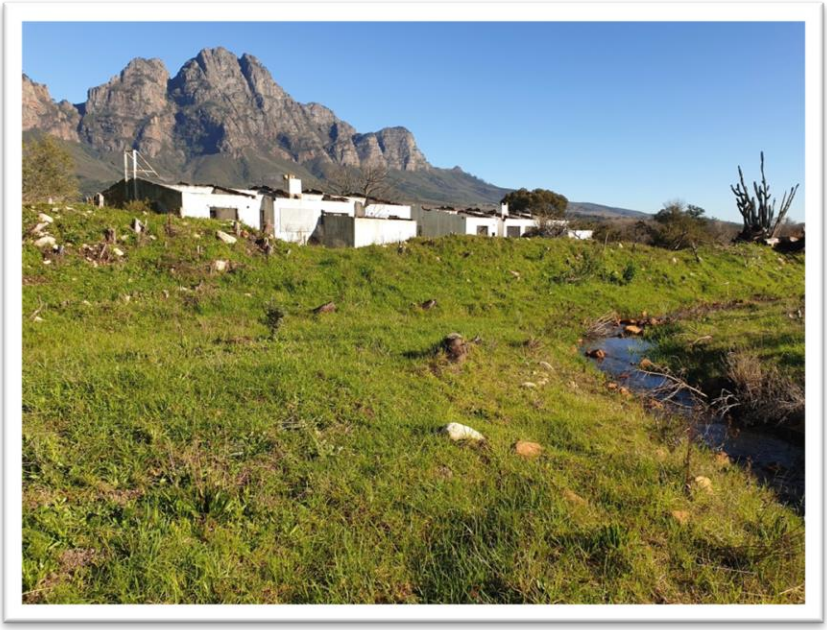
Freshwater Consulting

Baseline and Impact Assessment of Boschendal New Retreat Site, York Farm, Boschendal Estate

Freshwater ecosystems



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DRAFT REPORT

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Submitted to: Chand Environmental Consultants

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1 Introduction

1.1 Background and Approach

The Freshwater Consulting Group (FCG) was approached by Chand Environmental Consultants to provide a baseline and impact assessment of the inland aquatic ecosystems potentially affected by development of a New Retreat on York Farm, Boschendal Estate. The inland aquatic ecosystems on the broader Boschendal Estate have been assessed by FCG on a number of occasions in the past, and a map of wetlands, watercourses and their recommended (desktop) ecological buffers was provided for a Constraints Analysis of the whole site (see Figure 1.1), in March 2019 (Snaddon, 2019).

The New Retreat will comprise overnight guest accommodation, including the following:

- Eight upgraded accommodation units;
- Reception area;
- Communal area (library and ablution facility);
- Conference facilities;
- Dining facilities;
- Access roads, walkways and maintenance tracks;
- Water and waste water reticulation, and
- Landscaping around the facilities.

Three layout alternatives have been proposed.

Specifically, the terms of reference for this Assessment, and the approach followed, were as follows:

- Determine the location and extent of affected inland aquatic ecosystems. A site visit on 15th March 2020 enabled delineation (according the DWAF (2005) guidelines) of the inland aquatic ecosystems affected by the development. The ecosystems were mapped using a hand-held GPS, accurate to 2 – 3m.
- Assess the condition and ecological importance and sensitivity of the inland aquatic ecosystems: the accepted protocols for the assessment of ecological importance and sensitivity (EIS) and present ecological state (PES) were used to assess the affected ecosystems and determine suitable ecological buffers.
- Describe and assess the impacts associated with the construction and operational phases of the proposed development. The impacts expected to affect the inland aquatic ecosystems on and around the site were identified and described for both the construction and operational phases, according to the EIA regulations (April, 2017). Three development options were provided for assessment, which were compared against two possible no-go options.
- Provide input to water use authorisation: A number of Section 21 water uses are triggered by the development, and in addition, the development lies within the regulated area (within 500m of a wetland, and within 100m of a watercourse) for Section 21 (c) and (i) water uses. The relevant water uses were identified, and input provided for the authorisation process.
- Provide a rehabilitation plan for Stream 10 adjacent to the site, as a means of reducing the overall impact of the development on the stream.
- Write a report: the results of the site visit and the assessments described above are reported here. The report also highlights concerns regarding current development activities, and recommends mitigation measures for reducing or managing impacts.

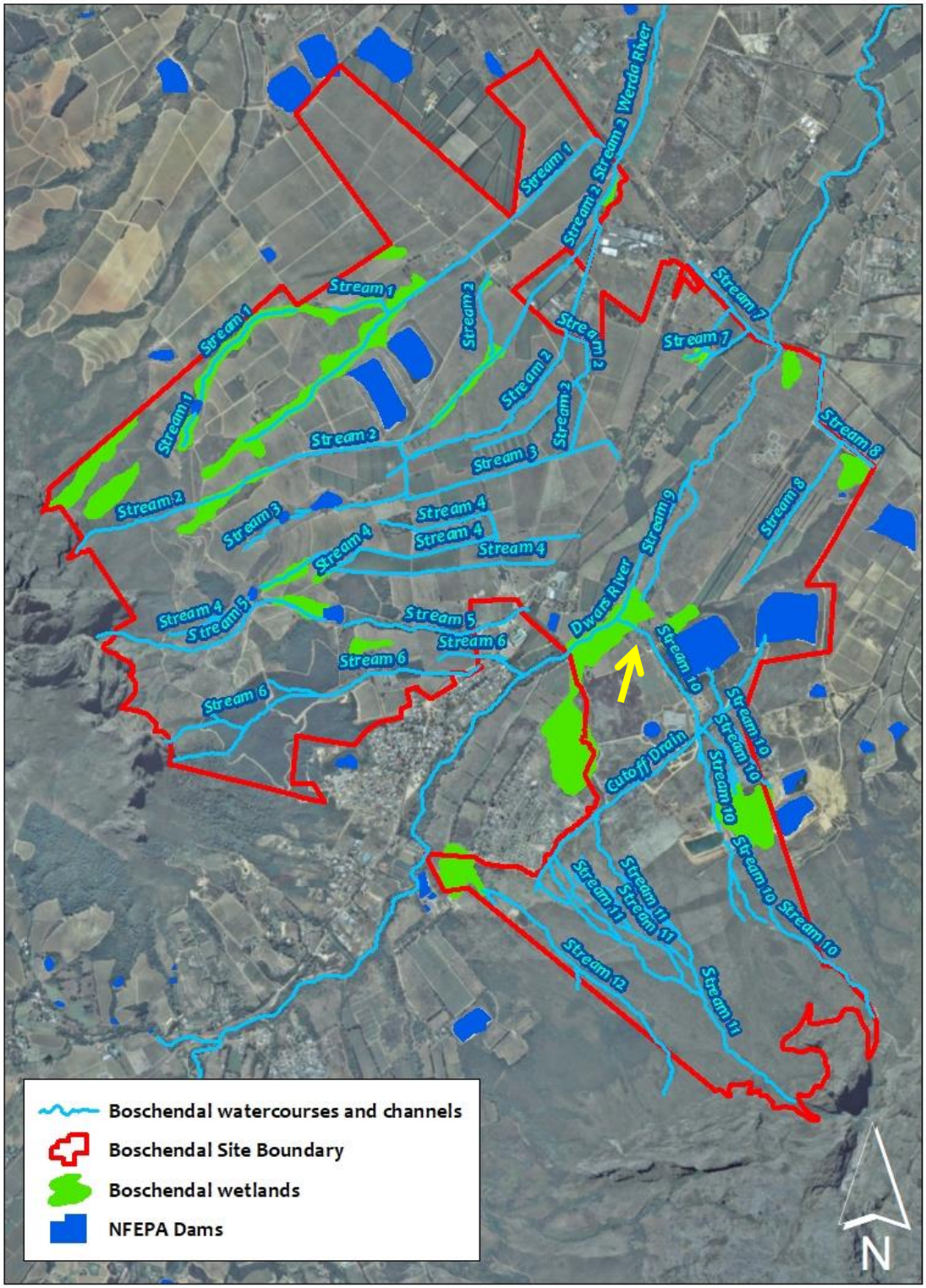

Figure 1.1 **Map of the wetlands and watercourses on Boschendal Estate, as mapped by the author of this report for a Constraints Analysis in 2019. Also shown are the farm dams as depicted on the National Freshwater Ecosystem Priority Area map for the area. The location of the New Retreat site is shown by a yellow arrow.**

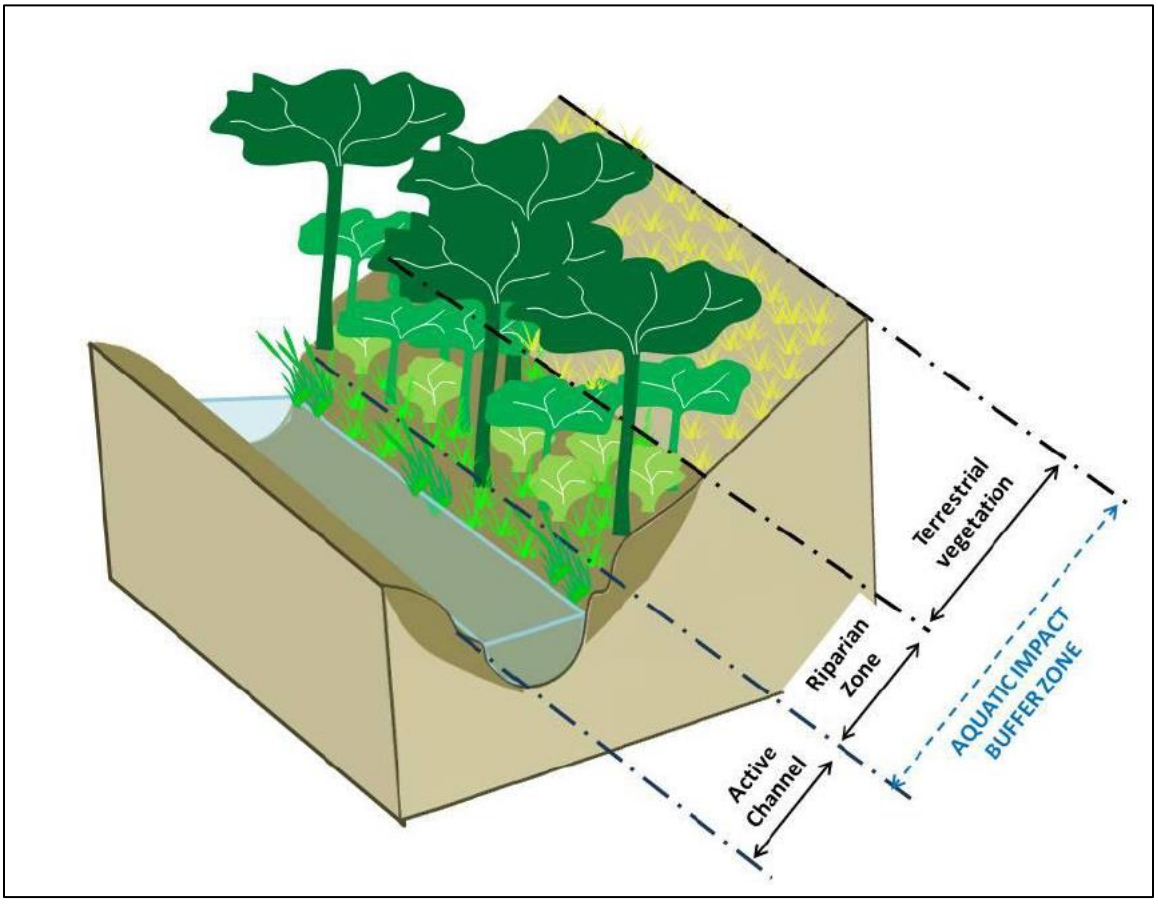

Figure 1.2 Schematic diagram indicating the boundary of active channel and riparian habitat, and the areas potentially included in an aquatic impact buffer zone (MacFarlane and Bredin, 2016). The buffer (measured from the edge of the active channel) protecting a watercourse must include the riparian zone, and can extend into terrestrial vegetation.

1.2 Definitions

The following definitions from the National Water Act (1998) are adhered to in this report:

- Watercourse (the words river, stream and watercourse are used interchangeably in this report):
  a. A river or spring;
  b. A natural channel in which water flows regularly or intermittently;
  c. A wetland, lake or dam into which, or from which, water flows; and
  d. Any collection of water which the Minister may, by notice in the Gazette, declare to be watercourse, and a reference to a watercourse includes, where relevant, its bed and banks;
- Wetland:
  - Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.
- Riparian areas or zones (see Figure 1.2):
  - Includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated

or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

1.3 Limitations and Assumptions

Mapping was done with a hand-held GPS in order to save time and costs. Accuracy is estimated as being approximately 2-3m. All buffers and regulatory zones shown on maps in this report were measured as a horizontal distance using GIS software, and not surveyed *in situ*. It is recommended that these lines be surveyed in detail and demarcated on all plans for the development.

Delineation of wetlands was done using the indicators described in the DWAF (2005) guidelines for delineation of wetlands and riparian areas. Primary data were not collected from the aquatic ecosystems, however, the visual assessments done for this baseline assessment, and historical data collected on Boschendal Estate since 2005, are considered sufficient for the purposes of this project.

It is assumed that the details provided for the development of the New Retreat are correct at the time of writing, and that any changes to the layout and proposed infrastructure will require a revision of this assessment.

1.4 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 author.

1.5 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 development under consideration.

1.6 Specialist Details

The author of this report is an independent specialist consultant, with 23 years of experience in the field of freshwater ecology, registered with the South African Council for Natural Scientific Professions (Ecologist, registration number 400225/06).

2 Description of the affected area

The New Retreat site and the associated water supply pipeline towards Lanquedoc are located in quaternary catchment G10C, in the Berg River Water Management Area, and the Stellenbosch Municipality. This catchment has a mean annual rainfall total of 1200 mm per annum, and lies in a high rainfall intensity zone (*sensu* Schulze, 2007). The site was probably cultivated in the past, but in more recent times, houses a cluster of ruins that used to be farm accommodation until just over 10 years ago.

Most of the Boschendal Estate falls within the ecoregion known as the south western coastal belt (Kleynhans *et al.*, 2005a) (see Table 2.1 for main attributes).

Table 2.1 Main attributes of the ecoregion that intersects with the New Retreat site (from Kleynhans *et al.*, 2005a).

Ecoregion	Terrain morphology	Dominant vegetation types	Altitude	Mean Annual Precipitation	Rainfall seasonality
South Western Coastal Belt (24)	Moderate relief plains; Closed hills; Mountains	West Coast Renosterveld; Sand Plain Fynbos; Mountain Fynbos	Mainly 0-300 mAMSL; hills up to 900 mAMSL	0 to 1500 mm/year	Winter

The geology of the Dwars River Valley, in which the site lies, is dominated by granites of the Stellenbosch Pluton of the Cape Granite Suite, while the surrounding mountains comprise quartzitic Table Mountain Group sandstones (Parsons, 2010). The soils on the site are alluvial sands and cobble, associated with the Dwars River. Historically, the vegetation on the site would have been Swartland Alluvium Fynbos, an endangered (Skowno et al., 2019) vegetation type typical of riverine valley floors and floodplains (Rebelo *et al.*, 2006). Few indigenous plant species remain on the site, covering only a total of 500m^2 within the site boundaries (Helme, 2021), due to a long history of transformation on the site.

A small seasonal tributary of the Dwars River runs across the site, identified as “Stream 10” in the Boschendal Constraints Analysis completed in 2019 (Snaddon, 2019). The tributary is typical of the many small seasonal streams draining out of the Groot Drakenstein Mountains that supply water to the perennial Dwars River in the valley below. These seasonal streams have cobble and sand beds, and banks that generally support riparian vegetation. Riparian trees around Stream 10 include *Searsia angustifolia* (smalblaar), *Brachylaena neriifolia* (Cape silver oak), and *Brabejum stellatifolium* (wild almond). The channel and banks have also been invaded by the exotic grass *Pennisetum clandestinum* (Kikuyu grass). The streams flowing across Boschendal Estate from the Groot Drakenstein mountains have unfortunately been highly transformed through agricultural activities in the past, the presence of many roads and tracks criss-crossing the slopes, and diversion of most of the surface flow out of the natural channels and into a diversion channel that runs across the mountain slopes. This is done by use of sluice gates (see Figure 2.2); at the time of the site visit, there was no natural flow passing the sluice gates into Stream 10. The diversion channel carries water into two farm dams, Normandie and York Dams, situated on the property close to the New Retreat site. When these dams overflow, the water flows into Stream 10.

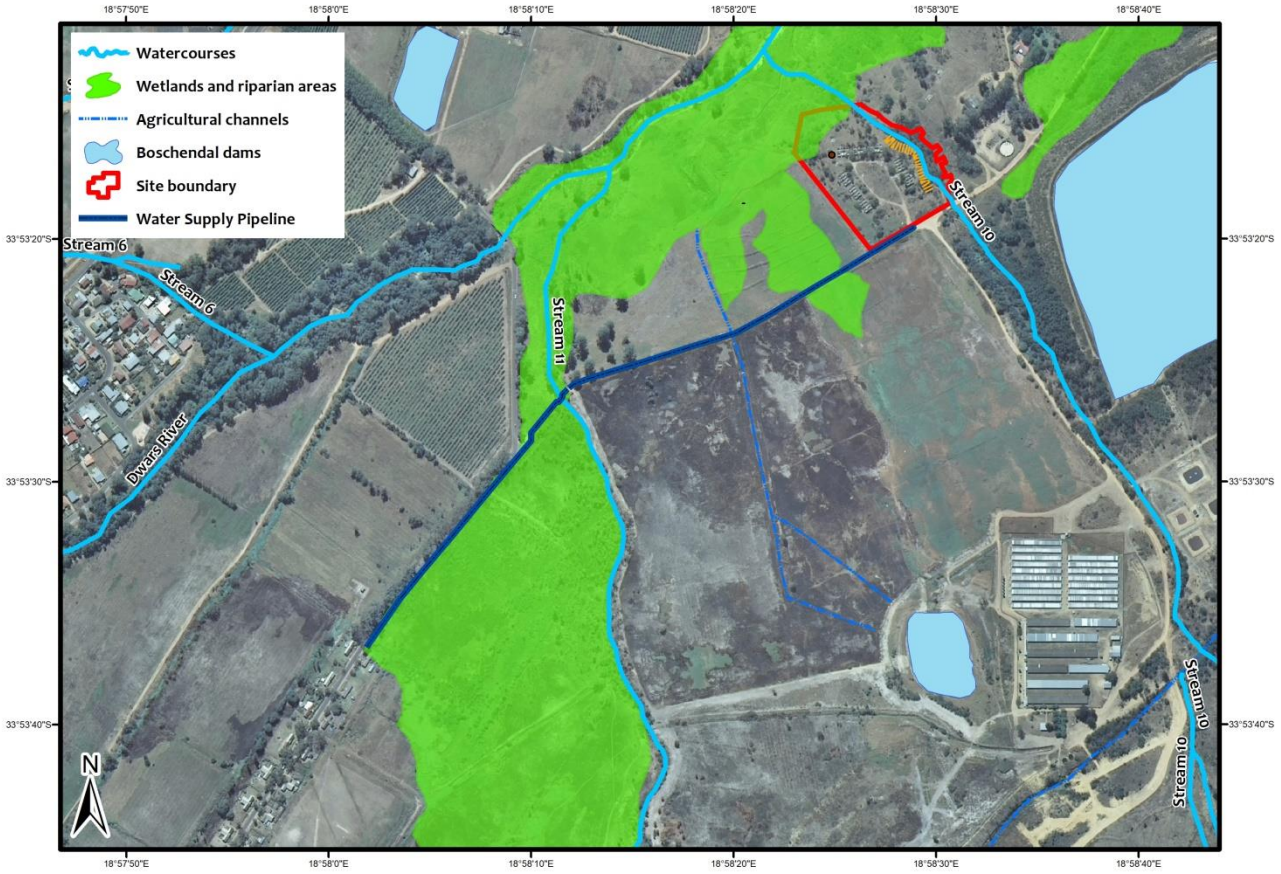

Figure 2.1 **Aerial image of the site, showing the site boundary, and the location of the inland aquatic ecosystems affected by the proposed development.**

Figure 2.2 **Diversion of surface flow from Stream 10 into the diversion channel flowing towards Normandie Dam. The sluice gates on the left were all closed at the time of the field visit in July 2020.**

Despite the transformations noted upstream, water quality in Stream 10 appears to be pure, although the rocks are coloured with what looks like iron deposits. This may be due to the lack of flushing flows along the stream channel as a result of the diversion of flow upstream, the dominance of iron-rich groundwater feeding the stream, rather than purer mountain runoff, or sediment from the dams upstream.

Fauna noted in the stream included the Cape River Crab, *Potomonautes perlatus*, blackfly larvae, *Simulium* spp., and numerous mayfly nymphs of the family Baetidae. These species are all hardy taxa, tolerant of impacted water quality.

Figure 2.3 Streambed of Stream 10, showing cobble, gravel and sand, and banks invaded by alien kikuyu grass. Note the orange colour of the rocks, indicative of iron-rich deposits, possibly from groundwater.

Figure 2.4 *Brachylaena neriifolia*, a riparian tree species on the banks of Stream 10, on the New Retreat site.

Figure 2.5 The Cape River Crab, *Potomonautes perlatus*, found in Stream 10.

There has been substantial erosion in Stream 10, in a section of river downstream of the proposed development. There is a small head-cut advancing upstream (Figure 2.6), within the channel, and the channel itself is incised (Figure 2.7), probably as a result of high velocity, high volume flows along the channel when the dams overflow. Stream 10 effectively receives more water than its natural catchment would generate, due to the diversion of other streams into the dams (see also Obree, 2021). The natural catchment of Stream 10 was calculated to be 4.0 km^2, compared with the 7.9 km^2 catchment currently discharging into the dams and Stream 10 (Obree, 2021). The dams do provide some attenuating capacity.

Figure 2.6 Head-cut in the channel of Stream 10.

Figure 2.7 Incised banks of Stream 10, downstream of the head-cut.

Stream 11 will also be affected by the development, specifically by the construction of a water supply pipeline that will be laid alongside the existing road to the New Retreat. As is the case for Stream 10, Stream 11 is diverted into the diversion channel some distance upstream of the proposed pipeline. The watercourse has been heavily invaded by IAPs, with few indigenous riparian plants remaining in the riparian area. The channel is earth-lined, with cobble and fine sediments, and is surrounded by a seep wetland that extends uphill towards Lanquedoc and the diversion channel.

There is a seep wetland located to the south-west of the site, flowing across the adjacent field, and into the Dwars River and a seep that is associated with Stream 11 further west (see Figure 2.1). A seep is a wetland area located on gently to steeply sloping land and dominated by the colluvial (i.e. gravity-driven),

unidirectional movement of water and material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend onto a valley floor. Water inputs are primarily via subsurface flows from an up-slope direction. The seep adjacent to the New Retreat site (the "New Retreat seep") has a clear drainage line towards the centre. The wetland is dominated by kikuyu and kweek grass (*Cynodon dactylon*), with a few sedges and other common wetland plants (Figure 2.8).

The seep around Stream 11 extends westwards towards Lanquedoc. Portions of this wetland have been invaded by IAPs, including *Eucalyptus* (gum trees), *Acacia saligna* (Port Jackson) and *Acacia mearnsii* (black wattle). At most, these IAPs account for 10% cover within the wetland. Indigenous species within the wetland include *Cliffortia strobilifera, Watsonia meriana, Monopsis lutea, Paspalum urvillei, Searsia angustifolia, Pennisetum macrourum* and *Senecio pubigerus* (Helme, 2021). Water that accumulates along the upstream, southern edge of the road has led to almost perennially wet areas along this side of the road.

A channelled valley-bottom wetland extends along the banks of the Dwars River, and into the northerly portion of the New Retreat site (see Figure 2.1 and Figure 2.10). This type of wetland is a mostly flat wetland area located on a valley floor, connected to an adjoining river channel.

The Dwars River valley-bottom wetland is also heavily invaded by kikuyu, but supports some indigenous wetland plants such as *Pennisetum macrourum*, *Watsonia meriana*, *Searsia angustifolia*, and *Typha capensis*. The wetland has been impacted by excavations for a dam close to the Dwars River channel, and IAP invasion.

Figure 2.8 Kikuyu-invaded seep wetland adjacent to the New Retreat site.

