Freshwater Consulting

Environmental Impact Assessment for erf 134, Cape Infanta: Inland Aquatic Ecosystems and Aquatic Biodiversity

DECEMBER 2024

DRAFT FOR DISCUSSION

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1 INTRODUCTION

1.1 Background and Approach

The Freshwater Consulting Group (FCG) was commissioned by Doug Jeffery Environmental Consultants to undertake an environmental impact assessment (EIA) of the inland aquatic ecosystems potentially affected by the proposed residential development of a portion of erf 134 at Cape Infanta, Western Cape. Erf 134 is located in the Stellenbosch Municipality and the Overberg District Municipality; the erf is currently zoned Agriculture 1, and is 3.04 ha in area.

Three alternative development layouts are proposed. Alternative 1 (13th April 2012) comprises 23 erven, 16 of which would be single storey and 7 double storey, Alternative 2 (26th August 2013) comprises 21 erven, 15 of which are single storey and 5 double storey and lastly, Alternative 3 (9th May 2023, updated November 2024) also with 21 erven.

The specific aims of the inland aquatic ecological input to the EIA, and our approach, were as follows:

Phase 1: Baseline study

- Assess the opportunities and constraints on and outside the site for development and depict these visually (if appropriate). In order to do this, the site was visited on the 25th August 2010 (winter). All inland aquatic ecosystems (watercourses and wetlands) on and surrounding (within 1km) the site were mapped on an aerial photograph of the area, and ground-truthed for those ecosystems directly impacted by the development (i.e. within the development footprint). The present ecological status (PES) and ecological importance and sensitivity (EIS) of the affected inland aquatic ecosystems was assessed, using accepted methods. The local context of the inland aquatic ecosystems was taken into account in this assessment, including interaction with groundwater. The watercourse passing through the site was dry at the time of the field visit, and there is anecdotal evidence that it flows only after major rain events. Collection of primary data (such as water quality and macroinvertebrates) from such ephemeral systems is challenged by the fact that they are seldom inundated for any length of time. The precautionary principle is advised in these circumstances, and the assumption made that water quality is good, and the aquatic fauna sensitive and important.
- Compile a baseline report describing and briefly assessing the extent and severity of the expected impacts of the development, to be used in Phase 2 (Environmental Impact Assessment), that will highlight concerns, and make recommendations regarding mitigation measures required. Opportunities for the incorporation of the stream into the development, while not impacting on riverine functioning, will be proposed.
- Attend meetings of the project team for integration purposes; and
- Prepare for and attend the public open house in order to present the summary of the baseline report.

Phase 2: Aquatic Biodiversity Specialist Assessment

- A site sensitivity verification was done for erf 134, in order to determine the sensitivity of the site with regards to aquatic biodiversity. The site is almost entirely rated as “very high sensitivity”, thus an Aquatic Biodiversity Specialist Assessment was deemed to be necessary for the development.
- The baseline report was updated to an Aquatic Biodiversity Specialist Assessment report, including a detailed assessment of the significance of the impacts associated with the three

development layouts, and the no development option. Specific management and monitoring requirements, to be used as the basis of conditions for the Environmental Authorisation (should it be granted), and a subsequent Environmental Management Programme, are provided.

1.2 Assumptions and limitations

The stream that crosses erf 134 is an ephemeral stream and was dry at the time of the site visit in 2010. It appears that the stream flows only after heavy rains. Collection of primary data (such as water quality and macroinvertebrates) from such ephemeral systems is challenged by the fact that they are seldom inundated for any length of time. The precautionary principle is advised in these circumstances, and the assumptions made that water quality is good, and the aquatic fauna sensitive and important. This elevates the overall sensitivity and importance of the stream, in the absence of data to prove otherwise.

1.3 Use of this Report

This report reflects the professional opinions of its author. It is the policy of FCG that the full and unedited contents of this report should be presented to the client, and that any summary of the findings should only be produced in consultation with the first author.

1.4 Declaration of Independence

This is to confirm that Kate Snaddon, the specialist consultant who is responsible for undertaking this study and preparing this environmental impact assessment report, is independent, and has no vested interests, financial or otherwise, in the proposed activity under consideration.

1.5 Specialist Details

The author of this report is an independent specialist consultant, with 25 years of experience in the field of freshwater ecology, registered with the South African Council for Natural Scientific Professions (registration number 400225/06).

2 DESCRIPTION OF THE AFFECTED INLAND AQUATIC ECOSYSTEMS

2.1 Overview

A small, unnamed ephemeral stream crosses the property, entering erf 134 along its south-eastern border. The stream flows along the southern portion of the property before entering the sea. At the time of the site visit, the stream was dry and, by all accounts, it flows only rarely, after heavy rains. The stream lies in the Breede River catchment and Breede River Water Management Area (WMA) (Lower Breede River sub-WMA), in quaternary catchment H70K, which incorporates the lower Breede River and some of the coastline to the east of the Breede River mouth. Erf 134 lies in the Overberg District Municipality, and within the Southern Coastal Belt Level 1 ecoregion, which has the following characteristics (from Kleynhans *et al*., 2005):

Closed hills and mountains with moderate to high relief are characteristic of this ecoregion, but plains are also significant. South and Southwest Coast Renosterveld vegetation types are dominant.

- MAP (mm): 300 to 1000
- Coefficient of Variation (% of annual precipitation): <20 to 40
- Rainfall concentration index: <15 to 50
- Rainfall seasonality: Winter to all year
- Mean annual temp. (°C): 10 to 20
- Mean daily max. temp. (°C): February - 22 to 30
- Mean daily max. temp. (°C): July - 12 to 20
- Mean daily min. temp. (°C): February - 10 to 18
- Mean daily min temp. (°C): July - 4 to 10
- Median annual simulated runoff (mm) for quaternary catchment: 10 to >250

The stream is short, rising on the slopes of the Potberg Mountain, just to the east of Kadiekop (Figure 2.1) and flowing for approximately 4 km to the sea. To the west of the site, the stream channel comprises bedrock and some cobble but mostly sand, but once the stream enters erf 134, the channel comprises only sand. The stream is supposed to flow under the road in a single pipe, but this pipe was completely blocked by sand and silt at the time of the site visit. Stormwater runoff from the road enters the property at several points. The stream channel is heavily invaded by *Acacia cyclops*.

Photo 1 Dirt road to Cape Infanta, showing one of the stormwater "swales" carrying runoff from the road onto erf 134.

The surrounding vegetation on erf 134 is either De Hoop Limestone Fynbos (least threatened) and Overberg Dune Strandveld (least threatened) along the coast (Mucina & Rutherford, 2006; Rebelo *et al*., 2006). The least threatened status of these vegetation types is largely due to the protection of large tracts within the De Hoop Nature Reserve.

Electrical conductivity of the local groundwater varies between 130 and 410 mS/m, with EC increasing towards the coastline as one moves from groundwater originating in the Skurweberg Formation (composed of inert quartzitic rocks resistant to weathering) through to that originating from the Rietvlei Formation (consisting of occasional siltstone and shale beds) (Parsons, 2005). Groundwater was found by Parsons (2005) to be virtually uncontaminated, despite the use of septic tanks and soakaways in Cape Infanta and Infanta Park. It is likely that the groundwater resources of the area are separated from surface runoff by relatively impermeable shale in the vicinity of the town (Parsons, 2005). An exception to this was found by Toens & Partners (1999) to be bacterial contamination in areas where Table Mountain Group formations outcrop, as the quartzites in the TMG formations are more permeable than shale.

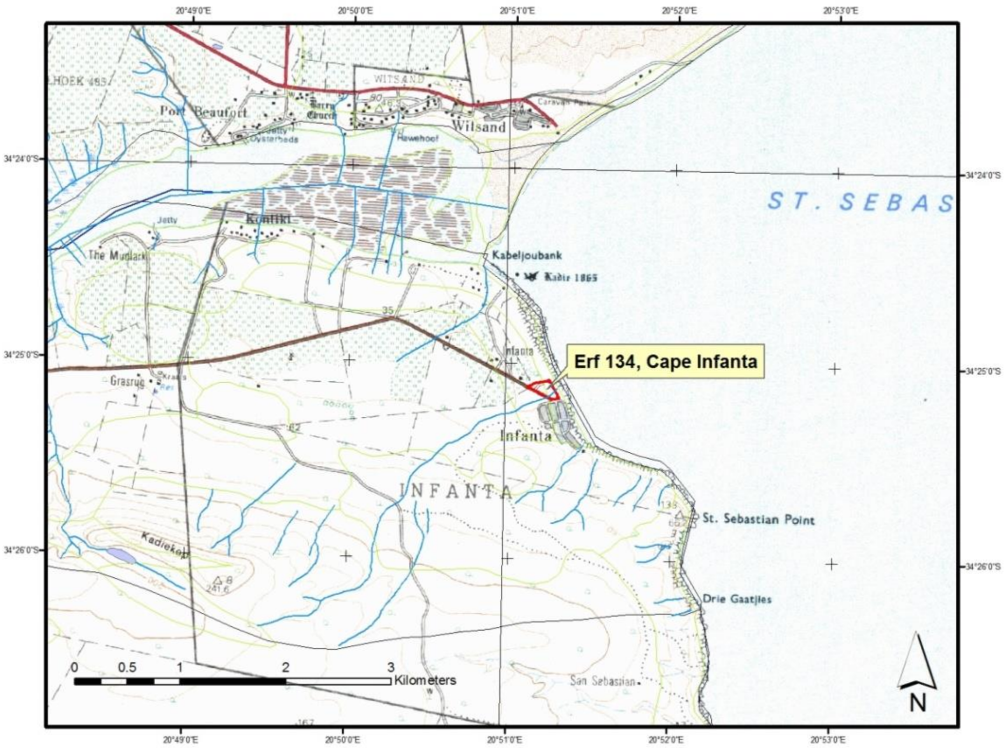

Figure 2.1 Location of erf 134 near the mouth of the Breede River, with rivers and streams shown as blue lines. The site is in the Overberg District Municipality.

2.2 Watercourse delineation

The stream as it flows over erf 134 does not have a clear riparian area around the edges of the channel. The channel itself is not visible, as flow along the channel is insufficient to create a defined channel. The riparian area around the watercourse has been heavily invaded by *Acacia cyclops*, and the soils in the riparian area are sandy soils, with no visible alluvial indicators. In the absence of soil and vegetation indicators (as per the national delineation guidelines (DWAF, 2005), delineation of the riparian area was not possible. Nonetheless, the centreline of the watercourse was surveyed, and is shown in Figure 2.2.

Figure 2.2 Aerial photograph of Cape Infanta, showing the watercourse (blue line) and its recommended ecological buffer (purple outline). The 1:100 year floodline falls within the buffer.

3 SITE SENSITIVITY VERIFICATION

The Environmental Impact Assessment Screening Tool of the Department of Forestry, Fisheries and the Environment (DFFE) shows that the site is within an area of very high aquatic biodiversity sensitivity. This is based on the fact that the site lies within a national Freshwater Ecosystem Priority Area (FEPA) sub-quaternary catchment. The status of the sub-catchment is such due to the known locations of populations of the fish species *Sandelia capensis* (Cape kurper) and *Pseudobarbus burchelli* cf. Breede (Breede River Redfin). As such the rivers in this catchment (in particular the mainstem of the lower Breede River) are considered "fish sanctuaries", requiring protection from negative impacts. It is, however, unlikely that these species occur in the short watercourses flowing off east-facing slopes of Potberg.

The presence of a watercourse on site does mean that this portion of the site is of very high sensitivity with regards to aquatic biodiversity, hence the need for an Aquatic Biodiversity Specialist Assessment (this report).

