Report No: 113223/12145a

# WORKING FOR WETLANDS REHABILITATION PROGRAMME, KWAZULU-NATAL

## REHABILITATION PLAN
## PROJECT: ISIMANGALISO
## W32H

**JULY 2019**

Agriculture, Forestry and Fisheries
Environmental Affairs
Water Affairs and Sanitation

Working for Wetlands

EXPANDED PUBLIC WORKS PROGRAMME
Creating opportunities towards human fullfilment

*This page was left blank intentionally*

**REHABILITATION PLAN FOR THE ISIMANGALISO PROJECT,**
**KWAZULU-NATAL PLANNING YEAR 2018/2019**
**AS PART OF**
**THE WORKING FOR WETLANDS PROGRAMME**
**FOR THE**
**DEPARTMENT OF ENVIRONMENTAL AFFAIRS**
**DIRECTORATE: WORKING FOR WETLANDS**

**MAIN REPORT**
**July 2019**


*Prepared by:* Aurecon South Africa (Pty) Ltd
PO Box 494
Cape Town
8000
South Africa
Tel: 021 526 9400
Fax: 021 526 9500
Email: Claire.Blanche@aurecongroup.com

*Prepared for:* Working for Wetlands Programme
Department of Environmental Affairs:
Natural Resource Management
Private Bag X447
Pretoria
South Africa
Tel: 012 399 8970
Email: FTererai@environment.gov.za



This report is to be referred to in bibliographies as:

Working for Wetland Programme. 2018. Rehabilitation Plan for the iSimangaliso Wetland Project, KwaZulu-Natal Province: Planning Year 2018/2019. Prepared by Simamkele Ntsengwane and Claire Blanché, Aurecon South Africa (Pty) Ltd as part of the planning phase for the Working for Wetlands Rehabilitation Programme. Report No. 113223/12145a.

*This page was left blank intentionally*

## PROJECT DETAILS

| Document control | | | | | |
|---|---|---|---|---|---|
| **Report title** | | Rehabilitation Plan for the iSimangaliso Wetland Project, KwaZulu-Natal: Planning Year 2018/2019 | | | |
| **Document ID** | | 113223/12145 | | **Project number** | 113223 |
| **File path** | | P:\Projects\113223 Plan & Env Comp Work for Wetlands\Enviro\7 DEL SERV\701 Provinces\KwaZulu-Natal\2018_2019\Reports\Rehab Plans\Isimangaliso | | | |
| **Client** | | Working for Wetlands Programme | | | |
| **Client contact** | | Dr Farai Tererai | | **Client reference** | WfWetlands: iSimangaliso |
| **Rev** | **Date** | **Revision details/status** | **Author** | **Reviewer** | **Approver** |
| 0 | June 2019 | Draft for Public comment | Simamkele Ntsengwane | Claire Blanché | Franci Gresse |
| 1 | July 2019 | Final for DEA | Simamkele Ntsengwane | Franci Gresse | Franci Gresse |
| **Contributors:** | | Mbali Goge, Assistant Director: Wetlands Programmes for KwaZulu-Natal Province<br>Craig Cowden and Steven Ellery of GroundTruth Water, Wetlands and Environmental Engineering<br>Ryan Domleo and Khwezi Mncwabe of Ground Truth Water, Wetlands and Environmental Engineering | | | |
| **Current revision** | | **Draft** | | | |

| Approval | | | |
|---|---|---|---|
| Reviewer signature | | Approver signature | |
| Name | Ms Claire Blanché | Name | Ms Franci Gresse |
| Title | Senior Environmental *Practitioner* | Title | Senior Environmental Practitioner |
| WfWetlands Approval | | | |
| Name | ***Ms Mbali Goge*** | | |
| Title | *Assistant Director: Wetlands Programmes for KwaZulu-Natal Province*<br>**Department of Environmental Affairs: Natural Resource Management Programmes** | | |

*This page was left blank intentionally*

# WORKING FOR WETLANDS: CONTEXT DOCUMENT

## 1. Introduction

Working for Wetlands (WfWetlands) is a government programme managed by the Natural Resource Management (NRM) Programme of the Department of Environmental Affairs (DEA), and is a joint initiative with the Departments of Water and Sanitation (DWS), and Agriculture, Forestry and Fisheries (DAFF). In this way the programme is an expression of the overlapping wetland-related mandates of the three parent departments, and besides giving effect to a range of policy objectives, it also honours South Africa's commitments under several international agreements, especially the Ramsar Convention on Wetlands.

The programme is mandated to protect pristine wetlands, promote their wise-use and rehabilitate those that are damaged throughout South Africa, with an emphasis on complying with the principles of the Expanded Public Works Programme (EPWP) and using only local Small, Medium and Micro Enterprises (SMMEs). The EPWP seeks to draw significant numbers of unemployed people into the productive sector of the economy, gaining skills while they work and increasing their capacity to earn an income.

## 2. Wetlands and their importance

Once considered valueless wastelands that needed to be drained or converted to more useful land use purposes, wetlands are now seen in an entirely different light. Today wetlands are more commonly perceived as natural assets and natural infrastructure able to provide a range of products, functions and services free of charge.

That which actually constitutes a wetland is often not fully understood. Common misconceptions have been that wetlands must be wet, must have a river running through them, or must always be situated in low-lying areas. The definition of a wetland is much broader and more textured: they are characterised more by soil properties and flora than by an abundance of water.

The National Water Act, No. 36 of 1998 defines a wetland as:

> *"land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".*

The Ramsar Convention defines wetlands as:

> *"areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed 6m" (Article 1, Ramsar Convention on Wetlands. 1971).*

Wetlands can therefore be seasonal and may experience regular dry spells (sometimes even staying dry for up to several years), or they can be frequently or permanently wet. Wetlands can occur in a variety of locations across the landscape (**Plate A**) and may even occur at the top of a hill, nowhere near a river. A pan, for example, is a wetland which forms in a depression. Wetlands also come in many sizes; they can be as small as a few square metres (e.g. at a low point along the side of a road) or cover a significant portion of a country (e.g. the Okavango Delta).

**Plate A: A large, seasonal wetland identifiable by the characteristic flora. This wetland contained no surface water at the time of the photograph**

Wetland ecosystems provide a range of ecological and social services which benefit people, society and the economy at large:

- Improving the ecological health of an ecosystem by performing many functions that include flood control, water purification, sediment and nutrient retention and export, recharge of groundwater, as well as acting as vital habitats for diverse plant and animal species.
- Providing ecological infrastructure replacing the need for municipal infrastructure by providing the same or better benefit at a fraction of the cost, for example:
    - The movement of water in the landscape is slowed down by wetlands, which offers the dual benefit of flood control as well as a means of purification.
    - The slow movement of water allows heavier impurities to settle and phreatic vegetation and micro-bacteria the opportunity to remove pollutants and nutrients.
- Functioning as valuable open spaces and create recreational opportunities for people that include hiking along wetlands, fishing, boating, and bird-watching.
- Having cultural and spiritual significance for the communities living nearby. Commercially, products such as reeds and peat are also harvested from wetlands (**Plate B**).

**Plate B: Commercial products made by locals from reeds harvested from wetlands**

Wetlands are thus considered to be critically important ecosystems as they provide both direct and indirect benefits to the environment and society.

## 3. Wetland degradation

It has been estimated that originally over 10% of the Republic of South Africa (RSA) was covered by wetlands. However, this figure decreases significantly every year owing to unsustainable land-use practices. It is estimated that more than 50% of South Africa's wetlands have been destroyed through drainage of wetlands for crops and pastures, poorly managed burning regimes, overgrazing, disturbances to wetland soils, vegetation clearing as well as industrial and urban development (including mining activities).

Although wetlands are high-value ecosystems that make up only a small fraction of the country, they rank among the most threatened ecosystems in South Africa. According to a recent Council of Scientific Research (CSIR) study (Nel and Driver, 2012), South Africa's remaining wetlands were identified as the most threatened of all South Africa's ecosystems, with 48% of wetland ecosystem types being critically endangered, 12% endangered and 5% vulnerable. Only 11% of wetland ecosystem types are well protected, with 71% not protected at all.

The remaining wetland systems suffer from severe erosion and sedimentation, undesirable plant species and aquatic fauna infestations, unsustainable exploitation, artificial drainage and damming, and pollution. The continued degradation of wetlands will impact on biodiversity, ecological function, and the provision of ecosystem services with subsequent impacts on livelihoods and economic activity, as well as health and wellbeing of communities. In the absence of functional wetlands, the carbon cycle, the nutrient cycle and the water cycle would be significantly altered, mostly detrimentally.

Wetland conservation and rehabilitation should be at the heart of water management. It is necessary to prioritise South Africa's remaining wetlands such that those that offer valuable ecosystem services and are least impacted by current pressures or threats are offered immediate attention to avoid further loss, conversion or degradation.

## 4. The Working for Wetlands Programme

South Africa is a dry country but is endowed with exceptionally rich biodiversity. The nation has a pressing reason to value the water-related services that wetlands provide. It is estimated that by 2025, South Africa will be one of fourteen African countries classified as "*subject to water scarcity*" (UNESCO, 2000). The conservation of wetlands is fundamental to the sustainable management of water quality and quantity, and wetland rehabilitation is therefore essential to conserving water resources in South Africa.

The guiding principles of the National Water Act, No. 36 of 1998, recognise the need to protect water resources. In responding to the challenge of stemming the loss of wetlands and maintaining and enhancing the benefits they provide, government has recognised that, in order to be truly effective, strategies for wetland conservation need to include a combination of proactive measures for maintaining healthy wetlands, together with interventions for rehabilitating those that have been degraded. These objectives are currently being expressed in a coordinated and innovative way through the WfWetlands Programme.

Working for Wetlands pursues its mandate of wetland protection, wise use and rehabilitation in a manner that maximises employment creation, supports small emerging businesses, and transfers skills amongst vulnerable and marginalised groups. In the 15 years since 2004, the WfWetlands Programme has invested over R 1.1 billion in wetland rehabilitation and has been involved in about 1 500 wetlands, thereby improving or securing the health of over 70 000 hectares of wetland environment. The WfWetlands Programme has a current budget of just over R 130 million per annum, of which 35% is allocated directly to paying wages. Being part of the EPWP, the WfWetlands Programme has created more than 34 000 jobs and over 3.2 million person-days of paid work. The local teams are made up of a minimum of 55% women, 65% youth and 2% disabled persons.

Wetlands are not easy ecosystems to map at a broad scale as they are numerous, often small and difficult to recognise and delineate on remotely sensed imagery such as satellite photos. The WfWetlands Programme houses the National Wetlands Inventory Project (NWI) which aims to provide clarity on the extent, distribution and condition of South Africa's wetlands. The project clarifies how many and which rivers and wetlands have to be maintained in a natural condition to sustain economic and social development, while still conserving South Africa's freshwater biodiversity.

The National Freshwater Ecosystem Priority Areas (NFEPA) has used the NWI data to produce the most comprehensive national wetland map to date, called the NFEPA Atlas. This atlas enables the planning of wetland rehabilitation on a catchment scale.

Other activities that form part of the WfWetlands Programme include:

- Raising awareness of wetlands among workers, landowners and the general public; and
- Providing adult basic education and training, and technical skills transfer (in line with the emphasis of the EPWP on training, the WfWetlands Programme has provided 250 000 days of training in vocation and life skills).

## 5. Rehabilitation interventions

The successful rehabilitation of a wetland requires that the cause of damage or degradation is addressed, and that the natural flow patterns of the wetland system are re-established (flow is encouraged to disperse rather than to concentrate). Approximately 800 interventions are implemented every year in the WfWetlands Programme. The key purposes of implementing interventions include:

- Restoration of hydrological integrity (e.g. raising the general water table or redistributing the water across the wetland area);
- Recreation of wetland habitat towards the conservation of biodiversity; and
- Job creation and social upliftment.

Typical activities undertaken within the projects include:

- Plugging artificial drainage channels created by development or historical agricultural practices to drain wetland areas for other land use purposes;
- Constructing structures (gabions, berms, weirs) to divert or redistribute water to more natural flow paths, or to prevent erosion by unnatural flow rates that have resulted from unsustainable land use practices or development; and
- Removing invasive alien or undesirable plant species from wetlands and their immediate catchments (in conjunction with the Working for Water initiative).

Methods of wetland rehabilitation may include hard engineering interventions such as:

- Earth berms and/or gabion structure(s) to block/ deactivate artificial channels that drain water from or divert polluted water to the wetland;
- Concrete and gabion weirs to act as settling ponds, reducing flow velocity or to re-disperse water across former wetland areas thereby re-establishing natural flow paths;
- Earth and/or gabion structure plugs to raise channel floors and reduce water velocity;
- Concrete or gabion structures to stabilise head-cut or other erosion and prevent gullies;
- Concrete and/or reno mattress strips as road crossings to address channels and erosion in wetlands from vehicles; and
- Gabion structures (mattresses or baskets) to assist as a platform for the growth of desired wetland vegetation.

Soft engineering interventions also offer successful rehabilitation methods, and the following are often used together with the hard engineering interventions:

- The use of biodegradable or natural soil retention systems such as eco-logs, Macmat-R plant plugs, grass or hay bales, and brush-packing techniques;
- The re-vegetation of stabilised areas with appropriate wetland and riparian plant species;
- Alien invasive plant clearing, which is an important part of wetland rehabilitation (this is supported by the Working for Water Programme).
- Fencing of sensitive areas within the wetland to keep grazers out and to allow for the re-establishment of vegetation;
- The removal of undesirable plant and animal species; and
- In some wetlands, it may be possible to involve the community to develop a management plan for wise use within a wetland. This can involve capacity building through educating and training the community members

who would monitor the progress. A plan could involve measures such as rotational grazing with long term benefits for rangeland quality.

## 6. Programme, projects and phases

In order to manage the **WfWetlands Programme**, wetlands have been grouped into "projects", and each **Wetland Project** encompasses several smaller wetland systems which are each divided into smaller, more manageable and homogenous wetland units. A Wetland Project may be located within one or more quaternary catchments within a Province. The WfWetlands Programme is currently managing 48 Wetland Projects countrywide, and rehabilitation activities range from stabilising degradation to the more ambitious restoration of wetlands to their original conditions.

Each Wetland Project is managed in three phases (as shown in the flow diagram in **Plate C**) over a two-year cycle. The first two phases straddle the first year of the cycle and involve planning, identification, design and authorisation of interventions. The third phase is implementation, which takes place during the second year.

In order to undertake these three phases, a collaborative team has been established as follows. The **Programme Team** currently comprises two subdirectories: a) Implementation and After Care and b) Planning, Monitoring and Evaluation. The Assistant Directors for Wetlands Programmes (ASDs) [1] report to the Implementation and After Care Deputy Director and are responsible for the identification and implementation of projects in their regions. The Programme Team is further supported by a small team that fulfil various roles such as Geographical Information Systems (GIS) and training. Independent Design Engineers and Environmental Assessment Practitioners (EAPs) are appointed to undertake the planning, design and authorisation components of the project. The project team is assisted by a number of wetland specialists who provide scientific insight into the operation of wetlands and bring expert and often local knowledge to the project teams. They are also assisted by the landowners and implementers who have valuable local knowledge of these wetlands.

The first phase is the identification of suitable wetlands which require intervention. The purpose of Phase 1 and the associated reporting is to identify:

- Priority catchments and associated wetlands/ sites within which rehabilitation work needs to be undertaken; and
- Key stakeholders who will provide meaningful input into the planning phases and wetland selection processes, and who will review and comment on the rehabilitation proposals.

**Phase 1** commences with a catchment and wetland prioritisation process for every province. The Wetland Specialist responsible for a particular province undertakes a desktop study to determine the most suitable wetlands for the WfWetlands rehabilitation efforts. The involvement of Provincial Wetland Forums and other key stakeholders is a critical component of the wetland identification processes since these stakeholders are representative of diverse groups with shared interests (e.g. from government institutions to amateur ecological enthusiasts). This phase also involves initial communication with local land-owners and other Interested and Affected Parties (I&APs) to gauge the social benefits of the work. Aerial surveys of the areas in question may be undertaken, as well as limited fieldwork investigations or site visits to confirm the inclusion of certain wetland projects or units. Once wetlands have been prioritised and agreed on by the various parties, specific rehabilitation objectives are determined for each wetland following a rapid wetland assessment undertaken by the Wetland Specialist.

**Phase 2** requires site visits attended by the fieldwork team comprising a Wetland Specialist, a Design Engineer, an EAP, and an ASD. Other interested stakeholders or authorities, landowners and in some instances the Implementing Agents (IAs) may also attend the site visits. This allows for a highly collaborative approach, as options are discussed by experts from different scientific disciplines, as well as local inhabitants with deep anecdotal knowledge. While on site, rehabilitation opportunities are investigated. The details of the proposed interventions are discussed, some survey work is undertaken by the engineers, and Global Positioning System (GPS) coordinates and digital photographs are taken for record purposes. Furthermore, appropriate dimensions of the locations are recorded in order to design and calculate quantities for the interventions. At the end of the site visit the rehabilitation objectives together with the location layout of the proposed interventions are agreed upon by the project team.

[1] Previously referred to as Provincial Coordinators (PCs).

During Phase 2, monitoring systems are put in place to support the continuous evaluation of the interventions. The systems monitor both the environmental and social benefits of the interventions. As part of the Phase 2 site visit, a maintenance inventory of any existing interventions that are damaged and/or failing and thus requiring maintenance is compiled by the ASD, in consultation with the Design Engineer.

Based on certain criteria and data measurements (water volumes, flow rates, and soil types); the availability of materials such as rock; labour intensive targets; maintenance requirements etc., the interventions are then designed. Bills of quantity are calculated for the designs and cost estimates made. Maintenance requirements for existing interventions in the assessed wetlands are similarly detailed and the costs calculated. The Design Engineer also reviews and, if necessary, adjusts any previously planned interventions that are included into the historical Rehabilitation Plans.

Phase 2 also comprises a reporting component where Rehabilitation Plans are prepared for each Wetland Project. The Rehabilitation Plans include details of each intervention to be implemented, preliminary construction drawings and all necessary documentation required by applicable legislation. The Rehabilitation Plans are reviewed by various government departments, stakeholders and the general public before a specific subset of interventions are selected for implementation.

**Landowner consent** is an important component of each phase in each Wetland Project. The ASDs are responsible for undertaking the necessary landowner engagement and for ensuring that the requisite landowner consent forms required as part of Phase 1 and 2 of this project are signed. Without the signed consent forms the WfWetlands Programme will not be able to implement rehabilitation interventions on the affected property.

**Phase 3** requires that certain Environmental Authorisations are obtained before work can commence in the wetlands (please see subsequent sections of this document for detail on Environmental Authorisations). Upon approval of the wetland Rehabilitation Plans by DEA, the work detailed for the project will be implemented within a year with on-going monitoring being undertaken thereafter. The Rehabilitation Plans are considered to be the primary working document for the implementation of the project via the construction/ undertaking of interventions[2] listed in the Plan.

It is typically at this point in the process when the final construction drawings are issued to the IAs. Seventeen IAs are currently employed in the WfWetlands Programme and are responsible for employing contractors and their teams (workers) to construct the interventions detailed in each of the Rehabilitation Plans. For all interventions that are based on engineering designs (typically hard engineered interventions), the Design Engineer is required to visit the site before construction commences to ensure that the original design is still appropriate in the dynamic and ever-changing wetland system. The Design Engineer will assist the IAs in pegging and setting-out interventions. The setting-out activities often coincide with the Phase 1 activities for the next planning cycle. Phase 3 concludes with the construction of the interventions, but there is an on-going monitoring and auditing process that ensures the quality of interventions, the rectification of any problems, and the feedback to the design team regarding lessons learnt.

[2] This could include soft options such as alien clearing or eco-logs, as well as hard structures for example weirs.

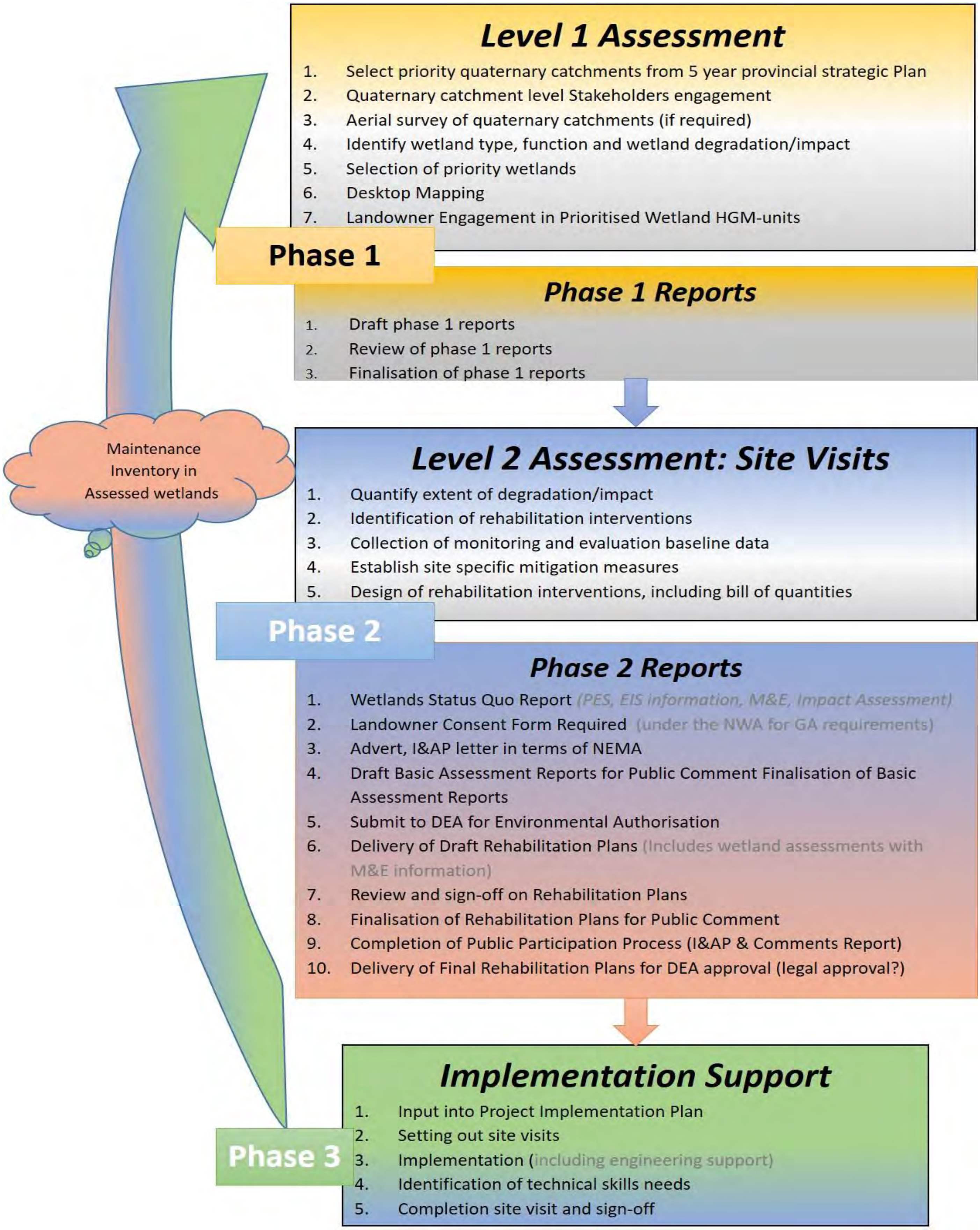



**Plate C: The Working for Wetlands planning process (Phase 1 to Phase 3)**

**Rehabilitation work within floodplain systems**

Based on lessons learnt and project team discussions held during the National Prioritisation workshop in November 2010 the WfWetlands Programme took an in-principle decision regarding work within floodplain systems.

Recognising the ecosystem services provided by floodplain wetlands and the extent to which they have been transformed, WfWetlands do not intend to stop undertaking rehabilitation work in floodplains entirely. Instead, WfWetlands propose to adopt an approach to the rehabilitation of floodplain areas that takes into account the following guiding principles:

a) As a general rule, avoid constructing hard interventions within an active floodplain channel; and rather
b) Explore rehabilitation opportunities on the floodplain surface using smaller (possibly more) softer engineering options outside of the main channel.

When rehabilitation within a floodplain setting is being contemplated, it will be necessary to allocate additional planning resources, including the necessary specialist expertise towards ensuring an adequate understanding of the system and appropriate design of the interventions.

## 7. Environmental legislation

One of the core purposes of the WfWetlands Programme is the preservation of South Africa's valuable wetland systems through rehabilitation and restoration.

South Africa has rigorous and comprehensive environmental legislation aimed at preventing degradation of the environment, including damage to wetland systems. The following legislation is of relevance:

- The National Environmental Management Act, No. 107 of 1998 (NEMA), as amended
- The National Water Act, No.36 of 1998 (NWA)
- The National Heritage Resources Act, No. 25 of 1999 (NHRA)

Development proposals within or near any wetland system are subject to thorough bio-physical and socio-economic assessment as mandatory processes of related legislation. These processes are required to prevent degradation of the environment and to ensure sustainable and environmentally conscientious development.

The WfWetlands Programme requires that both hard and soft interventions are implemented in the wetland system, and it is the activities associated with the construction of these interventions that triggers requirements for various authorisations, licenses or permits. However, it is important to note that the very objective of the WfWetlands Programme is to improve both environmental and social circumstances. The WfWetlands Programme gives effect to a range of policy objectives of environmental legislation, and also honours South Africa's commitments under several international agreements, especially the Ramsar Convention on Wetlands.

**Table A: List of applicable legislation**

| Title of legislation, policy or guideline | Administering authority | Date |
|---|---|---|
| The Constitution of South Africa, Act No.108 of 1996 | National Government | 1996 |
| National Environmental Management Act, No.107 of 1998 | Department of Environmental Affairs | 1998 |
| The National Water Act, No. 36 of 1998 | Department of Water and Sanitation | 1998 |
| Conservation of Agricultural Resources Act, No. 43 of 1983 | Department of Agriculture, Forestry & Fisheries | 1983 |
| National Heritage Resources Act, No. 25 of 1999 | National Heritage Resources Agency | 1999 |
| World Heritage Conventions Act, No. 49 of 1999 | Department of Environmental Affairs | 1999 |
| The National Environmental Management: Biodiversity Act, No. 10 of 2004 | Department of Environmental Affairs | 2004 |
| National Environmental Management: Protected Areas Act, No. 57 of 2003 | Department of Environmental Affairs | 2003 |
| The Mountain Catchments Areas Act, No. 63 of 1970 | Department of Water and Sanitation | 1970 |
| EIA Guideline Series, in particular:<br>• Guideline 5 – Companion to the NEMA EIA Regulations, 2010 (DEA, October 2012)<br>• Guideline 7 – Public Participation in the EIA process, 2012 (DEA, October 2012)<br>• Guideline 9 - Guideline on Need and Desirability, 2010 (DEA, October 2014) | Department of Environmental Affairs | 2012 - 2014 |
| International Conventions, in particular:<br>• The Ramsar Convention<br>• Convention on Biological Diversity<br>• United Nations Conventions to Combat Desertification<br>• New Partnership for Africa's Development (NEPAD)<br>• The World Summit on Sustainable Development (WSSD) | International Conventions | N/A |

Of particular relevance in **Table A** is the following legislation and the WfWetlands Programme has put systems in place to achieve compliance:

- The National Environmental Management Act, No. 107 of 1998 (NEMA), as amended
  - In terms of the 2014 Environmental Impact Assessment Regulations pursuant to the NEMA, certain activities that may have a detrimental impact on the environment (termed Listed Activities) require an Environmental Authorisation (EA) from the DEA. The implementation of interventions will trigger NEMA Listing Notices 1 and 3 (GN R983 and GN R985, as amended, respectively). In order to meet the requirements of these Regulations, it is necessary to undertake a Basic Assessment (BA) Process and apply for an EA. This was previously undertaken on an annual basis per Province for each individual wetland unit. However as of 2014, applications were submitted (per Province) for wetland systems, allowing WfWetlands to undertake planning in subsequent years within these wetlands without having to undertake a BA process. The rehabilitation plans still however require approval from the competent authority (i.e. DEA).
  - **Basic Assessment Reports** (BARs) will be prepared for each Province where work is proposed by the WfWetlands Programme. These BARs will present all Wetland Projects that are proposed in a particular province, together with information regarding the quaternary catchments and the wetlands that have been prioritised for the next few planning cycles (anywhere from one to three planning cycles depending on the information gained through the Catchment Prioritisation Process). The EAs will be inclusive of all Listed Activities that may be triggered and will essentially authorise any typical wetland rehabilitation activities required during the WfWetlands Programme implementation phase. Note that certain Listed

Activities have been excluded from the Basic Assessment as they fall under the ambit of a 'maintenance management plan' in the form of the Rehabilitation Plan for each project and are therefore subject to exclusion. The impacts thereof have however been considered within the respective Rehabilitation Plans.

- A condition of the EA's is that **Rehabilitation Plans** will be prepared every year after sufficient field work has been undertaken in the wetlands that have an EA. These Rehabilitation Plans will be made available to registered Interested and Affected Parties (I&APs) before being submitted to DEA for approval. The Rehabilitation Plans will describe the combination and number of interventions selected to meet the rehabilitation objectives for each Wetland Project, as well as an indication of the approximate location and approximate dimensions (including footprint) of each intervention.

- The National Water Act, No.36 of 1998 (NWA)
    - In terms of Section 39 of the NWA, a General authorisation[3] (GA) has been granted for certain activities that are listed under the NWA that usually require a Water Use License; as long as these activities are undertaken for wetland rehabilitation. These activities include '*impeding or diverting the flow of water in a watercourse*[4]' and '*altering the bed, banks, course or characteristics of a watercourse*[5]' where they are specifically undertaken for the purposes of rehabilitating[6] a wetland for conservation purposes. The WfWetlands Programme is required to register the 'water use' in terms of the GA.
- The National Heritage Resources Act, No. 25 of 1999 (NHRA)
    - In terms of Section 38 of the NHRA; any person who intends to undertake a development as categorised in the NHRA must at the very earliest stages of initiating the development notify the responsible heritage resources authority, namely the South African Heritage Resources Agency (SAHRA) or the relevant provincial heritage agency. These agencies would in turn indicate whether or not a full Heritage Impact Assessment (HIA) would need to be undertaken. Should a permit be required for the damaging or removal of specific heritage resources, a separate application will be submitted to SAHRA or the relevant provincial heritage agency for the approval of such an activity. WfWetlands has engaged with SAHRA regarding the wetland planning process and has committed to achieving full compliance with the heritage act over the next few years.

[3]Government Notice No. 1198, 18 December 2009
[4]Section 21(c ) of the NWA, No. 36 of 1998
[5]Section 21(i) of the NWA, No. 36 of 1998
[6]Defined in the NWA as "*the process of reinstating natural ecological driving forces within part of the whole of a degraded watercourse to recover former or desired ecosystem structure, function, biotic composition and associated ecosystem services*".

**TABLE OF CONTENTS**

## Appendices



## List of Figures

## List of Tables

## i. CONTEXT OF THE INFORMATION CONTAINED IN THIS REHABILITATION PLAN

### Approach to the NEMA Environmental Process

The legislation protecting the environment in South Africa was not written with the intention of preventing wetland rehabilitation efforts, but rather at curtailing development in sensitive environments. It is important to remember that the Working for Wetlands (WfWetlands) Programme is not a development proposal, and although this programme technically requires authorisations, licenses and permits, such rehabilitation projects were never meant to be sent through legislative processes aimed at preventing negative environmental impact.

In terms of the environmental management principles of the National Environmental Management Act, No. 107 of 1998 (NEMA), as amended, certain activities that may have a detrimental impact on the environment (termed Listed Activities) require Environmental Authorisation (EA) from DEA. The WfWetlands Programme will require that interventions be implemented and/or constructed in the wetland systems to ultimately restore some of the more natural wetland functions that have been lost to unsustainable land use practices or development. The implementation of interventions will trigger Listing Notices 1 and 3 (GN R 983 and GN R 985, as amended, respectively).

In order to meet the requirements of the Regulations pursuant to NEMA, it was necessary to undertake a Basic Assessment Process as outlined in Part 2 and Appendix 1 of GN R 982. Basic Assessment Report (BARs) were prepared and these reports presented all Wetland Projects for each Province, together with information regarding the quaternary catchments and the wetlands that were prioritised for the next few planning cycles (anywhere from one to three planning cycles depending on the information gained through the Catchment Prioritisation Process).

Rehabilitation Plans, associated with the Wetland Projects described in the BARs, have also been prepared and provide detail on the wetland problems, proposed rehabilitation interventions and rehabilitation objectives. These reports are also subject to a 30-day public comment period after which it is submitted to DEA for approval.

## ii. CONTACT DETAILS

| Details of the applicant: Working for Wetlands Programme | |
|---|---|
| **Contact Person:** | Dr Farai Tererai |
| **Street Address:** | Environment House, 473 Steve Biko Road, Arcadia, Pretoria, 0083 |
| **Postal Address:** | Private Bag X447, Pretoria, 0001 |
| **Tel:** | 012 399 8970 |
| **Fax:** | 086 520 7829 |
| **Email:** | Fterarai@environment.gov.za |
| **Details of the ASD: Working for Wetlands Programme** | |
| **Contact Person:** | Ms Mbali Goge |
| **Street Address:** | Department of Environmental Affairs, NRM KZN Region, R103 Midmar, Howick, 3290 |
| **Postal Address:** | PO Box 11022, Dorpspruit, 3206 |
| **Tel:** | 033 330 6197/072 819 4895 |
| **Fax:** | - |
| **Email:** | MGoge@environment.gov.za |
| **Details of the EAP: Aurecon South Africa (Pty) Ltd** | |
| **Contact Person:** | Franci Gresse |
| **Street Address:** | Aurecon Centre, 1 Century City Drive, Waterford Precinct, Century City, Cape Town |
| **Postal Address:** | PO Box 494, Cape Town, 8000 |
| **Tel:** | 021 526 6022 |
| **Fax:** | 021 526 9500 |
| **Email:** | Franci.Gresse@aurecongroup.com |

## iii. ABBREVIATIONS

| | |
|---|---|
| ASD | Assistant Director: Wetlands Programmes[7] |
| BAR | Basic Assessment Report |
| BGIS | Biodiversity Geographical Information System |
| BMP | Best Management Practice |
| CARA | Conservation of Agricultural Resources Act |
| CPP | Catchment Prioritisation Process |
| CSIR | Council for Scientific and Industrial Research |
| DAFF | Department of Agriculture, Forestry and Fisheries |
| DEA | Department of Environmental Affairs |
| DWS | Department of Water and Sanitation |
| EA | Environmental Authorisation in terms of the NEMA |
| EAP | Environmental Assessment Practitioner |
| EIA | Environmental Impact Assessment |
| EMPr | Environmental Management Programme |
| EPWP | Expanded Public Works Programme |
| GA | General authorisation in terms of the NWA |
| GIS | Geographical Information System |
| GPS | Global Positioning System |
| HGM | Hydrogeomorphic [unit] |
| HIA | Heritage Impact Assessment |
| IA | Implementing Agent |
| I&APs | Interested and Affected Parties |
| IDP | Integrated Development Plans |
| KZN | KwaZulu-Natal |
| M&E | Monitoring and Evaluation |
| MAP | Mean Annual Precipitation |
| MoU | Memorandum of Understanding |
| NEMA | National Environmental Management Act (Act 107 of 1998) |
| NFEPA | National Freshwater Ecosystem Priority Area |
| NHRA | National Heritage Resources Act |
| NRM | Natural Resource Management Programmes |
| NWA | National Water Act (Act 36 of 1998) |
| NWI | National Wetlands Inventory |
| PET | Potential Evapotranspiration |
| PIP | Project Implementation Plan |
| PPP | Public Participation Process |
| RSA | Republic of South Africa |
| SANParks | South African National Parks |
| SAHRA | South African Heritage Resources Agency |
| SMME | Small, Medium and Micro Enterprises |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| WfWetlands | Working for Wetlands |

[7] Previously referred to as the Provincial Coordinator (PC).

## iv. GLOSSARY OF TERMS

**Bedrock:** The solid rock that underlies unconsolidated material, such as soil, sand, clay, or gravel (Cowden and Kotze, 2008).

**Basic Assessment Report (BAR):** A report as required in terms of the 2014 EIA Regulations, of the National Environmental Management Act, No. 107 of 1998 (NEMA), that describes the proposed activities and their potential impacts.

**Best Management Practice (BMP):** Procedures and guidelines to ensure the effective and appropriate implementation of wetland rehabilitation by WfWetlands implementers. Such practices are informed by applied research.

**Biophysical:** The biological and physical components of the environment (Cowden and Kotze, 2008).

**Catchment:** All the land area from mountaintop to seashore which is drained by a single river and its tributaries. Each catchment in South Africa has been subdivided into secondary catchments, which in turn have been divided into tertiary catchments. Finally, all tertiary catchments have been divided into interconnected quaternary catchments. A total of 1946 quaternary catchments have been identified for South Africa. These subdivided catchments provide the main basis on which catchments are subdivided for integrated catchment planning and management (Cowden and Kotze, 2008).

**Environmental Assessment Practitioner (EAP):** The individual responsible for the planning, management and coordination of the environmental impact assessments, strategic environmental assessments, environmental management plans and/or other appropriate environmental instruments introduced through regulations of NEMA.

**Ecosystem Services or 'eco services':** The services such as sediment trapping or water supply, supplied by an ecosystem (in this case a wetland ecosystem).

**Environmental Impact Assessment (EIA):** A study of the environmental consequences of a proposed course of action via the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application.

**Environmental Management Programme (EMPr):** A detailed plan of action to organise and co-ordinate environmental mitigation, rehabilitation and monitoring during the implementation and maintenance of interventions identified under the WfWetlands Programme such that positive impacts are enhanced and negative impacts are avoided/minimised.

**Interested and Affected Parties (I&APs):** People and organizations that have interest(s) in the proposed activities, also referred to as stakeholders.

**Environmental Impact:** An environmental change caused by some human act.

**Implementer:** The person or organisation responsible for the construction of WfWetlands rehabilitation interventions.

**Intervention:** A method of wetland rehabilitation that aims to address the objectives of the particular wetland system, namely to restore the hydrological integrity of the system and support associated biodiversity. It can be in the form of a hard (structures made of hard materials which are fixed (e.g. a concrete weir) or soft intervention (e.g. re-vegetation), and are often used to support one another.

**Mitigation:** Actions to reduce the impact of a particular activity.

**Maintenance:** The replacement, repair or the reconstruction of an existing structure within the same footprint, in the same location, having the same capacity and performing the same function as the previous structure ('like for like').

**Public Participation Process (PPP):** A process of involving the public in order to identify issues and concerns, and obtain feedback on options and impacts associated with a proposed project, programme or development. Public Participation Process in terms of NEMA refers to: a process in which potential interested and affected parties are given an opportunity to comment on, or raise issues relevant to specific project matters.

**Project:** An area of WfWetlands intervention generally defined by a quaternary catchment or similar management unit such as a national park in which a single implementer operates.

**Quaternary Catchment: "**A fourth order catchment in a hierarchal classification system in which a primary catchment is the major unit" and that is also the "principal water management unit in South Africa" (DWS, 2011).

**Rehabilitation:** In the context of wetlands, refers to re-instating the driving ecological forces (including hydrological, geomorphological and biological processes) that underlie a wetland, so as to improve the wetland's health and the ecological services that it delivers.

**Significant impact:** An impact that by its magnitude, duration, intensity or probability of occurrence may have a notable effect on one or more aspects of the environment.

**Wetland:** "Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soils." (National Water Act, 36 of 1998) **and** "Land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants living there" (Cowden and Kotze, 2008).

## v. ASSUMPTIONS AND LIMITATIONS

In compiling this report, the following has been assumed:

- The information provided in this report is based on site visits that have been undertaken by the project team (Environmental Assessment Practitioner (EAP), Engineer, Wetland Specialist, the Assistant Directors for Wetlands Programmes (ASD)) and their subsequent input into the Reporting, which includes intervention design drawings, the wetland status quo report, in addition to input from the ASD. It is understood that this information is sufficient for the authorisation processes and associated Phase 3 (Implementation phase). This data and relevant information has informed the findings and conclusions of this report.
- Information contained in this Report will be used during Phase 3 to guide and inform the Implementing Agents on design and construction specifications as part of Phase 3. Implementing Agents will thus use this Rehabilitation Plan and the information contained herein when constructing all interventions, the designs of which have been included in this Report.
- The ASDs will be undertaking the landowner engagement and have obtained the requisite landowner consent forms required as part of Phase 1 and 2 of this project.
- The WfWetlands Programme has provided all relevant information and documentation required to compile this Rehabilitation Plan.
- Rehabilitation activities should not be carried out until the Wetland Rehabilitation Plan has been approved by DEA and formally signed off by WfWetlands.
- The implementation of this Rehabilitation Plan must take into account all relevant provisions of Working for Wetlands Best Management Practices (BMPs), the generic Environmental Management Programme (EMPr), as well as specific recommendations of the Basic Assessments and the requirements of the Environmental Authorisation (EA) for the all stages of the project.
- The requirement to spend at least 42% on wages out of the project budget has been taken into consideration by the project team during the planning process for wetland rehabilitation.
- Where appropriate interventions have not been implemented previously or included in the 2009/10, 2010/11, 2011/12, 2012/2013, 2013/14, 2014/15, 2015/16, 2016/17 or 2017/18 Project Implementation Plans (PIPs), these have been reviewed and where necessary re-designed for inclusion into the 2017/18 Rehabilitation Plan. This wetland Rehabilitation Plan therefore supersedes all previous plans for this project and only interventions from this plan should be included in the 2019/20 PIP.
- Should it be necessary to exclude interventions from the Rehabilitation Plan, the prioritisation of interventions across the project should strictly be followed.

## vi. GAPS IN KNOWLEDGE

- The information in this Report is based on existing available information and input from the ASD, the specialist wetland specialists, the Engineer, the EAP as well as comments from Interested and Affected Parties (I&APs). Until this Report has been finalised and signed off by WfWetlands, the content of the Report should be considered as preliminary.
- Designs for the rehabilitation interventions have been developed for site conditions as at the time of the planning site visits. Should site conditions change before the designs are implemented, changes to the design and the positions thereof may be necessary. In this case, project implementers may require the assistance of a professional engineer.
- The cost of construction at each project location will vary due to factors such as the local cost and availability of material, transport distances etc. The unit costs have been agreed with the ASDs based on their knowledge of past projects and therefore include an allowance for escalation.
- The labour-intensive targets identified in this project are based on assumed productivity rates for various components of the construction process. This will vary in practise and will require regular monitoring to ensure that labour targets are attained.

Aurecon South Africa (Pty) Ltd (Aurecon) acknowledges the authorship of any information contained in this document from previous planning years, to the previous provider: Land Resources International (LRI).

This Report must be read in conjunction with the 2018/2019 KwaZulu-Natal Basic Assessment Report, and the iSimangaliso Wetland Status Quo Report (2019) (**Appendix A** of this report).

## vii. DISCLAIMER

- This Rehabilitation Plan is for the iSimangaliso Wetland Project in the KwaZulu-Natal Province. The plan is to be used to implement the interventions identified as necessary to rehabilitate the Midlands wetlands and is to be approved by the DEA as part of the environmental authorisation process required in terms of Government Notice Regulation 982 of 4 December 2014, as amended (GN R982).
- The intervention points and wetland boundary polygons provided in this report are based on the shapefiles that have been provided by the wetland specialist. The datasets included in the Phase 1 Reports have been updated by the Wetland Specialists and verified by the ASDs. All reasonable efforts have therefore been made to ensure that the data is accurate. However, Aurecon does not accept responsibility for any remaining inaccuracies in the spatial data provided to us, which may be reflected in this report.
- Aurecon accepts responsibility for the engineering design to the extent that this is based on available information. The available information is limited to what could be interpreted during a single site visit of no longer than a few hours. No geotechnical, topographical, geomorphologic and other engineering related surveys have been undertaken to inform the design. This is non-standard engineering practice and therefore Aurecon is indemnified by the Client and does not accept responsibility for the associated risk of failure from the above limitations or any damages that may occur.
- This Rehabilitation Plan must not be amended without prior consultation and approval from DEA, the responsible EAP, Engineer, ASD and the WfWetlands Deputy Director for Planning, Monitoring and Evaluation.
- All changes to site instructions and/or construction drawings after the commencement of interventions must be motivated using the standard change request form supplemented with additional information as necessary.
- Aurecon is indemnified against any associated damages and accepts no liability associated with the construction and implementation of engineering interventions due to Aurecon being instructed to have limited contact with the implementer during the construction phase resulting in our inability to diligently supervise and assess any progress.
- The Client confirms that by accepting these drawings or reports, he acknowledges and accepts the abovementioned limitation of Aurecon's liability.

## viii. DISTRIBUTION LIST

| NAME | TITLE | FOR ACTION | FOR INFORMATION | RECEIVED PRIOR TO RELEASE |
|---|---|---|---|---|
| **PROPONENT** | | | | |
| Dr Farai Tererai | Deputy Director: Planning, Monitoring and Evaluation | ✓ | | ✓ |
| Dr Piet Louis Grundling | Deputy Director: Project Implementation | ✓ | | ✓ |
| Ms Mbali Goge | Assistant Director: Wetlands Programmes | ✓ | | ✓ |
| **INTERESTED AND AFFECTED PARTIES** | | | | |
| Refer to **Appendix G** | | | ✓(E-copy of Rehab Plan) | |
| **LANDOWNERS** | | | | |
| Refer to **Appendix E** | | | ✓(E-copy of Rehab Plan) | |

*This page was left blank intentionally*

# 1 INTRODUCTION

## 1.1 Document Outline

This document comprises the Rehabilitation Plan for the iSimangaliso Wetland Project identified as part of the Working for Wetlands Programme (WfWetlands). The Rehabilitation Plan is the primary working document for the implementation (construction/undertaking) of planned interventions in 2019/20, which are necessary to meet the wetland rehabilitation objectives that have been determined in earlier phases of the WfWetlands Programme. The iSimangaliso Rehabilitation Plan includes the following wetland systems:

- iSimangaliso Western Shores

The outline of this document is as follows:

- **Chapter 1:** This introductory section provides an outline of the document structure as well as contextualising the document within the legal environmental authorisation processes.
- **Chapter 2**: This section on project context provides a brief summary of the WfWetlands Programme, including the typical rehabilitation methods and intervention options used to date. This section also provides more detail on the iSimangaliso Wetland Project, including the selection of wetlands and their priority rating in the Province.
- **Chapter 3:** This section discusses the general methodologies for selecting and prioritising wetlands, through to designing interventions and developing the Rehabilitation Plan.
- **Chapter 4:** This section focuses on a wetland system within the iSimangaliso Wetland Project and includes a description of the respective wetland, motivation for the wetland selection, summary of the problems identified within the wetland, and outlines some of the main rehabilitation objectives for the wetland. A table of proposed interventions is provided together with any specific Environmental Management Plan issues to be considered when implementing the interventions. Finally, the section includes the baseline data needed to undertake future monitoring of the interventions.

Reports on the current status of each wetland are included as **Appendix A** of this report and should be consulted for the detailed findings of the site investigations. The General Construction Notes are included as **Appendix B** of this report and describe construction methods for various interventions. The specific Interventions and Design Drawings (as well as site specific mitigation measures) are included as **Appendix C** of this report in the form of an Intervention Booklet. The Environmental Authorisation (EA), to be included as **Appendix D**, and the Landowner Agreements, included as **Appendix E**, are to be in place prior to the implementation of any of the interventions taking place. **Appendix F** of this report represents the generic Environmental Management Programme. **Appendix G** provides the stakeholder databases, and **Appendix H** provides the curriculum vitae of the environmental assessment practitioners (EAPs) who compiled this report.

## 1.2 Environmental Authorisation

The iSimangaliso Wetland Project for this planning cycle is the subject of a Basic Assessment Process in terms of the Environmental Impact Assessment (EIA) Regulations (GN R982 of 4 December 2014, as amended) of the National Environmental Management Act (Act 107 of 1998) (NEMA) which culminated in the compilation of a Basic Assessment Report (BAR). It is intended that this Rehabilitation Plan is read in conjunction with the 2018/2019 KwaZulu-Natal Basic Assessment Report and requires that the Rehabilitation Plan be circulated to Registered Interested and Affected Parties (I&APs) and directly affected landowners for comment before being submitted to the DEA for approval. The public participation process for the Rehabilitation Plan and the BAR was combined and allowed registered I&APs a 30-day period to review and provide comment on the documents. The work detailed for the project will be implemented within a year of obtaining the necessary approvals for the Rehabilitation Plan, and on-going monitoring of the interventions will be undertaken from thereafter.

# 2 PROJECT CONTEXT

## 2.1 Working for Wetlands programme overview

The WfWetlands Programme is a government programme (similar to Working for Water, Working on Fire and Working for Ecosystems) managed under the Natural Resource Management (NRM) Programmes of the Department of Environmental Affairs (DEA) and is a joint initiative with the Departments of Water and Sanitation (DWS), and Agriculture and Forestry and Fisheries (DAFF). It forms part of the Expanded Public Works Programme (EPWP).

The vision of the WfWetlands Programme is to facilitate the protection, conservation, rehabilitation and sustainable use of wetlands in South Africa, in accordance with national policies and commitment to international conventions and regional relationships. The main objective of the programme is **wetland conservation** in South Africa, and this is conducted in a way that ensures **poverty reduction** through employment and skills development amongst vulnerable and marginalised groups.

As an EPWP, the WfWetlands Programme seeks to draw significant numbers of unemployed into the productive sector of the economy. These individuals gain skills while they work thus increasing their capacity to earn an income. Rehabilitation efforts are thus focused on wetland conservation and the appropriate use of wetlands in a way that attempts to maximise employment creation, support for small business and the transfer of skills to the unemployed and poor.

In the 15 years since 2004, the WfWetlands Programme has invested over R1.1 billion in wetland rehabilitation and has been involved in approximately 1 500 wetlands, thereby improving or securing the health of over 70 000 hectares of wetland environment. The WfWetlands Programme has created more than 34 000 jobs and over 3.2 million person-days of paid work. Local people are recruited to work and targets for employment specify that the programme’s workforce should comprise at least 55% women, 65% youth and 2% people with disabilities.

### 2.1.1 *Programme, Projects and Phases*

In order to manage the WfWetlands Programme, wetlands that have been prioritised and identified for rehabilitation have been grouped into “Wetland Projects” within each Province. Each Wetland Project encompasses several wetland systems which are each divided into smaller, more manageable and homogenous wetland units. As a result, a Wetland Project may be located within one or more quaternary catchments within a Province.

Each Project is managed in three phases over a two-year cycle. The first two phases (Phase 1 and Phase 2) straddle the first year of the cycle and involve planning, identification, design and authorisation of interventions. The third phase (Phase 3) is implementation of specific interventions to achieve rehabilitation, and this takes place during the second year. The WfWetlands Programme is currently managing 48 Wetland Projects countrywide, and approximately 800 interventions within these Wetland Projects will be implemented to meet the objectives of the Programme.

#### 2.1.2 *Methods of Rehabilitation*

The successful rehabilitation of a wetland requires that the cause of damage or degradation is addressed, and that the natural flow patterns of the wetland system are re-established (flow is encouraged to disperse rather than to concentrate). The main aims of the WfWetlands Programme are:

- Restoration of hydrological integrity (e.g. raising the general water table or redistributing the water across the wetland area); and
- Recreation of wetland habitat towards the conservation of biodiversity.

Rehabilitation activities range from stabilising degradation to the more ambitious restoration of wetlands to their original conditions. Typical activities within the Wetland Projects include:

- Plugging artificial drainage channels created by development or historical agricultural practices to drain wetland areas for other land use purposes;
- Removing historical farming/forestry roads and infrastructure;
- Constructing structures (gabions, berms, and weirs) to divert or redistribute water to more natural flow paths, or to prevent erosion by unnatural flow rates that have resulted from unsustainable land use practices or development; and
- Removing invasive alien or undesirable plant species from wetlands and their immediate catchments as part of the Working for Water Programme.

#### 2.1.3 *Intervention Options*

Methods of wetland rehabilitation may include hard engineering interventions such as:

- Earth berms in conjunction with gabion systems to block artificial channels that drain water from or divert polluted water to the wetland;
- Concrete weirs to act as settling ponds, to reduce flow velocity or to re-disperse water across former wetland areas thereby re-establishing natural flow paths;
- Concrete, earth or gabion structure plugs to raise channel floors and reduce water velocity;
- Concrete or gabion structures to stabilise head-cut or other erosion and prevent gullies; and
- Gabion structures (mattresses, blankets or baskets) to provide a platform for the growth of desired wetland vegetation.

Soft engineering interventions also offer successful rehabilitation methods, and the following are often used together with the hard engineering interventions:

- The revegetation of stabilised areas with appropriate wetland and riparian plant species;
- Fencing off of sensitive areas within the wetland to keep grazers out and to allow for vegetation to become re-established;
- The use of biodegradable or natural soil retention systems such as eco-logs, plant plugs, grass or hay bales, and brush-packing techniques; and
- The removal of undesirable plant and animal species as part of the Working for Water initiative. Alien invasive plant clearing is an important part of wetland rehabilitation.

For more information on the WfWetlands Programme, please refer to the WfWetlands Context Document included in the front of this report.

### 2.2 Project Team

The project team currently comprises a Director and three Deputy Directors who oversee the WfWetlands Programme and Assistant Directors for Wetlands Programmes (ASDs) who oversee the identification and implementation of projects in their regions. They are supported by a small team who fulfil various roles such administration, Geographical Information Systems (GIS) and training.

Aurecon South Africa (Pty) Ltd (Aurecon) has been appointed to undertake the project activities and associated reporting required by the WfWetlands Programme. The Aurecon team comprises Design Engineers and Environmental Assessment Practitioners (EAPs) who undertake the planning, design and authorisation components of the project. The Aurecon Team, in partnership with GroundTruth, is assisted by an external team of Wetland Specialists who provide scientific insight into the operation of wetlands and bring expert and often local knowledge of the wetlands. The project team is also complimented by the WfWetlands ASDs who are each responsible for provincial planning and implementation. The team responsible for the field work specific to this Rehabilitation Plan is listed in **Section 3.3.1.**

## 2.3 KwaZulu-Natal Wetland Projects

Wetland Projects for the 2018/2019 planning cycle were identified during the Phase 1 activities associated with the WfWetlands Programme. Catchment and wetland prioritisation assessments were undertaken by the Wetland Specialist/s to identify priority catchments and associated wetlands within which rehabilitation work needed to be undertaken. A review was undertaken to determine local knowledge and identify existing studies of the quaternary catchments in the province. The Programme's current five year strategic plans were further used as a guide to identify wetlands, as well as data from the National Freshwater Ecosystem Priority Areas (NFEPA) project. Decisions on priority areas were informed by input from wetland forums, biodiversity / conservation plans, municipalities, state departments and various other stakeholders.

Based on this process, quaternary catchments and associated wetland systems were identified for the 2018/2019 planning cycle in the KwaZulu-Natal Province (**Table 1**), which were the subject of a Basic Assessment Process as explained in **Section 1.2** above.

**Table 1: KwaZulu-Natal Wetland Projects**

| Project Name | Wetland System |
|---|---|
| iSimangaliso Wetland Park | iSimangaliso Western Shores |

An EIA application (to undertake a Basic Assessment Process) will be lodged with the National DEA in June 2019 for the undertaking of listed activities in terms of NEMA. The authorisation process is currently underway and will permit the WfWetlands Programme to undertake wetland rehabilitation in the above-mentioned wetland systems within the KwaZulu-Natal Province should a positive EA be issued. This EA will be included in **Appendix D** of this report as soon as it is available. No wetland rehabilitation work that constitutes a Listed Activity in terms of Regulations pursuant to NEMA may be undertaken until such time as this Rehabilitation Plan has been approved by the DEA, and the approval is included in **Appendix D**.

### *2.3.1 The iSimangaliso Wetland Project*

The iSimangaliso Wetland Park Project falls within a protected area in quaternary catchment W32H in the Mkuze River Floodplain, Maputaland, on the east coast of KwaZulu-Natal. The iSimangaliso Wetland Park was classified as a UNESCO World Heritage site in 1999 and hosts Africa's largest estuarine system and eight interlinking ecosystems. It is the third largest protected area in South Africa (Heritage tours, 2018). The park encompasses a variety of wetlands including approximately 25% of South Africa's peatlands and four Ramsar wetland sites.

The catchments associated with most wetlands located within the iSimangaliso Wetland Park are difficult to define for a number of reasons. Possibly the most important reason is the fact that these wetlands are part of the Maputaland coastal plain wetland complex which extends from south of St Lucia to as far north as Kosi Bay area (Watkeys et al. 1993). These wetlands are characterised by complex groundwater interactions as they lie at low elevations and very close to sea level. According to Macfarlane et al. (2007), the Maputaland coastal plain is characterised by highly complex surface-groundwater interactions which confounds the delineation and definition of wetland catchments in these areas as wetlands are fed both by their topographically defined catchments as well as by a much larger catchment feeding the regional water table. The hydraulic contribution from these two sources is likely to vary from wetland to wetland and as such this complicates the definition of catchment extent and catchment associated impacts. To avoid repetition, the descriptions of each wetland catchment will be limited to their topographically defined catchment. The Quaternary catchment W32H falls within the Usutu to Mhlathuze Water Management Area.

The WfWetlands Programme has focussed efforts on iSimangaliso for a number of years, with historical work occurring in Maputaland quaternary catchments W31L and W32B. More recently rehabilitation efforts have been focused in quaternary catchment W32H. During the 2013/2014 planning cycle, rehabilitation was implemented on both the Eastern (W32H-01) and Western (W32H-02) shores of the iSimangaliso Wetland Park. The problems identified then were largely caused by former forestry roads impacting on natural drainage and flow, abandoned borrow pits that are unsightly in the context of a protected area, and alien invasive species that jeopardize conservation efforts.

This planning cycle offers more work on the Western Shores within the same quaternary catchment (W32H). The iSimangaliso Wetland Park Management have identified more rehabilitation work for this planning cycle that would address much of the same problems, typically old forestry roads that are affecting flow regimes, old borrow pits that require rehabilitation, and infestations of alien invasive plant species. Based on recommendations made by the iSimangaliso Wetland Park Land Care Management Department and on the findings and prioritisation during the desktop analysis, eleven (11) wetlands that cover approximately 3300ha were selected for rehabilitation in this planning cycle (as illustrated in Figure 1 and listed in Table 2).

