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FRESHWATER HABITAT IMPACT ASSESSMENT

FOR THE

THE PROPOSED EXPANSION OF THE EXISTING "GOUE AKKER" CEMETERY IN BEAUFORT WEST

PREPARED FOR: Beaufort West Municipality

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

DATE: 13 March 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'.

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	Geography		
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INDEMNITY AND COPYRIGHT

Report citation:

Sharples Environmental Services cc, 2020. Freshwater Habitat Impact Assessment For The The Proposed Expansion Of The Existing "Goue Akker" Cemetery In Beaufort West.

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1 INTRODUCTION

Sharples Environmental Services cc (SES) has been appointed by *Beaufort West Municipality,* to conduct a Freshwater Specialist Impact Assessment for the proposed expansion of the existing "Goud Akker" cemetery in Beaufort West.

1.1 Location

The proposed cemetery is located on the southern side of Beaufort West, a town in the Central Karoo District Municipality. The study site can be accessed from the N12 national road via the Blyth Street turnoff. As can be seen in Figure 1 below, the expansion of the cemetery will be to the south of the existing cemetery. The cadastral map also indicates that there is a dry watercourse, called the Kuils River, to the east of the proposed expansion area.

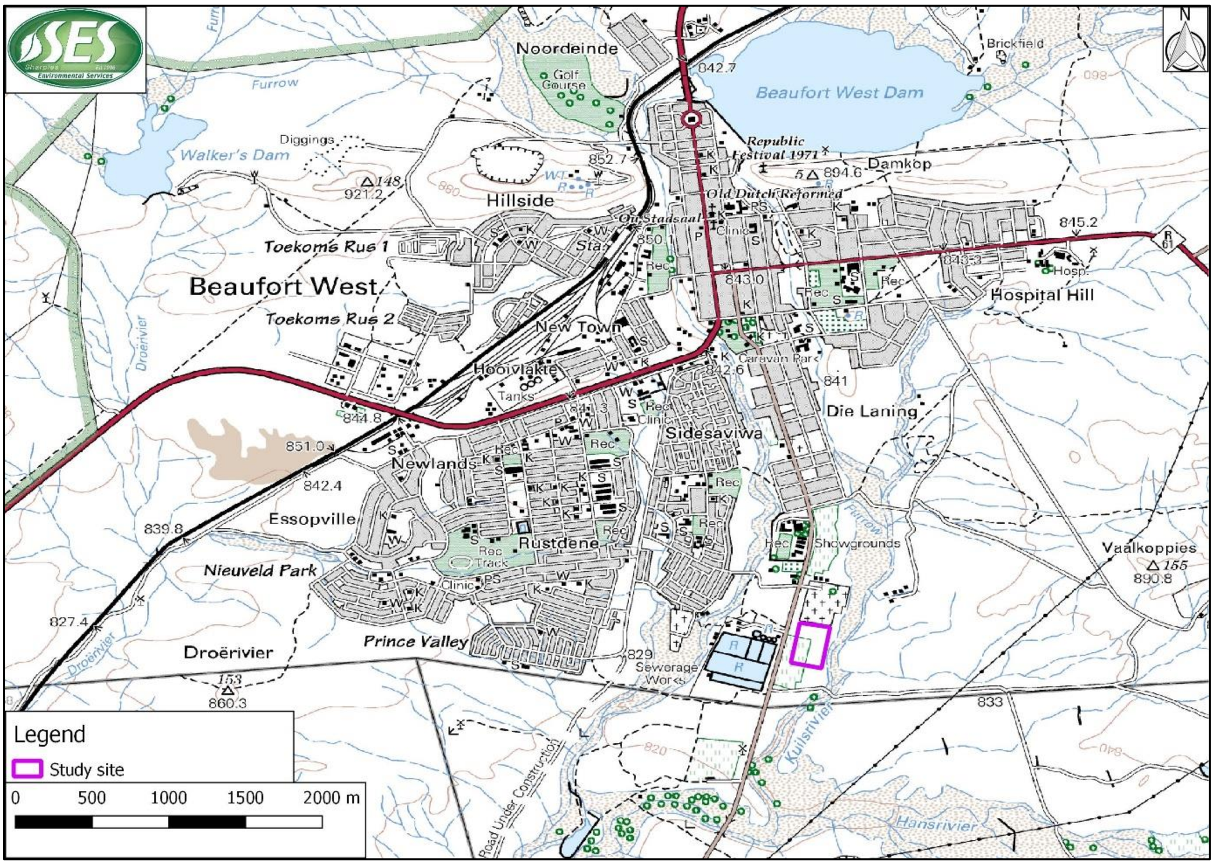

Figure 1: A cadastral map showing the location of the proposed expansion of the existing cemetery in relation to Beaufort West.

1.2 Background

Beaufort West is a mainly indigent community consisting of a total population of 34,085 residents and some 13,086 households based on the 2011 Census statistics. There are currently five (5) existing cemetery sites in Town namely Beaufort West Eastern Cemetery, Beaufort West Central

Cemetery, Botha Street Cemetery, "Goue Akker" North Cemetery and the "Goue Akker" Cemetery. The Municipality has identified an imminent shortage in future available burial space and that the existing cemeteries are near reaching their full capacity. It is estimated that the grave site at the "Goue Akker" cemetery currently has 691 burial space. The average monthly funerals are 41, leaving the "Goue Akker" cemetery with a capacity of approximately 16 months thus giving purpose to the urgent expansion of the cemetery. The Municipality have identified vacant land next to the existing "Goue Akker" cemetery for expansion purposes.

The proposed expansion of the existing cemetery will provide additional capacity of approximately 7 410 no. additional burial spaces and with a growth rate of 3% per annum will provide sufficient space for the next thirteen (13) years after the existing site has reached its capacity. The community of Beaufort West desperately needs additional capacity to bury their relatives.

The existing informal roads on the proposed cemetery land are not sufficient to accommodate regular traffic. New gravel roads need to be constructed in line with the proposed site's layout. Currently there are no existing ablution and caretaker facilities on the proposed site. The site will need to have caretaker facilities (for equipment storage) as well as ablution for people attending funerals. The exact location and level of service of these proposed facilities will be determined during the site planning and layout study.

The proposed layout plan of the expansion area designed by Aurecon is shown in Figure 2. This layout was designed for discussion purposes, not construction.

