

FRESHWATER ECOLOGICAL IMPACT ASSESSMENT

PROPOSED SWELLENDAM HOUSING AND BULK SEWER PIPELINE CONSTRUCTION

Prepared for: Swelledam Municipality

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1. INTRODUCTION AND BACKGROUND

Eco Impact Legal Consulting (Pty) Ltd (Eco Impact) is appointed by the Swellendam Municipality to assess the impacts of the proposed housing infrastructure, bulk sewerage and water pipeline upgrades and attenuation dams upgrade construction on the Freshwater Ecology.

The Swellendam Municipality proposes to establish a mixed use housing development on the Remaining Extent of Erf 1 at Swellendam.

The Swellendam Municipality proposes a subsidised housing project on a Remainder of Erf 1 at Swellendam, comprising of 950 residential erven. As well as 4 erven for community facilities, 2 erven for business, 3 for mixed use and 10 erven for public open space. Associated internal roads and associated services infrastructure.

Upgrades to attenuation dams 4 and 5 as the proposed development's runoff will have a direct influence on the capacity. These attenuation dams are situated in a degraded non-perennial drainage line which runs to the west of the proposed site.

Dam 5 –

- Clear and grub of wall embankments.
- Clear and grub for basin extensions (10,000m²)
- Cut to spoil for basin enlargements (7,100m³)
- Cut to fill wall embankment from selected excavated/imported material (1,000m³)
- Cut to fill berm from selected excavated/imported material (144m³)
- Construction of gabion lined spillway
- Concrete outlet structure (25m³)

Dam 4 –

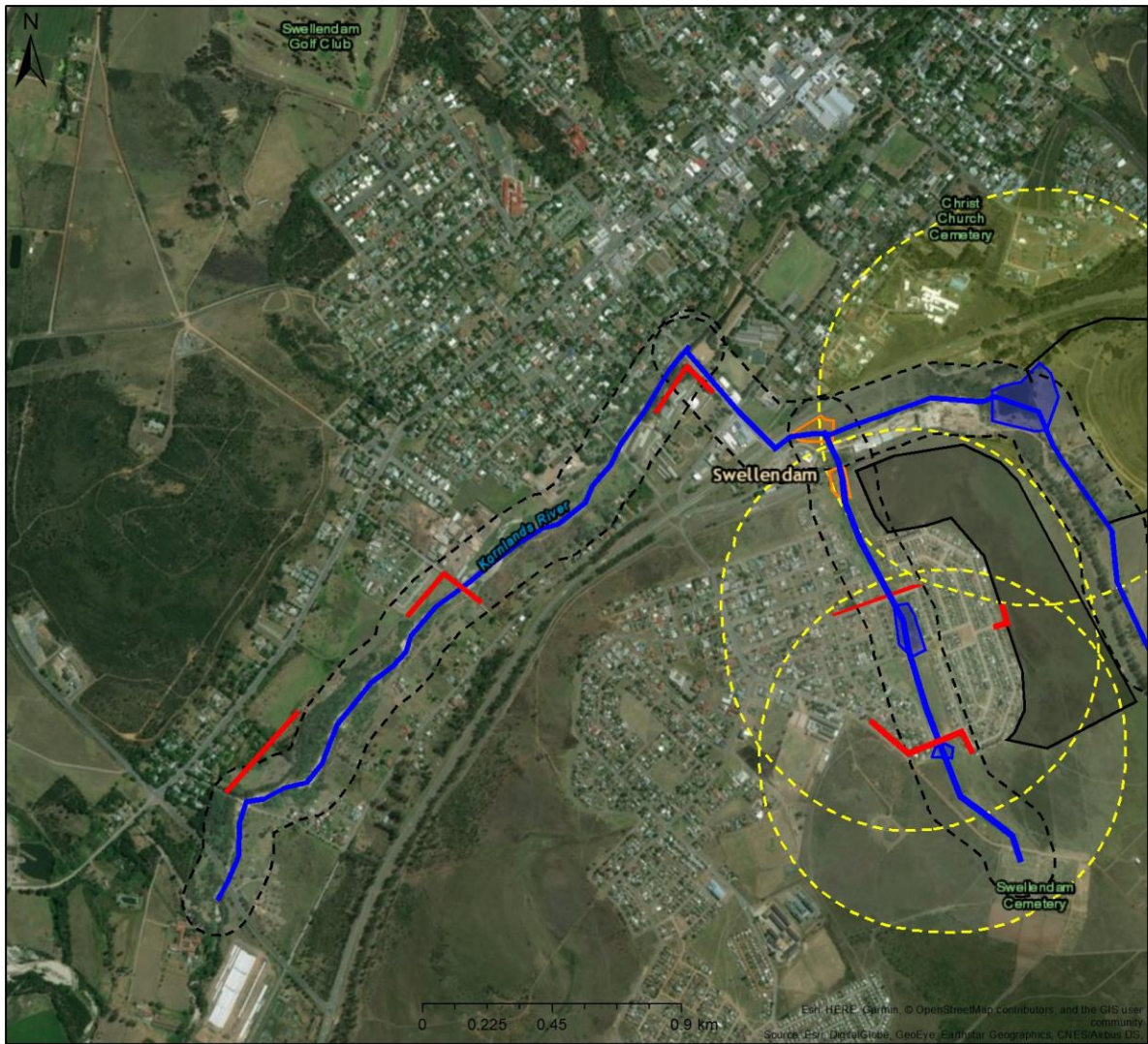
- Upgrading of the outlet works

Bulk water distribution will need to be upgraded. The following is currently proposed:

- SSW4.1: 94 m x 160 mm Ø parallel reinforcement of main pipe
- SSW4.6: 282 m x 160 mm Ø parallel reinforcement of main pipe
- SSW4.10: 77 m x 160 mm Ø inter-connection pipe
- SSW4.11: 352 m x 160 mm Ø parallel reinforcement of main pipe
- SSW4.17: 300 m x 160 mm Ø parallel reinforcement of main pipe
- SSW4.18: 263 m x 110 mm Ø new supply pipe & connections
- SSW5.2: 140 m x 160 mm Ø new supply pipe & connections
- SSW5.3: 107 m x 110 mm Ø new supply pipe & connections
- SSW4.7a: New 110 mm Ø zone valve
- SSW4.7b: New 75 mm Ø zone valve
- SSW5.1: New 15 l/s @ 20 m booster pump station

Sewer reticulation will need to be upgraded to accommodate the proposed development. The following is currently proposed:

- SSS1.2: 250 mm Ø New flow diversion
- SSS1.3: 84 m x 250 mm Ø New outfall sewer
- SSS1.6: 315 mm Ø New flow diversion
- SSS1.7: 100 m x 315 mm Ø New outfall sewer
- SSS1.8: 229 m x 315 mm Ø Re-align existing bulk sewer
- SSS1.9: 304 m x 315 mm Ø Re-align existing bulk sewer



Swellendam Housing Project. Water Uses

Scale: 1:18 056
 Date created: September 27, 2018



Figure 1: The water uses falling within the regulated zones that require authorization in terms of the National Water Act.

2. LEGISLATIVE REQUIREMENTS

National Water Act, 1998 (Act No. 36 of 1998)

The National Water Act guides the management of water in South Africa. The Act aims to regulate the use of water and activities that may impact on water resources through the categorisation of “listed water uses” encompassing water extraction and flow attenuation within catchments as well as the potential contamination of water resources, where the Department of Water and Sanitation (DWS) is the administering body in this regard. In terms of the proposed development and its nature, a specialist assessment is needed to provide Breede Gouritz Catchment Management Agency (BGCMA) as DWS administrator with the necessary information related to the proposed projects water uses and the potential impacts on the water resources of the area. It is the client’s intention to register and license all water uses related to this project.

3. METHOD OF ASSESSMENT, ASSUMPTIONS AND LIMITATIONS OF THE STUDY

Input into the overall project was driven by the following Terms of Reference, which required the specialist to:

- Identify and describe freshwater ecosystems in the study area based on existing data and an onsite survey;
- Place freshwater ecosystems in a regional context and describe freshwater ecosystem-dependent fauna and flora species present;
- Classify, describe and map freshwater ecosystems in terms of their ecological sensitivity and functional value;
- Comment on and map freshwater ecosystem sensitivity in terms of ecologically important habitats, ecological corridors and linkages with other ecological systems;
- Undertake a site walk-down with other specialists,
- Identify potential impacts of the proposed project on freshwater ecosystems;
- Assess the direct, indirect and cumulative impacts (pre and post-mitigation) of the final location of infrastructure (and alternatives, if applicable) on freshwater ecosystems in the study area using the prescribed impact assessment methodology;
- Recommend practicable mitigation measures to avoid and/or minimise/reduce impacts and enhance benefits;

3.1. Freshwater Ecological Assessment sites and site selection

The sites were visually assessed. Intermediate Habitat Assessment Integrity Assessment (IHIA) the Riparian Vegetation Response Assessment (VEGRAI) and the Ecological Importance and Sensitivity (EIS) was used to assess the risks to the freshwater ecology at the impact area.

