TONGAAT HULETT DEVELOPMENTS

TINLEY MANOR SOUTH ROAD DEVELOPMENT, KWAZULU-NATAL PROVINCE

WETAND FUNCTIONAL, ECOLOGICAL AND IMPORTANCE ASSESSMENT

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I, **Stephen Burton**, declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist

SiVEST Environmental

Name of company (if applicable)

06th March 2015

Date

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Contents Page

1 INTRODUCTION 1
1.1 Definition of Wetlands as Assessed in this Study 1
1.2 Wetland Ecosystem Services and Characteristics 2
1.3 Assumptions and Limitations 3
2 TECHNICAL DETAILS OF THE PROJECT 3
3 METHODOLOGICAL APPROACH 4
3.1 Present Ecological Status 4
3.4 Impact Assessment Methodology 7
4 GENERAL STUDY AREA 7
5 FINDINGS OF ASSESSMENT 9
5.1 Wetland HGM Classification 9
5.2 Present Ecological Status 15
5.3 WET-Ecoservices Assessment 23
5.4 Wetland Ecological Importance and Sensitivity 27
6 PROPOSED INFRASTRUCTURE 34
6.1 Road Infrastructure 34
6.2 Stormwater Attenuation Infrastructure 39
7 NATURE OF THE POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED DEVELOPMENT 41
7.1 Pre-construction Phase Potential Impacts 41
7.3 Operation Phase Potential Impacts 50
7.4 Decommissioning Phase Potential Impacts 53
8 SPECIALIST RECOMMENDATIONS 53
9 CONCLUSION 54
10 REFERENCES 58

Determination of Significance of Impacts 62
Impact Rating System Methodology 62

LIST OF TABLES

Table 1. Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands 4
Table 2. Ecosystems services included in WET-EcoServices (Kotze *et al*. 2009)....................... 5
Table 3. Environmental Importance and Sensitivity biotic and habitat determinants.................. 6
Table 4. Environmental Importance and Sensitivity categories for biotic and habitat determinants 7
Table 5. Wetland Areas and Wetland Catchment Areas..13
Table 6. Channelled Valley Bottom Wetlands PES 16
Table 7. Unchannelled Valley Bottom Wetlands PES...19
Table 8. Hillslope Seep Wetlands PES 21
Table 9. Umhlali Floodplain Wetland PES...22
Table 10. Ecological Importance and Sensitivity Category for Channelled Valley Bottom Wetlands...28
Table 11. Ecological Importance and Sensitivity Category for Unchannelled Valley Bottom Wetlands...29
Table 12. Ecological Importance and Sensitivity Category for Hillslope Seep Wetlands 1-5......31
Table 13. Ecological Importance and Sensitivity Category for Hillslope Seep Wetlands 6-10....32
Table 14. Ecological Importance and Sensitivity Category for Hillslope Seep Wetlands 11-15..33
Table 15. Ecological Importance and Sensitivity Category for the Umhlali Floodplain Wetland .34
Table 16. Impact rating for pre-construction impacts related to the construction lay-down area in the wetlands..41
Table 17. Impact rating for road impacts 43
Table 18. Impact rating for construction phase establishment of housing units in wetlands and the associated buffer zones 46
Table 19. Impact rating for construction phase service installation impacts..............................47
Table 20. Impact rating for construction phase increased storm water run-off, erosion and increased sedimentation impacts 48
Table 21. Impact rating for construction phase increased storm water run-off, erosion and increased sedimentation impacts 50
Table 22. Impact rating for operational phase wetland rehabilitation impacts 51
Table 23. Summary of the potential impacts for the proposed development on Tinley Manor. ..56
Table 24. Example of the significance impact rating table 63

LIST OF FIGURES

Figure 1. Regional locality map of the study area.. 8
Figure 2. Wetland map (north) 10
Figure 3. Wetland map (south)...11

Figure 4. Wetland map (west) 12
Figure 5. WET-Ecoservices results for Channelled Valley Bottom Wetlands............................24
Figure 6. WET-Ecoservices results for Unchannelled Valley Bottom Wetlands 25
Figure 7. WET-Ecoservices results for Hillslope Seep Wetlands..26
Figure 8. WET-Ecoservices results for the Flooplain Wetland 27
Figure 9. Tinley Manor South – Wetland, Road and Stormwater Layout. 35
Figure 10: Photos of the *Litchi Orchard Wetland*: Core wetland area (top left); drainage ditch (top right); and the existing road crossing the wetland (bottom) 37
Figure 11: Litchi Orchard Wetland..38
Figure 12: Litchi orchard wetland and road options (Source: Google Earth: Image taken on the 23/03/2012)..38
Figure 13: Sewerage works wetland and road..39

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1 INTRODUCTION

SiVEST SA (Pty) Ltd was appointed by **Tongaat Hulett Developments (PTY) Ltd** to undertake a wetland assessment for the proposed development on Tinley Manor South Road near Sheffield Manor situated within the KwaZulu-Natal Province. As the proposed development will be in and near to water resources, the need for a wetland assessment has been identified.

The purpose of this study is to assess the present ecological state (PES), functionality (in terms of ecosystem services provided by the wetlands), as well as the ecological importance and sensitivity provided by the wetlands on the study site. In addition, the potential impacts that are anticipated to arise as a result of the proposed development will be identified and assessed. Appropriate mitigation measures and recommendations have been provided.

1.1 Definition of Wetlands as Assessed in this Study

1.1.1 Wetlands

The lawfully accepted definition of a wetland in South Africa is that within the NWA. Accordingly, the NWA defines a wetland as, "*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*".

Moreover, wetlands are accepted as land on which the period of soil saturation is sufficient to allow for the development of hydric soils, which in normal circumstances would support hydrophytic vegetation (i.e. vegetation adapted to grow in saturated and anaerobic conditions).

Inland wetlands can be categorised into hydro-geomorphic units (HGM units). **SANBI (2009)** have described a number of different wetland hydro-geomorphic forms which include the following:

- *Channel (river, including the banks): an open conduit with clearly defined margins that (i) continuously or periodically contains flowing water, or (ii) forms a connecting link between two water bodies, where an in-stream wetland habitat occurs;*
- *Channelled valley-bottom wetland: a mostly flat valley-bottom wetland dissected by and typically elevated above a channel (see channel);*

- *Un-channelled valley-bottom wetland: a mostly flat valley-bottom wetland area without a major channel running through it, characterised by an absence of distinct channel banks and the prevalence of diffuse flows, even during and after high rainfall events;*
- *Floodplain wetland: the mostly flat or gently sloping wetland area adjacent to and formed by a Lowland or Upland Floodplain river, and subject to periodic inundation by overtopping of the channel bank;*
- *Depression: a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;*
- *Flat: a near-level wetland area (i.e. with little or no relief) with little or no gradient, situated on a plain or a bench in terms of landscape setting;*
- *Hillslope seep: a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope; and*
- *Valley head seep (or Hillslope Seep): a gently-sloping, typically concave wetland area located on a valley floor at the head of a drainage line.*

Any of the above mentioned wetland forms may occur within the study area. The types of wetlands identified by the study are addressed later in the report (**Section 5**).

1.2 Wetland Ecosystem Services and Characteristics

Wetlands are a very important component of the natural environment due to the high productivity of the systems as well as ecosystem goods and services that are provided. Wetlands are typically characterised by high levels of faunal biodiversity and are critical in sustaining human livelihoods through the provision of ecosystem services. Ecosystem Goods and Services (EG&S) refer to the benefits provided to people (society) by wetland ecosystems. These benefits may derive from outputs that can be consumed directly (referred to as ecosystem or ecological goods); indirect services/uses which arise from the functions or attributes occurring within the ecosystem; or possible future direct outputs or indirect uses **(Howe *et al.*, 1991)**. Wetland ecosystem services can include flood attenuation, sediment trapping, erosion control, nutrient cycling etc.

Wetlands are sensitive features of the natural environment. Degradation of wetlands and pollution thereof can result in a loss of biodiversity, as well as have an adverse impact on the human users whom depend on the resource (for ecosystem goods and services) to sustain their livelihoods. As such, wetlands are specifically protected under the NWA and generally under the NEMA as covered in the **Section 1.1** above.

Hydric soils, which are soils that are found within wetlands, are defined by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) as being, "soils that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part" (www.nrcs.usda.gov). These anaerobic conditions would typically support the growth of hydromorphic vegetation (vegetation adapted to grow in soils that are saturated and starved of oxygen) and are typified by the presence of redoximorphic features (**Section 3.2**). The presence of hydric (wetland) soils on the site of a proposed development is significant, as the alteration or destruction of these areas, or development within a certain radius of these areas would require authorisation in terms of the NWA and in terms of the Environmental Impact Assessment Regulations promulgated under the NEMA.

1.3 Assumptions and Limitations

This study has only focused on the functional, ecological importance and sensitivity, and ecosystem services assessment of wetlands. A wetland delineation study has previously been conducted (**SiVEST, 2013**) and does not fall within the scope of the assessment. Aquatic studies of fish, invertebrates, amphibians etc. have not been included in this report. Hydrological or groundwater studies have also not been included.

All shapefiles of the previous wetland assessment were provided. The classification exercise of the wetland HGM units was undertaken based on the wetland shapefiles that were provided.

As the study was limited to the study area (boundaries of the property), some wetlands may have extended further than the boundary of the study site where delineation did not take place, and therefore did not form part of the functional assessment.

An assessment of wetlands in the wider areas was not undertaken.

A thorough vegetation identification exercise was not undertaken. Recorded vegetation species was based on general observation during the field survey and can be found in **Appendix A**.

No alternatives were supplied for assessment. As such, no alternatives evaluation has been provided in this report.

2 TECHNICAL DETAILS OF THE PROJECT

As previously stated, **Tongaat Hulett Developments (PTY) Ltd** is proposing to develop Tinley Manor South Road property in the KwaZulu-Natal Province. The study site is approximately 550 ha in size and lies predominantly on the southern bank of the Umhlali River near the coastline, east of the N2 freeway. A small portion of the site lies to the north of the river and a second portion of the property straddles and lies to the west of the N2.

3 METHODOLOGICAL APPROACH

3.1 Present Ecological Status

In order to assess wetland health, it is essential to understand how the current hydrological, geomorphological and ecological functioning of the wetland deviates from the reference condition (i.e. how have the hydrological processes and components changed from natural reference condition). Understanding this deviation allows the present ecological status (PES) to be determined, which provides information on the integrity/health/state of a wetland.

WET-Health is a tool that is designed to provide a rapid assessment on the present ecological state of a wetland and examines the deviation from the natural reference condition by analysing the hydrological, geomorphological and vegetation components of a wetland in terms of the extent, intensity and magnitude of an impact (**Macfarlane *et al*., 2009**).

This was done by assigning a score on a scale of between 1 to 10 which is translated into one of six health classes ranging from A to F, with A representing completely unmodified (natural) and F representing modifications that have reached a critical level (**Macfarlane *et al*., 2009**). This is provided in **Table 1** below.

Table 1. Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands

Impact Category	Description	Impact Score Range	Present State Category
None	Unmodified, natural.	**0-0.9**	**A**
Small	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.	**1-1.9**	**B**
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	**2-3.9**	**C**
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	**4-5.9**	**D**
Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	**6-7.9**	**E**
Critical	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	**8-10**	**F**

Using a combination of threat and/or vulnerability, an assessment was also made for each component (hydrological, geomorphological and vegetation) on the likely Trajectory of Change

within the wetland (**Macfarlane *et al*., 2009**). The five categories of likely change are: large improvement, slight improvement, remains the same, slight decline and rapid decline (**Macfarlane *et al*., 2009**). Overall health of the wetland was then presented for each module by jointly representing the Present State and likely Trajectory of Change (**Macfarlane *et al*., 2009**).
For the purpose of this study, the WET-Health (**Macfarlane *et al*., 2009**) methodology (Level 2 assessment) was used to determine the PES for wetlands identified.

3.2 Wetland Ecosystem Services Assessment

Individual wetlands differ according to their hydro-geomorphic characteristics and the particular ecosystem services that they supply to society **(Kotze *et al*., 2009)**. The ecosystem services that were assessed through the WET-EcoServices **(Kotze *et al*., 2009)** methodology are listed in **Table 2** below.

The overall goal of the WET-EcoServices assessment was to assist decision makers, government officials, planners, consultant and educators in undertaking quick assessments of wetlands in order to reveal the ecosystem services that they supply **(Kotze *et al*., 2009)**. This ultimately provides an indication of the importance of the wetland unit. The WET-EcoServices applies only to palustrine (inland marsh-like) wetlands.

Table 2. Ecosystems services included in WET-EcoServices (Kotze *et al*. 2009).

<table>
<tr><td rowspan="15">Ecosystem services supplied by wetlands</td><td rowspan="9">Indirect benefits</td><td rowspan="8">Hydro-geochemical benefits</td><td colspan="2">Flood attenuation</td></tr>
<tr><td colspan="2">Stream flow regulation</td></tr>
<tr><td rowspan="5">Water quality enhancement benefits</td><td>Sediment trapping</td></tr>
<tr><td>Phosphate assimilation</td></tr>
<tr><td>Nitrate assimilation</td></tr>
<tr><td>Toxicant assimilation</td></tr>
<tr><td>Erosion control</td></tr>
<tr><td colspan="2">Carbon storage</td></tr>
<tr><td colspan="3">Biodiversity maintenance</td></tr>
<tr><td rowspan="6">Direct benefits</td><td colspan="3">Provision of water for human use</td></tr>
<tr><td colspan="3">Provision of harvestable resources[2]</td></tr>
<tr><td colspan="3">Provision of cultivated foods</td></tr>
<tr><td colspan="3">Cultural significance</td></tr>
<tr><td colspan="3">Tourism and recreation</td></tr>
<tr><td colspan="3">Education and research</td></tr>
</table>

Each hydro-geomorphic wetland unit that was delineated within the study area was assessed using the WET-EcoServices tool. Each hydro-geomorphic unit was labelled according to the hydro-geomorphic wetland unit it was classified as (for example, Channelled Valley Bottom Wetland). Where more than one of the same hydro-geomorphic wetland unit was identified along the proposed power line it was simply assigned a new number (for example, Channelled Valley Bottom Wetland_1). An output diagram indicating the ecosystem services offered was included.

3.3 Wetland Ecological Importance and Sensitivity

The ecological importance of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales (**DWAF, 1999**). The ecological sensitivity refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (**DWAF, 1999**). The ecological importance and sensitivity (EIS) was calculated according to the determinants listed in **Table 3** below and attributing a suitable[1] score to each determinant. Once calculated, the EIS category (EISC) was determined (**Table 4**). The category can range from A to D with A being Very High and D being Low/Marginal.