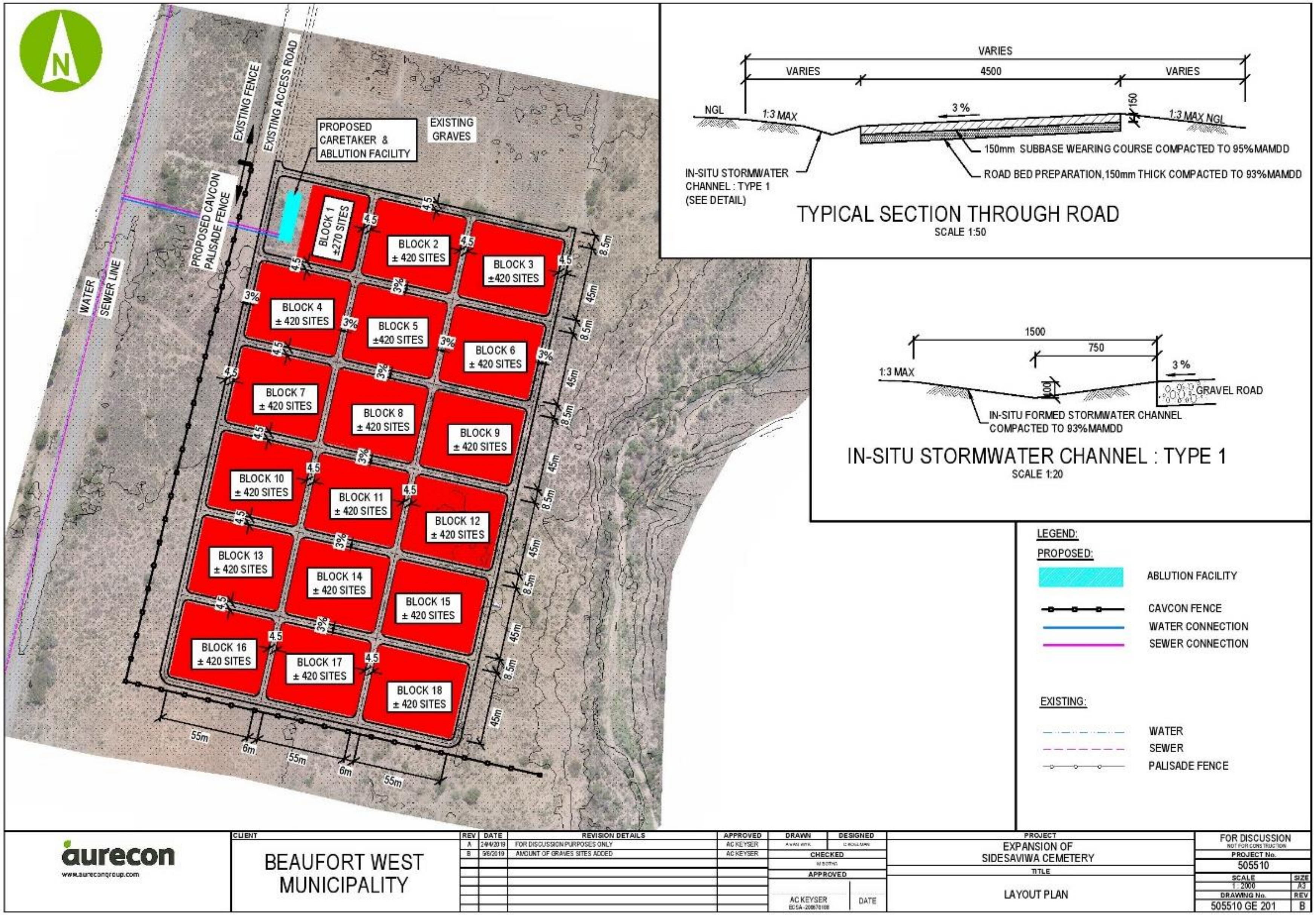

Figure 2: Proposed layout of the "Goue Akker" cemetery expansion.

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 Drainage Setting

The study area is located within the DWS Quaternary Catchment J21A within the Great Karoo Ecoregion. It is a low rainfall semi-arid area. The mean annual precipitation of the catchment is 230 mm which is significantly less than the potential evaporation rate of 2439mm per annum. The site is situated at an approximate elevation of 830 m on the plateau of the Karoo Basin. It consists of quaternary to recent alluvium overlying mudstone, siltstone and sandstone of the Beaufort Group; Karoo Sequence. The even land surface is broken by two types of topographical features: minor drainage lines (washes) and major drainage lines (Ephemeral Rivers). Neither type of drainage line carries water for more than a few hours during rainstorms. In washes and drainage lines the soils are sandy with little organic matter.

The National Freshwater Ecosystem Priority Areas (NFEPA) map 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 non-FEPA wetland southwest of the site. Upon closer investigation it was determined that this is the sewage treatment works. The Kuils River to the east and Gamka River to the west of the study site were classified as an Upstream FEPA rivers (Figure 3).

