Client

Hartenbos Hills Propco (Pty) Ltd

ERF 3122, HARTENBOS HEUWELS RESIDENTIAL DEVELOPMENT

FRESHWATER ECOLOGICAL IMPACT REPORT

Submitted to

Cape EAPrac (Pty) Ltd

Prepared by

Freshwater Consulting

Justine Ewart-Smith

Freshwater Consulting cc
Unit F3, Prime Park
Mocke Road
Diep River, 7800
Cell: 082 3738380
Email: Justine@freshwaterconsulting.co.za

January 2023

TABLE OF CONTENTS

DECLARATION OF SPECIALIST INDEPENDENCE

I, Justine Ewart-Smith, as a partner of Freshwater Consulting cc hereby confirm my independence as a specialist and declare that I do not have any interest, be it business, financial, personal or other, in any proposed activity of the client and their consultants. All the opinions expressed in this document are my own, based on professional judgement.

Full name: Justine Lindsay Ewart-Smith
The Freshwater Consulting cc
justine@freshwaterconsulting.co.za

STATEMENT OF COMPETENCE

Title: Dr

Position: Member and freshwater ecological specialist at Freshwater Consulting cc

Qualification(s): BSc, BSc Hons, MSc, PhD (zoology – freshwater ecosystems)

Experience: 23 years in freshwater ecosystems

Experience in study area: Freshwater specialist on a number of assessments in the Southern Cape Region, including both river and wetland assessments within the Gouritz Catchment within the vicinity of the site and the broader catchment as a whole.

Registration(s): Registered Professional Natural Scientist by SACNASP (Reg No 400746/15) for Ecological Science; Member of the South African Society of Aquatic Sciences (SASAqS).

1 INTRODUCTION

1.1 Background

Hartenbos Hills Propco (Pty) Ltd proposes to develop ERF 3122 (Hartenbos Heuwels) as a residential estate, which would be known as Hartenbos Garden Estate. Cape EAPrac are currently overseeing the environmental authorisation process which includes three phases. Phase 1, the Constraints (Sensitivity) Analysis was undertaken in 2017, during which Freshwater Consulting cc identified a number of freshwater ecosystems within the study area. These were evaluated in terms of their Ecological Condition and Ecological Importance and Sensitivity, which informed recommendations for development of a layout plan for the site. A preferred development layout plan was compiled in late 2017 and the project thus entered the Scoping Phase (phase 2) of the Environmental Authorisation process. In March 2018, a proposed development layout plan was assessed relative to the no-go alternative as the basis for further assessment of potential impacts from a freshwater ecological perspective.

Subsequent to the initial Scoping Assessment in 2018, a new development layout plan was compiled in December 2020 and an updated Services Report was submitted in June 2021 (LJR Civil 2021). In October 2021, Freshwater Consulting assessed the proposed new development layout plan (i.e. Alternative 2) with consideration of changes to Stormwater Management and the Sewer Network Layout Plan included in the Services Report (LJR Civil 2021) and updated the Scoping Freshwater Report accordingly.

In early 2022, the project entered the Environmental Impact Assessment Phase, requiring a detailed assessment of potential impacts to freshwater ecosystems. Following on from comments received from Interested & Affected Parties (I&APS) and the Department of Environmental Affairs & Development Planning (DEA&DP) in late 2022, a third alternative layout was developed for comparison with Alternative 2 and the no-go alternative (i.e. Alternative 1). This report therefore provides a review of potentially affected ecosystems identified in 2017 as a basis for assessment of impacts associated with Alternatives 2 and 3, relative to Alternative 1, with recommendations for mitigation during both the construction and operational phases of the project.

1.2 Terms of Reference

In terms of the Environmental Impact Assessment Phase, Freshwater Consulting cc were contracted to:

1. Perform a final review of the development alternatives;
2. Cross-reference with other relevant specialists (i.e. botanical / engineering) to ensure an integrated approach to the detailed impact assessment;
3. Engage with the relevant authorities regarding the freshwater ecological impact assessment methodology and approach to ensure that the approach complies with their requirements and discuss the findings/recommendations with them to ensure that the impact assessment report addresses their particular issues/concerns;
4. Evaluate the various impacts/issues/concerns identified in the freshwater ecological scoping report compared to the preferred proposal to determine the level and significance of remaining impacts;
5. Assess each impact in terms of the construction and operational/maintenance phase;
6. Where necessary address each impact in terms of its impact lifecycle i.e. short term / medium or long term impact;
7. Identify feasible management recommendations for each impact;

8. Evaluate each impact before and after mitigation/management;
9. Compile a draft Freshwater Ecological Impact Report;
10. Compile a PowerPoint presentation of the assessment and present the findings/recommendations to the project team;
11. Review and respond to all relevant submissions relevant to the freshwater ecological impact assessment;
12. Update the draft impact report to a final report;
13. Participate in public/authority meetings.

1.3 Use of this Report

This report reflects the professional judgement of its author. It is Freshwater Consulting's policy that the full and unedited contents thereof should be presented to the client and included in any application to relevant authorities. Any summary of the findings should only be produced with the approval of the author.

1.4 Assumptions and limitations

The site was first visited in August 2017 following an extended dry period and during one of the most severe droughts experienced by the Western Cape in recent history. Many of the wetland and riparian vegetation species were therefore dead and thus difficult to use as indicators for the delineation of wetlands and watercourses. Also, many of the soil indicators were difficult to identify and interpret because of previous disturbance associated with historic farming activities. In April 2022, the site was re-assessed, following a relatively wet period in recent years, thus improving confidence in the delineation and assessment of freshwater ecosystems. However, interpretation of soil indicators was still somewhat complicated by previous farming activities.

1.5 Definitions

According to the National Water Act (36 of 1998) wetlands are areas: "...*where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted for life in saturated soil."* Essentially, this means that wetlands are areas where water is the primary driving force. Therefore, wetlands develop in areas where water is present for prolonged periods of time but soils are saturated or inundated with water for varying lengths of time and at different frequencies.

- Many wetlands also comply with the National Water Act (NWA) (Act 36 of 1998)'s definition of a ***"watercourse'', namely*** -

  (a) a river or spring;

  (b) a natural channel in which water flows regularly or intermittently;

  (c) a wetland, lake or dam into which, or from which, water flows; and

  (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

1.6 The study area

The proposed Hartenbos Garden Estate comprises a single property, Erf 3122 (Figure 1.1) in an area known as Hartenbos Heuwels. It is situated on the low hills to the west of the town of Hartenbos within the Mosselbay Municipal Area, about 1.5 km west of the N2 highway. Erf 3122 is currently zoned for agriculture, although the study area and immediate surrounds are largely natural but with some evidence of historic farming activities to the west of the dirt road that traverses the site from north to south.

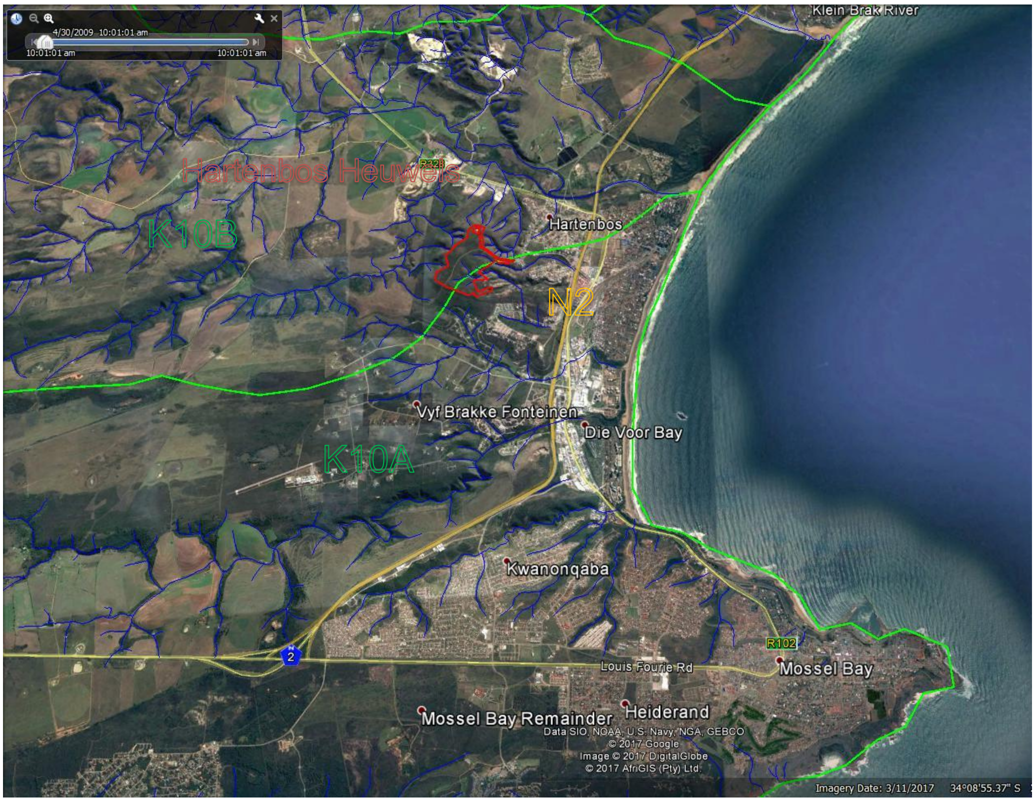


Figure 1.1 **The study area, Hartenbos Heuwels (Erf 3122) is situated to the west of Hartenbos and straddles two quaternary catchments within the Breede-Gouritz Water Management Area (WMA).**

2 STUDY APPROACH

2.1 Project Activities

During the Constraints Analysis of the project in 2017, freshwater ecosystems within the study area were initially identified through an assessment of desktop information of Google Earth Imagery, the NFEPA wetland and river layers, and the CBA layer (2017) for Mosselbay. All wetlands and watercourses were then verified through a site visit in August 2017 using on-site vegetation and soil markers to map the edge with MapPath software, a GPS tracking application for iPhone. The ecological condition and importance of these systems was initially assessed as a basis for recommending ecological buffers[1] as input to the development of the design layout for the project which was assessed during the Scoping Phase.

[1] The '*Buffer zone guidelines for rivers, wetlands and estuaries. Part 1: Technical Manual. WRC Report TT 715/1/17* (Macfarlane and Bredin, 2017) was used to establish a basis for setting buffers. It should be noted however that the prescribed tool is used to set buffers primarily for the protection of ecosystems from water quality impacts.

Considering a time lapse of five years since initial assessment of the site, the study area was revisited in April 2022 to verify the initial delineation of wetlands and watercourses, and to update the assessment of ecological condition. The various tools used for the classification, assessment of condition and ecological and functional importance and sensitivity for these ecosystems is described below.

2.2 Methods for the classification and assessment of freshwater ecosystems

2.2.1 Wetland and river classification

The user manual for "Inlands Systems"[2] developed for the hierarchical classification of wetlands in South Africa (Ollis *et al.* 2013) is the most widely used and accepted approach for wetland classification in South Africa. The Inland component of the Classification System has a six-tiered structure, progressing from Systems at the broadest spatial scale at level 1 through Regional Setting at level 2, Landscape Units at level 3 and then hydrogeomorphic Units (HGM) at the finest spatial scale (level 4). Levels 5 and 6 distinguish systems based on hydrological regime (level 5) and structural, chemical or biological characteristics (level 6). Level 4 (i.e. the HGM unit) is the focal point of the classification system, with the higher levels providing the broad biogeographical context for grouping functional wetland units at the HGM level and the lower levels providing a more detailed description of the characteristics of a particular HGM Unit. The HGM Unit and the hydrological regime of an Inland System together constitute a "Functional Unit" (Ollis *et al.* 2013). Rivers are included in the classification system at level 4B and are divided into broad geomorphological categories, based primarily on their gradients.

2.2.2 Assessment of Ecological Condition of freshwater ecosystems

During the constraints analysis and scoping phases of the project, wetland condition was assessed using the desk-top Present Ecological State (PES) methodology, adapted from DWAF (1999). While this approach provides a broad indication of wetland condition, the latest WET-Health Level 2 assessment methodology was used for the assessment of the Present Ecological State (PES) of the hydrology, geomorphology, water quality and vegetation of wetlands during this phase of the project (MacFarlane *et al.,* 2020). The method is based on the hydrogeomorphic (HGM) approach to wetland classification, providing a PES score for a wetland within each of the four modules – hydrology, geomorphology, water quality and vegetation and a combined overall score. The score provides a quantitative measure of the extent, magnitude and intensity of deviation from the reference or unimpacted condition. The wetland is divided into HGM units, and each unit assessed separately. The score places the wetland in a wetland health Category, A (unmodified system) to F (critically modified system) which are the same as the Habitat Integrity Categories for river ecosystems described below (see Table 2.1).

Habitat Integrity refers to the degree of naturalness of a freshwater ecosystem. It involves an assessment of a number of key criteria, relating to the present condition of a system, compared to the probable natural condition. The Index for Habitat Integrity (IHI) for rivers described in Kleynhans (1999) was used to assess the ecological condition of watercourses within or potentially affected by development within the study area. This assessment results in the assignment of a specific river reach to one of six PES broad Habitat Integrity categories ranging between Category A and Category F (Table 2.1).

---

[2] While the classification system of Ollis *et al.* (2013) encompasses wetlands as defined by the Ramsar Convention, which includes Marine and Estuarine Systems as well as Inland Systems, this project is concerned with the classification of wetlands defined as Inland Systems only, thus including wetlands as defined in section 2.2 above.

The habitat integrity assessment is based on a qualitative assessment of a number of pre-weighted criteria, with each criterion being scored between 1 and 25 and the final Habitat Integrity score being calculated as a percentage. The criteria include: water abstraction; flow modification; bed modification; channel modification; water quality; inundation; exotic macrophytes; exotic fauna; solid waste disposal; indigenous vegetation removal; encroachment of exotic vegetation; bank erosion; channel modification.

The calculated overall habitat integrity scores for each reach are grouped, to allow classification of subregions into Habitat Integrity categories (Table 2.1).

Table 2.1 Descriptions of Habitat Integrity categories (described in Kleynhans 1996 and MacFarlane *et al.* 2020)

CATEGORY	DESCRIPTION	SCORE
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 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.	0

2.2.3 Assessment of Ecological Importance and Sensitivity (EIS) of freshwater ecosystems

DWAF (1999) defines ecological **importance** of freshwater ecosystems as “an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales” and “**sensitivity**” as “the extent to which the biota is able to accommodate change in the major physico-chemical features of the system”.

The importance of seeps was assessed by considering the range of goods and services identified in the WET-Ecoservices V2 tool (Kotze *et al.*, 2020). These services include:

- Flood attenuation
- Streamflow regulation
- Sediment trapping
- Phosphate trapping
- Nitrate removal
- Toxicant removal
- Erosion control

- Carbon storage
- Maintenance of biodiversity
- Water supply for human use
- Natural resources
- Cultivated foods
- Cultural significance
- Tourism and recreation
- Education and research

The outcomes of the WET-Ecoservices assessment were then used to inform an assessment of the overall importance and sensitivity of the wetland using the Wetland Ecological Importance and Sensitivity (EIS) assessment tool of Rountree *et al.* (2013). The tool includes an assessment of three suites of importance criteria, namely:

- Traditional ecological importance and sensitivity (biodiversity support, landscape scale importance, and the sensitivity of the wetland to change),
- Hydrological and functional importance (water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide), and
- Human benefits (subsistence and cultural use of the wetland).

The maximum score for each suite of importance criteria was taken to be the overall EIS category for the wetland, as described in Table 2.2.

Table 2.2 Ecological Importance and Sensitivity Categories for wetlands and rivers (after DWAF 1999 and Rountree *et al.*, 2013).

Ecological Importance and Sensitivity Categories	Range of EIS scores
Very high: Rivers/Wetlands that are considered ecologically important and sensitive on a **national or even international** level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. .	>3 and ≤4
High: Rivers/Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications.	>2 and ≤3
Moderate: Rivers/Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications.	>1 and ≤2
Low/marginal: Rivers/Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications.	>0 and ≤1

For river ecosystems, both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity as described in Appendix A. In terms of this assessment, ecological importance and sensitivity is strongly biased towards the potential importance and sensitivity of the particular stream delineation, as it would expect to be under unimpaired conditions. This means that the present ecological status or condition (PES) is generally not considered in determining the ecological importance and sensitivity *per se.* Each watercourse is allocated to one of four EIS categories ranging from “very high” to “low/marginal (Table 2.2).

3 IDENTIFICATION AND DESCRIPTION OF FRESHWATER ECOSYSTEMS

3.1 Regional context

Hartenbos Garden Estate is situated within the Breede-Gouritz Water Management Area (WMA) and straddles two quaternary catchments, namely K10B and K10A (Figure 3.1). It therefore lies on the watershed between these two catchments which drain to the north and west (K10B) forming ephemeral watercourses beyond the study area that enter the Hartenbos River system, as well as to the south and east (K10A) via a series of ephemeral channels within the study area. These drain into the stormwater system of Bay View within the town of Hartenbos itself, east of the N2.

The site falls within the Southern Coastal Belt Ecoregion which is described by Kleynhans *et al*. (2005) as an area of hills and mountains with moderate to high relief and surrounding plains varying in altitude from sea level to 700 MASL. The natural vegetation of the site is described in Helme (2012) as Mossel Bay Shale Renosterveld which is listed as a threatened vegetation type.

Figure 3.1 indicates that two NFEPA priority wetlands occur within the study area. According to the NFEPA data, both these wetlands are classified as natural wetland flats and considered either in good condition (Class AB) or moderately modified (Class C). Both wetlands form part of a significant wetland cluster (Box 1).

Box 1: NFEPA wetland clusters:

Wetland clusters include wetlands that are embedded in a relatively natural landscape such that fauna can disperse and migrate among several different wetlands. These systems and the processes they support are threatened by fragmentation due to transformation of the landscape surrounding individual wetlands. Therefore one of the goals of NFEPA is to ensure protection of wetland clusters within specific vegetation types through management of these areas in a manner that supports connectively between wetlands within these clusters to promote dispersal and maintain their condition (Nel *et al*. 2011).

The 2017 Western Cape Biodiversity Spatial Plan (WCBSP) identifies the two NFEPA wetlands as Critical Biodiversity Areas (CBAs) (Figure 3.2). In particular, these aquatic habitats are rated as CBA1 areas because of their relatively natural condition. According to the land use guidelines described in the WCBSP handbook (Pool-Stanvliet *et al.* 2017), the desired management objective for CBA1 wetlands is to maintain them “in a natural or near-nature state with no further loss of natural habitat. Degraded areas should be rehabilitated”. The guidelines indicate further that “only low-impact, diversity-sensitive land uses are appropriate” (Pool-Standvliet *et al.* 2017). Despite the identification of several ephemeral streams in and surrounding the study area as CBAs in 2014, none of these were identified as CBAs in the most recent (2017) WCBSP.