**Table 2: Location of the identified wetlands within the iSimangaliso Wetland Project**

| Wetland Number | Wetland Name | Latitude | Longitude |
|---|---|---|---|
| W32H-03 | ISimangaliso Western Shores 3 | 28° 18' 24.86"S | 32° 23' 47.12"E |
| W32H-04 | ISimangaliso Western Shores 4 | 28° 20' 17.71"S | 32° 22' 57.42"E |
| W32H-05 | ISimangaliso Western Shores 5 | 28° 19' 40.48"S | 32° 21' 55.70"E |
| W32H-06 | ISimangaliso Western Shores 6 | 28° 20' 4.766"S | 32° 22' 13.11"E |
| W32H-07 | ISimangaliso Western Shores 7 | 28° 20' 9.63"S | 32° 22' 31.19"E |
| W32H-08 | ISimangaliso Western Shores 8 | 28° 20' 42.05"S | 32° 22' 32.85"E |
| W32H-09 | ISimangaliso Western Shores 9 | 28° 21' 46.39"S | 32° 23' 1.031"E |
| W32H-10 | ISimangaliso Western Shores 10 | 28° 19' 6.915"S | 32° 25' 59.57"E |
| W32H-11 | ISimangaliso Western Shores 11 | 28° 19' 15.82"S | 32° 25' 46.1"E |
| W32H-12 | ISimangaliso Western Shores 12 | 28° 18' 13.04"S | 32° 26' 24.07"E |
| W32H-13 | ISimangaliso Western Shores 13 | 28° 19' 31.94"S | 32° 25' 25.09"E |

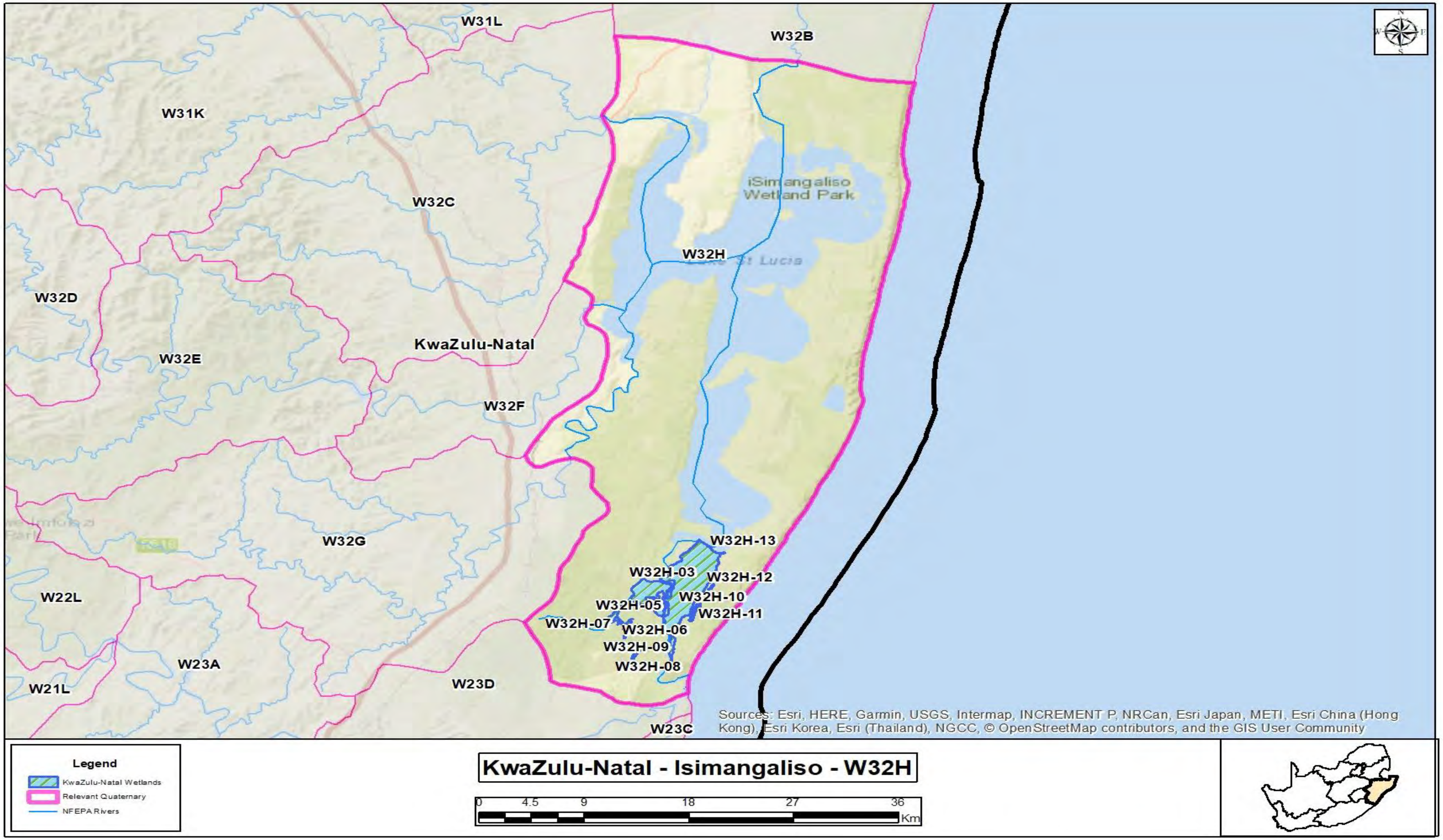



**Figure 1: Topographic map showing the location, cadastral boundaries and access routes of quaternary catchment W32H**

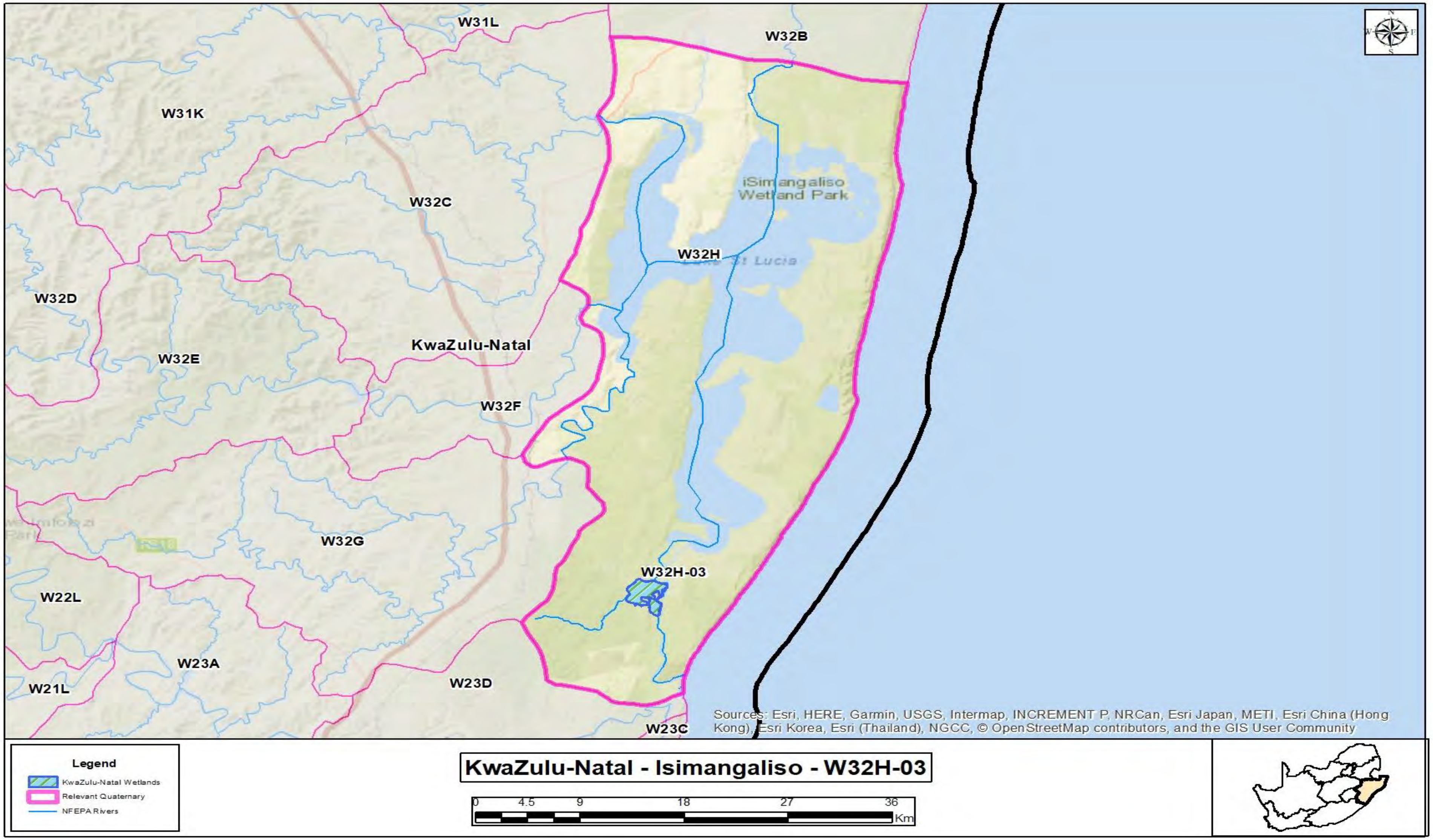



**Figure 2: Topographic map showing the location of iSimangaliso W32H-03**

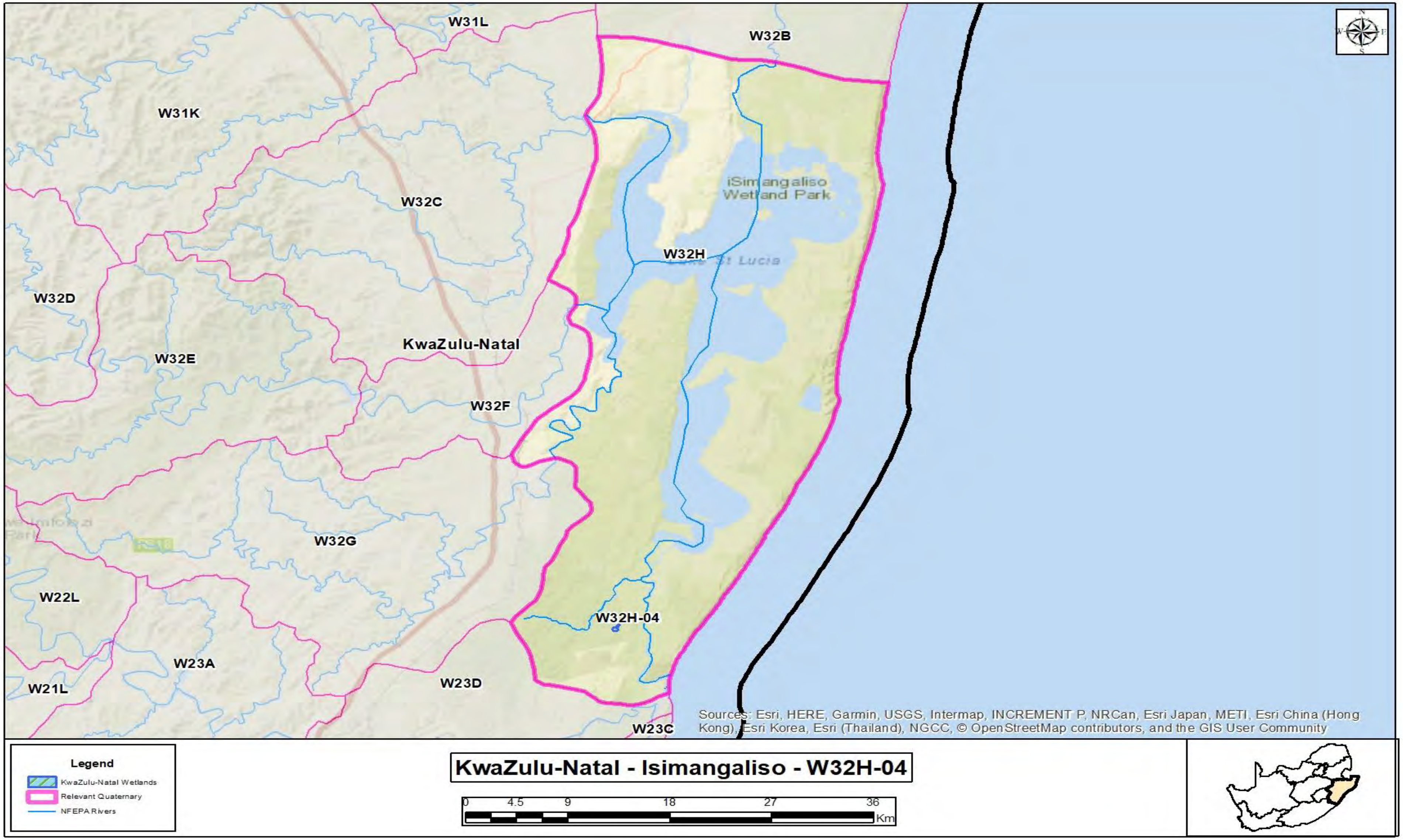



**Figure 3: Topographic map showing the location of iSimangaliso W32H-04**

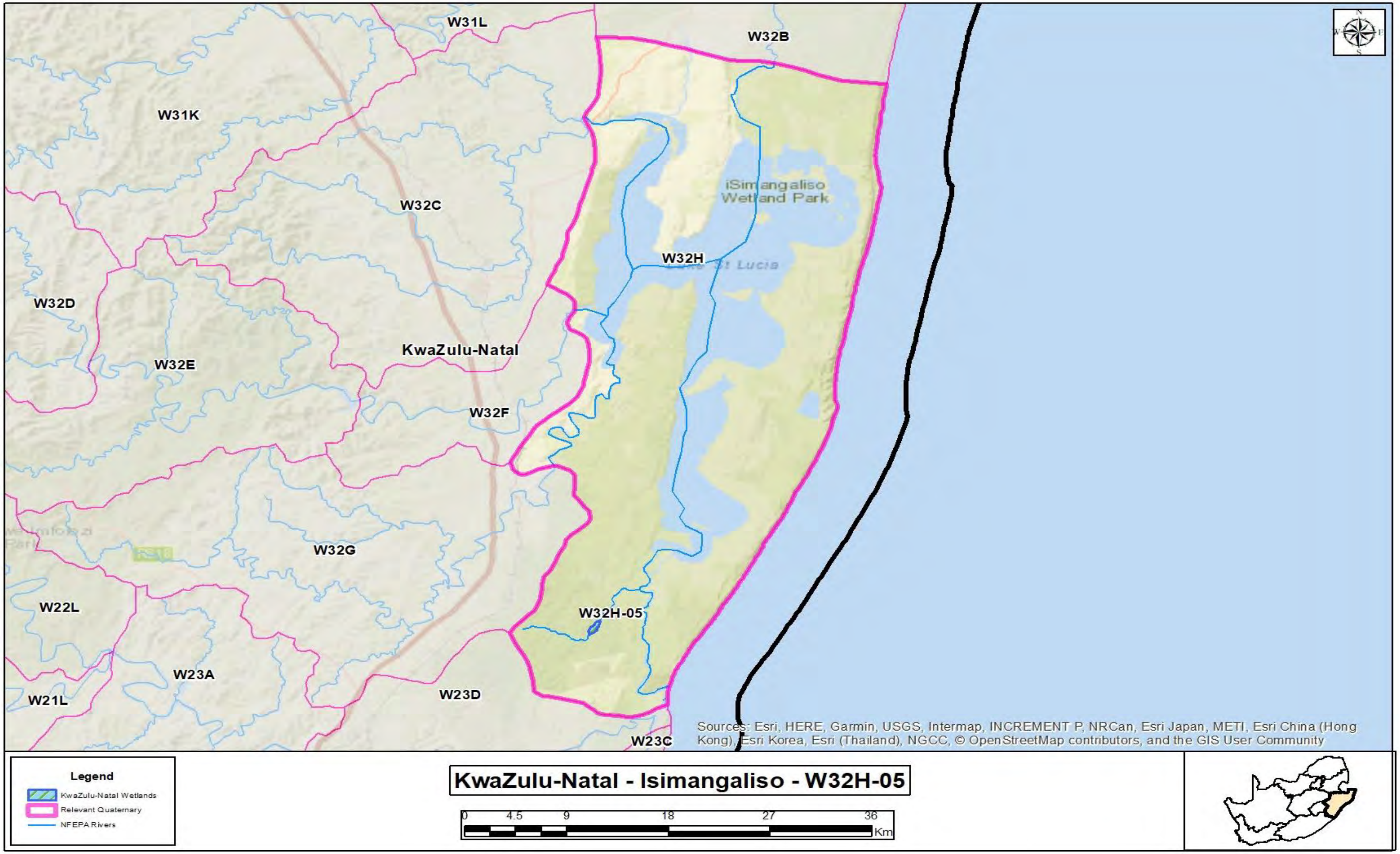



**Figure 4: Topographic map showing the location of iSimangaliso W32H-05**

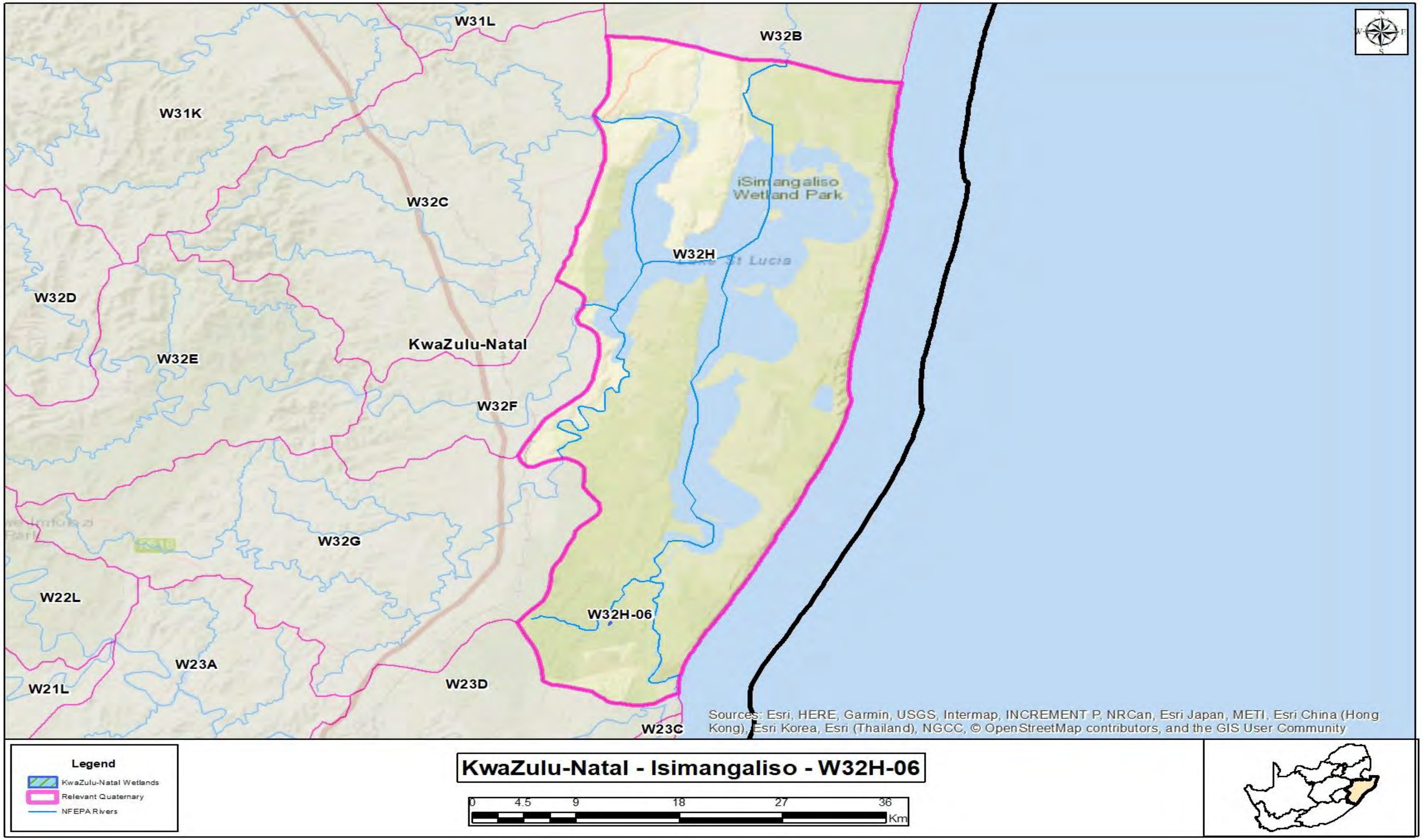



**Figure 5: Topographic map showing the location of iSimangaliso W32H-06**

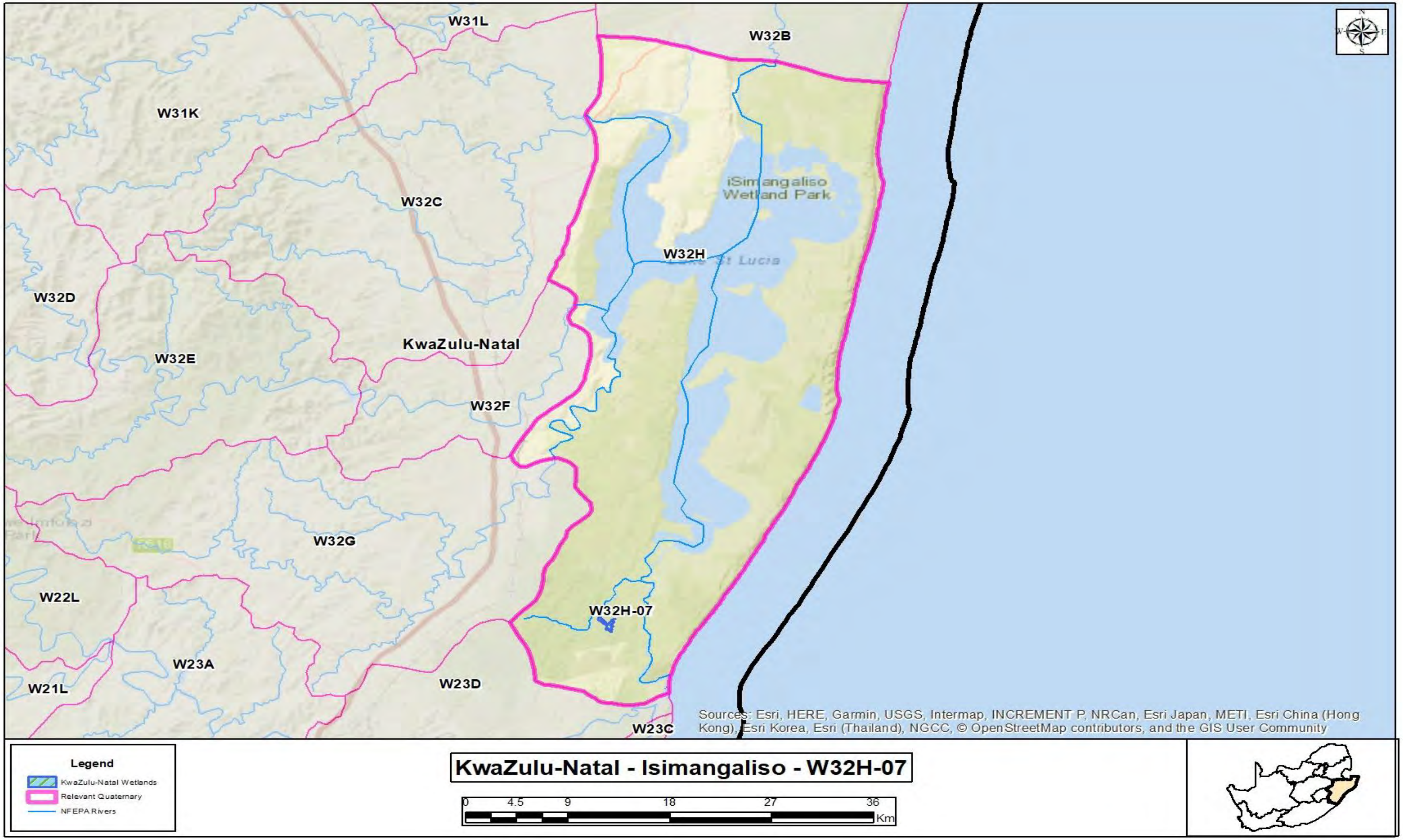



**Figure 6: Topographic map showing the location of iSimangaliso W32H-07**

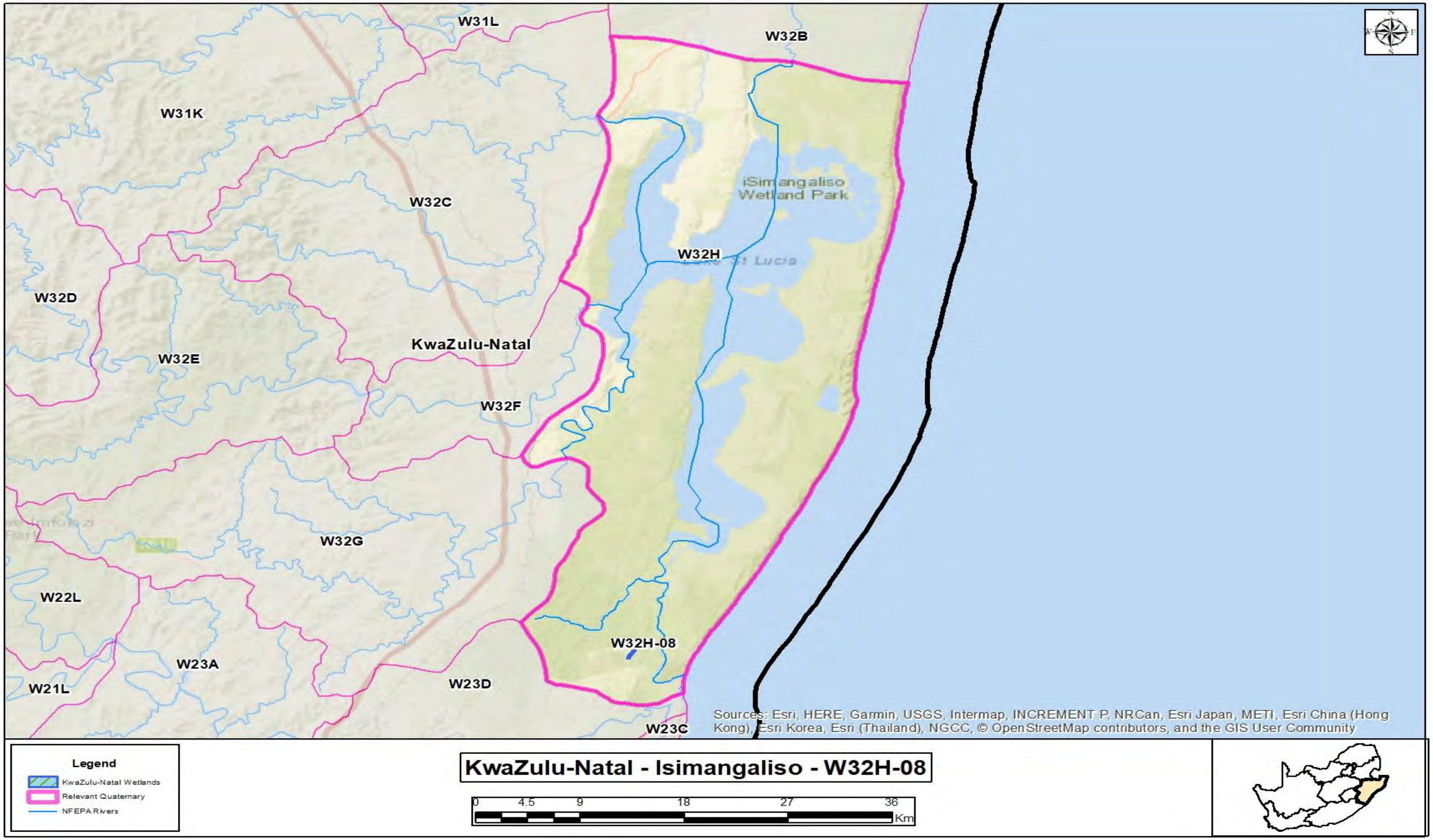



**Figure 7: Topographic map showing the location of iSimangaliso W32H-08**

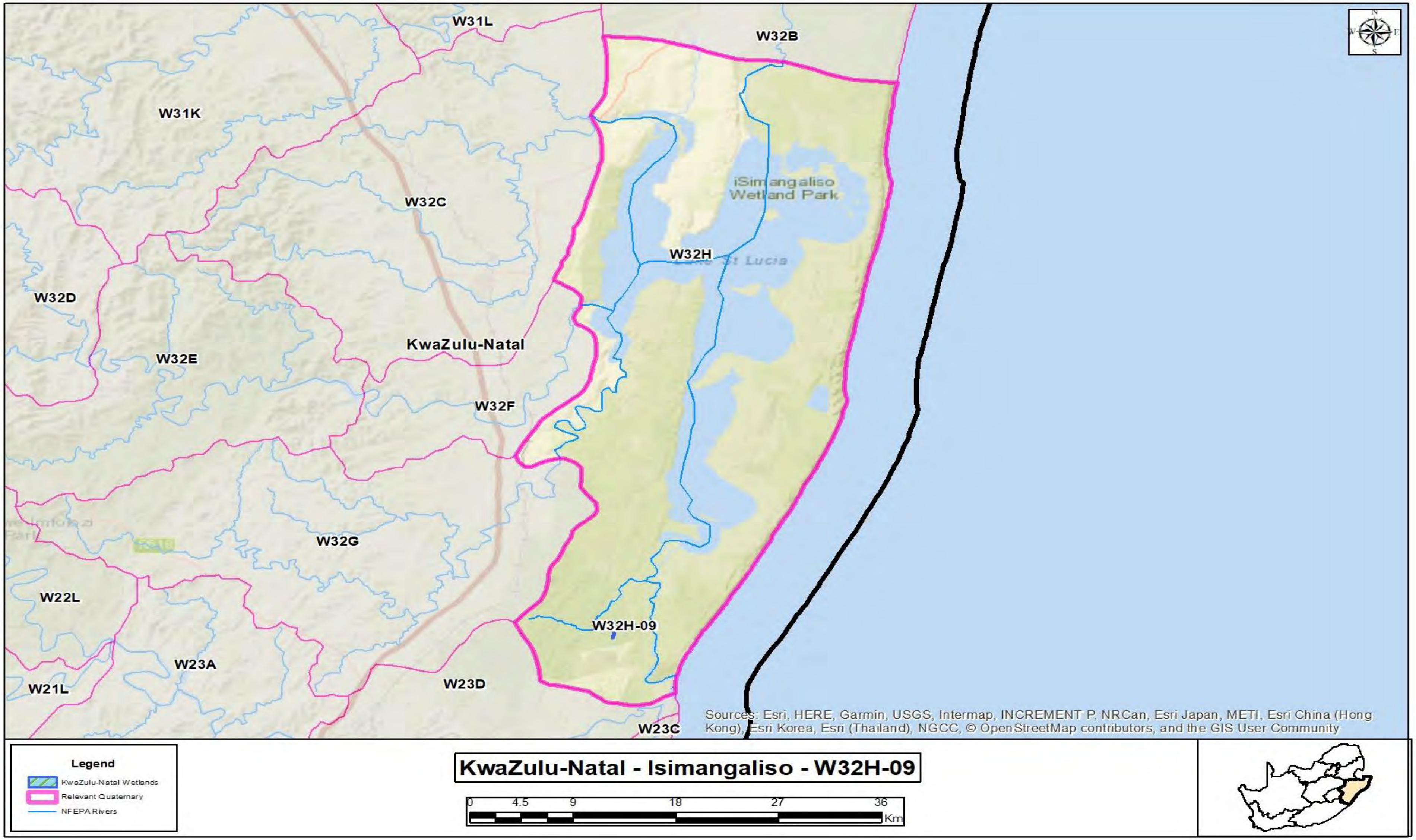



**Figure 8: Topographic map showing the location of iSimangaliso W32H-09**

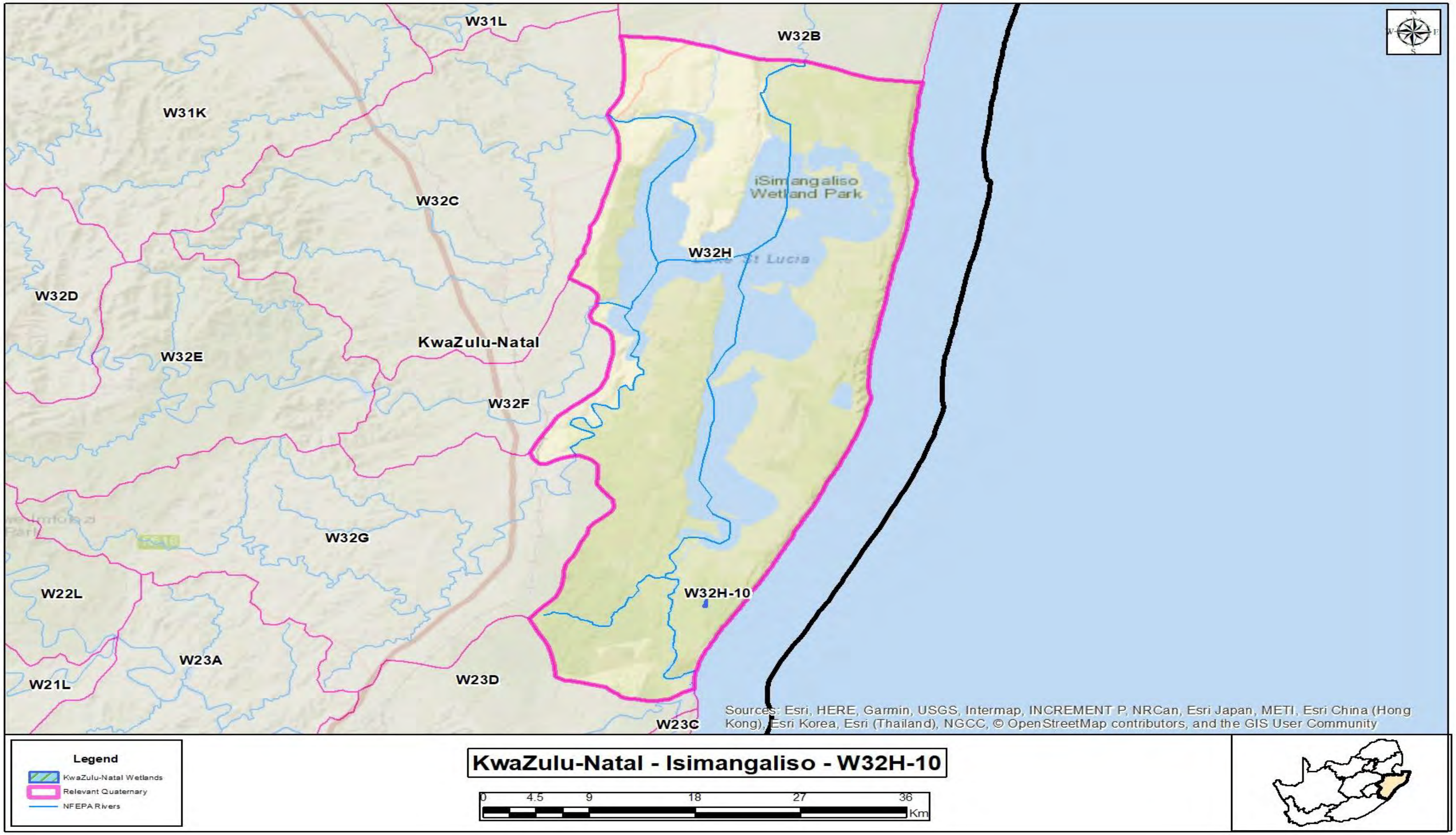



**Figure 9: Topographic map showing the location of iSimangaliso W32H-10**

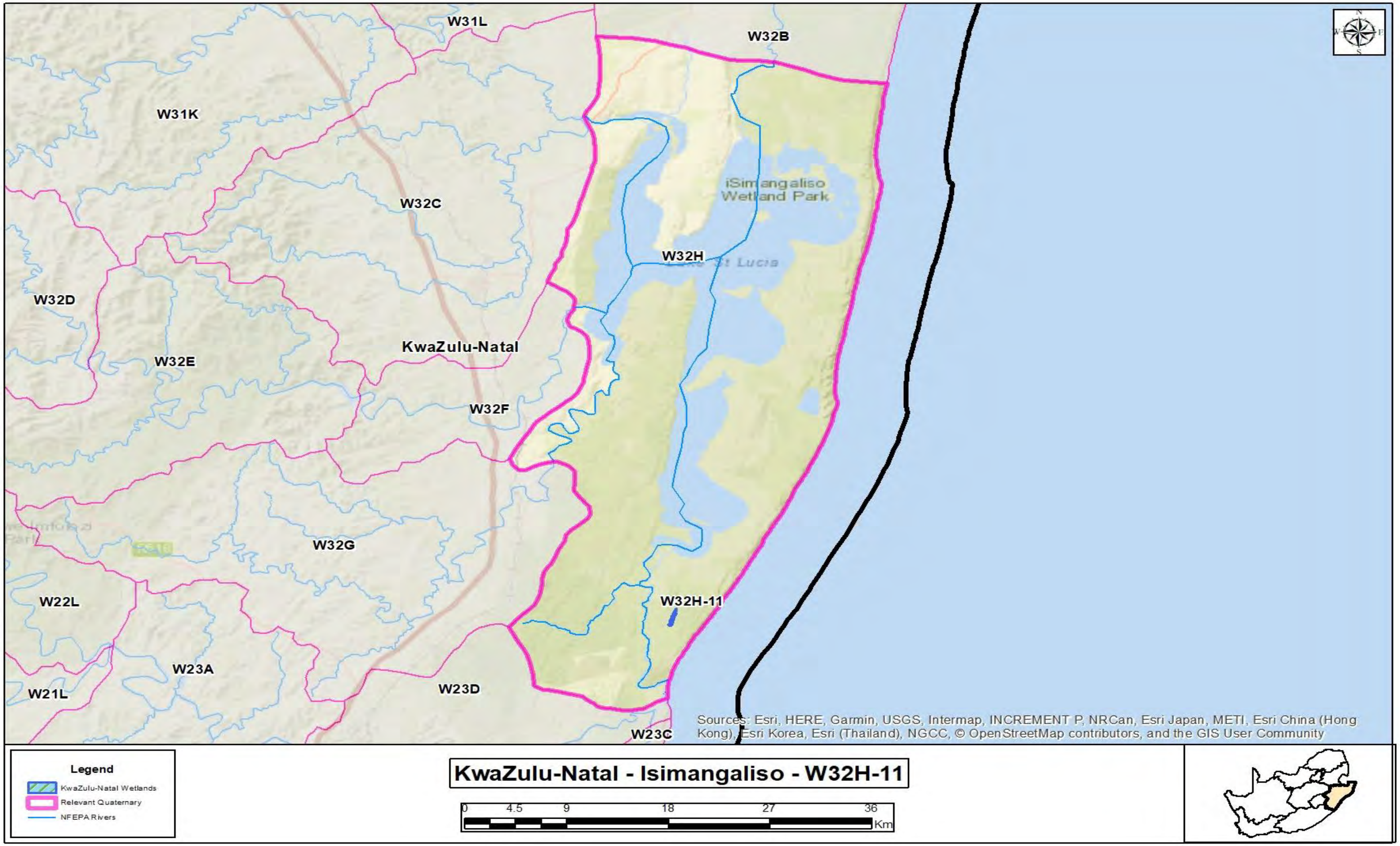



**Figure 10: Topographic map showing the location of iSimangaliso W32H-11**

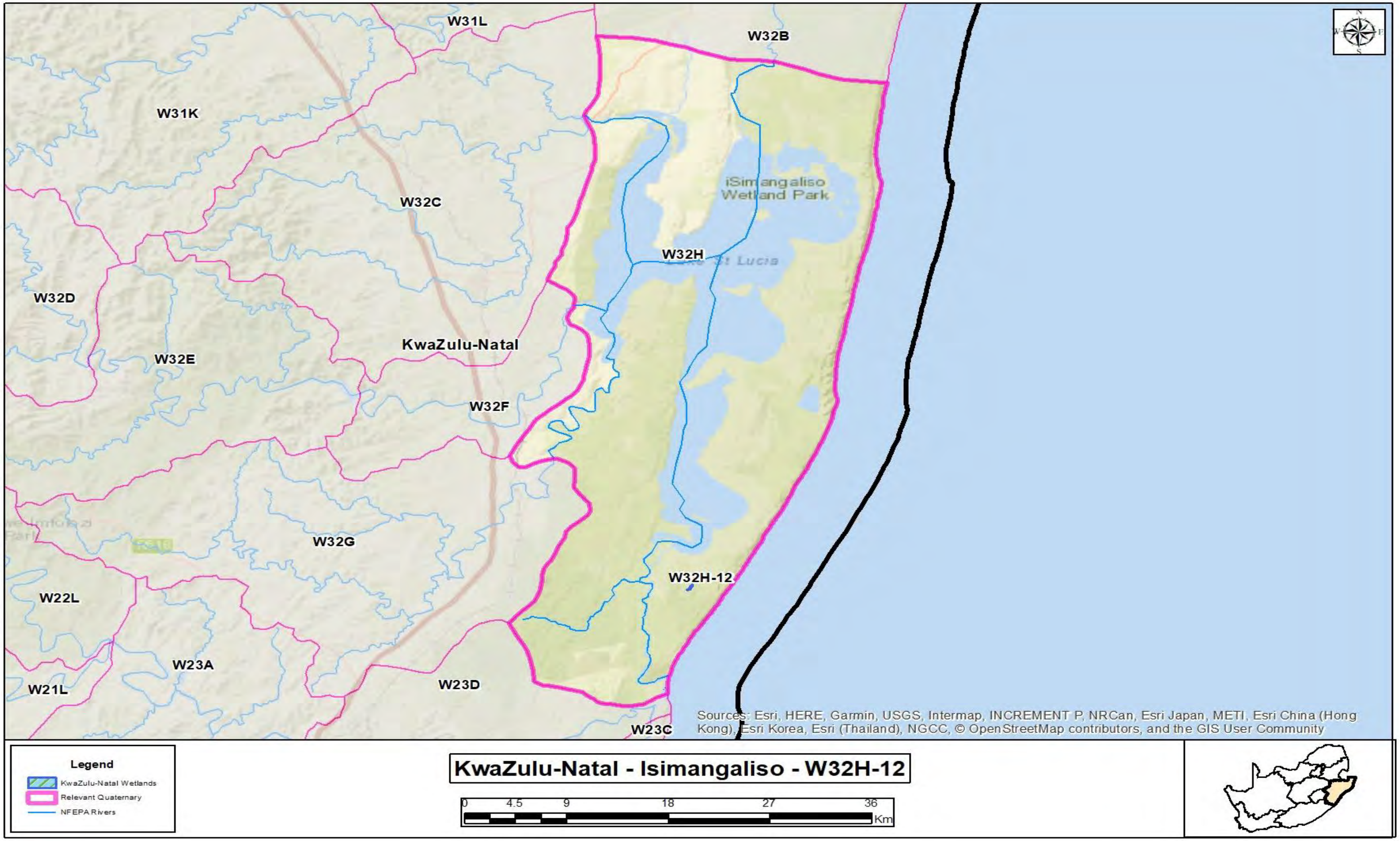



**Figure 11: Topographic map showing the location of iSimangaliso W32H-12**

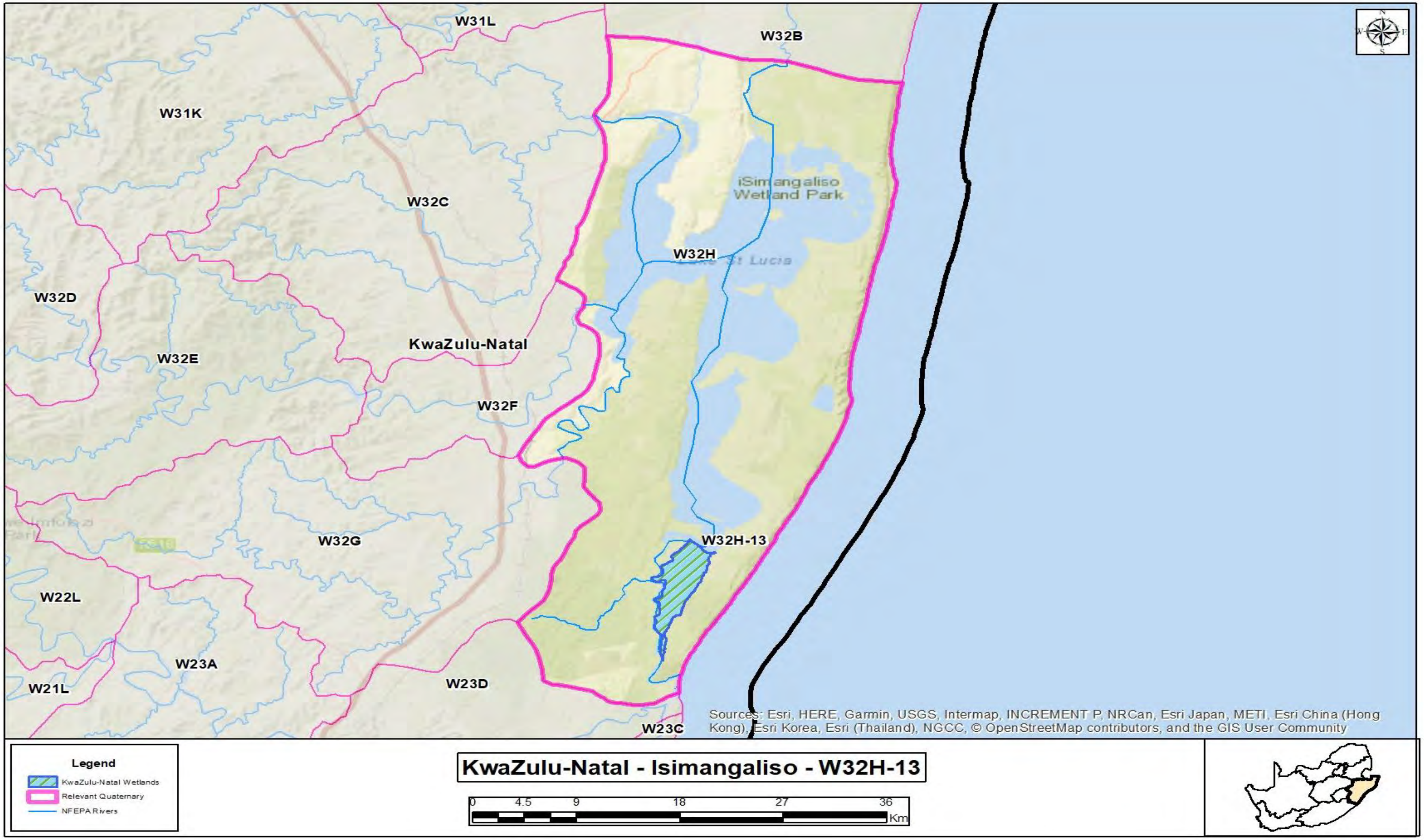



**Figure 12: Topographic map showing the location of iSimangaliso W32H-13**

### 2.3.2 *Project Scope*

The scope of this Wetland Project is detailed in the table below (**Table 3**):

**Table 3: Project Scope**

| | |
|---|---|
| **Province & Wetland Project** | KwaZulu-Natal: iSimangaliso |
| **Quaternary Catchments** | W32H |
| **Quaternary Catchment areas (Ha)** | 3 300 ha |
| **Nearest Town/s** | St Lucia |
| **Partnership** | iSimangaliso Wetland Park |
| **Number of wetlands identified during the assessment** | 11 |
| **Wetland names** | iSimangaliso Western Shores (03 – 11) |
| **Extension of existing work** | Yes |
| **Work to commence at new wetlands in 2019/ 2020** | Yes |
| **Available budget for new interventions** | Total R 5,000,000.00 |
| **Estimated cost of new interventions** | Total: R 5, 521,560.00 |

### 2.3.3 *Prioritisation of Wetlands*

The prioritisation was done in communication with the Land Care Manager at iSimangaliso Wetland Park and directly informed the Phase 2 site visit with the engineering team to quantify and formalise the wetland rehabilitation approach to optimise the functioning of the selected wetlands. The "priority" as depicted in the table below indicates the relative importance of each wetland within the wetland project (iSimangaliso Wetland Project) as a whole. Based on the wetland status quo reports conducted, the current progress of implementation within the project and the order of implementation of the rehabilitation interventions detailed in the following sections, the wetlands have been prioritised for rehabilitation in the following order (Table 4):

**Table 4: Prioritisation of wetlands**

| Priority | Wetland number | Wetland name | Rationale |
|---|---|---|---|
| 10 | W32H-03 | iSimangaliso -Western Shores 3 | A major threat to the iSimangaliso Wetland Park is damage to the hydrology and salinity of the wetland system, including reduction in the water supply through the transformation of the upper reaches for agriculture, and historical land uses such as forestry. Wetland rehabilitation is focussed on reinstating the natural water distribution patterns and preventing desiccation caused by the impeding effect of roads. Improved natural flow regimes will promote biodiversity and optimise the functioning of selected wetland systems.<br>Due to the intact and pristine nature of many of the systems within the larger iSimangaliso Wetland Park, the aim of the rehabilitation is to stabilise and restore the wetland systems to a state that resembles a natural reference state. |
| 7 | W32H-04 | iSimangaliso -Western Shores 4 | |
| 3 | W32H-05 | iSimangaliso -Western Shores 5 | |
| 4 | W32H-06 | iSimangaliso -Western Shores 6 | |
| 9 | W32H-07 | iSimangaliso -Western Shores 7 | |
| 5 | W32H-08 | iSimangaliso -Western Shores 8 | |
| 8 | W32H-09 | iSimangaliso -Western Shores 9 | |
| 1 | W32H-10 | iSimangaliso -Western Shores 10 | |

| Priority | Wetland number | Wetland name | Rationale |
|---|---|---|---|
| 2 | W32H-11 | iSimangaliso -Western Shores 11 | This rehabilitation work would also result in the enhancement of the functioning and the integrity of the wetlands (GroundThruth, 2019). |
| 11 | W32H-12 | iSimangaliso -Western Shores 12 | |
| 6 | W32H-13 | iSimangaliso -Western Shores 13 | |

### 2.3.4 Projected Rehabilitation Indicators

The rehabilitation planning process relies on the measurement of wetland ecological integrity based on the assessment of the hydrology, geomorphology and vegetation characteristics of the specified systems. In theory this information can be converted into a hectare equivalent which can serve as a baseline against which hectare equivalents of wetland habitat gained or secured through rehabilitation can be compared. In practice, the level of confidence associated with interpretations of this nature is usually low and difficult to defend and hence should be interpreted with great caution. For example, this approach should not be followed where a large wetland complex with many contiguous tributary arms of unknown size are present upstream. Similarly, the area of wetland gained should not be determined if there isn't good knowledge of inter alia the hydrogeological characteristics of both the bedrock and unconsolidated sedimentary cover. For wetlands that are assessed in detail using the Wet-Health methodology, the number of hectare equivalents gained through rehabilitation can be used as an indicator of rehabilitation success within each system (**Table 5**). The success of rehabilitation in wetlands that are not assessed in detail (such as those where only soft options, or IAP control and revegetation will occur) cannot be measured in this way, but the number of wetlands rehabilitated in this manner should be recorded.

**Table 5: Projected Values**

| Wetland No. | Area (ha) | Current hectare equivalents | Projected hectare equivalents gained | Total projected hectare equivalents | % Increase on current hectare equivalents |
|---|---|---|---|---|---|
| W32H-03 | 699 | 650.67 | 1.4 | 652.07 | 0.22 |
| W32H-04 | 17.96 | 15.04 | 1.08 | 16.12 | 7.18 |
| W32H-05 | 66.79 | 58.60 | 1.26 | 59.86 | 2.15 |
| W32H-06 | 1.47 | 1.25 | 0.11 | 1.36 | 8.80 |
| W32H-07 | 49.97 | 47.19 | 0.87 | 48.06 | 1.84 |
| W32H-08 | 14.80 | 9.46 | 1.72 | 11.18 | 18.18 |
| W32H-09 | 5.77 | 5.05 | 0.08 | 5.13 | 1.43 |
| W32H-10 | 5.95 | 5.83 | 0.08 | 5.91 | 1.37 |
| W32H-11 | 21.45 | 19.56 | 0.31 | 19.87 | 1.58 |
| W32H-12 | 5.78 | 5.18 | 0.05 | 5.23 | 0.97 |
| W32H-13 | 2411.40 | 2335.2 | 0 | 2335.2 | 0.00 |

Please note that important factors such as biodiversity, species habitat, sense of place cultural significance etc. are not incorporated into hectare equivalents and therefore the full value of the system is not quantified. For the purpose of this report and due to the reasons above, the above table only reflects the amount of hectare equivalents likely to be gained and/or secured as a result of the planned interventions.

# 3 GENERAL METHODOLOGY

Each Wetland Project is managed in three phases over a two-year cycle as shown in the flow diagram in **Figure 13** below. The first two phases straddle the first year of the cycle and involve planning, identification, design and authorisation of interventions. The third phase is implementation, which takes place during the second year.

## 3.1 Landowner Consent

The flow diagram (refer to **Figure 13**) clearly demonstrates the point at which various consent forms must be approved via signature from the directly affected landowner. The ASDs are responsible for undertaking the necessary landowner engagement and for ensuring that the requisite landowner consent forms required as part of Phase 1 and 2 of this project are signed. Please refer to **Appendix E** for a copy of the landowner agreement.

## 3.2 Phase 1

The Wetland Specialist responsible for the KwaZulu-Natal Province undertook a desktop study to determine the most suitable wetlands for the WfWetlands rehabilitation efforts. This phase also involved initial communication with local land-owners and other I&APs to gauge the social benefits of the work.

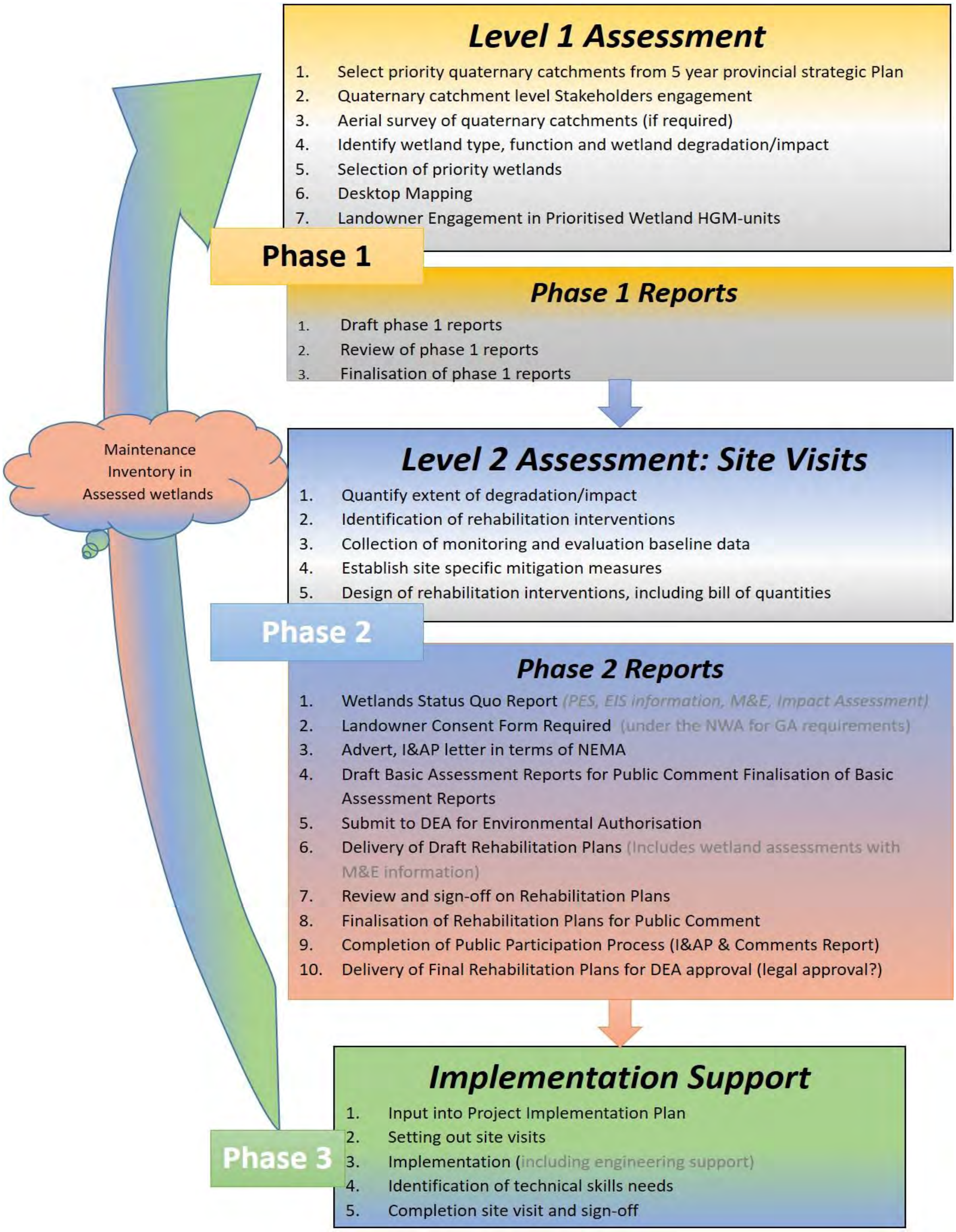



**Figure 13: The three phases that must be undertaken for the successful rehabilitation of wetlands**

## 3.3 Phase 2

### 3.3.1 <u>Site Visits</u>

Phase 2 required site visits attended by the fieldwork team comprising a Wetland Specialist, a Design Engineer, an EAP and an ASD. The following site visit was undertaken for the Midlands Wetland Project:

1. iSimangaliso (06 November 2018 – 08 November 2018)

The following team members attended the site visits:

- Ms Claire Blanché (Environmental Assessment Practitioner)
- Ms Mbali Goge (ASD)
- Mr Ryan Domleo (Engineer)
- Mr Khwezi Mncwabe (Engineer)
- Mr Craig Cowden (Wetland Specialist)
- Mr Steven Ellery (Wetland Specialist)

The team was assisted by members of the iSimangaliso Wetland Park Land Care Management Department. At the end of the site visit, the rehabilitation objectives together with the location layout of the proposed interventions were agreed upon by the project team.

During Phase 2, monitoring systems were put in place to support the continuous evaluation of interventions. The systems monitor both the environmental and social benefits of the interventions. An inventory of any existing interventions that were damaged and/or failing and thus requires maintenance is also compiled by the ASD during this phase, in consultation with the Design Engineer.

### *3.3.2 Wetland Reports*

The time and resources required to determine the current status of the wetlands was generally limited, and thus a rapid procedure was adopted to assist the project team in systematically carrying out the assessments under constraints. The procedure was based on the following steps:

**a. Assess impacts and threats**

The following steps were used by the Wetland Specialist to assess the impacts and threats within each wetland system:

- Describing the hydro-geomorphic setting of the wetland according to Kotze *et al*. (2008);
- Assessing the overall health of the wetland at a Level 2 using WET-Health (Macfarlane *et al*., 2007); and
- Identifying specific impacts and/or threats (based on the wetland status quo reports) to be addressed by structural rehabilitation and describing in more detail where necessary. For example, for head-cut erosion, the specific dimensions and level of activity of head-cuts would be described.

**b. Set rehabilitation objectives and choose appropriate measures for achieving the objectives**

Rehabilitation objectives were informed by the above assessments (*e.g*. if the primary threat to the wetland was identified as head-cut erosion threatening to propagate through the wetland then an appropriate rehabilitation objective would be to halt propagation of the erosion head-cut). The engineer was assisted by the Wetland Specialist in selecting appropriate interventions to achieve the identified rehabilitation objectives.

**c. Assess the likely contribution of rehabilitation interventions to wetland health and ecosystem delivery**

An assessment was undertaken of the predicted contribution that the identified rehabilitation interventions will make to improving wetland health and ecosystem services delivery by addressing the identified impacts/threats. Without these assessments, a wetland rehabilitation programme is unlikely to have a well-informed basis on which to improve the “return on investment” (with return being measured in terms of wetland health and ecosystem services delivery). This is directly linked into the WfWetlands Monitoring and Evaluation (M&E) Framework. The following steps were followed to assess the contribution of rehabilitation interventions within each wetland system:

- The spatial area likely to be affected by the proposed intervention/s was identified; and
- The benefits that were likely to result from achievement of the rehabilitation objective/s were determined in terms of the integrity of the affected area of the wetland (using WET-Health) and the ecosystem services that the area delivers (using WET-Ecoservices: Kotze *et al.*, 2008).

The same approach was used for the assessment of the different threats/impacts that would be addressed through rehabilitation. In this instance, the situation without rehabilitation (i.e. no intervention or *status quo*) was compared to the situation with rehabilitation. For assessing the effect on wetland health, wetlands were scored with and without rehabilitation on a scale of 0 (critically altered) to 10 (pristine), and this was undertaken for the hydrology, geomorphology and vegetation components of wetland health.

The benefit achieved is the improvement in relation to the maximum score. For example, in areas threatened by head-cut erosion which are to be rehabilitated by halting the spreading of the head-cut, the benefits in terms of health would be determined based on the difference between the current health and the projected health if the head-cut proceeded to erode through the threatened area. In such a case, stopping the expansion of the head-cut would presumably secure the current situation.

Refer to **Appendix A** which contains the Wetland Status Quo Report/s.

### 3.3.3 *Identification and location of intervention designs*

The project teams evaluated the various rehabilitation intervention options available and selected the most appropriate to achieve the rehabilitation objectives for the wetland. Choices of intervention options were also informed by the increased labour component as required by DEA. Any previously planned interventions that had not been implemented or included into the previous planning cycle reports were assessed and included into the current year's selection, if appropriate to the re-assessed rehabilitation objectives for the wetland. Agreed cost/benefit ratios in terms of 'Rands per hectare of rehabilitated wetland' were taken into account, along with operational considerations and larger scale project objectives.

After the appropriate intervention options were selected by the planning team, the engineer, in consultation with the Wetland Specialist determined the most appropriate designs and locations for the identified interventions in order to achieve the rehabilitation objectives for the wetland in question. GPS coordinates and digital photographs – sufficiently detailed to clearly identify the selected locations were then taken for record purposes. Appropriate dimensions of the locations were measured in order to be able to design and calculate quantities for the interventions.

#### i. Intervention naming convention

The accepted **naming convention** which has been applied to all interventions (old and new) is explained below with examples being provided as well.

A00A-00-000-00 (new),

A00A-00-000-01 (maintenance), where

| Number | Explanation | | |
|---|---|---|---|
| A00A | quaternary number | | |
| 00 | wetland number | | |
| **2**00 | intervention number with the '**200**' included for differentiation from previous interventions | | |
| **00** | **New** intervention | **01** | **Maintenance** to intervention |

An additional two digits will therefore be added to the end of each of the intervention numbers to indicate maintenance on this specific intervention and/or whether the structure is new (00) for tracking purposes. All new interventions will have a default of 00. Should built structures require maintenance, they would be numbered numerically beginning with '01' e.g. 01, 02, 03, etc. for each year that maintenance is undertaken on the intervention.

In addition, the new naming convention also added a '200' digit in the front of the intervention number to avoid confusion from previously named interventions.

### *3.3.4 Collection of monitoring & evaluation (M&E) baseline and basic assessment data*

In accordance with WET-Rehab-Evaluate (Cowden and Kotze, 2008) the collection of baseline monitoring information is important to allow for the evaluation of the performance of wetland rehabilitation activities. Monitoring and evaluation facilitate the dissemination of lessons learnt and provide a means of reporting on the success of specific wetland rehabilitation initiatives. The monitoring and evaluation (M&E) of an identified wetland rehabilitation project's performance is therefore considered vital to inform the evaluation of wetland rehabilitation success. Baseline monitoring needs to be carried out prior to the implementation of rehabilitation activities to provide comparable data for monitoring at a later stage, following the wetland rehabilitation.

While the engineer was working on measurement of the intervention locations, the Wetland Specialist gathered the additional data required for M&E baselines which included the following:

- Photographs and GPS co-ordinates of the identified problems;
- Fixed-point photography (in accordance with the guidelines outlined in WET-Rehab-Evaluate: Cowden and Kotze, 2008);
- WET-Health information (allowing the comparison of wetland ecological integrity before and after rehabilitation activities); and
- Details relating to the calculation of estimated hectare equivalents.

Any additional data/information required for the assessment of the potential impacts of the proposed interventions and construction activities was also collected by the Wetland Specialist and the EAP to inform the Basic Assessments.

At the end of the site visit a location layout of the agreed interventions and rehabilitation objectives was signed off by the ASD and landowner, as indicated by WfWetlands Signoff 2 in **Figure 13.**

### 3.3.5 *Engineering design*

The detailed procedure followed by the engineers is described in the Engineering Design Brief, which documents the procedure agreed upon by Aurecon and WfWetlands. The document also addresses important issues such as risk and liability. A summary of the process followed for the engineering design is described below:

- A hydrological assessment was undertaken to quantify the volume of water expected to be dealt with by the intervention for various recurrence intervals. The results of this assessment allowed the engineer to select a design flow to be applied to the intervention.
- Construction materials were selected based on a range of site specific criteria including expected velocities, availability of materials such as rock, labour intensive targets, maintenance requirements etc.
- Interventions were designed based on the above to meet the objectives for wetland rehabilitation.
- The intervention designs were drafted to show, at a minimum, a plan view, a longitudinal section and front elevation at appropriate scales, and appropriate dimensions. A legend indicating basket sizes was included for gabion structures to improve design clarity for the implementers.
- Bills of quantities were calculated for the designs and cost estimates were made based on unit costs and norms for each project area, as agreed with the ASD.
- Maintenance requirements for existing interventions in the assessed wetlands were similarly detailed and the anticipated costs calculated.

The engineer also reviewed and, if necessary, adjusted any previously planned interventions that are included into the current Rehabilitation Plan.

### 3.3.6 *Development of the Rehabilitation Plan*

The standardised Rehabilitation Plan format has been approved by the WfWetlands Programme Deputy Director for Planning, Monitoring and Evaluation. Summaries of the wetland prioritisation, problems and rehabilitation objectives are documented in the Rehabilitation Plan. Reports on the current status of the wetland, based on, *inter alia*, the information collected during the implementation of WET-Tools, were prepared by the Wetland Specialist, and are included as **Appendix A** to this report.

This Rehabilitation Plan was submitted to the WfWetlands ASD and Wetland Specialist for review before it was made available to stakeholders for comment. Any comments received during the comments period will be taken into account in the finalisation of the Rehabilitation Plan.

### 3.3.7 *Reporting Format*

All relevant information acquired during the assessments and field visits has been included in this document and its appendices.

- All intervention locations are given in geographical coordinates, (Degrees, Minutes and Seconds), based on the WGS84 datum.
- Mapping was done in Albers Equal Area Conic projection, WGS84 datum. The grids displayed on all maps are geographic and measured in Degrees Minutes and Seconds. The scale bar on each map is based on Albers Equal Area Conic projection and measured in metres.

# 4 ISIMANGALISO WESTERN SHORES 3 – 13 (W32H-03 – W32H-13)

The assessment of the iSimangaliso Western Shores wetlands, its problems, and the development of the rehabilitation objectives are described in detail in **Appendix A**: Wetland Status Quo Report. The following subsections provide a brief summary for this wetland system.

## 4.1 Landowner details

The iSimangaliso project area comprises of wetland systems within the iSimangaliso Wetland Park that are under the custodianship of the iSimangaliso Authority. This area is zoned as a Provincial Nature Reserve and is a World Heritage Site and is thus protected. Consent for any proposed wetland rehabilitation (subject to the approval of the Rehabilitation Plans) on this property has been obtained and is available in **Appendix E**.

**Table 6: iSimangaliso Western Shores 03 Landowner/s and SG Key**

| Wetland Number | Property SG Key | Owner / Trust | Consent Obtained |
|---|---|---|---|
| W32H-03 | N0HV00000001745900000 | iSimangaliso Wetland Park | Yes |
| W32H-04 | N0GV00000001739300000 | | |
| W32H-05 | | | |
| W32H-06 | | | |
| W32H-07 | | | |
| W32H-08 | N0GV00000001370200000 | | |
| W32H-09 | N0HV00000001745900000 | | |
| W32H-10 | N0HV00000001745900000 | | |
| W32H-11 | N0HV00000001745900000 | | |
| W32H-12 | | | |
| W32H-13 | | | |

## 4.2 Wetland details

The Western Shores of the iSimangaliso Wetland Park Project falls within quaternary catchment W32H in the Mkuze River Floodplain, Maputaland, on the east coast of KwaZulu-Natal. Khulu village is approximately 8 km south west of the site and the coastal town of St Lucia is approximately 7km south east of the site. **Table 7** and **Table 8** below provides a summary of key information about the wetland.

**Table 7: Summary of wetland details iSimangaliso 03 – 07**

| **Wetland Name** | iSimangaliso 03 (W32H-03) | iSimangaliso 04 (W32H-04) | iSimangaliso 05 (W32H-03) | iSimangaliso 06 (W32H-06) | iSimangaliso 07 (W32H-07) |
|---|---|---|---|---|---|
| **Wetland Number** | W32H-03 | W32H-04 | W32H-05 | W32H-06 | W32H-07 |
| **River System Name** | St Lucia River | | | | |
| **Land Use in Catchment** | Conservation area, tourism, old plantation land, occasional reed harvesting | Conservation area, tourism, old plantation land, occasional reed harvesting | Conservation area, tourism, old plantation land, occasional reed harvesting | Conservation area, tourism, old plantation land | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **Land Use in Wetland** | Conservation area, tourism, old plantation land, occasional reed harvesting | Conservation area, tourism, old plantation land, occasional reed harvesting | Conservation area, tourism, old plantation land, occasional reed harvesting | Conservation area, tourism, old plantation land | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **No. of Properties Intersecting Wetland Area** | 1 | 1 | 1 | 1 | 1 |
| **Date of Planning Site Visit** | November 2018 | November 2018 | November 2018 | November 2018 | November 2018 |
| **Wetland Assessor(s)** | Craig Cowden | Craig Cowden | Craig Cowden | Craig Cowden | Craig Cowden |
| **Wetland size** | 699.00 ha | 17.96 ha | 66.79 ha | 1.47 ha | 49.97 ha |

**Table 8: Summary of Wetland details iSimangaliso 08 – 13**

| **Wetland Name** | iSimangaliso 08 (W32H-08) | iSimangaliso 09 (W32H-09) | iSimangaliso 10 (W32H-10) | iSimangaliso 11 (W32H-11) | iSimangaliso 12 (W32H-12) | iSimangaliso 13 (W32H-13) |
|---|---|---|---|---|---|---|
| **Wetland Number** | W32H-08 | W32H-09 | W32H-10 | W32H-11 | W32H-12 | W32H-13 |
| **River System Name** | St Lucia River | | | | | |
| **Land Use in Catchment** | Conservation area, tourism, old plantation land, occasional reed harvesting, residential land, agricultural land | Conservation area, tourism, old plantation land | Conservation area, tourism, old plantation land | Conservation area, tourism, old plantation land | Conservation area, tourism, old plantation land | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **Land Use in Wetland** | Conservation area, tourism, old plantation land, occasional reed harvesting, residential land, agricultural land | Conservation area, tourism, old plantation land | Conservation area, tourism, old plantation land | Conservation area, tourism, old plantation land | Conservation area, tourism, old plantation land | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **No. of Properties Intersecting Wetland Area** | 1 | 1 | 1 | 1 | 1 | 1 |
| **Date of Planning Site Visit** | November 2018 | November 2018 | November 2018 | November 2018 | November 2018 | November 2018 |
| **Wetland Assessor(s)** | Craig Cowden | Craig Cowden | Craig Cowden | Craig Cowden | Craig Cowden | Craig Cowden |
| **Wetland size** | 14.80 ha | 5.77 ha | 3.98 ha | 21.45 ha | 5.78 ha | 24114.00 |

### 4.2.1 Motivation for selection

The iSimangaliso Wetland Park was an obvious priority given that it is one of the outstanding natural wetland and coastal sites of Africa, is a protected area and is recognised as a UNESCO World Heritage Site and contains four Ramsar sites. A major threat to the park is damage to the hydrology and salinity of the wetland system including reduction in the water supply by the transformation of the upper reaches by agriculture, and historical land uses such as forestry. Due to the intact and pristine nature of many of the systems within the larger iSimangaliso Wetland Park, the aim of the rehabilitation is to stabilise and restore the wetland systems to a state that resembles a natural reference state. This rehabilitation work would also result in the enhancement of the functioning and the integrity of the wetlands (GroundThruth, 2019). A number of considerations were taken into account during the selection of this wetland system, mainly:

- Size of the affected wetland;
- Catchment activities;
- Type of rehabilitation;
- Accessibility;
- Biophysical (hydrological and biodiversity connectivity) links to other rehabilitation projects;
- Cost of proposed rehabilitation work; and
- iSimangaliso Wetland Park management objectives.

### 4.2.2 Description

According to Mucina and Rutherford (2012) the geology and soils in the area consists of the Kaapvaal Craton and Mozambique belt. Soils within this unit are characteristically poor cation exchange lithic soils. Most of the wetlands are (seeps and depressions) are underground fed with the valley bottom wetlands receiving both ground water and surface flow. According to Macfarlane et al. (2007), the Maputaland coastal plain is characterised by highly complex surface-groundwater interactions which confounds the delineation and definition of wetland catchments in these areas as wetlands are fed both by their topographically defined catchments as well as by a much larger catchment feeding the regional water table.

The vegetation type within the wetland area and the catchment area at large is mapped as Maputaland Coastal Belt ecosystem, which is listed as an endangered Ecosystem in terms of the 2011 Schedule (Government Gazette of December 2011) of the National Environmental Management Biodiversity Act (Act 10 of 2004). The site also has Subtropical Alluvial Vegetation which is Critically Endangered ecosystem. (SANBI BGIS, 2018). Typical vegetation that dominates the site *includes Cymbopogon validus, Cyperus polstachyos, Cyperus dives, Juncus effuses, Imperata cylindrica, Gomphocarpus fruticous, Phragmites australis* and *Eleocharis dregeana.*

The catchment falls within the subtropical climatic zone of Africa. It experiences weather systems from both tropical and temperate regions. Light rainfall is experienced during the winter months (May to July) and contributes 20% of the annual rainfall in the region. In both summer and spring thunderstorms are created that produce rainfall, this is experienced most heavily in the spring months. The Mean Annual Precipitation (MAP) is 1200mm. The annual average temperature is 21.5°C. An understanding of the climate, i.e. the sensitivity of catchments to hydrological impacts influences rehabilitation planning activities.

The predominant land use in the targeted area is conservation, the entire wetland area is located within a protected area. Other existing land use activities in close proximity to the wetland area include; subsistence farming (livestock and crops), commercial farming, tourism and forestry.

Eleven target Areas (W32H-03 – W32H-13) have been identified by the Wetland Specialist (**Appendix A**) within the iSimangaliso Wetland Park which will be focused on for the 2018/2019 planning cycle (illustrated in Figure 4 and Table 9). The delineation of the target areas is highlighted in Table 9. The problems associated with each of these Target Areas follows below in Section 4.3.