3.2. Visual Assessment of Aquatic Assessment Points

Each site was selected in order to identify current conditions, with specific reference to impacts from surrounding activities where applicable. Both natural constraints placed on ecosystem structure and function, as well as anthropogenic alterations to the systems identified, was identified by observing conditions and relating them to professional experience. Photographs of each site were taken to provide visual records of the conditions at the time of assessment. Factors which were noted in the site-specific visual assessments included the following:

- Upstream and downstream significance of each point, where applicable;
- Significance of the point in relation to the study area;
- stream morphology;
- instream and riparian habitat diversity;

- stream continuity;
- erosion potential;
- depth flow and substrate characteristics;
- signs of physical disturbance of the area; and
- other life forms reliant on aquatic ecosystems.

3.3. Intermediate Habitat Integrity Assessment (IHIA)

It is important to assess the habitat of riverine systems in order to aid in the interpretation of the results of the community integrity assessments by taking habitat conditions and impacts into consideration. The general habitat integrity of the sites was assessed based on the application of the Intermediate Habitat Integrity Assessment for (Kemper; 1999). The Intermediate Habitat Integrity Assessment (IHIA) protocol, as described by Kemper (1999), was used using the site specific application protocols. This is a simplified procedure, which is based on the Habitat Integrity approach developed by Kleynhans (1996). The IHIA is conducted as a first level exercise, where a comprehensive exercise is not practical. The Habitat Integrity of each site was scored according to 12 different criteria which represent the most important (and easily quantifiable) anthropogenically induced possible impacts on the system. The instream and riparian zones were analysed separately, and the final assessment was then made separately for each, in accordance with Kleynhans' (1999) approach to Habitat Integrity Assessment. Data for the riparian zone is, primarily interpreted in terms of the potential impact on the instream component. The assessment of the severity of impact of modifications is based on six descriptive categories with ratings. Analysis of the data was carried out by weighting each of the criteria according to Kemper (1999). By calculating the mean of the instream and riparian Habitat Integrity scores, an overall Habitat Integrity score can be obtained for each site. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitats of the sites. The method classifies Habitat Integrity into one of six classes, ranging from unmodified/natural (Class A), to critically modified (Class F).

Table 1: Classification of Present State Classes in terms of Habitat Integrity [Based on Kemper 1999]

Ecological Category	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level and the lotic system has been modified completely with almost complete loss of natural habitat and biota. In worst instances basic ecosystem functions have been destroyed and changes are irreversible.	0-19

3.4. Riparian Vegetation Response Assessment Index (VEGRAI)

Riparian vegetation is described in the NWA (Act No 36 of 1998) as follows: "riparian habitat"

includes 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 land areas.

VEGRAI is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results (Kleynhans et al, 2007). Results are defensible because their generation can be traced through an outlined process (a suite of rules that convert assessor estimates into ratings and convert multiple ratings into an Ecological Category).

Table 2: Descriptions of the A-F ecological categories

Ecological Category	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level and the lotic system has been modified completely with almost complete loss of natural habitat and biota. In worst instances basic ecosystem functions have been destroyed and changes are irreversible.	0-19

The level of aquatic assessment undertaken was considered to be adequate for this study.

Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) of riparian areas is an expression of the importance of the aquatic resource for the maintenance of biological diversity and ecological functioning on a local scale to a more broader scale; 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).

Table 3: List of the EIS categories used in the assessment tool (Kleynhans & Louw, 2007)

EISC	General description	Range of median
Very high	Quaternaries/delineations that are considered to be unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3-4
High	Quaternaries/delineations that are considered to be unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species	>1-≤2

	diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use.	
Low/marginal	Quaternaries/delineations which are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

Table 4: Rating scheme used for the assessment of riparian EIS (Kleynhans & Louw, 2007)

Score	Channel Type	Conservation context			Vegetation and Habitat Integrity	Connectivity	Threat status of Vegetation Type
0	Ephemeral Stream	Non-FEPA river	No status	None/ Excluded	No natural remaining	None	No Status
1	Stream non-perennial		Upstream management area	Available	Very poor	Very poor	Least threatened
2	Stream-perennial flow		Rehab FEPA		Poor	Low	Vulnerable
3	Minor river-non-perennial flow		Fish corridor	Earmarked for conservation	Moderately modified	Moderate	Near Threatened
4	Minor river-perennial flow		Fish support area		Largely natural	High	Endangered
5	Major river-perennial flow	FEPA river	River FEPA	Protected	Unmodified / natural habitat	Very high	Critically Endangered

4. RESULTS OF THE LITERATURE REVIEW

The site is located in the Breede River catchment (Department of Water and Sanitation (DWS) Primary Drainage Region H), within the Breede-Gouritz Water Management Area (WMA). This WMA falls under the administration of the BGCMA. The proposed water uses would pass through sections of the H70B quaternary catchment. H70B is drained primarily by the Breede, Sonderend, Sout, Bot and Palmiet rivers. The natural vegetation on site used to be Swellendam Silcrete Fynbos, (Vulnerable conservation status). The impacted and surrounding area is however mostly transformed and disturbed as a result of previous agricultural and residential activities.

Two biodiversity conservation mapping initiatives are of relevance to the freshwater ecosystems within the study area; the Western Cape Biodiversity Spatial Plan mapping initiatives that were undertaken on a regional basis and the National Freshwater Ecosystem Priority Areas (NFEPAs) mapping initiative. The Koorlands River was identified as a NFEPAs wetland area (Natural valley floor floodplain wetland and an artificial NFEPAs wetland was identified in the western non-perennial stream where the sewer pipeline will cross the river.

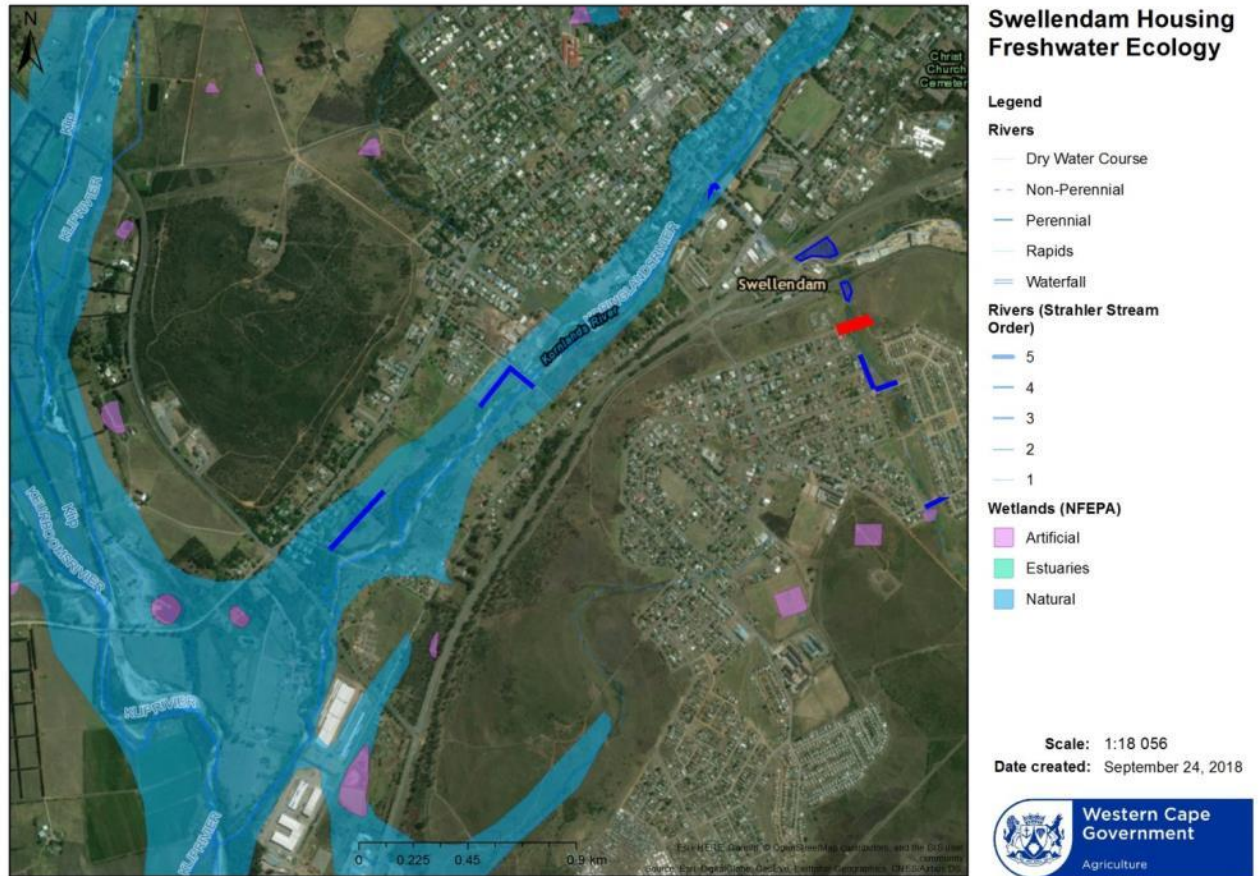


Figure 2: The National Freshwater Ecosystem Priority Areas (NFEPA) mapping initiative.