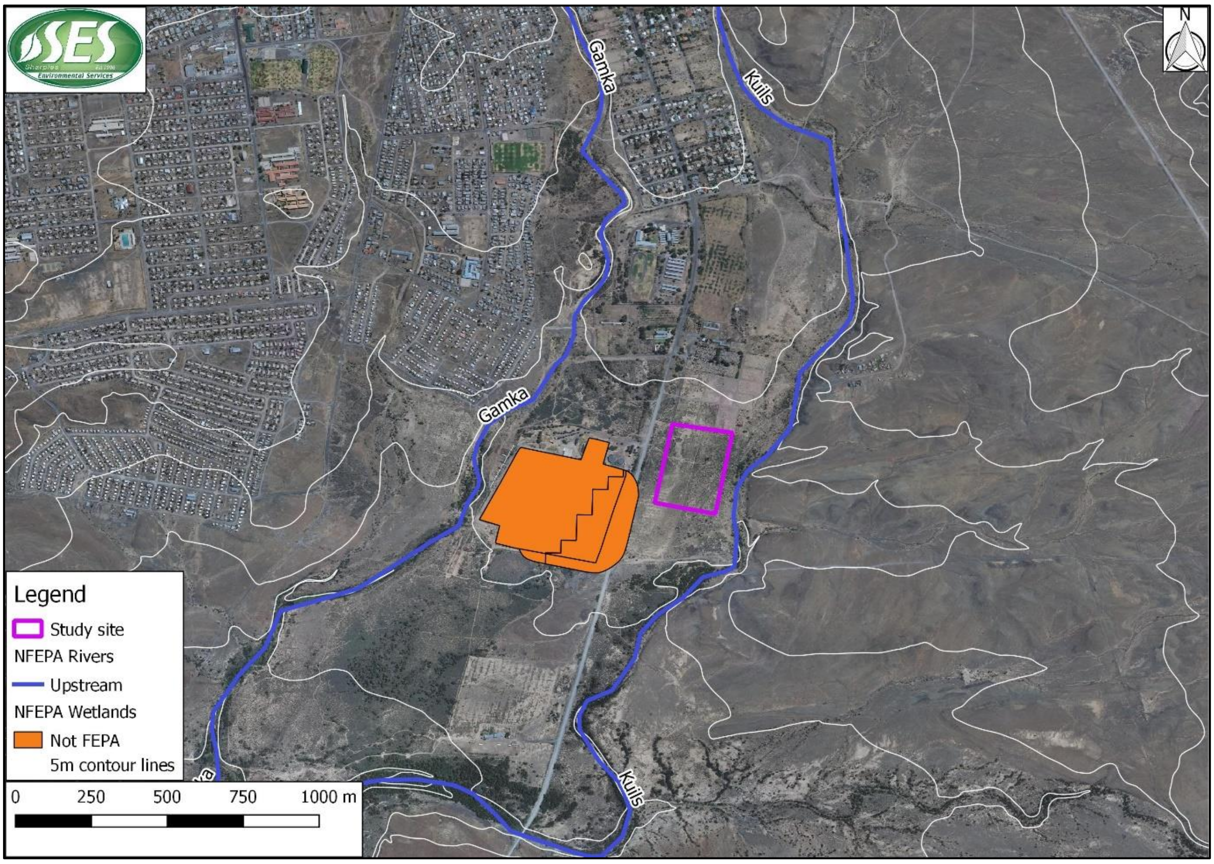

Figure 3: NFEPA identified freshwater features in relation to the study site.

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). The latest version is the National Wetland Map 5, that was released in 2019. This map did not identify any wetlands in proximity to the site. The sewage treatment works was however identified as artificial wetland, similar to the NFEPA results shown in Figure 3.

2.2 Vegetation

Mucina and Rutherford (2006) delineated vegetation units throughout Southern Africa and updated this data in 2012 and in 2018. According to the most recent available vegetation mapping, the study area is situated in Southern Karoo Riviere vegetation. This vegetation group is located in the Inland Saline Vegetation bioregion. The site is located in a terrestrial ecosystem that is of Least Concern in terms of its threat status.

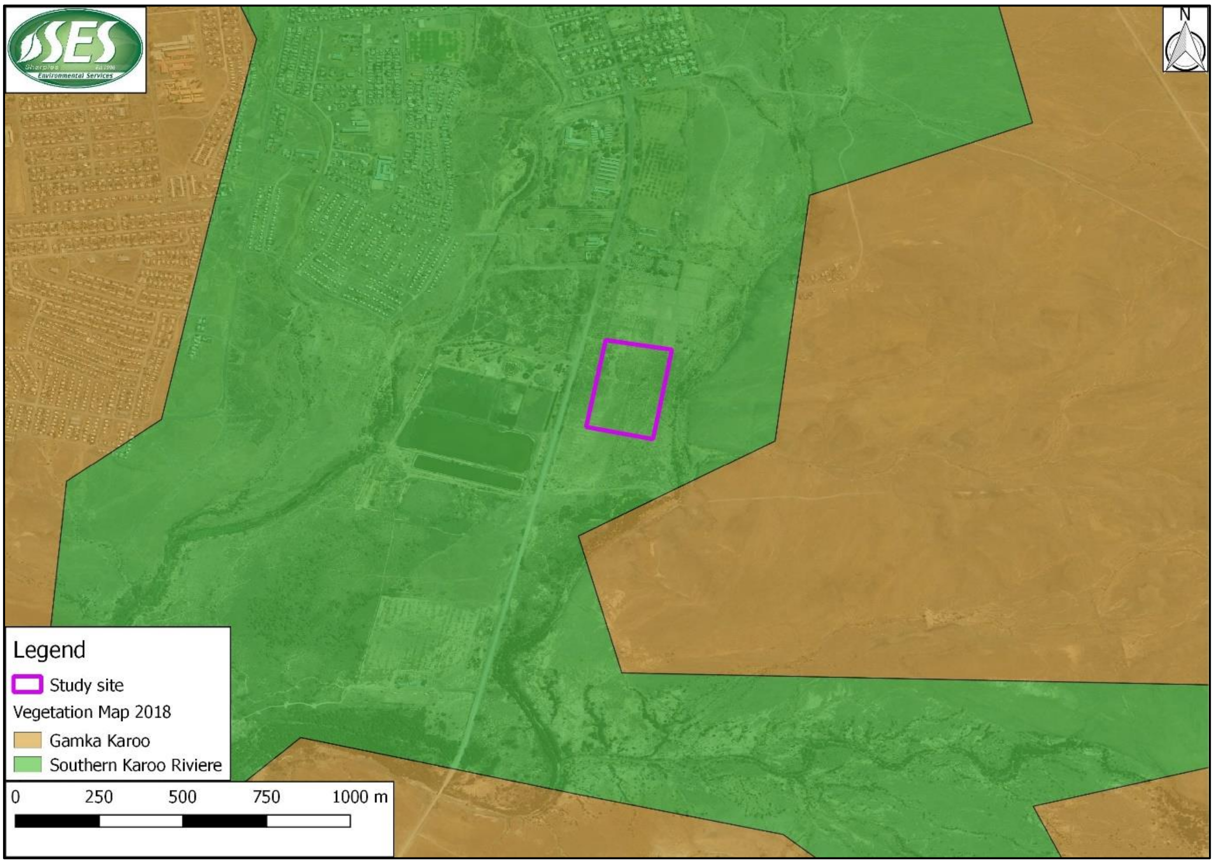

Figure 4: 2018 Vegetation map showing that the study site is located within Southern Karoo Riviere vegetation.

2.3 Conservation Context

The Western Cape Biodiversity Spatial Plan (WCBSP) is recognized 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). There are no CBA's within or in close proximity to the study site. There are however ESA1 and ESA2 areas identified within and adjacent to the study site. These areas were given the classification due to their proximity to watercourses and possible contribution to the health of these systems.