Table 3. Environmental Importance and Sensitivity biotic and habitat determinants

Determinant	Score	Confidence
Primary Determinants		
1. Rare & Endangered Species		
2. Populations of Unique Species		
3. Species/taxon Richness		
4. Diversity of Habitat Types or Features		
5. Migration route/breeding and feeding site for wetland species		
6. Sensitivity to Changes in the Natural Hydrological Regime		
7. Sensitivity to Water Quality Changes		
8. Flood Storage, Energy Dissipation & Particulate/Element Removal		
Modifying Determinants		
9. Protected Status		
10. Ecological Integrity		
TOTAL		
MEDIAN		
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE		

[1] Score guideline Very high = 4; High = 3, Moderate = 2; Marginal/Low = 1; None = 0
Confidence rating - Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1

Table 4. Environmental Importance and Sensitivity categories for biotic and habitat determinants

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level.	**>3 and <=4**	**A**
High Wetlands that are considered to be ecologically important and sensitive.	**>2 and <=3**	**B**
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale.	**>1 and <=2**	**C**
Low/marginal Wetlands that are not ecologically important and sensitive at any scale.	**>0 and <=1**	**D**

3.4 Impact Assessment Methodology

Current and potential impacts will be identified based on the proposed development and the potential impacts that may result for the construction, operation and decommissioning of the proposed development. The identified potential impacts will be evaluated using an impact rating method **(Appendix B)**. This is addressed in **Section 9**.

4 GENERAL STUDY AREA

As previously mentioned, the study area is approximately 550 ha in size and lies predominantly on the southern bank of the Umhlali River near the coastline, east of the N2 freeway. A small portion of the site lies to the north of the river and a second portion of the property straddles and lies to the west of the N2 (**Figure 1**).

The study area falls within the Mkomazi Primary catchment. More specifically, the study area is situated in quaternary catchment U30E. The study area is characterised by a series of undulating ridges and steep valleys. Drainage from the site is towards the Umhlali River.

Two broad geologies dominate the site. The western portion of the property is underlain by shale and this has led to the development of generally narrow, steeply incised drainage features across this portion. The eastern portion of the site by contrast is characterised by deep sands and the valleys tend to be broader and shallower.

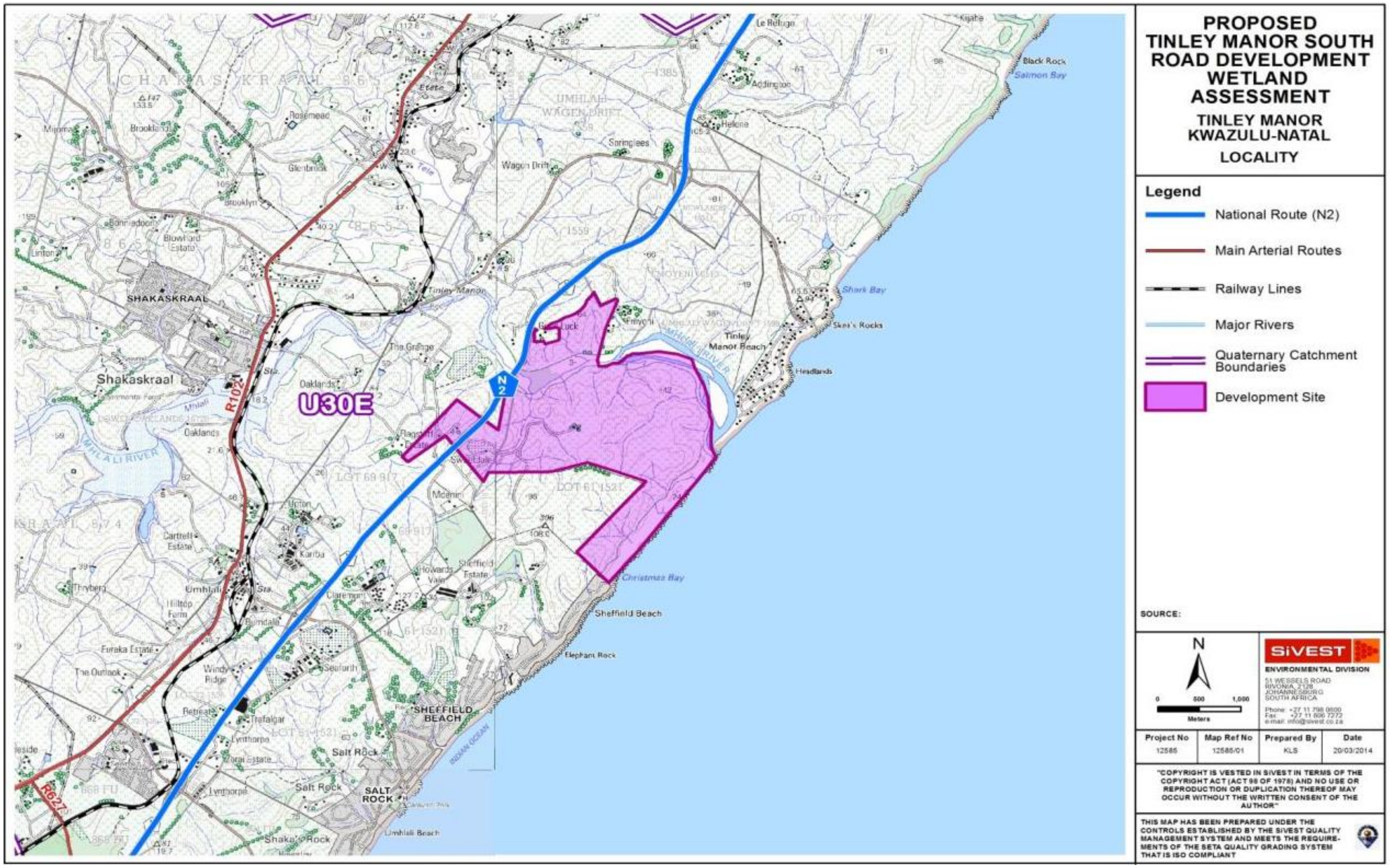

Figure 1. Regional locality map of the study area

The secondary dunes on site are very high and slope steeply down towards the coast. Seepage from the base of these features has formed a band of wetlands between the dunes and the sea.

The portion of the property to the north of the river also lies on shale derived soils, whilst the small fragment west of the N2 consists of both shale and sand derived elements.

The Umhlali River Floodplain dominates much of the river frontage of the site and the meandering stream has over time created a series of channels and islands across the broad flat floodplain. This portion of the site is characterised by unconsolidated sediments deposited during flood events.

The majority of the site has a long history of sugar production with much of the property planted to sugar cane. Valleys have been drained to increase arable land availability.

Indigenous vegetation on the site is limited to the riparian fringes, drains and channels through wetlands and portions of the coastal strip. Alien vegetation is limited to woodlots, cane loading zones and isolated infestations centred on disturbances across the site.

Delineation of the wetlands across the site identified four broad wetland geomorphological classes into which the various watercourses could be grouped. These included systems on shale derived soils, sand derived soils, seepage systems on the fore dunes and a floodplain element.

Current and historic land uses have left these systems moderately to highly disturbed and for the most part the functionality of these systems has been greatly reduced as a result of the systems being drained and significant modifications to the catchments.

5 FINDINGS OF ASSESSMENT

5.1 Wetland HGM Classification

The following wetland hydrogeomorphic units were identified in the study area (**Figure 2** to **Figure 4**):

- Six channelled valley bottom wetlands;
- Seven unchannelled valley bottom wetlands;
- Fifteen hillslope seep wetlands; and
- One Floodplain wetland.

A wetland catchment and area analysis was undertaken to delineate each wetlands catchment area as well as to determine the extent of the wetlands. The results are shown in

Table 5 below.

Figure 2. Wetland map (north)

Figure 3. Wetland map (south)

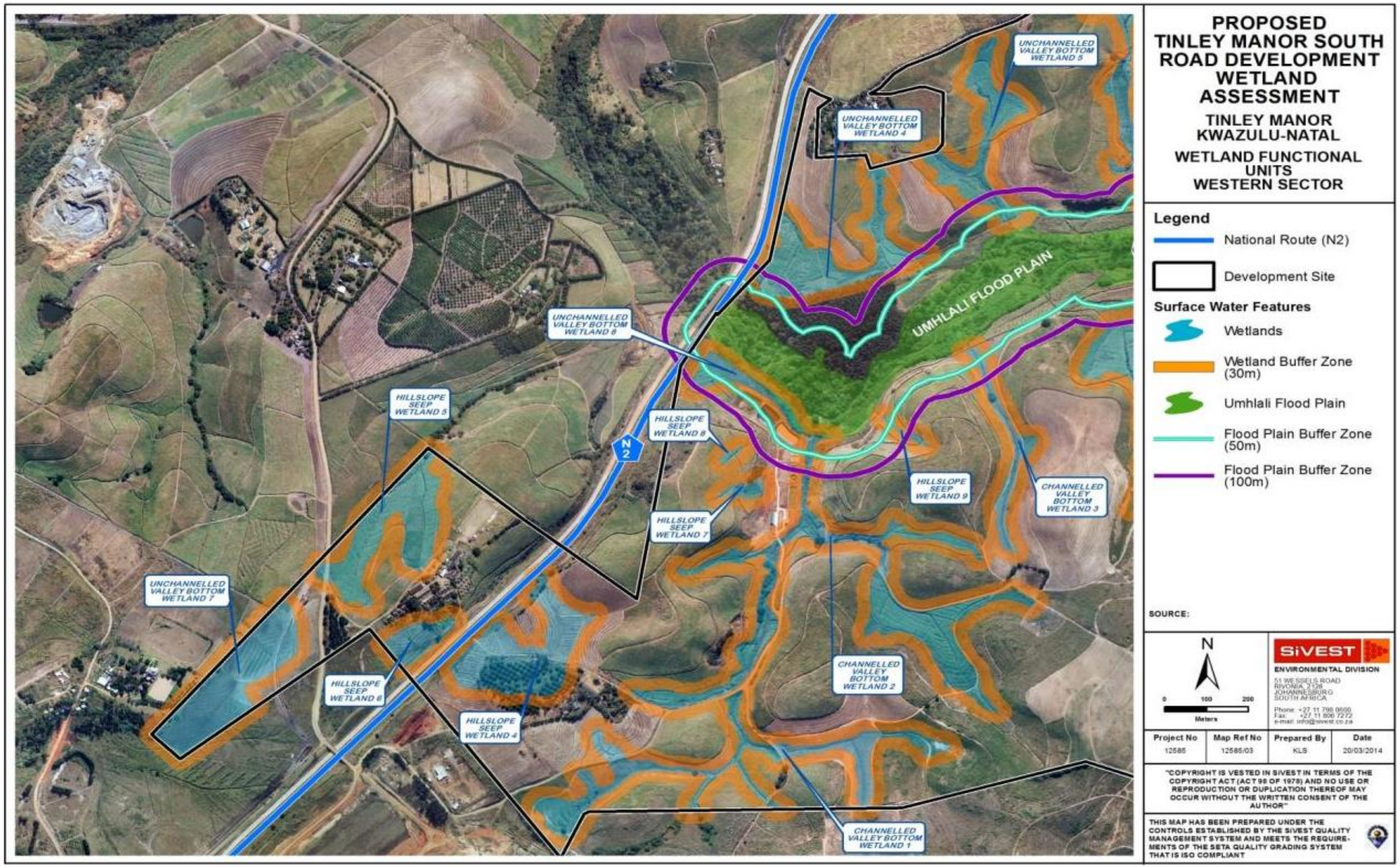

Figure 4. Wetland map (west)

Table 5. Wetland Areas and Wetland Catchment Areas

Name	Wetland Area (ha)	Wetland Catchment Area (ha)
Channelled Valley Bottom Wetland 1	5.15	117.45
Channelled Valley Bottom Wetland 2	8.42	177.54
Channelled Valley Bottom Wetland 3	1.32	24.40
Channelled Valley Bottom Wetland 4	2.39	22.11
Channelled Valley Bottom Wetland 5	5.06	28.86
Channelled Valley Bottom Wetland 6	9.40	85.73
Hillslope Seep Wetland 1	1.62	4.84
Hillslope Seep Wetland 2	2.85	25.50
Hillslope Seep Wetland 3	1.19	7.01
Hillslope Seep Wetland 4	4.83	23.94
Hillslope Seep Wetland 5	4.47	13.91
Hillslope Seep Wetland 6	1.14	10.67
Hillslope Seep Wetland 7	0.34	3.43
Hillslope Seep Wetland 8	0.11	1.60
Hillslope Seep Wetland 9	0.13	2.90
Hillslope Seep Wetland 10	0.83	3.59
Hillslope Seep Wetland 11	2.13	15.66
Hillslope Seep Wetland 12*	0.22	-
Hillslope Seep Wetland 13	4.59	13.64
Hillslope Seep Wetland 14	0.59	8.09
Hillslope Seep Wetland 15	0.53	4.28
Unchannelled Valley Bottom Wetland 1	0.46	5.88
Unchannelled Valley Bottom Wetland 2	6.33	81.85

Unchannelled Valley Bottom Wetland 4	4.07	52.87
Unchannelled Valley Bottom Wetland 5	3.13	16.36
Unchannelled Valley Bottom Wetland 6	1.72	21.16
Unchannelled Valley Bottom Wetland 7	5.12	11.55
Unchannelled Valley Bottom Wetland 8	1.17	99.16
Umhlali Floodplain Wetland	93.260	24 914.22

*Note – Wetland Catchment Area could not be calculated due to limited wetland extent and the level of contour detail available (5m) limitations.

The channelled valley bottom wetlands ranged in size from 1.32 hectares to 9.40 hectares. Wetland catchment size for the channelled valley bottom wetlands varied greatly from a minimum of 22.11 hectares to a maximum of 177.54 hectares. The unchannelled valley bottom wetlands were more limited in extent ranging from a minimum of 0.46 hectares to 6.33 hectares. Wetland catchment size were similarly limited in extent and ranged from 5.88 hectares to 99.16 hectares. The hillslope seep wetlands were very limited in extent by comparison to the other two wetland types with the smallest hillslope seep wetland measuring 0.11 hectares whilst the biggest hillslope seep wetland measured 4.83 hectares. Corresponding wetland catchment areas were equally limited by comparison to the other wetland types ranging from a minimum of 1.60 hectares to a maximum of 25.50 hectares. The floodplain wetland however is relatively extensive by comparison to the other wetland types measuring 93.26 hectares in extent. The wetland catchment is therefore likewise quite large by comparison encompassing an area of approximately 1112.00 hectares.