Figure 2.9 **Channelled valley-bottom wetland along the banks of the Dwars River, north of the New Retreat site.**

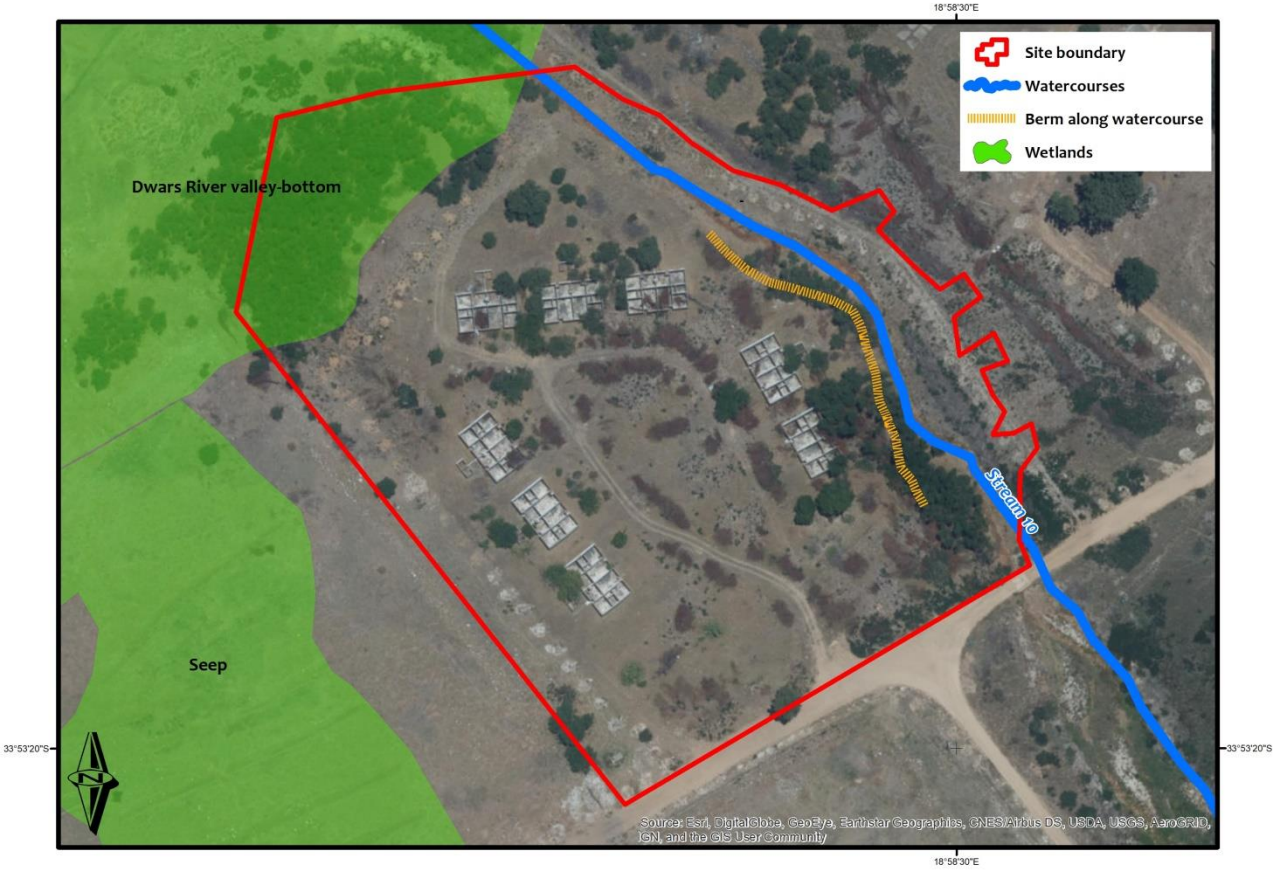

Figure 2.10 **Close up aerial photograph of the New Retreat site (red boundary) and the inland aquatic ecosystems on and close to the site.**

3 Delineation of inland aquatic ecosystems

The Department of Water and Sanitation (DWS) produced a wetland and riparian zone delineation manual (DWAF, 2005) that describes the indicative characteristics that can be used to distinguish between wetlands or riparian zones and the surrounding terrestrial landscape. These indicators are:

- **Vegetation**: the presence of plants adapted to or tolerant of saturated soils (hydrophytes) or alluvial soils;
- **Soils**: in the case of wetlands, the presence of wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation, and for riparian areas, the presence of alluvial soils and / or deposited material;
- **Hydrology**: a high water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil;
- **Terrain**: the position in the landscape that allows for retention of water and the development of wetlands, or for riparian areas, association with a watercourse.

The delineation of riparian areas relies most heavily on the vegetation, as there is often insufficient saturation of soils in riparian areas to allow for the development of hydromorphic soils (DWAF, 2005). Furthermore, the water table can be relatively distant from the soil surface, and riparian plants are often deep-rooting individuals, such as trees, seeking water at depth.

The outer boundary of a riparian area is frequently found where there is a noticeable change in:

- Plant species composition relative to the adjacent terrestrial area; and
- Physical structure, such as vigour or robustness of growth forms (e.g. health/productivity (greenness), size, structure), relative to the adjacent terrestrial areas.

For most of its length through the site, the stream lacks a defined riparian area, as it has been invaded by kikuyu, and the soils are difficult to auger due to the cobbled nature of the substrate. The edge of the active channel was, however, easy to delineate at the time of the field visit (as shown in Figure 3.1), due to the clear step between the inundated portion of the channel and the surrounding landscape. In its lower reaches, as the stream approaches the valley floor of the Dwars River, more riparian species were noted along the stream margins. A man-made berm comprising cobbles and boulders runs parallel to the left bank of the stream, for some of its length.

The Dwars River channelled valley-bottom wetland was delineated using primarily terrain and vegetation, again due to the difficulty in augering into the rocky soils. The land drops steeply down onto the valley floor, and there is a clear line of riparian species marking the edge of the valley-bottom wetland. These species include the grass *Pennisetum macrourum*, the tree species *Brachylaena neriifolia*, and the shrub *Searsia angustifolia*. The edge of the valley-bottom wetland is shown in Figure 3.1.

A seep wetland is present to the west of the site, fed by a drainage line running through the old agricultural fields. The outer edge of the wetland was difficult to delineate due to:

- Modifications to the terrain as a result of irrigation furrows or berms being dug in the field;
- Excavations from maintenance work done on a rising main pumping effluent from the Boschendal Winery to the waste treatment works at the Piggery, and
- A long-term leak from an air valve on a water mains pipe connecting the Wemmershoek water main with the Pniel Reservoir (Rudolph Schoonwinkel, pers. comm, July 2020). An air valve chamber is located in the middle of a small pond that has developed from the leak.

Taking all of these factors into account, an approximate delineation, with ~70% confidence, could be made around the seep wetland in the adjacent field, and is shown in Figure 3.1. The delineation is based on visual assessment of vegetation and wetness, and topography.

Figure 3.1 Close up map of the delineated stream and wetlands on and around the New Retreat site, Boschendal Estate.

The outer boundaries of the Stream 11 seep wetland were not delineated, due to time constraints, but the start and end of the extent of wetland affected by the location of the water supply pipeline are sufficiently accurate to be able to assess the impacts of the infrastructure for New Retreat.

Figure 3.2 Air valve chamber in a pond that has developed around a leaking water mains pipe, adjacent to the New Retreat site. The leak feeds the seep wetland next to the site, artificially enlarging the wetland area.

4 Assessment of type, threat status, condition and sensitivity

4.1 Ecosystem Type and Ecosystem Threat Status

The lower portion of Stream 10 is classified as an upper foothill river, with a seasonal (non-perennial) hydroperiod. Such river types within the south western coastal belt ecoregion are critically endangered, according to the.

The channelled valley-bottom wetland is a critically endangered wetland type within the southwest Fynbos Bioregion, and the seep is a vulnerable wetland type, according to the National Biodiversity Assessment (2018) (van Deventer et al., 2019a, 2019b).

4.2 Conservation Status and Ecological Sensitivity of the site

According to the National Freshwater Ecosystem Priority Area (NFEPA) project maps, the Dwars River sub-catchment, in which the New Retreat site lies, is classified as a Phase 2 Freshwater Ecosystem Priority Area (Figure 4.1). Phase 2 FEPAs are catchments with moderately modified river systems, which should not be degraded further (Nel et al., 2011). The site lies within the Boland Strategic Surface Water Source Area, as identified by Le Maitre et al. (2018).

The Western Cape Biodiversity Spatial Plan (Pool-Stanvliet *et al.*, 2017) identified large areas on the Drakenstein side of Boschendal Estate as Critical Biodiversity Areas, but these lie only to the north-west and south-east of the site (see Figure 4.2). A large proportion of the site itself was identified as an Ecological Support Area 2, which has relatively low priority for conservation. Applicable reasons provided in the WCBSP for inclusion of this area as an ESA2 are the threatened status of the original vegetation type and for water source and water resource protection (i.e. the Dwars River to the north, a major tributary of the Berg River and, to a lesser degree, Stream 10).

According to the Department of Environment, Forestry and Fisheries' Environmental Impact Assessment Screening Tool, the whole site falls within the very high sensitivity category. However, the Tool classifies all natural vegetation remnants in the Cape Floristic Region as very high sensitivity, irrespective of ecological condition or diversity. As advised by Helme (2021), this should be revised down to low sensitivity, with the exception of the stream, the wetlands, and their ecological buffers (see Section 6.2), which are considered to be of moderate to high sensitivity.

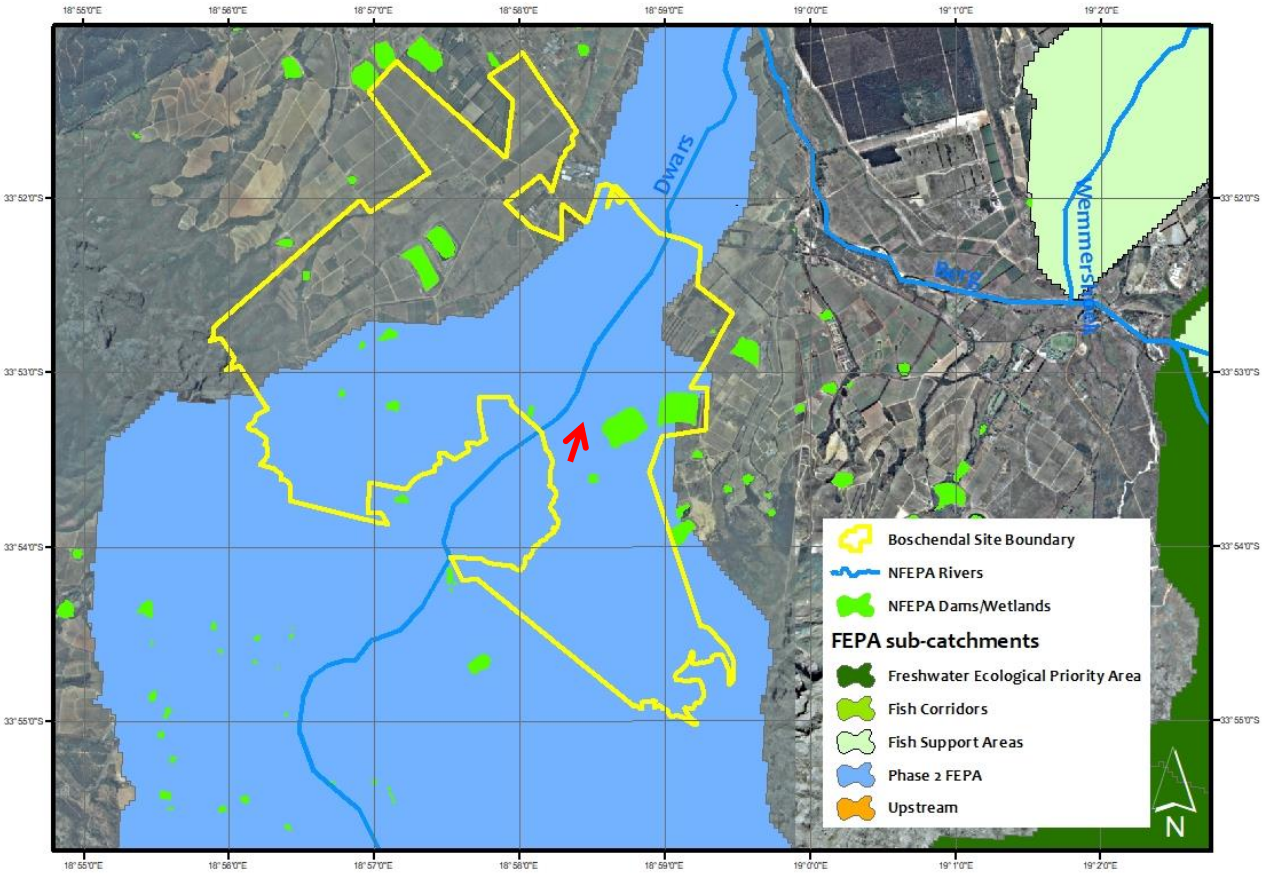

Figure 4.1 National freshwater priorities for the conservation of freshwater biodiversity and ecological processes in and around the Boschendal Estate. Adapted from the NFEPA map (Nel *et al.*, 2011). The location of the New Retreat site is shown with a red arrow.

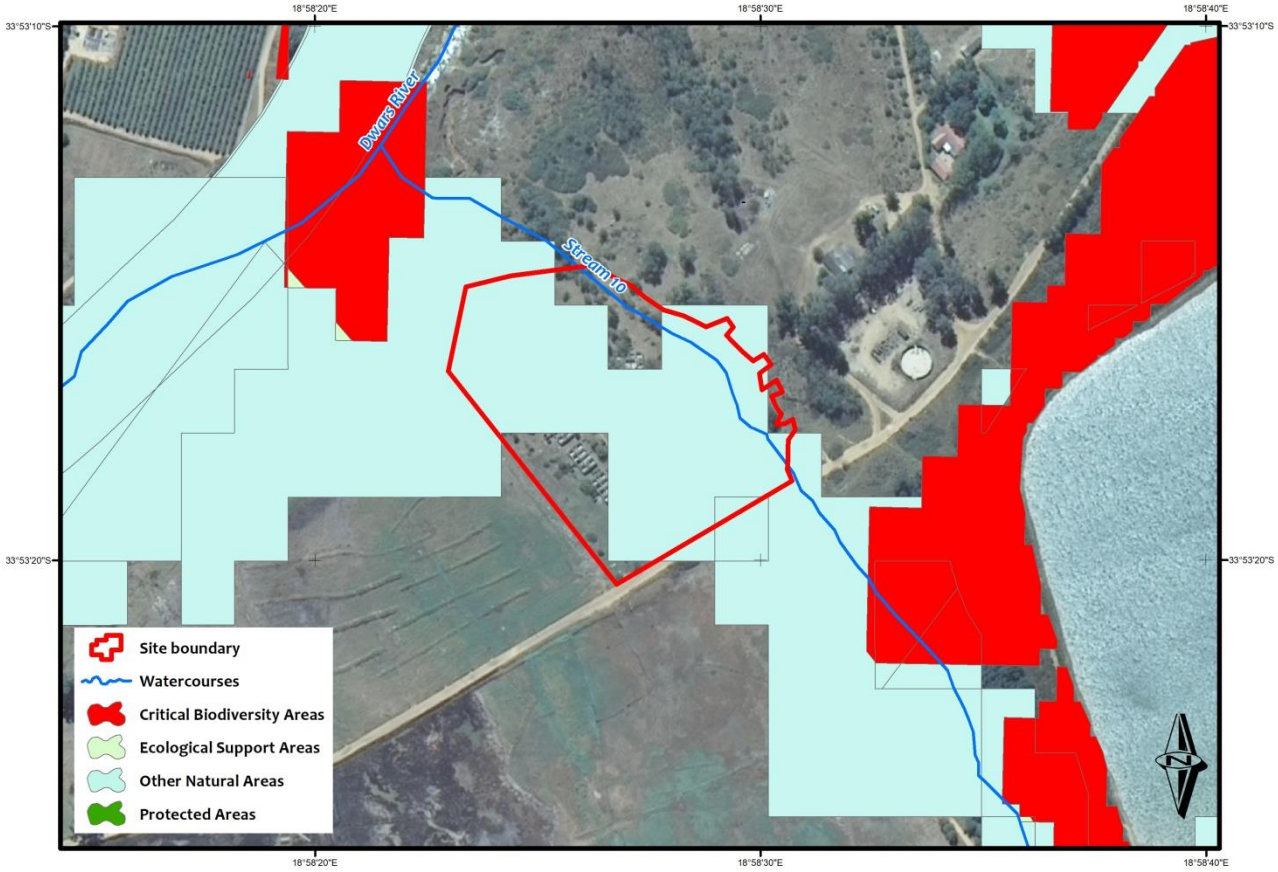

Figure 4.2 **Map of Critical Biodiversity Areas, Ecological Support Areas in and around the New Retreat site. Adapted from the Western Cape Biodiversity Spatial Plan (Pool-Stanvliet et al., 2017).**

4.3 Present ecological status, ecological importance and sensitivity of the inland aquatic ecosystems

4.3.1 Streams 10 and 11

An assessment of the conservation importance of an inland aquatic ecosystem (i.e. watercourse or wetland) should combine assessments of both the present ecological state (PES) or integrity of the ecosystem and its ecological importance and sensitivity (EIS). 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 freshwater ecosystem 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.

4.3.1.1 Present Ecological State

In the 1990s, the then Department of Water Affairs (now Department of Human Settlements, Water and Sanitation, DHSWS) Resource Directed Measures (RDM) approach provided 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 could be followed at different levels of detail – desktop, rapid, intermediate and comprehensive. In 2005, the methods were revised during the development of the EcoClassification approach (Kleynhans *et al.*, 2005b), and the indices were reviewed. 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 each river reach in a habitat integrity category (A – E/F) for both components (Table 4.2).

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.

Criterion	Relevance
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.

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

4.3.1.2 Ecological Importance and Sensitivity

The DWS-recommended method for the determination of the Ecological Importance and Sensitivity of a particular ecosystem considers the following ecological aspects of watercourses, in general (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 4.3 Ecological importance and sensitivity categories for rivers.

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.

4.3.1.3 Results

Stream 10 was assessed in two portions – the river reaches above the diversion channel, and the reaches below. Stream 11 was only assessed at the point at which the proposed water supply pipeline will cross over the watercourse (i.e. the lower section), as it will only marginally be impacted by the development.

The upper portion of Stream 10 lies in an upper C category – moderately modified - for PES, while the lower section below the diversion is in a D category (Table 4.4). Lower stream 11 lies in a D category – largely modified (Table 4.4). For all of the river reaches, the instream condition (channel, bed, banks) is better than the riparian zone. This is due to the impact that removal of indigenous riparian vegetation, and replacement with alien vegetation, mostly kikuyu grass, acacias and gums in the lower sections, has had on the river. In addition, the almost complete transformation of the hydrological regime in the lower river reaches of both Stream 10 and 11, as a result of diversion of flow, had had a significant impact on the health of the systems.

Table 4.4 Results of the assessment of Present Ecological State for Streams 10 and 11 on Boschendal Estate.

Criteria	Stream 10 above the diversion channel	Stream 10 below the diversion channel	Lower stream 11
Water abstraction	8	20	20
Inundation	0	5	5
Water quality modification	5	8	8
Flow modification - floods	8	20	20
Flow modification – low flows	9	20	20
Bed modification	5	8	10

Criteria	Stream 10 above the diversion channel	Stream 10 below the diversion channel	Lower stream 11
Channel modification	6	10	14
Exotic or invasive macrophytes	0	0	5
Exotic fauna	5	5	5
Solid waste disposal	5	5	8
Indigenous vegetation removal	10	18	20
Exotic vegetation encroachment	10	18	20
Bank erosion	8	14	8
PES - Riparian	**72 (C)**	**43 (D)**	**42 (D)**
PES – Instream	**80 (B)**	**60 (C)**	**54 (D)**
PES – Overall	**76 (C)**	**51 (D)**	**48 (D)**

Upper Stream 10 has a high ecological importance and sensitivity, while the lower river is of moderate EIS. Lower Stream 11 was found to be of moderate EIS. The quality of the habitat is such that the streams are likely to support populations of unique species, which are sensitive to changes in water quantity and quality. Sensitivity of the riverine fauna is greater in the upper portions of the streams, where disturbances are considerably less. Despite modifications to the lower portions of these rivers, however, the Boschendal streams are all important refuges for species, and provide essential ecological corridors in a highly transformed, cultivated landscape.

Table 4.5 Results of the assessment of Ecological Importance and Sensitivity for Stream 10 and 11 on Boschendal Estate.

EIS component	Stream 10 above the diversion channel	Stream 10 below the diversion channel	Lower Stream 11
Rare and/or endangered species	0 (not assessed)	0 (not assessed)	0 (not assessed)
Populations of unique species	2	2	2
Populations of intolerant species	3	1	1
Species/taxon richness	3	1	1
Diversity of aquatic habitat types or features	3	2	1
Refuge value of habitat type	3	2	2
Sensitivity to changes in hydrology	3	1	1
Sensitivity to changes in water quality	3	2	2
Migration route/corridor for instream and riparian biota	3	3	2
Proximity to National Parks, wilderness areas, Nature Reserves, Natural Heritage sites[1], Natural areas	3	3	3
Overall	**3 (High)**	**2 (Moderate)**	**1.5 (Moderate)**

[1] The Boschendal Estate is considered a graded Heritage Resource, according to the Heritage Act, and the Founder's Estate north of the Pniel Road is a National Heritage Site.

4.3.2 Wetlands

Four wetlands were assessed:

1. Dwars River valley-bottom wetland;
2. Seep wetland to the west of the site ("New Retreat seep"),
3. Seep wetland around Stream 11;
4. Seep wetland below York Dam.

4.3.2.1 Present Ecological State

The Level 1 WET-Health assessment methodology was developed for the rapid assessment of the Present Ecological State (PES) of the hydrology, geomorphology and vegetation of wetlands (MacFarlane *et al.,* 2009). The method is based on the hydrogeomorphic (HGM) approach to wetland classification, providing a PES score for a wetland within each of the three modules, and a combined overall score. The score provides a quantitative measure of the extent, magnitude and intensity of deviation from the reference or unimpacted condition. The score places the wetland in a wetland health category, A – F (see Table 4.6). The wetland is divided into HGM units, and each unit assessed separately.

Table 4.6 Present Ecological State categories for wetlands (from MacFarlane *et al.*, 2009).

Category	Wetland Impact Score	Description
A	0 – 0.9	Unmodified, natural.
B	1 – 1.9	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.
C	2 – 3.9	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.
D	4 – 5.9	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.
E	6 – 7.9	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.
F	8 - 10	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.

4.3.2.2 Ecological Importance and Sensitivity

The importance of the wetlands was assessed by considering the range of goods and services identified in the Wet-Ecoservices tool (Kotze *et al.*, 2009). These generic services include:

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

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

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

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

The maximum score for the three suites of importance criteria was taken to be the overall EIS category for the wetland, as described in Table 4.7.

Table 4.7 Ecological Importance and Sensitivity categories for wetlands (Rountree *et al.*, 2013).

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

4.3.2.3 Results

All of the assessed wetlands are transformed from their natural state, as a result of the long history of cultivation of the Estate. There is evidence of excavations and berms in both wetlands close to the site, as well as roads and tracks. The "New Retreat seep" wetland was assessed to be in a Category D – largely modified – while the Dwars River valley-bottom wetland lies in a category C – moderately modified. The seep around Stream 11 was assessed as to be category D, also largely modified. This wetland has been impacted by past agricultural activities and road construction, which now fragments the wetland and causes water to back up on the upstream (northern) side of the road. This is also the case for the "New

Retreat seep". There are some pipes under the road that carry water from the upstream to the downstream side of the road, but these are few. The seep below York Dam was assessed as being category C – this seep has also been transformed by the presence of the road and the dam, and a few farm buildings. The wetland vegetation persists, however, including palmiet, *Prionium serratum*.

Table 4.8 Results of the PES assessments for the three wetlands.

Hydrogeomorphic Unit	Area (ha)	Hydrology	Geomorphology	Vegetation	Overall
Dwars River channelled valley-bottom wetland	10.3	4.0 D	1.4 B	3.6 C	2.4 C
New Retreat seep	2.0	7.5 E	1.2 B	7.0 E	5.6 D
Stream 11 seep	17.4	9.5 F	1.3 B	5.0 D	5.9 D
York Dam seep	1.8	5.5 D	1.0 B	2.7 C	3.4 C

In terms of provision of ecosystem services, all of the wetlands perform roles in the landscape, with the Dwars River valley-bottom wetland emerging as slightly more important, due particularly to the larger size of this wetland, and the higher diversity and cover of indigenous wetland plants. The highest-scoring ecosystem service for the Dwars River wetland is phosphate trapping, followed by sediment trapping. These are ecological functions that are generally important in valley-bottom and floodplain wetlands, which are often large, gently sloping systems, with vegetation and soils that can trap sediments and nutrients.

Overall, the Dwars River valley-bottom wetland was placed in the High EIS category, while the New Retreat seep, Stream 11 and York Dam seeps lie in the Moderate category (Table 4.10).

Table 4.9 Ecosystem services performed by the two New Retreat wetlands, scored using the WET-Ecoservices protocol (Kotze et al., 2009).