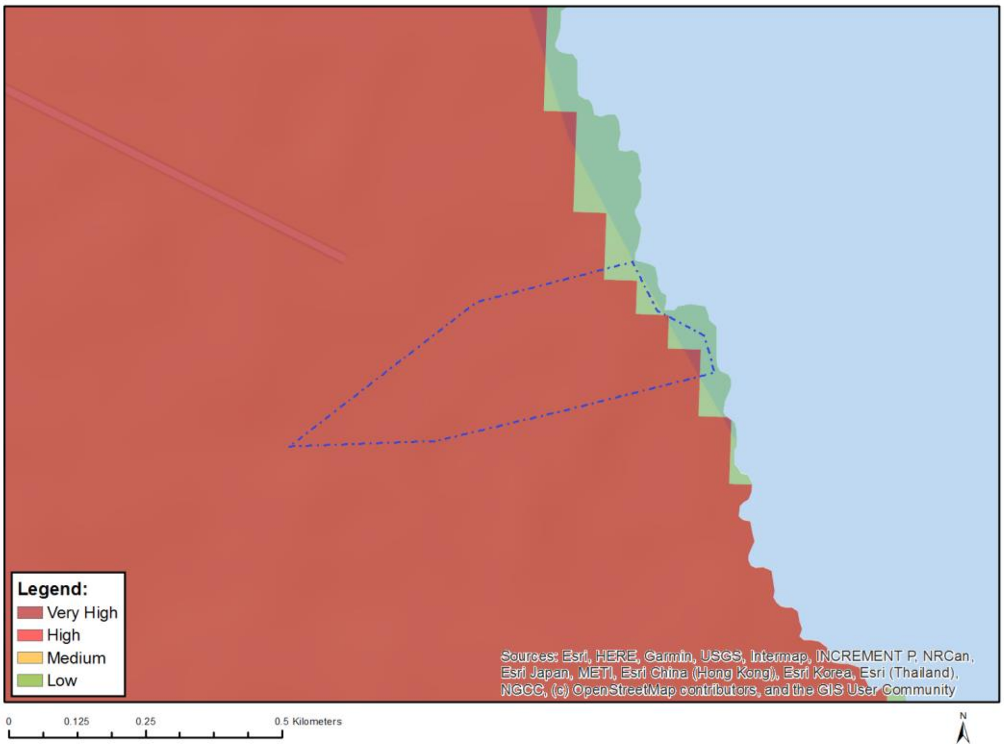

Figure 3.1 Sensitivity rating for erf 134, Cape Infanta (blue outline), according the DFFE's EIA Screening Tool.

4 ASSESSMENT OF THE CONDITION AND SENSITIVITY OF THE STREAM

4.1 Introduction

An assessment of the conservation importance or status of an inland aquatic ecosystem should combine assessments of both the current ecological integrity of the ecosystem and its perceived ecological importance and sensitivity. The *ecological integrity* of an ecosystem is defined as its ability to support and maintain a balanced, integrated composition of physico-chemical and habitat characteristics, as well as biotic components on temporal and spatial scales that are comparable to the natural characteristics of ecosystems of the region. The integrity of a system is directly influenced by its current state, and how much the system has been altered from the reference or unimpacted condition. The *ecological importance* of a river or stream is an expression of its importance to the maintenance of ecological diversity (i.e. both species and habitat diversity) and functioning on local and wider scales. *Ecological sensitivity* (or fragility) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Resh *et al.,* 1988; Milner, 1994). Both abiotic and biotic components of the system are taken into consideration in an assessment of ecological importance and sensitivity. It is strongly biased towards the potential importance and sensitivity of a particular section of a stream or river, as it would be expected under *unimpaired* conditions.

DWA's Resource Directed Measures (RDM) approach provides methods for the assessment of ecological integrity and of ecological importance and sensitivity, in the context of the determination of the ecological management class for riverine ecosystems as part of the Reserve Determination procedure (DWAF, 1999). This procedure can be followed at different levels of detail – desktop, rapid, intermediate and comprehensive. The rapid approach was followed for this study. Determination of the appropriate ecological management class for a river reach is useful in the context of an EIA, as this class, in conjunction with the attainable (or desired) ecological management class, provides an indication of the extent to which a river reach can be further modified (or not) by human activities that impact on that river reach. This will have a direct bearing on the significance of proposed impacts, and will guide the mitigation (if possible and relevant) of such impacts.

4.2 Methods

In 2005, DWS revised the methods for the determination of the PES of watercourses, through the development of the EcoClassification approach (Kleynhans *et al.*, 2005b). EcoClassification refers to the determination and categorisation of the Present Ecological State (PES; health or integrity) of various biophysical attributes of rivers relative the natural or close to the natural reference condition. This approach also allows for different levels of assessment, depending on time and budget, and the requirements of the assessment.

The rapid approach was followed for this study. Essentially this approach was based on assessment of existing impacts on two components of the stream - the **riparian** zone and the **instream** habitat, using visual information.

Assessments were made separately for both components, but data for the riparian zone were interpreted primarily in terms of their potential impact on the instream component. Criteria within each component are pre-weighted according to the importance of each, and each criterion is scored between 0 and 25, with six descriptive categories ranging from 0 (no impact), 1 to 5 (small impact), 6 to 10 (moderate impact), 11 to 15 (large impact), 16 to 20 (serious impact) and 21 to 25 (critical impact). The criteria are provided in Table 4.1.

The total scores for the instream and riparian zone components were used to place the stream in a habitat integrity or Present Ecological State (PES) category (A – F) for both components.

Table 4.1 Criteria used in the assessment of Present Ecological Status of watercourses (from Kleynhans, 1996).

Criterion	Relevance
Water abstraction	Direct impact on habitat type, abundance and size. Also implicated in flow, bed, channel and water quality characteristics. Riparian vegetation may be influenced by a decrease in the supply of water.
Inundation	Destruction of riffle, rapid and riparian zone habitat. Obstruction to the movement of aquatic fauna and influences water quality and the movement of sediments.
Water quality modification	Originates from point and diffuse point sources. Measured directly or agricultural activities, human settlements and industrial activities may indicate the likelihood of modification. Aggravated by a decrease in the volume of water during low or no flow conditions.
Flow modification – floods and low flows	Consequence of abstraction or regulation by impoundments. Changes in temporal and spatial characteristics of flow can have an impact on habitat attributes such as an increase in duration of low flow season, resulting in low availability of certain habitat types or water at the start of the breeding, flowering or growing season.
Bed modification	Regarded as the result of increased input of sediment from the catchment or a decrease in the ability of the river to transport sediment. Indirect indications of sedimentation are stream bank and catchment erosion. Purposeful alteration of the stream bed, e.g. the removal of rapids for navigation is also included.
Channel modification	May be the result of a change in flow, which may alter channel characteristics causing a change in marginal instream and riparian habitat. Purposeful channel modification to improve drainage is also included.
Exotic macrophytes	Alteration of habitat by obstruction of flow and may influence water quality. Dependent upon the species involved and scale of infestation.
Exotic fauna	Invasion by exotic fauna will influence indigenous biodiversity, with possible knock-on effects for habitat quality and availability.
Solid waste disposal	This refers to litter and any other solid waste, i.e. a direct anthropogenic impact which may alter habitat structurally, obstruct flow, or have a direct impact on biota. Also a general indication of the misuse and mismanagement of the river.
Indigenous vegetation removal	Impairment of the vegetated buffer will reduce its ability to protect the river from sediment and polluted runoff from the surrounding catchment. Refers to physical removal for farming, firewood and overgrazing.
Exotic vegetation encroachment	Excludes natural vegetation due to vigorous growth, causing bank instability and decreasing the buffering function of the riparian zone. Riparian area habitat diversity is reduced, and timing and quality of food source (leaves, wood, etc) for aquatic biota altered.
Bank erosion	Decrease in bank stability will cause sedimentation and possible collapse of the river bank resulting in a loss or modification of both instream and riparian habitats. Increased erosion can be the result of natural vegetation removal, overgrazing or exotic vegetation encroachment.

The DWS-recommended method for the determination of the **Ecological Importance and Sensitivity** for watercourses of a particular ecosystem considers the following ecological aspects of watercourses (DWAF, 1999):

- Rare and endangered instream and riparian biota;
- Unique instream and riparian biota;
- Intolerant instream and riparian biota;
- Species richness, both riparian and instream;
- Diversity of habitat types or features;
- Refuge value of habitat types;
- Sensitivity of habitat to flow changes;
- Sensitivity to water quality changes;
- Migration route/corridor for instream and riparian biota, and
- Presence of Protected Areas and conservation areas.

Each criterion is scored between 1 and 5, and the medians of these scores are calculated to derive the EIS category (Table 4.3).

Table 4.2 PES categories for watercourses (from Kleynhans, 1996).

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.	0-19

4.3 Results of assessment

In terms of both riparian and instream integrity, the stream is considered to be a **Category A (natural)** stream, as there is no significant abstraction of water from the stream, little modification to the channel and stream bed, and the surrounding vegetation is largely intact, with the exception of the section of stream flowing through erf 134 (Table 3.4).

In terms of ecological importance and sensitivity, only the abiotic component could be assessed, placing the stream in the '**high**' EIS category (Table 3.4). Due to its ephemeral nature, the stream is highly sensitive to changes in water quantity and quality, as any change will alter the characteristics of the stream. The stream is not highly important in terms of the provision of aquatic or semi-aquatic habitat, or as refuge for aquatic and semi-aquatic fauna and flora, due to the fact that the stream corridor is primarily a terrestrial feature, except during the days when there is flow in the stream. The stream flows off mountains that lie within the De Hoop Nature Reserve, which elevates its ecological importance.

Table 4.3 Ecological importance and sensitivity categories for watercourses.

Ecological Importance and Sensitivity Categories	General Description
Very high (score >3 and ≤4)	Reaches or rivers 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 channel / bed modifications and have no or only a small capacity for use.
High (score >2 and ≤3)	Reaches or rivers 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 channel / bed modifications but in some cases, may have a substantial capacity for use.
Moderate (score >1 and ≤2)	Reaches or rivers 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 channel / bed modifications and often have a substantial capacity for use.
Low/marginal (score >0 and ≤1)	Reaches or rivers that are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to channel / bed modifications and usually have a substantial capacity for use.

According to the DWA (1999), for a rapid determination of the ecological management class of a river, the "high" category equates to the default ecological management class of B – these are sensitive systems, where only a small risk of modifying the natural abiotic characteristics of the river should be allowed.

In summary, the **PES of the stream is Category A**, while the ecological management class for the stream is Class B. Future development in the stream's catchment and management of the stream must ensure that the stream remains in its current state, with no deterioration in management class. Overall, the stream can be considered to be of **very high conservation importance**. Due to the largely terrestrial nature of the stream corridor, it is important to also consider the conservation importance of the surrounding dunes and vegetation, and the requirements of any fauna that may use the stream corridor for dispersal, refuge, etc.

Table 4.4 Summary of the results of the assessments of HI and EIS for the stream entering erf 134, Cape Infanta.

Ecosystem	Habitat Integrity		Ecological Importance and Sensitivity
	Instream	*Riparian*	
Stream entering erf 134	94 CATEGORY A	91 CATEGORY A	2.5 HIGH

5 DESCRIPTION OF THE PROPOSED DEVELOPMENT

5.1 General description of the development

Three alternative development layouts are proposed. **Alternative 1** (13th April 2012) comprises 23 erven, 16 of which would be single storey and 7 double storey (Figure 5.1), **Alternative 2** (26th August 2013) comprises 21 erven, 15 of which are single storey and 5 double storey (Figure 5.2) and lastly, **Alternative 3** (19th May 2021, updated November 2024) also with 21 erven (Figure 5.3). The main material differences between Alternatives 2 and 3 are the location of the entrance roads and a shift in the configuration of the erven. All three development alternatives incorporate a conservation area in the north-western corner of the property. The location of the conservation area on Alternatives 2 and 3 takes account of the limestone sensitive area, as delineated in the botanist specialist report, and in both layouts the conservation area is just over 6 000 m^2.

