Agency for Cultural Resource Management

Specialists in Archaeological Studies and Heritage Resource Management

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25 November, 2010

Att: Ms Anelia Coetzee
CK Rumboll and Partners
PO Box 211
Malmesbury
7299

Dear Ms Coetzee,

ARCHAEOLOGICAL IMPACT ASSESSMENT PROPOSED DEVELOPMENT OF ERF 2569 WELLINGTON WESTERN CAPE

1. Introduction and brief

CK Rumboll and Partners, on behalf of Evergreen Estates requested that the Agency for Cultural Resource Management conduct an Archaeological Impact Assessment for the proposed development Erf 2569 near Wellington, in the Western Cape (Figure 1).

The proposed development entails the construction of 96 Group Housing units (1.54 ha), 99 General Residential units (0.89 ha), Public Open Space (1.38 ha) and internal streets and parking (0.81ha).

The proposed development site is 4.639 ha in extent and is currently zoned `Undetermined' and will need to be rezoned and subdivided in order for the proposed development activities to proceed.

A Notice of Intent to Develop (NID) has been completed by Mr Johan Botes (of CK Rumboll & Partners), but an AIA was not undertaken at the time.

2. Terms of reference

The Terms of Reference for the archaeological assessment were to:

- Identify and map any archaeological resources on the proposed site;
- Determine the importance of archaeological resources on the proposed site;
- Determine and asses the potential impacts of the proposed development on archaeological resources, and
- Recommend measures to minimise impacts associated with the proposed development.

3. The study site

Erf 2569 is located alongside the R301 (Van Riebeek Road) between Paarl and Wellington. Access to the property is via Vallei Street. The site is flat and slopes gently from east to west. The highly degraded Mbekweni River is situated on the northern boundary of the property the old Wellington Paarl Road is on the western boundary, informal housing and vacant land on the south and the residential township of Newton on the east. A decommissioned Waste Water Treatment Works (WWTW) is situated in the south east (refer to Figure 2). Virtually no natural vegetation occurs on the site, which is in a severely degraded and transformed state. The property must have at some stage been used for agricultural activities as old plough lines are still visible across much of the eastern portion. The site is covered in short, but thick Kweek grass. A few sporadic trees occur over the property. A wide gravel road and numerous small pedestrian footpaths intersect the site. There is a large pit that has been excavated in the centre of the site, and large volumes of clay and gravel have been dumped alongside the river in the northern boundary, which has been brought onto the property from elsewhere. A large informal rubbish dump and recycling enterprise is located in the western portion, where several large metal containers are also situated. A metal and concrete building on the site is currently being used as storage facility and accommodation for some of the workers. Dumping of building rubble is widespread over the property, as it litter. A small (dry) pond is located in the north east, which may be the remnants of the Mbekweni wetland system. There are no significant landscape features on the property (Figures 3-12).

4. Approach to the study

The proposed development site was searched for archaeological remains.

The site visit took place on 25th November, 2010.

A desk top study was also undertaken.

5. Constraints and limitations

There were no constraints or limitations associated with the study.

6. Results of the desk top study

About 25 Early Stone Age (ESA) tools, including several large side struck flakes and at least two handaxes were documented during a survey of the property known as Vlakkeland (the decommissioned WWTW) property[1]. It appears that the tools were brought onto the site when the sewerage ponds were first constructed more than 25 years ago as all the implements were found packed (with large numbers of river cobbles) against the inside sloping walls of the ponds. A few Early and Middle Stone Age tools were also documented during a study of Erf 34, near the Wellington Golf Course[2].

[1] Kaplan, J. 2007. Proposed establishment of a cemetery on Erven 8384-8388 and 8395-8397(Vlakkeland) Wellington. Report prepared for Braaf Environmental Consultants. Agency for Cultural Resource Management

[2] Kaplan, J. 2007. Proposed establishment of a cemetery on Erf 34 Wellington. Report prepared for Braaf Environmental Consultants. Agency for Cultural Resource Management

Several ESA flakes and a handaxe were also found during an inspection of earthworks at the Blouvlei Reservoir near Wellington[3].

All the remains occur in a disturbed context and were rated as having low significance.

7. Findings

No archaeological remains were documented during the study of Erf 2569. The site is severely degraded.

8. Impact statement

The impact of the proposed development on archaeological remains is likely to be **low**.

The probability of locating important archaeological remains during implementation of the project is likely to be highly improbable.

9. Conclusion

The Archaeological Impact Assessment of Erf 2569 Wellington has identified no significant impacts to pre-colonial archaeological material that will need to be mitigated prior to proposed construction activities commencing.