Ecosystem Service	Score				Comments
	New Retreat Seep	Dwars valley-bottom	Stream 11 seep	York Dam seep	
Flood attenuation	1.3	1.4	1.4	1.4	The wetlands are relatively small in comparison with their catchments, but the slopes are gentle. A gentle slope allows for a good capacity for attenuating flows. Flood attenuation capacity of the wetlands are also improved by the fact that they are seasonally saturated / inundated systems, with capacity to hold water – this is more so for the Dwars River VB wetland. Although the rainfall volume and intensity are high on the site, the runoff potential of the soils is moderately low (alluvial sands with some cobble).
Stream flow regulation	2.0	2.0	2.0	2.0	The importance of the wetlands for streamflow regulation is fairly high, due to the strong link to the Dwars River, and the fact that the site sits in the Boland Strategic Surface Water Area (SWSA).
Sediment trapping	1.7	2.5	1.7	1.7	Sediment trapping capacity is moderate, due to the relatively small sizes and gentle slopes of the wetlands. There is a higher diversity and cover of plants in the Dwars River VB wetland, thus more effective at trapping sediment. There is no evidence of large amounts of sediment deposited in the wetlands, however, it is likely that sediment is produced in the upstream catchments, due to agricultural activities.
Phosphate trapping	2.0	2.6	2.0	2.0	The effectiveness of phosphate trapping is linked to the sediment trapping capacity (above) and in addition is improved through diffuse flow of surface water through a wetland – this is more the case for the Dwars River VB wetland due to diffuse sub-surface flows entering the wetland. The opportunity for this service is high, due to agricultural land-use upstream of the wetlands, and waste water treatment plants upstream of both wetlands.
Nitrate removal	2.3	2.3	2.3	2.3	As above. The fairly well vegetated state of the wetlands increases nitrate removal.
Toxicant removal	1.9	2.4	1.9	1.9	As above for capacity for removal, but also a low opportunity due to upstream land-use that is unlikely to produce toxicants.
Erosion control	1.9	1.9	1.9	1.9	Not much evidence of erosion in the wetlands themselves. The erodibility of the soils in the catchment is Moderate (K-value of 0.48 (Schulze *et al.* (2007)). The wetlands are fairly well-vegetated (Dwars River VB more so than the seep, which is just grasses), so the surface roughness is considered to be moderate to moderately high.
Carbon storage	1.7	1.7	1.3	1.3	Although the presence of zones of seasonal saturation/inundation plays a role in increasing carbon storage, there is not much carbon evident in the wetland soils, which are alluvial and sandy. The capacity for carbon storage is relatively low.
Biodiversity maintenance	1.8	2.3	1.8	1.8	The biodiversity role played by the wetlands is relatively low, however a diversity of habitat in the Dwars River VB (depressions, marshes, vegetated areas) does increase its biodiversity value. It is unlikely that there are species of conservation concern, or of a threatened nature, in either of the wetlands. Of the two seeps, the Stream 11 seep has a higher diversity of wetland plants (see also Helme, 2021).
Water supply	1.2	1.3	1.2	1.2	The wetlands do not currently supply water for irrigation or farming, but the wetlands are important areas for cattle to graze and drink.
Harvestable natural resources	0.6	0.6	0.6	0.6	No resources are directly harvested from the wetlands, however, they are used for grazing.
Cultivated foods	0.0	0.0	0.0	0.0	There are no cultivated lands within the wetlands.
Cultural heritage	0.0	0.0	0.0	0.0	There is no known cultural heritage significance attached to the wetlands.
Tourism and recreation	1.0	1.1	1.0	1.0	The wetlands are on a well-known scenic route and wine route, but are currently not accessible to the public.

Ecosystem Service	Score				Comments
	New Retreat Seep	Dwars valley-bottom	Stream 11 seep	York Dam seep	
Education and research	0.8	1.0	0.8	0.8	Low potential for education and research opportunities.

Table 4.10 Summary of the EIS Scores for the New Retreat wetlands.

	New Retreat seep	Dwars River valley-bottom	Stream 11 seep	York Dam seep
Ecological Importance and Sensitivity	2.00	2.50	2.33	2.33
Hydro-functional Importance	1.84	2.09	1.83	1.83
Direct Human Benefits	0.59	0.68	0.59	0.59
Overall Importance and Sensitivity Score	**2.00**	**2.33**	**2.00**	2.00
Overall Importance and Sensitivity Category	**C (Moderate)**	**B (High)**	**C (Moderate)**	C (Moderate)

5 Legislation and guidelines governing the conservation and management of rivers and wetlands

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

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

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

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

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

5.2 Environmental Impact Assessment regulations issued in terms of NEMA (originally promulgated as Regulation 385, 2006, with new legislation adopted in December 2014 and amended in April 2017)

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

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

Key aspects include legislation that allows for:

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

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

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

5.4 Biodiversity Act

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

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

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

5.6 National Water Act (1998)

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

a. Taking water from a water resource;

b. Storing water;

c. Impeding or diverting the flow of water in a watercourse;

d. Engaging in a stream flow reduction activity;

e. Engaging in a controlled activity identified and declared as such in terms of the Act;

f. Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;

g. Disposing of waste in a manner which may detrimentally impact on a water resource;

h. Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;

i. Altering the bed, banks, course or characteristics of a watercourse;

j. Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and

k. Using water for recreational purposes.

DHSWS has issued a number of **General Authorisations** (GA) in terms of Section 39 of the National Water Act, whereby a water use may be authorised if it falls below a specific threshold, meets certain conditions criteria or does not impact on a listed ecosystem.

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

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

- The Western Cape's Critical Biodiversity Area (CBA) mapping, which CapeNature are currently updating and refining, together with the draft priority climate change adaption corridors, comprise the spatial extent of the Western Cape's biodiversity network. This must inform spatial planning and land use management decisions throughout the province.
- Using the latest available CBA mapping as a primary informant, regional, district and municipal SDFs must delineate Spatial Planning Categories (SPCs) that reflect suitable land use activities in the different CBA categories.
- To complement CapeNature's protected area expansion strategy and their Stewardship programme, SDFs should highlight priority areas outside the protected area network that are critical for the achievement of the province's conservation targets.

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

- Given current water deficits, which will be accentuated by climate change, a 'water wise' planning and design approach in the W 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.

5.8 Western Cape Biodiversity Spatial Plan (2017)

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

5.9 Stellenbosch Municipality Spatial Development Framework

The principles contained in the Stellenbosch SPF that are pertinent to this study include:

- All rivers above a minimum size shall be protected by river conservation zones of 10-30m on either side of the bank, depending on the width and maturity of the river (as determined by an aquatic ecologist or land surveyor). These zones should be returned to their natural riparian status for passive recreational use only, and no urban development or intensive agriculture shall be permitted within them.
- No foundations of permanent buildings shall be located within the 1:100 year flood lines (as determined by a hydrological engineer).
- Peak water demand should be accommodated with supplementary storage and recycling (e.g. rainwater tanks, grey water recycling) of water so that the municipality can focus on satisfying base demand and meeting the needs of the poor.
- Urban water demand management programs should be implemented to ensure that urban water demand does not undermine agricultural needs, including:
    - Rainwater harvesting should be mandatory on all new urban developments, and retrofitting of rainwater harvesting should be encouraged on all existing developments (where heritage constraints allow for this).
    - Grey water recycling should be promoted on all residential, commercial and industrial units with gardens.
- Water conservation measures should be adopted, for example minimising unaccounted for water through leak repair and pressure adjustment, installing water meters, educating consumers about water saving, promoting water saving devices and promoting water-wise gardening.
- Technologies that facilitate the efficient use of irrigation water should be encouraged.
- Conservation areas should continue to enjoy the highest possible level of protection in order to ensure water quality and quantity at least in the upper reaches of the river system.
- The eradication of alien vegetation from all areas should be supported.
- Sensitive biodiversity areas should be mapped, and clear and appropriate guidelines introduced to conserve them.
- Crest lines should be kept free of buildings and intensive agriculture to protect biodiversity.
- Ridge lines should be used for properly managed walking trails to increase recreational potential, tourism and income.
- Outside of formal conservation areas, land owners should be encouraged to conserve vegetation classified by SANBI as Endangered or Critically Endangered (particularly along ridge lines) and to link to existing conservancies (e.g. through the CapeNature Stewardship Program). These land uses should be classified in the Core SPC.

6 Constraints to development

There are two considerations to bear in mind when determining development constraints – (1) the regulatory zone around inland aquatic ecosystems (watercourses and wetlands) within which environmental or water use authorisations are triggered, and (2) the protection of the inland aquatic ecosystems themselves through the establishment of ecological buffers or development setbacks.

6.1 Regulatory zone

There are two regulatory zones to take into account:

- A 32m-wide regulatory zone (measured from the edge of the banks of a watercourse or the outer boundary of a wetland) within which an environmental authorisation (according to NEMA) is required;
- A regulatory zone that extends 500m from the outer boundary of a **wetland**, and 100m from the edge of the active channel or the outer boundary of the riparian area around a **watercourse**, within which a Section 21 (c) or (i) water use (according to the National Water Act (NWA)) may apply.

The whole of the New Retreat site lies within the Section 21 (c) and (i) water use authorisation regulatory zone, and a proportion of the site lies within the NEMA regulatory zone. Furthermore, a portion of the proposed water supply pipeline from Lanquedoc lies within 100 m of a watercourse, while the full length of the water pipeline lies within 500 m of a wetland. This report thus deals with the ecological input required to undertake both an environmental and a water use authorisation.

6.2 Development setbacks (ecological buffers)

In determining a development footprint that will have the least impact on an inland aquatic ecosystem, it is essential to establish the recommended development setback, or ecological buffer for each ecosystem. It is important to note that in order to protect the water resource, the development setback or buffer should be used instead of the blanket 32m or 100m setback requirement of NEMA or the NWA. The buffers for the Boschendal aquatic ecosystems potentially impacted by the New Retreat development were determined using the site-based protocol for buffer determination of MacFarlane and Bredin (2016). In the 2019 Boschendal Estate Constraints Analysis, the buffer width tool was used to determine appropriate buffers for the watercourses and wetlands, on a **generic basis** (residential development) and using **desktop data**, as detailed data were not collected for every watercourse and wetland on the Estate. For the New Retreat impact assessment, the buffers could be re-assessed, using **site-based data**.

The assessment is based on the PES and EIS of each aquatic ecosystem (see Section 4), and the assumed quality of the buffer during both phases of the project. It was assumed that the current vegetation would be representative of the buffers for both construction and operational phases. The density of vegetation plays a major role in determining the effectiveness of a buffer – a well-vegetated buffer, with a high basal cover (such as grass or sedges) is the most effective buffer, due to the ability of the plants and their roots to trap sediments, toxins and other pollutants before they reach the wetland or watercourse.

The recommended buffers for the affected reaches of both Stream 10 and Stream 11 are **21m for the Construction Phase and 15m for the Operational Phase**.

The recommended ecological buffers for the New Retreat seep, Dwars River valley-bottom wetland and the seeps associated with Stream 11 and York Dam are **17m for the Construction Phase and 15m for the Operational Phase**. Any existing infrastructure within these buffers can remain in place.

The long-term Operational buffers, measured as a horizontal distance from the outer edge of the active channel for the stream, and the outer edge of the wetlands, are shown in Figure 6.1.

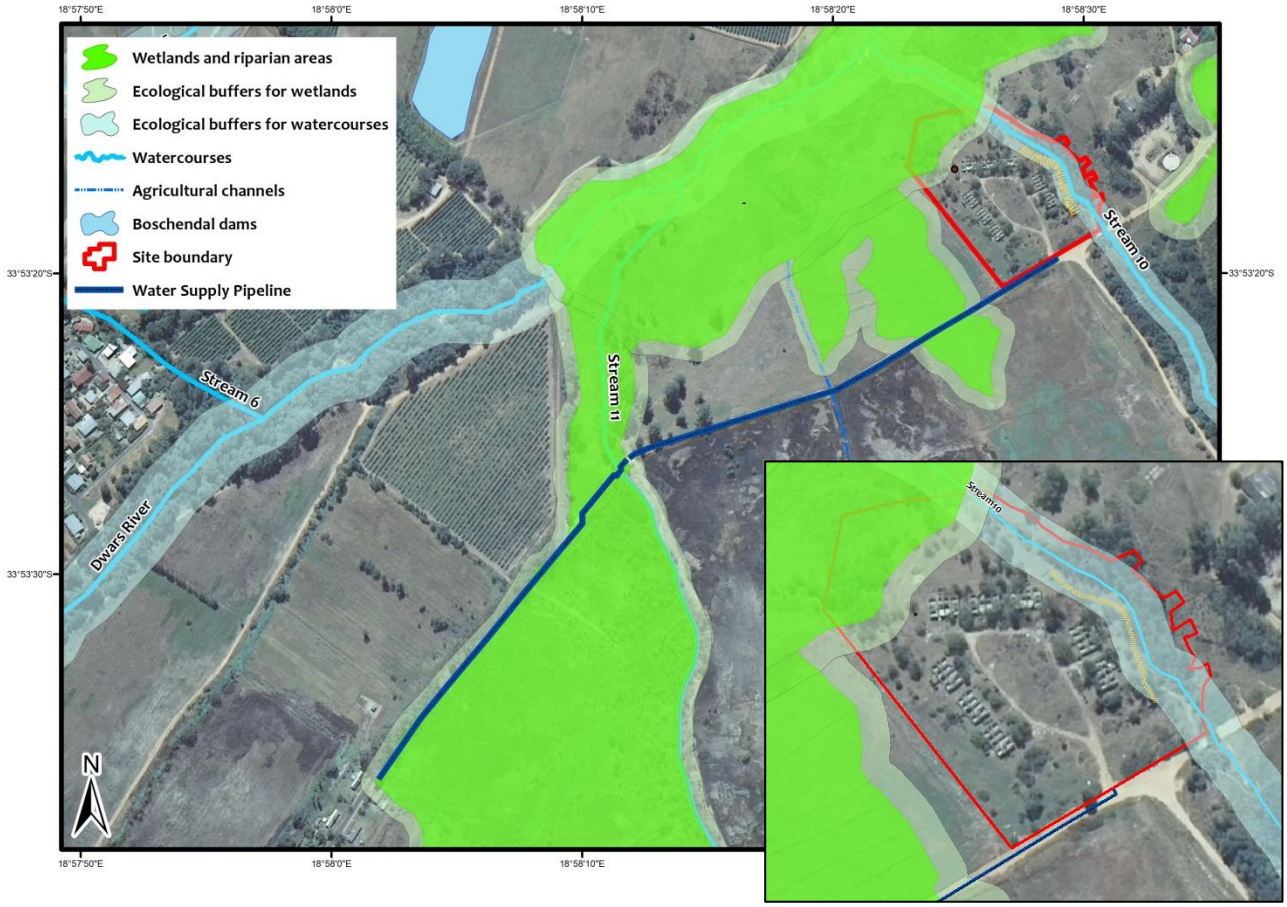

Figure 6.1 Map of recommended ecological buffers for the wetlands and streams on and around the New Retreat site, Boschendal Estate. These buffers were measured as horizontal distances from the edges of the ecosystems, and should be surveyed to provide more accurate information. The insert provides a close up of the development site and its ecological buffers.

6.3 Boschendal Corridors

In the Constraints Analysis of 2019 (Snaddon, 2019), a number of ecological corridors were identified. The aim of the ecological corridors would be to retain and, in some cases, improve the aesthetics of the area and the ecological functioning of the various inland aquatic ecosystems. The establishment of corridors through the site will ensure that any designated conservation areas (such as on the mountain slopes) do not become isolated and disconnected from the ecosystems that arise there, such as the watercourses that flow from the slopes of the Groot Drakenstein and Simonsberg mountains.

Activities and features that can occur within the recommended corridors include:

- Walkways, boardwalks and benches;
- Bird hides;
- Cultural or religious ceremonies;

- Signage;
- Permeable fences;
- Grazing;
- Picnic areas;
- Indigenous gardens; and
- Parking areas with permeable surfaces.

Two Ecological Corridors pass through the New Retreat site, one along Stream 10 and the other following the Dwars River. A third corridor extends along Stream 11 and its associated seep. By ensuring that hard development avoids the corridors, which align with the ecological buffers, and with implementation of the mitigation measures recommended in this report, the ecological integrity of the corridors should be maintained.

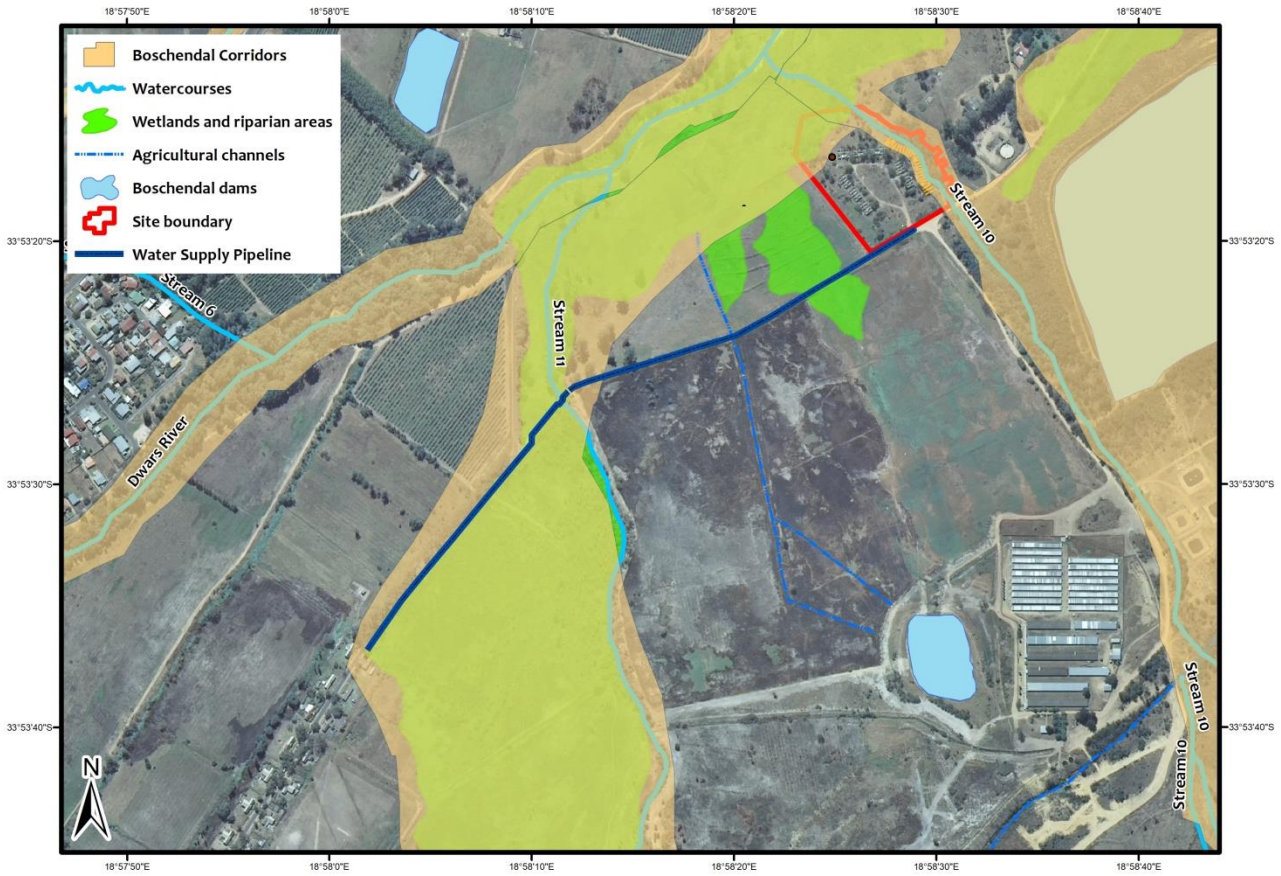

Figure 6.2 Location of Boschendal Ecological Corridors around the New Retreat site.

7 Impact Assessment

Five alternatives were assessed – development Alternatives 1, 2 and 3 (preferred), and two alternative No-go options. The evaluation of impacts was done using the criteria supplied in the EIA Regulations published by the Department of Environmental Affairs (2014), in terms of the Environmental Conservation Act, 1989 (Act No. 73 of 1989) and the latest gazetted procedures for the assessment of environmental themes for environmental authorisation (March 2020). The criteria are listed in Table 7.1.

7.1 Development alternatives

All three development alternatives comprise the following:

- Eight upgraded accommodation units;
- Reception area;
- Communal area (library and ablution facility);
- Conference facilities;
- Dining facilities;
- Access roads, walkways and maintenance tracks;
- Water and waste water reticulation, and
- Landscaping around the facilities.

Most of the developed footprint is located outside of the inland aquatic ecosystems and their ecological buffers recommended in Section 6.2. The exceptions to this are:

- Flood protection measures in and around Stream 10;
- Concrete drift on the Hoof Pad;
- Water supply pipelines;
- Pathways;
- A stormwater swale (Alternatives 1 and 2);
- An informal amphitheatre, and
- A service track to the waste water treatment unit (Alternatives 1 and 2).

The differences between development alternatives relate to the proposed services, specifically to the location of pipes and components of the waste water treatment facilities, the location of a water supply pipeline, and the location of a stormwater retention swale.

7.1.1 Water reticulation

Expected average daily water demand is 13 400 litres / day, not including irrigation. Irrigation water is proposed to come from the farm's existing irrigation network. For Alternatives 1 and 2, potable water is proposed to be sourced from Municipal supply, which would require the construction of three 10 000 litre reservoirs south of the property, to allow for gravity feed via a water pipe to the New Retreat. The new water pipe will be constructed within the gravel road that follows the pipe route (see Figure 7.2).

For Alternative 3, water is proposed to be sourced from Municipal supply, supplied from the Lanquedoc Municipal System. The 160 mm uPVC bulk water supply pipeline is proposed to run underground along the road (Hoof Pad) that accesses the site (see Figure 7.2). The routing of the western segment of the proposed water line will be determined on site, but would be limited to the northern side of the roadway, due to this location being currently disturbed. It would either be routed within the northern half of the road (i.e. hard/blacktop) or between the existing hard top and row of gum trees alongside it. The bulk

water meter will be placed at the security gate. The pipeline will cross over Stream 11 attached to the existing bridge culvert, and then continue westwards towards the connection point with the Lanquedoc Municipal network. The pipeline will also be attached to an existing culvert in the seep associated with Stream 11.