**Table 9: iSimangaliso Wetland delineation**

| Target Area | Wetland Number | Hydrogeomorphic Unit |
|---|---|---|
| 1 | W32H-03 | Floodplain complex |
| 2 | W32H-04 | Hillslope seep |
| 3 | W32H-05 | Floodplain complex |
| 4 | W32H-06 | Hillslope seep |
| 5 | W32H-07 | Unchannelled Valley bottom |
| 6 | W32H-08 | Unchannelled Valley bottom |
| 7 | W32H-09 | Depression |
| 8 | W32H-10 | Unchannelled Valley bottom |
| 9 | W32H-11 | Unchannelled Valley bottom |
| 10 | W32H-12 | Depression |
| 11 | W32H-13 | Floodplain complex |

### *4.2.3 Site photos*

**Plate 1 and Plate 2: Permanently inundated open-water impoundments upstream of old forestry roads in a valley-bottom setting. Impoundments such as these would not naturally occur in valley-bottom settings and are indicative of hydrological disconnectivity as a result of the forestry roads. Predominantly or permanently inundated channels within the wetland**


**Plate 3 and Plate 4: Former forestry roads comprising imported earth intercept wetland systems in a grid-like pattern, interrupting hydrological and biophysical connectivity within HGM units.**


**Plate 5 and Plate 6: Former forestry jeep tracks traverse the park.**


**Plate 7 and Plate 8: Drains and associated fill-berms on either side of forestry road embankments, exacerbating the interception of natural flow and disruption of wetland functioning caused by the roads.**

## 4.3 Wetland problems

The wetland has been subjected to a number of impacts associated with the modification of the system's hydrology. The impacts are related to historical practices that have significantly affected water distribution and retention patterns in the wetland. The impacts include the forest plantation trees growing along the wetland edge, encroachment by pastured grasses, incorrect road placements, old forestry roads that are affecting flow regimes, abandoned borrow pits and encroachment by alien vegetation. A major threat to the park is damage to the hydrology and salinity of the wetland system including reduction in the water supply by the transformation of the upper reaches by agriculture, and historical land uses such as forestry. The former forestry roads interrupt hydrological connectivity between upstream and downstream sections of wetland and it is therefore of high importance that as many of these roads are removed as possible (GroundThruth, 2019).

## 4.4 Rehabilitation objectives

The main aim of the rehabilitation work in the iSimangaliso wetland for the 208/2019 planning cycle is to enhance the functioning and integrity of the wetlands. Due to the intact and pristine nature of many of the systems within the larger iSimangaliso Wetland Park, the aim of the rehabilitation is to stabilise and restore the wetland systems to a state that resembles a natural reference state. The proposed rehabilitation interventions will secure and improve the overall integrity of the wetland system with a particular focus on the recovery of the hydrological functioning of the wetland habitats. To counter these impacts highlighted in section 4.3 and to prevent further degradation a set of objectives and strategies have been identified **(refer Table 10).**

**Table 10: Summary of rehabilitation objectives and strategies for the iSimangaliso Wetlands**

| Rehabilitation objective | Rehabilitation strategy |
|---|---|
| **iSimangaliso Western Shores 03: W32H-03** | |
| • Secure and improve overall integrity of wetland system.<br>• Recover hydrological functioning of wetland habitat.<br>• Protect the wetland from degradation. | • Remove old forestry road that runs in a general north-south direction and is orientated in the same direction as the natural grade of the wetland.<br>• Revegetate stabilised areas with appropriate wetland and riparian plant species.<br>• Construct two concrete culverts beneath the road to reinstate hydrological connectivity. |
| **Rehabilitation objective** | **Rehabilitation strategy** |
| **iSimangaliso Western Shores 04: W32H-04** | |
| • Secure and improve overall integrity of wetland system.<br>• Recover hydrological functioning of wetland habitat.<br>• Protect the wetland from degradation. | • Remove old forestry roads upstream and downstream of the wetland to reinstate some hydrological connectivity within the wetland.<br>• Remove three berms to create a low-level earthen berm that will direct any stormflows towards the culvert that runs beneath the tourist road.<br>• Revegetate stabilised areas with appropriate wetland and riparian plant species. |
| **iSimangaliso Western Shores 05: W32H-05** | |
| • Secure and improve overall integrity of wetland system.<br>• Recover hydrological functioning of wetland habitat.<br>• Protect the wetland from degradation. | • Remove three sections of old forestry road as well as an old earthen berm to a more natural flow path for the water within the channel.<br>• Revegetate stabilised areas with appropriate wetland and riparian plant species.<br>• Construct two concrete culverts beneath the road to reinstate hydrological connectivity. |

| Rehabilitation objective | Rehabilitation strategy |
|---|---|
| **iSimangaliso Western Shores 06: W32H-06** | |
| • Secure and improve overall integrity of wetland system.<br>• Recover hydrological functioning of wetland habitat.<br>• Protect the wetland from degradation. | • Remove old forestry road to reinstate a natural grade to this steep hillslope seep wetland and return wetland to a state of greater integrity and ability to function.<br>• Promote revegetation. |
| **iSimangaliso Western Shores 07: W32H-07** | |
| • Secure and improve overall integrity of wetland system.<br>• Recover hydrological functioning of wetland habitat.<br>• Protect the wetland from degradation. | • Remove old forestry road upstream to improve the overall hydrological integrity and functioning of the wetland. |
| **iSimangaliso Western Shores 08: W32H-08** | |
| • Secure and improve overall integrity of wetland system.<br>• Recover hydrological functioning of wetland habitat.<br>• Protect the wetland from degradation. | • Construct concrete culvert to allow for increased hydrological connectivity between the up and downstream sides of the wetland and reinstate natural flow path and prevent further damming of water.<br>• Remove old forestry road located approximately midway along the HGM unit to improve the hydrological integrity and functioning of the wetland.<br>• Deactivate drain and encourage dispersed surface flow.<br>• Promote revegetation. |
| **iSimangaliso Western Shores 09: W32H-09** | |
| • Secure and improve overall integrity of wetland system.<br>• Recover hydrological functioning of wetland habitat.<br>• Protect the wetland from degradation. | • Remove old forestry road upstream to improve the overall hydrological integrity and functioning of the wetland. |
| **iSimangaliso Western Shores 10: W32H-10** | |
| • Secure and improve overall integrity of wetland system.<br>• Recover hydrological functioning of wetland habitat.<br>Protect the wetland from degradation. | • Remove old forestry road upstream to improve the overall hydrological integrity and functioning of the wetland.<br>• Prevent further sediment deposition by backfilling and shaping. |
| **iSimangaliso Western Shores 11: W32H-11** | |
| • Secure and improve overall integrity of wetland system.<br>• Recover hydrological functioning of wetland habitat.<br>• Protect the wetland from degradation. | • Remove old forestry road to improve the overall hydrological integrity and functioning of the wetland.<br>• Promote revegetation. |
| **iSimangaliso Western Shores 12: W32H-12** | |
| • Secure and improve overall integrity of wetland system.<br>• Recover hydrological functioning of wetland habitat.<br>• Protect the wetland from degradation. | • Deactivate drain and encourage dispersed surface flow.<br>• Promote revegetation. |
| **iSimangaliso Western Shores 13: W32H-13** | |

| Rehabilitation objective | Rehabilitation strategy |
|---|---|
| • Secure and improve overall integrity of wetland system.<br>• Recover hydrological functioning of wetland habitat.<br>• Protect the wetland from degradation. | • Remove old forestry road to improve the overall hydrological integrity and functioning of the wetland.<br>• Promote revegetation. |

The proposed rehabilitation interventions will not only affect the ecological integrity of the broader wetland system but will also have a number of positive impacts on the supply of goods and services provided by the wetland.

## 4.5 Summary of proposed interventions

### *4.5.1 Work undertaken in previous planning cycles*

The iSimangaliso Wetland Project has been part of the WfWetlands Programme 2013/2014 Planning Cycle.

### *4.5.2 New interventions proposed*

An Intervention Booklet is included as **Appendix C** of this report. The booklet will be used on site by the implementers and provides detailed design information on each intervention proposed in this planning cycle. For the purposes of this report, the interventions contained within the booklet are summarised in **Table 11** below. The “implementation order” as depicted in the table indicates the timing order in which interventions should be implemented within the wetland (number 1 first).

Please note that the location of the interventions (Figure 14) may change slightly as a result of changes in the landscape (due to continued erosion, for example) that may occur during the time period between the initial planning site visit and the actual implementation of the interventions. It is therefore important to note that the coordinates and the intervention designs provided in the Intervention Booklet (**Appendix C**) may need to be adjusted slightly at the time of implementation.

### *4.5.3 Design selection and sizing*

The objectives of the interventions are to restore the natural flow patterns of the wetland, as well as wetland habitat and to maximise the levels of ecosystem functioning and integrity. The most appropriate and cost-effective method of doing this was considered to involve:

- The removal of incorrectly placed roads such as tourist roads and old forestry roads;
- Earth works; and
- Revegetation

**Table 11: Summary of the iSimangaliso interventions**

| Intervention Structure Type | Intervention Number | Proposed Action | Implementation Order |
|---|---|---|---|
| Excavation - Remove road | **W32H-03-201-00** | • Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. | 21 |
| Excavation - Remove road | **W32H-03-202-00** | • Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. | 22 |
| Excavation - Remove road | **W32H-03-203-00** | • Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. | 23 |
| Excavation - Remove road | **W32H-03-204-00** | • Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. | 24 |
| Excavation - Remove road | **W32H-03-205-00** | • Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. | 25 |
| Excavation - Remove road | **W32H-04-201-00** | • Excavate old road to surrounding natural ground level to reinstate hydrological processes within the wetland. | 14 |
| Excavation - Reshaping | **W32H-04-202-00** | • Excavate 100mm and cut surface to match grade of surrounding landscape | 15 |
| Excavation - Reshaping | **W32H-04-203-00** | • Excavate 300mm and cut surface to match grade of surrounding landscape | 15 |
| Excavation - Reshaping | **W32H-04-204-00** | • Excavate 150mm and cut surface to match grade of surrounding landscape | 15 |
| Excavation - Reshaping | **W32H-04-205-00** | • Reshape site to match the grade of the surrounding landscape to reinstate flows through the wetland. | 15 |
| Excavation - Remove road | **W32H-04-206-00** | • Excavate old road to surrounding natural ground level to reinstate hydrological processes within the wetland. | 13 |
| Earthworks - Construct berm | **W32H-04-207-00** | • To divert surface flows to existing culvert to prevent flooding of the road downstream | 26 |
| Excavation - Remove berm | **W32H-04-208-00** | • Excavate berm and backfill adjacent drain to reinstate diffuse flows through the wetland[8]. | 26 |
| Excavation - Remove berm | **W32H-04-209-00** | • Excavate berm and backfill adjacent drain to reinstate diffuse flows through the wetland. | 26 |

[8] Interventions W32H-04-208-00, W32H-04-209-00, W32H-04-210-00 and W32H-04-211-00 are all terrestrial and will not have any effect on the wetland function.

| Intervention Structure Type | Intervention Number | Proposed Action | Implementation Order |
|---|---|---|---|
| Excavation - Remove berm | **W32H-04-210-00** | • Excavate berm and backfill adjacent drain to reinstate diffuse flows through the wetland. | 26 |
| Excavation - Reshaping | **W32H-04-211-00** | • Slope out embankment to create gentler gradient to promote diffuse flows through the wetland. | 26 |
| Excavation - Remove stream crossing | **W32H-05-201-00** | • Excavate old stream crossing and spoil material at designated spoil pit | 1 |
| Excavation - Remove road | **W32H-05-202-00** | • Excavate old road to surrounding natural ground level to reinstate hydrological processes within the wetland. | 12 |
| Excavation - Remove road | **W32H-05-203-00** | • Excavate old road to surrounding natural ground level to reinstate hydrological processes within the wetland. | 16 |
| Excavation - Remove road | **W32H-05-204-00** | • Excavate old road to surrounding natural ground level to reinstate hydrological processes within the wetland. | 8 |
| Excavation - Remove road | **W32H-06-201-00** | • Excavate old road to surrounding natural ground level to move the hydrological regime of the wetland towards a more natural state. | 7 |
| Excavation - Remove road | **W32H-07-201-00** | • Excavate old road to surrounding natural ground level to eliminate open water spaces and allow diffuse flow throughout the wetland. | 9 |
| Excavation - Remove road | **W32H-07-202-00** | • Excavate old road to surrounding natural ground level to eliminate open water spaces and allow diffuse flow throughout the wetland. | 10 |
| Excavation - Remove road | **W32H-08-201-00** | • Excavate old road to surrounding natural ground level to promote diffuse flows throughout the wetland. | 17 |
| Excavation - Remove berm | **W32H-08-202-00** | • Excavate old road and backfill drain to promote diffuse flows throughout the wetland. | 18 |
| Excavation - Remove road | **W32H-09-201-00** | • Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. | 19 |
| Excavation - Remove road | **W32H-10-201-00** | • Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. | 2 |
| Earthworks - Backfill road | **W32H-10-202-00** | • Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. | 3 |
| Excavation - Remove road | **W32H-11-201-00** | • Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. | 4 |
| Excavation - Remove road | **W32H-11-202-00** | • Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. | 5 |

| Intervention Structure Type | Intervention Number | Proposed Action | Implementation Order |
|---|---|---|---|
| Earthworks - Backfill road scar | **W32H-11-203-00** | • Backfill road scar to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. | 6 |
| Excavation - Remove soil stockpile | **W32H-12-201-00** | • Backfill drain so as to reinstate a natural flow direction in the southern portion of the wetland. | 20 |
| Excavation - Remove road | **W32H-13-201-00** | • Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. | 11 |

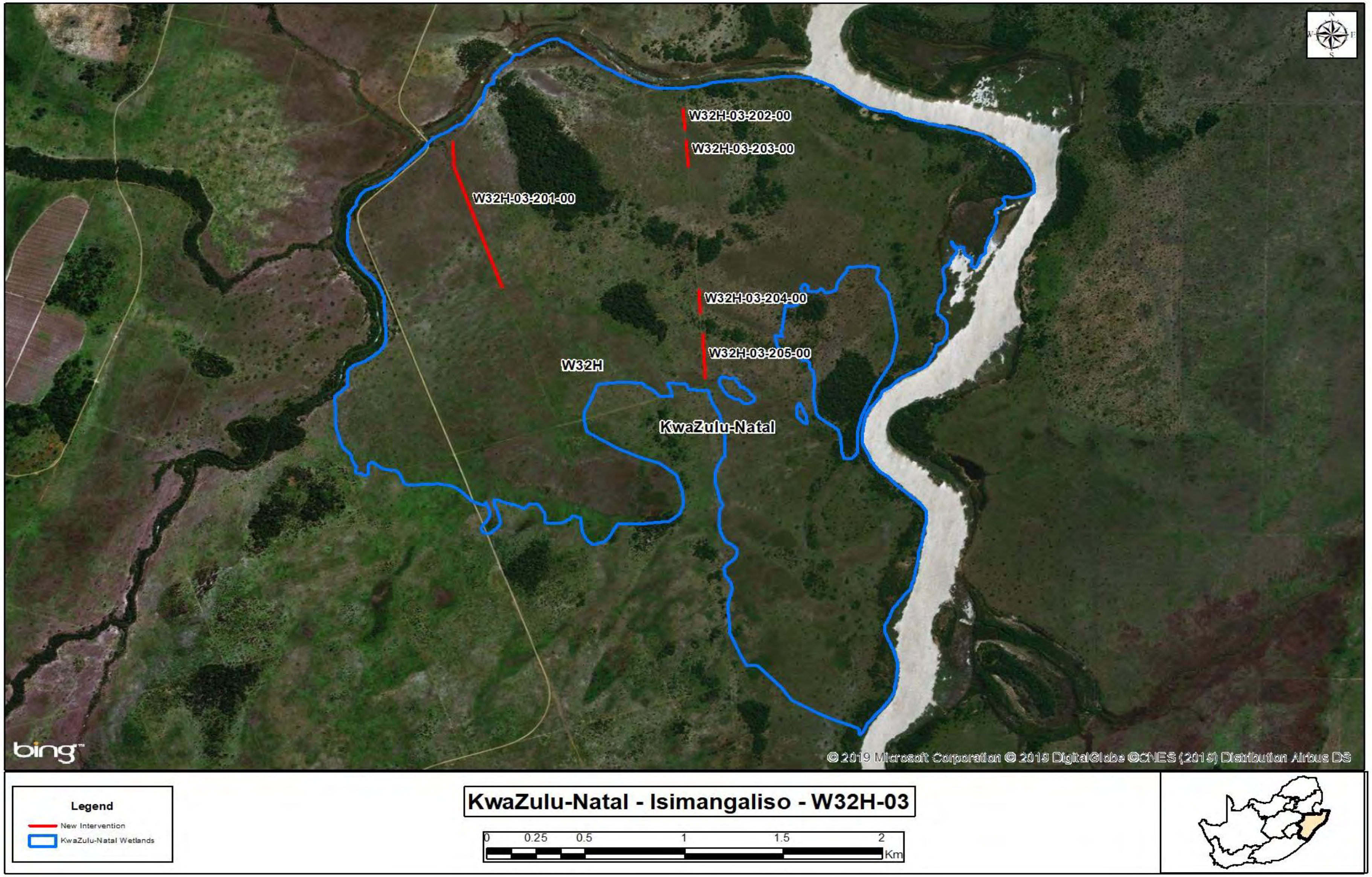



**Figure 14: Wetland map, W32H-03 with proposed new wetland interventions indicated**

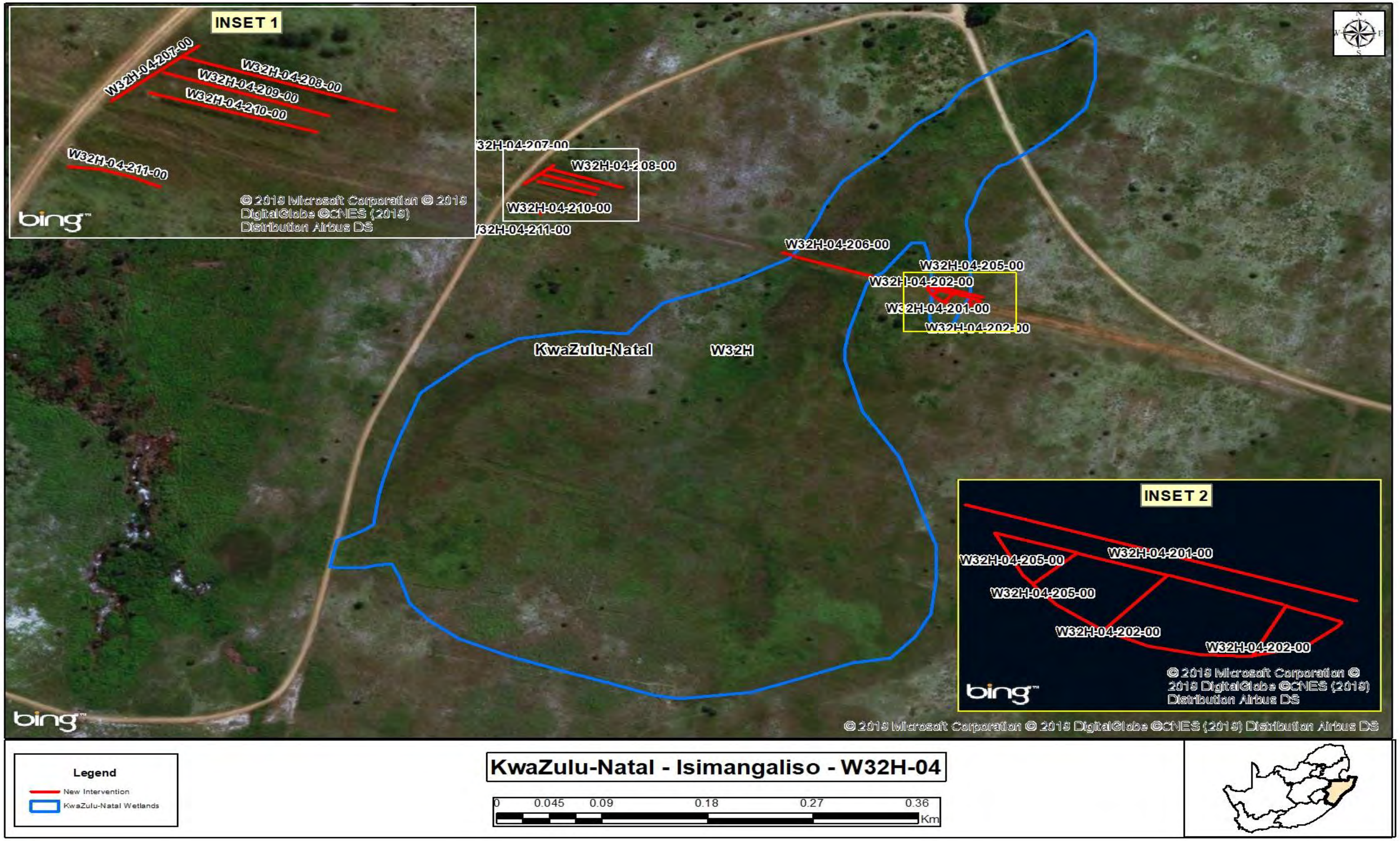



**Figure 15: Wetland map, W32H-04 with proposed new wetland interventions indicated**

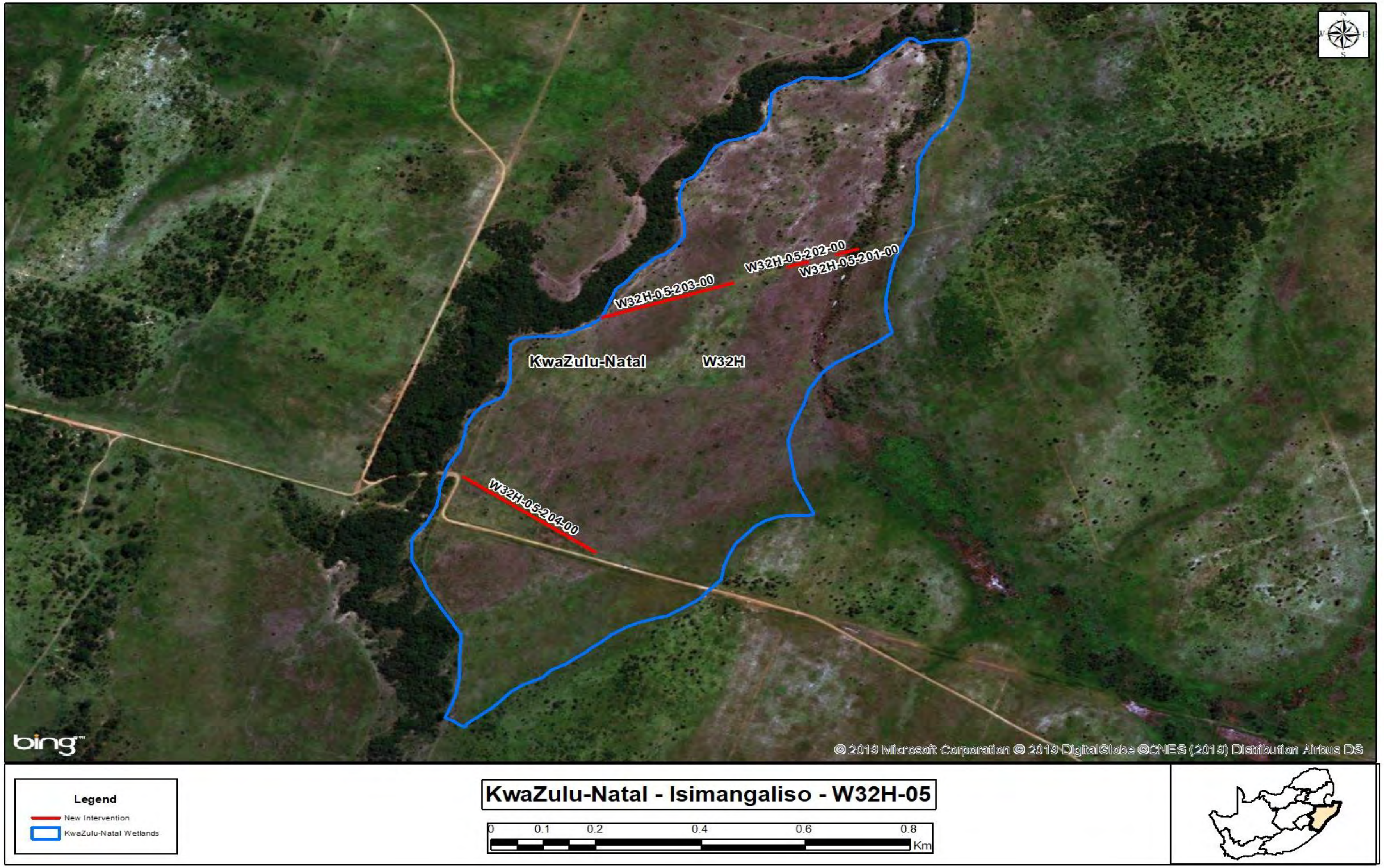



**Figure 16: Wetland map, W32H-05 with proposed new wetland interventions indicated**

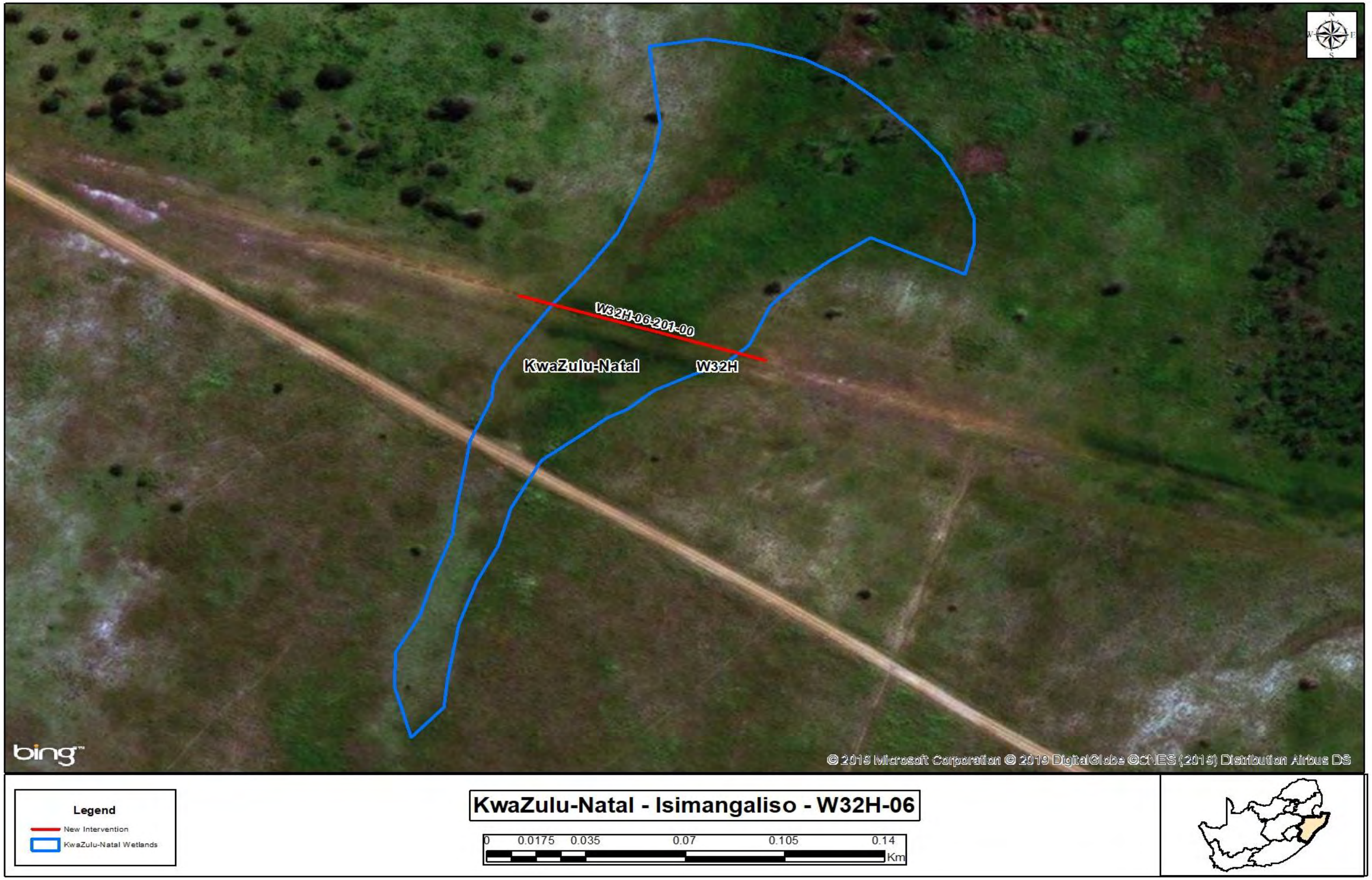



**Figure 17: Wetland map, W32H-06 with proposed new wetland interventions indicated**

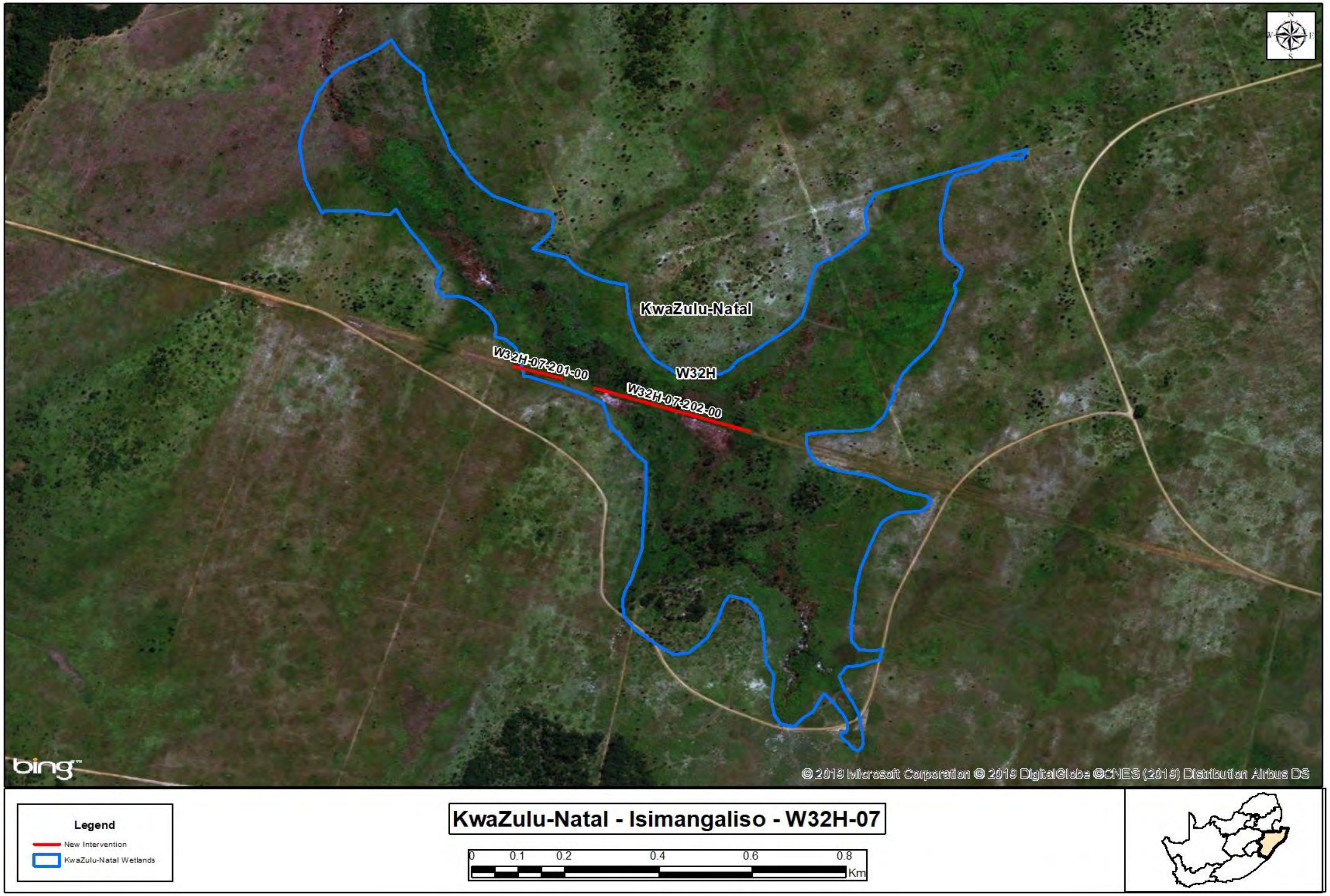



**Figure 18: Wetland map, W32H-07 with proposed new wetland interventions indicated**


**Figure 19: Wetland map, W32H-08 with proposed new wetland interventions indicated**

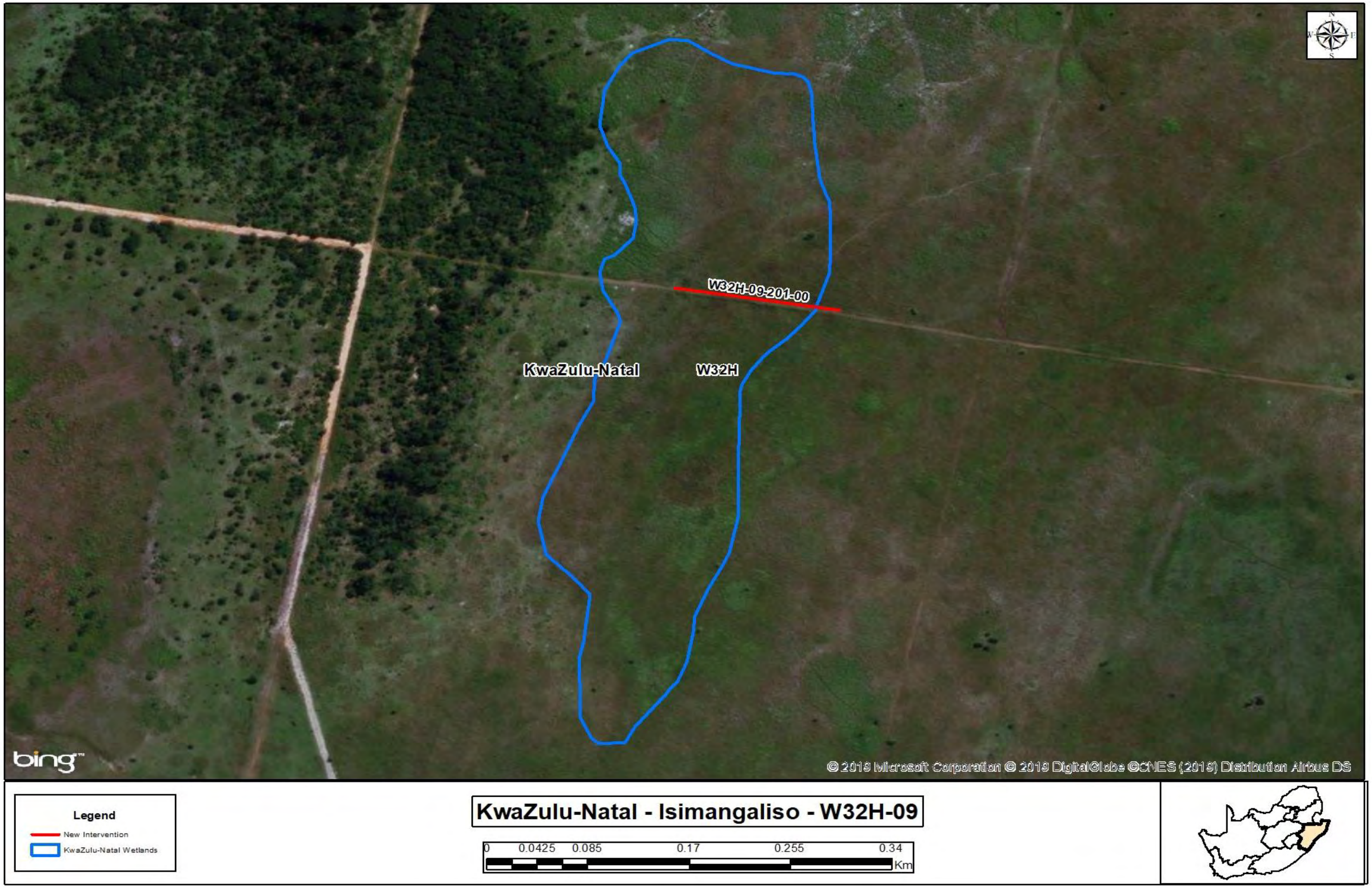



**Figure 20: Wetland map, W32H-09 with proposed new wetland interventions indicated**

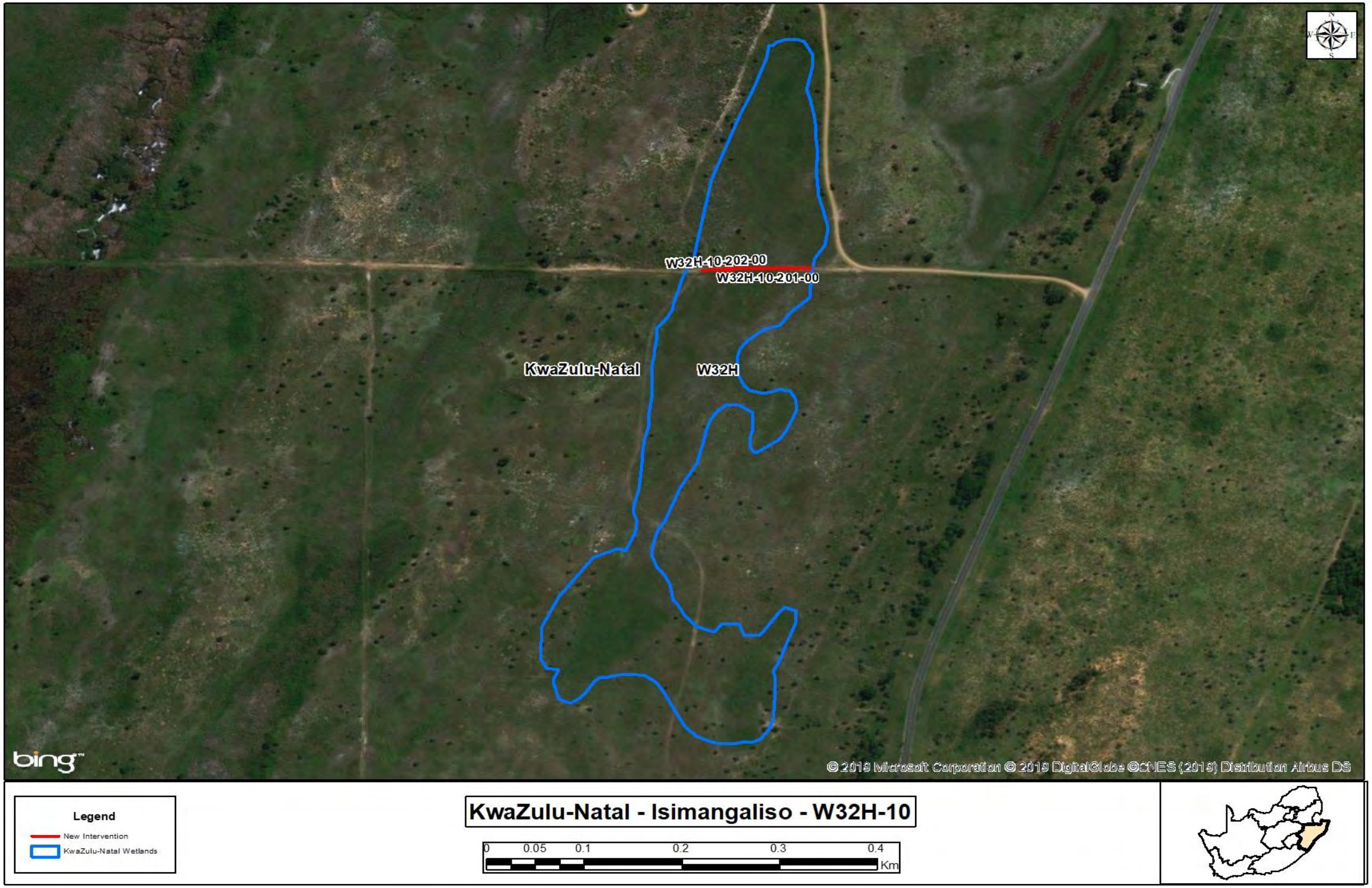



**Figure 21: Wetland map, W32H-10 with proposed new wetland interventions indicated**

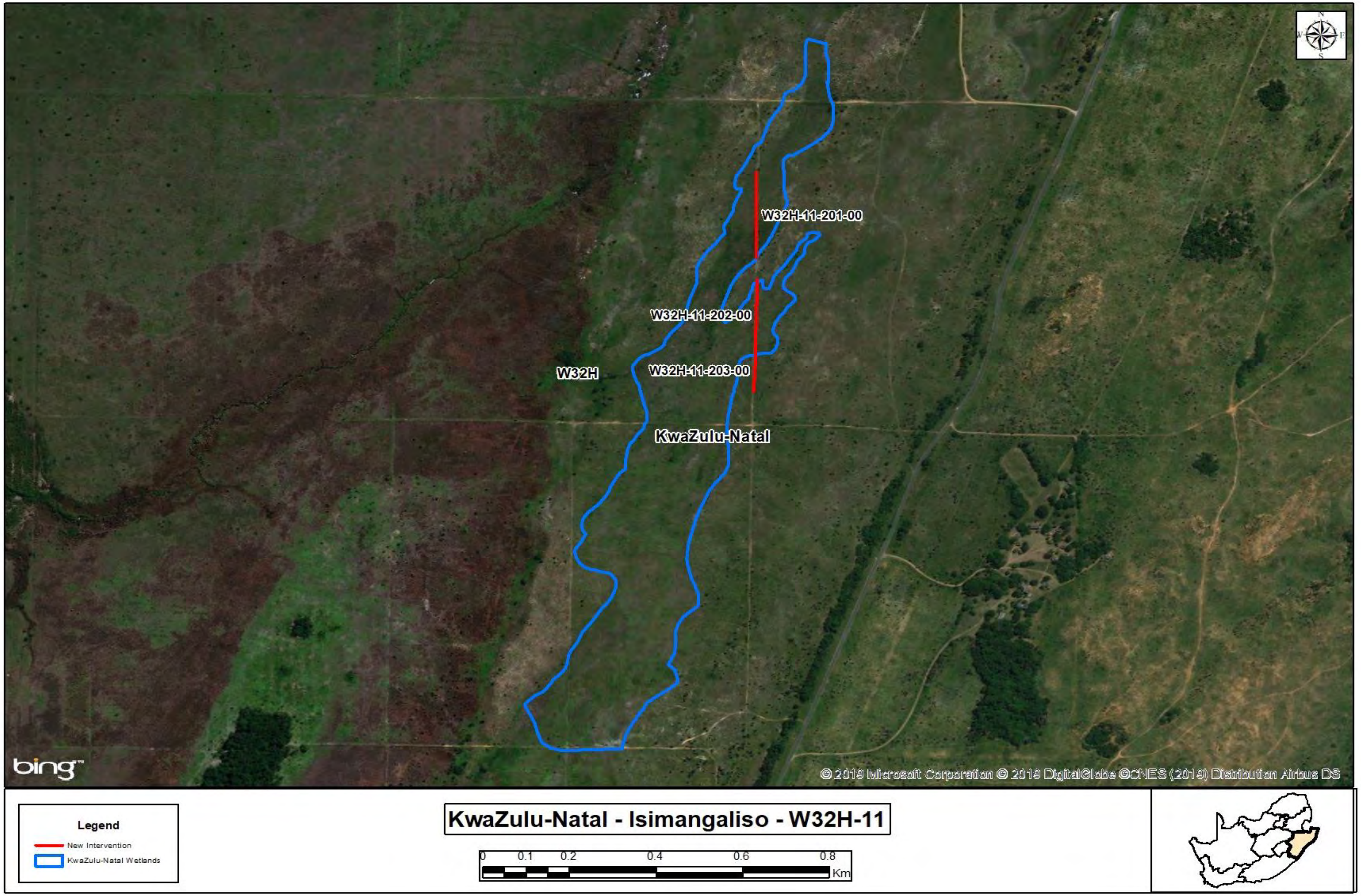



**Figure 22: Wetland map, W32H-11 with proposed new wetland interventions indicated**

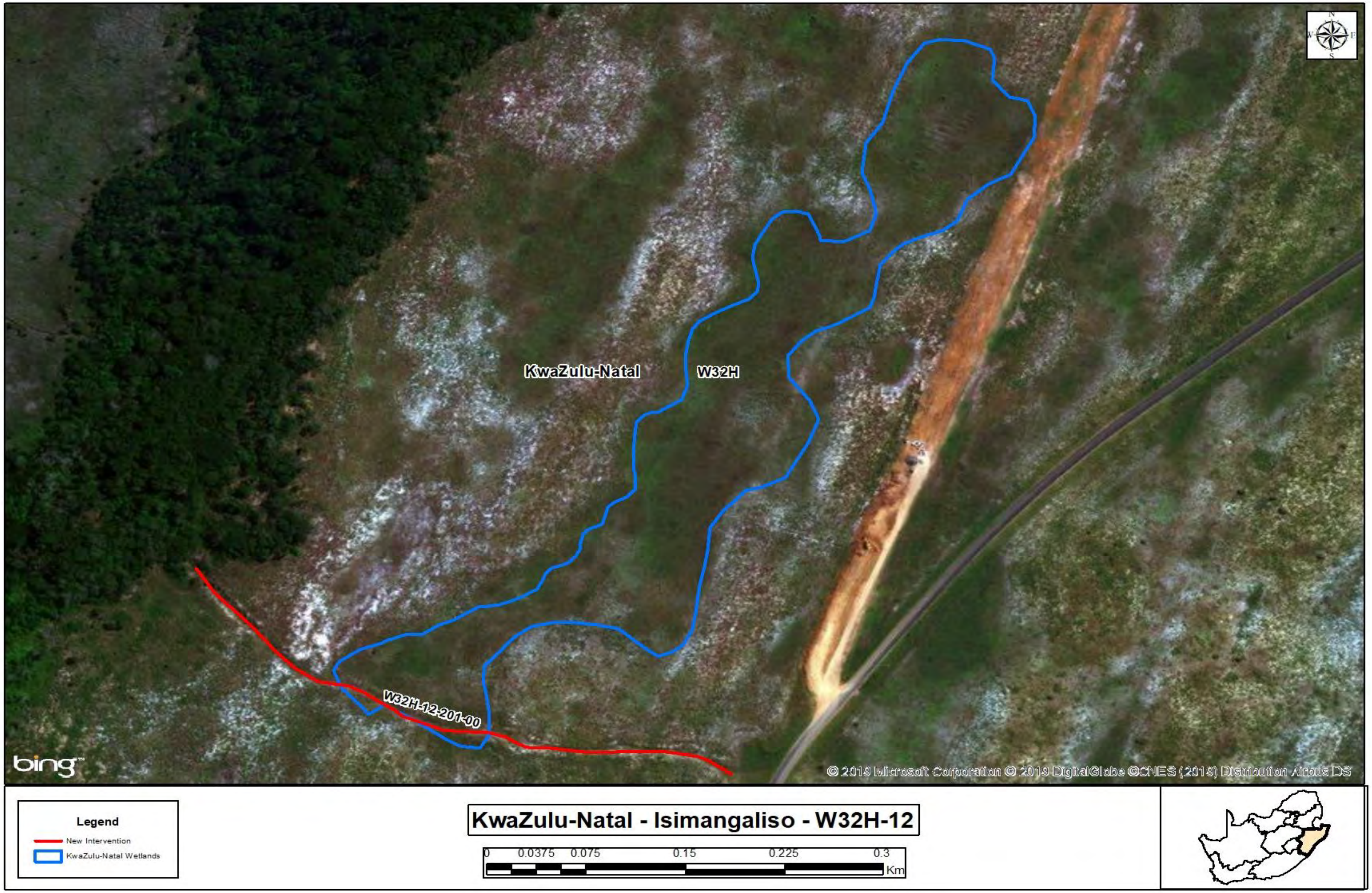



**Figure 23: Wetland map, W32H-12 with proposed new wetland interventions indicated**

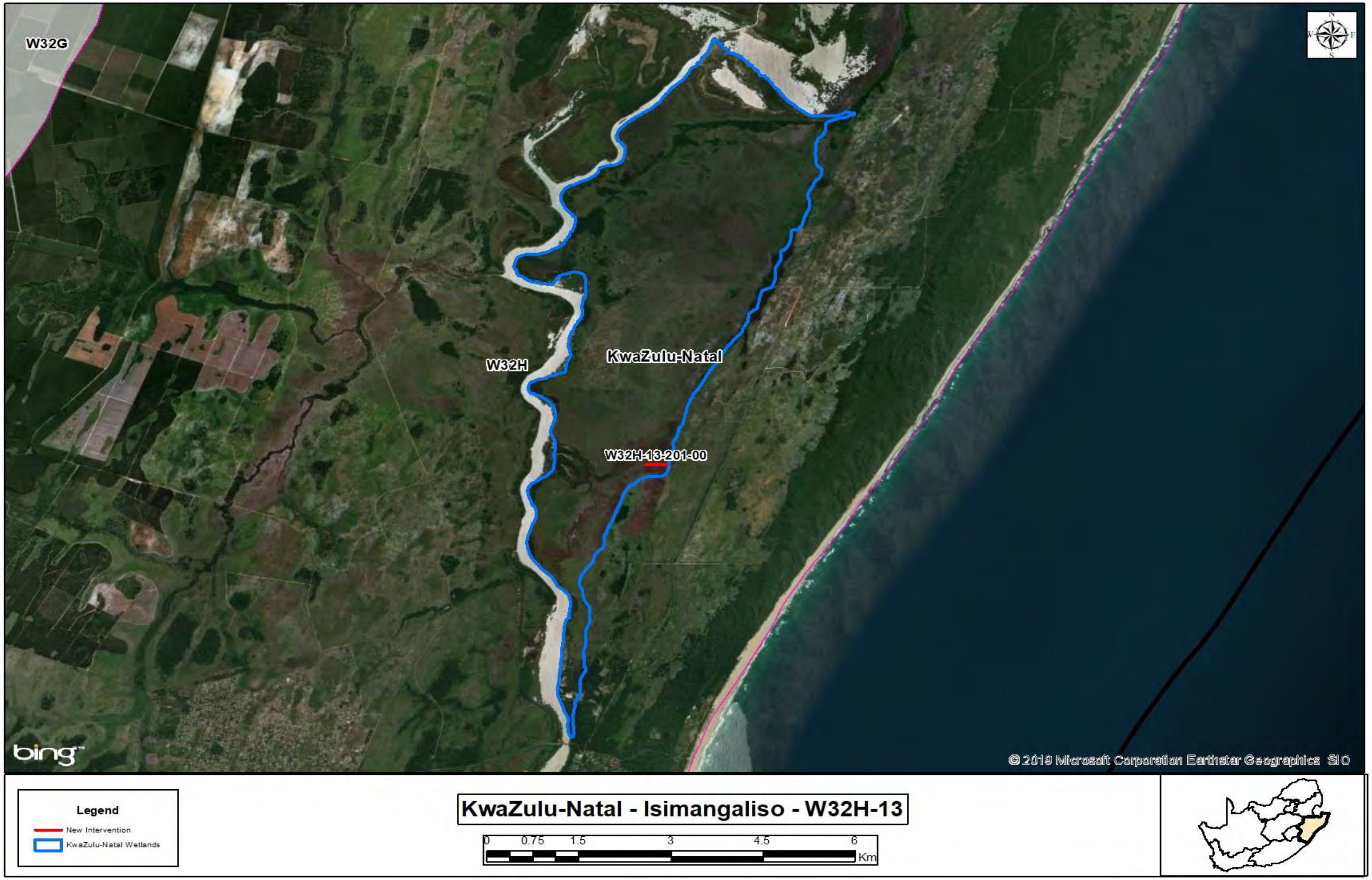



**Figure 24: Wetland map, W32H-13 with proposed new wetland interventions indicated**

## 4.6 Environmental Management Programmes issues

The proposed rehabilitation is to be undertaken on private land and the project team should access the site and manage the site in accordance with the WfWetlands Best Management Practices and specific requirements of the landowner. The implementation of these interventions must also take into account all relevant provisions of WfWetlands Best Management Practices and the EMPr, the recommendations of the approved Basic Assessments and Environmental Authorisation for the project. The Intervention Booklet, Environmental Authorisation and EMPr are included as **Appendices C, D and F** of this report, respectively, and shall accompany the Implementers to site.

## 4.7 Rehabilitation Monitoring

The collection of baseline information was carried out to be able to monitor and evaluate the effectiveness of the interventions, and to indicate any changes in the system associated with the wetland rehabilitation activities.

### *4.7.1 Baseline WET-Health data*

The assessment of the current level of ecological integrity of the wetland system provides a baseline assessment for comparative assessments that would be carried out for monitoring purposes three years after completion of the wetland rehabilitation activities. The following WET-Health information was collected for the iSimangaliso Wetland (refer to **Appendix A**):

**Table 12: Summary of present wetland health of iSimangaliso based on the Wet-Health assessment**

| HGM Unit | Hectares | Hydrology | | Geomorphology | | Vegetation | |
|---|---|---|---|---|---|---|---|
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| W32H-03 (Floodplain complex) | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 699.00 | 0.0 | → | 0.17 | → | 2.25 | → |
| | PES Category | A | | A | | C | |
| | Overall Impact Score | 0.69 | | | | | |
| | Overall PES Category | A | | | | | |
| W32H-04 (Hillslope Seep) | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 17.96 | 0.0 | → | 1.26 | ↑ | 4.43 | → |
| | PES Category | A | | B | | D | |
| | Overall Impact Score | 1.63 | | | | | |
| | Overall PES Category | B | | | | | |
| W32H-05 (Floodplain complex) | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 66.79 | 0.00 | → | 0.55 | → | 3.74 | → |
| | PES Category | A | | A | | C | |
| | Overall Impact Score | 1.23 | | | | | |
| | Overall PES Category | B | | | | | |

| HGM Unit | Hectares | Hydrology | | Geomorphology | | Vegetation | |
|---|---|---|---|---|---|---|---|
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| W32H-06 (Hillslope Seep) | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 1.47 | 1.00 | ↑ | 0.81 | → | 2.94 | → |
| | **PES Category** | B | | A | | C | |
| | **Overall Impact Score** | **1.50** | | | | | |
| | **Overall PES Category** | **B** | | | | | |
| W32H-07 (Unchannelled Valley Bottom) | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 49.97 | 0.00 | → | 0.34 | → | 1.61 | → |
| | **PES Category** | B | | A | | B | |
| | **Overall Impact Score** | **0.56** | | | | | |
| | **Overall PES Category** | **A** | | | | | |
| W32H-08 (Unchannelled Valley Bottom) | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 14.80 | 3.00 | ↑ | 2.33 | → | 5.81 | → |
| | **PES Category** | C | | C | | D | |
| | **Overall Impact Score** | **3.61** | | | | | |
| | **Overall PES Category** | **C** | | | | | |
| W32H-09 (Depression) | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 5.77 | 0.00 | → | 0.18 | → | 4.19 | → |
| | **PES Category** | A | | A | | D | |
| | **Overall Impact Score** | **1.25** | | | | | |
| | **Overall PES Category** | **B** | | | | | |
| W32H-10 (Unchannelled Valley Bottom) | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 5.95 | 0.0 | → | 1.34 | → | 0.37 | → |
| | **PES Category** | A | | A | | A | |
| | **Overall Impact Score** | **0.20** | | | | | |
| | **Overall PES Category** | **A** | | | | | |
| W32H-11 (Unchannelled Valley Bottom) | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 21.45 | 0.00 | → | 0.66 | → | 2.40 | → |
| | **PES Category** | A | | A | | C | |
| | **Overall Impact Score** | **0.87** | | | | | |
| | **Overall PES Category** | **A** | | | | | |

<table>
<tr><th rowspan="2">HGM Unit</th><th rowspan="2">Hectares</th><th colspan="2">Hydrology</th><th colspan="2">Geomorphology</th><th colspan="2">Vegetation</th></tr>
<tr><th>Impact Score</th><th>Trajectory Symbol</th><th>Impact Score</th><th>Trajectory Symbol</th><th>Impact Score</th><th>Trajectory Symbol</th></tr>
<tr><td rowspan="6">W32H-12 (Depression)</td><td rowspan="2">Hectares</td><td colspan="2">Hydrology</td><td colspan="2">Geomorphology</td><td colspan="2">Vegetation</td></tr>
<tr><td>Impact Score</td><td>Trajectory Symbol</td><td>Impact Score</td><td>Trajectory Symbol</td><td>Impact Score</td><td>Trajectory Symbol</td></tr>
<tr><td>5.78</td><td>1.00</td><td>→</td><td>0.00</td><td>→</td><td>2.13</td><td>→</td></tr>
<tr><td>PES Category</td><td colspan="2">B</td><td colspan="2">A</td><td colspan="2">C</td></tr>
<tr><td>Overall Impact Score</td><td colspan="6">1.04</td></tr>
<tr><td>Overall PES Category</td><td colspan="6">B</td></tr>
<tr><td rowspan="6">W32H-13</td><td rowspan="2">Hectares</td><td colspan="2">Hydrology</td><td colspan="2">Geomorphology</td><td colspan="2">Vegetation</td></tr>
<tr><td>Impact Score</td><td>Trajectory Symbol</td><td>Impact Score</td><td>Trajectory Symbol</td><td>Impact Score</td><td>Trajectory Symbol</td></tr>
<tr><td>2411.40</td><td>0.00</td><td>→</td><td>0.21</td><td>→</td><td>0.89</td><td>→</td></tr>
<tr><td>PES Category</td><td colspan="2">A</td><td colspan="2">A</td><td colspan="2">A</td></tr>
<tr><td>Overall Impact Score</td><td colspan="6">0.31</td></tr>
<tr><td>Overall PES Category</td><td colspan="6">C</td></tr>
</table>

# 5 REFERENCES


Cowden C. and Kotze D.C. 2008. WETRehabEvaluate: Guidelines for the monitoring and evaluation of wetland rehabilitation projects. WRC Report No TT 342/08, Water Research Commission, Pretoria.

Department of Water and Sanitation. 2011. The Groundwater Dictionary, Second Edition, Available at https://www.dwa.gov.za/groundwater/groundwaterdictionary.aspx.

Eco-Pulse Environmental Consulting Services. 2015. Wetland Status Quo Report: Project Name: Ivanhoe (U20A-01, U20A-02 and U20A-03).

Kotze D.C., Marneweck G.C., Batchelor A.L., Lindley D.S. and Collins N.B. 2008. *WETEcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands*. WRC Report No. TT 339/08. Water Research Commission, Pretoria.

Macfarlane D.M., Kotze D., Ellery W., Walters D., Koopman V., Goodman P., and Goge C. 2009. WET-Health: A technique for rapidly assessing wetland health. WRC Report TT 340/09. Wetlands Research Programme: Wetland Rehabilitation (WRC Project No. K5/1408). Water Research Commission, Pretoria.

Middleton, B.J. & Bailey, A.K. 2008. Water Resources of South Africa, 2005 Study (WR2005). Water Research Commission (WRC) Report TT380/08, Pretoria.

Mucina, L and Rutherford, MC. 2006. The Vegetation of South Africa, Lesotho and Swaziland, Strelitzia 19, South African National Biodiversity Institute: Pretoria.

Nel J.L. and Driver A. 2012. *South African National Biodiversity Assessment 2011: Technical Report. Volume 2: Freshwater Component*. CSIR Report Number CSIR/NRE/ECO/IR/2012/0022/A, Council for Scientific and Industrial Research, Stellenbosch.

SANBI Biodiversity GIS. 2018. BGIS Map Viewer KwaZulu-Natal Biodiversity Conservation Plan. [ONLINE] Available at: http://bgis.sanbi.org. [Accessed 16 February 2019]

UNESCO. 2000. Water use in the world: present situation/future needs. United Nations Educational, Scientific and Cultural Organization, http://www.unesco.org.

Wetland Status Quo Report: Maputaland and iSimangaliso Wetland Park. Prepared by Ixhaphozi Enviro Services. Author: Piet-Louis Grundling.

Working for Wetlands. 2017. Maputaland Phase 1: Wetland Rehabilitation Planning Report. Prepared GroundTruth, on behalf of Aurecon South Africa (Pty) Ltd as part of the planning phase for the Working for Wetlands Rehabilitation Programme. Report No. GTW561-KZN-Maputaland-PH1-2017.

Working for Wetlands Programme. 2019. Working for Wetlands Rehabilitation Programme, KwaZulu-Natal Province: Final Basic Assessment Report. Prepared by Aurecon. Report number: 113223/12033a.

# APPENDIX A

# WETLAND STATUS QUO REPORT

# WORKING FOR WETLANDS
# PROVINCE: KWAZULU-NATAL
# PROJECT: iSimangaliso

## Phase 2: Wetland Status Quo Report

DRAFT

February 2019

Report Reference: GTW561-060319-01

GroundTruth
Water, Wetlands and Environmental Engineering

# Report Control

<table>
<tr><th colspan="6">Document control</th></tr>
<tr><td colspan="2">Report title</td><td colspan="4">KZN iSimangaliso Phase 2: Wetland Status Quo Report</td></tr>
<tr><td colspan="2">Document ID</td><td colspan="2">GTW561-060319-01</td><td>Client project number</td><td></td></tr>
<tr><td colspan="2">Prepared by</td><td colspan="4"></td></tr>
<tr><td colspan="2">Client</td><td colspan="4">Aurecon South Africa (Pty) Ltd<br>PO Box 494<br>Cape Town<br>8000</td></tr>
<tr><td colspan="2">On behalf of</td><td colspan="4">Working for Wetlands Programme (WfWets)<br>Department of Environmental Affairs: Natural Resource Management<br>Private Bag X447<br>0001</td></tr>
<tr><td colspan="2">Client contact</td><td>Ms Claire Blanché<br>Tel: 021 526 6937</td><td>WfWet contact</td><td colspan="2">Dr Farai Tererai</td></tr>
<tr><td>Rev</td><td>Date</td><td colspan="2">Revision details/status</td><td colspan="2">Approver</td></tr>
<tr><td>0</td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td>1</td><td></td><td colspan="2"></td><td colspan="2"></td></tr>
<tr><td colspan="2">Contributors</td><td colspan="4"></td></tr>
<tr><td colspan="2">Report reference</td><td colspan="4"></td></tr>
<tr><th colspan="6">Approval</th></tr>
<tr><td colspan="2">Author signature</td><td colspan="2"></td><td rowspan="6">Date</td><td rowspan="6">06/03/2019</td></tr>
<tr><td colspan="2">Name</td><td colspan="2">Craig Cowden</td></tr>
<tr><td colspan="2">Title</td><td colspan="2">Mister</td></tr>
<tr><td colspan="2">Author signature</td><td colspan="2"></td></tr>
<tr><td colspan="2">Name</td><td colspan="2">Steven Ellery</td></tr>
<tr><td colspan="2">Title</td><td colspan="2">Mister</td></tr>
</table>

# Table of Contents

# List of Tables

# List of Figures

# List of Acronyms

| Acronym | Explanation |
|---|---|
| CARA | Conservation of Agricultural Resources Act |
| DAFF | Department of Agriculture, Forestry and Fisheries |
| DWS | Department of Water and Sanitation |
| EIS | Ecological Importance and Sensitivity |
| EPWP | Expanded Public Works Programme |
| HGM | Hydrogeomorphic |
| IDP's | Integrated Development Plans |
| KZN | KwaZulu-Natal |
| NEMA | National Environmental Management Act |
| NEMBA | National Environmental Management: Biodiversity Act |
| NRM | Natural Resource Management Programme |
| NWA | National Water Act |
| PES | Present Ecological State |
| PGS | Present Geomorphic State |
| PHS | Present Hydrological State |
| PIP | Project Implementation Plan |
| PVS | Present Vegetation State |
| WfWets | Working for Wetlands |

# Glossary of Terms

| Term | Explanation |
|---|---|
| **Best Management Practise (BMP)** | Procedures and guidelines to ensure the effective and appropriate implementation of wetland rehabilitation by WfWets implementers. Such practises are informed by applied research. |
| **Biophysical** | The biological and physical components of the environment (Cowden and Kotze, 2008). |
| **Catchment** | All the land area from mountaintop to seashore which is drained by a single river and its tributaries. Each catchment in South Africa has been subdivided into secondary catchments, which in turn have been divided into tertiary catchments. Finally, all tertiary catchments have been divided into interconnected quaternary catchments. A total of 1946 quaternary catchments have been identified for South Africa. These subdivided catchments provide the main basis on which catchments are subdivided for the integrated catchment planning and management (Cowden and Kotze, 2008). |
| **Ecosystem services or eco services'** | The service such as sediment trapping or water supply, supplied by an ecosystem (in this case a wetland ecosystem). |
| **Enhancement** | The modification of specific structural features of an existing wetland to increase one or more functions based on management objectives, typically done by modifying site elevations or the proportion of open water |
| **Intervention** | A method of wetland rehabilitation that aims to address the objectives of the particular wetland system, namely to restore the hydrological integrity of the system and support associated biodiversity. It can be in the form of a hard (structures made of hard materials which are fixed e.g. a concrete weir or soft interventions e.g. re-vegetation) |
| **Intervention – hard** | An intervention that's predominant material comprises concrete and/or gabions |
| **Intervention - soft** | An intervention that is considered to be predominantly earthworks based |
| **Mitigation** | Actions to reduce the impact of a particular activity |
| **Maintenance** | The replacement, repair or the reconstruction of an existing structure within the same footprint, the same location, having the same capacity and performing the same function as the previous structure ('like for like'). |
| **Project** | An area of WfWets intervention generally defined by a quaternary catchment or similar management unit such as a national park in which a single implementer operates. |
| **Quantum GIS** | A GIS programme that is used to present all data at a spatial scale |
| **Quaternary catchments** | "A fourth order catchment in a hierarchical classification system in which a primary catchment is the major unit: and that is also the "principal water management unit in South Africa' (DWS, 2011). |
| **Rehabilitation** | 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" (Kotze et al., 2008:p14). A system that is rehabilitated is not expected to be restored back to its reference state/benchmark |
| **Significant impact** | An impact that by its magnitude, duration, intensity or probability of occurrence may have a notable effect on one or more aspects of the environment. |
| **Wetland** | "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" (National Water Act No. 36 of 1998). |

| | |
|---|---|
| **Working for Wetlands** | Working for Wetlands (WfWets) is a government programme managed under the Natural Resource Management Programme (NRM) of the Department of Environmental Affairs. It is a joint initiative with the Departments of Water and Sanitation (DWS), and Agriculture, Forestry and Fisheries (DAFF). |

# 1. OVERVIEW OF WORKING FOR WETLANDS

Working for Wetlands (WfWet) is a government programme managed under the Natural Resource Management Programme (NRM) of the Department of Environmental Affairs. It is a joint initiative with the Departments of Water and Sanitation (DWS), and Agriculture, Forestry and Fisheries (DAFF). In this way the programme is an expression of the overlapping wetland-related mandates of the three parent departments, and besides giving effect to a range of policy objectives, it also honours South Africa's commitments under several international agreements, especially the Ramsar Convention on Wetlands and climate conventions.

The programme is mandated to protect pristine wetlands, promote their wise-use and rehabilitate those that are degraded throughout South Africa. The restoration component of the programme functions within the principles of the Expanded Public Works Programme (EPWP) seeking to draw significant numbers of unemployed people into the productive sector of the economy, gaining skills while they work and increasing their capacity to earn an income.