Overall, it can be stated that the wetlands falling within the study area are generally not extensive systems with the exception of the Umhlali floodplain wetland. Most are quite small (<10 hectares) in size, and have localised and limited catchment areas that are contained within the study area. The topography is a strong factor dictating the wetland type and characteristics in the study area. Relatively steep hills and sandy/loamy substrate provide a suitable template for the development of seasonal hillslope seep wetlands on the mid slopes. This wetland type was also the most commonly occurring wetland. Drainage into the valley bottom areas gives rise to the occurrence of the channelled and unchannelled valley bottom wetlands. The valley bottom wetlands are generally narrow and constrained by hilly topography. The wetlands are seasonal to permanently inundated. The Umhlali River is the primary water input to the Umhlali floodplain wetland. Progressive development of the floodplain wetland as a result of yearly inland flows and flood events has resulted in scouring out a wide valley bottom area susceptible to the deposition of sediments in the valley bottom. The substrate of the floodplain wetland contained mainly unconsolidated sandy sediments along with fine grained clay particles giving rise to permanent, seasonal and temporarily inundated areas.

5.2 Present Ecological Status

5.2.1 Channelled Valley Bottom Wetlands

The present ecological status for the channelled valley bottom wetlands are shown in **Table 6** below. The general present ecological state of the channelled valley bottom wetlands was found to be largely (Category D) to greatly modified (Category E). Despite differences in the sizes of the wetlands, many of the same impacts were found to affect all of the wetlands with varying degrees of severity. Factors that were found be impacting on the present ecological status are elaborated on below.

Table 6. Channelled Valley Bottom (CVB) Wetlands PES

Wetland Name	Hydrology		Geomorphology		Vegetation		Overall Health Score for entire Wetland	
	Impact Score	Category	Impact Score	Category	Impact Score	Category	Impact Score	Category
CVB_1	6.5	E	0.9	A	10	F	5.80	D (Largely modified)
CVB_2	6.5	E	1.6	B	10	F	6.03	E (Greatly modified)
CVB_3	5	D	1.1	B	10	F	5.37	D (Largely modified)
CVB_4	8.5	F	0.9	A	10	F	6.47	E (Greatly modified)
CVB_5	8.5	F	0.9	A	10	F	6.47	E (Greatly modified)
CVB_6	6.5	E	0.4	A	10	F	5.63	E (Greatly modified)

5.2.1.1 *Hydrological Factors affecting PES*

The majority of the channelled valley-bottom wetlands in the catchment have been almost completely transformed by sugar cane cultivation which is the predominant land use for the greater area. Access routes by means of farm dirt roads are pervasive and were also found to be a significant factor affecting the wetlands. Additionally, artificial drainage channels have been excavated within the wetlands for drainage purposes, creating the channel structure within the wetlands. Vegetation was found to have established within some of the artificial channels. However, in other cases, channels were found to be free draining with no vegetation cover. As a result, the hydrology of the wetlands is severely impacted.

At a general level, altered hydrology in terms of a reduction in water inputs resulting from efficient drainage systems as well as altered flood peaks were found to impact negatively on the present ecological condition. Altered flood peaks can vary from increased flood peaks following rain events when crops have been harvested and the ground is left exposed. Conversely, reduced flood peaks can occur when crops are growing and there is increased surface roughness. As previously mentioned, roads (farm/dirt roads) are also present throughout the study area which contribute to altered hydrological impacts by means of increased run-off which has an effect on flood peaks. This impact however was a relatively minor factor by comparison to the other earlier stated impacts affecting the wetlands.

The present ecological status for the hydrological component ranged from Category D (Largely modified) to Category F (Critically modified).

5.2.1.2 *Geomorphological Factors affecting PES*

The hydrological impacts were found to have minimal effects on the geomorphology component. The geomorphological component of the wetlands generally scored well and the wetlands were found to be intact. However, as previously stated road infrastructure is present, although any associated impacts (such as erosion/deposition features) were not very evident. However, increased run-off is likely to contain additional sediment and pollution (especially during seeding times when the ground is left exposed) thereby impacting on the geomorphology of the wetland. This was assessed to be a relatively minor impact factor.

The geomorphological present ecological status ranged from Category A (Unmodified/natural) to Category B (Largely natural).

5.2.1.3 *Vegetation Factors affecting PES*

The greatest impact on the wetlands was the transformation from natural vegetation to sugar cane. Patches of natural vegetation was present for some wetlands. The presence and colonisation of the area by a few alien vegetation species was evident in most instances including the following *Chromolaena odorata*, *Ipomoea purpurea*, *Lantana camara*, *Melia azedarach, Solanum lycopersicon* and *Sorghum halepense* being present. The hydrological and geomorphological impacts in turn were anticipated to influence vegetation composition. Altered throughputs and flood peaks as well as sediment and water quality impacts are likely to have contributed to alien plant invasion in-stream and on the banks of the wetlands.

The vegetation present ecological state for all the channelled valley bottom wetlands was attributed to a Category F (Critically modified).

5.2.2 Unchannelled Valley Bottom Wetlands

The present ecological status for the unchannelled valley bottom wetlands are shown in **Table 7** below. The general present ecological state of the unchannelled valley bottom wetlands was found to be moderately (Category C) to greatly modified (Category E). Again, many of the same impacts were found to affect all of the wetlands with varying degrees of severity impacting on the overall present ecological status. Factors that were found be impacting on the present ecological status are elaborated on below.

5.2.2.1 Hydrological Factors affecting PES

From a hydrological perspective, the same impacts as highlighted in the hydrological component for the channelled valley bottom wetlands in the previous section (**Section 5.2.1.1**) apply. These include:

- Altered water supply and throughputs;
- Altered flood peaks; and
- Increased run-off from hardened surfaces (farm/dirt roads).

Most unchannelled valley bottom wetlands were not affected by drainage channels with the exception of unchannelled valley bottom wetlands 2, 3 and 4.

The hydrological present ecological state ranged from Category A (Unmodified/natural) to Category E (Greatly modified).

Table 7. Unchannelled Valley Bottom Wetlands (UCVB) PES

Wetland Name	Hydrology		Geomorphology		Vegetation		Overall Health Score for entire Wetland	
	Impact Score	Category	Impact Score	Category	Impact Score	Category	Impact Score	Category
UCVB_1	5	D	0.7	A	9.8	F	5.17	D (Largely modified)
UCVB_2	3	C	1	A	4.8	D	2.93	C (Moderately modified)
UCVB_3	6.5	E	3.1	C	9.8	F	6.47	E (Greatly modified)
UCVB_4	5	D	1.5	B	10	F	5.50	D (Largely modified)
UCVB_5	3	C	0.4	A	5.6	D	3.00	C (Moderately modified)
UCVB_6	6.5	E	0.3	A	10	F	5.60	D (Largely modified)
UCVB_7	1	A	0	A	10	F	3.67	C (Moderately modified)

5.2.2.2 *Geomorphological Factors affecting PES*

Again the hydrological impacts were found to have minimal effects on the geomorphology component. Despite road infrastructure being present in the wetlands, potential associated impacts (such as erosion/deposition features) were not very noticeable. Increased run-off containing additional sediment and pollution during seeding times when the ground of the wetland surface is left exposed is expected to have a relatively minimal impact. The geomorphological state of the wetland was relatively intact aside from the artificial drainage channels in uncahnnelled valley bottom wetlands 2, 3 and 4.

The geomorphological present ecological state ranged from Category A (Unmodified/natural) to Category C (Moderately modified).

5.2.2.3 *Vegetation Factors affecting PES*

Complete transformation of the cover within the wetland from natural vegetation to sugar cane again was considered to be the most significant impact affecting the state of the wetlands. However, unchannelled valley bottom wetland 7 was not to be affected crop cultivation at present and showed signs of recovery. The hydrological and geomorphological impacts again have bearing on the vegetation state of the wetlands contributing to alien plant invasion in the wetlands.

The vegetation present ecological state for all channelled valley bottom wetlands attributed with either a Category D (Moderately modified) or a Category F (Critically modified).

5.2.3 Hillslope Seep Wetlands

The present ecological status for the hillslope seep wetlands are shown in **Table 8** below. The general present ecological state of the hillslope seep wetlands was found to range between a Category A (Unmodified/natural) to a Category E (Greatly modified). Many of the same impacts (sugar cane cultivation/transformation, roads and drainage channels) were found to affect all of the wetlands with varying degrees of severity impacting on the overall present ecological status. Factors that were found be impacting on the present ecological status are elaborated on below.

5.2.3.1 *Hydrological Factors affecting PES*

The hillslope seep wetlands were found to be impacted by the same factors as the channelled and unchannelled valley bottom wetlands given that the entire study area is affected by the same current land use. However, the wetlands located behind the coastal frontal dune were found to be in a somewhat better state (hillslope seep wetlands 14 and 15) where natural vegetation prevailed and cultivation impacts were not evident. Several impacts as identified above are therefore applicable from a hydrological perspective. These include:

Table 8. Hillslope Seep (HS) Wetlands PES

Wetland Name	Hydrology		Geomorphology		Vegetation		Overall Health Score for entire Wetland	
	Impact Score	Category	Impact Score	Category	Impact Score	Category	Overall Impact Score	Overall Impact Category
HS_1	0.00	A	0.30	A	4.90	D	1.73	B (Largely natural)
HS_2	1.00	A	1.30	B	5.60	D	2.63	C (Moderately modified)
HS_3	6.50	E	0.70	A	10.00	F	5.73	D (Largely modified)
HS_4	5.00	D	0.30	A	10.00	F	5.10	D (Largely modified)
HS_5	8.50	F	0.40	A	10.00	F	6.30	E (Greatly modified)
HS_6	8.50	F	0.50	A	10.00	F	6.33	E (Greatly modified)
HS_7	5.00	D	0.20	A	10.00	F	5.07	D (Largely modified)
HS_8	6.50	E	0.50	A	10.00	F	5.67	D (Largely modified)
HS_9	5.00	D	0.10	A	10.00	F	5.03	D (Largely modified)
HS_10	6.00	D	1.10	B	8.30	F	5.13	D (Largely modified)
HS_11	6.00	D	0.90	A	9.80	F	5.57	D (Largely modified)
HS_12	6.50	E	0.20	A	8.90	F	5.20	D (Largely modified)
HS_13	6.50	E	1.80	B	7.80	E	5.37	D (Largely modified)
HS_14	0.00	A	0.10	A	0.20	A	0.10	A (Unmodified)
HS_15	0.00	A	0.00	A	0.20	A	0.07	A (Unmodified)

- Altered water supply and throughputs;
- Altered flood peaks; and
- Increased run-off from hardened surfaces (farm/dirt roads).

The hydrological present ecological status for the wetlands ranged from Category A (Unmodified/natural) to Category E (Greatly modified).

5.2.3.2 *Geomorphological Factors affecting PES*

The geomorphological state of the hillslope seep wetlands were all relatively intact as no artificial drainage channels were found inside the wetlands. As a result, geomorphological impacts were mainly related to road infrastructure through the hillslope seep wetlands.

The geomorphological present ecological state for the hillslope seep wetlands was either a Category A (Unmodified/natural) or Category B (Largely modified).

5.2.3.3 *Vegetation Factors affecting PES*

Transformation of wetland vegetation to sugar cane was the primary impact affecting most of the hillslope seep wetlands whilst some alien encroachment was also evident affecting the present ecological status. Some of the main alien vegetation species identified in the hillslope seep wetlands consisted of *Ambrosia artemisiifolia*, *Asystasia gangetica*, *Canna indica*, *Chromolaena odorata*, *Cyperus rotundus*, *Lantana camara, Paspalum scrobiculatum*, *Psidium guajava*, *Richardia brasiliensis*, *Schinus terebinthifolius* and *Solanum mauritianum*. However, two wetlands in particular were found to be in an unmodified/natural state including hillslope seep wetlands 14 and 15.

The vegetation present ecological state ranged from Category A (Unmodified/natural) to Category F (Critically modified).

5.2.4 Floodplain Wetland

The present ecological status for the single floodplain wetland is shown in **Table 9** below. The general present ecological state of the wetland is a Category C (Moderately modified). Factors that were found be impacting on the present ecological status are elaborated on below.

Table 9. Umhlali Floodplain Wetland PES

Module	Impact Score	Category
Hydrology	6.5	E
Geomorphology	1.2	B
Vegetation	2.4	C
Overall Health Score for entire Wetland	3.37	C (Moderately modified)

5.2.4.1 *Hydrological Factors affecting PES*

The floodplain wetland was found to be mainly impacted on by a reduction in water supply input as a result of alien vegetation and crop cultivation in the floodplain areas. Extent of areas of bare soil on the other hand was found to have an influence on the level of floodpeak increase. A road coursing through the wetland additionally affected the hydrology of the system and the natural flows through the wetland. A reduction in surface roughness also had an influence in affecting the present ecological state of the floodplain wetland.

The hydrological present ecological state for the wetland is a Category E (Greatly modified).

5.2.4.2 *Geomorphological Factors affecting PES*

The geomorphological state of the floodplain wetland was relatively intact. However, the main factor affecting the present ecological state was due to the impact of artificial infilling as a result of the road bisecting the wetland.

The geomorphological present ecological state for the floodplain wetland was attributed to a Category B (Largely modified).

5.2.4.3 *Vegetation Factors affecting PES*

On the flood benches of the wetland, patches of sugar cane cultivation transformed previously natural vegetation. Additionally, alien vegetation encroachment presumably due to altered hydrological impacts as well as human disturbance affected the present ecological condition of the wetland. Some of the main alien vegetation species identified in the floodplain wetland consisted of *Ageratum conyzoides*, *Asystasia gangetica*, *Arundo donax*, Bambusoideae, *Cyperus rotundus*, *Ipomoea cairica*, *Indigofera suffruticosa*, *Melia azedarach*, *Shinus terebinthifolius* and *Stenotaphrum secundatum*.

The vegetation present ecological state of the floodplain wetland was attributed to a Category C (Moderately modified).

5.3 WET-Ecoservices Assessment

Due to the high number of wetlands and the similar characteristics shared between the wetland HGM types, the ecosystem services assessment has been grouped per HGM unit type.

5.3.1 Channelled Valley Bottom Wetlands

According to the results of the assessment (**Figure 5**), the ecosystem service offered by the channelled valley bottom wetlands which scored the highest (**moderately high**) was the sediment trapping ability of the wetlands. Other ecosystem services which scored at an **intermediate level** include erosion control, toxicant removal, nitrate removal, phosphate trapping, flood attenuation and water supply for human use. The ecosystem services which scored **below intermediate** levels include streamflow regulation, maintenance of biodiversity, carbon storage, tourism and recreation, education and research, cultural significance, cultivated foods and natural resources. The current transformed state of the wetlands has bearing on the degree of ecosystem services offered by the wetland. As a result of the level of transformation, the ecosystem services are limited to intermediate to low scores.