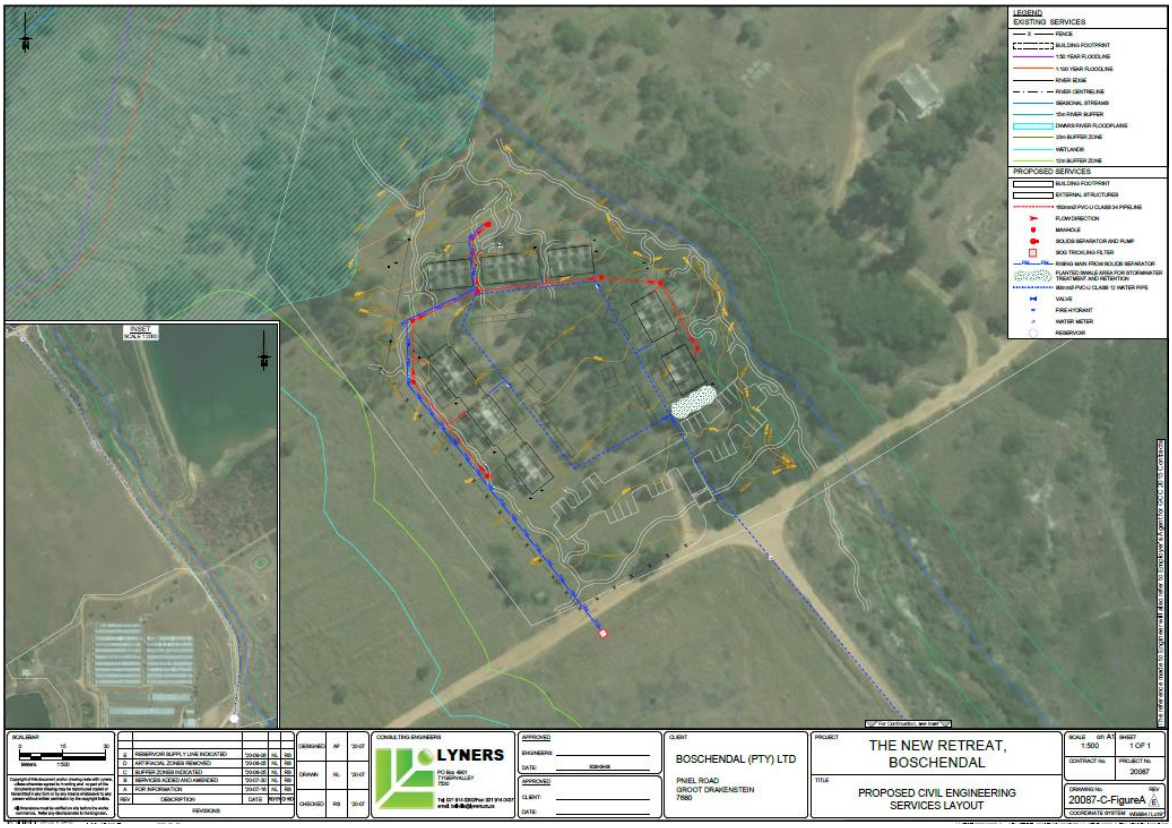

Figure 7.1 **Proposed route for the gravity water pipe for supply to the New Retreat, as shown for development Alternative 1 (dashed blue line in insert).**

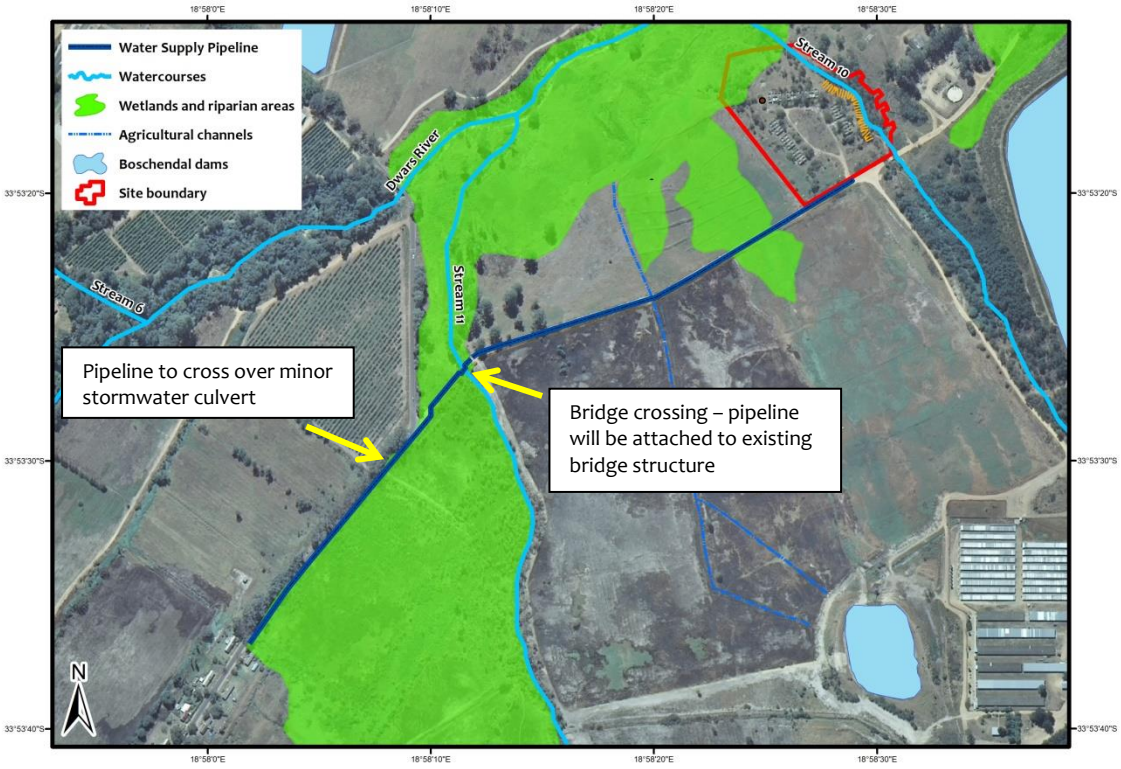

Figure 7.2 **Proposed route (dark blue line) for the water supply pipeline from Lanquedoc Municipal network connection.**

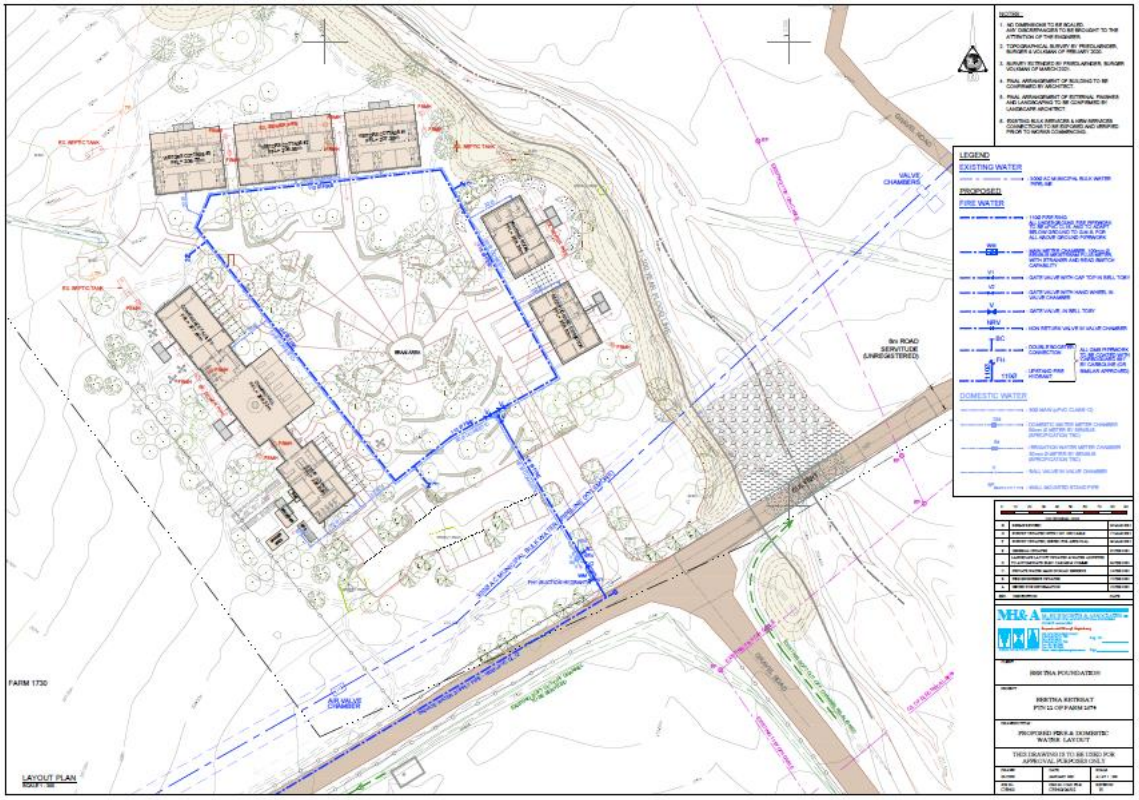

Figure 7.3 **Internal water reticulation system within the New Retreat site, Alternative 3.**

As a temporary measure, until the connection with the Lanquedoc supply can be constructed, potable water for all three development alternatives will be supplied from the nearby Boschendal bulk irrigation main. The supply will be conveyed a distance of approximately 300m in a new 160mm-diameter pipe from an upgraded connection on the northern side of Stream 10. The pipe will be laid in a trench alongside the road, and where it must cross over Stream 10 it will be surface mounted on the culvert deck. The pipeline will be located very close to a seep wetland below the neighbouring dam.

Figure 7.4 Proposed route for the temporary potable water supply line.

7.1.2 Sewer reticulation

There are a number of options for waste water treatment. The Stellenbosch Municipality has stipulated that they would prefer that the site is connected to the Pniel Waste Water Treatment Works, which is soon to be upgraded. However, this may not be completed in time for the operational phase of the project. The project engineers have recommended two alternatives: (1) a waste water treatment unit, and (2) a conservancy tank.

7.1.2.1 Waste water treatment unit (Alternatives 1 and 2)

A low energy biological treatment has been recommended, specifically a SOG trickling filter. Effluent would gravitate towards a solids separator to the north of the buildings, and the liquid component would then be pumped to the SOG trickling filter. Development Alternatives 1 and 2 differ from each other in terms of the location of the various components of the trickling filter system. Alternative 1 (Figure 7.5) proposes that all components of the sewage treatment unit (the septic tank, separator and SOG Filter) are placed at the lowest point on the site, on the side closest to the Dwars River, while Alternative 2 (Figure 7.6) proposes

placement of the SOG filter to the south of the site, on the other side of the road, with the septic tank and separator at a low point to the north of the New Retreat buildings. For Alternatives 1 and 2, treated waste water can be used for irrigation purposes (but see Section 8 for legislation in this regard) or for toilet flushing. According to the brochure for the unit, water is treated to general limits, as contained in Schedule 2 of Government Notice 665 of 2013.

An access track for servicing the waste water treatment unit pump and other components will be required. For Alternatives 1 and 2, the track is proposed to run along the western boundary of the site, and will encroach slightly into the buffer around the Dwars River valley-bottom wetland. A turning place will be required for trucks at the termination point of the road. The location of this turning point differs slightly between the two alternatives, due to the different locations for the treatment unit components. The track to the pump does not encroach into the ecological buffers for Alternative 3.

7.1.2.2 Conservancy tank (Alternative 3)

A 30 m^3 conservancy tank is proposed for Alternative 3, into which all waste water generated on the site would be pumped from a pump station located at a low point in the north-western portion of the site, *via* a rising main (Figure 7.7). The ideal location for the pump is on a site near an existing septic tank, where soils and vegetation have already been disturbed. The conservancy tank would be emptied on a regular basis by honeysucker.

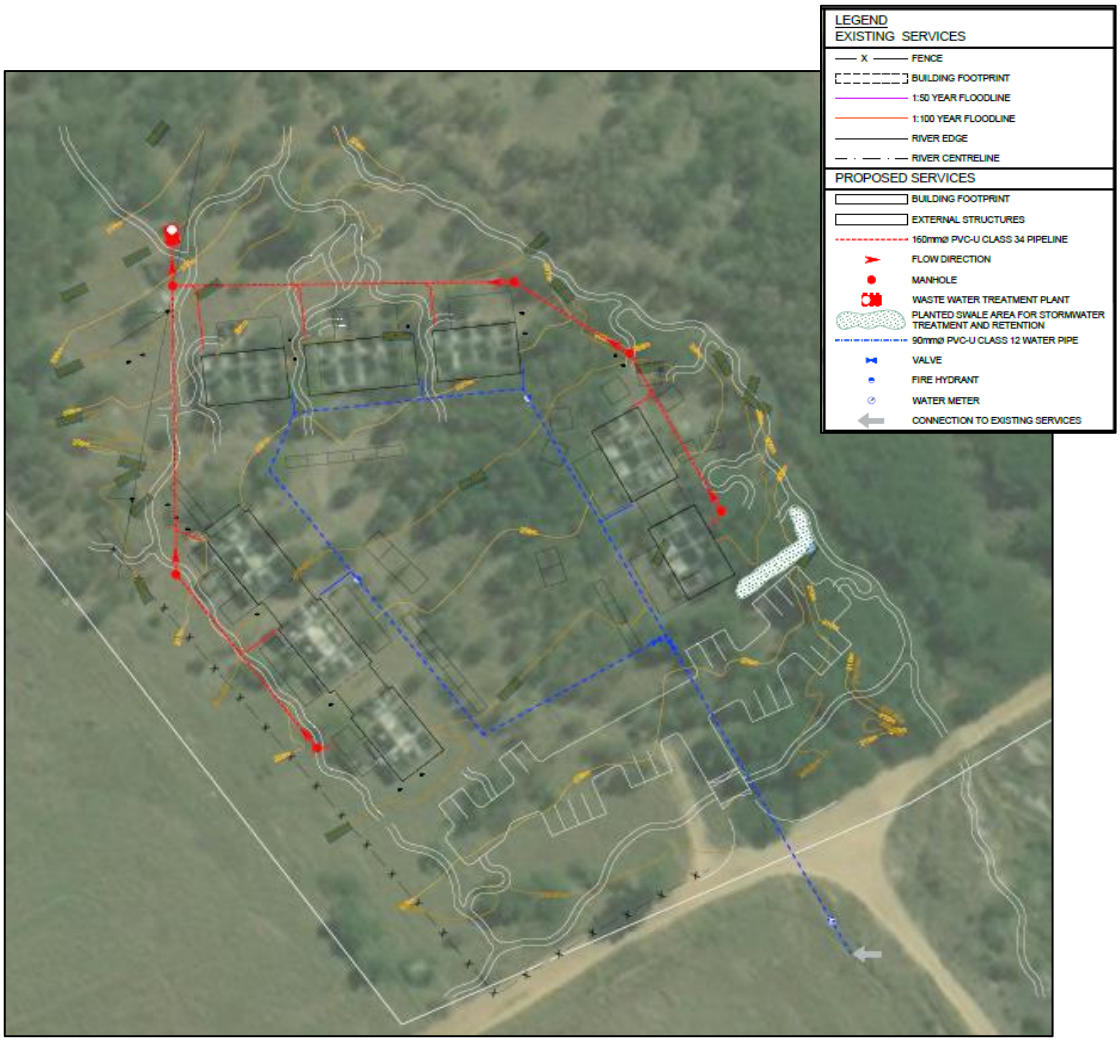

Figure 7.5 **Location of services for Alternative 1. The waste water treatment unit is placed to the north of the buildings, and is fed by gravity. From Lyners Consulting Engineers (16th July 2020).**

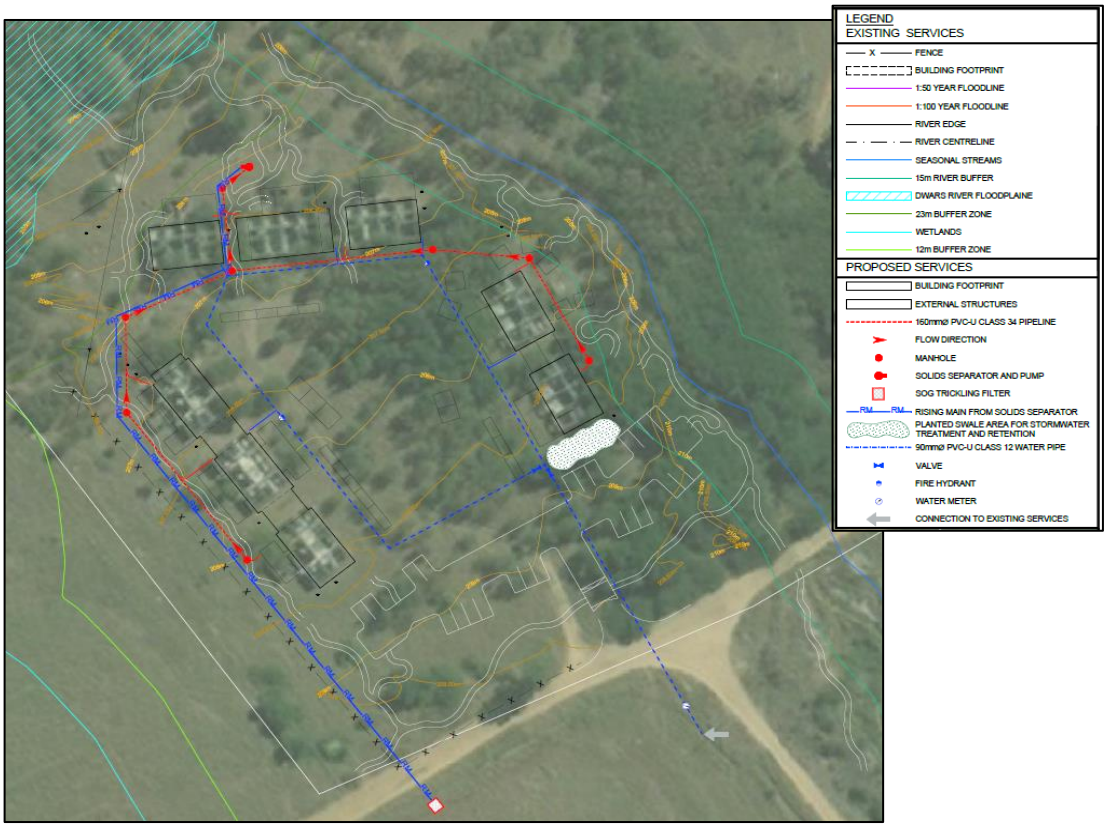

Figure 7.6 **Location of services for Alternative 2. The solids separator and pump are placed to the north of the buildings, and effluent is pumped south to the SOG filter located on the other side of the road. From Lyners Consulting Engineers (5th August 2020).**

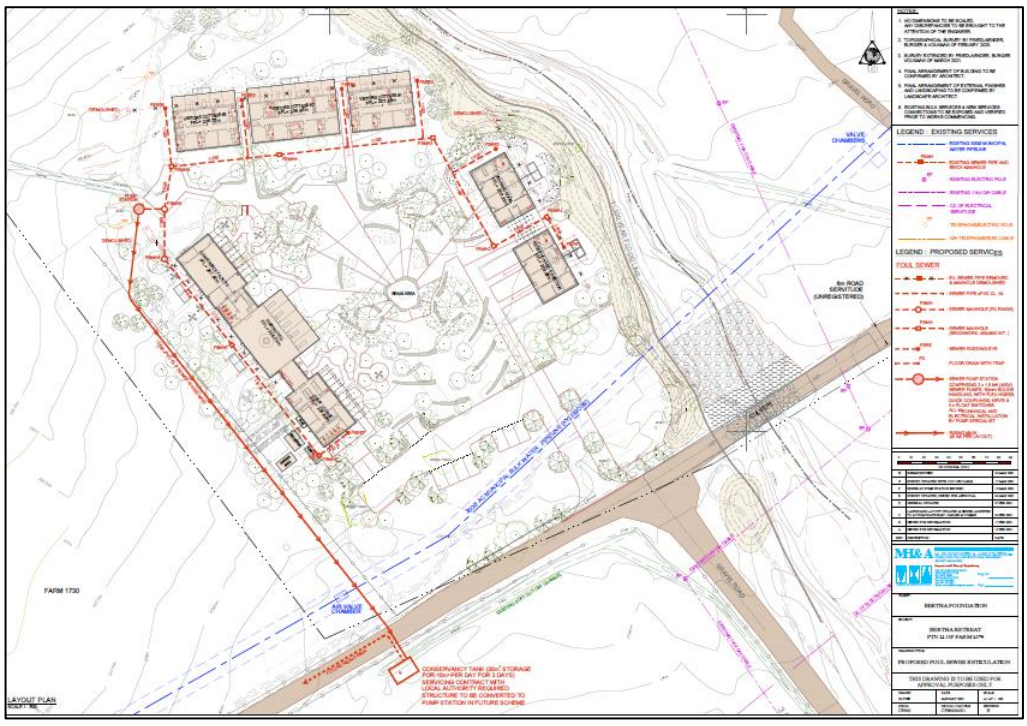

Figure 7.7 **Layout for the sewage treatment infrastructure for Alternative 3.Sewage will be collected from all units and pumped using a pump located in the north-western corner of the site, via a rising main to a conservancy tank to the south of Hoof Pad.**

7.1.3 Electrical infrastructure

The proposed development would be supplied with a 200KVA (300 Amp three phase) low voltage connection to the new site reticulation. The new supply would be taken from the existing Kylemore Farmers 1 Eskom 11kV line via a new 11kV Tee-off. This would be installed to run across the gravel farm road from the existing Eskom 11Kv overhead line. The new line would feed a new 11kV/420 Volt 200Kva pole-mounted transformer, installed on the site and connected to a new 300Amp (200Kva) three-phase low voltage Eskom bulk supply meter point. It is also the intention to supplement power from the grid with rooftop solar panels in the future.

7.1.4 Stormwater management

The site drains in a northerly direction towards the Dwars River valley floor. The size of the developed footprint is only slightly larger than existing, and there are new tracks, roads, parking and paved areas, and some compaction of soils on pathways. The increase in stormwater runoff is likely to be low. Downpipes from buildings will discharge runoff onto the ground surface, where it will be allowed to filter into the ground. Excess runoff will be directed to a vegetated swale for retention and filtration into the soil for Alternatives 1 and 2, while Alternative 3 aims to treat all stormwater at source, allowing it to filter into the ground or spread into vegetated areas. The location of the stormwater swale differs slightly between Alternatives 1 and 2. In Alternative 1, the swale is within the ecological buffer of Stream 10 (Figure 7.5), while for Alternative 2, it is located outside the buffer (Figure 7.6). No stormwater retention structure is proposed for Alternative 3, in which all parking areas and roads will be constructed with permeable materials, and all stormwater allowed to filter into the ground at the point it is generated.

Existing stormwater channels alongside the gravel road will be serviced, and the section of Hoof Pad that crosses over the New Retreat seep will be stabilised with concrete to create a formalised drift (Figure 7.8), as this section of road becomes inundated during winter.

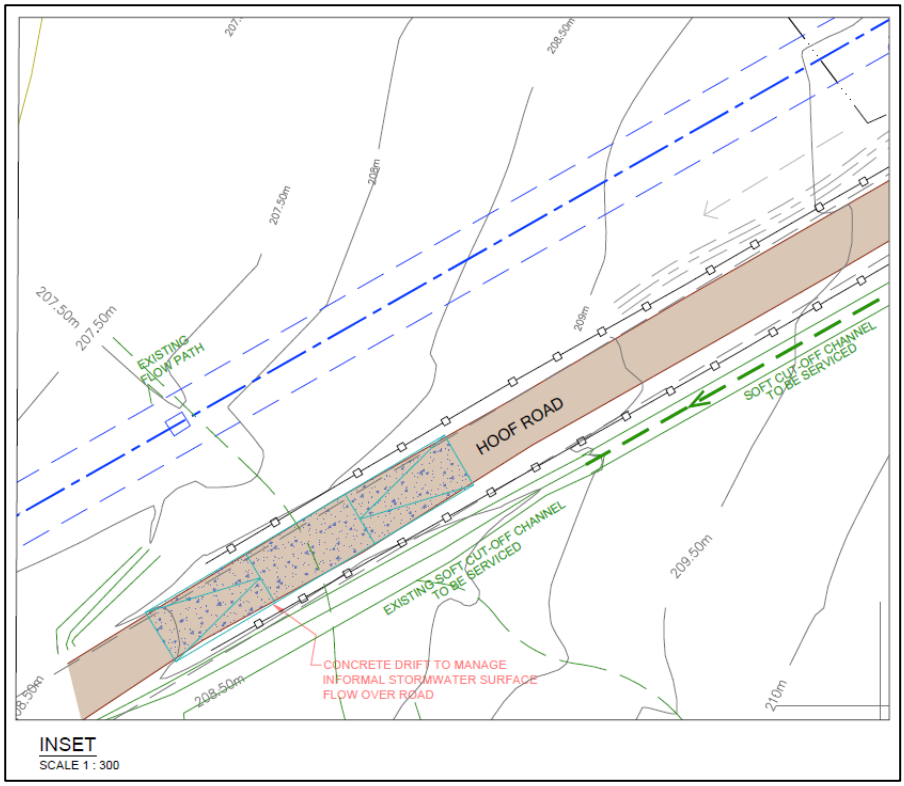

Figure 7.8 Proposed concrete drift on Hoof Pad, due to seasonal inundation of this section of road.

7.1.5 Flood management

A large proportion of the New Retreat site lies below the 1:100 year floodline (Obree, 2021). It was also found that the existing culvert carrying Stream 10 under the road does not have the capacity to contain the 1:100 year flood. With this volume (27 m^3/s) and velocity of water coming down the channel, the water will overtop the road on either side of the culvert and flow as sheet flow onto the site (Obree, 2021). It has been recommended that the bridge crossing be upgraded and stabilised, and that the existing berms on the channel banks be formalised to protect the site.

The work proposed includes:

- A new low level road crossing, comprising five low culverts (1.5 x 0.9 m) on reinforced concrete, and a new, lower road level (Figure 7.9);
- Formalisation and repair of existing berms on the left-hand bank of Stream 10 (to a minimum crest level of 205.91), and one short section of berm upstream of the bridge (Figure 7.10);
- A 300 mm reno mattress constructed out of river stone immediately downstream of the culverts, to protect the stream channel, followed by a section of natural river stone rip rap (Figure 7.10).