## 1.1 Objectives of Working for Wetlands

WfWet engages with provinces, especially government departments and agencies responsible for biodiversity and environment, and municipalities through individual projects. A stronger working relationship with these spheres of government is being promoted through the programme's emphasis on partnerships. In particular, compatibility with Integrated Development Plans (IDPs) and rehabilitation project objectives will be a key area of future focus. WfWet encourages municipalities to participate in provincial wetland forums because they are the platform for the roll-out of all the programmes processes, including planning for future work. Provincial wetland forums also offer support from the government departments and private sectors that are represented. Partnerships with non-governmental organizations and the private sector are also critical, requiring collaboration and cooperation with a wider range of stakeholders and role players in the wetland management field. The newly identified strategic framework of WfWet has underlined the need for a more refined process that the programme is embarking on with catchment-scale planning. Catchment-scale planning seeks to promote ecosystem-scale outcomes, long-term custodianship, and embedding of rehabilitation in broader local institutions and frameworks. The recent move to a systematic wetland rehabilitation planning process has provided a fertile and conducive platform for partnerships to be formed and/or strengthened as it draws in a much wider stakeholder base. This is in line with NRM's objective to increase its footprint through Land User Incentive based projects.

## 1.2 Relevant Legislation, Policies and Guidelines Applicable to the Project

WfWet operates within the context of the Constitution (1996), whereby everyone has the right to an environment that is not harmful to their health and wellbeing, and that is protected. The following national legislation, amongst others, are thus applicable:

- National Environmental Management Act, 1998 (NEMA)
- National Environmental Management: Biodiversity Act, No 10 of 2004 (NEMBA)
- National Water Act, 1998 (NWA)
- Conservation of Agricultural Resources Act , 1993 (CARA)

This legislation both directs WfWet in its vision and objectives and regulates the wetland rehabilitation activities which WfWet carries out. WfWet has put in place systems to achieve compliance with all applicable legislation. For example, Basic Assessments for Environmental Authorisation are carried out for all listed activities involved in wetland rehabilitation to comply with NEMA and a Memorandum of Agreement is in place with DWS to ensure compliance with the water licensing requirements of the NWA.

## 1.3 Introduction to Project

The KwaZulu-Natal iSimangaliso Wetland Park Project has seen the rehabilitation of wetland habitat on both the Eastern and Western Shores of the St Lucia River. These wetland systems are located in the W32H quaternary catchment and are situated to the north of the town of St Lucia and south of Lake St Lucia (**Table 1.1**). The focus of the wetland rehabilitation in iSimangaliso Wetland Park has been the removal of old forestry-related infrastructure, such as roads, drains, borrow pits and excavations. The iSimangaliso Wetland Park was declared South Africa's first natural heritage site in 1999, therefore the rehabilitation and continued functioning of these precious wetlands is very important. The rehabilitation of wetlands within the iSimangaliso Wetland Park will contribute to positively improving the functioning and integrity of the wetlands, which will ultimately lead to enhancement of a variety of ecosystem services provided by these wetland systems.

**Table 1.1** provides a summary of the proposed areas earmarked for Phase 2 rehabilitation, whilst **Figure 1.1** provides a visual overview of the identified wetlands within their respective quaternary catchment.

**Table 1.1 Project area descriptions for the quaternary catchment included in the study**

| **Province** | **KwaZulu-Natal** |
|---|---|
| **Quaternary Catchment** | W32H |
| **Project Name** | iSimangaliso |
| **Land Owner / Partnership** | iSimangaliso Wetland Park |
| **Planning Phase** | Phase 2 |
| **Nearest Town** | St Lucia |
| **Previous Work** | Yes |
| **Project Description** | Identify new wetland rehabilitation opportunities within iSimangaliso |

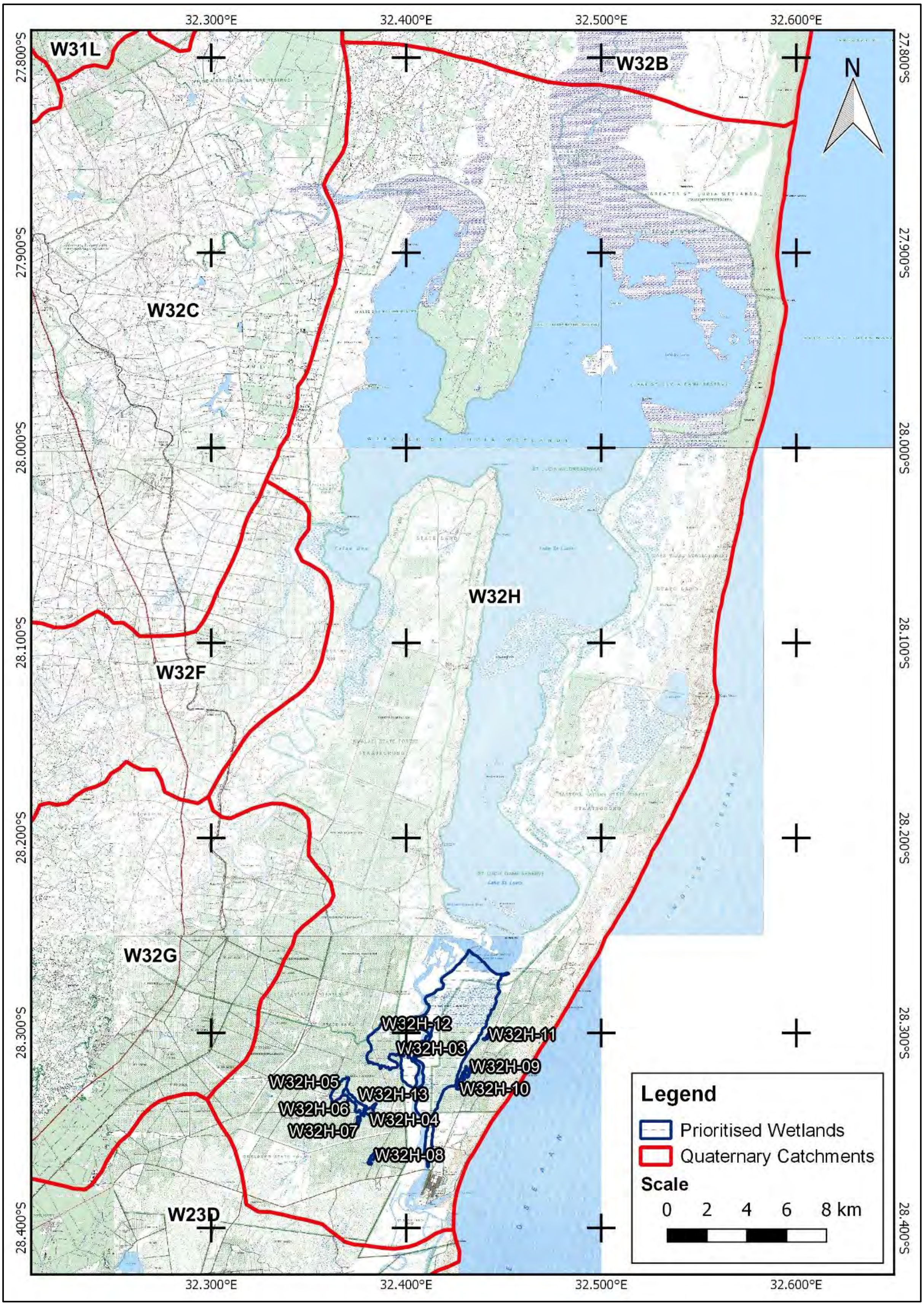



**Figure 1.1 Location of prioritised wetlands within their quaternary catchment**

# 2. METHODS

The rehabilitation of freshwater ecosystems is considered to be a complex undertaking and the planning process involves multiple disciplines. The relevant components of the following method description were adopted for the project and comprised of multiple steps, using existing information from previous studies and infield observations.

## 2.1 Assessment of Wetland Functioning and Condition

Determining the impacts on the wetland habitat requires the assessment and thus understanding of the levels of functioning and condition/integrity of the wetlands for the current and post-rehabilitation scenarios.

### 2.1.1 Assessment of Wetland Functioning

To quantify the level of functioning of the wetland systems, and to highlight their relative importance in providing ecosystem benefits and services at a landscape level, a WET-EcoServices (Kotze *et al.,* 2007) assessment was performed for the current and post-rehabilitation scenarios for all the high priority wetland systems identified during the WfWet Phase 1 planning phase. The WET-EcoServices assessment technique focuses on assessing the extent to which a benefit is being supplied by the wetland habitat, based on both:

- The opportunity for the wetland to provide the benefits; and
- The effectiveness of the particular wetland in providing the benefit.

Ecosystem services, which include direct and indirect benefits to society and the surrounding landscape, were assessed by rating various characteristics of the wetland and its surrounding catchment, based on the following scale:

- Low (0);
- Moderately Low (1);
- Intermediate (2);
- Moderately High (3); and
- High (4)

The scores obtained from these ratings for the wetland systems were then incorporated into WET-EcoServices scores for each of the fifteen ecosystem services (**Table 2.1**).

**Table 2.1 Ecosystem services supplied by wetlands**
(Kotze *et al.*, 2007, p14)

| | | | | | |
|---|---|---|---|---|---|
| **Ecosystem services supplied by wetlands** | **Indirect benefits** | **Regulating and supporting benefits** | Flood attenuation | | The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream |
| | | | Stream flow regulation | | Sustaining stream flow during low flow periods |
| | | | Water quality enhancement benefits | Sediment trapping | The trapping and retention in the wetland of sediment carried by runoff waters |
| | | | | Phosphate assimilation | Removal by the wetland of phosphates carried by runoff waters |
| | | | | Nitrate assimilation | Removal by the wetland of nitrates carried by runoff waters |
| | | | | Toxicant assimilation | Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters |
| | | | | Erosion control | Controlling of erosion at the wetland site, principally through the protection provided by vegetation |
| | | | Carbon storage | | The trapping of carbon by the wetland, principally as soil organic matter |
| | **Direct benefits** | **Biodiversity maintenance** | | | Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity |
| | | **Provisioning benefits** | Provision of water for human use | | The provision of water extracted directly from the wetland for domestic, agricultural or other purposes |
| | | | Provision of harvestable resources | | The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc. |
| | | | Provision of cultivated foods | | The provision of areas in the wetland favourable for the cultivation of foods |
| | | **Cultural benefits** | Cultural heritage | | Places of special cultural significance in the wetland, e.g. for baptism or gathering of culturally significant plants |
| | | | Tourism and recreation | | Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife |
| | | | Education and research | | Sites of value in the wetland for education or research |

### 2.1.2 Ecological Importance and Sensitivity

In accordance with DWAF (1999), the ecological importance of a water resource provides an expression of its importance to the maintenance of ecological diversity and functioning at local and wider scales. As WET-EcoServices does not provide a consolidated score that can be used as a target, the assessment scores were incorporated into the Ecological Importance and Sensitivity (EIS) assessment framework to provide an EIS score based on scores for ecological importance and sensitivity, hydro-functional importance, and direct human benefits (DWA, 2013). **Table 2.2** provides an overview of the ratings used to interpret the derived EIS scores.

**Table 2.2 Ecological Importance and Sensitivity Classes**

| Ecological Importance and Sensitivity Categories | Range of EIS Score | EIS Class |
|---|---|---|
| Very high: Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers. | 4 | **A** |
| High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quality and quantity of water in major rivers. | >3 and <4 | **B** |
| Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major river. | >2 and </=3 | **C** |
| Low/Marginal: Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers. | >1 and </=2 | **D** |
| None: Wetlands that are rarely sensitive to changes in water quality/hydrological regime. | 0 | **E** |

### 2.1.3 Assessment of Wetland Condition/Integrity

To determine the level of ecological integrity, a WET-Health (MacFarlane *et al.*, 2007) assessment was performed for the current, post-rehabilitation and without rehabilitation scenarios for the wetland systems (where appropriate). The WET-Health assessment technique gives an indication of the deviation of the system from the wetlands' natural reference condition for the following biophysical drivers:

- Hydrology - defined as the distribution and movement of water through a wetland and its soils;
- Geomorphology - defined as the distribution and retention patterns of sediment within the wetland; and
- Vegetation - defined as the vegetation structural and compositional state.

The impacts on the wetlands, determined by features of the wetlands and their catchments, were scored based on the impact scores and then represented as Present State Categories (PES) as outlined in WET-Health (**Table 2.3**).

**Table 2.3 Impact scores and present state categories for describing the integrity of wetlands** (MacFarlane *et al*., 2007)

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

The scores for hydrology, geomorphology and vegetation were simplified into a composite impact score, using the predetermined ratio of 3:2:2 (MacFarlane *et al.,* 2007) respectively for the three components. The composite impact score was used to derive a health score that then provided the basis for the calculation of hectare equivalents (also referred to as functional area), which can be described as the health of a wetland expressed as an area (Cowden et al. 2013).

## 2.2 Wetland rehabilitation and maintenance planning

A rehabilitation plan was compiled to achieve desired levels of functioning and integrity within the wetland systems. The compilation of the rehabilitation and maintenance plan was based on a site visit by the relevant specialists, including:

- A wetland specialist responsible for highlighting those problems identified as undermining the hydrological, geomorphic and vegetation integrity of the wetland habitat within the site and providing a rehabilitation strategy and objectives to achieve improvements in system functioning and integrity; and
- An environmental/soil conservation engineer responsible for identifying appropriate earthen, gabion and/or concrete interventions to achieve the rehabilitation objectives outlined by the ecologist.
- An Environmental Assessment Practitioner (EAP) responsible for over-seeing the proposed rehabilitation and determining whether environmental authorisation will be required for the overall strategy.
- The Provincial Coordinator (PC) for the province assists in identifying issues within various wetland systems and drives the relationship between the rehabilitation planning team and the affected communities. Often their understanding of the general landscape assists in defining the prioritised systems and identifying existing rehabilitation structures that may require maintenance activities.

- The iSimangaliso Land Care Management Department is responsible for the prioritisation of wetlands for rehabilitation, assisting in defining rehabilitation objectives and overseeing the implementation of the rehabilitation plan.

## 2.3 Monitoring and Evaluation

The monitoring and evaluation of the wetlands relies on collecting relevant baseline information, with the collected data including fixed point photographs. Furthermore, it should include the summary of the systems to be rehabilitated, including:

- Number of wetlands to be rehabilitated;
- Number of HGM units to be rehabilitated;
- Hectare equivalents gained/secured due to the rehabilitation; and
- Area (hectares) influenced by the proposed rehabilitation activities.

### 2.3.1 Fixed Point Photography/ Site Photographs

Where possible, pre-implementation photographs were recorded for the wetland and/or wetland complex, as outlined in WET-RehabEvaluate (Cowden and Kotze, 2009), to provide a visual baseline of the system prior to the implementation of the proposed rehabilitation activities. Visual monitoring can then be undertaken in subsequent years to document the changes of the systems.

### 2.3.2 Wetland Assessments

The ecological integrity and functioning of the wetlands should be monitored using the WET-Health (Macfarlane *et al.,* 2007) and WET-EcoServices (Kotze *et al.,* 2007) assessment techniques. The assessments undertaken for the Phase 2 planning will form the baseline data of the systems from which future assessments of the systems can be based.

# 3. ASSUMPTIONS AND LIMITATIONS

Studies that focus on the potential response of natural systems rely on various assumptions, with the following assumptions and limitations being made during the assessment of these particular wetland systems:

- The recovery of the vegetation on the site (under anticipated rehabilitated conditions) is expected to follow a pattern of succession from more terrestrial species to a more perennial, stable wetland plant community. For this reason, a lag period of a least five years was adopted to illustrate the medium-term impacts on vegetation following the hypothetical rehabilitation of the site.
- Assessment of impacts and rehabilitation outcomes is informed by a structured process, but is based on opinion rather than exact science (e.g. no supplementary monitoring of actual vegetation sampling was undertaken to assess the current mix of species within different areas).
- The assessment of importance and sensitivity is based on available desktop information and limited interactions with local stakeholders.
- The assessment of the wetland systems' ecological integrity includes catchment conditions and it should be noted that changes in the HGM units' catchments beyond those linked to the rehabilitation, may have an adverse effect on the systems' integrity. The assessment of wetland health is based on limited field assessments.
- The extent of wetlands was based on a combination of the KZN wetland priority area data (Macfarlane et al. 2011) and/or from previous planning cycles and desktop mapping and was subject to limited infield verification.
- The iSimangaliso wetlands form a large part of the Maputaland coastal plain wetland complex meaning that many of these wetlands are in direct contact with the regional water table. Therefore, they are fed both by their topographically defined catchments as well as a much larger catchment that feeds the regional water table. Therefore, the assessment of the catchment alterations to the water inputs are complicated by the fact that each wetland will receive varying contributions from these two sources.
- Due to the limited budget for implementation, only a select number of prioritised wetlands were considered by the rehabilitation team. These wetlands were prioritised, with input from iSimangaliso personnel, based on the following criteria:
  - Size of the affected wetland;
  - Catchment activities;
  - Type of rehabilitation (i.e. road removal, drain deactivation, pit infilling etc.);
  - Accessibility of rehabilitation site;
  - Relationship between proposed work and current rehabilitation work; and
  - Cost of proposed rehabilitation work.
- In order to accurately reflect the changes linked to the WfWets rehabilitation activities, the historical conditions within iSimangaliso Wetland Park needed to be considered. As such, historical imagery that both pre-dates and post-dates all forestry-related activity in the area was reviewed and disturbances were mapped based on the greatest extent of disturbance observed in historical imagery.

# 4. WETLAND DESCRIPTIONS

Planning associated with this project included a desktop review and infield verification of the issues within the identified wetland systems, the potential rehabilitation options and the prioritisation of systems based on anticipated returns associated with the proposed wetland rehabilitation initiatives. The prioritisation was done in communication with the Land Care Manager at iSimangaliso Wetland Park and directly informed the Phase 2 site visit with the engineering team to quantify and formalise the wetland rehabilitation approach to optimise the functioning of the selected wetlands. The selected wetlands are located within the W32H quaternary catchment which encompasses the iSimangaliso Wetland Park and includes Lake St Lucia within its watershed (**Table 4.1**). The focus of the rehabilitation is to remove old forestry infrastructure such as roads, drains and wetland crossings as well as to eradicate alien invasive vegetation from the freshwater ecosystems. Although there were a number of wetlands identified as candidate wetland systems for rehabilitation during the desktop assessment, due to the budget constraints, only 11 systems were prioritized for rehabilitation within the study site at this point in time (**Figure 4.1**).

**Table 4.1 Project area descriptions for each quaternary catchment included in the study**

| **Province** | **KwaZulu-Natal** |
|---|---|
| **Quaternary Catchment** | W32H |
| **Project Name** | iSimangaliso |
| **Land Owner / Partnership** | iSimangaliso Wetland Park |
| **Planning Phase** | Phase 2 |
| **Nearest Town** | St Lucia |
| **Previous Work** | Yes |
| **Project Description** | Identify new wetland rehabilitation opportunities within iSimangaliso |

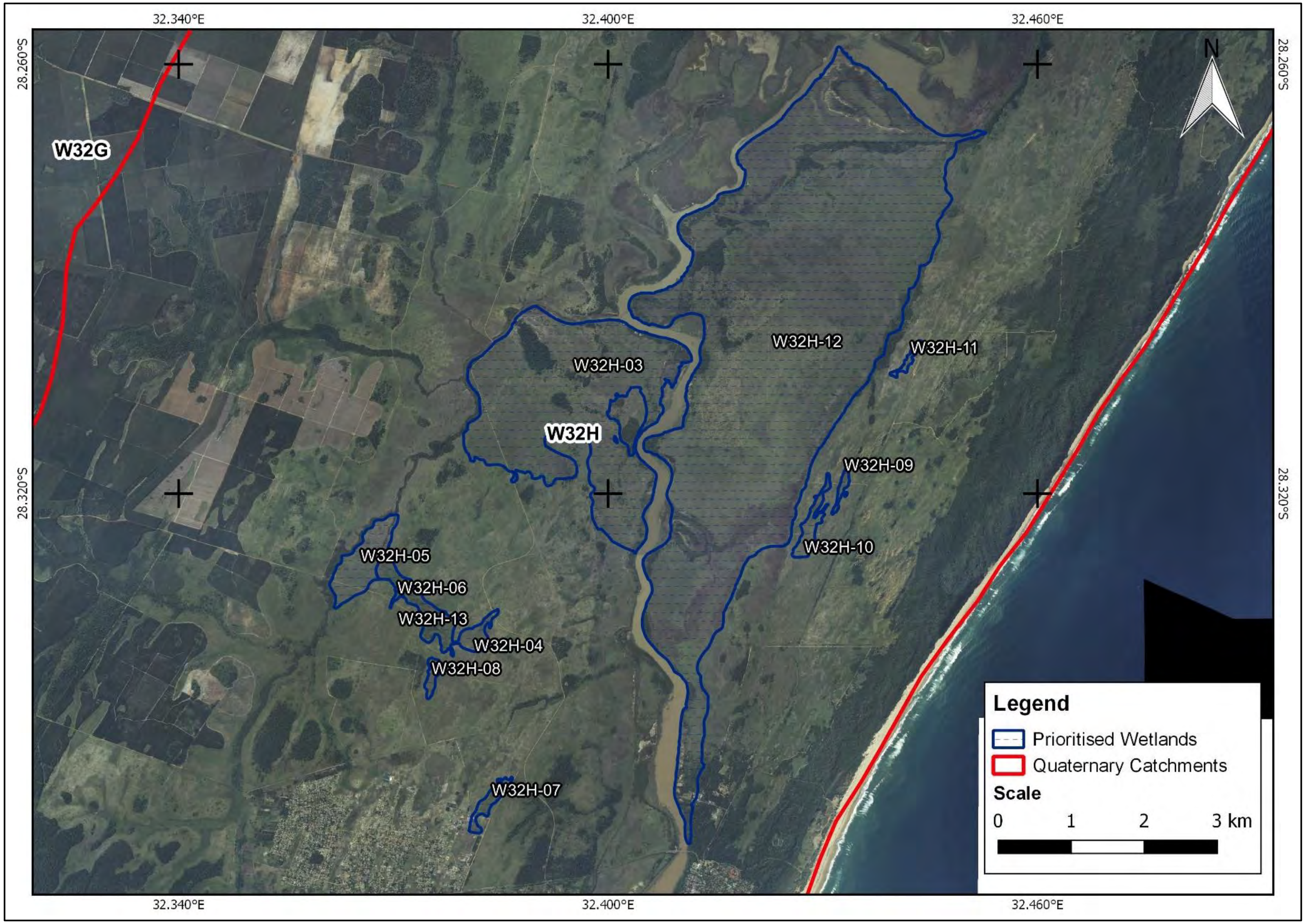



**Figure 4.1 Location of prioritised wetlands within their respective quaternary catchment**

**Table 4.2 Wetlands investigated during the desktop analysis**

| Quaternary Catchment | Wetland Label and Number | Latitude | Longitude |
|---|---|---|---|
| W32H | W32H-03 | 28°18'24.86"S | 32°23'47.12"E |
| | W32H-04 | 27°20'17.71"S | 32°22'57.42"E |
| | W32H-05 | 28°19'40.48"S | 32°21'55.70"E |
| | W32H-06 | 28°20'4.766"S | 32°22'13.11"E |
| | W32H-07 | 28°20'9.63"S | 32°22'31.19"E |
| | W32H-08 | 28°20'42.05"S | 32°22'32.85"E |
| | W32H-09 | 28°21'46.39"S | 32°23'1.031"E |
| | W32H-10 | 28°19'6.915"S | 32°25'59.57"E |
| | W32H-11 | 28°19'15.82"S | 32°25'46.1"E |
| | W32H-12 | 28°18'13.04"S | 32°26'24.07"E |
| | W32H-13 | 28°19'31.94"S | 32°25'25.09"E |

## 4.1 Wetlands identified for rehabilitation assessment

Based on recommendations made by the iSimangaliso Wetland Park Land Care Management Department and on the findings and prioritisation during the desktop analysis, eleven (11) wetlands that cover approximately 3300ha were selected for rehabilitation activities. These systems form part of the Maputaland coastal plain wetland complex, which is well connected to the local water table. Therefore, interaction between groundwater and surface water is constant – giving rise to such extensive wetland systems. **Table 4.3** provides a summary of the wetlands that have been included in the Phase 2 planning and the associated rehabilitation strategy.

**Table 4.3 Identified wetlands based on the desktop analysis and infield verification processes within W32H quaternary catchment.**

| Wetland Number | Hydrogeomorphic Unit | Area (ha) |
|---|---|---|
| W32H-03 | Floodplain complex | 699.00 |
| W32H-04 | Hillslope seep | 17.96 |
| W32H-05 | Floodplain complex | 66.79 |
| W32H-06 | Hillslope seep | 1.47 |
| W32H-07 | Unchannelled valley bottom | 49.97 |
| W32H-08 | Unchannelled valley bottom | 14.80 |
| W32H-09 | Depression | 5.77 |
| W32H-10 | Unchannelled valley bottom | 5.95 |
| W32H-11 | Unchannelled valley bottom | 21.45 |
| W32H-12 | Depression | 5.78 |
| W32H-13 | Floodplain complex | 2411.40 |

The iSimangaliso Wetland Park is characterised by large complexes of wetland area that have been rehabilitated for over 15 years. A large extent of these wetland areas was located on forestry land and as such were significantly degraded. Therefore, there is a lot of old remnant forestry infrastructure that is still nested within the wetland habitat that could be incorporated into future WFWets projects and would need to be subject to detailed planning.

## 4.2 Wetland 3 (W32H-03)

### 4.2.1 Wetland Details

**Table 4.4** provides a summary of the W32H-03 wetland, identified for further rehabilitation activities.

**Table 4.4 W32H-03 wetland details**

| | |
|---|---|
| **Wetland Name** | Wetland 3 |
| **Wetland Number/Label** | W32H-03 |
| **GPS Location** | 28° 18' 24.86"S<br>32° 23' 47.12"E |
| **Catchment Land Use** | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **Wetland Land Use** | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **Wetland Size (ha)** | 699.00 |

### 4.2.2 Wetland Characteristics

Wetland 3 (W32H-03) can be classified as a floodplain wetland complex meaning that the HGM unit is made up of multiple smaller wetland units that combine to form a large floodplain unit. The slope of the wetland is a very low 0.32% such that the overall wetland complex is characterised by many little conglomerations of open standing water. More than half of the HGM unit was historically planted with *Eucalyptus sp.* which were only removed between 2002 and 2010. Landscape features associated with these historical practices such as forestry roads, drains and river crossings have contributed to a reduction in wetland integrity and functioning of Wetland 3. Despite the complete clearing of all forestry related plant species, the forestry related infrastructure is still having a noticeable negative impact on wetland health.

The catchments associated with most wetlands located within the iSimangaliso Wetland Park are difficult to define for a number of reasons. The first and possibly the most important reason is the fact that these wetlands are part of the Maputaland coastal plain wetland complex which extends from south of St Lucia to as far north as the Kosi Bay area (Watkeys et al. 1993). These wetlands are characterised by complex groundwater interactions as they lie at low elevations and very close to sea level. The majority of the Maputaland coastal plain is underlain by late Mesozoic and Quaternary sequences which naturally lack mineral wealth and often weather to form very coarse, sandy substrates (Watkeys et al., 1993). These sandy substrates are often characterised by poor cation exchange capacities and by high hydraulic conductivities meaning that the surface-groundwater interaction is complex and difficult to define as water moves easily through the sandy substrates. According to Macfarlane et al. (2007), the Maputaland coastal plain is characterised by highly complex surface-groundwater interactions which confounds the delineation and definition of wetland catchments in these areas as wetlands are fed both by their topographically defined catchments as well as by a much larger catchment feeding the regional water table. The hydraulic contribution from these two sources is likely to vary from wetland to wetland and as such this complicates the definition of catchment extent and catchment associated impacts. This complicated surface-groundwater interaction is likely to run true for all wetlands (except for W32H-08 which lies on the western edge of the coastal plain) assessed in this rehabilitation cycle as they all sit within the Maputaland coastal plain complex. To avoid repetition, the descriptions of each wetland catchment will be limited to their topographically defined catchment. This description will serve as the description of the surface-groundwater interaction for the other wetland areas.

The topographically defined catchment area for Wetland 3 is characterised largely by natural wetland and terrestrial grassland areas and is relatively undisturbed. The wetland is defined on three sides by the Mpate and St Lucia Rivers and as such, the topographically-derived catchment area only extends to the south of the HGM unit. This area to the south slopes very gently towards two raised hillocks that sit 20m above the Mpate and St Lucia Rivers. The catchment boundary that lies in the valley between these two hills is artificially defined by a raised forestry road.

Wetland 3 is a large floodplain complex that is dominated by areas of shallow flooding interspersed with raised grassed hummocks. These shallow flooded areas are often characterised by *Cymbopogon validus, Cyperus polstachyos, Cyperus dives, Juncus effusus* and *Carex* sp. Other species that occurred within the wetland include *Cynodon dactylon, Centella asiatica, Stenotaphrum secundatum, Gomphocarpus fruticosus, Hyphaene coriacea* and *Phoenix reclinata*. A large area of indigenous forest runs down the centre of the HGM unit, which would be interspersed with shallow flooding during the wet season, similar to what was observed in the open grassed wetland areas. This wetland is thought to be sustained predominantly by precipitation and subsurface water inputs both originating from the topographically-defined catchment area and the regional water table. The majority of the northern and western sections of this wetland is defined by the Mpate River while the eastern section of the wetland is defined by the St Lucia Estuary. Therefore, the local water table is determined by the water level of these two waterbodies and it is assumed that the local water table beneath this wetland varies between <1m to no more than 7m deep.

As mentioned above, over half of this wetland was historically used as forestry land and there are still old forestry roads and drains that traverse the HGM unit (**Figure 4.2**). One of the old roads has been completely removed and revegetated in a previous rehabilitation cycle and another road is currently being removed and revegetated. There are still a number of roads that need to be removed from the HGM unit to completely clear the wetland of old forestry disturbances. A road, and the associated fire break, still runs the length of the primary wetland and interrupts some flows that would naturally flow in a north-westerly direction into the Mpate River. There are two old drains located in the south-eastern portions of the wetland that were historically used to drain the wetland to make way for plantations. Despite these disturbances the wetland appeared to be in a stable condition.

### 4.2.3 Benchmark reference state (W32H-03)

**Table 4.5** provides a summary of the benchmark / reference state characteristics of Wetland 3 (W32H-03).

**Table 4.5 Wetland 3 (W32H-03) reference benchmark state**

| Characteristic | Description |
|---|---|
| **HGM Unit** | Floodplain complex wetland. |
| **Wetness Regime** | Dominated by permanently and seasonally saturated soils. Fed by both surface and sub-surface water flows originating from local catchment and regional water table. |
| **Hydrology** | Under natural conditions, flow between shallow flooded areas would've been unhindered by roads or drains. |
| **Geomorphology** | Due to the gentle gradient, limited erosion and transportation of sediment out of the wetland would have occurred. |
| **Vegetation** | Vegetation would've been characterised by climax wetland species and the presence of disturbance tolerant pioneer species would've been limited. |

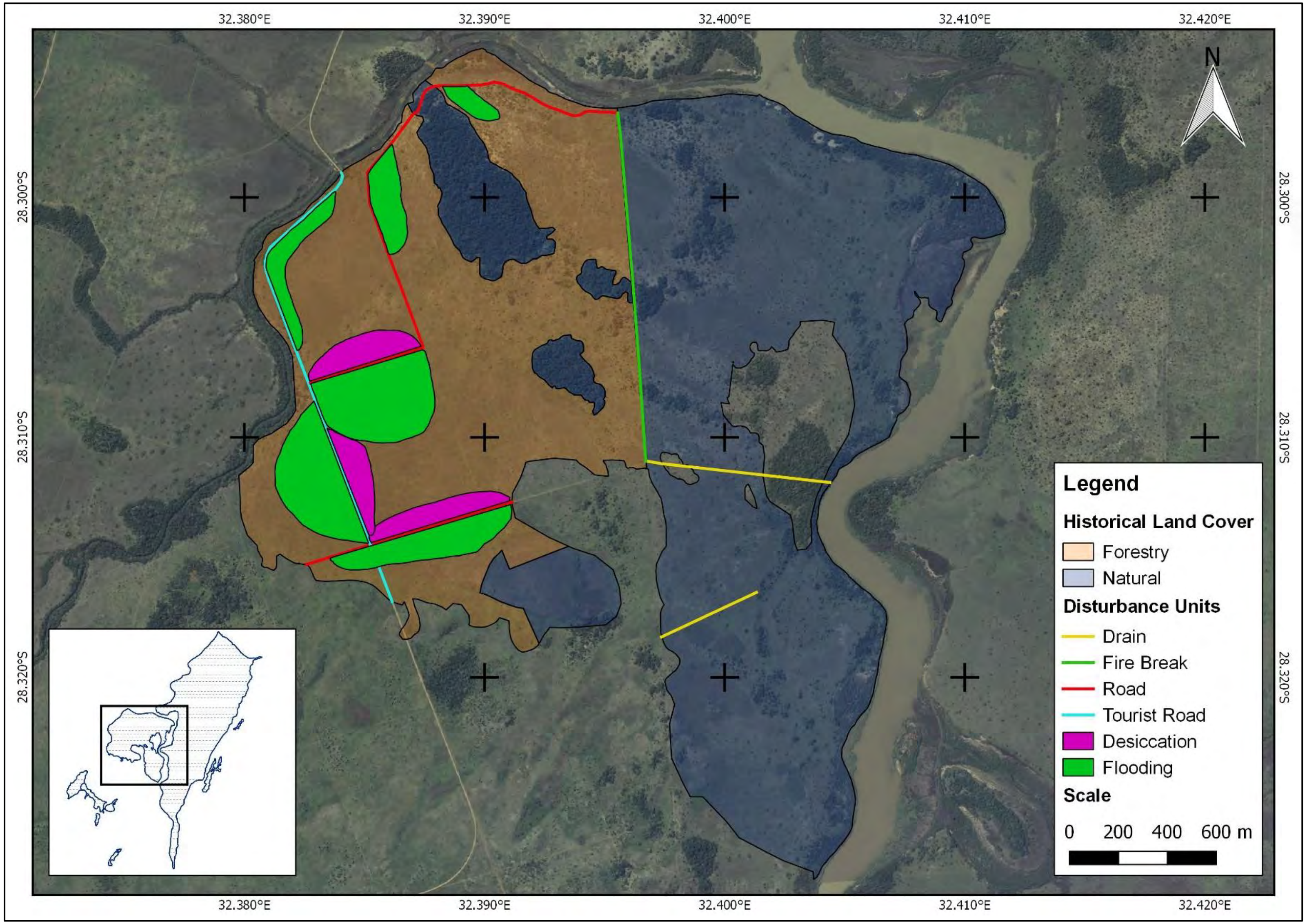



**Figure 4.2 Historical land use extents and current disturbance units in W32H-03 wetland**

## 4.3 Wetland 4 (W32H-04)

### 4.3.1 Wetland Details

**Table 4.6** provides a summary of Wetland 4 (W32H-04)

**Table 4.6 Wetland 4 (W32H-04) details**

| | |
|---|---|
| **Wetland Name** | Wetland 4 |
| **Wetland Number/Label** | W32H-04 |
| **GPS Location** | 27° 20' 17.71"S<br>32° 22' 57.42"E |
| **Catchment Land Use** | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **Wetland Land Use** | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **Wetland Size (ha)** | 17.96 |

### 4.3.2 Wetland Characteristics

Wetland 4 (W32H-04) can be classified as a hillslope seep wetland although there is a large flood-out zone located below the old forestry road where water would naturally connect to a wider stream network. There are sections of permanently, seasonally and temporarily wet areas within this HGM unit with the narrow hillslope seepage area remaining wet for the majority of the year and the flood-out zone remaining seasonally wet throughout the year. This flood-out zone has probably been created as a result of the construction of the tourist road to the south-west of the wetland as the road is raised and is made from highly consolidated material – preventing any flows from naturally exiting the wetland. There is only a single culvert beneath this road and all water entering Wetland 4 is channelled through this culvert to connect to another wetland area below the road. The old forestry roads within the southern bowl of the wetland have also possibly contributed to the expansion of the large bowl as they would deflect water in easterly and westerly directions as opposed to allowing water to flow down its natural course. Wetland 4 (W32H-04) was historically forestry plantation land as indicated by the old road network noted during the site visit. A review of the historical imagery showed that a large proportion of the wetland was subject to forestry cultivation, which would have severely limited the ability of the wetland to function in its natural state. However, rehabilitation within this HGM unit has been extensive and the majority of the evidence of forestry has been removed barring the road network and the area of infilling (**Figure 4.4**). The old forestry road at the head of the wetland is interrupting flows from the northern arm of the wetland to the southern bowl of the wetland as the road is raised and made from consolidated material. Water is being dammed up behind this road section and a small section of open water has formed behind the road (**Figure 4.3**)

The residual effects of forestry on the structure and functioning of wetlands is often great and can be difficult to identify. For example, the densely homogenous *Eucalyptus sp.* and *Pinus pinaster* plantations that characterised large portions of the iSimangaliso Wetland Park generally don't allow for the establishment of other plant species below their dense canopies. Therefore, when these plantations are removed for rehabilitation purposes, it is common for disturbance tolerant pioneer species to colonise the bare areas left behind. It can take decades before natural vegetation is able to re-establish in these disturbed areas. Therefore, it is common to see disturbance tolerant plant species such as *Cymbopogon validus, Pteridium* *aquilinum, Psidium guajava, Cynodon dactylon, Imperata cylindrica, Gomphocarpus fruticous, Stenotaphrum secundatum* and *Hyparrhenia rufa.* The bowl of the wetland is largely colonised by *Pteridium aquilinum* which is an indigenous invasive species that is often found in recently disturbed areas. *P. aquilinum* is known to be a fast-growing perennial species that is able to displace slower-growing wetland species as it is also able to tolerate relatively wet conditions. Without revegetation immediately after the removal of plantations, returning a wetland to its natural climax vegetative state can take a very long time, if ever. However, the rehabilitation of this wetland through the removal of the roads that still lie within the wetland extent would have a positive impact on the integrity and functioning of the wetland as the roads are currently interrupting natural hydrological processes in the wetland.

This wetland receives the majority of its water from subsurface flows, localised runoff and a secondary hillslope seep that is located in the eastern portion of the bowl of the wetland. This hillslope seep may have been absorbed into the bowl of the wetland as the bowl feature has expanded over time. The topographically-defined catchment for this particular wetland is relatively small as there are two hillocks to the north and south east of the wetland which act as the catchment boundary. The entire catchment was historically characterised by forestry land but through thorough rehabilitation and restoration of the catchment, the majority of the residual impacts of the structural plantation infrastructure have been removed.

The vegetation within the wetland area is a mix of obligate and facultative wetland species in the wetter areas of the HGM unit, with a mix of facultative wetland and terrestrial vegetation species in the drier areas of the HGM unit. The wetter areas are characterised by *Juncus* (c.f. *effusus* or *pallidus*), *Centella asiatica* and *Carex sp.* whereas the drier more terrestrial areas are characterised by *Cynodon dactylon, Themeda triandra Stenotaphrum secundatum, Scoparia dulcis* and *Hyphaene coriacea.*

**Figure 4.3 Photographic evidence of road interrupting natural flows in wetland. Area to the right of the road is the hillslope seep and area to the left (outside frame) is the bowl-shaped wetland area.**

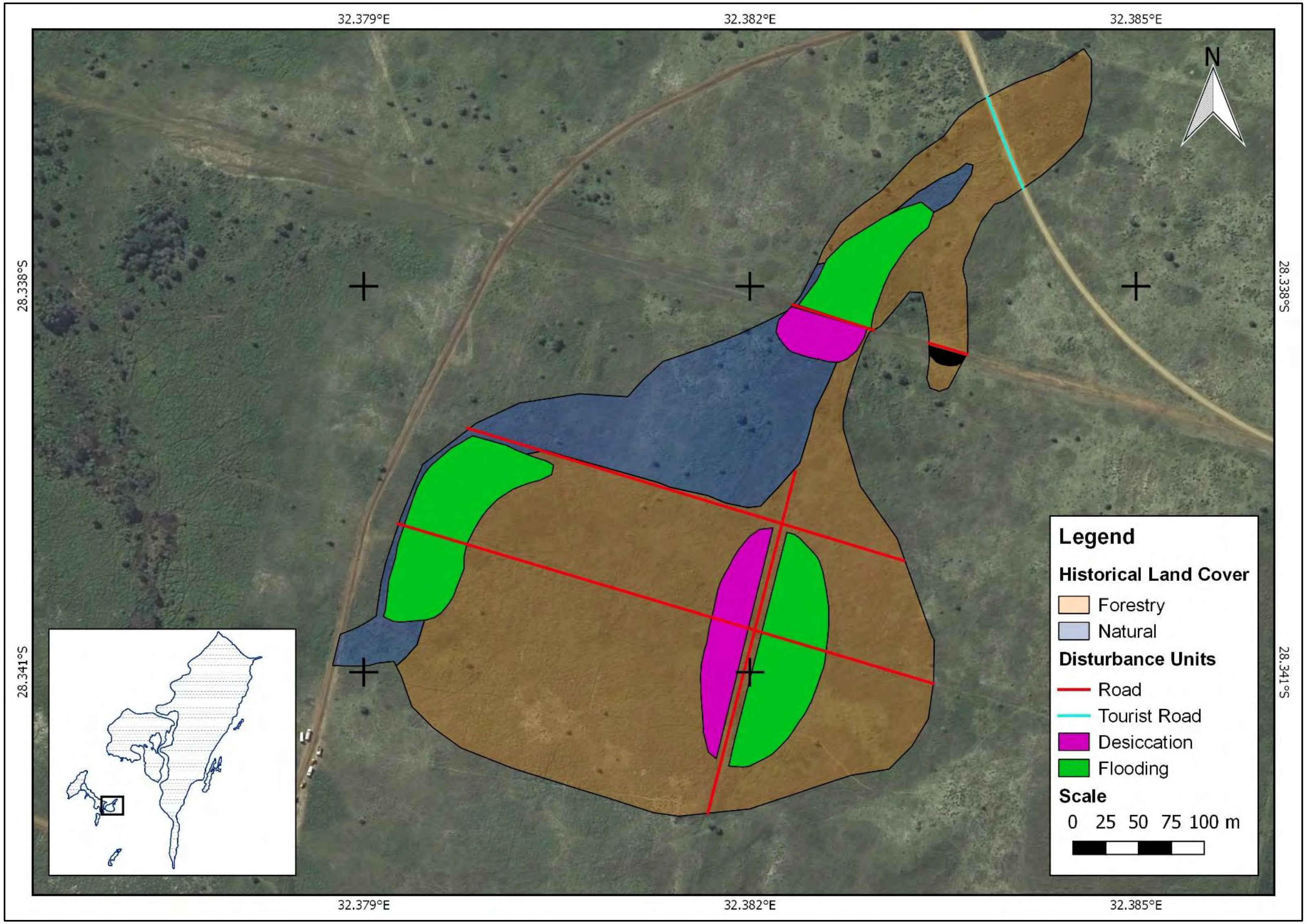



**Figure 4.4 Historical land uses and current disturbance units in Wetland 4 (W32H-04)**

### 4.3.3 Benchmark or reference state (W32H-04)

**Table 4.7** Wetland 4 (W32H-04) reference benchmark state provides a summary of the benchmark / reference state characteristics of Wetland 4 (W32H-04).

**Table 4.7 Wetland 4 (W32H-04) reference benchmark state**

| Characteristic | Description |
|---|---|
| **HGM Unit** | Hillslope seep with a link to a stream network |
| **Wetness Regime** | Under natural conditions the wetness regime would be characterised by a smaller section of seasonally wet areas as opposed to a larger area of temporary wetland. |
| **Hydrology** | Under natural conditions the flow through the wetland would have been less interrupted and the entire HGM unit would've been hydrologically linked. |
| **Geomorphology** | Due to the gentle gradient and the nature of the HGM unit, limited sediment transport would've occurred in the wetland. |
| **Vegetation** | Under natural conditions, the vegetation would've been more representative of a climax wetland vegetation mix as opposed to such a mix of wetland and disturbance tolerant species. Fewer terrestrial species would've been present within the HGM unit and the occurrence of *P. aquilinum* would've been significantly reduced. |

## 4.4 Wetland 5 (W32H-05)

### 4.4.1 Wetland Details

**Table 4.8** provides a summary of Wetland 5 (W32H-05), identified for rehabilitation activities.

**Table 4.8 Wetland 5 (W32H-05) details**

| | |
|---|---|
| **Wetland Name** | Wetland 5 |
| **Wetland Number/Label** | W32H-05 |
| **GPS Location** | 28° 19' 40.48"S<br>32° 21' 55.70"E |
| **Catchment Land Use** | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **Wetland Land Use** | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **Wetland Size (ha)** | 66.79 |

### 4.4.2 Wetland Characteristics

Wetland 5 (W32H-05) can be classified as a floodplain complex wetland with a riparian channel running up the eastern side of the HGM unit (**Figure 4.5**). The wetland area is extremely flat and is characterised by many shallow pools of open water that gather in localised topographic depressions. The HGM unit slopes very gently towards the Mpate River which defines the entire northern and western banks of the wetland and acts as a local control point for the wetland. The gentle gradient of the wetland encourages consistently diffuse flows throughout the wetland and allows for a very long water retention time. Therefore, the wetland is characterised by large tracts of permanently and seasonally wet soils where continued flooding on the surface occurs. There are also higher-lying sections within the HGM unit, which are characteristically drier and only temporarily wet during the year meaning that more terrestrial plant species can colonise these areas.

Upon a review of the historical imagery for the system, it is clear that intense forestry practices took place within the majority of the HGM unit at least since 1965 (earliest available image containing evidence of forestry practices). Despite intense rehabilitation in iSimangaliso Wetland Park to remove the remaining impacts of the plantation infrastructure, there are still remnants of this infrastructure that are interrupting the natural functioning of Wetland 5. There are three old forestry roads that traverse the HGM unit. One of these roads follows the Mpate River channel along the northern-most border of the wetland and is thought to be interrupting flows out of the wetland into the Mpate River. Another forestry road runs across the mid-section of Wetland 5 and partially interrupts connectivity of the southern section of the wetland with the northern section. However, this road has been trampled by hippo and buffalo in some places and the earth used to create it has been spread back to its natural grade, therefore only sections of this road are still interrupting hydrological flows. An earthen bridge associated with this road has been constructed across the riparian area in the eastern portion of this wetland. The eastern quarter of the bridge has been removed and flows down the riparian channel have been reinstated as a result of this, but there is a large section of the riparian channel that is still blocked by the earthen bridge. There is another small section of old forestry road that is located in the south-western corner of the wetland. The tourist road that is currently used by iSimangaliso Wetland Park cuts the southern section of the wetland in two as it is a raised road with no culverts to allow for through flow. Therefore, there is a large damming effect upstream (to the south) of the tourist road as well as an area downstream of the tourist road where the wetland is being starved of its natural water inputs as a result of the road. Ultimately, the infrastructure is having an effect on the integrity and functioning of the wetland and there would be benefits derived from removing a number of these structures. The residual effects of the plantations are also still evident within the wetland as there are a number of disturbance tolerant plant species that are present throughout the HGM unit such as *Cynodon dactylon*, *Cymbopogon validus, Stenotaphrum secundatum* and *Hyparrhenia rufa.* During the site visit, a large number of *Psidium guajava* plants – an alien invasive species – were observed within the drier portions of the HGM unit. The majority of these plants were still saplings of relatively uniform size as a fire had swept through the drier sections of this HGM unit in recent years and was responsible for killing off most of the adult *P. guajava* plants. These trees are disturbance-tolerant invasive species and if left to grow in the drier areas of the wetland, they could have adverse effects on species composition and water levels within the wetland.

Wetland 5 receives the majority of its water contributions from the regional water table as well as its topographically-defined catchment. As mentioned in **Section 4.2.2**, the soils in the Maputaland coastal plain are extremely porous such that much of the water that falls within this wetland's topographically-derived catchment will only enter into the HGM unit via subsurface flows if it enters the wetland at all. Wetland 5 receives some of its water from Wetlands 2 and 4 which are located to the east of Wetland 5 and flow in a westerly direction into Wetland 5. Wetland 7 is an unchannelled valley bottom wetland that ultimately collects water from Wetlands 4 and 6 before it decants into Wetland 5. However, much of the water inputs from Wetland 7 are directed into the riparian channel and diverted out of Wetland 5 via this channel.

The vegetation within the wetland is a mix of wetland and terrestrial plant species that are generally limited to their natural zones of wetness. However, a number of facultative wetland species such as *Cymbopogon validus, Centella asiatica, Cyperus fastigiatus* and *Cyperus polystachyos* were observed in both the dry and wetter areas. The terrestrial areas and the more temporary wetness zones were often colonised by grass species such as *Cymbopogon validus, Hyparrhenia rufa, Cynodon dactylon* and *Stenotaphrum secundatum.* Other species such as *Cassinopsis tiniflora, Psidium guajava, Gomphocarpus fruticosus, Phoenix reclinata* and *Hyphaene coriacea* were also found in the more temporary wetness zones. The vegetation within the more seasonal and permanent zones was comprised of *Juncus effusus, Juncus pallidus, Carex sp., Cyperacea* (c.f. *congestus, fastigiatus, dives* and *polystachyos*), *Phragmites australis* and *Eleocharis dregeana.*

### 4.4.3 Benchmark or reference state W32H-05

**Table 4.9** provides a summary of the benchmark / reference state characteristics of W32H-05.

**Table 4.9 Wetland 5 (W32H-05) reference benchmark state**

| Characteristic | Description |
|---|---|
| **HGM Unit** | Floodplain complex wetland |
| **Wetness Regime** | Dominated by seasonally and permanently wet soils with a mix of temporary wetland and terrestrial areas. |
| **Hydrology** | Under natural conditions the flow through the wetland would have been less interrupted and the entire HGM unit would've been hydrologically linked. The tourist road remains the largest and least permeable barrier within the wetland |
| **Geomorphology** | Due to the gentle gradient and the nature of the HGM unit, limited sediment transport would've occurred in the wetland, therefore the wetland is functioning at a near reference condition from a geomorphic perspective. |
| **Vegetation** | Under natural conditions, the vegetation would've been more representative of a climax wetland vegetation mix as opposed to such a mix of wetland and disturbance-tolerant species. Under natural conditions the vegetation composition would've excluded *P. guajava* and a less terrestrial mix of species would've been observed. |

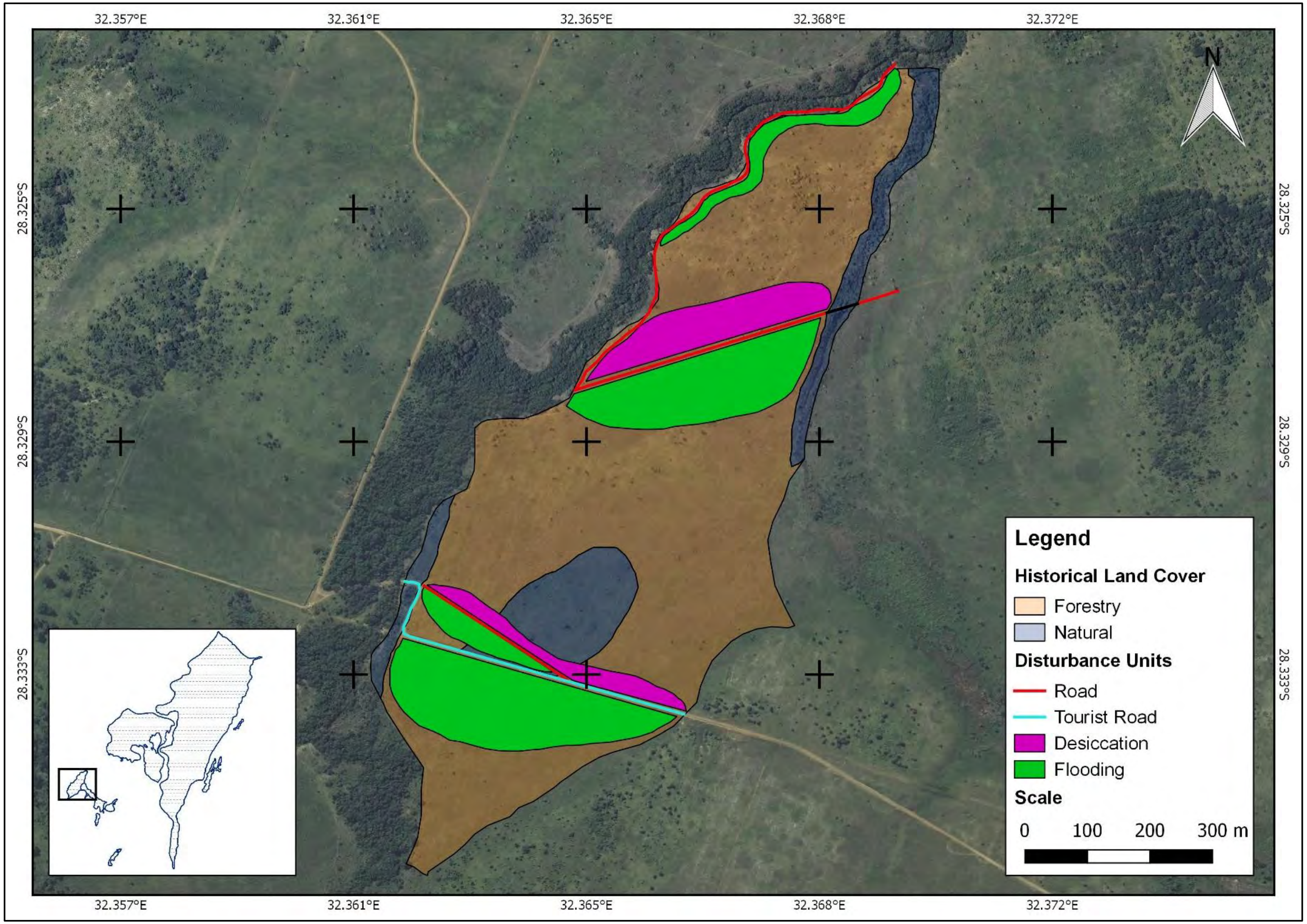



**Figure 4.5 Historical land uses and current disturbance units in Wetland 5 (W32H-05)**

## 4.5 Wetland 6 (W32H-06)

### 4.5.1 Wetland Details

**Table 4.10** provides a summary of Wetland 6 (W32H-06), identified for rehabilitation activities.

**Table 4.10 Wetland 6 (W32H-06) details**

| | |
|---|---|
| **Wetland Name** | Wetland 6 |
| **Wetland Number/Label** | W32H-06 |
| **GPS Location** | 28° 20' 04.766"S<br>32° 22' 13.11"E |
| **Catchment Land Use** | Conservation area, tourism, old plantation land |
| **Wetland Land Use** | Conservation area, tourism, old plantation land |
| **Wetland Size (ha)** | 1.47 |

### 4.5.2 Wetland Characteristics

Wetland 6 (W32H-06) has been classified as a hillslope seep that is connected to a stream network. Wetland 6 is a small tributary of Wetland 7 and decants into this unchannelled valley-bottom wetland. This wetland is small – approximately 1.47ha in size – and steep with a gradient of 4.1%. The wetland is fed by a small seepage in the hillslope that surfaces approximately 200m downslope of the top of the hill. It is unclear as to why the seep originates at this point in the hillslope but it may be a result of a localised sill of resistant strata just below the ground that forces groundwater to surface at this point. Much of the water flowing through the wetland was thought to be subsurface flows as the only surface water was observed above the old forestry road. This is indicative of the very porous medium upon which most of these Maputaland coastal plain wetlands sit.

The fringes of this wetland were incorporated into the area planted for forestry, but because the wetland sits on a hillslope and is relatively small, the majority of the HGM unit was left relatively untouched by the forestry companies as it would not have been worth draining (**Figure 4.7**). However, an old forestry road traverses the wetland approximately midway down the length of the HGM unit and the newer tourist road crosses in the upper reaches of the wetland. There is a culvert that has been constructed beneath the tourist road to allow for semi-natural flows to continue down the top half of the wetland. However, there is no through-flow allowance made by the old forestry road and there is a significant damming effect that was observed above this road. The section immediately below the road is characterised by a wider variety of terrestrial vegetation species, and the wetland species occurring directly below the road looked brown and dry, which is indicative of wetland that is being starved of its natural water inputs (**Figure 4.6**). It is assumed that both the tourist and the forestry roads are also limiting lateral inputs of water as water is trapped very effectively by both roads in the areas where there are no culverts, hence the removal of the old forestry road would move the hydrological regime of the wetland towards a more natural state.

The vegetation within the wetland area is largely comprised of indigenous species, although there were a number of *Psidium guajava* and *Pteridium aquilinum* plants that were observed in the drier portions of the wetland. The wetter areas were colonised predominantly by *Juncus effusus, Juncus pallidus* and *Centella asiatica* with a mix of *Cyperacea sp.* Species such as *Cymbopogan validus, Cynodon dactylon, Centella asiatica* and *Hyparrhenia rufa* were found abundantly in the drier areas of the HGM unit.

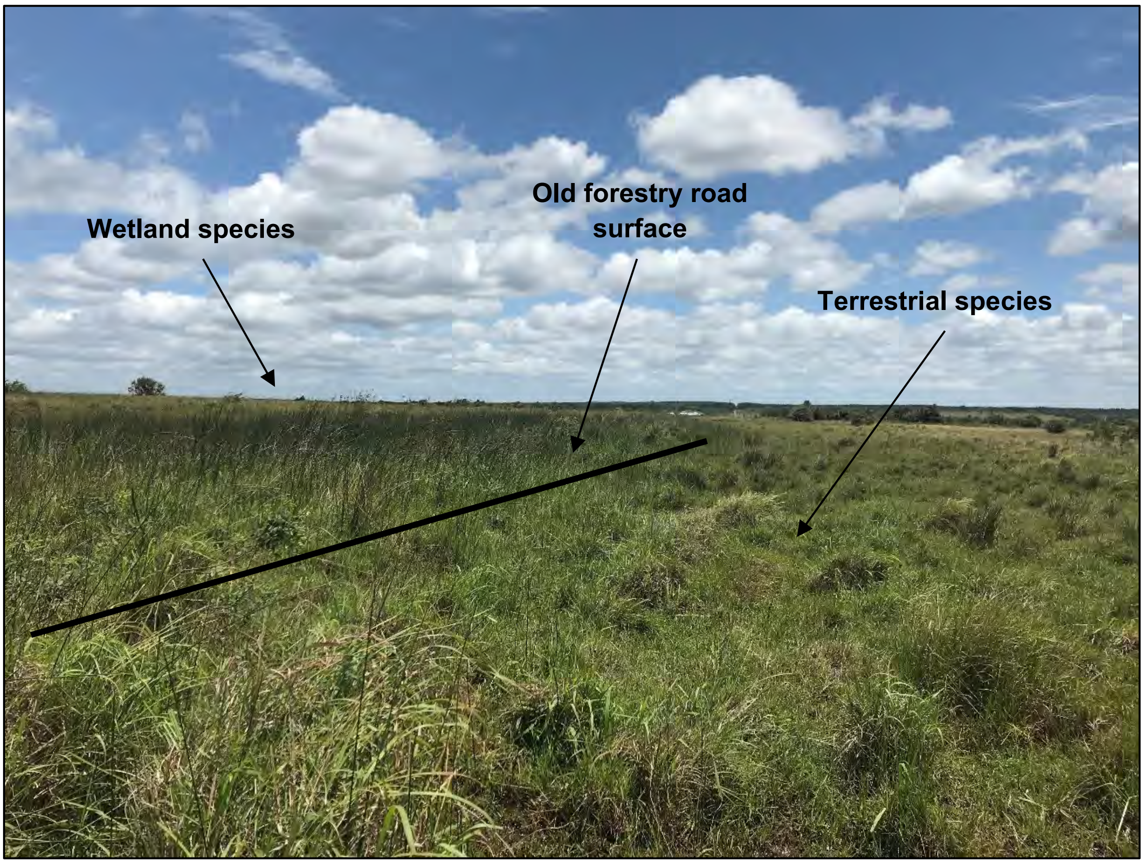



**Figure 4.6 Photographic evidence of wetland vegetation species colonising the area upstream of old forestry road and terrestrial species colonising the downstream area.**

### 4.5.3 Benchmark or reference state W32H-06

**Table 4.11** provides a summary of the benchmark / reference state characteristics of W32H-06.

**Table 4.11 Wetland 6 (W32H-06) reference benchmark state**

| Characteristic | Description |
|---|---|
| **HGM Unit** | Hillslope seepage with link to stream network |
| **Wetness Regime** | Small section of permanently and seasonally wet areas down the centre of the HGM unit above old forestry road with temporary wetness areas that dominate the remainder of the wetland area |
| **Hydrology** | Under natural conditions water would've passed through the wetland uninterrupted by roads. Water may have been diffusely spread throughout the wetland. |
| **Geomorphology** | Due to the small nature of this wetland, its ability to pick up and move sediment would have been limited, however sediment flux throughout the wetland would've been greater in its natural state. |
| **Vegetation** | Under natural conditions the vegetation would've excluded *P. guajava* and *P. aquilinum* and a less terrestrial dominated mix of species would've been observed. |

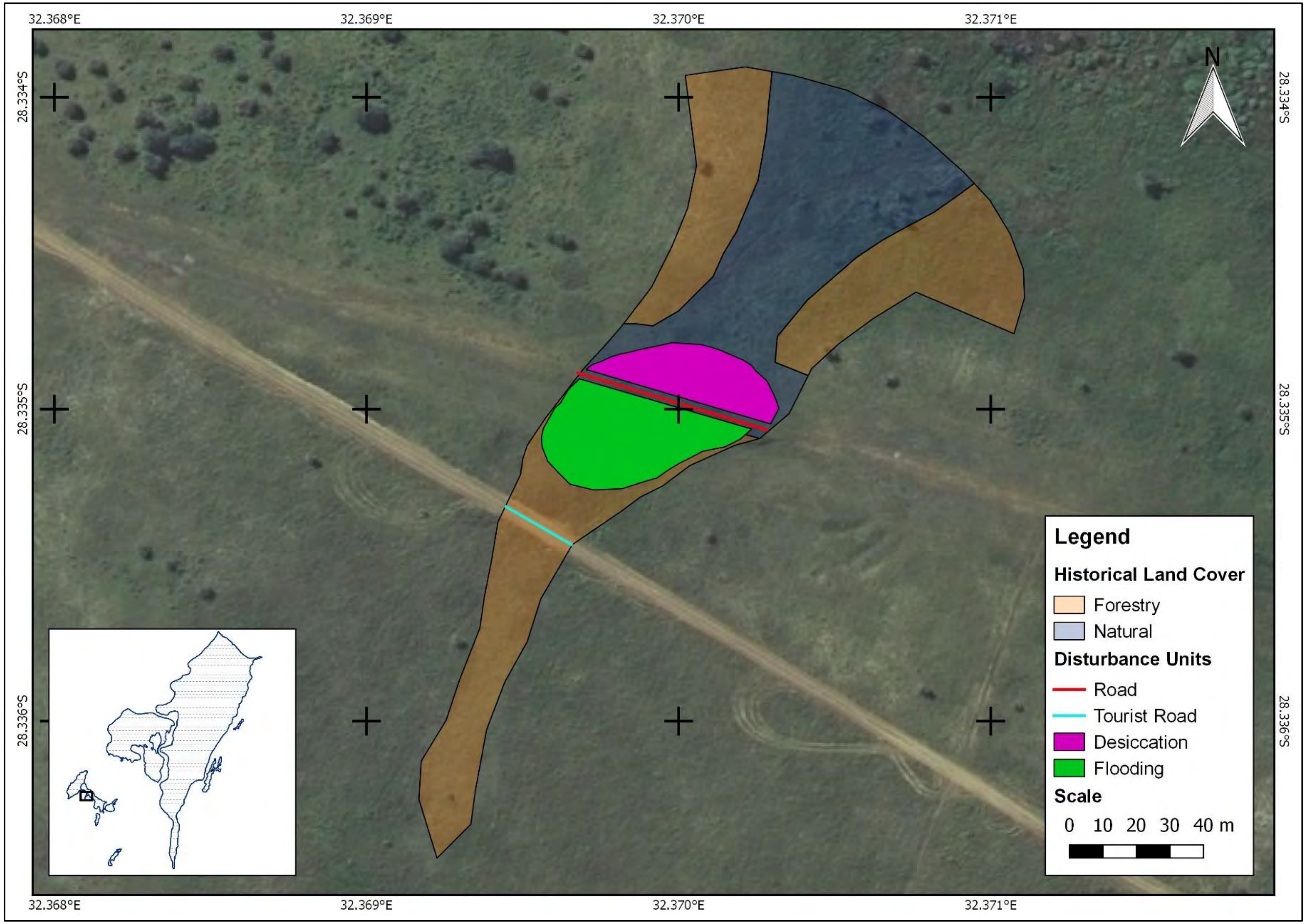



**Figure 4.7 Historical land cover and current disturbance units for Wetland 6 (W32H-06)**

## 4.6 Wetland 7 (W32H-07)

### 4.6.1 Wetland Details

**Table 4.12** provides a summary of Wetland 7 (W32H-07), identified for rehabilitation activities.

**Table 4.12 Wetland 7 (W32H-07) details**

| | |
|---|---|
| **Wetland Name** | Wetland 7 |
| **Wetland Number/Label** | W32H-07 |
| **GPS Location** | 28° 20' 09.63"S<br>32° 22' 31.19"E |
| **Catchment Land Use** | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **Wetland Land Use** | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **Wetland Size (ha)** | 49.97 |

### 4.6.2 Wetland Characteristics

Wetland 7 (W32H-07) has been classified as an unchannelled valley-bottom wetland with short sections of channelled flows. The upper half of the wetland is much steeper (slope of 1.5%) than the lower half of the wetland which has a slope of 0.63%. This can be attributed to the fact that the upper half of the wetland is located on the sides of the gently undulating hills in the area whereas the lower half of the wetland is located at the bottom of the valley between two hills. Wetland 7 is fed by both surface and subsurface flows – the surface flows often originating from hillslope seeps that are located on the sides of the hills surrounding the valley bottom. The sections of the wetland that have incised to create small, weakly-defined channels are all located below alluvial fans that have been created by these hillslope seeps. It is assumed that the deposition of the alluvial material by these tributaries has increased the slope of the wetland downstream of the fan in a localised area such that the stream energy increases sufficiently as it flows over these mounds to scour and erode small sections of the valley bottom below these features in the landscape. These channels lose confinement a short distance below the alluvial mounds as the wetland returns to its natural grade and the energy of the water dissipates. The catchment area of the HGM unit is defined by small, gently sloping hills on either side of the wetland. The portion of the wetland that falls within the lowest point of the valley bottom is characterised by permanently wet soils. The soils become seasonally and then temporarily wet farther up the valley sides.

A review of historical imagery revealed that a large portion of this wetland was used for forestry plantations and remnants of forestry infrastructure are still evident in the landscape today (**Figure 4.9**). The permanently and seasonally wet areas of the wetland were not used for plantations as it is thought that these areas were too wet for *Eucalyptus sp.,* however, the marginal areas of the wetland were all planted for forestry purposes. An old forestry road cuts the wetland into two sections approximately halfway down the HGM unit and this has resulted in the creation of substantial areas of open water above the road (**Figure 4.8**). The area directly below the old road has been colonised by a number of terrestrial tree species which is indicative of wetland area that has reduced water inputs. Very small portions of the tourist road cross the wetland area and have minimal effect on the functioning of the wetland as two of the three crossings have culverts that have been constructed beneath the road.