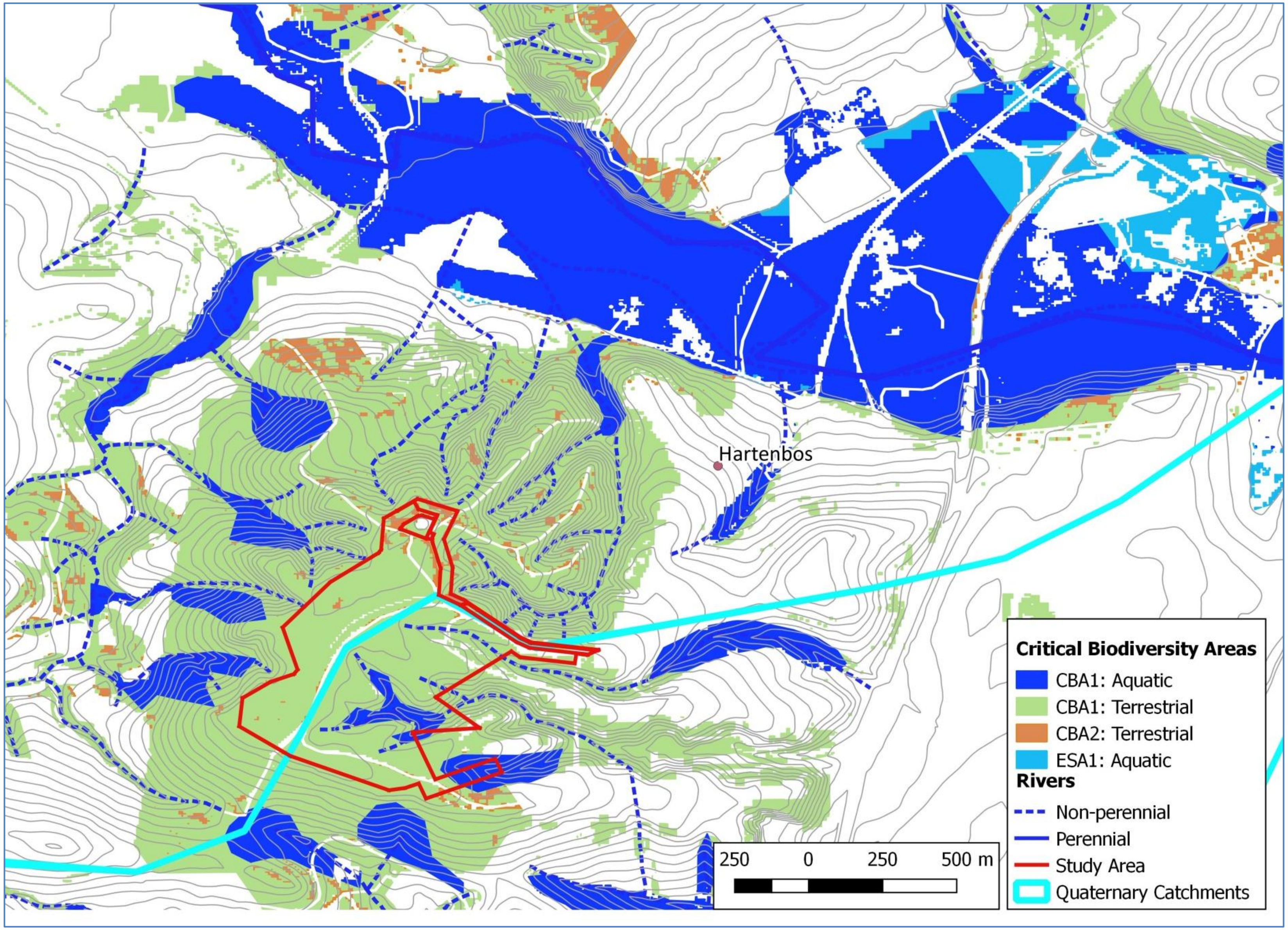


Figure 3.1 NFEPA wetlands for the Hartenbos area showing priority wetlands located within the study area.

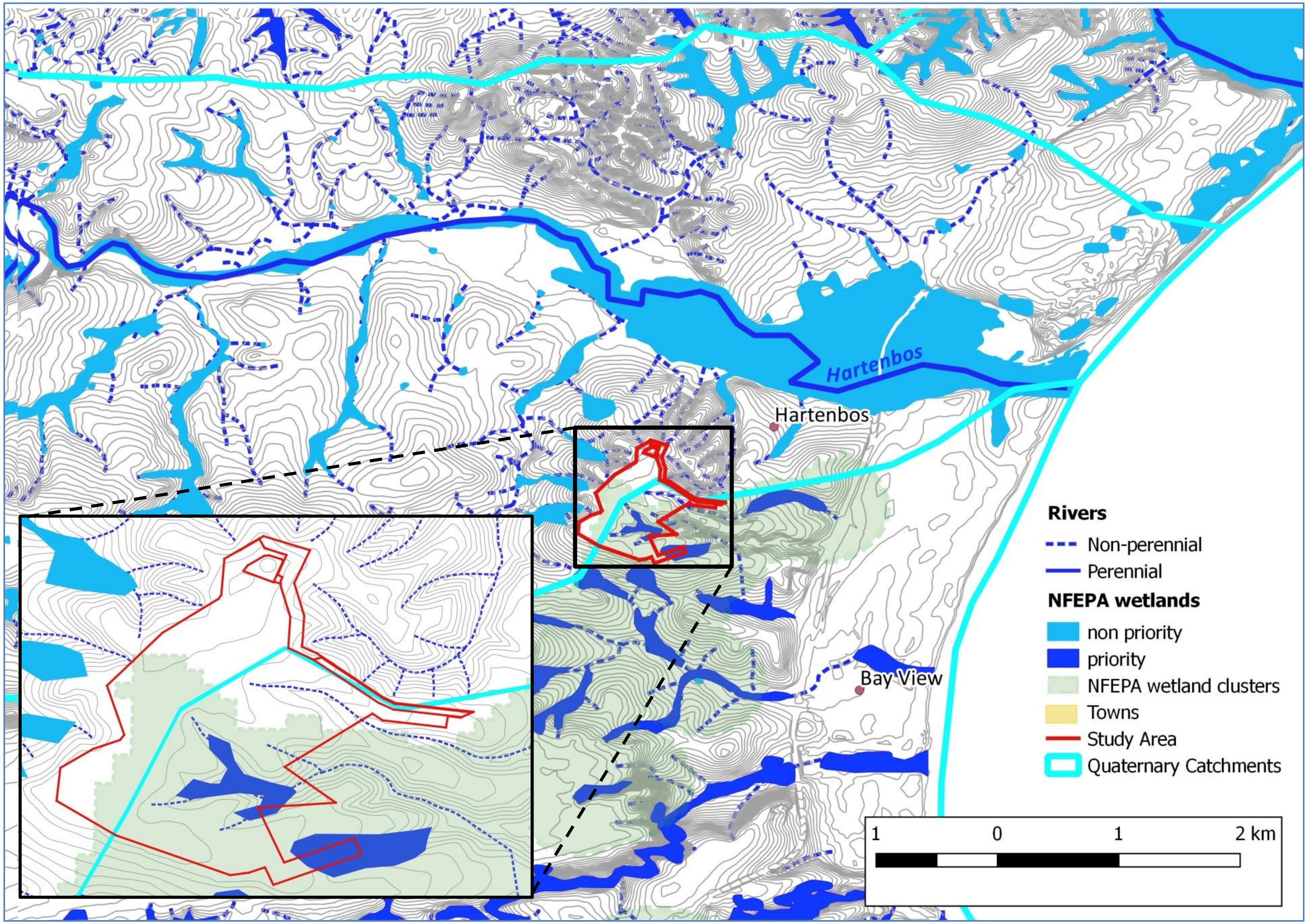


Figure 3.2 Critical Biodiversity Areas for the Hartenbos area showing aquatic CBA1's located within the study area.

3.2 Identification of freshwater ecosystems based on field verification

The field assessment in April 2022 confirmed the presence of six seep wetlands feeding downstream watercourses typical of hillslopes of the region (Figure 3.3). However, the extent of these areas was someone reduced following greater confidence in the interpretation of wetland indicators in 2022, relative to 2017 when drought conditions preceded the initial site visit (Figure 3.3). Considering that Erf 3122 is situated on a hilltop, numerous watercourses immediately beyond the study area boundary were also identified as areas of potential concern for development within the study area (Figure 3.3).

3.2.1 Wetlands

All six seep habitats were identified by their topographic setting (i.e. situated at the head of valleys), together with soil and vegetation indicators. Wetland soils were characteristically those with a grey matrix (Hue 10YR, Value 6, Chroma 1) distinct from soils upslope which were typically those with a red matrix. Although no mottling was evident in the soil profile between the surface and 50 cm, streaking was observed at approximately 20 cm depth in Hillslope Seep A, C, E and F suggesting that the central portions of these systems may be seasonal. Nevertheless, both the soils and vegetation of these habitats suggest that they are predominantly temporary wetlands habitats that are driven by localised runoff and interflows following rainfall events. Similarly, SEF (2014) reported that only temporary hillslope seep wetlands were present within the study area following their site visit in October 2014 when conditions were significantly wetter.

Nidorella ivifolia, although alien, is indicative of wetland habitats and was the key vegetation indicator defining the possibility of seasonally saturated conditions in Seeps A, C, E and F. In all six seeps, the vegetation was notably distinct from the upland areas.

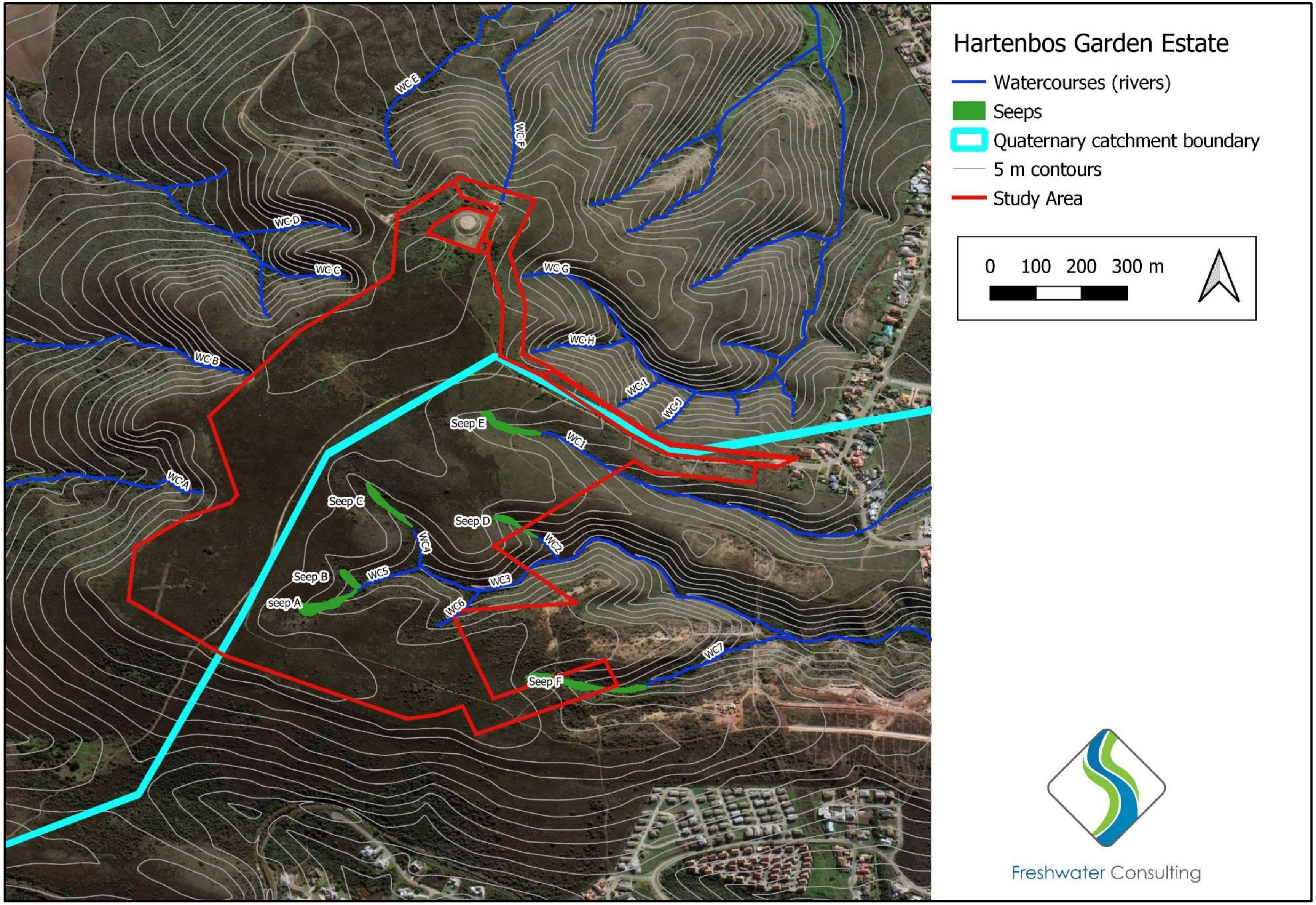


Figure 3.3 Seeps and watercourses identified and delineated within and surrounding the study area during this study.

Seep A: Shrubs such *Osteospermum monolifera* and S*earsia glauc*a are found along the temporary margin of the habitat. *Nidorella ivifolia*, *Selago dolosa*, and *Ficinia sp*., indicative of moist loamy sands, are characteristic of the central portion of the habitat (Figure 3.4). Other plants within the habitat include *Helicrysum pandurifolium*, *Hermannia althaeifolia and Oxalis ciliaris.* Although dominated by graminoids, particularly *Erogrostus curvula*, this species extends beyond the outer boundary of the wetland and may be indicative of historic disturbance. Invasion by *Acacia cyclops* (Rooikraans) has increased since the initial site visit in 2017, although the density of these aliens is still relatively low. The outer edge of this habitat may have been ploughed historically but the soil profile is still largely intact.

Figure 3.4 S*eep A* in April 2022 looking downslope towards the watercourse from its source on the flatter plateau showing the presence of indicators such as *Nidorella ivifolia* near the centre and larger shrubs such as *Osteospermum monilifera* along the outer margin. Grasses are present within the wetland but extend beyond the outer margin and may be indicative of disturbance. Invasion by *Acacia cyclops* (in the background) is increasing near the downslope extent of the seep.

Seep B: This is a small wetland heavily invaded with *Acacia cyclops* (Figure 3.5). Nevertheless, natural vegetation, particularly near its source include largely *Helicrysum cymosum, Helicrysum pandurifolium, Hermannia althaeifolia* and *Searsia glauca.*

Figure 3.5 Seep B (August 2017) is a small seep formed in a valley downstream of seep A that is heavily invaded by *Acacia cyclops.*

Seep C: This wetland is dominated by small scrubs, particularly *Helicrysum cymosum* and *Helicrysum pandurifolium*, together with larger shrubs such as *Osteospermum monolifera* and *Searsia glauca* along the margins (Figure 3.6). Small tufted *Ficinia* sp. characterised the central portion of the habitat and is likely indicative of seasonal saturation near the core. Other species included *Muraltia* sp. and *Erica* sp. with some graminoids such as *Eragrostus curvula*. Although not limited to the seep habitat, *Bobartia robusta,* characteristic of the south facing hillslopes of the region was growing densely at the downstream extent of the habitat where it transitions to a channel at the head of the watercourse. Similar to Seep A, invasion by alien *Acacia cyclops* was limited within this area, although has increased over the 5-year period since the initial site visit.

Figure 3.6 *Seep C* (August 2017) is a shrub dominated seep that feeds a watercourse.

Seep D: This is a narrow, relatively steep wetland dominated by shrubs, particularly *Osteospermum monilifera* (Figure 3.7). Although not limited to this habitat, relatively dense stands of *Bobartia robusta* were evident at the upstream extent of the habitat**.** No invasion by alien *Acacia cyclops* was evident within this habitat**.**

Figure 3.7 ***Seep D*** **(August 2017) looking downstream from its source showing dense stands of *Bobartia robusta* in the foreground with *Osteospermum monolifera* in the background further downstream.**

Seep E: This habitat is similar to Seep A, with patches of *Osteospermum monolifera* and *Searsia glauca* along the temporary margins and *Nidorella ivifolia* near the centre (Figure 3.8). The area is similarly dominated by graminoids such as *Eragrostus curvula* that extends beyond the wetland boundary. The habitat is interspersed with shrubs such as *Oxalis ciliaris, Helicrysum pandurifolium* and *Hermania lavandulifolia,* the latter listed as vulnerable. Unlike seep A, invasion by *Acacia cyclops* was greater and other invasives such as *Hakea sericea* were also present along the margins. Also, the downstream extent of the wetland is impacted somewhat by a dirt road which traverses the site. Besides loss of habitat, the road impedes runoff and thus impacts on the hydrological functioning of the habitat. Access to the area via the road has led to localised dumping which has also impacted on the habitat.

Figure 3.8 *Seep E* in April 2022 looking downslope with *Hermania lavandulifolia* in the foreground with Acacia cyclops in the background near the downslope extent of the habitat.

Seep F: This habitat supports a mixture of shrubs such as *Osteospermum monolifera* and *Searsia glauca* and grasses such as *Thamnochortus fruticosus*. Other species include *Metalasia densa* and *Hyperrhinia Hirta* with dense stands of *Bobartia robusta* at the downstream extent where the seep enters the water course and flows are more concentrated. Alien invasion by *Acacia cyclops has increased considerably since 2017 and thus the system has degraded in recent years.* Similar to Hillslope seep E, the seep is traversed by a dirt road which impacts to some extent on its hydrological functioning. Some dumping close to the road has impacted on the quality of habitat but this is limited.

Figure 3.9 ***Seep F* in August 2017 looking upstream from the dirt road that crosses the habitat**

3.2.2 Watercourses (ephemeral streams)

A number of ephemeral streams were identified and mapped within the study area as well as along the eastern and northern boundary of the Erf 3122 (Figure 3.3).

All six seep habitats identified within the study feed directly into a network of ephemeral streams as indicated in Figure 3.3. The transition from seep to stream in all instances was identified by the change from diffuse runoff to the presence of a channel with fluvial features that carry concentrated flows during rainfall events. Streams within the study area were characterised by a narrow riparian fringe, dominated by shrubs such as *Searsia glauca* and *Osteospermum monolifera*. Those that are largely unimpacted (i.e. WC2 and WC 4) are characterised as narrow (<1 m wide), shallow (<50 cm deep) channels and stable banks due to a dense, intact riparian fringe (Figure 3.10).

Nevertheless, some watercourses (i.e. WC 1, WC 3 and WC 6,) are significantly impacted by erosion which has promoted the invasion by alien *Acacia cyclops* and the loss of natural vegetation typical of the riparian fringe. In particular, watercourse 1 (WC 1) fed by hillslope seep E is characterised as a deep (approximately 2 m) gully with steep unstable banks. *Acacia cyclops* has invaded the riparian fringe with a loss of natural riparian species and there is evidence that the headcut of the channel is moving upstream towards the seep habitat (Figure 3.11). WC 5, while not eroded, has become invaded with *Acacia cyclops* in recent years with a distinct loss in habitat integrity.