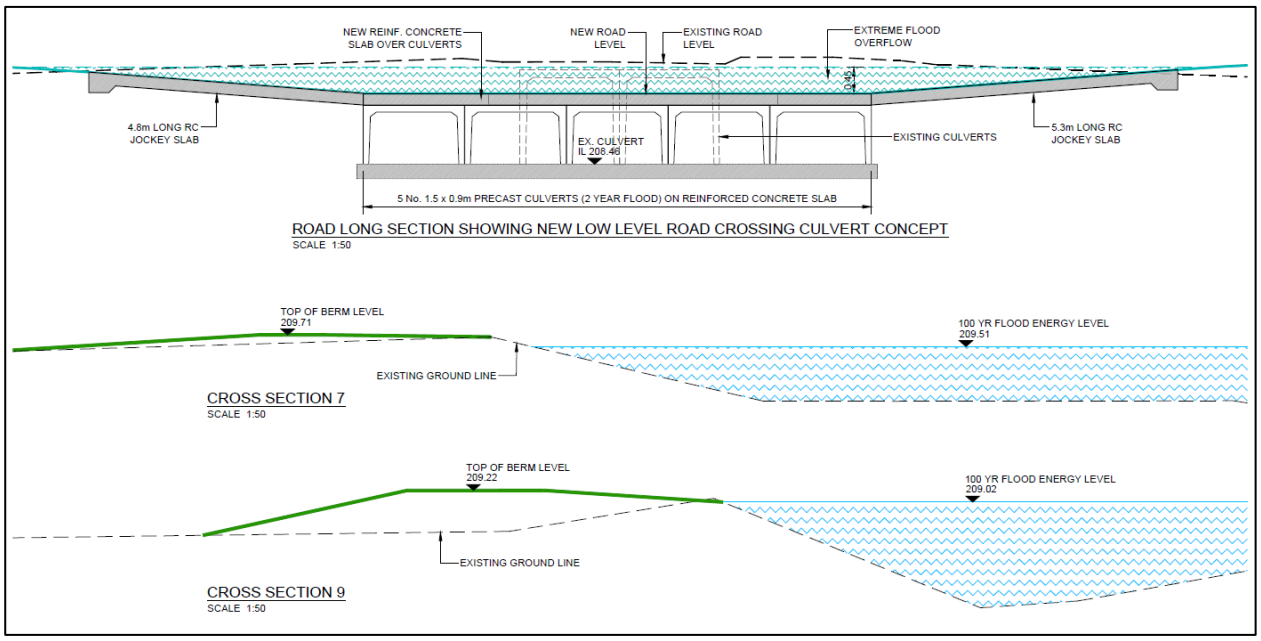

Figure 7.9 Cross-sections of the proposed new road crossing and berms on the left-hand bank of Stream 10.

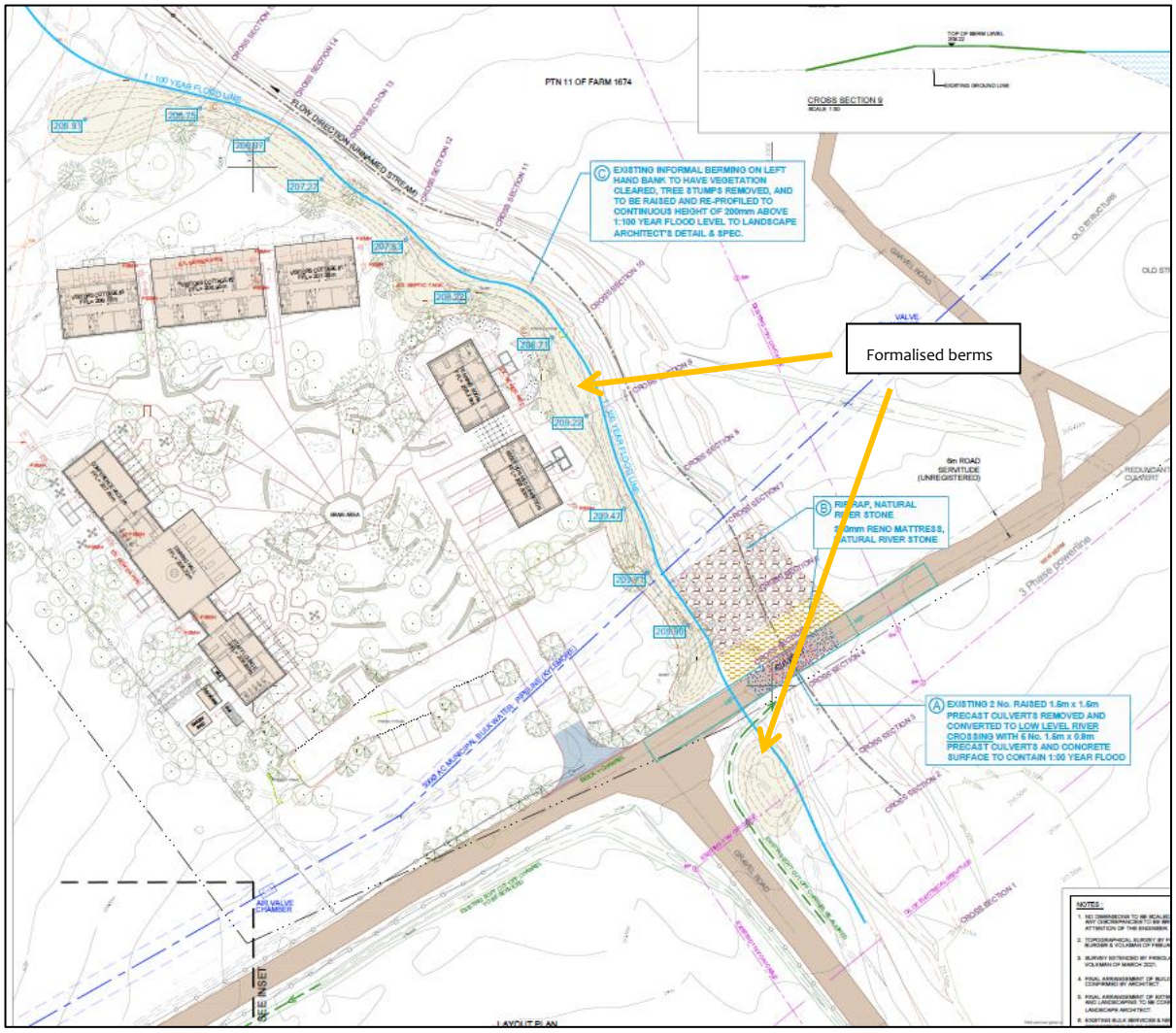

Figure 7.10 Location of the formalised and repaired berms for protection of the New Retreat site from flooding.

7.1.6 Landscaping

Hard landscaping of the site includes an open courtyard and a network of boardwalks, as well as an outdoor landscaped amphitheatre (Figure 7.11). Proposed parking areas would also be landscaped, but these would be tucked within further planting to soften the entrance and interface with the gravel road (Hoof Pad). Soft landscaping is proposed around buildings and in break-away and leisure areas. Tree lines as well as rehabilitated fynbos corridors are proposed to provide strong connections to the broader landscape. There would be peripheral areas to connect to nature through the provision of a continuous footpath through the rehabilitated fynbos and productive kitchen garden. The landscaping would also make use of permeable surfaces as much as possible.

All three development alternatives propose the construction of pathways around the perimeter of the buildings and through leisure areas and the proposed kitchen garden. It is proposed that the pathways be composed of either compacted earth or Gravel Fix, both options with timber pole side edging.

All alternatives also propose an informal amphitheatre, on the edge of the Dwars River valley-bottom wetland. The design for the amphitheatre is only at a conceptual stage, but proposes earth / grassed steps providing an amphitheatre facing the Dwars River (Figure 7.12).

Figure 7.11 Landscape plan for the New Retreat site (29 March 2021), prepared for Alternative 3 by TERRA+.

Figure 7.12 Informal landscaped amphitheatre located in the north-western corner of the site, within the

Dwars River valley-bottom wetland. Source: TERRA + Landscape Architects (2020).

7.2 No–go Option

The following description of the no–go option has been provided by Chand Environmental Consultants. There are existing land uses allowable on the portion of farmland on which the New Retreat is proposed. The site is zoned Agriculture and Rural in terms of the Stellenbosch Municipality Zoning Scheme by-law. The following land-uses are permitted:

- Agricultural building (≤2000m^2)
- Agriculture, such as grazing or cultivation;
- Dwelling house
- Forestry
- Natural environment
- Occasional use (one event/year)
- Private road
- Polytunnel (≤2000m^2)
- Second dwelling
- Employee housing (one unit)

Refurbishment of the existing cottages is allowable for agricultural purposes only (i.e. employee housing), but not for tourist accommodation and facilities. The latter would require a land-use application to the Stellenbosch Municipality to grant consent for a change in land-use (Nisa Mammon and Associates, pers. Comm., 1st September 2020).

The no-go option may thus include the following activities:

- Use of the existing cottages (in their current footprint) as farm accommodation or any other farm-related use like storage or administration;
- Use of the site for cultivation (which does not involve the release of GMOs);
- Use of the site for breeding of animals (which does not involve the release of GMOs), below the following thresholds:
    - 20 m^2 per large stock (i.e. horses) and less than 500 in total;
    - 30 m^2 per crocodile and less than 20;

- 8 m^2 per small stock unit (e.g. pigs, chickens, etc.) and less than 1000 in total, unless pigs are kept which would then be less than 250;
- 3 m^2 per rabbit, and less than 500;
- 250 m^2 per ostrich/emu, and less than 50.

All necessary rights for agricultural use are in place and all thresholds provided above are below Listed Activity triggers for environmental authorisation, **provided that these activities are located outside of the 32m buffer around wetlands and watercourses**, with the exception of agricultural activities (cultivation and grazing). A water use license is in place for any irrigation that may be required anywhere on the whole of the Boschendal Estate.

For the purposes of the assessment of impacts, two alternatives for the No-go option were considered in this report, as follows:

- **No-go Alternative 1**: this is the best case scenario, which would entail renovation of four of the eight buildings (those that lie outside the 32m buffer setback) for farm worker accommodation, and the remaining land is left as is (the remaining cottages would not be demolished);
- **No-go Alternative 2**: this is the worst case scenario, which would involve the cultivation of the full site and removal (demolition) of all buildings. It must be noted that this alternative is unlikely, due to the poor quality of the soil on site.

7.3 Description of probable impacts and mitigation measures

The following sections describe the impacts that are expected to affect the biodiversity and/or ecosystem functioning of the aquatic ecosystems on and adjacent to the New Retreat site on the Boschendal Estate.

7.3.1 Construction phase

The mitigation measures provided below should be incorporated into a construction Environmental Management Programme (EMPr), and audited throughout the construction process. An adequately qualified independent environmental control officer (ECO) must be appointed before construction begins. The construction EMPr must also include recommendations regarding the method statements required by the ECO.

Activity and *Impact*	**Mitigation measures**
Storage of building materials (sand, soil, bricks etc) in sensitive areas – this would *damage the soil structure, and would destroy or shade out plants growing in and around these ecosystems*. Dump areas frequently lead to the *compaction of soils*, which can influence re-growth of plants after construction. **This activity is possible for all alternatives.** Although No-go Alternative 2 does not include construction, the demolition of the buildings may require the temporary storage of building rubble.	• Ensure that all building materials and rubble are stored at least 50m away from the edge of the wetlands and stream channel, as demarcated prior to construction. Storage areas should be bunded adequately to prevent contaminated runoff from entering the aquatic ecosystems. • Materials should be stored in piles that do not exceed 1.5m in height and should be protected from the wind (such as using shade-cloth), to prevent spread of fine materials across the site. • All natural areas that are to remain untransformed but that are impacted by the dumping of materials must be ripped and re-planted after construction is complete, to the satisfaction of the Environmental Control Officer (ECO).
Leakage of fuels, oils, etc. from construction/demolition machinery – this would lead to *pollution of the wetlands or streams*.	• Construction/demolition activities that must take place within the aquatic ecosystems (such as the amphitheatre, demolition of buildings) or the

Activity and *Impact*	Mitigation measures
This activity is possible for all alternatives.	ecological buffers must be done in the dry season, to reduce the risks of contamination of the aquatic ecosystems through rainfall and runoff. • No mixing of concrete may occur close to (less than 50m) the wetlands or stream. • Machinery prone to oil or fuel leakage must be located at least 50m away from the edge of the wetlands and stream, and the area adequately 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. These service areas must be maintained, and toilets emptied on at least a weekly basis.
Foot and vehicular traffic across the site, leading to *destruction or deterioration of aquatic habitat.* Access to the wetlands and stream during construction/ demolition will lead to *damage of soils, substrate (in the stream) and vegetation*. Regular use of a particular area for pathways will lead to the *compaction of soils*. **This activity is possible for all alternatives.**	• Pathways and access roads for construction or demolition must avoid the stream and wetlands. • Construction/demolition activities that must take place within the aquatic ecosystems (such as the amphitheatre and pathways, and the demolition of buildings) or the ecological buffers must be done in the dry season. • Sensitive areas, such as the boundaries of the wetlands and the active channel of the stream, must be clearly demarcated and fenced off (using temporary fencing and danger tape) before any work or site preparation begins. These are no-go areas during the construction or demolition process. • All impacted natural areas must be ripped and re-planted after construction, to the satisfaction of the ECO.
Presence of construction/demolition teams and their machinery on site – this may lead to *noise and light pollution* in the area, which will *disturb aquatic and terrestrial fauna and flora*. **This activity is possible for all alternatives.**	• Construction/demolition activities that must take place within the aquatic ecosystems (such as the amphitheatre and pathways, and the demolition of buildings) or the ecological buffers must be done in the dry season. • If lights are used, these must be directed away from all sensitive areas. • Sensitive areas, such as the boundaries of the wetlands and the active channel of the stream, must be clearly demarcated and fenced off (using temporary fencing and danger tape) before any work or site preparation begins. These are no-go areas during the construction/demolition process.
Construction / demolition activities in or close to the wetlands or streams will lead to the loss of natural vegetation cover, and subsequent loss of biodiversity. This will be necessary for **all development Alternatives** for the construction of the flood protection measures, laying of the water supply pipelines, the amphitheatre, and pathways. In addition the servicing track for the waste water treatment unit for Alternatives 1 and 2 is close to the Dwars River wetland. Furthermore, this will be an impact associated with **No-go Alternative 2**.	• The proposed river rehabilitation plan (Section 8) provided in this report must be implemented, during the dry season. • The water supply pipelines for all development Alternatives must be laid in the road. • Water supply pipelines that must cross over any of the watercourses must be surface mounted on the culverts, to avoid any impact on the watercourses. • For Alternative 3, the pipeline must preferably be located to the north of Hoof Pad, where the landscape is more disturbed. • The temporary pipeline must be placed on the side

Activity and *Impact*	Mitigation measures
	of the road that is away from the York Dam seep wetland, so as to avoid the wetland. • Trenching for laying the water supply pipelines must be done in sections, so that trenches are left open for a minimum length of time. • A search and rescue of important or sensitive plants should be completed before construction occurs in sensitive areas. • Full-grown riparian tree species must not be disturbed or damaged. • IAPs must be removed from an area up to 20 m from the water supply pipeline. • Where alien plant species, particularly kikuyu grass, are removed, these must be replaced by indigenous species of similar growth form. • These disturbed areas must be checked regularly for alien and invasive seedlings.
Construction / demolition activities in or close to the wetlands or stream may lead to an increased input of mobile sediments, especially during the wet winter months when rain and runoff may cause *erosion and sedimentation*. This will be necessary for **all development Alternatives** for the construction of the flood protection measures, laying of the water supply pipeline, amphitheatre, pathways and servicing track for the waste water treatment unit. Furthermore, this will be an impact associated with **No-go Alternative 2**.	• Construction/demolition activities that must take place within the aquatic ecosystems (such as the flood protection measures, road drift, amphitheatre and pathways, and the demolition of buildings) or the ecological buffers must be done in the dry season, to reduce the risks of contamination of the aquatic ecosystems through rainfall and runoff. • The proposed river rehabilitation plan (Section 8) provided in this report must be implemented, during the dry season. • The water supply pipelines for all development Alternatives must be laid in the road. • For Alternative 3, the pipeline must preferably be located to the north of Hoof Pad, where the landscape is more disturbed. • Trenching for laying the water supply pipeline must be done in sections, so that trenches are left open for a minimum length of time. • Rock for the reno mattress, riprap and rehabilitation gabions may not be sourced from the streams on Boschendal Estate. • Special care should be taken around storm and heavy rain events. The construction site should be inspected for erosion damage at these times. • If construction areas are to be de-watered (e.g. after rains), this water must first be pumped into a settlement area or portable tank / pool, and not directly into the wetlands or stream. • Constant monitoring of the construction site by the Site Engineer and ECO must occur.
Top soil or sand brought onto the site, for filling and landscaping can lead to the *introduction of alien or invasive seedbanks*. **This activity is possible for all three development Alternatives** (especially for the repair of the berms), but **not** for the No-go Alternatives.	• Top soil and sand brought onto the site should be inspected for seedlings throughout construction. Seedlings must be removed regularly. • Constant monitoring of the construction site by the Site Engineer and ECO must occur, and all alien plant species removed from or destroyed on the site.

7.3.2 Operational phase

The activities (underlined), impacts (in italics) and mitigation measures associated with the operational phase, specified for each alternative, are detailed in the table below.

Activity and *Impact*	**Mitigation measures**
Stormwater discharge into natural areas – water quality impacts A *decrease in water quality* can follow from discharge of residential *stormwater runoff* into natural areas. Residential stormwater is generally not heavily polluted, but can contain oil and petrol from vehicles, and, of greater significance, nutrients such as nitrates and phosphates from homes and gardens. These nutrients can lead to the proliferation of algae in aquatic ecosystems, which can be problematic and unsightly. This impact is likely to impact both the site area and any downstream areas should this polluted water leave the property. **Development Alternatives 1 and 2** require construction of a stormwater detention pond or swale, which would discharge to the stream. **Alternative 3** however, proposes that all stormwater will be treated on site, allowing for localised retention of water and infiltration into the soil. Parking areas and roads will be constructed with permeable materials, thus dispensing with the need to build a stormwater retention structure. Stormwater generated by **No-go Alternative 1** is likely to be discharged to ground from roofs and hardened areas. Runoff from **No-go Alternative 2** is most likely to be discharged into the stream or wetlands.	• New hardened surfaces (impermeable) must be limited to the developable area outside the aquatic ecosystems and their buffers (**all alternatives**). • The pathways and amphitheatre planned within the wetlands and the ecological buffers must not be hardened, and compaction of soils along the pathways minimised to a narrow area (less than 1 metre). (**all development alternatives**) • Pathways outside the ecological buffers and the aquatic ecosystems can be constructed with gravel of Gravel Fix. (**all development alternatives**) • The vehicle track leading to the waste treatment components located on site, proposed to encroach into the Dwars River valley-bottom wetland buffer for Alternatives 1 and 2, must be constructed with permeable materials, such as permeable paving, Gravel Fix, mulch, or earth. **(Alternatives 1 and 2)** • Downpipes from all buildings to discharge to filtration areas. (**all alternatives**) • All hardened areas within the site should be associated (where possible) with vegetated filter strips (broad, sloped vegetated areas that accept shallow runoff from hardened surfaces), bioswales (landscaped areas that are designed to remove silt and a number of pollutants from runoff, through ensuring that water flows slowly along these gently sloping (<6% slope) features, often planted with grass or other plant species, mulch or riprap), and / or bio-retention systems (vegetated areas where runoff is filtered through a filter media layer, e.g. sand, as it percolates downwards), all of which are designed to reduce the quantity of runoff leaving a hardened surface and entering the stormwater system. **(all alternatives)** • Runoff from agricultural lands should discharge into filtration areas some distance from the stream and wetlands, to allow for infiltration to ground. **(No-go alternatives)**
Stormwater discharge into natural areas – water quantity impacts Any additional hardened surfaces within the New Retreat site will lead to *changes in water inputs and flow patterns*, as there will be an *increase in the quantity* of stormwater runoff exiting the developed footprint as opposed to filtering into the ground. Flow patterns will also be impacted, as *flood peaks will be increased in volume as well as frequency*. Discharge of stormwater into seasonally inundated / saturated portions of the wetlands will lead to a *loss of habitat quality*, as these systems will be inundated for longer and will *lose their seasonal character*. **Development Alternatives 1 and 2** require construction of a	• Effort should be made to minimise the hardening of surfaces across the whole site. Natural areas, gardens and road verges are areas where water can filter into the ground. **(all alternatives)** • New hardened surfaces (impermeable) must be limited to the developable area outside the aquatic ecosystems and their buffers. **(all alternatives)** • The pathways and amphitheatre planned within the wetlands and the ecological buffers must not be hardened, and compaction of soils along the pathways minimised to a narrow area (less than 1 metre). **(all development alternatives)** • Pathways outside the ecological buffers and the

Activity and *Impact*	Mitigation measures
stormwater detention pond or swale, which would discharge to the stream. **Alternative 3** however, proposes that all stormwater will be treated on site, allowing for localised retention of water and infiltration into the soil. Parking areas and roads will be constructed with permeable materials, thus dispensing with the need to build a stormwater retention structure. Stormwater generated by **No-go Alternative 1** is likely to be discharged to ground from roofs and hardened areas. Runoff from **No-go Alternative 2** is most likely to be discharged into the stream or wetlands.	aquatic ecosystems should be constructed with gravel of Gravel Fix. **(all development alternatives)** • The vehicle track leading to the waste treatment components located on site, proposed to encroach into the Dwars River valley-bottom wetland buffer, must be constructed with permeable materials, such as permeable paving, Gravel Fix, mulch, or earth. **(Alternatives 1 and 2)** • Stormwater should not be conveyed directly (e.g. by pipe or drain) into the wetlands or stream but must flow along unlined swales, permeable areas, and bioswales. **(all alternatives)** • Parking areas should be constructed using permeable materials to allow for infiltration of water. **(all development alternatives)** • As a principle, hardened areas should be associated (where possible) with vegetated filter strips (broad, sloped vegetated areas that accept shallow runoff from hardened surfaces), bioswales (landscaped areas that are designed to remove silt and a number of pollutants from runoff, through ensuring that water flows slowly along these gently sloping (<6% slope) features, often planted with grass or other plant species, mulch or riprap), and / or bio-retention systems (vegetated areas where runoff is filtered through a filter media layer, e.g. sand, as it percolates downwards), all of which are designed to reduce the quantity of runoff leaving a hardened surface and entering the stormwater system. **(All alternatives)**
<u>On-site treatment and/or storage of waste water.</u> The risks associated with this approach are: *contamination of soils, groundwater and aquatic ecosystems* from leaks or overflow from pipelines, the septic tank, conservancy tank, separator or SOG filter; or contamination from use of treated waste water for irrigation. The proposed waste water treatment system for **development Alternatives 1 and 2** is the SOG Trickling Filter system, which makes use of naturally-occurring filtration media and organisms to filter and treat liquid waste. A septic tank and solids separator is required, prior to the water being pumped to the SOG filter. Treated effluent may be used for irrigation or for flushing toilets. **Development Alternative 3** proposes a conservancy tank to the south of the gravel road (Hoof Pad), which would be regularly emptied. A rising main will be located on site, with a pump in the north-western corner for pumping untreated sewage to the tank. Waste water from the farm worker cottages in **No-go Alternative 1** is likely to be treated in the existing septic tanks and soak-aways. There will be no waste water generated by **No-go Alternative 2**.	• Waste water conveyance, storage or treatment infrastructure must be placed outside of the delineated ecological buffers. **(all alternatives)** • All sewage storage facilities must be regularly checked for leaks and overflow. **(all alternatives)** • The SOG filter should be placed as distant from the sensitive natural areas (stream and wetlands and their buffers) as possible, as proposed for Alternative 2. **(Alternatives 1 and 2)** • The area immediately around the solids separator and SOG filter should be protected with a berm, which would catch surface water flowing out of any of the components. **(Alternatives 1 and 2)** • Treated waste water should be recycled back into the toilet system. **(Alternatives 1 and 2)**
<u>Proximity of buildings and human activity to the wetlands and Dwars River</u>. This may lead to local *disturbance of fauna and flora*, through noise, light, trampling, etc. Fauna may move away from the site.	• Lighting should face away from the wetlands, and stream. **(all alternatives)** • Visitors should be discouraged from walking on the bed and banks of the stream, and into the wetter

Activity and *Impact*	Mitigation measures
This activity is possible for all alternatives.	areas, through construction of walkways and benches, guiding visitors to use specific pathways and areas. **(all development alternatives)**
Disturbance of soils for landscaping/gardening/farming *Alien or invasive seeds and seedlings may be transported onto site* during ongoing landscaping/gardening or farming activities. Alien vegetation is well adapted to establishing on previously disturbed soils and road verges. This may lead to a further loss of habitat quality, and increase in water uptake through transpiration. **This activity is possible for all alternatives.**	• Landscaping requiring ongoing maintenance around the units must be kept to a minimum, especially within the ecological buffers. Gardens should rather be natural areas, where the locally indigenous vegetation is allowed to grow. **(all development alternatives)** • No kikuyu grass is allowed anywhere on site. **(all alternatives)** • The spread of alien plant species into all natural areas must be prevented and monitored. **(all alternatives)** • Road verges must be monitored for alien species, especially grasses. **(all alternatives)**

7.3.3 Cumulative impacts

The cumulative impacts of most concern in this area are:

- Loss of open space, through catchment hardening;
- Loss or fragmentation of riverine or wetland habitat, as a result of encroachment into ecosystems and/or their ecological buffers;
- Deterioration in water quality, from discharge of stormwater or treated waste water into natural areas.