The vegetation within Wetland 7 is a wide mix of wetland and terrestrial species. Due to safety concerns relating to the presence of buffalo and hippo, only a small portion of the wetland was observed during the site visit as such a limited survey of the vegetation was conducted. The wet portions of the wetland were often characterised by *Juncus effusus, Juncus pallidus* and large stands of *Phragmites australis* and *Cyperus dives.* The open water dammed above the old road contained a healthy population of *Nymphaea nouchali*. The more seasonal zones of the wetland comprised of a mix of species such as *Cymbopogan validus, Thelypteris interrupta, Centella asiatica, Cyperus fastigiatus* and *Cyperus polystachyos* whereas the more terrestrial areas contained species such as *Cynodon dactylon, Hyparrhenia rufa, Imperata cylindrica, Eragrostis heteromera, Hyphaene coriacea, Phoenix reclinata* and *Stenotaphrum secundatum.*

### 4.6.3 Benchmark or reference state W32H-07

**Table 4.13** provides a summary of the benchmark / reference state characteristics of W32H-07.

**Table 4.13 Wetland 7 (W32H-07) reference benchmark state**

| Characteristic | Description |
|---|---|
| **HGM Unit** | Unchannelled valley-bottom |
| **Wetness Regime** | Topographically low points in the valley-bottom wetland would be characterised by permanently and seasonally wet zones. The entire length of the bottom of the valley would've contained permanently wet soils under natural conditions. |
| **Hydrology** | Under natural conditions water would've passed through the wetland uninterrupted by roads. There would be a more even spread of diffuse flow throughout the wetland without the creation of open water spaces in behind old forestry roads |
| **Geomorphology** | Sediment transport would've been more consistent throughout the HGM unit without barriers such as the old forestry roads. |
| **Vegetation** | Under natural conditions, the vegetation would've been more representative of a climax wetland vegetation mix as opposed to such a mix of wetland and disturbance tolerant plant species. |

**Figure 4.8 Photographic evidence of damming on the upstream side of old forestry road**

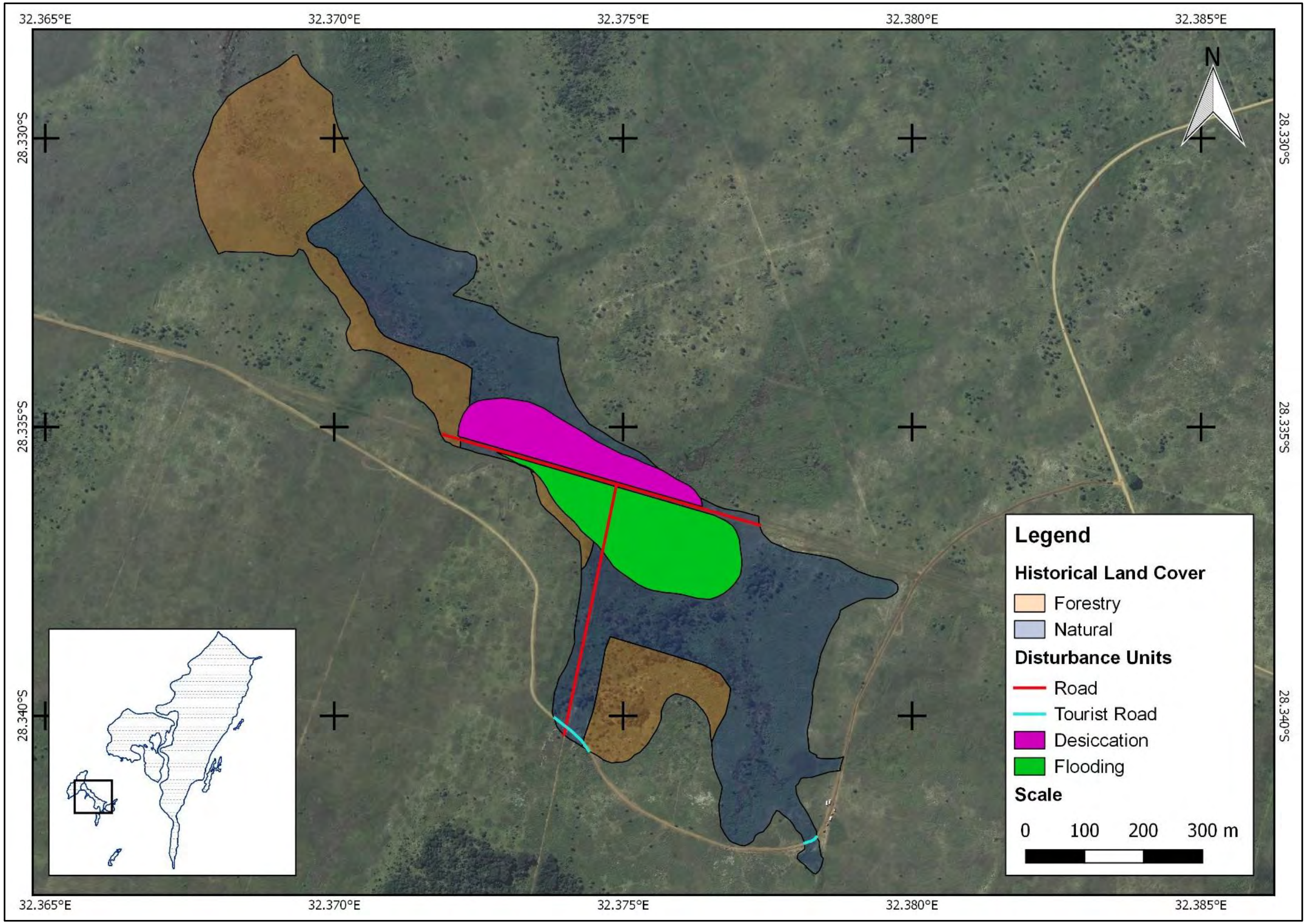



**Figure 4.9 Historical land cover and current disturbance units for Wetland 7 (W32H-07)**

## 4.7 Wetland 8 (W32H-08)

### 4.7.1 Wetland Details

**Table 4.14** provides a summary of Wetland 8 (W32H-08), identified for rehabilitation activities.

**Table 4.14 Wetland 8 (W32H-08) details**

| | |
|---|---|
| **Wetland Name** | Wetland 8 |
| **Wetland Number/Label** | W32H-08 |
| **GPS Location** | 28° 20' 42.05"S<br>32° 22' 32.85"E |
| **Catchment Land Use** | Conservation area, tourism, old plantation land, occasional reed harvesting, residential land, agricultural land |
| **Wetland Land Use** | Conservation area, tourism, old plantation land, occasional reed harvesting, agricultural land |
| **Wetland Size (ha)** | 14.80 |

### 4.7.2 Wetland Characteristics

Wetland 8 can be classified as an unchannelled valley-bottom system despite it not having a surface water outflow point. The wetland is characteristically an unchannelled valley-bottom wetland but due to human disturbances in the landscape, the outflow point has been completely blocked off by an old forestry road. Wetland 8 has sections of permanently and seasonally wet areas that have been shaped and directed by the network of drains and roads that cross the HGM unit. The areas of the wetland that are closer to the valley sides are much more temporarily wet and only become saturated after very wet periods. The soils within the wetland generally have a thick 10cm layer of black organic matter that sits on top of well-gleyed soils which are indicative of wetland habitat. The wetland has a very gentle slope of 0.5%, therefore diffuse flow is the predominant flow pattern within the HGM unit, although there are many areas of open water within the wetland area that are created as a result of damming by roads, drains and old plough scars. The wetland is thought to receive its water from surface and subsurface flows, the latter originating from the wider Maputaland coastal plain aquifer. Surface flows associated with the topographically-defined catchment are thought to contribute a large hydrological proportion of flow to the wetland as there is a large drain located at the very top of the HGM unit that flows into the HGM unit – conveying stormwater into the wetland. In addition, the majority of the HGM unit's catchment falls into the outskirts of the town of Duku which is a settlement characterised by urban-rural sprawl. A portion of the wetland itself extends outside of the boundary of the iSimangaliso Wetland Park into a small portion of the town of Duku and is subject to current land use impacts.

A review of historical imagery revealed that the entire HGM unit was used for forestry purposes and only after 2000 were the plantations removed from the HGM unit. Subsequent to the removal of the plantations, imagery revealed that the southern portion of the wetland, south of the old forestry road, was used by subsistence farmers as farm land until the iSimangaliso Wetland Park extended its boundaries after 2002 and incorporated this area into the park. There are a number of drains associated with the farming practices that are still evident within the wetland and are diverting water away from the western side of the wetland. Therefore, a preferential flow path has been created down the eastern side of the wetland as a result of this diversion (**Figure 4.10**). Due to the low slope of the wetland and the slow movement of water within the HGM unit, this preferential flow path is still characterised by diffuse flows, but it has meant that the western half of the wetland is significantly drier than the eastern portion of the wetland. There are two old forestry roads, which cross the wetland at a perpendicular angle to the direction of flow, as such there has been a damming effect above each road. The top most road runs along the outside of the fence of the iSimangaliso Wetland Park and has therefore not been constructed or maintained as well as the road traversing the middle portion of the HGM unit. During the wet season water flows over this top-most road and has therefore destroyed parts of it, reinstating semi-natural flow patterns across this section of wetland. However, the road running across the middle of the HGM unit was constructed on backfill material and raised above the wetland and is intercepting flows across the width of the wetland area. Much of the wetland area located outside of iSimangaliso is currently being used as farmland which will reduce the water inputs into the HGM unit. It may also increase sediment and nutrient inputs into the HGM unit especially after heavy rainfall events. In addition, a portion of the wetland has been excavated and the spoil has been used to create a dam wall such that further impoundment of flows within the wetland is occurring in the small farm dam that has been created within the wetland outside of the iSimangaliso fences. At the opposite side of the wetland, in the northern-most portion of the wetland, the management road that runs along the eastern boarder of the wetland has cut hydrological flows originating from Wetland 8 off from its natural flow path into an adjacent unchannelled valley-bottom wetland. A review of recent satellite imagery reveals a large damming effect created at the toe of this wetland where it would naturally flow into the adjacent HGM unit. Therefore, the rehabilitation of this wetland may result in many positive impacts to the HGM unit's integrity and its ability to provide functional services.

Being such a recently disturbed wetland, the vegetation within the HGM unit is also a mix of disturbance-tolerant pioneer species, obligate and facultative wetland plant species. In the wetter areas of the wetland, the vegetation composition is dominated by *Juncus effusus, Juncus pallidus, Centella asiatica* and *Cyperus sp.* – all of which are disturbance-tolerant species. The wetter areas are confined to the eastern section of the wetland therefore these species were primarily located on the eastern side of the wetland. The vegetation composition in the drier portions of the wetland is comprised of more terrestrial disturbance tolerant species such as *Cynodon dactylon, Imperata cylindrica, Cymbopogon validus, Eragrostis heteromera, Pteridium aquilinum, Gomphocarpus fruticosus* and *Hyparrhenia rufa.*

### 4.7.3 Benchmark or reference state for Wetland 8 (W32H-08)

**Table 4.15** provides a summary of the benchmark/reference state characteristics of W32H-08.

**Table 4.15 Wetland 8 (W32H-08) reference benchmark state**

| Characteristic | Description |
|---|---|
| **HGM Unit** | Unchannelled valley-bottom |
| **Wetness Regime** | Topographically low points in the valley-bottom wetland would be characterised by permanently and seasonally wet zones. The entire length and width of the bottom of the valley would've contained seasonally wet soils under natural conditions. |
| **Hydrology** | Under natural conditions water would've passed through the wetland uninterrupted by roads. There would be a more even spread of diffuse flow from west to east within the wetland without the creation of open water spaces dammed behind old forestry roads |
| **Geomorphology** | Potentially less sediment would've been transported into the wetland had there been less farming in the HGM unit and its catchment. |
| **Vegetation** | Under natural conditions, the vegetation would've been more representative of a climax wetland vegetation mix as opposed to such a mix of wetland and terrestrial disturbance tolerant species. |

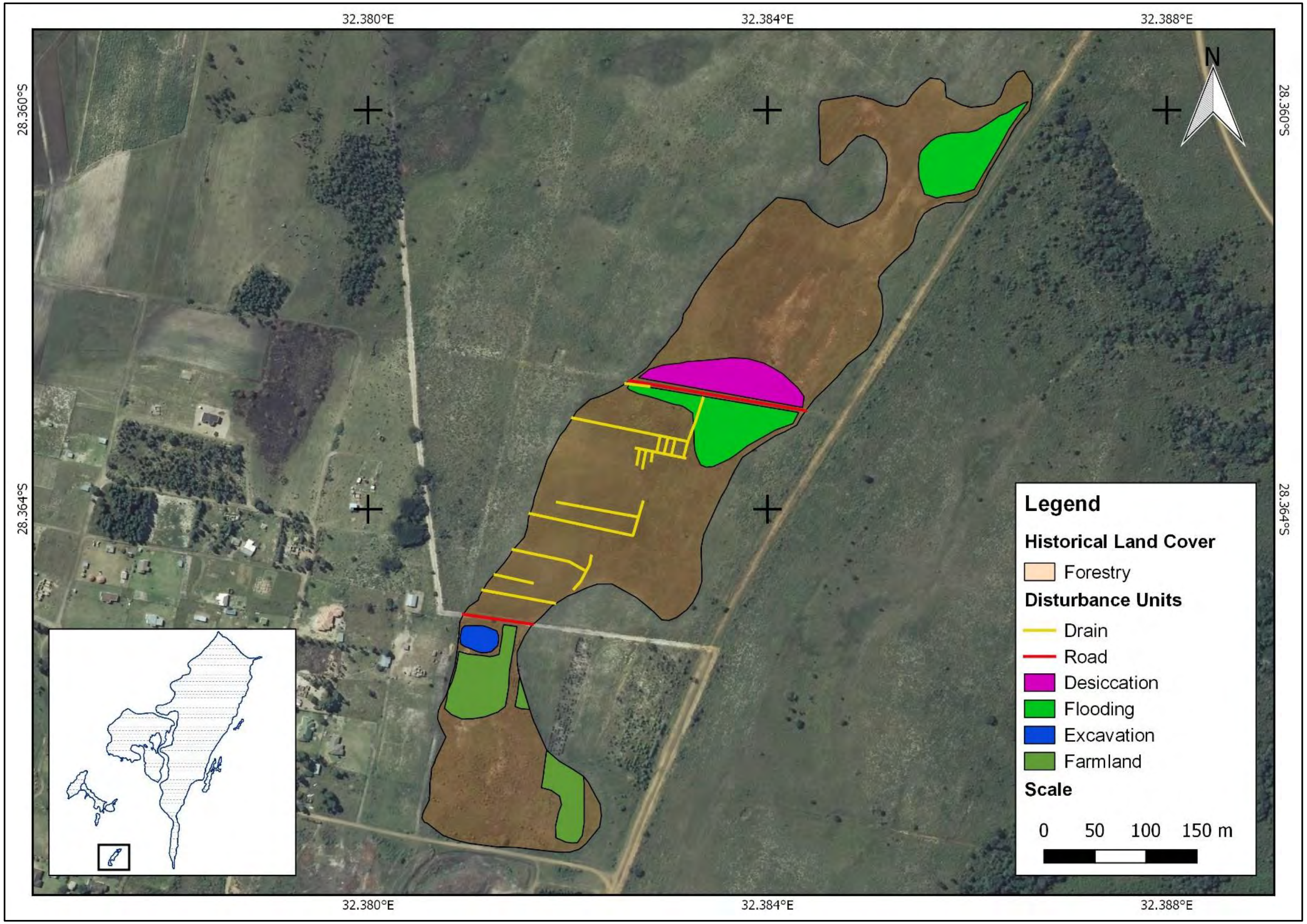



**Figure 4.10 Historical land cover and current disturbance units for Wetland 8 (W32H-08)**

## 4.8 Wetland 9 (W32H-09)

### 4.8.1 Wetland Details

**Table 4.16** provides a summary of Wetland 9 (W32H-09), identified for rehabilitation activities.

**Table 4.16 Wetland 9 (W32H-09) details**

| | |
|---|---|
| **Wetland Name** | Wetland 9 |
| **Wetland Number/Label** | W32H-09 |
| **GPS Location** | 28° 21' 46.39"S<br>32° 23' 01.03"E |
| **Catchment Land Use** | Conservation area, tourism, old plantation land |
| **Wetland Land Use** | Conservation area, tourism, old plantation land, |
| **Wetland Size (ha)** | 5.77 |

### 4.8.2 Wetland Characteristics

Wetland 9 can be classified as a depression wetland despite its elongated shape. Historically, the depression wetland may have been connected to a stream network, but possibly due to the reworking of the landscape as a result of forestry activities, this HGM unit is now isolated from any stream networks. The wetland area lies within a small elongated bowl and it appears that the predominant direction of flow is in a northerly direction along a very gentle slope of 0.23%. Considering the nature of the climate and the substrate upon which the wetland lies, it is assumed that water exits the wetland either via evapotranspiration or subsurface flows. The wetland is characterised by seasonally wet soils as it is a depression wetland and is primarily fed by precipitation. It is possible that groundwater inputs contribute to the overall wetness of the wetland, however the wetland sits upon a local plateau which stretches in a southerly direction and on a local interfluve that faces in a northerly direction. The plateau generally drains in an easterly direction and the interfluve acts as a local watershed for two valley lines that direct flow in north-westerly directions, as such it is thought that Wetland 9 acts as a groundwater recharge zone. The wetness of the soil profile decreases towards the edges of the depression and this is followed closely by a change in vegetation from the seasonally wet zones. The vegetation composition of the more terrestrial margins of the wetland are comprised of disturbance-tolerant species such as *Imperata cylindrica, Cynodon dactylon, Stenotaphrum secundatum, Eragrostis heteromera, Hyparrhenia rufa, Helichrysum decorum, Pteridium aquilinum* and *Hyperthelia dissoluta.* The presence of these species within the wetland is indicative of the disturbance caused by the forestry practices and the subsequent removal of the plantations. The wetter areas of the HGM unit are characterised by a mix of the disturbance tolerant species mentioned above as well as a few facultative wetland species such as *Cyperus sp., Carex sp.* and *Juncus sp.*

The wetland has historically been used for forestry purposes and the residual effects of that disturbance is still evident in the HGM unit today. Natural climax wetland vegetation will take a long time to re-establish within the wetland seeing as the disturbance-tolerant species have colonised much of the HGM unit. An old forestry road crosses the entire width of the wetland approximately midway down the length of the HGM unit and currently interrupts flows in a northerly direction (**Figure 4.11**). This interruption causes a substantial damming effect above the road. An excavation within the wetland that was used to generate material to build the road has also resulted in the creation of open water just below the road and interrupts flows to the lower parts of the depression wetland.

### 4.8.3 Benchmark or reference state for Wetland 9 (W32H-09)

**Table 4.17** provides a summary of the benchmark/reference state characteristics of W32H-09.

**Table 4.17 Wetland 9 (W32H-09) reference benchmark state**

| Characteristic | Description |
|---|---|
| **HGM Unit** | Depression |
| **Wetness Regime** | Topographically low points in the depression would be characterised by permanently wet zones. Under natural conditions the proportion of open water to diffuse flow zones would be much lower than it is currently. |
| **Hydrology** | Under natural conditions water would've passed through the wetland uninterrupted by roads or excavations. |
| **Geomorphology** | Under natural conditions this wetland would've functioned as an unchannelled valley-bottom wetland and would've been characterised by a very different set of geomorphic processes. |
| **Vegetation** | Under natural conditions, the vegetation would've been more representative of a climax wetland vegetation mix as opposed to a mix of wetland and terrestrial disturbance tolerant species. |

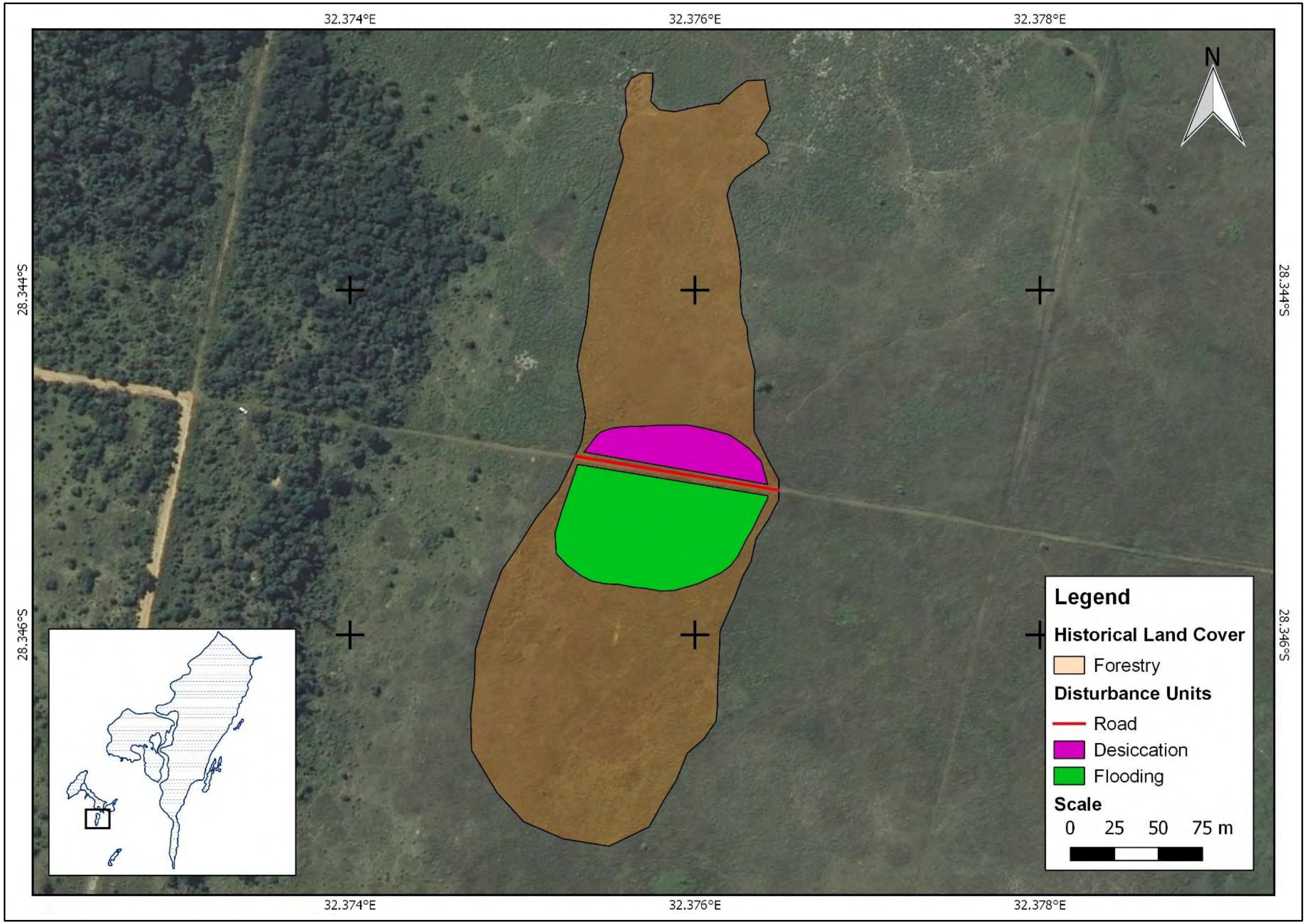



**Figure 4.11 Historical land cover and current disturbance units for Wetland 9 (W32H-09)**

## 4.9 Wetland 10 (W32H-10)

### 4.9.1 Wetland Details

**Table 4.18** provides a summary of Wetland 10 (W32H-10), identified for rehabilitation activities.

**Table 4.18 Wetland 10 (W32H-10) details**

| | |
|---|---|
| **Wetland Name** | Wetland 10 |
| **Wetland Number/Label** | W32H-10 |
| **GPS Location** | 28° 19' 06.92"S<br>32° 25' 59.57"E |
| **Catchment Land Use** | Conservation area, tourism, old plantation land |
| **Wetland Land Use** | Conservation area, tourism, old plantation land, |
| **Wetland Size (ha)** | 3.98 |

### 4.9.2 Wetland Characteristics

Wetland 10 (W32H-10) is located on the eastern shores of the St Lucia River and can be classified as an unchannelled valley-bottom despite the fact that it is not connected to a larger stream system. The HGM unit is elongated in shape and functions as a valley-bottom wetland as it has a distinct longitudinal slope sloping towards the north and water flows in a northerly direction. At the northern tip of the wetland a tourist road encircles the wetland, and it is possible that water is lost to subsurface flows at this point (**Figure 4.12**). The average slope of the wetland is approximately 0.78%, with the southern half of the wetland being much steeper than the northern section of the wetland. It is assumed that the HGM unit is fed by subsurface flows originating from the regional Maputaland coastal plain aquifer as well as by surface flows derived by the wetlands topographically-derived catchment. Wetland 10 forms part of a larger complex of closed valley-bottom wetlands that are separated by gently undulating interfluves. It is possible that all of these wetlands are connected by the regional ground water table and would all be affected similarly during wetting and drying climatic phases. The soil in the wetland is a gleyed sand matrix that is very porous and is a well-drained and leached sandy substrate indicative of wetland conditions.

Upon a review of the historical imagery it was revealed that the HGM unit was relatively well preserved during the time that the eastern shores were being used as forestry land. Therefore, the physical disturbance within the wetland is relatively limited and only consists of a single road crossing. This road crossing causes a damming effect within the wetland where water dams behind the road, preventing natural hydrological flows. While these closed valley-bottom wetlands have a longitudinal slope within them, there is also a tendency for water to create small localised depressions that hold water during the wet season. As such, damming behind roads isn't necessarily starving other wetland areas of hydrological inputs as a damming process is already occurring naturally within these wetlands, however the road interrupts much more nuanced processes such as macro and micro invertebrate gene transfer. With smaller, more disconnected dammed areas, the gene pools of specific plant and animal species are severely limited, therefore it is important that every effort is made to allow for natural flow and damming of water.

The vegetation within the wetland is comprised of disturbance-tolerant species that are indicative of a historically disturbed landscape. *Hyparrhenia rufa, Imperata cylindrica,* *Cynodon dactylon* and *Eragrostis heteromera* dominate the majority of the HGM unit while plant species such as *Juncus effusus, Cyperus sp.* and *Eleocharis dregeana* are scattered more infrequently within the HGM unit – specifically within the wetter areas of the wetland where there is limited disturbance.

### 4.9.3 Benchmark or reference state for Wetland 10 (W32H-10)

**Table 4.19** provides a summary of the benchmark/reference state characteristics of W32H-10.

**Table 4.19 Wetland 10 (W32H-10) reference benchmark state**

| Characteristic | Description |
|---|---|
| **HGM Unit** | Unchannelled valley-bottom |
| **Wetness Regime** | Topographically low points in the valley bottom would be characterised by permanently wet zones. |
| **Hydrology** | Under natural conditions water would've passed through the wetland uninterrupted by roads. |
| **Geomorphology** | The geomorphology of this particular wetland has been relatively un-impacted and functions at close to reference state capacity. |
| **Vegetation** | The vegetation is in a relatively natural condition and can therefore be considered to be functioning at near reference state conditions. |

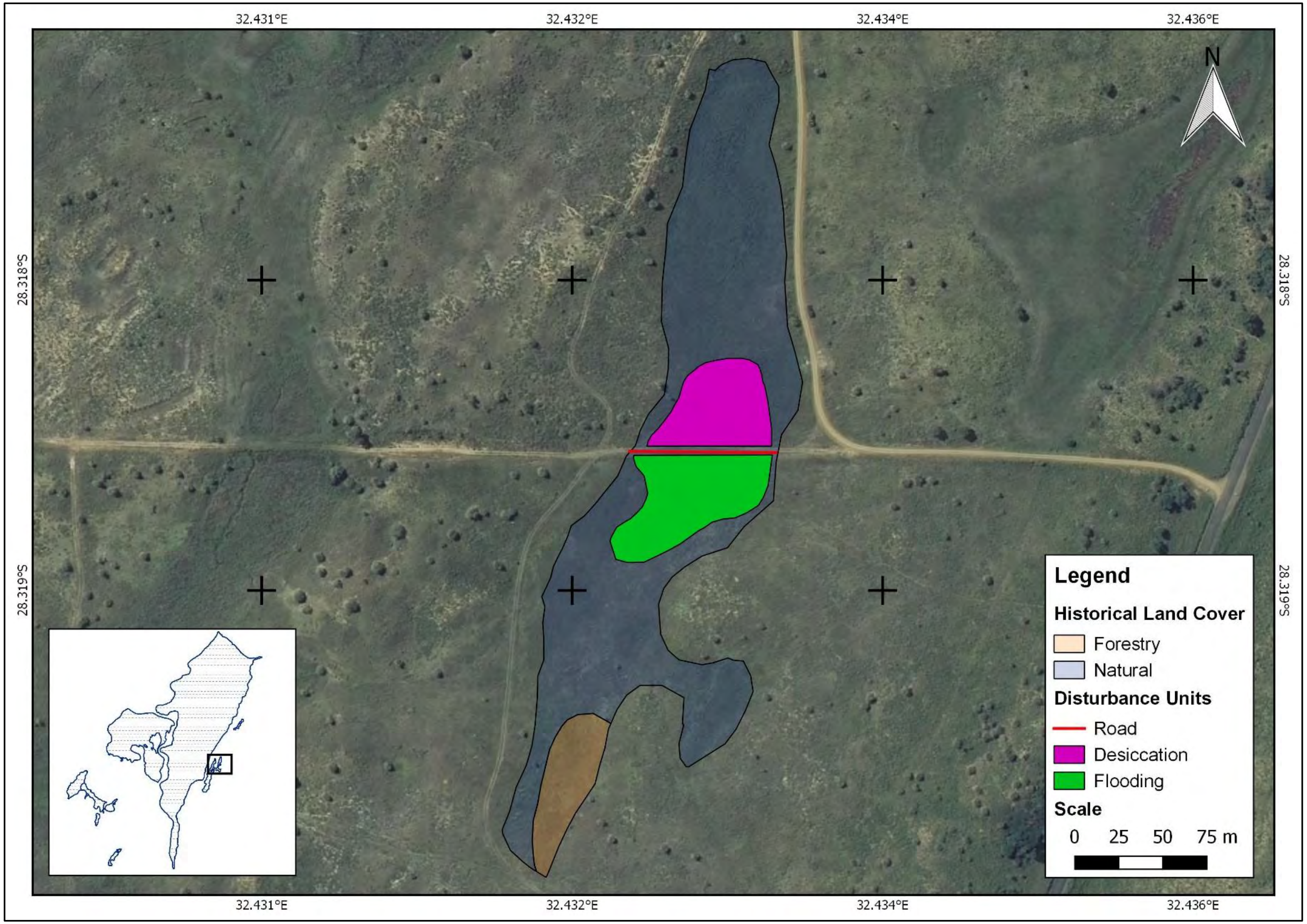



**Figure 4.12 Historical land cover and current disturbance units for Wetland 10 (W32H-10)**

## 4.10 Wetland 11 (W32H-11)

### 4.10.1 Wetland Details

**Table 4.20** provides a summary of Wetland 11 (W32H-11), identified for rehabilitation activities.

**Table 4.20 Wetland 11 (W32H-11) details**

| | |
|---|---|
| **Wetland Name** | Wetland 11 |
| **Wetland Number/Label** | W32H-11 |
| **GPS Location** | 28° 19' 15.82"S<br>32° 25' 46.10"E |
| **Catchment Land Use** | Conservation area, tourism, old plantation land |
| **Wetland Land Use** | Conservation area, tourism, old plantation land, |
| **Wetland Size (ha)** | 21.45 |

### 4.10.2 Wetland Characteristics

Wetland 11 forms part of the complex of elongated valley-bottom wetlands and is located directly to the west of Wetland 10. Therefore Wetland 11 can also be considered an unchannelled valley-bottom wetland with no distinct point of inflow. However, there is an outflow located midway along the HGM unit and the wetland discharges to the west. The northern reaches of the wetland drain in a southerly direction and the southern reaches of the HGM unit drain towards the north. The outflow is located at the lowest point of the HGM unit, where the northern and southern reaches drain towards. The HGM unit functions as a valley-bottom wetland and has a very gentle longitudinal slope of 0.38%. The southern tip of the wetland is defined by a local watershed point that is defined by an interfluve that runs in an east-west direction. The northern tip of the wetland is defined by a similar feature, as such the wetland drains in two directions. The valley bottom is characterised by sections where the valley bottom is wide and the slopes on the interfluves on either side of the valley are gentle as well as by sections where the valley bottom is much narrower and the valley sides are much steeper. The HGM unit contains large sections of permanently wet soils where the soils remain saturated year-round. A sulphurous odour was observed after multiple auger holes during the site visit that confirmed permanent wetness. The permanently wet areas are often associated with the sections of the valley that are narrow whereas the largest extents of the seasonal and temporary zones were observed in the wider, flatter areas of the wetland. The wetland is thought to receive water from both the regional aquifer as well as its small topographically-defined catchment.

A large proportion of Wetland 11 was used for forestry plantations and as a result the integrity and the functioning of the wetland has been reduced (**Figure 4.14**). The removal of homogenised plantations including *Eucalyptus sp.* has left behind large tracts of bare land that can be colonised by pioneer disturbance-tolerant species, which has been the case in Wetland 11. Large portions of the wetland contained species such as *Imperata cylindrica, Pteridium aquilinum, Hyparrhenia rufa, Cynodon dactylon, Stenotaphrum secundatum* and *Cymbopogon validus* which are known to be indicators of land that has been disturbed. These species will continue to colonise these areas and it is thought that it will be a prolonged period before climax wetland vegetation will recolonise these areas. The presence of old forestry roads is also another factor that has been detrimental to the functioning and integrity of the wetland as they prevent free-flow of water through the HGM unit. There are four old forestry roads that cross the HGM unit and are currently interrupting the hydrological functioning of the wetland. It was observed that damming occurs on both the upstream and downstream side of the roads as a result of excavation to generate material to build raised roads through the wetland (**Figure 4.13**). If these roads were removed, a constant hydrological linkage would be created throughout the HGM unit.

The vegetation composition within the wetter areas of the HGM unit is characterised by a range of obligate and facultative wetland species such as *Juncus effusus, Juncus pallidus, Cyperus fastigiatus, Cyperus rotundus, Cyperus dives, Centella asiatica* and *Phragmites australis.*

### 4.10.3 Benchmark or reference state for Wetland 11 (W32H-11)

**Table 4.21** provides a summary of the benchmark/reference state characteristics of W32H-11.

**Table 4.21 Wetland 11 (W32H-11) reference benchmark state**

| Characteristic | Description |
|---|---|
| **HGM Unit** | Unchannelled valley-bottom |
| **Wetness Regime** | Topographically low points in the valley bottom would be characterised by permanently wet zones. These zones of permanent wetness would not be confined to the narrow sections of the valley. |
| **Hydrology** | Under natural conditions water would've passed through the wetland uninterrupted by roads. |
| **Geomorphology** | None of the HGM unit would've been impacted upon by infilling and the associated decrease in wetland width. |
| **Vegetation** | Under natural conditions, the vegetation would've been more representative of a climax wetland vegetation mix as opposed to a mix of wetland and terrestrial disturbance-tolerant species. |


**Figure 4.13 Photographic evidence of damming on the upstream side of a forestry road.**

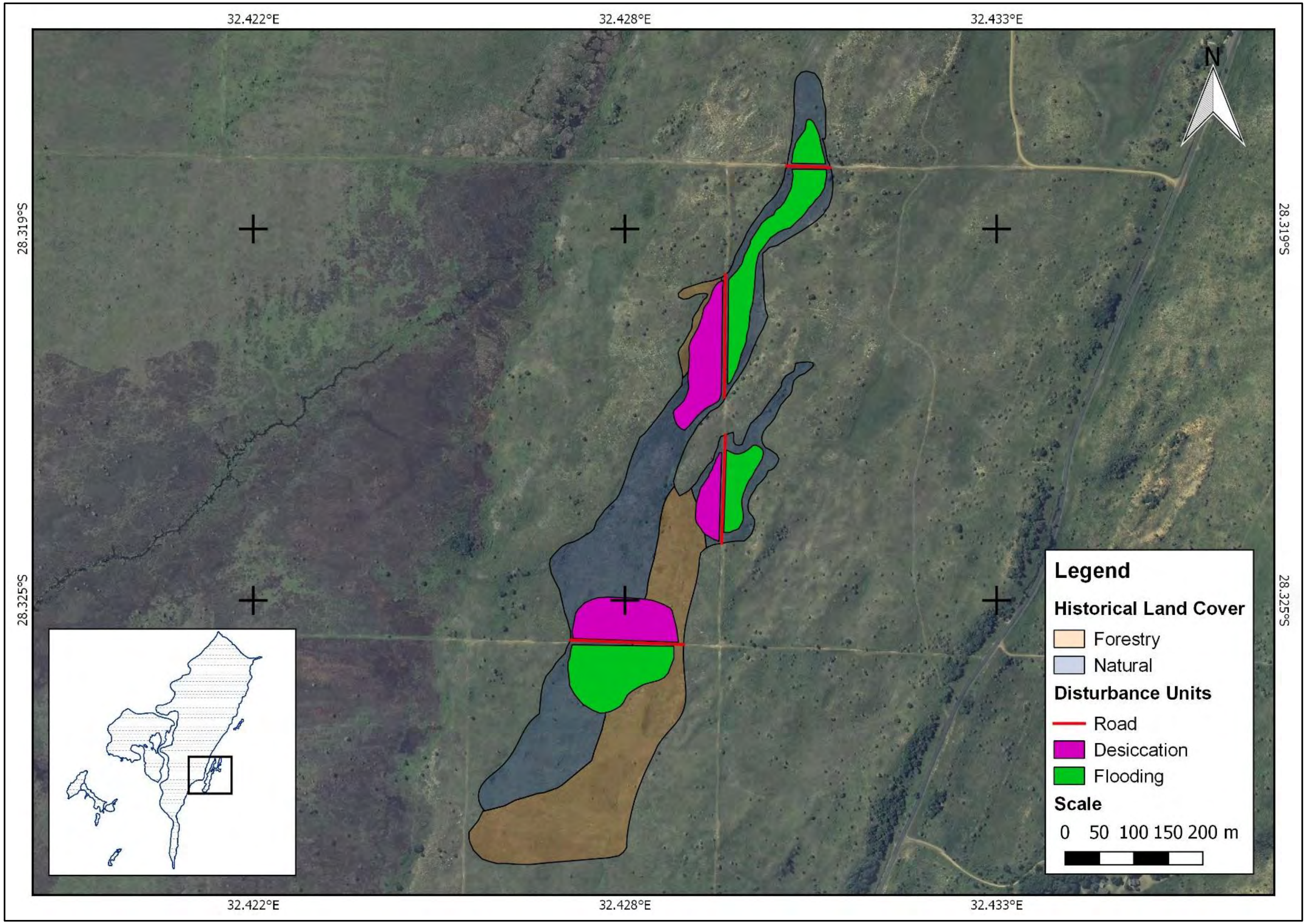



**Figure 4.14 Historical land cover and current disturbance units for Wetland 11 (W32H-11)**

## 4.11 Wetland 12 (W32H-12)

### 4.11.1 Wetland Details

**Table 4.22** provides a summary of Wetland 12 (W32H-12), identified for rehabilitation activities.

**Table 4.22 Wetland 12 (W32H-12) details**

| | |
|---|---|
| **Wetland Name** | Wetland 12 |
| **Wetland Number/Label** | W32H-12 |
| **GPS Location** | 28° 18' 13.04"S<br>32° 26' 24.07"E |
| **Catchment Land Use** | Conservation area, tourism, old plantation land |
| **Wetland Land Use** | Conservation area, tourism, old plantation land, |
| **Wetland Size (ha)** | 5.78 |

### 4.11.2 Wetland Characteristics

Wetland 12 can be classified as a depression wetland. While it has similar characteristics to a closed valley-bottom wetland, there are no distinct valley sides as observed in Wetlands 10 and 11. Wetland 12 is surrounded by a small aggraded area that has possibly aggraded as a result of aeolian sediment within the landscape. Therefore, it can be considered a depression wetland. It is also characterised by a low point located in the middle of the HGM unit as opposed to a low point occurring at one of the two ends of the HGM unit. This wetland occurs on a very porous substrate which can be likened to beach sand as it is very course-grained and bleached. However, the soil profile within the depression wetland below an initial layer of aeolian sand was gleyed and indicative of wetland habitat. Wetland 12 is thought to receive water from its small topographically-derived catchment, as well as from subsurface flows originating from the regional Maputaland coastal plain aquifer. The vegetation within the wetland was disturbed as sections of the eastern shores of the iSimangaliso Wetland Park had been burnt and as such there were limited vegetation indicators within the wetland. However, disturbance tolerant ruderal species such as *Cynodon dactylon, Hyparrhenia rufa* and *Juncus effusus* have started recolonising the burnt areas. A few *Hyphaene coriacea* and *Phoenix reclinata* palm trees survived the fire and occur around the wetland edges.

A review of historical imagery revealed that the majority of the wetland was formerly used as plantation land and therefore there are observable areas of disturbance despite the removal of the plantation trees between 2002 and 2006. A large drain was excavated at the southern end of the HGM unit and the spoil from the excavation was dumped along the edge of the drain margin (**Figure 4.15**). It is unclear what the intended purpose of the drain was, but it currently drains a small portion of the HGM unit as there is a breach in the infilled margin of the drain (**Figure 4.16**). Because the bottom of the drain is lower than the bottom of the depression wetland, a hydraulic gradient is created in the direction of the drain and as such, the depression wetland is losing water to the drain via both surface and subsurface flows. Therefore, the deactivation and infilling of the drains would reinstate a natural flow direction in the southern portion of the wetland area.

### 4.11.3 Benchmark or reference state for Wetland 12 (W32H-12)

**Table 4.23** provides a summary of the benchmark/reference state characteristics of W32H-12.

**Table 4.23 Wetland 12 (W32H-12) reference benchmark state**

| Characteristic | Description |
|---|---|
| **HGM Unit** | Depression |
| **Wetness Regime** | The bottom sections of the HGM unit would be characterised by seasonally wet zones whereas the outer areas of the depression would be characterised by temporarily wet zones. |
| **Hydrology** | Under natural conditions the entire HGM unit would drain towards the central point in the depression. |
| **Geomorphology** | The geomorphology of this particular wetland has been relatively un-impacted and functions at close to reference state capacity. |
| **Vegetation** | Under natural conditions, the vegetation would've been more representative of a climax wetland vegetation mix as opposed to a mix of wetland and terrestrial disturbance tolerant species. |

**Figure 4.15 Photographic evidence of the excavated drain and the spoil deposits running along either side of the drain.**

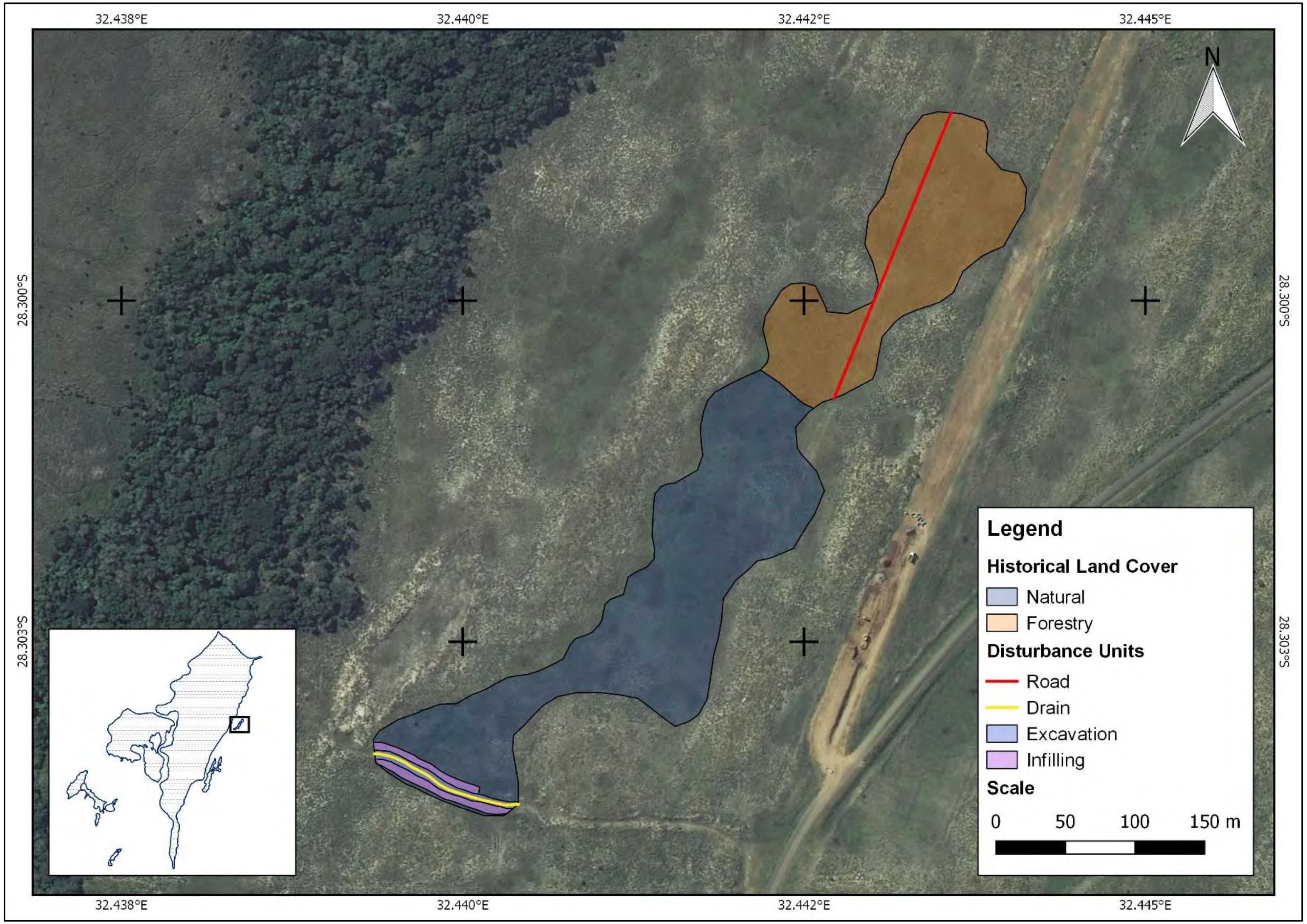



**Figure 4.16 Historical land cover and current disturbance units for Wetland 12 (W32H-12)**

## 4.12 Wetland 13 (W32H-13)

### 4.12.1 Wetland Details

**Table 4.24** provides a summary of Wetland 13 (W32H-13), identified for rehabilitation activities.

**Table 4.24 Wetland 13 (W32H-13) details**

| | |
|---|---|
| **Wetland Name** | Wetland 13 |
| **Wetland Number/Label** | W32H-13 |
| **GPS Location** | 28° 19' 31.94"S<br>32° 25' 25.09"E |
| **Catchment Land Use** | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **Wetland Land Use** | Conservation area, tourism, old plantation land, occasional reed harvesting |
| **Wetland Size (ha)** | 24114.00 |

### 4.12.2 Wetland Characteristics

Wetland 13 is the largest HGM unit assessed during this iSimangaliso rehabilitation cycle and can be classified as a floodplain wetland complex. A floodplain complex such as this is characterised by many smaller wetland areas that have formed as a result of processes associated with floodplains such as sporadic flooding and deposition of sediment within the wetland. The deposition of sediment occurs near the banks of the river, as such a floodplain such as this is often characterised by a low point towards the centre of the wetland where there is a channel-like feature that has formed. Therefore, part of the wetland drains towards the west and the other half of the wetland drains to the east (**Figure 4.18**). The wetland is fed predominantly by precipitation, over bank topping from the St Lucia River and subsurface flows which originate from the Maputaland coastal plain aquifer. Because this wetland is located so close to sea level and so close to the regional water table – there is a large proportion of the wetland that is characterised by permanently wet soils. There are areas of higher-lying ground which would only seasonally or temporarily be wet, and these areas are also very closely correlated to a change to more terrestrial vegetation species. The vegetation composition of the permanently wet areas of the wetland are comprised of *Juncus effusus, Juncus pallidus, Cyperus sp., Eleocharis dregeana* and *Phragmites australis,* whereas the more seasonally wet areas are characterised by *Cymbopogon validus, Cynodon dactylon, Stenotaphrum secundatum, Imperata cylindrica, Centella asiatica, Pentodon pentandrus, Scoparia dulcis, Hyparrhenia rufa, Hyphaene coriacea, Phoenix reclinata* and *Pteridium aquilinum.*

According to historical imagery, a large portion of the eastern edge of the wetland was used for plantation land and timber production (**Figure 4.18**). Because much of this forestry land fell within permanently wet zones, large drains had to be excavated to encompass the plantations to prevent flooding of those areas. These drains can still be seen from satellite imagery and it is thought that they are still having a detrimental effect on the integrity and functioning of the wetland. The drains will divert and hold surface water, preventing free movement of water from the old forestry land towards the part of the wetland that wasn't affected by forestry and vice versa. Old forestry roads also still traverse the wetland area where the plantations were located and these features too prevent hydrological flows from moving freely across the HGM unit (**Figure 4.17**). However, the size of the wetland in comparison to the area that is affected by this old forestry infrastructure is large and therefore the removal of this infrastructure will have a small impact on the overall integrity of the wetland.

### 4.12.3 Benchmark or reference state for Wetland 12 (W32H-13)

**Table 4.25** provides a summary of the benchmark/reference state characteristics of W32H-13.

**Table 4.25 Wetland 13 (W32H-13) reference benchmark state**

| Characteristic | Description |
|---|---|
| **HGM Unit** | Floodplain wetland complex |
| **Wetness Regime** | The wetland may have been characterised by much larger, less fragmented patches of open water and permanently wet areas. |
| **Hydrology** | Under natural conditions water would've passed through the wetland uninterrupted by roads and drains and the connectivity of the hydrological flows would've been much greater. |
| **Geomorphology** | The geomorphology of this particular wetland has been relatively un-impacted and functions at close to reference state capacity. |
| **Vegetation** | Under natural conditions, the vegetation would've been more representative of a climax wetland vegetation mix as opposed to a mix of wetland and terrestrial disturbance tolerant species. |

**Figure 4.17 Photographic evidence of the extent of damming that occurs behind roads within Wetland 13 (W32H-13)**

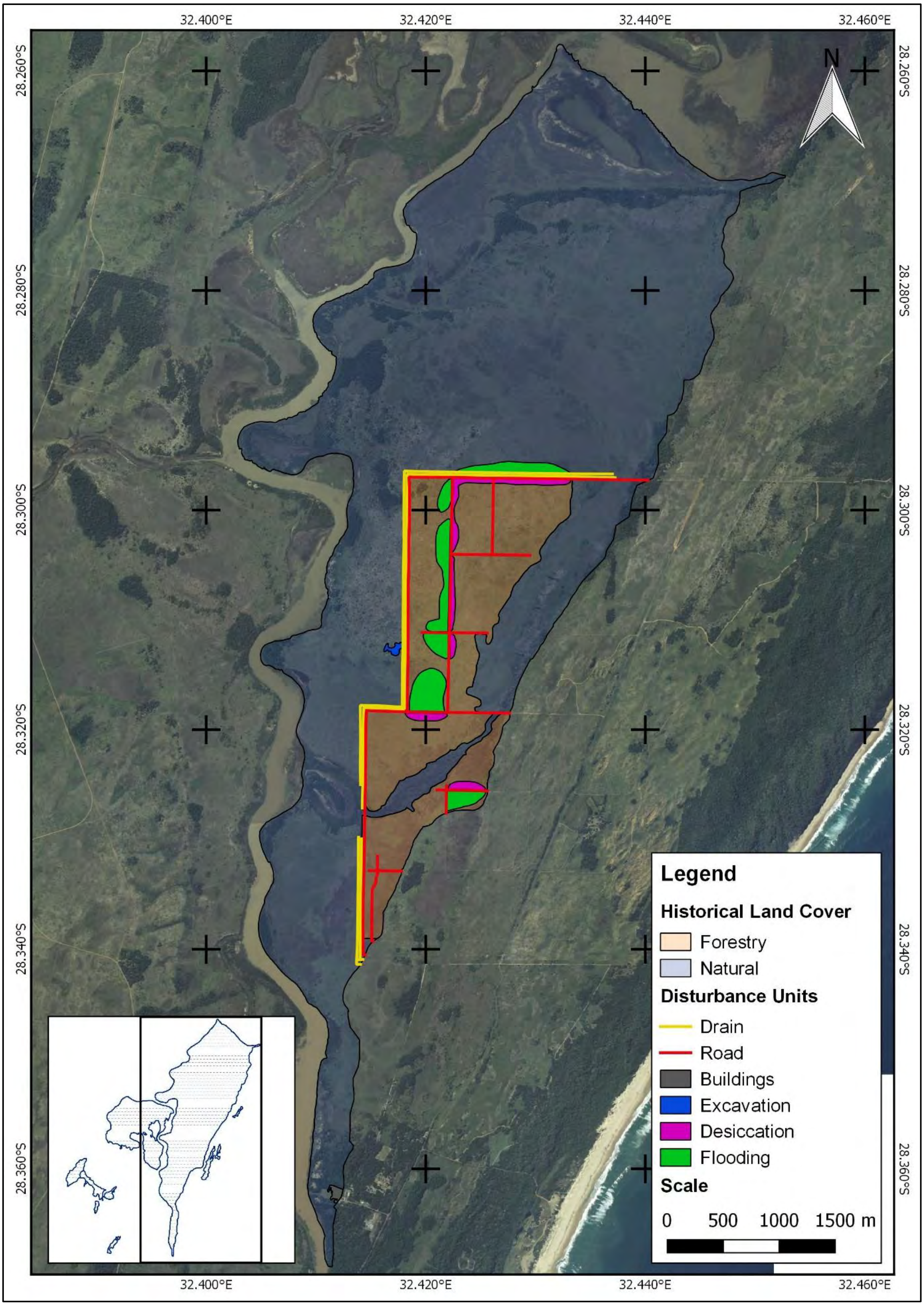



**Figure 4.18 Historical land cover and current disturbance units for Wetland 13 (W32H-13)**

# 5. STUDY RESULTS

The following section provides details pertaining to all eleven wetlands that fall within the W32H catchment and their functioning and integrity for the current and post-rehabilitation scenarios.

## 5.1 Wetland Ecological Functioning

The general features of the wetlands were assessed in terms of the ecosystem functioning at a landscape level for the current and post-rehabilitation scenarios. The score for each ecosystem service represents the likely extent to which that benefit is being supplied by the specific wetland and was interpreted based on the following rating outlined by Kotze et al. (2007):

- **<0.5 Low**
- **0.5-1.2 Moderately low**
- **1.3-2.0 Intermediate**
- **2.1-2.8 Moderately high**
- **>2.8 High**

Generally, the wetlands were observed to be supplying regulating services at an ***Intermediate*** to ***High*** level for the current scenario (**Table 5.1**). This is largely associated with the extent of vegetation cover, surface roughness, presence of indigenous plant species, biodiversity maintenance and hydrological zonation (Kotze et al. 2007). The majority of these wetlands exist in relatively pristine conditions and have not been exposed to recent disturbance and as such are able to provide regulating services at a relatively high level. For example, the larger and more connected HGM units all scored **>2.0** for streamflow regulation and the majority of the HGM units (including the smaller ones) scored **>2.0** for erosion control. These scores can be attributed to the dense indigenous vegetative cover observed within the HGM units and the resultant surface roughness scores. Overall, the highest scoring regulating services included biodiversity maintenance, erosion control and nitrate removal which generally scored upwards of **2.5**. The high scores associated with biodiversity maintenance is representative of the very diverse fauna and flora that is found within the iSimangaliso Wetland Park that specifically dwell in the wetland areas. There are a number of migratory and non-migratory wetland bird species that are found in the wetlands in iSimangaliso. There are also sections of swamp forest located within the wetland park which are a highly endangered wetland type. The high scores for nitrate removal are associated with the retention time of water within HGM units which is a result of the very low slopes of the wetlands in general as well as the high surface roughness that exists within many of the wetlands.

The wetlands scored ***Low*** to ***Moderately Low*** for provisioning services as the majority of the wetland areas assessed in this study fell within the iSimangaliso Wetland Park. Therefore, the protection status given to these wetlands is very high and as such, are not accessible to the public for harvesting of resources. Although, once a year, iSimangaliso opens its gates to allow a select number of reed harvesters to harvest reeds in the wetland park. However, the wetlands scored much higher in the cultural benefits section of the ecosystem service assessment and this can be attributed to the fact that the wetlands fall within iSimangaliso Wetland Park and are therefore on a very popular tourist route (**Table 5.1**). Therefore, the opportunity for recreational activities such as birding and game viewing is also high – as such

– the wetlands provide tourism and recreation services at a ***Moderately High*** to ***High*** level. Limited research has been conducted on the wetlands within the park and as such the provision of research and education ranged between ***Low*** and ***Moderately Low***.

Generally, in the post-rehabilitation scenario, the effectiveness of the systems to supply ecosystem services is likely to increase negligibly. The rehabilitation activities are focussed to the HGM units themselves therefore the opportunity of supplying these ecosystem services will not improve. The negligible increase in the effectiveness of ecosystem service provision is likely to be a consequence of the fact that the majority of these wetlands are already functioning near capacity as many of them are in fact relatively intact. The majority of the rehabilitation work involves the removal of old forestry roads and related infrastructure, therefore the impact of this rehabilitation on the functioning and integrity will be relatively small and will not reflect in a WET-Ecoservices assessment. Wetland 8 is the exception to this rule however, as the proposed rehabilitation work will have a drastic impact on its ability to provide ecosystem services (**Table 5.1**). The removal of the old agricultural drains and the old forestry road located within the wetland will reinstate a much more natural hydrological regime and will therefore increase the streamflow regulation, phosphate removal, nitrate assimilation and toxicant removal abilities of the wetland by up to 27,5%. The reinstatement of natural hydrological flows will also allow for the establishment of vegetation that is more representative of natural wetland vegetation.

**Table 5.1 Wetland functioning for Wetlands 3-6**

| | | Wetland 3 | | Wetland 4 | | Wetland 5 | | Wetland 6 | |
|---|---|---|---|---|---|---|---|---|---|
| Ecosystem Service | | Current State Importance Score | Post-rehab Change Score (%) | Current State Importance Score | Post-rehab Change Score (%) | Current State Importance Score | Post-rehab Change Score (%) | Current State Importance Score | Post-rehab Change Score (%) |
| Regulatory and Supporting Services | Flood Attenuation | 1,3 | 0,0 | 1,1 | 0,0 | 1.3 | 0,0 | 0,9 | 0,0 |
| | Stream Flow Regulation | 2,5 | 0,0 | 2,2 | 0,0 | 2,3 | 0,0 | 2,2 | 0,0 |
| | Sediment Trapping | 2,4 | 0,0 | 1,6 | 0,0 | 2,6 | 0,0 | 1,5 | 0,0 |
| | Phosphate Trapping | 2,6 | 0,0 | 2,2 | 0,0 | 2,7 | 0,0 | 2,1 | 0,0 |
| | Nitrate Removal | 3,0 | 0,0 | 2,8 | 0,0 | 2,9 | 0,0 | 2,7 | 0,0 |
| | Toxicant Removal | 2,6 | 0,0 | 2,1 | 0,0 | 2,7 | 0,0 | 2,0 | 0,0 |
| | Erosion Control | 3,3 | 0,0 | 2,8 | 0,0 | 3,1 | 0,0 | 2,6 | 0,0 |
| | Carbon Storage | 2,7 | 0,0 | 2,0 | 0,0 | 2,3 | 0,0 | 2,0 | 0,0 |
| | Biodiversity Maintenance | 3,5 | 0,0 | 2,9 | 5,0 | 2,8 | 2,5 | 2,9 | 5,0 |
| Provisioning Services | Water Supply | 1,6 | 0,0 | 1,0 | 0,0 | 1,3 | 0,0 | 1,0 | 0,0 |
| | Harvestable Natural Resources | 1,8 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| | Cultivated Foods | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| Cultural Services | Socio-Cultural Significance | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| | Tourism and Recreation | 3,1 | 0,0 | 2,7 | 0,0 | 3,0 | 0,0 | 2,1 | 0,0 |
| | Education and Research | 0,8 | 0,0 | 0,5 | 0,0 | 0,5 | 0,0 | 0,5 | 0,0 |

**Table 5.1 continued: Wetland functioning for Wetlands 7-10**

| Ecosystem Service | | Wetland 7 Current State Importance Score | Wetland 7 Post-rehab Change Score (%) | Wetland 8 Current State Importance Score | Wetland 8 Post-rehab Change Score (%) | Wetland 9 Current State Importance Score | Wetland 9 Post-rehab Change Score (%) | Wetland 10 Current State Importance Score | Wetland 10 Post-rehab Change Score (%) |
|---|---|---|---|---|---|---|---|---|---|
| Regulatory and Supporting Services | Flood Attenuation | 1,1 | 0,0 | 1,6 | -2,5 | 1,1 | 0,0 | 1,3 | 0,0 |
| | Stream Flow Regulation | 2,3 | 0,0 | 1,0 | 37,5 | 0,8 | 0,0 | 2,3 | 0,0 |
| | Sediment Trapping | 1,6 | 0,0 | 1,3 | 17,5 | 1,0 | 0,0 | 1,8 | 0,0 |
| | Phosphate Trapping | 2,2 | 0,0 | 1,7 | 17,5 | 1,4 | 0,0 | 2,3 | 0,0 |
| | Nitrate Removal | 2,9 | 0,0 | 2,0 | 27,5 | 1,5 | 0,0 | 2,9 | 0,0 |
| | Toxicant Removal | 2,2 | 0,0 | 1,9 | 20,0 | 1,4 | 0,0 | 2,3 | 0,0 |
| | Erosion Control | 2,9 | 0,0 | 3,0 | 0,0 | 2,7 | 0,0 | 2,8 | 0,0 |
| | Carbon Storage | 2,3 | 0,0 | 2,3 | 10,0 | 2,0 | 0,0 | 2,3 | 0,0 |
| | Biodiversity Maintenance | 2,9 | 5,0 | 2,2 | 2,5 | 2,7 | 2,5 | 2,7 | 2,5 |
| Provisioning Services | Water Supply | 1,3 | 0,0 | 1,3 | 15,0 | 0,7 | 0,0 | 1,3 | 0,0 |
| | Harvestable Natural Resources | 0,0 | 0,0 | 2,2 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| | Cultivated Foods | 0,0 | 0,0 | 2,8 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| Cultural Services | Socio-Cultural Significance | 0,0 | 0,0 | 1,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| | Tourism and Recreation | 2,6 | 0,0 | 2,1 | 0,0 | 2,4 | 0,0 | 2,7 | 0,0 |
| | Education and Research | 0,5 | 0,0 | 0,5 | 0,0 | 0,5 | 0,0 | 0,5 | 0,0 |

**Table 5.1 continued: Wetland functioning for Wetlands 11-13**

| | | Wetland 11 | | Wetland 12 | | Wetland 13 | |
|---|---|---|---|---|---|---|---|
| Ecosystem Service | | Current State | Post-rehab | Current State | Post-rehab | Current State | Post-rehab |
| | | Importance Score | Change Score (%) | Importance Score | Change Score (%) | Importance Score | Change Score (%) |
| Regulatory and Supporting Services | Flood Attenuation | 1,4 | 0,0 | 1,3 | 0,0 | 1,7 | 0,0 |
| | Stream Flow Regulation | 2,3 | 0,0 | 0,7 | 0,0 | 2,5 | 0,0 |
| | Sediment Trapping | 1,8 | 0,0 | 1,0 | 0,0 | 2,3 | 0,0 |
| | Phosphate Trapping | 2,3 | 0,0 | 1,3 | 0,0 | 2,4 | 0,0 |
| | Nitrate Removal | 2,9 | 0,0 | 1,4 | 0,0 | 3,0 | 0,0 |
| | Toxicant Removal | 2,3 | 0,0 | 1,2 | 0,0 | 2,5 | 0,0 |
| | Erosion Control | 2,8 | 0,0 | 2,7 | 0,0 | 3,3 | 0,0 |
| | Carbon Storage | 2,3 | 0,0 | 1,7 | 0,0 | 2,7 | 0,0 |
| | Biodiversity Maintenance | 2,8 | 2,5 | 2,7 | 0,0 | 2,6 | 0,0 |
| Provisioning Services | Water Supply | 1,3 | 0,0 | 0,4 | 0,0 | 1,6 | 0,0 |
| | Harvestable Natural Resources | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| | Cultivated Foods | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| Cultural Services | Socio-Cultural Significance | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 | 0,0 |
| | Tourism and Recreation | 2,7 | 0,0 | 2,0 | 0,0 | 3,1 | 0,0 |
| | Education and Research | 0,8 | 0,0 | 0,5 | 0,0 | 1,5 | 0,0 |

## 5.2 Ecological Importance and Sensitivity

The wetlands EIS scores range from a **B-D** categories (**Table 5.2**) for the current scenario. The overall importance and sensitivity therefore ranges from ***Marginal*** to ***High***. The EIS categories are derived from the highest of the three scores obtained in the assessment. The majority of the wetlands assessed in this study scored highest in the ecological importance and sensitivity category with only Wetland 6 scoring equally in both the ecological importance and sensitivity and hydro-functional importance categories. The ecological importance and sensitivity is linked to the endangered vegetation types, the endangered species, the Present Ecological Status (PES) of the wetlands and type of wetlands.

In the post-rehabilitation scenario, the overall EIS scores didn't change largely due to the proposed rehabilitation being relatively limited in extent compared to the size of the wetlands and resulting in limited changes in PES scores. As such, the wetlands remain within the **B-D** categories. The only wetland where scores did change was in Wetland 8 where a number of drains will be deactivated in addition to the removal or an old forestry road, hence the significant improvement of the hydro-functional importance score (**Table 5.2**).