A number of watercourses originating on the steep east and north facing slopes of Hartenbos Heuwels, beyond the study area were identified and assessed. These watercourses originate as channels without seeps at their upslope extent, probably because the steep terrain on these slopes does not permit the formation of wetland habitats. With the exception of WC H which is heavily eroded, these watercourses are still largely intact, despite varying levels of invasion by *Acacia cyclops*. In particular, watercourses E and F draining northwards from the northern boundary of the site were heavily invaded with *Acacia cyclops*.

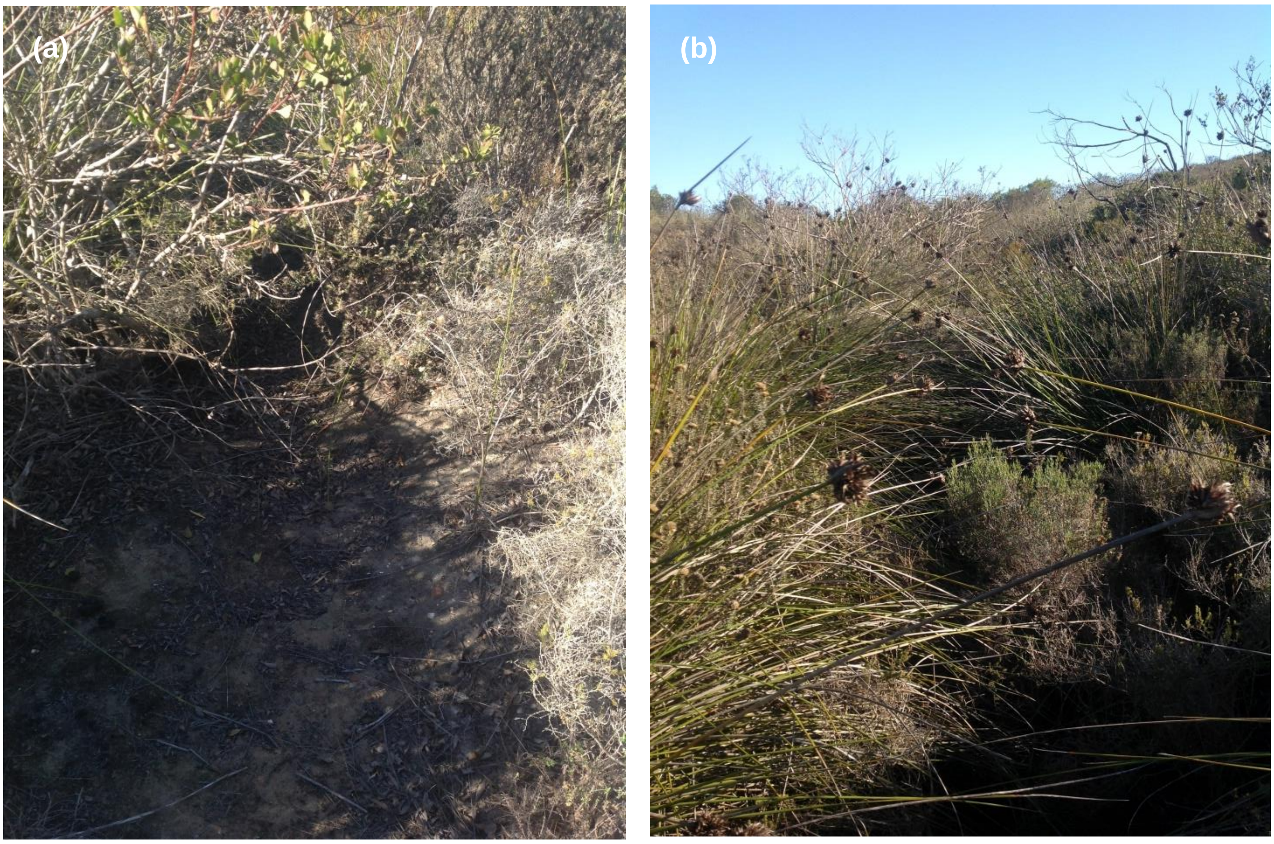


Figure 3.10 Watercourse immediately downstream of Hillslope Seep C (i.e. WC 4) in April 2022 showing a) the shallow active channel of the ephemeral stream with a sandy loam substratum that remains unvegetated due to intermittent, intense runoff and b) the intact riparian fringe of the active channel.

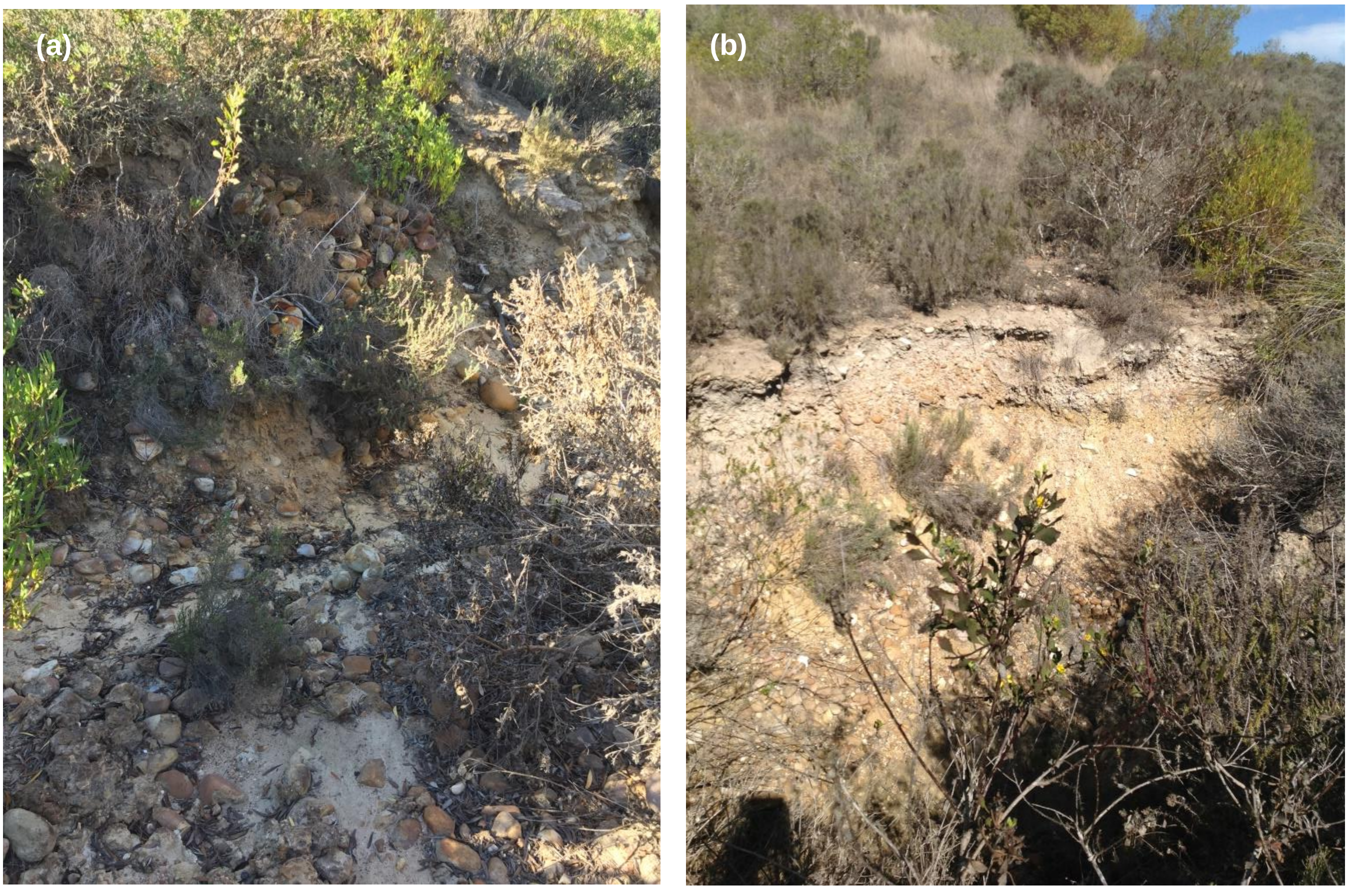


Figure 3.11 Severe gully erosion within a) WC 1 and b) WC 6 (August 2017) has led to a significant change in the hydraulic and geomorphological character of these watercourses. These ephemeral systems are also impacted by alien invasion (mostly *Acacia cyclops*) and the loss of natural riparian fringing vegetation which has affected their habitat integrity.

4 PRESENT ECOLOGICAL STATUS (PES) ASSESSMENT OF WETLANDS AND WATERCOURSES WITHIN THE STUDY AREA

The WET-Health assessment methodology (MacFarlane *et al.,* 2020) was used to assess the ecological condition of the seep wetland habitats within the study area, while the Habitat Integrity (IHI) for rivers (Kleynhans 1999) was used to provide information on the present ecological condition of the watercourses within and surrounding the study area. These methods are described in Section 2.2.

4.1 Seep wetlands within Erf 3122

Based on the Present Ecological Status assessment of the hydrological, geomorphological, water quality and vegetation of wetlands (Table 4.1), Seep D was the only system rated as a ***Category A*** in terms of overall PES, indicating that this wetland does not differ significantly from what would be considered natural. Despite the overall unmodified condition, the vegetation of the wetland, as consequently the hydrological integrity of the system is somewhat affected by the invasion of alien acacias, although invasion is minimal under current conditions and the habitat is largely intact. Wetlands A, C, E and F were rated as ***Category B*** in terms of overall PES suggesting that these systems are largely natural with few modifications, although minor loss of wetland habitat has occurred. These wetlands have been significantly invaded by alien *Acacia cyclops,* hence a Category C in terms of Vegetation (Table 4.1). In the case of Seep B, invasion by *Acacia cyclops* is significant, driving the overall PES ***Category C*** for this system, suggesting that it is moderately modified indicative of a loss and change in natural habitat and biota. In particular, invasion by aliens has resulted in a significant deterioration in the hydrological character of the system (Table 4.1), although loss of functionality remains predominantly unchanged.

Despite the relatively intact condition of these systems under current conditions, there is evidence of deterioration in recent years, particularly as a result of increased invasion by alien acacias. It is therefore likely that that alien invasion followed by gully erosion will intensify over time and thus hydrological and geomorphological processes will likely degrade and ultimately result in habitats that are significantly modified with a considerable loss of habitat without intervention to remove aliens in these habitats.

Table 4.1 Results of the Present Ecological Status (PES) assessment for the seep wetlands within the study area.

Seep	Hydrology		Geomorphology		Water Quality		Vegetation		Overall	
	Category	PES (%)	Category	PES (%)	Category	PES (%)	Category	PES (%)	Category	PES (%)
A	B	85	A	93	A	92	C	77	**B**	87
B	D	56	A	93	A	94	C	63	**C**	74
C	B	80	A	93	A	94	B	81	**B**	86
D	B	90	A	93	A	95	B	88	**A**	91
E	C	75	A	92	A	93	C	79	**B**	84
F	C	79	A	92	B	90	C	78	**B**	84

4.2 Watercourses within and surrounding Erf 3122

The ecological condition of watercourses relevant to this assessment ranged from a *Category A* to a *Category C* as indicated in Table 4.2 and Table 4.3. The only watercourse considered unmodified or near natural (i.e. Overall ***Category A***) was a short reach immediately below Seep D (i.e. WC 2, Table 2). Despite an overall Category A PES, the riparian status was rated as a ***Category B***, largely due to some invasion by alien *Acacia cyclops* and slight changes to the channel associated with loss of indigenous riparian fringe components. Watercourses 4 and 5 draining Seeps C and B respectively are considered largely natural but with some change in natural habitat due to alien invasion and associated hydrological changes and thus have an ***overall Category B*** (Table 4.2). Those watercourses rated as moderately modified with a loss of natural habitat (i.e. ***Overall Category C***) were those where the impact of alien invasion was rated as moderate or large and channel and bed modifications were serious due to significant erosion and gully formation within these channels (Table 4.2).

Table 4.2 Ecological Condition of watercourses within the study area

Watercourse	Instream	Riparian	Overall PES
WC 1	C	D	C
WC 2	A	B	A
WC 3	C	D	C
WC 4	B	C	B

WC 5	B	C	B
WC 6	C	D	C
WC 7	C	C	C

A number of watercourses originating on the steep east and north facing slopes of Hartenbos Heuwels, beyond the study area were identified and assessed. These watercourses originate as channels without seeps at their upslope extent, probably because the steep terrain on these slopes does not permit the formation of wetland habitats. With the exception of WC H, I and J draining northwards away from the study area (Figure 3.3) which were rated as moderately modified (i.e. ***Overall Category C***) due to excessive erosion and thus bed and channel modification, as well as alien invasion, all surrounding watercourses draining the hilltop plateau along the eastern and northern boundaries were considered largely natural with few modifications (i.e. ***Overall Category B***). Despite their overall Category B rating, however, watercourses E and F were heavily invaded with *Acacia cyclops* and thus their riparian score was rated as a Category C (Table 4.3)

Table 4.3 Ecological Condition of watercourses surrounding the study area

Watercourse	Instream	Riparian	Overall PES
WC A	A	B	B
WC B	A	B	B
WC C	B	B	B
WC D	A	B	B
WC E	B	C	B
WC F	B	C	B
WC G	B	C	B
WC H	C	D	C
WC I	B	C	C
WC J	B	C	C

5 ECOLOGICAL IMPORTANCE AND SENSITIVITY OF FRESHWATER ECOSYSTEMS

In terms of their biodiversity value the wetlands and watercourses within and surrounding Erf 3122 support a regionally threatened vegetation type (Mossel Bay Shale Renosterveld) (see Bergwind 2017). Despite some degradation of a number of these systems, largely due to erosion and invasion of aliens, they still provide ecologically functional habitat for the provision of shelter and food and the movement of fauna (see Todd 2017). Considering that Erf 3122 straddles two watersheds and thus the watercourses and seeps represent the source zones of watercourses further downstream, these systems are particularly important for connectivity and genetic dispersal of both fauna and flora between catchments at a landscape level.

Besides their contribution to the maintenance of biodiversity, the seeps within Erf 3122 contribute somewhat to ecosystem services such as flood attenuation, erosion control and nutrient trapping (Figure 5.1). Indeed, international research provides clear evidence to suggest that ephemeral streams and associated wetlands provide the same ecological and hydrological functions as perennial streams by transporting runoff, nutrient and sediments through a catchment (Levick *et al.* 2008). Relative to other temporary wetlands (with marginal evidence of seasonal saturation) within the region, the functional value of these systems is considered significant because they are still largely intact. Indeed, the hillslope seeps and watercourses within Erf 3122 that are largely natural with little invasion of alien vegetation support communities that are denser than the upslope terrestrial habitats and thus stabilize the channel banks and beds that contribute to their functional importance. Overall, these wetlands are considered of ***high Ecological Importance and Sensitivity and Moderate hydrological/functional importance*** (Table 5.1).

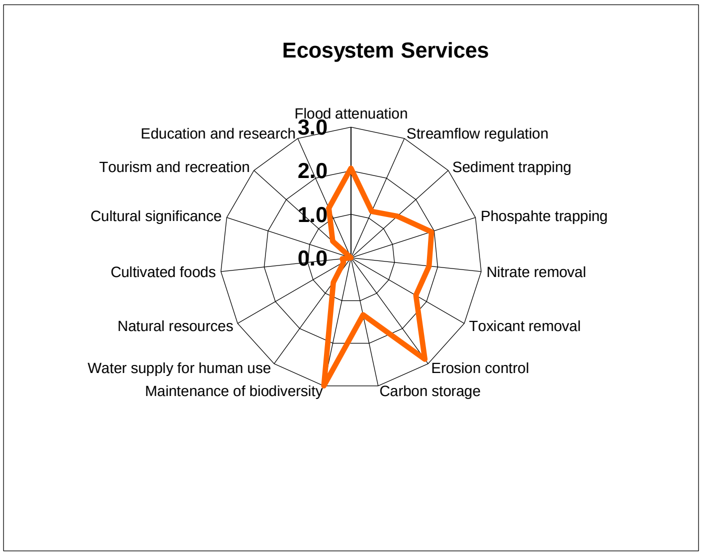


Figure 5.1 Graphic representation of ecosystem services provided by the seep wetlands within Erf 3122, using the WET-Health EcoServices too. Scores range from 0 (not present) to 4 (very important).

Table 5.1 Results of the ecological importance and sensitivity (EIS) assessment for the seep wetlands within Erf 3122. Scores range from 0 (no sensitivity / importance) to 4 (very highly sensitive and important).

Component assessed	Seep	
	Score	Category
Ecological Importance & sensitivity	3	High
Hydrological / Functional Importance	1.79	Moderate
Importance of Direct Human Benefits	0.49	Low/Marginal

Ephemeral watercourses, such as those on Erf 3122 are highly sensitive to anthropogenic disturbance. Even small changes in peak flows, runoff intensity and channelization can exacerbate erosion and bank destabilisation and elicit the knock-on effects of ecological degradation. Collectively therefore, these habitats are rated as having a ***high Ecological Importance and Sensitivity*** (Table 5.2).

Table 5.2 Results of the Ecological Importance and Sensitivity assessment for the watercourses within the study area

	Watercourses within the study area (K10A)	**Watercourses surrounding the study area (tributaries of the Hartenbos River System)(K10B)**
Biotic Determinants		
Rare and endangered biota	1	1
Unique biota	0	0
Intolerant biota[@]	2	2
Species/taxon richness	2	2
Aquatic Habitat Determinants		
Diversity of aquatic habitat types or features	2	2
Refuge value of habitat type	3	3
Sensitivity of habitat to flow changes	4	4
Sensitivity of flow related water quality changes	3	3
Migration route/corridor for instream and riparian biota	2	3
National parks, wilderness areas, Nature Reserves, Natural Heritage sites, Natural areas, PNEs	3	3
RATINGS	**2.1**	**2.2**
EIS CATEGORY	**High**	**High**

[@]The reference to permanently flowing water in A2 is not applicable to evaluation of ephemeral watercourses

6 LEGISLATION AND GUIDELINES GOVERNING THE CONSERVATION AND MANAGEMENT OF RIVERS AND WETLANDS

6.1 National Environmental Management Act (Act 107 as amended by Act 62 of 2008)

The National Environmental Management Act of 2008 (NEMA), outlines measures that….”*prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development*.”

Of particular relevance to this assessment is Chapter 1(4r), which states that sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, *wetlands*, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

Section 24 of NEMA requires that the potential impact on the environment, socio-economic conditions and cultural heritage of activities that require authorisation or permission by law, must be considered, investigated and assessed prior to implementation, and reported to the relevant regulatory authority.

For development outside the urban edge, many development activities within 32m of a watercourse, measured from the edge of the watercourse (taken to be the edge of the active channel), trigger the need for an environmental authorisation. This may be a basic assessment or a full environmental impact assessment, depending on the specifications of the activity.