Table 7.1 Criteria used for the assessment of impacts associated with the proposed New Retreat development.

Criterion	Description
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**.
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.
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).
Consequence	Indicate how the activity will affect the environment.
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).
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.
Reversibility	The degree to which an impact can be reversed, from **fully reversible**, to **partly reversible** to **irreversible**.
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.
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).
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).
Degree to which an impact can be mitigated	The impact can be **high** (fully mitigated), **moderate** (partly mitigated) or **not mitigated**.
Residual risks	Residual risks are that remain following the implementation of mitigation measures.
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 Assessment of impacts

7.4.1 Construction Phase

Although there are some differences between the layouts for development Alternatives 1 and 2, the nature and significance of the construction phase impacts are the same for both alternatives.

	Development Alternatives 1, 2 and 3	No-go alternative 1	No-go alternative 2
Potential impact and risk:	Storage of building or demolition materials (sand, soil, bricks etc) in or close to sensitive areas – this would damage the soil structure, and would destroy or shade out plants growing in and around these ecosystems. Dump areas frequently lead to the compaction of soils, which can influence re-growth of plants.		
Nature of impact:	Negative	Negative	Negative
Extent and duration of impact:	Site and short-term	Site and short-term	Site and short-term
Consequence of impact or risk:	This would lead to deterioration in ecological condition, or possibly permanent loss of natural habitat.		
Probability of occurrence:	Improbable	Improbable	Improbable
Degree to which the impact may cause irreplaceable loss of resources:	Marginal loss	Marginal loss	Marginal loss
Degree to which the impact can be reversed:	Fully reversible	Fully reversible	Fully reversible
Indirect impacts	None – impact is unlikely to be felt off-site or to influence broader ecological functioning		
Cumulative impact prior to mitigation:	Low	Low	Low
Significance rating of impact prior to mitigation	Low	Low to no impact	Low
Degree to which the impact can be avoided:	High	High	High
Degree to which the impact can be managed:	High	High	High
Degree to which the impact can be mitigated:	High	High	High
Proposed mitigation:	Store materials at least 50 m away from any sensitive areas in bunded areas. Protect piles (must be less than 1.5m high) of soil and other fine material, such as using shadecloth. Rehabilitate sensitive areas that are impacted by this activity.		
Residual impacts:	No residual impact if the mitigation is implemented.	Although Duty of Care applies to the No-go alternatives, it is unlikely that mitigation measures will be implemented. Residual impacts are likely.	
Cumulative impact post mitigation:	No impact	Low	Low
Significance rating of impact after mitigation	No impact	Low to no impact	Low

	Development Alternatives 1, 2 and 3	No-go alternative 1	No-go alternative 2
Potential impact and risk:	Leakage or spillage of fuels, oils, etc. from construction / demolition machinery – this would lead to pollution of the wetlands or stream.		
Nature of impact:	Negative	Negative	Negative
Extent and duration of	Local and short-term	Local and short-term	Local and short-term

	Development Alternatives 1, 2 and 3	No-go alternative 1	No-go alternative 2
impact:			
Consequence of impact or risk:	This would lead to deterioration in ecological condition.		
Probability of occurrence:	Probable	Probable	Probable
Degree to which the impact may cause irreplaceable loss of resources:	Marginal loss	Marginal loss	Marginal loss
Degree to which the impact can be reversed:	Partly reversible	Partly reversible	Partly reversible
Indirect impacts:	Pollution of the Dwars River.		
Cumulative impact prior to mitigation:	Medium	Medium	Medium
Significance rating of impact prior to mitigation	Low to medium	Low	Low to medium
Degree to which the impact can be avoided:	High	High	High
Degree to which the impact can be managed:	High	High	High
Degree to which the impact can be mitigated:	High	High	High
Proposed mitigation:	No mixing of concrete close to (< 50m) wetlands or stream. All machinery, toilets etc that are prone to leaks or spills must be located at least 50m away from wetlands and stream, and must be well maintained. Construction / demolition work in or close to the wetlands and stream must be during the dry season.		
Residual impacts:	There may be some residual impact that will linger after construction due to leaks / spills not being noticed / recorded. Soil pollution is sometimes hard to detect, and pollutants may find their way into sensitive areas.	Although Duty of Care applies to the No-go alternatives, it is unlikely that mitigation measures will be implemented. Residual impacts are likely.	
Cumulative impact post mitigation:	Low	Medium	Medium
Significance rating of impact after mitigation	Low	Low	Low to medium

	Development Alternatives 1, 2 and 3	No-go alternative 1	No-go alternative 2
Potential impact and risk:	Foot and vehicular traffic across the site, leading to destruction or deterioration of freshwater habitat.		
Nature of impact:	Negative	Negative	Negative
Extent and duration of impact:	Site and short-term	Site and short-term	Site and short-term
Consequence of impact or risk:	This would lead to deterioration in ecological condition or possible loss of wetland or river habitat.		
Probability of occurrence:	Improbable	Improbable	Improbable
Degree to which the impact may cause	Marginal loss	Marginal loss	Marginal loss

	Development Alternatives 1, 2 and 3	No-go alternative 1	No-go alternative 2
irreplaceable loss of resources:			
Degree to which the impact can be reversed:	Fully reversible	Fully reversible	Fully reversible
Indirect impact:	None – impact is unlikely to be felt off-site		
Cumulative impact prior to mitigation:	Medium	Medium	Medium
Significance rating of impact prior to mitigation	Low	Low	Low to medium
Degree to which the impact can be avoided:	High	High	High
Degree to which the impact can be managed:	High	High	High
Degree to which the impact can be mitigated:	High	High	High
Proposed mitigation:	Demarcate sensitive areas and avoid during construction / demolition. Work in or close to the wetlands or stream must take place during the dry season. Use existing roads and tracks. Rehabilitate impacted sensitive areas.		
Residual impacts:	No residual impacts if mitigation is implemented.	Although Duty of Care applies to the No-go alternatives, it is unlikely that mitigation measures will be implemented. Residual impacts are likely.	
Cumulative impact post mitigation:	No impact	Medium	Medium
Significance rating of impact after mitigation	No impact	Low	Low to medium

	Development Alternatives 1, 2 and 3	No-go alternative 1	No-go alternative 2
Potential impact and risk:	Presence of construction / demolition teams and their machinery on site – this may lead to noise and light pollution in the area, which will disturb aquatic and terrestrial fauna and flora.		
Nature of impact:	Negative	Negative	Negative
Extent and duration of impact:	Site and short-term	Site and short-term	Site and short-term
Consequence of impact or risk:	This would lead to the deterioration in condition of aquatic habitat and the consequent movement of flora and fauna away from the site.		
Probability of occurrence:	Probable	Probable	Probable
Degree to which the impact may cause irreplaceable loss of resources:	Marginal loss	Marginal loss	Marginal loss
Degree to which the impact can be reversed:	Partly reversible	Partly reversible	Partly reversible
Indirect impact:	Movement of fauna and flora from the site onto the broader Estate, or movement of species away from the Estate altogether, towards less disturbed sites.		
Cumulative impact prior to mitigation:	Low to medium	Low to medium	Low to medium
Significance rating of impact prior to mitigation	Low	Low	Low to medium
Degree to which the impact can be avoided:	Medium	Medium	Medium
Degree to which the impact can be managed:	Medium	Medium	Medium
Degree to which the	Medium	Medium	Medium

	Development Alternatives 1, 2 and 3	No-go alternative 1	No-go alternative 2
impact can be mitigated:			
Proposed mitigation:	Demarcate and avoid encroaching into sensitive areas during construction / demolition. Work in or close to the wetlands or stream must take place during the dry season. Direct lights away from sensitive areas.		
Residual impacts:	No residual impacts if mitigation is implemented.	Although Duty of Care applies to the No-go alternatives, it is unlikely that mitigation measures will be implemented. Residual impacts are likely.	
Cumulative impact post mitigation:	Low	Low to medium	Low to medium
Significance rating of impact after mitigation	Low	Low	Low to medium

	Development Alternatives 1, 2 and 3	No-go alternative 1	No-go alternative 2
Potential impact and risk:	Construction or demolition activities close to the wetlands or streams will lead to the loss of natural vegetation cover, and subsequent loss of biodiversity.		
Nature of impact:	Negative	Negative	Negative
Extent and duration of impact:	Local and short-term	Local and short-term	Local and short-term
Consequence of impact or risk:	This would lead to the deterioration in condition of aquatic habitat and loss of biodiversity.		
Probability of occurrence:	Highly probable	Highly probable	Highly probable
Degree to which the impact may cause irreplaceable loss of resources:	Marginal loss	Marginal loss	Marginal loss
Degree to which the impact can be reversed:	Partly reversible	Partly reversible	Partly reversible
Indirect impact:	None – impact is unlikely to be felt off-site.		
Cumulative impact prior to mitigation:	Low	Low	Low
Significance rating of impact prior to mitigation	Low to medium	Low	Low
Degree to which the impact can be avoided:	High	High	High
Degree to which the impact can be managed:	High	High	High
Degree to which the impact can be mitigated:	High	High	High
Proposed mitigation:	The proposed river rehabilitation plan (Section 8) provided in this report must be implemented, during the dry season. The water supply pipelines for all development Alternatives must be laid in the road. For Alternative 3, the pipeline must preferably be located to the north of Hoof Pad, where the landscape is more disturbed. Trenching for laying the water supply pipeline must be done in sections, so that trenches are left open for a minimum length of time.	n/a	
	Search and rescue of important or sensitive plants should be completed before construction or		

	Development Alternatives 1, 2 and 3	No-go alternative 1	No-go alternative 2
	demolition occurs. Full-grown riparian tree species must not be disturbed or damaged. Where alien species, particularly kikuyu grass, are removed, these must be replaced by indigenous species of similar growth form. Disturbed areas must be checked regularly for alien and invasive seedlings.		
Residual impacts:	No residual impacts if mitigation is implemented.	Although Duty of Care applies to the No-go alternatives, it is unlikely that mitigation measures will be implemented. Residual impacts are likely.	
Cumulative impact post mitigation:	No impact	Low	Low
Significance rating of impact after mitigation	Low	Low	Low

	Development Alternatives 1, 2 and 3	No-go alternative 1	No-go alternative 2
Potential impact and risk:	Construction or demolition activities close to the wetlands or stream may lead to an increased input of mobile sediments, especially during the wet winter months when rain and runoff may cause erosion and sedimentation.		
Nature of impact:	Negative	Negative	Negative
Extent and duration of impact:	Local and medium-term	Local and medium-term	Local and medium-term
Consequence of impact or risk:	This would lead to the deterioration in condition of aquatic habitat through erosion and sedimentation.		
Probability of occurrence:	Highly probable	Highly probable	Highly probable
Degree to which the impact may cause irreplaceable loss of resources:	Marginal loss	Marginal loss	Marginal loss
Degree to which the impact can be reversed:	Partly reversible	Partly reversible	Partly reversible
Indirect impact:	May cause sedimentation in the Dwars River downstream, which in turn can lead to head-cut erosion in the Dwars River channel due to change in longitudinal gradient.		
Cumulative impact prior to mitigation:	Medium	Medium	Medium
Significance rating of impact prior to mitigation	Low to medium	Low	Low to medium
Degree to which the impact can be avoided:	High	High	High
Degree to which the impact can be managed:	High	High	High
Degree to which the impact can be mitigated:	High	High	High
Proposed mitigation:	The proposed river rehabilitation plan (Section 8) provided in this report must be implemented, during the dry season. Rock for the reno mattress, riprap and rehabilitation gabions may not be sourced from the streams on Boschendal Estate. The water supply pipelines for all development Alternatives	n/a	

	Development Alternatives 1, 2 and 3	No-go alternative 1	No-go alternative 2
	must be laid in the road. For Alternative 3, the pipeline must preferably be located to the north of Hoof Pad, where the landscape is more disturbed. Trenching for laying the water supply pipeline must be done in sections, so that trenches are left open for a minimum length of time.		
	Demarcate and avoid encroaching into sensitive areas during construction or demolition. Construction/demolition close to the streams and wetlands must take place during the dry season. The site must be inspected after heavy rainfall to check for erosion damage. If construction / demolition areas are to be de-watered (e.g. after rains), this water must first be pumped into a settlement area, and not directly into the wetlands or stream. Impacted sensitive areas must be rehabilitated.		
Residual impacts:	No residual impacts if mitigation is implemented.	Although Duty of Care applies to the No-go alternatives, it is unlikely that mitigation measures will be implemented. Residual impacts are likely.	
Cumulative impact post mitigation:	Low	Medium	Medium
Significance rating of impact after mitigation	Low	Low	Low to medium

	Development Alternatives 1, 2 and 3	No-go alternative 1	No-go alternative 2
Potential impact and risk:	Top soil or sand brought onto the site, for filling and landscaping can lead to the introduction of alien or invasive seedbanks.		
Nature of impact:	Negative	Negative	Negative
Extent and duration of impact:	Local and medium-term	Local and medium-term	Local and medium-term
Consequence of impact or risk:	This would lead to the deterioration in condition of aquatic habitat and loss of water through higher transpiration rates of IAPs, compared to most fynbos species.		
Probability of occurrence:	Probable	Probable	Probable
Degree to which the impact may cause irreplaceable loss of resources:	Marginal loss	Marginal loss	Marginal loss
Degree to which the impact can be reversed:	Fully reversible	Fully reversible	Fully reversible
Indirect impact:	Spread of IAPs from the site onto the broader Estate, and downstream towards the Dwars River.		
Cumulative impact prior to mitigation:	Medium	Medium	Medium
Significance rating of impact prior to mitigation	Low to medium	Low	Low
Degree to which the impact can be avoided:	Medium	Medium	Medium
Degree to which the impact can be managed:	High	High	High
Degree to which the impact can be mitigated:	High	High	High

	Development Alternatives 1, 2 and 3	No-go alternative 1	No-go alternative 2
Proposed mitigation:	Inspect all soil and fill brought onto site and remove all seedlings. Site must be inspected at least weekly for alien and invasive seedlings, and these removed and destroyed.		
Residual impacts:	It is a challenge to ensure that the disturbance of soils and use of imported topsoils does not lead to the spread and establishment of alien plants. It is likely that some will avoid detection. Only constant monitoring and removal will solve this problem.	Although Duty of Care applies to the No-go alternatives, it is unlikely that mitigation measures will be implemented. Residual impacts are likely.	
Cumulative impact post mitigation:	Medium	Medium	Medium
Significance rating of impact after mitigation	Low	Low	Low

7.4.2 Operational phase

	Development Alternative 1	Development Alternative 2	Development Alternative 3	No-go Alternative 1	No-go Alternative 2
Potential impact and risk:	Stormwater discharge into natural areas – water quality impacts.				
Nature of impact:	Negative	Negative	Negative	Negative	Negative
Extent and duration of impact:	Local and long-term	Local and long-term	Local and long-term	Local and long-term	Local and long-term
Consequence of impact or risk:	May lead to pollution of wetlands, rivers and groundwater.				
Probability of occurrence:	Probable	Probable	Probable	Probable	Probable
Degree to which the impact may cause irreplaceable loss of resources:	Marginal loss	Marginal loss	Marginal loss	Marginal loss	Marginal loss
Degree to which the impact can be reversed:	Partly reversible	Partly reversible	Partly reversible	Partly reversible	Partly reversible
Indirect impact:	Pollution of the Dwars River downstream, and of groundwater.				
Cumulative impact prior to mitigation:	Medium	Medium	Medium	Medium	Medium
Significance rating of impact prior to mitigation	Medium	Medium	Low	Low	Medium
Degree to which the impact can be avoided:	Medium to high	Medium to high	High	Medium to high	Medium
Degree to which the impact can be managed:	High	High	High	High	High
Degree to which the impact can be mitigated:	High	High	High	High	High

	Development Alternative 1	Development Alternative 2	Development Alternative 3	No-go Alternative 1	No-go Alternative 2
Proposed mitigation:	Limit hardening of surfaces to within the developable area (outside buffers). The pathways and amphitheatre planned within the wetlands and the ecological buffers must not be hardened, and compaction of soils along the pathways minimised to a narrow area (less than 1 metre). Pathways outside the ecological buffers and the aquatic ecosystems can be constructed with gravel or Gravel Fix. Hardened surfaces should discharge into filtration areas.			Downpipes from renovated buildings to discharge to filtration areas.	Runoff from agricultural lands should discharge into filtration areas some distance from the stream and wetlands, to allow for infiltration to ground.
	The vehicle track leading to the waste treatment components must be constructed with permeable materials, such as permeable paving, Gravel Fix, mulch, or earth.				
Residual impacts:	None			Although Duty of Care applies to the No-go alternatives, it is unlikely that mitigation measures will be implemented. Residual impacts are likely.	
Cumulative impact post mitigation:	Low	Low	Low	Medium	Medium
Significance rating of impact after mitigation	Low	Low	Negligible	Low	Medium

	Development Alternative 1	Development Alternative 2	Development Alternative 3	No-go Alternative 1	No-go Alternative 2
Potential impact and risk:	Stormwater discharge into natural areas – water quantity impacts.				
Nature of impact:	Negative	Negative	Negative	Negative	Negative
Extent and duration of impact:	Local and long-term	Local and long-term	Local and long-term	Local and long-term	Local and long-term
Consequence of impact or risk:	May lead to change in hydrological patterns in wetlands, rivers (Stream 10 and Dwars River) and groundwater.				
Probability of occurrence:	Probable	Probable	Probable	Probable	Probable
Degree to which the impact may cause irreplaceable loss of resources:	Marginal loss	Marginal loss	Marginal loss	Marginal loss	Marginal loss
Degree to which the impact can be reversed:	Partly reversible	Partly reversible	Partly reversible	Partly reversible	Partly reversible
Indirect impact:	Changed hydrology in the Dwars River downstream.				
Cumulative impact prior to mitigation:	Medium	Medium	Medium	Medium	Medium
Significance rating of impact prior to mitigation	Low to medium	Low to medium	Low	Low	Medium

	Development Alternative 1	Development Alternative 2	Development Alternative 3	No-go Alternative 1	No-go Alternative 2
Degree to which the impact can be avoided:	Medium to high	Medium to high	High	Medium to high	Medium
Degree to which the impact can be managed:	High	High	High	High	High
Degree to which the impact can be mitigated:	High	High	High	High	High
Proposed mitigation:	Limit hardening of surfaces to within the developable area (outside buffers). The pathways and amphitheatre planned within the wetlands and the ecological buffers must not be hardened, and compaction of soils along the pathways minimised to a narrow area (less than 1 metre). Pathways outside the ecological buffers and the aquatic ecosystems can be constructed with gravel or Gravel Fix. Hardened surfaces should discharge into filtration areas.			Downpipes from renovated buildings to discharge to filtration areas.	Runoff from agricultural lands should discharge into filtration areas some distance from the stream and wetlands, to allow for infiltration to ground.
	The vehicle track leading to the waste treatment components must be constructed with permeable materials, such as permeable paving, Gravel Fix, mulch, or earth.		n/a		
Residual impacts:	None			Although Duty of Care applies to the No-go alternatives, it is unlikely that mitigation measures will be implemented. Residual impacts are likely.	
Cumulative impact post mitigation:	Low to medium	Low to medium	Low	Medium	Medium
Significance rating of impact after mitigation	Low	Low	Negligible	Low	Low to medium

	Development Alternative 1	Development Alternative 2	Development Alternative 3	No-go Alternative 1	No-go Alternative 2
Potential impact and risk:	On-site treatment and/or storage of waste water – impacts on water quality				
Nature of impact:	Negative	Negative	Negative	Negative	n/a
Extent and duration of impact:	Local and long-term	Local and long-term	Local and long-term	Local and long-term	n/a
Consequence of impact or risk:	May lead to contamination of soils, groundwater and aquatic ecosystems.				
Probability of occurrence:	Probable	Probable	Probable	Probable	n/a
Degree to which the impact may cause irreplaceable loss of resources:	Significant loss	Significant loss	Significant loss	Minimal loss	n/a
Degree to which	Partly reversible	Partly reversible	Partly reversible	Partly reversible	n/a

	Development Alternative 1	Development Alternative 2	Development Alternative 3	No-go Alternative 1	No-go Alternative 2
the impact can be reversed:					
Indirect impact:	Pollution of the Dwars River downstream, and of groundwater.				
Cumulative impact prior to mitigation:	Medium	Medium	Medium	Medium	n/a
Significance rating of impact prior to mitigation	Medium	Medium	Low	Low	n/a
Degree to which the impact can be avoided:	Medium to high	Medium to high	High	Medium to high	n/a
Degree to which the impact can be managed:	High	High	High	High	n/a
Degree to which the impact can be mitigated:	Medium	Medium	High	Medium	n/a
Proposed mitigation:	Place conveyance, storage and treatment components of waste water infrastructure outside of ecological buffers, and as far as possible from sensitive areas. Place a berm around the components to avoid contamination of surface flows from leaks or overflows. All facilities must be regularly checked for leaks and overflow.			n/a	n/a
	Treated waste water should preferably be recycled back into the toilet system, thus creating essentially a closed system. Treated waste water can also be used for irrigation of landscaped areas, but should be directed towards road verges, rather than the margins of the stream or the wetlands.		n/a		
Residual impacts:	There may be some residual impact on quality of water in the aquatic environment.			Although Duty of Care applies to the No-go alternatives, it is unlikely that mitigation measures will be implemented. Residual impacts are likely.	n/a
Cumulative impact post mitigation:	Low to medium	Low	Low	Medium	n/a
Significance rating of impact after mitigation	Low to medium	Low	Negligible / Low	Low	n/a

	Development Alternative 1	Development Alternative 2	Development Alternative 3	No-go Alternative 1	No-go Alternative 2
Potential impact and risk:	Proximity of buildings and human activity to the wetlands and Dwars River. This may lead to local disturbance of fauna and flora, through noise, light, trampling, etc. Fauna may move away from the site.				
Nature of impact:	Negative	Negative	Negative	Negative	Negative

	Development Alternative 1	Development Alternative 2	Development Alternative 3	No-go Alternative 1	No-go Alternative 2
Extent and duration of impact:	Local and long-term	Local and long-term	Local and long-term	Local and long-term	Local and long-term
Consequence of impact or risk:	May lead to a loss of habitat quality and movement of flora and fauna away from the site.				
Probability of occurrence:	Probable	Probable	Probable	Probable	Probable
Degree to which the impact may cause irreplaceable loss of resources:	Significant loss	Significant loss	Significant loss	Significant loss	Significant loss
Degree to which the impact can be reversed:	Fully reversible	Fully reversible	Fully reversible	Fully reversible	Fully reversible
Indirect impact:	Movement of fauna and flora from the site onto the broader Estate, or movement of species away from the Estate altogether, towards less disturbed sites.				
Cumulative impact prior to mitigation:	Low to medium	Low to medium	Low to medium	Low to medium	Low to medium
Significance rating of impact prior to mitigation	Low to medium	Low to medium	Low to medium	Low	Low
Degree to which the impact can be avoided:	Medium to high	Medium to high	Medium to high	Medium to high	Medium to high
Degree to which the impact can be managed:	High	High	High	High	High
Degree to which the impact can be mitigated:	High	High	High	High	High
Proposed mitigation:	Lighting should face away from the wetlands, and stream. Visitors should be discouraged from walking on the bed and banks of the stream, and into the wetter areas, through construction of walkways and benches, guiding visitors to use specific pathways and areas.				
Residual impacts:	There will be some residual impacts even after mitigation, as there will be an unavoidable increase in human activity in the immediate area.			Although Duty of Care applies to the No-go alternatives, it is unlikely that mitigation measures will be implemented. Residual impacts are likely.	
Cumulative impact post mitigation:	Low	Low	Low	Low to medium	Low to medium
Significance rating of impact after mitigation	Low	Low	Low	Low	Low

	Development Alternative 1	Development Alternative 2	Development Alternative 3	No-go Alternative 1	No-go Alternative 2
Potential impact and risk:	Disturbance of soils for landscaping / maintenance of gardens/agricultural activities. Alien or invasive seeds and seedlings may be transported onto site. Alien vegetation is well adapted to establishing on previously disturbed soils and road verges.				
Nature of impact:	Negative	Negative	Negative	Negative	Negative
Extent and duration of impact:	Local and long-term	Local and long-term	Local and long-term	Local and long-term	Local and long-term
Consequence of	May lead to a loss of habitat quality, and increased water uptake through transpiration.				