The Koorndals perennial river and non-perennial river that will be impacted was identified as Ecological Support Areas (ESAs) in the latest Western Cape Biodiversity Spatial Plan (2017). ESA's are supporting zones required to prevent the degradation of Critical Biodiversity Areas and Protected Areas.

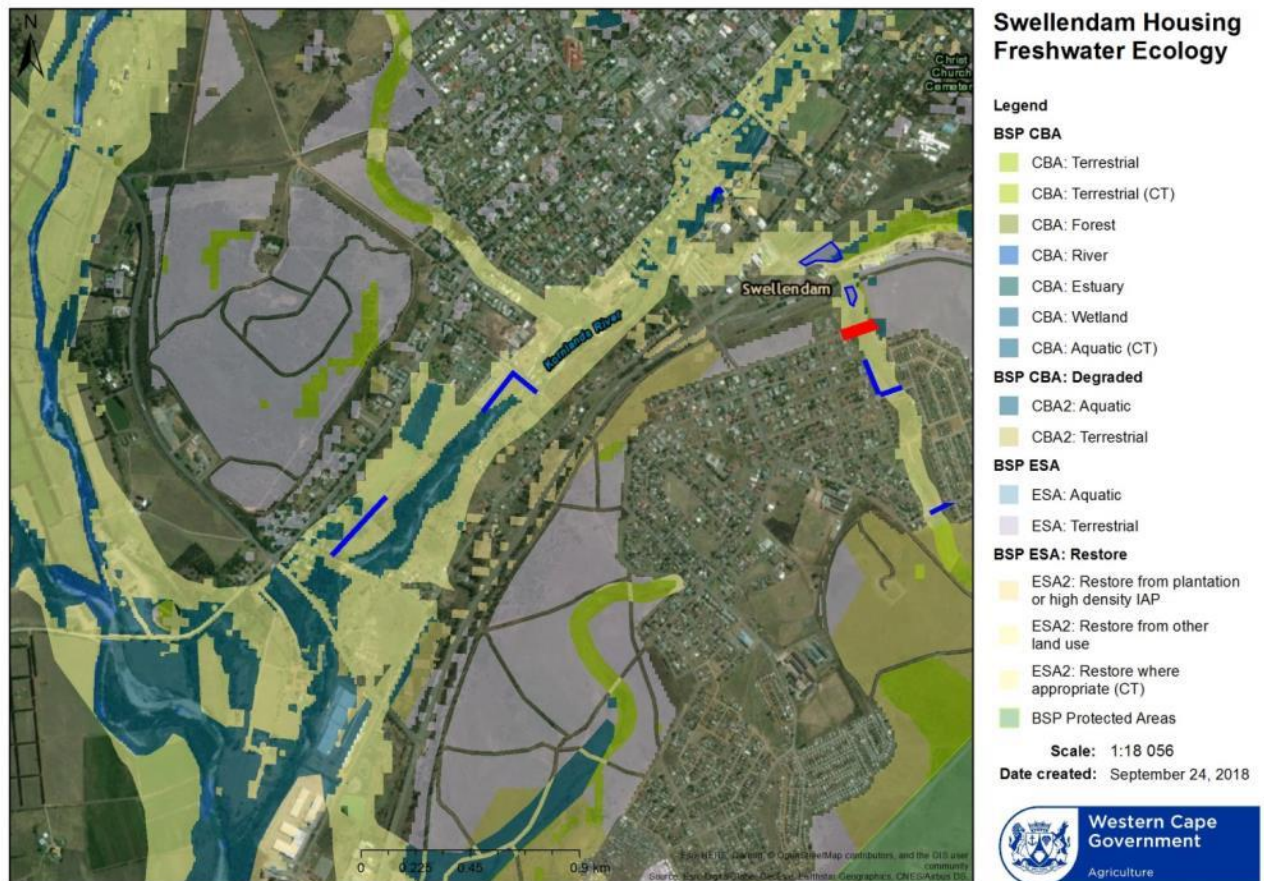


Figure 3: Western Cape Biodiversity Spatial Plan mapping initiative.

The non-perennial river on the western side of the proposed housing development in which two sewer pipeline crossings, a road and the upgrade of two attenuation dams is planned and proposed starts south of the site on a cemetery and flows in a northern direction.



Photo 1: Start of the Non-perennial River and gravel access road to cemetery.

It crosses the access gravel road to the cemetery before it flows in between two residential areas with two road crossings and a railway line before it meets up with a non-perennial river that runs east of the development also in a south west direction.



Photo 2: Non-perennial river on western side of housing development

The non-perennial river on the eastern edge of the housing development flows in a northern direction and then parallel with the N2 in a western direction until it meets up with the proposed upgrade area of the western stream attenuation dam. This non-perennial river starts at an area where small scale livestock is kept.



Photo 3: Upper catchment and start of the eastern Non-perennial River

A non-perennial river which flow from east to west meet up with this non-perennial river before it is crossed by the gravel road. A clay brick quarry is situated on the edge of the stream that flows from east to west.



Photo 4: Stream that meets up with the eastern non-perennial river.

A gravel road that give access to the small scale farming activities and clay brick quarry area crosses the eastern non-perennial river where after the non-perennial river flows into an instream dam.



Photo 5: Upstream view from the gravel access road crosses the eastern non-perennial river.



Photo 6: Downstream view from the gravel access road crosses the eastern non-perennial river.



Photo 7: Instream dam the eastern non-perennial river.

The non-perennial river flow in between industrial activities, stockpiling of mining aggregate and the N2 downstream of the instream dam.



Photo 8: Stockpile of mining aggregate on edge of non-perennial river with storm water runoff from these areas into the river.



Photo 9 a: Remnants of freshwater ecological features in sections of the non-perennial river downstream of the industrial activities. These areas are however limited.



Photo 9 b: Remnants of freshwater ecological features in sections of the non-perennial river downstream of the industrial activities. These areas are however limited.

All of these activities have a significant impact on the freshwater ecology of the non-perennial river.

From the proposed attenuation dam where the western and eastern non-perennial rivers meet up the non-perennial river is channelled in a concrete channel underneath the N2 and through the town until it meets up with the Koornlands perennial river.



Photo 10: Concrete channel section of the non-perennial river

The Koorlands river follows in an western direction through the town of Swellendam before it meets up with the Klippe river which is a tributary of the Bree River.



Photo 11: Downstream view of the Koorlands River where the sewer pipe will be upgrade on the eastern bank of the river.

5. FRESHWATER ECOLOGICAL ASSESSMENT RESULTS

A photographic record of each site was made in order to provide a visual record of the condition of each assessment site as observed during the field assessment. The photographs taken are presented, followed by a table summarising the observations for the various criteria made during the visual assessment undertaken at each point.

5.1(A) Activities Impacting on the Western Non-Perennial River

5.1.1. Water pipeline crossing at western non-perennial river.




	
<p>Photo 12: Propose upgrade of existing water pipeline inside road crossing.</p>	<p>Photo 13: Artificial wetland upstream of water pipeline crossing.</p>
	
<p>Photo 14: Artificial wetland downstream of water pipeline crossing.</p>	

Table 5: Descriptions of the location of water pipe in relation to mapped non-perennial river

Characteristics	Water pipeline site	Upstream area	Downstream area
Significance of the point	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.