6.2 Environmental Impact Assessment regulations issued in terms of NEMA (originally promulgated as Regulation 385, 2006, with new legislation adopted in December 2014)

These regulations identify activities deemed to have a potentially detrimental effect on natural ecosystems, including aquatic ecosystems, and outline the requirements and timeframe for approval of development applications. Different sorts of activities are listed as environmental triggers that determine different levels of impact assessment and planning required. The regulations detail the procedure to be followed for a basic or full environmental impact assessment.

6.3 Conservation of Agricultural Resources Act (Act 43 of 1983)

Key aspects include legislation that allows for:

- Section 6: Prescription of control measures relating to the utilisation and protection of vleis, marshes, water sponges and water courses. These measures are described in regulations promulgated in terms of the Act, as follows:

- Regulation 7(1): Subject to the Water Act of 1956 (since amended to the Water Act 36 of 1998), no land user shall utilise the vegetation of a vlei, marsh or water sponge or within the flood area of a water course or within 10 m horizontally outside such flood area in a manner that causes or may cause the deterioration or damage to the natural agricultural resources.

- Regulation 7(3) and (4): Unless written permission is obtained, no land user may drain or cultivate any vlei, marsh or water sponge or cultivate any land within the flood area or 10 m outside this area (unless already under cultivation).

6.4 Biodiversity Act

To provide for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act of **1998;** the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bio-prospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute.

6.5 Cape Nature Conservation Ordinance (Ordinance 19 of 1974; amended in 2000)

This ordinance provides measures to protect the natural flora and fauna, as well as listing nature reserves in the Western Cape that are managed by the Western Cape Nature Conservation Board (WCNCB). This ordinance, with the Western Cape Nature Conservation Board Act of 1998 was amended in 2000 to become the Nature Conservation Laws Amendment Act. Lists of endangered flora and fauna can be found in this act.

6.6 National Water Act (1998)

The main regulatory requirements with regards to aquatic features relates to the National Water Act No. 36 of 1998 (NWA). The NWA regulates 11 water uses that require authorisation, as follows:

a. Taking water from a water resource;
b. Storing water;
c. Impeding or diverting the flow of water in a watercourse;
d. Engaging in a stream flow reduction activity;
e. Engaging in a controlled activity identified and declared as such in terms of the Act;
f. Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
g. Disposing of waste in a manner which may detrimentally impact on a water resource;
h. Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
i. Altering the bed, banks, course or characteristics of a watercourse;
j. Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
k. Using water for recreational purposes.

A water use may be **Generally Authorised** (GA) if it falls within a specific threshold or area, and thus requires registration rather than a water use licence (WUL). In particular, the GA of the 26th August 2016 (Government Notice 509 of 2016) provides the limits and conditions of Section 21 (c) and (i) water uses that may be generally authorised, and defines the regulated zone within which the GA applies.

The proposed development of Hartenbos Garden Estate has the potential to trigger the following water uses:

- Section 21 (c) and (i): the development comes within 500m of a number of wetlands and watercourses, and thus has the potential to alter flow into these water resources, and alter their characteristics of the wetlands through altered hydrology and water quality.

6.7 Western Cape Provincial Spatial Development Framework (March, 2014)

Policies regarding the protection of biodiversity and ecosystem services in the Western Cape are:

- The Western Cape's Critical Biodiversity Area (CBA) mapping, which CapeNature are currently updating and refining, together with the draft priority climate change adaption corridors, comprise the spatial extent of the Western Cape's biodiversity network. This must inform spatial planning and land use management decisions throughout the province.

- Using the latest available CBA mapping as a primary informant, regional, district and municipal SDFs must delineate Spatial Planning Categories (SPCs) that reflect suitable land use activities in the different CBA categories.

- To complement CapeNature's protected area expansion strategy and their Stewardship programme, SDFs should highlight priority areas outside the protected area network that are critical for the achievement of the province's conservation targets.

Policies regarding the management, repair and optimisation of inland water resources are:

- A 'water wise' planning and design approach in the W Cape's built environment (given current water deficits, which will be accentuated by climate change) is to be mainstreamed.

- Rehabilitation of degraded water systems. This is a complex inter-disciplinary intervention requiring built environment upgrading (i.e. infrastructure and the built fabric), improved farming practises, as well as the involvement of diverse stakeholders.

- Introduce and retrofit appropriate levels of water and sanitation systems technologies in informal settlements and formal neighbourhoods with backyard shacks as a priority.

- Adopt an overarching approach to water demand management. Firstly efficiencies must be maximised, storage capacity sustainably optimised and ground water extraction sustainably optimised, with the last resort option of desalination being explored, if necessary.

- Protection and rehabilitation of river systems and high yielding groundwater recharge areas, particularly in areas of intensive land use (i.e. agricultural use, industry, mining and settlement interactions) should be prioritised.

- Development of Regional Plans for Water Management Areas to ensure that clear linkages and interdependencies between the natural resource base (including water resources) and the socio-economic development of the region are understood and addressed.

- Government facilities (inclusive of education, health and public works facilities) to lead in implementing effective and efficient water demand management programmes.

- Continue with programmes (such as Working for Water) which reduce the presence of alien vegetation along river systems.

6.8 Western Cape Biodiversity Spatial Plan (2017)

The Western Cape Biodiversity Spatial Plan (WCBSP) is the product of a systematic biodiversity planning assessment that delineates Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) which require safeguarding to ensure the continued existence and functioning of species and ecosystems, including the delivery of ecosystem services, across terrestrial and freshwater realms. These spatial priorities are used to inform sustainable development in the Western Cape Province. This product replaces all previous systematic biodiversity planning products and sector plans with updated layers and features.

6.9 Constraints to development

As described above, there are seven ephemeral streams and six seep wetlands identified within the study area and ten ephemeral streams adjacent to the study that may potentially be impacted by the Hartenbos Garden Estate Development. During the Constraints Analysis Phase of the project, two key considerations were taken into account in determining development constraints used to inform the development layout plan proposed in the Scoping Phase and refined for consideration in this, the Impact Assessment Phase of the development. Firstly, the regulated area around inland aquatic ecosystems (watercourses and wetlands) within which environmental or water use authorisations are triggered, and secondly, the protection of the inland aquatic ecosystems themselves through the establishment of ecological buffers or development setbacks.

6.9.1 Regulated area

There are two regulated areas to consider:

- A 32m-wide buffer area (measured from the edge of the banks of a watercourse or the outer boundary of a wetland) within which an environmental authorisation (according to NEMA) is required;

- A regulated area that extends 500m from the outer boundary of a **wetland or pan**, and up to the 1:100 year floodline or outer boundary of the riparian area, or if not determined, 100m from the edge of the active channel of a **watercourse**, within which a Section 21 (c) or (i) water use (according to the National Water Act) may apply.

6.9.2 Development setbacks (ecological buffers)

In determining a development footprint that will have the least impact on an inland aquatic ecosystem, it is essential to establish the recommended development setback, or ecological buffer for each ecosystem. It is important to note that in order to protect the water resource, the development setback or buffer should be used instead of the blanket 32m, 100m or 500m setback requirements of the NEMA/National Water Act. The buffers for the wetlands were determined using the site-based protocol for river and wetland buffer determination devised by MacFarlane and Bredin (2017). The assessment is based on the PES and EIS of the wetlands (Sections 4 and 0), and the assumed quality of the buffer during both phases of the project. It was assumed that the current vegetation (i.e. dominated by relatively intact natural shrubland vegetation with patches of alien invasive trees) would be representative of the buffers, even though this habitat may improve during the operational phase, should recommendations to remove and manage alien invasives be adhered to.

7 RECOMMENDATIONS FOR DEVELOPMENT PROPOSED DURING THE CONSTRAINTS ANALYSIS AND SCOPING PHASE

Within the context of the legal framework described in Section 5 and based on an assessment of freshwater ecosystems initially identified and described during the Constraints Analysis Phase and formalized during the Scoping Phase of the project, it was recommended that:

- All wetlands and watercourses be retained and are not fragmented through development such that dispersal and migration of fauna is compromised.

- Only low-impact, diversity sensitive land-use alternatives are considered for development of Erf 3122. It was recognised that, besides the seep habitats, the watercourses that they feed within the site and those that drain north and eastwards as source zones for river systems downstream also provide ecologically and hydrologically important habitat that should be protected for the maintenance of freshwater ecological integrity of the region.

- A minimum buffer of 50 m[3] surrounding mapped freshwater features be considered in the initial development layout as to minimise disturbance of fauna and protect the characteristics and hydrological and functioning of these systems (Figure 7.1).

- Buffers be used for recreation and the management of stormwater associated with residential developments.

- That stormwater on site is managed through the construction of swales and attenuation facilities. This is in keeping with the principles of Water Sensitive Urban Design (WSUDS), which promotes the management of stormwater quality and quantity to protect the receiving water course. While implementation of these measures would minimise risks to natural freshwater ecosystems within the area, swales through the study area may promote connectivity and reduce fragmentation of these systems thus minimising associated potential impacts.

Through an iterative process, these recommendations were considered in the compilation of the proposed development layout for Erf 3122 for further consideration in the Scoping Phase of the project.

Prior to finalization of the Scoping Phase, and through collaboration with the team engineer, changes were made to the design and operation of services proposed for the development. In particular, specific stormwater outlets were either removed or realigned in the Stormwater Management Plan compiled by LJR Civil (2021) to reduce potential stormwater runoff impacts to freshwater ecosystems. The updated Stormwater Layout Plan is included as Appendix C. Also, recommendations for the design and operation of the sewer network were considered to reduce the probability and risk of potential effluent contamination of freshwater ecosystems within the study area and is given as Appendix D.

---

[3] Based on an evaluation of the topographical setting, soil and landscape features surrounding these habitats together with specific habitat features, minimum buffers of 30 m were generated using the Buffer Determination Tool (MacFarlane and Bredin 2017) as a guideline for the protection of these systems. However the tool is primarily used for the protection of ecosystems from water quality impacts. Considering aspects such as hydrological functioning and disturbance to aquatic fauna, a minimum buffer of 50 m surrounding mapped freshwater features was recommended and used as input to the design of the development layout.

Together with consideration of mitigation measures, the extent to which these measures have effectively been considered in the design and operation of the development Alternatives described in Section 8, was used to inform the assessment of impacts in this report.

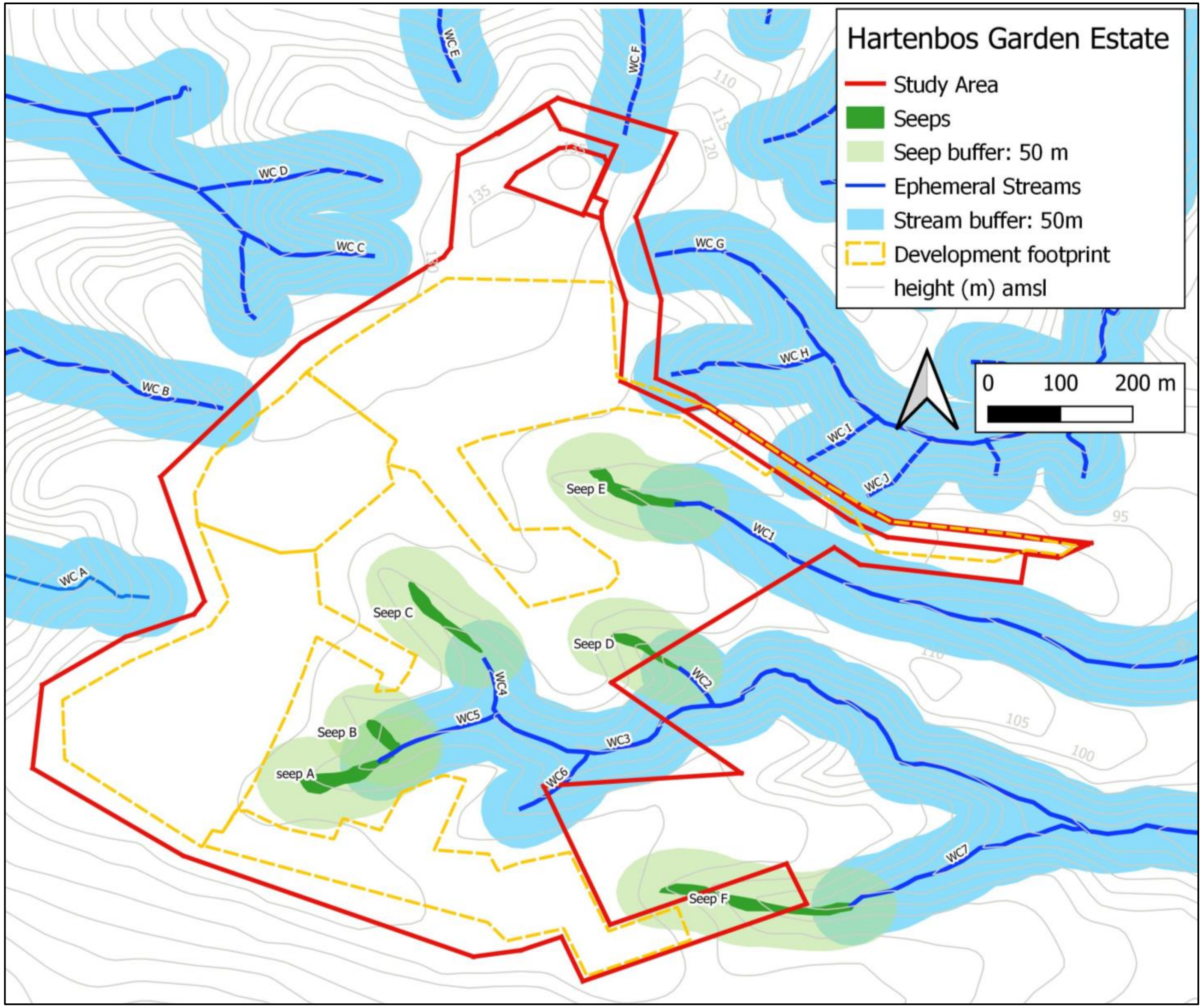


Figure 7.1 **Seeps and watercourses identified within and surrounding the study area showing the recommended buffer of 50m around these habitats, relative to the outer edge of the development footprint within the study area boundary (i.e. Erf 3122).**

8 DESCRIPTION OF THE PROPOSED RESIDENTIAL DEVELOPMENT ALTERNATIVES

During the initial stages of the EIA phase of the project, a single development alternative (i.e. Alternative 2) was assessed relative to the No-go development alternative (i.e. Alternative 1). However, following on from the Public Participation Process (PPP) whereby the proposed development alternative (Alternative 2) was assessed relative to the No-go development alternative (Alternative 1), a number of concerns relating mostly to the visual impacts were raised by DEA&DP. Consequently, a third alternative, the preferred alternative (Alternative 3) was therefore compiled in late 2022 to address these concerns. Also, a number of minor changes to improve ecological connectivity across the landscape were incorporated into Alternative 3 in response to comments made by Cape Nature during the Scoping Phase of the project.

8.1 No-development alternative (Alternative 1)

This will entail continuation of the status quo. Current levels of alien infestation are likely to increase and the extent of erosion within ephemeral watercourses will probably worsen. Although there are certain legal obligations regarding the clearing of aliens, there will be no incentive for any landowner to rehabilitate the land or the watercourses identified as conservation worthy.

8.2 Initial Development Alternative (Alternative 2)

Of a total area of 60.52 ha, Alternative 2 has a total development footprint of 24.2 ha. According to this alternative, the development consists of residential erven, a care centre, sports facilities with a club house and associated infrastructure. In terms of residential erven, 117 are relatively large (350-600 m^2), 122 are moderately sized (≤ 350 m^2), while 40 "garden houses" are small (200 m^2). There are 218 sectional title stands, including 54 one-to-three-bedroom terrace apartments, 144 village apartments (bachelor, 1 or 2 bedroom), and 20 assisted living stands. The care centre includes 34 sectional title stands for comprehensive care (Figure 8.1).

The development is situated outside all freshwater ecosystems and separated by a variable buffer of between 30 - 50 m. The ecosystems and surrounding buffer area fall within the area indicated as the "*Nature conservation area with tearoom and utility*" in the development layout plan (Figure 8.1). The watercourses beyond the development are largely separated from the built environment by an area designated as "*Private Open Space with tearooms, telecom station and maintenance shed*" (Figure 8.1). The entire development will be enclosed in a fence for security purposes.

The Stormwater Management Plan proposes to implement SUDS (Sustainable Urban Drainage System) principles to promote attenuation of stormwater runoff and maximise infiltration (LJR Civil 2021). In particular, the Stormwater Management Plan proposes the use of unlined vegetated buffer strips, unlined grass channels with rock/subsoil drains and energy dissipators to promote infiltration, enhance water quality amelioration and prevent erosion. Stormwater reticulation infrastructure includes a piped reticulation system designed for the 1 in 5 year storm events that will link with the retention infrastructure. Also, rain water harvesting is recommended such that stormwater events will be somewhat attenuated.

The Services Report prepared by LJR Civil indicates that, while situated at low points in the study area, sewer pump stations will make allowance for emergency capacity with standby pumps (LJR Civil 2021). With the exception of the pump station in the south eastern corner of the development layout plan which is 41 m from Seep F (Figure 7.1 and Figure 8.1), all other pump stations are well beyond the 50 m buffer area surrounding water resources. Also, the sewer reticulation system will be designed in such a way as to prevent blockages and possible overtopping of manholes. These measures will reduce the probability of sewage spills and thus minimize the risk of pollution events reaching any water courses.