The proposed development should be allowed to proceed.

Yours sincerely

Jonathan Kaplan

[3] Kaplan, J. Archaeological inspection Blouvlei Reservoir Wellington. Report prepared for Ninham Shand Environmental Consultants. Agency for Cultural Resource Management

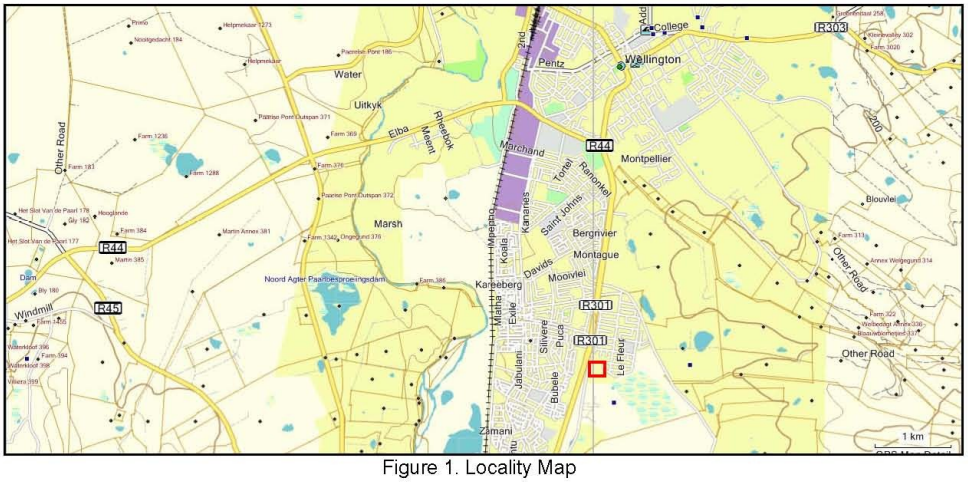


Figure 1. Locality Map

Figure 2. Aerial photograph of the study site

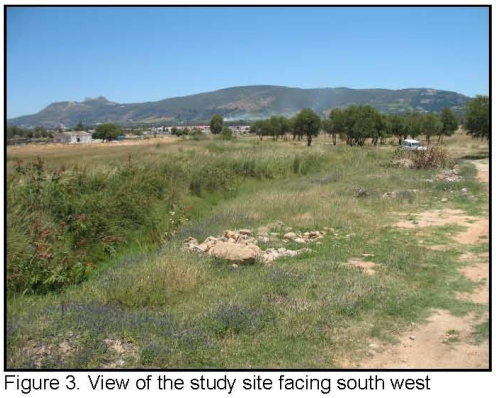


Figure 3. View of the study site facing south west

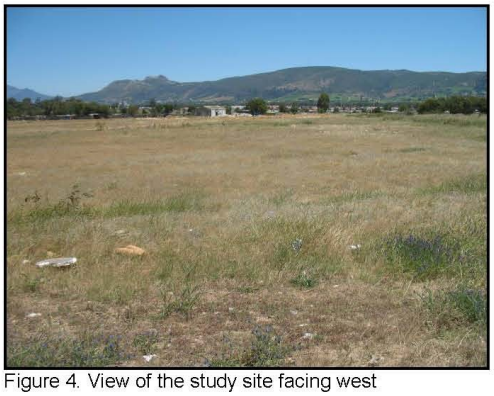


Figure 4. View of the study site facing west

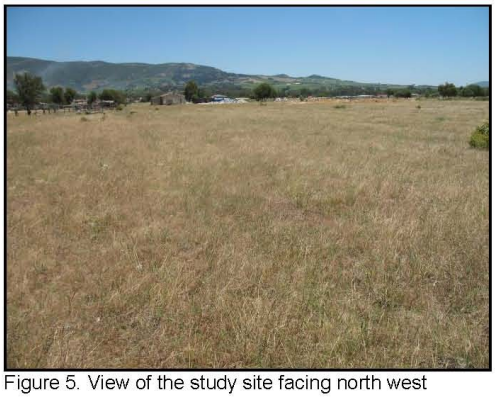


Figure 5. View of the study site facing north west

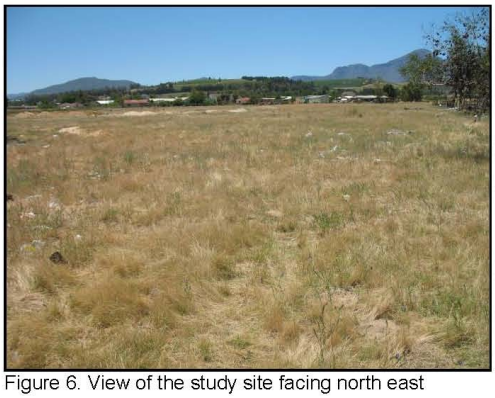


Figure 6. View of the study site facing north east

Figure 7. Large pit on the study site. View facing north east

Figure 8. View of the study site facing north east

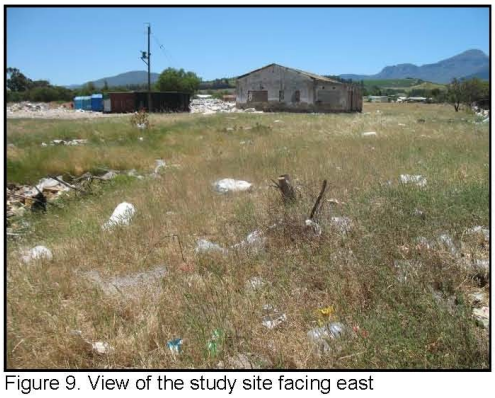


Figure 9. View of the study site facing east