**Table 5.2 Summary of the EIS Scores for Wetlands 3-8**

| | Wetland 3 | | Wetland 4 | | Wetland 5 | | Wetland 6 | | Wetland 7 | | Wetland 8 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Current | Post-rehab | Current | Post-rehab | Current | Post-rehab | Current | Post-rehab | Current | Post-rehab | Current | Post-rehab |
| Ecological Importance and Sensitivity | 3,4 | 3,4 | 2,6 | 2,6 | 3,0 | 3,0 | 2,0 | 2,0 | 2,6 | 2,6 | 2,2 | 2,4 |
| Hydro-functional Importance | 2,6 | 2,6 | 2,1 | 2,1 | 2,5 | 2,5 | 2,0 | 2,0 | 2,2 | 2,2 | 1,9 | 2,5 |
| Direct Human Benefits | 1,2 | 1,2 | 0,7 | 0,7 | 0,8 | 0,8 | 0,6 | 0,6 | 0,7 | 0,7 | 1,7 | 1,8 |
| Overall Importance and Sensitivity Score | 3,4 | 3,4 | 2,6 | 2,6 | 3,0 | 3,0 | 2,0 | 2,0 | 2,6 | 2,6 | 2,2 | 2,5 |
| Overall Importance and Sensitivity Category | B | B | C | C | C | C | D | D | C | C | C | C |

**Table 5.2 continued: Summary of the EIS Scores for Wetlands 9-13**

| | Wetland 9 | | Wetland 10 | | Wetland 11 | | Wetland 12 | | Wetland 13 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Current | Post-rehab | Current | Post-rehab | Current | Post-rehab | Current | Post-rehab | Current | Post-rehab |
| Ecological Importance and Sensitivity | 2,2 | 2,2 | 2,2 | 2,2 | 2,6 | 2,6 | 2,0 | 2,0 | 3,4 | 3,4 |
| Hydro-functional Importance | 1,5 | 1,5 | 2,3 | 2,3 | 2,3 | 2,3 | 1,4 | 1,4 | 2,6 | 2,6 |
| Direct Human Benefits | 0,6 | 0,6 | 0,8 | 0,8 | 0,8 | 0,8 | 0,5 | 0,5 | 1,0 | 1,0 |
| Overall Importance and Sensitivity Score | 2,2 | 2,2 | 2,3 | 2,3 | 2,6 | 2,6 | 2,0 | 2,0 | 3,4 | 3,4 |
| Overall Importance and Sensitivity Category | C | C | C | C | C | C | D | D | B | B |

| **Ecological Importance and Sensitivity Categories** | **Range of EIS Score** | **EIS Class** |
|---|---|---|
| Very high: Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers. | 4 | **A** |
| High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quality and quantity of water in major rivers. | >3 and <4 | **B** |
| Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major river. | >2 and </=3 | **C** |
| Low/Marginal: Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers. | >1 and </=2 | **D** |
| None: Wetlands that are rarely sensitive to changes in water quality/hydrological regime. | 0 | **E** |

## 5.3 Wetland Ecological Integrity Assessment

The ecological integrity or PES of the wetlands was assessed for the hydrology, geomorphology and vegetation components. The integrity of the biophysical components of the wetlands were assessed for the current and post-rehabilitation scenarios. The assessment results of the hydrological, geomorphic and vegetation components are outlined in the following sections. The majority of the rehabilitation work proposed for this cycle of rehabilitation involves old road and drain removal, with relatively limited extents, and therefore will not have a huge effect on the overall integrity and health of the selected wetlands.

### 5.3.1 Assessment of the Current Hydrological Impacts

The majority of the wetland systems in iSimangaliso Wetland Park have been subjected to historical cultivation of forestry plantations and the associated activities have impacted the functioning and integrity of the wetlands over the years. Although none of the systems are currently farmed, the residual impacts of drains, roads and vegetation composition changes are still evident within the wetlands, and therefore necessitates the rehabilitation work proposed here. The most significant impact on the hydrological integrity of the wetlands can be associated with the presence of old forestry roads that cross the wetland habitat. Nearly all of the wetlands assessed for rehabilitation contained at least one forestry road. The main impact associated with these forestry roads has been the interruption of natural hydrological flows and hydrological connectivity across entire HGM units. Water is often trapped upstream of roads causing a damming effect above the road and the section of wetland immediately downstream of the roads can often be desiccated as a result of the upstream damming. The damming and desiccation within a single HGM unit does have negative effects on the integrity of wetlands as the damming of water above a road will increase water loss through evaporation as well as alter vegetation composition to accommodate more aquatic species as opposed to obligate and facultative wetland species. The desiccation of wetland downstream of roads alters vegetation composition and negatively affects the distribution and retention time of water within a given wetland.

The impact scores recorded for the hydrological component of the wetlands ranged from **0,35** to **3,56** which translate to a range of Present Hydrological State (PHS) categories of **A** to **C** (**Table 5.3**). The change in ecosystem processes therefore ranges from Unmodified to Moderately Modified. The water inputs into the wetlands have been scored as being largely unmodified as the nature of the relationship between surface water and groundwater within the Maputaland Coastal Plain makes catchment areas very difficult to define. Therefore, the changes to water inputs section of WET-Health was omitted for the majority of the wetland assessments. Only Wetland 8 lies on the edge of the coastal plain and the majority of its catchment falls within the settlement of Duku. Therefore, the catchment impacts for Wetland 8 were considered in the PHS assessment. The changes in water distribution and retention patterns were moderately impacted upon by the presence of old forestry roads and drains within the wetlands.

**Table 5.3 Hydrological Impact Scores and PES categories for Wetland 3-8**

| **HGM Unit** | **Wetland 3** | **Wetland 4** | **Wetland 5** | **Wetland 6** | **Wetland 7** | **Wetland 8** |
|---|---|---|---|---|---|---|
| **Impact Type** | Impact Score | Impact Score | Impact Score | Impact Score | Impact Score | Impact Score |
| Changes in water inputs | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Changes in water distribution and retention patterns | 0,35 | 0,73 | 0,60 | 1,33 | 0,43 | 2,49 |
| Combined Hydrology Impact Score | 0,35 | 0,73 | 0,60 | 1,33 | 0,43 | 2,49 |
| **PES Category** | **A** | **A** | **A** | **B** | **A** | **C** |

**Table 5.3 continued: Hydrological Impact Scores and PES categories for Wetland 9-13**

| **HGM Unit** | **Wetland 9** | **Wetland 10** | **Wetland 11** | **Wetland 12** | **Wetland 13** |
|---|---|---|---|---|---|
| **Impact Type** | Impact Score | Impact Score | Impact Score | Impact Score | Impact Score |
| Changes in water inputs | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Changes in water distribution and retention patterns | 0,68 | 0,31 | 0,68 | 1,11 | 0,53 |
| Combined Hydrology Impact Score | 0,68 | 0,31 | 0,68 | 1,11 | 0,53 |
| **PES Category** | **A** | **A** | **A** | **B** | **A** |

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

### 5.3.2 Assessment of the Current Geomorphic Impacts

The current geomorphic impacts on the wetland systems are predominantly a consequence of the infilling associated with road infrastructure and the subsequent reduction of active wetland area. Similarly to the PHS, the impacts associated with catchment areas were also disregarded, thus the Present Geomorphic State (PGS) is predominantly associated with the impacts of roads and drains. Wetlands 2 and 6 were considered to be the most degraded from a geomorphic perspective as Wetland 2 is negatively impacted by the volume of infilling associated with old forestry roads whereas Wetland 8 is negatively impacted by sediment inputs from its catchment area.

The impact scores recorded for the geomorphic component of the wetland ranged from **0,00** to **2,32**, translating into Present Geomorphic State (PGS) categories of **A** to **C** (**Table 5.4**). Therefore, the ecosystem processes can then be considered to be largely natural with few modifications.

**Table 5.4 Geomorphological Impact Scores and PES categories for Wetlands 3-8**

| **HGM Unit** | **Wetland 3** | **Wetland 4** | **Wetland 5** | **Wetland 6** | **Wetland 7** | **Wetland 8** |
|---|---|---|---|---|---|---|
| **Impact Type** | Impact Score | Impact Score | Impact Score | Impact Score | Impact Score | Impact Score |
| Dams | 0,00 | N/A | 0,00 | 0,00 | N/A | N/A |
| Channel Straightening | 0,00 | N/A | 0,00 | 0,00 | N/A | N/A |
| Infilling | 0,20 | 1,26 | 0,55 | 0,81 | 0,34 | 0,32 |
| Runoff Characteristics | N/A | 0,00 | N/A | N/A | 0,00 | 2,00 |
| Erosional Features | N/A | 0,00 | N/A | N/A | 0,00 | 0,00 |
| Depositional Features | N/A | 0,00 | N/A | N/A | 0,00 | 0,00 |
| Loss of organic sediment | N/A | 0,00 | N/A | N/A | 0,00 | 0,00 |
| Combined Geomorphology Impact Score | 0,20 | 1,26 | 0,55 | 0,81 | 0,34 | 2,32 |
| **PES Category** | **A** | **B** | **A** | **A** | **A** | **C** |

**Table 5.4 continued Geomorphological Impact Scores and PES categories for Wetlands 9-13**

| **HGM Unit** | **Wetland 9** | **Wetland 10** | **Wetland 11** | **Wetland 12** | **Wetland 13** |
|---|---|---|---|---|---|
| **Impact Type** | Impact Score | Impact Score | Impact Score | Impact Score | Impact Score |
| Dams | N/A | N/A | N/A | N/A | 0,00 |
| Channel Straightening | N/A | N/A | N/A | N/A | 0,00 |
| Infilling | 0,18 | 0,34 | 0,66 | N/A | 0,20 |
| Runoff Characteristics | 0,00 | 0,00 | 0,00 | 0,00 | N/A |
| Erosional Features | 0,00 | 0,00 | 0,00 | 0,00 | N/A |
| Depositional Features | 0,00 | 0,00 | 0,00 | 0,00 | N/A |
| Loss of organic sediment | 0,00 | 0,00 | 0,00 | 0,00 | N/A |
| Combined Geomorphology Impact Score | 0,18 | 0,34 | 0,66 | 0,00 | 0,20 |
| **PES Category** | **A** | **A** | **A** | **A** | **A** |

### 5.3.3 Assessment of the Current Vegetation Impacts

The most significant impact associated with the old forestry land is the impact on the composition of the vegetation within the wetland habitats in iSimangaliso Wetland Park. The nature of plantations – specifically plantations containing *Pinus sp.* and *Eucalyptus sp.* – does not allow for the establishment of any undergrowth below the larger trees. Therefore, the vegetation composition becomes homogenised. When the plantations were removed and preliminary rehabilitation of the areas took place, disturbance-tolerant, pioneer species were able to colonise the old plantation areas and were able to dominate those spaces. It can take upwards of fifty years for natural climax wetland vegetation to re-colonise a historically disturbed area associated with plantation land. For example, Wetlands 2, 6, 7 and 10 consisted of large areas of *Pteridium aquilinum* which is a native disturbance tolerant pioneer species which can easily colonise large areas of wetland. The dominance of species such as *P. aquilinum* and *Psidium guajava* often prevents the establishment of native wetland vegetation and thus negatively affects the PES of the wetland system. It should be noted that vegetation scores are subject to change over time due to the dynamic nature of vegetation growth and the natural progression of succession. Vegetation scores would also be affected by changes in hydrology and geomorphology and hence the change in vegetation scores in the post-rehabilitation landscape.

The impact scores recorded for the vegetation component of the wetlands ranged from **0,37** to **5,81**, translating into Present Vegetation State (PVS) of **A** to **D** (**Table 5.5**). The changes in ecosystem process and loss of natural habitat is considered to be '**Natural**' to '**Largely Modified**'.

**Table 5.5 Vegetation Impact Scores and PES category for Wetlands 3-8**

| **HGM Unit** | **Wetland 3** | **Wetland 4** | **Wetland 5** | **Wetland 6** | **Wetland 7** | **Wetland 8** |
|---|---|---|---|---|---|---|
| **Disturbance Class** | Impact Score | Impact Score | Impact Score | Impact Score | Impact Score | Impact Score |
| Old Abandoned Lands (Recent) | 1,96 | 3,54 | 0,00 | 2,29 | 0,00 | 3,57 |
| Old Abandoned Lands (Old) | 0.14 | 0,00 | 3,04 | 0,00 | 1,31 | 1,62 |
| Infrastructure | 0,15 | 0,30 | 0,25 | 0,65 | 0,21 | 0,07 |
| Dense Alien Vegetation Patches | 0,00 | 0,00 | 0,13 | 0,00 | 0,00 | 0,00 |
| Shallow Flooding By Dams | 0,00 | 0,59 | 0,31 | 0,01 | 0,09 | 0,14 |
| Crop Lands | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 | 0,42 |
| Combined Vegetation Impact Score | 2,25 | 4,43 | 3,70 | 2,94 | 1,61 | 5,81 |
| **PES Category** | **C** | **D** | **C** | **C** | **B** | **D** |

**Table 5.5 continued Vegetation Impact Scores and PES category for Wetlands 9-13**

| **HGM Unit** | **Wetland 9** | **Wetland 10** | **Wetland 11** | **Wetland 12** | **Wetland 13** |
|---|---|---|---|---|---|
| **Disturbance Class** | Impact Score | Impact Score | Impact Score | Impact Score | Impact Score |
| Old Abandoned Lands (Recent) | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Old Abandoned Lands (Old) | 3,87 | 0,23 | 1,82 | 1,84 | 0,72 |
| Infrastructure | 0,32 | 0,14 | 0,58 | 0,29 | 0,17 |
| Dense Alien Vegetation Patches | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Shallow Flooding By Dams | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Crop Lands | 0,00 | 0,00 | 0,00 | 0,00 | 0,00 |
| Combined Vegetation Impact Score | 4,19 | 0,37 | 2,40 | 2,13 | 0,89 |
| **PES Category** | **D** | **A** | **C** | **C** | **A** |

### 5.3.4 Overall Current State Impacts

For ease of interpretation the scores for hydrology, geomorphology and vegetation can be simplified into a composite impact score for the HGM units by weighting the scores obtained as outlined in Macfarlane et al. (2007). A summary of the overall results from the current scenario are outlined below (**Table 5.6**). The assessment of the wetland habitat under current conditions identified modifications which include:

- Modifications associated with historic plantation infrastructure such as:
  - Old forestry roads;
  - Old forestry drains;
  - Excavation and infilling associated with forestry activities; and
- Vegetation composition changes associated with removal of plantation trees.

**Table 5.6 Overall current wetland impact scores and PES categories for Wetlands 3-6**

| Wetland | | Wetland 3 | Wetland 4 | Wetland 5 | Wetland 6 |
|---|---|---|---|---|---|
| Hydrology | Impact Score | 0,00 | 0,00 | 0,00 | 1,00 |
| | PES Category | A | A | A | B |
| Geomorphology | Impact Score | 0,17 | 1,26 | 0,55 | 0,81 |
| | PES Category | A | B | A | A |
| Vegetation | Impact Score | 2,25 | 4,43 | 3,74 | 2,94 |
| | PES Category | C | D | C | C |
| Overall | Impact Score | 0,69 | 1,63 | 1,23 | 1,50 |
| | PES Category | A | B | B | B |

**Table 5.6 continued overall current wetland impact scores and PES categories for Wetlands 7-10**

| Wetland | | Wetland 7 | Wetland 8 | Wetland 9 | Wetland 10 |
|---|---|---|---|---|---|
| Hydrology | Impact Score | 0,00 | 3,00 | 0,00 | 0,00 |
| | PES Category | A | C | A | A |
| Geomorphology | Impact Score | 0,34 | 2,33 | 0,18 | 0,34 |
| | PES Category | A | C | A | A |
| Vegetation | Impact Score | 1,61 | 5,81 | 4,19 | 0,37 |
| | PES Category | B | D | D | A |
| Overall | Impact Score | 0,56 | 3,61 | 1,25 | 0,20 |
| | PES Category | A | C | B | A |

**Table 5.6 continued overall current wetland impact scores and PES categories for Wetlands 11-13**

| Wetland | | Wetland 11 | Wetland 12 | Wetland 13 |
|---|---|---|---|---|
| Hydrology | Impact Score | 0,00 | 1,00 | 0,00 |
| | PES Category | A | B | A |
| Geomorphology | Impact Score | 0,66 | 0,00 | 0,21 |
| | PES Category | A | A | A |
| Vegetation | Impact Score | 2,40 | 2,13 | 0,89 |
| | PES Category | C | C | A |
| Overall | Impact Score | 0,87 | 1,04 | 0,31 |
| | PES Category | A | B | A |

The composite impact scores were then used to derive hectare equivalents, which were used as the 'currency' for assessing the loss and/or gains in wetland integrity (**Table 5.8**) (Cowden and Kotze 2009).

The 3299,94ha of wetland habitat is currently equivalent to 3153,10ha of intact wetland habitat. Based on the post-rehabilitation PES scores for the wetlands, the condition of the wetland habitat is likely to improve to the equivalent of 3160,00ha of functional wetland habitat through the adoption of the proposed rehabilitation measures. This is considered to be a gain of approximately 6,90ha of functional wetland habitat. The rehabilitations interventions proposed for the selected iSimangaliso Wetland Park wetlands are largely to remove old forestry roads in order to reinstate natural hydrological flows and connectivity within the HGM units. As can be seen in **Table 5.6**, the scores associated with the health of the vegetation contribute most to the adverse overall health scores. However, rehabilitation of vegetation in wetlands can be extremely challenging, time and resource consuming and results can often be less effective than initially predicted. Therefore, the focus of this rehabilitation at this point in time is on the reinstatement of natural hydrological flows. However, once all infrastructure associated with forestry activities has been removed and regulatory hydrological and geomorphic services have been restored to the wetland systems, rehabilitation objectives in iSimangaliso Wetland Park may need to change to focus on biodiversity conservation for example. According to Cowden et al. (2014), vegetative recovery during and after wetland rehabilitation is generally the most challenging to predict and achieve as a result of the dynamic nature of vegetation. Simply addressing hydrological and geomorphic wetland problems through rehabilitation is not sufficient to reinstate climax wetland vegetation, especially in a landscape that is dominated by disturbance-tolerant and invasive plant species. Therefore, active removal of invasive and disturbance-tolerant plant species and subsequent revegetation need to form part of the rehabilitation planning at iSimangaliso Wetland Park in order to completely rehabilitate the historically transformed wetlands. This rehabilitation approach may be incorporated into future rehabilitation planning cycles. **Figure 5.3** provides a graphic representation of the functional wetland area within the current and post-rehabilitation scenarios, illustrating the gains associated with the adoption of the currently proposed rehabilitation activities.

**Table 5.7 Overall HGM unit hectare equivalents for the current and post-rehabilitation scenarios for each of the wetlands**

| **Wetland** | | **Wetland 3** | **Wetland 4** | **Wetland 5** | **Wetland 6** | **Wetland 7** | **Wetland 8** |
|---|---|---|---|---|---|---|---|
| **Area (ha)** | | **699,00** | **17,96** | **66,79** | **1,47** | **49,97** | **14,80** |
| **Current** | **Impact Score** | 0,69 | 1,63 | 1,23 | 1,50 | 0,56 | 3,61 |
| | **PES Category** | **A** | **B** | **B** | **B** | **A** | **C** |
| | **Hectare Equivalents** | 650,67 | 15,04 | 58,60 | 1,25 | 47,19 | 9,46 |
| **With Rehabilitation** | **Impact Score** | 0,67 | 1,02 | 1,04 | 0,76 | 0,38 | 2,45 |
| | **PES Category** | **A** | **B** | **B** | **A** | **A** | **B** |
| | **Hectare Equivalents** | 652,07 | 16,12 | 59,86 | 1,36 | 48,06 | 11,18 |

| **Wetland** | | **Wetland 9** | **Wetland 10** | **Wetland 11** | **Wetland 12** | **Wetland 13** |
|---|---|---|---|---|---|---|
| **Area (ha)** | | **14,8** | **5,95** | **21,45** | **5,78** | **2411,00** |
| **Current** | **Impact Score** | 1,25 | 0,20 | 0,87 | 1,04 | 0,31 |
| | **PES Category** | **B** | **A** | **B** | **B** | **A** |
| | **Hectare Equivalents** | 5,05 | 5,83 | 19,56 | 5,18 | 2335,2 |
| **With Rehabilitation** | **Impact Score** | 1,11 | 0,07 | 0,74 | 0,95 | 0,31 |
| | **PES Category** | **B** | **A** | **A** | **A** | **A** |
| | **Hectare Equivalents** | 5,91 | 5,91 | 19,87 | 5,23 | 2335,2 |

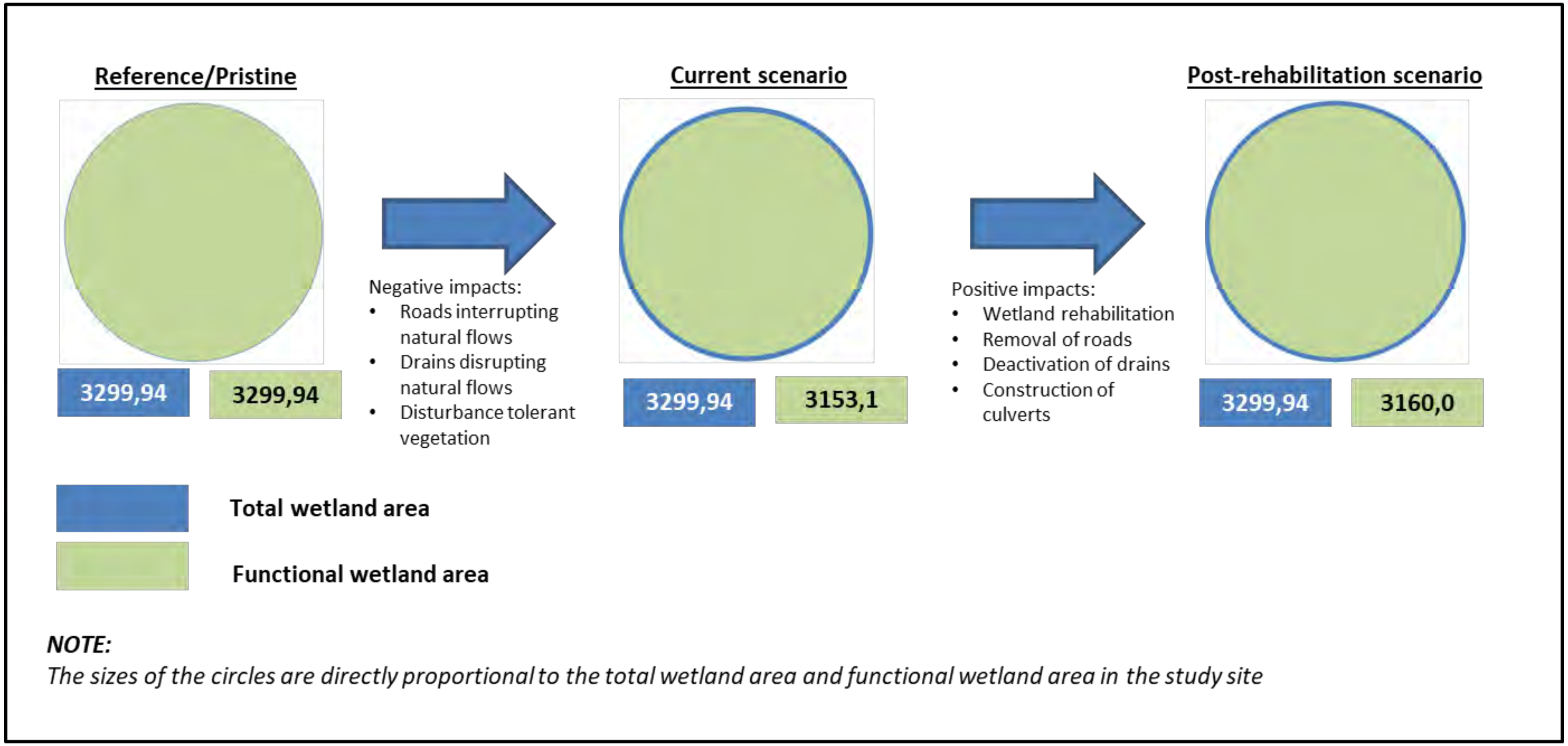



**Figure 5.1 A graphic representation of the wetland habitat within the landscape, in terms of both spatial extent and functional area, from reference conditions through to the post-rehabilitation scenario (Cowden et al. 2013).**

# 6. WETLAND REHABILITATION INTERVENTIONS

Wetland rehabilitation can be described as a process in which the causes and symptoms of the wetland degradation are addressed, ensuring the wetland integrity and functionality are maintained and/or improved to a desired state. A proactive approach in terms of corrective interventions is recommended to address the impacts within the wetland systems. The following section serves to describe the rehabilitation of the wetland ecosystems, including the objectives, which attempt to maximise the levels of ecosystem functioning and integrity. The planning of the rehabilitation interventions was carried out by wetland specialist in conjunction with an environmental engineer, as well as an environmental assessment practitioner (EAP).

## 6.1 Wetland Problems within the iSimangaliso Wetland Park Systems

The wetlands earmarked for rehabilitation within the iSimangaliso Wetland Park have mostly been altered as a result of historical forestry plantations. The predominant drivers of current degradation within these wetlands include the disturbed vegetation composition and the fact that the hydrological functioning of the wetlands is being interrupted by old forestry roads. A number of the selected wetlands are also currently being affected by newer roads that have been built subsequent to the creation of the iSimangaliso Wetland Park and are currently used by reserve managers and tourists. The roads interrupt hydrological connectivity between upstream and downstream sections of wetland and it is therefore of high importance that as many of these roads are removed as possible. Based on discussions and site visits with the Land Care Management Department at iSimangaliso, a number of road crossings and old drains were prioritised for removal during the site visit in November 2018. However, a number of the roads that interrupt important flow paths within wetlands are used extensively by reserve managers and tourists and cannot be removed and were not prioritised during the initial site visit. However, after discussions with the Land Care Management Department, a number of additional roads were authorised for removal and a number of culverts will be constructed beneath roads that cannot be removed to allow for semi-natural flows to resume across the wetland. These additional interventions will only be specified by engineers once the current rehabilitation plan is nearing its end. The proposed rehabilitation strategies for the eleven identified systems are described below.

## 6.2 Wetland rehabilitation aim and objectives

With the implementation of wetland rehabilitation, it is important to set aims and objectives for the planned rehabilitation in accordance with WET-RehabPlan (Kotze et al. 2009).

**Aim:**

Due to the intact and pristine nature of many of the systems within the larger iSimangaliso Wetland Park, the aim of the rehabilitation is to stabilise and restore the wetland systems to a state that resembles a natural reference state. This rehabilitation work would also result in the enhancement of the functioning and the integrity of the wetlands.

**Objectives:**

The primary objective of the wetland rehabilitation is to secure and improve the overall integrity of the systems with a particular focus on the recovery of the hydrological functioning of the wetland habitats. The geomorphological and vegetation health of the wetlands are likely to improve as a consequence of the recovery of the hydrological functioning as sediment will be transported naturally once again and natural water retention and distribution within the HGM units is likely to encourage climax wetland vegetation growth.

## 6.3 Wetland rehabilitation strategy for Wetland 3

As mentioned in previous sections, only a portion of Wetland 3 has been considered for rehabilitation as there are a number of old forestry roads within the HGM unit that are still being used as management roads. The rehabilitation within Wetland 3 is focussed on the removal of an old forestry road that runs in a general north-south direction and is orientated in the same direction as the natural grade of the wetland (**Figure 6.1**). Therefore, the road is not having a pronounced impact on interrupting flows within the wetland as it intercepts flows very poorly. However, the raised and compacted nature of the old road surface has allowed for the establishment of a number of more terrestrial plant species such as *Psidium guajava* and *Cymbopogon validus*. The road will be removed by hand as the sensitivity of the surrounding fauna and flora requires a method of removal that is more delicate than removal by a machine. The road will be removed to a level that coincides with natural ground level and allows for water to flow along natural pathways. The additional material created from the removal of the road will be spoiled at a nearby spoil site (borrow pits linked to road construction) and the exposed soil within the wetland will be planted with appropriate vegetation to stabilise the soil. The revegetation process will happen as the road is removed such that there is very little chance for excess sediment to be mobilised within the HGM unit. A fire break located to the east of the old forestry road has also been specified for removal and will be removed in a similar fashion to that of the road. However, only smaller sections of the fire break are still intact meaning that there are only small sections that need to be removed.

In addition to the removal of the road and the fire break, two concrete culverts will be built underneath the tourist road to the west of the old forestry road to reinstate hydrological connectivity between a small section of wetland to the west of the tourist road and the eastern section of the wetland. These concrete culverts will reinstate natural hydrological flows across the HGM unit. An old drain that was associated with the forestry plantations will also be deactivated as it is currently decreasing the water retention time of the wetland in a small area surrounding the drain. The deactivation of this drain will involve filling it with spoil – possibly spoil generated during the removal of the road and fire break within the HGM unit.

### 6.3.1 Wetland Rehabilitation Interventions

**Table 6.1** provides a summary and location of the interventions proposed for Wetland 3 (W32H-03).

**Table 6.1 W32H-03 intervention list**

| Intervention Number | Intervention Type | Location | Priority |
|---|---|---|---|
| **W32H-03-201-00** | Road removal | Start: 28° 18' 22.32" S<br>32° 23' 14.83" E<br>End: 28° 17' 56.34" S<br>32° 23' 06.49" E | 1 |
| **W32H-03-202-00** | Skimming of old fire break to natural ground level | Start: 28° 17' 50.50" S<br>32° 23' 44.40" E<br>End: 28° 17' 54.14" S<br>32° 23' 44.77" E | 2 |
| **W32H-03-203-00** | Skimming of old fire break to natural ground level | Start: 28° 17' 56.15"S<br>32° 23' 44.92"E<br>End: 28° 17' 54.14" S<br>32° 23' 45.34"E | 2 |
| **W32H-03-204-00** | Skimming of old fire break to natural ground level | Start: 28° 18' 22.84"S<br>32° 23' 47.03"E<br>End: 28° 18' 06.85"S<br>32° 23' 47.35"E | 2 |
| **W32H-03-205-00** | Skimming of old fire break to natural ground level | Start: 28° 18' 30.71"S<br>32° 23' 47.67"E<br>End: 28° 18' 38.53"S<br>32° 23' 48.13"E | 2 |

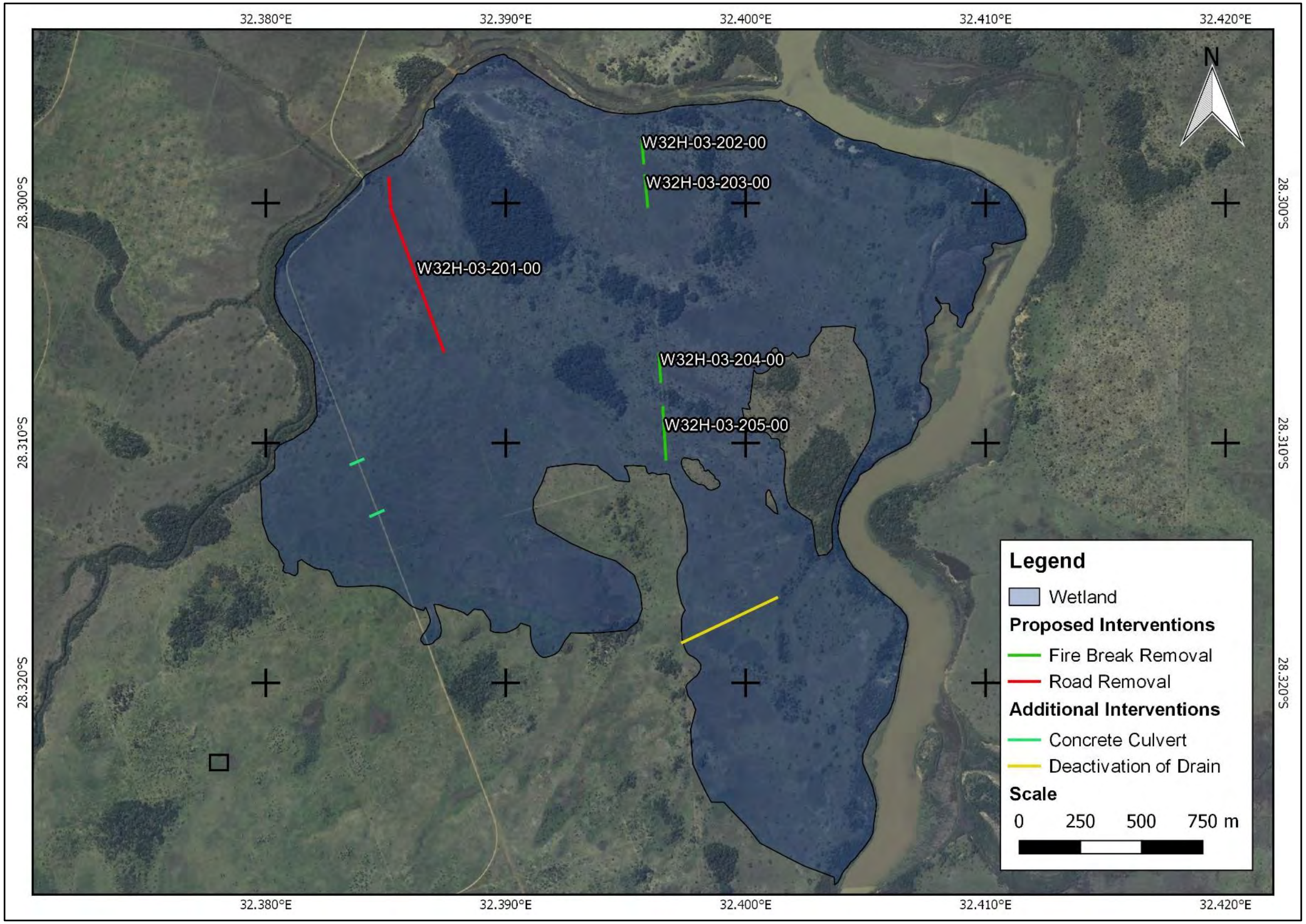



**Figure 6.1 Proposed rehabilitation strategy for Wetland 3 (W32H-03)**

## 6.4 Wetland Rehabilitation Strategy for Wetland 4

A number of old forestry roads that exist within Wetland 4 are the primary drivers of diminished wetland integrity in this particular HGM unit. Historic forestry roads within this wetland are responsible for interrupting hydrological connectivity between upstream and downstream sections of the wetland, however, only two have been specified for removal (**Figure 6.2**). The removal of these two roads is likely to reinstate some hydrological connectivity within the wetland, which in turn should also limit the coverage of *Pteridium aquilinum* within the HGM unit. Both roads will be removed by hand and all spoil material will be deposited in a nearby spoil site or will be used in the reshaping of land to the west of the HGM unit. The small arm of the wetland located to the east of the main arm of the wetland has historically been infilled to raise the forestry road above the wetland surface and as such, the surface of the ground will need to be skimmed to return this arm of the wetland to its natural grade and level. The depth of the fill increases in a westerly direction and as such the required amount of material to be skimmed will increase farther to the west. As with Wetland 3, the revegetation of the exposed earth will occur immediately after the roads have been removed and will be done with an appropriate suite of wetland tolerant species.

In addition to the currently specified rehabilitation work within the wetland, three additional roads have been authorised for removal in the bowl of the wetland and should be removed using the same methods mentioned above. The removal of these roads will reinstate complete hydrological connectivity within the wetland and water will begin to move through the wetland along natural pathways once again.

Additional earthworks to the west of Wetland 4 have been specified and authorised. Although this rehabilitation is terrestrial, the work will improve the aesthetic value of the iSimangaliso Wetland Park. Three earthen berms will be removed and the material generated will be used to create a low-level earthen berm that will direct any stormflows towards the culvert that runs beneath the tourist road. Excess material generated by the removal of the berms will also be used to fill the small depressions that have been created between these berms. The steep embankment located directly south of the culvert that runs beneath the tourist road will be reshaped to a natural grade and level and any excess material generated during this process can be used in the creation of the earthen berms. All earthworks will be conducted by hand so as to limit vegetation destruction and complete soil reworking. Revegetation of reworked areas will occur on the same day as the earthworks so as to ensure no sediment is transported away from the rehabilitated area.

### 6.4.1 Wetland Rehabilitation Interventions

**Table 6.2** provides a summary and location of the interventions proposed for Wetland 4 (W32H-04).

**Table 6.2 W32H-04 intervention list**

| Intervention Number | Intervention Type | Location | Priority |
|---|---|---|---|
| **W32H-04-201-00** | Road removal | Start: 28° 20' 18.71"S<br>32° 23' 01.66"E<br>End: 28° 20' 18.25"S<br>32° 22' 59.96"E | 1 |
| **W32H-04-202-00** | Skimming of ground to natural wetland level (100mm) | 28° 20' 18.91"S<br>32° 23' 01.38"E | 2 |
| **W32H-04-203-00** | Skimming of ground to natural wetland level (300mm) | 28° 20' 18.81"S<br>32° 23' 00.93"E | 2 |
| **W32H-04-204-00** | Skimming of ground to natural wetland level (400mm) | 28° 20' 18.68"S<br>32° 23' 00.50"E | 2 |
| **W32H-04-205-00** | Skimming of ground to natural wetland level (150mm) | 28° 20' 18.52"S<br>32° 23' 00.26"E | 2 |
| **W32H-04-206-00** | Road removal | Start: 28° 20' 18.14"S<br>32° 22' 58.78"E<br>End: 28° 20' 17.27"S<br>32° 22' 56.02"E | 1 |
| **W32H-04-207-00** | Low-level berm construction | Start: 28° 20' 14.48"S<br>32° 22' 49.75"E<br>End: 28° 20' 15.10"S<br>32° 22' 48.88"E | 3 |
| **W32H-04-208-00** | Berm removal | Start: 28° 20' 15.22"S<br>32° 22' 51.66"E<br>End: 28° 20' 14.62"S<br>32° 22' 49.56"E | 3 |
| **W32H-04-209-00** | Berm removal | Start: 28° 20' 15.26"S<br>32° 22' 50.99"E<br>End: 28° 20' 14.78"S<br>32° 22' 49.43"E | 3 |
| **W32H-04-210-00** | Berm removal | Start: 28° 20' 15.44"S<br>32° 22' 50.90"E<br>End: 28° 20' 15.01"S<br>32° 22' 49.30"E | 3 |
| **W32H-04-211-00** | Reshaping | Start: 28° 20' 16.06"S<br>32° 22' 49.41"E<br>End: 28° 20' 15.82"S<br>32° 22' 48.51"E | 3 |

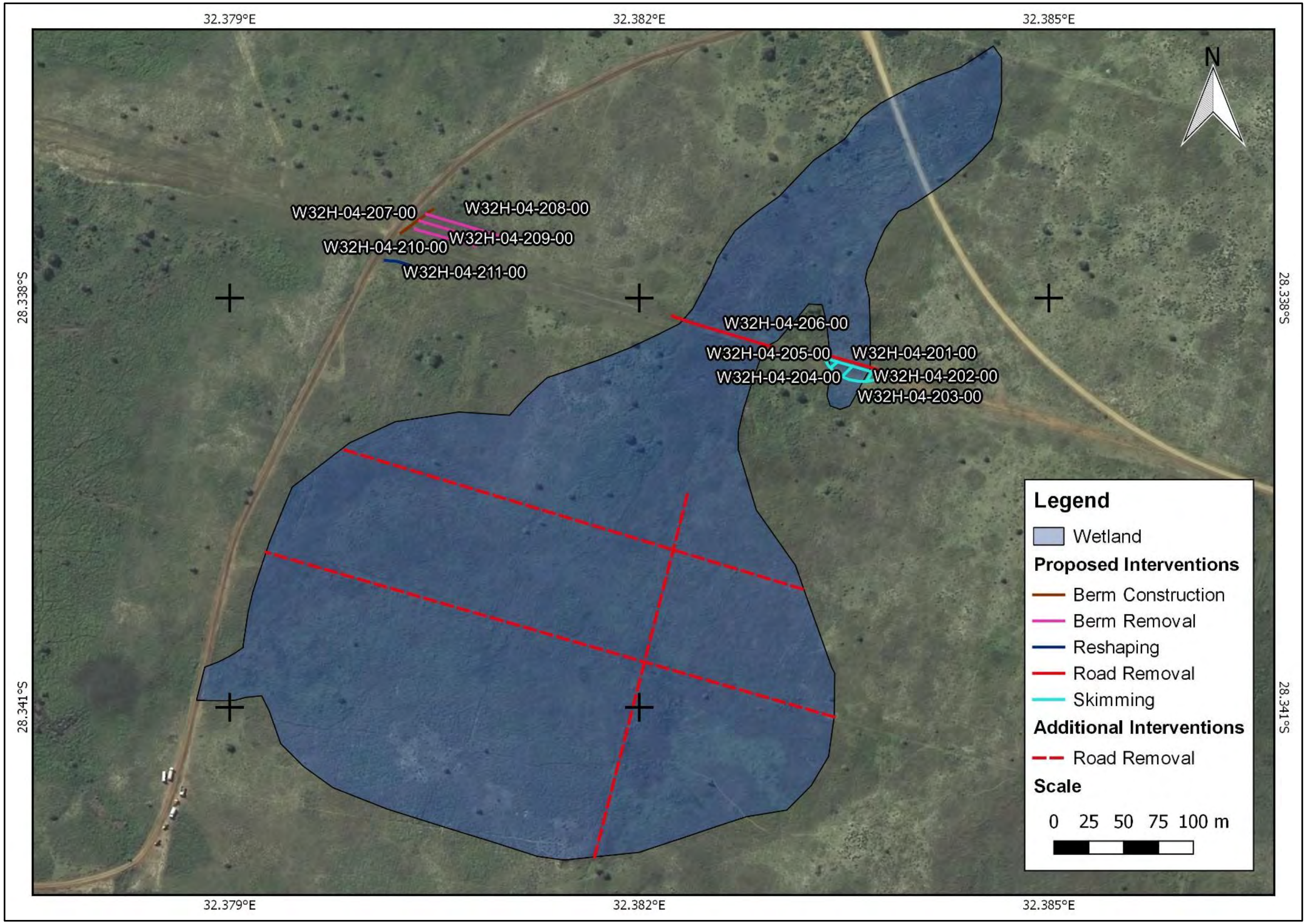



**Figure 6.2 Proposed rehabilitation strategy for Wetland 4 (W32H-04)**

## 6.5 Wetland Rehabilitation Strategy for Wetland 5

Wetland 5 is a large floodplain wetland that has been hydrologically divided and split up by old forestry roads and a more recently constructed tourist road. The rehabilitation plan for Wetland 5 includes the removal of three sections of old forestry road as well as an old earthen bridge that crosses a small channel located on the eastern border of the wetland. The old earthen bridge will need to be removed first as it will require a machine for its removal. One of the old forestry roads specified for removal is the only access point to this bridge and therefore the bridge will need to be removed prior to this road being removed. There are two concrete culverts located underneath the bridge which will need to be extricated and taken offsite. Although a portion of the bridge has been removed already, the complete removal of the remainder of the bridge will reinstate a more natural flow path for the water within the channel that it crosses. One of the old forestry roads specified for removal is located approximately in the middle of the HGM unit and intercepts a large proportion of the flows en route to the Mpate River. This road, along with another section of road located towards the south west of the HGM unit, will be removed by hand and the material generated will be spoiled at a nearby spoil site. The revegetation of the old road areas will occur on the same day that the roads are removed to ensure negligible sediment mobilisation within the wetland.

In addition, the tourist road that is located in the southern reaches of the HGM unit cuts the HGM unit in two as no surface water can pass from one side of the road to the other. Therefore, two concrete culverts will be constructed beneath the tourist road to allow for hydrological connectivity between the southern and the northern portions of the HGM unit.

### 6.5.1 Wetland Rehabilitation Interventions

**Table 6.3** provides a summary and location of the interventions proposed for Wetland 5 (W32H-05).

**Table 6.3 W32H-05 intervention list**

| Intervention Number | Intervention Type | Location | Priority |
|---|---|---|---|
| **W32H-05-201-00** | Bridge removal | Start: 28° 19' 37.00"S<br>32° 22' 07.53"E<br>End: 28° 19' 37.41"S<br>28° 19' 37.41" | 1 |
| **W32H-05-202-00** | Road removal | Start: 28° 19' 37.88"S<br>32° 22' 04.48"E<br>End: 28° 19' 38.26"S<br>32° 22' 03.17"E | 2 |
| **W32H-05-203-00** | Road removal | Start: 28° 19' 39.31"S<br>32° 21' 59.84"E<br>End: 28° 19' 41.74"S<br>32° 21' 51.68"E | 2 |
| **W32H-05-204-00** | Road removal | Start: 28° 19' 52.62"S<br>32° 21' 43.04"E<br>End: 28° 19' 57.92"S<br>32° 21' 51.27"E | 2 |

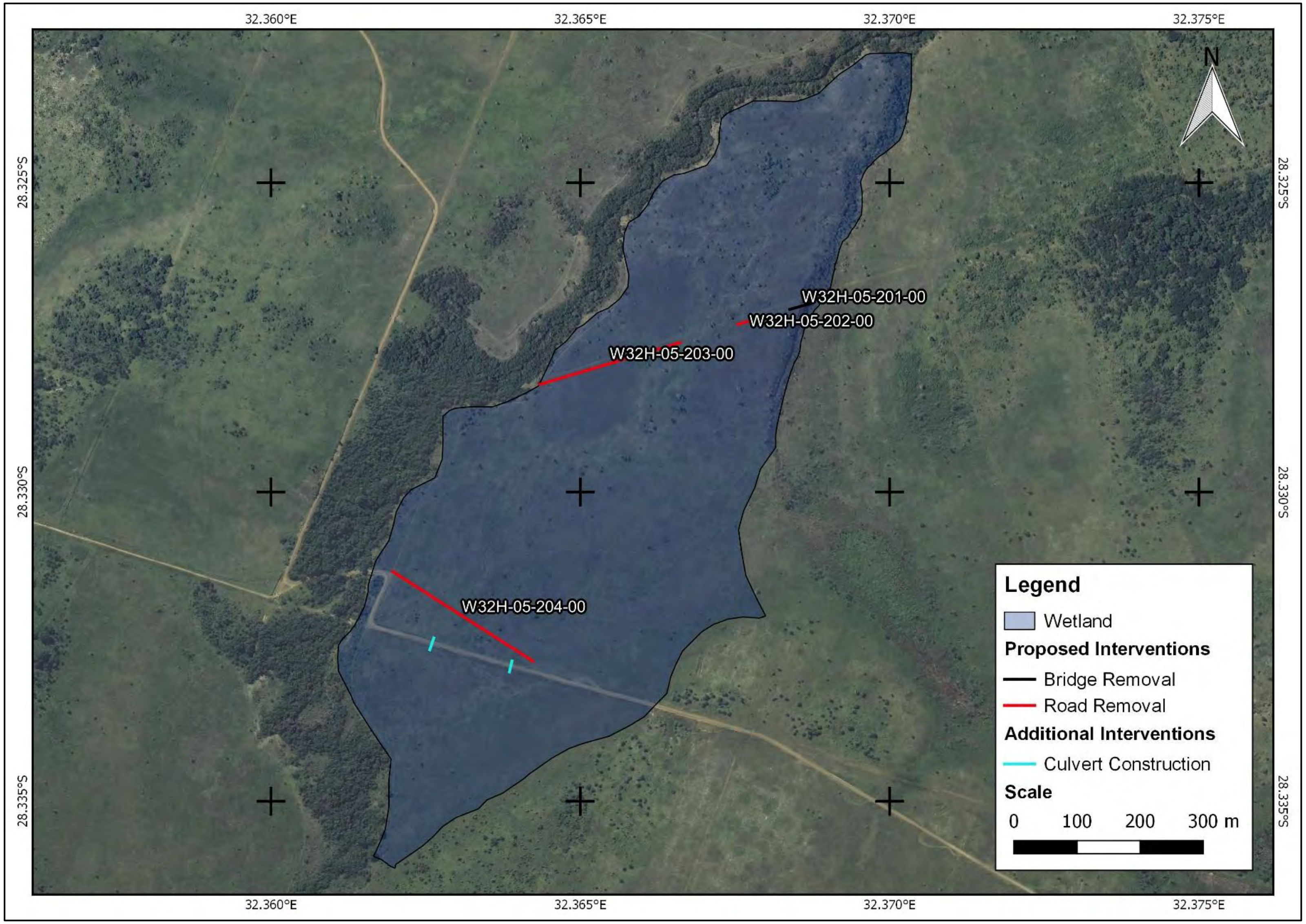



**Figure 6.3 Proposed rehabilitation strategy for Wetland 5 (W32H-05)**

## 6.6 Wetland Rehabilitation Strategy for Wetland 6

The presence of an old forestry road is the main driver affecting the hydrological functioning and integrity of Wetland 6. As such, the rehabilitation of Wetland 6 is focussed on the removal of this road (**Figure 6.4**). The road bisects the wetland and completely interrupts surface flows between the upstream and downstream sections of the wetland. The removal of the road will be done by hand to ensure minimal disturbance of the surrounding vegetation and the material created by the road removal will be spoiled at a nearby spoil site. The removal of the road will reinstate a natural grade to this steep hillslope seep wetland and will return the wetland to a state of greater integrity and ability to function. Once the road has been removed, the bare earth will be revegetated immediately with a mix of appropriate slope stabilising wetland vegetation.

### 6.6.1 Wetland Rehabilitation Interventions

**Table 6.4** provides a summary and location of the interventions proposed for Wetland 6 (W32H-06).

**Table 6.4 W32H-06 intervention list**

| Intervention Number | Intervention Type | Location | Priority |
|---|---|---|---|
| **W32H-06-201-00** | Road removal | Start: 28° 20' 4.36"S<br>32° 22' 11.71"E<br>End: 28° 20' 5.18"S<br>32° 22' 14.46"E | 1 |

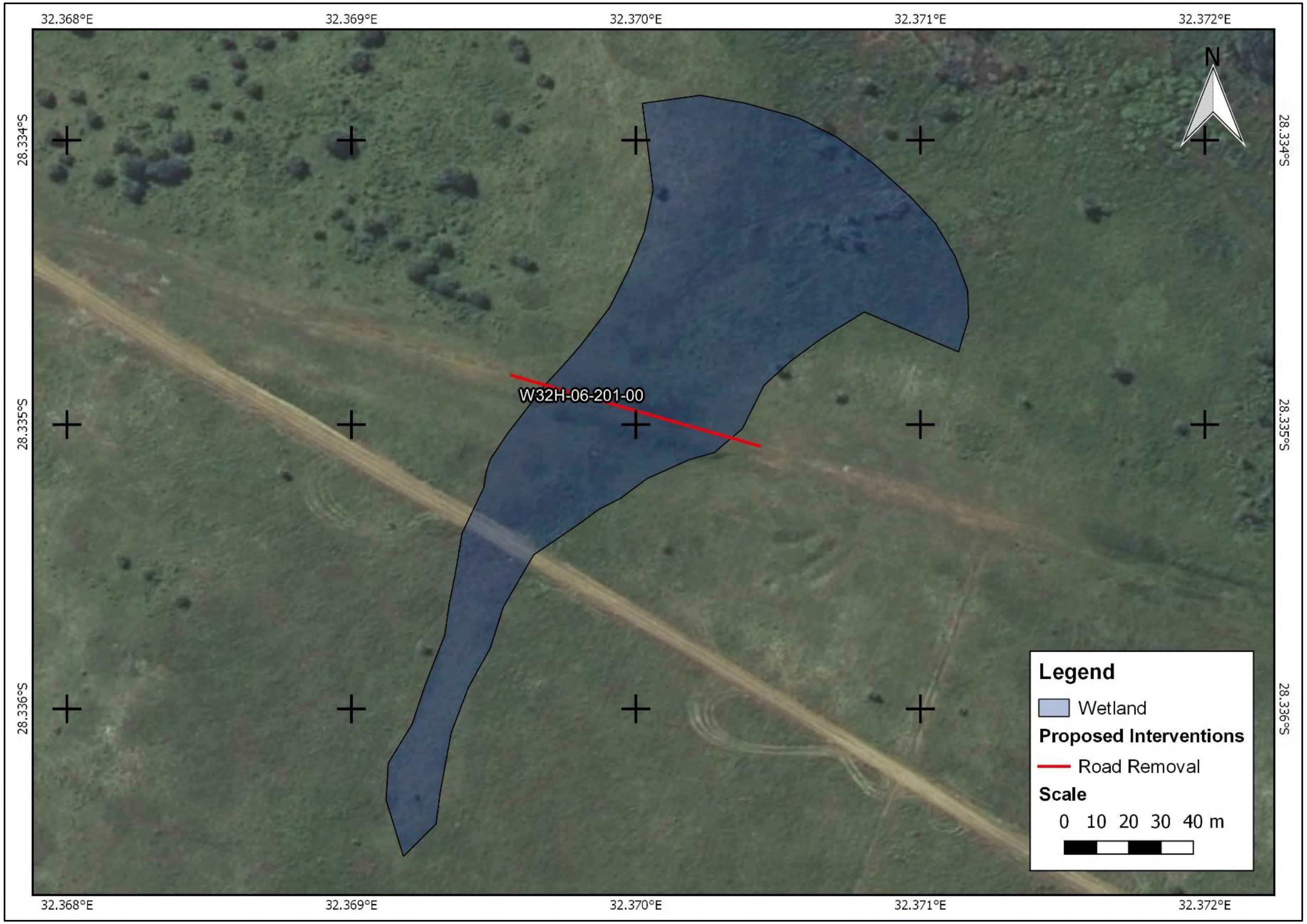



**Figure 6.4 Proposed rehabilitation strategy for Wetland 6 (W32H-06)**

## 6.7 Wetland Rehabilitation Strategy for Wetland 7

Wetland 7 has been hydrologically impacted by a continuation of the old forestry road that is being removed from Wetland 6 (**Figure 6.5**). This old forestry road is responsible for large areas of dammed open water upstream of it and for areas of desiccation downstream of the road. Therefore, the removal of this road will be the focus of the rehabilitation for Wetland 7. Some portions of the road have already been trampled and flattened by hippopotamus trails and as such, preferential flow paths have slowly been created along these paths. However, the removal of the entire road would improve the overall hydrological integrity and functioning of the wetland. Therefore, sections of road will be removed by hand to a level that is equivalent to the natural grade of the wetland and the material generated from the removal will either be used to create a more gradual grade below the old road or will be spoiled in a nearby spoil site. Revegetation of the old road site will occur immediately as the road is removed to prevent sediment mobilisation within the HGM unit.

### 6.7.1 Wetland Rehabilitation Interventions

**Table 6.5** provides a summary and location of the interventions proposed for Wetland 7 (W32H-07).

**Table 6.5 W32H-07 intervention list**

| Intervention Number | Intervention Type | Location | Priority |
|---|---|---|---|
| **W32H-07-201-00** | Road removal | Start: 28° 20' 6.22"S<br>32° 22' 18.16"E<br>End: 28° 20' 7.17"S<br>32° 22' 21.47"E | 1 |
| **W32H-07-202-00** | Road removal | Start: 28° 20' 7.81"S<br>32° 22' 23.74"E<br>End: 28° 20' 10.97"S<br>32° 22' 34.57"E | 1 |

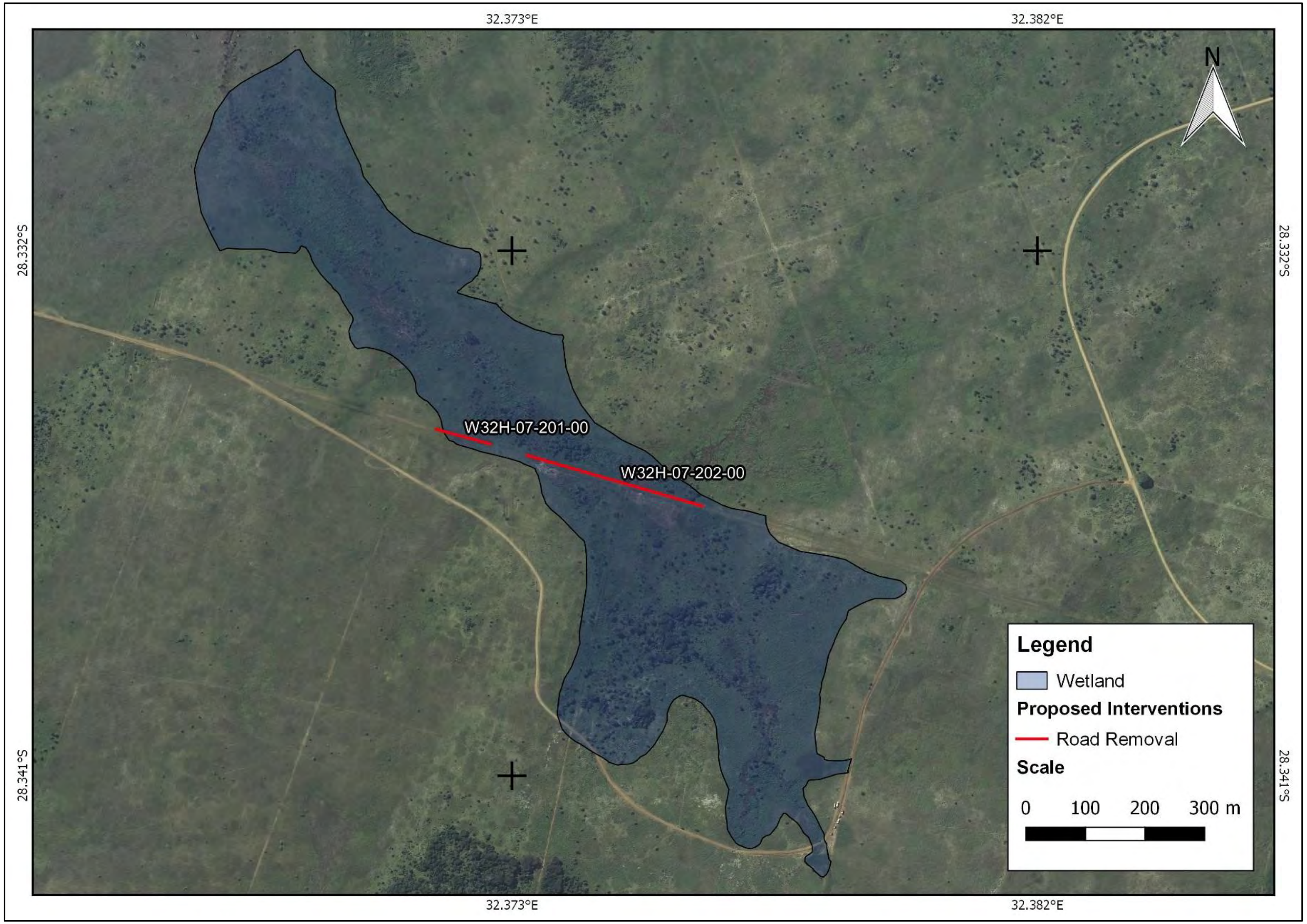



**Figure 6.5 Proposed rehabilitation strategy for Wetland 7 (W32H-07)**

## 6.8 Wetland Rehabilitation Strategy for Wetland 8

Wetland 8 is arguably the most degraded wetland that has been selected for rehabilitation in iSimangaliso Wetland Park and would benefit proportionally more than other HGM units in terms of functionality and integrity with the adoption of the proposed rehabilitation strategy. The main factor affecting the hydrological and geomorphological integrity of Wetland 8 is the presence of old agricultural drains that have been excavated along the western margin of the HGM unit (**Figure 6.6**). These drains are responsible for redirecting flows towards the eastern side of the HGM unit and are therefore creating an unnatural preferential flow path along the eastern side of the wetland. This preferential flow path also transports additional sediment towards the east of the HGM unit and is therefore slowly creating relief on this side. Two old forestry roads also split the HGM unit in half and intercept all flows completely, creating open water upstream of the old roads and desiccating sections of the wetland on the downstream side of the old roads. However, one of the roads runs along the fence line of the iSimangaliso Wetland Park and is used as a fence patrol route and therefore cannot be removed. However, a concrete culvert will be constructed underneath this road to allow for increased hydrological connectivity between the up and downstream sides of the wetland. The second forestry road located approximately midway along the HGM unit will be removed by hand and the material created by this process will be used to fill in the drains within the HGM unit. The old agricultural drains will be filled with this road material and will be compacted to an appropriate density to ensure that water will still be able to pass through it, but will not be susceptible to erosion. Both the removal of the old forestry road and the filling of the agricultural drains will be subject to revegetation which will happen immediately after both rehabilitation activities are completed. The revegetation process will be conducted with an appropriate mix of wetland vegetation that will be able to withstand partial submergence as the western section of the HGM unit will become an active part of the wetland once again.

The toe of Wetland 8 historically connected to a stream network that flowed in an easterly direction, but an old forestry road that is now used as a management road was constructed across the point of connection and now prevents this hydrological connectivity. A concrete culvert will be constructed beneath the management road to reinstate this natural flow path and to prevent further damming of water in Wetland 8 and desiccation of the river channel.

### 6.8.1 Wetland Rehabilitation Interventions

**Table 6.6** provides a summary and location of the interventions proposed for Wetland 8 (W32H-08).

**Table 6.6 W32H-08 intervention list**

| Intervention Number | Intervention Type | Location | Priority |
|---|---|---|---|
| **W32H-08-201-00** | Road removal | Start: 28° 21' 47.05"S 32° 23' 4.50"E<br>End: 28° 21' 45.77"S 32° 22' 57.70"E | 1 |
| **W32H-08-202-00** | Drain deactivation | Start: 28° 21' 45.91"S 32° 22' 58.16"E<br>End: 28° 21' 45.80"S 32° 22' 57.19"E | 1 |

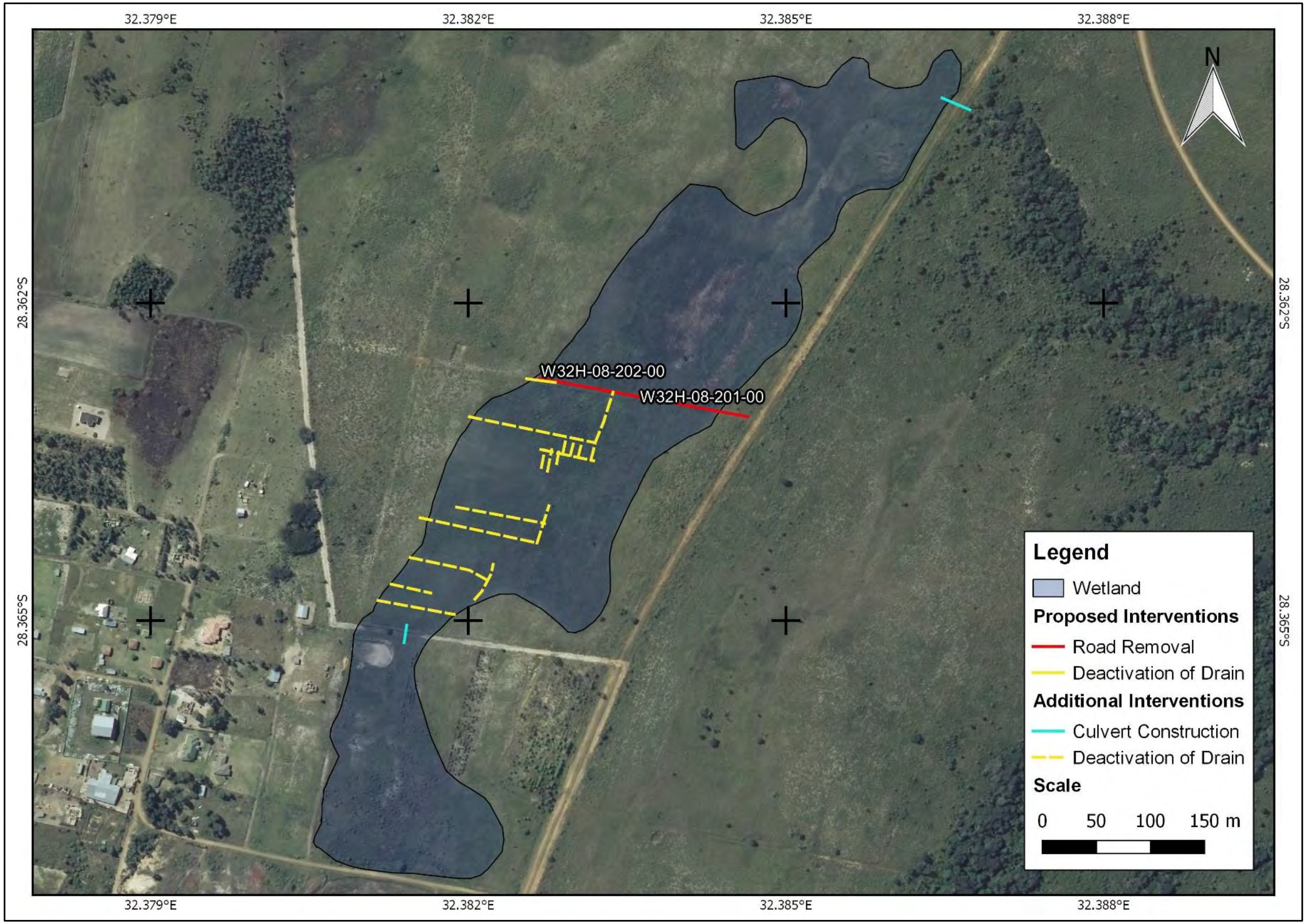



**Figure 6.6 Proposed rehabilitation strategy for Wetland 8 (W32H-08)**

## 6.9 Wetland Rehabilitation Strategy for Wetland 9

The main factor affecting the functioning and integrity of Wetland 9 is the vegetation composition and the fact that it is dominated by terrestrial disturbance tolerant species. However, there is an old forestry road that cuts the wetland almost exactly in half and is interrupting natural hydrological flows (**Figure 6.7**). The removal of this road will reinstate natural hydrological connectivity within Wetland 9. The road will be removed by hand and will be revegetated immediately after removal with an appropriate mix of vegetation species. The spoil generated from the removal of the road will be deposited into a nearby spoil site.

### 6.9.1 Wetland Rehabilitation Interventions

**Table 6.7** provides a summary and location of the interventions proposed for Wetland 9 (W32H-09).

**Table 6.7 W32H-09 intervention list**

| Intervention Number | Intervention Type | Location | Priority |
|---|---|---|---|
| **W32H-09-201-00** | Road removal | Start: 28° 20' 42.60"S<br>32° 22' 35.76"E<br>End: 28° 20' 41.90"S<br>32° 22' 31.08"E | 1 |

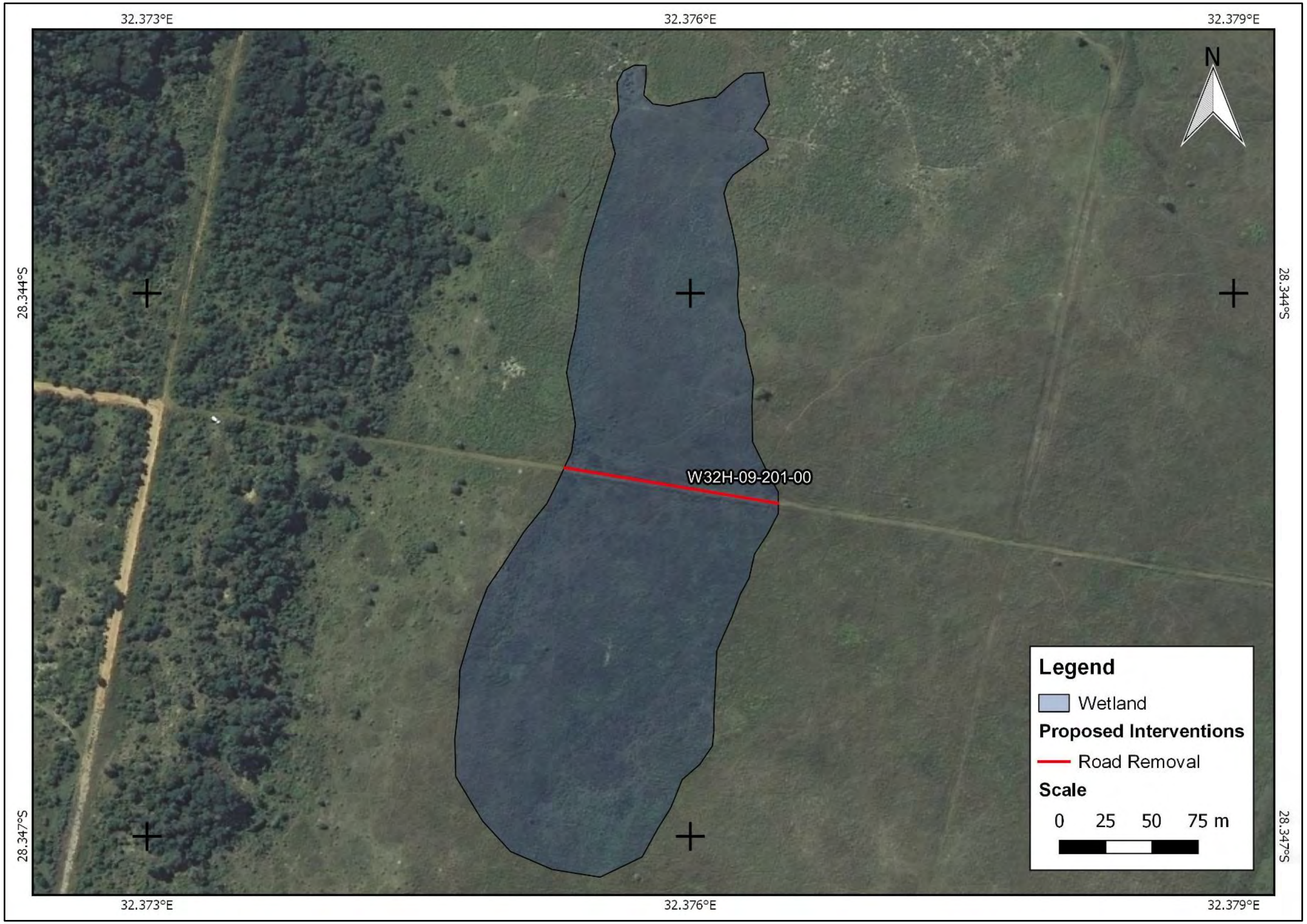



**Figure 6.7 Proposed rehabilitation strategy for Wetland 9 (W32H-09)**

## 6.10 Wetland Rehabilitation Strategy for Wetland 10

Wetland 10 is a small closed unchannelled valley-bottom wetland that has been negatively impacted upon by an old forestry road that runs midway across the HGM unit and interrupts natural hydrological processes (**Figure 6.8**). The presence of the road has resulted in damming of surface water upstream of the road and desiccation of the HGM unit downstream of the road. Therefore, there is limited hydrological connectivity across the HGM unit and the proposed rehabilitation plan is likely to rectify that. The removal of the road will be done by hand and the material derived from the removal of the road will be used to backfill a section of the wetland which was excavated to generate material to build the road initially. The exposed road and backfill areas will be revegetated immediately after the earthworks have been completed so as to prevent unnatural sediment transport in a downstream direction.

