

# DRAFT MAINTENANCE MANAGEMENT PLAN and Rehabilitation Plan for Paddavlei Wetland, including the associated hillslope seep areas and ecological corridor upstream and downstream of the vlei in Hawston, Overstrand Local Municipality, Western Cape Province

**Available for public comment:**

Friday, 31 July to Tuesday, 29 September 2020

**JULY 2020**



**Applicant:**

Overstrand Local Municipality

**Prepared by:**



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## EXECUTIVE SUMMARY

### Brief Project Description

The Overstrand Local Municipality has initiated a process to compile a rehabilitation and a maintenance management plan for Paddavlei Wetland, situated in Hawston, near Hermanus, in the Western Cape Province (see Figure a: Locality Map). Paddavlei Wetland is an open body of water within a wider wetland area that drains into the Skilpadsvlei and from there to the Bot River Estuary.

In order to execute the rehabilitation plan a Maintenance Management Plan (MMP) is compiled that will allow for regular maintenance activities to be undertaken within the Paddavlei.

The wetland, ecological corridor, hillslope seeps and infrastructure associated with these aquatic features will potentially require periodic maintenance, which is addressed by the MMP.

BlueScience (Pty) Ltd. has been appointed to compile the rehabilitation plan and the MMP. Cornerstone Environmental Consultant (Pty) Ltd. (hereafter "Cornerstone") is assisting BlueScience with the public participation activities that are required as part of this MMP process.

Paddavlei Wetland forms part of an aquatic ecological corridor that is formed between the Onrus Mountain to the east and a coastal dune system to the west. The corridor arises within the Hoek van die Berg Nature Reserve and provides connectivity to the Bot River Lagoon and estuary to the north. Historically, Paddavlei was a seasonal open water pan but in more recent years it has become increasingly overgrown with bulrushes and its ecological condition has degraded. Due to concerns raised by the surrounding Hawston community, the Overstrand Municipality has initiated a process to rehabilitate the wetland. The wetland, ecological corridor, hillslope seeps and infrastructure associated with these aquatic features will potentially require periodic maintenance, which are addressed by the MMP.

The maintenance and management activities to be undertaken have been categorised into the following three main activity categories (Section 6 of the MMP provides method

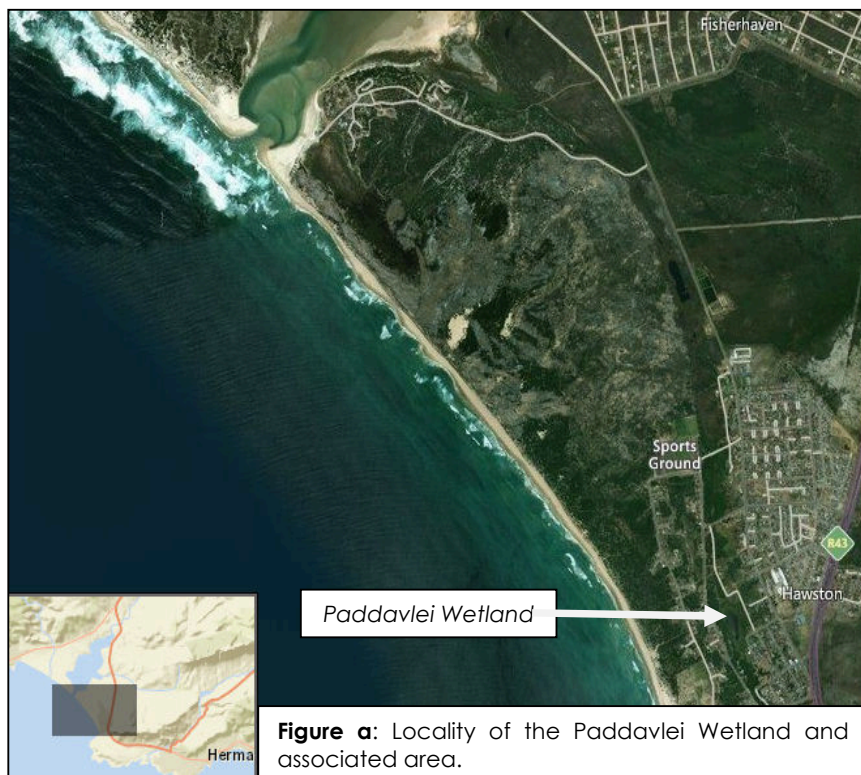
#### What is a MMP?

A MMP is a document, which have been preapproved by the authorities, that describes maintenance activities that need to take place within a watercourse and/or which entails the removal of indigenous vegetation.

The MMP specifically relates to Activities 19 and 27, as listed in the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA) Environmental Impact Assessment (EIA) Regulations Listing Notice 1 of 2014 (GN R. 327), as amended. In line with the MMP, infilling or removal of more than 10m<sup>3</sup> material within a watercourse, and/or the clearance of 1 ha or more of indigenous vegetation, are allowed only if the works are undertaken for maintenance purposes AND forms part of the MMP when approved by the Department of Environmental Affairs and Development Planning (DEA&DP).

#### What are maintenance activities?

"Maintenance", as defined in terms of the NEMA, refers to "activities performed to keep a structure or system functioning or in service on the same location, capacity and footprint." It is therefore "like for like" activities.



**Figure a:** Locality of the Paddavlei Wetland and associated area.

statements, which include mitigation measures, to be implemented for each of the activities):

**Activity 1a:** Clearing of invasive alien vegetation;

**Activity 1b:** Clearing of indigenous *Phragmites* reeds;

**Activity 2:** Repairs to- or replacement of damaged formal river crossings, and water level management; and

**Activity 3:** Removal of material (debris, rock and sediment) at infrastructure.

## Overview of the Aquatic Features

Paddavlei Wetland consists of a much-reduced open water area, surrounded by a bulrush (*Typha capensis*) dominated reed bed. The upper extent of the vlei starts at the houses along Bush Street. The vlei then widens at Vlei Street, extending up to Long Street. Where Long Street turns to the west and then north again, the wetland narrows. At this point pipe a culvert and embankment has been placed within the wetland that allows access over the vlei. The wetland then continues northward in a narrow band to Chapel Street (refer to the Figure on the cover page of the MMP/ this Executive Summary).

### Biodiversity Conservation Importance

The aquatic ecological corridor in which Paddavlei is located is linked to the following formally protected areas:

1. The Bot-Kleinmond Estuarine System, into which the aquatic ecological corridor drains, is a designated Ramsar wetland and recognised as one of the ten most significant wetlands for water birds in South Africa during the dry summer months and is an nursery area for fish; and
2. Hoek van die Berg Private Nature Reserve to the south-east of Paddavlei, with the associated aquatic ecological corridor arising within the reserve.

The entire aquatic ecological corridor, including Paddavlei, has been mapped as a natural Freshwater Ecosystem Priority Area (FEPA) Wetland (Channelled valley-bottom wetland within the South Strandveld Bioregion) by the National FEPA and National Wetland Mapping projects. The larger Bot River catchment is not mapped as a FEPA River sub-quaternary catchment.

Only the downstream Middelvlei / Skilpadvlei and Bot Lagoon are mapped as aquatic Critical Biodiversity Areas (wetlands and estuary) that are required to meet biodiversity objectives and should be maintained to prevent any further loss of aquatic habitat. The coastal dune field to the west of the vlei is also mapped as an aquatic Ecological Support Area. Paddavlei and the remainder of its associated wetland corridor is mapped as an aquatic (wetland and watercourse) Ecological Support Area that should be restored. These areas are not deemed essential for meeting biodiversity targets but play an important role in supporting the functioning of Protected Areas or Critical Biodiversity Areas and are often vital for delivering ecosystem services. **The management objective is to restore and/or manage these areas to minimize impact on ecological processes and ecological infrastructure functioning, especially soil and water-related services, and to allow for faunal movement. The improvement of Paddavlei, as a community asset, is essential and is a primary objective of the proposed rehabilitation actions.**

The aquatic ecological corridor also provides an important ecological connectivity between the Bot Lagoon, the wetlands within the corridor, *Juncus cf. kraussii* wetlands at Hoek van die Berg and the Vermont Pan to the east of Hawston.

## Potential Impacts

The impacts associated with the three proposed activity categories included in the MMP (as listed above) were assessed considering the ecologic condition and sensitivity of the aquatic features on the site. The outcome of the impact assessment is that the significance of the potential impacts associated with Activities 1 and 3 (listed above) will be low to very low negative to medium positive with implementation of the recommenced management and mitigation measures. The significance of the impacts associated with Activity 2 (listed above) will be very low negative with implementation of the recommenced maintenance and mitigation measures.

## Public Participation Process

A key part of this project is the undertaking of a public participation process with all Paddavlei affiliated interest groups, the local community and the relevant organs of state/organisations. The key focus of this public participation process is to:

1. Obtain historical information on the function/purpose of the wetland;
2. Determine the existing use of wetland;
3. Determine the vision and needs of the local community as well as the desired state of the wetland;  
and
4. Obtain comment on the Draft MMP for the Paddavlei Wetland.

The public participation process for this project was therefore designed around the specific objectives of the MMP process and involved various interest groups, individuals and organs of state/organisations (hereafter collectively referred to as 'interested and affected parties', i.e. I&APs) to enable the preparation of a comprehensive rehabilitation plan (Annexure B1 to the Draft MMP document) and MMP that incorporates the inputs from I&APs and which complies with the relevant regulatory requirements.

**The Draft MMP, as well as the rehabilitation plan (Annexure B1 to the Draft MMP document), is available for comment from I&APs from Friday, 31 July to Tuesday, 29 September 2020. A 60-day comment period** is provided due to the current COVID-19 lockdown situation; this extension is in line with section 4.4 of GN No. 650 of 5 June 2020.

The availability of the Draft MMP and the rehabilitation plan for comment was **advertised** in the Village News and the Hermanus Times on 29 and 30 July 2020 respectively. **Notices** were also fixed at publicly accessible places, such as shops in the Hawston area. The advert and notices will inform people of the MMP process, invite them to comment on the document, and invite them to attend the public open day.

A **public open day** will take place on **18 August 2020**, at the **Thusong Centre, Vlei Street, Hawston**. I&APs are welcome to visit the open day venue any time **between 15:00 and 18:00** on the day. Communication during the open day will be in both English and Afrikaans. The public open day will provide opportunity for residents to ask questions and to provide input on an individual basis, and to obtain direct feedback from the project team members. The public open day is scheduled early in the 60-day commenting period to ensure that adequate time is available after the open day for people to submit further written comments. The necessary COVID-19 safety protocols will be implemented during the public open day.

**Letters**, which will include the Executive Summary (in English and Afrikaans) of the rehabilitation plan and Draft MMP document, will be hand-delivered/dropped-off to the landowners/occupiers of properties that are directly adjacent to the site, and adjacent properties 1000m downstream of the application area.

The Draft MMP, the rehabilitation plan (as Annexure B1 to the Draft MMP document), as well as the Executive Summary (in English and Afrikaans) as a separate downloadable document, can be **downloaded** from the following link: <https://www.overstrand.gov.za/en/documents/strategic-documents/environmental-management-services>.

**Hard copies** of the Draft MMP and the rehabilitation plan (as Annexure B1 to the Draft MMP document), as well as the Executive Summary (in English and Afrikaans), will be made available to members of the public during the public open day (to take home).

Electronic or hard copy formats of the document can also be sent to the I&AP / organs of state upon request.

A Comments and Responses Report will be prepared to document all the comments received during the above-mentioned comment period. The Comments and Responses Report will be included in the Final MMP when submitted to the DEA&DP for their approval.

## **MMP Implementation**

The Overstrand Municipality will be responsible for implementation of the management and mitigation measures contained in the rehabilitation plan and MMP, as well as to oversee the monitoring of the maintenance and management activities. Records of implementation of the maintenance activities should be kept by the Municipality.

## **Conclusion**

It is concluded that the proposed rehabilitation and subsequent maintenance and management activities will not result in significant negative impacts but will result in positive impacts on the environment if the prescribed maintenance and mitigation measures are implemented successfully.

# UITVOERENDE OPSOMMING

## Kort Projekbeskrywing

Die Overstrand Plaaslike Munisipaliteit het 'n proses begin om 'n rehabilitasie- en instandhoudingsbestuursplan vir Paddavlei-vleiland in Hawston, naby Hermanus, in die Wes-Kaap, op te stel (sien Figuur a: Liggingskaart). Paddavlei-vleiland is 'n oop watermassa binne 'n breër vleilandgebied wat in die Skilpadsvlei dreineer en van daar na die Botstrandmeer dreineer.

Ten einde die rehabilitasieplan uit te voer, is 'n Onderhoudsbestuursplan (OBP) opgestel wat voorsiening maak vir gereelde instandhoudingsaktiwiteite binne die Paddavlei.

Die Paddavlei-vleiland, en die gepaartgaande ekologiese korridor, heuwelvleilandareas en die infrastruktuur wat hiermee verband hou, sal van tyd tot tyd onderhoud benodig. Hierdie onderhoud sal deur die OBP aangespreek word.

BlueScience (Edms) Bpk. (hierna BlueScience) is aangestel om die rehabilitasieplan en die OBP op te stel. Cornerstone Environmental Consultant (Edms) Bpk. (hierna "Cornerstone") help BlueScience met die openbare deelname aktiwiteite wat benodig word as deel van hierdie OBP-proses.

Paddavlei-vleiland vorm deel van 'n akwatiese ekologiese korridor tussen die Onrusberge in die ooste en 'n kusduinstelsel in die weste. Die korridor begin binne die Hoek van die Berg-natuurreservaat en verbind die natuurreservaat met die Botstrandmeer en die riviermonding in die noorde. Paddavlei was histories 'n seisoenale oopwaterpan, maar in meer onlangse jare het dit al meer toegegroeï met biesies, en die ekologiese toestand daarvan het agteruitgegaan. As gevolg van kommer wat deur die Hawstongemeenskap uitgespreek is, het die Overstrand Munisipaliteit 'n proses begin om die vleiland te rehabiliteer.

Die voorgestelde instandhoudings- en bestuursaktiwiteite is in die volgende drie aktiwiteits-kategorieë ingedeel (Afdeling 6 van die OBP bevat metodestellings, wat versagtingsmaatreëls insluit, wat vir elk van die aktiwiteite geïmplementeer moet word):

**Aktiwiteit 1a:** Opruiming van indringerplante;

**Aktiwiteit 1b:** Opruiming van inheemse Phragmites-riete;

### Wat is 'n MMP?

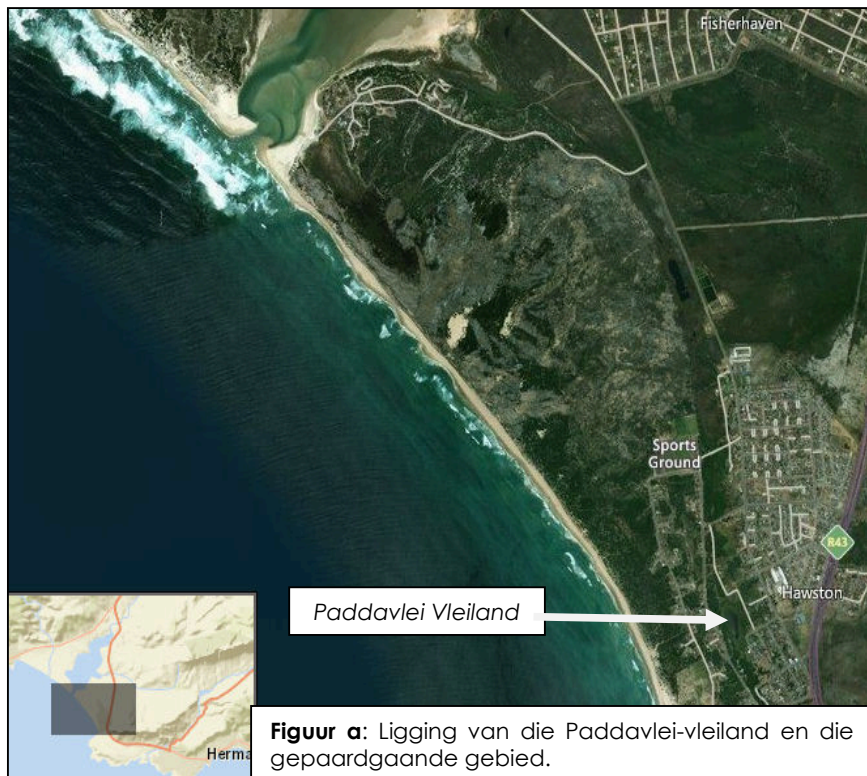
'n MMP is 'n dokument wat deur die owerhede vooraf goedgekeur is, wat onderhoudsaktiwiteite beskryf wat binne 'n waterloop moet plaasvind en / of die verwydering van inheemse plantegroei behels.

Die MMP hou spesifiek verband met aktiwiteite 19 en 27, soos gelys in die Wet op Nasionale Omgewingsbestuur, 1998 (Wet Nr. 107 van 1998), soos gewysig (NEMA) Omgewingsimpakstudie (OIE)-regulasies Kennisgewing 1 van 2014 (GN R.) 327), soos gewysig. In ooreenstemming met die MMP, word die invulling of verwydering van meer as 10m<sup>3</sup> materiaal binne 'n waterloop en / of die vrystelling van 1 ha of meer inheemse plantegroei slegs toegelaat indien die werke vir onderhoudsdoeleindes onderneem word en deel vorm van die MMP wanneer goedgekeur deur die Departement van Omgewingsake en Ontwikkelingsbeplanning.

### Wat is instandhoudingsaktiwiteite?

'Onderhoud', soos omskryf in terme van die NEMA, verwys na 'aktiwiteite wat uitgevoer word om 'n struktuur of stelsel te laat funksioneer of op dieselfde plek, kapasiteit en voetspoor te kan funksioneer.' Dit is dus aktiwiteite soos "like for like".

Paddavlei was histories 'n seisoenale oopwaterpan, maar in meer



**Figuur a:** Ligging van die Paddavlei-vleiland en die gepaartgaande gebied.

**Aktiwiteit 2:** Herstelwerk aan of vervanging van beskadigde formele rivieroorgange en bestuur van die watervlak; en

**Aktiwiteit 3:** Verwydering van materiaal (puin, rots en sediment) by infrastruktuur.

## Oorsig van die akwatiese kenmerke

Paddavlei-vleiland bestaan uit 'n verkleinde oopwatergebied, omring deur 'n bieise (*Typha capensis*) oorheersde rietbedding. Die boonste gedeelte van die vlei begin by die huise langs Bushstraat. Vandaar verbreed die vlei in Vleistraat en strek tot by Langstraat. Die vleiland vernou waar Langstraat weswaarts draai en dan weer noordwaarts. Op hierdie punt is 'n duikweg en wal in die vleiland, wat toegang oor die vlei moontlik maak. Die vleiland gaan dan noordwaarts voort in 'n nou band na Chapelstraat (verwys na die Figuur op die voorblad van die OBP / hierdie Uitvoerende Opsomming).

### Die belangrikheid van die bewaring van biodiversiteit in die area

Die akwatiese ekologiese korridor waarin Paddavlei geleë is, is verbind aan die volgende formeel beskermde gebiede:

1. Die Bot-Kleinmond Strandmeer-stelsel, waarin die akwatiese ekologiese korridor dreineer, is aangewys as 'n Ramsar-vleiland en word erken as een van die tien belangrikste vleilande vir watervoëls in Suid-Afrika gedurende die droë somermaande, en is 'n broeiarea vir visse; en
2. Hoek van die Berg Privaat Natuurreservaat suid-oos van Paddavlei, met die gepaardgaande akwatiese ekologiese korridor wat in die reservaat ontstaan.

Die hele akwatiese ekologiese korridor, insluitend Paddavlei, is gekarteer as 'n natuurlike varswater-ekosistemprioriteitsgebied.

Slegs die stroomaf Middelvlei / Skilpadvlei en die Botstrandmeer areas word aangedui as akwatiese kritiese biodiversiteitsgebiede (vleilande en riviermonding). Hierdie areas is dus belangrik om die biodiversiteitsdoelwitte vir die gebied te bereik, en moet in stand gehou word om verdere verlies aan akwatiese habitat te voorkom. Die kusduinveld wes van die vlei word as 'n akwatiese ekologiese ondersteuningsgebied gekarteer. Paddavlei en die res van die geassosieerde vleilandkorridor word gekarteer as 'n akwatiese (vleiland en waterloop) ekologiese ondersteuningsarea wat herstel moet word. Hierdie gebiede word nie noodsaaklik geag vir die bereiking van biodiversiteitsdoelwitte nie, maar speel 'n belangrike rol in die ondersteuning van die funksionering van beskermde gebiede of kritiese biodiversiteitsgebiede en is dikwels noodsaaklik vir die lewering van ekosisteldienste. **Die bestuursdoelwit is om hierdie gebiede te herstel en / of te bestuur om die impak op ekologiese prosesse en ekologiese infrastruktuur-funksionering, veral grond- en waterverwante dienste, te minimaliseer en om die beweging van die diere moontlik te maak. Die verbetering van Paddavlei-vleiland, as 'n gemeenskaplike bate, is noodsaaklik en is 'n primêre doelwit van die voorgestelde rehabilitasie-aksies.**

Die akwatiese ekologiese korridor bied ook 'n belangrike ekologiese verbinding tussen die Botstrandmeer, die vleilande in die korridor, vleilande by Hoek van die Berg en die Vermont Pan oos van Hawston.

## Moontlike impakte

Die impak wat geassosieer word met die drie voorgestelde aktiwiteitskategorieë wat by die OBP ingesluit is (soos hierbo gelys), is geëvalueer met inagneming van die ekologiese toestand en sensitiwiteit van die akwatiese eienskappe op die terrein. Die uitkoms van die impakstudie dui dat die potensiele impakte wat verband hou met Aktiwiteite 1 en 3 (hierbo gelys) laag tot baie laag negatief tot medium positief sal wees met die implementering van die aanbevole bestuurs- en versagtingsmaatreëls. Die impak wat verband hou met Aktiwiteit 2 (hierbo gelys), sal baie laag negatief wees met die implementering van die instandhoudings- en versagtingsmaatreëls.

## Publieke deelnameproses

'n Belangrike deel van hierdie projek is die onderneem van 'n publieke deelnameproses met alle belangegroepes wat verband hou met Paddavlei, die plaaslike gemeenskap en die betrokke staatsorgane / organisasies. Die sleutelfokus van hierdie openbare deelnameproses is om:

1. Historiese inligting te verkry oor die funksie / doel van die vleiland;
2. Die bestaande gebruik van die vleiland te bepaal;
3. Die visie en behoeftes van die plaaslike gemeenskap sowel as die gewenste toestand van die vleiland te bepaal; en

#### 4. Kommentaar te verkry op die Konsep-OBP vir die Paddavei-vleiland.

Die publieke deelnameproses vir hierdie projek is dus ontwerp rondom die spesifieke doelstellings van die OBP-proses en verskillende belangegroepes, individue en staatdepartemente / organisasies (hierna gesamentlik "belanghebbende en geaffekteerde partye" genoem, dit wil sê B&GP'e) betrek ten einde 'n omvattende rehabilitasieplan (Aanhangsel B1 tot die Konsep OBP-dokument) en OBP op te stel wat die insette van B&GP'e insluit en wat aan die toepaslike regulatoriese vereistes voldoen.

**Die Konsep-OBP asook die rehabilitasieplan (as Aanhangsel B1 tot die Konsep OBP-dokument) is beskikbaar vir kommentaar deur B&GP'e vanaf Vrydag, 31 Julie tot Dinsdag, 29 September 2020.** 'n Kommentaarperiode van 60 dae word voorsien as gevolg van die huidige COVID-19-inperkingsituasie.

Die beskikbaarheid van die Konsep-OBP en die rehabilitasieplan vir kommentaar is op onderskeidelik 29 en 30 Julie 2020 in die *Village News* en die *Hermanus Times* **geadverteer**. **Kennisgewings** is ook by openbare plekke aangebring, soos winkels in die Hawston-omgewing. Die advertensie en kennisgewings sal mense inlig oor die OBP-proses, hulle uitnooi om kommentaar op die dokument te lewer en hulle uitnooi om die publieke opedag by te woon.

'n **Publieke opedag** vind op 18 Augustus 2020 in die **Thusong-sentrum, Vleistraat, Hawston**, plaas. Lede van die publiek is welkom om die opedag lokaal tussen **tussen 15:00 en 18:00** op die dag te besoek. Kommunikasie gedurende die opedag sal in beide Engels en Afrikaans plaasvind. Die opedag sal inwoners die geleentheid bied om vrae te stel en insette op individuele basisse te lewer, en om direkte terugvoer van die projekspanlede te kry. Die opedag word vroeg in die 60-dae kommentaarperiode geskeduleer om te verseker dat voldoende tyd beskikbaar is na die opedag vir verdere skriftelike of telefoniese kommentaar. Die nodige COVID-19 veiligheidsprotokolle sal tydens die opedag geïmplementeer word.

**Briewe**, wat die uitvoerende opsomming (in Engels en Afrikaans) van die rehabilitasieplan en die OBP-dokument insluit, sal afgelewer word by die grondeienaars / inwoners van eiendomme direk aangrensend tot die vleiland, en aangrensende eiendomme 1000m stroomaf van die terrein.

Die Konsep-OBP asook die rehabilitasieplan (as Aanhangsel B1 tot die Konsep-OBP dokument), asook die Uitvoerende Opsomming (Afrikaans en Engels) as 'n afsonderlike aflaaibare dokument, kan **elektronies afgelaai** word by: <https://www.overstrand.gov.za/en/documents/strategic-documents/environmental-management-services>.

**Harde kopieë** van die Konsep-OBP asook die rehabilitasieplan (as Aanhangsel B1 tot die Konsep-OBP dokument), asook die Uitvoerende Opsomming (in Engels en Afrikaans), sal gedurende die publieke opedag beskikbaar gestel word aan lede van die publiek.

Elektroniese of harde kopie formate van die dokument kan ook na die B&GP'e / staatsdepartemente gestuur word, op versoek, indien nodig.

'n Kommentaar- en antwoordverslag sal opgestel word om al die kommentaar wat gedurende die bogenoemde kommentaarperiode ontvang word, te dokumenteer. Die kommentaar en antwoordeverslag sal by die Finale OBP ingesluit word wanneer dit aan die Departement van Omgewingsake en Ontwikkelingsbeplanning gestuur word vir goedkeuring.

### **OBP Implementering**

Die Overstrand Plaaslike Munisipaliteit sal verantwoordelik wees vir die implementering van die bestuurs- en versagtingsmaatreëls vervat in die rehabilitasieplan en die OBP, asook om toesig te hou oor die instandhouding en bestuursaktiwiteite. Die Munisipaliteit moet rekords hou van die implementering van die instandhoudingsaktiwiteite.

### **Ter Afsluiting**

Die uitkoms van die Konsep-OBP en die rehabilitasieplan is dat die voorgestelde rehabilitasie en instandhoudings- en bestuursaktiwiteite nie 'n beduidende negatiewe impak op die Paddavei stelsel sal hê nie, maar 'n positiewe impak op die omgewing word verwag indien die voorgeskrewe instandhoudings- en versagtingsmaatreëls suksesvol geïmplementeer word.

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## **ANNEXURES**

### **Annexure A: Proof of Public Participation Process - To be included in the Final MMP**

- A1: Advertisements, Notices and Facebook posts *(To be included in the Final MMP)*
- A2: Letters issued to Organs of State/Organisations requesting comment on the Draft MMP and Draft Rehabilitation Plan *(To be included in the Final MMP)*
- A3: Written comments received on the Draft MMP and Draft Rehabilitation Plan *(To be included in the Final MMP)*
- A4: Comments and Responses Report *(To be included in the Final MMP)*

### **Annexure B: Specialist Reports**

- B1: Belcher, T. & Grobler, D. 2020. Rehabilitation and maintenance and management plan for Paddavlei wetland, including the associated hillslope seep areas and ecological corridor upstream and downstream of the vlei in Hawston. BlueScience: Somerset West.



**Request for the relevant Competent Authority to define or adopt a Maintenance Management Plan for a watercourse in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), Environmental Impact Assessment Regulations, 2014 (as amended).**

File Reference Number:  
Date Received by Department:  
Date Received by Component:  
Form Duly Signed and Dated:

(For official use only)	
	Yes No

**PROJECT TITLE**

MAINTENANCE MANAGEMENT PLAN FOR PADDAVLEI WETLAND, INCLUDING THE ASSOCIATED HILLSLOPE SEEP AREAS AND ECOLOGICAL CORRIDOR UPSTREAM AND DOWNSTREAM OF THE VLEI, HAWSTON IN THE OVERSTRAND MUNICIPAL AREA

**A. SCOPE AND IMPORTANT INFORMATION**

- 1) This document is to be used to ensure that the request for adopting or defining a Maintenance Management Plan (MMP) in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA"), Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) is undertaken to the sufficient standard and requirements as defined by the competent authority, the Department of Environmental Affairs and Development Planning of the Western Cape Government (henceforth the Department). It is advised that the determination of applicability regarding the scale of the proposed maintenance/management activity(ies) be undertaken through a pre-application consultation with the Department.
- 2) The geographical scope of the MMP is limited to watercourses as defined in the EIA Regulations, 2014(as amended). The document does not relate to coastal activities or activities to be undertaken in an estuary.
- 3) The use of this document for the development of a MMP for a watercourse **will only** be considered when the proposed maintenance activities constitute any one of the following listed activities identified in terms of the NEMA EIA Regulations, 2014 (as amended):

*EIA Regulations Listing Notice 1 of 2014 (as amended)*

- Activity 19, Listing Notice 1: The infilling or depositing of any material of more than 10 cubic meters into, or the dredging, excavation, removal or moving of soil, sand, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse; but excluding where such infilling, depositing, dredging, excavation, removal or moving-

- (a) will occur behind a development setback;
- (b) is for maintenance purposes undertaken in accordance with a maintenance management plan;
- (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies;
- (N.B. Points (d) and (e) does not apply as these activities fall within the coastal zone)

*EIA Regulations Listing Notice 2 of 2014 (as amended)*

- Activity 15, Listing Notice 2: The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for-
  - I. The undertaking of a linear activity; or
  - II. Maintenance purposes undertaken in accordance with an MMP.

*EIA Regulations Listing Notice 3 of 2014 (as amended)*

- Activity 12, Listing Notice 3: The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with an MMP.

**i. Western Cape**

- i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;
  - ii. Within critical biodiversity areas identified in bioregional plans;
  - iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning; or
  - v. On land designated for protection or conservation purposes in an Environmental Management Framework adopted in the prescribed manner, or a Spatial Development Framework adopted by the MEC or Minister.
- (NB. Point iii does not apply as this activity falls within the coastal zone)

- 4) In deciding the request, the competent authority may define conditions related to auditing compliance with the MMP; monitoring requirements; reporting requirements, review; updating and amending the document and period for which the MMP is defined/adopted.
- 5) The purpose of the MMP is to maintain both man-made and ecological infrastructure in a manner that either improves the current state of, and/or reduces the negative impacts on a watercourse to ensure that ecosystems services are preserved/improved and to prevent further deterioration of the watercourse.
- 6) Notwithstanding the MMP possibly being defined or adopted by the Competent Authority, any other applicable statutory requirement must still be complied with (e.g. any obligations under the National Water Act, 1998 (Act 36 of 1998) or the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983)).
- 7) The proponent must note that an MMP for a watercourse **must** be undertaken through consultation with the Department of Water and Sanitation and/or the relevant Catchment

Management Agency (responsible water authority). This is to ensure compliance in terms of a Permissible Water Use as set out in the National Water Act, 1998 (Act No. 36 of 1998). It is recommended that this process for authorisation in terms of the National Water Act be clarified prior to the drafting and submission of the MMP.

- 8) The development of this document has been done in such a way so as to meet the requirements of both this Department as the competent authority in terms of the NEMA EIA Regulations, 2014 (as amended), as well as the requirements of the delegated water authority, regarding general authorisation considerations for sections 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998), to ensure alignment between the two authorities when defining or adopting the MMP.
- 9) In situations where a Water Use Licence Application (WULA) is required by the water authority regarding the proposed activities within an MMP, this will not prevent the proponent from submitting a request for a MMP to be defined or adopted by the Department.
- 10) Unless protected by law, all information contained in, and attached to this document, shall become public information on receipt by the competent authority.
- 11) A duly dated and originally signed copy of this document together with one hard copy and one electronic copy of the MMP must be posted, to the Department at the postal address given below, or delivered to the Registry Office of the Department.
- 12) A copy of the final defined/adopted MMP and cover letter **must** be submitted to the responsible water authority.
- 13) **NOTE: Adopting or defining the MMP does not absolve the proponent from complying with any applicable legislation or the general “duty of care” set out in Section 28(1) of the NEMA that states, “Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.” (Note: When interpreting this “duty of care” responsibility, cognisance must be taken of the national environmental management principles contained in Section 2 of the NEMA.**
- 14) **NOTE: This document can be used as a template to assist in the information required and is to be filled out in full. The Department reserves the right to request any additional information during the initial development and submission of the draft MMP.**
- 15) **NOTE: The Department reserves the right to not adopt the MMP and require that an application be submitted to obtain Environmental Authorisation for the respective activities. Furthermore, consideration for the review should also be aligned to the periodic reviews of the General Authorisation for sections 21 (c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) to ensure continued alignment and compliance.**

## B. MAINTENANCE MANAGEMENT PRINCIPLES

- 1) The following are overarching principles to be used by landowners and managers when considering the development and implementation of an MMP:
  - a. The anticipation and prevention of negative impacts and risks, then minimisation, rehabilitation or 'repair', where a sequence of possible mitigation measures to avoid, minimize, rehabilitate and/or remedy negative impacts is explicitly considered;
  - b. Avoid and reduce unnecessary maintenance;
  - c. Maintenance and management of a watercourse must be informed by the condition of the physical and ecological processes that drive and maintain aquatic ecosystems within a catchment, relative to the desired state of the affected system;
  - d. Management actions must aim to prevent further deterioration to the condition of affected watercourses and, overall, be guided by a general commitment to improving and maintaining ecological infrastructure for the delivery of ecosystem services;
  - e. Managers and organs of state must identify, address and, where feasible, eliminate the factors that necessitate intrusive, environmentally damaging maintenance; and
  - f. A process of continuous management improvement be applied, namely Planning; Implementing; Checking (monitoring, auditing, determine corrective action) and Acting (management review).

