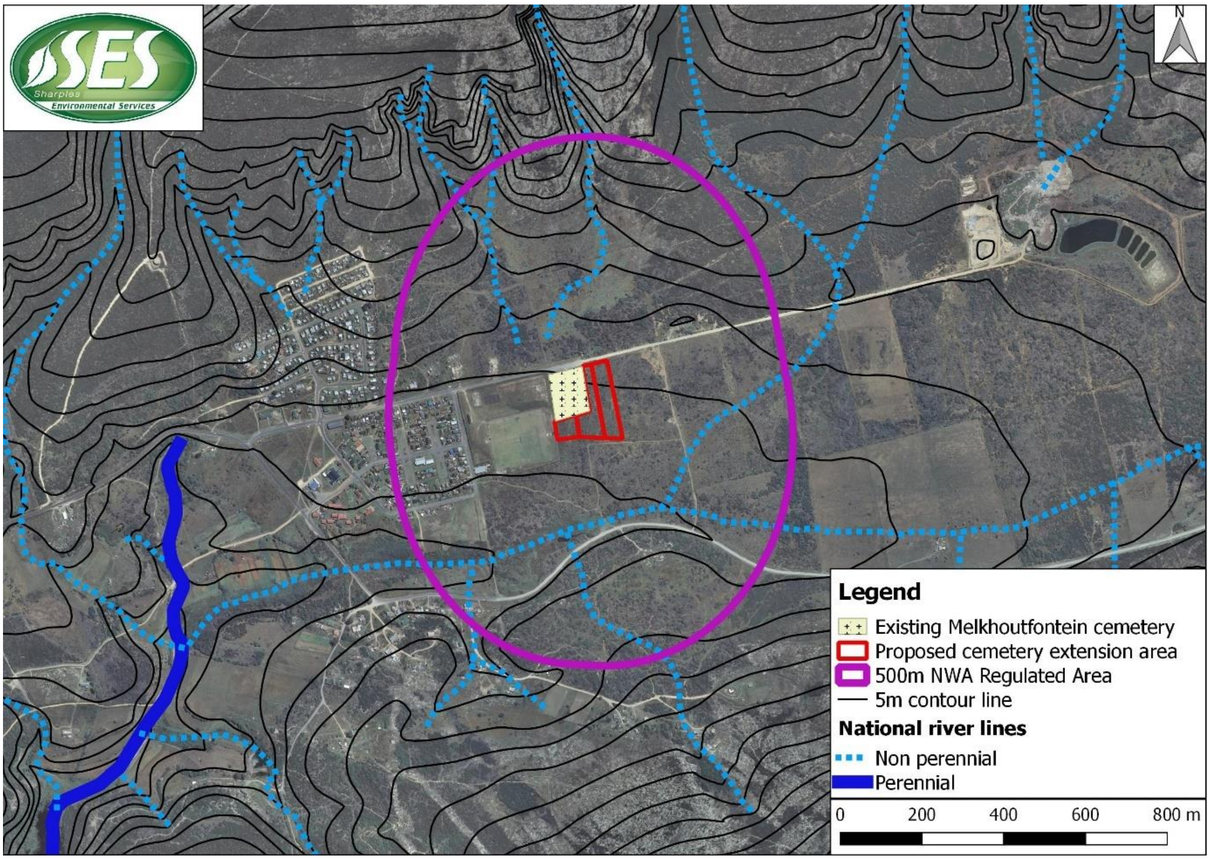


Figure 5: Map of the study area in relation to the drainage lines from the national river database

2.2 South African Inventory of Inland Aquatic Ecosystems

The National Freshwater Ecosystem Priority Areas (NFEPA 2011) data provides strategic spatial priorities for conserving South Africa's aquatic ecosystems and supporting sustainable use of water resources. FEPAs were identified based on a range of criteria dealing with the maintenance of key ecological processes and the conservation of ecosystem types and species associated with rivers, wetlands and estuaries (Driver *et al.* 2011). The NFEPA project identified wetlands within the area, however, none are classified as FEPA wetlands. The river indicated by the NFEPA project within the study area is classified as a FEPA.

In 2018 the national wetland and river dataset, including the 2011 NFEPA data, was updated as part of the National Biodiversity Assessment (SANBI 2018). A South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established and offers a collection of data layers pertaining to ecosystem types and pressures for both rivers and inland wetlands. National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) 2018. The South African National Wetlands Map (NWM) provides information on the location, spatial extent, and ecosystem types of estuarine and inland aquatic ecosystems (Van Deventer *et al.*, 2018).

According to the data provided by the South African Inventory of Inland Aquatic Ecosystems (SAIIAE 2018) there is no aquatic habitat within the proposed cemetery expansion site. The NWM identifies a channelled valley bottom wetland situated approximated 230 m downslope of the proposed new cemetery boundary (Figure 6), and a seep wetland located on the northern border of the study area (500m from the cemetery site). The wetland vegetation group is classified as Albany Thicket and is listed by the dataset as critically endangered and lacking protection.

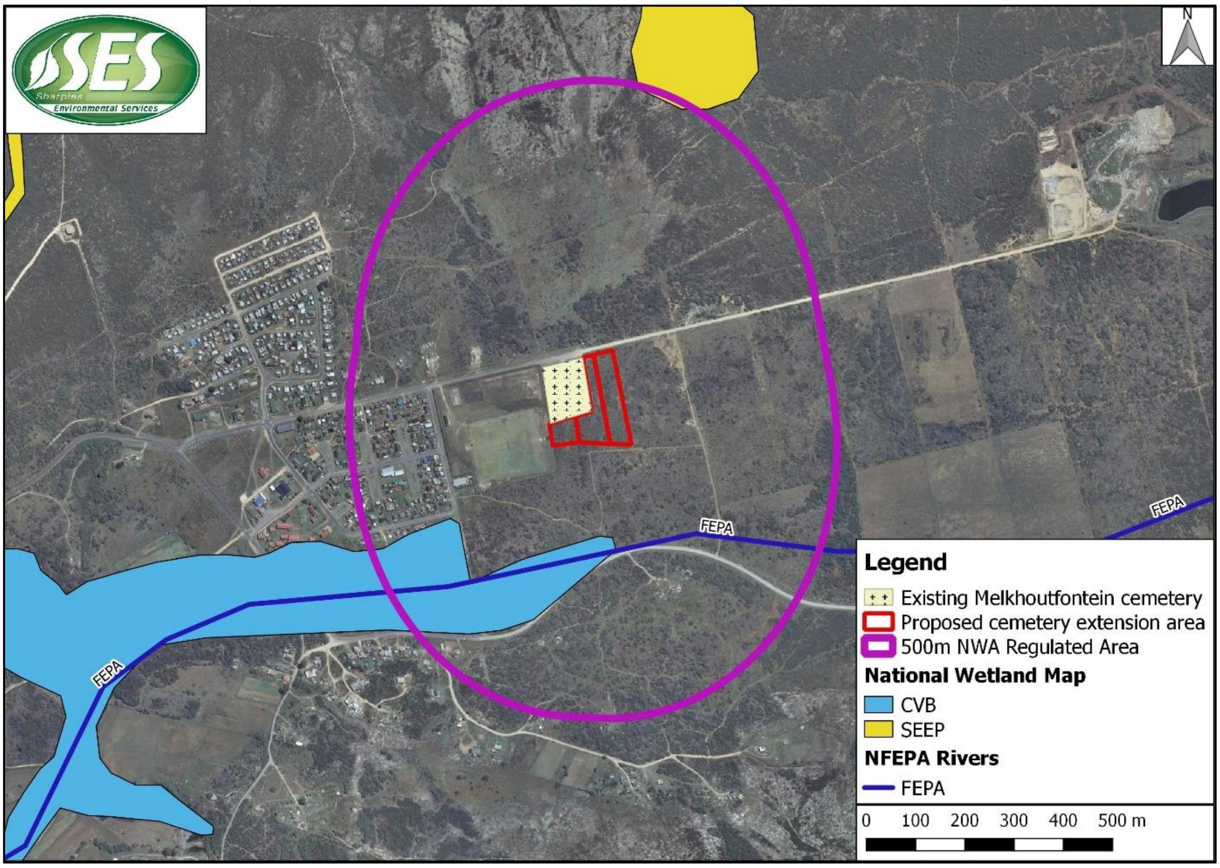


Figure 6:The proposed site and NWA Regulated Area in relation to the data provided by the South African Inventory of Inland Aquatic Ecosystems (CSIR 2018)

2.3 Western Cape Biodiversity Spatial Plan

The Western Cape Biodiversity Spatial Plan (WCBSP) is recognised by both the Department of Environmental Affairs and South African National Biodiversity Institute. The primary purpose of a map of Critical Biodiversity Areas and Ecological Support Areas is to guide decision-making about where best to locate development. Critical Biodiversity Areas (CBA's) are required to meet biodiversity targets. These areas have high biodiversity and ecological value and therefore must be kept in a natural state without further loss of habitat or species. Low-impact, biodiversity sensitive land uses are the only land uses allowed in CBA's. Critically Endangered (CR) ecosystems, critical corridors for maintaining landscape connectivity and areas required to meet biodiversity pattern targets, are included in CBA's. The WCBSP made a distinction between areas likely to be in a natural condition (CBA1) and areas that could be degraded (CBA2). Ecological Support Areas (ESA's) are not essential for meeting biodiversity targets but are important as they support the functioning of CBA's and Protected Areas (PA's). ESA's support landscape connectivity, surrounds ecological infrastructure that provide ecosystem services, and strengthen resilience to climate change. These areas include Endangered vegetation; water source and recharge areas; and riparian habitat around rivers and wetlands. The WCBSP also made a distinction between ESA's in a functional condition (ESA1) and degraded areas in need of restoration (ESA2).

The BSP data categorises the habitat on the proposed site as CBA1 Terrestrial (Figure 7). There are no aquatic features identified within or directly surrounding the proposed cemetery expansion area. However, the watercourse identified to the south of the site is classified as CBA 1 River and CBA 1 wetland habitat. There should not be any further habitat loss within the CBA1 areas.