The total cover of developable erven for all three alternatives is roughly 50%. All alternatives allow for the existing Main House and stoep, braai area and graveyard to remain as is, incorporated into the development as a separate erf. The existing garage and store will remain for all alternatives.

The final alternative is the **no development option**. This represents the status quo in terms of zoning – Agriculture 1 – and in terms of current permissible uses - primary use is for cultivation of land for crops and plants or the breeding of animals, or the operation of a game farm on an extensive basis on natural veld or land. The latter use includes activities and buildings that are reasonably connected with the main farming activities of the farm. Consent uses include additional dwelling units (a maximum of an additional five units), farm store, farm stall, intensive feed farming, riding school, nursery, service trade, and/or tourist facilities.

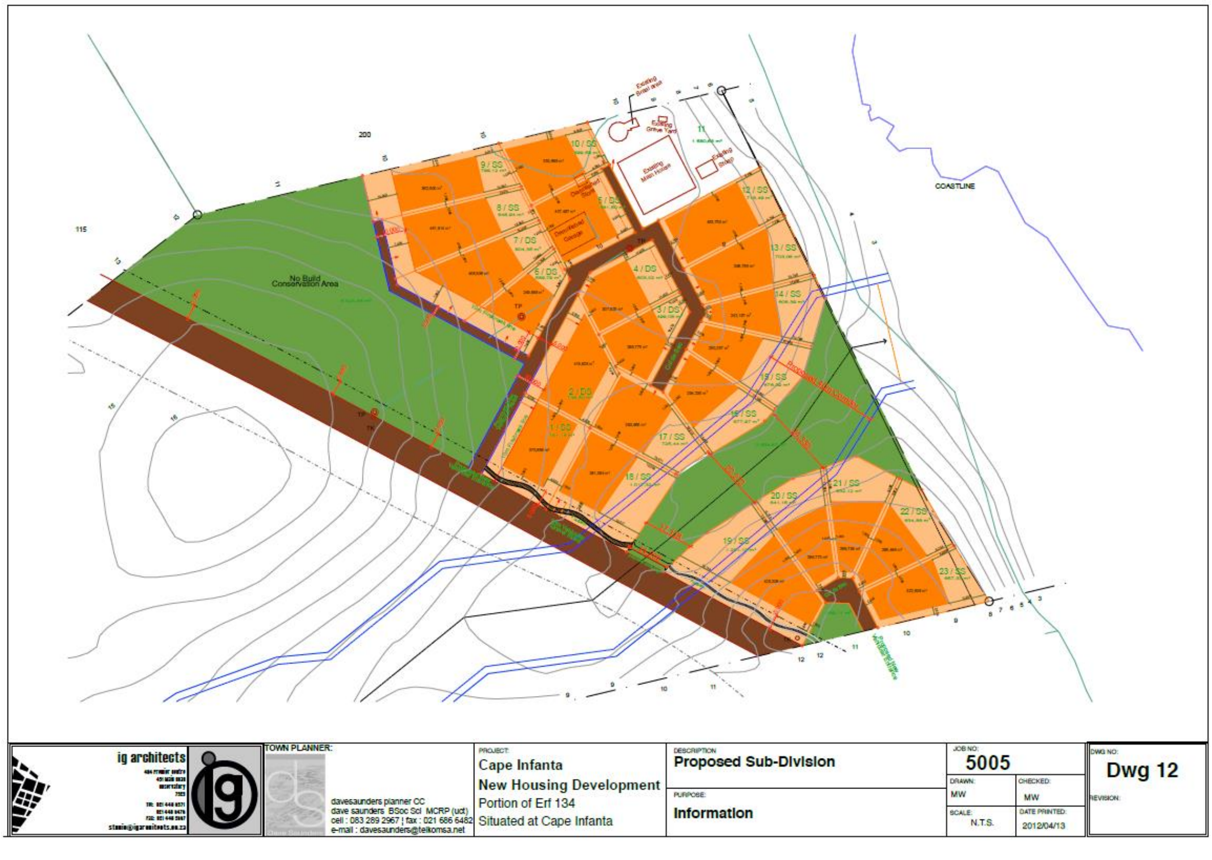

Figure 5.1 Alternative 1 layout for erf 134 Cape Infanta, comprising 23 erven and a conservation area in the north-western corner.

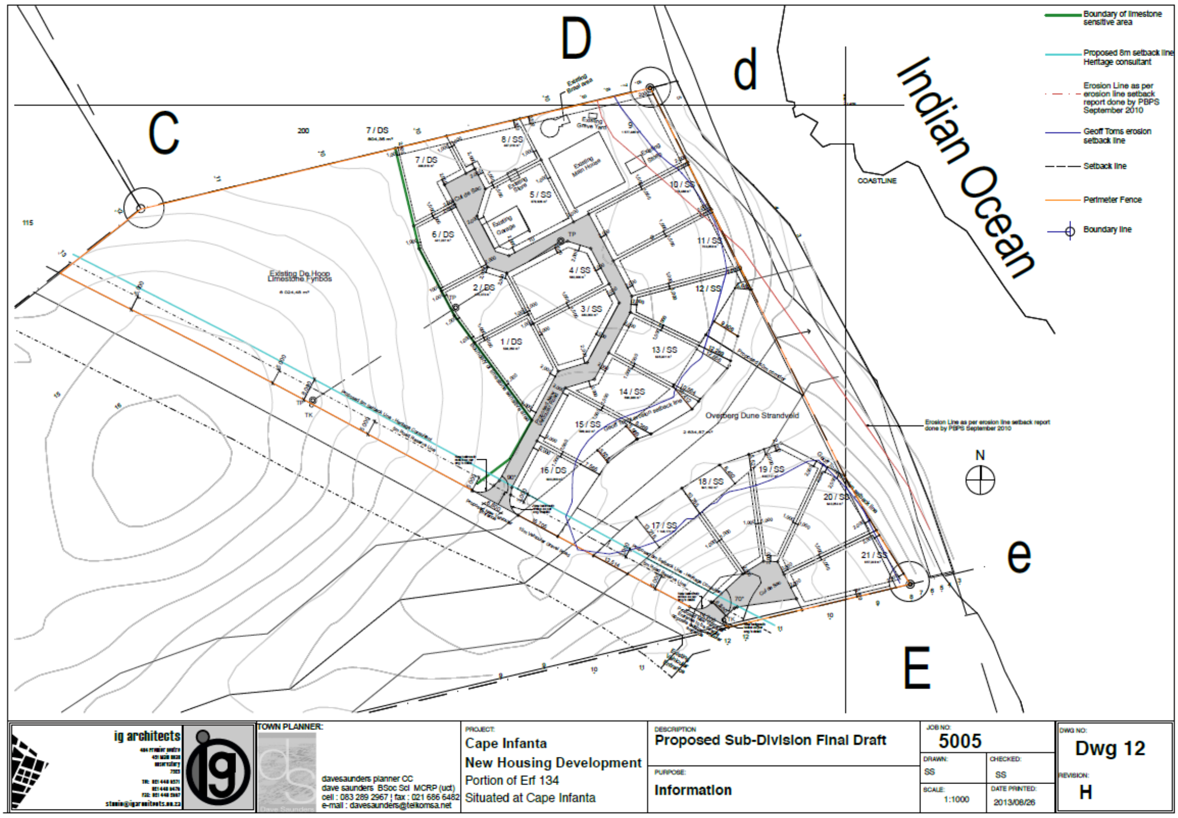

Figure 5.2 Alternative 2 layout for erf 134 Cape Infanta, comprising 21 erven and a conservation area in the north-western corner.

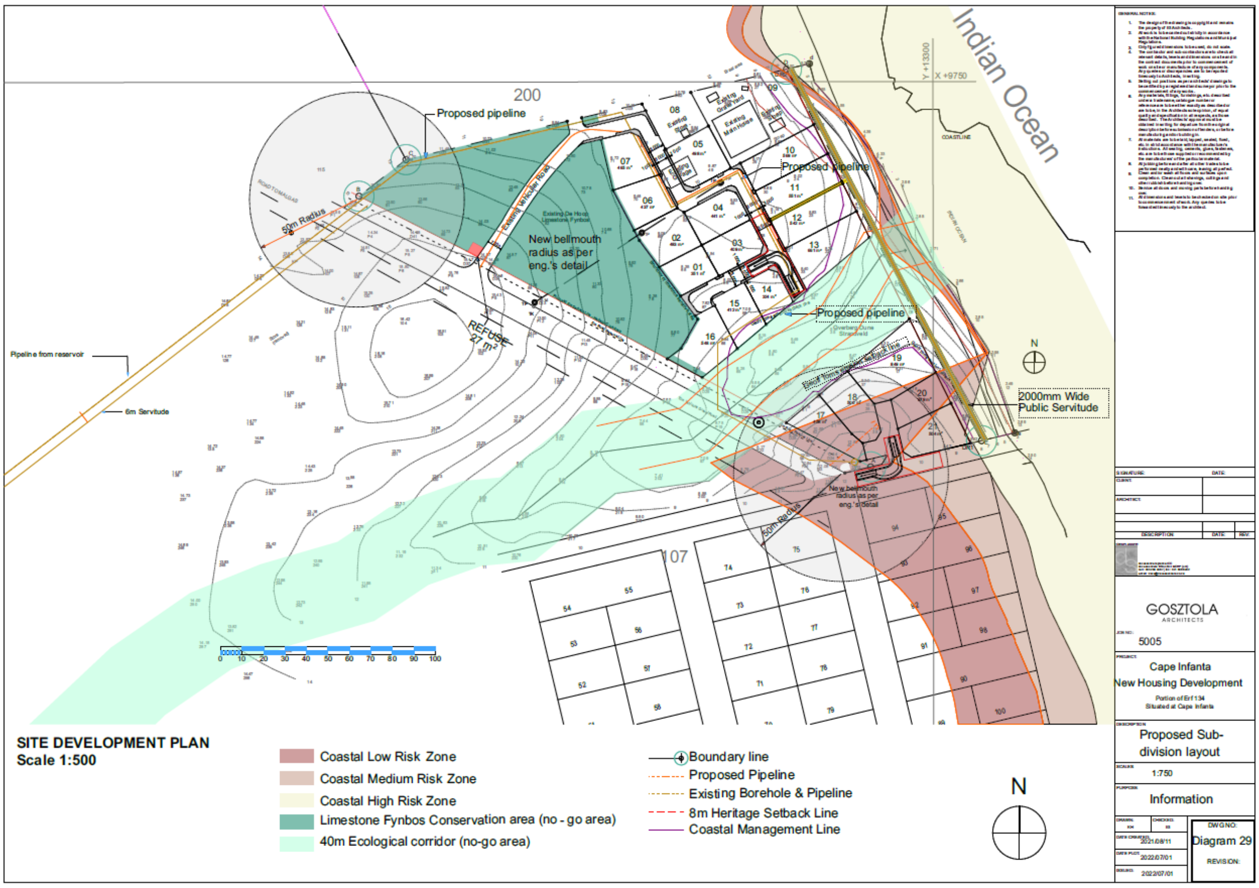

Figure 5.3 Alternative 3 layout proposed for erf 134 Cape Infanta, comprising 21 erven and a conservation area in the north-western corner. The main differences between Alternatives 2 and 3 are the location of the entrance roads, and the configuration of the erven.

Alternatives 1, 2 and 3 were developed through an iterative process, whereby the concerns of all specialists involved in the assessment phase were addressed and accommodated. The following specific concerns were raised from a freshwater ecological perspective:

- More open space within the development for the infiltration of runoff and precipitation;
- Smaller hardened footprint, and so less stormwater generated, and
- A sufficiently wide (40m) corridor around the watercourse is accommodated by the development layouts. The establishment of such a corridor will protect the watercourse/stream and the surrounding dunes that contribute runoff to the stream during rainfall.