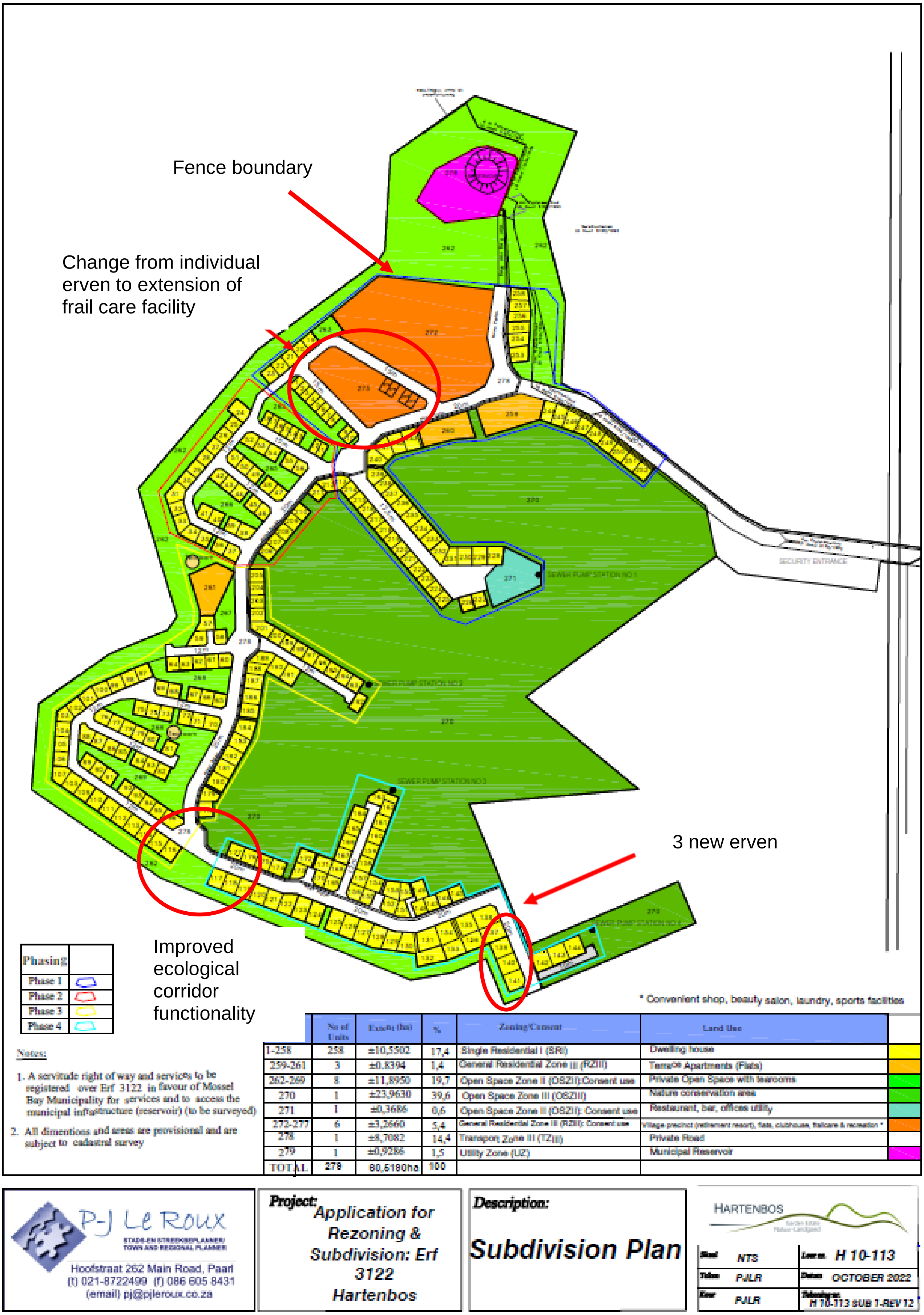
Ptn Nos	No of Units	Extent (ha)	%	Zoning	Land Use
[illegible]-279	280	±10,9908	18,0	Single Residential I (SRI)	Dwelling house
280-282	3	±0.8394	1,4	General Residential Zone III (RZIII)	Terrace Apartments (Flats)
283-290	8	±12,0989	19,9	Open Space Zone II (OSZII)	Private Open Space with tearooms, teaoom station and maintenance shed
291	1	±23,9230	39,6	Open Space Zone III (OSZIII)	Nature conservation area with tearoom and utility
292	1	±0,3686	0,6	Open Space Zone II (OSZII)	Sport Facilities, clubhouse, restaurant, bar, offices utility
294	1	±2,4333	4,0	General Residential Zone III (RZIII)	Village precinct, flats, clubhouse, frailcare & recreation *
295	1	±8,7082	14,4	Transport Zone III (TZIII)	Private Road
296	1	±0,9286	1,5	Utility Zone (UZ)	Municipal Reservoir
TOTAL	298	60,6180ha	100		

Figure 8.1 Alternative 2 Development Layout Plan for Erf 3122.

8.3 Preferred Development Alternative (Alternative 3)

Alternative 3 is very similar to Alternative 2 with the following changes:

- The perimeter fence in Alternative 2 extends around the municipal reservoir following the boundary of the study area (purple area in Figure 8.1), while the perimeter fence in Alternative 3 follows the boundary of the frail care facility (orange are in Figure 8.2). The majority of the butterfly reserve therefore falls beyond the development and ecological connectivity across the watershed between the municipal reservoir and the boundary of the development is improved.
- The frail care facility has been reduced from three storeys to two storeys and thus the extent of the frail care facility has been extended as indicated in Figure 8.2.
- The ecological corridor between the development and natural habitat to the south-west of the development has been increased to improve ecological connectivity (Figure 8.2).
- The erven removed to increase the ecological corridor have been moved to the south-eastern extent of the development (Figure 8.2).
- Furthermore, the movement of animals between the development and the areas north of the site will be improved through ensuring that the security gates at the entrance to the development remain open during the day time.



	No of Units	Extent (ha)	%	Zoning/Consent	Land Use
1-258	258	±10,5502	17,4	Single Residential I (SRI)	Dwelling house
259-261	3	±0.8394	1,4	General Residential Zone III (RZIII)	Terrace Apartments (Flats)
262-269	8	±11,8950	19,7	Open Space Zone II (OSZII):Consent use	Private Open Space with tearooms
270	1	±23,9630	39,6	Open Space Zone III (OSZIII)	Nature conservation area
271	1	±0,3686	0,6	Open Space Zone II (OSZII): Consent use	Restaurant, bar, offices utility
272-277	6	±3,2660	5,4	General Residential Zone III (RZIII): Consent use	Village precinct (retirement resort), flats, clubhouse, frailcare & recreation *
278	1	±8,7082	14,4	Transport Zone III (TZIII)	Private Road
279	1	±0,9286	1,5	Utility Zone (UZ)	Municipal Reservoir
TOTAL	278	60,5180ha	100		

Figure 8.3 Alternative 3: The Preferred Development Layout Plan for Erf 3122.

9 PROTOCOL FOR THE ASSESSMENT OF IMPACTS TO FRESHWATER ECOSYSTEMS

The evaluation of impacts is based on an evaluation of the nature of each impact and the significance assigned to each impact is based on an assessment of the extent, intensity, duration and probability of occurrence as described below:

The evaluation of impacts in this report is based on an evaluation of the nature of each impact and the significance assigned to each impact is based on an assessment of the extent, intensity, duration and probability of occurrence as described below:

Nature of the impact:

- Description of the **type of effect** the activity would have on the affected environment.

Extent:
Reflects the importance of the environment on:

- **Site specific** scale: impact (and implications) limited to the project site.
- **Local** scale: Impact extends only as far as the activity, limited to the site and its immediate surroundings, and local assets/ resources.
- **Regional** scale: Impact extends to a regional scale, and affects provincial resources, e.g. District or Province; Western Cape.
- **National** scale: Impact extends to a national scale, and affects national resources; South Africa.
- **International scale:** Impact extends across national borders, and affects global resources

Duration:

- **Short term** (0-5 years);
- **Medium term** (6-15 years);
- **Long term** (>15 years with the impact ceasing after full implementation of all development components with mitigations);
- **Permanent** (mitigation, either human or natural, will not occur in such a way or in such a time span that the impact can be considered transient).

Intensity:

- **Negligible** (the impact is so small that effects on the natural functioning of the environment are not detectable at all);
- **Low** (affects the environment such that natural functions or processes are not affected – or not degraded significantly more than their present state);
- **Medium** (affected environment is altered but natural functions or processes continue, albeit in a modified/ increasingly modified way);
- **High** (natural functions or processes are altered to the extent that they will temporarily or permanently cease).

Probability of occurrence:

- **Improbable** (low likelihood of the impact occurring);
- **Probable** (distinct possibility of the impact occurring);
- **Highly probable** (the impact will most likely occur);
- **Definite** (the impact will occur regardless of any preventative measures).

Significance of impact:
The significance of each impact identified was guided by the protocols outlined in PHS Consulting (2018) as follows:

Significance is the product of **probability** and **severity**.

Probability describes the likelihood of the impact actually occurring, and is rated as follows:

Probability	
Improbable	Rating 1
Probable	Rating 2
Highly Probable	Rating 3
Definite	Rating 4

The **severity factor** is calculated from the factors given to "**intensity**" and "**duration**".
Intensity and duration factors are awarded to each impact, as described below.

The **intensity factor** is awarded to each impact according to the following method:

Intensity Factor	
Negligible	Factor 0
Low	Factor 1
Medium	Factor 2
High	Factor 3

Duration describes the length of time for which the impact will endure and is rated as follows

Duration Factor	
Short term	Factor 1
Medium term	Factor 2
Long term	Factor 3
Permanent	Factor 4

The **severity factor** is therefore calculated as follows:

THE SEVERITY FACTOR = INTENSITY FACTOR X DURATION FACTOR

The product of severity and probability therefore provides the **significance rating** as follows:

Significance	
Negligible	Significance rating = <4
Low	Significance rating = 4-6
Medium	Significance rating = 7-15
High	Significance rating: = 16-29
Very high	Significance ration >30

10 ASSESSMENT OF POTENTIAL IMPACTS AND PROPOSED MITIGATION

The evaluation of impacts is based on an evaluation of the extent, intensity, duration and probability of identified impacts to freshwater ecosystems in relation to their current condition, and ecological importance and sensitivity as described in Sections 4 and 5. Evaluation of these factors is then used to define the significance of each impact through comparison with the "no-development" scenario described in Section 8.1.

The potential impact to freshwater ecosystems associated with the proposed development was assessed separately for the design phase, construction-phase impacts and then operational phase impacts. The design phase impacts were based on the evaluation of the final layout plan presented in Section 8.1, while the assessment of operational phase impacts was based largely on the description of storm water management proposed in the Civil Engineering Service Report compiled by LIR Civil (2021) with relevant components summarised in Section 8. All identified impacts were considered prior to mitigation and then separately with consideration of mitigation measures.

10.1 Design Phase

10.1.1 Description and evaluation of potential impacts

Based on the layout plan for both Alternatives 2 and 3 (Figure 8.1 and 8.3), there are no structures that encroach into wetland habitat or bypasses any watercourses. Evidently, the development footprint associated with both Alternatives 2 and 3 for the Hartenbos Garden Estate will not result in the direct loss of any wetland or watercourse identified within the study area. Furthermore, the recommended buffer of 50 m around seeps and watercourses is largely achieved, particularly around systems with steep topography that are most vulnerable to water quality and quantity impacts. An exception is the extension of a single erf (Erf 299) to within 41 m of Seep F (Figure 7.1) and the location of the sewer pump station number 4 within 30 m of Seep F (Figure 7.1 and Figure 8.1). Furthermore, the entrance road extends to within 20 of the source of watercourses H, I and J draining northwards, beyond the boundary of Erf 3122 (Figure 7.1).

Nevertheless, a perimeter fence for both Alternatives 2 and 3 will be constructed around the development and will need to cross various seeps and watercourses, specifically along the south-eastern boundary (i.e. Watercourses 1, 3 and 6 as well as seeps D and F) (Figure 7.1). Fence crossings could obstruct flow and result in erosion and/or change in the flow path of a watercourse. Furthermore, fence crossings may restrict the movement of biota that use watercourses as corridors, thus affecting linear connectivity in the landscape. Without mitigation, the impact would endure in the long term with a moderate intensity with a distinct probability of occurrence. Thus, it is rated as a negative impact of ***a medium significance prior to consideration of mitigation measures*** (Table 10.1).

Considering the small size and longitudinal nature of these wetlands and watercourses, however, it is likely that fence poles can avoid these habitats entirely such that the risk of flow obstruction and potential erosion is negligible. Also, fence design can make provision for the movement of biota by ensuring that animals can move freely. Large mesh size crossing these resources will also ensure that flows are not impeded. With careful consideration of fence pole positions and fence design, it is likely that ***residual impacts will be negligible***.

Further to the issue of connectivity, the layout does not provide continuous open space corridors between these habitats for the movement and dispersal of biota across the water shed within the study area, particularly due to the presence of access roads through the area as indicated in both Alternatives 2 and 3. Nevertheless, it is possible that limited movement of biota may occur across residential erven. Increased connectivity between wetlands within the study area and those to the south of the study area has been somewhat addressed in Alternative 3 through the provision of a broader corridor between these areas (Figure 8.3). Nevertheless, this area will still be traversed by the access road through this area (Figures 8.2 and 8.3). Considering the national importance of linking wetland clusters rated as CBA 1 habitats, the loss of connectivity may extend to the region with a distinct possibility of occurrence. The impact will endure in the long term but is considered of moderate intensity because some movement may still occur between systems within the conservation area and possibly through the gardens of residential erven, swales and urban open space. Thus, the impact (relevant to both Alternatives 2 and 3) is rated as ***medium significance prior to the consideration of mitigation measures*** (Table 10.1)**.** The loss of connectivity could be somewhat mitigated through:

- the creation of underpasses across the road network at strategic locations to permit the movement of biota.

- Adequate provision for the movement of biota across fencing erected either around the development or within the development.

- Appropriately vegetated and maintained open space with indigenous vegetation to promote the quality of habitat that can function as corridors.

Should these measures be effectively implemented and maintained in the long term, then the intensity of the impact would be reduced to low in the case of Alternative 2, resulting in an overall negative impact with a ***low significance with mitigation*** (Table 10.1). Due to the wide corridor provided for in Alternative 3 between wetlands within the study area and those to the south of the site, the effective implementation of mitigation measures would reduce the intensity of the impact to very low such that the ***significance with mitigation is considered very low*** ((Table 10.1). However, it is recommended that the finer detail of fence design, vegetation of the open spaces and bridge bypass structures be approved collaboratively between a botanist, faunal specialist and freshwater ecologist during the detailed design of these structures to ensure that these measures are adequately addressed, prior to construction. Furthermore, it is recommended that the design and maintenance of these structures be included in the Operational EMPr to ensure that their efficacy in the long term.

10.2 Construction phase

Construction phase impacts for the development are relevant to both Alternatives 2 and 3.

10.2.1 Description and evaluation of potential impacts

If unmitigated, the likelihood of construction related impacts to watercourses and wetlands, within close proximity to proposed new infrastructure is medium to high, particularly in the case of Seep F and watercourses H, I and J immediately north of the study area which drain these steep north facing slopes with their source in close proximity to the proposed new entrance roads

Associated construction related activities and the associated impacts could include:

- Dumping of waste material in wetlands or watercourses. Dumping of sand, soil bricks, gravel, cement etc within freshwater ecosystems will result in the loss and/or degradation of habitat. Changes in soil structure associated with dumping can compromise the ability to effectively rehabilitate these systems and thus the impact could endure in the long term if unmitigated.
- Polluted runoff from stockpiles or work camps situated in close proximity to freshwater ecosystems. This includes runoff associated with vehicle washing, soil erosion from stockpiles and chemicals leached from stockpiles. Also, faecal contamination of freshwater ecosystems may occur through the use of open areas as toilets by construction staff. Considering the ephemeral nature of the streams and wetlands within the study area, it is likely that pollutants will accumulate and could persist in the medium term if not contained and removed from the site. The moderately steep topography of the site increases the likelihood of contamination if clear measures are not implemented to ensure containment and effective removal. Considering that these systems are largely intact, the impact would be considered of high intensity if not mitigated.
- Uncontrolled access and movement of personnel, vehicles and machinery through wetlands and watercourses that are largely intact. This would lead to damage of the soils and vegetation and may result in increased erosion of these systems. This could result in the loss of habitat that could endure in the medium term if not mitigated.
- Sedimentation due to landscaping and earth movement to level the areas for construction of infrastructure such as road and pipelines. Sediments may be particularly mobile during the wet months and the steep slopes surrounding wetlands and watercourses make them particularly vulnerable to sedimentation. This could lead to the loss of habitat that is largely unimpacted and would be considered an impact of high intensity that would endure in the medium term if not contained or removed.
- Disturbance of freshwater fauna and flora through the presence of construction staff and machinery will lead to noise and light pollution in an area that is currently unaffected by such impacts and thus the impact would be of a high intensity.
- Introduction of sand for construction purposes could contain alien seed with a distinct possibility of increased spread of aliens into watercourses and seep habitats. Although some alien invasion is already evident, the intensity of the impact could still be of medium intensity and would endure in the long term if not mitigated.

Given that all these habitats have a high ecological importance and sensitivity, and most are largely intact with few modifications, these impacts could be of medium to high intensity, depending on the nature of the activity (Table 10.2). Without mitigation, there is a high probability of these impacts occurring and these impacts may endure in the medium or long term, even if the activities are remedied immediately. This would result in ***negative impacts of medium to high significance without mitigation*** (Table 10.2).

10.2.2 Recommended construction phase mitigation measures

The loss of habitat through dumping of waste, inappropriate placement of stockpiles and trampling by construction personnel and machinery can be minimised by ensuring that the open space areas that encompass seeps and watercourses within the area are adequately demarcated and fenced off from the development edge prior to the start of construction. The fencing should be removed when construction in the vicinity of the open space areas has been completed.

The risk of contamination of seeps and watercourses can be minimised by:

- Ensuring that construction within the 50 m buffer area of watercourses and wetlands, does not take place during wet periods. In the Hartenbos region, historical rainfall records show that rainfall peaks in the spring (October/November) and again in autumn (April) with the lowest rainfall between December and February. While limiting construction within any watercourse or wetland buffer between December and January will reduce the risk of runoff into watercourses and wetlands from newly cleared areas and stockpiles, rainfall does occur beyond this period. Therefore, potential rainfall needs to be continuously

monitored and additional measures implemented to either prevent or remediate any damage if necessary.
- Ensuring that all stockpiled materials are stored at least 50 m away from wetlands and watercourses.
- Ensuring that stockpile areas do not exceed 1.5 m in height.
- Ensuring that all stockpiles are covered and thus protected from wind to prevent spread of material.
- Ensuring that stockpile areas are adequately bunded such that there is no runoff from these areas into freshwater ecosystems, particularly where the terrain is steep.
- Ensuring that washing of vehicles and machinery take place well away from wetlands and watercourses (at least 50 m). All machinery should be regularly checked for leaks.
- The provision of adequate ablution facilities for construction workers to avoid contamination of wetland habitats through human waste.
- Ensuring that any disturbance created through construction related activities is identified by the ECO and effectively remediated through rehabilitation of the habitat.

A Construction Phase Environmental Management Programme (CEMP) must be compiled and its implementation enforced during the construction phase through regular inspection by an ECO with experience of freshwater ecosystems. The CEMP must include measures that adequately address the above construction-related issues, including specifications for:

- Adequate construction site setbacks from conservation areas (at least 50 m) such that runoff does not enter watercourses or seeps from these areas;
- Adequate bunding and other controls over refuelling areas;
- Litter controls;
- Construction phase stormwater management to prevent contaminated runoff entering the wetlands and watercourses;
- Remediation and/or rehabilitation of disturbed habitats, if necessary.

While implementation of all the above mitigation measures should effectively reduce the intensity of these impacts to low, adherence to these measures is often difficult to enforce and thus there is still some probability of occurrence. Nevertheless, based on the protocols given in Section 9, a low impact intensity would result in ***negligible construction phase residual impacts after consideration of mitigation*** (Table 10.2).

.

Table 10.1 Impacts associated with DESIGN PHASE for development of Hartenbos Garden Estate on Erf 3122 (Alternatives 2 and 3). All impacts are negative unless indicated otherwise.