### 6.10.1 Wetland Rehabilitation Interventions

**Table 6.8** provides a summary and location of the interventions proposed for Wetland 10 (W32H-10).

**Table 6.8 W32H-10 intervention list**

| Intervention Number | Intervention Type | Location | Priority |
|---|---|---|---|
| **W32H-10-201-00** | Road removal | Start: 28° 19' 06.93"S<br>32° 26' 00.94"E<br>End: 28° 19' 6.94"S<br>32° 25' 58.00"E | 1 |
| **W32H-10-202-00** | Backfilling and reshaping | Start: 28° 19' 06.99"S<br>32° 25' 58.25"E<br>End: 28° 19' 07.04"S<br>32° 25' 57.25"E | 2 |

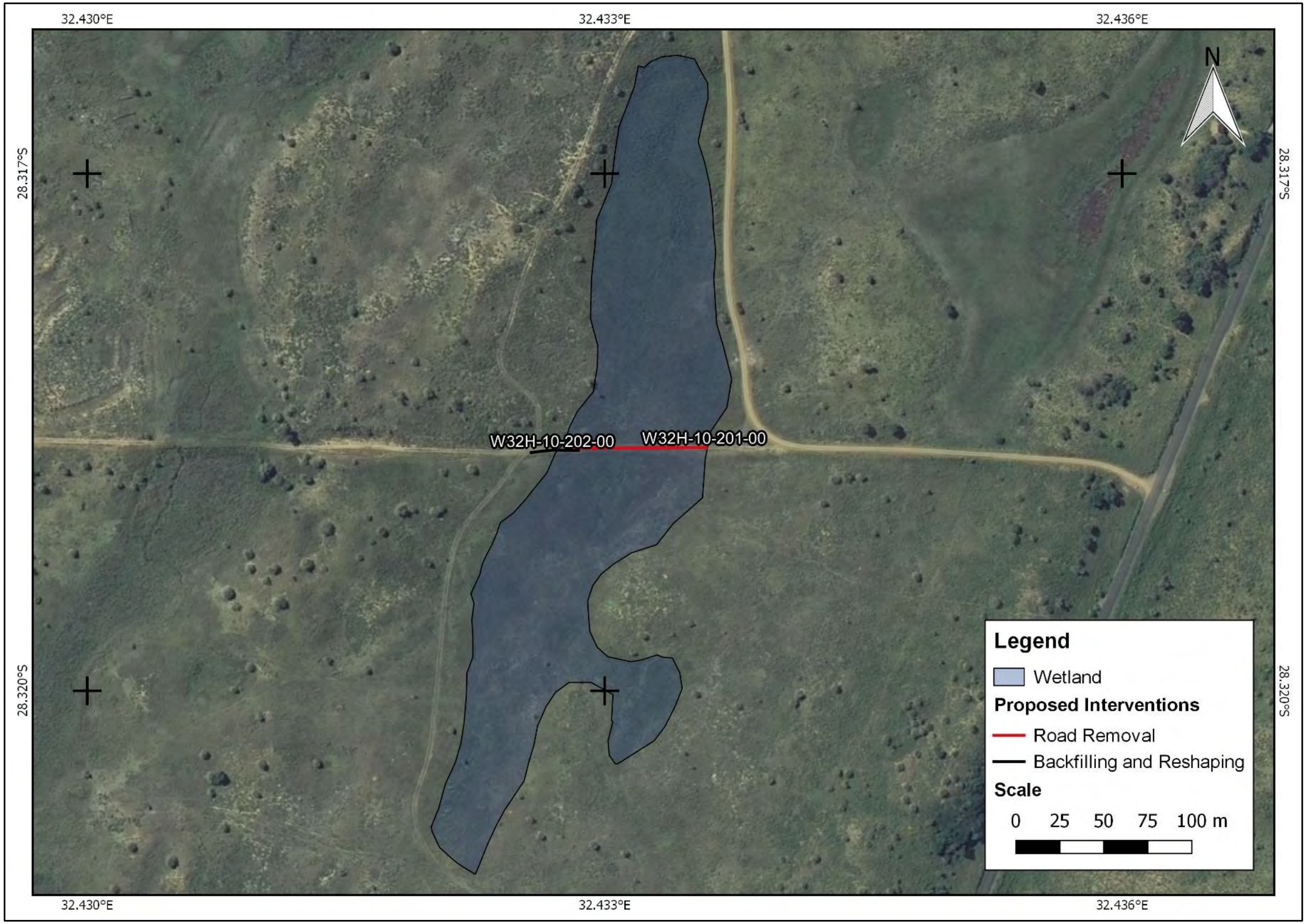



**Figure 6.8 Proposed rehabilitation strategy for Wetland 10 (W32H-10)**

## 6.11 Wetland Rehabilitation Strategy for Wetland 11

Wetland 11 is characterised by two main wetland arms that drain into a single valley-bottom wetland which drains into a large floodplain wetland. Both the arms of the wetland have been cut in half by old forestry roads (**Figure 6.9**). The northern arm is bisected by two different roads, although only one of these roads has been specified for rehabilitation in this cycle, both roads are having an impact on the hydrological functioning and integrity of the wetland. The southern arm of the wetland is also bisected by a road which has been specified for removal which, once it has been removed, is likely to reinstate a more natural hydrological regime. The material generated by the removal of the road will be used to backfill a road scar located outside of the wetland area to the south of the road that crosses the southern arm of the wetland. The roads will be removed by hand and will be revegetated as soon as the removal has occurred so as to prevent unnecessary and unnatural transport of sediment downstream.

### 6.11.1 Wetland Rehabilitation Interventions

**Table 6.9** provides a summary and location of the interventions proposed for Wetland 11 (W32H-11).

**Table 6.9 W32H-11 intervention list**

| Intervention Number | Intervention Type | Location | Priority |
|---|---|---|---|
| **W32H-11-201-00** | Road removal | Start: 28° 19' 12.51"S<br>32° 25' 46.10"E<br>End: 28° 19' 19.31"S<br>32° 25' 46.10"E | 1 |
| **W32H-11-202-00** | Road removal | Start: 28° 19' 21.01"S<br>32° 25' 46.14"E<br>End: 28° 19' 26.88"S<br>32° 25' 46.01"E | 1 |
| **W32H-11-203-00** | Backfilling old road scar | Start: 28° 19' 26.96"S<br>32° 25' 46.02"E<br>End: 28° 19' 29.90"S<br>32° 25' 45.89"E | 2 |

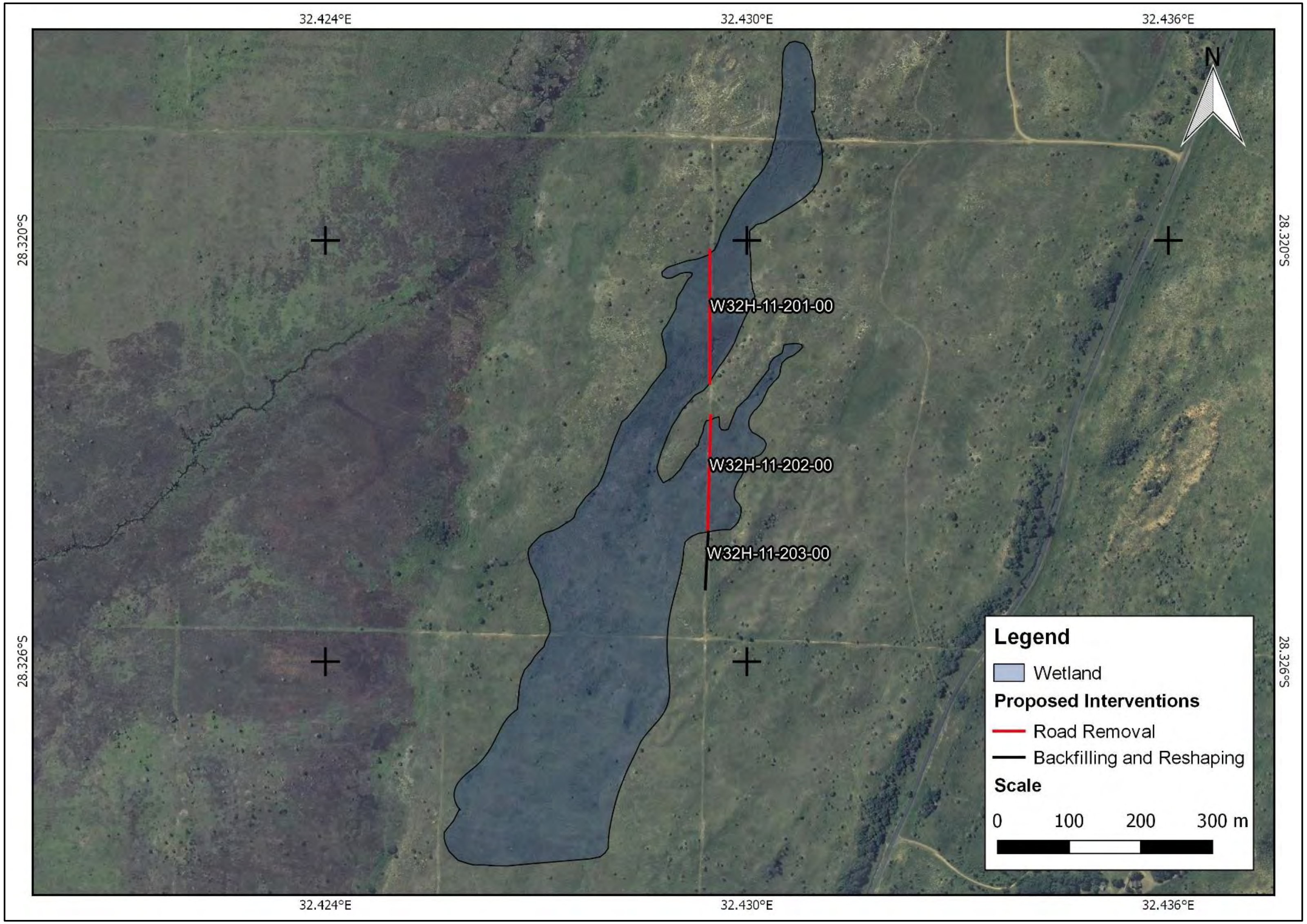



**Figure 6.9 Proposed rehabilitation strategy for Wetland 11 (W32H-11)**

## 6.12 Wetland Rehabilitation Strategy for Wetland 12

Wetland 12 is a small depression wetland that is currently being negatively affected by a large drain and associated infilling located at the southernmost end of the wetland (**Figure 6.10**). The drain is currently draining the southern quarter of the wetland and is responsible for the desiccation of this section of the wetland. The drain was excavated to drain the wetland to make way for old forestry land and the spoil generated during the excavation was deposited on either side of the drain, making two large mounds on either side of the drain. This spoil material will be used to fill the drain and will have to be done using a machine as the volume of material required to fill the drain is too large to be moved by hand. The fill material will have to be compacted to an appropriate density such that water will infiltrate at close to natural rates. The majority of the drain is located outside of the wetland habitat so the revegetation of the infilled drain will only be of great importance in close proximity to the wetland itself. The revegetation process will need to incorporate species of plants that are able to survive in both wetland and terrestrial conditions as this particular wetland is located on particularly porous sand meaning that it is a well-drained substrate.

### 6.12.1 Wetland Rehabilitation Interventions

**Table 6.10** provides a summary and location of the interventions proposed for Wetland 12 (W32H-12).

**Table 6.10 W32H-12 intervention list**

| Intervention Number | Intervention Type | Location | Priority |
|---|---|---|---|
| **W32H-12-201-00** | Drain deactivation | Start: 28° 18' 14.39"S<br>32° 26' 31.43"E<br>End: 28° 18' 8.96"S<br>32° 26' 18.27"E | 1 |

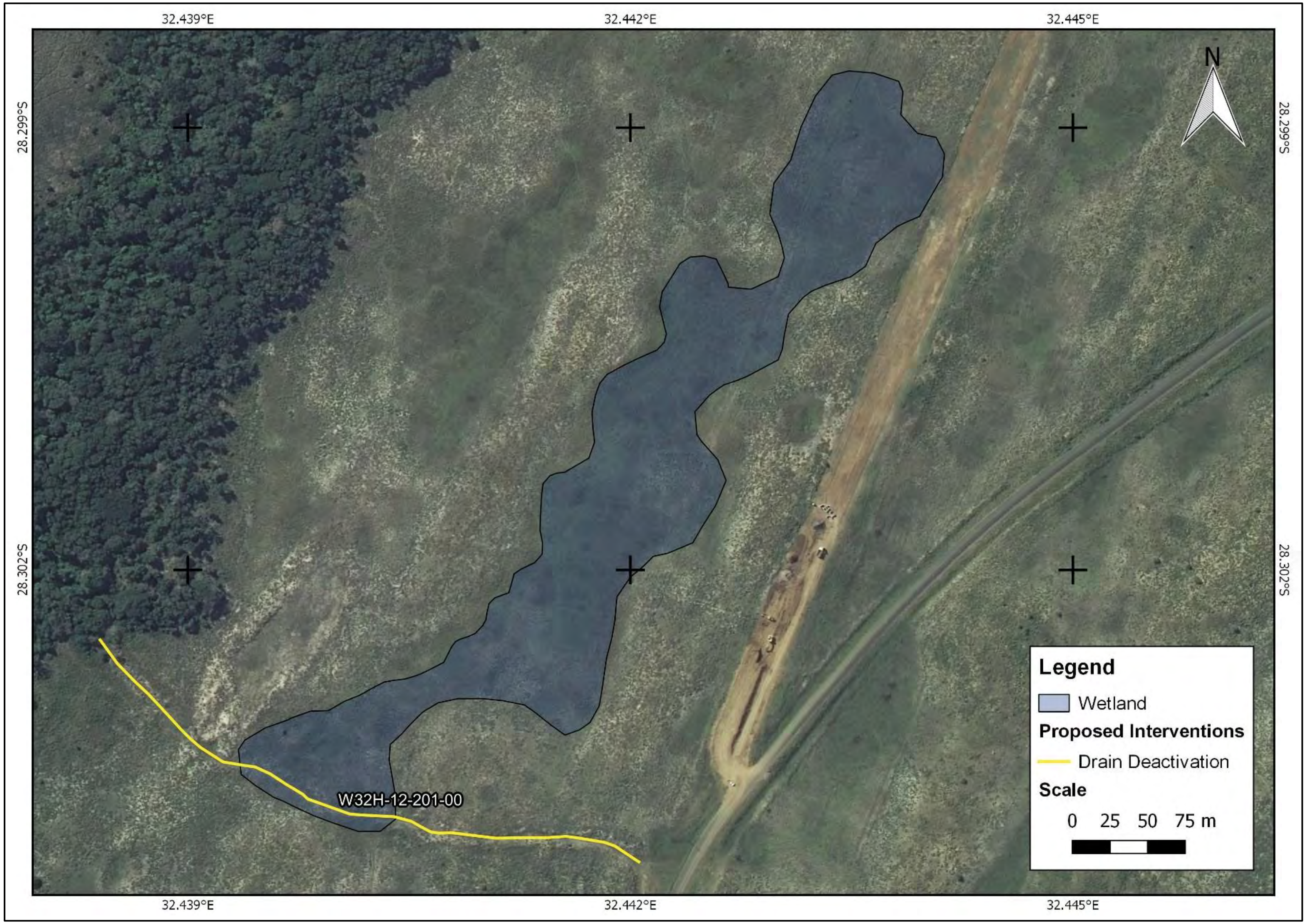



**Figure 6.10 Proposed rehabilitation strategy for Wetland 12 (W32H-12)**

## 6.13 Wetland Rehabilitation Strategy for Wetland 13

Wetland 13 is a large floodplain wetland that runs along the banks of the St Lucia River. Portions of it have historically been cultivated for forestry purposes and as such, there are many old roads and drains that traverse the HGM unit that negatively affect the integrity and functioning of the wetland system. However, only one of these old forestry roads has been authorised for rehabilitation in this cycle. The road does interrupt natural hydrological processes and the system will benefit from its removal. The removal of the road will be done by hand and the material generated by the removal will either be spoiled in the road scar to be filled near Wetland 11 or will be transported to a spoil site elsewhere. Revegetation of the road scar will be done immediately after road removal. Based on the assessment of the impacts within this large HGM unit, there is significant additional rehabilitation potential in this floodplain complex. **Figure 4.18** illustrates the extent of the road and drain network that traverse this HGM unit and are significantly altering the integrity and the functioning of the wetland. It is understood that a number of these roads are still utilised for management purposes, but simple culvert interventions would go a long way to reinstating natural hydrological connectivity in this HGM unit. This wetland could potentially be the focus of future rehabilitation planning in the iSimangaliso Wetland Park.

### 6.13.1 Wetland Rehabilitation Interventions

**Table 6.11**Table 6.10 provides a summary and location of the interventions proposed for Wetland 13 (W32H-13).

**Table 6.11 W32H-13 intervention list**

| Intervention Number | Intervention Type | Location | Priority |
|---|---|---|---|
| **W32H-13-201-00** | Road removal | Start: 28° 19' 32.08"S 32° 25' 30.87"E End: 28° 19' 31.92"S 32° 25' 19.27"E | 1 |

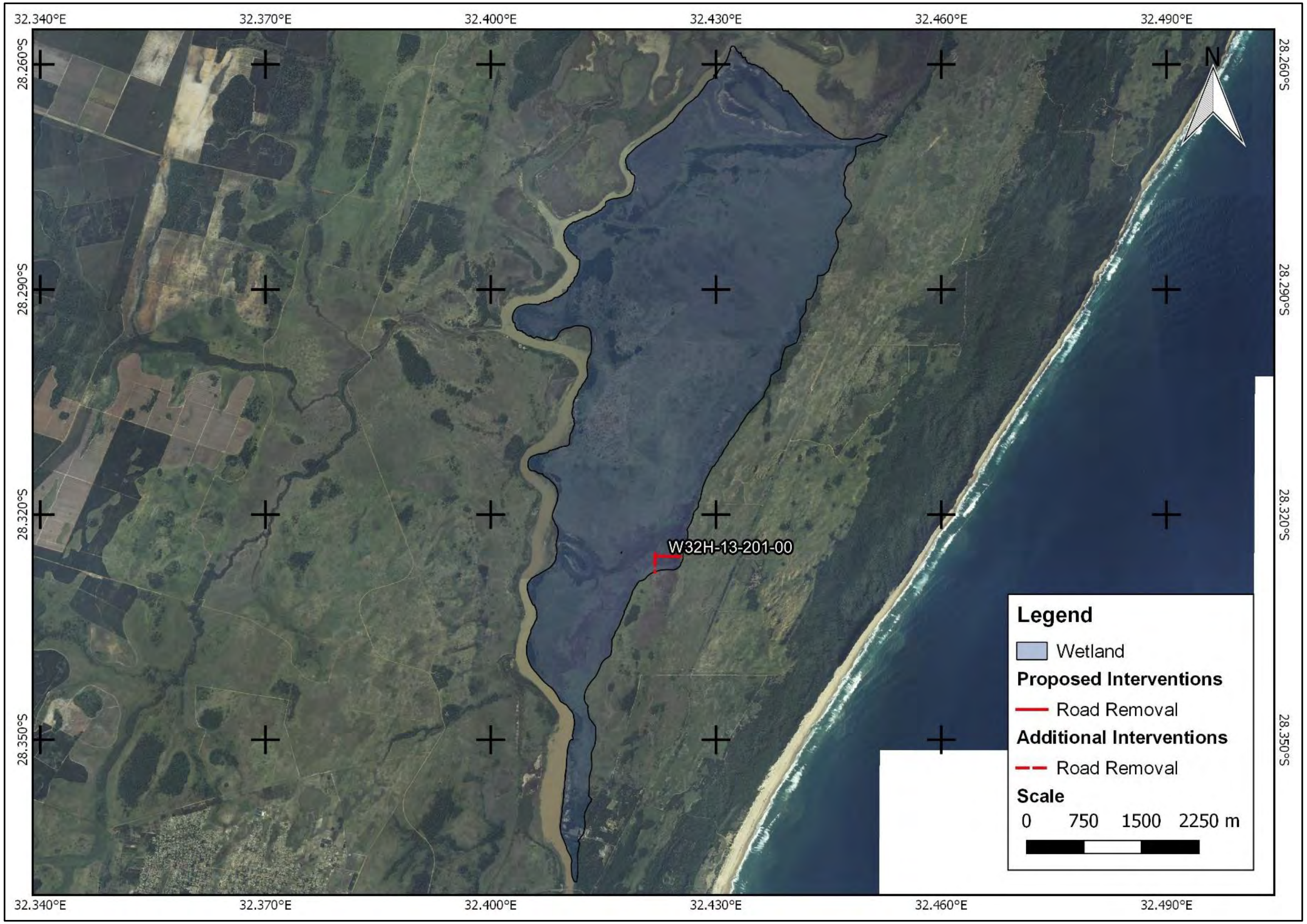



**Figure 6.11 Proposed rehabilitation strategy for Wetland 13 (W32H-13)**

## 6.14 Monitoring and Evaluation

This section provides an overview of the data collected and a summary of the study results from which future monitoring and evaluation can be based.

### 6.14.1 Baseline WET-Health Data

The assessment of the current level of ecological integrity of the wetland systems provides a baseline assessment for comparative assessments that would be carried out for monitoring purposes three years after completion of the wetland rehabilitation activities. The following WET-Health information was collected for the iSimangaliso Wetlands (**Table 6.12**). Fixed-point photography techniques were not utilised to collect baseline wetland integrity data due to landscape and topography limitations. The landscape is extremely flat meaning there were limited opportunities to photographically capture wide areas of wetland for baseline data purposes. However, aerial imagery was utilised to collect baseline data and will be valuable for future monitoring purposes in the future as well.

**Table 6.12 Summary of present wetland health Wetlands 3-6 based on the WET-Health assessment**

| HGM Unit | Hectares | Hydrology | | Geomorphology | | Vegetation | |
|---|---|---|---|---|---|---|---|
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| W32H-03 | 699,00 | 0,00 | → | 0,17 | → | 2,25 | → |
| | PES Category | A | | A | | C | |
| | Overall Impact Score | 0,69 | | | | | |
| | Overall PES Category | A | | | | | |
| W32H-04 | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 17,96 | 0,00 | → | 1,26 | ↑ | 4,43 | → |
| | PES Category | A | | B | | D | |
| | Overall Impact Score | 1,63 | | | | | |
| | Overall PES Category | B | | | | | |
| W32H-05 | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 66,79 | 0,00 | → | 0,55 | → | 3,74 | → |
| | PES Category | A | | A | | C | |
| | Overall Impact Score | 1.23 | | | | | |
| | Overall PES Category | B | | | | | |
| W32H-06 | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 1,47 | 1,00 | ↑ | 0,81 | → | 2,94 | → |
| | PES Category | B | | A | | C | |
| | Overall Impact Score | 1,50 | | | | | |
| | Overall PES Category | B | | | | | |

**Table 6.12 continued Summary of present wetland health Wetlands 7-10 based on the WET-Health assessment**

| HGM Unit | Hectares | Hydrology | | Geomorphology | | Vegetation | |
|---|---|---|---|---|---|---|---|
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| W32H-07 | 49,97 | 0,00 | → | 0,34 | → | 1.61 | → |
| | PES Category | A | | A | | B | |
| | Overall Impact Score | 0,56 | | | | | |
| | Overall PES Category | A | | | | | |
| W32H-08 | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 14,80 | 3,00 | ↑ | 2,33 | → | 5,81 | → |
| | PES Category | C | | C | | D | |
| | Overall Impact Score | 3,61 | | | | | |
| | Overall PES Category | C | | | | | |
| W32H-09 | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 14,81 | 0,00 | → | 0,18 | → | 4,19 | → |
| | PES Category | A | | A | | D | |
| | Overall Impact Score | 1.25 | | | | | |
| | Overall PES Category | B | | | | | |
| W32H-10 | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 5,95 | 0,00 | → | 0,34 | → | 0,37 | → |
| | PES Category | A | | A | | A | |
| | Overall Impact Score | 0,20 | | | | | |
| | Overall PES Category | A | | | | | |

**Table 6.12 continued Summary of present wetland health Wetlands 11-13 based on the WET-Health assessment**

| HGM Unit | Hectares | Hydrology | | Geomorphology | | Vegetation | |
|---|---|---|---|---|---|---|---|
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| W32H-11 | 21,45 | 0,00 | → | 0,66 | → | 2,40 | → |
| | PES Category | A | | A | | C | |
| | Overall Impact Score | 0,87 | | | | | |
| | Overall PES Category | A | | | | | |
| W32H-12 | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 5,78 | 1,00 | → | 0,00 | → | 2,13 | → |
| | PES Category | B | | A | | C | |
| | Overall Impact Score | 1,04 | | | | | |
| | Overall PES Category | B | | | | | |
| W32H-13 | Hectares | Hydrology | | Geomorphology | | Vegetation | |
| | | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol | Impact Score | Trajectory Symbol |
| | 2411,00 | 0,00 | → | 0,21 | → | 0,89 | → |
| | PES Category | A | | A | | A | |
| | Overall Impact Score | 0,31 | | | | | |
| | Overall PES Category | A | | | | | |

| Trajectory Class | Description | Trajectory Symbol |
|---|---|---|
| **Improve** | Hydrological condition is likely to improve over the next 5 years | ↑ |
| **Remain stable** | Hydrological condition is likely to remain stable over the next 5 years | → |
| **Slight deterioration** | Hydrological condition is likely to deteriorate slightly over the next 5 years | ↓ |
| **Substantial deterioration** | Substantial deterioration of hydrological condition is expected over the next 5 years. | ↓↓ |

# 7. REFERENCES

Begg GW. 1989. *The wetlands of Natal (part 3). The location, status and function of the priority wetlands of Natal*. Natal Town and Regional Planning Report 73.

Cowden C, Kotze D, Pike T. 2013. Assessment of the long-term response of two wetlands to Working for Wetlands rehabilitation. WRC Report No. 2035/1/13. Pretoria: Water Research Commission.

Cowden C, Kotze DC, Ellery WN, Sieben EJJ. 2014. Assessment of the long-term response to rehabilitation of two wetlands in KwaZulu-Natal, South Africa. African Journal of Aquatic Science. 39(3): 237-247

Cowden C, Kotze DC. 2009. *WET-RehabEvaluate: Guidelines for the monitoring and evaluation of wetland rehabilitation projects.* WRC Report No TT 342/08. Pretoria: Water Research Commission.

DWA (Department of Water Affairs). 2013. *Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0)*. WRC Report No. 1788/1/12. Pretoria: Water Research Commission and DWA.

DWAF (Department Of Water Affairs and Forestry). 1999: *Resource Directed Measures for Protection of Water Resources. Volume 3: River Ecosystems Version 1*. Report No. N/29/99, Pretoria.

Kotze DC, Ellery WN, Rountree M, Grenfell MC, Marneweck G, Nxele IZ, Breen DC, Dini J, Batchelor AL, Sieben E. 2009. *WET-RehabPlan: Guidelines for planning wetland rehabilitation in South Africa.* WRC Report No. TT 336/08. Pretoria: Water Research Commission.

Kotze DC, Marneweck GC, Batchelor AL, Lindley DS, Collins NB. 2007. *WET-EcoServices: A technique for rapidly assessing ecosystem services supplied by wetlands.* WRC Report No TT 339/08. Pretoria: Water Research Commission.

Macfarlane DM, Walters D, Cowden C. 2011. A wetland health assessment of KZNs priority wetlands. Report prepared for Ezemvelo KZN Wildlife.

Macfarlane DM, Kotze D, Walters D, Koopman V, Goodman P, Ellery W, Goge C. 2007. *WET-Health. A technique for assessing wetland health*. WRC Report No. TT340/08. Pretoria: Water Research Commission.

Watkeys MK, Mason TR, Goodman PS. 1993. *The role of geology in the development of Maputaland, South Africa.* Journal of African Earth Sciences: Vol. 16 (1-2) pg. 205-221.

# WORKING FOR WETLANDS
# PROVINCE: KWAZULU-NATAL
# PROJECT: iSimangaliso

## Wetland Descriptions

JANUARY 2019

GroundTruth
Water, Wetlands and Environmental Engineering

# 1. WETLAND DESCRIPTIONS

Phase 1 planning associated with this project included a desktop review and infield verification of the issues within the identified wetland systems, the potential rehabilitation options and the prioritisation of systems based on anticipated returns associated with the proposed wetland rehabilitation initiatives. The prioritisation of the Phase 1 planning was done in communication with the Land Care Manager at iSimangaliso Wetland Park and the Phase 1 component of the study directly informed the Phase 2 site visit with the engineering team to quantify and formalise the wetland rehabilitation approach to optimise the functioning of the selected wetlands. The selected wetlands are located within the W32H quaternary catchment which encompasses the iSimangaliso Wetland Park and includes Lake St Lucia within its watershed (**Table 1.1**). The focus of the rehabilitation will be to remove old forestry infrastructure such as roads, drains and wetland crossings as well as to eradicate alien invasive vegetation from freshwater ecosystems. Although there were many wetlands identified as candidate wetland systems for rehabilitation during this Phase 1 desktop assessment, due to the size of the systems, limited accessibility and time constraints, only 11 systems were prioritized for rehabilitation within the study site. A number of additional wetlands were prioritised for this rehabilitation cycle, but due to budgetary constraints only a select number of the prioritised wetlands were visited and measured by the rehabilitation team (**Figure 1.1**).

**Table 1.1 Project area descriptions for each quaternary catchment included in the study**

| **Province** | **KwaZulu-Natal** |
|---|---|
| **Quaternary Catchment** | W32H |
| **Project Name** | iSimangaliso |
| **Land Owner / Partnership** | iSimangaliso Wetland Park |
| **Planning Phase** | Phase 1 |
| **Nearest Town** | St Lucia |
| **Previous Work** | Yes |
| **Project Description** | Identify new wetland rehabilitation opportunities within iSimangaliso |

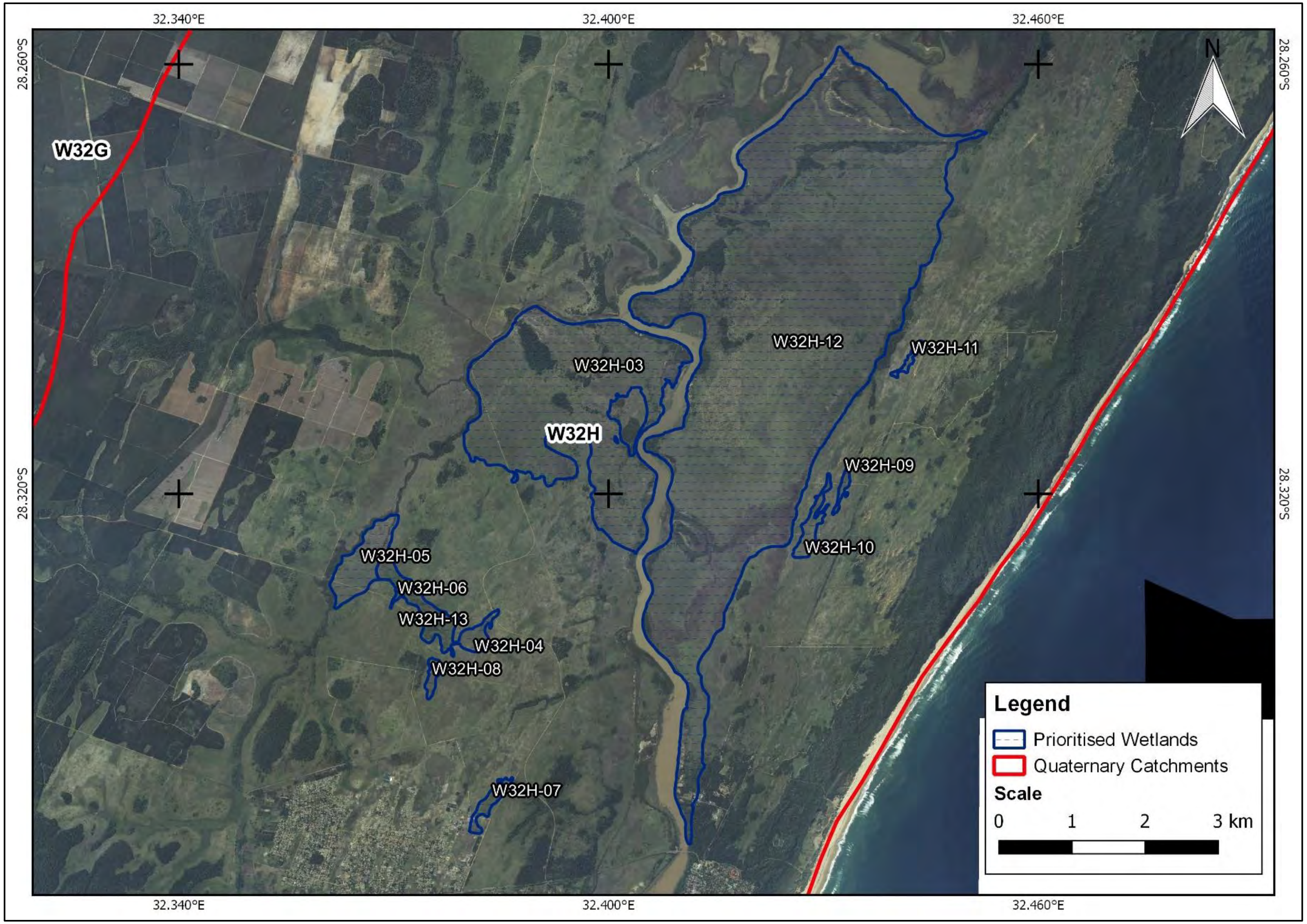



**Figure 1.1 Location of prioritised wetlands within the iSimangaliso Wetland Park within their respective quaternary catchment**

## 1.1 Wetlands identified for rehabilitation assessment

Based on recommendations made by the iSimangaliso Wetland Park Land Care Management Department and on the findings and prioritisation during the desktop analysis, eleven (11) wetlands that cover approximately 3300ha were selected for rehabilitation. These systems form part of the Maputaland coastal plain wetland complex which is very well connected to the local water table. Therefore interaction between groundwater and surface water is constant – giving rise to such a large extent of wetland. **Table 1.2** provides a summary of the wetlands that have been included in the Phase 2 planning and the associated rehabilitation strategy.

**Table 1.2 Identified wetlands based on the desktop analysis and infield verification processes within W32H quaternary catchment.**

| Wetland Number | Hydrogeomorphic Unit | Area (ha) |
|---|---|---|
| W32H-03 | Floodplain complex | 699.00 |
| W32H-04 | Hillslope seep | 17.96 |
| W32H-05 | Floodplain complex | 66.79 |
| W32H-06 | Hillslope seep | 1.47 |
| W32H-07 | Unchannelled valley bottom | 49.97 |
| W32H-08 | Unchannelled valley bottom | 14.80 |
| W32H-09 | Depression | 5.77 |
| W32H-10 | Unchannelled valley bottom | 5.95 |
| W32H-11 | Unchannelled valley bottom | 21.45 |
| W32H-12 | Depression | 5.78 |
| W32H-13 | Floodplain complex | 2411.40 |

The iSimangaliso Wetland Park is characterised by large complexes of wetland area that have been rehabilitated for over 15 years. A large extent of these wetland areas was located on forestry land and as such were significantly degraded. Therefore there is a lot of old remnant forestry infrastructure that is still nested within wetland habitat that could be incorporated into future WFWets projects and would need to be subject to detailed Phase 1 and Phase 2 planning.

## 1.2 Wetland 3 (W32H-03)

### 1.2.1 Wetland Details

**Table 1.3** provides a summary of the W32H-03 wetland, identified for further rehabilitation activities.

**Table 1.3 W32H-03 wetland details**

| | |
|---|---|
| Wetland Name | **Wetland 3** |
| Wetland Number/Label | **W32H-03** |
| GPS Location | **28° 18' 24.86"S**<br>**32° 23' 47.12"E** |
| Catchment Land Use | **Conservation area, tourism, old plantation land, occasional reed harvesting** |
| Wetland Land Use | **Conservation area, tourism, old plantation land, occasional reed harvesting** |
| Wetland Size (ha) | **699,00** |

### 1.2.2 Wetland Characteristics

Wetland 3 (W32H-03) can be classified as a floodplain complex wetland system meaning that the HGM unit is made up of multiple smaller wetland units that combine to form a large floodplain unit. The slope of the wetland is a very low 0.32% such that the overall wetland complex is characterised by many little conglomerations of open standing water. More than half of the HGM unit was historically planted with *Eucalyptus sp.* which were only removed between 2002 and 2010. Landscape features associated with these historical practices such as forestry roads, drains and river crossings have contributed to a reduction in wetland integrity and functioning of Wetland 3 (**Figure 1.2**). Despite the complete clearing of all forestry related plant species, the forestry related infrastructure is still having a noticeable negative impact on wetland health.

The catchments associated with most wetlands located within the iSimangaliso Wetland Park are difficult to define for a number of reasons. The first and possibly the most important reason is the fact that these wetlands are part of the Maputaland coastal plain wetland complex which extends from south of St Lucia to as far north as Kosi Bay area (Watkeys et al. 1993). These wetlands are characterised by complex groundwater interactions as they lie at low elevations and very close to sea level. The majority of the Maputaland coastal plain is underlain by late Mesozoic and Quaternary sequences which naturally lack mineral wealth and often weather to form very coarse, sandy substrates (Watkeys et al. 1993). These sandy substrates are often characterised by poor cation exchange capacities and by high hydraulic conductivities meaning that the surface-groundwater interaction is complex and difficult to define as water moves easily through the sandy substrates. According to Macfarlane et al. (2007), the Maputaland coastal plain is characterised by highly complex surface-groundwater interactions which confounds the delineation and definition of wetland catchments in these areas as wetlands are fed both by their topographically defined catchments as well as by a much larger catchment feeding the regional water table. The hydraulic contribution from these two sources is likely to vary from wetland to wetland and as such this complicates the definition of catchment extent and catchment associated impacts. This complicated surface-groundwater interaction is likely to run true for all wetlands (except for W32H-08 which lies on the western edge of the coastal plain) assessed in this rehabilitation cycle as they all sit within the Maputaland coastal plain complex. To avoid repetition, the descriptions of each wetland catchment will be limited to their topographically defined catchment. This description will serve as the description of the surface-groundwater interaction for the other wetland areas.

The topographically defined catchment area for Wetland 3 is characterised largely by natural wetland and terrestrial grassland areas and is relatively undisturbed. The wetland is defined on three sides by the Mpate and St Lucia Rivers and as such, the topographically derived catchment area only extends to the south of the HGM unit. This area to the south slopes very gently towards two raised hillocks that sit 20m above the Mpate and St Lucia Rivers. The catchment boundary that lies in the valley between these two hills is artificially defined by a raised forestry road.

Wetland 3 is a large floodplain complex that is dominated by areas of shallow flooding interspersed with raised grassed hummocks. These shallow flooded areas are often characterised by *Cymbopogon validus, Cyperus polstachyos, Cyperus dives, Juncus effusus* and *Carex sp.* Other species that occurred within the wetland include *Cynodon dactylon, Centella asiatica, Stenotaphrum secundatum, Gomphocarpus fruticosus, Hyphaene coriacea* and *Phoenix reclinata*. A large section of indigenous forest area runs down the centre of the HGM unit, separating the HGM unit down the middle. During the wet season, this forested patch too would be interspersed with shallow flooding, similar to what was observed in the open grassed wetland area. This wetland is thought to be sustained predominantly by precipitation and subsurface water inputs both originating from the wider topographically defined catchment area and the regional water table. The majority of the northern and western sections of this wetland is defined by the Mpate River while the eastern section of the wetland is defined by the St Lucia Estuary. Therefore, the local water table is defined by the water level of these two waterbodies and it is assumed that the local water table beneath this wetland varies between <1m to no more than 7m deep.

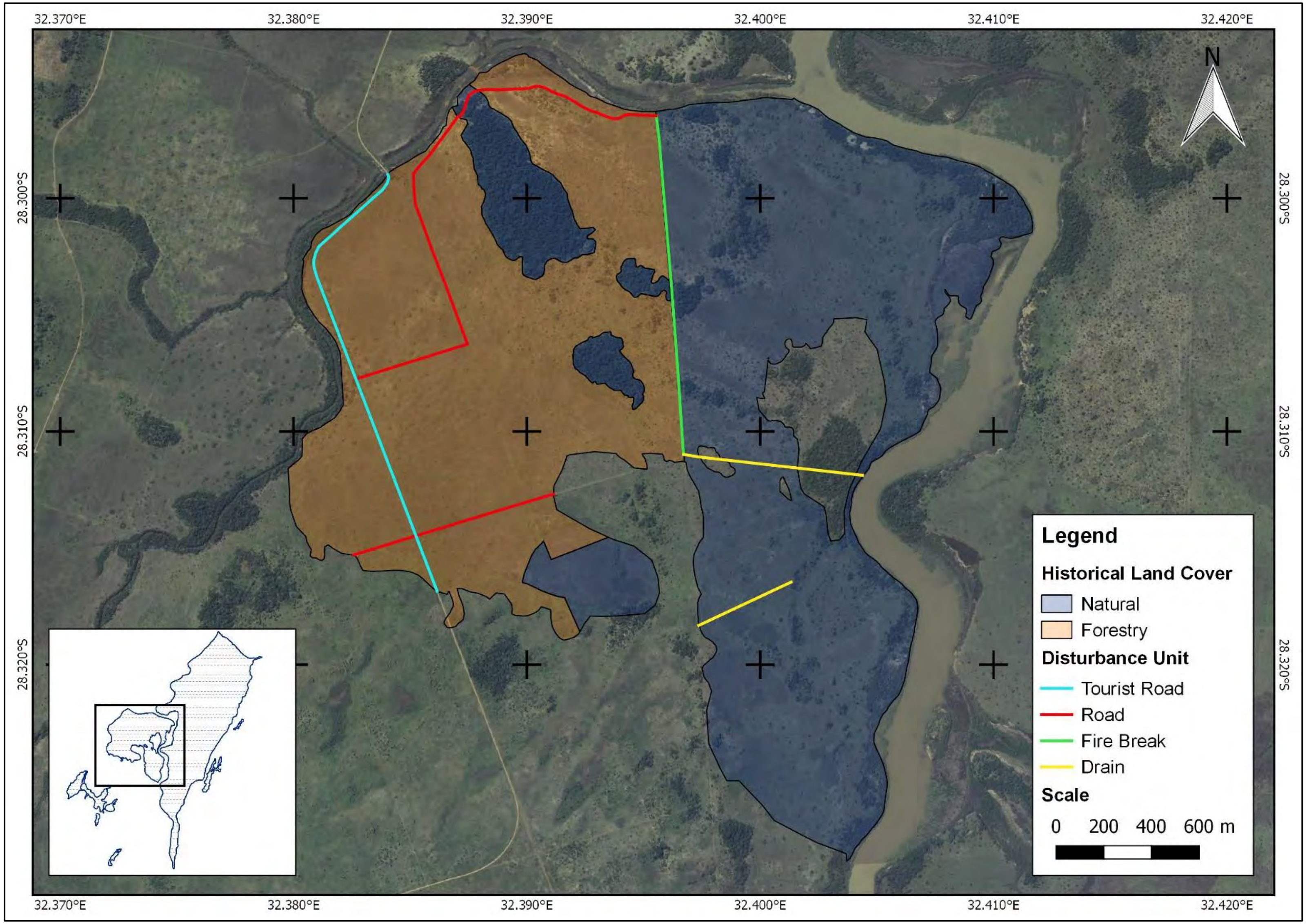



**Figure 1.2 Historical land use extents and current disturbance units in W32H-03 wetland**

## 1.3 Wetland 4 (W32H-04)

### 1.3.1 Wetland Details

**Table 1.4** provides a summary of Wetland 4 (W32H-04)

**Table 1.4 Wetland 4 (W32H-04) details**

| | |
|---|---|
| Wetland Name | **Wetland 4** |
| Wetland Number/Label | **W32H-04** |
| GPS Location | **27° 20' 17.71"S**<br>**32° 22' 57.42"E** |
| Catchment Land Use | **Conservation area, tourism, old plantation land, occasional reed harvesting** |
| Wetland Land Use | **Conservation area, tourism, old plantation land, occasional reed harvesting** |
| Wetland Size (ha) | **17.96** |

### 1.3.2 Wetland Characteristics

Wetland 4 (W32H-04) can be classified as a hillslope seep wetland although there is a large flood-out zone located below the old forestry road where water would naturally connect to a wider stream network. There are sections of permanently, seasonally and temporarily wet areas within this HGM unit with the narrow hillslope seepage area remaining wet for the majority of the year and the flood-out zone remaining seasonally wet throughout the year. This flood-out zone has probably been created as a result of the construction of the tourist road to the south west of the wetland as the road is raised and is made from highly consolidated material – preventing any flows from naturally exiting the wetland. There is only a single culvert that runs beneath this road and all water entering Wetland 4 is channelled through this culvert to connect to another wetland area below the road. The old forestry roads within the southern bowl of the wetland have also possibly contributed to the expansion of the large bowl as they would deflect water in easterly and westerly directions as opposed to allowing water to flow down its natural course. Wetland 4 (W32H-04) was historically forestry plantation land as indicated by the old road network noted during the site visit. A review of the historical imagery showed that a large proportion of the wetland was subject to forestry cultivation which would have severely limited the ability of the wetland to function in its natural state. However, rehabilitation within this HGM unit has been extensive and the majority of the evidence of forestry has been removed barring the road network and the area of infilling (**Figure 1.3**). The old forestry road at the head of the wetland is interrupting flows from the northern arm of the wetland to the southern bowl of the wetland as the road is raised and made from consolidated material. Water is being dammed up behind this road section and a small section of open water has formed behind the road (**Figure 1.4**).

The residual effects of forestry on the structure and functioning of wetlands is often great and can be difficult to identify. For example, the densely homogenous *Eucalyptus sp.* and *Pinus pinaster* plantations that characterised large portions of the iSimangaliso Wetland Park generally don't allow for the establishment of other plant species below their dense canopies. Therefore, when these plantations are removed for rehabilitation purposes, it is common for disturbance tolerant pioneer species to colonise the bare areas left behind. It can take decades before natural vegetation is able to re-establish in these disturbed areas. Therefore it is common to see disturbance tolerant plant species such as *Cymbopogon validus, Pteridium aquilinum, Psidium guajava, Cynodon dactylon, Imperata cylindrica, Gomphocarpus fruticous,* *Stenotaphrum secundatum, Hyparrhenia rufa* and *Themeda triandra.* The bowl of the wetland is largely colonised by *Pteridium aquilinum* which is an indigenous invasive species that is often found in recently disturbed areas. *P. aquilinum* is known to be a fast growing perennial species that is able to displace slower growing wetland species as it is also able to tolerate relatively wet conditions. Without revegetation immediately after the removal of plantations, returning a wetland to its natural climax vegetative state can take a very long time, if ever. However, the rehabilitation of this wetland through the removal of the roads that still lie within the wetland extent would have a positive impact on the integrity and functioning of the wetland as the roads are currently interrupting natural hydrological processes in the wetland.

The vegetation within the wetland area is a mix of obligate and facultative wetland species in the wetter areas of the HGM unit with a mix of facultative wetland and terrestrial vegetation species in the drier areas of the HGM unit. The wetter areas are characterised by *Juncus* (c.f. *effusus* or *pallidus*) and *Carex sp.* whereas the drier more terrestrial areas are characterised by *Cynodon dactylon, Stenotaphrum secundatum, Centella asiatica, Scoparia dulcis* and *Hyphaene coriacea.*

**Figure 1.3 Photographic evidence of road interrupting natural flows in wetland. Area to the right of the road is the hillslope seep and area to the left (outside frame) is the bowl shaped wetland area.**

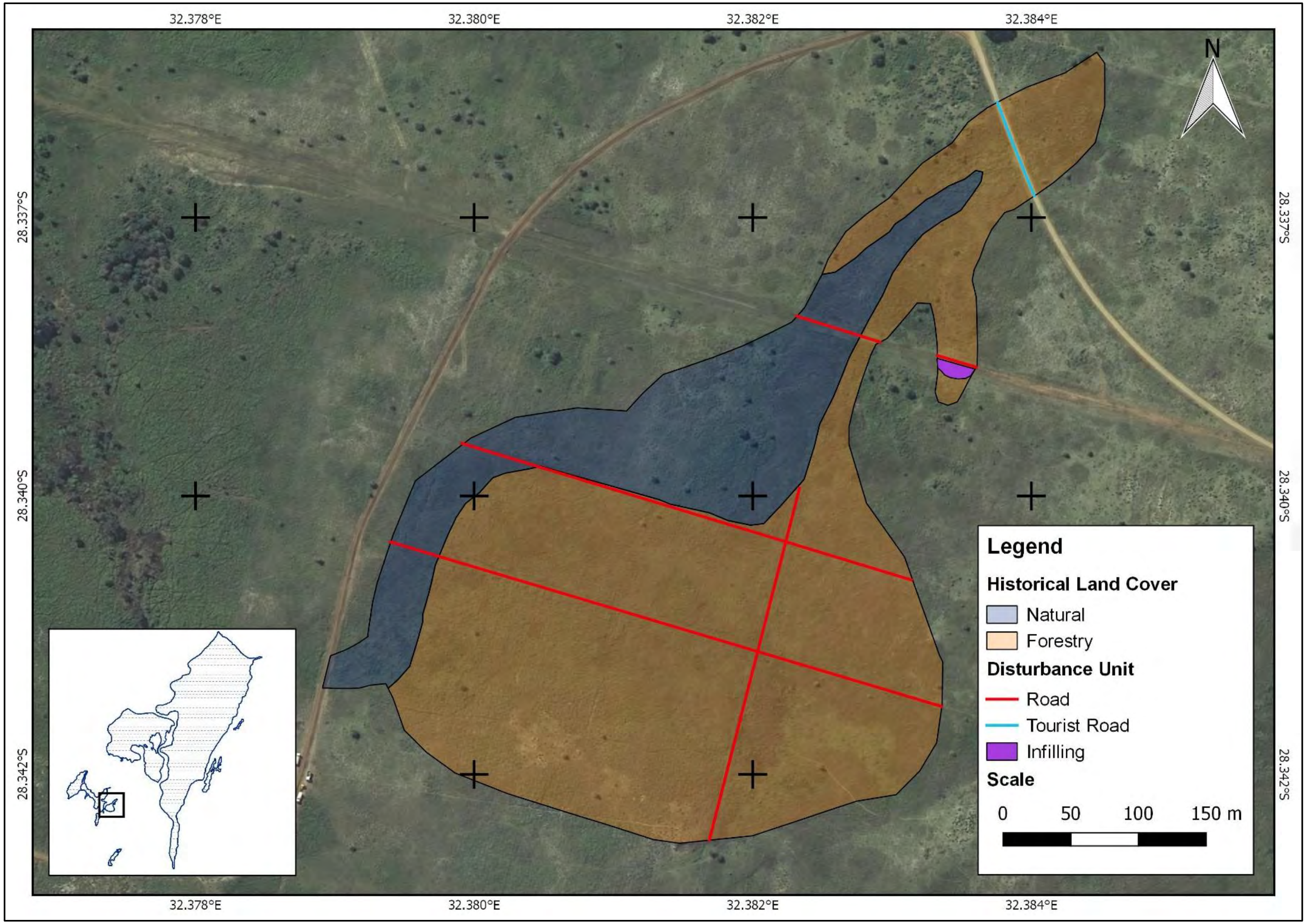



**Figure 1.4 Historical land uses and current disturbance units in Wetland 4 (W32H-04)**

## 1.4 Wetland 5 (W32H-05)

### 1.4.1 Wetland Details

**Table 1.5** provides a summary of Wetland 5 (W32H-05), identified for rehabilitation activities.

**Table 1.5 Wetland 5 (W32H-05) details**

| | |
|---|---|
| Wetland Name | **Wetland 5** |
| Wetland Number/Label | **W32H-05** |
| GPS Location | **28° 19' 40.48"S**<br>**32° 21' 55.70"E** |
| Catchment Land Use | **Conservation area, tourism, old plantation land, occasional reed harvesting** |
| Wetland Land Use | **Conservation area, tourism, old plantation land, occasional reed harvesting** |
| Wetland Size (ha) | **66.79** |

### 1.4.2 Wetland Characteristics

Wetland 5 (W32H-05) can be classified as a floodplain complex wetland with a riparian channel running up the eastern side of the HGM unit (**Figure 1.5**). The wetland area is extremely flat and is characterised by many shallow pools of open water that gather in localised topographic depressions. The HGM unit slopes very gently towards the Mpate River which defines the entire northern and western banks of the wetland and acts as a local control point for the wetland. The gentle gradient of the wetland encourages consistently diffuse flows throughout the wetland and allows for a very long water retention time. Therefore the wetland is characterised by large tracts of permanently and seasonally wet soils where continued flooding on the surface occurs. There are also higher lying sections within the HGM unit as well which are characteristically drier and only temporarily wet during the year meaning that more terrestrial plant species can colonise these areas.

Upon a review of the historical imagery for the system, it is clear that intense forestry practices took place within the majority of the HGM unit at least since 1965 (earliest available image containing evidence of forestry practices). Despite intense rehabilitation in iSimangaliso Wetland Park to remove the remaining impacts of the plantation infrastructure, there are still remnants of this infrastructure that are interrupting the natural functioning of Wetland 5. There are three old forestry roads that traverse the HGM unit. One of these roads follows the Mpate River channel along the northern most boarder of the wetland and is thought to be interrupting flows out of the wetland into the Mpate River. Another forestry road runs right across the mid-section of Wetland 5 and partially interrupts connectivity of the southern section of the wetland with the northern section. However, this road has been trampled by hippo and buffalo in some places and the earth used to create it has been spread back to its natural grade, therefore only sections of this road are still interrupting hydrological flows. An earthen bridge associated with this road has been constructed across the riparian area in the eastern portion of this wetland. The eastern quarter of the bridge has been removed and flows down the riparian channel have been reinstated as a result of this, but there is a large section of the riparian channel that is still blocked by the earthen bridge. There is another small section of old forestry road that is located in the south western corner of the wetland. The tourist road that is currently used by iSimangaliso Wetland Park cuts the southern section of the wetland in two as it is a raised road with no culverts to allow for through flow. Therefore there is a large damming effect upstream (to the south) of the tourist road as well as an area downstream of the tourist road where the wetland is being starved of its natural water inputs as a result of the road. Ultimately, the infrastructure is having an effect on the integrity and functioning of the wetland and there would be benefits derived from removing a number of these structures. The residual effects of the plantations are also still evident within the wetland as there are a number of disturbance tolerant plant species that are present throughout the HGM unit such as *Cynodon dactylon*, *Cymbopogon validus, Stenotaphrum secundatum* and *Hyparrhenia rufa.* During the site visit, a large number of *Psidium guajava* plants – an alien invasive species – were observed within the drier portions of the HGM unit. The majority of these plants were still saplings of relatively uniform size as a fire had swept through the drier sections of this HGM unit in recent years and was responsible for killing off most of the adult *P. guajava* plants. These trees are disturbance tolerant invasive species and if left to grow in the drier areas of the wetland, they could have adverse effects on species composition and water levels within the wetland.

The vegetation within the wetland is a mix of wetland and terrestrial plant species that are generally limited to their natural zones of wetness. However a number of facultative wetland species such as *Cymbopogon validus, Centella asiatica, Cyperus fastigiatus* and *Cyperus polystachyos* were observed in both the dry and wetter areas. The terrestrial areas and the more temporary wetland zones were often colonised by grass species such as *Cymbopogon validus, Hyparrhenia rufa, Cynodon dactylon* and *Stenotaphrum secundatum.* Other species such as *Cassinopsis tiniflora, Psidium guajava, Gomphocarpus fruticosus, Phoenix reclinata* and *Hyphaene coriacea* were also found in the more temporary wetland zones. The vegetation within the more seasonal and permanent zones was comprised of *Juncus effusus, Juncus pallidus, Carex sp., Cyperacea* (c.f. *congestus, fastigiatus, dives* and *polystachyos*), *Phragmites australis* and *Eleocharis dregeana.*

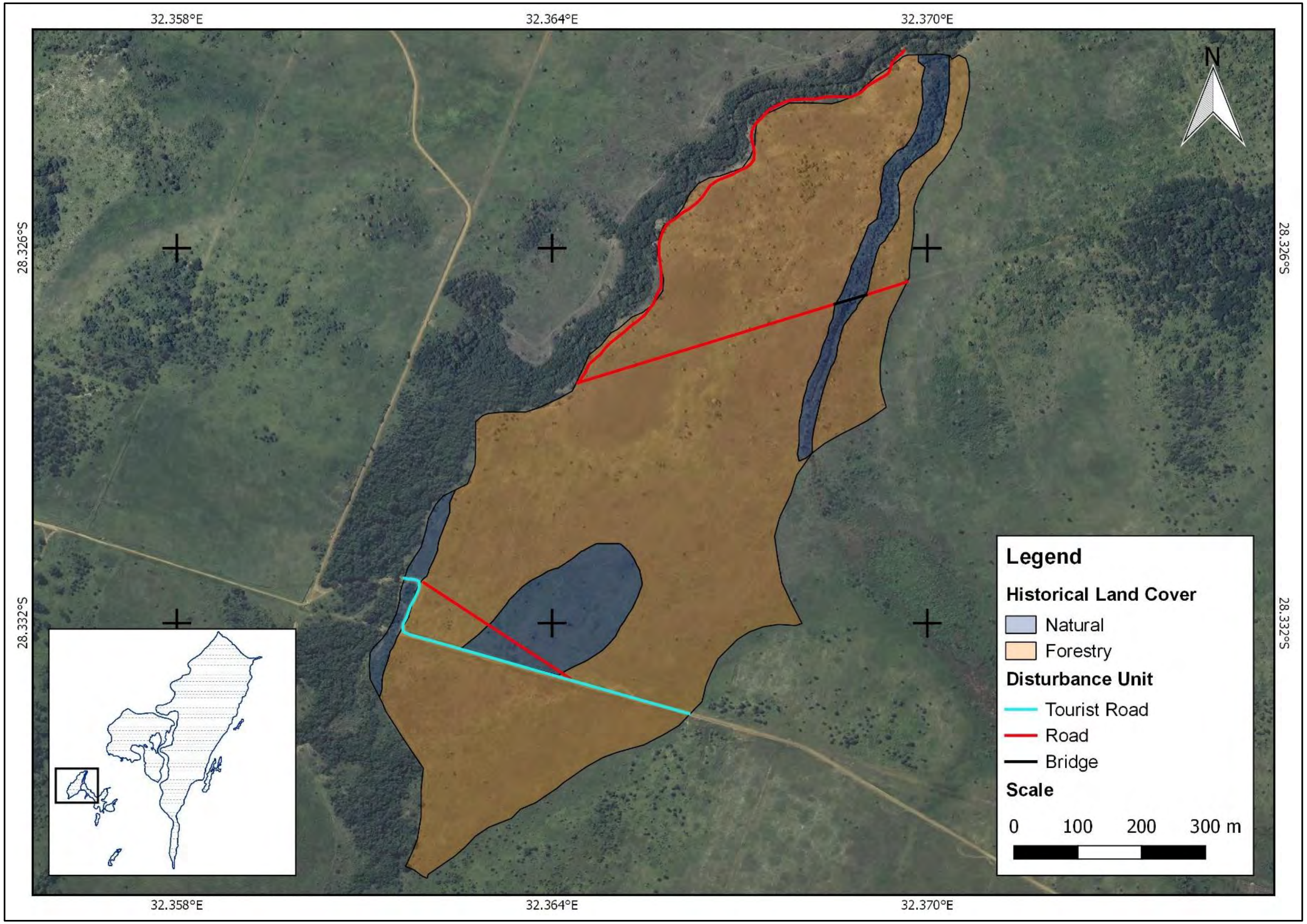



**Figure 1.5 Historical land uses and current disturbance units in Wetland 5 (W32H-05)**

## 1.5 Wetland 6 (W32H-06)

### 1.5.1 Wetland Details

**Table 1.6** provides a summary of Wetland 6 (W32H-06), identified for rehabilitation activities.

**Table 1.6 Wetland 6 (W32H-06) details**

| | |
|---|---|
| Wetland Name | **Wetland 6** |
| Wetland Number/Label | **W32H-06** |
| GPS Location | **28° 20' 4.766"S**<br>**32° 22' 13.11"E** |
| Catchment Land Use | **Conservation area, tourism, old plantation land** |
| Wetland Land Use | **Conservation area, tourism, old plantation land** |
| Wetland Size (ha) | **1.47** |

### 1.5.2 Wetland Characteristics

Wetland 6 (W32H-06) has been classified as a hillslope seep that is connected to a stream network. Wetland 6 is a small tributary of Wetland 7 and decants into this unchannelled valley bottom wetland. This wetland is small – approximately 1.47ha in size – and steep with a gradient of 4.1%. The wetland is fed by a small seepage in the hillslope that surfaces approximately 200m downslope of the top of the hill. It is unclear as to why the seep originates at this point in the hillslope but it may be a result of a localised sill of resistant strata just below the ground that forces groundwater to surface at this point. Much of the water flowing through the wetland was thought to be subsurface flows as the only surface water was observed above the old forestry road. This is indicative of the very porous medium upon which most of these Maputaland coastal plain wetlands sit.

The fringes of this wetland were incorporated into the area planted for forestry, but because the wetland sits on a hillslope and is relatively small, the majority of the HGM unit was left relatively untouched by the forestry companies as it would not have been worth draining (**Figure 1.7**). However, an old forestry road cuts the wetland in half approximately midway down the length of the HGM unit and the newer tourist road crosses in the upper reaches of the wetland. There is a culvert that has been constructed beneath the tourist road to allow for semi-natural flows to continue down the top half of the wetland. However, there is no through-flow allowance made by the old forestry road and there is a significant damming effect that was observed above this road. The section immediately below the road is characterised by a wider variety of terrestrial vegetation species, and the wetland species occurring directly below the road looked brown and dry, which is indicative of wetland that is being starved of its natural water inputs (**Figure 1.6**). It is assumed that both the tourist and the forestry roads are also limiting lateral inputs of water as water is trapped very effectively by both roads in the areas where there are no culverts, hence the removal of the old forestry road would move the hydrological regime of the wetland towards a much more natural state.

The vegetation within the wetland area is largely comprised of indigenous species, although there were a number of *Psidium guajava* and *Pteridium aquilinum* plants that were observed in the drier portions of the wetland. The wetter areas were colonised predominantly by *Juncus effusus, Juncus pallidus* and *Centella asiatica* with a mix of *Cyperacea sp.* Species such as *Cymbopogan validus, Cynodon dactylon, Centella asiatica* and *Hyparrhenia rufa* were found abundantly in the drier areas of the HGM unit.