5.2 Internal Roads

There will be two access roads onto the property for all Alternatives. For Alternative 3, the northern entrance road will run along the existing vehicular track. All internal roads are proposed to be 3m wide, with a 5m-wide road reserve (Fraser, 2014, 2020). This will accommodate mixed vehicular and pedestrian use. The roads will be surfaced with pavers, tar or 700mm wide concrete strips and the 1m-wide road reserve on either side will be grassed swales with some landscaping with indigenous vegetation to intercept runoff and allow infiltration.

5.3 Water supply

Water will be supplied from rainwater harvesting and storage structures, and boreholes. Water demand is expected to be in the order of 21 000 litres per day (Fraser, 2023). Rainwater storage tanks (most likely to be located underground in order to minimise the visual impact) of 5 kl capacity have been recommended for the houses, as it is expected that none of the houses will be occupied for more than 4 months of the year. Rainwater will be collected via roofs and guttering, and stored in tanks.

Parsons (2006) reported that there would be sufficient borehole water for 80 housing units, and that the water is of sufficient quality for drinking purposes, although it has been reported as being brackish. A Water User Licence would not be necessary, as a total of 1 m^3/day can be abstracted from each borehole before a Licence becomes necessary, and this quantity is more than sufficient to augment the rainwater supply. All boreholes are located to the west of the gravel road adjacent to the property, and it has been recommended (Fraser, 2023) that a reservoir be built close to one of the boreholes, and water transferred to the development via an existing pipeline (Figure 5.4). A new water pipeline would need to be constructed to take water into the development, and this pipe would be placed within the ecological buffer recommended for the watercourse (see Section 7.2) and will cross the watercourse within the roadway embankment, at 1m depth in a steel sleeve. The pipe will be located between the road edge and the culvert headwall at the crossing over the watercourse.

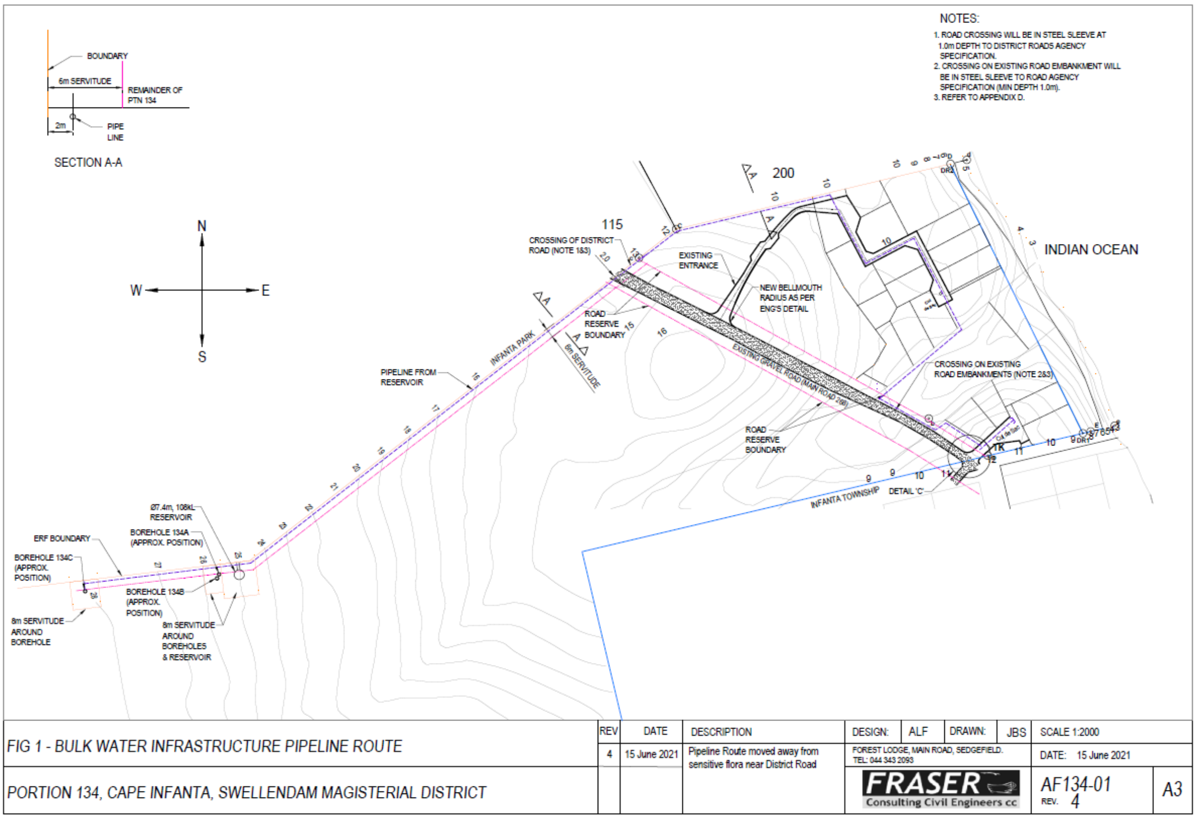

Figure 5.4 **Location of the borehole, water supply pipeline and proposed 108 kl reservoir to the west of the site.**

5.4 Stormwater Management

The stormwater management system has been designed using the principles of Sustainable Urban Drainage Systems (SUDS), which aim to mimic the natural (pre-development) system as far as possible. The natural state of runoff on the property is that 80% of natural runoff would flow towards the watercourse, and 20% towards the ocean (Fraser, 2014), and that the vegetated and rough characteristics of the surrounding catchment imply that most precipitation will be held on the land rather than flow overland into the watercourse or ocean.

The construction of hardened surfaces on the property would change this situation. In order to avoid this unnatural change, it is proposed that all roof runoff be directed into rainwater tanks, and that overflow from the tanks, and water running off all other hardened surfaces (e.g. roads) would be conveyed towards areas where water will be retained and allowed to filter into the ground, e.g. localised water sinks and soakaways (sand pits), rain gardens (essentially landscaped (i.e. not hardened) areas that lie immediately adjacent to the hard surfaces, such as roads, parking areas), grass swales and other permeable surfaces.

5.5 Sewage Management

The development is likely to produce roughly 17 kl sewage per day, at full occupancy (Fraser, 2023). The **primary option** for the treatment of sewage is a household package treatment plant, as supplied by Maskam Water™. The recommended option is the Fusion Series Treatment System. The treated effluent from such a plant complies with DWS's General Limits. The system requires a 6 monthly service, and it is recommended that each household takes care of its own effluent, instead of one or two plants for the whole development.

The process includes:

- A sedimentation chamber;
- An anaerobic chamber;
- A aerator filter media chamber; and
- A treated water storage chamber.

The water can be recycled for non-potable use such as flushing toilets, with the remaining effluent being used for irrigation or being discharged underground to a soak-away. Alternatively, all the effluent can be discharged to a soak-away as the surrounding soil is sand and is very porous.

An **alternative option** is the use of septic tanks and soak aways, a method that has been successful for many decades in Cape Infanta and which carries a low risk for groundwater and surface water pollution in the area (Parsons, 2020; Ross, 2020). The water will typically be conveyed to a 2500 litre tank, and will use either a single or two-tank system. There is the option of splitting grey water from black water. Only clean water is allowed to leave the final tank, leaving solids, oil and grease behind, where bacteria break down the matter. Recommendations for septic tank operation are made by Fraser (2023), thus ensuring that this sewage manage system will operate at the highest standards of hygiene and at the same time reduce the likelihood of negative impacts, such as overflow and pollution. Treatment is to also to DWS General Limits (Fraser, 2020).

6 LEGISLATION GOVERNING THE CONSERVATION AND MANAGEMENT OF WETLANDS AND RIVERS IN SOUTH AFRICA

The following sections briefly summarise those sections of the South African legislation and guidelines documents that pertain to the conservation and management of rivers and wetlands.

6.1 National Environmental Management Act (Act 107 of 1998, 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.

The Environmental Impact Assessment Regulations are stipulated in Government Notice R. 543 of 18th June 2010.

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

Key aspects include legislation that allows for:

<u>Section 6:</u> 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).

6.3 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.

6.4 National Water Act (1998)

The following non-consumptive water uses relate to activities that may impact on the integrity and function of water resources and the overall quality of the resource:

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.

DWA have issued a number of **General Authorisations (GA)** in terms of Section 39 of the National Water Act.

6.5 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 have updated and refined as the Western Cape Biodiversity Spatial Plan (see Section 6.6), 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:

- Given current water deficits, which will be accentuated by climate change, a 'water wise' planning and design approach in the Western Cape's built environment is to be mainstreamed.
- Rehabilitation of degraded water systems 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.

- An overarching approach to water demand management is to be adopted – 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.
- Regional Plans to be developed for Water Management Areas to ensure clear linkages and interdependencies between the natural resource base (including water resources) and the socio-economic development of the region are understood and addressed.
- Agricultural water demand management programmes to be developed with an emphasis on the Breede Valley and Oliphants / Doorn agricultural areas. Industrial water demand management programmes to be developed with an emphasis on Saldanha, Southern Cape and Cape Town. Settlement water demand management programmes to be developed with an emphasis on the Cape Town functional region.
- 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.

6.6 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.

6.7 Swellendam Spatial Development Framework (2020)

The Swellendam Municipality SDF is informed by the Provincial Spatial Development Framework Plan and the Western Cape Spatial Plan. One of the key objectives under the goal “Promote inter-municipal co-ordination to support sustainable use of natural resources and infrastructure” is to manage and protect water resources, catchments and dams. The promotion of conservation of biodiversity and sustainable environmental management based on bioregional planning objectives is identified as a critical issue.

With regard to Infanta, the local spatial development principles are to:

- Promote conservation of the surrounding natural environment and setting;
- Restrict inappropriate residential development;
- Maintain the pristine natural environment and rural coastal character, and
- Contain the urban footprint of Infanta within a clearly demarcated urban edge (see Figure 6.1).

Specifically, the following is included in the Framework:

Conservation of Sensitive Biophysical Environment: Sensitive areas of the biophysical environment should be managed with conservation objectives in mind, and should be protected from urban development. In this regard, the following areas are of particular importance:

- The urban edge areas immediately adjacent to areas of natural vegetation.

- The coastline, natural drainage system and areas immediately adjacent thereto.
- Any dune systems, particularly any frontal dunes along, the coastline.

Corridors of Linear Open Spaces:

- The functioning of the drainage line (see Figure 6.1) which effectively separates Infanta from Infanta Park should be protected and managed with conservation objectives in mind to ensure that both its ecological and hydraulic functionality is optimised and maintained.
- The existing coastal setback line, which is, in effect, the demarcated urban edge, should be maintained. No development should be permitted in this setback area, thereby ensuring that a continuous coastal corridor is maintained.