- 2) The following table provides a simple overview for the determination of the need for an MMP:

	<b>Question</b>	<b>If the answer to any of the questions is YES, then an MMP may be applicable.</b>
2.1	Is there a watercourse on or adjacent to the property?	Yes
2.2	Has there been a history of flood damage or vandalism to the existing infrastructure or watercourse – erosion and/or sedimentation?	Yes
2.3	Is there infrastructure or any community at risk of being damaged by flooding?	Yes
2.4	Is the design of infrastructure considered inadequate in terms of managing the risk of flooding, erosion and/or sedimentation?	Yes
2.5	Would you consider an improved design to existing infrastructure to reduce maintenance needs?	Yes
2.6	Are there specific incidences where the watercourse is obstructed, or blockages occur that alter the flow of the river during floods?	Yes
2.7	Is there an existing obstruction in the watercourse that has changed the flow of the river under normal conditions?	Yes
2.8	Is there a marked increase in the rate of erosion/sedimentation being experienced which threatens operations and assets?	Yes
2.9	Is there a presence of alien or bush encroachment vegetation within the watercourse and/or the presence of woody debris after flooding?	Yes

- 3) It is important to consider that the type of maintenance required will impact on the level of assessment needed in terms of the impact the activity will have on the system and how best to mitigate the impact. Types of maintenance can broadly be classified in the following categories, with recognition that maintenance activities vary across the rural and urban context:

Maintenance Category	Types of maintenance activities (examples only)
<p><b>Category A:</b> Sediment removal as a result of deposition or sediment deposition as a result of erosion</p>	<ul style="list-style-type: none"> <li>• Clearing sediment or placing sediment at:               <ul style="list-style-type: none"> <li>○ Pump hole/trench</li> <li>○ Return flow (irrigation)</li> <li>○ Off-take weir</li> <li>○ Stormwater outfall</li> <li>○ Detention/retention ponds</li> <li>○ Canalized urban rivers</li> <li>○ Bridges, culverts and drifts</li> </ul> </li> <li>• Prevent formation of islands in the channel of the river</li> <li>• Dredging of in-stream dams</li> </ul>
<p><b>Category B:</b> Emergency repairs – urgent action required to manage risk and damage to assets</p>	<ul style="list-style-type: none"> <li>• Repair to erosion of riverbank or servicing infrastructure (e.g. pipelines/roads)</li> <li>• Removal of material built up as a result of flooding/sedimentation and increasing risk to infrastructure</li> <li>• Address damage or replacement of infrastructure (e.g. bridge, pipeline, pump house)</li> <li>• Manage the condition of flood protection berms, and existing structures such as gabions, canalized and stormwater systems</li> <li>• Installing temporary gravel approaches at flood-damaged river crossings</li> </ul>
<p><b>Category C:</b> Managing alien invasive and bush encroachment plant species</p>	<ul style="list-style-type: none"> <li>• Clearing of alien invasive vegetation out of a watercourse to reduce maintenance requirements as they relate to erosion and sedimentation</li> <li>• Management of indigenous species categorized as bush encroachment, to improve hydrological flow and reduce associated flooding impacts</li> </ul>
<p><b>Category D:</b> Rehabilitation and restoration activities for maintaining ecological infrastructure</p>	<ul style="list-style-type: none"> <li>• Development and maintenance of ecological buffering systems to improve and/or restore functioning (e.g. wetlands and stormwater detention ponds)</li> <li>• Actively rehabilitating riparian zones through planting of locally indigenous species</li> <li>• Bank grading and movement/removal of berms and barriers to flow</li> </ul>

- 4) The development of appropriate method statements to mitigate the impact of the maintenance needs, should be aligned within the framework of these considerations:
- a. Watercourses experience a natural process of sedimentation and erosion, with varying rates depending on the geomorphology and the integrity of the land-uses within the catchment;

- b. Manipulation of the watercourse results in increased erosion and/or deposition being experienced further downstream, perpetuating greater need for manipulation and more drastic and costly maintenance interventions;
  - c. Locally indigenous riparian and wetland vegetation assists in the stabilization of riverbanks through effective root structures, while contributing to improve in-stream habitat and water quality conditions;
  - d. Invasive alien and bush encroachment vegetation significantly impact on the functioning of a watercourse, often leading to increased flood associated damage, with further implications and a reduction in water quality and availability;
  - e. Persons undertaking maintenance activities have a responsibility to ensure a sense of duty of care is applied as prescribed within NEMA Section 28(1).
- 5) It is recognized that within urban areas, sedimentation and erosion rates are significantly amplified as a result of development in urban areas and thus systems associated with watercourses in such areas can no longer be considered as 'natural'. In such a context, the drivers of such a process are often located outside the control of the landowner or responsible authority (i.e. Municipality). Therefore, the response taken to address the needs of a maintenance management plan for a watercourse within the urban environment may be limited in mitigating the requirement for maintenance to be undertaken.

**C. REQUEST FOR THE COMPETENT AUTHORITY TO DEFINE OR ADOPT A MAINTENANCE MANAGEMENT PLAN FOR A WATERCOURSE IN TERMS OF THE NEMA, EIA REGULATIONS 2014 (AS AMENDED).**

The following information must be submitted as part of the request for the competent authority to define or adopt the MMP:

**1. PERSONAL DETAILS**

Highlight the Departmental Sub-Region(s) in which the maintenance is to be undertaken. (mark the appropriate box with an 'X'). For Departmental details see Annexure A.

REGION 1 (City of Cape Town Metropolitan and West Coast District) <input type="checkbox"/>	REGION 2 (Cape Winelands District, Overberg District) <input checked="" type="checkbox"/>	REGION 3 (Eden & Central Karoo Districts) <input type="checkbox"/>
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Name of person/authority who will undertake responsibility for the activity:	Overstrand Municipality		
Contact person (if other):	Ms Penelope Aplon		
Postal address:	P.O Box 20, Hermanus		
Telephone:	+27 (0) 28 313 8000	Postal code:	7200
Fax:	+27 (0) 28 312 1894	Cell:	
Email:	Penelope Aplon <pmichaels@overstrand.gov.za>		
Name of person who has prepared the MMP:	Bluescience (Pty) Ltd		
Contact Person (if other):	Ms Toni Belcher		
Postal address:	PO Box 455, Somerset Mall		
Telephone:	021 8510555	Postal code:	7137
Fax:		Cell:	
E-mail:	toni@bluescience.co.za		
Name of landowner(s) on whose behalf the plan has been developed: *	Overstrand Municipality		
Contact person(s):	Ms Penelope Aplon		
Postal address:	P.O Box 20, Hermanus		
Telephone:	+27 (0) 28 313 8000	Postal code:	7200
Fax:	+27 (0) 28 312 1894	Cell:	
E-mail:	Penelope Aplon <pmichaels@overstrand.gov.za>		
Municipality for proposed project:	Overstrand Municipality		
Farm name(s), erf(s) and portion number(s) etc*:	Remainder of Farm 566 (Middle Vlei), Hawston and extending into Erf 394 and a portion of Rem/1 <i>The hillslope seeps lie within private properties (Erven 57, 60, 116, 117, 130, 1123, 1126, Re/49, Re/1387)</i>		
Magisterial District or Town:	Hawston, Overstrand		
Name(s) of watercourse(s) in question:	Paddavlei and associated hillslope seeps and ecological corridor		
<b>*In instances where there is more than one landowner, please attach a list of landowners with their full names, contact details, farm name, farm number, portion number, Erf number, coordinates and signed declaration confirming approval for development and responsibility of the MMP</b>			

## 2. DECLARATION

### THE PERSON THAT WILL BE UNDERTAKING THE MAINTENANCE

I ....., in my **personal capacity** or **duly authorised** (please circle the applicable option) by ..... (name of legal entity) thereto hereby declare that I/we:

- Request the MMP to be adopted by the Competent Authority;
- Regard the information contained herein to be true and correct for this Maintenance Management Plan;
- Am fully aware of my responsibilities in terms of the National Environmental Management Act of 1998 ("NEMA") (Act No. 107 of 1998) and that, notwithstanding the adoption of this MMP, I/we shall comply with any other statutory requirement applicable, which may include, but not limited to the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), the National Water Act, 1998 (Act No. 36 of 1998) and the Environmental Impact Assessment Regulations, 2014 (as amended) ("EIA Regulations"), in terms of NEMA;
- Am fully aware that the proposed maintenance constitutes a listed activity in terms of the NEMA EIA Regulations, 2014 (as amended) and that an environmental assessment for environmental authorisation may be required for any other listed activities not included as part of this MMP;
- Acknowledge that any activity undertaken that does not form part of the defined and adopted MMP, will be subject to the Section 24(F) of NEMA and that appropriate enforcement and compliance requirements will follow;
- Shall undertake only those tasks described in the MMP, failing which environmental authorisation will be required, where applicable;
- Shall provide the competent authorities with access to all information at my disposal that is relevant to this request;
- Shall be responsible for any costs incurred in complying with environmental legislation;
- Hereby indemnify the government of the Republic, the competent authority and all its officers, agents and employees, from any liability arising out of, inter alia, any loss or damage to property or person as a consequence of undertaking this MMP; and
- Am aware that a false declaration is an offence in terms of Regulation 48(1)(a) GN No. R. 982 of 4 December 2014 (as amended).

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Signature of the proponent:

Date:

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Name of institution/company:

### 3. BACKGROUND AND INTRODUCTION

#### 3.1. Definitions of Terms and Acronyms

##### Definitions:

##### **Maintenance Management Plans (MMP) and Maintenance Activities**

An MMP is a document that describes maintenance activities that need to take place within a riverine environment that have been pre-approved by the authorities. MMPs specifically relate to Activities 19 and 12 as listed in the NEMA EIA Regulations Listing Notice 1 of 2014 (GN R. 983) and Listing Notice 3 of 2014 (GN R. 985) respectively. Infilling or removal of more than 10m<sup>3</sup> material within a watercourse, and/or removal of indigenous vegetation of more than 300m<sup>2</sup> within a Critical Biodiversity Area (CBA) are allowed, only if the works are undertaken for maintenance purposes AND form part of this MMP when approved by the DEA&DP.

Maintenance activities are activities performed to keep a structure or system functioning or in service on the same location, capacity and footprint. It is therefore activities that do not change the size of structures (thus "like for like" activities).

**"Activity"** means an activity identified in any notice published by the Minister or MEC in terms of section 24D(1)(a) of the Act as a listed activity or specified activity. Activity in this document refers to the activities as listed in Listing Notice 1, 2 and 3 of the Environmental Impact Assessment Regulations, 2014.

**"Bush Encroachment"** means stands of plants of the kinds specified in column 1 of Table 4 of the Conservation of Agricultural Resources Act (Act No. 43 of 1983) where individual plants are closer to each other than three times the mean crown diameter;

**"Diverting"** as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 26 August 2016), means to, in any manner, cause the instream flow of water to be rerouted temporarily or permanently.

**"Ecological Infrastructure"** refers to naturally functioning ecosystems that deliver valuable services to people, such as water and climate regulation, soil formation and disaster risk reduction.

**"Flood event"** is the event where land is inundated by the overflowing of water from a river channel and where this event causes significant damage to infrastructure or results in watercourse erosion and/or sediment deposition.

NOTE that flooding can be a natural phenomenon in many river or wetland systems which, due to encroachment and human modification of the form and function of the affected system, may have evolved into a potential hazard to life or property.

**"Flow-altering"** as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 26 August 2016), means to, in any manner, alter the instream flow route, speed or quantity of water temporarily or permanently.

**"Impeding"** as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 26 August 2016), means to, in any manner, hinder or obstruct the instream flow of water temporarily or permanently, but excludes the damming of flow so as to cause storage of water.

**“Indigenous vegetation”** refers to vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years. Consideration will be made where the indigenous plants species are considered as bush encroachment species and thus requiring active maintenance.

**“Maintenance”** means actions performed to keep a structure or system functioning or in service on the same location, capacity and footprint.

**“Maintenance Management Plan”** means a management plan for maintenance purposes defined or adopted by the competent authority.

**“River Management Plans”** as defined in the General Authorisation, in terms of section 39 of the National Water Act, 1998 (Act no 36 of 1998) for Water Uses as defined in Section 21(c) and 21(i) (GN. 509 of 26 August 2016), any river management plan developed for the purposes of river or storm water management in any municipal/metropolitan area or described river section, river reach, entire river or sub quaternary catchment that considers the river in a catchment context.

**“River reach”**, a length of river characterised by a particular channel pattern and channel morphology, resulting from a uniform set of local constraints on channel form. A river reach is typically hundreds of meters in length.

**“Stretch”** a section of watercourse, delineated between two or more mapped coordinates, within which proposed maintenance activities are to take place as guided by an MMP.

**“Thalweg”** refers to the line of lowest elevation within a valley or watercourse.

**“Watercourse”** means:

- (a) a river or spring;
- (b) a natural channel in which water flows regularly or intermittently;
- (c) a wetland, lake or dam into which, or from which, water flows; and
- (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse as defined in the National Water Act, 1998 (Act No. 36 of 1998);

a reference to a watercourse includes, where relevant, its bed and banks. The extent of a watercourse includes, where relevant, its bed and banks of which make up the riparian habitat or the 1:100-year flood line, whichever is the greatest.

**“Wetland”** means, 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.

**Acronyms:**

BGCMA	Breede Gouritz Catchment Management Agency
BGIS	Biodiversity Geographic Information Systems
CARA	Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), as amended
CBA	Critical Biodiversity Areas
DEADP	Department of Environmental Affairs and Development Planning
DWA	Department of Water Affairs (now Department of Water and Sanitation)
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EI	Ecological Importance
EIA	Environmental Impact Assessment
ES	Ecological Sensitivity
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Areas
GA	General Authorisation
GN	Government Notice
GPS	Global Positioning System
I&APs	Interested and Affected Parties
MMP	Maintenance Management Plan
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended
NEM:BA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act, 1998 (Act 36 of 1998), as amended
PES	Present Ecological State
TEC	Target Ecological Category
SANBI	South African National Biodiversity Institute
WMA	Water Management Area
WCBSA	Western Cape Biodiversity Spatial Plan
WUA	Water Users Association
WUL	Water Use License

### 3.1 Background and Introduction

*Provide a strategic overview of the need for the development of the MMP – what is the need for this plan; how this plan will aim to contribute to furthering sustainable practices and reducing and/or mitigating the need for maintenance.*

*This section must also include details of the responsible party who will implement the MMP, engineers or other specialists appointed and the specifications for their appointment to assess the needs for the maintenance work, the Environmental Assessment Practitioner (EAP) or consultant appointed to compile the MMP. A short portfolio of evidence which indicates the relevant freshwater/ aquatic experience of the EAP/consultant or the person who prepared the MMP is required as supporting information to the introduction.*

*Should sufficient expertise and resources be available for the development of an MMP by the applicant, the process of appointing an EAP for the final compilation and submission of the MMP to the Department is still required.*

#### **3.2.1 Project Introduction and Activity Description**

The Paddavlei Wetland forms part of an aquatic ecological corridor that is formed between the Onrus Mountain to the east and a coastal dune system to the west. The corridor arises within Hoek van die Berg Nature Reserve and provides connectivity to the Bot River Lagoon and estuary to the north. Historically Paddavlei was a seasonal open water pan but in more recent years it has become increasingly overgrown with bulrushes and its ecological condition has degraded. Due to concerns raised by the surrounding Hawston community, Overstrand Municipality initiated a process to rehabilitate the wetland. The wetland, ecological corridor, hillslope seeps and infrastructure associated with these aquatic features will potentially require periodic maintenance. This maintenance and management plan addresses this maintenance.

#### **3.2.2 Need for this MMP and how it will contribute to future sustainable practices and reducing and/or mitigating the need for maintenance**

This MMP is intended to provide the necessary permissions to undertake maintenance activities at the Paddavlei wetland as well as within the associated hillslope seeps and the ecological corridor upstream and downstream of the vlei. The maintenance activities comprise primarily of the following activities to ensure that the wetland features remain in a desired ecological condition and are able to provide valued goods and services to the surrounding Hawston community:

- Clearing of nuisance growth of indigenous reeds;
- Aline vegetation clearing;
- Removal of dumped waste material and buildup of sediment and organic material in the wetlands;
- Water level management to control nuisance plants growth and aesthetic appeal; and
- Maintenance of roads and stormwater infrastructure in corridor.

#### **3.2.3 Party/ies responsible for implementation of this MMP**

The MMP is for Overstrand Local Municipality to undertake the required maintenance works.

#### **3.2.4 Specialist Consultants and Environmental Assessment Practitioner**

BlueScience (Pty) Ltd prepared a Rehabilitation and Management Plan for Paddavlei that has informed this MMP (**Annexure B**). See **Table 1** for more information on the MMP project team.

**Table 1: MMP project team, roles, qualifications and registrations/associations.**

Team Member	Company	Role / Expertise	Qualifications	Registrations and Associations
<b>Ms Toni Belcher</b>	BlueScience (Pty) Ltd	Freshwater Ecologist	M.Sc. Environmental Management; 30 years of relevant experience	Registered Natural Scientist -SACNASP No. 400040/10
<b>Mr Dana Grobler</b>	BlueScience (Pty) Ltd	Freshwater Ecologist	BSc (Hons); HED (1989) 32 years of relevant experience	Registered Natural Scientist - SACNASP <sup>1</sup> No. 002272;

### 3.2.5 Template used to compile this MMP

This MMP was prepared on the “Template for the Development of a Maintenance Management Plan for a Watercourse” that was issued by the Department of Environmental Affairs and Development Planning (DEA&DP) during March 2017.

## 3.3. Relevant Legislation and Strategies

### 3.3.1 National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended

This MMP specifically relates to **Activities 19 and 27** as listed in the National Environmental Management Act, 1998 (Act No. 107 of 1998), (NEMA) EIA Regulations **Listing Notice 1 of 2014 (GN R. 327)**, as amended, as well as **Activity 12** as listed in the NEMA EIA Regulations **Listing Notice 3 of 2014 (GN R. 324)**, as amended.

**Listing Notice 1, Listed Activity 19**, relates to “the infilling or depositing of any material of more than 10 cubic meters into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic meters from - (i) a watercourse...”.

Maintenance Activities 2 and 3, as per Section 3.2.1 above, often entail the removal or depositing of more than 10m<sup>3</sup> of material from or into the river system, hence the applicability of Listing Notice 1, Listed Activity 19. Note the definition of a “watercourse” in **Box 1**.

**Listing Notice 1, Listed Activity 27** reads as follows:

“The clearance of an area of 1 hectare or more, but less than 20 hectares of indigenous vegetation...”.

#### Box 1: Relevant Definition

##### What is a “watercourse”?

“Watercourse” in this document, is defined as in the National Water Act, 1998 (Act no 36 of 1998), and means:

“(a) a river or spring;

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

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

(d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse;

Furthermore, the extent of a watercourse includes, where relevant, its bed and banks of which make up the riparian habitat or the 1:100-year flood line, whichever is the greatest. Excludes the estuarine

<sup>1</sup> SACNASP: South African Council for Natural Scientific Professions

The areas to be cleared from alien vegetation or indigenous *Phragmites* reeds (i.e. Section 3.2.1, Activities 1a and 1b) may, over time, constitute more than 1 ha of indigenous vegetation in total, hence the inclusion of the Listed Activity 27 within this MMP. See **Box 2** for the definition of "indigenous vegetation".

**Listing Notice 3, Listed Activity 12**, relates to "the clearance of an area of 300 square meters or more of indigenous vegetation...

(a) Western Cape...

i) Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been Identified as critically endangered in the National Spatial Biodiversity Assessment 2004;

ii) Within critical biodiversity areas identified in bioregional plans, ..."

Sections of the study broader (downstream) area are listed as "Critically Endangered", as well as "Critical Biodiversity Areas" (CBAs) (**Annexure B**). Maintenance Activity 1, as per Section 3.2.1 above, entails the clearance of alien and/or indigenous vegetation. Listing Notice 3, Listed Activity 12 will be triggered if 300m<sup>3</sup> or more of indigenous vegetation will be cleared within a Critically Endangered ecosystem or within a CBA area, irrespective of the level of alien infestation. Note the definition of "indigenous vegetation" in the **Box 2**.

A Basic Assessment process should be undertaken and Environmental Authorisation obtained before activities listed in Listing Notices 1 and 3 may be commenced with. **Listing Notice 1, Listed Activities 19 and 27, and Listing Notice 3, Activity 12 are however allowed without Environmental Authorisation, if such activities are required "for maintenance purposes undertaken in accordance with a maintenance management plan"**.

The NEMA EIA Regulations Listing Notice 1 of 2014, as amended, defines "maintenance" and "maintenance management plan" as follows:

- "maintenance means actions performed to keep a structure or system functioning or in service on the same location, capacity and footprint"; and
- "maintenance management plan means a management plan for maintenance purposes defined or adopted by the competent authority".

An MMP is therefore designed to protect those undertaking maintenance works from being fined or legally prosecuted for routine maintenance activities which involves the above listed activities in rivers or on riverbanks.

This MPP will, after lapsing of the comment period, be finalised and submitted to the DEA&DP for approval in terms of the above-mentioned listed activities.

It is of the utmost importance that the holder of the MMP adhere to the MMP to prevent the triggering of listed activities that may need to be authorised. If in doubt, the DEA&DP should be contacted before commencement of any other activities not specified in this MMP.

It should be noted that adoption of a MMP by the DEA&DP does not absolve the holder of the MMP from its general "duty of care" set out in Section 28(1) of the NEMA which states that "Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment." When interpreting this "duty of care" responsibility, cognisance must be taken of the principles of sustainability as contained in Section 2 of the NEMA.

## Box 2: Relevant Definition

### What is "indigenous vegetation"?

"Indigenous vegetation" refers to "vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years. Consideration will be made where the indigenous plants species are considered as bush encroachment species and thus requiring active maintenance".

### **3.3.2 National Water Act, 1998 (Act No. 36 of 1998), as amended**

The National Water Act, 1998 (Act No. 36 of 1998), as amended (NWA) regulates the protection, use and governance of water resources, including rivers, wetlands and groundwater.

Part 1: General Principles (Sections 21 to 26 of the NWA) sets out general principles for regulating water use. Water use, as referred to in Section 21 of the NWA, is defined broadly and includes, *inter alia*, taking and storing water, activities which reduce stream flow, altering a watercourse, and recreation. In general, a water use must be licensed unless it is listed in Schedule I, is an existing lawful use, is permissible under a general authorisation (GA) in terms of Section 39 of the NWA, or if a responsible authority waives the need for a license.

The Department of Water and Sanitation's (DWS's) risk-based assessment was used in the MMP. Typically, activities within a low risk rating category can be authorised under the General Authorisation for Section 21 (c) and (i) of the NWA. Those with a higher risk rating need to be licensed. It should however be noted that the risk assessment undertaken as part of this MMP was not undertaken to specifically inform any water use authorisation process although the assessment would assist the Breede-Gouritz Catchment Management Agency (BGCMA) in its consideration of the proposed activities and their water use authorisation requirements. Many of the proposed maintenance activities are aimed at rehabilitation of the aquatic ecosystem, such as alien vegetation removal, or can be considered as an existing lawful use as they are associated with the maintenance of existing water supply scheme infrastructure. Section 5.3.5 below for the risk assessment.

Input from the DWS is required on the desired way forward in order in for the MMP activities to comply with the requirements of the NWA.

## 4. ENGAGEMENT PROCESS

### 4.1 Authority Engagement

Please indicate (with an 'x') which of the following authorities have been consulted to provide input based on the proposed maintenance activities:

- Department of Water and Sanitation
  - Catchment Management Agency
  - CapeNature
  - SANParks
  - Western Cape Department of Agriculture, Directorate: Sustainable Resource Management
  - District Municipality (*Overberg District Municipality*)
  - Local Municipality (*Overstrand Local Municipality*)
  - Irrigation Board / Water Users Association
  - Heritage Western Cape
  - Department of Agriculture, Forestry and Fisheries
  - Department of Environmental Affairs & Development Planning
  - Other (please list):
- 

*For each of the indicated authorities, please provide an explanation as to their required involvement. Details of interactions with each of the respective authorities should be captured by providing an attendance register and minutes of meetings attended with the authority in question. Comments received from the authorities must be submitted and referenced within the final application.*

*For an MMP where multiple property owners are involved or a plan is developed for members of an association, it is recommended that a Project Liaison Committee is setup, to achieve the following objectives:*

- *Present the project work plan and objectives for approval;*
- *Present the initial findings and draft of the plan for discussion and approval;*
- *Present the final accepted plan for adoption and clarification.*

*In cases where the Municipality is the proponent, it is advised that the Project Liaison Committee represent the multiple departments involved with the maintenance and management of watercourse, which could include but is not limited to departments of, Stormwater, Water and Sanitation, Environment, Parks and Wastewater. Such an approach seeks to ensure alignment and an understanding of the roles and responsibilities of the varying maintenance requirements within the Municipality.*

### 4.2 Public Participation

*You are required to notify any and all potential interested and affected party(ies) of the proposed activity(s) and allow them the opportunity to comment on the MMP for a watercourse. The detail required is outlined below, however this can be further discussed and determined as part of the pre-consultative meeting with the Department, which would ensure due diligence and good governance principles are applied.*

It is noted, that for the development of MMPs for watercourses within the urban edge, by Municipalities, public notice can be undertaken through the advertisement of the development of a MMP within local/community newspapers for the respective areas, with the relevant evidence of such an advertisement included in the final submission.

The following public participation recommendations regarding the two different scales of application are as follows. If no, then motivation must be given as to why a particular process was not undertaken:

**Multiple properties / maintenance and management activities along a watercourse occurring along a stretch of no more than 1 kilometre (≤1000 meters):**

(i) Given written notice to the owner or person in control of that land if the person undertaking the maintenance activity is not the owner or person in control of the land.	<b>Yes / No</b>	Overstrand is the primary landowner
(ii) Given written notice to adjacent landowners (up to 500m upstream and downstream from furthest upstream and downstream maintenance site and opposite side of the banks) of the development of the MMP.	<b>Yes / No</b>	Written notice provided to adjacent landowners, as part of the public participation process.
(iii) Stakeholder meeting held for adjacent landowners, in which MMP is presented. This must include an opportunity for adjacent landowners to provide comment.	<b>Yes / No</b>	Stakeholder meeting is to be held where adjacent landowners will be provided with opportunity to comment on MMP as part of public participation process.
(iv) Given written notice to any organ of state having jurisdiction in respect of any aspect of the activity(ies) proposed within the development of the MMP.	<b>Yes / No</b>	Written notice provided to relevant organs of state as part of the public participation process.
(v) Provided written notice and confirmation to the relevant Water Users Association (WUA) or Irrigation Board (IB) of the development of the MMP, if applicable.	<b>Yes / No</b>	There is no WUA/IB currently operational in the area of concern. The BGCMA has been notified of the compilation of this MMP.

Kindly note, the Department may request further or allow reduced requirements for public participation, noting the specific circumstances applied to each application. Please include or delete the respective sections as agreed to with the Department in the pre-consultative, with supporting evidence of this agreement included.

Please circle the appropriate answer above to indicate the public participation process that has been followed to give notice of this request to potential interested and affected parties and attach any comments and/or objections received, with evidence provided and referenced.

## 5. DATA COLLECTION AND ASSESSMENT

### **Information required for maintenance and management activities for a single/ multiple owners along a watercourse.**

- 5.1 Provide a map (at an appropriate scale) of the watercourse or stretch of watercourse being applied for within the stretch where maintenance activities will take place being clearly defined – consideration must be made to mapped features relating to Critical Biodiversity Areas (CBAs) and National Freshwater Ecosystem Priority Areas (NFEPAs).
- 5.2 GPS coordinates must be provided for both the site(s) at which maintenance activities will take place and included on the map which defines the stretch of watercourse. Coordinates must be provided in degrees, minutes and seconds using the Hartebeesthoek94 WGS84 co-ordinate system. Where numerous properties/sites are involved (e.g. linear activities), you may attach a list of property descriptions and co-ordinates to this form.
- 5.3 Specialist assessment to be undertaken to determine (NOTE: information relating to the specifications and Terms of Reference used for the appointment of all specialist inputs must be provided):
- Hydrological and geomorphological assessment of watercourse functioning;
  - The relevant Present Ecological Status (PES) of the stretch of watercourse in question, if not available an assessment is to be done to determine PES in accordance with the Department of Water and Sanitation (DWS) guidelines;
  - What is the reason/cause for the maintenance activities based on an ecological and hydrological assessment of the watercourse within the context of the larger catchment;
  - What are the drivers of system functioning within the watercourse and what is the ecological objective – based on historical condition and PES;
  - What is the management objective given the ecological status of the watercourse based on historical and PES data; as set out in agreement with the person(s) responsible for undertaking the maintenance activities;
  - What is the impact on the watercourse/river system (resource quality characteristics: flow regime, geomorphology, water quality, habitat and biota) for a minimum of 500m both up and downstream of the proposed maintenance activities, with the mitigation measures included?
  - An appropriate assessment for risk for each of the proposed types of maintenance activities and linked management actions in terms of the risk matrix for General Authorisations (GA) of Section 21 (c) and (i) by the DWS (GN 509 of 2016) or where applicable.
- 5.4 Mapped biodiversity features such as Critical Biodiversity Area, Ecological Support Area, National Freshwater Ecosystem Priority Area (NFEPAs), and the National list of Ecosystems that are threatened and in need of protection (2011) gazetted in terms of Section 53 of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA), as well as relevant provincial specific plans and classifications etc. Please consult the website [www.bgis.sanbi.org.za](http://www.bgis.sanbi.org.za) to determine mapped features.
- 5.5 Include a description of existing or previous protection measures or reinforcements (e.g. gabions or groynes etc.) and infrastructure. Describe any evidence of erosion and/or

*siltation at the various sites and outlining possible causal factors and maintenance practices.*

- 5.6 Provide historical maps and data (images/flow/water quality/land use) of the river channel (if available) in order to assess the natural to changing flow patterns of the watercourse to determine cause of maintenance and possible impact of the maintenance activities, to inform mitigation measures.*
- 5.7 Provide a photographic record for the condition of the riparian habitat around maintenance sites, with the presence of important and/or sensitive habitat/species noted.*
- 5.8 For sites prone to flood damage, a description regarding the history and effect of past floods and include dates of most recent events must be provided. This must inform the process to understand what actions are required along the stretch of the watercourse to reduce such impacts to the resource quality characteristics.*
- 5.9 Explain the risks associated with the no-go option for the MMP i.e. the risk of not undertaking the maintenance activities as stated in the MMP.*
- 5.10 Reference must be made to any strategic plan where available, for example, a Catchment Management Strategy, with the objectives of the MMP shown to be in alignment with such plans.*

**A: Information required for a single / multiple property / WUA / IB / municipality applying for a single RMMP which covers a stretch of river longer than 1km/ a catchment / sub-catchment area:**

**5.1. Map of the project area:**



**Figure 1. Topographical map (3419AC) for the area, with the location of Paddavlei Wetland indicated**

## 5.2. General Description of Aquatic Features

**Table 3: Summary of key information related to the study area**

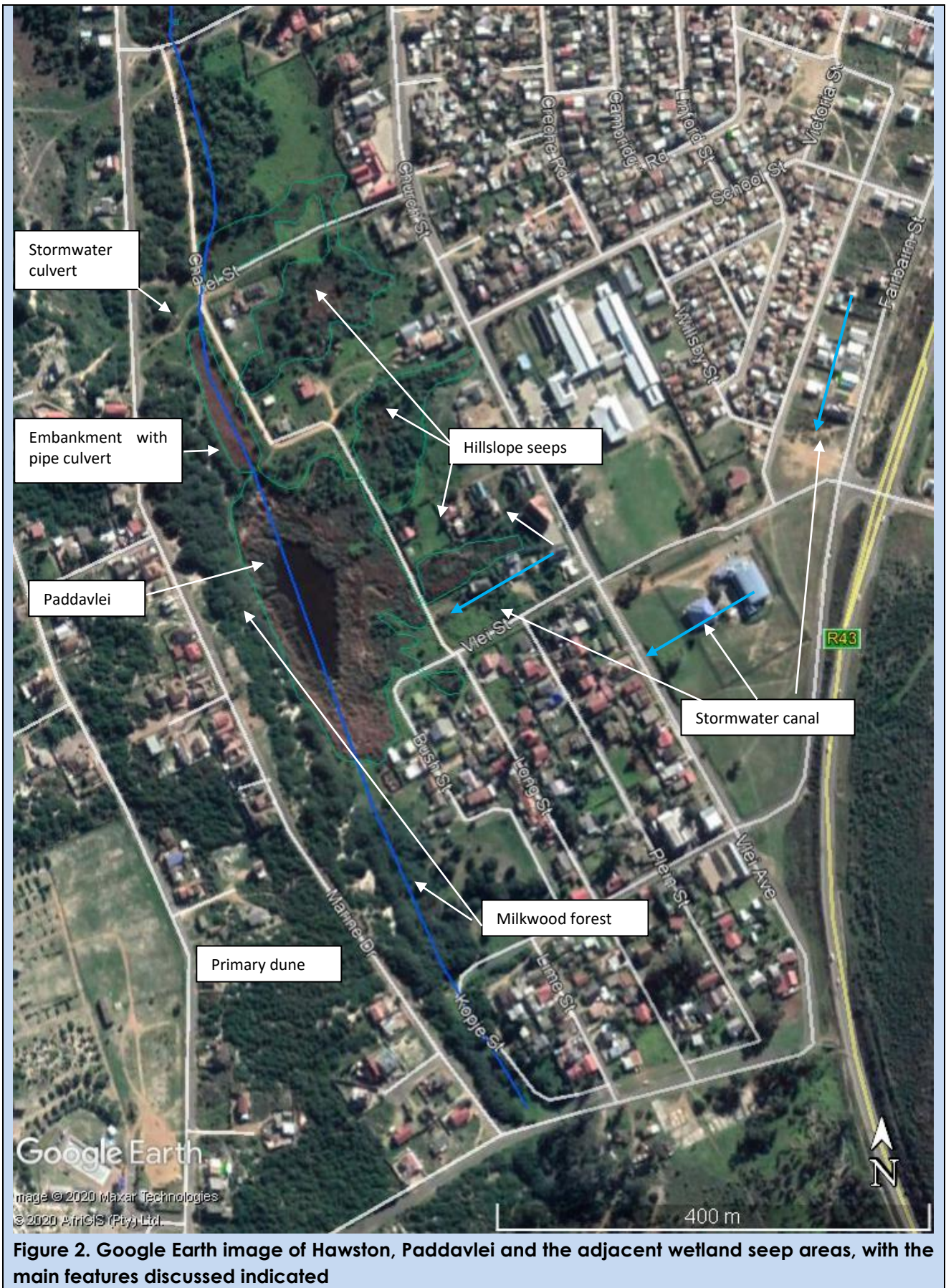
Descriptor	Name / Details	Notes
Water Management Area (WMA)	Breede Gouritz WMA	
Catchment Area	Bot River	
Quaternary Catchment	G40G	
Present Ecological State	Bot Lagoon: C (Moderately Modified)	Bot/Kleinmond Estuarine Management Plan and Water Resource Class and Resource Quality Objectives for the Breede Gouritz WMA
Ecological Importance and Sensitivity	Ecological Importance – Very High	
Target Ecological Category	C (Moderately Modified)	
Water resource component potentially impacted	Paddavlei and associated hillslope seeps and ecological corridor	
Latitude	34°23'31.16"S	Centre of the Paddavlei
Longitude	19° 7'47.47"E	

Paddavlei wetland consists of a much-reduced open water area, surrounded by a bulrush (*Typha capensis*) dominated reed bed. The upper extent of the vlei starts at the houses along Bush Street. The vlei then widens at Vlei Street, extending up to Long Street. Where Long Street turns to the west and then north again, the wetland narrows. At this point pipe culvert and embankment has been placed within the wetland that allows access over the vlei. The wetland then continues northward in a narrow band to Chapel Street (Figure 2).

The shallow margins of the vlei along Long Street comprise of a mix of indigenous tabakbos (*Senecio halimifolius*), fonteinbos (*Psoralea pinnata*), milkweed (*Gomphocarpus physocarpus*), arum lilies (*Zantedeschia aethiopica*) and the sedge *Cyperus longus* and exotic kikuyu (*Pennisetum clandestinum*) and Pampas grass (*Cortaderia selloana*), Brazilian peppertrees (*Schinus terebinthifolia*), syringa (*Melia azedarach*), red sesbania (*Sesbania punicea*), castor-oil plant (*Ricinus communis*), nasturtiums (*Tropaeolum majus*) and Patterson's curse (*Echium plantagineum*).

The seaward edge of the wetland is bounded by a large dune with a milkwood (*Sideroxylon inerme*) forest dominating the foot of the dune, along the western edge of the vlei. A milkwood forest also dominates the aquatic corridor upstream while downstream of the vlei, the milkwood forest is degraded and invaded with alien Acacia trees. The remaining vegetated edges of the vlei consist of shrubs such as *Searsia lucida*, *S. glauca*, *S. tomentosa* and *Chrysanthamoides monillifera*, with fynkweek grass (*Cynodon dactylon*), with clumps of sour figs *Carpobrotus edulis* and *C. asciniciformis*, pelargoniums (*Pelargonium alchemilloides*) and asparagus ferns (*Asparagus sp.*). A moderate level of alien plant infestation of Rooikrans (*Acacia cyclops*) and Port Jackson (*A. saligna*) occurs within the dunes and forested areas while the grassed areas around the vlei are overgrown with invasive alien kikuyu grass.

The town of Hawston surrounds the wetland, with some of the residential development lying below the flood levels for the wetland. On the hillslope to the east of the vlei are a number of hillslope seeps that are associated with stormwater runoff from the town. Consideration of the past imagery of the site also appear to indicate that the area where the seeps occur have longer been in existence and are naturally occurring but have increased in extent and inundation as a result of the stormwater runoff.