Figure 11. Back of the building

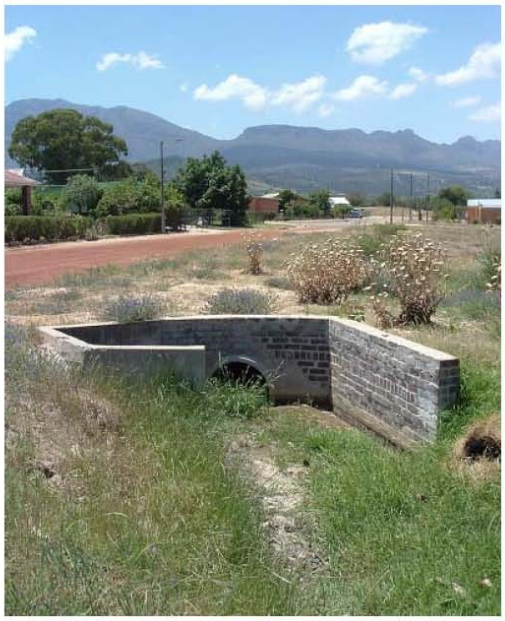
Figure 10. Metal and concrete building

Figure 12. View of the study site and the Mbekweni River facing east

Aquatic Ecosystem Assessment of the Mbekweni River,

ERF 2569 Wellington

December 2007



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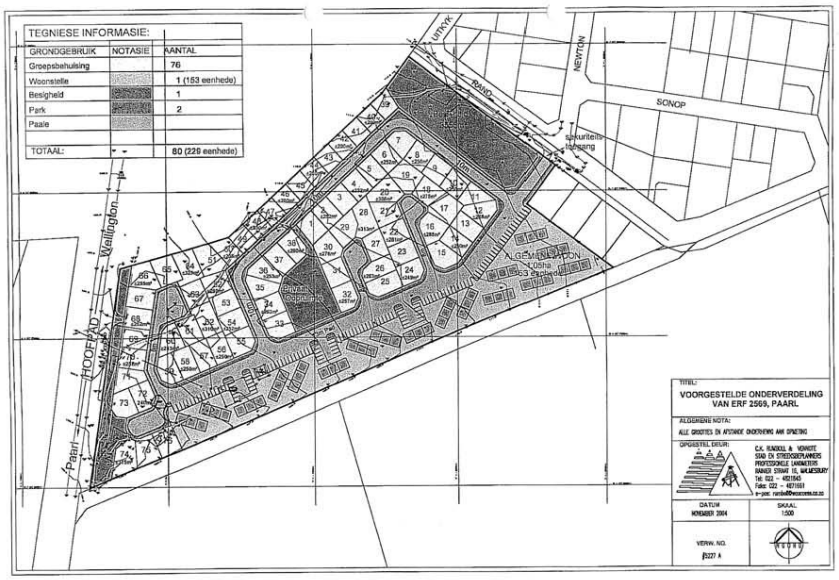
1. INTRODUCTION

1.1 General Background

This assessment is in support of a proposed residential development on Erf 2569, Wellington (figure 1). The site is 4.6351 ha in extent and largely undeveloped. The adjacent surrounding areas to the site are the residential development of Newtown and surrounding agricultural land.

Figure1. Concept layout of the proposed residential development



The proposed development consists largely of the construction of residential homes, with a shopping complex on the northern extent. The table below provides more detail on the proposed development activities.