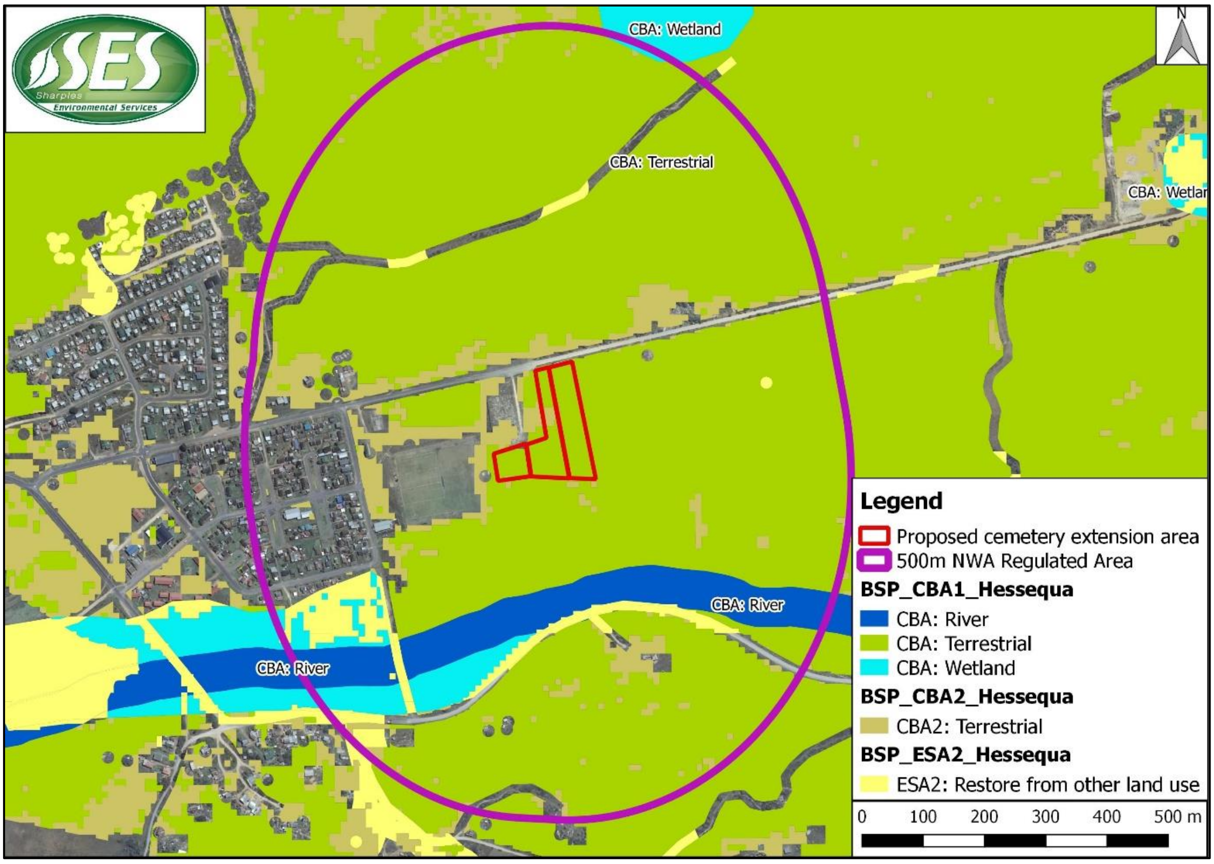


Figure 7: The study site in relation to features identified by the WCBSP (Pence, 2017).

3 APPROACH AND METHODS

3.1 Desktop Assessment Methods

- The contextualization of the study area was undertaken in terms of important biophysical characteristics and the latest available aquatic conservation planning information in a Geographical Information System (GIS). It is imperative to develop an understanding of the regional drainage setting and longitudinal dynamics of the watercourse. The conservation planning information aids in the determination of importance and sensitivity, management objectives, and the significance of potential impacts.
- Following this, desktop delineation and illustration of all watercourses within the study area was undertaken utilising available site-specific data such as aerial photography, contour data and water resource data. Digitization and mapping were undertaken using QGIS 2.18 GIS software (Table 3).

- These results, as well as professional experience, allowed for the identification of specific watercourses that could potentially be impacted by the development and therefore required groundtruthing and detailed assessment. The following data sources listed within Table 2 assisted with the assessment.

Table 2: Utilised data and associated source relevant to the proposed project

Data	Source
Google Earth Pro™ Imagery	Google Earth Pro™
DWS Eco-regions (GIS data)	DWS (2005)
South African Vegetation Map (GIS Coverage)	Mucina & Rutherford (2018)
National Biodiversity Assessment Threatened Ecosystems (GIS Coverage)	SANBI (2018)
Geology	Surveyor General (2019)
Contours (elevation) - 5m intervals	Surveyor General
NFEPA river and wetland inventories (GIS Coverage)	CSIR (2011)
NEFPA river, wetland and estuarine FEPAs (GIS Coverage)	CSIR (2011)
Western Cape Biodiversity Framework 2017: Critical Biodiversity Areas of the Western Cape.	Pence (2017)
National Wetland Map 5	Van Deventer, et al. (2018)

3.2 Baseline Assessment Methods

- Infield site assessments were conducted on the 10th of June 2020 to confirm the location and extent of the systems identified as likely to be impacted by the proposed project. There are a number of factors which influence the level of impact, such as type of system, position of the system in relation to the project and position the system is located in the landscape. The identified aquatic ecosystems were classified in accordance with the, '*National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa'* (Ollis *et al*. 2013) and *WET-Ecoservices* (Kotze *et al*. 2009).
- Infield delineation was undertaken with a hand-held GPS, for mapping of any potentially affected aquatic ecosystems, in alignment with standard field-based procedures in terms of the Department of Water and Sanitation (DWAF 2008) *Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas*. The delineation is based upon observations of the landscape setting, topography, vegetation and soil characteristics (using a hand-held soil auger for wetland soils).
- Determination of the Present Ecological State (PES), functional importance assessment and Ecological Importance and Sensitivity (EIS) assessment of the delineated wetland habitat.
  - The health/condition or Present Ecological State (PES) of the wetland was assessed using the Level 1 WET-Health assessment tool (Macfarlane *et al.* 2008), which is based on an understanding of both catchment and on-site impacts and the impact that these

aspects have on system hydrology, geomorphology and the structure and composition of wetland vegetation.

- Wetland benefits can be classified into goods/products (directly harvested from wetlands), functions/ services (performed by wetlands), and ecosystem scale attributes. The WET-Ecoservices tool (Kotze *et al*., 2009) is utilised to assess the goods and services that the individual wetlands under assessment provide, thereby aiding informed planning and decision-making. The tool provides guidelines for scoring the importance of a wetland in delivering each of 15 different ecosystem services (including flood attenuation, sediment trapping and provision of livestock grazing).
- The Ecological Importance and Sensitivity (EIS) of freshwater habitats is an expression of the importance of the water resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2007). There Wetland EIS Tool was utilised to determine EIS (Kleynhans, 1999).

- Determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) assessment of the delineated river/riparian habitats was undertaken utilising:
  - Qualitative Index of Habitat Integrity (IHI) tool adapted from (Kleynhans, 1996) – PES
  - DWAF (DWS) River EIS tool (Kleynhans, 1999) - EIS
- The PES and EIS results then allowed for the determination of management objectives for the potentially impacted aquatic ecosystems. hRefer to the Table below and Annexure 12 for a list and description of the tools utilised.

Table 3: Tools utilised for the assessment of water resources impacted upon by the proposed project.

METHOD/TOOL*	**SOURCE**	**REFERENCE**	**APPENDIX (ANNEXURE)**
Delineation of wetland and/or Riparian areas	*A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas.*	(DWAF 2005)	12.1
Classification of wetlands and/ or other aquatic ecosystems	*National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa & WET-Ecoservices*	(Ollis *et al*., 2013, Kotze *et al*., 2009)	12.2
Present Ecological State (PES) Assessment (Wetland)	*WET-Health Assessment*	(McFarlane *et al.* 2009)	12.3
Functional Importance Assessment (Wetland)	*WET-Ecoservices Assessment*	(Kotze *et al*., 2009)	12.4
Ecological Importance & Sensitivity (EIS) Assessment (wetland)	*DWAF Wetland EIS Tool*	(Duthie 1999)	12.5

Present Ecological State (PES) Assessment (River)	*Rapid IHI (Index of Habitat Integrity) tool developed Kleynhans (1996), Modified by DWAF*	(Ecoquat)	12.6
Ecological Importance & Sensitivity (EIS) Assessment (River)	*DWAF EIS tool developed by Kleynhans (1999)*	(Kleynhans, 1999)	12.7

3.3 Impact Assessment Methods

- The approach adopted is to identify and predict all potential direct and indirect impacts resulting from an activity from planning to rehabilitation. Thereafter, the impact significance is determined.
- Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). The degree of significance depends upon three dimensions: the measurable characteristics of the impact (e.g. intensity, extent and duration), the importance societies/communities place on the impact, and the likelihood / probability of the impact occurring. A methodology for assigning scores to the respective impacts is described in Annexure 12.
- Actions are thereafter recommended to prevent and mitigate the identified impacts on aquatic habitat, in alignment with the mitigation hierarchy, as well as any measures necessary to restore disturbed areas or ecological processes.

3.4 Opportunities and Constraint Analysis

- Regarding any proposed development on the property, a buffer area from the boundary of the aquatic habitat must be determined. The specific size of the buffer zone was determined by a tool developed by Macfarlane and Bredin (2016) called *Buffer zone guidelines for rivers, wetlands and estuaries*, site-based information and professional opinion. The final buffer requirement includes the implementation of practical management considerations/mitigation measures.
- Identify legislation and permit requirements that are relevant to the development proposal from an aquatic perspective.
- Present recommendations of the suitability of the site based on sensitivity analysis.

4 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are relevant:

- The location of the proposed development was extrapolated from data provided by the client.
- No alternatives were provided for assessment.

- Aquatic ecosystems vary both temporally and spatially. Once-off surveys such as this are therefore likely to miss certain ecological information due to seasonality, thus limiting accuracy and confidence.
- Infield soil and vegetation sampling was only undertaken within a specific focal area around the proposed development, while the remaining watercourses were delineated at a desktop level with limited accuracy.
- No detailed assessment of aquatic fauna/biota was undertaken.
- The vegetation information provided is based on observation not formal vegetation plots. As such species documented in this report should be considered as a list of dominant and/or indicator wetland/riparian species and only provide a very general indication of the composition of the riverine vegetation communities.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the field survey and based on the assessor's working knowledge and experience with similar development projects. The degree of confidence is considered high.
- The study does not include flood line determination.

5 RESULTS AND FINDINGS

Following desktop and field analysis of the aquatic habitats, relevant to the boundary of the proposed cemetery expansion and 500m Regulated Area of the National Water Act (Act 36 of 1998), the subsequent results were obtained.

5.1 Identification and delineation

The freshwater habitats potentially impacted by the proposed project were identified and mapped on a desktop level utilising available data, following which, the infield site assessment (conducted on the 10th of June 2020) confirmed the location and extent of these systems (Figure 9). There are a number of factors which influence the level of impact, such as type of system, position of the system in relation to the project and position the system is located in the landscape. Desktop data indicated various non perennial river lines within the 500m Regulated Area, a valley bottom wetland south of the site, and a seep wetland 500 m north of the site. However, infield assessment identified only one watercourse within the study area; a channelled valley bottom wetland situated approximately 200 m south of the proposed site (Figure 8). There was no evidence of aquatic habitat within or directly surrounding the new cemetery site (Figure 9).