Surrounding anthropogenic activities	The site is situated at the point where the pipeline will cross the non-perennial river.	The site is situated upstream where the pipeline will cross the non-perennial river.	The site is situated downstream where the pipeline will cross the non-perennial river.
Riparian zone characteristics	The riparian zone at this point is totally destroyed and consists of a road.	Limited riparian at this point and it is characterised by constructed attenuation dam dominated by <i>Pennisetum clandestinum</i> and <i>Typha capensis</i> .	Limited riparian at this point and it is dominated by <i>Pennisetum clandestinum</i> with patches of <i>Typha capensis</i> .
Depth characteristics	No water was flowing during time of site visit. Constructed road surface	No water was flowing during time of site visit. The river at this point is characterised by a constructed attenuation dam.	No water was flowing during time of site visit. The river however has a deep natural channel.
Flow conditions	No water was flowing during time of site visit. Constructed road surface	No water was flowing during time of site visit.	No water was flowing during time of site visit.
Water clarity	No water was flowing during time of site visit. Constructed road surface	No water was flowing during time of site visit.	No water was flowing during time of site visit.
Stones habitat characteristics	Constructed road surface	Consisted of a silted river bed with no stones or diverse habitat	Consisted of a silted river bed with no stones or diverse habitat
Vegetation habitat characteristics	None. Road surface	Limited and dominated by <i>Pennisetum clandestinum</i> .	Limited and dominated by <i>Pennisetum clandestinum</i> .
Other habitat characteristics	None as result of infrastructure.	None as result of constructed attenuation dam. The surrounding land uses, cemetery in the catchment, road crossings and attenuation dam all contributed to the poor ecological state that the non-perennial river is in.	None as result of upstream constructed attenuation dam and road crossing. The surrounding land uses, cemetery in the catchment, road crossings and attenuation dam all contributed to the poor ecological state that the non-perennial river is in.
Erosion potential	None as result of infrastructure.	Banks at this point are relatively stable and there is little potential for erosion.	Banks at this point are relatively stable and there is little potential for erosion.

5.1.2. Non-perennial river where water pipeline will cross as well as expansion of the water pipeline on the bank of the non-perennial river next to the edge of existing erven.



Photo 15: Water pipeline crossing upgrade.



Photo 16: Water pipeline crossing upgrade.



Photo 17: Water pipeline upgrade.



Photo 18: Water pipeline crossing upstream of upgrade.



Photo 19: Water pipeline crossing downstream of upgrade.

Table 6: Descriptions of the location of water pipe in relation to mapped non-perennial river

Characteristics	Water pipeline site	Upstream area	Downstream area
Significance of the point	This point is to be used as a reference	This point is to be used as a reference point for the	This point is to be used as a reference

	point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.
Surrounding anthropogenic activities	The site is situated at the point where the pipeline will cross the non-perennial river and be upgraded outside the river and floodplain.	The site is situated upstream where the pipeline will cross the non-perennial river.	The site is situated downstream where the pipeline will cross the non-perennial river.
Riparian zone characteristics	The riparian zone at this point is totally destroyed and consists of a road as well as disturbed non indigenous vegetated areas.	Limited riparian at this point and it is characterised by constructed attenuation dam dominated by <i>Pennisetum clandestinum</i> with patches of <i>Typha capensis</i> .	Limited riparian at this point and it is dominated by <i>Pennisetum clandestinum</i> with patches of <i>Typha capensis</i> .
Depth characteristics	Constructed road surface and flat area on bank of river outside flood plain.	No water was flowing during time of site visit. The river at this point is characterised by a constructed attenuation dam.	No water was flowing during time of site visit. The river however has a deep natural channel.
Flow conditions	Constructed road surface	No water was flowing during time of site visit.	No water was flowing during time of site visit.
Water clarity	No water was flowing during time of site visit. Constructed road surface	No water was flowing during time of site visit.	No water was flowing during time of site visit.
Stones habitat characteristics	Constructed road surface	Consisted of a silted river bed with no stones or diverse habitat	Consisted of a silted river bed with no stones or diverse habitat
Vegetation habitat characteristics	None. Road surface and degraded areas	Limited and dominated by <i>Pennisetum clandestinum</i> .	Limited and dominated by <i>Pennisetum clandestinum</i> .
Other habitat characteristics	None as result of infrastructure.	None as result of constructed attenuation dam. The surrounding land uses, cemetery in the catchment, road crossings and attenuation dam all contributed to the poor ecological state that the non-perennial river is in.	None as result of upstream constructed attenuation dam and road crossing. The surrounding land uses, cemetery in the catchment, road crossings and

			attenuation dam all contributed to the poor ecological state that the non-perennial river is in.
Erosion potential	None as result of infrastructure.	Banks at this point are relatively stable and there is little potential for erosion.	Banks at this point are relatively stable and there is little potential for erosion.

5.1.3. Proposed new access road over non-perennial river.



Photo 20: Proposed road crossing site in non-perennial river.



Photo 21: Upstream view of proposed road crossing.



Photo 22: Downstream view of proposed road crossing.

Table 7: Descriptions of the location of new road crossing in relation to mapped non-perennial river

Characteristics	Water pipeline site	Upstream area	Downstream area
Significance of the point	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts

	impacts on the surrounding area.		on the surrounding area.
Surrounding anthropogenic activities	The site is situated at the point where the road will cross the non-perennial river.	The site is situated upstream where the road will cross the non-perennial river.	The site is situated downstream where the road will cross the non-perennial river.
Riparian zone characteristics	The riparian zone at this point is totally degraded and dominated by <i>Pennisetum clandestinum</i> .	Limited riparian at this point and it is dominated by <i>Pennisetum clandestinum</i> with patches of <i>Typha capensis</i> , <i>Zantedeschia aethiopica</i> , <i>Cyperus sp</i> , <i>Searsia laevigata</i> , <i>Pennisetum macrourum</i> and <i>Cotula sp</i> .	Limited riparian at this point and it is dominated by <i>Pennisetum clandestinum</i> .
Depth characteristics	The river however has a deep natural channel.	The river however has a deep natural channel.	The river however has a deep natural channel.
Flow conditions	No water was flowing during time of site visit.	No water was flowing during time of site visit.	No water was flowing during time of site visit.
Water clarity	No water was flowing during time of site visit.	No water was flowing during time of site visit.	No water was flowing during time of site visit.
Stones habitat characteristics	Consisted of a silted river bed with no stones or diverse habitat	Consisted of a silted river bed with no stones or diverse habitat	Consisted of a silted river bed with no stones or diverse habitat
Vegetation habitat characteristics	The vegetation at this point is totally degraded and dominated by <i>Pennisetum clandestinum</i> .	The vegetation at this point is totally degraded and dominated by <i>Pennisetum clandestinum</i> .	The vegetation at this point is totally degraded and dominated by <i>Pennisetum clandestinum</i> .
Other habitat characteristics	The surrounding land uses, cemetery in the catchment, road crossings and attenuation dam all contributed to the poor ecological state that the non-perennial river is in.	The surrounding land uses, cemetery in the catchment, road crossings and attenuation dam all contributed to the poor ecological state that the non-perennial river is in.	The surrounding land uses, cemetery in the catchment, road crossings and attenuation dam all contributed to the poor ecological state that the non-perennial river is in.
Erosion potential	Low. Banks at this point are relatively stable and there is little potential for erosion.	Low. Banks at this point are relatively stable and there is little potential for erosion.	Low. Banks at this point are relatively stable and there is little potential for erosion.

5.1.4. Attenuation dam upgrade upstream of the rail way line in non-perennial river.



Photo 23: Existing attenuation dam to be upgraded.



Photo 24: Upstream view of the non-perennial river where the proposed attenuation dam upgrade is proposed.



Photo 25: Existing attenuation dam to be upgraded.

Table 8: Descriptions of the location of attenuation dam in relation to mapped non-perennial river

Characteristics	Water pipeline site	Upstream area	Downstream area
Significance of the point	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.
Surrounding anthropogenic activities	The site is situated at the point where the existing attenuation dam will be upgraded in the non-perennial river.	The site is situated upstream where the existing attenuation dam will be upgraded in the non-perennial river.	The site is situated downstream where the existing attenuation dam will be upgraded in the non-perennial river.
Riparian zone characteristics	The riparian zone at this point is altered	Limited riparian at this point and it is	Limited riparian at this point as a result

	as a result of the existing attenuation dam and downstream flow modification as result of the construction of the railway line. The vegetation at this point is dominated by <i>Typha capensis</i> with patches of <i>Zantedeschia aethiopica</i> , <i>Searsia laevigata</i> , etc.	characterised by constructed attenuation dam dominated by <i>Pennisetum clandestinum</i> with patches of <i>Typha capensis</i> .	of the constructed railway line.
Depth characteristics	The river at this point is characterised by a constructed attenuation dam.	No water was flowing during time of site visit. The river at this point is characterised by a constructed attenuation dam.	No water was flowing during time of site visit. River channel destroyed as a result of the constructed railway line.
Flow conditions	No water was flowing during time of site visit.	No water was flowing during time of site visit.	No water was flowing during time of site visit.
Water clarity	No water was flowing during time of site visit.	No water was flowing during time of site visit.	No water was flowing during time of site visit.
Stones habitat characteristics	The river at this point is characterised by a constructed attenuation dam.	Consisted of a silted river bed with no stones or diverse habitat	None as a result of the constructed railway line.
Vegetation habitat characteristics	Limited and dominated by <i>Pennisetum clandestinum</i> .	Limited and dominated by <i>Pennisetum clandestinum</i> .	None as a result of the constructed railway line.
Other habitat characteristics	Artificial wetland as a result of the constructed attenuation dam and railway line that block the river flow.	The surrounding land uses, cemetery in the catchment, road crossings and attenuation dam all contributed to the poor ecological state that the non-perennial river is in.	The surrounding land uses, cemetery in the catchment, road crossings and attenuation dam all contributed to the poor ecological state that the non-perennial river is in.
Erosion potential	Low. Banks at this point are relatively stable and there is little potential for erosion.	Low. Banks at this point are relatively stable and there is little potential for erosion.	Low. Banks at this point are relatively stable and there is little potential for erosion.