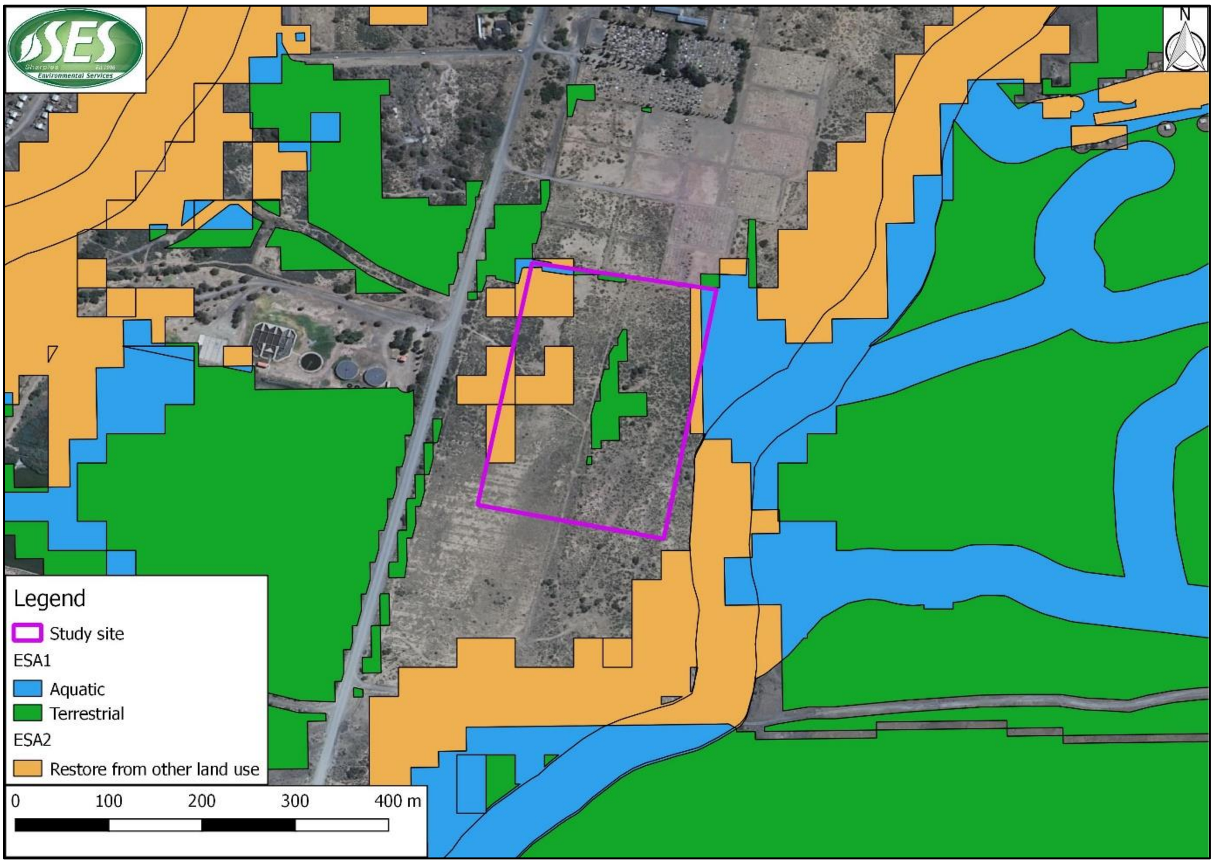

Figure 5: The study site in relation to features identified by the WCBSP (Pence, 2017).

2.4 Existing impacts upon watercourses

Catchment and site-specific impacts are important for determining a baseline of the current status quo for the watercourses that will be impacted by any proposed developments. These characteristics are also important to note as they are used in assessing the various systems. The aquatic habitat in proximity to the study area have been impacted by alien vegetation encroachment, road crossings, an instream dam, erosion, overgrazing and drought.

The Kuils River flows through the town of Beaufort West. On the northern side of town, the Beaufort West Dam is located instream on the Kuils River. The dam restricts sediment from being deposited further downstream. It also contributes to the incised nature of the channel compared to its likely broader natural condition.

From the spill way of the dam, the river flows through town where urban development has encroached, and various road crossings were constructed over the Kuils River. Runoff from urban areas differ from natural runoff. Urban runoff contains pollutants such as such as solid domestic waste that can bury aquatic habitat and hydrocarbons that deteriorate water quality. Runoff rates and volumes are increased by urban development due to hardened surfaces that reduce infiltration. Roads, pipelines, culverts and bridges create migration barriers to biota, resulting in reach to zone scale instream biological impacts. Localised scour (small scale erosion) around structures or flow impediments can result and alter the natural bank and channel, channel bank stability and floodplain processes. Additionally, flood protection measures and general infilling within the watercourses has modified the bed and bank characteristics. Road and pipeline crossings that concentrate diffuse, wide floodplain flows into a few small channels or culverts can also inadvertently trigger gully formation. The encroachment of roads and housing onto floodplains and wetlands can dramatically alter the flow rates, water quality and sediment regimes of watercourses.

The infestation of alien invasive plants in the drainage lines of the study area has altered the surface runoff and water inputs to watercourses. Within the watercourses, these plants confine flows, shade the riparian area, and smother indigenous vegetation from the periphery. Additionally, the alien species decrease dry season flow which has resulted in terrestrial plant species encroaching into and establishing. The alien plant infestation in the riparian areas is causing significant negative impacts upon the watercourses.

The ongoing droughts in the area decrease vegetation robustness, leading to increased sediment input into watercourses and reduced flood attenuation.

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 26th of February 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 shapefiles with a more accurate layout have been provided as of yet.
- No alternatives were provided for assessment as of yet.
- 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 good.
- The study does not include flood line determination.

5 RESULTS AND FINDINGS

Following desktop and field analysis of the aquatic habitats, relevant to the proposed pipeline, the subsequent results were obtained.

5.1 Identification and classification

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 26th of February 2020) confirmed the location and extent of these systems (Figure 6). 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. Two rivers were identified in the study area, namely the Gamka River and the Kuils River, as well as numerous tributary washes, that are characteristic of the arid landscape.

5.2 Risk screening

It was determined that the Kuils River will potentially be impacted upon by the proposal as it is directly downslope of the site. The other watercourses have no risk of being impacted upon as they are located in separate drainage basins and not in proximity to the site. Therefore, these systems were not investigated further but a detailed assessment of the Kuils River was undertaken.