Description of impact		Extent	Duration	Intensity	Probability	Significance	Confidence
Activity: *Placement of Perimeter fence crossing seeps and watercourses (Alternatives 2 and 3)*							
Obstruction of flow with potential erosion and loss of longitudinal connectivity	Without mitigation	Regional	Long term	Moderate	Probable	Medium	M
	With mitigation	Regional	Long term	Negligible	Probable	Negligible	L
Activity: *Development of residential erven and access road network*							
Loss of connectivity for the movement of biota across the watershed between wetlands.	Without mitigation *(Alternatives 2 & 3)*	Regional	Long term	Moderate	Probable	Medium	M
	With mitigation *(Alternative 2)*	Regional	Long term	Low	Probable	Low	L
	With mitigation *(Alternative 3)*	Regional	Long term	Very low	Probable	Very low	L

Table 10.2 Impacts associated with CONSTRUCTION PHASE activities for development of Hartenbos Garden Estate on Erf 3122 (Alternatives 2 & 3). All impacts are negative unless indicated otherwise.

Description of impact		Extent	Duration	Intensity	Probability	Significance	Confidence
Activity: *Dumping of waste material; stockpiling, uncontrolled movement of construction staff and vehicles within or in close proximity to wetland habitat or watercourses and introduction of sand with alien seed*							
Physical destruction or deterioration of freshwater ecosystems	Without mitigation	Local	Long term	High	Highly Probable	High	M
	With mitigation	Local	Short term	Low	Probable	Negligible	M
Contamination of freshwater ecosystems	Without mitigation	Local	Medium term	High	Highly Probable	High	M
	With mitigation	Local	Short term	Low	Probable	Negligible	M
Increased disturbance of aquatic and semiaquatic fauna	Without mitigation	Local	Short term	High	Highly Probable	Medium	M
	With mitigation	Local	Short term	Low	Probable	Negligible	M
Sedimentation and loss of habitat quality	Without mitigation	Local	Medium term	High	Highly Probable	High	M
	With mitigation	Local	Short term	Medium	Probable	Negligible	M
Introduction of alien seed in building sand and increased alien invasion	Without mitigation	Local	Long term	Medium	Probable	Medium	M
	With mitigation	Local	Short term	Low	Improbable	Negligible	M

10.3 Operational Phase impacts

10.3.1 Increased catchment hardening and stormwater runoff

The operational phase impacts associated with development are relevant to both Alternatives 2 and 3.

10.3.1.1 Description and evaluation of impacts

The ephemeral seeps and watercourses within and surrounding the study area are particularly vulnerable to hydrological and water quality changes associated with catchment hardening (Ewart-Smith 2017). Consideration of the sensitivity of these habitats to changes in the quality and quantity of runoff was taken into consideration in the design philosophy for the management of Stormwater in the Civil Engineering Services Report (LJR Civil 2021) for the development. More specifically, design criteria included in the Stormwater Management Plan are based on the Water Sensitive Urban Design (WSUDS) principles which provide attenuation and promote infiltration. The design therefore includes "*well vegetated buffer strips, unlined grass channels with rock/subsoil drains (retention channels), and energy dissipaters*" (LJR Civil 2021). Also, detention structures at all outlets are proposed as a means of reducing the risk of erosion (LJR Civil 2021). While these measures may minimise the risk of stormwater related impacts to freshwater ecosystems, there is still some possibility (albeit limited) that increased stormwater runoff could result in channel erosion, particularly during intense storm events. Considering the relatively steep topography of the study area and ephemeral/temporary nature, these systems are highly sensitive to changes in the nature and volume of runoff and thus prone to erosion. Erosion would lead to down-cutting and loss of in-channel habitat through unsightly donga formation and sedimentation of habitats further downstream. This would result in a long-term impact of high intensity although with a low likelihood of the impact occurring due to design criteria included in the Stormwater Management Plan. It is therefore considered a ***negative impact of medium significance*** (Table 10.3).

Besides the effect on receiving streams, increased stormwater runoff could result in an increase in the duration and frequency of saturation of wetlands that are temporarily saturated and naturally dry for extended periods. This may result in a shift in community structure of the natural vegetation with associated impacts to biotic integrity. All these ecosystem are however well buffered by setbacks, and thus the likelihood of the impact occurring is low. This impact is therefore considered a long term impact of medium intensity and is rated as a ***negative impact of low significance*** (Table 10.3).

Stormwater runoff from gardens and landscaped open space can be rich in nutrients due to fertilisers and pesticides that may be used to manage these areas. Enrichment of seeps and watercourses could result in vegetation changes and associated loss of habitat integrity and biodiversity. This is considered a negative impact but of low intensity (due to provision of buffers) but with a distinct possibility of occurrence and is thus an ***impact of medium significance*** if not mitigated appropriately (Table 10.3).

10.3.1.2 Mitigation measures

Besides effective implementation of the design criteria detailed in the Stormwater Management it is recommended that the following measures be implemented as part of the operational phase of the development:

- Open spaces should be landscaped with indigenous vegetation with low water and fertilizer requirements and private title holders should be encouraged to do the same.

- Removal of alien vegetation and rehabilitation of eroded watercourses within the development footprint will somewhat offset the vulnerability of these systems to further erosion.
- Swales, or unlined channels should be vegetated with appropriate wetland plants to maximize the efficacy of nutrient uptake and attenuation of runoff. These swales will need to be maintained with the possibility of sediment and vegetation removal and replanting if and when necessary.
- All surface flow must be directed towards these vegetated swales, where trapping of sediments and pollutants can occur and infiltration is promoted within the development area.
- Stormwater outlets with energy dissipaters should all be fitted with litter and sediment traps, with sediment assumed to be an efficient mechanism for the removal of at least some of the total phosphorous load.
- The effectiveness of any Stormwater Management Plan should be monitored throughout the longevity of the development and adaptive management measures should be set in place to address any potential impacts should these measures not be effective at maintaining ecologically important wetland habitat. In this development, monitoring of potential erosion and increased saturation of wetlands is of particular importance.

An Operational Phase Environmental Management Programme (OEMP) must be prepared for the entire site. The EMP must provide sufficient detail on the management of buffer areas surrounding wetlands and watercourses to ensure protection of these systems. Specifications for rehabilitation of eroded channels and appropriate removal and long-term maintenance of invasive-alien-free private open space areas on the site must be included.

Also, it is recommended that a detailed monitoring plan be compiled which addresses the monitoring and management of stormwater such that adaptive measures can be implemented in the event that water quality and quantity changes to seeps and watercourses associated with stormwater runoff from the site are detected over the long term.

Residual stormwater impacts on freshwater ecosystems will depend on the extent to which these mitigation measures can be effectively implemented, including long term management of the site. However, if implemented and managed effectively, the negative impacts of stormwater on these systems could be of low intensity with a low likelihood of occurrence. With mitigation, these impacts are thus considered of ***low significance.***

10.3.2 Disturbance of wetlands and watercourses in conservation area

10.3.2.1 Description and evaluation of impacts

If not effectively managed, development of Hartenbos Garden Estate could result in disturbance of seep wetlands set aside for protection within the estate, as a result of increased passage of pedestrians across them, and their use for riding and walking. Such impacts would result in trampling of wetland plants and could create erosion pathways through wetland patches. Also, such disturbance would result in an increased likelihood of invasion by weeds and /or other alien plants, established in local gardens and including species such as highly invasive kikuyu grass. There is a distinct possibility that these habitats could be impacted and that the impacts would be of medium intensity and ensure in the long term. This would result in a ***negative impact of medium significance if not mitigated.***

10.3.2.2 Mitigation measures

Disturbance of wetlands in the conservation area can be mitigated through managing the movement through these areas. In particular, users should be limited to accessing the area via boardwalks or set paths which will define the extent of disturbance and limit interruptions to surface and subsurface flows. Mitigation measures against increased likelihood of invasion by weeds and /or other alien plants can be achieved through the implementation of a policy for the estate that stipulates that only indigenous vegetation be planted in open space landscaping. The use of indigenous vegetation should also be encouraged among individual property owners / users as well. Furthermore, adequate financial and human resources provision must be made for long-term alien clearing in the open space corridors and rehabilitation of eroded channels. Implementation of these measures would reduce the likelihood and intensity of these impacts such that ***residual negative impacts would be considered of low significance*** (Table 10.3).

10.3.3 Sewage contamination

10.3.3.1 Description and evaluation of impacts

The Sewer Network Layout Plan for the Hartenbos Garden Estate development (LJR 2021) indicates that sewer pump stations will be located at low points on the edge of the development. Essentially, these pump stations are thus situated on the boundary between development and the buffer areas surrounding Hillslope Seeps C, D and F, as well as Watercourse 5 (Figure 7.1 and Figure 8.1). Despite the buffer area between these pumps and wetlands and watercourse, undetected leakage from these pumps could result in contamination of by unprocessed sewage of these ecological habitats. This would result in severe water quality changes to these largely unmodified systems with a resultant loss of ecological integrity. Nevertheless, the Services Report for the development (LJR Civil 2021) stipulates that each pump station should be provided with a standby pump that will automatically come into operation if a duty pump fails and thus the risk of contamination is somewhat addressed. Also, lined sumps for emergency containment downstream of each pump station will ensure that, in the event of a sewage spill, effluent will be largely contained. The efficacy of fully operational sewage pumps however relies heavily on ongoing management and maintenance of these pump stations. Considering there is significant distance (more than 50 m in most instances) between sewer pumps and water resources, it is unlikely that raw effluent will discharge into any water course or seep, in the event of pump failure and spillage from the emergency sumps. One exception is Seep F which is 30 m downstream from sewer pump 4 (Figure 7.1 and Figure 8.1). In the event of pump failure and delayed response to a sewer spill with effluent discharge beyond the emergency sump, the intensity of the impact would be of medium intensity due to the buffer distance. However, considering the measures in place to contain effluent, there is a very low probability of the impact occurring and thus it is considered a ***negative impact of low significance without mitigation*** (Table 10.3).

10.3.3.2 Mitigation measures

The probability of sewage contamination can be reduced even further ensuring that all sewage pumps are effectively managed and maintained and that any blockages in the system are dealt with timeously and effectively for the full longevity of the estate. Also, each pump station should be fitted with a generator so that, in the event of power failures, the sewer network can still function optimally. It is further recommended that all pump stations, regardless of the number of dwellings being serviced, be designed with emergency storage capacity with a minimum capacity equivalent to four hours flow at the average flow rate. Should these measures be implemented, then any impact would only endure in the short term and thus any ***residual negative impacts are considered negligible.*** (Table 10.3).

10.4 Cumulative impacts

Farming and expansion of urban development within the Hartenbos region continues to impact on the water quality and integrity of the rivers and wetlands within the catchment. While development of Hartenbos Garden Estate on Erf 3122 may contribute to these impacts, effective implementation of mitigation measures, particularly with regards to stormwater management and the long-term maintenance of open space and areas set aside for conservation will most likely offset these impacts.

10.5 Assessment of the no-development alternative

Without long-term management intervention, including alien removal and rehabilitation of erosion dongas on the site, alien species along watercourses and within seep habitats are likely to spread and the extent of erosion along watercourses will likely increase. In the long-term therefore, habitats in good condition and of high ecological importance may degrade, resulting in a loss of habitat integrity and biodiversity. This is considered an impact of low intensity, considering the current level of invasion. However, the impact is highly probably and will endure in the long term and is thus a ***negative impact of Medium Significance*** (Table 10.4**).**

Table 10.3 Impacts associated with OPERATIONAL PHASE for development of Hartenbos Garden Estate on Erf 3122 (Alternatives 2 &3). All impacts are negative unless indicated otherwise.

Description of impact		Extent	Duration	Intensity	Probability	Significance	Confidence
Activity: *Increased stormwater runoff into watercourses and seeps*							
Change in the natural hydrology of ephemeral streams with an increase in size and volume of peak flows, leading to erosion and habitat loss.	Without mitigation With mitigation	Local Local	Long term Medium term	H M	Improbable Improbable	Medium Low	M M
Increase in the duration and frequency of saturation of wetlands and loss of biotic integrity.	Without mitigation With mitigation	Regional Local	Long term Medium term	M L	Probable Improbable	High Negligible	M M
Water quality deterioration a shift in vegetation community structure resulting in a loss of ecosystem integrity	Without mitigation With mitigation	Regional Local	Long term Medium term	L L	Probable Improbable	High Negligible	M M
Activity: *Increased disturbance of wetlands and watercourses through trampling*							
Degradation of vegetation and habitat quality through trampling with an increased risk of erosion and invasion by weedy species.	Without mitigation With mitigation	Local Local	Long term Medium term	M L	Probable Improbable	Medium Negligible	M M
Activity: *Operation of sewage pump stations within the estate*							
Potential risk of pump failure and contamination of wetlands and watercourses with sewage effluent.	Without mitigation With mitigation	Local Local	Medium term Short term	M M	Improbable Improbable	Low Negligible	M M

Table 10.4 Impacts associated with THE NO-GO DEVELOPMENT OPTION (Alternative 1). All impacts are negative unless indicated otherwise

Description of impact		Extent	Duration	Intensity	Probability	Significance	Confidence
Activity*: No development and thus no formal protection of natural ecosystems and management of alien invasion*							
Ongoing invasion of watercourse and wetlands by alien vegetation and associated loss of habitat.	Without mitigation With mitigation	Regional N/A	Long term N/A	L N/A	Highly Probable N/A	Medium N/A	M N/A

11 WATER USE AUTHORISATION

While the development of Hartenbos Garden Estate is outside of the regulated area for the watercourses within and adjacent to the site (i.e. outside of the 1:100 year floodline or outer boundary of the riparian area), development comes within 500 m of a number of seep wetlands. Thus, several activities associated with construction and operation of the development are considered non-consumptive water uses in terms of Section 21 (c) and (i) of the National Water Act as described in Section 6.6. The location of each water use and the potentially affected resource is given in Appendix E

Water uses in terms of section 21 (c) and (i) may be Generally Authorised if the risk to water resources, as provided by the Risk Assessment Matrix in Notice 509 of 2016 (GN 40229 of 26th August 2016), are considered low. With mitigation, the risks to water resources were rated as low (Table 11.1), based on the protocol described in Appendix B.

However, specific water uses, regardless of their risk to water resources are excluded from the General Authorisation. Of relevance to Hartenbos Garden Estate, item 3 (e) of GN 40229 indicates that "*The General Authorisation does not apply to any water use in terms of section 21 (c) and (i) of the Act associated with construction, installation or maintenance of any sewerage pipelines, pipelines carrying hazardous materials and the raw water and wastewater treatment works."* The Breede-Gouritz Catchment Management Agency (BGCMA) have confirmed that, despite measures to negate the possibility of sewage effluent entering any water resource as detailed in the services report (LJR Civil 2021), the activity requires a Water Use licence (WUL). It is therefore recommended that the project proceed with a full Water Use Licence Application (WULA).

Table 11.1 Risk Assessment Matrix for Section 21 (c) and (i) water uses associated with Hartenbos Garden Estate (Alternative 3: preferred alternative)

RISK ASSSESSMENT FOR WETLANDS AND WATERCOURSES ON ERF 3122, HARTENBOS: PROPOSED RESIDENTIAL DEVELOPMENT
Impacts assume full implementation of control measures as mitigation as presented
Risk Matrix completed by Justine Ewart-Smith - SACNASP Reg no. 400746/15

Impact Nr	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat	Biota	Severity	Spatial scale	Duration	Conseq	Freq of activity	Freq of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
1	Design/layout	Placement of a perimenter fence crossing watercourses and seeps	Obstruction of flow and reduction in connectivity	Potential erosion and change in flow path and restricted longitudical movement of biota	**2**	**1**	**2**	**1**	1.5	1	1	3.5	**1**	2	5	1	9	32	**LOW**	Considering the small size and longitudinal nature of these wetlands and watercourses, it is likely that fence poles can avoid these habitats entirely such that the risk of flow obstruction and potential erosion is negligible. Also, fence design can make provision for the movement of biota by ensuring that animals can move freely. Large mesh size crossing these resources will also ensure that flows are not impeded.
2		Development of residential erven and assess road network	Loss of connectivity for the movement of biota across the watershed between wetlands as well as between wetlands within a 'wetland cluster' as identified on the NFEPA map.	Reduction in the dispersal and movement of biota between wetland patches. Through implementation of specific design and operational features, some connectivity could be retained within this development layout and thus the residual impact, with mitigation is considered of low significance.	**1**	**1**	**1**	**2**	1.25	3	1	5.25	**1**	2	5	2	10	53	**LOW**	Connectivity between isolated wetland habitats can be improved through: 1) the creation of underpasses across the road network at strategic locations to permit the movement of biota; 2) Adequate provision for the movement of biota across fencing erected either around the development or within the development. 3) Appropriately vegetated and maintained open space with indigenous vegetation to promote the quality of habitat that can function as corridors.
3	Construction	Dumping of waste material within or in close proximity to wetlands	Damage to wetland habitat and change in soil structure	Loss and/or degradation of wetland habitat in good condition that is considered of high ecological importance and sensitivity on a national scale. Physical destruction of these habitats can be easily prevented by demarcating sensitive habitats as no-go areas and thus the residual impacts are of low significance.	**1**	**1**	**1**	**1**	1	1	1	3	**1**	1	5	1	8	24	**LOW**	The risk of dumping can be minimised by ensuring that all wetlands and watercourses are fenced off from the development edge prior to the start of construction to reduce the likelihood that it will be affected by construction activities. The fencing should be removed when construction in the vicinity of the open space areas has been completed.
4		Stockpiling of materials within or in close proximity to wetlands; washing of vehicles in close proximity to wetlands or watercourses; defaecation close to close to wetlands or watercourse as a	Pollution (water quality deterioration) of wetlands or watercourse through the runoff of contaminants such as fuel, oil, concrete, wash-water, sediment and sewage into these ecosystems.	Receipt of poor quality, sediment laiden runoff in the various ephemeral channels and or wetlands identified on site could impact negatively on the integrity of freshwater ecosystems that are in relatively good condition and of high ecological importance and sensitivity. These impacts can however be easily mitigated through the effective implementation and adherence to specific measures. Thus the residual water quality impacts associated with construction would be low.	1	1	1	1	1	1	1	3	1	1	5	2	9	27	**LOW**	Contamination of sensitive wetlands can be minimised by: 1) Ensuring that construction within the 50 m buffer area of watercourses and wetlands, does not take place during wet periods. In the Hartenbos region, historical rainfall records show that rainfall peaks in the spring (October/November) and again in autumn (April) with the lowest rainfall between December and February. While limiting construction within any watercourse or wetland buffer between December and January will reduce the risk of runoff into watercourses and wetlands from newly cleared areas and stockpiles, rainfall does occur beyond this period. Therefore, potential rainfall needs to be continuously monitored and additional measures implemented to either prevent or remediate any damage if necessary. 2) Ensuring that all stockpiled materials are stored at least 50 m away from wetlands and watercourses. 3) Ensuring that Stockpile areas do not exceed 1.5 m in height and are protected from wind to prevent spread of material. 4) Ensuring that stockpile areas are adequately bunded such that there is no runoff from these areas into freshwater ecosystems, particularly where the terrain is steep 5) Ensuring that washing of vehicles and machinery take place well away from wetlands and watercourses (at least 50 m). All machinery should be regularly checked for leaks. 6) Providing of adequate ablution facilities for construction workers to avoid contamination of wetland habitats through human waste.
5		Uncontrolled movement of construction staff and vehicles within or in close proximity to wetlands	Physical destruction or damage of wetland habitat by workers and machinery operating within or in close proximity to wetlands	Physical destruction would result in the loss of wetland habitat resulting in a negative impact. Nevertheless, these construction related impacts are readily mitigated and thus the residual negative impacts would be low	1	1	1	1	1	1	1	3	1	1	5	1	8	24	**LOW**	Physical destruction can be minimised by ensuring that wetlands and watercourses are fenced off from the development edge prior to the start of construction to reduce the likelihood that it will be affected by construction activities. The fencing should be removed when construction in the vicinity of the open space areas has been completed. Any disturbance created through construction related activities is remediated through rehabilitation of the habitat.
6		Increased activity within close proximity to wetland ecosystems	Disturbance of aquatic fauna as a result of the noise from construction teams and their machinery working within or in close proximity to wetlands	Reduction in the use of habitat by aquatic and semi-aquatic fauna. The impact can be somewhat reduced by maintaining adequate distance (a minimum of 50m from wetlands) where possible. However, there will could still be some disturbance to some wetlands where development extends to within 30 m of the wetland (Seep F) but will be of low signficance with mitigation.	1	1	1	2	1.25	1	1	3.25	1	1	5	1	8	26	**LOW**	Disturbance can be minimised by demaraction of the buffers surrounding wetlands and watercourses as no-go areas where possible. Where construction occurs within the 50 m buffer area, the maximum possible buffer around all watercourses and wetlands should be defined and demarcated by a freshwater ecologist.