**Figure 2. Google Earth image of Hawston, Paddavlei and the adjacent wetland seep areas, with the main features discussed indicated**



**Figure 3. View of the core Paddavlei area, west of Long Street**



**Figure 4. View of the northern portion of Paddavlei near Chapel Street**



**Figure 5. View of one of the hillslope seeps, east of Long Street**

### **5.3. Biodiversity Conservation Importance**

The aquatic ecological corridor in which Paddavlei is located is linked to formally protected areas:

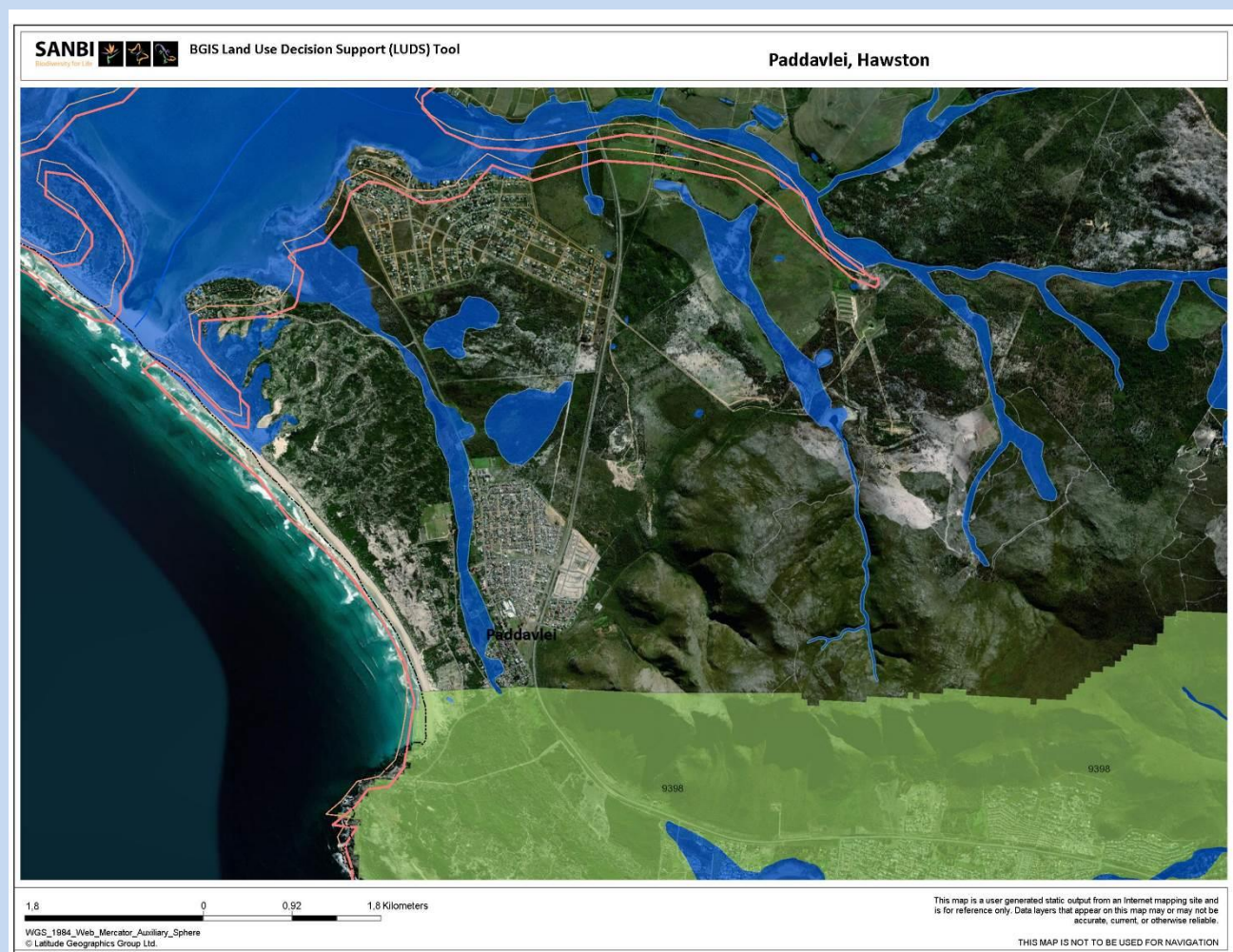
1. The Bot-Kleinmond Estuarine System, into which the aquatic ecological corridor drains, is a designated Ramsar wetland and recognised as one of the ten most significant wetlands for water birds in South Africa during the dry summer months (86 species of water bird have been recorded) and is an nursery area for fish (41 fish species from 24 families recorded, of which 19 species are dependent on estuaries to complete their lifecycle); and
2. Hoek van die Berg Private Nature Reserve to the south-east of Paddavlei, with the associated aquatic ecological corridor arising within the reserve.

Over and above the formally protected areas, there are two sets of biodiversity conservation mapping initiatives at a national, provincial and local scale are of relevance to the identification of aquatic features of ecological and biodiversity conservation importance. These are the National Freshwater Ecosystem Priority Areas (FEPA) map and the 2017 Western Cape Biodiversity Spatial Plan (WCBSP)

The entire aquatic ecological corridor, including Paddavlei, has been mapped as a natural Freshwater Ecosystem Priority Area (FEPA) Wetland (Channelled valley-bottom wetland within the South Strandveld Bioregion) by the National FEPA and National Wetland Mapping projects (Figure 6). The larger Bot River catchment is not mapped as a FEPA River sub-quaternary catchment.

Only the downstream Middelvlei / Skilpadvlei and Bot Lagoon are mapped as aquatic Critical Biodiversity Areas (wetlands and estuary) (Figure 7) that are required to meet biodiversity and should be maintained to prevent any further loss of aquatic habitat. Paddavlei and the remainder of its associated wetland corridor is mapped as an aquatic (wetland and watercourse) Ecological Support Area that should be restored. These areas are not deemed essential for meeting biodiversity targets but play an important role in supporting the functioning of Protected Areas or Critical Biodiversity Areas and are often vital for delivering ecosystem services. The management objective is to restore and/or manage these areas to minimize impact on ecological processes and ecological infrastructure functioning, especially soil and water-related services, and to allow for faunal movement. The coastal dune field to the west of the vlei is also mapped as an aquatic Ecological Support Area.

The aquatic ecological corridor also provides an important ecological connectivity between the Bot Lagoon, the wetlands within the corridor, *Juncus cf. kraussii* wetlands at Hoek van die Berg and the Vermont Pan to the east of Hawston.



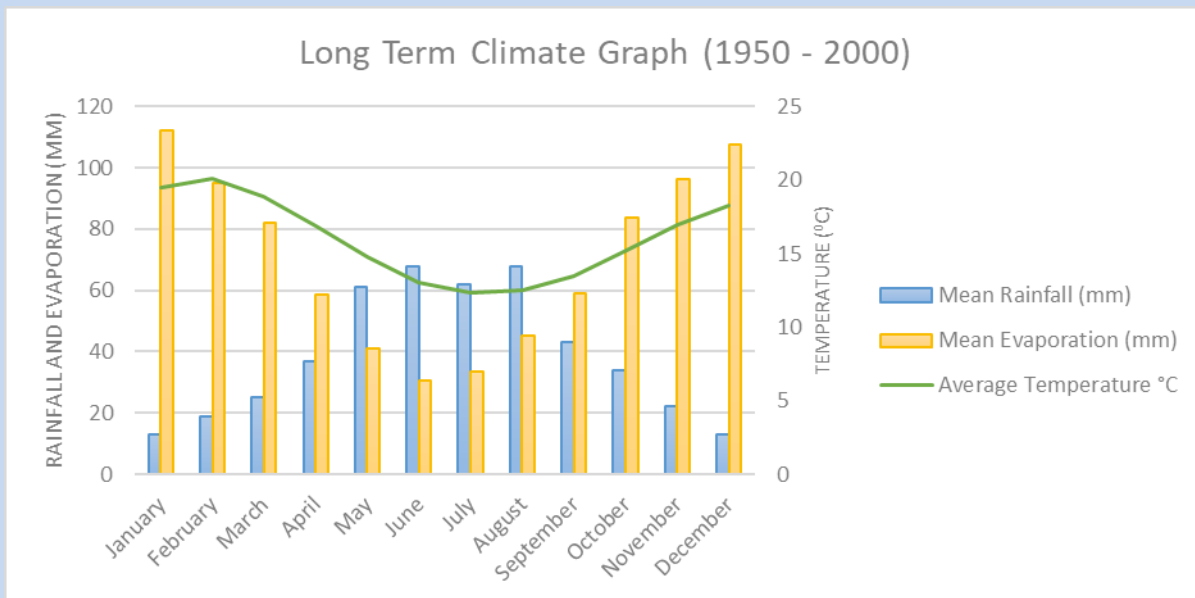
**Figure 6. National Freshwater Ecosystem Priority Area River and Wetland mapping for the area where the red oval indicates the locality of Paddavlei**



**Figure 7. Ecological Support Areas (ESA) River mapping for the area where the red oval indicates the locality of Paddavlei**

## 5.4 Climate and Hydrology

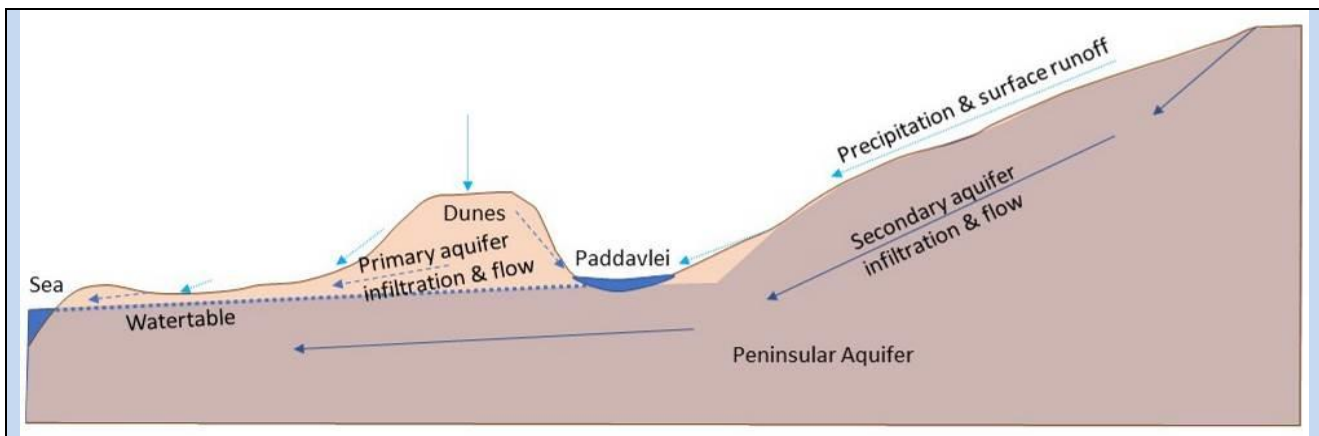
Hawston experiences a Mediterranean climate, with cool wet winters and warm dry summers. Average daily temperatures range from 12-14° C in winter and 15-20°C in summer (Figure 8). The region is the coldest during July when the mercury drops to below 7°C on average during the night. The annual average rainfall for the area is 561 mm, with the lowest rainfall (13 mm) occurring in December and January and the highest (68 mm) in June and August. The total annual evaporation for the area is 845 mm and is highest in January (112 mm). During the driest months (December to March), the area is also exposed to the prevailing southeast winds and the fire hazard is greatest.



**Figure 8: Long term climate graphs for the area (Source: SA Atlas of Climatology and Agrohydrology, 2009, R.E. Schulze)**

The site falls within the lower Bot River Catchment (Department of Water and Sanitation Quaternary Catchment G40G). This Quaternary Catchment is characterised by a relatively high Mean Annual Precipitation of 701 mm, a Mean Annual Evaporation of 1 415 mm, and a simulated Mean Annual Runoff of 24.6 million cubic metres over a total area of 220 km<sup>2</sup>. The cumulative mean annual runoff for the entire Bot River Catchment (catchment area of 920 km<sup>2</sup>) is estimated to be 98.67 million cubic metres. The catchment of Paddavlei is much smaller at approximately 0.93 km<sup>2</sup> with a mean annual precipitation of 561 mm. Infiltration rates are also high for most of the catchment with very little direct surface water runoff. Most of the runoff from the Onrus Mountain is intercepted upstream of the R43 road and channelised via stormwater canals. Given the above, the average surface water runoff to the vlei is likely to be less than 50 000 m<sup>3</sup> per annum.

The expected ground and surface water flows at Paddavlei are as follows (illustrated in Figure 9): Rainfall at Paddavlei will infiltrate the surrounding sands and flow in a direction that mimics the topography. It is expected that the wetland area is fed from the mountain run-off and from rainwater infiltration in the low-lying area around the wetland. Rainfall infiltration at the high dune area will infiltrate to the bedrock where it would flow towards the sea. Groundwater from the secondary aquifer is recharged from rainfall in the Onrus Mountain and flows in a south westerly direction towards the sea.



**Figure 9. Schematic diagram of the surface and groundwater interaction at Paddavlei**

### **5.5. Present Ecological Status**

The Paddavlei wetland can be classified as a duneslack depression with associated hillslope seep areas. The mosaic of wetland habitats within the ecological corridor on the valley floor also forms part of a series of unchanneled and channeled valley bottom wetland habitats.

Wetland areas are formed by very distinct hydrological, water quality and sediment dynamics that characterise the plant communities and other biota occurring within the wetlands. With the onset of development, hydrology (i.e. change in variability and seasonality of flow), water quality (in particular nutrient enrichment) and sediment dynamics (increased sediment deposition) are transformed, and the characteristics of the wetlands and the associated ecology are also transformed.

The Paddavlei wetland was found to be in a largely natural to moderately modified ecological state (B/C Category) while the associated hillslope seeps are in a moderately modified ecological condition. The surrounding land use activities have impacted on the habitat as well as the flow and water quality of the water feeding the wetland areas. The hillslope seeps that are smaller in extent and within the urban areas have been more impacted, particularly in terms of hydrology, water quality and vegetation.

The present ecological condition of the wetland areas has a negative trend (deteriorating), thus justifying the need for rehabilitation and maintenance management interventions.

The main impacts on the wetland area are a combination of direct and indirect cause and effect relationships as listed below:

- A direct loss of some of the wetland habitat due to the construction of roads within the wetland area;
- Wetland habitat modification and degradation as a result of disturbance caused by adjacent housing that extends to within the wetland areas;
- Flow modification from storm water runoff have resulted in an increase in the inundation of the wetland with a change in the associated wetland vegetation – the more permanently wet conditions favour the growth of bulrush (*Typha capensis*) reeds within the wetlands;
- A reduction of sub-surface flow to the wetlands due to increased groundwater use;
- Modification of the geomorphological character and hydraulics within the wetland systems as a result of infrastructure placed within the wetlands;
- Water quality modification from storm water runoff have resulted in nutrient enrichment of the wetland areas with an increase in wetland vegetation, again favouring the growth of bulrush (*Typha capensis*) reeds;
- Water quality degradation as a result of seepage from septic and overflowing conservancy

- tank systems that occur within or adjacent to the wetland areas;
- Terrestrial encroachment of the outer edges of the wetland as well as invasion by indigenous bulrush as well as alien plants such as kikuyu grass that results in wetland habitat and vegetation transformations;
  - Increasing sedimentation of the wetland areas due to the fact that the increasing growth of bulrush adds with the entrapment of sediment; and
  - Dumping of litter, particularly within the storm water inlets to the wetland, and rubble have modified the wetland habitat and impacted on the integrity of the wetland.

#### **5.6. Ecological Importance and Sensitivity**

Wetland areas are valued for the goods and services that they are able to provide, including the provision of habitat for biota. Once wetlands are altered, their ability to provide goods and services become impaired. It is thus important to manage the wetlands to ensure that they can continue to provide the valued goods and services.

Paddavlei and its associated hillslope seeps are considered of **moderate to high** ecological and functional importance. This is largely due to the fact that the wetlands form part of the ecological corridor linking the Vermont Pan (approx. 3 km to the south-east of Paddavlei) and a number of other wetlands with the Bot River Lagoon (more than 3 km to the north-west of the vlei). The wetlands also provide valued goods and services (in particular flood attenuation and water quality amelioration services) and represent a regionally threatened habitat type that supports red data fauna such as the Western Leopard Toad (*Sclerophys pantherinus*) as well as a number of other amphibians and water bird species.

#### **5.7. Recommended Ecological Category for the Paddavlei Wetland and its associated Aquatic Ecosystems**

The Paddavlei Wetland forms part of an integrated mosaic of wetlands that is linked to the Bot Lagoon and should be managed and / or maintained in at least a C category (moderately modified) ecological condition. This would be in agreement with the Recommended or Target Ecological Category for the Bot River Lagoon.

It is however also recommended that the wetland area be zoned as shown in Figure 10, with areas indicated to be of biodiversity conservation value being rehabilitated where necessary and maintained in a largely natural (B Category) condition while certain areas are zoned and rehabilitated for aesthetic and recreational use. These areas could be maintained in a moderately modified ecological condition (C Category).



## **5.8. Freshwater Impact Assessment**

The impacts of the proposed activities included in this MMP are assessed in light of the ecological condition and sensitivity of the aquatic features on the site, as discussed above. The activities listed below related largely to those activities that have been identified in the wetland Rehabilitation and Management Plan as requiring intervention. Many of the activities identified require not only initial interventions but also longer-term maintenance and are hence included in this MMP.

### **Activity 1a: Clearing of alien vegetation**

Paddavlei as well as the associated hillslope wetlands and the ecological corridor upstream and downstream of the wetland contain invasive alien vegetation such as: Port Jackson willows (*Acacia saligna*), Rooikrans (*A. cyclops*), golden wattle (*A. pycnantha*), *Eucalyptus* sp., weeping willows (*Salix babylonica*) manatoka (*Myoporum montanum*), Pampas grass (*Cortaderia selloana*), Brazilian peppertree (*Schinus terebinthifolia*), syringa (*Melia azedarach*), red sesbania (*Sesbania punicea*), castor-oil plant (*Ricinus communis*), nasturtiums (*Tropaeolum majus*), Patterson's curse (*Echium plantagineum*) as well as kikuyu grass (*Pennisetum clandestinum*).

Growth of alien vegetation within the watercourses and wetlands, particularly if it is invasive, is usually at the expense of natural, indigenous aquatic vegetation which simply cannot compete. Negative impacts of alien vegetation include: reduced water availability; reduced habitat diversity and an associated reduction in biodiversity; much hotter and destructive fires which destroy indigenous seed in the soil and are difficult to control; and form barriers to the movement of biota. It also provides limited goods and services in relation to that of the natural vegetation. The removal of invasive alien plants from the ecological corridor and wetlands is desirable not only from an aquatic ecological perspective but also due to the fact that they reduce the ability of the aquatic features to provide a number of valuable goods and services.

Significance of impacts without mitigation: Low to moderate significance depending on methods employed and the level of intervention required to remove the alien vegetation without impacting on the aquatic habitat and remaining indigenous vegetation.

#### Proposed mitigation:

- Identify alien plants to be removed. A table of the key alien plants (Table 5) has been included in the method statement to assist with this. If unsure, please contact the Department of Agriculture or CapeNature for assistance. Regular monitoring and control of alien vegetation should be undertaken to ensure that the plants are removed while still young saplings that can more easily be removed (usually pulling of seedlings by hand is possible when the soil is wet). This also prevents the spread of the alien plants once seeds have been produced;
- Avoid trampling or clearing indigenous vegetation by using established paths where possible;
- Clear alien vegetation according to the described alien vegetation removal methods for each invasive species as provided in the detailed method statements or with the methods and herbicides/biological control recommended on the Working for Water website: <http://www.dwaf.gov.za/wfw/>;
- A phased plan for the alien vegetation clearing may need to be compiled where the alien vegetation is extensive that progressively removes the alien vegetation. Prioritisation of the areas could be linked to other maintenance activities to obtain the best results with the least impact;
- Clear felled alien vegetation from the aquatic habitats and remove to an approved disposal area;
- Where necessary revegetate cleared areas with suitable indigenous vegetation as suggested in this report. Planted areas will require irrigation and care for a period of 1-2 years following

planting. This is particularly a requirement where most of the natural flow within the watercourses have been diverted for use or where the re-established vegetation is on the dry banks of the rivers. Planting of the new vegetation at the start of the wet season can assist ensuring that the new vegetation is kept wet however one would need to then avoid planting new vegetation within the areas that will be inundated in winter or subjected to flood flows. . Clearing of alien vegetation on the wider dune area will need to be undertaken with care to not clean the dune of cover vegetation and destabilise it. Work in this area would thus need to be under the guidance of a rehabilitation specialist with suitable applicable expertise; and

- Ongoing monitoring and clearing of regrowth of alien plants within these areas will be required.

Significance of impacts after mitigation: Very low disturbance impact if mitigation measures are effectively implemented; if revegetation with indigenous species and follow-up control takes place, a low to moderate positive impact could be expected.

Impact table:

Potential impact on freshwater features	Clearing of alien vegetation		
Nature	Disturbance of aquatic habitat and vegetation	Status	-
Impact source(s)	Clearing of instream and riparian vegetation		
Impacted aquatic ecosystem	Aquatic habitat and biota at the site where clearing takes place		
Irreplaceability of resources	Moderate to high		
Magnitude	Extent	Local	
	Intensity	Moderate	
	Duration	Short to medium term	
	Reversibility	Reversible	
	Probability	High	
Significance	Without mitigation	Medium to Low negative	M / L -
	With mitigation	Very Low negative to Low/Medium positive	VL- / L/M+
Cumulative impact	Without mitigation	High	
	With mitigation	Very Low with the potential for a positive impact	
Confidence	Medium/high		

### Activity 1b: Clearing of nuisance growth of indigenous vegetation

Nuisance growth of indigenous aquatic vegetation such as bulrush and common reeds usually needs to be managed in rivers within agricultural areas where the natural control measures such as floods have significantly been reduced, grazing by large mammals does not occur and where there is an elevated supply of nutrients such as with irrigation return flows. The removal of these plants is thus periodically undertaken in order to maintain an open channel to ensure that flow in the channel is unimpeded. The control of nuisance growth of indigenous reeds needs to be undertaken very judiciously, with careful control and consideration for the environment. **Control** should only aim to remove excessive plant growth and build-up of material that can cause flooding.

Bulrush (*Typha capensis*) and common reeds (*Phragmites australis*) are indigenous plants with an ecological function. Where natural vegetation occurs along the river channel it offers a degree of refuge and habitat for biota as well as providing essential ecological services such as reducing erosion, causing deposition of silt, cooling instream habitats and reducing wind, thereby reducing evaporation. It is thus essential that where natural vegetation exists it should be retained as far as possible.



The primary impact of clearing of reeds and bulrushes is the disturbance of riparian and aquatic habitat. Secondary impacts would be the potential to facilitate erosion as well as facilitating the invasion of the cleared area by alien plant species. Furthermore, the reduction in surface roughness as a result of the cleared vegetation allows the river to flow through that reach at a higher velocity. If one doubles the velocity at which water is flowing, then the power of the water to cause erosion

has been determined to increase fourfold.

Spanish reed (*Arundo donax*) is similar to the indigenous common reed, *Phragmites australis* is an alien invasive reed which should be eradicated and not just controlled as is the case with *Phragmites* reeds. It is therefore important to distinguish between the two species (Table 4).

Significance of impacts without mitigation: Medium to low negative significance, depending on method and extent of the clearing as well as the sensitivity of the aquatic ecosystem as determined in the previous section.

**Table 4: The key differences between common reeds (controlled) and Spanish reed (eradicated)**

Common reeds ( <i>Phragmites australis</i> )	Spanish reed ( <i>Arundo donax</i> )
	
Thinner stem (Culms (stem) up to 2.5cm thick)	Thicker stem (Culms (stem) up to 5cm thick)
Shorter stem (Culm (stem) up to 4m tall)	Taller stem (Culm (stem) up to 6m tall)
Smaller leaf (Leaf blades are 1-5cm wide and up to 60cm long)	Bigger leaf (Leaf blades are 5-7cm wide and up to 91 cm long)

Proposed mitigation:

Methods for control of *Typha* bulrushes:

- Clearing should be undertaken in a phased manner – potentially 6 portions that would be split between the hillslope seeps and dividing Paddavlei into 3 sections (northern, eastern and western portions), to reduce the impact on the wetlands. Prioritisation of the areas could be linked to other maintenance activities to obtain the best results with the least impact, for example together with invasive alien vegetation clearing;
- A combination of clearing methods is likely to be required:
  - Herbicides (Glycophosphate 360/MAMBA with 0.1% wetting agent and dye for treatment of bulrush) can be effective when applied while the plant is flowering. The decaying plant material that results however accumulates and causes hypertrophic conditions, while providing a good substrate for regrowth of the bulrush. The use of herbicides in the wetland areas should only be as a last resort and under specialist guidance. This method could be considered to treat certain regrowth areas in the drier areas on the margins of the vlei and on the hillslope seeps by spraying of the new shoots and leaves within 3 months of the initial clearing has taken place.
  - Manual removal (pulling) works best on small seedlings when they can be easily pulled out of the damp soil and may work for certain of the wetland areas. This approach could be used in a similar way to the herbicides in the areas of regrowth on the margins of the vlei and within the hillslope seeps.
  - The most feasible method for Paddavlei would be a combination of mechanical and

hand cutting at the end of the growing season and when water levels are low, and the plants have died back. A differentiated approach should be used within the vlei and wetland areas. Use of a mechanical means is only recommended for the north-eastern and eastern edges of the vlei that are accessible to an excavator with a long arm that can extend into the vlei and physically remove the bulrush and some of the build-up of organic material associated with the reeds. Bulrush on the remaining margins of the vlei that are associated with the milkwood forest should be controlled through cutting of the rushes. Two clippings about a week or two apart will achieve the best results. The cutting should be scheduled for April /May when the cut area would be submerged soon after in at least 8 to 10 cm of water when water levels rise in the vlei. The dead material can be removed in spring when water levels drop.

- Burning of dense reed growth within Paddavlei is not recommended considering the proximity of the wetland areas to residences as well as the milkwood forest. Burning also tends to stimulate the growth of the rushes.
- Increase and maintenance of the water levels to assist the management of nuisance reeds.

The following methods are proposed for the removal of *Phragmites* reeds:

- The removal of indigenous instream vegetation should where possible be conducted by hand-cutting/mowing and should avoid the large-scale disturbance of soil and removal of vegetated material on the banks or in the channel. Digging or hand pulling of the reeds is ineffective due to the plant's extensive root system and simply contributes to the expansion of *Phragmites* while causing turbidity in the water column;
- The reeds could also be burnt in sections if burning permissions are granted. This however not recommended as burning has been observed to typically stimulate regrowth as well increase the density of regrowth. Where indigenous vegetation occurs adjacent to the reeds to be burnt, firebreaks (or other protection measures) should be established to ensure that the riparian vegetation is not burnt; and
- Under specific conditions, cutting and burning can be used as it will stimulate stem growth – the young shoots and stems are then sensitive and can be treated with an appropriate herbicide.

The following mitigation measures should be adhered to in conjunction with the above clearing methods:

- Removal of instream indigenous vegetation should be limited to nuisance growth of reeds and bulrushes that impede flow through channels and drains, or are causing a reduction in wetland plant diversity in wetland areas;
- Clearing should be conducted at the end of summer and should not be conducted more than once a year;
- The reeds should be cut below the lowest leaf and the remaining stump should not be longer than 15cm. If a brush cutter is used, mowing should be no lower than 12cm from the ground to minimise impacts to small animals and indigenous plants;
- If mowers are used, care should be taken that they do not damage banks or other indigenous vegetation such as sedges and rushes;
- The remaining indigenous vegetation within the scope of the MMP should not be cleared. The disturbance of the watercourses and wetland areas when undertaking clearing activities should also be limited as far as possible, using existing access points;
- The upstream and downstream impacts of any vegetation clearing activities should be minimized, such as the prevention of increased sedimentation downstream of the site by not undertaking the activity during the rainy period;
- If plants and soil in surrounding wetland areas are disturbed by the clearing of reeds or bulrushes, follow-up revegetation should be undertaken;

- Indigenous sedges and other grasses should be allowed to establish in cleared sections; and
- Remove all cut reeds and cleared alien vegetation from the watercourse/wetland area.

Significance of impacts after mitigation: Low negative to Medium positive

Impact table:

Potential impact on freshwater features	Clearing of indigenous aquatic vegetation		
Nature	Disturbance of aquatic habitat and vegetation	Status	-
Impact source(s)	Clearing of instream and riparian indigenous nuisance vegetation		
Impacted aquatic ecosystem	Aquatic habitat and biota at the site where clearing takes place		
Irreplaceability of resources	Moderate to high		
Magnitude	Extent	Local	
	Intensity	Moderate	
	Duration	Short to medium term	
	Reversibility	Reversible	
	Probability	High	
Significance	Without mitigation	Medium to Low negative	M/L-
	With mitigation	Low negative to Medium positive	L- to M+
Cumulative impact	Without mitigation	Low	
	With mitigation	Low	
Confidence	Medium/high		

**Activity 2: Repairs to infrastructure**

This maintenance activity entails repairing infrastructure within or adjacent to the wetlands, so that they retain their original footprint and capacity in a like-for-like scenario. Any additions to infrastructure are, by definition, not within the scope of an MMP. This infrastructure at Paddavlei comprises largely of existing road and walkway crossings, and stormwater related structures. The repairs will typically involve a localised and relatively short-term disturbance of the soil and vegetation while infrastructure is repaired. Disturbed areas are susceptible to invasion by alien plants.

Significance of impacts without mitigation: Low

Proposed mitigation:

- Minimise the spatial extent of disturbance and the frequency of, or requirement for, maintenance activities. The disturbance footprint should be clearly demarcated. No activities should take place outside of this area;
- Repairs should be preferably conducted during the dry period (November/December to February/March) when there is low flow in the watercourses and less chance of run-off from the disturbed areas;
- Manual labour within any of the aquatic habitats is preferred to the use of mechanical equipment to minimise physical disturbance around the activity location;
- Good house-keeping practices should be followed such as the use of machinery which does not leak oils or other substances, and if applicable adequate waste disposal and removal, as well as the adequate provision and servicing of toilets. The site of the maintenance activity must be managed so that any construction material (especially cement and fuel products) is not washed into the wetland during storm events. Emergency spill kits should be kept on site;
- The maintained infrastructure should not impact on the structural integrity of the wetland nor result in any alteration to the flow- and sediment transport in the wetland;
- Any cleared sediment, vegetation or spoil material associated with the maintenance activity should be removed out of the wetlands, preferably to an approved disposal site;
- After construction, any areas within the maintenance footprint that have been degraded from their condition prior to construction and as a result of the maintenance activities must be

restored to their former condition. If required disturbed areas should be revegetated with appropriate indigenous plant species as listed in Table 6 or as recommended in the rehabilitation plan for the site;

- Installation of mechanisms to all the water level to be higher in Paddavlei to assist with the management of the nuisance reeds and to improve the historic open water body; and
- Monitor and control alien plants in the disturbed areas to encourage regrowth of indigenous species.

Significance of impacts after mitigation: Very Low

Impact table:

Potential impact on freshwater features	Repairs to infrastructure		
Nature	Impaired water quality and localized disturbance of aquatic habitat	Status	-
Impact source(s)	The repair works within aquatic habitats as well as pollutants, disturbed silt and sediments associated with repair works		
Impacted aquatic ecosystem	Aquatic habitat and biota within site and downstream		
Irreplaceability of resources	Moderate		
Magnitude	Extent	Local	
	Intensity	Moderate to low	
	Duration	Short term impacts but repetitive nature	
	Reversibility	Reversible	
	Probability	Possible	
Significance	Without mitigation	Low negative	L-
	With mitigation	Very Low negative	VL-
Cumulative impact	Without mitigation	Low	
	With mitigation	Low	
Confidence	Medium/high		

### **Activity 3: Removal of deposited material (litter and debris as well as build-up of excessive organic material) at Paddavlei**

Sediment and other deposited material (litter and debris as well as build-up of excessive organic material as a result of die-off of reeds/bulrush) may need to be periodically removed maintain the integrity of the wetland and to allow access to infrastructure or to ensure that the infrastructure can continue to operate efficiently. At Paddavlei, this relates to clearing of waste and organic material within the vlei area and its surrounds as well as removal of material within culverts at the crossings, or at the stormwater drain structures. The clearing of this material can result in a localized disturbance within the associated aquatic habitats. This disturbance can result in increased turbidity as a result of suspension of silt into the water column if the work is undertaken in inundated areas. Invasion by alien plants also tends to occur at the disturbed area. The below mitigation measures are intended to prevent these potential impacts.

Significance of impacts without mitigation: Medium to Low depending of the extent of material removal.

Proposed mitigation:

- Material may be removed within the aquatic habitats only during the dry season (November/December to February/March) except for when emergency maintenance works need to be undertaken;
- The disturbed area around the infrastructure should be kept to a minimum. Where possible existing access points to the site should be used and any indigenous vegetation that is established adjacent to the works should preferably remain intact;
- While the work is being carried out; if required, temporary sediment trapping should be put in

place to filter water draining the area that will most likely contain high sediment loads;

- Minimise upstream/downstream impacts at the site;
- Manual labour should be used where possible within the aquatic habitats, where the use of mechanical removal is unavoidable, the extent of operation of the machinery within aquatic habitats should be minimized;
- The disturbed area should where applicable coincide with the programme and approach for clearing of bulrush or reeds;
- Disturbed areas should be kept clear of alien vegetation.
- Removed material should be completely taken out of the wetlands;
- Disturbed areas within the aquatic habitats should be revegetated with indigenous plant species as listed in Table 6.

Significance of impacts after mitigation: Low negative to medium positive

Impact table:

Potential impact on freshwater features	Removal of material (litter and debris as well as build-up of excessive organic material as a result of die-off of reeds/bulrush) within the vlei and at infrastructure		
Nature	Disturbance of riparian and aquatic habitat with the potential of increased turbidity downstream if activity takes place while there is flow in the watercourse	Status	-
Impact source(s)	Direct mechanical disturbance of aquatic habitats		
Impacted aquatic ecosystem	Aquatic habitat and biota within site		
Irreplaceability of resources	Moderate		
Magnitude	Extent	Local	
	Intensity	Moderate	
	Duration	Short term impacts but repetitive nature	
	Reversibility	Reversible	
	Probability	Probable	
Significance	Without mitigation	Medium to Low negative	M/L -
	With mitigation	Low negative to Medium positive	L- to M+
Cumulative impact	Without mitigation	Low	
	With mitigation	Low	
Confidence	Medium/high		

### Risk Assessment

Risk assessments were carried out for the proposed maintenance activities as discussed above in order to assess the potential or risk of these activities altering the ecological condition of the aquatic ecosystems. In terms of the risks that the activities pose to the aquatic ecosystems (summaries provided in the tables below), the maintenance activities were all considered to be low if mitigated as recommended in the method statements.

#### Summary risk assessment for Activity 1a – Clearing of alien vegetation

Phases	Activity	Aspect	Impact	Significance	Risk Rating
Control / clearing of alien vegetation	Access to site	Creating an access route to the site if required	Disturbance of soil and vegetation, water quality impairment	32.5	L
	Cutting and poisoning target plant species	Control measures and Physical removal of plants		33.75	L
	Follow up control	Pulling saplings and spraying re-sprouted shoots		33	L

#### Summary risk assessment for Activity 1b – Clearing of *Typha* bulrushes and *Phragmites* reeds

Phases	Activity	Aspect	Impact	Significance	Risk Rating	Adjust Risk Rating
Control / clearing of	Access to site	Creating an access route to the site if required	Disturbance of soil and vegetation,	63	L	L

invasive indigenous vegetation	Cutting, poisoning reeds/ rushes	Control intervention of nuisance rushes in wetland	flow impacts and water quality impairment	88	M	L
	Removal of organic material	Physical removal of plants		88	M	L

### Summary risk assessment for Activity 2 – Repairs to the infrastructure associated with aquatic features

Phases	Activity	Aspect	Impact	Significance	Risk Rating
Repairs to an existing piece of infrastructure in the ecological corridor	Access site and clear vegetation if needed	Clearing and disturbance of vegetation and soil	Disturbance of aquatic habitat, short-term increased sediment loads in water	33.75	L
	Physical repair to a structure in a like-for-like fashion	Structural repairs - further disturbance and foreign substances (example: concrete) on site	Potential contamination of water quality, on-going disturbance of habitat	38.5	L
	Clearing/rehab of site where needed	Reshaping disturbed areas, removing construction material and equipment, planting indigenous vegetation if needed	No significant negative impact- potential for positive impacts if rehabilitation of site is adequate	27	L

### Summary risk assessment for Activity 3 – Removal of deposited material (litter and debris as well as build-up of excessive organic material) at Paddavlei

Phases	Activity	Aspect	Impact	Significance	Risk Rating
Removal of deposited material (litter and debris as well as build-up of excessive organic material) at Paddavlei	Access site and clear vegetation if needed	Clearing and disturbance of vegetation and soil	Disturbance of soil and vegetation. Potential water quality impacts - increased turbidity	33.75	L
	Physically removing the material	Lifting material out of ecological corridor and Paddavlei area		50.875	L
	Handling of removed material - removal to suitable disposal site	Removing material out of aquatic corridor		35	L

### A description of the risk rating categories

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands may be excluded.
56 – 169	(M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.