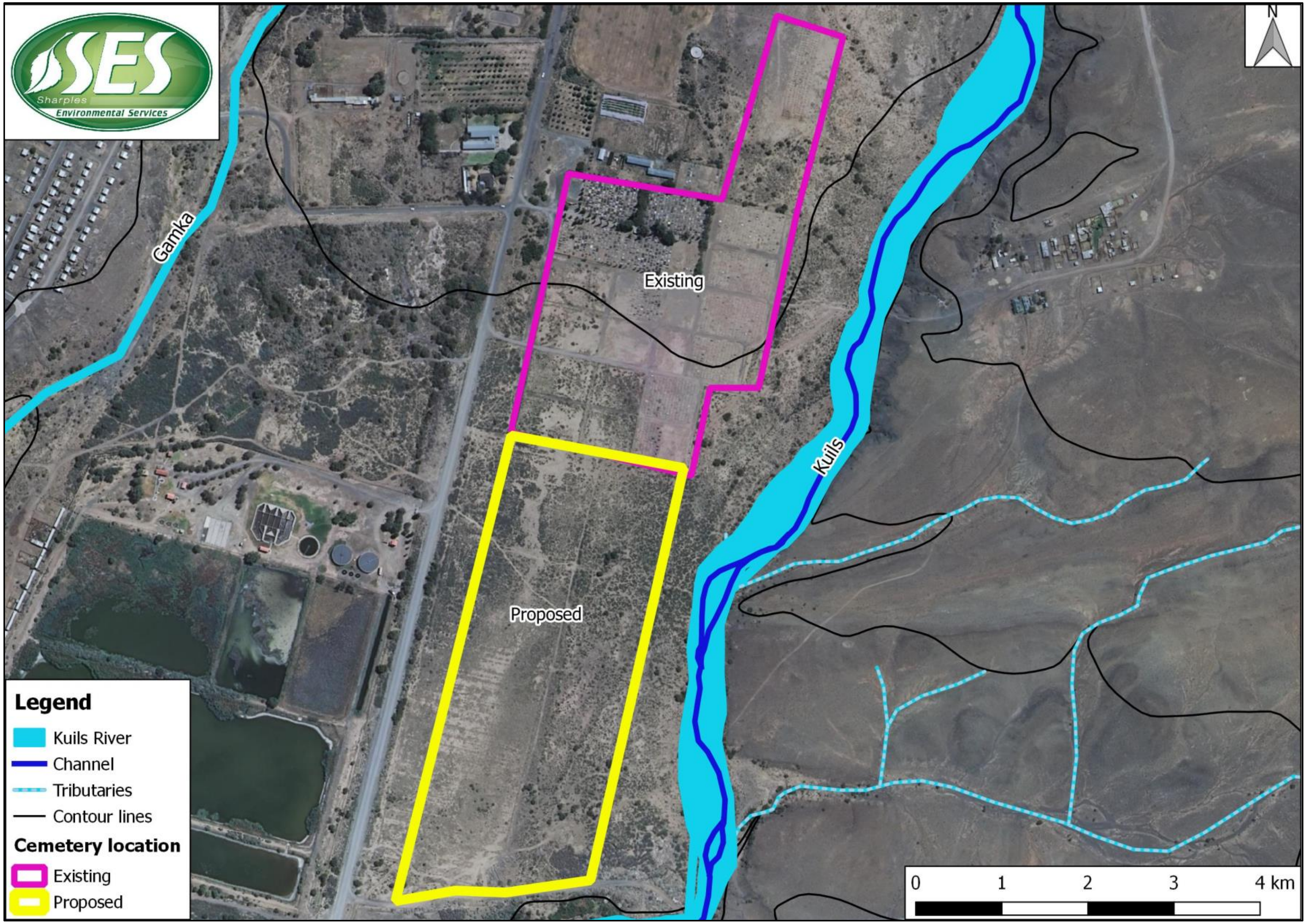

Figure 6: The proposed site of the cemetery expansion in relation to the surrounding watercourses

5.2.1 Gamka and Kuils Rivers

These are two ephemeral rivers within the area. They are both characteristic of Lower Foothills rivers with a very gentle gradient mixed bed alluvial channel. The systems are of similar ecological integrity as they share biophysical characteristics and have been similarly impacted by land use and cover changes. They have historically been impacted by land cover changes such as town infrastructure and overgrazing in their catchments. Large scale land degradation has resulted in substantial networks of rill and gully erosional features. Currently, a large amount of building rubble is continually being illegally dumped in small heaps around the entire area. Additionally, large amounts of solid domestic waste and organic refuse are being dumped into the drainage lines.

The rivers are approximately between 15 and 25m in width but both are less than 1.2m in depth. They have incised to bedrock and are disconnected from the floodplain. The channel has low surface roughness consisting of sand and gravel material between outcrops of planed bedrock. Sand waves and mid channel bars are present and vegetated during wet periods. The riparian vegetation is largely comprised of *Acacia karroo, Prosopis sp. (*alien*), Lycium ferocissimum, Pennisetum clandestimum* (alien*), and Cynodon dactylon*.

There is a drainage divide between the Gamka River and the site, which will prevent the Gamka system from being impacted upon by the project. However, the site is within the catchment of the Kuils River it may be impacted by site clearance, stormwater runoff and soil disturbance. Therefore, only the Kuils River underwent detailed impact assessment and the Gamka River was not studied further.

The Kuils river is a dryland river system but during the site visit the lower reach was uncharacteristically flowing after a large rainfall event (Figure 7). The channel substrate in this area was dominated by fine sand and silt sediments due to deposition from flood waters. Prior to this wet period the area experienced prolonged drought conditions and the riparian characteristics were different.

Figure 7: Photograph of the Kuils River channel during site assessment

The photograph in Figure 8 clearly shows the green riparian corridor of the Kuils River in relation to the sparsely vegetated and degraded catchment. Indicated in Figure 8 is the approximate location of the proposed cemetery expansion site in relation to the river, town, and existing cemetery. The site is degraded and rill erosion transports surface flows and a large amount of sediment into the riparian area to the east (downslope).