Figure 8: Photograph taken on the proposed cemetery site (upon the hillside) showing the tall reeds of the Melkhoutfontein Wetland, approximately 200 m downslope, on the valley floor.

Figure 9: Photograph showing the proposed cemetery expansion site. Note the lack of any aquatic habitat on site.

It was determined that there is potential for the wetland, located downslope of the new cemetery area, to be impacted upon by the project (Figure 8). Therefore, it was delineated infield and subjected to detailed further assessment as the Melkhoutfontein Wetland (Figure 10).

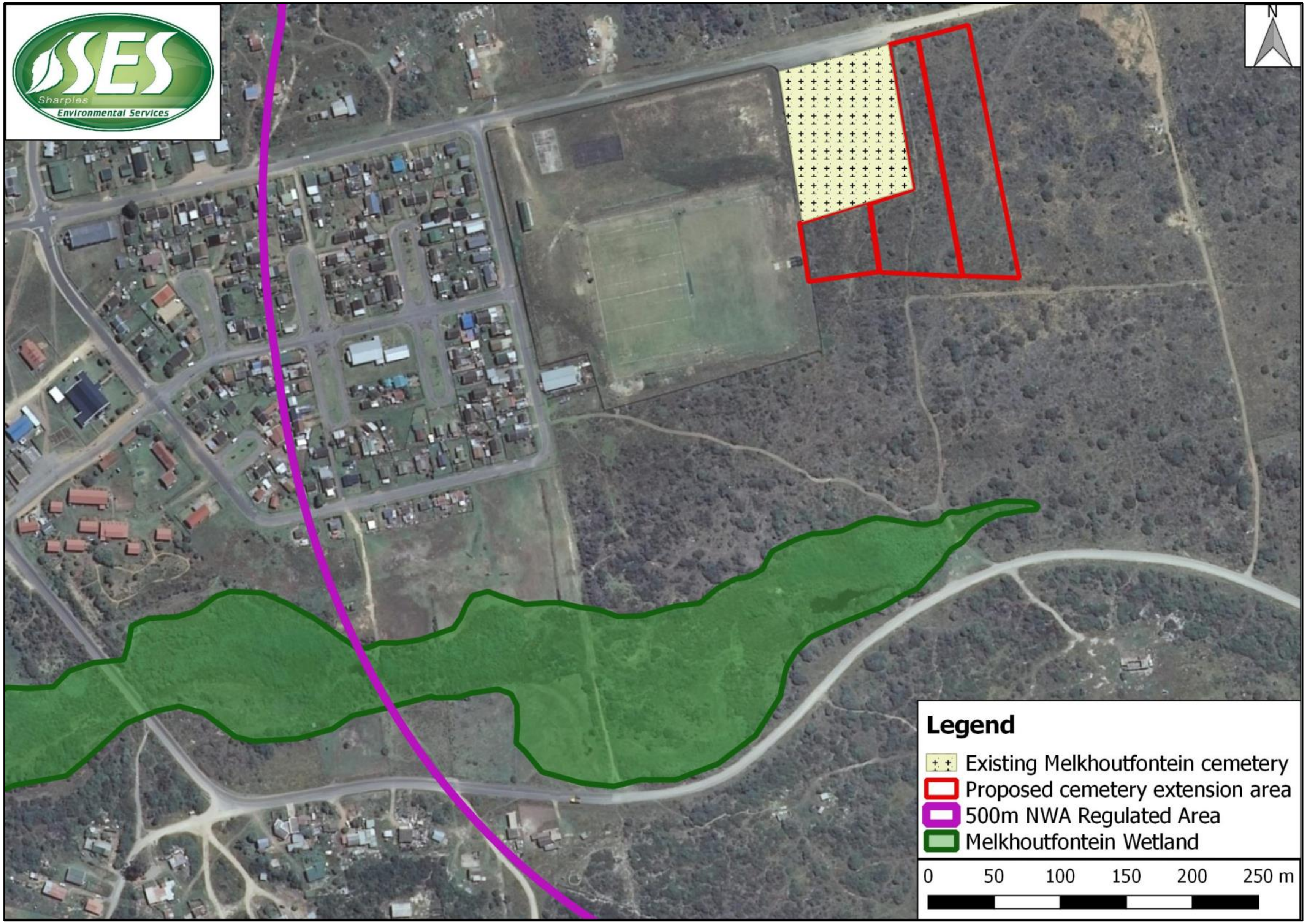


Figure 10: The proposed site of the cemetery expansion in relation to the nearest watercourse, the Melkhoutfontein Wetland

5.2 Melkhoutfontein Wetland

5.2.1 Description

The Melkhoutfontein Wetland is an unchannelled valley bottom wetland which flows in a diffuse manner along the shallow valley floor towards the Goukou River in the west (Figure 11). The sediment source responsible for the formation of the wetland is alluvial in nature and depositional processes presently dominate the geomorphic dynamics of the system. The longitudinal slope of the wetland upon the plateau is gentle and incision is controlled by the dam in the lower reach which acts as a local base level. The valley cross section is relatively flat, and although localised channels may form within vegetation, there is a lack of channel development within the wetland. The dominate water inputs are sourced from lateral and longitudinal groundwater seepage which sustains flows such that the wetland remains wet for long periods. Therefore, it can be described as a permanent wetland with seasonal and temporary zones located in a narrow area laterally. It is characterised by low velocity, diffuse flow patterns, within a well-vegetated habitat.

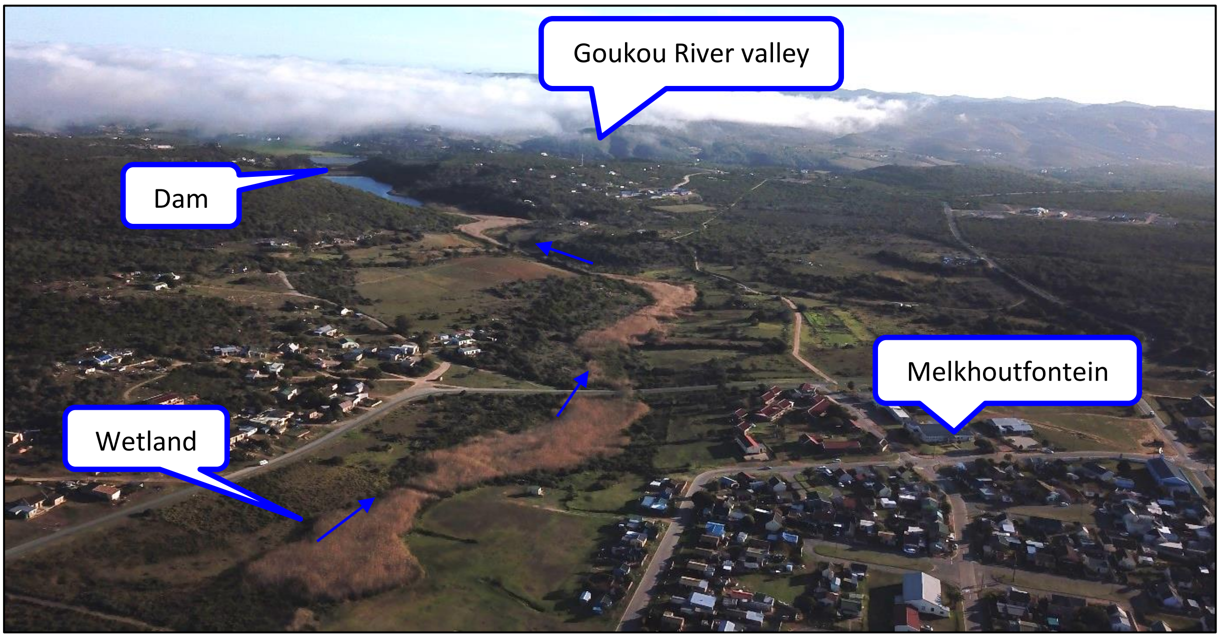


Figure 11: Aerial photograph of the Melkhoutfontein Wetland flowing towards the Goukou River in the west

Although such wetlands occasionally undergo phases of erosion, the characteristics of the Melkhoutfontein Wetland result in a significantly slower cycle of aggradation and incision. The artificial dam structure acting as a local base level, as well as the evenly spread sedimentation patterns (typical of the unchannelled valley bottom wetland type), maintain a homogenous wetland surface with diffuse flow and prevent localised steepening initiating erosional processes. However, anthropogenic interventions which cause confined flows, and changes in catchment land use/ cover which alter the water and sediment supply to the wetland, increase the geomorphic vulnerability of the system and result in unnatural erosion or aggradation phases. The surrounding landscape was largely utilised for subsistence agriculture but is becoming increasingly urbanised due to population growth. The valley is intersected by roads and pathways which confine flows and can result in localised erosion and habitat loss.

The wetland vegetation, excepting a small portion at its source, is dominated by dense reed beds of *Phragmites australis (*Figure 12). Although considered a native species in southern Africa, it grows to form tall monospecific stands, which can outcompete other wetland plant species (Canavan *et al.*, 2018). This results in the plant often being viewed as a threat to biodiversity and a physical nuisance to landowners/communities. *Phragmites australis* tolerates various environmental conditions and has the ability to withstand significant habitat disturbance. Therefore, it often establishes and thrives in disturbed wetlands (with high nutrient and sediment inputs) in which other wetland species struggle to withstand (Massacci *et al.,* 2001).

The reeds may provide some valuable functions within disturbed wetland habitat, such as stabilising erosion and water purification, and thus establishment of the pioneer plant should potentially be seen as part of a cycle of ecological succession (and possibly rehabilitation under a reed management plan). The reeds within the Melkhoutfontein Wetland may be characteristic of a natural successional ecological process, however, the infestation is likely a result of anthropogenic disturbance. For example, soils have been disturbed by agriculture, the construction of the dam may have altered soil wetness characteristics upstream, and land use changes within the catchment can cause sedimentation and nutrient inputs, which are all modifications favouring the successful growth of *P. australis.* It may explain the difference in vegetation composition in the upper most wetland habitat, which is more biodiverse but dominated by sedges (Juncus sp.). The small area at the head of the wetland is seemingly less disturbed habitat in which the reeds have not established (Figure 13).

Figure 12: Photograph of the dense wetland vegetation, largely reeds (<u>Phragmites australis</u>), which entirely dominate the vegetation composition downslope of the upper gravel crossing within the wetland.