The risk rating scores assume that the activity is conducted according to the method statements of this MMP. The nature of an MMP dictates that it only relates to the maintenance of authorized infrastructure structures or maintenance activities.

## 6. METHOD STATEMENT

- 6.1 The method statement must provide a step-by-step plan (which may include a schematic diagram etc.) to inform the responsible person(s) on the process and actions to take in a sequential and logical manner, which aims to reduce the impact of undertaking the activity within a reasonable timeframe and cost.
- 6.2 A method statement should be compiled for each individual activity given the likely specific circumstances and conditions of a site requiring maintenance. However, in situations whereby uniform conditions and circumstances are evident for multiple sites requiring the same type of activity, a method statement can be given for a specific type of activity to be undertaken at multiple sites given the aforementioned requirements.
- 6.3 The detail of the method statement will be assessed by the Department and other relevant regulatory authorities to ensure actions that are taken are such that they do not perpetuate increased incidences of erosion/deposition of material.
- 6.4 Time periods must be given within which the maintenance actions contemplated need to be implemented. An indication must be made whether maintenance actions will be repeated, e.g. clearing of silt/debris from under a bridge annually or after flood events.
- 6.5 The following serves as a general guide required to minimise the spatial impact of the maintenance activity:
- Repairs and maintenance should be undertaken within the dry season, except for emergency maintenance works.
  - Where at all possible, existing access routes should be used. In cases where none exist, a route should be created through the most degraded area avoiding sensitive/indigenous vegetation areas.
  - Responsible management of pollutants through ensuring handling and storage of any pollutants is away from the watercourse. When machinery is involved, ensure effective operation with no leaking parts and refuel outside of the riparian area, at a safe distance from the watercourse to manage any accidental spillages and pose no threat of pollution.
  - At no time should the flow of the watercourse be blocked (temporary diversions may be allowed) nor should the movement of aquatic and riparian biota (noting breeding periods) be prevented during maintenance actions.
  - No new berms can be created.
  - In circumstances which require the removal of any topsoil, this must be sufficiently restored through sustainable measures and practices.
  - Concerted effort must be made to actively rehabilitate repaired or reshaped banks with indigenous local vegetation.
  - No deepening of the watercourse beyond the original, pre-damage determined thalweg, unless such deepening is directly related to the natural improved functioning and condition of such a watercourse.

- Where at all possible, limit the disturbance to the zone of the thalweg. This is due to the ecological importance of the low flow channel and respective habitat being allowed to re-establish improving the ecological condition.
- The build-up of debris/sediment removed from a maintenance site may:
  - be utilised for the purpose of in-filling or other related maintenance actions related to managing erosion, which form part of an adopted MMP;
  - not be used to enlarge the height, width or any extent of existing berms;
  - not be deposited anywhere within the watercourse or anywhere along the banks of a river where such action is not part of the proposed maintenance activity (ies). Material that cannot be used for maintenance purposes must be removed out of the riparian area to a suitable stockpile location or disposal site. Further action and consideration may be required where the possibility of contaminated material may occur, such as in urban watercourses.
- The use of foreign material, such as concrete, rubble, woody debris and/or dry land-based soil, is strictly prohibited from being used in maintenance actions, unless for the specific purpose of repairs to existing infrastructure, coupled with appropriate mitigation measures.
- On completion of the maintenance action, the condition of the site in terms of relative topography should be similar to the pre-damaged state (i.e. the shape of the river bank should be similar or in a state which is improved to manage future damage). This ultimately dictates that the channel, banks and bed cannot be made narrower, higher or deepened, respectively. Exceptions are considered for systems involved with the management of stormwater and improvements for water quality within the urban context.

## Method Statements:

In this MMP, all maintenance activities, and therefore also the Method Statements, are grouped into three categories:

- Activity 1: Clearing of nuisance vegetation:
  - Activity 1a: Clearing of invasive alien vegetation;
  - Activity 1b: Clearing of indigenous Phragmites reeds;
- Activity 2: Repairs to- or replacement of damaged formal river crossings; and the installation of water level control mechanisms to increase and maintain the water levels in Paddavlei; and
- Activity 3: Removal of material (debris, rock and sediment) at infrastructure.

### **ACTIVITY 1: CLEARING OF INVASIVE ALIEN AND CONTROL OF NUISANCE GROWTH VEGETATION**

Paddavlei, its associated hillslope wetland and the ecological corridor are, in places, overgrown with vegetation, either invasive alien plants (Activity 1a) or a nuisance growth of indigenous aquatic plants (Activity 1b). The removal of these plants needs to be periodically undertaken to maintain the aquatic habitats in a desired ecological state that can continue to provide valued goods and services.

#### **Activity 1a: Removal of invasive alien plants**

Paddavlei as well as the associated hillslope wetlands and the ecological corridor upstream and downstream of the wetland contain invasive alien vegetation such as: Port Jackson willows (*Acacia saligna*), Rooikrans (*A. cyclops*), golden wattle (*A. pycnantha*), *Eucalyptus sp.*, weeping willows (*Salix babylonica*), manatoka (*Myoporum montanum*), Pampas grass (*Cortaderia selloana*), Brazilian peppertree (*Schinus terebinthifolia*), syringa (*Melia azedarach*), red sesbania (*Sesbania punicea*), castor-oil plant (*Ricinus communis*), nasturtiums (*Tropaeolum majus*), Patterson's curse (*Echium plantagineum*) as well as kikuyu grass (*Pennisetum clandestinum*).

Growth of alien vegetation within the watercourses and wetlands, particularly if it is invasive, is usually at the expense of natural, indigenous aquatic vegetation which simply cannot compete. Negative impacts of alien vegetation include: reduced water availability; reduced habitat diversity and an associated reduction in biodiversity; much hotter and destructive fires which destroy indigenous seed in the soil and are difficult to control; and form barriers to the movement of biota. It also provides limited goods and services in relation to that of the natural vegetation. The removal of invasive alien plants from the ecological corridor and wetlands is desirable not only from an aquatic ecological perspective but also due to the fact that they reduce the ability of the aquatic features to provide a number of valuable goods and services.

The following mitigation measures and method statements are suggested in order to enable the activity to be carried out with the lowest impact.

<b>Description</b>	<b>Activity 1a: Clearing of alien vegetation within the river channel and riparian zone</b>	
<b>Actions</b>	It is necessary to remove and control the alien vegetation in the river. The following general sequence of actions are required: 1) Identify alien invasive species 2) Cutting or pulling of target plants, or application of appropriate herbicide 3) Treatment of plant remainders with appropriate herbicide or treatment of herbacious plants that cannot be pulled 4) Removal of plant material from the riparian zone 5) Follow-up work to prevent regrowth and the production of seed still remaining in soil 6) Revegetation of areas with indigenous vegetation where necessary	
<b>Impacts of actions</b>	The following impacts are anticipated as a result of undertaking the removal activity: Disturbance to aquatic habitat and vegetation	
<b>Severity of impacts</b>	<b>Disturbance of aquatic habitat</b>	If all mitigation measures are implemented the severity of the impact will be <b>Very Low</b>
<b>Measures to mitigate the severity of the impact</b>	<b>Disturbance of aquatic habitat vegetation</b>	<ul style="list-style-type: none"> <li>• Identify alien plants to be removed. If unsure, please contact the Department of Agriculture or CapeNature for assistance. Regular monitoring and control of alien vegetation should be undertaken to ensure that the plants are removed while still young saplings that can more easily be removed (usually pulling of seedlings by hand is possible when the soil is wet). This also prevents the spread of the alien plants once seeds have been produced;</li> <li>• Avoid trampling or clearing indigenous vegetation by using established paths where possible;</li> <li>• Clear alien vegetation according to the described alien vegetation removal methods for each invasive species as provided in the detailed method statements or with the methods and herbicides/biological control recommended on the Working for Water website: <a href="http://www.dwaf.gov.za/wfw/">http://www.dwaf.gov.za/wfw/</a>;</li> <li>• Clear felled alien vegetation from the river corridor. Larger tree stumps can be left to minimise erosion of the cleared area;</li> <li>• Where necessary revegetate cleared areas with suitable indigenous vegetation as suggested under this MMP report. Planted areas will require irrigation and care for a period of 1-2 years following planting. This is particularly a requirement where most of the natural flow within the watercourses have been diverted for use or where the re-established vegetation is on the dry banks of the rivers. Planting of the new vegetation at the start of the wet season can assist ensuring that the new vegetation is kept wet however one would need to then avoid planting new vegetation within the areas that will be inundated in winter or subjected to flood flows; and</li> <li>• Ongoing monitoring and clearing of regrowth of alien plants within these areas will be required.</li> </ul>
Remedial measures	<b>There are no additional remedial mitigation measures other than those listed above. As such, all mitigation measures as outlined above should be implemented in full.</b>	
Method of Access	Existing access roads should be utilised as far as possible.	
Period of activity	The time period of the maintenance management activity will vary depending on the level of infestation. The activity will be ongoing to control alien vegetation recovery and recruitment.	

Further information on the six actions listed above:

**Action 1: Identify alien invasive species:**

**Table 5: Invasive alien species were identified within the study area**

Rooikrans (*Acacia cyclops*)  
NEMBA category 1b



Port Jackson willow (*Acacia saligna*)  
NEMBA category 1b



Golden wattle (*Acacia pycnantha*)  
NEMBA category 1b



weeping willows (*Salix babylonica*)  
Not listed



manatoka (*Myoporum montanum*)  
NEMBA Category 3 (Category 1b in riparian areas)



Brazilian peppertree (*Schinus terebinthifolia*)  
NEMBA Category 3 (Category 1b in riparian areas)



Red river gum (*Eucalyptus camaldulensis*)  
NEMBA category 1b



Red sesbania (*Sesbania punicea*)  
NEMBA Category 1b



Spanish reed (*Arundo donax*)  
NEMBA category 1b



syringa (*Melia azedarach*)  
NEMBA Category 1b



Pampas grass (*Cortaderia selloana*)  
NEMBA category 1b



nasturtiums (*Tropaeolum majus*)  
Not listed



Castor Oil (*Ricinus communis*)  
NEMBA Category 2



Kikuyu grass (*Pennisetum clandestinum*)  
NEMBA category 1b in wetlands



Patterson's curse (*Echium plantagineum*)  
NEMBA Category 1b



### Action 2 – Cutting or pulling of target plants

Individual or sparsely distributed small (< 30 cm tall) invader plant saplings can be pulled by hand or using a puller/popper tool when the plants are between 30 cm and ± 50 cm tall. Alternatively, saplings may be cut using a lopper (long-handled secateur-like instrument) and the stumps painted with herbicide in the case of coppicing species.

Gloves are needed. Seedlings need to be gripped by the stem as close to the ground as possible and pulled out in one smooth motion - taking care to remove the entire root system avoiding breaking off the plants at ground-level as they will then regrow.

Mechanical felling (using a chainsaw) applies to all larger trees and, in most situations, during the initial clearing operation, includes their removal from the site. Coppicing should be prevented by the chemical treatment of the cut-stumps immediately after cutting.

No uprooting of trees should take place anywhere where natural vegetation is required to develop as buried alien seed is brought to the surface where it germinates while the bare or uncovered soil encourages alien seed to germinate.

Mechanical brush-cutting is not acceptable where natural vegetation is required as the remaining stumps of alien species are often stimulated to grow more vigorously, much like pruning a fruit tree, while the regrowth from the stumps is generally rapid and forms dense stands which requires concentrated application and uses more chemicals.

All alien plants should be cut as close to the ground as possible since even small branches left on stumps can continue to grow (side stems should all be removed before applying herbicide to the cut stump). Another advantage of cutting low is that this increases the size of the stump area - which results in improved herbicide intake guaranteeing greater success.

While contractors usually select and provide their own equipment the following suggestions should be kept in mind. Hand-tools such as hand saws and bow saws can be used where stems do not exceed 50 mm diameter and should result in a clean-cut surface to allow for the more successful application and absorption of the herbicide.

With larger plants moderately sized chainsaws in the 2.5 kW range become necessary. Note that only experienced operators may use chain saws and that full PPE (Personal Protective Equipment) must be worn at all times (including ear protection). Chain saws are much more cost-efficient than hand-tools if plants exceed a 50 mm stem diameter. In the case of dense infestations of tall, slender (50-80 mm diameter) plants brush-cutters in the 2.5 to 3 kW class could be used. The site should not be cleared of all vegetation when chain saws and brush cutters are to be used. Indigenous vegetation should be preserved. The impacts of trampling and accidental cutting of indigenous vegetation (grasses, sedges, shrubs etc.) should be avoided. The supervising ecologist should train the contractor to enable the identification and preservation of indigenous vegetation.

Note that if the contractor chooses to conduct the manual clearing operation with a chain saw then it is imperative that all workers attend a chain saw course (usually provided by the suppliers). All re-fuelling should be done over drip-trays (to prevent spills). Any spilled fuel must be disposed of off the site at a suitable waste-receiving facility. Fuel should be properly stored away at all times.

The contractor should fully comply with all the provisions of the Occupational, Health and Safety Act.

The cut plant material must be removed immediately after cutting to avoid seed being released from the cut material and reinfesting the cleared area. Compaction of soil, such as through trampling or vehicle movement, should be avoided or kept to an absolute minimum by using existing tracks or paths.

### Action 3 - Treatment of plant remainders with appropriate herbicide or of herbacious plants that cannot be manually removed

Cut the larger trees, smaller trees and pull juveniles with an appropriate tool depending on the size of the plants. Apply herbicide containing a colorant onto the standing remainder of the cut stumps and stems immediately after cutting. The herbicide is to be applied with a brush or appropriate device, ensuring no spillage occurs onto the surrounding vegetation or onto the ground. The applications of herbicides using a backpack pump and spay onto stumps or foliage is not recommended as drift onto adjacent indigenous plants is highly likely, especially during windy conditions, however light.

The application of the herbicide is essential to ensure the die back of the entire root system to prevent the re-growth or coppicing (forming of new shoots from the stumps).

Large volumes of herbicide mix should not be carried around. Regular refilling of containers in specified areas outside vegetated areas is advised. Mixed herbicides should not be stored for longer than a day. During the day the herbicides must be stored in a shaded area preferably in a dark container.

A dye (e.g. EcoBlue) should also be mixed with the herbicide prior to application so that the treated stumps are clearly marked. The recommended herbicide and a wetting agent should be used to ensure effective application.

The use of **diesel as a wetting agent is not recommended** due to the potential for environmental contamination.

Unless stated, herbicide/dye mixing concentrations and application rates for the different species are available from the suppliers. Importantly, **Material Safety Data Sheets (MSDSs)** for all chemicals and herbicides used must be available on site at all times. These documents contain vital information pertaining to environmental toxicity, health and safety regulations, flammability, storage instructions, procedures to follow in case of accidental ingestion and disposal methods.

All herbicides must be mixed on a drip tray or ground sheet in a demarcated area, out of direct sunlight, and well away from natural vegetation or surface water. The workers should under no circumstances rinse herbicide equipment in streams, pools or ponds. They should, as a matter of necessity, observe the instructions for the safe use, mixing and application of the herbicide.

The Department of Agriculture or the Working for Water Programme could be approached by landowners for the supply of the herbicide and advice about its application, which they will supply free of charge. It is, however, unlikely that they will assist physically on private property and here the landowner must take over the responsibility.

The most appropriate herbicide for the control of *Pennisetum clandestinum* (kikuyu grass) should be obtained and should be applied 2-3 times a year in the late summer on fresh growths in the areas that are affected.

#### Action 4 - Removal of plant material from the riparian zone

The cut plant material must be removed immediately after cutting to avoid seed being released from the cut material and reinfesting the cleared area. Compaction of soil, such as through trampling or vehicle movement, should be avoided or kept to an absolute minimum by using existing tracks or paths.

The plant material **that does not contain any ripe seed** can be chipped in a mechanical chipper and used to cover bared areas on the property that are in need of cover to suppress dust, or weeds and to increase the organic content of the soil where needed. More chipped cut material can be removed per load than bulky unchipped material.

A free standing self-propelled chipper can be used and can be rented from an agent. These chippers can cause injury if not operated correctly. They should only be operated by trained and fully equipped persons according to the manufacturer's instructions and safety precautions.

It is important to position the chipper in such a way as to ensure the easy flow of work and feeding of material into the chipper. A container, preferably a trailer or truck, should catch the material during chipping for removal and transportation to the area in which it can be used or stored. The material **should not** be disposed of in municipal solid waste disposal sites.

Larger, un-chippable stems and branches can either be sold for firewood or donated to local communities for that purpose.

It is important to note that a cover of chips on the soil suppresses the regrowth of indigenous plants. Only areas where vegetation regrowth is to be

restricted should be covered in wood chips. The material can also be stored in an area where it will not pose a fire hazard after it has dried out, for use at a later stage.

Plant material that contains seeds should not be sold or distributed on site as this will distribute the seeds to other areas on the site that will either be re-infested or become invaded. If the alien vegetation removal takes place when mature, viable, seeds are present on the plant, then the chipped material should be separated and clearly marked and its use only take place under conditions where the aliens will be easily and readily eradicated.

#### Action 5 – Control re-growth of alien vegetation

It has been well-documented that the single most important aspect governing the success of invasive plant control is follow-up work. Follow-up clearing should thus commence as soon as possible after initial clearing due to the fact that if left unattended, the seedlings or untreated cut stumps and the re-growth from stumps will grow to form impenetrable thickets which will be much more costly and difficult to eradicate.

Australian acacias produce enormous quantities of viable seed in the absence of natural control mechanisms. This results in a build-up of seed banks in the soil because the seed does not lose much viability over time and germinates profusely following fires or after other disturbances which leaves areas bare of vegetation.

In addition to removing competitive vegetation cover, fire breaks the seed dormancy by damaging the hard-protective seed coat of some plants, which allows the stimulatory ingress of water and air. The large seed bank is one of the most important obstacles to the long-term control of invasive alien species and its extent is often under-estimated. Furthermore, the rapid growth rate of the *Acacia* plants easily outcompetes that of the slower growing indigenous riparian plants. The tall dense vegetation of exotic invasive tall shrubs and low trees inhibits the regrowth and reduces the density of the indigenous plants. The dense infestations result in an increased fuel load which implies hotter, more destructive wild-fires that are more difficult to contain.

The following general sequence should be used to control of the regrowth and germination of woody alien invasive species:

- Hand-pull all young plants 2-3 times a year;
- Cut the larger plants;
- Treat the plant remainders with an appropriate herbicide;
- Remove the plant material to the perimeters of the site;
- Chip the cut material;
- Remove the chips from the site;
- Deposit the material in a designated area;
- The chipped material can be utilized on the property for a particular purpose (i.e. for compost, weed or dust suppression) or it can be sold.

Pull all young plants 2-3 times a year. Individual or sparsely distributed small (< 30 cm tall) invasive aliens can be pulled by hand or by using a puller/popper tool (when plants are between 30 cm and ± 50 cm tall). Gloves are needed. Seedlings and juveniles need to be gripped by the stem as close to the ground as possible and pulled out with a smooth motion, taking care to remove the entire root system. Should the plant break off, then the stump must be treated with herbicide.

Saplings may also be cut using shears or a lopper (long-handled secateurs-like instrument) in which case the cut stumps must each be painted with herbicide to eliminate coppicing.

It is important to keep the disturbance of surrounding vegetation and soil at a minimum during this operation as the germination of alien plants benefit from the disturbance.

The control of dense stands of indigenous *Phragmites australis* (fluitjiesriet) and *Typha capensis* (papkuil) requires a particular approach in some areas, particularly where natural flooding is absent for lengthy periods.

#### The control of the Spanish reed (*Arundo donax*)

The following method is proposed:

- Cut the tall stems as close as possible to ground level;
- Allow the rhizomes to re-sprout;
- Spray the foliage of the young re-sprouting leaves in late autumn (April / May) before the leaves die back with an appropriate herbicide (Glyphosate 360). Use a low-pressure nozzle that can deliver a fine mist to improve uptake of the herbicide by the leaves;
- Take care to reduce spray drift as much as possible, and where feasible apply herbicides by the cut stem method;
- Be aware of indigenous plants close to or within the stand of Spanish reed and do not spray or cut them; and
- Plant remains, and rhizomes must be left for a few months to rot until dead *in situ* covering their cut bases.

Do not plough or bulldoze the rhizomes out.

Take care not to confuse the indigenous fluitjiesriet with the Spanish reed.

#### Control of Kikuyu grass (*Pennisetum clandestinum*):







Poison kikuyu with a foliar herbicide (e.g. Agil) during the summer growing season (before end March). This type of herbicide normally kills anything green, target only the kikuyu grass areas when spraying. Wait for a week or two for the grass to be completely brown before removing the dead grass. It is likely to need to be sprayed more than once.







#### Action 6 – Re-vegetate with indigenous species




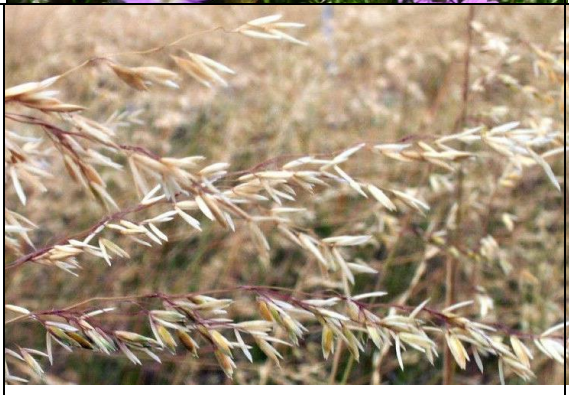
The following woody and perennial local indigenous plants are recommended for establishment within the corridor

**Table 6. Indigenous plant species recommended for revegetation within the Paddavlei Ecological Corridor**

Species	Common name/s	Zone	Photograph	Common name/s	Zone	Photograph	Common name/s
<i>Senecio halimifolius</i>	tabakbos	Seasonal wetland areas		<i>Cyperus longus</i>	galingale sedge	Margins and wetted edge of wetlands	
<i>Scirpoides nodosus</i>	Club rush	Seasonal wetland areas		<i>Juncus kraussii</i>	Salt marsh rush	Seasonal wetland areas	

<p><i>Chrysanthamoides monilifera</i></p>	<p>bietou</p>	<p>Margins of wetlands</p>		<p><i>Leonotis leonurus</i></p>	<p>wilde dagga</p>	<p>Margins of wetlands</p>	
<p><i>Psoralea pinnata</i></p>	<p>fonteinbos</p>	<p>Seasonal wetland areas</p>		<p><i>Chasmanthes aethiopica</i></p>	<p>cobra lilies</p>	<p>Margins of wetlands</p>	
<p><i>Zantedeschia aethiopica</i></p>	<p>Arum lily</p>	<p>Seasonal wetland areas</p>		<p><i>Searsia lucida</i> and <i>S. tomentosa</i></p>	<p>S.karee</p>	<p>Margins of wetlands</p>	




<p><i>Sideroxylon inerme</i></p>	<p>milkwood</p>	<p>Margins of wetlands</p>		<p><i>Stoebe plumosa</i></p>	<p>slangbos</p>	<p>Margins of wetlands</p>	
<p><i>Salvia aurea</i></p>	<p>Brown sage</p>	<p>Margins of wetlands</p>		<p><i>Gomphocarpus physocarpus</i></p>	<p>milkweed</p>	<p>Margins of wetlands</p>	
<p><i>Metalsia muricata</i></p>	<p>blombos</p>	<p>Margins of wetlands</p>		<p><i>Carpobrotus edulis</i> and <i>C. asciniiformis</i></p>	<p>sour figs</p>	<p>Margins of wetlands</p>	

<p><i>Pelargonium alchemilloides</i></p>	<p>Pelargonium</p>	<p>Margins of wetlands</p>		<p><i>Geranium incanum</i></p>	<p>carpet geranium</p>	<p>Margins of wetlands</p>	
<p><i>Cynodon dactylon</i></p>	<p>Kweekgras</p>	<p>Seasonal wetland areas</p>		<p><i>Ehrharta villosa</i></p>	<p>Pypgras</p>	<p>Margins of wetlands</p>	

### **ACTIVITY 1a: Clearing of nuisance growth of indigenous vegetation**

*Typha capensis* bulrushes and common *Phragmites australis* reeds are indigenous plants with an ecological function as providing habitat for biota, reducing erosion, causing deposition of silt, cooling instream habitats and reducing wind, thereby reducing evaporation. It is thus essential that where natural vegetation exists it should be retained as far as possible and disturbed areas should be rehabilitated. Therefore, the objective of this activity is to control the reeds or bulrushes and not to eradicate them completely.

*Typha* bulrush and *Phragmites* reed growth in general needs to be managed in watercourses and wetlands within developed areas where the natural control measures such as floods have largely been removed and there is an elevated supply of nutrients. The removal of these plants may need to thus be periodically to maintain an open channel. **Control** should only aim to remove excessive plant growth and build-up of material that can cause flooding. These reeds are indigenous and must not be **eradicated** as they provide valued goods and services. It is thus important to distinguish between *P. australis* which should be controlled and the alien Spanish reed, *Arundo donax*, which should be eradicated (see table below).

Species	Common name/s	Photograph	Maintenance Objective
<i>Typha capensis</i>	Bulrush		To be controlled when a nuisance - indigenous plant
<i>Phragmites australis</i>	Common reed		To be controlled when a nuisance - indigenous plant
<i>Arundo donax</i>	Spanish reed or giant cane		To be eradicated – invasive alien plant

Clearing of reeds and bulrushes results in a disturbance of riparian and aquatic habitat. There are several ways to control or clear these plants within aquatic habitats. The level of impact of clearing varies depending on the methods used. A bulldozer can be used to clear the vegetation but, in the process, all other plants are removed, and the aquatic habitat modified. The result is a high impact. Reeds can be cleared by hand or through grazing will however result in a very low impact. Secondary impacts are the potential to facilitate erosion and invasion by alien plant species.

Description of activity	<b>Activity 1b: Clearing of nuisance reed/rush growth within the aquatic habitats</b>	
Actions	<ul style="list-style-type: none"> <li>• The removal of indigenous instream vegetation should where possible be conducted by hand-cutting/mowing or through grazing and should avoid the large-scale disturbance of soil and removal of vegetated material from aquatic habitats. Digging or hand pulling of the reeds tends to be ineffective due to the plant's extensive root system and simply contributes to the expansion of the reeds while causing turbidity in the water column. This method would work best in follow up work to remove small seedlings when they can be easily pulled out of the damp soil and may work for certain of the wetland areas;</li> <li>• The reeds could also be burnt in sections if burning permissions are granted. It is however not recommended as burning has been observed to typically stimulate regrowth as well increase the density of regrowth. Where indigenous riparian vegetation such as the milkwoods and residences occur adjacent to the reeds to be burnt, firebreaks (or other protection measures) would need to be established. For these reasons, this approach is not recommended;</li> <li>• Under specific conditions the cutting and burning can be used as it will stimulate stem growth and the young growth can be eaten by cattle.</li> <li>• Herbicides (Glycophosphate 360/MAMBA with 0.1% wetting agent and dye) can be effective when applied while the plant is flowering. The decaying plant material that results however accumulates and causes hypertrophic conditions, while providing a good substrate for regrowth of the bulrush. The use of herbicides in the wetland areas should only be as a last resort and under specialist guidance. The young regrown plants are sensitive to herbicidal control so the method can work for follow up treatments;</li> <li>• If machinery is utilized to remove the reeds and the associated sediment, the works in the within and adjacent to the wetlands should not impact on the structural integrity of the wetland area. Mechanical clearing of reeds should be less frequent than annually and should be limited in extent (the entire extent of the reed bed should not be cleared, only a portion thereof). This method is only recommended for the north-eastern and eastern edges of the vlei that are accessible to a excavator with a long arm that can extend into the vlei and physically remove the bulrush and some of the build-up of organic material associated with the reeds.;</li> <li>• The most successful method for control of bulrush is through physical cutting and burning in conjunction with flooding. Cutting and/or burning should take place at the end of autumn when water levels are low but when the cut area will be submerged in at least 10 cm of water when water levels rise again. Two subsequent cuttings of the bulrush will be required within the end of the growing season (April/May) to suppress the regrowth prior to the inundation; and</li> <li>• Pulling of bulrush can work where the plants are small seedlings.</li> </ul>	
Impacts of actions	The following impacts are anticipated as a result of undertaking the inspection activity: Disturbance to aquatic habitat and vegetation	
Severity of impacts	<b>Disturbance of aquatic habitat vegetation</b>	If all mitigation measures are implemented the severity of the impact will be <b>Low</b> .
Measures to mitigate the severity of the impact	<b>Disturbance to the local vegetation</b>	<p>The following mitigation measures should be adhered to in conjunction with the above clearing methods:</p> <ul style="list-style-type: none"> <li>• Removal of indigenous instream indigenous vegetation should be limited to nuisance growth of reeds and bulrushes;</li> <li>• Clearing should be conducted at the end of summer and should not be conducted more than once a year;</li> <li>• The reeds should be cut below the lowest leaf and the remaining stump should not be longer than 15cm. If a brush cutter is used, mowing should be no lower than 12cm from the ground to minimise impacts to small animals and indigenous plants;</li> <li>• If mowers are used, care should be taken that they do not damage banks or other indigenous vegetation such as sedges and rushes;</li> <li>• The remaining indigenous riparian vegetation within the scope of the MMP should not be cleared. The disturbance of the aquatic habitat when undertaking clearing activities should also be limited as far as possible, using existing access points;</li> <li>• While the work is being carried out; if required, temporary sediment trapping – such as sand bags - should be put in place to filter water that will most likely contain high sediment loads;</li> <li>• The upstream and downstream impacts of any vegetation clearing activities should be minimized;</li> <li>• If the aquatic habitat disturbed by the activity, follow-up revegetation may be required - Indigenous sedges and other grasses should be allowed to establish in cleared sections</li> <li>• Remove all cut reeds and cleared alien vegetation from the aquatic habitats.</li> </ul>
Remedial measures if mitigation inadequate	<b>No additional remedial mitigation measures other than those listed above. As such, all mitigation measures as outlined above should be implemented in full.</b>	
Method of Access	Existing roads and pathways should be utilised as far as possible.	
Time for activity	Varies depending on the level of infestation. The activity will be ongoing to control nuisance vegetation recovery and recruitment.	

## **ACTIVITY 2: Repairs to infrastructure**

This maintenance activity entails repairing infrastructure within or adjacent to the wetlands, so that they retain their original footprint and capacity in a like-for-like scenario. Any additions to infrastructure are, by definition, not within the scope of an MMP. This infrastructure at Paddavlei comprises largely of existing road and walkway crossings, and stormwater related structures. The repairs will typically involve a localised and relatively short-term disturbance of the soil and vegetation while infrastructure is repaired. Disturbed areas are susceptible to invasion by alien plants.

Description of activity	<b>Activity 2: Repairs to infrastructure</b>	
Actions	Repair a defined piece of infrastructure	
Impacts of actions	Minor repairs typically involve a short term, localised disturbance of aquatic habitat at the site of the infrastructure being repaired. Furthermore, following repairs disturbed areas can contribute towards high silt and sediment loads where the material is not held by the roots of plants. The installation of water level control mechanisms to assist with the increase of water levels in Paddavlei and the management of the water levels to assist in the control of nuisance plant growth and to create an open water body.	
Severity of impacts	<b>Impaired water quality and habitat disturbance</b>	If all mitigation measures are implemented the severity of the impact will be <b>Very Low</b> .
Measures to mitigate the severity of the impact	<b>Impaired water quality and habitat disturbance</b>	Minimise the spatial extent of disturbance and the frequency of, or requirement for, maintenance activities. The disturbance footprint should be clearly demarcated. No activities should take place outside of this area; Repairs should be preferably conducted during the dry period (November/December to February/March) when there is low flow in the watercourses and less chance of run-off from the disturbed areas; Manual labour within any of the aquatic habitats is preferred to the use of mechanical equipment to minimise physical disturbance around the activity location; Good house-keeping practices should be followed such as the use of machinery which does not leak oils or other substances, and if applicable adequate waste disposal and removal, as well as the adequate provision and servicing of toilets. The site of the maintenance activity must be managed so that any construction material (especially cement and fuel products) is not washed into the wetland during storm events. Emergency spill kits should be kept on site; The maintained infrastructure should not impact on the structural integrity of the wetland nor result in any alteration to the flow- and sediment transport in the wetland; Any cleared sediment, vegetation or spoil material associated with the maintenance activity should be removed out of the wetlands, preferably to an approved disposal site; After construction, any areas within the maintenance footprint that have been degraded from their condition prior to construction and as a result of the maintenance activities must be restored to their former condition. If required disturbed areas should be revegetated with appropriate indigenous plant species as listed in Table 6 or as recommended in the rehabilitation plan for the site; Monitor and control alien plants in the disturbed areas to encourage regrowth of indigenous species, and Monitor the effectiveness of water level control mechanism in its attempt to control and manage nuisance plants.
Remedial measures if mitigation inadequate	<b>There are no additional remedial mitigation measures other than those listed above. As such, all mitigation measures as outlined above should be implemented in full.</b>	
Access to the site	Existing roads and pathways should be utilised as far as possible. Existing infrastructure should be used as mechanism to install water level control mechanisms.	
Period of maintenance management activity	The time period of the maintenance management activity will vary depending on the level of repairs required.	

### **ACTIVITY 3: Sediment removal at infrastructure**

Sediment and other deposited material (litter and debris as well as build-up of excessive organic material as a result of die-off of reeds/bulrush) may need to be periodically removed maintain the integrity of the wetland and to allow access to infrastructure or to ensure that the infrastructure can continue to operate efficiently. At Paddavlei, this relates to clearing of waste and organic material within the vlei area and its surrounds as well as removal of material within culverts at the crossings, or at the stormwater drain structures. The clearing of this material can result in a localized disturbance within the associated aquatic habitats. This disturbance can result in increased turbidity as a result of suspension of silt into the water column if the work is undertaken in inundated areas. Invasion by alien plants also tends to occur at the disturbed area. The below mitigation measures are intended to prevent these potential impacts.

Description activity	<b>Activity 3: Sediment removal at infrastructure</b>	
Actions	<ul style="list-style-type: none"> <li>• Access the site with team or machinery;</li> <li>• Remove sediment from the location of infrastructure;</li> <li>• Deposit sediment downstream of infrastructure (if less than 10m<sup>3</sup>);</li> <li>• Remove to a suitable stockpile location outside the aquatic habitats; and</li> <li>• Revegetate any riparian areas disturbed by the activities.</li> </ul>	
Impacts of actions	The following impacts are anticipated as a result of undertaking the inspection activity: Disturbance of aquatic habitat and vegetation	
Severity of impacts	<b>Disturbance of aquatic habitat and vegetation</b>	If all mitigation measures are implemented the severity of the impact will be <b>Low</b>
Measures to mitigate the severity of the impact	<b>Disturbance of aquatic habitat and vegetation</b>	<ul style="list-style-type: none"> <li>• Material may be removed within the aquatic habitats only during the dry season (November/December to February/March) except for when emergency maintenance works need to be undertaken;</li> <li>• The disturbed area around the infrastructure should be kept to a minimum. Where possible existing access points to the site should be used and any indigenous vegetation that is established adjacent to the works should preferably remain intact;</li> <li>• While the work is being carried out; if required, temporary sediment trapping should be put in place to filter water draining the area that will most likely contain high sediment loads;</li> <li>• Minimise upstream/downstream impacts at the site;</li> <li>• Manual labour should be used where possible within the aquatic habitats, where the use of mechanical removal is unavoidable, the extent of operation of the machinery within aquatic habitats should be minimized;</li> <li>• The disturbed area should where applicable coincide with the programme and approach for clearing of bulrush or reeds;</li> <li>• Disturbed areas should be kept clear of alien vegetation.</li> <li>• Removed material should be completely taken out of the wetlands;</li> <li>• Disturbed areas within the aquatic habitats should be revegetated with indigenous plant species as listed in Table 6.</li> </ul>
Remedial measures if mitigation inadequate	<b>There are no additional remedial mitigation measures other than those listed above. As such, all mitigation measures as outlined above should be implemented in full.</b>	
Method of Access	Existing roads and pathways should be utilised as far as possible.	
Time period of activity	The time period of the maintenance management activity should take place within one day.	

## **7. MONITORING AND REPORTING**

The Overstrand Municipality is responsible for overseeing the monitoring of the maintenance and management activities under the auspices of this MMP. The table on the following page lists ongoing monitoring that would take place to pro-actively address any potential impacts to the ecological integrity of the aquatic ecosystems associated with the MMP as well as the specific monitoring required during MMP activities.