Table 11.2 continued   Risk Assessment Matrix for Section 21 (c) and (i) water uses associated with Hartenbos Garden Estate (Alternative 3)

Impact Nr	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat	Biota	Severity	Spatial scale	Duration	Conseq	Freq of activity	Freq of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Control Measures
7	**Operation**	Construction of residential development within close proximity to wetland habitat	Increased catchment hardening and stormwater runoff into wetlands/watercourses	Erosion of channels, particularly during intense storm events, which could lead to down-cutting and loss of in-channel habitat through unsightly donga formation and sedimentationof habitats further downstream. Effective implementation of the design criteria specified in the stormwater management plan, together with additional recommended mitigation measures would signficantly reduce the risk of this impact.	**3**	**1**	**2**	**2**	2	1	1	4	2	2	5	2	11	44	**LOW**	Removal of alien vegetation and rehabilitation of eroded watercourses within the development footprint will somewhat offset the vulnerability of these systems to further erosion. Swales, or unlined channels should be vegetated with appropriate wetland plants to maximize the efficacy of nutrient uptake and attenuation of runoff. These swales will need to be maintained with the possibility of sediment and vegetation removal and replanting if and when necessary. All surface flow must be directed towards these vegetated swales, where trapping of sediments and pollutants can occur and infiltration is promoted within the development area. Stormwater outlets with energy dissipaters should all be fitted with litter and sediment traps, with sediment assumed to be an efficient mechanism for the removal of at least some of the total phosphorous load. Open spaces should be landscaped with indigenous vegetation with low water and fertilizer requirements and private title holders should be encouraged to do the same. The effectiveness of any Stormwater Management Plan should be monitored throughout the longevity of the development and adaptive management measures should be set in place to address any potential impacts should these measures not be effective at maintaining ecologically important wetland habitat. In this development, monitoring of potential erosion and increased saturation of wetlands is of particular importance.
8				Increase in the duration and frequency of saturation of wetlands that are naturally dry for extended periods. This may result in a shift in community struct of the antural vegetation with associated impacts to biotic integrity. Effective implementation of the design criteria specified in the stormwater management plan, together with additional recommended mitigation measures would signficantly reduce the risk of this impact.	**3**	**1**	**2**	**2**	2	1	1	4	2	2	5	2	11	44	**LOW**	
				Stormwater runoff from gardens and landscaped open space can be rich in nutrients due to fertilisers and pesticides that may be used to manage these areas. Enrichment of watercourses and wetlands through directing stormwater runoff to these habitats could result in vegetation changes and associated loss of habitat integrity and biodiversity in wetlands. Effective implementation of the design criteria specified in the stormwater management plan, together with additional recommended mitigation measures would signficantly reduce the risk of this impact.	**1**	**3**	**3**	**2**	2.25	1	1	4.25	2	2	5	1	10	43	**LOW**	
9			Uncontrolled use of the conservation area by residents and pets.	Loss or degradation of wetland habitat through trampling, with the potential risk of increased erosion through wetlands and invasion by weedy alien species. These impacts can be effectively minimised through management interventions that control access to and use of these areas.	**1**	**1**	**3**	**3**	2	1	1	4	1	2	5	1	9	36	**LOW**	Disturbance of wetlands in the conservation area can be mitigated through managing the movement through these areas. In particular, users should be limited to accessing the area via boardwalks or set paths which will define the extent of disturbance and limit interruptions to surface and subsurface flows. Mitigation measures against increased likelihood of invasion by weeds and /or other alien plants can be achieved through the implementation of a policy for the estate that stipulates that only indigenous vegetation be planted in open space landscaping. The use of indigenous vegetation should also be encouraged among individual property owners / users as well. Furthermore, adequate financial and human resources provision must be made for long-term alien clearing in the open space corridors and rehabilitation of eroded channels.
			Sewage contamination through operational failure of sewage pumps and / or pipe blockages	Water quality deterioration and associated loss of ecological integrity. The risk of sewage spills can be signicantly reduced by ensuring that the system is fully operational at all times for the longevity of the project.	**1**	**3**	**2**	**2**	2	1	3	6	1	1	5	1	8	48	**LOW**	The probability of sewage contamination can be effectively reduced by ensuring that all sewage pumps are effectively managed and maintained and that any blockages in the system are dealt with timeously and effectively for the full longevity of the estate. Also, each pump station should be fitted with a generator so that, in the event of power failures, the sewer network can still function optimally. It is further recommended that all pump stations, regardless of the number of dwellings being serviced, be designed with emergency storage capacity with a minimum capacity equivalent to four hours flow at the average flow rate.

12 CONCLUSIONS AND RECOMMENDATIONS

Hartenbos Garden Estate is situated within the Breede-Gouritz Water Management Area and straddles quaternary catchments K10B and K10A. It therefore lies on a watershed drained by ephemeral watercourses immediately north and west of the study area with six, largely temporary seep wetlands feeding watercourses within the study that drain eastwards. The surrounding landscape was historically subject to farming activities and invasion by alien *Acacia cyclops* and associated hydrological changes, together with erosion of some watercourses has resulted in a loss of ecosystem integrity of some of these ecosystems, particularly the ephemeral channels. However, most of the seep wetlands are largely intact with little alteration to their water quality and geomorphological character. Together these wetlands and watercourses offer a network of freshwater habitat that supports ecologically and hydrologically functional habitat that is considered of high Ecological Importance and Sensitivity at a regional scale.

Through an iterative process of compiling the preferred development layout for Erf 3122, all seeps and watercourses identified in the sensitivity analysis were accommodated in the area designated for conservation in the design layout plan provided for in both Alternatives 2 and 3. Thus, the development of this site, according to both development alternatives, does not result in the any direct loss of wetland habitat. Also, a variable setback (mostly 30-50 m) between the development edge and seeps / watercourses was achieved in both alternatives. While a perimeter fence will cross several watercourses and seeps, it is possible that any impacts associated with flow impediment and longitudinal connectivity can be minimised through fence design and avoidance of these habitats in the placement of fence poles.

The seep wetlands within the Hartenbos Garden Estate are identified as part of an important wetland cluster in the NFEPA dataset as well as Critical Biodiversity Areas (CBA1) because they offer relatively high quality connected habitat that supports the dispersal of fauna. Relative to the no-development alternative however, connectivity between freshwater ecosystems across the watershed is significantly compromised in both Alternatives 2 and 3. Nevertheless, the provision of a wider corridor in Alternative 3 relative to Alternative 2, together with the provision of mitigation measures, significantly reduces this impact. Considering the importance of these habitats that straddle two watersheds for the movement of biota, it is imperative that measures to maximise connectivity and movement of biota within and across the watershed are incorporated into the design. Thus, based on the improved connectivity provided for in Alternative 3, this option is the preferred alternative from a freshwater ecological perspective.

While some construction phase impacts are identified, these are readily mitigated and are unlikely to result in any significant negative impacts. However, construction will need to be managed and monitored to ensure that mitigation measures are effectively implemented and adhered to. It is therefore recommended that a Construction Phase Environmental Management Programme (CEMP) be compiled and its implementation enforced during the construction phase through regular inspection by an ECO with experience of freshwater ecosystems.

Despite the provision of a setback, the ephemeral seeps and watercourses within and surrounding the study area are particularly vulnerable to water quality and quantity changes associated with catchment hardening. Without effective mitigation, these impacts may result in the permanent loss or degradation of freshwater ecosystems of high ecological importance. Effective mitigation measures to offset these impacts have however been identified and if implemented effectively and managed in the long term, are likely to offset these negative impacts. It is recommended that these measures are detailed in an Operational Phase

Environmental Management Programme (OEMP) and that the efficacy of their implementation is monitored in the long term.

With mitigation, risks posed to water resources associated with both the construction and operation of the development are considered low and thus could be considered for General Authorisation in terms of the section 21 (c) and (i) water uses. Nevertheless, the development involves the construction of a sewage network and this activity is excluded from the General Authorisation process, regardless of the level of risk posed to water resources. It is therefore recommended that the project proceed with a full Water Use Licence Application (WULA) as advised by the BGCMA.

13 REFERENCES

Bergwind (2017). Botanical Survey and Sensitivity Assessment of Erf 3122, Hartenbos Heuwels, Western Cape.

Department of Water Affairs and Forestry (DWAF) (2005). A practical field procedure for identification and delineation of wetlands and riparian areas. Department of Water Affairs and Forestry, Pretoria.

Department of Water Affairs and Forestry (DWAF)(1999). Resource Directed Measures for the protection of water resources. Version 1.0.

Ewart-Smith, J.L (2017). Baseline (Sensitivity) assessment of freshwater ecosystems. Erf 3122, Hartenbos Heuwels Residential Development. Submitted to Cape EAPrac (Pty) Ltd for ATKV Sake (Pty) Ltd as part of Phase 1 of the EIA process for development.

Helme, N. (2012). Botanical assessment for Erf 3122 and remainder of portion 4 of Hartenbos 217, Hartenbos, Western Cape.

Kleynhans, C.J., Thirion, C. and Moolman, J. (2005). A Level I River Ecoregion classification system for South Africa, Lesotho and Swaziland. Report No. N/0000/00/REQ0104.

Kleynhans (1999). A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River (Limpopo System, South Africa). Journal of Aquatic Ecosystem Health 5: 41-54.

Kotze, DC, DM Macfarlane, RJ Edwards (2020). WET-EcoServices Version 2: A technique for rapidly assessing ecosystem services supplied by wetlands and riparian areas. WRC Report No. 2737/1/21, Water Research Commission, Pretoria.

Levick, L., J. Fonseca, D. Goodrich, M. Hernandez, D. Semmens, J. Stromberg, R. Leidy, M. Scianni, D.P. Guertin, M. Tluczek, and W. Kepner. (2008) The Ecological and Hydrological significance of Ephemeral and Intermittent Streams in the Arid and Semi-arid American Southwest, U.S. Environmental Protection agency and USDA/ARS Southwest Watershed Research Center, EPA/600/R-08/134, ARS/233046, 116p.

LJR Civil Consultants (2021). Services Report for Hartenbos Garden Estate Residential Development. Erf 3122 Hartenbos. Project No 1704062.

Macfarlane, D., Ollis, D., and Kotze, D (2020). WET-Health Version 2.0: A refined suite of tools for assessing Present Ecological State of wetland ecosystems. WRC Project No. K5/2549. Water Research Commission, Pretoria, South Africa.

Macfarlane, D.M. and Bredin, I.P. 2017. Buffer zone guidelines for rivers, wetlands and estuaries. Part 1: Technical Manual. WRC Report TT 715/1/17, Water Research Commission, Pretoria.

Nel J.L., Driver A., Strydom W., Maherry A., Petersen C., Roux D.J., Nienaber S., van Deventer H, Smith-Adao LB and Hill L. (2011). Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources. WRC Report No. TT 500/11, Water Research Commission, Pretoria.

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

Pool-Stanvliet , R., Duffell-Canham, A., Pence, G. and Smart, R. (2017). The Western Cape Biodiversity Spatial Plan Handbook. Stellenbosch: Cape Nature.

Rountree, M.W., Malan, H. and Weston, B. (eds). (2013). Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). Joint Department of Water Affairs/Water Research Commission Study. Report No. 1788/1/13. Water Research Commission, Pretoria

Strategic Environmental Focus (SEF) (2014). Hartenbos Heuwels Residential Development: Wetland Assessment. Prepared for ATKV. SEF reference number: 504632

APPENDIX A: ASSESSMENT OF ECOLOGICAL IMPORTANCE AND SENSITIVITY OF RIVERS (TAKEN FROM DWAF 1999)

This approach estimates and classifies the ecological importance and sensitivity of the streams in a catchment by considering a number of components surmised to be indicative of these characteristics. The following ecological aspects should be considered as the basis for the estimation of ecological importance and sensitivity:

- The presence of rare and endangered species, unique species (i.e. endemic or isolated populations) and communities, intolerant species and species diversity should be taken into account for both the instream and riparian components of the river.

- Habitat diversity should also be considered. This can include specific habitat types such as reaches with a high diversity of habitat types, i.e. pools, riffles, runs, rapids, waterfalls, riparian forests, etc.

- With reference to points 1 and 2, biodiversity in its general form (i.e., Noss 1990) should be taken into account as far as the available information allows.

- The importance of the particular river or stretch of river in providing connectivity between different sections of the river, i.e. whether it provides a migration route or corridor for species should be considered.

- The presence of conservation or relatively natural areas along the river section should also serve as an indication of ecological importance and sensitivity.

- The sensitivity (or fragility) of the system and its resilience (i.e., the ability to recover following disturbance) of the system to environmental changes should also be considered. Consideration of both the biotic and abiotic components is included here.

A number of biotic and habitat determinants considered to be important for the determination of ecological importance and sensitivity are scored. The medians of these scores are calculated to derive the ecological importance and sensitivity category.

Table A1 Ecological Importance and Sensitivity categories.

Ecological Importance and Sensitivity Categories	General Description
Very high	Quaternaries/delineations that are considered to be unique on a national or even 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.
High	Quaternaries/delineations that are considered to be unique on a national scale due to 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 a substantial capacity for use.
Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually not very sensitive to flow modifications and often have a substantial capacity for use.

Low/marginal	Quaternaries/delineations that are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.

Determinants

Generally, a four point (1 to 4) scoring system is used to assess the various aspects of ecological importance and sensitivity. In some cases a five point (0 to 4) scoring system is used (Table 2). Determinants are assessed according to biological determinants (Table B2) and aquatic habitat determinants (Table B3).

Due to the uniqueness of the Fynbos Biome, it was decided to treat the Western Cape somewhat different with regard to some determinants in order to increase the applicability of the methodology in this part of the country (Luger 1999a & b). These modifications are indicated in the relevant tables.

Table A2 **Biotic determinants (instream and riparian) for assessment of ecological importance and sensitivity**.

Determinant*	**Guidelines And Description**	**Scoring Guidelines**
Rare and[@] endangered biota	Biota can be rare or endangered on a local, Provincial and National scale. Useful sources for this information include the South African Red Data Books that are suitable for assessment on a National scale. However, species (or taxa in the case of invertebrates) can be rare or endangered on a Provincial or local scale but not on a National scale. Professional judgement needs to be utilised in such cases.	Very High - rating=4; One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books). High - rating=3; One or more species/taxon judged to be rare or endangered on a Provincial/regional scale. Moderate - rating=2; More than one species/taxon judged to be rare or endangered on a local scale. Marginal - rating=1; One species/taxon judged as rare or endangered at a local scale. None - rating=0; No rare or endangered species/taxon at any scale
Unique biota[@]	Endemic or uniquely isolated species populations (or taxa, i.e. in the case of invertebrates) that are not rare or endangered should be included here. This assessment should also consider local, Provincial and National scales and should be treated separately from rare and endangered species (i.e. the same species should not be considered). The assessment should be based on professional knowledge. Fynbos biome: Within this biome all the biota would be unique. The rivers were therefore assessed within the context of the biome for the Western Cape (Luger 1999a).	Very High - rating=4; One or more population (or taxon) unique on a National scale. For the Western Cape – rated on a biome scale. High - rating=3; One or more population (or taxon) judged to be unique on a Provincial/regional scale. For the Western Cape - rated on a sub-regional scale (i.e. northern, western, southern and karroid). Moderate – rating=2; More than one population (or taxon) judged to be unique on a local scale. Marginal - rating=1; One population (or taxon) judged to be unique at a local scale. None - rating=0; No population (or taxon) judged to be unique at any scale.
Intolerant biota	Intolerant biota includes those species (or taxa in the case of invertebrates) that are known (or derived or suspected) to be intolerant to decreased or increased flow conditions as well as changed physical habitat and altered water quality conditions related to decreased or increased flows. As little experimental information is available on the intolerance of	Very High - rating=4; A very high proportion of the biota is expected to be dependent on permanently flowing water during all phases of their life cycle. High - rating=3; A high proportion of the biota is expected to be dependent on permanently flowing water during all phases of their life cycle.

	indigenous biota, assessment should be based on professional judgement. Kwazulu/Natal: There is no quaternary without flow and everywhere that there is flow an invertebrate community dependent on flow develops. This would mean that every quaternary should be rated highly with respect to this criterion. The solution to the problem was to use only fish (Chutter 1999).	Moderate - rating=2; A small proportion of the biota is expected to be dependent on permanently flowing water during some phases of their life cycle. Marginal - rating=1; 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. None - rating=0; Rarely if any biota expected with any dependence on flowing water.
Species/taxon richness	Species/taxon richness can be assessed on a comparative basis according to a local, Provincial or National scale. Strictly, this kind of assessment should be based on the grouping of ecologically similar rivers. However, such a system is still under development and assessment will again to have to be based on professional judgement.	Very High - rating=4; Rated on a National scale. For the Western Cape - rated on a biome scale. High - rating=3; Rated on a Provincial/regional scale. For the Western Cape - rated on a sub-regional scale (i.e. northern, western, southern and karroid). Moderate - rating=2; Rated on a local scale. Marginal/low - rating=1; Not significant at any scale. (a rating of none is not appropriate in this context)

*: The current guidelines will mostly be applicable to vertebrates and vascular plants for which information is more readily available than for other groups. In cases where expert knowledge allows for the assessment of biota other than vertebrates and vascular plants, such information should be included. The taxonomic groups on which the assessment is based should be indicated. In cases where invertebrates (in particular) and other plants are used as indicators, the relevant scoring system may have to be adapted by the relevant ecological experts.