Table 1. Proposed development outline

Description	Number	Approx size (m2)
Single Residential	153	Undetermined
Group Housing	76	200m^2 and 360m^2
Public construction	1	1731m^3
Shopping complex	1	3556m^2

The legal application process for the development requires that the environmental impacts on the aquatic ecosystems should be investigated, and application for the development needs to be made to both the Department of Environmental Affairs and Development Planning (DEADP) and to the Department of Water Affairs and Forestry (DWAF). The approvals required from DWAF as well as DEADP for the proposed development are as follows:

- A water use licence from DWAF for the altering of the bed, banks and characteristics of the watercourse, in terms of section 21 of the National Water Act, Act 36 of 1998; and
- An Environmental Authorisation (EA) in terms of the Environmental Impact Assessment Regulations in Chapter 5 of the National Environmental Management Act, 1998, from DEADP to address the environmental impacts of the development.

Figure 2. Aerial photo of the Mbekweni River running through the study site

1.2 Limitations of the assessment

Limitations and uncertainties often exist within the various techniques adopted to assess the condition of ecosystems. The following limitations apply to the techniques and methodology utilised to undertake this study:

- Analysis of the freshwater ecosystems was undertaken according to nationally developed methodologies as defined by DWAF as part of the national River Health Programme (RHP) and undertaken at a rapid level.

- No water quality or aquatic life (fish and macroinvertebrates) integrity assessments were undertaken due to the absence of suitable flow conditions

- Recommendations are made with respect to the adoption of a buffer zone within the development site based on the river's functioning. These recommendations are based on professional opinion as well as indicator-derived estimations using the DWAF's RHP methodologies determining ecological reference conditions and riparian zone structural and habitat intactness.
- Mapping of wetlands were not carried out, but captured on a rapid level in the River Vegetation Index (RVI) assessment carried out on a DWAF level 4 basis.

1.3. Terms of Reference

Input for this assessment of the impacts on the aquatic ecosystems was guided by the following terms of reference:

Task 1: Freshwater assessment and identification of impact from the proposed development and the recommended mitigation measures

Task 2: Facilitate the application for a water use authorisation

1.4 Use of this report

This report reflects the professional judgement of its author. The report should be kept in its full and unedited form and any summary of these findings should only be produced in consultation with the author.

2. DESCRIPTION OF AFFECTED AQUATIC ECOSYSTEMS

2.1 General description of the catchment and freshwater ecosystem

The Mbekweni River, a minor tributary of the Berg River, originates in the lower western region of the Hawekwa Mountains and flows in a westerly direction to the townships of Newtown and Mbekweni where it finally joins the Berg River north of Paarl (Sinske 2007).

The natural vegetation of the region is West Coast Renosterveld and Southwest Fynbos. Over time, this vegetation has been largely transformed or replaced by farming and urban related developments. Much of the river channel has also been altered by land use activities, where the upper reaches have been highly modified by agriculture and a number of farm dams are present in this reach. In Newtown, downstream of the agricultural area, the river channel has most been canalised and is no longer a clearly defined channel. Downstream of the proposed development site, the river again flows through agricultural and the river is confined to channel alongside the roads.

As a result, the Mbekweni catchment has lost many of its natural functionality due to channel straightening, additions of storm water and invasion of exotic vegetation species.