Figure 13: Photograph of the wetland head, upslope of a gravel road crossing, showing the dense, indigenous sedge vegetation (Juncus sp.) and saturated organic wetland soils

5.2.2 Historic impacts

Wetland health is defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition (Macfarlane *et al*. 2009). Catchment and site-specific impacts are important for determining a baseline of the current status quo. The earliest available aerial photography of the Melkhoutfontein Wetland indicates that the wetland has been subjected to human disturbances for decades. It is even possible that the wetland extent has in fact increased in recent years as agricultural activities lessen. This makes the reference condition difficult to predict but there is sufficient evidence to support the unchannelled valley bottom wetland type. It is highly likely that, in a natural condition, it would have a diffuse flow pattern, fed largely by groundwater seepage, and contain short but robust indigenous vegetation.

In 1954 the town of Melkhoutfontein had not yet been established. The dam and cemetery were also undeveloped in 1954 but the main access roads had been constructed. A vast amount of indigenous vegetation in the catchment had already been cleared for livestock grazing and croplands. The upper wetland reach had been subjected to significant habitat loss by 1954 (Figure 14). Historic imagery from 1974 indicates that the extent of the wetland has decreased due to the encroachment of agricultural fields and road crossings have decreased the level of longitudinal connectivity (Figure 15). More recent aerial imagery indicates that much of the previously disturbed areas have recovered to a certain level of functioning and the extent of the wetland has increased. The resilience of these dynamic ecosystems is clear.

In 2012 the satellite imagery shows evidence of an excavated drain through the Melkhoutfontein Wetland (Figure 16). The exact purpose of these excavations is unknown but potentially to drain the wetland for the expansion of grazing land. The head of the drain is located where there is currently a borehole and water toughs. In 2017 the wetland was burnt (Figure 17). This was potentially done in an attempt to manage the *Phargmites australis* (as mentioned above) and to increase grazing land or for community security reasons.

Therefore, it is clear that the many human impacts the wetland has been subjected to over time are significant but have not resulted in complete wetland loss. The most critical past modifications to the wetland condition include the construction of the dam, the road crossings, and the catchment vegetation changes.

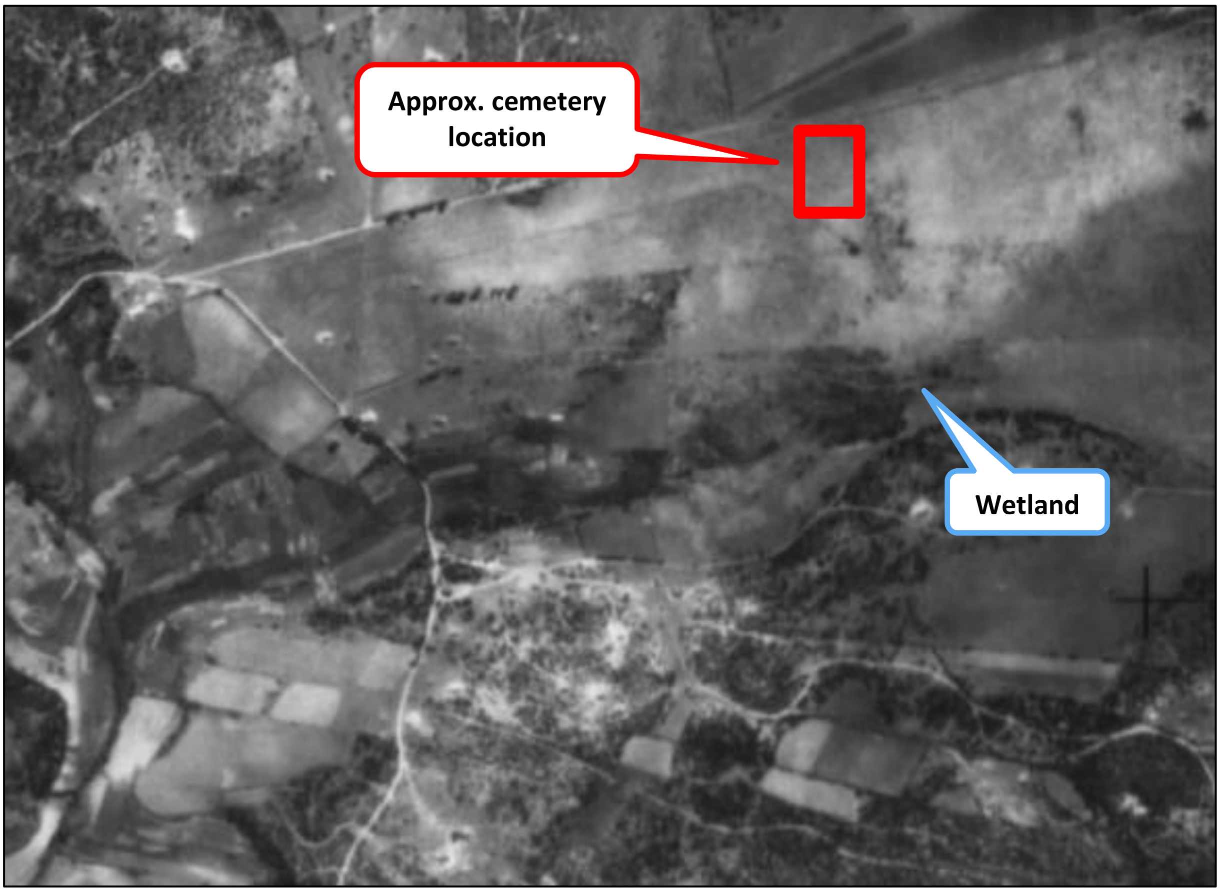


Figure 14: Historic aerial photograph of Melkhoutfontein in 1954

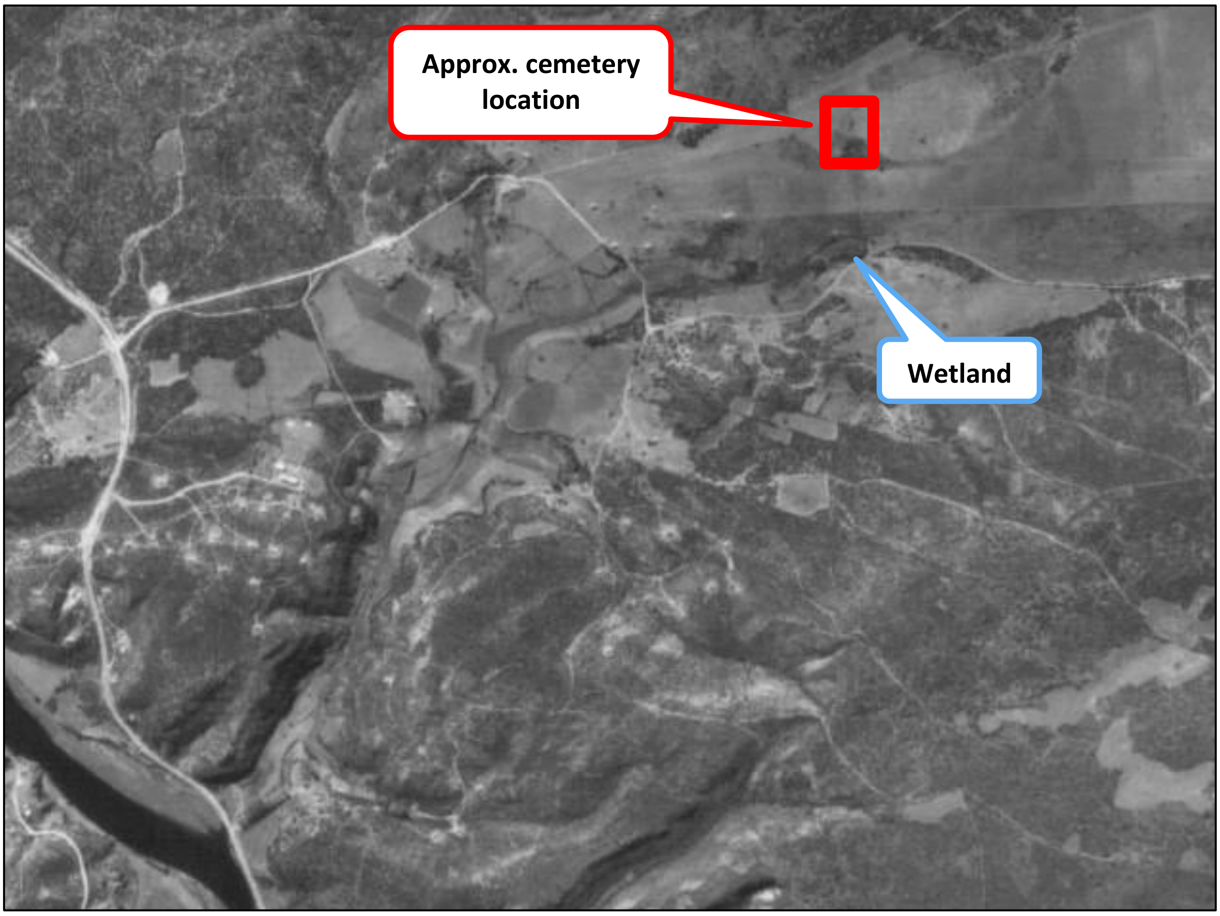


Figure 15: Historic aerial photograph of Melkhoutfontein in 1974

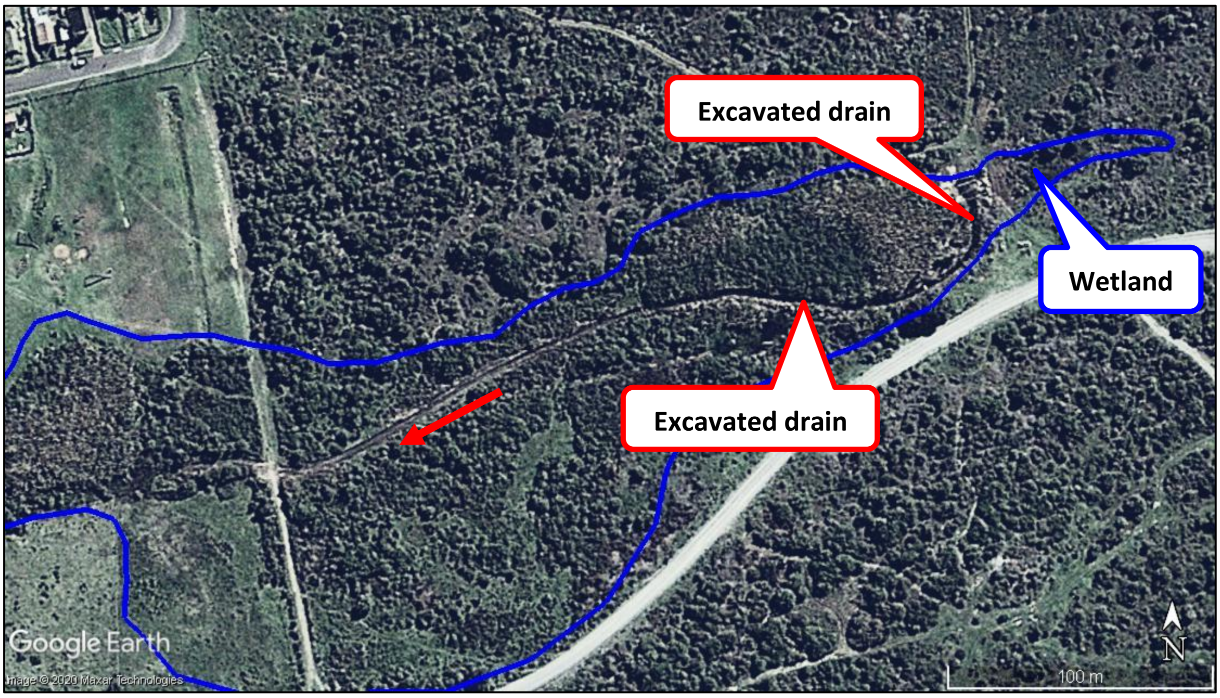


Figure 16: Google satellite imagery dated 2012 showing past excavations of a drain within the wetland