In the case of rare and endangered and unique biota: the highest of the possible scores should be provided, i.e.:

- If a species is rare and endangered on a national scale, it should be scored as very high for this determinant.
- If a species is rare and endangered on a regional scale but it is very unique on a national scale, it should be scored as very high for this determinant.

Table A3 Habitat (instream and riparian) determinants for assessment of ecological importance and sensitivity.

Determinant*	Guidelines And Description	Scoring Guidelines
Diversity of aquatic habitat types or features	Diversity of habitat types in a river delineation should be assessed according to local, Provincial and National scales (riffles, rapids, runs, pools and backwaters and the associated marginal areas and substrate types, lotic wetlands (source sponges, floodplain habitat types) and the riparian zone). Assessment should again be based on professional judgement.	Very High - rating=4; Rated on a National scale. High - rating=3; Rated on a Provincial/regional scale. Moderate - rating=2; Rated on a local scale Marginal/low – rating=1; Not significant at any scale. (a rating of none is not appropriate in this context)
Refuge value of habitat types	The functionality of the habitat types present should be assessed in terms of their ability to provide refugia to biota during periods of environmental stress on a local, Provincial and National scale. Assessment is based on available information and expert judgement.	Very High – rating=4; Rated on a National scale. High - rating=3; Rated on a Provincial/regional scale. Moderate - rating=2; Rated on a local scale

Determinant*	Guidelines And Description	Scoring Guidelines
		Marginal/low - rating=1; Not significant at any scale. (a rating of none is not appropriate in this context)
Sensitivity of habitat to flow changes	This assessment should essentially take into account the size of the stream as well as the habitat types available. The presumption is that only a limited decrease or increase in the flow (and the related depth and width) of certain rivers (often "smaller" streams) will result in particular physical habitat types (i.e. riffles), becoming unsuitable for biota as compared to "larger" streams. Assessment is based on available information and expert judgement.	Very High - rating=4; Streams of a particular size and with abundant habitat types highly sensitive to flow decreases or increases at all times High - rating=3; Streams of a particular size and with some habitat types being highly sensitive to flow decreases or decreases at all times. Moderate - rating=2; Streams of a particular size and with some habitat types being susceptible to flow decreases or increases during certain seasons. Marginal/low - rating=1; Streams of a particular size and with habitat types rarely sensitive to flow decreases or increases. (a rating of none is not appropriate in this context)
Sensitivity to flow related water quality changes	This assessment should also consider the size and flow of the stream in terms of its sensitivity to water quality changes. A decrease in the natural flow volume may, for example, result in a diminished assimilative capacity (in the situation where effluent forms part of the total flow volume) or may cause natural water quality variables (i.e. water temperature and oxygen) to reach levels detrimental for biota (also applicable to increases in flow). The assumption regarding the sensitivity of "smaller" streams is also applicable here. In terms of organic pollution load, it has been pointed out that slow flowing deep rivers would be impacted over greater distances than fast flowing shallow rivers where re-areation rates would be high (Chutter 1999). Assessment is based on available information and expert judgement.	Very High - rating=4; Streams of a particular size (usually "small") and with abundant habitat types highly sensitive to water quality changes related to flow decreases or increases at all times. High - rating=3; Streams of a particular size (usually "small") and with some habitat types being highly sensitive to water quality related changes related to flow decreases or increases at all times. Moderate - rating=2; Streams of a particular size (often "larger") and with some habitat types being sensitive to water quality related flow decreases or increases during certain seasons. Marginal/low - rating=1; Streams of a particular size (often "larger") and with habitat types rarely sensitive to water quality change related to flow decreases or increases. (a rating of none is not appropriate in this context)
Migration route/corridor for instream and riparian biota	The importance of a specific stream delineation in terms of the link it provides for the upstream and downstream biological functioning of other sections of the stream, is indicated here (i.e. connectivity). In essence the biological connectivity provided by a particular stream delineation can influence its ecological importance and result in an adapted (i.e. higher) rating than it would have had if was assessed only on its own. Assessments should be based on the results of ratings for individual stream network delineations, professional	Very high - rating=4; The stream delineation is a critical link in terms of connectivity for the survival of biota upstream and downstream and is very sensitive to modification. High - rating=3; The stream delineation is an important link in terms of connectivity for the survival of biota upstream and downstream and is sensitive to modification. Moderate - rating=2; The stream delineation is a moderately important link in terms of

Determinant*	Guidelines And Description	Scoring Guidelines
	judgement and available information. The sensitivity of the migration route/corridor to modifications and disruptions form part of the assessment. Within this context, headwater quaternaries/delineations could have a low importance as a migration route /corridor (at a sub-quaternary or other smaller delineation, migration route/corridor may be more important)	connectivity for the survival of biota upstream and downstream and is moderately sensitive to modification. Marginal/Low - rating=1; The stream delineation is a marginally/low important link in terms of connectivity for the survival of biota upstream and downstream and has a marginal sensitivity to modification None – rating=0; The stream delineation is not of any importance in terms of connectivity for the survival of biota upstream and downstream.
National parks, Wilderness areas, Nature reserves Natural Heritage sites Natural areas	The presence of conservation (i.e. National Parks, Wilderness areas and Nature Reserves) and natural areas (i.e. unproclaimed, relatively unmodified/undisturbed areas) within a stream delineation will logically place an additional emphasis on the ecological importance and sensitivity of a stream. The importance of such areas for the conservation of the aquatic ecological diversity on different scales must be judged, i.e. the presence of a quaternary or other delineation in a conservation or natural area does not automatically indicates a high score.	Very high - score=4; The stream delineation is present within an area very important for the conservation of ecological diversity on a National and even international scale. High - score=3; The stream delineation is present within an area important for the conservation of ecological diversity on a National scale. Moderate - score=2; The stream delineation is present within an area important for the conservation of ecological diversity on a provincial /regional scale. Marginal/Low - score=1; The stream delineation is present within an area important for the conservation of ecological diversity on a local scale. Very low - score=0; The stream delineation is not present within an area important for the conservation of ecological diversity on any scale.

*: The scoring system indicated here is mainly applicable to vertebrates. In cases where invertebrates (in particular) and plants are used as indicators, the relevant scoring system may have to be adapted by the relevant ecological experts.

Determining the ecological importance and sensitivity category (EISC): The median score for the biotic and habitat determinants is interpreted as indicated in Table A4.

Table A4 Ecological importance and sensitivity categories. Interpretation of median scores for biotic and habitat determinants.

Ecological Importance And Sensitivity Category*	Range Of Median
Very high Quaternaries/delineations that are considered unique on a national or even 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 and ≤4
High Quaternaries/delineations that are considered to be unique on a national scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms	>2 and ≤3

of biota and habitat) may be sensitive to flow modifications but may have a substantial capacity for use.	
Moderate Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually not very sensitive to flow modifications and often have a substantial capacity for use.	>1 and ≤2
Low/marginal Quaternaries/delineations that are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.	>0 and ≤1

*: Quaternaries refer to the mainstem river in a quaternary.

APPENDIX B: PROTOCOL FOR THE ASSESSMENT OF RISK BASED ON THE RISK ASSESSMENT MATRIX

The risk assessment matrix for Section 21 (c) and (i) water uses was introduced in August 2016, and it adopts an approach similar to the EIA regulations, where each impact is assessed in terms of severity, likelihood and consequence. The matrix requires the assessment of each activity associated with the construction and operation of any development project in terms of the impacts expected to affect resource quality characteristics (flow regime, water quality, geomorphology, and habitat/biota) of watercourses and wetlands. Each impact is scored in terms of the severity of its effect on each of the resource quality characteristics, and the scores are then averaged to give a total for severity. Each impact is then scored in terms of its:

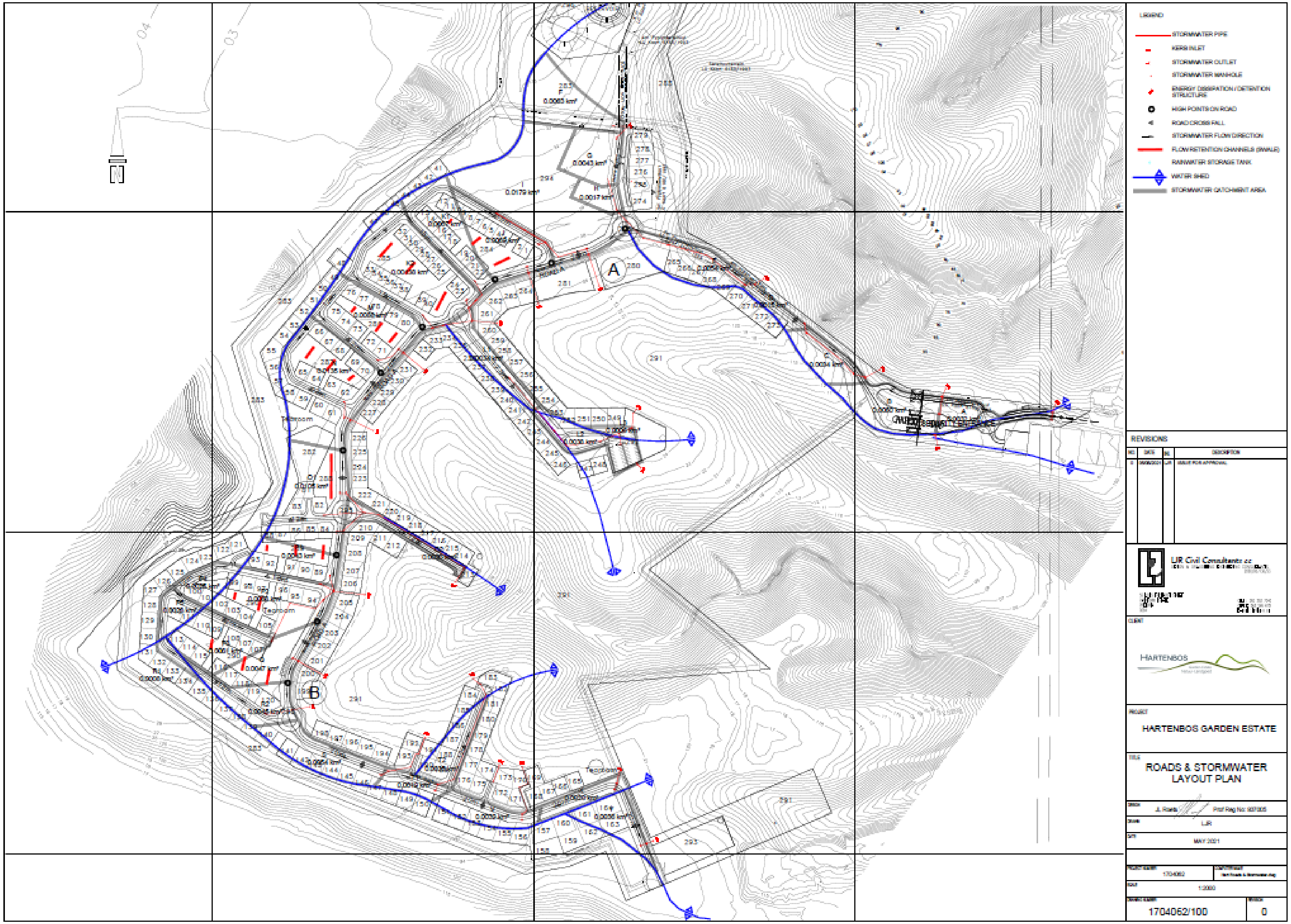
- **Consequence**, which is the product of the severity of the impact, the spatial scale or extent, and the duration of the impact; and
- **Likelihood**, which is the sum of the frequency of the activity, frequency of the impact, existence of legislation governing the activity and ecosystem; and the *ease of detection* of the impact.

The significance of the impact is calculated as the product of its consequence and likelihood. The final score is used to assign a risk rating to the impact (see Table B1), **assuming implementation of effective mitigation measures.**

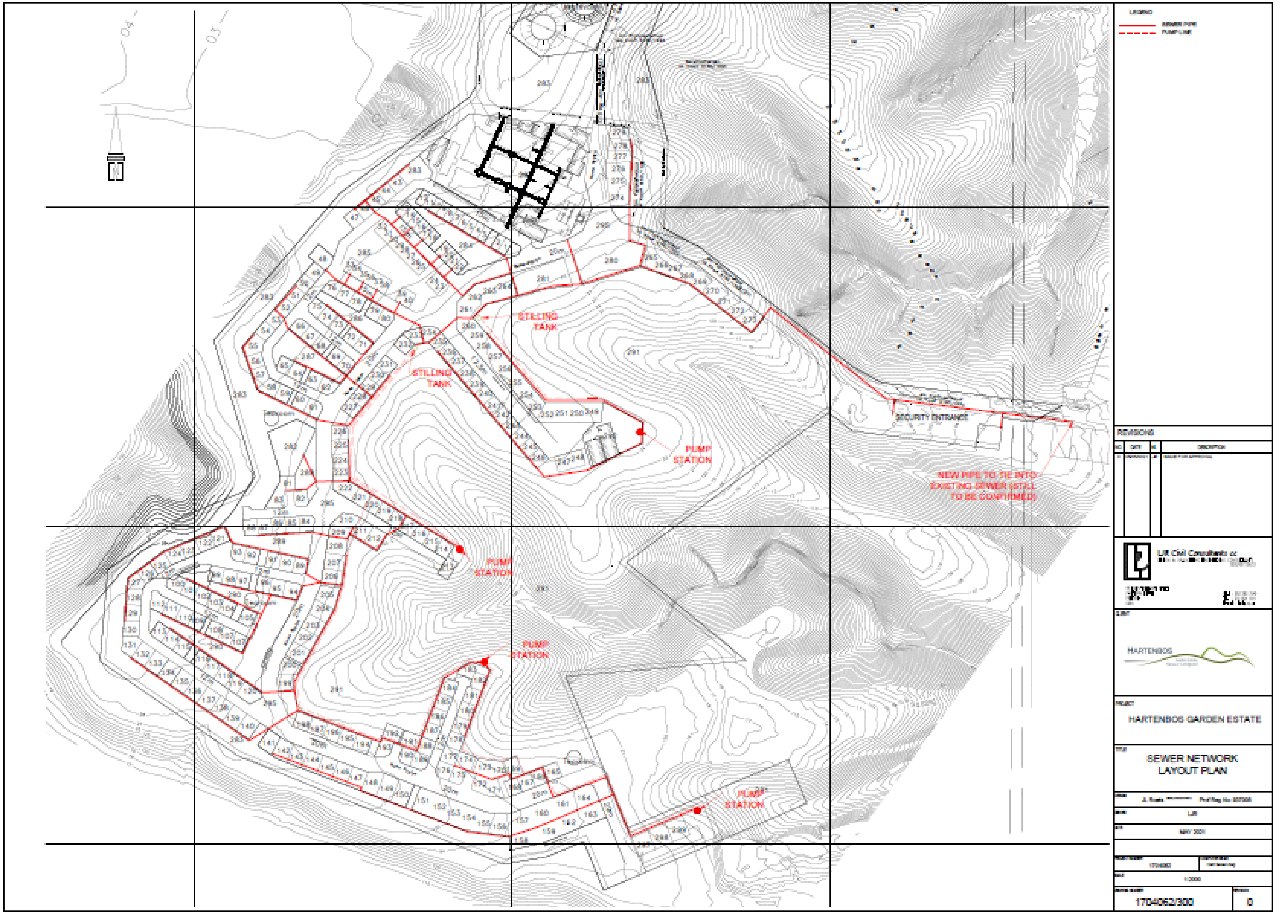
Table B1 Rating Classes for the Risk Assessment.

Rating	Class	Management Description
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Licence required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. License required.

APPENDIX C: ROADS AND STORMWATER LAYOUT PLAN FOR HARTENBOS GARDEN ESTATE (APPENDIX G IN LJR CIVIL 2021)



APPENDIX D: SEWER NETWORK LAYOUT PLAN (APPENDIX K IN LJR CIVIL 2021)



APPENDIX E: THE LOCATION OF SECTION 21 (C) & (I) WATER USES AND THE POTENTIALLY AFFECTED WATER RESOURCES

KML name	Affected Water Resource	Water Use Desciption	Section 21c	Section 21i	Latitude	Longitude
Hartenbos_Water Uses_fence crossings_seeps	Seep F	Fence crossing	Yes	Yes	-34.13270392	22.08882094
	Seep F	Fence crossing	Yes	Yes	-34.13248219	22.08778382
	Seep D	Fence crossing	Yes	Yes	-34.12955145	22.08716334
Hartenbos_Water Uses_fence crossings_watercourses	Watercourse 6	Fence crossing	Yes	Yes	-34.13128415	22.08582046
	Watercourse 6	Fence crossing	Yes	Yes	-34.13115719	22.08598854
	Watercourse 3	Fence crossing	Yes	Yes	-34.13035611	22.08727778
	Watercourse 1	Fence crossing	Yes	Yes	-34.12841778	22.08904088
Hartenbos_Water Uses_Sewage Pump Station_seeps	Seep E	Sewage Pump Station	Yes	Yes	-34.12845574	22.08624332
	Seep F	Sewage Pump Station	Yes	Yes	-34.13267851	22.0876556
Hartenbos_Water Uses_Sewage Pump Station_watercourses	Watercourse 5	Sewage Pump Station	Yes	Yes	-34.12986099	22.0847116
	Watercourse 3	Sewage Pump Station	Yes	Yes	-34.13080251	22.08509102
Hartenbos_Water Uses_Stormwater Pond_seeps	Seep D	Stormwater Pond	Yes	Yes	-34.12877192	22.08617306
	Seep E	Stormwater Pond	Yes	Yes	-34.12805525	22.08601146
	Seep E	Stormwater Pond	Yes	Yes	-34.1268116	22.08561799
	Seep E	Stormwater Pond	Yes	Yes	-34.12709968	22.08495049
	Seep E	Stormwater Pond	Yes	Yes	-34.1274018	22.084817
	Seep C	Stormwater Pond	Yes	Yes	-34.12772501	22.08387548
	Seep C	Stormwater Pond	Yes	Yes	-34.12840656	22.08314475
	Seep B	Stormwater Pond	Yes	Yes	-34.13030076	22.08390285
	Seep B	Stormwater Pond	Yes	Yes	-34.12992423	22.08291991
	Seep A	Stormwater Pond	Yes	Yes	-34.13087979	22.08230863
	Seep A	Stormwater Pond	Yes	Yes	-34.13147396	22.08167122
	Seep A	Stormwater Pond	Yes	Yes	-34.13194778	22.08308854
	Seep F	Stormwater Pond	Yes	Yes	-34.1329532	22.08675932
Hartenbos_Water Uses_Stormwater Pond_watercourses	Watercourse 1	Stormwater Pond	Yes	Yes	-34.12857519	22.09079633
	Watercourse 5	Stormwater Pond	Yes	Yes	-34.13097662	22.08411963
	Watercourse 6	Stormwater Pond	Yes	Yes	-34.1317932	22.08464837
	Watercourse 6	Stormwater Pond	Yes	Yes	-34.13199697	22.08512615
	Watercourse 6	Stormwater Pond	Yes	Yes	-34.13187752	22.08606064