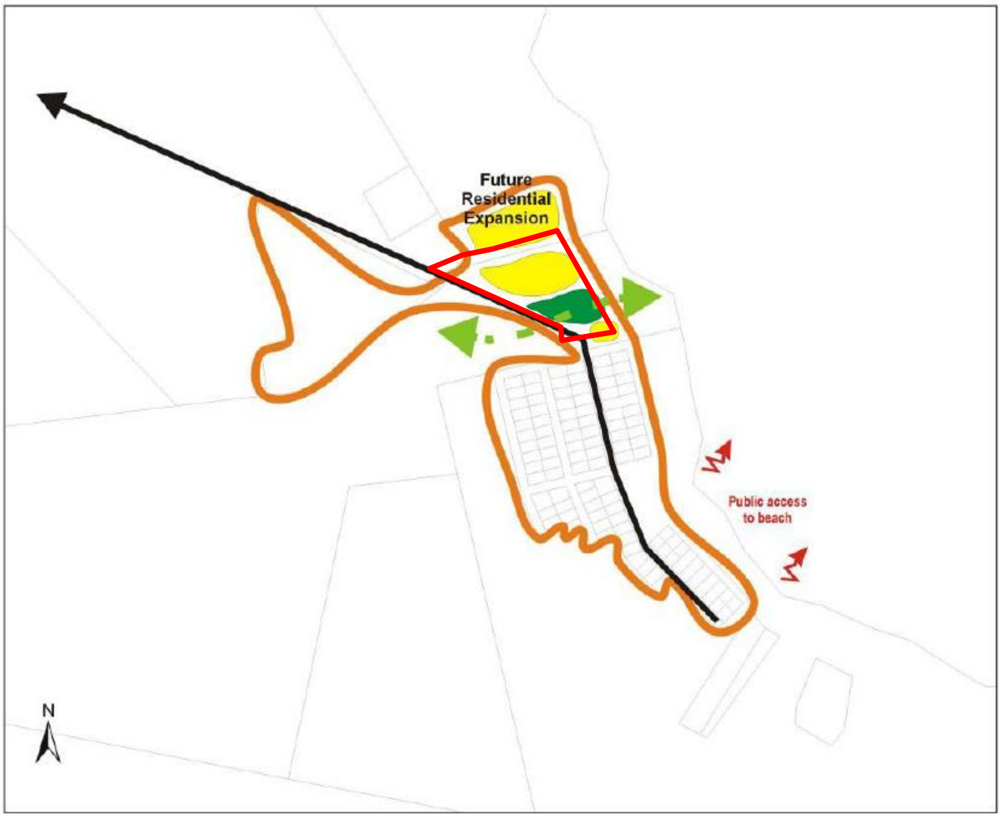

Figure 6.1 Spatial management model for Infanta (Swellendam SDF). The red boundary is erf 134 and the green dashed line is the watercourse corridor.

6.8 National Environmental Management: Biodiversity Act (Act 10 of 2004)

The Act aims to:

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

7 DESCRIPTION AND ASSESSMENT OF EXPECTED IMPACTS

The impacts that are expected to be associated with the proposed development (Alternatives 1, 2 and 3 – see Section 5.1) can be divided into those associated with the proposed layout, the construction phase (including pre-construction) and the operational phase.

7.1 Description of impacts and mitigation measures

7.1.1 Development Phase (design and construction)

A detailed construction environmental management programme (CEMPr) must be completed before the construction phase commences. The CEMPr must have input from all relevant specialists, and must contain detailed guidance on the minimization of disturbance during construction.

Trenching within the ecological corridor for laying of bulkwater pipeline – this may lead to mobilisation of sediment into the watercourse, or ocean, especially during high rainfall events, and may lead to the short-term loss of natural vegetation within the working area.

Mitigation:

- Ideally, the pipeline should be located outside of the ecological corridor.
- The width of the construction footprint must be kept to a minimum.
- Trenches must be excavated by hand, and not using machinery.
- Excavation of the pipeline trench must be done during the dry season.
- Opened trenches must be filled as quickly as possible after trenching is initiated. This is to keep the disturbed areas open and unstabilised for the shortest period possible. No trenches must be opened within three days of predicted heavy rainfall.
- The disturbed pipeline area must be rehabilitated, with input from a botanist, in order to snrue that the area recovers from the impacts of construction.

Storage or dumping of building materials (sand, soil, bricks etc.) or temporary lay-down of equipment close to the watercourse and its corridor – such dumping would damage the soil structure, and would destroy or shade out plants growing in and around the stream. Building materials, particularly fine material such as sand, dumped near the stream may gradually flow down the slope and enter the stream corridor.

Mitigation:

- Ensure that all building materials and equipment are stored at least 50m away from the watercourse corridor, as demarcated prior to construction.
- Materials should be stored in piles that do not exceed 1.5m in height and should be protected from the wind, to prevent spread of fine materials across the site.

Pollution of the stream corridor through leakage of fuels, oils, etc. from construction machinery, from washing of instruments or flushing of concrete mixers and other vehicles as well as sediments from de-watering of excavations. The ephemeral nature of the stream means that such pollutants would accumulate, and would flush into the sea only after heavy rains, which may lead to significant pollution of the coastal zone.

Mitigation:

- Any construction activities close to the stream cease during periods of heavy rain, to reduce the risks of contamination of the stream and ocean through rainfall and runoff.
- Machinery prone to oil or fuel leakage must be located at least 50 m away from any sensitive ecosystem, and the area bunded in order to contain leakages.
- Water pumps and cement mixers shall have drip trays to contain oil and fuel leaks – these must be cleaned regularly.
- Suitable toilet and wash facilities must be provided to avoid the use of sensitive areas for these activities.

<u>Destruction or deterioration of freshwater habitat as a result of foot and vehicular traffic</u> – access across and around the stream corridor onto the building site is likely to lead to damage of soils and vegetation.

Mitigation:

- The watercourse corridor must be well marked during the pre-construction phase.
- Pathways and access roads must be routed away from the stream corridor and coastline.

<u>Disturbance of freshwater fauna and flora</u> – the presence of construction teams and their machinery will lead to noise and light pollution in the area, which will disturb the local fauna and flora.

Mitigation:

- The construction site and access pathways should avoid sensitive areas, which must be demarcated during the pre-construction phase. If lights are used, these should be directed away from the stream corridor and coastline.
- Any animals found during site preparation or construction must be recorded and handed to the ECO.
- An education programme for all employees must be run at the start of construction, and when new contractor teams start on site.

<u>Introduction and spread of alien invasives</u> – top material brought onto the site, for filling and landscaping can lead to the introduction of alien or invasive seedbanks.

Mitigation:

- All soils and top material must be bought from a reliable source, and must be free of alien seeds or alien grass runners.

<u>Cumulative impacts associated with construction:</u>

All of the impacts described above will have a cumulative effect on the local environment, even if these are mitigated against. This activity would happen in the context of an urban environment close to the ocean and Breede River mouth, and thus all construction impacts would have an additive effect, i.e. each construction impact has the potential to harm the environment, to a lesser or greater extent, depending on the likelihood and effectiveness of mitigation. The impacts of greatest significance are those that are likely to create a disturbance or lead to the pollution of natural areas, or those that may persist for some time.

7.1.2 Operational Phase

A detailed environmental management programme (EMPr) must be compiled for the ongoing management of the development, and especially of its natural open spaces and conservation areas. The EMP must have input from all relevant specialists, and must contain detailed guidance on the minimization of disturbance and maximisation of conservation efforts.

The main points of the EMPr should be published as notices within every home so that all residents and visitors are aware of the sensitive environment in which the development is placed.

All development Alternatives will result in the hardening of the property and loss of terrestrial open space. This would impact on the movement of flora and fauna both in and out of the stream corridor, and across the erf to the coast or up the slopes. The whole of erf 134 to the east of the gravel road lies within a "coastal protection zone", as defined in the Integrated Coastal Management Act (2009). The purpose of this type of protection zone is to ensure protection of ecosystems associated with the coastline, which would include the mouths of rivers and streams meeting the sea. While development is allowed in coastal protection zones, this should be done in such a way as to avoid negative impacts on the ecosystems affected.

Mitigation:

While the open spaces within the development – in the north-western corner and around the watercourse – will mitigate to some extent against the impacts associated with the loss of open space and hardening of the property, there is limited connectivity between these two areas. These spaces are connected by a fairly narrow corridor along the western edge of the property adjacent to the gravel road. The movement of fauna and flora across the site would be improved through not constructing fences between the houses, thus allowing fauna to move between the houses. If fences must be constructed, these must be designed to allow the free movement of small mammals. A further mitigation would be through ensuring that all gardens are planted with locally indigenous plant species.

The open spaces provided for in all Alternatives, and the proposed SUDS infrastructure should allow for sufficient area for the infiltration of runoff across the site. No further mitigation measures are recommended in this regard.

All three Alternatives will result in the setting aside of a considerable portion of the site as conservation area. While there is no detail on how this area will be managed, this represents a positive impact that it is unlikely would apply to the no development alternative, due to the uncertainties associated with this option.

Cumulative impacts associated with the layout:

The activity will happen within a context of existing and possible future coastal development and hardening of the urban area of Cape Infanta (roads and houses). Thus, there is a cumulative effect of the loss of open space, which can be mitigated, but which is assumed to be of the same significance as the impacts of this development assessed on its own. This impact would have an additive effect over the long-term, i.e. each development will add to the effect to a lesser or greater extent, depending on mitigation, but always with a negative impact on the environment.

One of the main concerns about the operational phase of the residential development (Alternatives 1, 2 and 3) is the generation and management of stormwater. The stream is ephemeral and any change in hydrology will change the nature of the system, and lead to a deterioration in the quality of habitat provided within the corridor.

Mitigation:

- The proposed stormwater management system, if implemented in full, would adequately mitigate against the negative impacts associated with the generation, storage and discharge of stormwater on the site. It is understood that all stormwater generated by the development will be minimised at the point of accumulation, with only high discharge volumes and natural runoff being directed towards the watercourse and coastline.
- The pipe carrying water under the road must be cleaned out, so that this does not pose a flood risk for the proposed development. In addition, stormwater runoff from the dirt road into Cape Infanta must be formalised.

There will be <u>on-site treatment of waste water</u>, through the use of small package plants or septic tanks and soak-aways. Neither of these options for treatment of waste water will discharge treated effluent water directly into the watercourse, however, over time, these systems do release water which may contain nutrients into the soil. Due to the sandy nature of the soil, these will filter into the ground and may contaminate the groundwater, and ultimately may enter the river corridor. The risk of this occurring is low, however.

Mitigation:

- Treated waste water should not be used for irrigation, but can be used for flushing of toilets.
- All septic tanks and package plants are to be placed outside the 40m ecological corridor.
- Package plants, septic tanks and soak-aways must be checked to ensure that they are working, at least annually.
- Residents of the development must be educated in the use of household chemicals, detergents and solvents. It is inappropriate to use substances that could affect the efficiency of the septic tanks. Certain chemicals, such as bleaches, can destroy the bacterial communities in the septic tank.

The development will need to <u>abstract water from groundwater resources</u> in the area. This may lead to local drawdown of groundwater resources.

Mitigation:

- Both permanent residents and occasional visitors must be encouraged to use water sparingly, as groundwater is a precious resource, and the impacts of increased abstraction relatively unknown.
- Use of rainwater must be facilitated through construction of rainwater tanks, and use of rainwater encouraged.
- Only locally indigenous plants shall be allowed in gardens and landscaped areas. Grassed lawns must be of indigenous species, such as *Cynodon dactylon* (kweekgras).

<u>Disturbance of fauna and flora</u> - the proximity of the residential units and roads to the stream corridor and coastal zone will lead to an increase in disturbance in the form of noise, light, and physical disturbance from trampling by people and pets. The proposed buffer zone around the watercourse will provide some protection for the fauna and flora.

Mitigation:

- Residential and road lights should be directed away from the stream corridor and coastline.

- Residents, visitors and their pets should be discouraged from walking into and through the stream corridor. Boardwalks can be used to allow pedestrian access into the corridor, while protecting the fauna and flora.

Spread of alien invasives - landscaped areas may introduce exotic species that easily invade into natural areas, thus outcompeting indigenous species, and leading to a loss of diversity.

Mitigation:

- The stream corridor should be planted with appropriate indigenous vegetation, where necessary, and a barrier provided between landscaped areas (gardens or roadsides) and the corridor (e.g. a pathway).
- Kikuyu grass should not be allowed on the site.
- Road reserves can be grassed with indigenous species such as *Cynodon dactylon* (kweekgras).
- The spread of alien plant species into the natural areas must be prevented and monitored.

Removal of alien vegetation - this is an opportunity to remove all alien and invasive plant species that inhabit the site, and so increase the local biodiversity of flora as well as the depending on the vegetation.

All three alternatives will result in the management of a considerable portion of the site as a conservation area. While there is no detail on how this area will be managed, this represents a positive impact that it is unlikely would apply to the no development alternative, due to the uncertainties associated with this option.