Form A (attached) must be completed by the relevant person(s) before maintenance activities are undertaken and Form B after a maintenance activity has been completed. A copy of each completed Form A & B must be kept on record by Overstrand Municipality.

Form A should be completed at least 7 working days before the commencement of any maintenance activity and Form B at least 3 working days following the completion of the maintenance activity(ies). At least two photographs are required from two different points of perspective (A and B) looking at the site (coordinates of these points are required). When listing the activity type and reference code, this must be done by specifically listing the relevant detail within the MMP.

It is important to note that any and all activities undertaken outside the scope of the MMP, in terms of the action outlined within the given method statement, the responsible person(s) will be subject to Section 24(F) of NEMA and that appropriate enforcement and compliance requirements will follow.

DEA&DP may, within a reasonable notice period, request to evaluate the maintenance activities and assess the maintenance sites as per the adopted MMP.

REPORTING FOR INTENT TO UNDERTAKE MAINTENANCE ACTIVITIES – FORM A				
Section A: Landowner Details				
Name	Surname	Farm No.	Erf No.	Today's Date
Section B: Details of proposed maintenance activity				
WUA/GA reference number and DEA&DP reference number for MMP.	Activity Type:	Reference code ( <i>make reference to MMP</i> )	Footprint area (m <sup>2</sup> )	Volume of material (m <sup>3</sup> )
Equipment to be used:	Description of method for planned activity:			Date when work will commence:
Date of last flood event for site:	Note any further damage and comments regarding the state of the site			
Section C: Photographs of activity location before maintenance				
<b>Before A</b>  Coordinates: S  E				
<b>Before B</b>  Coordinates: S  E   Date of photos taken:				

**REPORTING FOR COMPLETION OF MAINTENANCE ACTIVITIES – FORM B**

**Section A: Landowner Details**

<b>Name</b>	<b>Surname</b>	<b>Farm No.</b>	<b>Erf No.</b>	<b>Today's Date</b>

**Section B: Details of proposed maintenance activity**

<b>WUA/GA reference number and DEA&amp;DP reference number for MMP.</b>	<b>Activity Type:</b>	<b>Reference code (make reference to MMP)</b>	<b>Footprint area (m<sup>2</sup>)</b>	<b>Volume of material (m<sup>3</sup>)</b>

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<b>Equipment that was used:</b>	<b>Description of method for completed activity and if commence date changed</b>	<b>Date activity completed</b>

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<b>Date of last flood event for site:</b>	<b>Note any challenges or difficulties experienced in following the MMP method statement</b>

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**Section C: Photographs of activity location after maintenance**

<b>After A</b>  <b>Coordinates:</b> S  E	
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<b>After B</b>  <b>Coordinates:</b> S  E   <b>Date of photos taken:</b>	
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## **REFERENCE GUIDE FOR DRAFTING MMPs FOR A WATERCOURSE**

Ecosystem Guidelines for Environmental Assessment in the Western Cape, Edition 2, 2016. Available at: [www.bgis.org.za](http://www.bgis.org.za)

Wetland offsets: A best practice guideline for South Africa, 2016. Available at: <http://www.wrc.org.za>

Preliminary guideline for the determination of buffer zones for rivers, wetlands and estuaries, 2014. Available at: <http://www.wrc.org.za>

National Water Act, 1998 (Act No. 36 of 1998). Available at: <http://www.gov.za/documents/national-water-act>

General Authorisation, in terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998) for water uses as defined in Section 21 (c) or Section 21 (i).

**ANNEXURE A: PROOF OF PUBLIC PARTICIPATION PROCESS –  
TO BE INCLUDED IN THE FINAL MMP**

Annexure A1: Advertisements, Notices and Facebook posts *(To be included in the Final MMP)*

Annexure A2: Letters issued to Organs of State/Organisations requesting comment on the Draft MMP and Draft Rehabilitation Plan *(To be included in the Final MMP)*

Annexure A3: Written comments received on the Draft MMP and Draft Rehabilitation Plan *(To be included in the Final MMP)*

Annexure A4: Comments and Responses Report *(To be included in the Final MMP)*

## **ANNEXURE B: SPECIALIST REPORTS**

**Annexure B1:** Belcher, T. & Grobler, D. 2020. Rehabilitation and maintenance and management plan for Paddavlei wetland, including the associated hillslope seep areas and ecological corridor upstream and downstream of the vlei in Hawston.  
BlueScience: Somerset West.

# REHABILITATION AND MAINTENANCE MANAGEMENT PLAN FOR PADDAVLEI, HAWSTON IN THE OVERSTRAND MUNICIPAL AREA OF THE WESTERN CAPE

Background Information, Aquatic Ecological Assessment and  
Rehabilitation Recommendations for Paddavlei

30 JULY 2020



Compiled for:



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Title: Background Information, Aquatic Ecological Assessment and Rehabilitation Recommendations for Paddavlei

Authors: Belcher, A. and Grobler, D

Study Name: Rehabilitation and Maintenance Management Plan for Paddavlei, Hawston in the Overstrand Municipal Area of the Western Cape

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APPROVED BY:

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PROJECT MANAGER

DATE:

BLUESCIENCE (PTY) LTD

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APPROVED BY:

PROJECT MANAGER

DATE

ENVIRONMENTAL MANAGEMENT SECTION

DIRECTORATE: INFRASTRUCTURE AND PLANNING

OVERSTRAND MUNICIPALITY

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Document reference:

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## LIST OF ABBREVIATIONS/ ACRONYMS

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°C	-	Degrees Celsius
C.A.P.E.	-	Cape Action Plan for People and the Environment
CARA	-	Conservation of Agricultural Resources Act
CBA	-	Critical Biodiversity Areas
(BG)CMA	-	(Breede Gouritz) Catchment Management Agency
CSIR	-	Council for Scientific and Industrial Research
DEADP	-	Department of Environmental Affairs and Development Planning
DEA	-	Department of Environmental Affairs
DWAF	-	Department of Water Affairs and Forestry
DWS	-	Department of Water and Sanitation
EC	-	Electrical conductivity
EIS	-	Ecological Importance and Sensitivity
ESA	-	Ecological Support Area
FEPA	-	Freshwater Ecosystem Priority Area
GN	-	Government Notice
ha	-	hectare
HDA	-	Hawston Development Association
km	-	kilometre
km <sup>2</sup>	-	square kilometres
ℓ	-	litre
ℓ/s	-	litres per second
m	-	metre
m <sup>3</sup>	-	cubic metre
m <sup>3</sup> /a	-	cubic metre per annum
Mm <sup>3</sup> /a	-	Million cubic metres per annum
m <sup>3</sup> /s	-	cubic metre per second
MAE	-	Mean Annual Evapotranspiration
mamsl	-	metres above mean sea level
MAP	-	Mean Annual Precipitation

MAR	-	Mean Annual Runoff
mbgl	-	metres below ground level
mg/ℓ	-	milligram per litre
mm	-	millimetre
mm/a	-	millimetre per annum
MMP	-	Maintenance Management Plan
MSL	-	Mean Sea Level
mS/m	-	milliSiemens per metre
NEMA	-	National Environmental Management Act
NWA	-	National Water Act
NWM	-	National Wetland Mapping
PEG	-	Paddavlei Eco Group
PES	-	Present Ecological Status
RDM	-	Resource Directed Measures
SANBI	-	South African National Biodiversity Institute
TEC	-	Target Ecological Category
TDS	-	Total dissolved solids
WCBSPP	-	Western Cape Biodiversity Spatial Plan
WC/WDM	-	Water conservation and water demand management
WMA	-	Water Management Area
WSDP	-	Water Services Development Plan
WWTW	-	Wastewater Treatment Works

## 1. INTRODUCTION

The Paddavlei Wetland forms part of an aquatic ecological corridor that is formed between the Onrus Mountain to the east and a coastal dune system to the west. The corridor arises within Hoek van die Berg Nature Reserve and provides connectivity to the Bot River Lagoon and estuary to the north. Historically Paddavlei was a seasonal open water pan but in more recent years it has become increasingly overgrown with bulrushes and its ecological condition has degraded. Due to concerns raised by the surrounding Hawston community, Overstrand Municipality has initiated a process to rehabilitate the wetland. This document is intended to provide the background information and recommendations for the rehabilitation and maintenance of the wetland.

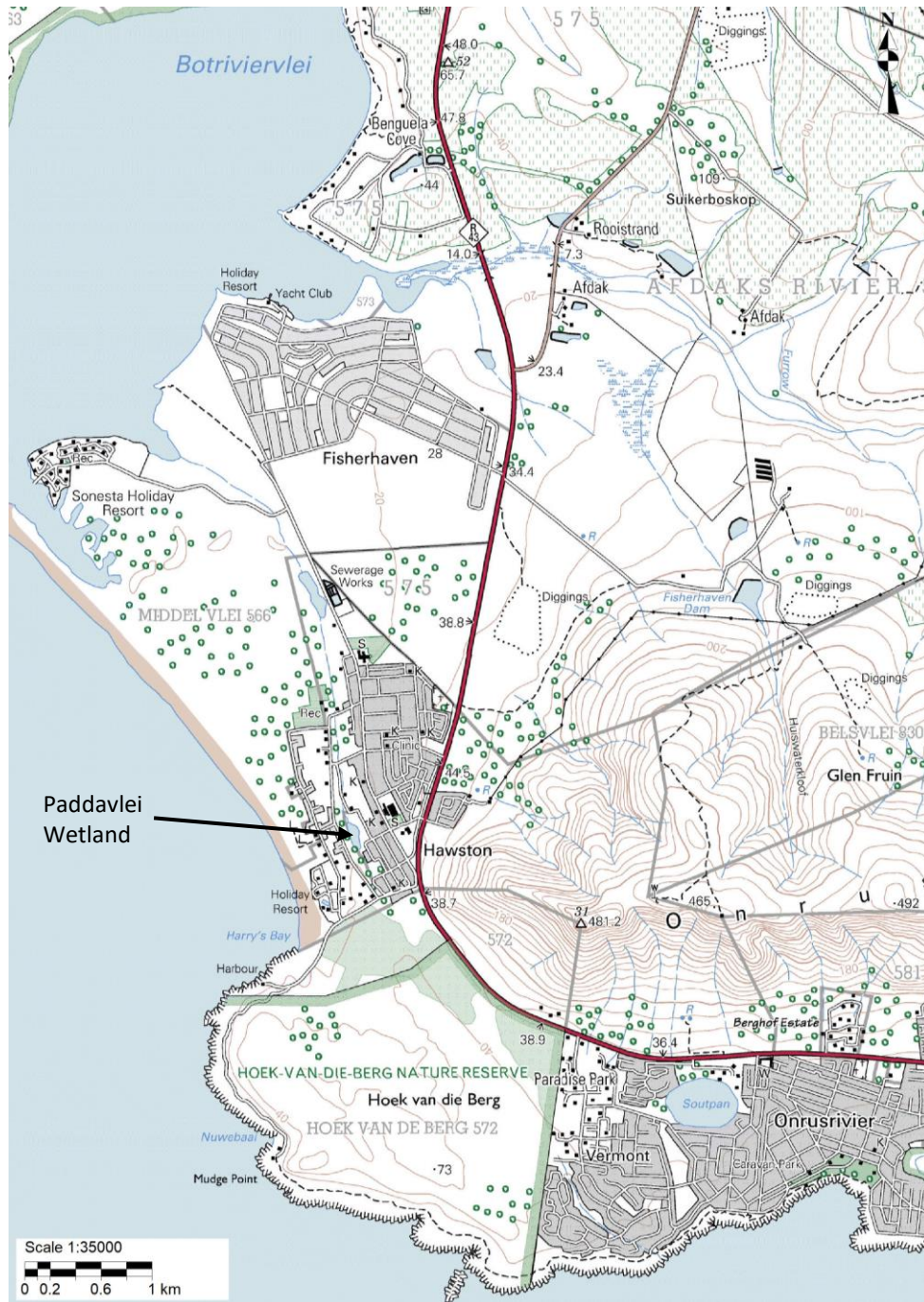


Figure 1. Topographical map (3419AC) for the area, with the location of Paddavlei Wetland indicated

## 2. BACKGROUND AND PURPOSE OF THE REHABILITATION AND MAINTENANCE MANAGEMENT PLAN

The Paddavlei Wetland is central to Hawston, lying within the ecological corridor that runs from south to north through the middle of the settlement. Early memories of the vlei by senior members of the community are fond, remembering many childhood hours being spent swimming, sailing small wooden toy boats on the waters and catching tadpoles. A fountain at the vlei provided water and washing of clothes and the subsequent 'dressing' of the bushes around the vlei with the washed items was a familiar sight.

Today, Paddavlei is dominated by bulrush to such an extent that it is largely inaccessible to the surrounding community as well as aquatic biota. The area surrounding the vlei has also become overgrown with invasive alien plants and is a dumping area for waste.

In 2016, a concerned group of residents called the Paddavlei Eco Group (PEG), sub-group of the Hawston Development Association (HDA), began an initiative to rehabilitate the Paddavlei. After consultation with the Hawston community and scientists (experts) and a review of available literature, a proposal to address the rehabilitation of the vlei was submitted to various government departments including the Department of Environmental Affairs (DEA) to secure support and funding. A meeting was held with DEA and CapeNature and a letter was subsequently received indicating DEA's support for the proposal.

In 2017, the Paddavlei Ecosystem Rehabilitation report was compiled by Mr Michael Austin for the HAD. That contained key recommendations for the rehabilitation of not only Paddavlei but the wider associated ecological corridor from Hawston to the Bot Lagoon. Most of the recommendations in the report relate to what is indicated to be damage done to the wetland and the environment by a discontinued plan to drain the water out of the Paddavlei system, such as: blocking the drainage pipeline; removing a drain pipe and temporary roadway; re-establishing an open drain for storm water; closing the drainage ditch and re-establishing the flow of water downstream of Paddavlei; removing the waste disposal area and sewer that extend into the wetland downstream of Paddavlei; stopping the discharge of treated wastewater from the wastewater works into Skilpadvlei; addressing the input of litter into the wetland from storm water runoff and removing and policing of dumping of rubble and rubbish into the wetland. Removing of invasive alien vegetation and addressing the encroachment of reeds in the wetland were also addressed in the recommendations. It was proposed that the rehabilitation involve the surrounding community, empowering residents, obtaining local support for the work and using local labour.

The vision of the PEG for Paddavlei is as follows:

- To enjoy a green belt that extends from the Vermont pan to the Bot River estuary with Paddavlei as the central jewel of this green belt of wetlands;
- To have fresh, clean, natural rainwater flowing into Paddavlei because the sewage and storm water problems that currently contribute so much to its pollution have been resolved;
- To have Paddavlei and its environs as the completely litter free, protected and valued natural heart of Hawston where people feel safe and want to relax and enjoy nature;
- To have the entire area free of alien vegetation and to have the invasive reeds cut back to the degree necessary for the people, birds, frogs, fish and other creatures to be able to return; and
- To have a continuous circular walkway from Paddavlei to Skilpad Vlei for walking/running; a suitable bird hide; fishing spots; a launch spot for canoes; a recreational/educational space, an amphitheatre possibly, where also music and drama could be enjoyed.

This Plan takes note of the above and is intended to provide rehabilitation and maintenance recommendations for the future management of the focus area of Paddavlei Wetland in Hawston in the Overstrand Municipal Area of the Western Cape. Despite the absence of all the information necessary to draw up such a management plan, the implementation of various management actions required to address those issues identified in this report are critical. It is recognized that the process of implementing rehabilitation and maintenance management actions cannot wait until all the information is in place. Rehabilitation is also an ongoing process and should be phased. This will allow the rehabilitation measures to be constantly improved upon as better knowledge of the aquatic ecosystem becomes available in a learning from doing manner.

### 3. SITUATIONAL ASSESSMENT

#### 3.1. CHARACTERISTICS AND PHYSICAL FEATURES OF THE AREA

Paddavlei is located within the Southern Folded Mountains Aquatic Ecoregion, on the south-western slopes of the Onrus Mountains. The Paddavlei Wetland (referred to simply as Paddavlei in the remainder of this document) is a central feature within the town of Hawston. The town is located on the lower slopes of the Onrus Mountain with distinctive features comprising of the R43 Provincial Route passing through its eastern extents and several dune systems occurring on its western extent to its coastal edge with the Atlantic Ocean. Paddavlei is central to the town and forms part of a significant ecological corridor that links biodiversity areas such as Hoek van die Berg to the south, with the Bot Lagoon and the Kogelberg Biosphere Reserve to the north.

The vlei itself is largely bounded by Harbour Road to the south, George Viljoen Street to the north, Long and Bush Street to the east and the dunes and milkwood forest to the west. The core wetland area only really starts approximately 60 m south of Vlei Street and extends northwards for approximately 300 m to where Long Street makes a 'dog-leg' towards the vlei and a low embankment and pipe culvert limit the expansion of the vlei northwards. A much smaller vlei area that receives stormwater from residential areas to the north-west feeds into this vlei area. There are also a number of stormwater outlets and seeps on the eastern hillslopes, within Hawston that drain into the vlei from downslope of Church Street to the east.

#### 3.2 TOPOGRAPHY

Paddavlei is located at the foot of the Onrus Mountain. The hillslope drops relatively steeply from the mountain top at 481 m above mean sea level down to the R43 road than more gradually down to Paddavlei that is at about 9 m above mean sea level (mamsl) (Figure 2). The surrounding area to the west of the site is characterised by a primary sand dune with a height of about 17 mamsl and a narrow coastal plain of approx. 300 m with smaller drift sand dunes.

The longitudinal elevation profile for the aquatic ecological corridor (Figure 3) shows that the drainage within the corridor arises from within Hoek van die Berg Nature Reserve, with the watershed lying approximately 600 m to the south of Harbour Road. The drop from the watershed to Paddavlei is steeper (approximately 2.25 %), after which the slope of the corridor down to the Bot Lagoon is relatively flat (approx. 0.1%). The depressions at Paddavlei and Skilpadvlei are visible, where the general topography of the area (10 m to 14 mamsl) drops down to 8 m to 9 mamsl.

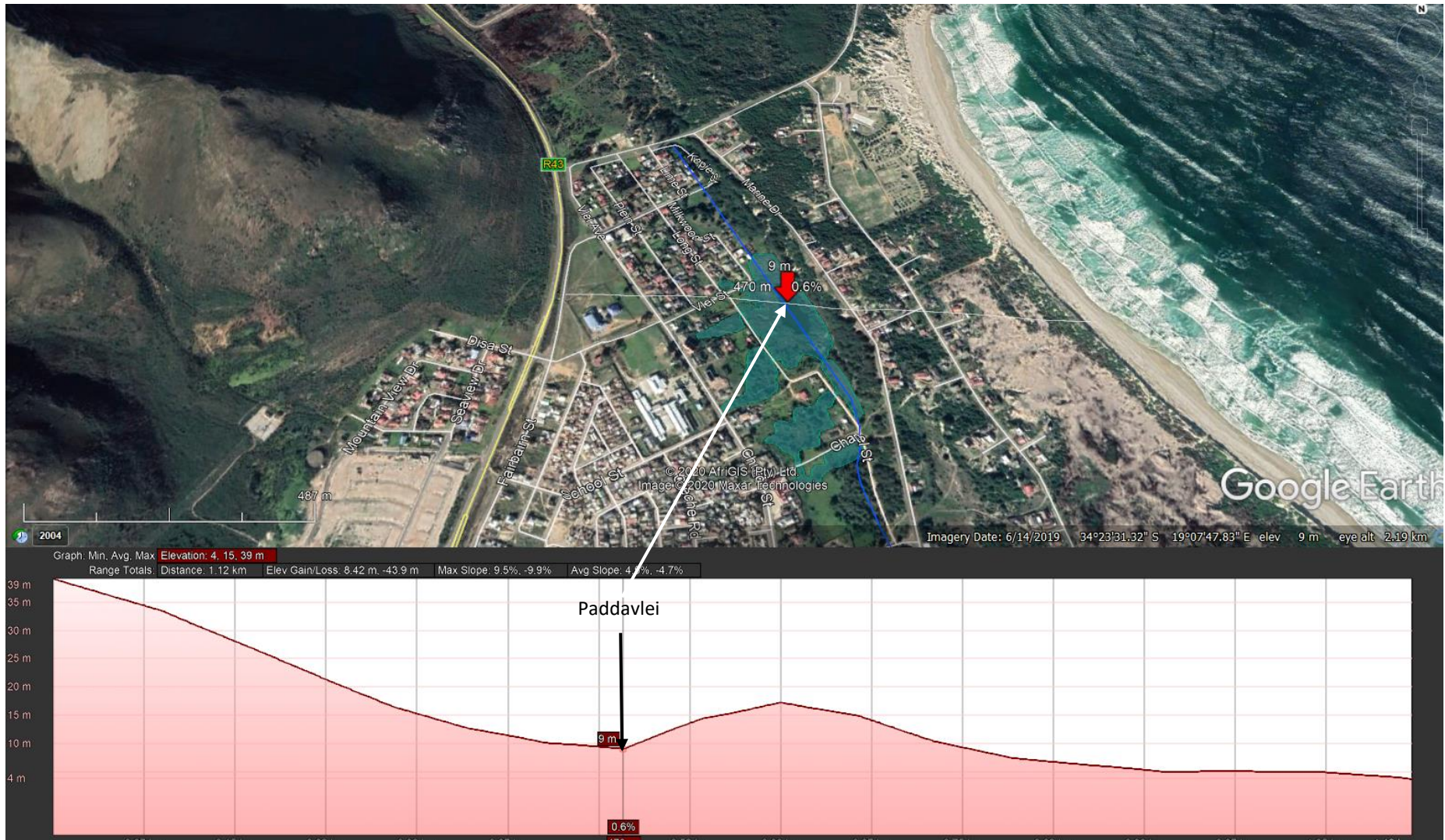


Figure 2. Cross-sectional elevation profile at Paddavlei, shown in Google Earth for the section from the R43 Road to the coastline

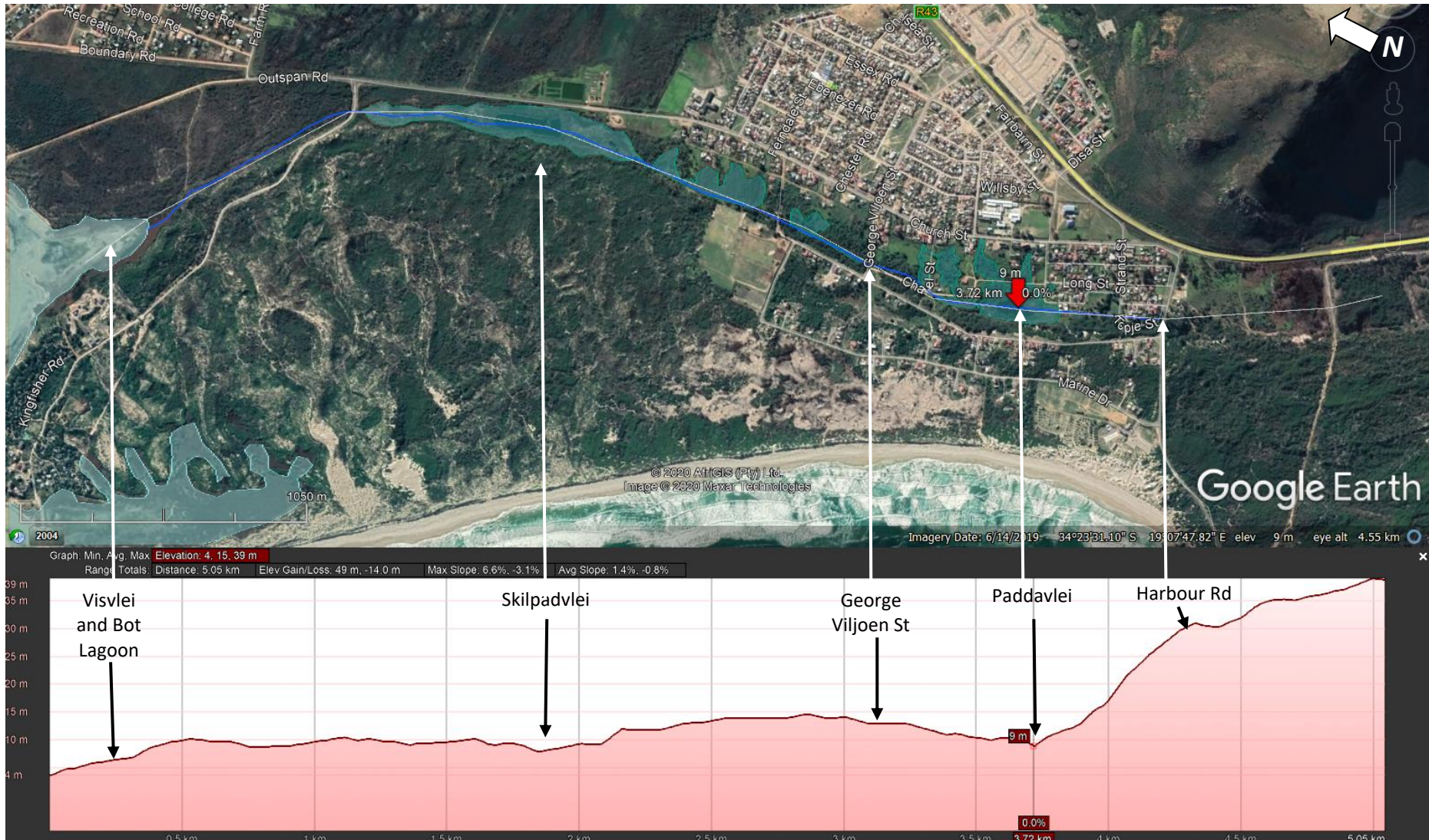


Figure 3. Longitudinal profile of the Aquatic Ecological Corridor associated with Paddavlei, shown in Google Earth with the main topographical features indicated.

### 3.3 CLIMATE

Hawston experiences a Mediterranean climate, with cool wet winters and warm dry summers. Average daily temperatures range from 12-14° C in winter and 15-20°C in summer (Figure 4). The region is the coldest during July when the mercury drops to below 7°C on average during the night. The annual average rainfall for the area is 561 mm, with the lowest rainfall (13 mm) occurring in December and January and the highest (68 mm) in June and August. The total annual evaporation for the area is 845 mm and is highest in January (112 mm). During the driest months (December to March), the area is also exposed to the prevailing southeast winds and the fire hazard is greatest.

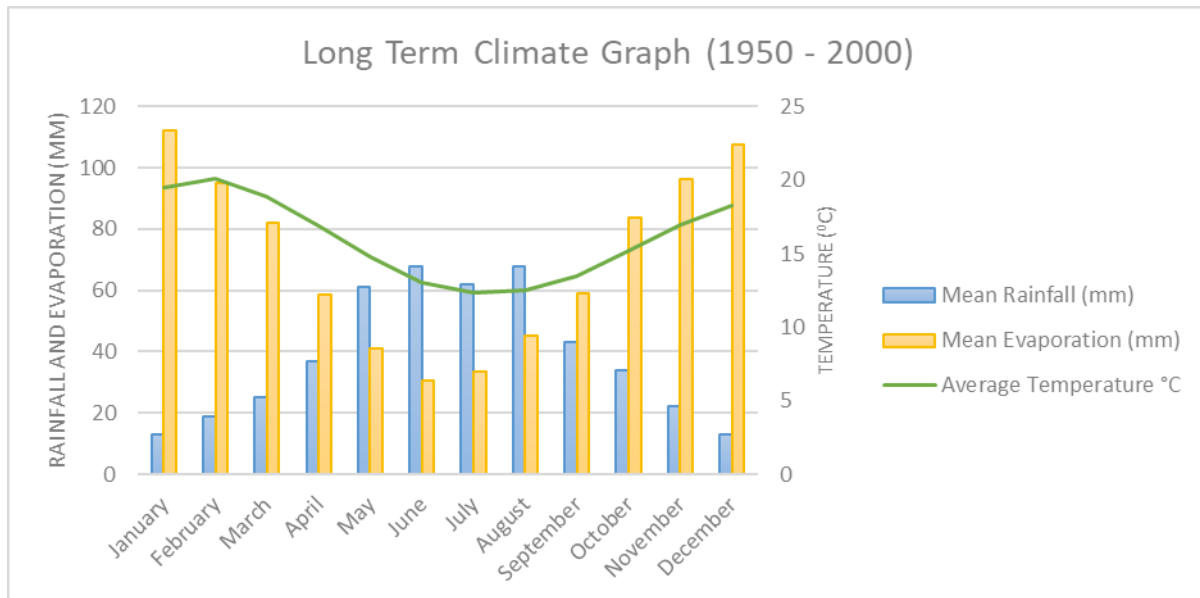


Figure 4: Long term climate graphs for the area (Source: SA Atlas of Climatology and Agrohydrology, 2009, R.E. Schulze)

### 3.4 GEOLOGY AND SOILS

In terms of Geology, at a regional level, the main stratigraphic units in the area belong to the Malmesbury Group, Cape Granite Suite, Table Mountain Group, Bokkeveld Group and the Bredasdorp Group. The site is underlain by Quaternary-Age sediments and quartzite's of the Peninsula Formation of the Table Mountain Group. The youngest formations in the area are the sediments of the Bredasdorp Group, which overly the basement rocks. These overlying strata mainly consist of aeolian sand deposits and littoral sandstone and limestone and occur along the coastal zone. The Peninsula Formation consists mainly of planar-bedded, light grey, coarse grained quartzitic sandstones (Figure 5).

On the hillslope to the east of the vlei the underlying geology comprises siltstone, mudstone and shale of the Bokkeveld Group. The soils on the slopes have a marked clay accumulation, are strongly structured and a non-reddish colour. Soil depth is less than 450 mm and the soils are highly erodible. To the west of this, recent coastal sand and dunes with slight occurrence along the coast of shale of the Bokkeveld Group and sandstone of the Peninsula Formation, Table Mountain Group. These greyish, sandy soils are deep (more than 750mm) and excessively drained. They also have a high erodibility potential. The distinct transition from the soils of the hillslope to the deep sandy soils of the dunes occurs along the aquatic ecological corridor.



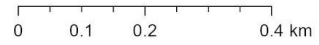
**Legend**

**Broad Soils Classification (ENPAT)**

- Glenrosa and/or Mispah forms (other soils may occur)
- Grey regic sands
- Miscellaneous land classes, rocky

- Plinthic catena
- Prismacutanic and/or pedocutanic diagnostic horizons dominant
- Red-yellow apedal, freely drained soils

- Soils with a diagnostic ferrihumic horizon
- Vertic, melanic, red structured diagnostic horizons, undifferentiated



Scale: 1:9 028

Date created: June 5, 2020

Compiled with CapeFarmMapper



**Figure 5. Broad soils classification for the area (South African Atlas of Climatology and Agrohydrology obtained from CapeFarmMapper, 2020)**

### 3.5 VEGETATION

The area falls within the southwest coastal region of the Cape Floristic Region in the Fynbos Biome. The region is one of only six in the world and is the smallest, occupying only 0.1 % of the world's land surface and supporting 9000 plant species. This floristic region is however under threat from agriculture, urbanisation and alien plants, particularly in lower lying areas with an estimated 67 % of the threatened plant species in the country occurring only in the southern portions Western Cape and these total over 1800 species (Raimondo *et al* 2009). According to the SA Vegetation Map (Mucina and Rutherford 2006), Paddavlei falls within the Overberg Coastal Bioregion and primarily within Overberg Dune Strandveld with Hangklip Sand Fynbos occurring on the lower slopes of the Onrus Mountain (Figure 6).

Paddavlei occurs in the transition area between a coastal plane with a large headland bypass dune, which is now vegetated by both alien and indigenous vegetation and the hillslope within its fynbos vegetation that has largely been transformed by activities within Hawston.

Overberg Dune Strandveld occurs between the Cape Hangklip and Cape Infanta on alkaline coastal sands. It is regarded as a Least Threatened vegetation type, with 94 % remaining and 41 % protected. Alien vegetation and coastal development present major threats to this vegetation. At Paddavlei this vegetation type is widespread to the west of the ecological corridor and corresponds with the underlying deeper dune sand. Species diversity is moderate to low, particularly in the areas invaded by invasive alien vegetation. This vegetation type is not known to support many plant species of conservation concern and plant composition from one area to the next is remarkably constant. Of particular note however is the milkwood forest along the ecological corridor at the foot of the primary dune to the west of the vlei system. Milkwoods (*Sideroxylon inerme*) are listed as a Protected Species and must not be removed or damaged without the relevant permits.

Hangklip Sand Fynbos is restricted to deep acid sand on the lowlands between the Cape Peninsula and Onrus. It is regarded as an Endangered vegetation type and is threatened by urban development, alien vegetation and agriculture. This unit has less than 45 % of its original extent remaining with about 20 % protected. This vegetation type does not appear to be represented at Paddavlei as its original extent lies within the developed areas of Hawston.

Woody invasive alien vegetation is common within the aquatic ecological corridor both upstream (south) and downstream (north) of Paddavlei. Species include Port Jackson willows (*Acacia saligna*), rooikrans (*A. cyclops*), golden wattle (*A. pycnantha*), *Eucalyptus sp.*, weeping willows (*Salix babylonica*) and manatoka (*Myoporum montanum*).

*Typha capensis* (bulrush) was the dominant wetland species present in the vlei. Other wetland species observed within the wider wetland area comprised of tabakbos (*Senecio halimifolius*), fonteinbos (*Psoralea pinnata*), milkweed (*Gomphocarpus physocarpus*), arum lilies (*Zantedeschia aethiopica*) and the sedge *Cyperus longus*. The terrestrial vegetation surrounding the wetland was mostly transformed. Alien kikuyu (*Pennisetum clandestinum*) and indigenous buffalo (*Stenotaphrum secundatum*) and fynkweek (*Cynodon dactylon*) grass, with clumps of sour figs (*Carpobrotus edulis* and *C. asciniiformis*), wilde dagga (*Leonotis leonurus*), cobra lilies (*Chasmanthes aethiopica*), carpet geranium (*Geranium incanum*), pelargoniums (*Pelargonium alchemilloides*) and asparagus ferns (*Asparagus sp.*). Alien plant species found within the wetland included Pampas grass (*Cortaderia selloana*), Brazilian peppertree (*Schinus terebinthifolia*), syringa (*Melia azedarach*), red sesbania (*Sesbania punicea*), castor-oil plant (*Ricinus communis*), nasturtiums (*Tropaeolum majus*) and Patterson's curse (*Echium plantagineum*).

On the primary dune which confines the wetland to the south was a thicket of milkwoods (*Sideroxylon inerme*) with some karee (*Searsia lucida* and *S. tomentosa*) and bietou (*Chrysanthamoides monilifera*), amongst moderately scattered rooikrans (*Acacia cyclops*) and Port Jackson (*A. saligna*).

Ecological drivers and spatial components of ecological processes are regarded as important elements of good conservation planning as these are some of the primary determinants keeping natural systems operational and in balance. The Overberg Dune Strandveld area is not a fire driven system and fire should be kept out of this area to prevent an increased density of alien species.



- Legend**
- |                                |                                  |
|--------------------------------|----------------------------------|
| <b>VEGMAP 2018 (Beta)</b>      | FFs 12 Overberg Sandstone Fynbos |
| AZd 3 Cape Seashore Vegetation | FS 7 Overberg Dune Strandveld    |
| FFd 6 Hangklip Sand Fynbos     |                                  |

0 0.1 0.2 0.4 km  
**Scale:** 1:9 028  
**Date created:** June 5, 2020



**Figure 6. 2018 Vegetation map for the area (SANBI VegMap 2018 obtained from CapeFarmMapper, 2020)**

## 3.6 HYDROLOGY AND GEOHYDROLOGY

### 3.6.1 SURFACE WATER RUNOFF

The site falls within the lower Bot River Catchment (Department of Water and Sanitation Quaternary Catchment G40G). This Quaternary Catchment is characterised by a relatively high Mean Annual Precipitation of 701 mm, a Mean Annual Evaporation of 1 415 mm, and a simulated Mean Annual Runoff of 24.6 million cubic metres over a total area of 220 km<sup>2</sup>. The cumulative mean annual runoff for the entire Bot River Catchment (catchment area of 920 km<sup>2</sup>) is estimated to be 98.67 million cubic metres. The catchment of Paddavlei is much smaller at approximately 0.93 km<sup>2</sup> with a mean annual precipitation of 561 mm. Infiltration rates are also high for most of the catchment with very little direct surface water runoff. Most of the runoff from the Onrus Mountain is intercepted upstream of the R43 road and channelised via stormwater canals. Given the above, the average surface water runoff to the vlei is likely to be less than 50 000 m<sup>3</sup> per annum.