5.1.5. Attenuation dam upgrade in non-perennial river between railway line and N2.



Table 9: Descriptions of the location of attenuation dam in relation to mapped non-perennial river

Characteristics	Water pipeline site	Upstream area	Downstream area
Significance of the point	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.
Surrounding anthropogenic activities	The site is situated at the point where the attenuation dam will be constructed in the non-perennial river.	The site is situated upstream where the attenuation dam will be constructed in the non-perennial river.	The site is situated downstream where a attenuation dam will be constructed in the non-perennial river.
Riparian zone characteristics	The riparian zone at this point is altered as a result of the existing upstream modifications and impacts on the non-perennial river. Consist mostly of pioneer plants with no freshwater ecology functioning left.	None at this point as a result of the constructed railway line.	None at this point. River is channelled in concrete channel.
Depth characteristics	Flat area	Flat area	None. Water is channelled underneath the N2 and into a concrete channel.
Flow conditions	No water was	No water was flowing	None. Water is

	flowing during time of site visit. The river channel at this point consists of a small eroded channel as a result of the concentrate stream release underneath the railway line.	during time of site visit. The river channel at this point consists of a small eroded channel as a result of the concentrate stream release underneath the railway line.	channelled underneath the N2 and into a concrete channel.
Water clarity	No water was flowing during time of site visit.	No water was flowing during time of site visit.	No water was flowing during time of site visit.
Stones habitat characteristics	Consisted of eroded river channel with sand and stone river bed.	Consisted of eroded river channel with sand and stone river bed.	None. Water is channelled underneath the N2 and into a concrete channel.
Vegetation habitat characteristics	Degraded and dominated by pioneer plants.	Degraded and dominated by pioneer plants.	None. Water is channelled underneath the N2 and into a concrete channel.
Other habitat characteristics	The surrounding land uses, cemetery in the catchment, road crossings and attenuation dam all contributed to the poor ecological state that the non-perennial river is in.	The surrounding land uses, cemetery in the catchment, road crossings and attenuation dam all contributed to the poor ecological state that the non-perennial river is in.	None. Water is channelled underneath the N2 and into a concrete channel.
Erosion potential	Low. Banks at this point are relatively stable and there is little potential for erosion.	Low. Banks at this point are relatively stable and there is little potential for erosion.	None. Water is channelled underneath the N2 and into a concrete channel.

5.1(B) Habitat Assessment Of The Whole Non-Perennial River

Instream Habitat Integrity

Weights	14	13	13	13	14	10	9	8	6		
REACH	Water abstraction	Flow modification	Bed modification	Channel modification	Water quality	Inundation	Exotic macrophytes	Exotic fauna	Solid waste disposal	Total Score (%)	Classification
Impacted Site	0	25	25	25	22	25	22	22	9	78,44	E: The loss of natural habitat, biota and basic ecosystem functions is extensive.

None	Small	Moderate	Large	Serious	Critical
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Riparian Zone Habitat Integrity

Weights	13	12	14	12	13	11	12	13		
REACH	Vegetation removal	Alien encroachment	Bank erosion	Water abstraction	Flow modification	Channel modification	Water quality	Inundation	Total Score (%)	Classification
Impacted Site	25	25	3	0	25	25	22	25	74,24	E: The loss of natural habitat, biota and basic ecosystem functions is extensive.

None	Small	Moderate	Large	Serious	Critical
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From the results of the application of the IHIA to the impacted site, it is evident that the rivers reach is modified and that the loss of natural habitat, biota and basic ecosystem functions is extensive. Instream impacts included a large impact from flow modifications, inundation as well as bed and channel modifications. Overall, the site achieved a 78.44 % score for instream integrity.

Riparian impacts included a large impact from flow modifications, inundation, alien vegetation encroachment as well as bed and channel modifications. Overall, the site achieved an 74.24 % score for instream integrity.

The site obtained an overall IHIA rating of 76.34%, which indicates the loss of natural habitat, biota and basic ecosystem functions is extensive. (Class E conditions).

5.1. (C) Riparian Vegetation Response Assessment Index (VEGRAI)

Table 10: The overall VEGRAI score of the impacted area

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	10,0	3,8	2,7	2,0	60,0
NON MARGINAL	10,4	6,5	3,8	1,0	100,0
2.0					160,0
LEVEL 3 VEGRAI (%)				10,3	
VEGRAI EC				F	
AVERAGE CONFIDENCE				3,3	

The score attained for the VEGRAI indicated that the riparian system falls into the category F. This indicates that the loss of natural habitat, biota and basic ecosystem functions is extensive. Modifications have reached a critical level and the system has been modified completely with almost complete loss of natural habitat and biota. In worst instances basic ecosystem functions have been destroyed and changes are irreversible.

5.1. (D) Ecological Importance and Sensitivity (EIS)

Table 11: Results of the EIS assessment for the affected watercourse

Component	Score	Confidence	Comments/description
Channel type	3	5	Channelled non-perennial river.
Conservation context	2	5	No Status
Vegetation and habitat Integrity	1	5	Largely modified
Connectivity	0	5	Not connected. Downstream connection is lost.
Threat Status of Vegetation Type	0	5	Vegetation has endangered conservation status
EIS Category	1.2		Moderate Importance

EIS considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale. The median of the resultant score is calculated to derive the EIS category.

The non-perennial river is considered to be of marginal ecological importance.

5.2 (A) Activities Impacting on the Koornlads Perennial River

5.2.1. Sewer pipeline upgrade on southern bank of Koornlads River.



Photo 27: Propose upgrade of existing sewer pipeline.



Photo 28: Upstream view of Koornlads river where the sewer pipeline upgrade is proposed.



Photo 29: Upstream view of Koornlads river where the sewer pipeline upgrade is proposed.

Table 12: Descriptions of the location of sewer pipe upgrade in relation to mapped perennial river

Characteristics	Sewer pipeline site	Upstream area	Downstream area
Significance of the point	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.
Surrounding anthropogenic activities	The site is situated at the point where the pipeline will be upgraded next to the perennial river.	The site is situated upstream where the pipeline will run next to the perennial river.	The site is situated downstream where the pipeline will run next to the perennial river.

Riparian zone characteristics	The riparian zone at this point is totally destroyed.	Limited riparian vegetation at this point.	Limited riparian vegetation at this point.
Depth characteristics	Water was flowing during time of site visit in the Koorlands River next to the site.	Water was flowing during time of site visit. The river has a deep natural channel.	Water was flowing during time of site visit. The river has a deep natural channel.
Flow conditions	Water was flowing during time of site visit in the Koorlands River next to the site.	Water was flowing during time of site visit. The river has a deep natural channel.	Water was flowing during time of site visit. The river has a deep natural channel.
Water clarity	Site outside the river.	The water observed in the Koorlands River at the time of the survey was clear.	The water observed in the Koorlands River at the time of the survey was clear.
Stones habitat characteristics	Site outside the river.	The river channel is characterised by alluvial river rock channel.	The river channel is characterised by alluvial river rock channel.
Vegetation habitat characteristics	The riparian zone at this point is totally destroyed.	Limited riparian at this point and it is characterised by <i>Pennisetum macrourum</i> . <i>Acacia mearnsii</i> was recently cleared and the area is dominated by pioneer grasses.	Limited riparian at this point and it is characterised by <i>Pennisetum macrourum</i> . <i>Acacia mearnsii</i> was recently cleared and the area is dominated by pioneer grasses.
Other habitat characteristics	None. Situated outside river.	The river channel is characterised by alluvial river rock channel.	The river channel is characterised by alluvial river rock channel.
Erosion potential	None. Outside river and its banks.	Banks at this point are relatively stable and there is little potential for erosion.	Banks at this point are relatively stable and there is little potential for erosion.

5.2.2. Non-perennial river where water pipeline will cross as well as expansion of the water pipeline on the bank of the non-perennial river next to the edge of existing erven.



Photo 30: Upgrade of existing sewer pipeline hanged downstream on the bridge.



Photo 31: Upgrade of existing sewer pipeline outside the river and its banks.



Photo 32: Upstream of Koornlands River of existing sewer pipeline crossing.



Photo 33: Upstream of Koornlands River of existing sewer pipeline crossing.