Cumulative impacts associated with operation:

All of the above operational impacts will have an additive cumulative effect on the natural environment, either negative or positive (in the case of alien vegetation removal). The impacts of most concern would be the loss of open space, generation of stormwater, on-site treatment of waste water, and the use of groundwater resources. There may currently be the capacity for this particular development, but should there be further development in the area, the additive effect may exceed the capacity.

7.2 Recommended ecological buffer for the watercourse

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 a water resource, the development setback or buffer should be used instead of the blanket 32m, 500m or 100m setback requirements of the NEMA/National Water Act. For watercourses, the 1:100 year floodline should preferably be within the recommended buffer.

The buffer for the watercourse was determined using the site-based protocol for buffer determination of MacFarlane and Bredin (2017). The assessment is based on the PES and EIS of the watercourse (see Section 4), and the assumed quality of the buffer during both phases of the project. In this case, it was assumed that the current vegetation (i.e. fairly sparse, shrubby vegetation) will remain within the buffer. The density of vegetation within a buffer plays a major role in determining its effectiveness – a well-vegetated buffer, with a high basal cover (such as grass or sedges) is the most effective, due to the ability of the plants and their roots to trap sediments, toxins and other pollutants before they reach the wetland.

The recommended buffer for the watercourse is 20m, for both the construction and operational phases. Due to the lack of a clearly defined channel, the buffer was measured from the centreline of the watercourse, as shown in Figure 2.2. In this instance, this was considered more than adequate for the protection of the watercourse, due to its intermittent nature, and thus the lack of sensitive riverine fauna and flora. The main aim of the buffer is to protect the riverine corridor, and the surrounding slopes, which supply water to the watercourse (from rainfall), in addition to supply from upstream.

7.3 Methods for the assessment of impacts

The evaluation of impacts was done using the criteria supplied in the EIA Regulations published by the Department of Environmental Affairs, in terms of the National Environmental Management Act (Act 107 of 1998), on 4th December 2014, and amended on the 7th April 2017. The criteria are listed in Table 7.1.

Table 7.1 Criteria used for the assessment of impacts associated with the proposed Cape Infanta development.

	Criterion	Description
a)	**Nature of Impact**	Define or describe the type of effect (**negative** or **positive**) that a proposed activity would have on the environment. This description includes **what is to be affected**.
b)	**Extent**	Describe whether the impact occurs on a scale limited to the **site** area, **local** area (i.e. limited to the site and within 10 km of the site), **regional** (covers an entire region or extends into another region) or **national** (national implications or crosses over national boundaries) scale.
c)	**Duration**	Predict whether the lifespan of the impact will be **short term** (0 to 5 years); **medium term** (5 to 15 years); **long term** (i.e. beyond the operational phase but not permanently), or **permanent** (i.e. mitigation through natural processes or human intervention will not occur in such a way or in such time span that the impact can be considered transient).
d)	**Consequence**	Indicate how the activity will affect the environment.
e)	**Probability**	Describe the probability of the impact actually occurring as **definite** (impact will occur regardless of mitigations), **highly probable** (most likely), **probable** (distinct possibility), or **improbable** (low likelihood).
f)	**Irreplaceable loss of resources**	Describes the degree to which resources will be irreplaceably lost due to the proposed activity. It can be **no loss of resources**, **marginal loss**, **significant loss** or **complete loss** of resources.
g)	**Reversibility**	The degree to which an impact can be reversed, from **fully reversible**, to **partly reversible** to **irreversible**.
h)	**Indirect impacts**	Indirect impacts are secondary impacts and usually occur at a different place or time. Specialists will need to elaborate on any indirect or secondary impacts of proposed activities. If there are no indirect impacts specialist will need to briefly explain so.
i)	**Cumulative impact**	An effect which in itself may not be significant but may become significant if added to other existing or potential impacts that may result from activities associated with the proposed development. Cumulative impacts prior to and post mitigation must be assessed. The cumulative effect can be: **negligible** (the impact would result in negligible to no cumulative effect), **low** (the impact would result in insignificant cumulative effects), **medium** (the impact would result in minor cumulative effects) or **high** (the impact would result in significant cumulative effects).
j)	**Degree to which the impact can be avoided**	This indicates the degree to which an impact can be avoided. The degree of avoidance can either be **high** (impact is completely avoidable), **moderate** (impact is avoidable with moderate mitigation), **low** (the impact is difficult to avoid and will require significant mitigation measures) or **unavoidable** (the impact is cannot be avoided even with significant mitigation measures).
k)	**Degree to which impact can be managed**	This indicates the degree to which an impact can be managed. The degree of management can either be **high** (impact is completely manageable), **moderate** (impact is manageable with moderate mitigation), **low** (the impact is difficult to manage and will require significant mitigation measures) or **unmanageable** (the impact is cannot be managed even with significant mitigation measures).

	Criterion	Description
l)	**Residual impacts**	Residual impacts are those impacts that remain following the implementation of mitigation measures. Residual impacts must be identified and discussed. If there are no residual impacts, the specialist will need to briefly explain that the activity will have no residual impacts.
m)	**Degree to which an impact can be mitigated**	The impact can be **high** (fully mitigated), **moderate** (partly mitigated) or **not mitigated**.
n)	**Significance**	The significance of impacts shall be assessed with and without mitigations. The significance of identified impacts on components of the affected environment shall be described as: • **Very high negative or positive**: A negative impact will have highly significant effects which are unlikely to be mitigated adequately. A positive impact will have a highly significant positive effect on the environment. • **High negative or positive**: A negative impact will have significant effects and will require significant mitigation measures to achieve an accepted level of impact. A positive impact will have significant positive effects. • **Medium positive or negative**: The impact would have a moderate effect on the environment, requiring moderate mitigation (if negative). • **Low negative or positive**: The impact will have negligible effect on the environment and will require little or no mitigation (if negative). • **No impact**: Where the impact will not have an influence on the environment.

7.4 Results of Assessment

7.4.1 Development phase (design and construction)

	Alternatives 1, 2 and 3	No-Go
Freshwater Impacts		
Potential impact and risk:	**Trenching within the ecological corridor for laying of bulkwater pipeline, leading to mobilisation of sediment into the watercourse, or ocean, especially during high rainfall events, and may lead to the short-term loss of natural vegetation within the working area**	
Nature of impact:	Negative impact on the condition of the ecological corridor and stream habitat	N/A
Extent and duration of impact:	Local and short term	N/A
Consequence of impact or risk	Deterioration in stream Present Ecological State	N/A
Probability of occurrence:	Probable	N/A
Degree to which the impact can be reversed:	Fully reversible	N/A
Degree to which the impact may cause irreplaceable loss of resources:	Partly replaceable	N/A
Indirect Impacts:	Sedimentation in the tidal zone, and smothering of vegetation in the watercourse	N/A
Cumulative impact prior to mitigation:	Low to medium negative	N/A
Significance rating of impact prior to mitigation	Low to medium negative	N/A

	Alternatives 1, 2 and 3	No-Go
Degree to which the impact can be avoided:	Medium	N/A
Degree to which the impact can be mitigated:	Medium (assuming the pipeline cannot be moved out of the ecological corridor)	N/A
Proposed mitigation:	Assuming that the pipeline cannot be moved out of the ecological corridor, the following mitigation measures apply: • The width of the construction footprint must be kept to a minimum. • Trenches must be excavated by hand, and not using machinery. • Excavation of the pipeline trench must be done during the dry season. • Opened trenches must be filled as quickly as possible after trenching is initiated. This is to keep the disturbed areas open and destabilised for the shortest period possible. No trenches must be opened within three days of predicted heavy rainfall. • The disturbed pipeline area must be rehabilitated, with input from a botanist, in order to ensure that the area recovers from the impacts of construction.	N/A
Residual Impacts:	None	N/A
Cumulative impact post mitigation:	Low	N/A
Significance rating of impact after mitigation	Low	N/A

	Alternatives 1, 2 and 3	No-Go
Freshwater Impacts		
Potential impact and risk:	**Damage the soil structure, and destroy or shade out plants growing in and around the stream**	
Nature of impact:	Negative impact on the condition of the stream habitat	N/A
Extent and duration of impact:	Local and short term	N/A
Consequence of impact or risk	Deterioration in stream Present Ecological State	N/A
Probability of occurrence:	Probable	N/A
Degree to which the impact can be reversed:	Fully reversible	N/A
Degree to which the impact may cause irreplaceable loss of resources:	Partly replaceable	N/A
Indirect Impacts:	No indirect impacts due to low intensity and local scale of the impact	N/A
Cumulative impact prior to mitigation:	Low to medium negative	N/A
Significance rating of impact prior to mitigation	Low to medium negative	N/A

	Alternatives 1, 2 and 3	No-Go
Degree to which the impact can be avoided:	High	N/A
Degree to which the impact can be mitigated:	High	N/A
Proposed mitigation:	• Ensure that all building materials and equipment are stored at least 50m away from the watercourse corridor, as demarcated prior to construction. • Materials must be stored in piles that do not exceed 1.5m in height and must be protected from the wind, to prevent spread of fine materials across the site.	N/A
Residual Impacts:	None	N/A
Cumulative impact post mitigation:	Negligible	N/A
Significance rating of impact after mitigation	Negligible	N/A

	Alternatives 1, 2 and 3	No-Go
Freshwater Impacts		
Potential impact and risk:	**Pollution of the stream corridor through leakage of fuels, oils, etc. from construction machinery**	
Nature of impact:	Negative impact on the water quality within the stream and coastline	N/A
Extent and duration of impact:	Regional and Long term	N/A
Consequence of impact or risk	Deterioration in water quality in the stream	N/A
Probability of occurrence:	Probable	N/A
Degree to which the impact can be reversed:	Partially reversible	N/A
Degree to which the impact may cause irreplaceable loss of resources:	Irreplaceable	N/A
Indirect Impacts:	This may impact negatively on water quality on the coastline (intertidal and tidal zone), which may manifest during or after construction.	N/A
Cumulative impact prior to mitigation:	Medium negative	N/A
Significance rating of impact prior to mitigation	Low to medium negative	N/A
Degree to which the impact can be avoided:	Medium	N/A
Degree to which the impact can be mitigated:	Medium	N/A
Proposed mitigation:	• Any construction activities close to the stream cease during periods of heavy rain, to reduce the risks of contamination of the stream and ocean through rainfall and runoff. • Machinery prone to oil or fuel leakage must be located at least 50 m away from any sensitive ecosystem, and the area bunded in order to contain leakages.	N/A

	Alternatives 1, 2 and 3	**No-Go**
	• Water pumps and cement mixers shall have drip trays to contain oil and fuel leaks – these must be cleaned regularly. • Suitable toilet and wash facilities must be provided to avoid the use of sensitive areas for these activities.	
Residual Impacts:	Even with mitigation, there may be some soil contamination around the construction site, which will slowly wash into the stream and the sea. The intensity is likely to be low.	N/A
Cumulative impact post mitigation:	Low to medium negative	N/A
Significance rating of impact after mitigation	Low negative	N/A

	Alternatives 1, 2 and 3	**No-Go**
Freshwater Impacts		
Potential impact and risk:	**Destruction or deterioration of freshwater habitat as a result of foot and vehicular traffic**	
Nature of impact:	Negative impact on stream habitat	N/A
Extent and duration of impact:	Local and Short term	N/A
Consequence of impact or risk	Deterioration in condition of stream habitat	N/A
Probability of occurrence:	Probable	N/A
Degree to which the impact can be reversed:	Fully reversible	N/A
Degree to which the impact may cause irreplaceable loss of resources:	Partly replaceable	N/A
Indirect Impacts:	Unlikely to be any indirect impacts due to the low intensity and local scale of the impact	N/A
Cumulative impact prior to mitigation:	Low negative	N/A
Significance rating of impact prior to mitigation	Low negative	N/A
Degree to which the impact can be avoided:	High	N/A
Degree to which the impact can be mitigated:	High	N/A
Proposed mitigation:	• The watercourse corridor must be well marked during the pre-construction phase. • Pathways and access roads must be routed away from the stream corridor and coastline.	N/A
Residual Impacts:	None	N/A
Cumulative impact post mitigation:	Negligible	N/A
Significance rating of impact after mitigation	Negligible	N/A