### 3.6.2 GEOHYDROLOGICAL CHARACTERISTICS

The site is underlain by the Peninsula Aquifer, within the Overberg Region, a Strategic Water Source Area for groundwater. The Peninsula Aquifer is classified as a major, fractured type aquifer. Average borehole yields for this aquifer are between 0.5 and 2 ℓ/s and the salinity range is <70 mS/m. The Peninsula Aquifer waters typically have a low pH. The average depth to groundwater is about 12 m below ground level within the valley floor. Recharge of the aquifer is indicated to be on average 59 mm per year, occurring largely on the upper slopes of the Onrus Mountains. The aquifer is classified as having very high vulnerability to contamination, mainly due to overlying sand material which will allow rapid infiltration of polluted waters into the aquifer.

Paddavlei appears to be largely groundwater fed, with an inflow of water at a fountain in the upper vlei referred to by Hawston residents as 'die pompie'. The fountain daylights at the contact between the sand and the bedrock, before draining into the vlei. This water typically has a much higher pH (pH of approx. 8) which is typical of groundwater in primary aquifers along the coast due to the high CaCO<sub>3</sub> content of the sands. The electrical conductivity (EC) of this water also tends to be high with ranges typically of between 150 – 415 mS/m due to proximity to the sea.

### 3.6.3 SURFACE AND GROUNDWATER CONTRIBUTIONS TO PADDAVLEI

The expected ground and surface water flows at Paddavlei are as described below and illustrated in Figure 7.

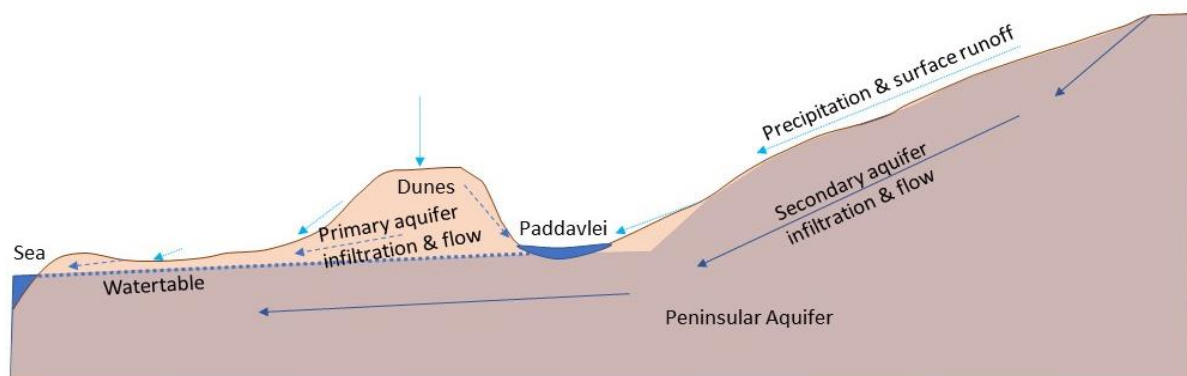


Figure 7. Schematic diagram of the surface and groundwater interaction at Paddavlei

Rainfall at Paddavlei will infiltrate the surrounding sands and flow in a direction that mimics the topography. It is expected that the wetland area is fed from the mountain run-off and from rainwater infiltration in the low-lying area around the wetland. Rainfall infiltration at the high dune area will infiltrate to the bedrock where it would flow towards the sea. Groundwater from the secondary aquifer is recharged from rainfall in the Onrus Mountain and flows in a south westerly direction towards the sea.

### 3.7 AQUATIC ECOSYSTEMS

Paddavlei lies within an aquatic ecological corridor that comprises of a number of valley bottom wetlands linked by a watercourse that drains from near the R43 in the Hoek van die Berg Nature Reserve, northwards to the Bot River Lagoon. This back dune aquatic ecological corridor is largely associated with dispersal of surface and sub surface flow along the length of the valley floor. There are no wetland habitats in the corridor upstream of Harbour Road. The watercourse within this upper section also does not have a defined channel.

Paddavlei is the upstream-most wetland in corridor. The vlei currently has a surface area of approximately 3 ha that is dominated (overgrown) with bulrush. Associated with the vlei, is a smaller downstream wetland section of approximately 0.5 ha that is also dominated with bulrush. There are a number of wetland seep areas leading down the hillslope to the east of the vlei that are largely associated with stormwater runoff from the catchment and developed areas east of the vlei, within Hawston and along the R43 Road.

Downstream of Paddavlei, a milkwood riparian forest tends to dominate the watercourse which drains into Middelvlei / Skilpadvlei before flowing down to Visvlei and the Bot River Lagoon. A more detailed description and assessment of Paddavlei is included in Section 4.

The delineation of the wetlands, as displayed in Google Earth image overlays and used in the maps in this report, is not intended to provide the exact boundaries of the wetland areas.

### 3.8 AQUATIC FAUNA

The Bot-Kleinmond System provides crucial habitat and breeding grounds for multiple fish and amphibian species. These include the Bot River Klipfish (*Clinus spatulatus*) which is listed as Endangered, the Freshwater Mullet (*Myxus capensis*) which is listed as Vulnerable, the endemic Micro frog (*Microbatrachella capensis*) which is listed as Critically Endangered, the Endangered Cape Platanna (*Xenopus gilli*) and the Endangered Western Leopard Toad (*Sclerophrys pantherina*).

Due to the dense reed growth and largely sub-surface flow within the aquatic corridor it is highly unlikely that any of the estuarine fish occur within Paddavlei. It has been suggested by some local residence that the Paddavlei wetland contains indigenous reedfin minnows, (some reedfin minnow fish species are rated as threatened or endangered). Cape Nature (personal communication with Dean Impson) however indicated that there are no reedfin species within the wetland, only alien banded tilapia (*Tilapia sparrmanii*).

The system also provides valuable habitat for birdlife with more than 118 species recorded. In particular, large numbers (up to 36 000) of red-knobbed coot (*Fulicia cristata*) occur. Five bird species that are listed in the South African Red Data Book are: White pelican (*Penecalus onocrotalus*) and the Caspian Tern (*Hydroprogne caspia*), listed as rare; Greater flamingo (*Phoenicopterus ruber*) and lesser flamingo (*P. minor*) are listed as intermediate; and African Fish eagle (*Haliaeetus vocifer*) is listed as vulnerable.

While Paddavlei does not have the estuarine habitats to support the birdlife of the Bot River Lagoon, it does provide habitat for wetland birds such as Grey Heron (*Ardea cinerea*), Cattle Egret (*Bubulcus ibis*), Red-

knobbed Coot (*Fulica cristata*), Common Moorhen (*Gallinula chloropus*), red bishop (*Euplectes orix*), Cape weaver (*Ploceus capensis*)

### 3.9 BIODIVERSITY CONSERVATION IMPORTANCE

The aquatic ecological corridor in which Paddavlei is located is linked to formally protected areas:

1. The Bot-Kleinmond Estuarine System, into which the aquatic ecological corridor drains, is a designated Ramsar wetland and recognised as one of the ten most significant wetlands for water birds in South Africa during the dry summer months (86 species of water bird have been recorded) and is an nursery area for fish (41 fish species from 24 families recorded, of which 19 species are dependent on estuaries to complete their lifecycle); and
2. Hoek van die Berg Private Nature Reserve to the south-east of Paddavlei, with the associated aquatic ecological corridor arising within the reserve.

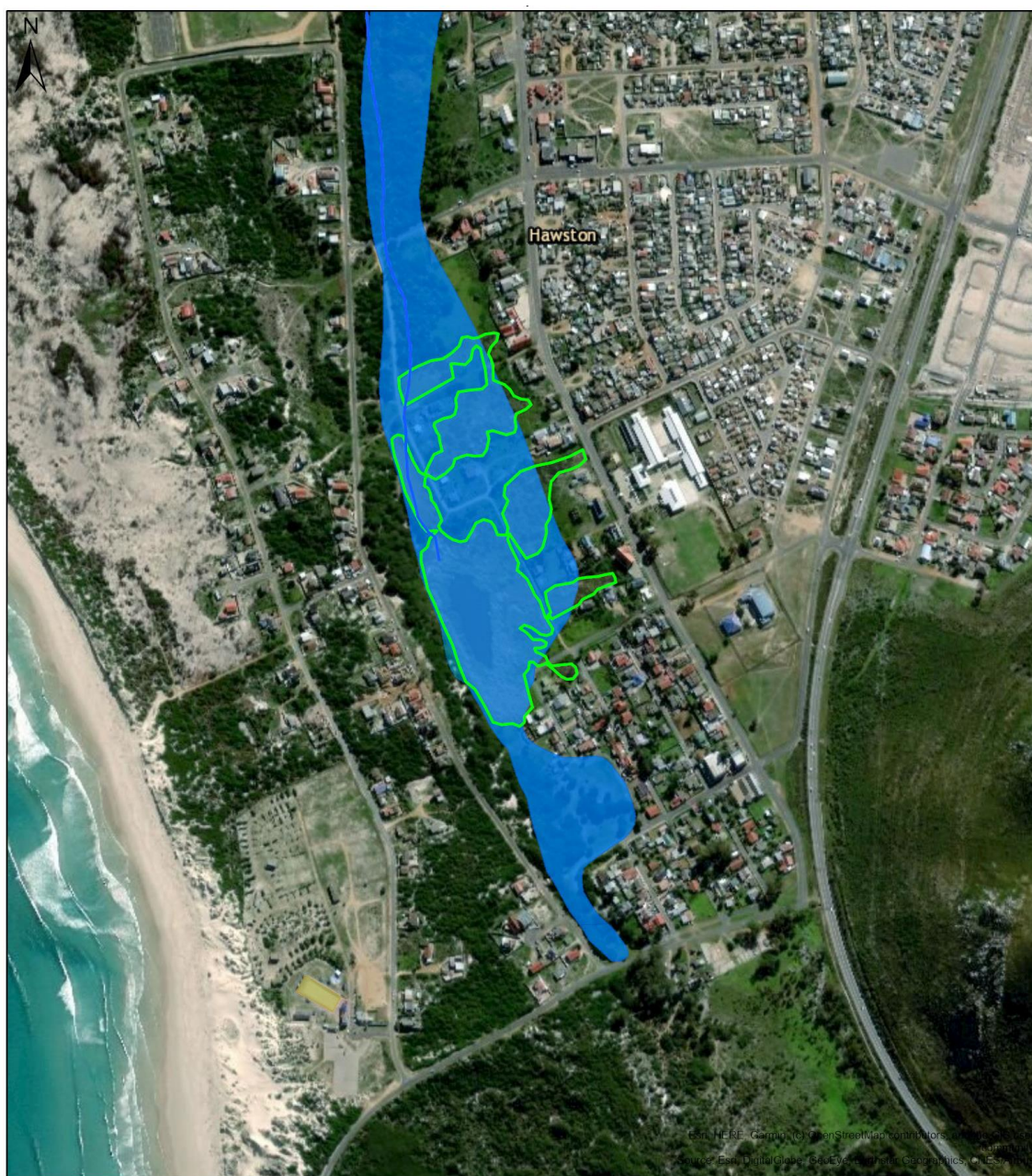
Over and above the formally protected areas, there are two sets of biodiversity conservation mapping initiatives at a national, provincial and local scale are of relevance to the identification of aquatic features of ecological and biodiversity conservation importance. These are the National Freshwater Ecosystem Priority Areas (FEPA) map and the 2017 Western Cape Biodiversity Spatial Plan (WCBSPP)

FEPAs are intended to provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. FEPAs were determined through a process of systematic biodiversity planning and were identified using a range of criteria for serving ecosystems and associated biodiversity of rivers, wetlands, and estuaries. The entire aquatic ecological corridor, including Paddavlei, has been mapped as a natural Freshwater Ecosystem Priority Area (FEPA) Wetland (Channelled valley-bottom wetland within the South Strandveld Bioregion) by the National FEPA and National Wetland Mapping projects (Figure 8). The larger Bot River catchment is not mapped as a FEPA River sub-quaternary catchment.

The 2017 WCBSPP aims to guide sustainable development by providing a synthesis of biodiversity information to decision makers. The map indicates areas of land as well as aquatic features which must be safeguarded in their natural state if biodiversity is to persist and ecosystems are to continue functioning. The main map categories are Critical Biodiversity Areas (Terrestrial and Aquatic), Ecological Support Areas (Critical and Other), Other Natural Remaining Areas and No Natural Remaining Areas. The first two mentioned categories represent the biodiversity priority areas which should be maintained in a natural to near natural state. The last two mentioned categories are not considered as priority areas and a loss of biodiversity within these areas may be acceptable.

Only the downstream Middelvlei / Skilpadvlei and Bot Lagoon are mapped as aquatic Critical Biodiversity Areas (wetlands and estuary) that are required to meet biodiversity and should be maintained to prevent any further loss of aquatic habitat. Paddavlei and the remainder of its associated wetland corridor is mapped as an aquatic (wetland and watercourse) Ecological Support Area that should be restored. These areas are not deemed essential for meeting biodiversity targets but play an important role in supporting the functioning of Protected Areas or Critical Biodiversity Areas and are often vital for delivering ecosystem services. The management objective is to restore and/or manage these areas to minimize impact on ecological processes and ecological infrastructure functioning, especially soil and water-related services, and to allow for faunal movement. The coastal dune field to the west of the vlei is also mapped as an aquatic Ecological Support Area.

The aquatic ecological corridor also provides an important ecological connectivity between the Bot Lagoon, the wetlands within the corridor, *Juncus cf. kraussii* wetlands at Hoek van die Berg and the Vermont Pan to the east of Hawston.



- Legend**
- |                                  |                         |
|----------------------------------|-------------------------|
| <b>Wetlands (NWM5)</b>           | <b>Wetlands (NFEPA)</b> |
| Channelled valley-bottom wetland | Natural                 |
| Seep wetland                     |                         |
|                                  | <b>Rivers</b>           |
|                                  | Non-Perennial           |

0 0.1 0.2 0.4 km

Scale: 1:9 028

Date created: June 5, 2020

Compiled with CapeFarmMapper



**Figure 8. National Freshwater Ecosystem Priority Area (NFEPA) Wetland and National Wetland Mapping (NWM) for Paddavlei (CSIR FEPA Mapping, 2011 obtained from CapeFarmMapper, 2020)**

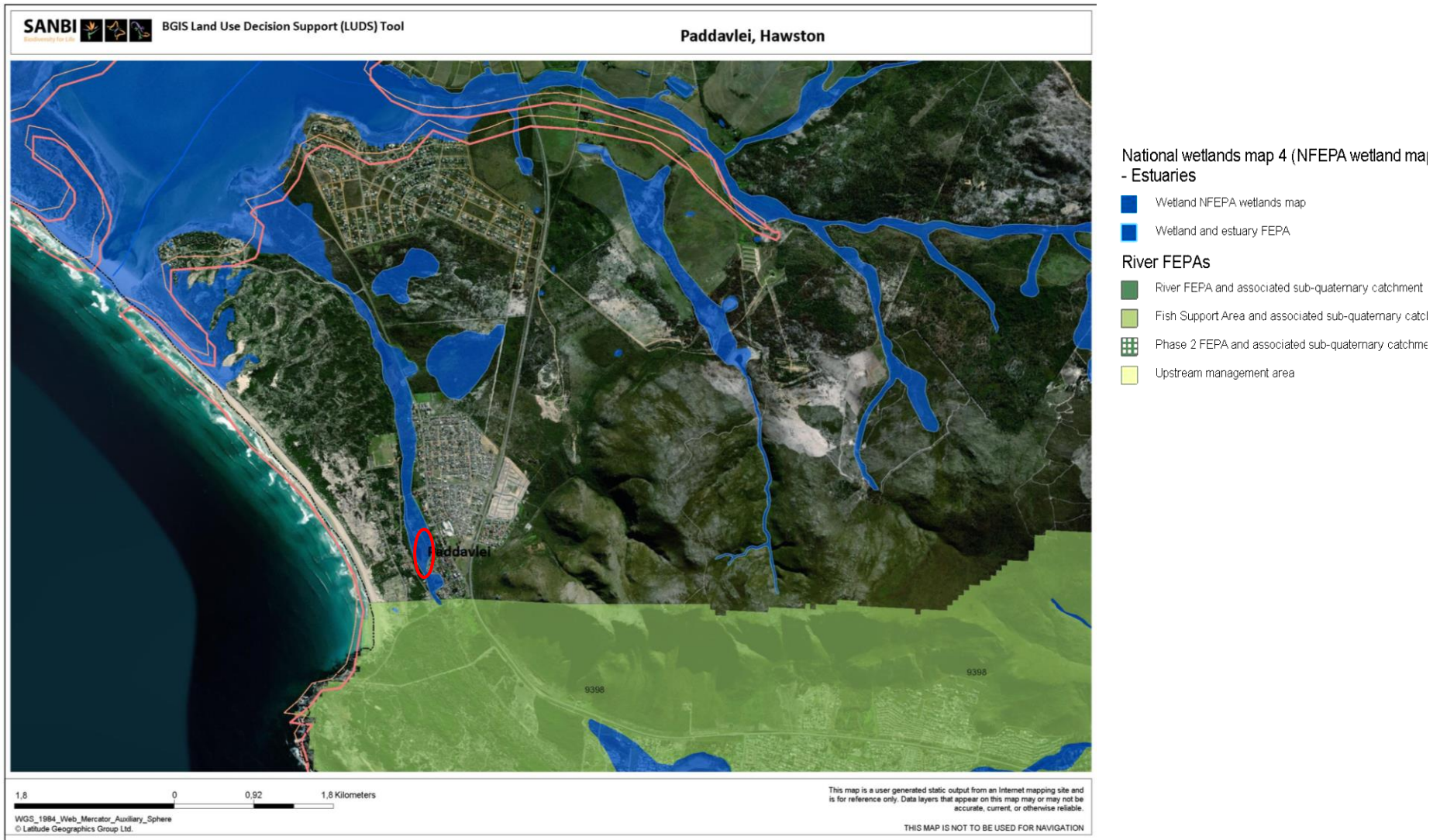


Figure 9. National Freshwater Ecosystem Priority Area River mapping for the area where the red oval indicates the locality of Paddavlei



**Legend**

**BSP ESA: Restore**

ESA2: Restore from other land use

**BSP ESA**

ESA: Aquatic

ESA: Terrestrial

Other Natural Area

BSP Protected Areas

0 0.1 0.2 0.4 km

Scale: 1:9 028

Date created: June 5, 2020

Compiled with CapeFarmMapper



**Western Cape Government**

Agriculture

**Figure 10. Ecological Support Areas (ESA) River mapping for the area where the red oval indicates the locality of Paddavlei**

The delineation of the NFEPA and ESA that is provided in Figures 8, 9 and 10 is provided by the National datasets and the boundaries of these area cannot be used as absolute accurate. The milkwood forests clearly needs to be included in the priority areas.

#### 4. MODIFICATION TO PADDAVLEI AND ITS SURROUNDING AREA

Shell middens from the Later Stone Age along the shoreline, as well as scatters of Middle Stone Age, as well as Early Stone Age stone tools have been documented along the coastline near Hawston. The rocky shoreline around this area would have provided abundant coastal resources while the watercourses, springs and pans provided fresh water and the large milkwood trees provided shelter. Most of the coastal shell middens probably date to the period between 5000 and 3000 years ago, but the presence of pottery in the area indicates that hunter-gathers and possibly even Herders were living in the area within the last 2000 years (Kaplan, 2016).

The Hawston area was originally known as Herriesbaai after a Swede Harry Cruise who was shipwrecked in the area and settled at the cove (previously known as Fish- or Harderbaai). Early memories of Hawston (Maree, 2003) indicate that it was settled in the mid- 19<sup>th</sup> century by freed slaves who had to pay an annual rental fee of £30 with the understanding that the land would become theirs after 30 years of occupancy. Payment had however ceased by 1890. In 1901, following a dispute about harvesting of the dune forest, the occupants were ordered to leave the area adjacent to the vlei. This order was ignored however in late 1902 a cloudburst flooded the valley and forced the settlers to move at least out of the valley floor. Plots were then surveyed in 1904 and rented until 1925 when the plots were eventually sold to the residents. Paddavlei was well known as good grazing land that was used by '*kalk branders*' and fishermen who were living in this '*uitspan bebied*'. In 1945 as a result of flood damage to the properties adjacent to Paddavlei, a channel was dug to drain water out of the vlei.

The early settlement comprised of two distinct areas, the core fishing settlement area (Middelvlei South) immediately adjacent to Paddavlei with its connecting road, Strand Street, to the fishing harbour; and Middelvlei within its long rectangular plots extending down to the ecological corridor where a diversion canal out of the watercourse provided water for the plots. In 1963 the town became a Declared Coloured Group Area and a resettlement area for forced removals from the surrounding areas. Subsequent settlement and housing schemes brought more recent development and altered the original fishing community character of the settlement.

The early settlers in Hawston obtained their water from fountains in the area that were located near the harbour (since covered with sand), near Paddavlei and on the hillslopes at the foot on the Onrus Mountain (Duiwelsgat and Hammanskloof). In 1933 a handpump '*Die Kassie*' was installed in the town to provide water to the residents. In 1944 a fountain on neighbouring land was also piped to the town as an additional supply of water. The first borehole in the town was drilled in 1945 at a cost of £850 that was supposed to yield 2500 gallons of water per hour (approx. 3 litres per second) but at about 30 m to drilling attempt needed to be halted. A further borehole was drilled in 1951 with a similar yield but also failed due to the sandy sediment into which the borehole was drilled.

While it had been proposed to construct a dam for Hawston in 1918 already, two dams were eventually constructed to provide water for the town in 1954 due to the fact that water shortage and the associated health issues were a concern in the town. Pipes were laid from the dams with taps installed at the corner of each street. In 1960, water meters were placed in each erven and landowners needed to pay to be connected to the water infrastructure. The water conservation programme for the wider Hermanus area came into being in 1966 and Hawston was incorporated into the bulk infrastructure of this wider area.

#### 4.1 MORE RECENT MODIFICATIONS TO THE PADDAVLEI AREA

Aerial photographs from 1938 to 2005 (Appendix B) were studied to assess the more recent changes to Paddavlei and its surrounding area. The earliest available aerial image, taken in 1938 (Appendix B, Plate 1 left), shows the dune system to the west of Paddavlei to still be largely natural state and covered with indigenous vegetation. The developed area of Hawston, to the east of the vlei, was largely confined to the area west of Church Street and comprised of a mix of agricultural plots in the north (Middelvlei) and rural housing to the south (Middelvlei South). At the time of this image, Paddavlei comprised of a dry open pan with a narrow milkwood fringe along its western edge as well as upstream and downstream of the pan. There appeared to be more of a vegetated wetland habitat downstream of the pan and some seepage from the hillslope to the east of the pan. Strand Street was the only road crossing the corridor to provide access to the fishing harbour. In the 1961 image (Appendix B, Plate 1 right), Paddavlei was likely filled with water. The vlei at that time had a well-defined edge with very limited wetland vegetation. The denser milkwood forest is visible along its western edge but there is little to no wetland vegetation on its eastern edge. Some seeps are visible on the eastern hillslope. Alien woody species, *Acacia cyclops* (rooikrans) and *A. saligna* (Port Jackson wattle) had started invading the dune field.

In the 1973 and 1989 images (Appendix B, Plate 2) there had been significant growth of Hawston. Similarly, Paddavlei had grown in extent. In the 1973 image the vlei seems to have remained a relatively open water pan feature, drying in the summer months while the 1989 image shows the pan with increasing reed growth. The road infrastructure within Hawston had also been formalised with crossings over the corridor at Harbour Road, George Viljoen Street and the extension of Marine Drive. Most of the dune area was covered by woody aliens. The final two images from 2004 and 2018 (Appendix B, Plate 3) were obtained from Google Earth and show a still further expansion of bulrush growth at Paddavlei as well as on the hillslope to the east of the vlei. These images also show the further expansion of Hawston, both to the west and east of the vlei.

## 5. PRESENT DAY ACTIVITIES AND INFRASTRUCTURE

### 5.1 POPULATION

The total population of Hawston (SDF 2020) was 8 214 within 1 931 households, with the majority of the population (68 %) being of working age (15 to 64 years). The youth (younger than 15 years) comprise 28 % of the population. The average population growth per year, calculated for the 2001 Census to 2011 Census, is 2 %. This is a drop from the growth between the 1996 and 2001 Census data of more than 11%. The forecast of the growth since the 2011 Census is 1.5 % per year.

### 5.2 INFRASTRUCTURE

Nearly all dwellings (92 %) in Hawston are formal dwellings with 90 % of the dwellings having piped water and 81 % having a flushed toilet connected to sewage. The town is closely linked to the neighbouring town of Fisherhaven and spatial planning of the two areas is shared.

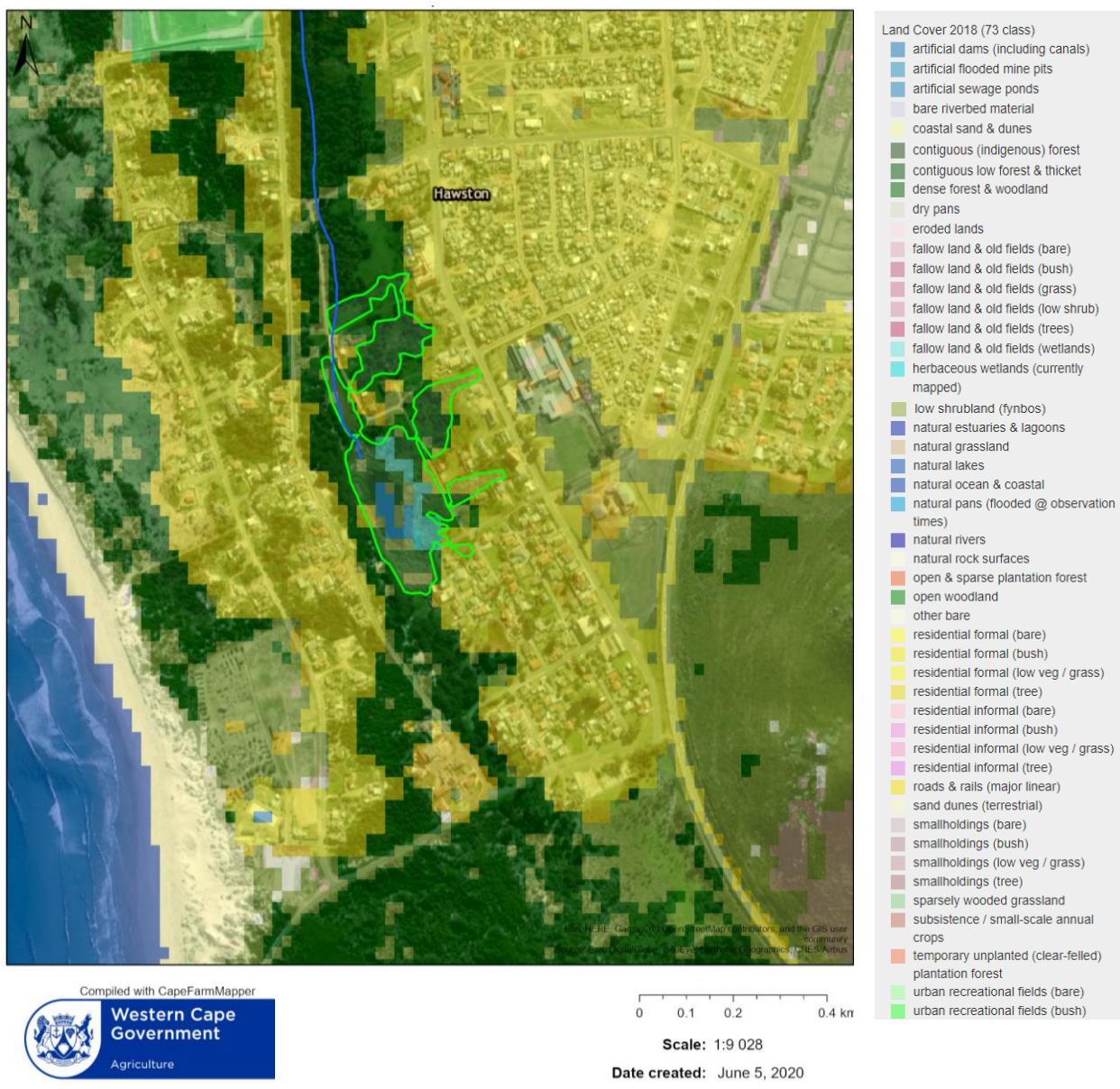
The town is linked to the bulk water supply of the larger Hermanus area and receives water from De Bos Dam. Only the upper section of the town, above Church Street is however connected to the bulk sewer system that conveys the sewage to the wastewater treatment works at Middelvlei. The portion of the town closer to Paddavlei still has septic tanks that require a tanker to evacuate the tanks and take it to the wastewater treatment system.

Stormwater management primarily takes place along open channels along the roads. At the R43 Road there is a relatively large series of stormwater ponds that eventually drains down the hillslope from Fairbairn Street

and then down Vlei and Strand Streets to discharge into the vlei. A portion of a stormwater pipeline was also installed in the lower end of the vlei to drain the wetland. The pathway was installed at the time of the installation of the pipeline.

### 5.3 LAND AND WATER USE

The 2018 landcover map for the area clearly indicates the vegetated ecological corridor orientated north south and central to Hawston. Some wetland area is mapped at Paddavlei (Figure 11). The landscape immediately to the west and east of the corridor comprises of low density, low to medium income residential areas in close proximity to the wetland. Further to the west lies vegetated dunes and the coastline while further to the west lies the R43 Road and further residential development before the fynbos covered slopes of the Onrus Mountain.



**Figure 11. Landcover map for the area (Land Cover 73-class DEA 2018, obtained from CapeFarmMapper 2020)**

## 6. CLIMATE CHANGE AND SEA LEVEL RISE

Two aspects relating to climate change are of relevance to Paddavlei and Hawston, the potential weather pattern changes and sea level rise. In terms of the predicted weather pattern changes for the area, it is predicted that over the next 50-100 years show the Overberg area can expect warmer temperatures (an between 1 and 1.5 degrees Celsius by 2050), more winter droughts, and more heavy rainfall in April and September. This would result of higher flood risk to the lower lying areas adjacent to Paddavlei, particularly with the current abundance of reed and the likely increased sedimentation of the vlei. Stormwater management measures within the developed areas around the vlei, within Hawston, would significantly impact on the flooding of the low-lying areas within the ecological corridor.

With regards to the potential for sea level rise, Hawston is largely developed behind the dunefield and is generally restricted behind the 6.5 mamsl contour line (with the exception of the Hawston Abalone Village caravan park/swimming pool/recreational area). Extreme sea level, estuary flooding, shoreline and tidal reach evolution modelling has shown that large portions of the Overberg area could be vulnerable to coastal hazards induced by sea level rise, if extensive coastal development had to occur along stretches of currently undeveloped coastline and within estuaries e.g. Bot River estuary and Hawston dunefield. Any further development within the primary dune system shoreward of current structures should be restricted due to the fact that the development of the primary dune system may result in a dune migration into the recreational area, as sea level rises and the shoreline migrates further inland over time.

## 7. AQUATIC ECOLOGICAL ASSESSMENT

### 7.1. REFERENCE CONDITIONS FOR PADDAVLEI

Based on past aerial imagery and descriptions of Paddavlei, the vlei was a seasonal open water pan system that was part of a series of largely channel-less valley bottom wetlands formed behind the coastal dune system. A milkwood forest bordered the vlei to the north, west and south of the vlei, associated with the lower eastern slope of the primary dune that borders the western edge of the vlei. The vegetation on the eastern side of the vlei was associated with the lower hillslope of Onrus Mountain (Hangklip Sand Fynbos). The marginal vegetation around the pan on this eastern edge is likely to have comprised of low shrubs and sedges and grasses such as *Chrysanthamoides monilifera*, *Senecio halimifolius*, *Stoebe plumosa*, *Salvia aurea*, *Gomphocarpus physocarpus*, *Metalasia muricata*, *Zantedeschia aethiopica*, *Juncus acutus*, *J. kraussii*, *Scirpus nodosus*, *Cyperus longus*, *Chondropetalum tectorum*, *Carpobrotus edulis* and *C. asceniciformis*, *Pelargonium alchemilloides*, *Asparagus spp.*, *Cynodon dactylon* and *Ehrharta villosa*.

Indications are that there was an island within the pan that provided good habitat for water birds and that amphibians were abundant within the vlei during winter when the vlei was inundated with water.

### 7.2. DESCRIPTION OF PADDAVLEI (PRESENT DAY)

Paddavlei wetland consists of a much-reduced open water area, surrounded by a bulrush (*Typha capensis*) dominated reed bed. The upper extent of the vlei starts at the houses along Bush Street. The vlei then widens at Vlei Street, extending up to Long Street. Where Long Street turns to the west and then north again, the wetland narrows. At this point pipe culvert and embankment has been placed within the wetland that allows access over the vlei. The wetland then continues northward in a narrow band to Chapel Street (Figure 12).

The shallow margins of the vlei along Long Street comprise of a mix of indigenous tabakbos (*Senecio halimifolius*), fonteinbos (*Psoralea pinnata*), milkweed (*Gomphocarpus physocarpus*), arum lilies (*Zantedeschia aethiopica*) and the sedge *Cyperus longus* and exotic kikuyu (*Pennisetum clandestinum*) and Pampas grass (*Cortaderia selloana*), Brazilian peppertrees (*Schinus terebinthifolia*), syringa (*Melia azedarach*), red sesbania (*Sesbania punicea*), castor-oil plant (*Ricinis communis*), nasturtiums (*Tropaeolum majus*) and Patterson's curse (*Echium plantagineum*).

The seaward edge of the wetland is bounded by a large dune with a milkwood (*Sideroxylon inerme*) forest dominating the foot of the dune, along the western edge of the vlei. A milkwood forest also dominates the aquatic corridor upstream while downstream of the vlei, the milkwood forest is degraded and invaded with alien Acacia trees. The remaining vegetated edges of the vlei consist of shrubs such as *Searsia lucida*, *S. glauca*, *S. tomentosa* and *Chrysanthamoides monilifera*, with fynkweek grass (*Cynodon dactylon*), with clumps of sour figs *Carpobrotus edulis* and *C. asceniciformis*, pelargoniums (*Pelargonium alchemilloides*) and asparagus ferns (*Asparagus sp.*). A moderate level of alien plant infestation of rooikrans (*Acacia cyclops*) and Port Jackson (*A. saligna*) occurs within the dunes and forested areas while the grassed areas around the vlei are overgrown with invasive alien kikuyu grass.

The town of Hawston surrounds the wetland, with some of the residential development lying below the flood levels for the wetland. On the hillslope to the east of the vlei are a number of hillslope seeps that are associated with stormwater runoff from the town. Consideration of the past imagery of the site also appear to indicate that the area where the seeps occur have longer been in existence and are naturally occurring but have increased in extent and inundation as a result of the stormwater runoff.

Appendix C contains a number of photographs of the main features within the wetland. Appendix D contains the more detailed ecological assessment of Paddavlei. Below is a summary of the findings of the assessment.



**Figure 12. Google Earth image of Hawston, Paddavlei and the adjacent wetland seep areas, with the main features discussed indicated**

### 7.3. WETLAND DRIVERS AND RESPONSES

As described in Section 6 there are a number of drivers and ecological responses that define the characteristics of wetlands. The fundamental conditions required for a wetland to exist include: a suitable geomorphological setting, favourable hydrology, and a substrate able to support hydrophytic vegetation. When these conditions are met, the physical, chemical and biological processes that make wetlands such valuable ecosystems are allowed to occur (Hayes, *et al.*, 2000).

Modifications of the drivers will result in unintended and often unwelcome, ecological consequences e.g. domination of the vegetation by nuisance plants or infilling with sediment.

The main drivers (or principle elements) that will determine the rehabilitation of the Paddavlei wetland are the water supply (depth and duration of saturation), topography, soil types and water quality within the wetland area. All other biological aspects will be a response to these drivers.

**Water inflow or supply** - Paddavlei as a depression wetland that formed within the valley formed by a duneslack within a well-drained sand dune system. The depression is in direct contact with the regional groundwater table and is thus fed by both groundwater as well as its local topographically defined catchment. As a result, the vlei was largely seasonal and only tended to be inundated in winter when there is surface water runoff and the water table was raised. The draining of the vlei, or the removal of the retention ability of the area to maintain deeper water areas in winter, will result in the domination of nuisance plants as the water levels can no longer assist the process to prevent the invasion of the larger open water body.

**Water quality** - The natural quality of the water would have been nutrient poor, more alkaline and slightly brackish due to the location within coastal dunes.