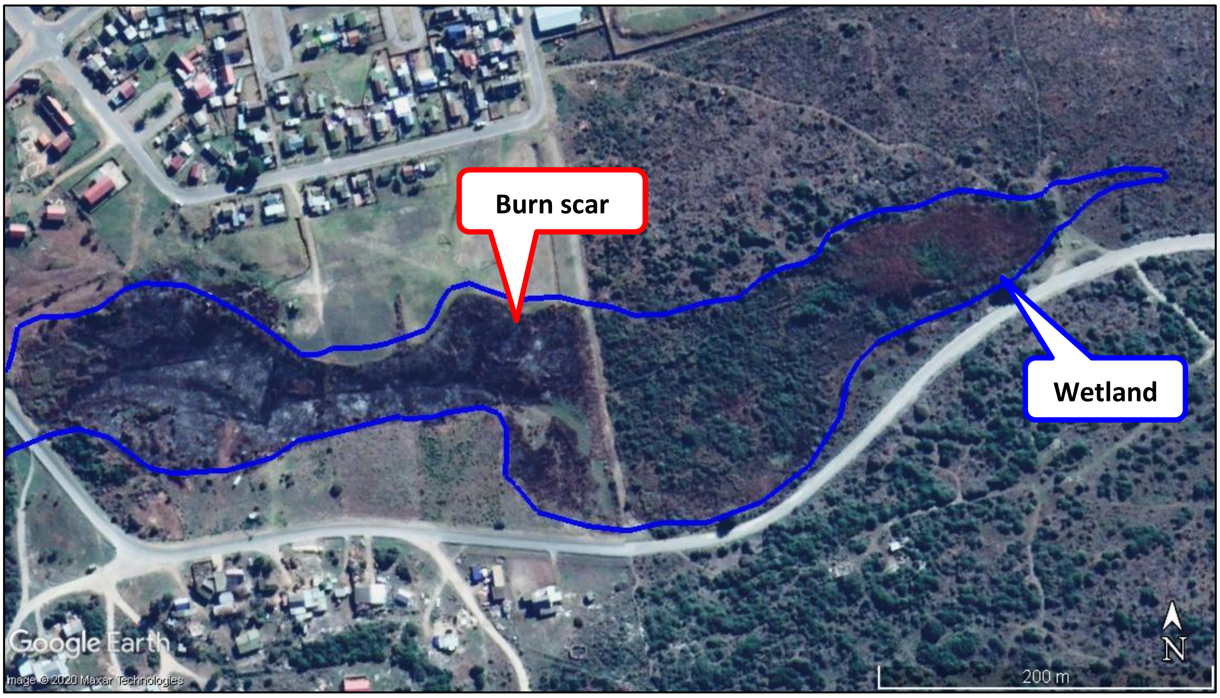


Figure 17: Google satellite imagery dated 2017 showing evidence of fire within the wetland

5.2.3 Present Ecological State (PES)

The Melkhoutfontein Wetland has deviated from the estimated reference condition but maintains a fair level of natural ecological functioning and form. The Wet-Health2 assessment determined that the wetland falls within the 'C' ecological category for present condition (Table 4).

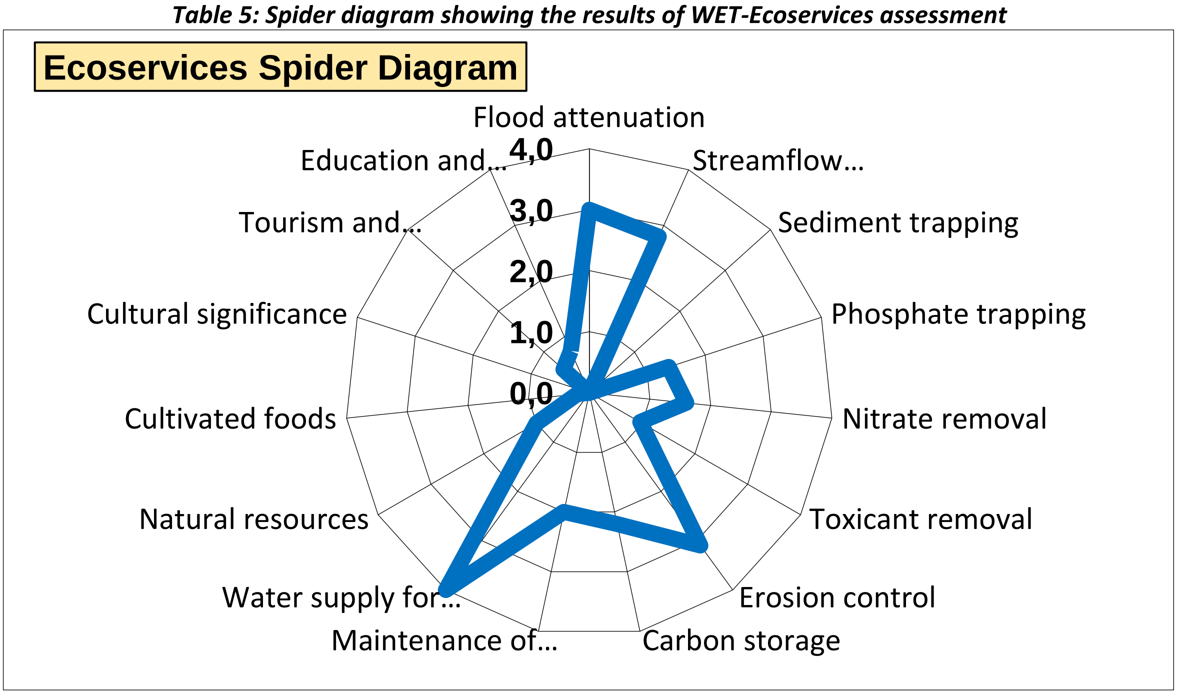
Table 4: Summary of PES Assessment

Level 2: PES Outcomes				
This tab provides an overall summary of the WET-Health Assessment that can be used for reporting purposes				
	Wetland PES Summary			
Wetland name	Melkhoutfontein Wetland			
Assessment Unit	Unchannelled valley bottom			
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	3,5	2,0	1,5	3,0
PES Score (%)	65%	80%	85%	70%
Ecological Category	**C**	**B**	**B**	**C**
Trajectory of change	↓	→	→	→
Combined Impact Score	2,6			
Combined PES Score (%)	74%			
Combined Ecological Category	**C**			
Confidence	Moderate: Field-based 'Level 2' assessment but relatively high probability of connection to regional aquifer			

5.2.4 Ecosystem services and functional importance

The Melkhoutfontein Wetland has an extremely high ecological importance and provides valuable services to society. The wetland feeds the dam which provides water supplies to the broader area. The habitat regulates stream flow into the dam and protects such infrastructure from flooding and erosion. The wetland provides water purification by cleaning pollutants that enter from the catchment prior to them entering the dam. The WET- Ecoservices assessment is summarised in the diagram below (Table 5).

Table 5: Spider diagram showing the results of WET-Ecoservices assessment



5.2.5 Recommended Ecological Category:

The recommended ecological category (REC) is used to inform future management objective for an aquatic ecosystem. The REC can be determined by using the PES (Present Ecological State) and EIS (Ecological Importance and Sensitivity) scores of the system (see table below; DWAF 2007). The wetland assessed has a Fair 'C' PES and a Very High 'A' EIS which places it in the REC 'B' category which advocates the improvement of the system (Table 6).

Table 6: Management objectives for the watercourse based on PES & EIS scores (DWAF 2007).

			Ecological Importance and Sensitivity (EIS)			
			Very High	**High**	**Moderate**	**Low**
PES	**A**	Pristine	A Maintain	A Maintain	A Maintain	A Maintain
	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good	B Improve	B/C Improve	**C** **Maintain**	C Maintain
	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Poor	D Improve	E/F Improve	E/F Maintain	E/F Maintain

6 IDENTIFIED IMPACTS

Aquatic ecosystems are particularly vulnerable to human activities and these activities can often result in irreversible damage or longer term, cumulative changes. The significance of an impact to the environment or ecosystem can only be assessed in terms of the change to ecosystem services, resources and biodiversity value associated with that system or component being assessed. The approach adopted is to identify and predict all potential direct and indirect impacts resulting from an activity from planning to rehabilitation. Thereafter, the impact significance is determined. Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). The degree of significance depends upon three dimensions: the measurable characteristics of the impact (e.g. intensity, extent and duration), the importance societies/communities place on the impact, and the likelihood / probability of the impact occurring.

The direct and indirect impacts associated with the project are grouped into four encapsulating impact categories, where associated or interlinked impacts are grouped. Impacts have been separated into construction and operational phases of the project within these categories.

6.1 Disturbance of aquatic habitat

The disturbance or loss of aquatic vegetation and habitat refers to the direct physical destruction or disturbance of aquatic habitat caused by vegetation clearing, disturbance of riparian habitat, encroachment and colonisation of habitat by invasive alien plants.

6.1.1 Construction Phase

There is potential for disturbance of vegetation during construction from machinery, vehicles and workers. The movement of topsoil and incorrectly placed stockpiles could bury aquatic habitat and increase sedimentation rates. Due to construction, alien invasive species may encroach further into any disturbed areas and outcompete indigenous vegetation thereby reducing aquatic biodiversity. However, proper site management as per the EMP will avoid these impacts.