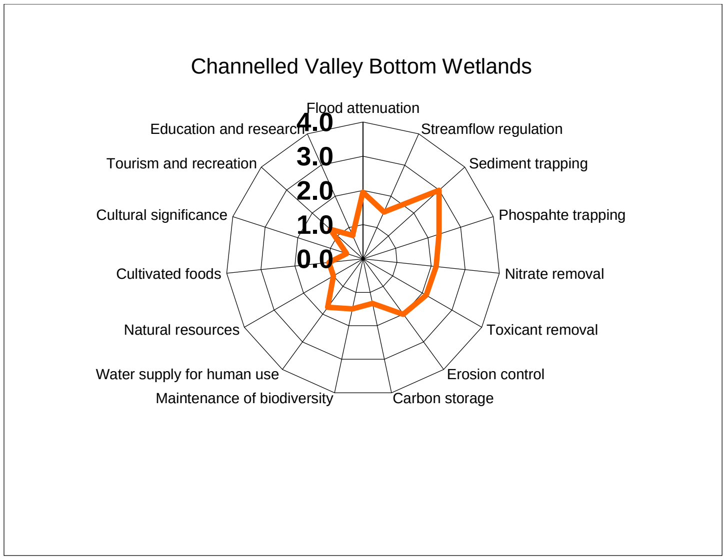

Figure 5. WET-Ecoservices results for Channelled Valley Bottom Wetlands

5.3.2 Unchannelled Valley Bottom Wetlands

The ecosystem services (**Figure 6**) provided by the channelled valley bottom wetlands were very similar to the channelled valley bottom wetlands given similar impacts and a similar ecological state. However, the unchannelled valley bottom wetlands were found to provide a higher level of ecosystem services for a greater range functions. Accordingly, the wetlands were assessed as providing a **moderately high** level of ecosystems services in terms of sediment trapping ability, phosphate trapping, nitrate removal, toxicant removal and erosion control. The only ecosystem service with an **intermediate** score was flood attenuation ability. The remaining ecosystem services that scored **below intermediate** included carbon storage, maintenance of biodiversity, water supply for human use, natural resources, cultivated foods, cultural significance, tourism and recreation, education and research as well as streamflow regulation. Transformation of the wetland for agricultural purposes and the resultant effect on alteration of flow can once more be considered to be a significant factor affecting the ability of the wetland to contribute to a higher degree of ecosystem services provided.

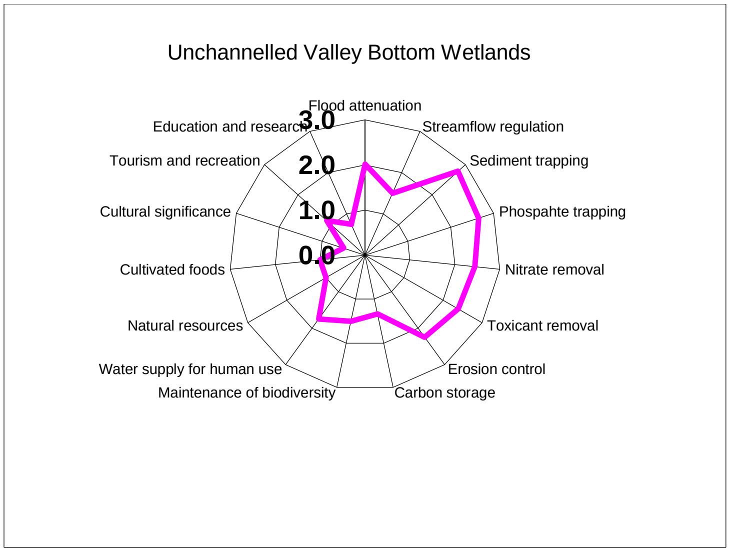

Figure 6. WET-Ecoservices results for Unchannelled Valley Bottom Wetlands

5.3.3 Hillslope Seep Wetlands

The ecosystem services identified that can be provided by the hillslope seep wetlands (**Figure 7**) were found to be diverse but very limited. The highest scoring ecosystem services, which were assessed at a **moderately high** level, include phosphate trapping, nitrate removal and toxicant removal abilities. At an **intermediate level**, the ecosystems services provided include sediment trapping, flood attenuation and erosion control. Most scores however were below **intermediate** to **low**. These include streamflow regulation, carbon storage, maintenance of biodiversity, water supply for human use, natural resources, cultivated foods, tourism and recreation, education and research. Complete transformation of the vegetation component of the wetland and associated impacts to the present ecological condition are the main contributing factors affecting the ability of the wetland to contribute to a greater degree of ecosystem services.

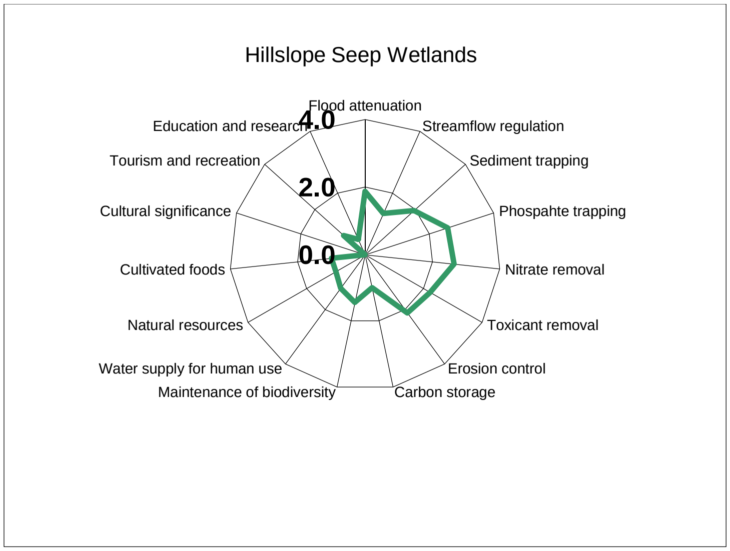

Figure 7. WET-Ecoservices results for Hillslope Seep Wetlands

5.3.4 Floodplain Wetland

According to the results of the ecosystem services assessment for the floodplain wetland (**Figure 8**), the highest scoring ecosystem services which were assessed at a **moderately high** level included maintenance of biodiversity, sediment trapping, phosphate trapping, nitrate removal, toxicant removal, erosion control and as well as tourism and recreation. At an **intermediate** level, ecosystems services included carbon storage and flood attenuation. **Below intermediate** level of ecosystems services provided include streamflow regulation, water supply for human use, natural resources, cultivated foods and, education and research. The **lowest** scoring ecosystem services provided by the floodplain wetland is cultural significance. Land use impacts associated with the wetland catchment for the purposes of agriculture can be considered to be a factor affecting the ability of the wetland to provide a higher degree of wetland ecosystem services.

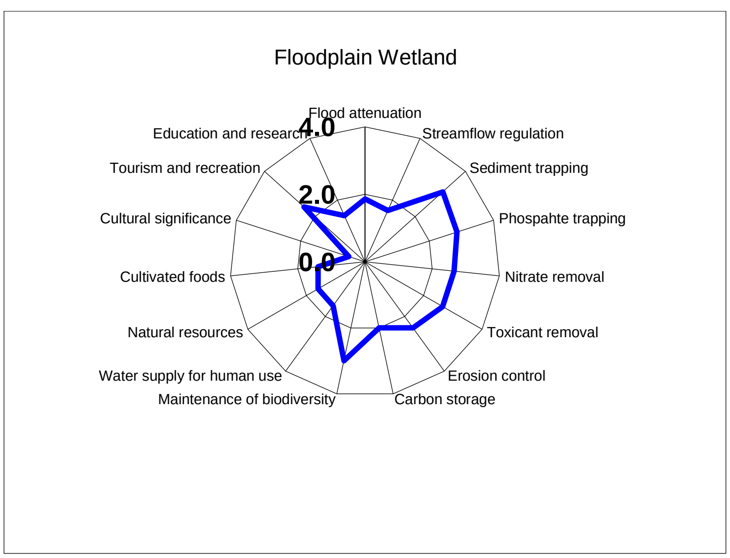

Figure 8. WET-Ecoservices results for the Flooplain Wetland

5.4 Wetland Ecological Importance and Sensitivity

The ecological importance and sensitivity was assessed for each wetland HGM unit. The scores are given below.

5.4.1 Channelled Valley Bottom Wetlands

The wetland ecological importance and sensitivity of each of the wetland HGM units is provided in **Table 10** below. The channelled valley bottom wetlands almost all scored a **Class C (Moderate)** level of ecological importance and sensitivity, with the exception of channelled valley bottom wetland 2. Contributing factors for a moderate level of ecological importance and sensitivity for most of the wetlands include transformation and channelization impacts, which have a bearing on habitat quality and the potential occurrence of wetland fauna. Channelled valley bottom wetland 2 however was found to be associated with a riparian habitat which contained protected plant and tree species. These include *Cryptocarya latifolia*, *Dracaena aletriformis* and *Drimiopsis maculate*. Channelled valley bottom wetland 2 scored a **Class B (High)** level of ecological importance and sensitivity as a result.

5.4.2 Unchannelled Valley Bottom Wetlands

The wetland ecological importance and sensitivity of each of the unchannelled valley bottom wetlands is provided in **Table 11** below. Due to the similar ecological state for many of the wetlands (unchannelled valley bottom wetlands 2 and 4-7) were scored to have a **Class C (Moderate)** level of ecological importance and sensitivity. Transformation and channelization impacts again had a major influence decreasing the sensitivity of the wetlands. Unchannelled valley bottom wetlands 1 and 3 were more impacted by artificial drainage ditches which further degraded the ecological condition and therefore sensitivity of the wetlands. These two wetlands were assigned a **Class D (Low)** ecological importance and sensitivity.

Table 10. Ecological Importance and Sensitivity Category for Channelled Valley Bottom Wetlands

	Channelled Valley Bottom Wetland 1		Channelled Valley Bottom Wetland 2		Channelled Valley Bottom Wetland 3		Channelled Valley Bottom Wetland 4		Channelled Valley Bottom Wetland 5		Channelled Valley Bottom Wetland 6	
Determinants	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**
1. Rare & Endangered Species	0	0	2	3	0	0	0	0	0	0	0	0
2. Populations of Unique Species	1	3	1	3	1	3	1	3	1	3	1	3
3. Species/taxon Richness	2	2	2	2	2	2	2	2	2	2	2	2
4. Diversity of Habitat Types or Features	1	3	3	3	1	3	1	3	1	3	1	3
5. Migration route/breeding and feeding site for wetland species	2	3	3	3	2	3	2	3	2	3	2	3
6. Sensitivity to Changes in the Natural Hydrological Regime	2	2	2	2	2	2	2	2	2	2	2	2
7. Sensitivity to Water Quality Changes	1	3	2	3	1	3	1	3	1	3	1	3
8. Flood Storage, Energy Dissipation & Particulate / Element Removal	2	2	2	2	2	2	2	2	2	2	2	2
9. Protected Status	0	3	0	3	0	3	0	3	0	3	0	3
10. Ecological Integrity	2	2	2.5	2	2	2	2	2	2	2	2	2
Score	**13**	**23**	**19.5**	**26**	**13**	**23**	**13**	**23**	**13**	**23**	**13**	**23**
Median	**1.5**	**2.5**	**2**	**3**	**1.5**	**2.5**	**1.5**	**2.5**	**1.5**	**2.5**	**1.5**	**2.5**
Overall Ecological Importance and Sensitivity	**C**	**Moderate**	**B**	**High**	**C**	**Moderate**	**C**	**Moderate**	**C**	**Moderate**	**C**	**Moderate**

Table 11. Ecological Importance and Sensitivity Category for Unchannelled Valley Bottom Wetlands

	Unchannelled Valley Bottom Wetland 1		Unchannelled Valley Bottom Wetland 2		Unchannelled Valley Bottom Wetland 3		Unchannelled Valley Bottom Wetland 4		Unchannelled Valley Bottom Wetland 5		Unchannelled Valley Bottom Wetland 6		Unchannelled Valley Bottom Wetland 7	
Determinants	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**
1. Rare & Endangered Species	0	0	0	0	0	0	0	0	0	0	0	0	1	3
2. Populations of Unique Species	1	3	1	3	1	3	1	3	1	3	1	3	3	3
3. Species/taxon Richness	1	3	2	2	1	3	2	2	2	2	2	2	2	2
4. Diversity of Habitat Types or Features	1	3	2	2	1	3	2	2	2	2	2	2	3	3
5. Migration route/breeding and feeding site for wetland species	1	3	2	2	1	3	2	2	2	2	2	2	3	3
6. Sensitivity to Changes in the Natural Hydrological Regime	2	2	2	2	2	2	2	2	2	2	2	2	2	2
7. Sensitivity to Water Quality Changes	1	3	1	3	1	3	1	3	1	3	1	3	2	2
8. Flood Storage, Energy Dissipation & Particulate / Element Removal	2	2	2	2	2	2	2	2	2	2	2	2	2	2
9. Protected Status	0	3	3	2	0	3	0	3	0	3	3	2	0	3
10. Ecological Integrity	2	2	2	2	2	2	2	2	2	2	2	2	3	3
Score	**11**	**24**	**17**	**20**	**11**	**24**	**14**	**21**	**14**	**21**	**17**	**20**	**21**	**26**
Median	**1**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**3**
Overall Ecological Importance and	**D**	**Low**	**C**	**Moderate**	**D**	**Low**	**C**	**Moderate**	**C**	**Moderate**	**C**	**Moderate**	**C**	**Moderate**

5.4.3 Hillslope Seep Wetlands

The wetland ecological importance and sensitivity of each of the wetland HGM units is provided in **Table 12** to **Table 14** below. Due to the similar ecological state for many of the hillslope seep wetlands, hillslope seep wetlands 3-13 were scored to have a **Class D (Low)** level of ecological importance and sensitivity.

Hillslope seep wetlands 1, 2, 14 and 15 however scored much higher due to the decreased level of transformation of the wetlands and their location on the secondary dune just off the coastline. These wetlands were scored as having a **Class B (High)** ecological importance and sensitivity.

5.4.4 Floodplain Wetland

The wetland ecological importance and sensitivity for the floodplain wetland (**Table 15**) was categorised as a **Class B (High)**. The floodplain has been impacted on by three main factors including cultivation on the banks of the Umhlali River, roads through the wetland and a degree of alien vegetation species encroachment. Nonetheless, functionality of the wetland and habitat quality is still good with a riparian habitat associated with the wetland. Assemblages of protected tree species were observed including *Barringtonia racemosa* and *Sclerocarya birrea*. Fish, amphibian and avifaunal occurrence and activity were also observed although the species could not be identified.