**Geomorphology and sediment** - Topographical changes result from the need to construct infrastructure such as roads within the wetland areas which also impacts on the geomorphological and hydraulic characteristic – the way in which the water moves through the wetland.

The natural drivers of the wetland have been altered by increasing urban development in the following ways:

- Developed areas and increased water supply to these areas tend to generate more runoff, resulting in an increase in the inundation pattern in the wetland;
- Sewage generated within the urban areas is often a source of contamination of the natural water, increasing nutrient levels in the water and resulting in microbiological pollution;
- Stormwater runoff from developed areas also modifies the natural water quality by increasing the natural nutrient levels of the water;

The above changes in sediment, flow and water quality drivers provide habitat that is well suited for the prolific growth of the indigenous bulrush which then tends to dominate the wetland habitat and out compete other indigenous plants and became a nuisance plant. Physical disturbance of the wetland habitat also provides opportunity for other alien plants to invade the area. The change in vegetation within the wetland increases the roughness of the wetland which then slows the flow and allows for an increase in sediment deposition within the wetland. This makes the wetland increasingly shallower and more suitable for expanding reed growth into what were formally deeper open water habitats. As the vegetation composition of the wetland changes so too changes its ability to support aquatic biota – dense reedbeds often provide a barrier for the movement of amphibians and the loss of diversity of habitats will also result in the loss of biodiversity.

#### 7.4. PRESENT ECOLOGICAL STATUS OF PADDAVLEI

The Paddavlei wetland can be classified as a dune slack depression with associated hillslope seep areas. The mosaic of wetland habitats within the ecological corridor on the valley floor also forms part of a series of unchanneled and channeled valley bottom wetland habitats.

Wetland areas are formed by very distinct hydrological, water quality and sediment dynamics that characterise the plant communities and other biota occurring within the wetlands. With the onset of development, hydrology (i.e. change in variability and seasonality of flow), water quality (in particular nutrient enrichment) and sediment dynamics (increased sediment deposition) are transformed, and the characteristics of the wetlands and the associated ecology are also transformed.

The Paddavlei wetland was found to be in a largely natural to moderately modified ecological state (**B/C Category**) while the associated hillslope seeps are in a moderately modified ecological condition (Appendix D). The surrounding land use activities have impacted on the habitat as well as the flow and water quality of the water feeding the wetland areas. The hillslope seeps that are smaller in extent and within the urban areas have been more impacted, particularly in terms of hydrology, water quality and vegetation.

The present ecological condition of the wetland areas has a **negative trend** (deteriorating), thus justifying the need for rehabilitation and maintenance management interventions.

The main impacts on the wetland area are a combination of direct and indirect cause and effect relationships as listed below:

- A direct loss of some of the wetland habitat due to the construction of roads within the wetland area;
- Wetland habitat modification and degradation as a result of disturbance caused by adjacent housing that extends to within the wetland areas;
- Flow modification from storm water runoff have resulted in an increase in the inundation of the wetland with a change in the associated wetland vegetation – the more permanently wet conditions favour the growth of bulrush (*Typha capensis*) reeds within the wetlands;
- A reduction of sub-surface flow to the wetlands due to increased groundwater use;
- Modification of the geomorphological character and hydraulics within the wetland systems as a result of infrastructure placed within the wetlands;
- Water quality modification from storm water runoff have resulted in nutrient enrichment of the wetland areas with an increase in wetland vegetation, again favouring the growth of bulrush (*Typha capensis*) reeds;
- Water quality degradation as a result of seepage from septic and overflowing conservancy tank systems that occur within or adjacent to the wetland areas;
- Terrestrial encroachment of the outer edges of the wetland as well as invasion by indigenous bulrush as well as alien plants such as kikuyu grass that results in wetland habitat and vegetation transformations;
- Increasing sedimentation of the wetland areas due to the fact that the increasing growth of bulrush adds with the entrapment of sediment; and

- Dumping of litter, particularly within the storm water inlets to the wetland, and rubble have modified the wetland habitat and impacted on the integrity of the wetland.

#### 7.5. ECOLOGICAL IMPORTANCE AND SENSITIVITY AND ECOSYSTEM SERVICES SUPPLIED BY THE WETLANDS

Wetland areas are valued for the goods and services that they are able to provide, including the provision of habitat for biota. Once wetlands are altered, their ability to provide goods and services become impaired. It is thus important to manage the wetlands to ensure that they can continue to provide the valued goods and services

Paddavlei and its associated hillslope seeps are considered of **moderate to high** ecological and functional importance. This is largely due to the fact that the wetlands form part of the ecological corridor linking the Vermont Pan (approx. 3 km to the south-east of Paddavlei) and a number of other wetlands with the Bot River Lagoon (more than 3 km to the north-west of the vle). The wetlands also provide valued goods and services (in particular flood attenuation and water quality amelioration services) and represent a regionally threatened habitat type that supports red data fauna such as the Western Leopard Toad (*Sclerophys pantherinus*) as well as a number of other amphibians and water bird species.

#### 7.6. RECOMMENDED ECOLOGICAL CATEGORY FOR THE PADDAVLEI WETLAND AND ITS ASSOCIATED AQUATIC ECOSYSTEMS

A Water Resource Class and Resource Quality Objectives (RQOs) for the Bot Estuary (Quaternary Catchment G40G) have been included in the proposed Breede Gouritz Water Management Area Water Resource Class and Resource Quality Objectives (Government Notice No 1298 of Government Gazette No 42053, dated 23 November 2018). The Recommended or Target Ecological Category (TEC) for the estuary is C (moderately modified). RQOs have also been recommended for the estuary.

The Bot River Lagoon was not assessed as part of this assessment but is an important consideration in the management of Paddavlei Wetland as the wetland lies within the ecological corridor that drains into the lagoon. Considering the largely natural to moderately modified ecological condition of the wetland and the moderate to high importance, the wetland should at least not be allowed to degrade further but should be rehabilitated where possible. The wetland also forms part of an integrated mosaic of wetlands that should be managed as a single aquatic feature of significance that should be rehabilitated and / or maintained in at least a C category (moderately modified) ecological condition. This would be in agreement with the TEC for the Bot River Lagoon in the draft Breede Gouritz RQOs.

It is however also recommended that the wetland area be zoned, with areas indicated to be of biodiversity conservation value being rehabilitated where necessary and maintained in a largely natural (**B Category**) condition while certain areas are zoned and rehabilitated for aesthetic and recreational use. These areas could be maintained in a moderately modified ecological condition (**C Category**).

## 8. REHABILITATION AND MANAGEMENT PLAN

Wetland rehabilitation refers to the process of assisting in: (1) the recovery of a degraded wetland's health and ecosystem service-delivery by reinstating the natural ecological driving forces or (2) halting the decline in health of a wetland that is in the process of degrading, so as to maintain its health and ecosystem service-delivery. Establishing favourable hydrological conditions is generally the key to wetland rehabilitation. Vegetation, other biota and wetland functions and their associated values will tend to follow with little additional external input required. It is generally best not to use extreme engineering solutions, elaborate control structures or intensive maintenance where it can be avoided. These are not only costly but are also unlikely to be sustainable in the long term. Planting of vegetation should be confined primarily to strategic areas under high threat of erosion that require rapid stabilisation. For the remainder of the wetland it will generally be enough to rely on natural colonisation by suitable plants.

The best wetland rehabilitation projects are usually those that require the least modification to existing conditions. Sites that have virtually all the components in place but that need only minor modifications offer the most cost-effective solutions and are the most likely to be successful (Hayes *et al.*, 2000). In the past the rehabilitation of wetland sites has generally taken place in isolation of the broader context of the site. A wetland site which is rehabilitated often forms part of a greater wetland area subject to a variety of disturbances and other factors influenced by management. Furthermore, all wetlands, whether pristine, degraded or rehabilitated, exist within catchments and landscapes that have an enormous influence on how the wetland functions and develops.

Key elements that should form part of this wetland rehabilitation and management plan are the following:

- Rehabilitation objectives and guiding principles for rehabilitation;
- Methods for the rehabilitation of the wetlands;
- Maintenance Management Plan for longer term management of the wetland (separate document); and
- Monitoring and auditing of the wetland areas.

It must be noted that this rehabilitation plan cannot be considered to be a comprehensive restoration plan, which would have had as its objective the return of the wetland to a condition prior to any development.

### 8.1. REHABILITATION OBJECTIVES

Key rehabilitation objectives that relate to the goods and services provided by the wetlands to be rehabilitated within the site are to:

- Improve the aquatic habitat and biodiversity of the Paddavlei aquatic ecosystem; and
- In so doing, improve the value of the wetlands to the Hawston community;

Much of the above objectives can be achieved through removing and controlling alien vegetation and nuisance growth of bulrush; removal of some infilled areas and dumped solid waste; and by introducing improved stormwater management measures and management of sewage systems immediately adjacent to Paddavlei.

The recommended ecological condition of the Paddavlei is largely natural to moderately modified where the wetland area would be divided into use zones with an associated ecological objective (Figure 13). The proposed zonation would comprise of two zones:

- Biodiversity conservation zone that should be rehabilitated and maintained in a largely natural ecological condition; and

- Recreational zone that should be rehabilitated and maintained in a moderately modified ecological condition.



Figure 13. Recommended zonation of Paddavlei, where the green area is the section of the ecological corridor that would be rehabilitated and maintained for biodiversity conservation and the yellow area would be designated for recreational use

## 8.2. GUIDING PRINCIPLES

The following principles should guide the wetland rehabilitation process to ensure the integrity of the wetlands as well as its functionality is improved:

- Wetlands result from several driving forces including geomorphological setting, hydrology, physical processes such as sediment movement, biogeochemical processes such as nutrient cycling, and biological processes such as competition. These forces interact to result in the functions and services associated with wetlands. Rehabilitation is the reinstatement of the driving forces to improve the integrity of the wetland and increase its capacity for providing services.
- Wetland rehabilitation must be integrated with the surrounding landscape if it is to address the causes of wetland degradation and should not just address the symptoms;
- The wetland rehabilitation measures must have meaningful ownership by those living adjacent to the wetland;
- The rehabilitation measures should be undertaken in a phased, and prioritised, manner. Specifically, any larger scale rehabilitation measures (such as the removal of the bulrush) should be undertaken in phases that allows for the observation of the wetland responses before continuing with further rehabilitation works;
- The initial rehabilitation measures should be undertaken actively (clearing of alien vegetation and reeds, removal of infilling and waste material from the wetland habitat and vegetating the areas with wetland vegetation) and allowance given for the recovery of the wetlands to continue passively - only maintenance activities should need to follow;
- The intent should be to encourage biodiversity within the wetlands and to prevent a single species (for example bulrush), or a limited number of species, from dominating the wetlands. Plant species occurring within the wetland should as far as possible, comprise of what would naturally have occurred in the area;
- Runoff to the wetland areas should resemble the natural seasonal flow patterns as far as possible with adequate stormwater management measures in place to address increased runoff from surrounding developed areas;
- The retention of deeper water areas must be prioritised to enable the management of nuisance plants;
- Monitoring is required to determine the level to which the rehabilitation objectives are being met; and
- Maintenance of the wetland areas should be undertaken in accordance with the approved MMP to ensure long term management of the wetland area.

### 8.3. REHABILITATION RECOMMENDATIONS AND METHOD STATEMENTS

The key activities that need to take place for the rehabilitation of the wetland areas comprise of the following:

1. Removal of the nuisance growth of bulrush in wetland areas;
2. Clearing of invasive alien vegetation from within and adjacent to the wetlands;
3. Removal of dumped waste material from within and adjacent to the wetlands;
4. Improvement of stormwater management within Hawston to attenuate and diffuse the stormwater as far as possible to reduce the direct discharge of stormwater into the wetlands. Sand and litter traps should also be incorporated into the stormwater management system;
5. Improvement of sewage management within the immediate surrounds of Paddavlei;
6. Installation of mechanisms to increase the water levels for certain periods of the year; and
7. Removal or upgrading of infrastructure within the ecological corridor at Paddavlei.

The abovementioned proposed rehabilitation interventions are in no particular or priority order.

Detail on the methods that would be used to undertake these activities are provided below. These activities would be followed by longer term maintenance and management of the wetland areas (such as the ongoing clearing of invasive alien vegetation) that are addressed in an approved Maintenance and Management Plan (MMP) for the site. Note should be taken of the mitigation measures that have been provided by the Department of Environmental Affairs and Development Planning for works within watercourses and wetland areas that have been included as Appendix E.

A prioritisation exercise of the key activities and locations for implementation of the activities is included in Section 9.4.

#### 8.3.1 CLEARING OF NUISANCE GROWTH OF BULRUSH

*Typha* bulrushes although indigenous aquatic vegetation, under optimal conditions of a constant water supply that is nutrient rich as is typical of stormwater runoff water from developed areas, tend to proliferate and result in a nuisance growth as is currently the case within the Paddavlei wetland and many of the associated seeps and stormwater canals. The roots of these plants also tend to trap sediment and increase the rate at which sediment will accumulate within the wetlands and canals. Bulrush is however sensitive to water levels, not growing in water depths of deeper than 1.5 m and also not readily growing in areas with prolonged dry periods. Availability of nutrients in the water influences the rate at which the bulrush will grow.

As the bulrush is a symptom of the increase in stormwater runoff to the wetland areas, it is highly recommended that the attempts to manage bulrush growth address both the cause and the symptom, i.e. as mentioned previously, the stormwater management within Hawston needs to be investigated and improved to reduce the stormwater impacts to the flow / inundation and water quality in the wetlands. If this is not addressed the requirement to continue to clear bulrush in the wetlands will remain a significant and ongoing task.

Control of the bulrush will require two activities, an initial larger scale clearing of the bulrush and then follow up control of regrowth. Due to the extent of the bulrush within the wetland habitats it is recommended that the clearing be undertaken in a phased manner – potentially 6 portions that would be split between the hillslope seeps and dividing Paddavlei into 3 sections (northern, eastern and western portions), to reduce the impact on the wetlands during and directly following the clearing process. Differing approaches are likely to be needed depending on the different areas (see discussion below). Prioritisation of the areas could be linked to

other rehabilitation measures to obtain the best results with the least impact, for example while invasive alien vegetation is being targeted on the eastern edge of Paddavlei or any of the seep areas, the bulrush could also be cleared.

Controlling excessive bulrush growth is extremely difficult and can be quite costly, particularly in natural systems such as in the case of Paddavlei. Clearing techniques for bulrush consist of use of herbicides, physical pulling or cutting and drowning and burning. The use of livestock to control regrowth can also be undertaken.

Controlling excessive *Typha* growth is extremely difficult and can be quite costly. Herbicides (Glycophosphate 360/MAMBA with 0.1% wetting agent and dye) can be effective when applied while the plant is flowering. The decaying plant material that results however accumulates and causes hypertrophic conditions, while providing a good substrate for regrowth of the bulrush. The use of herbicides in the wetland areas should only be as a last resort and under specialist guidance. This method could however be considered to treatment of certain regrowth areas in the drier areas on the margins of the vlei and on the hillslope seeps by spraying of the new shoots and leaves within 3 months of the initial clearing has taken place.

Manual removal (pulling) works best on small seedlings when they can be easily pulled out of the damp soil and may work for certain of the wetland areas. This approach could be used in a similar way to the herbicides in the areas of regrowth on the margins of the vlei and within the hillslope seeps.

Controlling bulrush through fire and physical cutting in conjunction with flooding has been indicated as the most successful method for control but burning of dense reed growth within Paddavlei is not recommended considering the proximity of the wetland areas to residences as well as the milkwood forest.

The most feasible method for Paddavlei thus appear to be a combination of mechanical and hand cutting at the end of the growing season and when water levels are low, and the plants have died back. A differentiated approach should be used within the vlei and wetland areas. Use of a mechanical means is only recommended for the north-eastern and eastern edges of the vlei that are accessible to a excavator with a long arm that can extend into the vlei and physically remove the bulrush and some of the build-up of organic material associated with the reeds. Bulrush on the remaining margins of the vlei that are associated with the milkwood forest should be controlled through cutting of the rushes. Two clippings about a week or two apart will achieve the best results. The cutting should be scheduled for April /May when the cut area would be submerged soon after in at least 8 to 10 cm of water when water levels rise in the vlei. The dead material can be removed in spring when water levels drop.

Once the initial cleaning of dense reedbed has been cleared from the vlei, the need to remove any associated further sediment and organic matter in the vlei will need to be investigated further.

This works should be able to be dealt within under the MMP for Paddavlei and a more detailed method statement for the clearing of bulrush is included in the MMP.

### 8.3.2. ALIEN VEGETATION CLEARING

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The purpose of this activity is to remove invasive alien vegetation from the wetland areas. Currently the invasive alien vegetation within the wetland areas comprises of the following invasive alien species (Listed Invasive Species in terms of section 70(1)(a) of the National Environmental Management: Biodiversity Act, 2004 as species which must be controlled are indicated):

- Port Jackson willows (*Acacia saligna*) Category 1b
- Rooikrans (*A. cyclops*) Category 1b

- Golden wattle (*A. pycnantha*), Category 1b
- *Eucalyptus* sp. Category 1b (most species within riparian areas)
- weeping willows (*Salix babylonica*) Not listed
- manatoka (*Myoporum montanum*) Category 3 (Category 1b in riparian areas)
- Pampas grass (*Cortaderia selloana*) Category 1b
- Kikuyu grass (*Pennisetum clandestinum*) Category 1b in wetlands
- Brazilian peppertree (*Schinus terebinthifolia*) Category 3 (Category 1b in riparian areas)
- syringa (*Melia azedarach*) Category 1b
- red sesbania (*Sesbania punicea*) Category 1b
- castor-oil plant (*Ricinis communis*) Category 2
- nasturtiums (*Tropaeolum majus*) Not listed
- Patterson's curse (*Echium plantagineum*) Category 1b

**Category 1b and 3** Listed Invasive Species are prohibited and must be controlled

**Category 2** Listed Invasive Species are those species which require a permit and should not be allowed to spread

The general approach to alien vegetation clearing within the wetland areas is as follows:

- Identify alien plants to be removed. If unsure, please contact the Department of Agriculture or CapeNature for assistance. Regular monitoring and control of alien vegetation should be undertaken to ensure that the plants are removed while still young saplings that can more easily be removed (usually pulling of seedlings by hand is possible when the soil is wet). This also prevents the spread of the alien plants once seeds have been produced;
- Avoid trampling or clearing indigenous vegetation by using established paths where possible;
- Clear alien vegetation according to the described alien vegetation removal methods for each invasive species as provided in the detailed method statements or with the methods and herbicides/biological control recommended on the Working for Water website: <http://www.dws.gov.za/wfw/>;
- Clear felled alien vegetation from the river corridor. Larger tree stumps can be left to minimise erosion of the cleared area;
- Where necessary revegetate cleared areas with suitable indigenous vegetation as suggested in this report. Planted areas will require irrigation and care for a period of 1-2 years following planting. This is particularly a requirement where most of the natural flow within the watercourses have been diverted for use or where the re-established vegetation is on the dry banks of the rivers. Planting of the new vegetation at the start of the wet season can assist ensuring that the new vegetation is kept wet however one would need to then avoid planting new vegetation within the areas that will be inundated in winter or subjected to flood flows; and

- Ongoing monitoring and clearing of regrowth of alien plants within these areas will be required.

This works should be able to be dealt within under the MMP for Paddavlei and a more detailed method statement for the removal of invasive alien vegetation is included in the MMP.

As for the clearing of bulrush, due to the extent of the alien invasive plant growth it is recommended that a phases plan for the alien vegetation clearing be compiled the progressively removes the alien vegetation. Prioritisation of the areas could be linked to other rehabilitation measures to obtain the best results with the least impact. Clearing of alien vegetation on the wider dune area will need to be undertaken with care to not clean the dune of cover vegetation and destabilise it. Work in this area would thus need to be under the guidance of a rehabilitation specialist with suitable applicable expertise.

Kikuyu grass (*Pennisetum clandestinum*) in particular is invasive within Paddavlei and will need a focused effort to be removed. The grass is very hard to remove because if any runners are left behind, they will start growing again. It is best to poison kikuyu with a foliar herbicide (e.g. Agil) during the summer growing season (before end March). When using herbicides, it is essential to apply the correct herbicide, in the right dose, at the right time, using the correct application method. Use only registered herbicides, follow manufacturer's instructions on the label, and wear the appropriate protective clothing during handling. All registered herbicides are labelled with important information to assist in selecting the correct product and give the recommended application methods and dose. Labels also provide safety and poisoning information and recommended disposal methods. Follow-up with the removal of dead material.

Follow-up alien vegetation control measures will need to be ongoing and for several years at least, depending on the site conditions, and rate and success of regeneration or revegetation. Progressively less follow-up weeding should be required once indigenous plants are regenerating well and at a rate faster than the invasive plants can become re-established. The cultivation of vegetation to be planted within an area that requires replanting should only be done with species that are selected and that are suitable for the area and the type of habitat in which it would have the most optimal chance of survival.

### 8.3.3. REMOVAL OF DUMPED WASTE MATERIAL FROM WITHIN AND ADJACENT TO THE WETLANDS

Dumping of rubble, litter and waste material is common throughout the area surrounding Paddavlei and particularly adjacent to roads. It is recommended that the litter rubble and waste material be removed. As recommended before this work could be undertaken when other rehabilitation measures are being undertaken in an area to obtain the best results with the least impact. It is recommended that the source of the problem also be considered and that a solution to the dumping of waste be sought such as placing waste skips at locations where waste material is typically dumped such as in the open Erf 165 on Milkwood Street, along Long Street / Chapel Street, particularly where George Viljoen Street and the extension of Marine Drive crosses the ecological corridor. These skips should be inspected and emptied at suitable disposal facilities regularly. This works should be able to be dealt within under the MMP for Paddavlei and a method statement for the removal of sediment and material from the vlei and hillslope seeps is provided in the MMP.

### 8.3.4. IMPROVEMENT OF STORMWATER MANAGEMENT

One of the key sources of the changing characteristic of Paddavlei is as a result of stormwater drainage into the vlei. The stormwater runoff from within the urbanised areas of Hawston results in modification to the

surface water contribution and nutrient enrichment of the wetland areas, as well as carries litter to the wetlands. It is highly recommended that there be an investigation of a stormwater management system for the town that will attenuate and diffuse the stormwater within the town (preferably above Church Street) as far as possible to reduce the direct discharge of stormwater into the wetlands. Sand and litter traps should also be incorporated into the stormwater management system. Depending on the outcome of such an investigation, an environmental authorisation process may be required to be undertaken the proposed works. Some of the works may be able to proceed without the requirement for any environmental or water use authorisation.

#### 8.3.5. IMPROVEMENT OF SEWAGE MANAGEMENT WITHIN THE IMMEDIATE SURROUNDS OF PADDAVLEI

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The portion of Hawston within the valley and closest to Paddavlei is still on septic and/or conservancy tanks that need to be evacuated by tankers and taken to the Hawston Wastewater Treatment Works. The cost of this is borne by the resident and is done on the request of the resident. It is recommended that a system be investigated where this process is undertaken on regular intervals by the municipality and the cost incorporated into the municipal rates and taxes for the erven. Consideration should also be given to including this area into the bulk sewage infrastructure of the area although is likely to result in a sewer pipeline needing to be laid adjacent to the Paddavlei wetland that would need to be adequately mitigated to prevent sewage spills into the wetland area. This recommendation should be able to proceed without the need of any environmental or water use authorisation.

#### 8.3.6. REMOVAL OR UPGRADING OF INFRASTRUCTURE WITHIN PADDAVLEI

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There are three structures within the ecological corridor at Paddavlei that potentially alter the water movement through the corridor: an embankment and pipe culvert that has been placed through the wetland near Erf 53 on the extension of Long Street; a small box culvert under George Viljoen Street; and stormwater infrastructure at the lower, northern-most extent of Paddavlei.

The embankment and pipe culvert near Erf 53 appear to serve little purpose except to provide a pathway over the vlei at this point. It is recommended that removal of the embankment and culvert be removed and replaced with walkway that allows for better movement of water through this area, for example a series of smaller culverts that would better spread the flow or a raised boardwalk.

The culvert at George Viljoen Street was completely blocked at the time of the site visit with dumped waste. There is however not a clearly defined channel at this point thus it would appear that flow within the ecological corridor at this point is diffuse and largely sub-surface flow and that the culvert structure has little impact on flow at the road, with the exception of during high flow events. There is also a pipeline directly adjacent to the culvert at this point. An assessment should be undertaken to determine the required sizing of the culvert for high flow event to prevent flooding of adjacent properties.

This works could potentially proceed under an approved MMP for Paddavlei if the infrastructure is to be replaced in a like for like manner (replacement of the embankment crossing with an improved walkway that will have a lesser impact on the wetland).

The installation of mechanisms to add better control of the water levels in Paddavlei, with the objective to increase the deeper water areas must be considered.

In the stormwater works undertaken in 2009, a stormwater structure was placed in the northern extent of the vlei. The impact of this infrastructure on the movement of water through the ecological corridor requires further investigation. The intent of the infrastructure was to drop the water level of the vlei in winter to prevent flooding of the adjacent properties to the vlei. The level of the stormwater culvert however appears to have been placed too low and results in water that should be allowed to continue to flow downstream to be diverted out of the ecological corridor. This water is important in maintaining the ecological functioning of the milkwood forest immediately downstream of the vlei. A simple solution might be to just prevent the water from entering the stormwater pipeline until the water level in the vlei exceeds a certain height where it will flood the adjacent properties. It is however also likely that through management of the bulrush (and the associated build-up of sediment and organic material) in the vlei, the flooding of adjacent properties will no longer pose a problem and the stormwater structure can be removed.

There are a number of vacant properties that have not been constructed within or immediately adjacent to the wetland areas. Consideration needs to be given to future development within these erven. Where possible, these areas should remain as open areas and not be developed. Such considerations should be undertaken together with the assessment of the stormwater management requirements for the Hawston as some of the hillslope open areas could potentially be utilised for stormwater management.

#### 8.4. IMPLEMENTATION OF THE REHABILITATION MEASURES

The success of any rehabilitation plan lies heavily on its ability to be implemented. A number of rehabilitation activities have been recommended in the previous section. These all require an implementation agent, human and financial resources as well as in many cases, environmental and water use authorisations.

It is assumed that Overstrand is the primary implementing agent for the rehabilitation plan. It can however not successfully be implemented and maintained by the local authority alone and needs to support and assistance of the surrounding residents of Hawston. A public participation process is being undertaken as part of the rehabilitation plan finalisation to ensure that the proposed measures meet with the expected objectives of the community. It has also been indicated in the earlier Rehabilitation Plan compiled by Mr Austin that the community does support the initiative to rehabilitate the vlei. It was also proposed that where possible local labour would be utilised to undertake the works.

As Overstrand Municipality will likely need to budget for many of the rehabilitation works proposed, a prioritisation exercise has been undertaken below to guide the rehabilitation priorities both in terms of tasks as well as priority areas. The tasks identified have been assessed in a matrix that considers the following aspects to determine the recommended prioritisation those tasks:

1. Benefits to the aquatic ecosystem;
2. Costs associated;
3. Ease of execution;
4. Regulatory difficulty; and
5. Desirability from community.

A broad scoring system was applied to each aspect as is included in each column of the table. These scores were then totalled, with the highest score indicating the highest priority.

**Table 1: Prioritisation Matrix for the Recommended Rehabilitation Tasks**

No.	Task	Ecosystem benefit	Costs	Ease of execution	Regulatory difficulty	Community desirability	Total score (Average Score)
	Scores	Low benefit=1 Medium benefit=2 Very beneficial=3;	High cost(>R50k)=1; Medium cost(R20k-R50k)=2; Low cost(<R20k)= 3	Difficult =1 Moderate=2 Easy=3	EA/WUL=1 MMP/GA=2 None required=3	Low desire=1 Medium desire=2 High desire=3	
1	Removal of the nuisance growth of bulrush	3	1	1 to 2	2	3	10 – 11 (2 to 2.2)
2	Clearing of invasive alien vegetation	2	2	2	3	2	11 (2.2)
3	Removal of dumped waste material	2	3	1	1	3	10 (2)
4	Improvement of stormwater management – Upslope attenuation and litter/sediment traps	3	1	2	1?	2	9 (1.8)?
5	Improvement of sewage management –improve maintenance of septic tanks	3	3	3	3	3	<b>12 (3)</b>
6	Upgrading of walkway at Long Street	2	2	2	2	1	9 (1.8)
7	Upgrading of culvert at George Viljoen Street	1	2	2	2	2	9 (1.8)
8	Alteration to Stormwater Infrastructure at northern extent of Paddavlei- this required further investigation	?	?	?	?	?	?

Where:

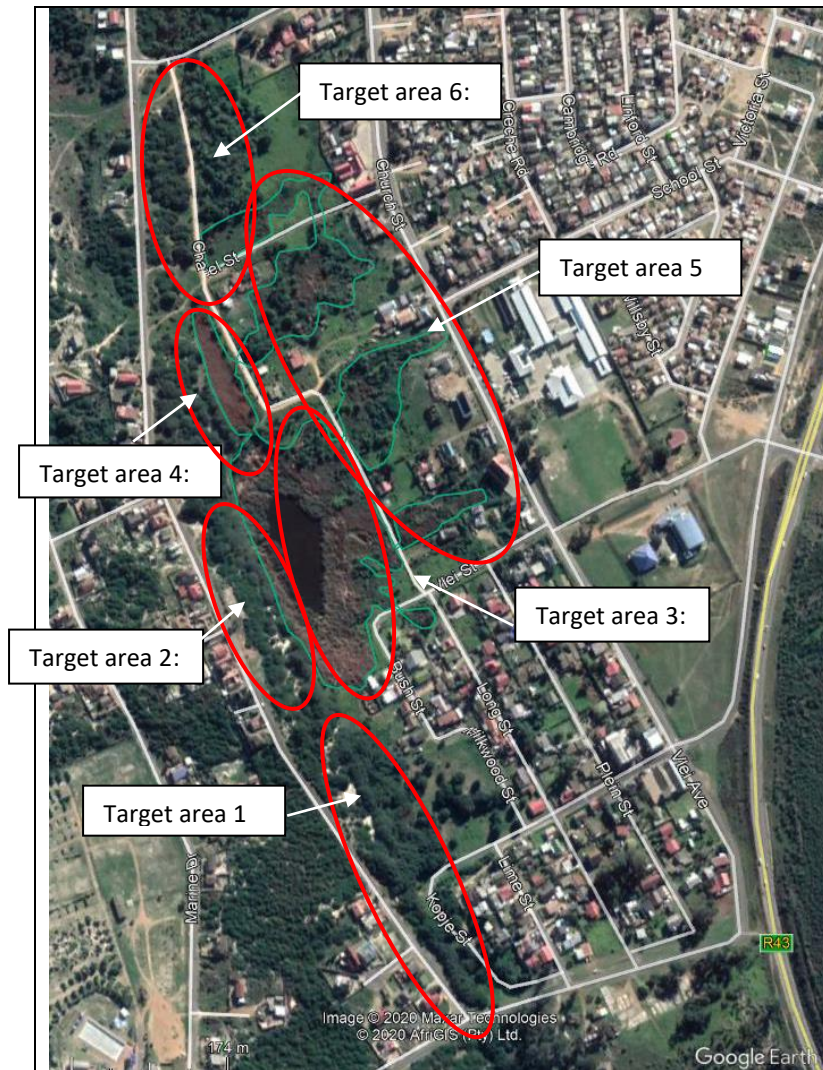
$k = R1000$

MMP/GA = Approved Maintenance Management Plan and falls within the ambit of the General Authorisation for Section 21(c)&(i) water uses

EA/WUL = Potentially an Environmental Authorisation and Water Use Licence may be required

In terms of the above prioritisation exercise, the improved management of septic tanks adjacent to the vlei has the highest priority, followed by clearing of invasive alien vegetation and the bulrush reeds as well as the removal of dumped waste material in and adjacent to the vlei. All of these activities could potentially be carried out under an approved MMP for the vlei area and would just be limited in terms of implementation by the associated budgetary constraints. The other activities associated with improvements made to the stormwater management system and infrastructure will all likely need some further investigatory work and could, depending on the work required, require additional authorisations.

**Table 2. Prioritisation of tasks in terms of target areas**



The potential target areas for rehabilitation and the associated tasks (as numbered in Table 1 where Tasks 1, 2, 3 and 5 have been identified as priority tasks and are highlighted in bold) are listed below:

Target area 1: Upstream of Paddavlei from Harbour Road: Tasks **2**, **3**, **5**

Target area 2: Western margins of Paddavlei Tasks **1**, **2**

Target area 3: Eastern to southern margins of Paddavlei Tasks **1**, **2**, **3**, **4**, **5**

Target area 4: Northern extent of Paddavlei Tasks **1**, **2**, **5**, **6**

Target area 5: Hillslope seeps Tasks **1**, **2**, **3**, **4**, **5**

Target area 6: Section of corridor from Chapel Street to George Viljoen Street Tasks **2**, **3**, **7**, **8**

From the above it can be seen that for the priority tasks identified, Target area 1 would address most of the priority tasks however direct benefits to the Paddavlei wetland itself would not be visualised. The target area that address all of the priority tasks and give immediate visual benefit would be target area 3 and following on that target area 5. These are both substantial areas and would required significant work and budget. The work may then, particularly with regards to the clearing of bulrush, need to phased into smaller portions of work within these areas over a period of time.

## 9. PROGRAMME FOR IMPLEMENTATION OF THE PLAN

*To be compiled after first review of draft rehab plan has been completed and various consultations have been undertaken.*

**Table 3: Rehabilitation Plan Programme**

ACTION	TARGET AREA	RESPONSIBLE BODY (S)	TIMING	DELIVERABLE / OBJECTIVE
Removal of the nuisance growth of bulrush				
Clearing of invasive alien vegetation				
Removal of dumped waste material				
Improvement of stormwater management – Upslope attenuation and litter/sediment traps				
Improvement of sewage management –improve maintenance of septic tanks				
Upgrading of walkway at Long Street				
Upgrading of culvert at George Viljoen Street				
Alteration to Stormwater Infrastructure at northern extent of Paddavlei- this required further investigation				

## 10. MONITORING PROGRAMME

To inform the ongoing rehabilitation, maintenance and management of the Paddavlei wetland, monitoring of the measures undertaken and the responses within the wetland are necessary. The following monitoring programme is recommended and includes the following information:

- indicators to be measured;
- frequency, interval and timing of monitoring; and
- evaluation procedure.

### 10.1 MONITORING OF THE REHABILITATION WORKS

Monitoring of the rehabilitation works and ecosystem response should include, but not be limited to, the following parameters:

- Monitoring for signs of erosion or increased sedimentation within the wetland areas;
- Visual monitoring for any water quality issues of concern within the aquatic habitats and surrounding areas;
- Monitoring of alien vegetation growth and dumping of waste that needs to be addressed; and
- Monitoring of implementation and responses to rehabilitation works to inform any adjustments required to the rehabilitation measures.

It is recommended that this monitoring be undertaken by an official from the Environmental Management Section of Overstrand Municipality on a monthly basis during and for a period of 6 months after completion of rehabilitation works.

### 10.2 MONITORING OF WATER LEVELS AND QUALITY

Any measurement of surface water quality would only be possible in the wetland in winter. It is recommended that basic water quality variables are monitored monthly during this period within the vlei (pH, suspended solids, total dissolved salts / electrical conductivity, ortho-phosphates, nitrate/nitrite and ammonia as well as *E-coli* can be used as an indicator to understand the water input into the wetland, particularly in terms of whether there is sewage infiltration into the wetland.

A calibrated and topographically referenced water level measuring pole or peck should be installed to record the water level and the change of water level over the season.

### 10.3 MONITORING OF AQUATIC ECOSYSTEM HEALTH IMPROVEMENTS

#### *Fixed-point photography*

To illustrate the improvement in the wetland habitat associated with the rehabilitation interventions, fixed-point photography monitoring should be used. The following guidelines should be followed when locating photographic points for fixed-point photographs:

- photo-points should be selected at various locations at the rehabilitation sites that are easily located and accessible at all times;
- record the geographical co-ordinates of each point using a GPS. This provides any individual with the information required to navigate to the exact location of each photo point; and

- a permanent field marker should be placed in the ground at each point, to ensure that photos are always taken from exactly the same point. If possible, the orientation of the photo at the point should be recorded on the marker.