6.1.2 Operational Phase

There is less direct risk to aquatic habitat during the operational phase as it will have been transformed already during construction and the cemetery boundary is to be walled. The project may promote the establishment of disturbance-tolerant biota, including colonization by invasive alien species, weeds and pioneer plants if there is any ongoing disturbance near the riparian zone. Although this impact is initiated during the construction phase it is likely to persist into the operational phase. If the No Go zone is adhered to, and it should be as a wall is planned around the cemetery, and stormwater is managed, there will be no disturbance upon the river habitat.

6.2 Erosion and sedimentation

Sedimentation and erosion refers to the alteration in the physical characteristics of the wetland as a result of increased turbidity and sediment deposition, caused by soil erosion and earthworks that are associated with construction activities, as well as instability and collapse of unstable soils during project operation. These impacts can result in the deterioration of aquatic ecosystem integrity and a reduction/loss of habitat for aquatic dependent flora & fauna.

6.2.1 Construction Phase

Vegetation clearing and exposure of bare soils upslope of freshwater habitat during construction will decrease the soil binding capacity and cohesion of the soils and thus increase the risk of erosion and sedimentation downslope. This activity may cause the burying of aquatic habitat. Ineffective site stormwater management, particularly in periods of high runoff, can lead to soil erosion from confined flows. Formation of rills and gullies from increased concentrated runoff. This increase in volume and velocity of runoff increases the particle carrying capacity of the water flowing over the surface. Soil compaction resulting in reduced infiltration and increased surface runoff together with the artificial creation of preferential flow paths due to construction activities, will result in increased quantities of flow entering the systems. However, the magnitude of these activities is very small.

6.2.2 Operational Phase

Where soil erosion problems initiated during the construction phase are not timeously and adequately addressed, these can persist into the operational phase of the development project and continue to have a negative impact on wetland. The creation of preferential flow paths, if not mitigated against, will result in erosion in the catchment and the river systems. As graves are dug, there may be sedimentation downslope, due to soil disturbance. With proper site management these impacts will be completely avoided.

6.3 Water pollution

Water and/or soil pollution cause negative changes in the physical, chemical, and biological characteristics of water resources (i.e. water quality). This can result in possible deterioration in aquatic ecosystem integrity and a reduction in, or loss of, species of conservation concern (i.e. rare, threatened/endangered species). Additionally, litter indirectly decreases the aesthetic value of the aquatic habitat.

6.3.1 Construction Phase

During construction there are a number of potential pollution inputs into the soils and watercourse (such as hydrocarbons and raw cement). These pollutants alter the water quality parameters such as turbidity, nutrient levels, chemical oxygen demand and pH. These alternations impact the species composition of the systems, especially species sensitive to minor changes in these parameters. Sudden drastic changes in water quality can also have chronic effects on aquatic biota in general and result in localised extinctions. Hydrocarbons including petrol/diesel and oils/grease/lubricants associated with construction activities (machinery, maintenance, storage, handling) may potentially enter the system by means of surface runoff or through dumping by construction workers. The incorrect positioning and maintenance of the portable chemical toilets and use of the surrounding environment as ablution facilities may result in sewage and chemicals entering the system. However, the site is approximately 200 m away from aquatic habitat so this impact is highly unlikely to occur.

6.3.2 Operational Phase

The burial of coffins may pose an environmental risk since the metals that are used in coffin-making may corrode or degrade into harmful toxins. These may leach into the surrounding **soils** and groundwater. As this wetland receives the majority of its water inputs from the groundwater it may be impacted if the groundwater is contaminated by items buried in the cemetery. Also, during maintenance of the structures there could be water pollution impacts similar to those encountered in the construction phase.

6.4 Flow modification

The changes in the quantity, timing and distribution of water inputs and flows within the watercourses. Possible ecological consequences associated with this impact may include deterioration in freshwater ecosystem integrity, reduction/loss of habitat for aquatic dependent flora & fauna, and a reduction in the supply of ecosystem goods & services.

6.4.1 Construction Phase

Land clearing and earth works upslope will reduce infiltration rates and increase the surface runoff volume and velocity. Such changes in surface roughness and runoff rates may lead to some rill and gully erosion. Altered water inputs from upslope disturbances as well as modified water distribution and retention patterns may affect the hydrological integrity of water resource. However, the likelihood of this small disturbance activity resulting in any significant hydrological changes is small.

6.4.2 Operational Phase

One has to ensure that surface flows are slowed and enter the valley in a diffuse pattern. This will be easy to accomplish due to the gentle gradient and uniform micro-topography of the site, as well as the high infiltration rates of the soils. If the buffer area is not altered and remains vegetated, and the stormwater runoff is managed, the impacts can be avoided and the hydrological regime will not be modified.

7 IMPACT SIGNIFICANCE ASSESSMENT

Impact significance is defined broadly as a measure of the desirability, importance and acceptability of an impact to society (Lawrence, 2007). The degree of significance depends upon three dimensions: the measurable characteristics of the impact (e.g. intensity, extent and duration), the importance societies/communities place on the impact (or resource being affected), and the likelihood / probability of the impact occurring. A methodology for assigning scores to the respective impacts is described in Annexure 12. The impact significance of the cemetery expansion was determined for each potential impact of the project (Table 7). The is potential for the activities associated with the expansion of the cemetery to cause a Low level of impact upon aquatic habitat. Mitigation can easily reduce it to acceptably low levels and completely avoid most impacts. Therefore, with mitigation, stormwater management, and the application of the buffer area, it was determined that the project will have a Very Low to No impact.

Table 7: Evaluation of potential impacts of the cemetery expansion on the surrounding aquatic habitats. "With mitigation" assumes a scenario where the buffer is implemented and all of the mitigation recommendations within this report are adopted.

	Impact	Mitigation	Extent	Duration	Magnitude	Probability	Significance	Reversibility	Mitigation Potential	Irreplaceable Resource Loss
Construction Phase	Disturbance of aquatic vegetation	Without Mitigation	Local(2)	Short (2)	Minor (2)	Improbable (2)	**Low (12)**	Partly	Medium	No
		With Mitigation	Site only (1)	Very short (1)	Small (0)	Highly Improbable (1)	**Very Low (2)**	Barely	Low	No
	Erosion & sedimentation	Without Mitigation	Local (2)	Short (2)	Low (4)	Probable (3)	**Low (24)**	Partly	High	No
		With Mitigation	Site only (1)	Very Short (1)	Minor (2)	Improbable (2)	**Very Low (8)**	Barely	Low	No
	Water pollution	Without Mitigation	Regional (3)	Short (2)	Minor (2)	Improbable (2)	**Low (14)**	Partly	High	No
		With Mitigation	Local (2)	Very short (1)	Small (0)	Highly Improbable (1)	**Very Low (3)**	Barely	Low	No
	Flow modification	Without Mitigation	Local (2)	Short (2)	Small (0)	Improbable (2)	**Very Low (8)**	Partly	Medium	No
		With Mitigation	Site only (1)	Very short (1)	Small (0)	Highly Improbable (1)	**Very Low (2)**	Barely	Low	No
Operational Phase	Erosion & sedimentation	Without Mitigation	Local (2)	Permanent (5)	Minor (2)	Probable (3)	**Low (27)**	Partly	Medium	No
		With Mitigation	Site only(1)	Permanent (5)	Small (0)	Highly Improbable (1)	**Very Low (6)**	Barely	Low	No

	Flow modification	Without Mitigation	Local (2)	Permanent (5)	Small (0)	Highly Improbable (1)	**Very Low (7)**	Partly	Low	No
		With Mitigation	Site only (1)	Permanent (5)	Small (0)	Highly Improbable (1)	**Very Low (6)**	Barely	Low	No
	Water pollution	Without Mitigation	Local (2)	Permanent (5)	Minor (2)	Probable (3)	**Low (27)**	Barely	Low	No
		With Mitigation	Local (2)	Permanent (5)	Small (0)	Improbable (2)	**Low (14)**	Barely	Low	No
	Disturbance of aquatic vegetation	Without Mitigation	Site only (1)	Short (2)	Small (0)	Improbable (2)	**Very Low (6)**	Partly	Medium	No
		With Mitigation	Site only (1)	Short (2)	Small (0)	Highly Improbable (1)	**Very Low (3)**	Barely	Low	No

8 MITIGATION MEASURES

The mitigation of negative impacts on biodiversity and ecosystem goods and services is a legal requirement for authorisation purposes and must take on different forms depending on the significance of the impact and the specific area being affected. Mitigation requires the adoption of the precautionary principle and proactive planning that is enabled through a mitigation hierarchy. Its application is intended to strive to first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining significant residual negative impacts on biodiversity (DEA 2013). Many of the potential impacts associated with this project can be completely avoided.

The mitigation measures detailed within this report must be taken into consideration during financial planning of the construction phase of the development. This to ensure that sufficient funds are available to implement all the measures required to maintain the current PES score of the watercourse impacted upon.

Any potential risks must be managed and mitigated to ensure that no deterioration to the water resource takes place. Standard management measures should be implemented to ensure that any on-going activities do not result in a decline in water resource quality. Consideration should also be given to the rehabilitation of watercourses where feasible. Mitigation measures related to the impacts associated with the construction activities are intended to augment standard/generic mitigation measures included in the project-specific Environmental Management Programme (EMPr).

The monitoring of the development activities is essential to ensure the mitigation measures are implemented. Therefore, compliance with the mitigation recommendations must be audited by a suitably qualified independent Environmental Control Officer with an appropriately timed audit report. In the case where there is extensive damage to any aquatic system, where rehabilitation is required, a suitably qualified aquatic specialist must audit the site. Monitoring for non-compliance must be done on a daily basis by the contractors. Photographic records of all incidents and non-compliances must be retained. This is to ensure that the impacts on the aquatic habitat are adequately managed and mitigated against and the successful rehabilitation of any disturbed areas within any system occurs.

If there is no intrusion into the valley then the potential impacts will be easily managed or avoided. The furthest distance between activities and the wetland must be maintained, and at the least, a buffer zone of 32m should be applied. An aquatic impact buffer zone is defined as a zone of vegetated land designed and managed so that sediment and pollutant transport carried from source areas via diffuse surface runoff is reduced to acceptable levels (Macfarlane and Bredin 2016). As the proposed cemetery boundary is more than 200 m away from the wetland, there is no need to encroach into the valley. The following mitigation measures must be adhered to and monitored:

8.1 Construction Phase

- Outside the working corridor, all watercourses are to be considered no go areas and a 32 m construction buffer must be adhered to. Any unnecessary intrusion into these areas is prohibited.
- Designated areas for stockpiling of raw materials must be identified before material is brought onto site. Stockpiles should not be placed in vegetated areas that will not be cleared. Erosion control measures including silt fences, low soil berms and/or shutter boards must be put in place around the stockpiles to limit sediment runoff from stockpiles. No increase in sediments reaching the wetland should occur.
- No stockpiling is to occur within 100m of water resources. All stockpiling areas must be approved by the ECO before stockpiling occurs.
- Staff environmental induction must take place prior to construction commencing and any subcontractors utilised must be inducted before starting work onsite. The ECO must monitor the compliance of the Contractors and instruct the Contractors where necessary.