Table 13: Descriptions of the location of sewer pipe in relation to mapped perennial river

Characteristics	Sewer pipeline site	Upstream area	Downstream area
Significance of the point	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.
Surrounding anthropogenic activities	The site is situated at the point where the pipeline will be upgraded next to and over the perennial river.	The site is situated upstream where the pipeline will run next to and over the perennial river.	The site is situated downstream where the pipeline will run next to and over the perennial river.
Riparian zone	The riparian zone at	Limited riparian	Limited riparian

characteristics	this point is totally destroyed.	vegetation at this point due to rocking river bed.	vegetation at this point due to rocking river bed.
Depth characteristics	Water was flowing during time of site visit in the Koorlands River. Channel is moderate at this point in the Koorlands River.	Water was flowing during time of site visit. The river has a moderate natural channel.	Water was flowing during time of site visit. The river has a moderate natural channel.
Flow conditions	Water was flowing during time of site visit in the Koorlands River next to the site.	Water was flowing during time of site visit. The river has a moderate natural channel.	Water was flowing during time of site visit. The river has a moderate natural channel.
Water clarity	Water at this site in the Koorlands River is clear.	Water at this site in the Koorlands River is clear.	Water at this site in the Koorlands River is clear.
Stones habitat characteristics	The river channel is characterised by alluvial river rock channel.	The river channel is characterised by alluvial river rock channel.	The river channel is characterised by alluvial river rock channel.
Vegetation habitat characteristics	The riparian zone at this point is totally destroyed.	Riparian at this point is characterised by <i>Pennisetum macrourum</i> , <i>Acacia mearnsii</i> , <i>Phragmites australis</i> and in a fairly good condition despite the presence of alien vegetation.	Riparian at this point is characterised by <i>Pennisetum macrourum</i> , <i>Acacia mearnsii</i> , <i>Phragmites australis</i> and in a fairly good condition despite the presence of alien vegetation.
Other habitat characteristics	None. Existing infrastructure	The river channel is characterised by alluvial river rock channel.	The river channel is characterised by alluvial river rock channel.
Erosion potential	None. Outside river and its banks and existing infrastructure.	Banks at this point are relatively stable and there is little potential for erosion.	Banks at this point are relatively stable and there is little potential for erosion.

5.1.3. Proposed upgrade of sewer pipeline next to the perennial river outside the flood lines.



Photo 34: Proposed sewer pipeline upgrade next to river.



Photo 35: Condition of the riparian vegetation of the Koornlads River next to the proposed sewer pipeline upgrade.

Table 14: Descriptions of the location of upgrade to the existing sewer pipeline in comparison to the mapped perennial river

Characteristics	Sewer pipeline site	Next to sewer pipeline upgrade area
Significance of the point	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.	This point is to be used as a reference point for the site. Any degradation from this point would serve as an indication of impacts on the surrounding area.
Surrounding anthropogenic activities	The site is situated at the point where the pipeline will be upgraded next to the perennial river.	The site is situated upstream where the pipeline will run next to and over the perennial river.
Riparian zone characteristics	The riparian zone at this point is totally destroyed.	Riparian vegetation in good condition at this point. <i>Acacia mearnsii</i> has an impact on species diversity.
Depth characteristics	None. Outside the river and its floodplain.	Water was flowing during time of site visit. The river has a moderate natural channel.
Flow conditions	None. Outside the river and its floodplain.	Water was flowing during time of site visit. The river has a moderate natural channel.
Water clarity	None. Outside the river and its floodplain.	Water at this site in the Koornlads River is clear.
Stones habitat characteristics	None. Outside the river and its floodplain.	The river channel is characterised by alluvial river rock channel.
Vegetation habitat characteristics	None. Outside the river and its floodplain.	Riparian at this point is characterised by <i>Pennisetum macrourum</i> , <i>Acacia mearnsii</i> , <i>Phragmites australis</i> and in a fairly good condition despite the presence of alien vegetation.
Other habitat characteristics	None. Existing infrastructure	The river channel is characterised by alluvial river rock channel.
Erosion potential	None. Outside river and its banks	Banks at this point are relatively

	and existing infrastructure.	stable and there is little potential for erosion.
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5.2 Habitat Assessment Of The Whole Koornlands Perennial River

Instream Habitat Integrity

Weights	14	13	13	13	14	10	9	8	6		
REACH	Water abstraction	Flow modification	Bed modification	Channel modification	Water quality	Inundation	Exotic macrophytes	Exotic fauna	Solid waste disposal	Total Score (%)	Classification
Impacted Site	0	12	3	3	3	2	2	2	2	86.3	B: Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.

None	Small	Moderate	Large	Serious	Critical
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Riparian Zone Habitat Integrity

Weights	13	12	14	12	13	11	12	13		
REACH	Vegetation removal	Alien encroachment	Bank erosion	Water abstraction	Flow modification	Channel modification	Water quality	Inundation	Total Score (%)	Classification
Impacted Site	2	15	3	0	3	3	2	2	85.2	B: Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.

None	Small	Moderate	Large	Serious	Critical
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From the results of the application of the IHIA to the impacted site, it is evident that the rivers reach is modified and that the loss of natural habitat, biota and basic ecosystem functions is extensive. Instream impacts included a large impact from flow modifications, inundation as well as bed and channel modifications. Overall, the site achieved a 86.3 % score for instream integrity.

Riparian impacts included a large impact from flow modifications, inundation, alien vegetation encroachment as well as bed and channel modifications. Overall, the site achieved an 85.2 % score for instream integrity.

The site obtained an overall IHIA rating of 85.75%, which indicates that the river is largely natural with few modifications. (Class B conditions).

5.2.1. Riparian Vegetation Response Assessment Index (VEGRAI)

Table 15: The overall VEGRAI score of the impacted area

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	50,0	18,8	3,3	2,0	60,0
NON MARGINAL	70,0	43,8	3,5	1,0	100,0
	2,0				160,0
LEVEL 3 VEGRAI (%)				62,5	
VEGRAI EC				C	
AVERAGE CONFIDENCE				3,4	

The score attained for the VEGRAI indicated that the riparian system falls into the category C. Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.

5.2.2. Ecological Importance and Sensitivity (EIS)

Table 16: Results of the EIS assessment for the affected watercourse

Component	Score	Confidence	Comments/description
Channel type	4	5	Channelled non-perennial river.
Conservation context	5	5	No Status
Vegetation and habitat Integrity	3	5	Largely modified
Connectivity	3	5	Not connected. Downstream connection is lost.
Threat Status of Vegetation Type	0	5	Vegetation has endangered conservation status
EIS Category	3		Very high

EIS considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale. The median of the resultant score is calculated to derive the EIS category.

The perennial river is considered to be of high ecological importance.

6. IMPACT ASSESSMENT OF THE ACTIVITIES

Nature of impact: Loss of freshwater ecology habitat
Discussion: Habitat destruction is the alteration of a natural habitat to the point that it is rendered unfit to

support the species dependent upon it as their home territory. Many organisms previously using the area are displaced or destroyed, reducing biodiversity. Modification of habitats for agriculture as well as surface mining and urban development are the main causes of habitat destruction in this case. Additional causes of habitat destruction include water pollution, introduction of alien species and overgrazing. The non-perennial riverine systems have very low flows as part of their annual hydrological cycles and are particularly susceptible to changes in habitat condition. The proposed development project has the potential to lead to habitat loss and/or alteration of the aquatic and riparian resources on the study area. It is however important to note that the freshwater ecology, and especially aquatic habitats of most of the systems has been seriously to critically impaired or impacted already as a result of existing infrastructure and as such the risk to the receiving environment as a result of the proposed project is reduced to some degree.

Cumulative impacts:

Riparian zone

Earthworks in the vicinity of drainage systems leading to increased runoff and erosion and altered runoff patterns.

Construction of the pipelines and attenuation dams altering stream flow patterns and water velocities.

Alien invasive vegetation encroachment.

Erosion and incision of riparian zone.

Instream zone

Loss of aquatic refugia.

Altered substrate conditions due to the deposition of silt

Altered depth and flow regimes in the major drainage systems

Alien vegetation proliferation

Mitigation:

Essential mitigation measures:

- Limit the footprint area of the construction activity to what is absolutely essential in order to minimise the loss of aquatic habitats in the area.
- Keep all demarcated sensitive zones outside of the construction area off limits during the construction phase of the project;
- On-going aquatic ecological monitoring must take place on a 6 monthly basis by a suitably qualified assessor.

Recommended mitigation measures

- Permit only essential construction personnel within 32m of all riparian systems;
- Restrict construction activities to the drier summer months, if possible, to avoid sedimentation and siltation of riparian features in the vicinity of the proposed development and aim for completion in early spring at which time revegetation should take place allowing for a full summer growing season to become established.