Table 12. Ecological Importance and Sensitivity Category for Hillslope Seep Wetlands 1-5

	Hillslope Seep Wetland 1		Hillslope Seep Wetland 2		Hillslope Seep Wetland 3		Hillslope Seep Wetland 4		Hillslope Seep Wetland 5	
Determinants	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**
1. Rare & Endangered Species	0	0	0	0	0	2	0	2	0	2
2. Populations of Unique Species	3	2	2	2	0	2	0	2	0	2
3. Species/taxon Richness	3	2	2	2	1	3	1	3	1	3
4. Diversity of Habitat Types or Features	3	2	2	2	1	3	1	3	1	3
5. Migration route/breeding and feeding site for wetland species	2	2	2	2	1	3	1	3	1	3
6. Sensitivity to Changes in the Natural Hydrological Regime	3	2	3	2	3	3	2	2	2	2
7. Sensitivity to Water Quality Changes	2	2	2	2	2	2	1	3	1	3
8. Flood Storage, Energy Dissipation & Particulate / Element Removal	2	2	2	2	2	2	2	2	2	2
9. Protected Status	3	2	3	2	0	3	0	3	0	3
10. Ecological Integrity	3	3	2	2	2	2	1	3	1	3
Score	**24**	**19**	**20**	**18**	**12**	**25**	**9**	**26**	**9**	**26**
Median	**3**	**2**	**2**	**2**	**1**	**2.5**	**1**	**3**	**1**	**3**
Overall Ecological Importance and Sensitivity	**B**	**High**	**B**	**High**	**D**	**Low**	**D**	**Low**	**D**	**Low**

Table 13. Ecological Importance and Sensitivity Category for Hillslope Seep Wetlands 6-10

Determinants	Hillslope Seep Wetland 6		Hillslope Seep Wetland 7		Hillslope Seep Wetland 8		Hillslope Seep Wetland 9		Hillslope Seep Wetland 10	
	Score	Confidence Level	Score	Confidence Level	Score	Confidence Level	Score	Confidence Level	Score	Confidence Level
1. Rare & Endangered Species	0	2	0	2	0	2	0	2	0	2
2. Populations of Unique Species	0	2	0	2	0	2	0	2	0	2
3. Species/taxon Richness	1	3	1	3	1	3	1	3	1	3
4. Diversity of Habitat Types or Features	1	3	1	3	1	3	1	3	1	3
5. Migration route/breeding and feeding site for wetland species	1	3	1	3	1	3	1	3	1	3
6. Sensitivity to Changes in the Natural Hydrological Regime	2	2	2	2	2	2	2	2	2	2
7. Sensitivity to Water Quality Changes	1	3	1	3	1	3	1	3	1	3
8. Flood Storage, Energy Dissipation & Particulate / Element Removal	2	2	2	2	2	2	2	2	2	2
9. Protected Status	0	3	0	3	0	3	0	3	0	3
10. Ecological Integrity	1	3	1	3	1	3	1	3	1	3
Score	**9**	**26**	**9**	**26**	**9**	**26**	**9**	**26**	**9**	**26**
Median	**1**	**3**	**1**	**3**	**1**	**3**	**1**	**3**	**1**	**3**
Overall Ecological Importance and Sensitivity	**D**	**Low**	**D**	**Low**	**D**	**Low**	**D**	**Low**	**D**	**Low**

Table 14. Ecological Importance and Sensitivity Category for Hillslope Seep Wetlands 11-15

	Hillslope Seep Wetland 11		Hillslope Seep Wetland 12		Hillslope Seep Wetland 13		Hillslope Seep Wetland 14		Hillslope Seep Wetland 15	
Determinants	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**	**Score**	**Confidence Level**
1. Rare & Endangered Species	0	2	0	2	0	2	0	0	0	0
2. Populations of Unique Species	0	2	0	2	0	2	3	2	3	2
3. Species/taxon Richness	1	3	1	3	1	3	3	2	3	2
4. Diversity of Habitat Types or Features	1	3	1	3	1	3	3	2	3	2
5. Migration route/breeding and feeding site for wetland species	1	3	1	3	1	3	2	2	2	2
6. Sensitivity to Changes in the Natural Hydrological Regime	2	2	2	2	2	2	3	2	3	2
7. Sensitivity to Water Quality Changes	1	3	1	3	1	3	2	2	2	2
8. Flood Storage, Energy Dissipation & Particulate / Element Removal	2	2	2	2	2	2	2	2	2	2
9. Protected Status	0	3	0	3	0	3	3	2	3	2
10. Ecological Integrity	1	3	1	3	1	3	3	3	3	3
Score	**9**	**26**	**9**	**26**	**9**	**26**	**24**	**19**	**24**	**19**
Median	**1**	**3**	**1**	**3**	**1**	**3**	**3**	**2**	**3**	**2**
Overall Ecological Importance and Sensitivity	**D**	**Low**	**D**	**Low**	**D**	**Low**	**B**	**High**	**B**	**High**

Table 15. Ecological Importance and Sensitivity Category for the Umhlali Floodplain Wetland

Determinants	Umhlali Floodplain Wetland	
	Score	**Confidence Level**
1. Rare & Endangered Species	0	0
2. Populations of Unique Species	3	2
3. Species/taxon Richness	3	2
4. Diversity of Habitat Types or Features	3	2
5. Migration route/breeding and feeding site for wetland species	2	2
6. Sensitivity to Changes in the Natural Hydrological Regime	3	2
7. Sensitivity to Water Quality Changes	2	2
8. Flood Storage, Energy Dissipation & Particulate / Element Removal	2	2
9. Protected Status	3	2
10. Ecological Integrity	3	3
Score	**24**	**19**
Median	**3**	**2**
Overall Ecological Importance and Sensitivity	**B**	**High**

6 PROPOSED INFRASTRUCTURE

A development plan has been provided to us by Tongaat Hulett Developments care of SMEC, and includes the layout of proposed internal roads within the development, as well as proposed water and sewerage routing, and the proposed storm water attenuation ponds. In addition, it must be noted that the constraints of the site have been taken into account, and the development footprint has therefore been reduced to exclude areas on the North side of the Umhlali River. The proposed infrastructure layout is included in **Figure 9** below. Please note potential impacts and appropriate mitigation measures are contained in **Section 7** below.

6.1 Road Infrastructure

A preliminary road layout has been compiled. Ideally this proposed layout should minimise the impacts on the on-site wetlands and riparian areas. This can be achieved by:

- Avoiding / circumventing wetlands and sensitive environmental areas;
- Upgrading existing farm roads, rather than constructing new roads; and
- Where wetland areas need to be crossed, a single crossing, perpendicular to the flow and shortest crossing distance should be implemented;

The Tinley Manor South Site has significant access constraints and thus finding a zero or low impact access point is difficult. In all likelihood on-site wetland areas will be affected or even lost due to necessary road construction to open up the development opportunities contained on the site. Associated impacts can be mitigated by careful planning and resource loss will need to be offset by wetland rehabilitation on the remainder of the site.

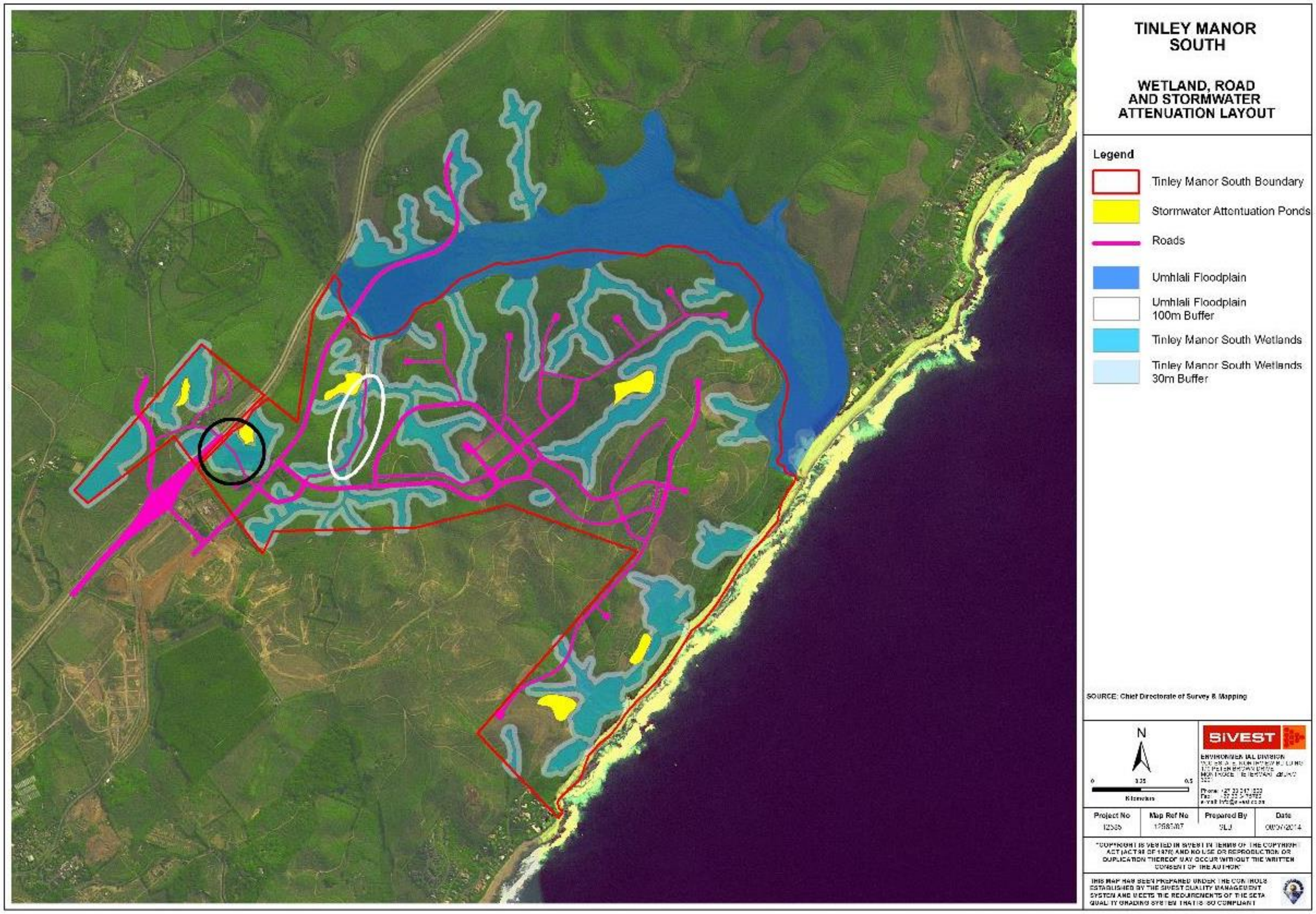

Figure 9. Tinley Manor South – Wetland, Road and Stormwater Layout.

Even though the proposed road layout does take cognisance of the delineated wetland areas for the most part (**Figure 9**), there are still some areas which are cause for concern

6.1.1 Litchi Orchard Wetland

The *Litchi Orchid wetland* (black circle in **Figure 9** above) is located near the south western corner of the site. This wetland can best be described as a hillslope seep which drains towards the adjacent N2 highway. This wetland used to form part of a larger system but has since been divided by the construction of the N2 highway (**Figure 11**).

Historically, much of this wetland unit was developed as part of a litchi orchid, which has subsequently been replaced by sugar cane. A number of tree stumps still remain as a last vestige of its former use. A small functional wetland core remains intact (**Figure 10, top left** and **Figure 12**). This wetland unit has been subjected to a number of anthropogenic impacts including agricultural development, alien infestation, artificial drainage (**Figure 10, top right**) and road creation (**Figure 10, bottom**). These impacts have resulted in a shrinkage of the effective wetland area as well as a decrease in wetland function, typically associated with hillslope seeps *inter alia;* water quality enhancement and erosion control. This wetland ultimately drains into the N2 storm water management system, an anthropogenic system which is not in need of direct environmental protection.

The current road layout plans to cross this system in order to gain access to the eastern portion of the site. Currently the road alignment bisects the hill side slope (**Figure 11**) and if this alignment is developed the wetland will effectively be destroyed. Although this wetland has been significantly modified it still can be rehabilitated to provide valuable wetland functions in the future.

Two access options have been identified:

1. Option 1 entails upgrade the existing road that bisects the hill side seep. If road widening is required it should take place into the sugar cane (downstream) rather than into the functioning wetland core (located along the southern boundary of the road).

2. Option 2 entails constructing a new road whose routing goes above the existing wetland (**Figure 12**). The proposed road routing will need to cross relatively steep slopes and thus erosion control measures will need to be implemented to ensure the downslope wetland core is not negatively influenced.

Option 2 is recommended with the following conditions:

- Comment from a road engineer is sourced to determine if the proposed routing is viable;
- The road routing does not infringe on the upper boundary of the delineated wetland;
- Erosion control and storm water management mitigatory measures are implemented; and
- The litchi orchard wetland is rehabilitated which may include removing / modifying the existing road.