8.2 Post-construction/ Rehabilitation Phase

Although it is recommended that no construction should be allowed to occur within or impact upon watercourses under the current proposal, there is always potential for accidental disturbance therefore guidelines for rehabilitation of aquatic habitats are provided. The aim of the rehabilitation is to ensure the necessary procedures are appropriately implemented in the natural environment that may be negatively affected by the development. The plan will promote the re-establishment of the ecological functioning of any area disturbed by construction activities. Also consult WET-RehabEvaluate, WET-RehabMethods (Cowden and Kotze, 2009), and the river rehabilitation manual developed by Day *et al.* 2016, for further information.

Important guidelines for rehabilitation are:

- The area must be maintained through alien invasive plant species removal (which is the landowner's responsibility regardless of mitigation associated with this project) and the establishment of indigenous vegetation cover to filter run-off before it enters the freshwater habitat.

- It is the contractor's responsibility to continuously monitor the area for alien species during the contract and establishment period which if present should be removed. Alien invasive species within the construction corridor must be removed. Alien invasive species that are likely to encroach are Acacia species, such as Rooikrans.
- Removal of these species shall be undertaken in a way which prevents any damage to the remaining indigenous species and inhibits the re-infestation of the cleaned areas.
- Any use of herbicides in removing alien plant species is required to be investigated by the ECO before use, for the necessity, type proposed to be used, effectiveness and impacts of the product on aquatic biota.
- Alien/ invasive species shall not be stockpiled, they should be removed from site and dumped at an approved site.
- Removal of vegetation must only be when essential for the continuation of the project. Do not allow any disturbance to the adjoining natural vegetation cover or soils.
- The solid domestic waste must be removed and disposed of offsite. All post-construction building material and waste must be cleared in accordance with the EMPr.
- Erosion features that have developed due to construction within the aquatic habitat due to the project are required to be stabilised. This may also include the need to deactivate any erosion headcuts/rills/gullies that may have developed.
- A monitoring programme shall be in place, not only to ensure compliance with the EMPr throughout the construction phase, but also to monitor any post-construction environmental issues and impacts during the vegetation establishment phase.

8.3 Operational Phase

- The establishment and infestation of alien invasive plant species must be prevented, managed and eradicated in the areas impacted upon by the project.
- The encroachment of any further infrastructure or vehicles into the aquatic buffer area must be prevented.
- Maintenance must ensure that no solid waste is left on site that can be washed down or blown into the aquatic habitat.
- The volume and velocity of any stormwater runoff must be reduced through discharging the surface flow at multiple locations, preventing erosion.

9 WATER USE AUTHORISATION IMPLICATIONS

The proposed cemetery expansion will require water use authorisation as the site encroaches into the regulated area of the Melkhoutfontein Wetland. Any activity within the regulated area of a wetland or river requires water use authorisation and registration under Section 21 (c) and (i) of the National Water Act (Act 36 of 1998). It will be necessary to complete a Risk Matrix as specified in the Government Notice R509 of 2016 for section 21 (c) and (i) water uses (impeding or diverting flow or changing the bed, banks or characteristics of a watercourse) as defined under the NWA (1998). Should the Risk Matrix determine the project to have Low risk upon freshwater habitat then authorisation via General Authorisation (GA) with the BGCMA is possible.

10 CONCLUSION

Sharples Environmental Services cc were appointed by Hessequa Municipality to conduct an independent specialist aquatic habitat impact assessment for the proposed expansion of the Melkhoutfontein Cemetery, to provide specialist input into the environmental authorisation process and fulfil water use authorisation requirements. All watercourses within the 500m radius study area of the proposed site were identified, delineated, investigated infield, and screened in accordance to their risk of being impacted upon. It was found that the wetland downslope of the site could potentially be impacted upon.

The direct and indirect impacts associated with the project were identified and grouped into four encapsulating impact categories. The impacts identified are:

- The disturbance of aquatic vegetation
- Sedimentation and erosion
- Water pollution
- Flow modification

The impacts associated with the project are assessed as being of Low significance. However, this may potentially be decreased to Very Low impact significance with the implementation of effective mitigation measures. The impacts are considered to be easily mitigated provided the mitigation measures and monitoring plan within this report are implemented and adhered to during the construction and operational phase of the project. Mitigation measures must focus on avoiding sensitive areas. The proposal is deemed acceptable from an aquatic habitat perspective. The applicant should apply for a General Authorisation from the Breede Gouritz Catchment Management to fulfil the water use requirements of the National Water Act (Act 36 of 1998).

11 References

ARMITAGE, N., VICE, M., FISHER-JEFFES, L., WINTER, K., SPIEGEL, A., & DUNSTAN, J. 2013. Alternative Technology for Stormwater Management: *The South African Guidelines for Sustainable Drainage Systems.* Report to the Water Research Commission. Pretoria

BROMILOW, C. 2001. Problem Plants of South Africa: a Guide to the Identification and Control of more than 300 invasive plants and other weeds. Briza Publications, Pretoria.

KIM CANAVAN, IAIN D PATERSON, CARLA LAMBERTINI, MARTIN P HILL, Expansive reed populations—alien invasion or disturbed wetlands?, *AoB PLANTS*, Volume 10, Issue 2, April 2018

CSIR (Council for Scientific and Industrial Research). 2010. National Aquatic Ecosystem Priority Areas (NFEPA). Council for Scientific and Industrial Research, Pretoria, South Africa.

DEPARTMENT OF ENVIRONMENTAL AFFAIRS, DEPARTMENT OF MINERAL RESOURCES, CHAMBER OF MINES, SOUTH AFRICAN MINING AND BIODIVERSITY FORUM, AND SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE. 2013. Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector. Pretoria.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, 1999a. Resource Directed Measures for Protection of Water Resources. Volume 4. Wetland Ecosystems Version 1.0, Pretoria.

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.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY, 2007. Internal Guideline: Generic Water Use Authorisation Application Process

Department of Water Affairs (DWA), 2014. *Reserve Determination Studies for Surface Water, Groundwater, Estuaries and Wetlands in the Gouritz Water Management Area:* Desktop EcoClassification Report. Prepared by Scherman Colloty & Associates. Report no. RDM/WMA16/00/CON/0213.

DEPARTMENT OF WATER AFFAIRS AND FORESTRY. 2009. DWAF Training Manual: National Water Act Section 21(c) and (i) Water Uses. Version: November 2009.

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 Aquatic Ecosystem Priority Areas. Report to the Water Research Commission*. Pretoria

DWAF. 2008. Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas, prepared by M. Rountree, A. L. Batchelor, J. MacKenzie and D. Hoare. Stream Flow Reduction Activities, Department of Water Affairs and Forestry, Pretoria, South Africa

KLEYNHANS, C.J., 1996. Index of Habitat Integrity (IHI).

KOTZE, D.C., MARNEWECK, G.C., BATCHELOR, A.L., LINDLEY, D.S. AND COLLINS, N.B. 2009. WET-Ecoservices: A technique for rapidly assessing ecosystem services supplied by wetlands.

NAIMAN, R.J., AND H. DECAMPS. 1997. The ecology of interfaces -- riparian zones. Annual Review of Ecology and Systematics 28:621-658

MACFARLANE, D.M. and Bredin, I.P. 2016. Buffer zone guidelines for rivers, wetlands and estuaries. Part 2: Practical Guide. WRC Report No (tbc), Water Research Commission, Pretoria.

MACFARLANE, D.M., KOTZE, D.C., ELLERY, W.N., WALTERS, D., KOOPMAN, V., GOODMAN, P. & GOGE, C. 2008. WET-Health: A technique for rapidly assessing wetland health, Version 2.

MASSACCI, A., PIETRINI, F. & IANNELLI, M.A. 2001. Remediation of wetlands by Phragmites australis: the biological basis. Minerva Biotecnol. 13: 135-140.

MUCINA, L. AND RUTHERFORD, M. C. (EDS) 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

LAWRENCE, D.P., 2007. Impact significance determination - Designing an approach. Environmental Impact Assessment Review 27: 730 - 754.

ROGERS KH. 1995. Riparian Wetlands. In: Wetlands of South Africa, Cowan GI (ed). Department of Environmental Affairs and Tourism: Pretoria.

SOUTH AFRICAN NATIONAL PARKS. 2014. Garden Route National Park: State of Knowledge. South African National Parks unpublished report.

TURPIE J; Taljaard S; van Niekerk L; Adams J; Wooldridge T; Cyrus D; Clark B; & Forbes N. 2013. The Estuary Health Index: A standardised metric for use in estuary management and the determination of ecological water requirements. WRC Report No 1930/1/12.

VAN GINKEL, C.E., GLEN, R.P., GORDAN-GRAY, K.D., CILLIERS, C.J., MUASYA AND VAN DEVENTER, P.P., 2011. Easy identification of some South African Wetland Plants (Grasses, Resticios, Sedges, Rushes, Bulrushes, Eriocaulons and Yellow-eyed grasses). WRC Report No. TT 459/10.