Criteria	Without Mitigation	With Mitigation	No-Go Alternative	
			Without Mitigation	With Mitigation
Extent	2	1	Not Applicable (No construction activities to take place during the No-Go Alternative)	
Duration	5	5		
Magnitude	2	2		
Probability	4	2		
Significance	36-Medium	16-Low		
Status	Medium significance if not mitigated	No significance if mitigated		
Reversibility	0%			
Irreplaceable loss of	2- Partly Replaceable			

resources		
Can impacts be mitigated?	2-Partly, but impact on subsurface geological layers during excavations is inevitable.	

Nature of impact: Disturbance to subsurface geological layers.
Discussion: Construction and excavation activities will affect the underlying geological layers on site to some extent.
Cumulative impacts: It is not anticipated that the impact will be high as the affected substrata is very shallow and the integrity of the underlying ground structures will thus not be sacrificed.
Mitigation: Due to the nature of the impacts, not much can be done to mitigate the impact, only the severity of it can be managed. Mitigation and management for affecting geology is to ensure that removal of soil is kept to a minimum – removal of soil should only be in areas where infrastructure will be established. Disturbance through the river must preferably be in summer and definitely not when the river flows. The pipe must be laid and the area compacted in one time and the area must be immediately filled, shaped, compacted and rehabilitated.

Criteria			No-Go Alternative	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Extent	2	1	Not Applicable (No construction activities to take place during the No-Go Alternative)	
Duration	5	5		
Magnitude	2	2		
Probability	4	2		
Significance	36-Medium	16-Low		
Status	Medium significance if not mitigated	No significance if mitigated		
Reversibility	0%			
Irreplaceable loss of resources	2- Partly Replaceable			
Can impacts be mitigated?	2-Partly, but impact on subsurface geological layers during excavations is inevitable.			

Nature of impact: Degradation / loss of naturally occurring / indigenous flora and habitats.
Discussion: Special precaution is to be taken during the construction of the infrastructure that falls within the regulated area as determined in the NWA. Construction activities must be controlled to ensure that the river and its buffer areas are not negatively impacted.
Cumulative impacts: Loss of significantly impacted upon vegetation and habitat.

Mitigation:

- Undertake construction activities only in identified and specifically demarcated areas.
- Invasive vegetation to be removed during construction to be disposed of at landfill site in such a manner that seeds must not be able to spread from the disposal site or during transportation.
- In order to access the river with the required construction equipment and activities, and upgrading of the attenuation dams, vegetation will need to be cleared. All vegetation removed must be disposed of at a suitable disposal facility.
- At no point may construction equipment stand unauthorised within or near the river.
- All excess sediment removed from the watercourses must be utilised as part of the building activities or be removed from site. At no point may this material be dumped on site or within any of the other freshwater features identified within the surrounding area. Topsoil will have a high density of alien invasive seeds which will need to be controlled into the operational phase.
- It is recommended that the upgraded attenuation dams be designed to be as natural as possible (earthed and unlined) and vegetated to function as a constructed wetland for water quality filtration.
- One culvert crossings are proposed over the river to gain access. Care must be taken when constructing the culverts to ensure that the design accommodates a 1 in 100 year flood event and that the base levels are maintained so that no erosion or ponding of water occurs surrounding the crossing.
- Soil surrounding the wingwalls must be suitably backfilled and sloped (minimum of a 1:3 ratio) and concrete aprons as well as gabion mattresses should be installed both up and downstream for energy dissipation and sediment trapping.
- All soils within the river surrounding the culvert must be loosened on completion of works to allow for revegetation.

No-Go Alternative				
Criteria	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Extent	3	2	Not Applicable (No construction activities to take place during the No-Go Alternative)	
Duration	2	1		
Magnitude	4	2		
Probability	4	2		
Significance	36 - Medium Significance	10 - Low Significance		
Status	Medium significance if not mitigated	No significance if mitigated		
Reversibility	30%	70%		
Irreplaceable loss of resources	2 - Resource may be partly destroyed			
Can impacts be mitigated?	2 - Partly mitigable			

Nature of impact:

Damage to existing infrastructure.

Discussion:

Construction activities will impact upon existing sewer pipelines that may occur along the pipeline route as well as when connected to the existing sewer line. Damage to private property of adjacent landowners may potentially occur.

Cumulative impacts:

Damage or loss of existing infrastructure. Damage and loss of private property adjacent to the proposed activity. Spillage of sewerage into the natural environment.

Mitigation:

- Care should be taken when conducting construction activities in close proximity to infrastructure and private property;
- Should any damage occur to existing infrastructure or private property as a result of construction activities; the relevant service provider / landowner must be contacted and the repair/replacement must be commissioned to the satisfaction of the service provider / landowner. Should spillage occur, the BGCMA and DEA&DP: Pollution and chemical management directorate must be informed immediately.

No-Go Alternative				
Criteria	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Extent	3	2	Not Applicable (No construction activities to take place during the No-Go Alternative)	
Duration	1	1		
Magnitude	2	0		
Probability	4	3		
Significance	24 - Low Significance	9 - Low Significance		
Status	Low Significance if not mitigated	No significance if mitigated		
Reversibility	90%			
Irreplaceable loss of resources	1 - Resource will not be lost			
Can impacts be mitigated?	1 - Completely mitigable			

Nature of impact:

Waste management.

Discussion:

General construction waste will be generated during the construction phase. Poor waste management practices on site may lead to dumping and windblown litter creating a negative visual impact and nuisance for adjacent landowners / users as well as impacting the natural environment.

Cumulative impacts:

- Dumping;
- Windblown litter causing nuisance;
- Pollution / degradation of the natural environment.

Mitigation:

- All waste generated on site shall be collected and disposed of at a registered landfill facility;
- All safe disposal certificates and waste manifests from service providers to be kept and maintained;
- All staff to receive training on correct waste management practices.

No-Go Alternative				
Criteria	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Extent	2	1	Not Applicable (No construction activities to take place during the No-Go Alternative)	
Duration	2	1		
Magnitude	2	2		
Probability	3	2		

Significance	18 - Low Significance	8 - Low Significance	
Status	Low Significance if not mitigated	No significance if mitigated	
Reversibility	90%		
Irreplaceable loss of resources	1 - Resource will not be lost		
Can impacts be mitigated?	1 - Completely mitigable		

Nature of impact:

Infrastructure failure.

Discussion:

Infrastructure failure will result in the spillage of raw sewerage into the receiving environment.

Cumulative impacts:

Pollution of the receiving environment as well as offensive odours from the spillage causing a nuisance to adjacent landowners / users.

Mitigation:

- Regular inspection and maintenance of the sewer pipeline.
- Infrastructure failure reported or identified to be fixed as a priority.
- Spillage of raw sewerage to be mitigated and remediated where required.
- Should any damage occur to existing infrastructure or private property as a result of construction activities; the relevant service provider / landowner must be contacted and the repair/replacement must be commissioned to the satisfaction of the service provider / landowner. Should spillage occur, the BGCMA and DEA&DP: Pollution and chemical management directorate must be informed immediately.

No-Go Alternative

Criteria	No-Go Alternative		Without Mitigation	With Mitigation
	Without Mitigation	With Mitigation		
Extent	3	2	Not Applicable (No construction activities to take place during the No-Go Alternative)	
Duration	2	1		
Magnitude	4	4		
Probability	2	2		
Significance	18 - Low Significance	14 - Low Significance		
Status	Low Significance	Low Significance		
Reversibility	60%			
Irreplaceable loss of resources	2 - Resources may be partly destroyed			
Can impacts be mitigated?	2 - Partially			

Cumulatively, if adequately mitigated the potential impacts of the proposed activities to be undertaken will be of low negative significance and will in the short term just require some rehabilitation of the disturbed areas and longer term monitoring and control of the growth of alien invasive plants, erosion and waste accumulation.

7. CONCLUSION

Eco Impact Legal Consulting (Pty) Ltd were appointed to undertake a Present Ecological

State (PES) and Ecological Importance and Sensitivity (EIS) analysis of the freshwater and riparian resources as part of the Water Use Authorization application.

The proposed project form part of service delivery to the proposed housing project and the upgrade of water and sewerage pipelines, attenuation dams and new road crossing is require.

Based on the impact assessment it is evident that there are six possible impacts on the freshwater ecology of the area observed. In considering the impacts and mitigation, it is assumed that a high level of mitigation will take place without high prohibitive costs. From the table it is evident that prior to mitigation, the impacts on the loss of freshwater ecology habitat, disturbance to subsurface geological layers, degradation / loss of naturally occurring / indigenous flora and habitats are medium level impacts, which can be mitigated and will be reduced to low level impacts. The other tree impacts identified all has low impacts that is reduce to very low with the proposed mitigation measures.