	Development Alternative 1	Development Alternative 2	Development Alternative 3	No-go Alternative 1	No-go Alternative 2
impact or risk:					
Probability of occurrence:	Probable	Probable	Probable	Probable	Probable
Degree to which the impact may cause irreplaceable loss of resources:	Significant loss	Significant loss	Significant loss	Significant loss	Significant loss
Degree to which the impact can be reversed:	Fully reversible	Fully reversible	Fully reversible	Fully reversible	Fully reversible
Indirect impact:	Spread of IAPs from the site onto the broader Estate, and downstream towards the Dwars River.				
Cumulative impact prior to mitigation:	Low to medium	Low to medium	Low to medium	Low to medium	Low to medium
Significance rating of impact prior to mitigation	Low	Low	Low	Low	Low
Degree to which the impact can be avoided:	Medium to high	Medium to high	Medium to high	Medium to high	Medium to high
Degree to which the impact can be managed:	High	High	High	High	High
Degree to which the impact can be mitigated:	High	High	High	High	High
Proposed mitigation:	Landscaping/gardening around the units must be kept to a minimum in the ecological buffers. Gardens should rather be natural areas, where the locally indigenous vegetation is allowed to grow. No kikuyu grass is allowed anywhere on site. The spread of alien plant species into all natural areas must be prevented and monitored. Road verges must be monitored for alien species, especially grasses.			Remove alien vegetation from the site.	
Residual impacts:	No residual impacts if mitigation is effectively implemented.			Removal of alien vegetation on site is unlikely to occur, so the impact will remain.	
Cumulative impact post mitigation:	Low positive	Low positive	Low positive	Low to medium negative	Low to medium negative
Significance rating of impact after mitigation	Low positive	Low positive	Low positive	Low negative	Low negative

8 Rehabilitation plan for the site

The impacts on the watercourses and (less so) the wetlands that are on and close to the New Retreat site can be mitigated by the implementation of a rehabilitation plan specifically for Stream 10 (as it lies on the property), the creation of a riverine corridor along its course and for the wetlands on and around the site. The sections that follow describe the principles behind the rehabilitation and the details of a proposed rehabilitation plan.

8.1 Principles of ecological rehabilitation

- Rehabilitation is the reinstatement or improvement in the effectiveness of the driving forces that created and continue to shape and sustain the ecosystem (Kotze *et al.*, 2009; Russell, 2009);
- The goal of rehabilitation should not be to return an ecosystem to and maintain it in a static state at some time in the past, but rather to aim to achieve a dynamic and resilient system that can respond to change and that is largely self-maintaining, requiring little human intervention over time;
- Rehabilitation should be integrated with the surrounding landscape in order to address the upstream and downstream causes of degradation;
- If a rehabilitation programme is to be effective and sustainable, there must be ownership of the project by the landowner or land-user, and their commitment to sustaining the integrity of the system must be demonstrated, and
- Rehabilitation should be well-planned with clearly stated and measurable objectives, effectively implemented, and must be continually monitored and evaluated.

8.2 Rehabilitation plan for Stream 10

The "driving forces" for the watercourse mentioned under the "Principles of Ecological Rehabilitation" above include the following:

- Flow regime - The timing, duration and temporal sequencing of floods, baseflows (low flows), and the general movement of water into, through and out of the stream corridor exert a strong influence over the flora and fauna living in it, and over the physical and chemical characteristics of the ecosystem.
  There is minimal opportunity for returning the flow of Stream 10 to a more natural regime. The flow regime has been considerably altered by the diversion channel and the presence of large storage dams upstream of the development site. This will not be the focus of rehabilitation.
- Bed and bank stability - The distribution of sediment within the river, as well as the types of substrate are important determinants of bank and bed stability. Unnatural erosion and deposition will lead to a change in the morphology of the river channel, and the way in which water flows along the channel. This can have knock-on effects downstream. Exotic trees can change the physical properties of the substrate in the stream channel and on the banks, leading to erosion of the bed and banks, and sedimentation within the channel downstream.
  There is an in-channel head-cut at contour 203.5m, and the banks of the stream are steeply incised from this point downstream towards the Dwars River. The flow regime (patterns and quantities of flow, and flow velocities) has been altered by the diversion channel and the dams upstream, possibly leading to unnaturally high and sudden discharges in the stream. This increase in stream power that comes with an increase in flow velocity will lead to further gully and head-cut erosion (e.g. Day *et al.*, 2016). It is possible that the historical berm alongside Stream 10 has over time caused concentration

of flows in the stream, when these should be spread out over a wider area and into the Dwars River floodplain.

The rehabilitation plan proposes interventions that aim to stabilise the channel and the banks without impacting further on the characteristics of the stream, and avoiding flooding of property and roads.

- Water quality - This is a major driver of biological responses within all aquatic ecosystems.
  It is expected that stabilisation of the bed and banks of the watercourse, and the introduction of a mix of instream and riparian plants to further stabilise the system and improve biodiversity, will have a positive impact on water chemistry.
- Biota and biological processes – The fauna and flora inhabiting the river channel have adapted to the current conditions over time. In addition, the biota themselves influence the above drivers – for instance, riparian vegetation is extremely important for stabilisation of the river banks, controlling nutrients and providing habitat and for providing a buffer between the river and the surrounding development and agriculture. Riparian areas are particularly prone to invasion by alien invasive plant species, due to the ready availability of water.
  This rehabilitation plan proposes the removal of all kikuyu and other exotic plant species within the stream corridor, and re-planting with indigenous shrubs and trees. This will favour the return of more stream flora and fauna to this section of river.

8.2.1 Ecological Rehabilitation and Management Actions

8.2.1.1 Bed (head-cut) stabilisation

- A head-cut is located at contour 203.5m (Figure 8.1 and Figure 8.2).

Figure 8.1 Head-cut in the channel of Stream 10.

- The ideal longitudinal slope to prevent erosion along a river channel is 1:7 (roughly 14%). Currently the short steep section of channel that is of concern downstream of the head-cut

(contour 203.5m to 198.5m – a stretch of roughly 12m) has a gradient of 39%. The steep gradient of the bed may lead to the head-cut advancing upstream.

- It is recommended that a small weir be constructed at the site of the head-cut, tied into the banks, followed by a steep but stepped waterfall structure and a short section of armouring on the base of the channel downstream of the "waterfall" to prevent down-cutting.

8.2.1.2 Bank (lateral) stabilisation

- Ideally, bank slopes should be around 1:3 (roughly 33%; Russell, 2009) to 1:4. There is a short section of river where both banks (left and right) are approximately 60% (see Figure 8.2). The bank material is rocky (sandstone cobble and soil) and difficult to shape. Removing sufficient fill to shape the banks to an acceptable gradient would require significant earthworks. This is not recommended.
- Banks should be stabilised, however, possibly using gabion structures.
- **All mature indigenous trees must be kept in place.**

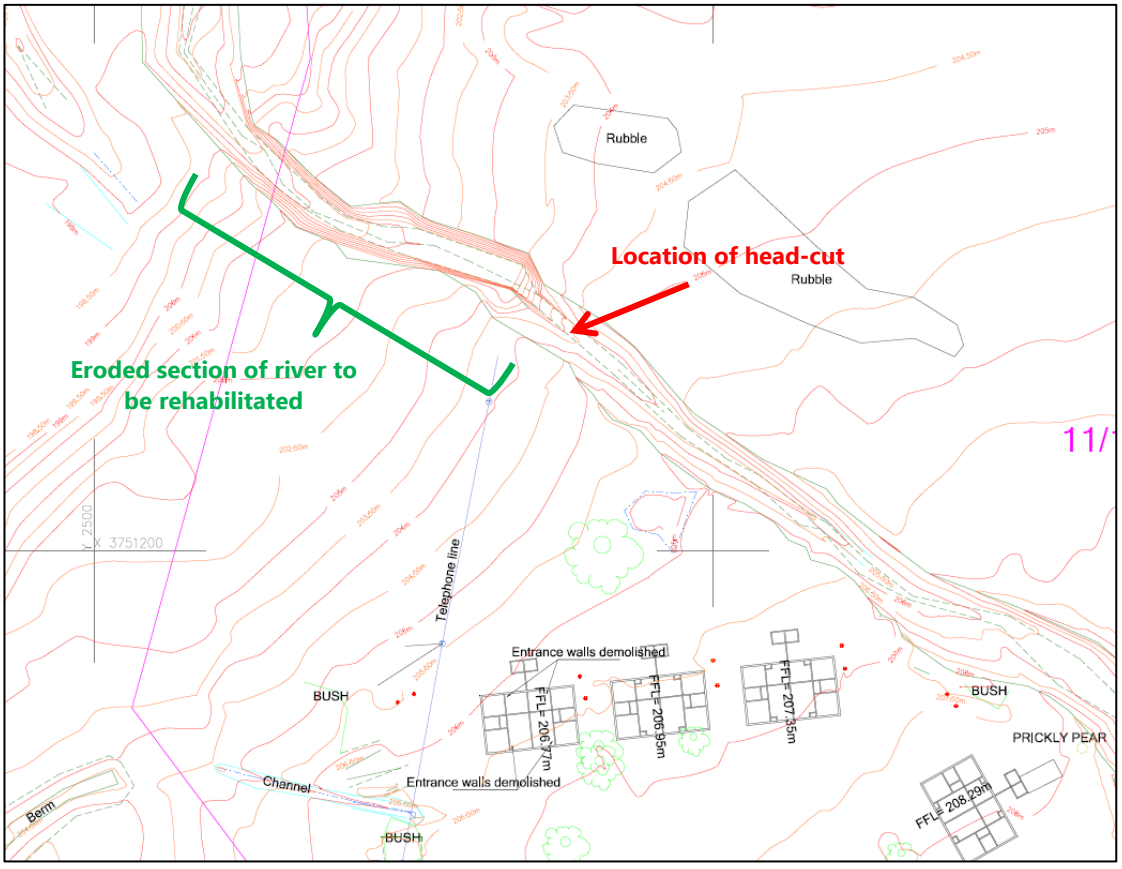

Figure 8.2 Extract from survey drawing for the New Retreat (FBV, Feb 2021) showing location of eroded section of river to be rehabilitated.

Figure 8.3 Steep right-hand bank downstream of the head-cut.

- The proposal presented by MH & A engineers for a stepped gabion weir structure will achieve stabilisation of the channel and head-cut. This proposes the construction of a series of gabion weirs along the stretch of river below the head-cut (Figure 8.4). The upper weir will flood the head-cut in order to stabilise this section of channel.

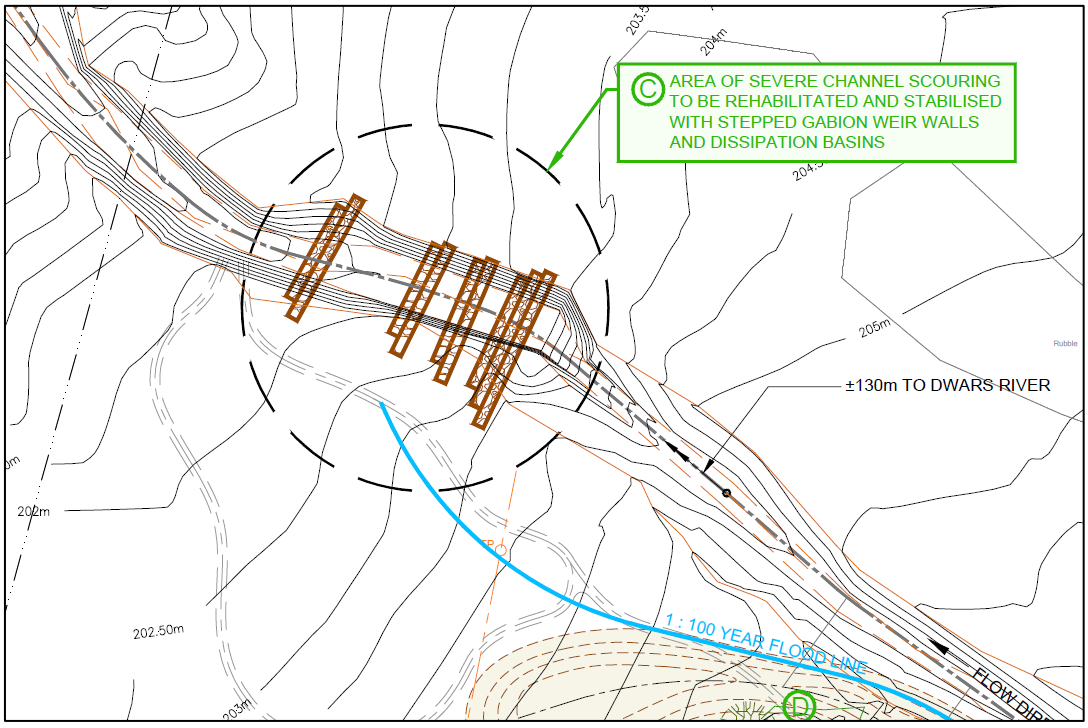

Figure 8.4 Proposed series of gabion weirs to stabilise the area of scour in Stream 10.

- There must be no dredging of the river channel, removal of indigenous plants or removal of sediment or rock, without the approval of a freshwater ecologist.

- Rock for the gabions cannot be taken from any of the streams on Boschendal Estate.
- Work in the river channel must be undertaken during the dry months of the year. The shape and topography of the channel and banks mean that flow diversion will not be possible.
- Other stabilisation measures can be used elsewhere on the site, in order to prevent erosion in and around planted areas. Stabilisation materials include:
    - Ecologs (dry woody material or sand contained in a hessian and chicken wire roll – (see Figure 8.6);
    - Biodegradable netting/matting;
    - Geotextile matting of thick filaments designed to be secured over a vulnerable slope to prevent surface erosion (see Figure 8.6);
    - Mulch stabilisation, or
    - Compost stabilisation

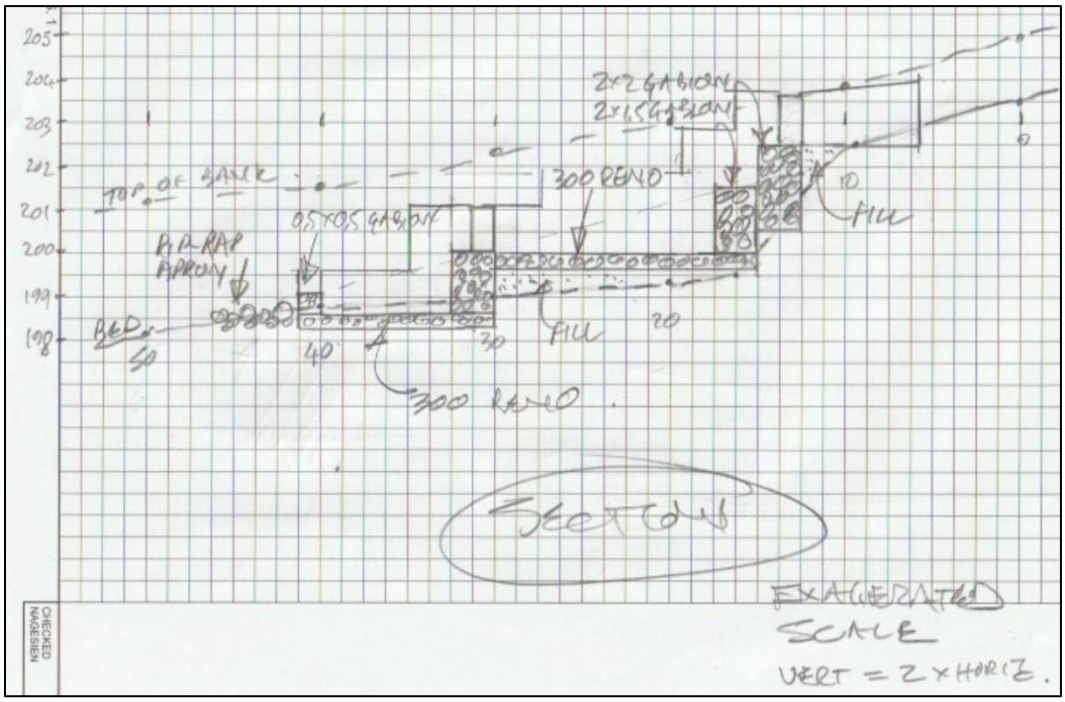

Figure 8.5 Cross-section through gabion weirs (MH&A). Scale is exaggerated – vertical scale is equal to twice the horizontal.

Figure 8.6 (Left) Ecologs used to stabilise the banks of a stream; (Below) Geotextile stabilisation of a slope.

8.2.1.3 Removal of invasive alien plant species

All invasive alien plants (IAPs) must be removed entirely from the stream 10 corridor, and also along the water supply pipeline route, up to a distance of 20 m from the trench, as recommended by the botanist (Helme, 2021). This includes the highly invasive Kikuyu grass (*Pennisetum clandestinum*). The following guidelines must be applied for grass removal:

- Herbicide can be used, but it is recommended that Focus Ultra be used instead of a glyphosate-based herbicide such as Roundup.
- Ensure herbicide application is done only during the dry season. After spraying with Focus Ultra, grasses tend to change colour within 1 – 3 weeks, and a follow-up application can focus on grasses not killed by the first application;
- Ensure safe use of herbicide (Pest Control Operator supervision, personal protective equipment, standard health and safety requirements);
- After die-back of the grass, the plant can be removed by hand, ensuring that all runners are removed;
- Allow for spot-spraying of re-sprouting grass in isolated areas;

After removal of the Kikuyu, the bare soil must be re-planted as soon as possible with indigenous plant species. Herbicide must be applied to all freshly-cut tree stumps to prevent resprouting.

8.2.1.4 Re-planting of rehabilitated areas

Areas that have been impacted by construction within the wetlands, streams or their buffers must be re-planted with indigenous plant species. The graphic and table below provide some guidance for planting, which should be used in conjunction with guidelines provided by the botanist and landscape architects.

Appropriate species for the three zones around the stream are as follows:

Zone 1 – river margin (sedges and rushes)	Zone 2 – transitional zone (sedges, restios, rushes and shrubs)	Zone 3 – dry bank (shrubs and trees)
Juncus effusus (rush)	*Juncus effusus* (rush)	*Brabejum stellatifolium* (wild almond)
Juncus kraussii (rush)	*Cliffortia graminea*	*Maytenus oleoides* (kershoud)
Ficinia nodosa (clubrush)	*Cliffortia ferruginea*	*Metrosideros angustifolius (smalblaar)*
Ficinia brevifolia	*Restio spp. (restios)*	*Kiggelaria africana (wild peach)*
Fuirena coerulescens	*Meterosideros angustifolia*	*Brachylaena neriifolia*
Juncus lomatophyllus		*Cliffortia graminea*
		Cliffortia ferruginea
		Olea europea subsp. africana
		Searsia angustifolia
		Kiggelaria africana
		Searsia lancea
		Capeochloa cincta

8.3 Rehabilitation of wetlands

The two wetlands located on and close to the site – the Dwars River valley-bottom wetland, and the New Retreat seep – may be negatively impacted by some of the landscaping proposals. The significance of these impacts has been assessed as being **low negative**, assuming that mitigation measures are implemented. These include:

- Any areas of soil within the wetlands and their buffers that may have been compacted through dumping or storage of building materials must be ripped and replanted, and checked for invasion by IAP seedlings;
- Where the wetlands or their buffers encroach onto the New Retreat site, these areas must be cleared of IAPs, including kikuyu grass. See Section 8.2.1.3 above for guidelines for IAP removal;

- Cleared areas must be replanted with locally indigenous plant species. Appropriate species can be chosen from the Zone 1 and Zone 2 species advised in Section 8.2.1.4 above.

The two wetlands affected by the laying down of water supply pipelines – the wetland around Stream 11, and the York Dam seep – are unlikely to be substantially impacted by this activity. The significance of the impact is likely to be **low negative**, if the pipelines are located within the road reserve and so within the already disturbed footprint of the road, and if the pipeline is always located on the opposite side of the road to the wetland.

8.4 Timing of implementation

The rehabilitation plan for Stream 10 must commence once the flood protection measures proposed for the watercourse have been constructed. Implementation of the river rehabilitation plan can proceed in a phased manner.

Rehabilitation of wetlands and their buffers must be implemented once the landscaping of affected areas has been completed, and should be completed in one phase, with a follow-up maintenance phase to follow planting.

8.5 Monitoring

Implementation of this rehabilitation plan must be monitored by a suitably qualified freshwater ecologist during, and on completion of the rehabilitation activities. The ecologist must check the following:

- Hard engineering interventions are built to specifications;
- The head-cut and bank incision have not advanced further compared with the current situation;
- All IAPs have been removed from the Stream 10 corridor, wetlands and their buffers, and along the water supply pipeline, up to 20 m from the trench;
- The bed and banks that have been impacted by the felling of trees and removal of alien grasses must be in good condition, and not eroding or bare;
- Areas within the streams, wetlands and buffers that have been impacted by construction and rehabilitation activities have been re-planted.

It is the responsibility of the landowner to ensure that this monitoring visit takes place timeously, i.e. upon completion of each phase of rehabilitation. It is the responsibility of the ecologist to provide a short report (in the form of a letter) regarding the implementation of this rehabilitation plan. The report must be submitted to the case officer at Department of Human Settlements, Water and Sanitation, Bellville.

9 Water use authorisation

9.1 Water uses

The following water uses are likely to be triggered by development Alternative 3 (the preferred alternative) at New Retreat:

c. Impeding or diverting the flow of water in a watercourse;

g. Disposing of waste in a manner which may detrimentally impact on a water resource;

i. Altering the bed, banks, course or characteristics of a watercourse;

Section 21 water use (g) is dealt with in Government Notice 665 of September 2013, and water uses (c) and (i) in GN 509 of August 2016.

GN 665 deals with the **Section 21 (g) water use** in Schedule 3. At the New Retreat site, this relates specifically to the storage of domestic waste water, for disposal or treatment. The storage of up to 10 000 m^3 of waste water for disposal, the disposal of waste water into an irrigation system (as outlined in Schedule 1), and the storage of domestic waste water in a conservancy tank for up to 50 households is permitted, as long as this is not detrimental to a water resource (wetlands or watercourses) or to human health and safety. **The mitigation measures recommended in this report aim to avoid any detrimental impacts on the aquatic ecosystems on and close to the site.**

All of the activities associated with construction and operation of the New Retreat and the associated infrastructure may have an impact on the flow, bed, banks and characteristics of Stream 10 and the wetlands on and off the site (**Section 21 (c) and (i) water uses**). These water uses apply within the regulatory zone, as discussed in Section 6.1, which extends up to the 1:100 year floodline for Stream 10, and up to 100 m from the banks of Stream 11[2], and 500m from the delineated edge of the wetlands. The greatest impacts are associated with construction activities, flood protection measures, laying of the water supply pipelines (the temporary supply pipeline will have a low negative impact), landscaping, building of tracks, and the maintenance of the waste water system occurs within or close to the wetlands, and the ecological buffers.

The process to be followed to obtain authorisation for these categories of water use is different for each water use, and relates to the **risk** associated with the water use. For the purposes of assessing risk, this is assumed to be the same as the impacts, identified in Section 7.3, which will potentially affect the hydrology, water quality, habitat (geomorphology and vegetation) and / or biota of wetlands and watercourses.

9.2 Section 21 (c) and (i) Risk assessment matrix

The General Authorisation (GA) in terms of Section 39 of the Water Act (1998) provided in GN 509 of 2016 provides guidance and the conditions of authorisation regarding the alteration of the bed, banks, course and characteristics of a watercourse (Section 21 (i)). The recent amendment of the Section 21 (c) and (i) GA introduced a risk assessment matrix that allows for the determination of the level of risk associated with any given activity. Low risk water uses are **generally authorised**, requiring registration of the water use only, while activities with a moderate to high level of risk to the water resource require a full water use licence application.

[2] A 1:100 year floodline was not determined for Stream 11, as it is impacted only by the water supply pipeline. In this case, a distance 100m from the bank of the stream represents the regulatory area.

9.2.1 Method

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

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

The significance of the impact is calculated as the product of its consequence and likelihood. The final score is used to assign a risk rating to the impact (see Table 9.1), **assuming implementation of effective mitigation measures as outlined in Section 7.3 and the Appendix**.

Table 9.1 Rating Classes for the Risk Assessment.

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

9.2.2 Results

The full risk assessment matrices are provided for all aquatic ecosystems impacted by the development in the Appendix, along with the mitigation measures (extracted from Section 7.3) required to reduce the risks to the levels assessed. A risk assessment was completed per aquatic ecosystem impacted by the development.

All risks associated with the proposed development of the New Retreat can be reduced to low, assuming all mitigation measures (including the rehabilitation plan) are implemented.