Figure 10: Photos of the *Litchi Orchard Wetland*: Core wetland area (top left); drainage ditch (top right); and the existing road crossing the wetland (bottom)

Figure 11: Litchi Orchard Wetland

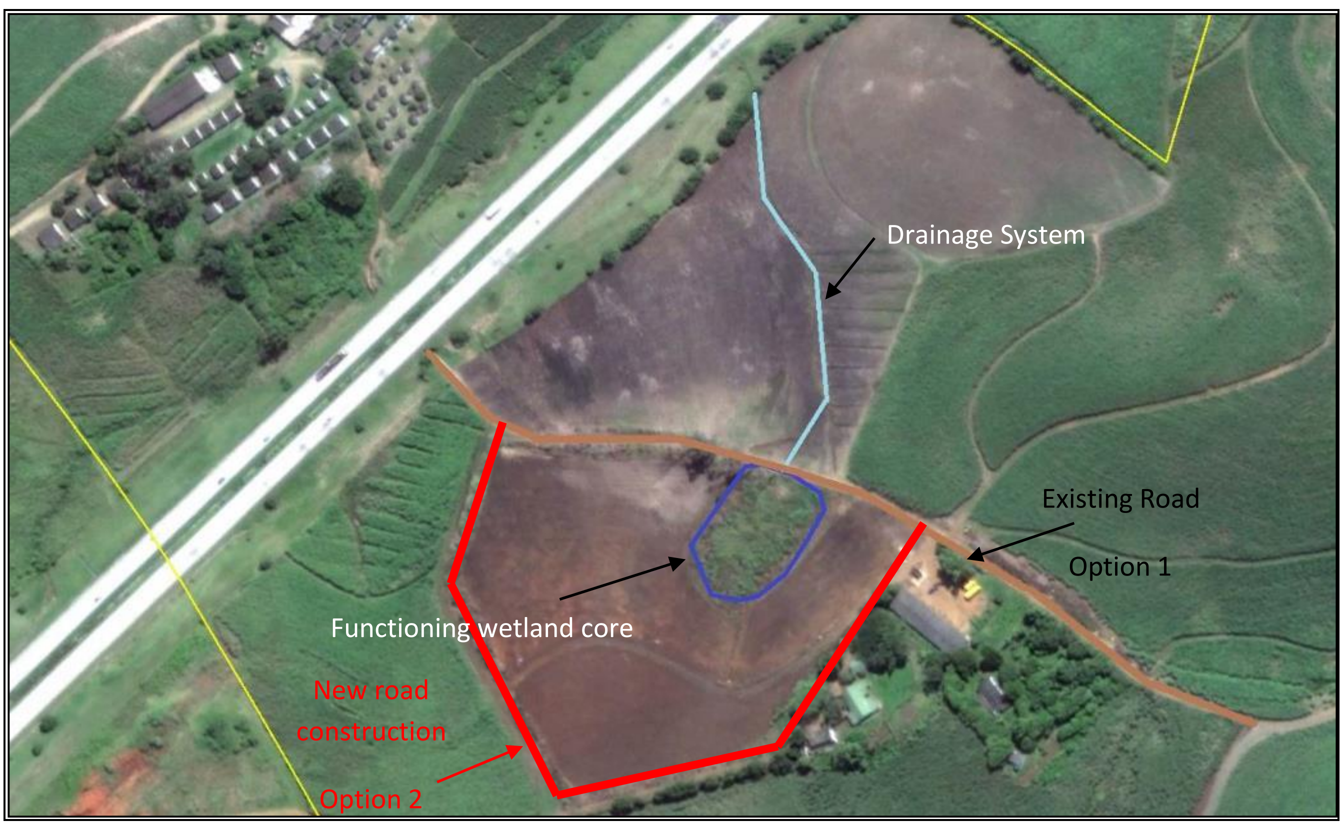

Figure 12: Litchi orchard wetland and road options (Source: Google Earth: Image taken on the 23/03/2012)

6.1.2 Wastewater Treatment Facility Wetland

The *wastewater treatment facility wetland* (white circle in **Figure 9** above) is located near the south western portion of the Umhlali floodplain on site. This wetland can best be described as a channelled valley Bottom wetland which drains towards the Umhlali floodplain. This wetland used to form part of a larger system but has since been altered by the construction of a wastewater treatment facility (**Figure 13**).

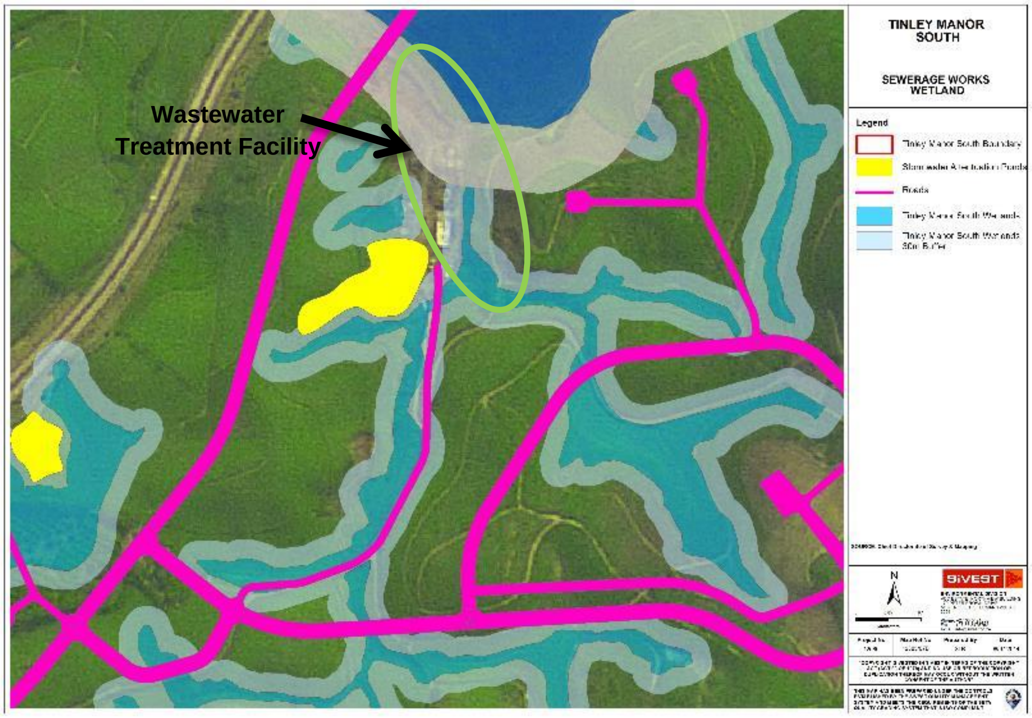

Figure 13: Sewerage works wetland and road.

Although this road is within the buffer of the wetland unit found along the valley bottom, the alignment makes use of the existing road routing to the sewerage treatment works, and attempts to remove the existing road from the wetland wherever possible.

6.2 *Storm water Attenuation Infrastructure*

A number of storm water attenuation ponds have been designed across the site (see **Figure 9** above), and these have been placed so as to be outside of the wetlands that are present on site, while making use of the wetland buffers to ameliorate the potential impacts that water released from these structures could have. The storm water attenuation ponds should therefore have minimal impact on the wetlands across the site.

6.3 *Water and Sewerage Infrastructure*

With a development of this nature, it is a requirement that appropriate services are supplied to the development, and therefore water and sewerage infrastructure has been designed across the site (see **Figure 14** below). The water supply for the site will be sourced from existing Umgeni Water pipe lines within the general area, and will then be able to be gravity fed from the high southern portion of the site to the lower lying areas. The sewer system will obviously collect at the lower reaches of the site, and will be fed into the existing wastewater treatment facility that is on site. There will however be a requirement to build a pump station and sewer rising main from the beach front portions of the site to ensure that the waste water can then be fed into the existing wastewater treatment facility.

Figure 14: Sewerage and water infrastructure routing and wetlands.

Both the water and wastewater systems include a number of wetland crossings, and where possible the systems have been placed outside of the wetlands and their associated buffers. However, the wastewater system especially, will need to be placed within the Umhlali floodplain buffer for large portions of the site, as a gravity feed is required, and the floodplain buffer is the lowest lying area outside of the floodplain wetland itself. The placement of infrastructure within the buffer will reduce the impact significantly. Further the buffer will require some form of rehabilitation as it is currently utilised for sugar cane production. Therefore when these areas are transformed away from agriculture, it will provide the perfect opportunity to place the infrastructure into the soils and then rehabilitate the land thereafter.

7 NATURE OF THE POTENTIAL IMPACTS ASSOCIATED WITH THE PROPOSED DEVELOPMENT

Several impacts will potentially take place as a result of the proposed development. This section will identify and contextualise each of the potential impacts within the context of the proposed development and the identified and delineated wetlands. The identified impacts will be rated according to an impact rating system (**Appendix B**). Once this has been undertaken the effect of the environmental impact will be determined and recommendations will be provided towards mitigating the potential impact. The identification and rating of impacts will be undertaken for the pre-construction phase, construction phase, operational phase and decommissioning phase of the proposed development.

7.1 Pre-construction Phase Potential Impacts

7.1.1 Impacts associated with the Construction Lay-down Area

A construction lay-down area is likely to be required for development. The location of the construction lay-down area will be important as placing this area in the wetlands are likely to result in direct negative physical impacts. Direct negative impacts can include vegetation clearing and degradation, topsoil removal and compaction impacts due to temporary structures and vehicle movement.

Impacts related to worker ingress and the degradation of the wetlands may similarly result. Potential contamination and pollution impacts from stored oils, fuels, and other hazardous substances or materials are also a possibility. Finally, where site clearing may be required in the wetland in order for the lay-down area to be established, this will result in the clearance/removal of vegetation at the surface leaving the wetlands vulnerable to erosion and sedimentation impacts.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 16** below.

Table 16. Impact rating for pre-construction impacts related to the construction lay-down area in the wetlands

IMPACT TABLE	
Environmental Parameter	**Wetlands and the associated buffer zones**
Issue/Impact/Environmental Effect/Nature	Impacts associated with the construction lay-down area directly in wetlands
Extent	*Site*
Probability	*Possible*
Reversibility	*Partly reversible*
Irreplaceable loss of resources	*Marginal loss of resources*
Duration	*Medium term*
Cumulative effect	*Medium cumulative Impact*

Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced greatly and the degree impact minimised to low.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	- 36 (medium negative)	- 15 (low negative)
Mitigation measures	**Seasonal Scheduling of the Construction process** –Construction must be scheduled to take place during winter when flows are lowest (preferably May and August). **Location of the Lay-down Area** –Lay-down areas must not be situated in any wetlands or associated buffer zones. All wetlands must be clearly demarcated for the duration of the pre-construction and construction phases. Utilization of Bonnox fencing or wooden stakes at sufficient height that is visible from a distance must be used. Storage of materials, liquids or solid / hazardous and non-hazardous are not to be located in any of the wetlands or the associated buffer zones. Vehicles must be kept at least 100 m from any of the wetlands. **Preventing Fire Risks to Wetlands and People** - Operational fire extinguishers are to be available in the case of a fire emergency. It is recommended that a fire management and emergency plan be compiled by a suitably qualified health and safety officer and implemented for the development.	

7.2 Construction Phase Potential Impacts

7.2.1 Road Impacts

Roads will be required to be established during the construction phase. The roads may potentially traverse the identified wetlands. Should this take place, road establishment may have negative physical impacts on the wetlands. Roads may be in the form of dirt roads or tarred roads for main access areas that will be consolidated for the purposes of the proposed development. In both instances, loss of wetland vegetation and habitat will take place. Additionally, in order to avoid permanently wet areas, culverts under the roads may be required to avoid standing or flowing water. The establishment of the culvert bridges will result in direct degradation of the wetland as well as loss of wetland soils and vegetation.

Indirect impacts that may also be anticipated include increased run-off entering wetlands. Following rainfall events, increased and accelerated run-off can be generated. Exposed bare and compacted surfaces contribute to increased surface run-off and preclude water infiltration. Increased run-off can affect the current hydrological regime of the wetland altering its state even further. Additional secondary impacts as a result of increased run-off include erosion of the banks and bed of the wetlands due to increased base flow. Sediment accumulated by surface run-off can also be picked up and transported into the wetland systems, resulting in sediment plumes which are commonly associated with the establishment of alien vegetation within wetlands.

Construction vehicles (heavy and light) are likely to require access to areas where the proposed development is to take place. Potential negative impacts can include vibration (disturbance), compaction and degradation impacts to the wetlands and the associated buffer zone soils and flora. Moreover, leaks or spills of oils, fluids or fuels from vehicles and machinery in general or during re-fuelling or servicing in the wetlands and the associated buffer zones are a possibility. Should any leakage or spillage occur in a wetland, watercourse and/or the associated buffer zone, potential soil contamination can result and further degrading the state of the wetlands. Fuels and oils also pose a fire risk not only to the wetlands but also neighbouring areas and nearby farming settlement areas. Therefore, adequate measures must be in place to prevent potential harm or loss of life.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 17** below.

Table 17. Impact rating for road impacts

IMPACT TABLE		
Environmental Parameter	**Wetlands and the associated buffer zones**	
Issue/Impact/Environmental Effect/Nature	Road establishment and vehicle/machinery degradation to the wetlands and the associated buffer zones	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Barely reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Low cumulative Impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reduced to a low impact.*	
	Pre-mitigation impact rating	Post mitigation impact rating

Extent	1	1
Probability	3	2
Reversibility	3	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	1	1
Intensity/magnitude	3	2
Significance rating	- 39 (medium negative)	- 22 (low negative)
Mitigation measures	**Permission and Approval to construct in Wetlands (if required)** -No vehicles are allowed in the demarcated wetlands areas unless authorisation from the Department of Water Affairs and the relevant environmental authorities has been applied for and granted. A water use licenses will therefore be required where it is necessary to cross the wetlands and will be needed prior to construction commencing (Section 21 (c) and (i) of the National Water Act). **Preventing Physical Degradation of Wetlands** - Existing roads are to be used where possible. New roads must be planned to avoid all wetlands. Additionally, road designs must integrate adequate measures to prevent the generation of increased run-off for temporary access areas (dirt roads) as well as roads that will be developed for the operational phase of the proposed development. A construction and operational storm water management plan must therefore be compiled and adhered to. The operational storm water management plan must take into account water outlet structures that incorporate energy dissipation designs. Where possible "soft" structures are to be implemented into the designs (such as grass blocks etc.).	
Mitigation measures	No culvert bridges are to be established. However, only where this is completely unavoidable and authorisation has been granted from the relevant environmental and water authorities, any bridges that will be constructed must be designed so as to limit the disruption, constriction or canalisation of flow under them. Where possible, existing crossing points should be upgraded rather than new crossings created and redundant crossings rehabilitated. The road crossings must also be routed so that the wetland is crossed at right angles to the direction of flow. Box culverts should be used to divert flow through the wetland and stream crossings and the box culverts must be established across the entire stream channel or seasonal wetland zone. If existing crossings are utilised, pipe culverts must be replaced with an adequate number of box culverts. With regards to wetland crossings only, the road fill foundation and base should be permeable to water	

	flow to ensure low flow seepage is maintained and that water does not dam up behind the road during heavy rainfall. Erosion protection measures (e.g. Reno-mattresses) must be established below the box culverts. The final design for each wetland crossing must be approved by the wetland specialist prior to construction commencing. Disturbance to the wetland soils along the road crossing footprint should be restricted to an established construction right-of-way (ROW) corridor. The ROW corridor within the wetland should be as narrow as practically possible and should be demarcated and fenced off during the site setup phase to the satisfaction of the ECO. The construction ROW should comprise the road and embankment footprint only. All wetland areas outside of the demarcated ROW must be considered no-go areas. **Preventing Soil and Wetland Contamination** -All vehicles and machinery are to be checked for oil, fuel or any other fluid leaks before entering the construction areas. All vehicles and machinery must be regularly serviced and maintained No fuelling, re-fuelling, vehicle and machinery servicing or maintenance is to take place within 100 m of any of the wetlands. The construction site is to contain sufficient safety measures throughout the construction process to deal with accidental spills. These include, but are not limited to, oil spill kits, fire extinguishers, fuel, oil or hazardous substances storage areas must be bunded to 110% volume to prevent oil or fuel contamination of the ground and/or nearby surface water resource or associated buffer zone. No hazardous materials are to be stored or brought within 100 m of any of the wetlands. Should a designated storage area be required, the storage area must be placed at the furthest location from the sensitive areas. Appropriate safety measures as stipulated above must be implemented.