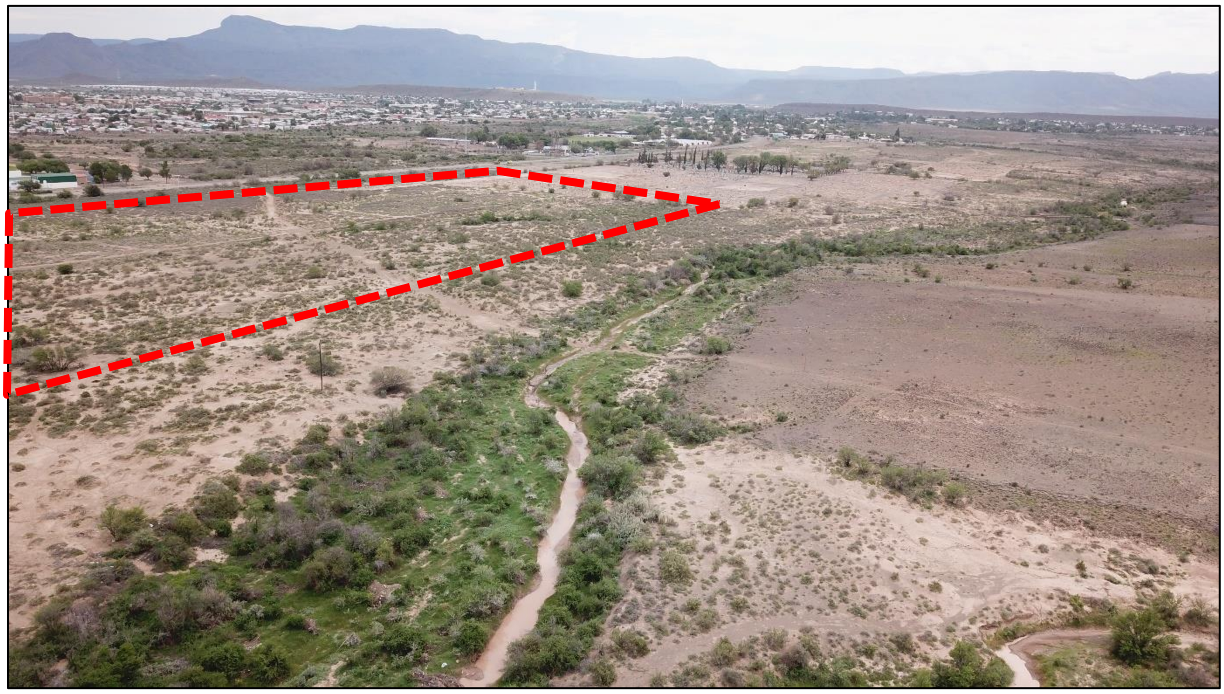

Figure 8: Photograph showing the Kuils River system in relation to the approximate boundary of the proposed site (red rectangle) and surrounding catchment

5.2.2 Washes

A wash is a dry bed of a stream; particularly a watercourse associated with arid environments and is characterized by large, high-energy discharges with high bed-material load transport (Figure 9). Washes are often intermittent and their beds sparsely vegetated. There are various such washes in the area that transport water and sediment into the larger drainage lines through the concentration of sheetflow during rainfall events. Although natural features in the semi-arid environment, these systems are vulnerable to erosion due to desertification of areas and land cover changes.

Figure 9: Two wash systems that join the Kuils River from the east and will not be impacted upon.

There are no washes within or directly surrounding the site and none of these systems will be impacted upon by the proposed cemetery expansion. No further assessment was deemed necessary.

5.3 Present Ecological State (PES)

The Present Ecological State (PES) refers to the health or integrity of river systems and includes both instream habitat as well as riparian habitat adjacent to the main channel. The rapid Index of Habitat Integrity (IHI) tool (Kleynhans, 1996) was used to determine river PES by comparing the current state of the in-stream and riparian habitats (with existing impacts) relative to the estimated reference state without anthropogenic impacts.

The Kuils River has largely deviated from the estimated reference state mostly due to catchment land degradation. Past and present overgrazing of the surrounding vegetation, coupled with dispersive soils has led to loss of topsoil, erosion and increased sediment input into the river. Although erosion is a natural process in the landscape, these dryland systems are predisposed to gully formation, and the erosion has been exacerbated by poor land management. Due to the significant impacts of catchment land cover changes, alien plant infestation, and the dumping of waste, the Kuils River is classified as moderately modified having scored within the ‘C’ category for PES (Table 4). The level of impact on river characteristics (specifically water quality, inundation, and flow modification) would have been significantly higher if the river was perennial in nature.

Table 4: Present Ecological State of the river system

Rapid Habitat Integrity Assessment (Ecoquat Model)			
Determinand	**Score (0-5)**	**% intact**	**Rationale**
Bed modification	4	30	The Kuils River has been subjected to significant indirect bed alterations that have substantially reduced the quality /availability of habitat for biota. Sedimentation due to excessive inputs from erosion in the catchment is evident. However, erosion is part of the natural dynamic and only accelerated by anthropogenic activities.
Flow modification	1,5	80	The river has an intermittent flow regime and therefore there are limited changes in spatial and temporal flow, but the prolonged drought did affect the ability of the river to provide habitat. There is also no surface abstraction or many impoundments in this reach and thus the change is small.
Inundation	0,5	90	Very limited to high flow periods that are infrequent. Due to the biophysical characteristic’s negligible inundation in this reach.
Bank condition	3	50	The banks are eroded in the reach but remain relatively stable. The sediment is rather introduced by rill erosion of the hillslope. It is natural for the banks to cut and fill.
Riparian condition	4	30	The riparian area has been severely degraded and reduced through vegetation clearance. The vegetation has been overgrazed and alien invasive species have established

			within the bed and banks. However, the thicket vegetation is prominent.
Water quality modification	1,5	80	Due to the ephemeral nature of these rivers there is infrequently water in the system. However, should water flow it will be significantly impacted by the waste that has been dumped in the riparian area and channel.
Average Score	**2,4**	60,0	**Moderately modified.** Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
Ecological Category	**C**	Fair	

5.4 Ecological Importance and Sensitivity (EIS):

The Ecological Importance and Sensitivity (EIS) of riparian areas is a representation of the importance of the aquatic resource for the maintenance of biological diversity and ecological functioning, whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance (Kleynhans & Louw, 2007).

The ecological importance and sensitivity category of this reach of the Kuils River was determined as being 'Moderate' (C category). The system does not have a high sensitivity as it is only intermittently inundated and has no significant diversity of habitat along the reach. However, it acts as an important ecological corridor. Table 5 below provides a summary of the EIS assessment determinants and results for the system.

Table 5: The results of the EIS assessment of the Kuils River

Ecological Importance and Sensitivity assessment (Rivers)			
Determinants		**Score (0-4)**	**Rationale**
BIOTA (RIPARIAN & INSTREAM)	Rare & endangered (range: 4=very high - 0 = none)	1,5	Although no rare or endangered species were encountered on site there are some species that are vulnerable on a local scale.
	Unique (endemic, isolated, etc.) (range: 4=very high - 0 = none)	2,0	Fynbos species: More than one population (or taxon) judged to be unique on a local scale.
	Intolerant (flow & flow related water quality) (range: 4=very high - 0 = none)	3,0	The species associated with these riparian systems are likely very tolerant of increases and decreases in flow as the systems are intermittently inundated. A very low proportion of the biota is expected to be only temporarily dependent on flowing water for the completion of their life cycle. Sporadic and seasonal flow events expected