Figure 3. Topographical map of the Mbekweni River

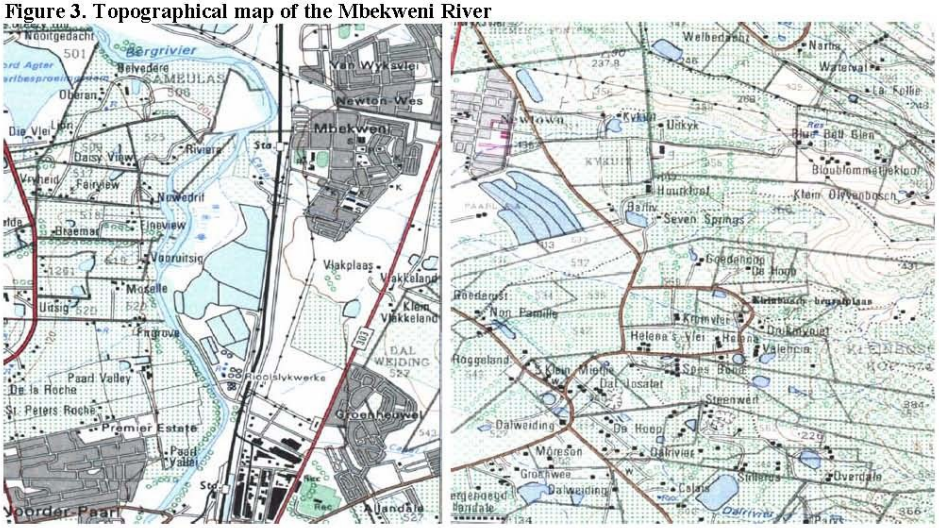


Figure 4. Aerial view of the Study area and surrounding catchment

2.2 Ecological Classification of the stream in the study area

In order to assess the condition and ecological importance and sensitivity of the river segment under study, it is necessary to understand how the river habitat characteristics and stream flow was under natural conditions (prior direct and induced human modifications). This is achieved through classifying rivers according to what its ecological characteristics are *in situ* and extrapolating these characteristics in comparison with data derived reference conditions, or via professional judgment using catchments of similar physical and biological characteristics. Thus, by deducing ecological reference conditions, impacts on the site can be measured and classed to channel condition, riparian zone integrity, stream quality, as well as factors impacting with reference to the catchment as a whole.

River typing or classification involves the hierarchical grouping of rivers into ecologically similar units so that inter- and intra-river variation in factors that influence water chemistry, channel type, substratum composition and hydrology are best accounted for. This tool provides a framework for reference conditions of streams understudy, by comparing these conditions to streams that are similar. Thus, the classification of rivers provides the basis for assessing river condition to allow comparison between similar river (as a reference) and the river understudy. The primary classification of rivers is a division into Ecoregions. Rivers within an ecoregion are further divided into sub-regions.

Ecoregions: groups of rivers within South Africa, which share similar physiography, climate, geology, soils and potential natural vegetation. For the purposes of this study, the ecoregional classification presented in DWAF (1999), which divides the country's rivers into 18 ecoregions, was used.

Sub-regions: sub-regions (or geomorphological zones) are groups of rivers, or segments of rivers, within an ecoregion, which share similar geomorphological features, of which gradient is the most important. The use of geomorphological features is based on the assumption that these are a major factor in the determination of the distribution of the biota.

Table 2. Classification of the Van Wyksrivier at the proposed development site

River	Ecoregion	Subregion
Van Wyksrivier	Southern Coastal Belt	Lower foothills

Table 3. Characteristics of the Southern Coastal Belt

Main Attributes	Southern Coastal Belt
Terrain Morphology: Broad division (Primary)	Plains; Low to Moderate Relief; Open Hills; Lowlands; **Closed Hills; Mountains; Moderate and High Relief**
Vegetation types (dominant types in bold) (Secondary)	**South and South West Coast Renosterveld;** Central Mountain Renosterveld; Limestone fynbos; Mountain Fynbos; Laterite Fynbos; Dune Thicket; Patches Afromontane Forest
Altitude (m a.m.s.l) (Primary)	0-700
MAP (mm) (modify)	300 to 600
Coefficient of Variation (% of annual precipitation)	25 to 39
Rainfall concentration index	<15 to 49
Rainfall seasonality	Winter to all year
Mean annual temp. (°C)	10 to 20
Mean daily max. temp. (°C): February	22 to 30
Mean daily max. temp. (°C): July	14 to 20
Mean daily min. temp. (°C): February	12 to 17
Mean daily min temp. (°C): July	4 to 9
Median annual simulated runoff (mm) for quaternary catchment	10 to >250

3. ECOLOGICAL STATUS OF THE STREAM

RVI and Site Characterisation assessments were carried out to provide information on the ecological condition of the Mbekweni River. No detailed assessments were carried out in terms of water quality, SASS5, geomorphology or fish. The results of the Site Characterisation Assessment was used to provide a desktop estimate of the site's habitat integrity.

From the Site Characterisation assessment, Table 4, the geomorphological and physical characteristics of the stream can be classified as a typical non-confined valley bottom wetland system or a simple lower foothill tributary, of the Berg River in this instance.

Table 4. Geomorphological and Physical features of the Mbekweni River

Valley Form	Floodplain/Valley side Bench
Lateral mobility or entrenchment	Non-confined
Channel form	Simple (no macro-channel)
Channel pattern	Single thread: low sinuosity
Channel type	Gravel and sand

The catchment condition and land-use impacts on the site include agricultural related disturbance activities and direct habitat disturbance related activities. From figure 3, it can be seen that the

river flows into the site via a storm water structure (photo titled upstream) used for the development of the residential area North-west of the site (Newtown). The photo titled "downstream" shows some alien vegetation stands (*A. saligna*) with no indigenous riparian shrubs present on the left hand bank (LHB) of the river. The photo titled "floodplain vegetation" displays the scattered representation of the few plant species found, which was mostly common weeds and indigenous grassy vegetation. Wetland features were common on the site, particularly around the storm water outlet and on the right hand bank (RHB) of the river. This can probably be as a result of a historic wetland area prior to the construction of the Newtown settlement and storm water modifications.