	Alternatives 1, 2 and 3	No-Go
Freshwater Impacts		
Potential impact and risk:	**Disturbance of freshwater fauna and flora due to light and noise pollution**	
Nature of impact:	Negative impact on biodiversity - stream fauna and flora	N/A
Extent and duration of impact:	Local and Short term	N/A
Consequence of impact or risk	Movement of fauna off site, and deterioration in condition of plant communities leading to loss of biodiversity on the site	N/A
Probability of occurrence:	Definite	N/A
Degree to which the impact can be reversed:	Partially reversible	N/A
Degree to which the impact may cause irreplaceable loss of resources:	Partly replaceable	N/A
Indirect Impacts:	Fauna may move off the site and onto other properties, increasing inter-species interactions elsewhere. This is likely to be of low intensity, as the neighbouring areas to the north and west of the site can probably accommodate the number of individuals that may be impacted in this manner.	N/A
Cumulative impact prior to mitigation:	Medium negative	N/A
Significance rating of impact prior to mitigation	Low to Medium negative	N/A
Degree to which the impact can be avoided:	Medium	N/A
Degree to which the impact can be mitigated:	Medium	N/A
Proposed mitigation:	• The construction site and access pathways should avoid sensitive areas, which must be demarcated during the pre-construction phase. If lights are used, these should be directed away from the stream corridor and coastline. • Any animals found during site preparation or construction must be recorded and handed to the ECO. • An education programme for all employees must be run at the start of construction, and when new contractor teams start on site.	N/A
Residual Impacts:	This impact is difficult to mitigate completely, so there is likely to be a residual impact, although of low intensity.	N/A
Cumulative impact post mitigation:	Low to Medium negative	N/A
Significance rating of impact after mitigation	Low negative	N/A

	Alternatives 1, 2 and 3	No-Go
Freshwater Impacts		
Potential impact and risk:	**Introduction and spread of alien invasives – top material brought onto the site, for filling and landscaping can lead to the introduction of alien or invasive seed banks.**	
Nature of impact:	Negative impact on biodiversity, condition of the stream habitat, and hydrology (uptake of water by IAPs)	N/A
Extent and duration of impact:	Regional and Long term	N/A

	Alternatives 1, 2 and 3	No-Go
Consequence of impact or risk	Deterioration in condition of the stream habitat, and altered hydrology.	N/A
Probability of occurrence:	Highly Probable	N/A
Degree to which the impact can be reversed:	Partially reversible	N/A
Degree to which the impact may cause irreplaceable loss of resources:	Irreplaceable	N/A
Indirect Impacts:	Altered hydrology over the long-term may be considered an indirect impact, but has been included here as a direct impact.	N/A
Cumulative impact prior to mitigation:	Medium negative	N/A
Significance rating of impact prior to mitigation	Medium negative	N/A
Degree to which the impact can be avoided:	Medium	N/A
Degree to which the impact can be mitigated:	Medium	N/A
Proposed mitigation:	• All soils and top material must be bought from a reliable source, and must be free of alien seeds or grass runners.	N/A
Residual Impacts:	It is virtually impossible to rid soils of all IAP seed, so it is likely that there will be some residual impact after implementation of all mitigation measures recommended here.	N/A
Cumulative impact post mitigation:	Low to Medium negative	N/A
Significance rating of impact after mitigation	Low to Medium negative	N/A

7.4.2 Operational Phase

	Alternatives 1, 2 and 3	No-Go
Freshwater Impacts		
Potential impact and risk:	**Development of open space**	
Nature of impact:	Negative impact on **movement and health of local fauna and flora**	N/A
Extent and duration of impact:	Local and permanent	N/A
Consequence of impact or risk	Fragmentation of landscape connectivity could lead to deterioration in habitat condition within the watercourse corridor, and loss of biodiversity as fauna move off the site.	N/A
Probability of occurrence:	Probable	N/A
Degree to which the impact can be reversed:	Irreversible	N/A
Degree to which the impact may cause irreplaceable loss of resources:	Partly replaceable	N/A

	Alternatives 1, 2 and 3	No-Go
Indirect Impacts:	Flora and fauna may move off the site and search for habitat elsewhere, which may place pressure on habitat, communities and populations elsewhere	N/A
Cumulative impact prior to mitigation:	Medium negative	N/A
Significance rating of impact prior to mitigation	Medium negative	N/A
Degree to which the impact can be avoided:	Low	N/A
Degree to which the impact can be mitigated:	High	N/A
Proposed mitigation:	• While the open spaces within the development – in the north-western corner and around the watercourse – will mitigate to some extent against the impacts associated with the loss of open space and hardening of the property, there is limited connectivity between these two areas. These spaces are connected by a fairly narrow corridor along the western edge of the property adjacent to the gravel road. The movement of fauna and flora across the site would be improved through not constructing fences between the houses, thus allowing fauna to move between the houses. A further mitigation would be through ensuring that all gardens are planted with locally indigenous plant species. • The open spaces provided for in Alternatives 1, 2 and 3, and the proposed SUDS infrastructure should allow for sufficient area for the infiltration of runoff across the site. No further mitigation measures are recommended in this regard. • Alternatives 1, 2 and 3 will result in the setting aside of a considerable portion of the site as conservation area. While there is no detail on how this area will be managed, this represents a positive impact that it is unlikely would apply to the no development alternative, due to the uncertainties associated with this option.	N/A
Residual Impacts:	There will be a residual impact on the flora and fauna around the watercourse, due to the change in the local landscape, despite mitigation. This will be low of low intensity, due to the available open space surrounding the property.	N/A
Cumulative impact post mitigation:	Low to medium negative	N/A
Significance rating of impact after mitigation	Low negative	N/A

	Alternatives 1, 2 and 3	No-Go
Freshwater Impacts		
Potential impact and risk:	**Pollution of the watercourse and coastline from stormwater**	
Nature of impact:	Negative impact on water quality in the stream and coastline	
Extent and duration of impact:	Regional and Permanent	Regional and Permanent

	Alternatives 1, 2 and 3	No-Go
Consequence of impact or risk	Deterioration in water quality in the stream and the sea along the coastline	
Probability of occurrence:	Probable	Unlikely
Degree to which the impact can be reversed:	Partly reversible	Partly reversible
Degree to which the impact may cause irreplaceable loss of resources:	Irreplaceable	Irreplaceable
Indirect Impacts:	No indirect impacts likely	No indirect impacts likely
Cumulative impact prior to mitigation:	Low to medium negative	Low negative
Significance rating of impact prior to mitigation	Low to medium negative	Low negative
Degree to which the impact can be avoided:	High	High
Degree to which the impact can be mitigated:	Partly mitigated	Partly mitigated
Proposed mitigation:	• The proposed stormwater management system, if implemented in full, would adequately mitigate against the negative impacts associated with the generation, storage and discharge of stormwater on the site. It is understood that all stormwater generated by the development will be minimised at the point of accumulation, with only high discharge volumes and natural runoff being directed towards the watercourse and coastline. • The stormwater pipe carrying water under the road must be cleaned out, so that this does not pose a flood risk for the proposed development. In addition, stormwater runoff from the dirt road into Cape Infanta must be formalised.	N/A
Residual Impacts:	None	N/A
Cumulative impact post mitigation:	Low to medium negative	Negligible
Significance rating of impact after mitigation	Low negative	Negligible

	Alternatives 1, 2 and 3	No-Go
Freshwater Impacts		
Potential impact and risk:	**Pollution of the watercourse, groundwater and coastline through on-site treatment of waste water**	
Nature of impact:	Negative impact on water quality in the stream, groundwater and coastline	
Extent and duration of impact:	Regional and Permanent	Regional and Permanent
Consequence of impact or risk	Deterioration in water quality in the stream, groundwater and the sea along the coastline	
Probability of occurrence:	Probable	Unlikely
Degree to which the impact can be reversed:	Partly reversible	Partly reversible

	Alternatives 1, 2 and 3	**No-Go**
Degree to which the impact may cause irreplaceable loss of resources:	Irreplaceable	Irreplaceable
Indirect Impacts:	No indirect impacts likely	No indirect impacts likely
Cumulative impact prior to mitigation:	Low to medium negative	Low negative
Significance rating of impact prior to mitigation	Low to medium negative	Low negative
Degree to which the impact can be avoided:	Moderate	High
Degree to which the impact can be mitigated:	Partly mitigated	Partly mitigated
Proposed mitigation:	• Treated waste water should **not** be used for irrigation, but can be used for flushing of toilets. • All septic tanks and package plants are to be placed outside the 40m ecological corridor. • Package plants, septic tanks and soak-aways must be checked to ensure that they are working, at least annually. • Residents of the development must be educated in the use of household chemicals, detergents and solvents. It is inappropriate to use substances that could affect the efficiency of the septic tanks. Certain chemicals, such as bleaches, can destroy the bacterial communities in the septic tank.	N/A
Residual Impacts:	It is likely that there will be low intensity negative residual impacts associated with the treatment of waste water, as there is always slow leakage of organic pollutants from these systems over time.	Although there may also be some pollution from the existing septic tank, this is likely to have a negligible effect on the local environment.
Cumulative impact post mitigation:	Low to medium negative	Negligible
Significance rating of impact after mitigation	Low negative	Negligible

	Alternatives 1, 2 and 3	**No-Go**
Freshwater Impacts		
Potential impact and risk:	**Increased volumes of stormwater runoff**	
Nature of impact:	Negative impact on hydrology of the coastline	
Extent and duration of impact:	Regional and Permanent	Regional and Permanent
Consequence of impact or risk	Deterioration in condition of the stream due to altered hydrology	
Probability of occurrence:	Probable	Probable
Degree to which the impact can be reversed:	Fully reversible	Fully reversible

	Alternatives 1, 2 and 3	No-Go
Degree to which the impact may cause irreplaceable loss of resources:	Irreplaceable	Irreplaceable
Indirect Impacts:	No indirect impacts likely	No indirect impacts likely
Cumulative impact prior to mitigation:	Medium negative	Low to medium negative
Significance rating of impact prior to mitigation	Low to medium negative	Low negative
Degree to which the impact can be avoided:	High	High
Degree to which the impact can be mitigated:	Partly mitigated	Partly mitigated
Proposed mitigation:	See above	N/A
Residual Impacts:	There is likely to be some residual amount of stormwater flowing into the watercourse as a result of the development, even with the proposed mitigation. This will be of low intensity and so of low significance.	N/A
Cumulative impact post mitigation:	Low to medium negative	Low
Significance rating of impact after mitigation	Low negative	Negligible

	Alternatives 1, 2 and 3	No-Go
Freshwater Impacts		
Potential impact and risk:	**Abstraction of water from groundwater resources with risk of drawdown of local water table**	
Nature of impact:	Negative impact on local ecosystems dependent on groundwater, due to drawdown of local water table	
Extent and duration of impact:	Regional and Permanent	Regional and Permanent
Consequence of impact or risk	Deterioration in condition of ecosystems dependent on groundwater, leading to loss of biodiversity and altered hydrology.	
Probability of occurrence:	Probable	Unlikely
Degree to which the impact can be reversed:	Fully reversible	Fully reversible
Degree to which the impact may cause irreplaceable loss of resources:	Irreplaceable	Irreplaceable
Indirect Impacts:	No indirect impacts likely	No indirect impacts likely
Cumulative impact prior to mitigation:	Medium negative	Low negative
Significance rating of impact prior to mitigation	Low negative	Low negative
Degree to which the impact can be avoided:	Medium	Medium
Degree to which the impact can be mitigated:	Partly mitigated	Partly mitigated