			to be sufficient.
	Species/taxon richness (range: 4=very high - 1=low/marginal)	2,0	The condition of the area and vegetation type results in a low species/taxon richness
RIPARIAN & INSTREAM HABITATS	Diversity of types (4=Very high - 1=marginal/low)	2,0	There is a low diversity in aquatic habitat types due to intermittently flowing system with a uniform substrate material
	Refugia (4=Very high - 1=marginal/low)	3,5	The river has a limited ability to provide refuge to biota during times of environmental stress. This is due to the limited diversity of habitat and intermittent flow. However, the drylands environment increases the number of environmental stresses faced by biota and thus the refuge demand.
	Sensitivity to flow changes (4=Very high - 1=marginal/low)	2,0	Intermittent rivers, with limited habitat types, are only susceptible to flow decreases or increases during certain seasons.
	Sensitivity to flow related water quality changes (4=Very high - 1=marginal/low)	2,0	The river has habitat types rarely sensitive to water quality change related to flow decreases or increases.
	Migration route/corridor (instream & riparian, range: 4=very high - 0 = none)	3,0	A moderately important link in terms of connectivity for the survival of biota upstream and downstream (not necessarily fish though) and is moderately sensitive to modification. The network provides a corridor to the Gamka River which is of significant importance. This tool was developed for use on perennial systems.
	Importance of conservation & natural areas (range, 4=very high - 0=very low)	3	It is identified by the NFEPA project as an Upstream FEPA and therefore, although it is not in a natural condition, it has does contribute to conservation downstream.
MEDIAN OF DETERMINANTS		2,00	
ECOLOGICAL IMPORTANCE AND SENSITIVITY CATEGORY (EIS)		**MODERATE, EC=C**	*Some elements sensitive to changes in water quality/hydrological regime*

5.5 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). However, it is also important to consider the feasibility to realistically either maintain or improve the current condition of the water resource. The river assessed has a Fair 'C' PES and a Moderate 'C' EIS which places it in the REC 'C' category which advocates the maintenance of the system (Table 6). Additionally, it is considered to be a realistic and feasible objective as the project must not cause any further degradation in the system.

Table 6: Management objectives for the rivers 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 three 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 riparian vegetation

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 loss or disturbance of riparian zone vegetation during construction from machinery, vehicles and workers. The movement of topsoil and incorrectly placed stockpiles could bury aquatic habitat. Due to construction, alien invasive species may encroach further into any disturbed areas and outcompete indigenous vegetation thereby reducing aquatic biodiversity. If the No Go zone is adhered to there will be no direct impacts upon the riparian vegetation or habitat.

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 is to be fenced. 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. Additionally, the stormwater infrastructure of the housing and associated road network will increase and concentrate flows into the systems. This may indirectly lead to erosion in the remaining wetland habitat that compromises the remaining vegetated habitat. If the No Go zone is adhered to, and it should be as a fence 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 river 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. The slope, land degradation and highly erosive soils increase the risk of erosion. 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.

6.2.2 Operational Phase

Where soil erosion problems and bank stability concerns 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 adjacent/downstream water resources in the study area. 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.

6.3 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.

6.3.1 Construction Phase

Land clearing and earth works adjacent to the riparian system 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 will ultimately affect the hydrological integrity of water resources. However, there is already a dense rill and gully network on the hillslope. A stormwater management plan must attempt to halt this existing erosion on site, and following which it should prevent any further erosion.

6.3.2 Operational Phase

One has to ensure that surface flows are slowed and enter the river valley in a diffuse pattern. This is likely to be difficult to accomplish due to the existing concentrated flow paths on the hillslope. Structural measures will be needed to halt this rill erosion and prevent further erosion. Good stormwater management and vegetation of the downslope side of the site (and potentially brushpacking of Prosopsis on the slope between the river and fence, will assist with this. Ultimately, the operational surface will alter the natural processes of rain water infiltration and surface runoff, promoting increased volumes and velocities of storm water runoff, which can be detrimental to the rivers receiving concentrated flows off of the area. However, if the new cemetery designs the fence and or stormwater berm and catchpit, or line of vegetation, there is opportunity to improve the current erosive situation. If the stormwater management plan ensures measures to slow and disperse flows over the landscape, the impact will be far lower.

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 8). The is potential for the activities associated with the expansion of the cemetery to cause a Medium level of impact upon aquatic habitat. This is an unnecessarily high impact significance as mitigation can easily reduce it to acceptably low levels. Therefore, with mitigation, good stormwater management, and the application of the 28m buffer area, it was determined that the project will have a Low impact. There is opportunity for the project to have some positive impacts upon the environment if the current erosion network in the study area is stabilised.

Table 7: Evaluation of potential impacts of the cemetery expansion on the surrounding aquatic habitats. "With mitigation" assumes a scenario where the 28m 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)	Medium (3)	Low (4)	Probable (3)	**Low - Medium (27)**	Partly	Medium	No
		With Mitigation	Site only (1)	Very short (1)	Minor (2)	Improbable (2)	**Low (8)**	Barely	Low	No
	Erosion & sedimentation	Without Mitigation	Regional (3)	Medium (3)	Moderate (6)	Probable (3)	**Medium (36)**	Partly	High	Yes
		With Mitigation	Site only (1)	Very Short (1)	Minor (2)	Probable (3)	**Low (12)**	Barely	Low	No
	Flow modification	Without Mitigation	Regional (3)	Short (2)	Low (4)	Probable (3)	**Low - Medium (27)**	Partly	Medium	No
		With Mitigation	Site only (1)	Very short (1)	Minor (2)	Improbable (2)	**Low (8)**	Barely	Low	No
Operational Phase	Erosion & sedimentation	Without Mitigation	Local (2)	Permanent (5)	Moderate (6)	Highly Likely (4)	**Medium (52)**	Partly	Medium	Yes
		With Mitigation	Site only(1)	Permanent (5)	Minor (2)	Improbable (2)	**Low (16)**	Barely	Low	No
	Flow modification	Without Mitigation	Regional (3)	Medium (3)	Moderate (6)	Probable (3)	**Medium (36)**	Partly	High	Yes
		With Mitigation	Site only (1)	Very Short (1)	Minor (2)	Probable (3)	**Low (12)**	Barely	Low	No
	Disturbance of aquatic vegetation	Without Mitigation	Local (2)	Permanent (5)	Low (4)	Improbable (2)	**Low (22)**	Partly	Medium	No
		With Mitigation	Site only(1)	Permanent (5)	Small (0)	Improbable (2)	**Low (12)**	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).

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 watercourses 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.

The following mitigation measures must be adhered to and monitored:

8.1 Design Phase:

8.1.1 No-Go Buffer Zones

Aquatic buffer zones which are designed to act as barriers between human activities and sensitive water resources in order to protect them from adverse negative impacts. Buffer zones associated with water resources have been shown to perform a wide range of functions, and have therefore been adopted as a standard measure to protect water resources and associated biodiversity. 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).

Regarding the proposed cemetery, a buffer area from the boundary of the riparian habitat must be adopted and demarcated. 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*. The final buffer requirement includes the implementation of practical management considerations/ mitigation measures. The results recommended that a 28 m aquatic buffer zone between any proposed activities and the river edge.