The following guidelines should be followed when implementing fixed-point photography for monitoring:

- the orientation of the photograph should be recorded;
- use of the same zoom ratio each time. If this is not possible, record the settings used. The camera should preferably be located at a fixed height;
- photographs should be taken at roughly the same time of year and at the same time of the day, and under similar weather conditions. This would limit the variability of the wetland habitat associated with vegetative and hydrological changes linked to seasons;
- a standard object, such as a metre rule should be included in the photograph as a reference for scale; and
- record relevant information about factors that may influence features in the photograph (e.g. a recent fire, late or early rains, etc.), especially those relating to the appearance of the site.

#### *Wetland Health Monitoring*

It is recommended that a wetland health assessment is undertaken a year and three years after the completion of the rehabilitation. The assessment of the wetland unit's health should be undertaken using the WET-Health tool developed by Macfarlane *et al* (2009). The Wetland Ecological Assessment included in this rehabilitation plan should provide a baseline for comparative evaluation purposes.

#### 10.4 FREQUENCY, INTERVAL AND TIMING OF MONITORING

Monitoring should take place during the initial stages of the rehabilitation project as well as operational / recovery phase. During the rehabilitation phase, monitoring should be more regular to identify issues quickly and have them remedied. Once these activities are complete in the wetland, and monitoring frequency can become less frequent and would largely be associated with monitoring of maintenance works. The final, long term monitoring will assess the overall success of the rehabilitation program once the system has had time to stabilise. A monitoring framework is provided in the following table.

### 11. COMMITMENT AND DECLARATION BY THE COMMUNITY

It is proposed that a declaration be compiled by the community in which the community declare their commitment to the ongoing improvement and management of the wetland to the benefit for the community.

Such a declaration could include the following:

We as community undertake:

- Not to dispose of solid waste in and near the wetland;
- To combat the growth of alien invasive vegetation in our properties and the wetland;
- Will not annex the wetland and community area for private use and benefit; but
- Will enhance the vleis and endeavour to make it a feature of enjoyment and benefit to the community.

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## APPENDICES

### APPENDIX A: GLOSSARY OF TERMS

**AQUIFER:** a geological formation, which has structures or textures that hold water or permit appreciable water movement through them [from National Water Act (Act No. 36 of 1998)].

**BIODIVERSITY:** a measure of the relative diversity of organisms in different ecosystems or a totality of genes, species and ecosystems in a region.

**BOREHOLE:** includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer [from National Water Act (Act No. 36 of 1998)].

**CATCHMENT:** the area from which any rainfall will drain into the watercourse, contributing to the runoff at a particular point in a river system; synonymous with the term river basin.

**ECOLOGY:** the study of the interrelationships between organisms and their environment.

**ECOLOGICAL CATEGORY** is used to define and type the ecological condition of a water resource in either the present, past or future in terms of the deviation of biophysical components from the natural state or Reference Condition.

**ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)** provides an indication of the presence of rare and/or sensitive species and sensitive habitats within an aquatic ecosystem. The ecological importance is an expression of its importance to the maintenance of biological diversity and ecological functioning on local and wider scales. Ecological sensitivity (or fragility) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred.

**ECOSYSTEM:** an organic community of plants and animals and the physical environment they inhabit.

**ENVIRONMENTALLY SENSITIVE AREA:** A fragile ecosystem, which will be maintained only by conscious attempts to protect it.

**FRACTURED AQUIFER:** an aquifer that owes its water-bearing properties to fracturing caused by folding and faulting; see secondary aquifer.

**FRESHWATER:** water that contains less than 1 000 mg/L salts.

**GEOHYDROLOGY:** the study of the properties, circulation and distribution of groundwater; in practice used interchangeably with hydrogeology; but in theory hydrogeology is the study of geology from the perspective of its role and influence in hydrology while geohydrology is the study of hydrology from the perspective of the influence on geology.

**GROUNDWATER:** water found in the subsurface in the saturated zone below the water table or piezometric surface i.e. the water table marks the upper surface of groundwater systems.

**GROUNDWATER FLOW:** the movement of water through openings and pore spaces in rocks below the water table i.e. in the saturated zone.

**GROUNDWATER RESOURCE:** all groundwater available for beneficial use, including man, aquatic ecosystems and greater environment.

INSTREAM HABITAT includes the physical structure of a watercourse and the associated vegetation in relation to the bed of the watercourse (National Water Act 36 of 1998).

MEAN ANNUAL PRECIPITATION: Frequently abbreviated to MAP, this is the long-term mean annual precipitation a specified period of time, at a particular point along a river and for a particular catchment and catchment development condition.

MEAN ANNUAL RUNOFF: Frequently abbreviated to MAR, this is the long-term mean annual flow calculated for a specified period of time, at a particular point along a river and for a particular catchment and catchment development condition.

PRESENT ECOLOGICAL STATUS (PES) of a water resource refers to the current ecological condition of the resource or a component of the resource, derived from, or described as a change for the worse from a described Reference Condition, which ideally relates to the historically natural condition.

PRIMARY AQUIFER: an aquifer in which water moves through the original interstices of the geological formation.

RECHARGE: the addition of water to the zone of saturation, either by the downward percolation of precipitation or surface water and / or the lateral migration of groundwater from adjacent aquifers.

REHABILITATION (ecological) refers to measures taken in the process of returning an impacted area to a condition ecologically similar to a desired ecosystem structure, function, biotic composition and associated ecosystem services. Rehabilitation thus entails undertaking certain remedial action to minimise the adverse impacts on the environment and to prevent further environmental degradation from occurring, continuing or recurring.

RESTORATION (ecological) is the practice of renewing and restoring degraded, damaged, or destroyed ecosystems and habitats in the environment back to their former ('pre-development natural state') by active human intervention and action.

RESERVE: The quantity and quality of water required (a) to satisfy basic human needs by securing a basic water supply, as prescribed under the Water Services Act, 1997 (Act No. 108 of 1997) for people, who are now or who will, in the reasonably near future, be (i) relying upon; (ii) taking water from; or (iii) being supplied from, the relevant water resource; and (b) to protect aquatic ecosystems in order to secure ecologically sustainable development and use of the relevant water resource as indicated in the National Water Act (Act No. 36 of 1998).

RESOURCE QUALITY: The quality of all the aspects of a water resource including: (a) the quantity, pattern, timing, water level and assurance of instream flow; (b) the water quality, including the physical, chemical and biological characteristics of the water; (c) the character and condition of the instream and riparian habitat; and (d) the characteristics, condition and distribution of the aquatic biota.

RESOURCE QUALITY OBJECTIVE: Quantitative and verifiable statements about ground and surface water quantity, water quality, habitat integrity and biotic integrity that specify the requirements (goals) needed to ensure a particular level of resource protection.

RIPARIAN: area of land directly adjacent to a stream or river, influenced by stream-induced or related processes.

RIPARIAN HABITAT includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an

extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas (National Water Act 36 of 1998).

**RIVER:** a physical channel in which runoff will flow; generally larger than a stream, but often used interchangeably.

**RIVER SYSTEM:** A network of rivers ranging from streams to major rivers and, in some cases, including rivers draining naturally separate basins that have been inter-connected by man-made transfer schemes.

**SALINITY:** The concentration of dissolved salts in water. The most desirable drinking water contains 500 parts per million or less of dissolved minerals.

**SECONDARY AQUIFER:** an aquifer in which water moves through secondary openings and interstices, which developed after the rocks were formed i.e. weathering, fracturing, faulting.

**SPRING or FOUNTAIN:** a point where groundwater emerges, usually as a result of topographical, lithological or structural controls.

**STREAM:** a small narrow river; often used interchangeably with river.

**SURFACE WATER:** Bodies of water, snow or ice on or above the surface of the earth (such as lakes, streams, ponds, wetlands, etc.).

**TARGET or RECOMMENDED ECOLOGICAL CATEGORY** is the desired ecological condition of an aquatic ecosystem that is recommended a water resource be managed as that allows for a certain level of ecosystem function and supports certain habitats and biota.

**UNCONFINED AQUIFER:** an aquifer with no confining layer between the water table and the ground surface where the water table is free to fluctuate.

**VLEI:** a colloquial South African term for wetland.

**WATERCOURSE AND WETLAND REHABILITATION** refers to the process of assisting recovery of a degraded watercourse or wetland in terms of the condition, function, and associated biodiversity, or in maintaining the health of that aquatic ecosystem that is threatened by degradation, through the implementation of remedial interventions or proactive preventative measures. It involves the manipulation of the physical (e.g. blocking drainage canals), chemical, or biological characteristics (e.g. assisting the regeneration of the natural vegetation and/ or clearing of invasive alien species on the wetland site or in its buffer zone) of a degraded wetland system in order to repair or improve wetland integrity and associated ecosystem services.

**WATERCOURSE"** means - (a) a river or spring; (b) a natural channel in which water flows regularly or intermittently; (c) a wetland, lake or dam into which, or from which, water flows; and (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks (National Water Act 36 of 1998).

**WATER TABLE:** the upper surface of the saturated zone of an unconfined aquifer at which pore pressure is at atmospheric pressure, the depth to which may fluctuate seasonally.

**WETLANDS** are defined 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" (National Water Act 36 of 1998).

APPENDIX B: PAST IMAGERY FOR THE AREA



Plate 1. Past aerial imagery of the area taken in 1938 and 1961, overlain in Google Earth with the present-day aquatic features shown

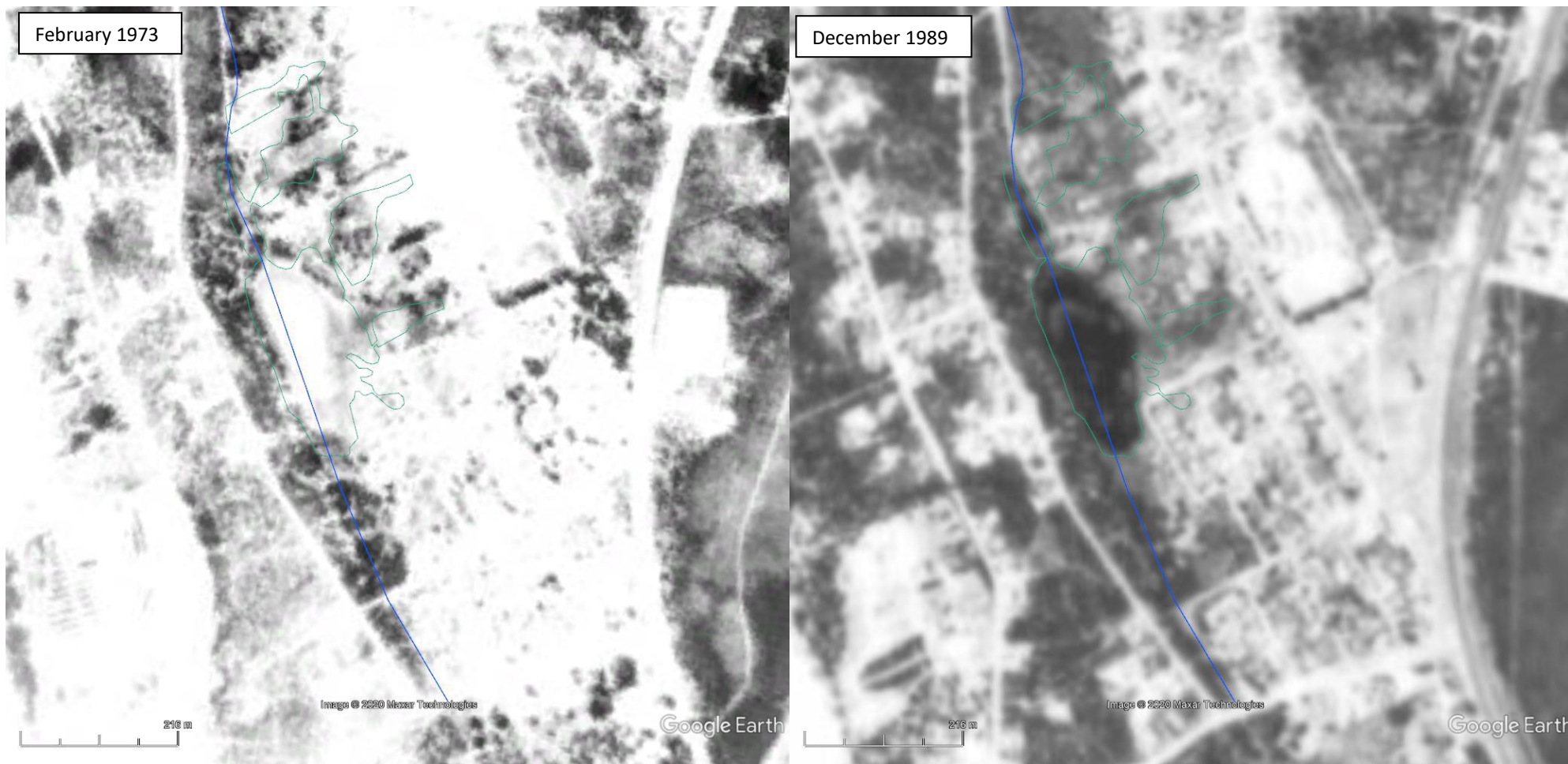


Plate 2. Past aerial imagery of the area taken in 1973 and 1989, overlain in Google Earth with the present-day aquatic features shown



Plate 3. Past Google Earth imagery of the area taken in 2004 and 2018, with the present-day aquatic features shown

APPENDIX C: PHOTOGRAPHS OF THE SITE



Plate 4: View of the stormwater attenuation adjacent to the R43 Road



Plate 5. View of the stormwater canal draining into Paddavlei along Vlei Street (left) and the stormwater pipe that installed in the lower Paddavlei



**Plate 6. View of the start of a hillslope seep adjacent to the open area previously referred to as 'Die Kraal'**



**Plate 7. View of one of the hillslope seeps, east of Long Street**



**Plate 8. View of the milkwood forest directly upstream of Paddavlei**



**Plate 9. View of the core Paddavlei area, west of Long Street**



**Plate 10. View of the lower Paddavlei near Chapel Street**



**Plate 11. Photograph of the pipe culvert and embankment that separates the core vlei area from the lower section**



**Plate 12. View of the section of the corridor directly downstream of Paddavlei at George Viljoen Street**



**Plate 13. Photograph of the culvert at George Viljoen Street, filled with litter**

APPENDIX D: AQUATIC ECOLOGICAL ASSESSMENT OF THE PADDAVLEI WETLAND



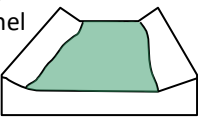
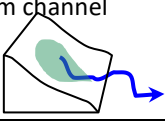


The wetland assessment consisted of the following aspects:

1. Wetland classification and delineation;
2. Wetland present ecological integrity; and
3. Wetland Ecological Importance and Sensitivity and Ecosystem Services supplied by the wetlands.


D.1 WETLAND CLASSIFICATION

The classification of the wetland in the study area for wetland typing was based on the WET-EcoServices technique (Kotze *et al*, 2005). The WET-EcoServices technique identifies seven main types of wetland based on hydro-geomorphic characteristics (Table D1). The Paddavlei wetland can be classified as a dune slack depression with associated hillslope seep areas. The mosaic of wetland habitats within the ecological corridor on the valley floor also forms part of a series of valley bottom wetland habitats.

Table D4. Wetland hydro-geomorphic types typically supporting inland wetlands in South Africa

Hydro-geomorphic types	Description	Source of water <sup>1</sup>	
		Surface	Sub-surface
 <p>Floodplain</p>	Valley bottom areas with well-defined stream channel, gently sloped, characterized by floodplain features (oxbow depressions and natural levees) with alluvial transport and deposition of sediment (net accumulation). Water inputs from main channel overtopping and from adjacent slopes.	***	*
 <p>Valley bottom with a channel</p>	Valley bottom areas with well-defined stream channel but lacking characteristic floodplain features. May be gently sloped with a net accumulation of alluvial deposits or may have steeper slopes with a net loss of sediment. Water inputs from main channel (overspill) and adjacent slopes.	***	*/ ***
 <p>Valley bottom without a channel</p>	Valley bottom areas with no well-defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/ ***
 <p>Hillslope seepage linked to a stream channel</p>	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.	*	***
 <p>Isolated Hillslope seepage</p>	Slopes on hillsides, characterized by the colluvial movement of materials. Water inputs mainly from sub-surface flow and outflow very limited or through diffuse sub-surface / surface flow but with no visible connection to a stream.	*	***
 <p>Depression (includes Pans)</p>	A basin shaped area with a closed elevation contour that allows for the accumulation of surface water. It may also receive sub-surface water. An outlet is usually absent, and isolated from the stream channel network.	*/ ***	*/ ***

<sup>1</sup> Precipitation is an important water source and evapotranspiration an important output in all of the above

Water source: \* Contribution usually small  
 \*\*\* Contribution usually large  
 \*/ \*\*\* Contribution may be small or important depending on the local circumstances  
 Wetland

**Table D5. Classification of the Paddavlei wetland areas**

Name	Paddavlei dune slack depression	Hillslope seeps
System	Inland	
Ecoregion	Southern Coastal Belt	
Landscape setting	Valley floor	
Longitudinal zones	Depression within a valley floor	Hillslope
Drainage	No visible channel in or outflow – largely sub-surface flow except after rainfall	Sub-surface with Stormwater inputs
Seasonality	Naturally seasonally inundated – present day more permanently inundated	
Anthropogenic influence	Largely natural with increasing local habitat disturbance and invasion with alien vegetation; also, modification to quantity and quality of water	Direct local habitat disturbance and loss due to surrounding development, stormwater input and some invasion by alien plants
Vegetation	<i>Typha capensis</i> dominated	Mix of indigenous <i>Typha capensis</i> , <i>Senecio halimifolius</i> and invasive alien kikuyu grass
Substrate	Quarzitic sands	
Salinity	Fresh	

## D2. WETLAND INTEGRITY

The Present Ecological Status (PES) Method (DWAF 2005) was used to establish the integrity of the wetlands in the study area and was based on the modified Habitat Integrity approach developed by Kleynhans (DWAF, 1999; Dickens *et al*, 2003). Table D3 displays the criteria and results from the assessment of the habitat integrity of the wetland (Table D4). These criteria were selected based on the assumption that anthropogenic modification of the criteria and attributes listed under each selected criterion can generally be regarded as the primary causes of the ecological integrity of a wetland.

**Table D6. Habitat integrity assessment criteria for palustrine wetlands (Dickens *et al*, 2003)**

Criteria/Attributes	Relevance
<b>Hydrologic</b>	
Flow Modification	Abstraction of ground and surface water, dams or increased runoff from developed areas. Changes in flow which affect inundation of wetlands and biota.
Permanent Inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.
<b>Water Quality</b>	
Water Quality Modification	Point source discharges or diffuse sources from upstream agricultural activities, human settlements and industrial activities. Aggravated by decrease in flow.
Sediment Load Modification	Reduction due to entrapment by impoundments or increase due to land use practices. Cause of unnatural rates of erosion, accretion or infilling of wetlands.
<b>Hydraulic/Geomorphic</b>	
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.
Topographic Alteration	Infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities that change wetland habitat directly in inundation patterns.
<b>Biota</b>	
Terrestrial Encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology
Indigenous Veg Removal	Direct destruction of habitat through farming and other activities, affecting habitat and flow attenuation functions, organic matter inputs and increases erosion.
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).
Alien Fauna	Presence of alien fauna affecting faunal community structure.
Overuse of Biota	Overgrazing, overfishing, etc.

**Table D7. Wetland habitat integrity assessment (score of 0=critically modified to 5=unmodified)**

Criteria & Attributes	Paddavlei wetland	Hillslope seeps
<b>Hydrologic</b>		
Flow Modification	2.8	2.6
Permanent Inundation	2.6	2.8
<b>Water Quality</b>		
Water Quality Modification	2.6	2.0
Sediment Load Modification	3.0	2.3
<b>Hydraulic/Geomorphic</b>		
Canalisation	3.5	2.0
Topographic Alteration	3.2	2.6
<b>Biota</b>		
Terrestrial Encroachment	3.5	3.0
Indigenous Vegetation Removal	4.5	3.0
Invasive Plant Encroachment	2.5	2.6
Alien Fauna	3.6	2.8
Over utilisation of Biota	3.8	3.8
Total Mean	3.2	2.6
<b>Category</b>	<b>B/C</b>	<b>C</b>

**Table D8. Relation between scores given and ecological categories**

Scoring Guidelines Per Attribute*	Interpretation of Mean* of Scores for all Attributes: Rating of Present Ecological Status Category (PESC)
Natural, unmodified - score=5.	Within general acceptable range CATEGORY A >4; Unmodified or approximates natural condition.
Largely natural - score=4.	CATEGORY B >3 and <4; Largely natural with few modifications, but with some loss of natural habitats.
Moderately modified - score=3.	CATEGORY C >2 and <3; moderately modified, but with some loss of natural habitats.
Largely modified - score=2.	CATEGORY D <2; largely modified. A large loss of natural habitats and basic ecosystem functions has occurred. OUTSIDE GENERALLY ACCEPTABLE RANGE
Seriously modified - rating=1.	CATEGORY E >0 and <2; seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
Critically modified - rating=0.	CLASS F 0; critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

The WET-Health method was then used to determine that overall Present Ecological Status (PES) for the wetlands. PES scores were determined for geomorphology, hydrology, water quality and vegetation to generate the overall score and ecological category (Table D9).

**Table D9. WET-Health assessment of wetland areas in the study area**

Components	Method used for assessment	Paddavlei wetland		Hillslope seeps	
		PES%	PES Cat.	PES%	PES Cat.
Hydrology PES	Hydro Module	70	C	60 %	C/D
Geomorphology PES	Geomorph Module	99	A	96 %	A
Water quality PES	Landuse-WQ Model	78	B/C	65 %	C
Vegetation PES	Veg Module	69	C	55 %	D
<b>Overall Wetland PES</b>	<b>WET-Health</b>	<b>78 %</b>	<b>B/C</b>	<b>69 %</b>	<b>C</b>

The surrounding land use activities have impacted on the habitat as well as the flow and water quality of the water feeding the wetland areas. The hillslope seeps that are smaller in extent and within the urban areas have been more impacted, particularly in terms of hydrology, water quality and vegetation.

### D3. ECOLOGICAL IMPORTANCE AND SENSITIVITY AND ECOSYSTEM SERVICES SUPPLIED BY THE WETLANDS

The assessment comprises of three components, an assessment of the ecological importance and sensitivity (EIS) of the wetlands, an assessment of the hydrological importance and an assessment of the direct human benefits of the wetland. The EIS component of the assessment considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The hydrological importance and human benefit assessment examine and rate the services provided by wetlands according to the guidelines as described by Kotze *et al* (2005). The determinants are rated according to a four-point scale (Table D7). The median of the highest resultant score for each component of the assessment is calculated to derive the EIS category (Table D9). The results from the wetland assessment are provided in Table D8.

**Table D10. Scale used to assess importance or sensitivity**

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

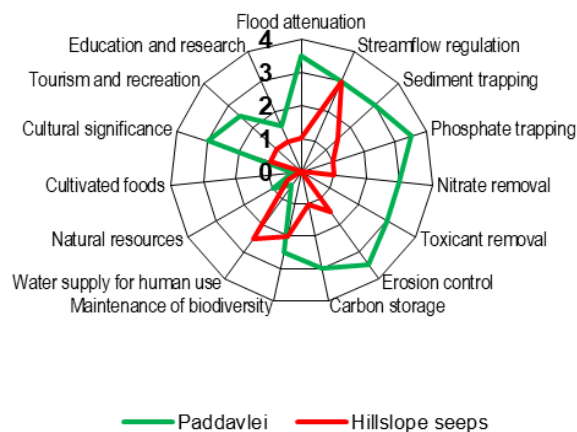
**Table D11: Results of the EIS assessment for the wetland areas**

Ecological Importance	Paddavlei wetland	Hillslope seeps
Biodiversity support	2.50	1.67
Presence of Red Data species	2	1.5
Populations of unique species	2.5	2
Migration/breeding/feeding sites	3	1.5
Landscape scale	1.90	1.30
Protection status of the wetland	2	0.5
Protection status of the vegetation type	1	2
Regional context of the ecological integrity	2.5	2
Size and rarity of the wetland type/s present	2	1
Diversity of habitat types	2	1
Sensitivity of the wetland	2.17	2.00
Sensitivity to changes in floods	2	2
Sensitivity to changes in low flows/dry season	2	1.5
Sensitivity to changes in water quality	2.5	2.5
<b>ECOLOGICAL IMPORTANCE &amp; SENSITIVITY</b>	<b>2.50</b>	<b>2.00</b>

Flood attenuation	3.5	1
Streamflow regulation	3	3
Sediment trapping	3	1.5
Phosphate assimilation	3.5	1
Nitrate assimilation	3	1
Toxicant assimilation	3	0
Erosion control	3.5	1.5
Carbon storage	3	1
<b>HYDROLOGICAL/FUNCTIONAL IMPORTANCE</b>	<b>3.19</b>	<b>1.25</b>
Water for human use	0.5	2.5
Harvestable resources	1	0.5
Cultivated foods	0.25	0
Cultural heritage	3	1
Tourism and recreation	2.5	1
Education and research	1.5	1
<b>IMPORTANCE OF DIRECT HUMAN BENEFITS</b>	<b>1.46</b>	<b>1.00.08</b>
<b>OVERALL IMPORTANCE (highest score)</b>	<b>3.19</b>	<b>2.0</b>

**Table D12. Ecological importance and sensitivity categories (DAAF, 1999)**

EISC	General description	Range of median
Very high	Quaternaries/delineations unique on a national and international level based on unique biodiversity. These rivers are very sensitive to flow modifications and have no capacity for use.	>3-4
High	Quaternaries/delineations unique on a national scale based on their biodiversity. These rivers may be sensitive to flow modifications but may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations unique on a provincial or local scale due to biodiversity. These rivers are not very sensitive to flow modifications and often have substantial capacity for use.	>1-≤2
Low/marginal	Quaternaries/delineations not unique on any scale. These rivers are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1



**Figure D1. Chart representation of the Ecological Goods and Services provided by the wetlands**

Paddavlei and its associated hillslope seeps are considered of **moderate to high** ecological and functional importance. This is largely due to the fact that the wetlands form part of the ecological corridor linking the Vermont Pan and a number of other wetlands with the Bot River Lagoon. The wetlands also provide valued goods and services (in particular flood attenuation and water quality amelioration services) and represent a regionally threatened habitat type that supports red data fauna such as the Western Leopard Toad (*Sclerophys pantherinus*) as well as a number of other amphibians and bird species.

APPENDIX E: RESOURCE QUALITY OBJECTIVES FOR THE WETLANDS

<b>Paddavlei</b>		
<b>Component</b>	<b>Objective</b>	<b>Comments</b>
Water Quantity	The wetland should as far as possible function as a seasonal wetland system with inundation of the wetland habitat largely only taking place during the high rainfall period of June to September.	Inundation of the wetlands during the winter months should take place and will be driven by groundwater levels within the wetland.
Water Quality	<p>Water Quality PES Component of the WET-Health (Wetland IHI WQ Module) &gt; 75%</p> <p><i>Nutrients:</i>                      Orthophosphates &lt; 0.075 mg/l (50 %ile)                      Total Inorganic Nitrogen &lt; 1.75 mg/l (50 %ile)</p> <p><i>Salts:</i>                      Electrical Conductivity &lt; 310 mS/cm (95 %ile)</p> <p><i>System Variables:</i>                      pH range of 5.5 to 8.5 (5 and 95 %iles)                      Dissolved oxygen &gt; 4 mg/l (5 %ile)</p> <p><i>Toxins:</i>                      Ammonia &lt; 0.073 mg/l (95 %ile)</p> <p><i>Pathogens:</i>                      E. coli &lt; 165 counts/100 ml (95 %ile)</p>	Direct stormwater discharge and sewer leakages into the wetland area should be prevented.
Habitat	Geomorphology, Vegetation and Overall Wetland PES > 75%	No invasive or alien (exotic) or terrestrial woody plants should occur within the wetland and its adjacent buffer area.

## APPENDIX F: DEADP GUIDELINES FOR MAINTENANCE WORKS IN WATERCOURSES AND WETLANDS

The DEADP Maintenance Management Plan (MMP) guidelines (DEADP 2017) provide the following set of guiding principles for maintenance work in water courses that are of relevance to this site:

- Repairs and maintenance should be undertaken within the dry season, except for emergency maintenance works.
- Where at all possible, existing access routes should be used. In cases where none exist, a route should be created through the most degraded area avoiding sensitive/indigenous vegetation areas.
- Responsible management of pollutants through ensuring handling and storage of any pollutants is away from the aquatic habitats. When machinery is involved, ensure effective operation with no leaking parts and refuel outside of the riparian area, at a safe distance from the aquatic feature to manage any accidental spillages and pose no threat of pollution.
- At no time should the flow of the watercourse / wetland be blocked (temporary diversions may be allowed) nor should the movement of aquatic biota (noting breeding periods) be prevented during maintenance actions.
- No new berms can be created.
- In circumstances which require the removal of any topsoil, this must be sufficiently restored through sustainable measures and practices.
- Concerted effort must be made to actively rehabilitate repaired or reshaped banks with indigenous local vegetation.
- No deepening of the watercourse / wetland beyond the original, pre-damage determined depth, unless such deepening is directly related to the natural improved functioning and condition of such an aquatic feature.
- The build-up of debris/sediment removed from a maintenance site may:
  - be utilised for the purpose of in-filling or other related maintenance actions related to managing erosion, which form part of an adopted MMP;
  - not be used to enlarge the height, width or any extent of existing berms;
  - not be deposited anywhere within the watercourse or anywhere along the banks of a watercourse or wetland where such action is not part of the proposed maintenance activity (ies). Material that cannot be used for maintenance purposes must be removed out of the area to a suitable stockpile location or disposal site. Further action and consideration may be required where the possibility of contaminated material may occur.
- The use of foreign material, such as concrete, rubble, woody debris and/or dry land-based soil, is strictly prohibited from being used in maintenance actions, unless for the specific purpose of repairs to existing infrastructure, coupled with appropriate mitigation measures.
- On completion of the maintenance action, the condition of the site in terms of relative topography should be similar to the pre-damaged state (i.e. the shape of the riverbank should be similar or in a state which is improved to manage future damage). This ultimately dictates that the channel, banks and bed cannot be made narrower, higher or deepened, respectively. Exceptions are considered for systems involved with the management of stormwater and improvements for water quality within the urban context.

APPENDIX F: C.A.P.E. DRAFT MANAGEMENT GUIDELINES FOR INLAND WETLANDS

Red flagging of potential ecological / hydrological linkages and issues	Sensitive to	Within 1:20 year floodline	Up to 1:100-year floodline	Upstream catchment
Valley bottom wetlands with channel				
<p>Linked to upstream river system – so potentially important as an ecological corridor linking up- and downstream areas</p> <p>Hydrological connectivity – may be affected by upstream water use and impact on downstream systems (e.g. estuaries)</p> <p>May be strong groundwater component</p> <p>Natural seasonality is an important component determining condition.</p>	<p>Changes in upstream flows</p> <p>Decreases in surface and/or groundwater flows – lowering of discharge could reduce scour, leading to encroachment by aquatic and marginal vegetation, and channel narrowing – this would increase likelihood of downcutting and erosion after flood events; for ephemeral systems, decreases in flow could push these transitional systems into impacted terrestrial areas, with loss of wetland function.</p> <p>Increases in surface and/or groundwater flows – these could lead to changes in plant structure, e.g. an increase in hardy sedges and reeds (e.g. <i>Typha capensis</i>) and a decrease in seasonal wetland vegetation communities – changes in plant zonation e.g. increased width of we bank vs dry bank – loss of important seasonally inundated breeding areas (e.g. inundated sedge habitat used by larvae of many invertebrate taxa)</p> <p>Creation of erosion nick-points as a result of channel constriction</p> <p>Depending on plant community structure, may be sensitive to:</p> <p>Increased nutrients – leading to changes in marginal vegetation type and invasion by floating aquatic plants</p> <p>Changes in salinity</p>	<p>Infilling / excavation</p> <p>Roads – interrupt flow, loss of connectivity</p> <p>Culverts – constriction of flow</p> <p>Canalisation</p> <p>Channelisation</p> <p>Alien vegetation</p> <p>Impoundment</p> <p>Abstraction</p> <p>Well points</p> <p>Stormwater or other point source inflows</p> <p>Irrigation return flows</p> <p>Grazing / trampling</p>	<p>Intensive livestock farming / grazing</p> <p>Intensive agriculture</p> <p>Wellpoints</p> <p>Poorly serviced / informal settlements</p> <p>Suburban gardens</p> <p>Golf course greens</p>	<p>Abstraction</p> <p>Impoundment</p> <p>River diversion / water transfer</p> <p>WWTW discharges (need to explain acronym)</p> <p>Extensive woody alien invasion</p> <p>Poorly serviced / informal settlements</p>

Red flagging of potential ecological / hydrological linkages and issues	Sensitive to	Within 1:20 year floodline	Up to 1:100-year floodline	Upstream catchment
<b>Non-isolated hillslope seep</b>				
Usually strongly groundwater dependent, but also connected to a riverine system. Generally important for water supply to downstream systems May form important (or impacted) grazing or water areas in arid regions	Sensitive to groundwater abstraction / changes in surface runoff characteristics Fragmentation Alterations to fire regime Sensitive to water quality changes – increased nutrients likely to change vegetation community structure Low vulnerability to sedimentation Vulnerable to impoundment (this could deepen system and lead to changes in habitat structure) and abstraction (potentially leading to creation of seasonal or intermittent system) Vulnerable to fragmentation as a result of roads / tracks intersecting seeps	Infilling / excavation Cultivation Roads – interrupt flow Culverts – concentration of flow Channelisation Abstraction Wellpoints Alien vegetation Stormwater or other point source inflows Impoundment Grazing and trampling – particularly non-permanent basin seeps	Intensive livestock farming / grazing Intensive agriculture Wellpoints Sources of sediment Poorly serviced / informal settlements Suburban gardens Golf course greens	Abstraction Impoundment Upstream diversion of surface water supply WWTW discharges Poorly serviced / informal settlements Extensive alien plant invasion
<b>Non-isolated depression</b>				
Natural fluctuations in water level is an important component determining condition May provide locally rare habitat type along channeled systems, supporting fauna more typical of lacustrine / lentic environments Larger systems may provide recreational opportunities Linked to upstream river system – so potentially important as an ecological corridor linking up- and downstream areas Hydrological connectivity – may be affected by upstream water use and impact on downstream systems	Changes in inundation regime - could critically alter habitat structure and function Often highly sensitive to water quality changes, which could be of extended duration, due to limited flushing of water body (especially those without channeled outflow Potentially prone to accumulation of sediments, depending on size May be prone to encroachment / infilling as potentially hard to identify wetland boundaries outside of saturation / inundation period	Infilling / excavation Artificial deepening Drainage Aquaculture Alien vegetation Recreational activities Grazing Cultivation Roads Salt mining	Intensive agriculture Intensive livestock grazing Draining / infilling Roads – interrupt flow Culverts – constriction of flow Market gardening – where nutrient enrichment is an issue Creation of flood control berms Golf courses	Large-scale abstraction River diversion or transfer Impoundments Cultivation Impacts to floodplain hydrology

Activities in wetlands may trigger a listed activity in terms of the NEMA regulations. The following guidelines apply:

- Identify and delineate wetlands during winter months. (Some wetlands are not easily identified during the dry summer.) Wetlands are identified by a combination of soil type and plant species.
- Keep natural buffer areas of 50 – 75 m around wetlands free of alien plants and irrigated crops.
- Do not restrict or block the water supply to a wetland.
- Take care not to modify or disturb the catchment of a wetland (e.g. by road construction), as this may lead to increased runoff and possible erosion of the wetland.
- Do not over abstract or divert surface or groundwater feeding into a wetland, which may cause it to dry up. High-yielding boreholes should not be sunk in or near wetlands.
- Dam construction within wetlands transforms the wetland into a permanent water body, resulting in the loss of the important wetland “sponge” habitat. Dams should thus be constructed outside wetlands and stream channels. (Water use authorisation required.)
- Avoid siting pollution sources like waste disposal sites, domestic effluent, etc. near wetlands.
- Regularly clear wetlands of invasive alien plants, taking care not to disturb the soil (i.e. do not use heavy machinery).
- All modifications of water flow in or through a wetland is illegal. Disturbed wetlands can often be successfully restored by returning the flow to its original state through closing of drainage ditches and trenches.
- Certain wetlands (especially grassy floodplains) can be grazed, provided that no over- grazing occurs, and that it is done in the correct season (December to April).
- Most wetlands should ideally be kept free of grazing. Grazing large stock in wetlands in winter and spring can cause severe erosion and loss of biodiversity and is not recommended.