Figure 5. Photographs representing various views of the river segment.

Upstream *Flood plain Vegetation* *Downstream*

4. SUMMARY OF AQUATIC ECOSYSTEM ASSESSMENT AND RECOMMENDATIONS

4.1 Habitat Integrity of the Mbekweni River

The Mbekweni River at the site is a foothill river characteristic of a channelled valley bottom wetland system and contributes as a tributary of the Berg River. No evident flood bench or terrace was discernable at the site, due to the flat nature and lack of zonation patterns across the riparian area.

The substrate on the riverbed is predominantly gravel. Deposition of fine silty sediments occurred on the bed and probably cause low oxygen levels instream when the river flows. This would infer that the water quality is probably in a fair to poor class because of the additional stormwater discharge and residential activities upstream.

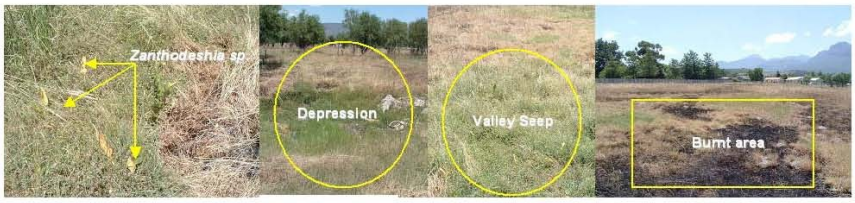
Table 5. Index of Habitat Integrity Assessment results and criteria assessed

Instream Criteria	*Weight*	*Score*	Riparian Zone Criteria	*Weight*	*Score*
Water abstraction	14	**8**	Water abstraction	13	**7**
Flow modification	13	**13**	Inundation	11	**2**
Bed modification	13	**12**	Flow modification	12	**11**
Channel modification	13	**9**	Water quality	13	**10**
Water quality	14	**16**	Indigenous vegetation removal	13	**8**
Inundation	10	**2**	Exotic vegetation encroachment	12	**5**
Exotic macrophytes	9	**0**	Bank erosion	14	**1**
Exotic fauna	8	**0**	Channel modification	12	**11**
Solid waste disposal	6	**10**			
Category		***D***	***Category***		***D***

The major impact to the stream's habitat integrity is largely flow modification, water quality and solid waste disposal (Table 5). Water abstraction activities, alien invasion and the removal of indigenous riparian vegetation are impacting on the aquatic habitat integrity, but to a lesser degree. However, the absence of a riparian buffer area suggests a lack of the river's ability to attenuated floods and to protection to the surrounding land from these floods.

Evidence of a remnant wetland system is consistent across the northern regions of the Erf, indicated by the seeps, depressions, resilience of burnt areas and hydrophilic plant species scattered in these areas (figure 5). This remnant wetland area has become highly disturbed as a result of dumping of rubble and removal and sand from the area.

Figure 6. Photographs representing various wetland areas adjacent to the river segment



4.2 Riparian Zone Quality of the Mbekweni River

The riparian zone quality was classified as poor, which indicates an extensively modified system. The loss of natural habitat, biota and basic ecosystem functions are extensive. Factors that influence this result are the lack of canopy species across the riparian zone. The relevance of canopy species is due to the structural support they provide to the river's geomorphology; the refugia they provide for fauna; the source of food they give to the river as well as the habitat they create insteam and at the stream margin for fish and invertebrates. Other factors taken into consideration in the riparian quality assessment are the representation of vegetation across the zone and the river zonation itself. Both factors were found to have unnatural distributions, with little or no representations of riparian shrub and tree species; a persistent overgrowth of riparian reed or sedge species; and an evident lack of riparian upper zone, which provides the last support against flooding and acts as the transition zone between the terrestrial and riparian ecosystems.

Alien plant invasion was also a common feature across the study site, but did not occupy large surface areas. These species include *A. saligna*, *Echium plantagineum* and *Ricinus communis*.

Evidence of a wetland system was found on the site and may indicate that this stream became a channeled valley-bottom wetland at this point, with active seep areas draining into the river. However, the scope of the study did not allow an investigation to be carried out any further.