12 ANNEXURE (METHODOLOGIES)

12.1 Delineation of Riparian Areas

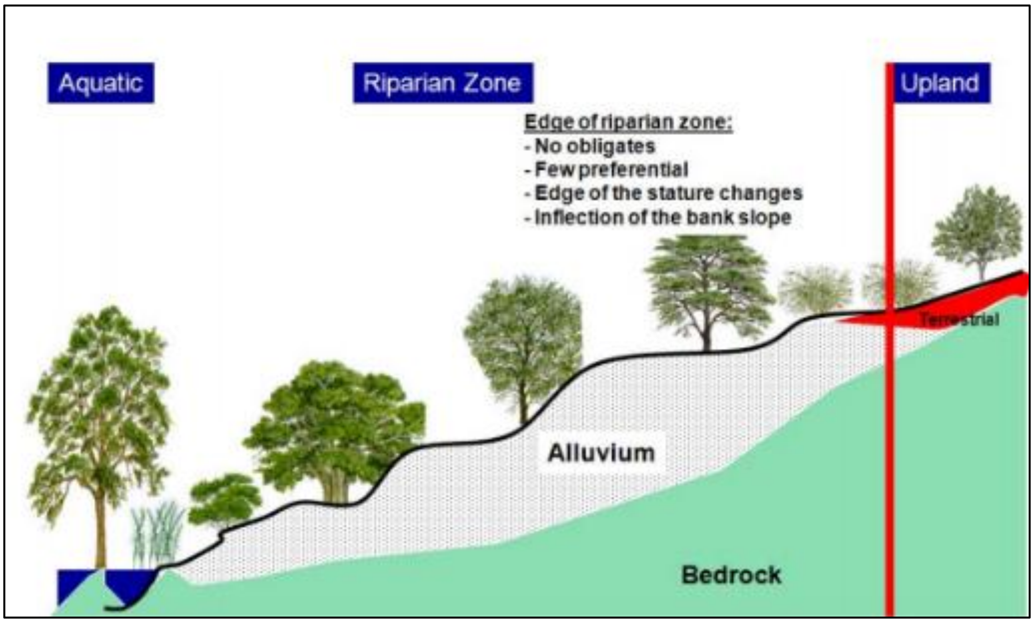
Riparian zones are described as "the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas" i , Riparian zones can be thus be distinguished from adjacent terrestrial areas through their association with the physical structure (banks) of the river or stream, as well as the distinctive structural and compositional vegetation zones between the riparian and upland terrestrial areas (Figure 8). Unlike wetland areas, riparian zones are usually not saturated for a long enough duration for redoxymorphic features to develop. Riparian zones instead develop in response to (and are adapted to) the physical disturbances caused by frequent overbank flooding from the associated river or stream channel.

Like wetlands, riparian areas can be identified using a set of indicators. The indicators for riparian areas are: - **Landscape position**; - Alluvial soils and recently deposited material; - **Topography** associated with riparian areas; and - **Vegetation** associated with riparian areas. Landscape Position As discussed above, a typical landscape can be divided into 5 main units, namely the: - Crest (hilltop); - Scarp (cliff); - Midslope (often a convex slope); - Footslope (often a concave slope); and - Valley bottom. Amongst these landscape units, riparian areas are only likely to develop on the valley bottom landscape units (i.e. adjacent to the river or stream channels; along the banks comprised of the sediment deposited by the channel). Alluvial soils are soils derived from material deposited by flowing water, especially in the valleys of large rivers. Riparian areas often, but not always, have alluvial soils. Whilst the presence of alluvial soils cannot always be used as a primary indicator to accurately delineate riparian areas, it can be used to confirm the topographical and vegetative indicators. Quaternary alluvial soil deposits are often indicated on geological maps, and whilst the extent of these quaternary alluvial deposits usually far exceeds the extent of the contemporary riparian zone; such indicators are useful in identifying areas of the landscape where wider riparian zones may be expected to occur.

Topography and recently deposited material associated with riparian areas The National Water Act definition of riparian zones refers to the structure of the banks and likely presence of alluvium. A good indicator of the presence of riparian zones is the presence of alluvial deposited material adjacent to the active channel (such as benches and terraces), as well as the wider incised "macro-channels" which are typical of many of southern Africa's eastern seaboard rivers. Recently deposited alluvial material outside of the main active channel banks can indicate a currently active flooding area; and thus the likely presence of wetlands. Vegetation associated with riparian areas unlike the delineation of wetland areas, where redoxymorphic features in the soil are the primary indicator, the identification of riparian areas relies heavily on vegetative indicators. Using vegetation, the outer boundary of a riparian area can be defined as the point where a distinctive change occurs: - in species composition relative to the adjacent terrestrial area; and - in the physical structure, such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas. Growth form refers to the health, compactness, crowding, size, structure and/or numbers of individual plants.

As with the delineation approach for wetlands, the field delineation method for riparian areas focuses on two main indicators of riparian zones: - **Vegetation Indicators**, and - **Topography** of the banks of the river or stream.

Additional verification can be obtained by examining for any recently alluvial deposited material to indicate the extent of flooding and thus obtain at least a minimum riparian zone width. The following procedure should be used for delineation of riparian zones: A good rough indicator of the outer edge of the riparian areas is the edge of the macro channel bank. This is defined as the outer bank of a compound channel, and should not be confused with the active river or stream channel bank. The macro-channel is an incised feature, created by uplift of the subcontinent which caused many rivers to cut down to the underlying geology and creating a sort of “restrictive floodplain” within which one or more active channels flow. Floods seldom have any known influence outside of this incised feature. Within the macro-channel, flood benches may exist between the active channel and the top of the macro channel bank. These depositional features are often covered by alluvial deposits and may have riparian vegetation on them. Going (vertically) up the macro channel bank often represents a dramatic decrease in the frequency, duration and depth of flooding experienced, leading to a corresponding change in vegetation structure and composition.



A schematic diagram illustrating the edge of the riparian zone on one bank of a large river. (DWAF 2008)

12.2 Present Ecological State (PES) – Riparian

Habitat is one of the most important factors that determine the health of river ecosystems since the availability and diversity of habitats (in-stream and riparian areas) are important determinants of the biota that are present in a river system (Kleynhans, 1996). The 'habitat integrity' of a river refers to the "maintenance of a balanced composition of physic-chemical and habitat characteristics on a temporal and spatial scale that are comparable to the characteristics of natural habitats of the region" (Kleynhans, 1996). It is seen as a surrogate for the assessment of biological responses to driver changes.

DWAF have developed a modified IHI, designed to accommodate the time constraints associated with desktop assessments or for instances where a rapid assessment of river conditions is required. The protocol does not distinguish between instream and riparian habitat and addresses six simple metrics to obtain an indication of Present Ecological State (PES). Each of the criteria are rated on a scale of 0 (close to natural) to 5 (critically modified) according to the following metrics:

- Bed modification
- Flow modification
- Inundation
- Bank condition
- Riparian zone condition
- Water quality modification

This assessment was informed by (i) a site visit where potential impacts to each metric were assessed and evaluated and (ii) an understanding of the catchment feeding the river and landuses / activities that could have a detrimental impact on river ecosystems.

The rating scale for each of the various metrics in the assessment

RATING SCORE	IMPACT CLASS	DESCRIPTION
0	**None**	*No discernible impact or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.*
0.5 - 1.0	**Low**	*The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.*
1.5 - 2.0	**Moderate**	*The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability are also limited.*
2.5 - 3.0	**Large**	*The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.*
3.5 - 4.0	**Serious**	*The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not influenced.*
4.5 - 5.0	**Critical**	*The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.*

The six metric ratings of the HGM under assessment are then averaged, resulting in one value. This value determines the Habitat Integrity PES category for the HGM (Table A11.6b).

Table A11.6b: The habitat integrity PES categories

HABITAT INTEGRITY PES CATEGORY	DESCRIPTION
A: Natural	Unmodified, natural.
B: Good	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
C: Fair	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
D: Poor	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.
E: Seriously modified	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.
F: Critically modified	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.

12.3 Ecological Importance & Sensitivity – Riparian

The ecological importance of a wetland/river is an expression of its importance to the maintenance of biological diversity and ecological functioning on local and wider scales. Ecological sensitivity (or fragility) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Kleynhans & Louw, 2007; Resh et al., 1988; Milner, 1994). Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity (Table A11.7a).

Table A11.7a: Components considered for the assessment of the ecological importance and sensitivity of a riparian system. An example of the scoring has also been provided.

Ecological Importance and Sensitivity assessment (Rivers)		
	Determinants	**Score (0-4)**
BIOTA (RIPARIAN & INSTREAM)	Rare & endangered (range: 4=very high - 0 = none)	0,5
	Unique (endemic, isolated, etc.) (range: 4=very high - 0 = none)	0,0
	Intolerant (flow & flow related water quality) (range: 4=very high - 0 = none)	0,5
	Species/taxon richness (range: 4=very high - 1=low/marginal)	1,5
RIPARIAN & INSTREAM HABITATS	Diversity of types (4=Very high - 1=marginal/low)	1,0
	Refugia (4=Very high - 1=marginal/low)	1,5
	Sensitivity to flow changes (4=Very high - 1=marginal/low)	1,0
	Sensitivity to flow related water quality changes (4=Very high - 1=marginal/low)	1,0
	Migration route/corridor (instream & riparian, range: 4=very high - 0 = none)	1,0
	Importance of conservation & natural areas (range, 4=very high - 0=very low)	2
MEDIAN OF DETERMINANTS		1,00
ECOLOGICAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS)		**LOW, EC=D**

The scores assigned to the criteria in Table A11.7a were used to rate the overall EIS of each mapped unit according to Table A11.7b, below, which was based on the criteria used by DWS for river eco-classification (Kleynhans & Louw, 2007) and the WET-Health wetland integrity assessment method (Macfarlane et al., 2008).

Table A11.7b: The ratings associated with the assessment of the EIA for riparian areas

RATING	EXPLANATION
None, Rating = 0	Rarely sensitive to changes in water quality/hydrological regime
Low, Rating =1	One or a few elements sensitive to changes in water quality/hydrological regime
Moderate, Rating =2	Some elements sensitive to changes in water quality/hydrological regime
High, Rating =3	Many elements sensitive to changes in water quality/ hydrological regime
Very high, Rating =4	Very many elements sensitive to changes in water quality/ hydrological regime

12.4 Direct, Indirect and Cumulative Impacts Methodology

Direct, indirect and cumulative impacts should be assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high).
- The **duration**, wherein it will be indicated whether:
    - The lifetime of the impact will be of a very short duration (0-1 years) – assigned a score of 1.
    - The lifetime of the impact will be of short duration (2-5 years) – assigned a score of 2;
    - Medium term (5-15 years) – assigned a score of 3;
    - Long-term (> 15 years) – assigned a score of 4; or
    - Permanent – assigned a score of 5.

- The **magnitude**, quantified on a scale of 0-10, where:
    - 0 is small and will have no effect on the environment,
    - 2 is minor and will not result in an impact on processes,
    - 4 is low and will cause a slight impact on processes,
    - 6 is moderate and will result in processes continuing but in a modified way,
    - 8 is high (processes are altered to the extent that they temporarily cease), and
    - 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

- The **probability** of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1-5, where:
    - 1 is very improbable (probably will not happen),
    - 2 is improbable (some possibility, but low likelihood),
    - 3 is probable (distinct possibility),
    - 4 is highly likely (most likely) and;
    - 5 is definite (impact will occur regardless of any prevention measures).

- The **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high;
- The degree to which the impact can be reversed.
- The degree to which the impact may cause irreplaceable loss of resources; and
- The degree to which the impact can be mitigated.
- The significance is calculated by combining the criteria in the following formula, **S = (E+D+M) P**, where:
    - S = significance weighting
    - E = extent
    - D = duration
    - M = magnitude
    - P = probability

- The significance weightings for each potential impact are as follows:
    - <30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop the area),
    - 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
    - >60 points: High (i.e. where the impact must have an influence on the decision process to develop the area).