NON-PERENNIAL RIVER WITH THE PROPOSED WATER PIPELINE UPGRADES, ATTENUATION DAMS UPGRADE AND NEW ROAD CROSSING ACTIVITIES.

Habitat Assessment

From the results of the application of the IHIA to the impacted site, it is evident that the rivers reach is modified and that the loss of natural habitat, biota and basic ecosystem functions is extensive. Instream impacts included a large impact from flow modifications, inundation as well as bed and channel modifications. Overall, the site achieved a 78.44 % score for instream integrity.

Riparian impacts included a large impact from flow modifications, inundation, alien vegetation encroachment as well as bed and channel modifications. Overall, the site achieved an 74.24 % score for instream integrity.

The site obtained an overall IHIA rating of 76.34%, which indicates the loss of natural habitat, biota and basic ecosystem functions is extensive. (Class E conditions).

Riparian Vegetation Response Assessment Index (VEGRAI)

The score attained for the VEGRAI indicated that the riparian system falls into the category F. This indicates that the loss of natural habitat, biota and basic ecosystem functions is extensive. Modifications have reached a critical level and the system has been modified completely with almost complete loss of natural habitat and biota. In worst instances basic ecosystem functions have been destroyed and changes are irreversible.

Ecological Importance and Sensitivity (EIS)

EIS considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale. The median of the resultant score is calculated to derive the EIS category.

The non-perennial river is considered to be of moderate ecological importance.

PERENNIAL KOORNLANDS RIVER WITH THE PROPOSED SEWER PIPELINE UPGRADES

Habitat Assessment

From the results of the application of the IHIA to the impacted site, it is evident that the rivers reach is modified and that the loss of natural habitat, biota and basic ecosystem functions is extensive. Instream impacts included a large impact from flow modifications, inundation as well as bed and channel modifications. Overall, the site achieved a 78.44 % score for instream integrity.

Riparian impacts included a large impact from flow modifications, inundation, alien vegetation encroachment as well as bed and channel modifications. Overall, the site achieved an 74.24 % score for instream integrity.

The site obtained an overall IHIA rating of 76.34%, which indicates the loss of natural habitat, biota and basic ecosystem functions is extensive. (Class E conditions).

Riparian Vegetation Response Assessment Index (VEGRAI)

The score attained for the VEGRAI indicated that the riparian system falls into the category F. This indicates that the loss of natural habitat, biota and basic ecosystem functions is extensive. Modifications have reached a critical level and the system has been modified completely with almost complete loss of natural habitat and biota. In worst instances basic ecosystem functions have been destroyed and changes are irreversible.

Based on the findings of this study it is the opinion of the freshwater ecologists that the proposed construction activities be considered favourably, from a freshwater ecological point of view, provided that the mitigatory measures presented in this report are strictly adhered to.

Ecological Importance and Sensitivity (EIS)

EIS considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale. The median of the resultant score is calculated to derive the EIS category.

The perennial river is considered to be of high ecological importance.

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APPENDIX A: ABBREVIATED CURRICULUM VITAE AND DECLARATION OF INDEPENDENCE OF FRESHWATER SPECIALIST

Name:	Nicolaas Willem Hanekom (Pri.Sci.Nat)
Profession:	Ecological Scientist
Nationality:	South African
Years experience	26 Years
Academic Qualifications	<ul style="list-style-type: none"> • National Diploma, Nature Conservation (Cape Technikon) • B. Tech Degree in Nature Conservation (Cape Technikon) • M.Tech in Nature Conservation (Cape Peninsula University of Technology) • Completed various Environmental Management Courses • Qualified Environmental Management System ISO 14001: 2004 Audit: Internal Auditor Course Based on ISO 19011:2002 (Centre for Environmental Management North West University)
Areas of specialisation:	<ul style="list-style-type: none"> • Ecosystem (terrestrial and aquatic) monitoring and assessments • Design of monitoring programmes for ecosystems (terrestrial and aquatic) • Environmental Impact Assessments • River classification and environmental water requirements • Wetlands Delineation • River and Wetlands management • Water Use Authorization Applications • Water quality management • River Health Assessments
Countries of Work Experience:	South Africa (Northern Cape, Western Cape, Free State, Mpumalanga, Gauteng)
Employment Record	<ul style="list-style-type: none"> • Student at Bontebok National Park (1992) • Assistant Reserve Manager at Gariiep Dam Nature Reserve, Free State (1993 - 1998) • Reserve Manager, Conservation Services Manager for Western Cape Nature Conservation Board (1998 - 2006) • External Lecturer at Cape Peninsula University of Technology (2003 - 2005) • Director: Environmental Management at Cape Lowlands Environmental Services (2006 – 2010) • Director, Environmental Management and lead Environmental Impact Assessment Practitioner at Eco Impact (Pty) Ltd (2010 – to date)
Professional membership, accreditations and courses	<ul style="list-style-type: none"> • South African Council for Natural Scientists Professions Pri.Sci.Nat (Ecological Science) • Riparian vegetation identification and health assessment. Internal Western Cape Nature Conservation short course presented by Dr C Boucher (Stellenbosch University) in 2000. • SASS5 Aquatic Biomonitoring Training Course. 2 to 5 September 2013. Ground Truth Water and Environmental Engineering consultancy in partnership with the Department of Water Affairs. • Workshop on “Section 21(c) and (i) Water Use Training: Understanding Watercourses and Managing Impacts to their Characteristics”. 10 May 2017. Presented by Dr Wietsche Roets of the Department of Water and Sanitation (Sub-Directorate: Instream Water Use).
Summary of	1992: South African National Parks. Student at Bontebok National Park

<p>experience</p>	<p>with management and monitoring actions related to the Breede River. 1993 -1998: Free State Nature Conservation. Ecological management and monitoring actions related to the Gariep Dam, Orange and Caledon Rivers.</p> <p>1998 -2006: CapeNature. Ecological management and monitoring actions related to the Berg River Estuary, Verlorenvlei, Lamberts bay's Jackalsvlei, Wadrikt Soutpanne, Oliphant's River mouth, Rocherpan Nature Reserve, etc. Review and assessment of EIA applications, inclusive of Freshwater ecology. Did some site visits with Department of Water Affairs and Forestry (Hester Lyons) to confirm the presence of aquatic ecological features during EIA water use registration applications.</p> <p>2006 to date: Cape Lowland Environmental Services and Eco Impact Legal Consultant. Ecological (Freshwater and aquatic) Specialist input, assessment, monitoring and reports.</p>
<p>Publications and assessment reports</p>	<p>Just to name a few. Was involved in many Ecological Assessments, monitoring and inputs in EIA applications.</p> <ul style="list-style-type: none"> • Elandskloof Farm 475 Citrusdal Biodiversity Baseline Survey. August 2010. This Biodiversity Assessment Covering Terrestrial and Aquatic Aspects to Inform Decisions Regarding The Proposed Elandskloof Weir Flood Damage Project On Farm 475, In The Citrusdal Area. • Cape Solar Energy Electricity Generation Facility. Farm 187/3 & 187/13 Kenhardt. Biodiversity And Ecological Baseline Survey. January 2011. (Included Terrestrial and aquatic ecological assessments and water use authorization applications) • Prieska Photovoltaic Power Generation Project. Prieska Commonage Northern Cape. Biodiversity And Ecological Baseline Survey. July 2011. (Included Terrestrial and aquatic ecological assessments and water use authorization applications) • Witteklip Erf 123 Extension, Vredenburg. Biodiversity Baseline Survey. Updated - October 2012 (Included Terrestrial and aquatic ecological assessments and water use authorization applications) • Baseline Biodiversity Survey And Wetland Delineation for ECCA Holdings: Cape Bentonite Mine on Erf 1412 Near Heidelberg. Prepared for: Shangoni Management Services Pry (Ltd). October 2014. • Freshwater Impact Assessment Laingsburg Flood Damage Repairs & Storm Water Infrastructure. 18 February 2016. • Ecological Assessment for Swartland Municipality - Upgrades To Voortrekker/Bokomo Road And Voortrekker/Rozenburg Road Intersections and Upgrade to the Diep River Bridge, Malmesbury on A Portion Of Erf 327, Malmesbury (Road) Erf 1530, Diep River Bridge Crossing, and Erf 1528, Property South of Diep River where Road Widening and Turning Circle Will Be Constructed. March 2016. (Freshwater Ecology Inputs and Water Use Registration) • Freshwater Impact Assessment. McGregor Bridge, Robertson Bridge and Willem Nels River Maintenance Management Plan. 24 June 2016. (Freshwater Ecology assessment and input as well as Water Use Registration) • Water Use Authorization Application Risk Matrix. Orange Grove Trust Vegetation Clearing and Agricultural Development on Portion 4 of Farm Glen Heatlie No 316, Worcester. 12 June 2017. (Freshwater ecological inputs in EIA process and Water Use

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