	Alternatives 1, 2 and 3	No-Go
Proposed mitigation:	• Both permanent residents and occasional visitors must be encouraged to use water sparingly, as groundwater is a precious resource, and the impacts of increased abstraction relatively unknown. • Use of rainwater must be facilitated through construction of rainwater tanks, and use of rainwater encouraged. • Only locally indigenous plants shall be allowed in gardens and landscaped areas. Grassed lawns must be of indigenous species, such as *Cynodon dactylon* (kweekgras).	N/A
Residual Impacts:	Water will be consumed and this cannot be avoided. Mitigation should reduce the likelihood of there being a negative consequence of water use down to low.	None
Cumulative impact post mitigation:	Low to medium negative	Negligible
Significance rating of impact after mitigation	Low negative	Low negative

	Alternatives 1, 2 and 3	No-Go
Freshwater Impacts		
Potential impact and risk:	**Disturbance of fauna and flora through noise light and trampling**	
Nature of impact:	Negative impact on biodiversity - stream fauna and flora	
Extent and duration of impact:	Local and Permanent	Local and Permanent
Consequence of impact or risk	Movement of fauna off site, and deterioration in condition of plant communities leading to loss of biodiversity on the site	
Probability of occurrence:	Probable	Improbable
Degree to which the impact can be reversed:	Fully reversible	Fully reversible
Degree to which the impact may cause irreplaceable loss of resources:	Partly replaceable	Partly replaceable
Indirect Impacts:	Fauna may move off the site and onto other properties, increasing inter-species interactions elsewhere. This is likely to be of low intensity, as the neighbouring areas to the north and west of the site can probably accommodate the number of individuals that may be impacted in this manner.	
Cumulative impact prior to mitigation:	Medium negative	Low negative
Significance rating of impact prior to mitigation	Medium negative	Low negative
Degree to which the impact can be avoided:	High	High
Degree to which the impact can be mitigated:	Partly mitigated	Partly mitigated
Proposed mitigation:	• Residential and road lights must be directed away from the stream corridor and coastline. • Residents, visitors and their pets must be discouraged from walking into and through the stream corridor.	N/A

	Alternatives 1, 2 and 3	No-Go
	• Boardwalks can be used to allow pedestrian access into the corridor, while protecting the fauna and flora.	
Residual Impacts:	This impact is difficult to mitigate completely, so there is likely to be a residual impact, although of low intensity.	N/A
Cumulative impact post mitigation:	Low to medium negative	Low negative
Significance rating of impact after mitigation	Low negative	Negligible

	Alternatives 1, 2 and 3	No-Go
Freshwater Impacts		
Potential impact and risk:	**Introduction and spread of alien invasives through landscaping activities and gardening**	
Nature of impact:	Negative impact on biodiversity, condition of the stream habitat, and hydrology (uptake of water by IAPs)	
Extent and duration of impact:	Regional and Long-term	Regional and Long-term
Consequence of impact or risk	Deterioration in habitat condition, and reduced water availability.	
Probability of occurrence:	Highly Probable	Probable
Degree to which the impact can be reversed:	Partly reversible	Partly reversible
Degree to which the impact may cause irreplaceable loss of resources:	Partly replaceable	Partly replaceable
Indirect Impacts:	No indirect impacts are likely. All impacts are direct.	
Cumulative impact prior to mitigation:	Medium negative	Low negative
Significance rating of impact prior to mitigation	Medium negative	Low negative
Degree to which the impact can be avoided:	High	High
Degree to which the impact can be mitigated:	Partly mitigated	Partly mitigated
Proposed mitigation:	• The stream corridor must be planted with appropriate indigenous vegetation, where necessary, and a barrier provided between landscaped areas (gardens or roadsides) and the corridor (e.g. a pathway). • Kikuyu grass must not be allowed on the site. • The spread of alien plant species into the natural areas must be prevented and monitored.	N/A
Residual Impacts:	It is virtually impossible to rid soils of all IAP seed, so it is likely that there will be some residual impact after implementation of all mitigation measures recommended here.	
Cumulative impact post mitigation:	Low to medium negative	Low negative
Significance rating of impact after mitigation	Low negative	Low negative

	Alternatives 1, 2 and 3	No-Go
Freshwater Impacts		
Potential impact and risk:	**Clearing alien vegetation from the site**	
Nature of impact:	Positive impact on biodiversity and ecosystem functioning	
Extent and duration of impact:	Regional and Long-term	Regional and Long-term
Consequence of impact or risk		
Probability of occurrence:	Definite	Improbable
Degree to which the impact can be reversed:	Fully reversible	Fully reversible
Degree to which the impact may cause irreplaceable loss of resources:	N/A	N/A
Indirect Impacts:	None	
Cumulative impact prior to mitigation:	Medium positive	Low to medium positive
Significance rating of impact prior to mitigation	Medium positive	Low to medium positive
Degree to which the impact can be avoided:	Low	Low
Degree to which the impact can be mitigated:	N/A	N/A
Proposed mitigation:	N/A	N/A
Residual Impacts:	N/A	N/A
Cumulative impact post mitigation:	N/A	N/A
Significance rating of impact after mitigation	N/A	N/A

8 SUMMARY AND CONCLUSIONS

- Three feasible development layouts have been proposed for erf 134, Cape Infanta. **Alternative 1** (13th April 2012) comprises 23 erven, 16 of which would be single storey and 7 double storey, **Alternative 2** (26th August 2013) comprises 21 erven, 15 of which are single storey and 5 double storey and lastly, **Alternative 3** (9th May 2023) also with 21 erven. The main material differences between Alternatives 2 and 3 are the location of the entrance roads and a shift in the configuration of the 21 erven. All three development alternatives incorporate a conservation area in the north-western corner of the property and a 40m-wide corridor following the watercourse, which incorporates the 1:100 year floodline for the ephemeral stream. The total cover of developable erven for all alternatives is approximately 50%.
- Alternatives 1, 2 and 3 address the following specific concerns from a freshwater ecological perspective:
    - More open space within the development for the infiltration of runoff and precipitation;
    - A smaller hardened footprint, and so less stormwater generated, and
    - A sufficiently wide (40 m) corridor around the watercourse is accommodated by the layout. The establishment of such a corridor will protect the stream and the surrounding dunes that contribute runoff to the stream during rainfall. The erven in Alternative 3 are all outside of the proposed watercourse corridor. There may be a low negative impact associated with the construction of the bulkwater supply pipeline within the ecological corridor. Mitigation measures to ensure that this impact is contained within a small footprint are provided in this report.
- The width of the watercourse corridor was determined, as is best practice, according to the width of the channel, its flow patterns (ephemeral, in this case), condition of the watercourse (good condition) and the vegetation adjacent to the watercourse, and the nature of the proposed activity surrounding the river (the nature of the impact influences the width of the buffer required to protect the system from the impact). The ecological buffer recommended for the protection of the ephemeral watercourse on the site is 20m, which should be measured from the edge of the channel (MacFarlane and Bredin, 2017), and it must include the 1:100 year floodline. In this case, the edge of the channel was difficult to identify due to the very ephemeral nature of surface flow within the system, but the recommended ecological buffer of 20m measured from the centreline is considered to be adequate for protection of the watercourse. The boundary of the recommended buffer is outside of the 1:100 year floodline, creating an adequate ecological corridor through the development.
- The 40m-wide watercourse corridor is of an adequate width to allow for sufficient terrestrial habitat on either side of the stream to create a buffer against the proposed activity, as required by the Swellendam SDF. This will protect an adequate zone of dune habitat adjacent to the stream, off which rainfall runs into the stream. The corridor will also allow for the movement of fauna and flora through the site.
- The location of the conservation area on Alternatives 2 and 3 takes account of a limestone fynbos sensitive area, as delineated in the botanist specialist report, and in both layouts the conservation area is just over 6 000 m^2.
- Alternatives 2 and 3 comprise fewer erven and less road surface than Alternative 1. However, this difference does not translate into a difference in the significance of the impacts associated with the three alternatives, at least from a freshwater ecological perspective.
- The impacts of Alternatives 1, 2 and 3 were assessed against the no development alternative.

- The no development alternative represents the status quo in terms of zoning – Agriculture 1 – and in terms of current permissible uses - primary use is for cultivation of land for crops and plants or the breeding of animals, or the operation of a game farm on an extensive basis on natural veld or land. The latter use includes activities and buildings that are reasonably connected with the main farming activities of the farm. Consent uses include additional dwelling units (a maximum of an additional five units), farm store, farm stall, intensive feed farming, riding school, nursery, service trade, and/or tourist facilities.
- There are several negative impacts associated with the construction of Alternatives 1, 2 and 3, the most significant of which is the introduction of alien plant species through the use of topsoil for filling and landscaping on the site. Topsoil must be obtained from a reliable source, and local topsoil made use of wherever possible. All of the construction impacts can be minimised through the implementation of several mitigation measures, which must be detailed in an environmental management plan for the site, prior to the commencement of construction.
- There are no construction impacts associated with the no development option, however the current zoning of the property does allow for the construction of a further 5 units.
- Alternatives 1, 2 and 3 will result in the hardening of the property and the loss of terrestrial open space. This would impact on the movement of flora and fauna both in and out of the stream corridor, and across the erf to the coast or up the slopes. While the open spaces within the development – in the north-western corner and around the watercourse – will mitigate to some extent against the impacts associated with the loss of open space and hardening of the property, there is limited connectivity between these two areas. These spaces are connected by a fairly narrow corridor along the western edge of the property adjacent to the gravel road. The movement of fauna and flora across the site would be improved through the absence of any fences between the houses, thus allowing fauna to move between the houses. A further mitigation would be through ensuring that all gardens are planted with locally indigenous plant species. With mitigation, this impact was assessed as being of medium negative significance for both development alternatives.
- This negative impact is balanced by the positive impact of the creation of a conservation area in the north-western portion of the site. While there is no detail on how this area will be managed, this represents a positive impact that it is unlikely would apply to the no development option, due to the uncertainties associated with this option.
- Other concerns about the operational phase of the residential development (all three Alternatives) are the generation and management of stormwater and water from the package treatment units and / or septic tanks and soak-aways. The stream is ephemeral and any change in hydrology or pollution of the watercourse due to the introduction of residential stormwater runoff, the seepage from septic tanks and soak-aways, or the use of treated effluent for irrigation will change the nature of the system, and lead to a deterioration in the quality of habitat provided within the corridor. This may also lead to a cumulative effect over time, should more developments occur in the area. This impact was assessed as being of low to medium significance before mitigation, and of low significance with mitigation. Treated effluent from package plants may not be discharged directly to the watercourse or coastline, and should not be used for on-site irrigation of open areas, due to the risk of pollution. Treatment plants, septic tanks and soak-aways must be located outside of the 40m ecological corridor, and checked regularly.
- While the abstraction of groundwater may lead to the drawdown of local groundwater resources, this is likely to be of low intensity and so of low significance. However, the cumulative effect of this impact may increase in significance should further developments be proposed in the area. Rainwater tanks must be constructed and residents encouraged to use rainwater.

- These operational phase impacts may also be associated with the no development option, but this is unlikely due to the low density of units allowed.
- Detailed environmental management programmes (EMPr) must be compiled for the construction phase and ongoing management of the development, and especially of its natural open spaces and conservation areas. The EMPr's must have input from all relevant specialists, and must contain detailed guidance on the minimization of disturbance and maximisation of conservation efforts.
- The no development option is likely to lead to fewer ecological impacts of significance, and so is the preferred overall option from a freshwater ecological perspective. However, Alternatives 1, 2 and 3 do take into account the concerns raised throughout the project, specifically with regard to the watercourse on the site.
- Alternative 3 is the preferred development layout from a freshwater ecological impact, as all of the erven are located outside of the watercourse corridor.
- With sensitive management of the natural areas on the site, and the implementation of the mitigation measures recommended here, the impacts of this proposed development could be minimised.

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