Table 6. A Table representing the Ecological Specifications and Thresholds of Probable Concerns for the Mbekweni River, adapted from Herdien (2007)

Metric Group	Metric	Ecospecs	TPCs
Marginal zone	Vegetation cover	Maintain existing cover (between 50-60%) of indigenous marginal vegetation species (*Cyperus spp.* and *Pennisetum spp.*)	Reduction of (<30%) of indigenous marginal vegetation species
		Tolerate and/or reduce existing cover of alien tree species *A.saligna* (Port Jackson), and *Sesbania sp.*(red sesbania)	Increase cover of exotic species (>50%)
Lower zone	Vegetation cover	Increase the riparian vegetation cover to 50% (*Olea capensis, Agathosma* sp. etc.)	Any further reduction of indigenous vegetation
Upper zone	Vegetation cover	No Upper Zone could be delineated.	No Upper Zone could be delineated.
All zones	Indigenous Riparian Vegetation Recruitment and Structure	Maintain at least 30% indigenous riparian shrub and tree species in the marginal zone, with a 10% recruitment rate.	Maintain a recruitment rate that is higher than exotic species
		Maintain at least 50% indigenous riparian shrub, and tree species in the wetbank zone with a 20% recruitment rate.	Maintain a recruitment rate that is higher than exotic species

4.3 Ecological Importance and Sensitivity (EIS)

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

Table 7. Definition of the four-point scale used to assess biotic and habitat determinants presumed to indicate either importance or sensitivity

Four point scale	Definition
1	One species/taxon judged as rare or endangered at a local scale.
2	More than one species/taxon judged to be rare or endangered on a local scale.
3	One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.
4	One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books)

Table 8. Ecological importance and sensitivity categories (DWAF, 1999).

EISC	General description	Range of median
Very high	Quaternaries/delineations that are considered to be unique on a national and international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3-4
High	Quaternaries/delineations that are considered to be unique on a national scale based on their biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use.	>1-≤2
Low/ marginal	Quaternaries/delineations that are not unique on any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

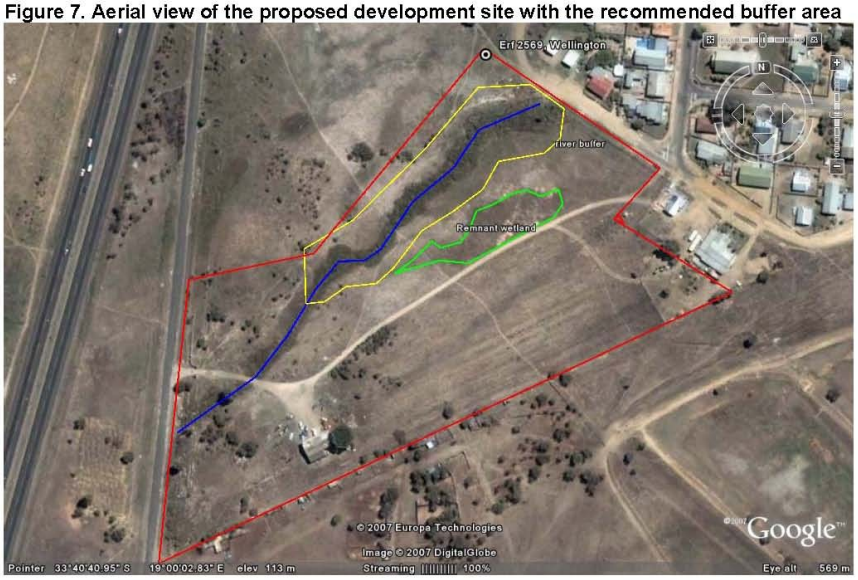
Table 9. Results of the EIS assessment for the Mbekweni River

Biotic Determinants	
Rare and endangered biota	1
Unique biota	1
Intolerant biota	1
Species/taxon richness	1
Aquatic Habitat Determinants	
Diversity of aquatic habitat types or features	1
Refuge value of habitat type	1
Sensitivity of habitat to flow changes	2
Sensitivity of flow related water quality changes	2
Migration route/corridor for instream and riparian biota	1
National parks, wilderness areas, Nature Reserves, Natural Heritage sites, Natural areas, PNEs	0
RATINGS	**1.1**
EIS CATEGORY	**Low/ moderate**

4.4 Recommendations

The Mbekweni River has a low ecological importance, but as it is a seasonal river, it is quite sensitive to flow and water quality changes. The current ecological condition is fair with a section of the river and wetland area having a good potential for rehabilitation. Thus, the river and the associated wetland area, as shown in the figure below, should be protected by a development setback or buffer of preferably that recommended by the Western Cape Provincial Spatial Development framework, i.e. 30m measured on either side of the centre line of the river. This buffer will provide at least some protection from the impacts of the proposed development.