10 Conclusions

- The development of the New Retreat on Boschendal Estate will potentially have an impact on six inland aquatic ecosystems – two seasonal streams, Stream 10 and Stream 11, both of which flow into the Dwars River, the Dwars River valley-bottom wetland, and three hillslope seep wetlands close to to the property.
- Three alternative development proposals were assessed, in terms of their impacts on the inland aquatic ecosystem on and around the site.
- For all development Alternatives, most of the developed footprint is located outside of the inland aquatic ecosystems and their ecological buffers recommended in this report. The exceptions to this are:
    - Flood protection measures in and around Stream 10;
    - Concrete drift on the Hoof Pad;
    - Water supply pipelines (to Lanquedoc and for temporary supply);
    - Pathways;
    - A stormwater swale (Alternatives 1 and 2);
    - An informal amphitheatre, and
    - A service track to the waste water treatment unit (Alternatives 1 and 2).
- The differences between development Alternatives relate to the proposed services, specifically to the location of pipelines and components of the waste water treatment unit, and the location of a stormwater retention swale. In Alternative 1, the swale is within the ecological buffer of Stream 10, while for Alternative 2, it is located outside the buffer. There is no stormwater retention swale proposed for Alternative 3. Furthermore, Alternative 1 proposes that all components of the sewage treatment unit (the septic tank, separator and SOG Filter) are placed at the lowest point on the site, on the side closest to the Dwars River, while Alternative 2 proposes placement of the SOG filter to the south of the site, on the other side of the road, with the septic tank and separator at a low point to the north of the New Retreat buildings. A conservancy tank is proposed for Alternative 3, located on the south side of the access road. A pump station is located in the north-western corner of the property, and a rising main will carry pumped sewage up to the conservancy tank.
- The 1:100 year floodline was determined for the site. Most of the property is at risk from flooding, so it is proposed that the road crossing be replaced with five lower culverts, the channel stabilised with reno mattress and riprap, and the berms along the left-hand bank be restored. Additional restoration of an existing berm is also required upstream of the gravel road, on the left-hand bank of the stream.
- In order to mitigate against the negative impacts associated with proposed activities that are in, or close to (i.e. within ecological buffers of) the watercourses and wetlands identified on and around the site, a rehabilitation plan is proposed in this report. Rehabilitation activities are designed to mitigate against the impacts associated specifically with the proposed flood protection measures in Stream 10, and landscaping in and around the wetlands and Stream 10. The rehabilitation plan addresses bed (head-cut) stabilisation, bank (lateral) stabilisation, removal of invasive alien plants, and the re-planting of affected areas.
- Implementation of the relevant components of the rehabilitation plan must commence upon completion of the landscaping and / or the flood protection measures. The rehabilitation plan can be implemented in a phased manner, and must include monitoring visits by a freshwater ecologist.
- Two alternative No-go options were assessed for comparison, defined as follows:

  - **No-go Alternative 1**: this is the best case scenario, which would entail renovation of four of the eight buildings (those that lie outside the 32m NEMA buffer for the stream) for farm worker accommodation, and the remaining land is left as is (the remaining cottages would not be demolished);
  - **No-go Alternative 2**: this is the worst case scenario, which would involve the cultivation of the full site and removal (demolition) of all buildings. It must be noted that this alternative is unlikely, due to the poor quality of the soil on site.
- There are a number of short- to medium-term impacts associated with the construction phase of the project, which are limited to the site or a distance a few kilometres away, due to the downstream transport of sediment and possible pollutants. The impacts of greatest severity are linked to the construction activities proposed for the flood protection measures, footpaths, service track (Alternatives 1 and 2), amphitheatre and water pipelines. However, these impacts can be mitigated, which would reduce the significance of these impacts to, at worst, low negative, for all three development alternatives.
- The construction of the water supply pipelines to the development (both the long-term plan of linking to the Lanquedoc supply, and the temporary pipeline) will affect a number of the freshwater ecosystems identified on and close to the site. The impacts associated with this activity can be mitigated, through location of the pipelines within the currently disturbed footprint of the roads, and by surface mounting the pipelines on the culverts in the affected streams. It is important that the pipelines always be located on the opposite side of the road to the affected wetlands – specifically, the Stream 11 seep and the York Dam seep. Other mitigation measures for the trenching for the pipes are provided in the report.
- There are construction and /or demolition impacts associated with both No-go alternatives, but mitigation is unlikely despite Duty of Care. Thus, impacts are likely to carry a low to, at worst, low to medium negative impact. These are likely to be more severe for No-go Alternative 2, due to the demolition of all cottages, which is likely to have a greater impact on the aquatic ecosystems than the renovation of some cottages (outside the 32m buffer) for farm workers.
- An operational impact of concern for all development Alternatives is the on-site treatment /storage/conveyance of waste water, which could lead to deterioration in water quality in sub-surface and surface water should there be leaks in the system, or overflow of untreated or treated effluent.
- A SOG filter is proposed for Alternatives 1 and 2. The treated effluent may be of poor quality should the system not function as required. Moving the SOG filter well away from the wetlands and stream (as proposed for development Alternative 2), and using the treated effluent for flushing toilets, as opposed to irrigation, will mitigate against this impact, reducing its significance to low negative for Alternative 2. The option of a conservancy tank, as proposed for Alternative 3, also carries a low negative impact, with the risks of pollution being associated with the rising main, and the possibility of leaks or overflow from the tank. Purely from a waste water management perspective, Alternative 3 poses the least risk to the inland aquatic ecosystems on and close to the site.
- Stormwater runoff from newly hardened surfaces (roofs and roads) may also lead to increased input of unseasonal flow into the stream or wetlands, and deterioration in water quality. A number of mitigation measures are recommended here, which would adequately reduce the significance of these impacts by reducing their likelihood and severity. The proposed stormwater swales for Alternatives 1 and 2 should be sufficient to retain stormwater, and allow infiltration of water and improvement in quality. The residual impact will be, at most, of low negative significance. The location of the stormwater swale outside of the stream's ecological buffer, as proposed for Alternative 2, is preferable. However, the use of permeable surfaces

and efforts to deal with stormwater where it arises, as proposed for Alternative 3, carries the lowest risk of impact.

- The removal of alien vegetation from the site is highly unlikely with the no-go Alternatives but, if implemented during and after construction of the New Retreat, will lead to a low positive impact on the site for both development alternatives. Kikuyu has encroached into all the natural areas on site, and this is choking the local plants. It would be of great biodiversity value if this species was removed from the site, and replaced with indigenous grass and shrub species.
- Overall, No-go Alternative 1 is the preferred option from an aquatic ecological perspective, due to minimal disturbance and limited continued use of the site. In terms of the development options, Alternative 3 will have a marginally lower impact on the aquatic ecosystems than Alternatives 1 and 2, and is thus the preferred development alternative. With the implementation of all mitigation measures, specifically including the implementation of the rehabilitation plan, effective site monitoring, conservation of all mature riparian trees, use of compacted earth for pathways in the buffers, and the removal of invasive alien plants (IAPs) from the site, there may ultimately be a positive impact on the environment.
- A biodiversity offset will not be necessary to counteract the impacts of development.
- With mitigation, development Alternative 3 poses at worst a **low risk** to the characteristics of the inland aquatic ecosystems affected by the development, and it is recommended that the development be generally authorised in terms of Section 21 (c) and (i) water uses, and in terms of a Section 21 (g) water use.
- Two Ecological Corridors pass through the New Retreat site, one along Stream 10 and the other following the Dwars River, and a third along Stream 11 and its wetland. By ensuring that any new hard development avoids the corridors, which correspond with the ecological buffers, and with implementation of all the mitigation measures recommended in this report, the ecological integrity of the corridors is likely to be maintained, and possibly improved.

11 References

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Appendix: Risk assessment matrices

Stream 10:

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

NAME and REGISTRATION No of SACNASP Professional member: …Kate Snaddon…… Reg no. …… 400225/06……

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

					Severity																	
No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures - See EIA REPORT for full list of mitigation measures	PES AND EIS OF WATER-COURSE
1	Construction	Construction activities in or close to the watercourse	Storage or dumping of building / landscaping materials in close proximity to the watercourse	Compaction of soils; movement of building materials (sand, rubble, etc) into the watercourse	1	1	1	1	1	1	2	4	1	1	5	1	8	**32**	L	80	Ensure that materials are stored at least 50m away from the edge of the riparian area	PES is Category D; EIS is moderate.
			Leakage of fuels, oils, etc. from construction machinery.	Pollution of sensitive areas, deterioration in water quality	0	1	1	1	0.75	2	2	4.75	1	1	5	2	9	**42.75**	L	80	Ensure that machinery is bunded, and located at least 50m away from the riparian area.	
			Increased mobilisation of fine sediment and sand	Erosion and sedimentation	0	1	1	2	1	2	2	5	1	3	5	2	11	**55**	L	80	River rehabilitation plan to be implemented during the dry season. Construction close to the stream must be done in the dry season. Where water pipelines must cross over the stream, the pipes must be surface mounted on the culvert. Rock for the reno mattress, riprap and rehabilitation gabions may not be sourced from the streams on Boschendal Estate. Monitor construction site after rainfall events. De-watering must be done into settlement ponds before allowed to flow back into the stream.	
			Pedestrian access onto and around the construction site	Trampling of sensitive habitat; noise and light pollution; introduction and spread of alien invasive species	1	0	1	1	0.75	1	2	3.75	1	2	5	2	10	**37.5**	L	80	Demarcate the ecological buffers and ensure that construction activities remain outside of this area. The construction site must be monitored for the spread of IAPs.	
				Pollution of sensitive areas from human waste, deterioration in water quality	0	1	0	1	0.5	2	2	4.5	1	2	5	3	11	**49.5**	L	80	Ensure that toilets are provided and used by construction workers. If waste is found, it must be removed immediately and disposed of.	
2	Operational	Stormwater management	Discharge of stormwater runoff into watercourse	Altered hydrology and water quality	1	0	0	0	0.2	2	2	4.2	2	1	5	3	11	**46.2**	L	50	New hardened surfaces (impermeable) must be limited to the developable area outside the aquatic ecosystems and their buffers. The track leading to the waste treatment components located on site, proposed to encroach into the Dwars River valley-bottom wetland buffer, must be constructed with permeable materials, such as permeable paving, gravelfix, gravel, mulch, or earth. Hardened surfaces must discharge surface water to filtration areas.	
		Disturbance of soils for landscaping/gardening	Introduction of IAPs	Loss of biodiversity	0	0	1	0	0.25	2	3	5.25	1	1	5	2	9	**47.25**	L	80	Landscaping requiring ongoing maintenance around the units must be kept to a minimum, especially within the ecological buffers. Gardens should rather be natural areas, where the locally indigenous vegetation is allowed to grow. No kikuyu grass is allowed anywhere on site. The spread of alien plant species into all natural areas must be prevented and monitored. Road verges must be monitored for alien species, especially grasses.	
		Proximity of development to sensitive areas	Disturbance (noise, light) of fauna and flora	Loss of biodiversity	0	0	0	1	0.25	1	2	3.25	3	1	5	4	13	**42.25**	L	50	Lighting should face away from the wetlands, and stream. Visitors should be discouraged from walking on the bed and banks of the stream, and into the wetter areas, through construction of walkways and benches, guiding visitors to use specific pathways and areas.	
		On site storage / conveyance of waste water	Leakage of treated waste water into watercourse, soils or groundwater	Pollution of sensitive areas, deterioration in water quality	0	1	0	0	0.25	2	2	4.25	3	1	5	3	12	**51**	L	50	Infrastructure to be placed well away from the wetland and its buffer. Pipes and tanks must be regularly checked for leaks and overflow.	

Dwars River Valley-Bottom Wetland:

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

NAME and REGISTRATION No of SACNASP Professional member: …Kate Snaddon…….. Reg no. …… 400225/06……

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

					Severity																
No.	**Phases**	**Activity**	**Aspect**	**Impact**	**Flow Regime**	**Physico & Chemical (Water Quality)**	**Habitat (Geomorph + Vegetation)**	**Biota**	**Severity**	**Spatial scale**	**Duration**	**Consequence**	**Frequency of activity**	**Frequency of impact**	**Legal Issues**	**Detection**	**Likelihood**	**Significance**	**Risk Rating**	**Confidence level**	**Control Measures - See BA REPORT for full list of mitigation measures**	**PES AND EIS OF WETLAND**
1	Construction	Construction activities in or close to the wetland	Storage or dumping of building / landscaping materials in close proximity to the wetland	Compaction of soils; movement of building materials (sand, rubble, etc) into the wetland	1	1	1	1	1	1	2	4	1	1	5	1	8	**32**	L	80	Ensure that materials are stored at least 50m away from the edge of the edge of the wetland	PES is Category C; EIS is high.
			Leakage of fuels, oils, etc. from construction machinery.	Pollution of sensitive areas, deterioration in water quality	0	1	1	1	0.75	1	2	3.75	1	1	5	2	9	**33.75**	L	80	Ensure that machinery is bunded, and located at least 50m away from the edge of the wetland.	
			Increased mobilisation of fine sediment and sand	Erosion and sedimentation	0	1	1	1	0.75	1	2	3.75	1	2	5		8	**30**	L	80	Construction close to the wetland (e.g. the amphitheatre) must be done in the dry season. Monitor construction site after rainfall events. De-watering must be done into settlement ponds before allowed to flow back into any natural areas.	
			Pedestrian access onto and around the construction site	Trampling of sensitive habitat; noise and light pollution; introduction and spread of alien invasive species	1	0	1	1	0.75	1	2	3.75	1	1	5	2	9	**33.75**	L	80	Demarcate the ecological buffer and ensure that construction activities remain outside of this area. The construction site must be monitored for the spread of IAPs.	
				Pollution of sensitive areas from human waste, deterioration in water quality	0	1	0	1	0.5	1	2	3.5	1	2	5	3	11	**38.5**	L	80	Ensure that toilets are provided and used by construction workers. If waste is found, it must be removed immediately and disposed of.	
2	Operational	Stormwater management	Discharge of stormwater runoff into wetland	Altered hydrology and water quality	1	0	0	0	0.25	2	2	4.25	2	1	5	3	11	**46.75**	L	50	New hardened surfaces (impermeable) must be limited to the developable area outside the aquatic ecosystems and their buffers. Roads and parking areas must be constructed with permeable materials, such as permeable paving, gravelfix, gravel, mulch, or earth. Hardened surfaces must discharge surface water to filtration areas.	
		Disturbance of soils for landscaping/gardening	Introduction of IAPs	Loss of biodiversity	0	0	1	0	0.25	2	3	5.25	1	1	5	2	9	**47.25**	L	80	Landscaping requiring ongoing maintenance around the units must be kept to a minimum, especially within the ecological buffers. Gardens should rather be natural areas, where the locally indigenous vegetation is allowed to grow. No kikuyu grass is allowed anywhere on site. The spread of alien plant species into all natural areas must be prevented and monitored. Road verges must be monitored for alien species, especially grasses.	
		Proximity of development to sensitive areas	Disturbance (noise, light) of fauna and flora	Loss of biodiversity	0	0	0	1	0.25	1	2	3.25	3	1	5	4	13	**42.25**	L	50	Lighting should face away from the wetland. Visitors should be discouraged from walking into the wetland, through construction of walkways and benches, guiding visitors to use specific pathways and areas.	
		On site storage / conveyance of waste water	Leakage of untreated waste water from pipes or conservancy tank	Pollution of sensitive areas, deterioration in water quality	0	1	0	0	0.25	2	2	4.25	3	1	5	3	12	**51**	L	50	Infrastructure to be placed well away from the wetland and its buffer. Pipes and tanks must be regularly checked for leaks and overflow.	

New Retreat Seep wetland:

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

NAME and REGISTRATION No of SACNASP Professional member: …Kate Snaddon…… Reg no. …… 400225/06……..

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

No.	Phases	Activity	Aspect	Impact	Severity				Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures - See BA REPORT for full list of mitigation measures	PES AND EIS OF WETLAND
					Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota														
1	Construction	Construction activities in or close to the wetland	Storage or dumping of building / landscaping materials in close proximity to the wetland	Compaction of soils; movement of building materials (sand, rubble, etc) into the wetland	1	1	1	1	1	1	2	4	1	1	5	1	8	**32**	L	80	Ensure that materials are stored at least 50m away from the edge of the wetland	PES is Category D; EIS is moderate.
			Leakage of fuels, oils, etc. from construction machinery.	Pollution of sensitive areas, deterioration in water quality	0	1	1	1	0.75	1	2	3.75	1	1	5	2	9	**33.75**	L	80	Ensure that machinery is bunded, and located at least 50m away from the wetland.	
			Increased mobilisation of fine sediment and sand	Erosion and sedimentation	0	1	1	1	0.75	1	2	3.75	1	2	5		8	**30**	L	80	Water supply pipeline must be located in the road, on the north side. Construction close to the wetland (e.g. the low level concrete drift, water supply pipeline) must be done in the dry season. Monitor construction site after rainfall events. De-watering must be done into settlement ponds before allowed to flow back into any natural areas.	
			Pedestrian access onto and around the construction site	Trampling of sensitive habitat; noise and light pollution; introduction and spread of alien invasive species	1	0	1	1	0.75	1	2	3.75	1	1	5	2	9	**33.75**	L	80	Demarcate the ecological buffers and ensure that construction activities remain outside of this area. The construction site must be monitored for the spread of IAPs.	
				Pollution of sensitive areas from human waste, deterioration in water quality	0	1	0	1	0.5	1	2	3.5	1	2	5	3	11	**38.5**	L	80	Ensure that toilets are provided and used by construction workers. If waste is found, it must be removed immediately and disposed of.	
2	Operational	Stormwater management	Discharge of stormwater runoff into wetland	Altered hydrology and water quality	1	0	0	0	0.25	2	2	4.25	2	1	5	3	11	**46.75**	L	50	New hardened surfaces (impermeable) must be limited to the developable area outside the aquatic ecosystems and their buffers. The track leading to the waste treatment components located on site, proposed to encroach into the Dwars River valley-bottom wetland buffer, must be constructed with permeable materials, such as permeable paving, gravelfix, gravel, mulch, or earth.	
		Disturbance of soils for landscaping/gardening	Introduction of IAPs	Loss of biodiversity	0	0	1	0	0.25	2	3	5.25	1	1	5	2	9	**47.25**	L	80	Landscaping requiring ongoing maintenance around the units must be kept to a minimum, especially within the ecological buffers. Gardens should rather be natural areas, where the locally indigenous vegetation is allowed to grow. No kikuyu grass is allowed anywhere on site. The spread of alien plant species into all natural areas must be prevented and monitored. Road verges must be monitored for alien species, especially grasses.	
		Proximity of development to sensitive areas	Disturbance (noise, light) of fauna and flora	Loss of biodiversity	0	0	0	1	0.25	1	2	3.25	3	1	5	4	13	**42.25**	L	50	Lighting should face away from the wetland. Visitors should be discouraged from walking into the wetland, through construction of walkways and benches, guiding visitors to use specific pathways and areas.	
		On site storage / conveyance of waste water	Leakage of treated waste water into wetland soils or groundwater	Pollution of sensitive areas, deterioration in water quality	0	1	0	0	0.25	2	2	4.25	3	1	5	3	12	**51**	L	50	Infrastructure to be placed well away from the wetland and its buffer. Pipes and tanks must be regularly checked for leaks and overflow.	

Stream 11:

Note: there are no operational impacts affecting Stream 11.

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

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					Severity																
No.	**Phases**	**Activity**	**Aspect**	**Impact**	**Flow Regime**	**Physico & Chemical (Water Quality)**	**Habitat (Geomorph + Vegetation)**	**Biota**	**Severity**	**Spatial scale**	**Duration**	**Consequence**	**Frequency of activity**	**Frequency of impact**	**Legal Issues**	**Detection**	**Likelihood**	**Significance**	**Risk Rating**	**Confidence level**	**Control Measures - See EIA REPORT for full list of mitigation measures**	**PES AND EIS OF WATER-COURSE**
1	Construction	Construction activities in or close to the watercourse (construction of the water supply pipeline)	Storage or dumping of building / landscaping materials in close proximity to the watercourse	Compaction of soils; movement of building materials (sand, rubble, etc) into the watercourse	0	1	1	0	0.5	1	2	3.5	1	1	5	1	8	**28**	L	80	Ensure that materials are stored at least 50m away from the edge of the riparian area	PES is Category D; EIS is moderate.
			Leakage of fuels, oils, etc. from construction machinery.	Pollution of sensitive areas, deterioration in water quality	0	1	1	0	0.5	2	2	4.5	1	1	5	2	9	**40.5**	L	80	Ensure that machinery is bunded, and located at least 50m away from the riparian area.	
			Increased mobilisation of fine sediment and sand	Erosion and sedimentation	0	1	1	0	0.5	2	2	4.5	1	3	5	2	11	**49.5**	L	80	River rehabilitation plan to be implemented during the dry season. Construction close to the wetlands or stream must be done in the dry season. Where water pipelines must cross over the stream, the pipes must be surface mounted on the culvert. Rock for the reno mattress, riprap and rehabilitation gabions may not be sourced from the streams on Boschendal Estate. Monitor construction site after rainfall events. De-watering must be done into	
			Pedestrian access onto and around the construction site	Trampling of sensitive habitat; noise and light pollution; introduction and spread of alien invasive species	0	0	1	0	0.25	1	2	3.25	1	2	5	2	10	**32.5**	L	80	Demarcate the ecological buffers and ensure that construction activities remain outside of this area. The construction site must be monitored for the spread of IAPs.	
				Pollution of sensitive areas from human waste, deterioration in water quality	0	1	0	0	0.25	2	2	4.25	1	2	5	3	11	**46.75**	L	80	Ensure that toilets are provided and used by construction workers. If waste is found, it must be removed immediately and disposed of.	

Stream 11 seep:

Note: there are no operational impacts affecting the seep around Stream 11.

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

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					Severity																
No.	Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures - See BA REPORT for full list of mitigation measures	PES AND EIS OF WETLAND
1	Construction	Construction activities in or close to the wetland (construction of water supply pipeline)	Storage or dumping of building materials in close proximity to the wetland	Compaction of soils; movement of building materials (sand, rubble, etc) into the wetland	1	1	1	1	1	1	2	4	1	1	5	1	8	**32**	L	80	Ensure that materials are stored at least 50m away from the edge of the wetland	PES is Category D; EIS is moderate.
			Leakage of fuels, oils, etc. from construction machinery.	Pollution of sensitive areas, deterioration in water quality	0	1	1	1	0.75	1	2	3.75	1	1	5	2	9	**33.75**	L	80	Ensure that machinery is bunded, and located at least 50m away from the wetland.	
			Increased mobilisation of fine sediment and sand	Erosion and sedimentation	0	1	1	1	0.75	1	2	3.75	1	2	5		8	**30**	L	80	Water supply pipeline must be located in the road, on the north side. Construction close to the wetland must be done in the dry season. Trenching for laying the water supply pipeline must be done in sections, so that trenches are left open for a minimum length of time. Monitor construction site after rainfall events. De-watering must be done into settlement ponds before allowed to flow back into any natural areas.	
			Pedestrian access onto and around the construction site	Trampling of sensitive habitat; noise and light pollution; introduction and spread of alien invasive species	1	0	1	1	0.75	1	2	3.75	1	1	5	2	9	**33.75**	L	80	Construction activities must remain wthin the road reserve. The construction site must be monitored for the spread of IAPs.	
				Pollution of sensitive areas from human waste, deterioration in water quality	0	1	0	1	0.5	1	2	3.5	1	2	5	3	11	**38.5**	L	80	Ensure that toilets are provided and used by construction workers. If waste is found, it must be removed immediately and disposed of.	

York Dam seep:

Note: there are no operational impacts affecting the seep below York Dam.

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I water use Risk Assessment Protocol)

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No.	Phases	Activity	Aspect	Impact	Severity																PES AND EIS OF WETLAND
					Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures - See BA REPORT for full list of mitigation measures	
1	Construction	Construction activities in or close to the wetland (construction of water supply pipeline)	Storage or dumping of building materials in close proximity to the wetland	Compaction of soils; movement of building materials (sand, rubble, etc) into the wetland	1	1	1	0	0.75	1	2	3.75	1	1	5	1	8	**30**	L	80	Ensure that materials are stored at least 50m away from the edge of the wetland	PES is Category C; EIS is moderate.
			Leakage of fuels, oils, etc. from construction machinery.	Pollution of sensitive areas, deterioration in water quality	0	1	1	0	0.5	1	2	3.5	1	1	5	2	9	**31.5**	L	80	Ensure that machinery is bunded, and located at least 50m away from the wetland.	
			Increased mobilisation of fine sediment and sand	Erosion and sedimentation	0	1	1	0	0.5	1	2	3.5	1	2	5		8	**28**	L	80	Water supply pipeline must be located in the road, on side away from the seep. Construction close to the wetland must be done in the dry season. Trenching for laying the water supply pipeline must be done in sections, so that trenches are left open for a minimum length of time. Monitor construction site after rainfall events. De-watering must be done into settlement ponds before allowed to flow back into any natural areas.	
			Pedestrian access onto and around the construction site	Trampling of sensitive habitat; noise and light pollution; introduction and spread of alien invasive species	0	0	1	0	0.25	1	2	3.25	1	1	5	2	9	**29.25**	L	80	Construction activities must remain wthin the road reserve. The construction site must be monitored for the spread of IAPs.	
				Pollution of sensitive areas from human waste, deterioration in water quality	0	1	0	0	0.25	1	2	3.25	1	2	5	3	11	**35.75**	L	80	Ensure that toilets are provided and used by construction workers. If waste is found, it must be removed immediately and disposed of.	