7.2.2 Establishment of Housing Units Impacts

A layout of the proposed development has not been provided. However, it is possible that the housing units may enter into the identified wetland areas and the associated buffer zones. Potential impacts that may result include the clearing of wetland vegetation and soils for foundation establishment. As a result, the established footprint of the housing units in a wetland will result in wetland loss of habitat.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 18** below.

Table 18. Impact rating for construction phase establishment of housing units in wetlands and the associated buffer zones

IMPACT TABLE		
Environmental Parameter	**Wetlands and the associated buffer zones**	
Issue/Impact/Environmental Effect/Nature	Physical removal and destruction of wetland soils and vegetation resulting in wetland habitat loss	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Barely reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Low cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be minimised.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	3	1
Irreplaceable loss	2	1
Duration	3	1
Cumulative effect	1	1
Intensity/magnitude	3	1
Significance rating	- 39 (medium negative)	- 7 (low negative)
Mitigation measures	**Preventing Impacts to Wetlands and the Associated Buffer Zones** –The final layout plan for the proposed development must take into consideration the wetland and associated buffer zones and where possible avoid these highly sensitive areas. Additionally, it is recommended that the wetlands and the associated buffer zones be designated as conservation of open space areas and managed as such. In doing so, impacts to the wetlands can be avoided in this instance.	

7.2.3 Service Installation Impacts

The installation of water, sewer and telephone lines may have a negative impact on the identified wetlands and the associated buffer zones. In order for the installation of these services to be undertaken, excavation is generally required. Should planned service networks enter into wetland areas, excavation and consequent removal of overlying vegetation can result. Additionally, in order for excavation to take place, often heavy vehicles can be used which can inflict added compaction and physical impacts. Ultimately, wetland degradation is therefore a likely possibility.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 19** below.

Table 19. Impact rating for construction phase service installation impacts

IMPACT TABLE		
Environmental Parameter	Wetlands and the associated buffer zones	
Issue/Impact/Environmental Effect/Nature	Degradation and removal of wetland and watercourse soils and vegetation	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Medium term*	
Cumulative effect	*Low cumulative Impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With mitigation measures, the impact can be reduced somewhat to a low negative impact.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	1	1
Intensity/magnitude	3	1
Significance rating	- 33 (medium negative)	- 6 (low negative)
Mitigation measures	**Avoiding Impacts to Wetlands and the Associated Buffer Zones** – The service plan layout must take into consideration the identified wetlands and buffer zones. All wetland and associated buffer zone areas are to be regarded as no-go areas. No services are to be routed through or into the wetlands and the associated buffer zone areas, with services crossing being contained to road ways and existing corridors of disturbance.	

	Sewer manholes must not be located within the wetland and its associated buffer, i.e. the horizontal and vertical alignments of the pipes must remain constant when passing through these sensitive areas.

7.2.4 Increased Run-off, Erosion and Sedimentation Impacts

Extensive vegetation clearing will need to take place for the proposed development. Excessive or complete vegetation clearance in the surrounding areas is likely to result in exposing the soil surface, leaving the ground susceptible to wind erosion and storm water run-off impacts after rainfall events. A further impact as a result of erosion and storm water run-off impacts is increased sedimentation to wetlands. Increased sediments deposited from eroded areas into the wetland areas tend to destabilise the natural hydrological dynamics and the associated ecological processes often leading to negative impacts. Deposited sediments can smother vegetation and change wetland flow paths and dynamics, making affected areas susceptible to alien plant invasion leading to negative impacts.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 20** below.

Table 20. Impact rating for construction phase increased storm water run-off, erosion and increased sedimentation impacts

IMPACT TABLE		
Environmental Parameter	**Wetlands and the associated buffer zone**	
Issue/Impact/Environmental Effect/Nature	Erosion, increased storm water run-off and increased sedimentation impacting on the wetland and watercourse	
Extent	*Site*	
Probability	*Definite*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Significant loss of resources*	
Duration	*Medium term*	
Cumulative effect	*High cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be minimized to low.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	2
Reversibility	2	2
Irreplaceable loss	3	2
Duration	2	2
Cumulative effect	3	2

Intensity/magnitude	3	2
Significance rating	- 45 (medium negative)	- 22 (low negative)
Mitigation measures	**Preventing Increased Run-off and Sedimentation Impacts** –Vegetation clearing is to take place in a phased manner, only clearing areas that will be constructed on immediately. Vegetation must not be completely removed outside of the construction footprint areas. Adequate structures must be adopted, including temporary or permanent (only in extreme cases where necessary) to address run-off and sediment volumes generated by construction activities. The use of silt fencing, sandbags or hessian "sausage" nets to prevent sediment being released from construction areas. These "soft" temporary structures can also prevent erosion in susceptible construction areas. All impacted areas are to be adequately sloped after construction to prevent the onset of erosion. To prevent increased run-off, the use of grass blocks and swales to locally reduce accelerated storm water run-off can be used. Should run-off need to be reticulated to attenuation features, these should be located outside of the wetland. All storm water discharge points must also be located outside of the wetlands. The storm water discharge points must be armoured against erosion with vegetated Reno mattresses.	
Mitigation measures	Erosion and nick points within the wetlands should be rehabilitated to prevent further degradation of the systems. Smaller points can be rehabilitated with slope modification and the correct re-vegetation. Larger erosion points may require the keying in of gabion structures and Reno mattresses to prevent further soil loss. The above measures should be addressed with the assistance of the Environmental Control Officer (ECO). Other similarly suitable measures stipulated by the ECO can be adopted where appropriate. **Protection of Stockpiled Soils** –Stockpiled soils will need to be protected from wind and water erosion. Stockpiled soils are not to exceed a 2 m height and are to be bunded by suitable materials.	

7.3 Operation Phase Potential Impacts

7.3.1 Increased Run-off, Erosion and Sedimentation Impacts

The proposed development will include housing units as well as extensive areas of paving and / or tarred roads. As a result, impermeable surfaces will contribute to the generation of increased surface run-off. Increased run-off is also likely to generate accelerated run-off as flows accumulate and carry momentum as it flows down slope. Increased accelerated run-off can create a more powerful erosive force as flows progress into the lower lying areas and wetlands. Additionally, sediment can easily be transported with increased run-off into the lower lying valley bottom areas and wetlands. Sedimentation in wetlands is considered pollution and affecting the natural sediment regime of the wetland and the natural flow paths and dynamics.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 21** below.

Table 21. Impact rating for construction phase increased storm water run-off, erosion and increased sedimentation impacts

IMPACT TABLE		
Environmental Parameter	**Wetlands and the associated buffer zones**	
Issue/Impact/Environmental Effect/Nature	Increased and accelerated storm water run-off, erosion and increased sedimentation impacting on the wetlands and the associated buffer zones.	
Extent	*Site*	
Probability	*Probable*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*High cumulative impact*	
Intensity/magnitude	*High*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be minimized to low.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	3	2
Intensity/magnitude	3	2
Significance rating	- 42 (medium negative)	- 24 (low negative)
	Preventing Increased Run-off, Erosion and Sedimentation Impacts –An operational storm water management plan must be designed. This plan must consider the use of energy dissipation	

Mitigation measures **Mitigation measures**	structures in the overall design. Importantly, all discharge points must make use of energy dissipation structures. It may be required that an attenuation pond is necessary to assist with storm water management. It is likely that the position of the attenuation pond will need to be situated in a low lying valley bottom area. However, the position of the attenuation pond must not be located in a wetland area but rather outside of it. Additionally, every effort must be made so that run-off levels are adequately calculated so as not to completely obstruct flows to wetlands that rely on water inputs. Natural run-off levels will therefore need to be calculated and taken into consideration when designing attenuation structures.

7.3.2 Post-construction Wetland Rehabilitation Impacts

At the time that the wetland assessment was undertaken, all wetlands had been impacted on to a greater or lesser degree by the transformation of wetland areas to sugar cane fields. An opportunity therefore exists for the rehabilitation of the affected wetland areas to restore a more natural state. Positive impacts that can be expected as a result include restoration of wetland habitat for wetland specific species, restoration of wetland hydrological and geomorphological functionality and restoration of wetland vegetation. This can be achieved by implementing prudent wetland rehabilitation and management strategies.

Assessment of the above potential negative impacts and mitigation measures thereto are provided in **Table 22** below.

Table 22. Impact rating for operational phase wetland rehabilitation impacts

IMPACT TABLE		
Environmental Parameter	**Wetlands and the associated buffer zones**	
Issue/Impact/Environmental Effect/Nature	Restore wetland sugar cane transformation impacts	
Extent	*Site*	
Probability	*Possible*	
Reversibility	*Completely reversible*	
Irreplaceable loss of resources	*Marginal loss of resources*	
Duration	*Long term*	
Cumulative effect	*Medium cumulative impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the impact can be reverse to a medium positive impact.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	2	2
Reversibility	4	4
Irreplaceable loss	2	1

Duration	3	3
Cumulative effect	2	3
Intensity/magnitude	3	3
Significance rating	- 42 (medium negative)	+ 42 (medium positive)
Mitigation measures	**Restoration of Wetlands** –To restore the wetland functional components, the sugar cane crops will need to be removed and the drains within them will require deactivation Plugging of the drainage ditches by means of vegetation plugs will improve surface roughness and the attenuation ability of the wetland. Additional positive impacts associated with this measure will be an increase in wetland perimeter of the degraded wetlands. All alien vegetation within the drains will also need removal. Once this has been undertaken, initial re-vegetation should focus on restoring a protective ground cover once the sugar cane has been removed to prevent erosion. Indigenous turf grasses such as *Stenotaphrum secundatum* and *Cynodon dactylon* should be used for the re-vegetation exercise to establish an initial level of cover. Natural successional processes should drive the shift in vegetation composition from hygrophilous turf grasses to true hydrophilic species once the flooding regime is restored. Indigenous riparian tree species such as *Ficus* sp., *Rauvolfia caffra*, *Voacanga thouarsii* and *Syzygium cordatum* should be planted within all the drainage lines to further stabilise the water courses.	
Mitigation measures	To assist in the restoration of Hillslope Seep Wetland 1, it is recommended that current dirt road that fragments to systems is diverted around to the southern boundary outside of the associated buffer zone. The affected wetland area will then need to be ripped, scarified and re-vegetated as stipulated above. The removal and ongoing control of alien invasive plants is essential across the site. The removal of the sugar cane in wetlands specifically will create an ideal habitat for many alien plants. Therefore, control of these species should be ongoing during both the construction phase as well as a stipulated function of the managing authority (Home-owners Association/Body Corporate) for the open spaces/wetlands during the operational phase of the development.	

7.4 Decommissioning Phase Potential Impacts

7.4.1 Decommissioning Impacts

Should the proposed development need to be decommissioned, the same impacts as identified for the construction phase of the proposed development may be anticipated where structures and buildings will be removed. This includes removal of roads, housing units, services and storm water management structures (for example, attenuation ponds). Similar degradation and wetland habitat loss impacts can be expected to occur and the stipulated mitigation measures where relevant must be employed as appropriate to minimise impacts.

8 SPECIALIST RECOMMENDATIONS

The primary recommendation from a wetland perspective is to plan the position of the buildings, roads alignments, services and storm water management structures outside of wetlands to avoid impacts. Should this be undertaken, there will be minimal impacts on the wetland areas.

A secondary recommendation is to maintain all wetlands as conservation areas and rehabilitate each wetland by removing crops and re-vegetating with suggested species as highlighted in **Section 7.3.2** above. Should this be undertaken, the proposed development will have a positive impact on the identified wetlands and improve the present ecological state. Additionally, rehabilitating the wetlands will improve the functionality and the delivery of ecosystem services as identified in this report.

Finally, site specific recommendations form **Section 6** above must also be taken into consideration. These include:

- The Tinley Manor South Site has significant access constraints and thus finding a zero or low impact access point is difficult. In all likelihood on-site wetland areas will be affected or even lost due to site access road construction. Associated impacts can be mitigated by careful planning, and resource loss will need to be offset by any wetland rehabilitation on the remainder of the site;
- A low impact internal road layout can be achieved by:
  - Avoiding / circumventing wetlands and sensitive environmental areas;
  - Upgrading existing farm roads, rather than constructing new roads; and
  - Where wetland areas need to be crossed, a single crossing and shortest crossing distance should be implemented;
- Two options have been tabled in order to provide site access near the litchi orchard wetland. Option 2, which entails constructing a new road above the existing wetland is recommended if the following conditions are met:
  - Comment from a road engineer is sourced to determine if the proposed routing is viable;
  - The road routing does not infringe on the upper boundary of the delineated wetland;

- Erosion control and storm water management mitigatory measures are implemented; and
- The litchi orchard wetland is rehabilitated which may include removing / modifying the existing road;

9 CONCLUSIONS

A wetland functional assessment is provided in this report for the proposed development. This was undertaken in order to determine the present ecological state, functionality (in terms of ecosystem services provided by the wetlands), as well as the ecological importance and sensitivity provided by the wetlands on the study site. Potential impacts were also identified and appropriate mitigation measures were proposed.

To determine the present ecological state, the methodology as stipulated by **Macfarlane *et al*. (2009**) was followed. For the functionality assessment of the wetlands, the methodology as specified by **Kotze *et al*. (2009)** was undertaken. Finally, to determine that ecological importance and sensitivity, the **DWAF, 1999** was utilised. The SiVEST impact rating methodology was used for the determination of impacts and their significance.

The above assessments were applied to all the wetlands identified in a previous wetland delineation assessment report compiled by **SiVEST**. The following wetlands formed part of scope for the functional assessment:

- Six channelled valley bottom wetlands;
- Seven unchannelled valley bottom wetlands;
- Fifteen hillslope seep wetlands; and
- One Floodplain wetland.

A buffer zone of 30 m was applied to all wetlands except the Umhlali floodplain wetland. The Umhlali floodplain wetland was given a 50 m and 100 m buffer. It is felt that the 50 m buffer would be more than sufficient to protect this unit. However the 100 m setback is given as an ideal.