Figure 7. Aerial view of the proposed development site with the recommended buffer area



Where this buffer width cannot be established, a riverine corridor of not less than 40m as depicted in the figure should be maintained. Erf boundaries can encroach into the buffer, but no hard development should be located here. This buffer will provide some protection for the aquatic systems from the impacts of the development, such as pollution, introduction of invasive alien plant species and human disturbance.

Stormwater generated on the site should not be carried to the stream, as this would impact on both the flow and quality in the river, and alter its character significantly.

The river should as far as possible be rehabilitated and incorporated into the development as an aesthetic feature. Rehabilitation work should include erosion control measures and improvement of existing river crossings to ensure that they do not impede the flow of the river. Areas that are regarded should be replanted with indigenous plants.

Road crossings should be minimized within the identified buffer area in the above figure and any work on the streams that constitutes alterations to the bed and banks should require authorization from the Department of Water Affairs and Forestry.

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Downstream of the identified buffer area, the aquatic ecosystem has a very low level of ecological functioning and, as such, provides little of the associated goods and services. Along this section of the river one could consider to allow minimal buffer zones and canalisation using ecologically acceptable materials and landscaping. The remnant wetland area is also very degraded and does not contribute significantly to the ecological functioning of the river system. Loss of this wetland area would not be a significant impact to the river system.

An Environmental Management Plan (EMP) should be formulated for the proposed development in accordance with the requirements of the IEA regulations. Within the EMP management of areas

that are considered for rehabilitation (wetbank/buffer area) can also be addressed, as well as to ensure that the existing riparian ecological structures and functions remain intact after the construction phase is complete. The recommended plan should consider and include of the following, amongst others:

- A clear understanding of the relationship between ecosystem services and change in biotic diversity
- A clear understanding of the relationship between habitat transformation and ecosystem changes
- The establishment of a protective buffer area, up to 30m should be established (establishment of dense growth of indigenous existing and suitable cosmopolitan indigenous shrub species)
- Clearing or felling of alien invasive trees within the stream margin and wetbanks
- Retention of indigenous riparian vegetation
- Clearing of woody debris and hard rubble on site
- The removal of obstructions that particularly block the channel flows and structures promoting erosion control (buffer, hard structures, etc.)
- Channel stabilizers at the previous diversion causeway to the off-stream retention dam
- Activities that lead to elevated levels of turbidity must be minimised. Bulldozing and the use of other mechanical machinery in the riparian zone should also be prevented as far as possible

It is envisaged that should the proposed development be undertaken in accordance with the EMP, the impact of the development will be very little due to the to the already deteriorated state of the river. A concern for the development lies in the northern region of development plan (Right Hand Bank of the river), where active seeps are present. Also, should the development canalise the river, active flood prevention structures should be designed for possible heavy flood events (1:50yr or larger floods).

5. REFERENCES

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APPENDIX

METHODOLOGY

1 INDEX OF HABITAT INTEGRITY

Assessment of habitat integrity of a river can be seen as a precursor of the assessment of biotic integrity and is a measure of the degree to which a river has been modified from its natural state. Habitat and biotic integrity together constitute ecological integrity (Kleynhans, 1996). A site-based approach was carried out at all sites, where it is based on ground level observations at each monitoring site, but also makes use of other sources of information (maps, local knowledge etc.). The objectives of the Index of Habitat Integrity (IHI) assessment is to put into perspective the significance of various factors in the degradation of the habitat integrity of a specific river (Kleynhans, 1996).

The methodology (Kleynhans, 1996) involves an assessment of the number and severity of anthropogenic impacts on a river and the damage they potentially inflict upon the system. These disturbances include both abiotic and biotic factors, which are regarded as the primary causes of degradation of a river. The severity of each impact is ranked using a six-point scale with 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).

Criteria evaluated in the Index for Habitat Integrity

Instream Criteria	*Weight*	**Riparian Zone Criteria**	*Weight*
Water abstraction	14	Water abstraction	13
Flow modification	13	Inundation	11
Bed modification	13	Flow modification	12
Channel modification	13	Water quality	13
Water quality	14	Indigenous vegetation removal	13
Inundation	10	Exotic vegetation encroachment	12
Exotic macrophytes	9	Bank erosion	14
Exotic fauna	8	Channel modification	12
Solid waste disposal	6		
Total	**100**	**Total**	**100**
Score (% of total)		**Score (% of total)**	
Category		***Category***	

Intermediate Habitat Integrity categories (from Kleynhans, 1996)

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