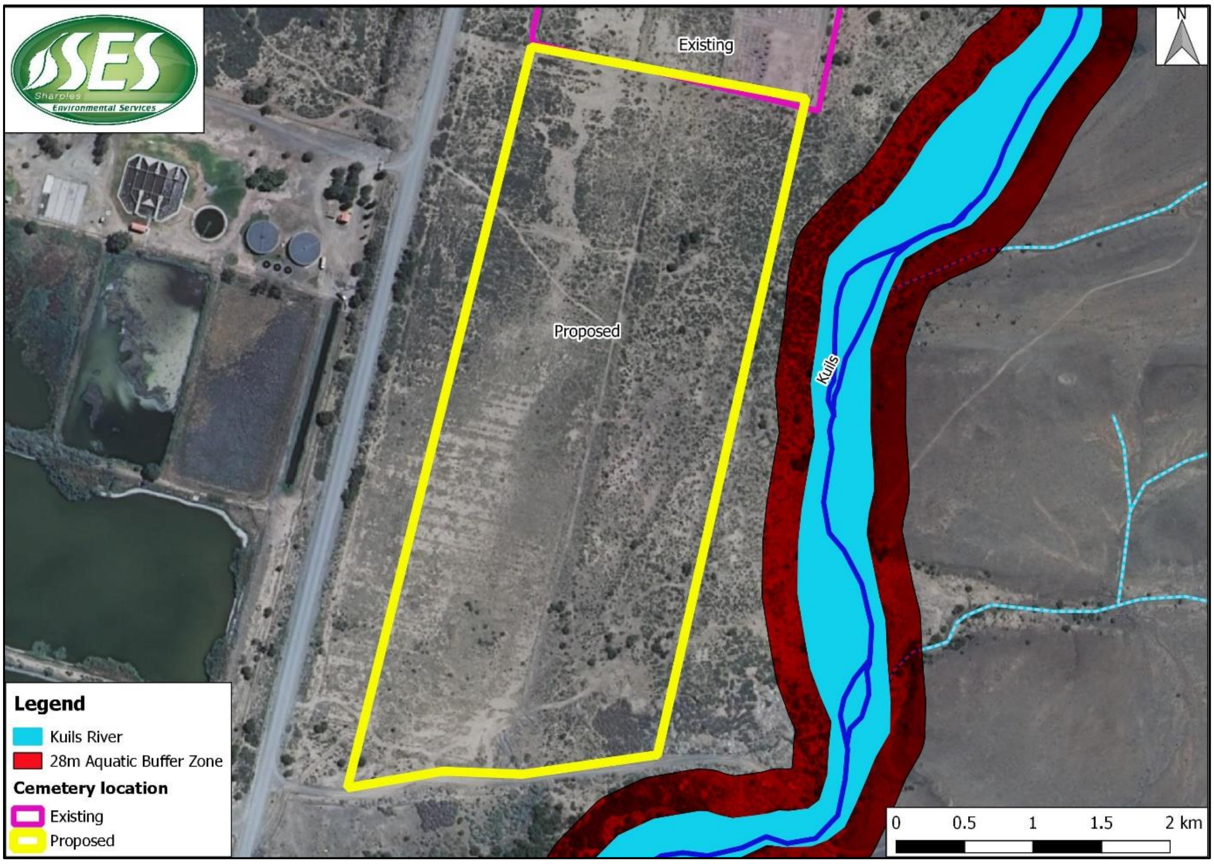

Figure 10:The proposed cemetery site in relation to the 28m recommended aquatic buffer zone

8.2 Construction Phase

- Outside the working corridor, all watercourses are to be considered no go areas and a 28 m construction buffer must be adhered to. Any unnecessary intrusion into these areas is prohibited.
- The edges of the construction servitude / development zone within the vicinity of the freshwater habitat must be clearly staked-out and demarcated using highly visible material (e.g. danger tape) prior to construction commencing.
- 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 stockpiling is to occur on or near slopes or 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.

8.3 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 *cacti* and *Prosopis* species.
- 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.

8.4 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 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 Kuils River. 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 Beaufort West Municipality to conduct an independent specialist aquatic habitat impact assessment for the proposed expansion of the Goue Akker 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 Kuils River will be impacted upon.

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

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

The impacts associated with the project are assessed as being of Low-Medium significance. However, this may potentially be decreased to 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 as far as possible and stabilising erosion features. 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).

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12 ANNEXURE (METHODOLOGIES)

12.1 Delineation of Riparian Areas

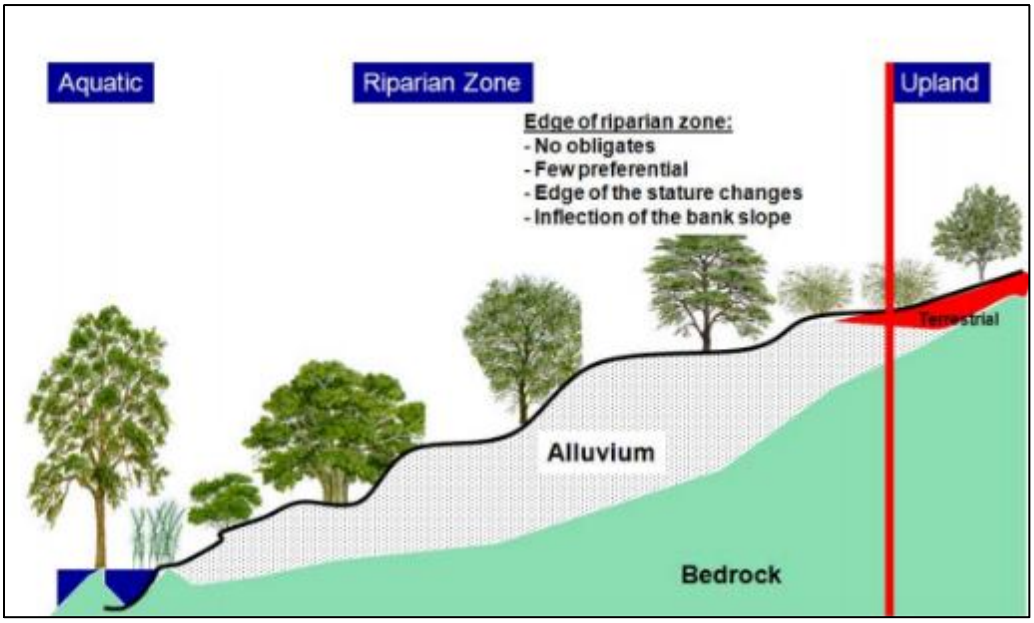
Riparian zones are described as “the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition 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).