In terms of the findings for the present ecological state of the wetlands, hydrological impacts as a result of sugar cane cultivation transformation, drainage ditches and roads had the largest influence in altering the natural hydrology of the wetlands. Geomorphologically, however, the wetlands were found for the most part to be intact with limited to no erosion. However, structural impact to the wetlands (for the purpose of drainage ditches for agricultural reasons) was the main factor degrading most wetlands but only to a limited degree. From a vegetation perspective, transformation of the vegetation to sugar cane was the main factor affecting the vegetation state. However, alien vegetation was also a factor affecting some wetlands. The general present ecological state of the channelled valley bottom wetlands was found to be largely (Category D) to greatly modified (Category E). The general present ecological state of the unchannelled valley bottom wetlands was found to be moderately (Category C) to greatly modified (Category E). The general present ecological state of the hillslope seep wetlands was found to range between a

Category A (Unmodified/natural) to a Category E (Greatly modified). Lastly, the general present ecological status of the floodplain wetland is a Category C (Moderately modified).

From a functionality perspective, ecosystem services offered by the channelled valley bottom wetlands which scored the highest (**moderately high**) was the sediment trapping ability of the wetlands. Other ecosystem services which scored at an **intermediate level** include erosion control, toxicant removal, nitrate removal, phosphate trapping, flood attenuation and water supply for human use. The ecosystem services which scored **below intermediate** levels include streamflow regulation, maintenance of biodiversity, carbon storage, tourism and recreation, education and research, cultural significance, cultivated foods and natural resources.

In terms of the unchannelled valley bottom wetlands, the wetlands were assessed as providing a **moderately high** level of ecosystems services in terms of sediment trapping ability, phosphate trapping, nitrate removal, toxicant removal and erosion control. The only ecosystem service with an **intermediate** score was flood attenuation ability. The remaining ecosystem services that scored **below intermediate** included carbon storage, maintenance of biodiversity, water supply for human use, natural resources, cultivated foods, cultural significance, tourism and recreation, education and research as well as streamflow regulation.

With regards to the hillslope seep wetlands, the highest scoring ecosystem services (which were assessed at a **moderately high** level) include phosphate trapping, nitrate removal and toxicant removal abilities. At an **intermediate level**, the ecosystems services provided include sediment trapping, flood attenuation and erosion control. Most scores however were below **intermediate** to **low**. These include streamflow regulation, carbon storage, maintenance of biodiversity, water supply for human use, natural resources, cultivated foods, tourism and recreation, education and research.

Finally, for the floodplain wetland, the highest scoring ecosystem services which were assessed at a **moderately high** level included maintenance of biodiversity, sediment trapping, phosphate trapping, nitrate removal, toxicant removal, erosion control and as well as tourism and recreation. At an **intermediate** level, ecosystems services included carbon storage and flood attenuation. **Below intermediate** level of ecosystems services provided include streamflow regulation, water supply for human use, natural resources, cultivated foods and, education and research. The **lowest** scoring ecosystem services provided by the floodplain wetland is cultural significance.

The functionality of all the wetlands (to a greater or lesser extent) was primarily limited by current impacts relating to the transformation of the wetlands for sugar cane production.

In terms of ecological importance and sensitivity, the channelled valley bottom wetlands almost all scored a **Class C (Moderate)** level of ecological importance and sensitivity, with the exception of channelled valley bottom wetland 2. Channelled valley bottom wetland 2 scored a **Class B (High)** level of ecological importance and sensitivity. Unchannelled valley bottom wetlands were fairly similar to the channelled valley bottom wetlands and unchannelled valley bottom wetlands 2 and

4-7 scored a **Class C (Moderate)** level of ecological importance and sensitivity. Unchannelled valley bottom wetlands 1 and 3 were more impacted by artificial drainage ditches which further degraded the ecological condition and therefore scored a **Class D (Low)** level of ecological importance and sensitivity. Due to the similar ecological state for many of the hillslope seep wetlands, hillslope seep wetlands 3-13 were scored to have a **Class D (Low)** level of ecological importance and sensitivity. Hillslope seep wetlands 1, 2, 14 and 15 however scored much higher due to the decreased level of transformation, scoring a **Class B (High)** level ecological importance and sensitivity. The wetland ecological importance and sensitivity for the floodplain wetland was categorised as **Class B (High)**.

An assessment of proposed infrastructure, in relation to wetlands, was undertaken, and it was noted that the design of the storm water, water, and wastewater infrastructure avoided the wetland units on site wherever possible, and wetland crossings were minimised. However, the routing of the main access road through the old Litchi Orchard Wetland was questioned, as it will lead to the complete loss of this wetland system, and other routings are available for consideration. It was also noted that the current access road for the Wastewater treatment facility on site was within a wetland and that the new routing would remove it from the wetland, but would still be within the wetland buffer zone. Having made an assessment of the infrastructure that will be required to service the Tinley Manor South Development; the author is of the opinion that best practice has been followed where possible by avoiding the sensitive environments. The proposed layout and associated infrastructure is considered to be very aware of the environmental constraints and thus the impacts, specifically on wetlands will be very limited and will only potentially affect one wetland unit on site. Having noted the potential impact, it needs to be considered that the wetland is already significantly transformed, reduced in size, and isolated from its natural flow path by the N2 highway.

Foreseen potential negative and positive impacts in terms of the pre-construction, construction, operation and decommissioning phases of the proposed development were identified and assessed. The impacts for each phase of the proposed development are summarised as shown in **Table 23** below.

Table 23. Summary of the potential impacts for the proposed development on Tinley Manor.

PRE-CONSTRUCTION PHASE		
Impact	**Pre-mitigation Rating**	**Post Mitigation Rating**
Impacts associated with the Construction Lay-down Area	- 36 medium negative	- 15 low negative
CONSTRUCTION PHASE		
Impact	**Pre-mitigation Rating**	**Pre-mitigation Rating**
Road Impacts	- 39 medium negative	- 22 low negative
Establishment of Housing Unit Impacts	- 39 medium negative	- 7 low negative
Service Installation Impacts	- 33 medium negative	- 6 low negative

Increased Run-off, Erosion and Sedimentation Impacts	- 45 medium negative	- 22 low negative
OPERATION PHASE		
Impact	**Pre-mitigation Rating**	**Pre-mitigation Rating**
Increased Run-off, Erosion and Sedimentation Impacts	- 42 medium negative	- 24 low negative
Post-construction Wetland Rehabilitation Impacts	- 42 medium negative	+ 42 medium positive

Should the proposed development need to be decommissioned, the same impacts as identified for the construction phase of the proposed development can be anticipated. A similar degree of impacts are expected to occur and the stipulated mitigation measures where relevant must be employed as appropriate to minimise impacts.

Lastly, specialist recommendations were proposed and centre on the avoidance of wetlands and the associated buffer zones to prevent most impacts from taking place on the wetlands. A secondary recommendation is to maintain all wetlands as conservation areas and rehabilitate each wetland by removing crops and undertaking appropriate re-vegetation. The final recommendation is to take into consideration the site specific recommendations from section 6 above.

Given the responsible planning that has been undertaken, and the associated reduction in wetland impacts through the realignment and removal of infrastructure from wetland areas, the proposed development of the Tinley Manor South site should have minimal negative impacts on the wetlands on site. It is the opinion of this specialist that the proposed layout will actually lead to a significant positive impact for the wetlands on site through the rehabilitation of systems that have previously been heavily degraded. Further the connectivity of the wetlands has been retained, and will be further enhanced through the removal of unnecessary cane tracks, and thus their functionality will be greatly improved.

The developer should be commended for a proposed development layout that has gone to great lengths to reduce encroachment and placement of services within sensitive wetland environments, and the promotion of these contiguous landscape features with rehabilitation will see a significant increase in the delivery of ecosystem goods and services.

10 REFERENCES

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Appendix A:

Floral Species List

Species name	Common name	Status	Growth form	Category
Ageratum conyzoides	Blue weed	Indigenous	Herb	N/A
Ambrosia artemisiifolia	Common ragweed	Alien	Herb	N/A
Anredera cordifolia	Madeira vine	Alien	Creeper	N/A
Arundo donax	Spanish reed	Alien	Grass	1
Asystasia gangetica	Creeping foxglove	Alien	Herb	N/A
Bambusoideae	Bamboo	Alien	Tree	N/A
Barringtonia racemosa	**Powder-puff tree**	**Protected**	**Tree**	**N/A**
Bidens pilosa	Black Jack	Alien	Herb	N/A
Brachylaena discolor	Silver oak	Indigenous	Tree	N/A
Bridelia micrantha	Mitzeerie	Indigenous	Tree	N/A
Canna indica	Canna	Alien	Herb	1
Canthium inerme	Turkey berry	Indigenous	Tree	N/A
Cardiospermum grandiflorum	Balloon vine	Alien	Herb	1
Casearia sp.	Sword-leaf	Indigenous	Tree	N/A
Chamaecrista mimosoides	Fishbone dwarf cassia	Indigenous	Herb	N/A
Chromolaena odorata	Triffid weed	Alien	Herb	1
Chrysanthemoides monilifera	Tick berry	Indigenous	Shrub	N/A
Clerodendrum glabrum	Tinderwood	Indigenous	Tree	N/A
Commelina erecta	Slender day flower	Indigenous	Herb	N/A
Conyza bonariensis	Fleabane	Alien	Herb	N/A
Crotalaria lanceolata	Lanceleaf rattlebox	Indigenous	Herb	N/A
Cryptocarya latifolia	**Broad leaf Wild Quince**	**Indigenous**	**Tree**	**Rare/Declining**
Cussonia zuluensis	Natal cabbage tree	Indigenous	Tree	N/A
Cyperus dives		Indigenous	Sedge	N/A
Cyperus rotundus	Purple nut sedge	Alien	Sedge	N/A
Dalbergia obovata	Climbing flat bean	Indigenous	Climber	N/A
Desmodium dregeanum	Marsh Desmodium	Indigenous	Herb	N/A
Desmodium incanum	Spanish clover	Alien	Herb	N/A
Dioscorea cotinifolia	Wild yam	Indigenous	Herb	N/A

Dracaena aletriformis	**Dragon tree**	**Protected**	**Shrub**	**N/A**
Drimiopsis maculata	**Green drimiopsis**	**Protected**	**Herb**	**N/A**
Ekebergia capensis	Cape ash	Indigenous	Tree	N/A
Eragrostis ciliaris	Woolly love grass	Indigenous	Grass	N/A
Ethulia conyzoides		Indigenous	Herb	N/A
Eucalyptus grandis	Rose gum	Alien	Tree	2
Ficus natalensis	Natal Fig	Indigenous	Tree	N/A
Ficus sur	Cape fig	Indigenous	Tree	N/A
Gomphocarpus physocarpus	Milkweed	Indigenous	Herb	N/A
Gomphrena celosioides	Bachelor's button	Alien	Herb	N/A
Helichrysum kraussii		Indigenous	Herb	N/A
Helichrysum ruderale	Yellow everlasting	Indigenous	Herb	N/A
Hewittia malabarica		Indigenous	Herb	N/A
Indigofera suffruticosa	Wild indigo	Alien	Herb	N/A
Ipomoea cairica	Morning glory	Alien	Herb	N/A
Ipomoea purpurea	Common morning glory	Alien	Creeper	3
Ischaemum fasciculatum		Indigenous	Grass	N/A
Kyllinga alba		Indigenous	Sedge	N/A
Lagenaria sphaerica	Wild melon	Indigenous	Herb	N/A
Lantana camara	Tick berry	Alien	Shrub	1
Leersia hexandra	Swamp rice grass	Indigenous	Grass	N/A
Ludwigia octovalvis	Raven primrose willow	Indigenous	Herb	N/A
Mariscus sp.			Sedge	N/A
Melia azedarach	Syringa	Alien	Tree	3
Melinis repens	Natal red top	Indigenous	Grass	N/A
Morus alba	White mulberry	Alien	Tree	3
Nephrolepis exaltata	Sword Fern	Indigenous	Fern	N/A
Panicum maximum	Guinea grass	Indigenous	Grass	N/A
Paspalum scrobiculatum	Kodo Millet	Alien	Grass	N/A
Paspalum urvillei	Vasey grass	Alien	Grass	N/A
Persicaria attenuata	Bristly snakeroot	Indigenous	Herb	N/A
Phoenix reclinata	Wild date palm	Indigenous	Palm	N/A
Phragmites australis	Common reed	Alien	Grass	N/A
Phragmites mauritianum		Alien	Grass	N/A
Priva cordifolia		Indigenous	Herb	N/A
Psidium guajava	Guava tree	Alien	Tree	2
Pycreus mundtii		Indigenous	Sedge	N/A
Rhoicissus tridentata	Bushman's grape	Indigenous	Climber	N/A
Richardia brasiliensis	Brazilian clover	Alien	Herb	N/A

Scadoxus puniceus	Paintbrush lily	Indigenous	Bulbous herb	N/A
Schinus terebinthifolius	Brazilian pepper tree	Alien	Tree	1
Sclerocarya birrea	**Marula tree**	**Protected**	**Tree**	**N/A**
Senecio helminthioides		Indigenous	Herb	N/A
Senna didymobotrya	Peanut butter senna	Alien	Shrub	3
Setaria lindenbergiana		Indigenous	Grass	N/A
Setaria megaphylla	Broad-leafed bristle grass	Indigenous	Grass	N/A
Setaria sagittifolia	Arrow grass	Indigenous	Grass	N/A
Sida dregei	Spider leg	Indigenous	Herb	N/A
Solanum Lycopersicon	Tomato	Alien	Shrub	N/A
Solanum mauritianum	Bugweed	Alien	Tree	1
Sorghum halepense	Johnson grass	Alien	Grass	N/A
Stenotaphrum secundatum	St. Augustine grass	Alien	Grass	N/A
Strelitzia nicolai	Giant White Bird of Paradise	Indigenous	Tree	N/A
Syzygium cordatum	Umdoni	Indigenous	Tree	N/A
Tagetes minuta	Southern cone marigold	Alien	Herb	N/A
Tarenna pavettoides	Brides bush	Indigenous	Tree	N/A
Trema orientalis	Pigeon wood	Indigenous	Tree	N/A
Trichilia dregeana	Forest mahogany	Indigenous	Tree	N/A
Trichilia emetica	Natal mahogany	Indigenous	Tree	N/A
Triumfetta rhomboidea		Indigenous	Herb	N/A
Typha capensis	Bulrush	Indigenous	Sedge	N/A

Appendix B:

Impact Rating Methodology

The determination of the effect of an environmental impact on an environmental parameter (in this instance, wetlands) is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global) whereas intensity is defined by the severity of the impact (e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence). Significance is calculated as per the example shown in **Table 24**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System Methodology

Impact assessments must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is usually assessed according to the project stages:

- *planning*
- *construction*
- *operation*
- *decommissioning*

In this case, a unique situation is present whereby various scenarios have been posed and evaluated accordingly. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used To Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

Table 24. Example of the significance impact rating table

NATURE		
Includes a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.

3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		

1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.**		

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.

Points	**Impact Significance Rating**	**Description**
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

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