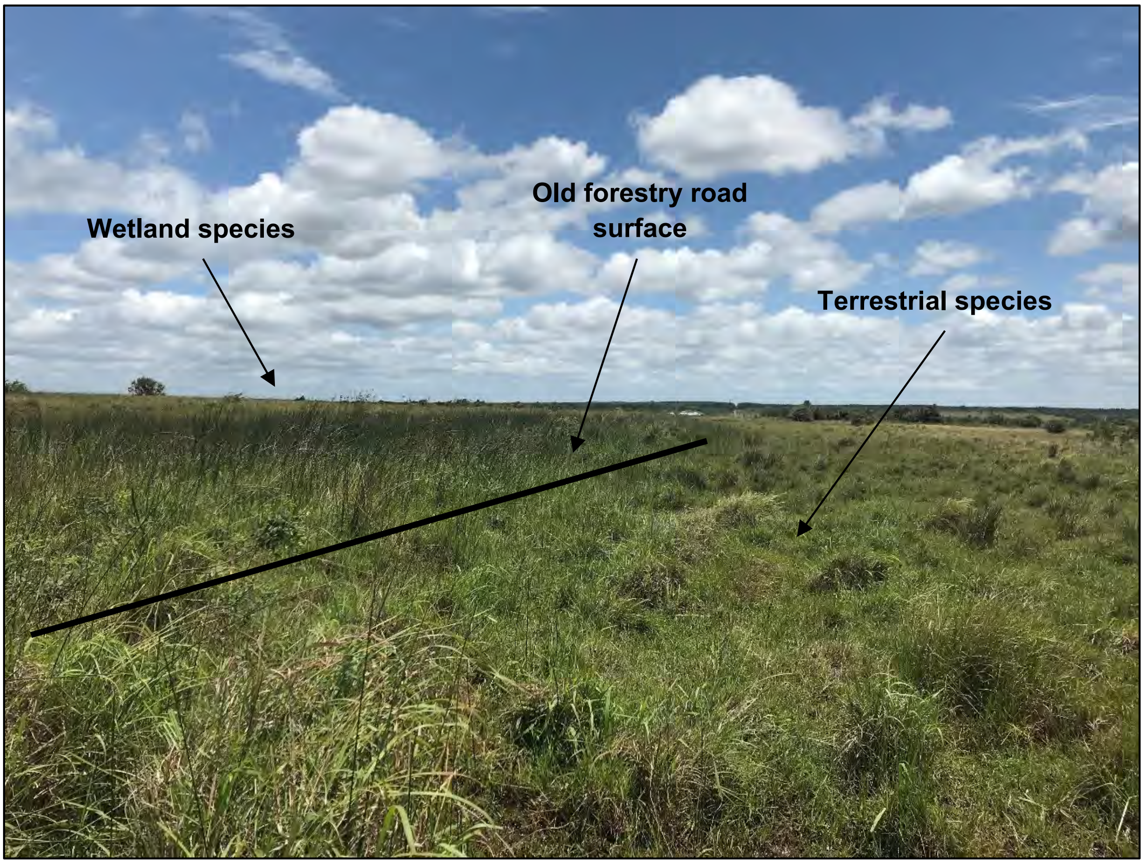



**Figure 1.6 Photographic evidence of wetland vegetation species colonising area upstream of old forestry road and terrestrial species colonising the downstream area.**

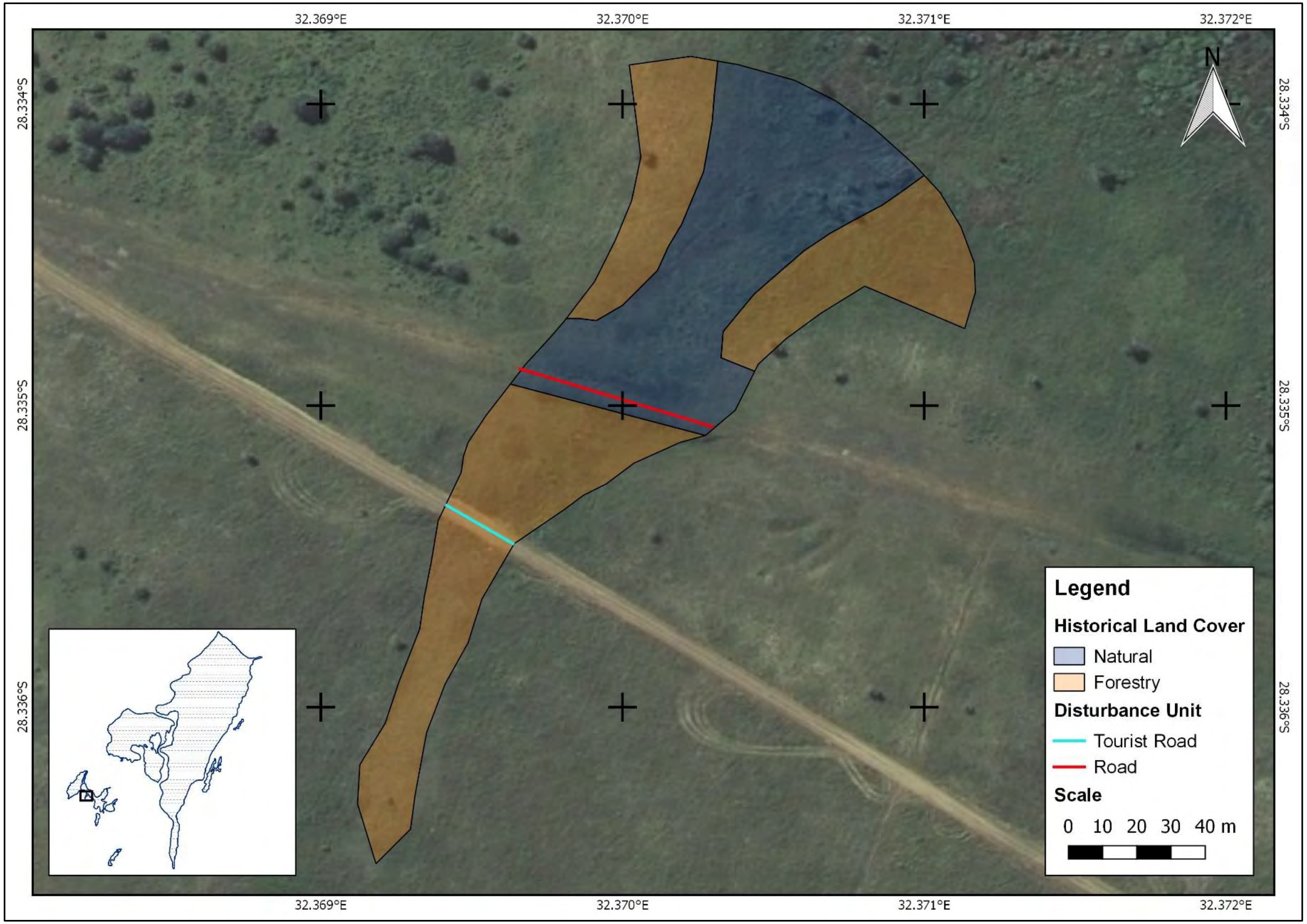



**Figure 1.7 Historical land cover and current disturbance units for Wetland 6 (W32H-06)**

## 1.6 Wetland 7 (W32H-07)

### 1.6.1 Wetland Details

**Table 1.7** provides a summary of Wetland 7 (W32H-07), identified for rehabilitation activities.

**Table 1.7 Wetland 7 (W32H-07) details**

| | |
|---|---|
| Wetland Name | **Wetland 7** |
| Wetland Number/Label | **W32H-07** |
| GPS Location | **28° 20' 9.63"S**<br>**32° 22' 31.19"E** |
| Catchment Land Use | **Conservation area, tourism, old plantation land, occasional reed harvesting** |
| Wetland Land Use | **Conservation area, tourism, old plantation land, occasional reed harvesting** |
| Wetland Size (ha) | **49.97** |

### 1.6.2 Wetland Characteristics

Wetland 7 (W32H-07) has been classified as an unchannelled valley bottom wetland with short sections of channelled flows. The upper half of the wetland is much steeper (slope of 1.5%) than the lower half of the wetland which has a slope of 0.63%. This can be attributed to the fact that the upper half of the wetland is located on the sides of the gently undulating hills in the area whereas the lower half of the wetland is located at the bottom of the valley between two hills. Wetland 7 is fed both by surface and subsurface flows – the surface flows often originating from hillslope seeps that are located on the sides of the hills surrounding the valley bottom. Wetland 7 receives the majority of its water from its tributaries as well as from subsurface flows derived from its tributaries. The catchment area of the HGM unit is defined by small, gently sloping hills on either side of the wetland. The portion of the wetland that falls within the lowest point of the valley bottom is characterised by permanently wet soils. The soils become seasonally and then temporarily wet farther up the valley sides.

A review of historical imagery revealed that a large portion of this wetland was used for forestry plantations and remnants of forestry infrastructure are still evident in the landscape today (**Figure 1.8**). The permanently and seasonally wet areas of the wetland were not used for plantations as it is thought that these areas were too wet for *Eucalyptus sp.,* however, the marginal areas of the wetland were all planted for forestry purposes. An old forestry road cuts the wetland into two sections approximately halfway down the HGM unit and this has resulted in the creation of substantial areas of open water above the road (**Figure 1.9**). The area directly below the old road has been colonised by a number of terrestrial tree species which is indicative of wetland area that has reduced water inputs.

The wet portions of the wetland were often characterised by *Juncus effusus, Juncus pallidus* and large stands of *Phragmites australis* and *Cyperus dives.* The open water dammed above the old road contained a healthy population of *Nymphaea nouchali*. The more seasonal zones of the wetland comprised of a mix of species such as *Cymbopogan validus, Thelypteris interrupta, Centella asiatica, Cyperus fastigiatus* and *Cyperus polystachyos* whereas the more terrestrial areas contained species such as *Cynodon dactylon, Hyparrthelia rufa, Imperata cylindrica, Eragrostis heteromera, Hyphaene coriacea, Phoenix reclinata* and *Stenotaphrum secundatum.*

**Figure 1.8 Photographic evidence of damming on upstream side of old forestry road**

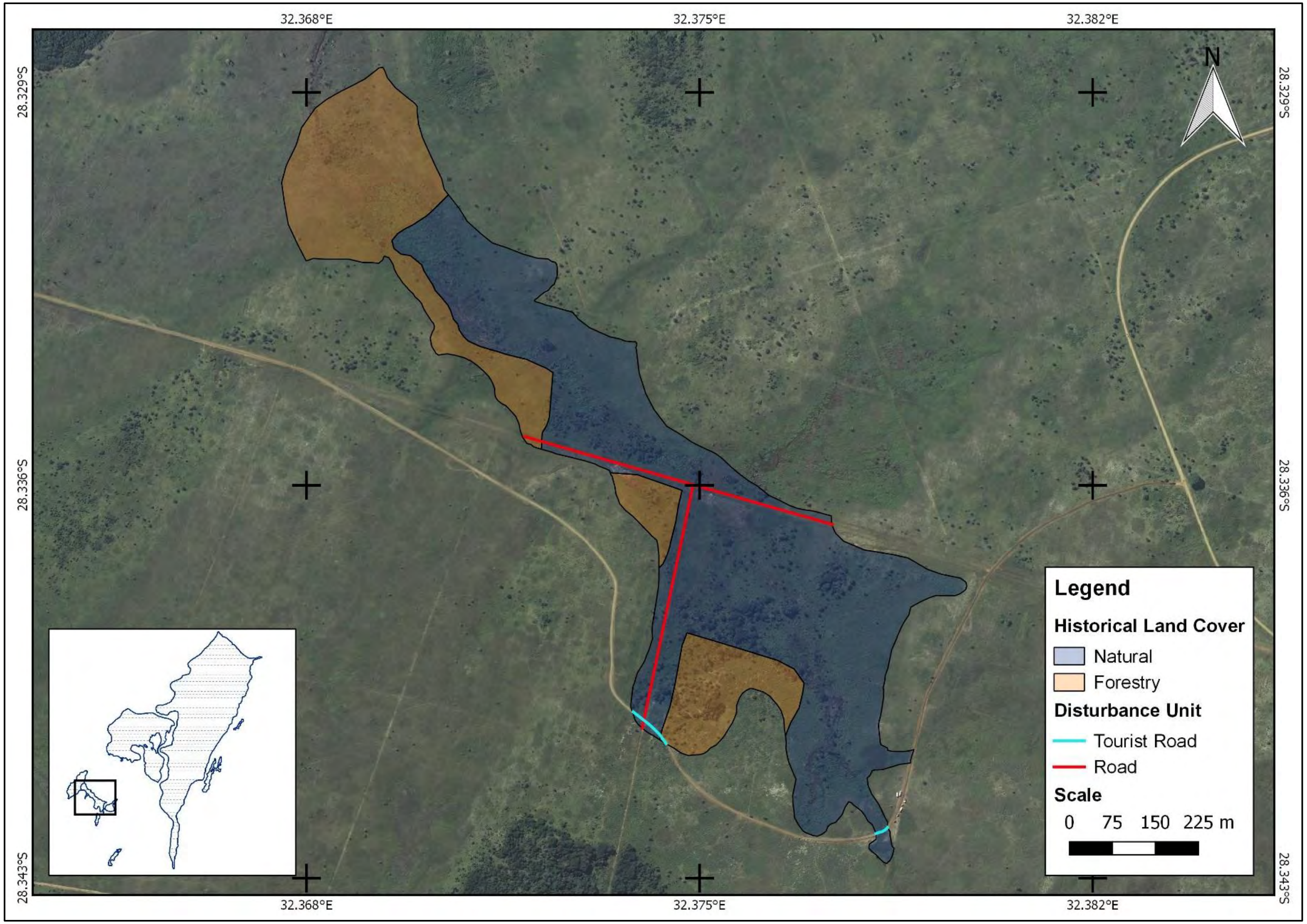



**Figure 1.9 Historical land cover and current disturbance units for Wetland 7 (W32H-07)**

## 1.7 Wetland 8 (W32H-08)

### 1.7.1 Wetland Details

**Table 1.8** provides a summary of Wetland 8 (W32H-08), identified for rehabilitation activities.

**Table 1.8 Wetland 8 (W32H-08) details**

| | |
|---|---|
| Wetland Name | **Wetland 8** |
| Wetland Number/Label | **W32H-08** |
| GPS Location | **28° 20' 42.05"S<br>32° 22' 32.85"E** |
| Catchment Land Use | **Conservation area, tourism, old plantation land, occasional reed harvesting, residential land, agricultural land** |
| Wetland Land Use | **Conservation area, tourism, old plantation land, occasional reed harvesting, agricultural land** |
| Wetland Size (ha) | **14.80** |

### 1.7.2 Wetland Characteristics

Wetland 8 can be classified as an unchannelled valley bottom despite it not having a surface water outflow point. The wetland is characteristically an unchannelled valley bottom wetland but due to human disturbances in the landscape, the outflow point has been completely blocked off by an old forestry road. Wetland 8 has sections of permanently and seasonally wet areas that have been shaped and directed by the network of drains and roads that cross the HGM unit. The areas of the wetland that are closer to the valley sides are much more temporarily wet and only become saturated after very wet periods. The wetland is thought to receive its water from surface and subsurface flows, the latter originating from the wider Maputaland coastal plain aquifer. Surface flows associated with the topographically defined catchment are thought to contribute a large hydrological proportion of flow to the wetland as there is a large drain located at the very top of the HGM unit that flows into the HGM unit – conveying stormwater into the wetland. In addition, the majority of the HGM unit's catchment falls into the outskirts of the town of Duku Duku which is an urban-rural sprawl settlement. A portion of the wetland itself extends outside of the boundary of the iSimangaliso Wetland Park into a small portion of the town of Duku Duku and is not protected in the same way that the wetland within iSimangaliso is protected.

A review of historical imagery revealed that the entire HGM unit was used for forestry purposes and only after the year 2000 were the plantations removed from the HGM unit (**Figure 1.11**). Subsequent to the removal of the plantations, imagery revealed that the top portion of the wetland above the old forestry road was used by subsistence farmers as farm land until the iSimangaliso Wetland Park extended its boundaries after 2002 and incorporated this area into the park. There are a number of drains associated with the farming practices that are still evident within the wetland and are diverting water away from the western side of the wetland. Therefore a preferential flow path is being created down the eastern side of the wetland as a result of this diversion (**Figure 1.10**). Due to the low slope of the wetland and the slow movement of water within the HGM unit, this preferential flow path is still characterised by diffuse flows, but it has meant that the western half of the wetland is significantly drier than the eastern portion of the wetland. There are two old forestry roads located within the wetland which cross the wetland at a perpendicular angle to the direction of flow, as such there has been a damming effect above each road. The top most road runs along the outside of the fence of the iSimangaliso Wetland Park and has therefore not been constructed or maintained as well as the road cutting through the middle of the HGM unit. During the wet season water flows over this top-most road and has therefore destroyed parts of it, reinstating semi-natural flow patterns across this section of wetland. However, the road running across the middle of the HGM unit was built raised above the wetland and is intercepting flows right the way across the wetland area. Much of the wetland area located outside of iSimangaliso is currently being used as farmland which will reduce the water inputs into the HGM unit. It may also increase sediment and nutrient inputs into the HGM unit especially after heavy rainfall events. In addition, a portion of the wetland has been excavated and the spoil has been used to create a dam wall such that further impoundment of flows within the wetland is occurring in the small farm dam that has been created within the wetland outside of the iSimangaliso fences. At the opposite side of the wetland, in the northern most portion of the wetland, the management road that runs along the eastern boarder of the wetland has cut hydrological flows originating from Wetland 8 off from its natural flow path into an adjacent unchannelled valley bottom wetland. A review of recent satellite imagery reveals a large damming effect created at the toe of this wetland where it would naturally flow into the adjacent HGM unit. Therefore the rehabilitation of this wetland may result in many positive impacts to the HGM unit’s integrity and its ability to provide functional services.

Being such a recently disturbed wetland, the vegetation within the HGM unit is also a mix of disturbance tolerant pioneer species, obligate and facultative wetland plant species. In the wetter areas of the wetland, the vegetation composition is dominated by *Juncus effusus, Juncus pallidus, Centella asiatica* and *Cyperus sp.* – all of which are disturbance tolerant species. The wetter areas are confined to the eastern section of the wetland therefore these species were primarily located on the eastern side of the wetland. The vegetation composition in the drier portions of the wetland is comprised of more terrestrial disturbance tolerant species such as *Cynodon dactylon, Imperata cylindrica, Cymbopogon validus, Eragrostis heteromera, Pteridium aquilinum, Gomphocarpus fruticosus* and *Hyparrhenia rufa.*

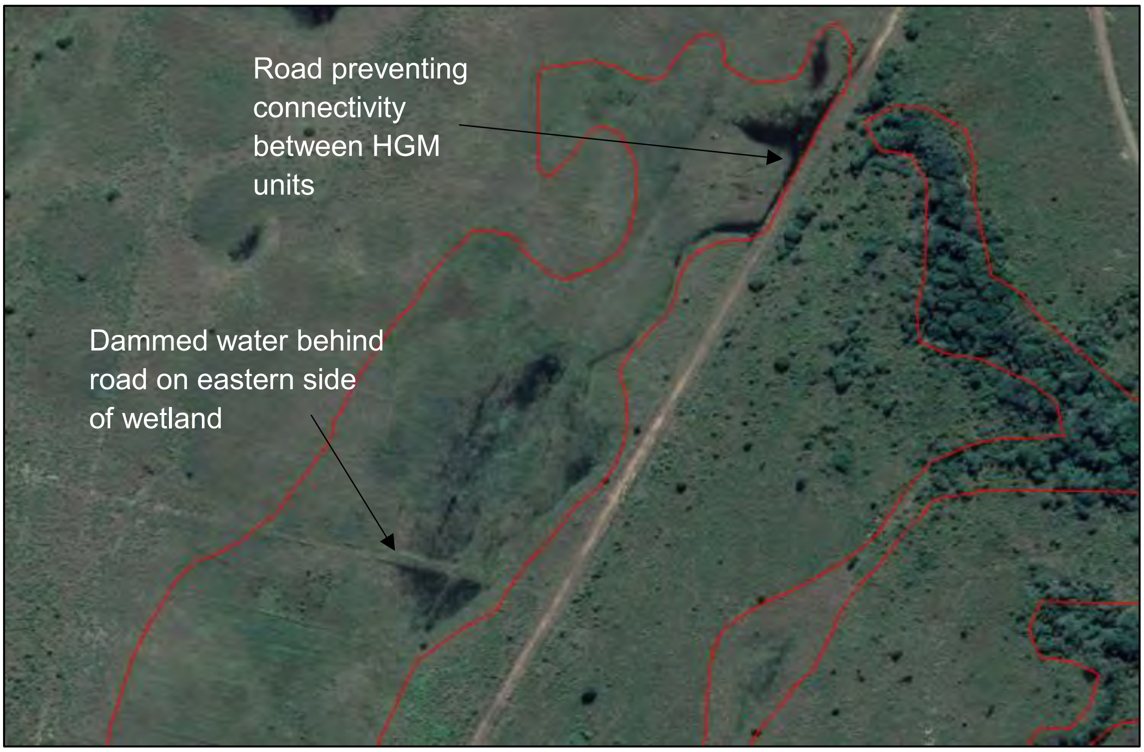



**Figure 1.10 - 2017 Google Earth satellite imagery showing disruptions to hydrological flows in wetland and the preferential flow on the eastern side of the HGM unit during wet season.**

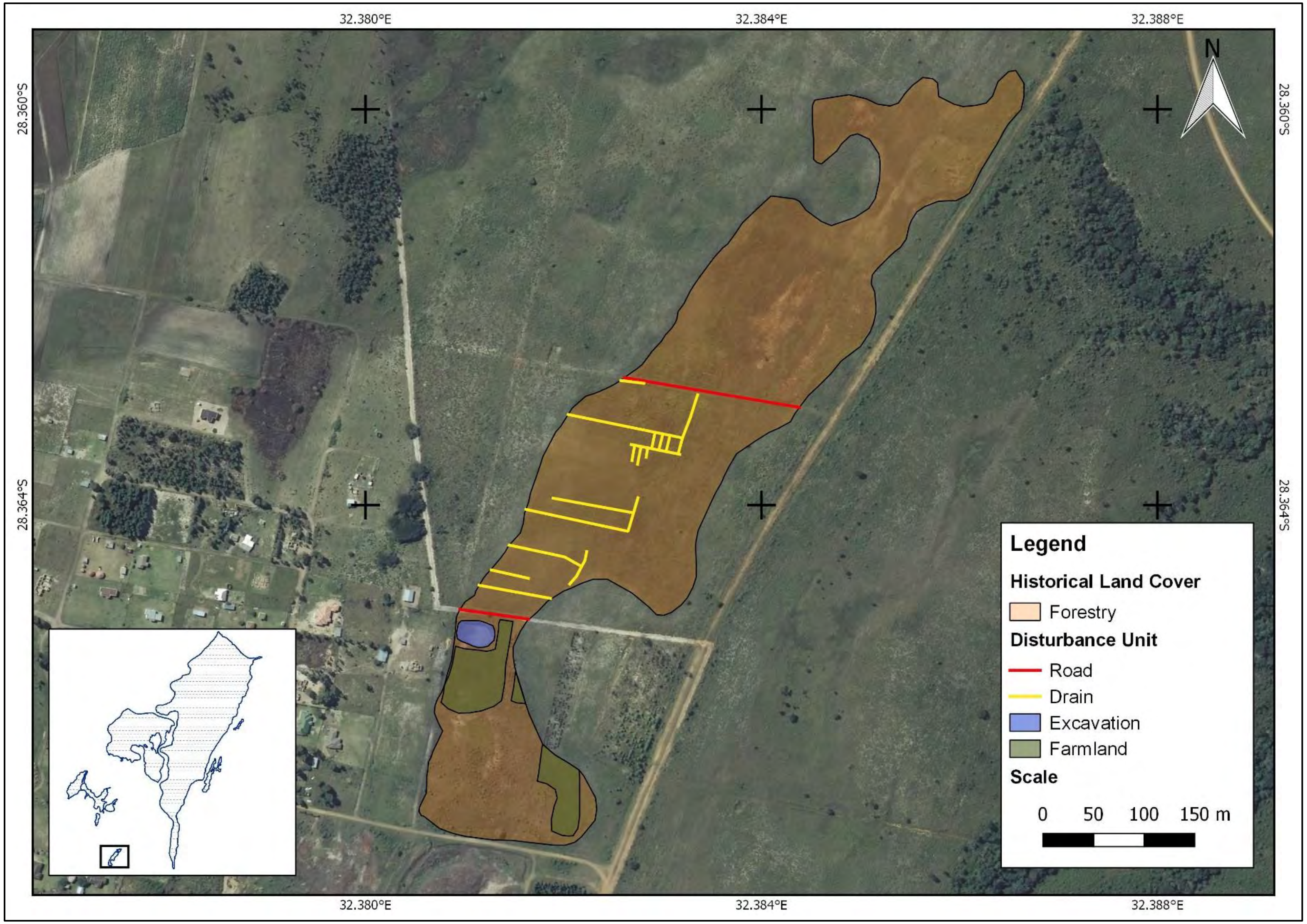



**Figure 1.11 Historical land cover and current disturbance units for Wetland 8 (W32H-08)**

## 1.8 Wetland 9 (W32H-09)

### 1.8.1 Wetland Details

**Table 1.9** provides a summary of Wetland 9 (W32H-09), identified for rehabilitation activities.

**Table 1.9 Wetland 9 (W32H-09) details**

| | |
|---|---|
| Wetland Name | **Wetland 9** |
| Wetland Number/Label | **W32H-09** |
| GPS Location | **28° 21' 46.39"S**<br>**32° 23' 1.031"E** |
| Catchment Land Use | **Conservation area, tourism, old plantation land** |
| Wetland Land Use | **Conservation area, tourism, old plantation land,** |
| Wetland Size (ha) | **5.77** |

### 1.8.2 Wetland Characteristics

Wetland 9 can be classified as a depression wetland despite its elongated shape. Historically, the depression wetland may have been connected to a stream network, but possibly due to the reworking of the landscape as a result of forestry activities, this HGM unit is now isolated from any stream networks. The wetland area lies within a small elongated bowl and it appears that the predominant direction of flow is in a northerly direction along a very gentle slope of 0.23%. Considering the nature of the climate and the substrate upon which the wetland lies, it is assumed that water exits the wetland either via evapotranspirative means or via subsurface flows. The wetland is characterised by seasonally wet soils as it is a depression wetland and is primarily fed by precipitation. It is possible that groundwater inputs contribute to the overall wetness of the wetland, however the wetland sits upon a local plateau which stretches in a southerly direction and on a local interfluve that faces in a northerly direction. The plateau generally drains in an easterly direction and the interfluve acts as a local watershed for two valley lines that direct flow in north westerly directions, as such it is thought that Wetland 9 acts as a groundwater recharge zone. The wetness of the soil profile decreases towards the edges of the depression and this is followed closely by a change in vegetation from the seasonally wet zones. The vegetation composition of the more terrestrial margins of the wetland are comprised of disturbance tolerant species such as *Imperata cylindrica, Cynodon dactylon, Stenotaphrum secundatum, Eragrostis heteromera, Hyparrhenia rufa, Helichrysum decorum, Pteridium aquilinum* and *Hyperthelia dissoluta.* The presence of these species within the wetland is indicative of the disturbance caused by the forestry practices and the subsequent removal of the plantations. The wetter areas of the HGM unit are characterised by a mix of the disturbance tolerant species mentioned above as well as a few facultative wetland species such as *Cyperus sp., Carex sp.* and *Juncus sp.*

The wetland has historically been used for forestry purposes and the residual effects of that disturbance is still evident in the HGM unit today. Natural climax wetland vegetation will take a long time to re-establish within the wetland seeing as the disturbance tolerant species have colonised much of the HGM unit. An old forestry road crosses the entire width of the wetland approximately midway down the length of the HGM unit and currently interrupts flows in a northerly direction (**Figure 1.12**). This interruption causes a substantial damming effect above the road (**Figure 1.13**). An excavation within the wetland that was used to generate material to build the road has also resulted in the creation of open water just below the road and interrupts flows to the lower parts of the depression wetland.

**Figure 1.12 - 2017 Google Earth satellite imagery showing disruptions to hydrological flows in wetland during wet season.**

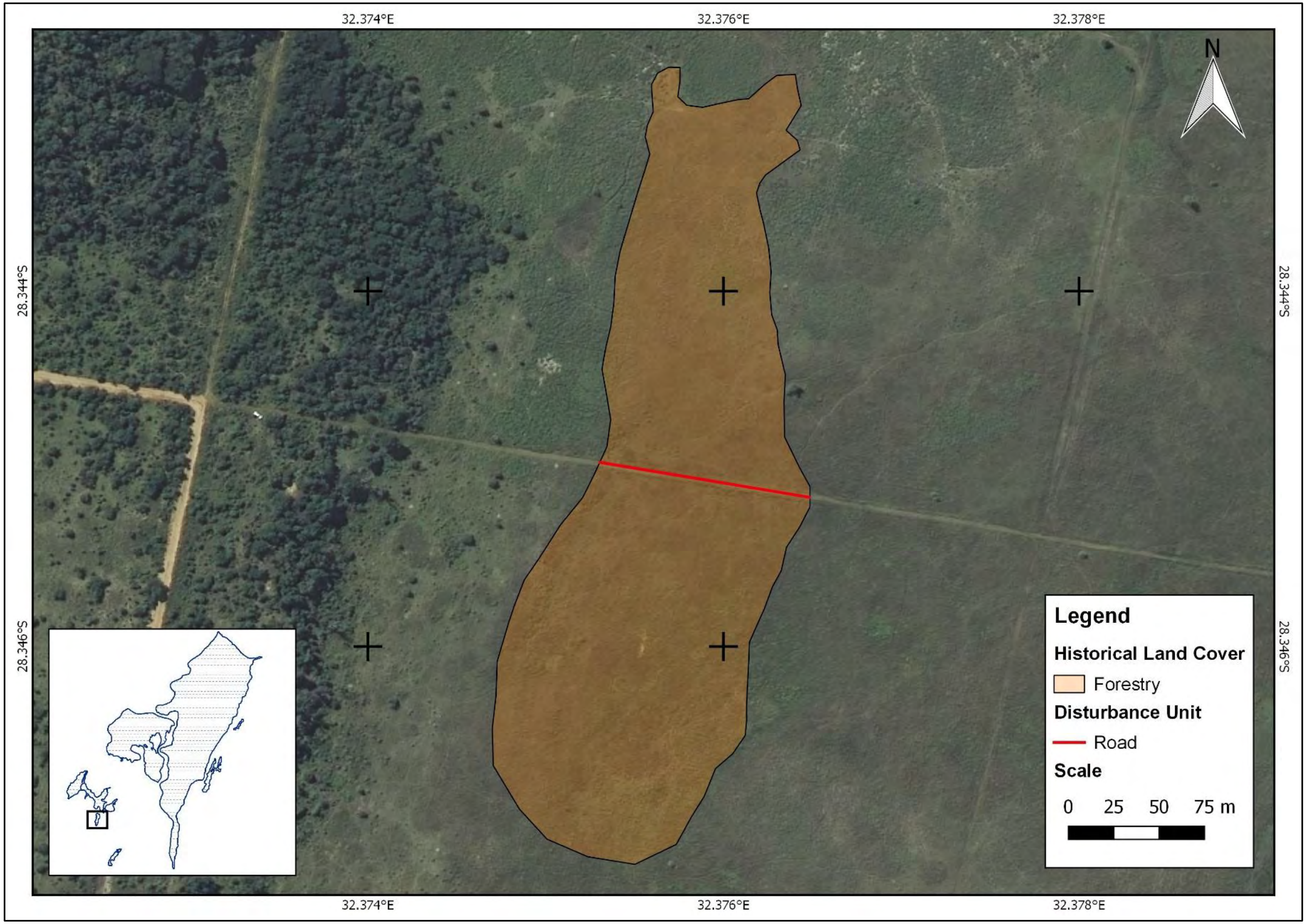



**Figure 1.13 Historical land cover and current disturbance units for Wetland 9 (W32H-09)**

## 1.9 Wetland 10 (W32H-10)

### 1.9.1 Wetland Details

**Table 1.10** provides a summary of Wetland 10 (W32H-10), identified for rehabilitation activities.

**Table 1.10 Wetland 10 (W32H-10) details**

| | |
|---|---|
| Wetland Name | **Wetland 10** |
| Wetland Number/Label | **W32H-10** |
| GPS Location | **28° 19' 6.915"S**<br>**32° 25' 59.57"E** |
| Catchment Land Use | **Conservation area, tourism, old plantation land** |
| Wetland Land Use | **Conservation area, tourism, old plantation land,** |
| Wetland Size (ha) | **3.98** |

### 1.9.2 Wetland Characteristics

Wetland 10 (W32H-10) is located on the eastern shores of the St Lucia River and can be classified as an unchannelled valley bottom despite the fact that it is not connected to a larger stream system. The HGM unit is elongated in shape and functions as a valley bottom wetland would as it has a distinct longitudinal slope sloping towards the north and water flows in a northerly direction. At the northern tip of the wetland the wetland disappears beneath a tourist road which encircles the tip of the wetland and it is possible that water is lost to subsurface flows at this point (**Figure 1.14**). The average slope of the wetland is approximately 0.78%, with the southern half of the wetland being much steeper than the northern section of the wetland. Wetland 10 forms part of a larger complex of blocked valley bottom wetlands that are separated by gently undulating interfluves. It is possible that all of these wetlands are connected by the regional ground water table and would all be affected similarly during wetting and drying climatic phases. The soil in the wetland is a gleyed sand matrix that is very porous and is a well-drained and leached sandy substrate indicative of wetland conditions.

Upon a review of the historical imagery it was revealed that the HGM unit was relatively well preserved during the time that the eastern shores were being used as forestry land. Therefore the physical disturbance within the wetland is relatively limited and only consists of a single road crossing. This road crossing causes a damming effect within the wetland where water dams behind the road, preventing natural hydrological flows. While these closed valley bottom wetlands have a longitudinal slope within them, there is also a tendency for water to create small localised depressions that hold water during the wet season. As such, damming behind roads isn't necessarily starving other wetland areas of hydrological inputs as a damming process is already occurring naturally within these wetlands, however the road interrupts much more nuanced processes such as macro and micro invertebrate gene transfer. With smaller, more disconnected dammed areas, the gene pools of specific plant and animal species are severely limited, therefore it is important that every effort is made to allow for natural flow and damming of water.

The vegetation within the wetland is comprised of disturbance tolerant species that are indicative of a historically disturbed landscape. *Hyparrhenia rufa, Imperata cylindrica, Cynodon dactylon* and *Eragrostis heteromera* dominate the majority of the HGM unit while plant species such as *Juncus effusus, Cyperus sp.* and *Eleocharis dregeana* are scattered more infrequently within the HGM unit – specifically within the wetter areas of the wetland.

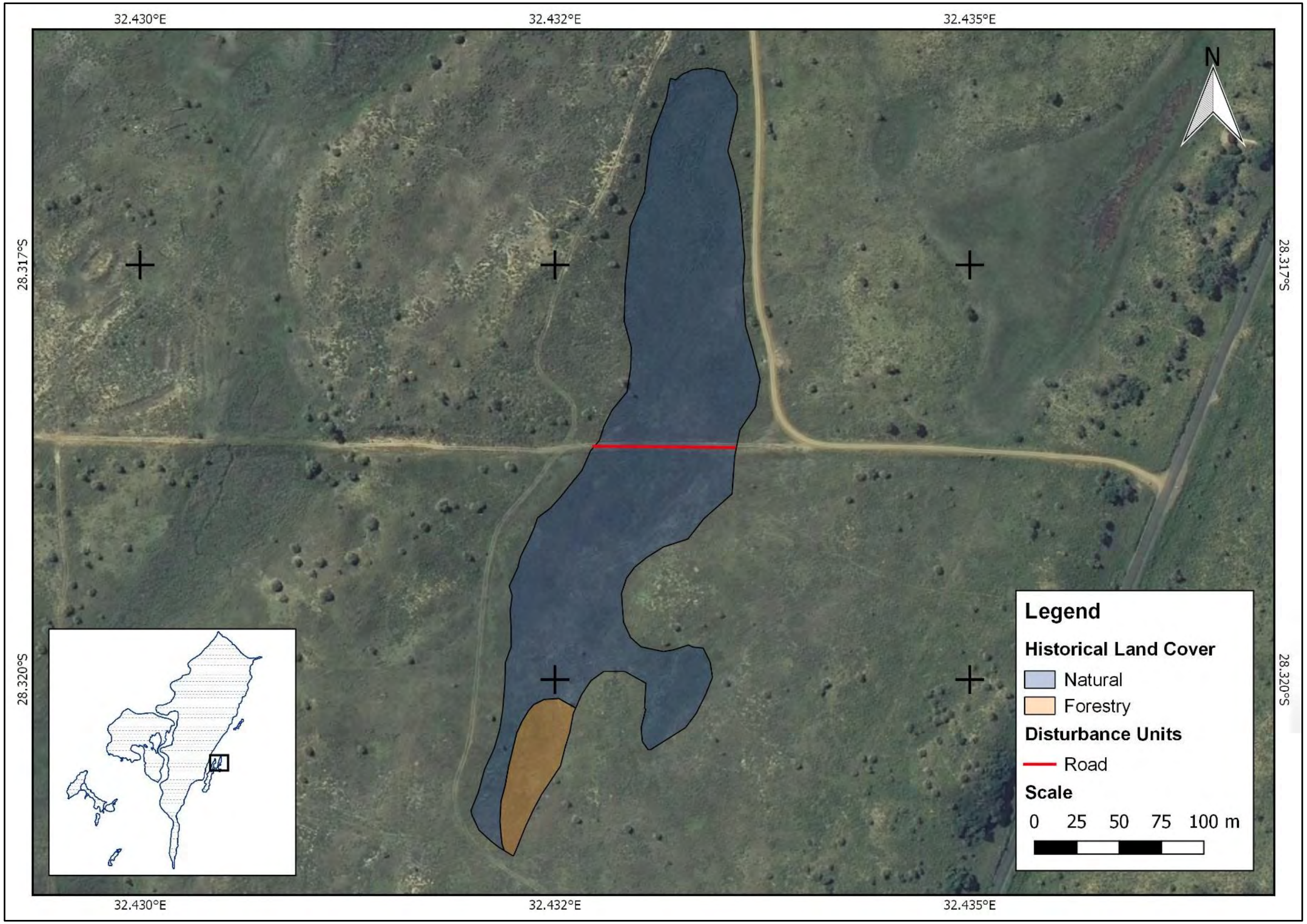



**Figure 1.14 Historical land cover and current disturbance units for Wetland 10 (W32H-10)**

## 1.10 Wetland 11 (W32H-11)

### 1.10.1 Wetland Details

**Table 1.11** provides a summary of Wetland 11 (W32H-11), identified for rehabilitation activities.

**Table 1.11 Wetland 11 (W32H-11) details**

| | |
|---|---|
| Wetland Name | **Wetland 11** |
| Wetland Number/Label | **W32H-11** |
| GPS Location | **28° 19' 15.82"S**<br>**32° 25' 46.1"E** |
| Catchment Land Use | **Conservation area, tourism, old plantation land** |
| Wetland Land Use | **Conservation area, tourism, old plantation land,** |
| Wetland Size (ha) | **21.45** |

### 1.10.2 Wetland Characteristics

Wetland 11 forms part of the complex of elongated valley bottom wetlands and sits one interfluve to the west of Wetland 10. Therefore Wetland 11 can also be considered an unchannelled valley bottom wetland with no distinct point of inflow. However, there is an outflow located midway along the HGM unit and the wetland discharges to the west. The northern reaches of the wetland drain in a southerly direction and the southern reaches of the HGM unit drain towards the north. The out flow is located at the lowest point of the HGM unit, where the northern and southern reaches drain towards. The HGM unit functions as a valley bottom wetland and has a very gentle longitudinal slope of 0.38%. The southern tip of the wetland is defined by a local watershed point that is defined by an interfluve that runs in an east-west direction. The northern tip of the wetland is defined by a similar feature, as such the wetland drains in two directions. The valley bottom is characterised by sections where the valley bottom is wide and the slopes on the interfluves on either side of the valley are gentle as well as by sections where the valley bottom is much narrower and the valley sides are much steeper. The HGM unit contains large sections of permanently wet soils where the soils remain saturated year round. A sulphurous odour was observed after multiple auger holes during the site visit that confirmed permanent wetness. The permanently wet areas are often associated with the sections of the valley that are narrow whereas the largest extents of the seasonal and temporary zones were observed in the wider, flatter areas of the wetland. The wetland is thought to receive water from both the regional aquifer as well as its small topographically defined catchment.

A large proportion of Wetland 11 was used for forestry plantations and as a result the integrity and the functioning of the wetland has been reduced (**Figure 1.16**). The removal of homogenised plantations such as *Eucalyptus sp.* plantations leave behind large tracts of bare land that can be colonised by pioneer disturbance tolerant species which has been the case in Wetland 11. Large portions of the wetland contained species such as *Imperata cylindrica, Pteridium aquilinum, Hyparrhenia rufa, Cynodon dactylon, Stenotaphrum secundatum* and *Cymbopogon validus* which are known to be indicators of land that has been disturbed. These species will continue to colonise these areas and it is thought that it will be a long time before climax wetland vegetation will recolonise these areas. The presence of old forestry roads is also another factor that has been detrimental to the functioning and integrity of the wetland as they prevent free-flow of water through the HGM unit. There are four old forestry roads that cross the HGM unit and are currently interrupting the hydrological functioning of the wetland.

It was observed that damming occurs on both the upstream and downstream side of the roads as a result of excavation to generate material to build raised roads through the wetland (**Figure 1.15**). If these roads were removed, a constant hydrological linkage would be created throughout the HGM unit.

The vegetation composition within the wetter areas of the HGM unit is characterised by a range of obligate and facultative wetland species such as *Juncus effusus, Juncus pallidus, Cyperus fastigiatus, Cyperus rotundus, Cyperus dives, Centella asiatica* and *Phragmites australis.*


**Figure 1.15 Photographic evidence of damming on the upstream side of a forestry road.**

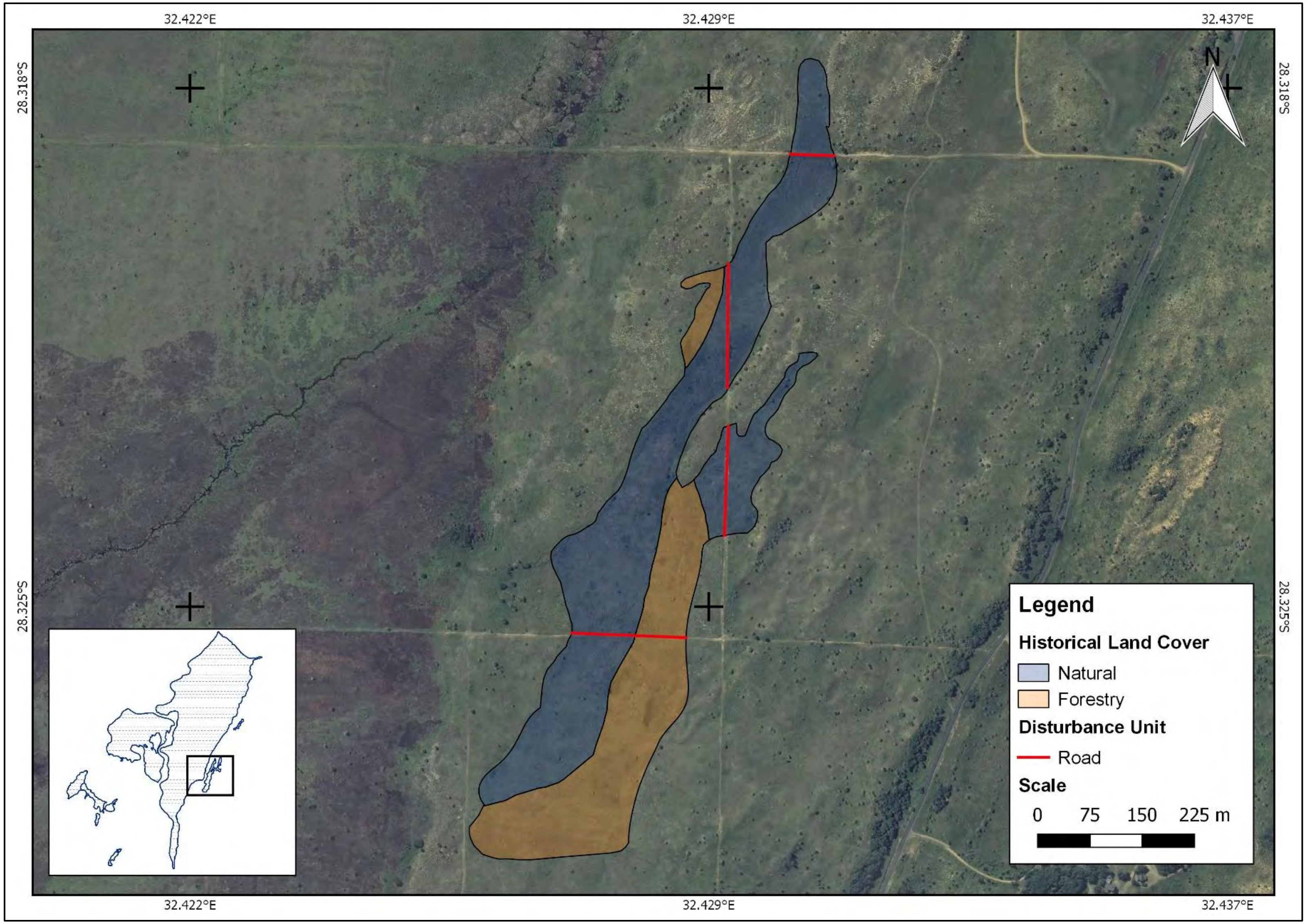



**Figure 1.16 Historical land cover and current disturbance units for Wetland 11 (W32H-11)**

## 1.11 Wetland 12 (W32H-12)

### 1.11.1 Wetland Details

**Table 1.12** provides a summary of Wetland 12 (W32H-12), identified for rehabilitation activities.

**Table 1.12 Wetland 12 (W32H-12) details**

| | |
|---|---|
| Wetland Name | **Wetland 12** |
| Wetland Number/Label | **W32H-12** |
| GPS Location | **28° 18' 13.04"S**<br>**32° 26' 24.07"E** |
| Catchment Land Use | **Conservation area, tourism, old plantation land** |
| Wetland Land Use | **Conservation area, tourism, old plantation land,** |
| Wetland Size (ha) | **5.78** |

### 1.11.2 Wetland Characteristics

Wetland 12 can be classified as a depression wetland. While it has similar characteristics to a closed valley bottom wetland, there are no distinct valley sides as observed in Wetlands 8 and 9. Wetland 12 is surrounded by a small aggraded area that has possibly aggraded as a result of wind moving sediment within the landscape. Therefore it can be considered a depression wetland. It is also characterised by a low point located in the middle of the HGM unit as opposed to a low point occurring at one of the two ends of the HGM unit. This wetland occurs on a very porous substrate which can be likened to beach sand as it is very course grained and bleached. However, the soil profile within the depression wetland below an initial layer of aeolian sand was gleyed and indicative of wetland habitat. Wetland 12 is thought to receive water from its small topographically derived catchment as well as from subsurface flows originating from the regional Maputaland coastal plain aquifer. The vegetation within the wetland is was disturbed as a fire had recently swept across a large section of the eastern shores of the iSimangaliso Wetland Park and as such there were limited vegetation indicators within the wetland. However, disturbance tolerant ruderal species such as *Cynodon dactylon, Hyparrhenia rufa* and *Juncus effusus* have started recolonising the burnt areas. A few *Hyphaene coriacea* and *Phoenix reclinata* palm trees survived the fire and occur around the wetland edges.

A review of historical imagery revealed that the majority of the wetland was formerly used as plantation land and therefore there are observable areas of disturbance despite the removal of the plantation trees between 2002 and 2006. A large drain was excavated at the southern end of the HGM unit and the spoil from the excavation was dumped along the edge of the drain margin (**Figure 1.17**). It is unclear what the intended purpose of the drain was, but it currently drains a small portion of the HGM unit as there is a breach in the infilled margin of the drain (**Figure 1.18**). Because the bottom of the drain is lower than the bottom of the depression wetland, a hydraulic gradient is created in the direction of the drain and as such, the depression wetland is losing water to the drain via both surface and subsurface flows. Therefore the deactivation and infilling of the drains would reinstate a natural flow direction in the southern portion of the wetland area.

**Figure 1.17 Photographic evidence of the excavated drain and the spoil deposits running along either side of the drain.**

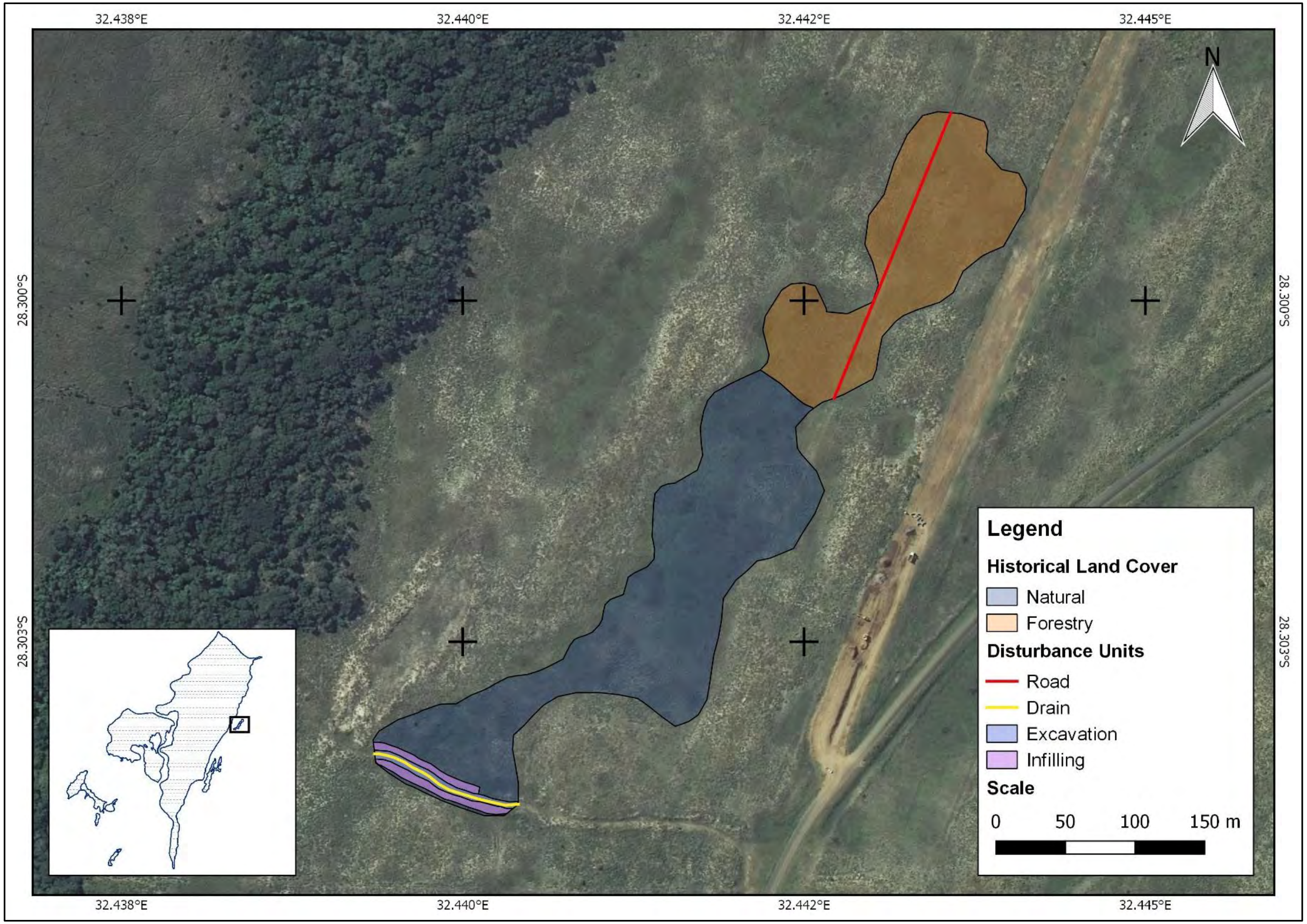



**Figure 1.18 Historical land cover and current disturbance units for Wetland 12 (W32H-12)**

## 1.12 Wetland 13 (W32H-13)

### 1.12.1 Wetland Details

**Table 1.13** provides a summary of Wetland 13 (W32H-13), identified for rehabilitation activities.

**Table 1.13 Wetland 13 (W32H-13) details**

| | |
|---|---|
| Wetland Name | **Wetland 13** |
| Wetland Number/Label | **W32H-13** |
| GPS Location | **28° 19' 31.94"S**<br>**32° 25' 25.09"E** |
| Catchment Land Use | **Conservation area, tourism, old plantation land, occasional reed harvesting** |
| Wetland Land Use | **Conservation area, tourism, old plantation land, occasional reed harvesting** |
| Wetland Size (ha) | **24114.00** |

### 1.12.2 Wetland Characteristics

Wetland 13 is the largest HGM unit assessed during this iSimangaliso rehabilitation cycle and can be classified as a floodplain wetland complex. A floodplain complex such as this is characterised by many smaller wetland areas that have formed as a result of processes associated with floodplains such as sporadic flooding and deposition of sediment within the wetland. The deposition of sediment occurs near the banks of the river, as such a flood plain such as this is often characterised by a low point towards the centre of the wetland. The wetland is fed predominantly by precipitation and subsurface flows which originate from the Maputaland coastal plain aquifer. Because this wetland is located so close to sea level and so close to the regional water table – there is a large proportion of the wetland that is characterised by permanently wet soils. There are areas of higher lying ground which would only seasonally or temporarily be wet, and these areas are also very closely correlated to a change to more terrestrial vegetation species. The vegetation composition of the permanently wet areas of the wetland are comprised of *Juncus effusus, Juncus pallidus, Cyperus sp., Eleocharis drageana* and *Phragmites australis* whereas the more seasonally wet areas are characterised by *Cymbopogon validus, Cynodon dactylon, Stenotaphrum secundatum, Imperata cylindrica, Centella asiatica, Pentodon pentandrus, Scoparia dulcis, Hyparrhenia rufa, Hyphaene coriacea, Phoenix reclinata* and *Pteridium aquilinum.*

According to historical imagery, a large portion of the eastern edge of the wetland was used for plantation land and timber production (**Figure 1.20**). Because much of this forestry land fell within permanently wet zones, large drains had to be excavated to encompass the plantations to prevent flooding of those areas. These drains can still be seen from satellite imagery and it is thought that they are still having a detrimental effect on the integrity and functioning of the wetland. The drains will divert and hold surface water, preventing free movement of water from the old forestry land towards the part of the wetland that wasn't affected by forestry and vice versa. Old forestry roads also still traverse the wetland area where the plantations were located and these features too prevent hydrological flows from moving freely across the HGM unit (**Figure 1.19**). However, the size of the wetland in comparison to the area that is affected by this old forestry infrastructure is large and therefore the removal of this infrastructure will have a small impact on the overall integrity of the wetland.

**Figure 1.19 Photographic evidence of the extent of damming that occurs behind roads within Wetland 13 (W32H-13)**

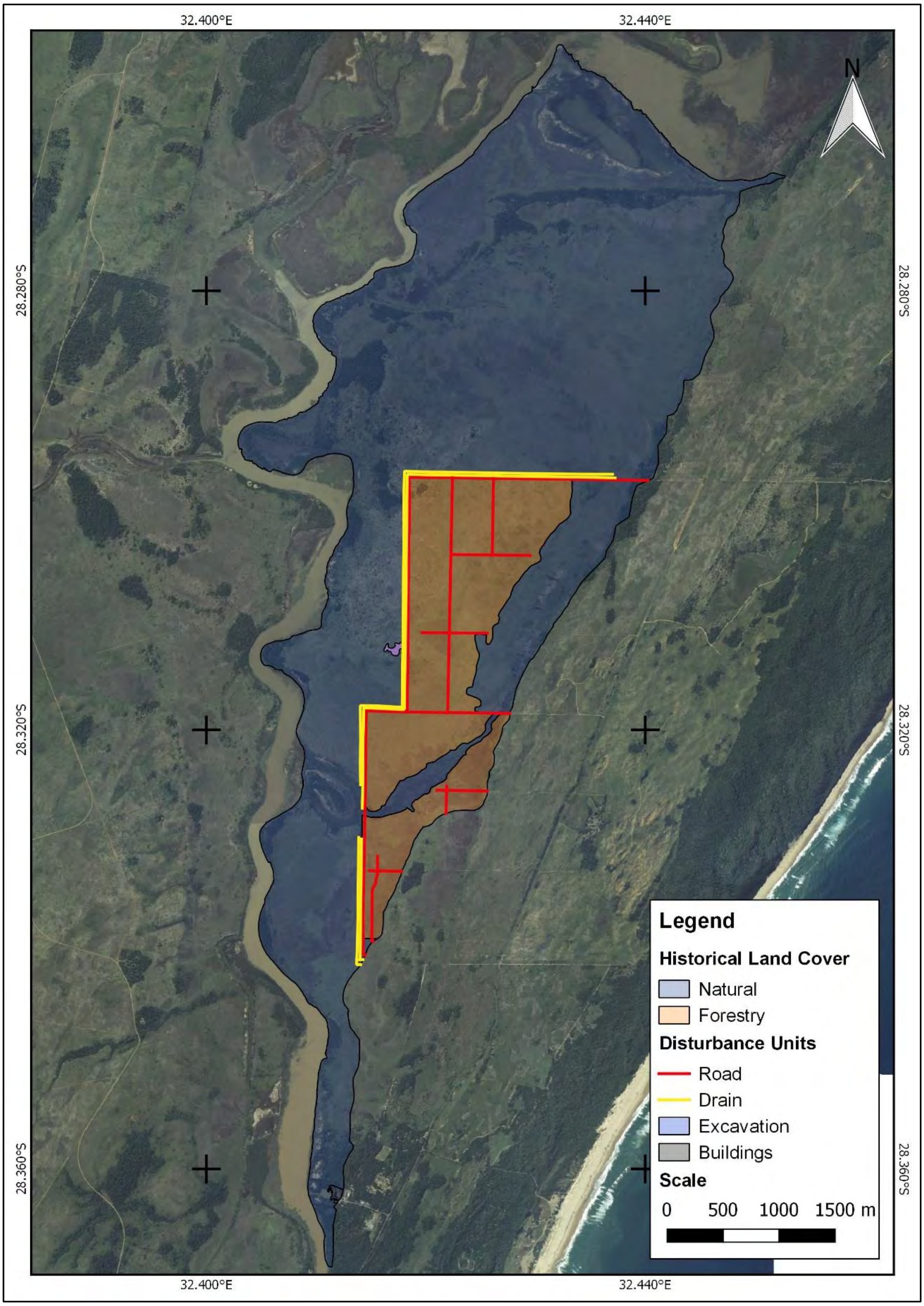



**Figure 1.20 Historical land cover and current disturbance units for Wetland 13 (W32H-13)**

# APPENDIX B

# GENERAL CONSTRUCTION NOTES

*(Ignore notes which are inapplicable)*

1. **Occupational health and safety is a priority!** All necessary precautionary measures must be undertaken to ensure safety of the team. Particular attention must be given to deep excavations where gentle sloping back of soil or shoring must be applied to prevent possible soil collapse. Where risks are foreseen, these must be reported to the Occupational Health and Safety Agent employed by SANBI, who may need to seek further advice. In addition, no excavated earth or other materials should be stockpiled within a distance of one metre from the edge of any excavation. The one metre wide strip along the edges of all sides of an excavation should at all times be kept clear of objects such as lumps of clay, rocks or tools that could injure workers in the excavation if they were to fall in.

2. Check all dimensions on site to determine if any amendments to the designs are necessary. Note the required final height of the structure relative to the original ground level. The responsible engineer must be consulted before any changes are made to dimensions.

3. Excavation must be carried out to the final levels. Soil must be placed in areas best suited for re-use, for example, when building an earthen diversion embankment, the soil excavated should be used immediately in building up the embankment (on condition the excavated soil is of suitable quality). The excavated soil should alternatively be stockpiled immediately upstream of the site of the proposed wall. The topsoil must be stockpiled separately from the subsoil.

4. Where soil is to be the foundation for non-soil structures (for example, gabions and rafted weirs), all sand deposits must be removed and the floor well compacted while the soil is at optimum moisture content.

5. In instances where the addition of Gypsum ($CaSO4$) has been specified for the amelioration of a dispersive soil, mixing must be carried out off site, after which it must be transported to the construction site.

6. When the final level of the soil construction has been reached the previously stockpiled topsoil must be added as an extra height and planted to suitable vegetation (unless other provision for protection of the structure has been specified).

7. When backfilling soil against concrete or gabion work, extra care must be taken to ensure that a waterproof join with the structure is, as far as possible, achieved. Compaction must be carried out in layers as specified by the engineer. Material containing organic matter must not be used for this backfilling purpose.

8. Ensure that the correct steel reinforcing, as specified, has been delivered to site. Ensure that the minimum cover, as specified by the engineer, is achieved at all times. All welded steel mesh joins must have an overlap of at least 200mm and must be securely tied with 2mm building wire. At least three rings at 150mm spacing are required. Where reinforcing bars are used, bars at joins must be overlapped as per the distance specified

on the drawings. Particular attention must be paid to ensure the correct placing of steel reinforcing (particularly steel mesh with different bar sizes).

9. Before placing concrete on a rock foundation, carefully chip away any loose surface layers and wash away all debris. New surfaces must be painted with a cement slurry prior to the placing of the concrete.

10. Ensure that all shuttering is strong and well supported. It is recommended that the concrete be placed in layers no greater than one metre per day. The shuttering must be well oiled on the inside to prevent the concrete from sticking. Spacers between shuttering must be placed every one metre, both vertically and horizontally, with a minimum of two in both directions.

11. Note that when mixing concrete it is preferable to use a full pocket of cement with each mix. The specified cement water ratio must be maintained at all times.

12. The poured concrete must be "rodded" to ensure proper compaction. Never add more than one metre height of concrete in any one day, and attempt to lay the concrete in even, horizontal layers throughout the length of any section. Check the specifications for any requirement of expansion joints. The shuttering should be left for at least two days before stripping. Wetting the concrete while it is curing will make for a strong construction. Backfilling of soil against the completed structure may only be done after a period of at least seven days.

13. The use of "plums" in concrete: in some instances it may be feasible and economic to reduce the amount of concrete in mass gravity structures, by replacing up to 33% of the volume of concrete by the judicious use of suitable hand sized quarried rock. Where this is specified the rocks (purchased as handstone) must be so placed that there is always a minimum cover of 50mm between the rock and the shuttering, as well as between any two adjacent rocks. This should only be done where it is stated on the drawings that is permissible.

14. The standard procedures for the opening up and wiring together of gabion baskets and mattresses are well documented, and supplied with every delivery of the products. They must be strictly adhered to in all respects. Ensure that the lids of the final (top) baskets are always folded down and wired in a downstream direction.

15. Where rock-filled gabion baskets are used for the construction of keywalls, the trenches must be dug wide enough so that sufficient access is available to properly backfill and compact all the way around them. Making the trench only wide enough to receive the baskets is not acceptable, as water will eventually find its way around the structures and cause problems.

16. Where structures are to be built in dispersive soils, the following should be noted:

    - Impermeable cut off wall (at least 500mm deep) to be constructed under spillway section of the structure
    - Key walls to be impermeable

- Impermeable barriers to be constructed between key walls and spillway section of structures

17. Sloping and vegetating gully banks where specified:

    Where the gully is no more than approximately 1.0 metre deep, and the catchment area small (say ten hectares), the topsoil of the site immediately adjoining the channel is removed and stockpiled in a safe place nearby. The subsoil thus laid bare is excavated at a slope not less than 1:3 (V:H) and deposited in the gully. This deposit is carefully compacted while in a moist state. The topsoil is now returned to the sloped area, and spread as evenly as possible over it. Vegetation suitable to the site is planted. The additional advantage to this idea is that, as the channel cross section is made shallower and wider and established to vegetation, so the chances of floodwaters overflowing into the adjacent flood area will be that much greater. Note that the base of the modified channel should be planted to strong, hydrophitic plants while the outer edges will require plants more suited to drier regimes. It must be emphasised that the stockpiling of the topsoil and its replacement is vital, especially where very erodible subsoil is present. Failure to do this will be tantamount to a waste of money and effort.

18. The orientation of all wetlands and interventions is to be taken facing downstream i.e. left bank and right bank are to be identified **facing downstream**.

19. The Bill of Quantities for the various rehabilitation interventions only included revegetation in those instances where the engineer considered the re-vegetation of the denuded area as important due to the size of the area affected or due to the risk associated with scouring and erosion.

# APPENDIX C

# INTERVENTION BOOKLET

| Intervention Number | Description | Type | Reference Document | Design Revision |
|---|---|---|---|---|
| W32H-03-201-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-03-202-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-03-203-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-03-204-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-03-205-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-04-201-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-04-202-00 | Reshaping landscape | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-04-203-00 | Reshaping landscape | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-04-204-00 | Reshaping landscape | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-04-205-00 | Reshaping landscape | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-04-206-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-04-207-00 | Berm construction | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-04-208-00 | Berm removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-04-209-00 | Berm removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-04-210-00 | Berm removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-04-211-00 | Reshaping embankment | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-05-201-00 | Old stream crossing removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-05-202-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-05-203-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-05-204-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-06-201-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-07-201-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-07-202-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-08-201-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-08-202-00 | Berm removal and backfill drain | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-09-201-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-10-201-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-10-202-00 | Backfill road | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-11-201-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-11-202-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-11-203-00 | Backfill road scar | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |
| W32H-12-201-00 | Remove soil stockpile and backfill drain | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |

| | | | | |
|---|---|---|---|---|
| W32H-13-201-00 | Road removal | New | KZN iSimangaliso: Rehab Plan 2019 | Rev A |

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°18'22.21"S<br>End: 28°17'56.29"S |
| Longitude (D°M'S") | Start: 32°23'14.66"E<br>End: 32°23'06.27"E |

## Location Photograph: W32H-03-201-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 685.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°17'50.6"S<br>End: 28°17'53.97"S |
| Longitude (D°M'S") | Start: 32°23'44.39"E<br>End: 32°23'44.68"E |

## Location Photograph: W32H-03-202-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 30.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°17'55.92"S<br>End: 28°18'00.49"S |
| Longitude (D°M'S") | Start: 32°23'44.86"E<br>End: 32°23'45.28"E |

## Location Photograph: W32H-03-203-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 67.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°18'22.73"S<br>End: 28°18'26.77"S |
| Longitude (D°M'S") | Start: 32°23'47.12"E<br>End: 32°23'47.19"E |

## Location Photograph: W32H-03-204-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | m³ | R 397.00 | 185.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°18'30.67"S<br>End: 28°18'38.47"S |
| Longitude (D°M'S") | Start: 32°23'47.79"E<br>End: 32°23'48.24"E |

## Location Photograph: W32H-03-205-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 395.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to reinstate hydrological processes within the wetland. |
| Latitude (D°M'S") | Start: 28°20'18.19"S<br>End: 28°20'18.72"S |
| Longitude (D°M'S") | Start: 32°22'59.96"E<br>End: 32°23'01.64"E |

## Location Photograph: W32H-04-201-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 95.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Reshaping landscape |
| Rehabilitation Objectives | Reshape site to match the grade of the surrounding landscape to reinstate flows through the wetland. |
| Latitude (D°M'S") | Start: 28°20'18.86"S |
| Longitude (D°M'S") | Start: 32°23'01.37"E |

## Location Photograph: W32H-04-202-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Reshaping | $m^3$ | R 397.00 | 5.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate 100mm and cut surface to match grade of surrounding landscape

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Reshaping landscape |
| Rehabilitation Objectives | Reshape site to match the grade of the surrounding landscape to reinstate flows through the wetland. |
| Latitude (D°M'S") | Start: 28°20'18.81"S |
| Longitude (D°M'S") | Start: 32°23'00.95"E |

## Location Photograph: W32H-04-203-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Reshaping | m³ | R 397.00 | 58.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate 300mm and cut surface to match grade of surrounding landscape

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Reshaping landscape |
| Rehabilitation Objectives | Reshape site to match the grade of the surrounding landscape to reinstate flows through the wetland. |
| Latitude (D°M'S") | Start: 28°20'18.65"S |
| Longitude (D°M'S") | Start: 32°23'00.51E |

## Location Photograph: W32H-04-204-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Reshaping | $m^3$ | R 397.00 | 45.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate 400mm and cut surface to match grade of surrounding landscape

Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Reshaping landscape |
| Rehabilitation Objectives | Reshape site to match the grade of the surrounding landscape to reinstate flows through the wetland. |
| Latitude (D°M'S") | Start: 28°20'18.50"S |
| Longitude (D°M'S") | Start: 32°23'00.24"E |

Location Photograph: W32H-04-205-00

Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Reshaping | $m^3$ | R 397.00 | 6.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate 150mm and cut surface to match grade of surrounding landscape

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to reinstate hydrological processes within the wetland. |
| Latitude (D°M'S") | Start: 28°20'17.27"S<br>End: 28°20'18.10"S |
| Longitude (D°M'S") | Start: 32°22'56.07"E<br>End: 32°22'58.75"E |

## Location Photograph: W32H-04-206-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | m³ | R 397.00 | 422.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Berm construction |
| Rehabilitation Objectives | To divert surface flows to existing culvert to prevent flooding of the road downstream |
| Latitude (D°M'S") | Start: 28°20'15.08"S<br>End: 28°20'14.46"S |
| Longitude (D°M'S") | Start: 32°22'48.91"E<br>End: 32°22'49.75"E |

## Location Photograph: W32H-04-207-00

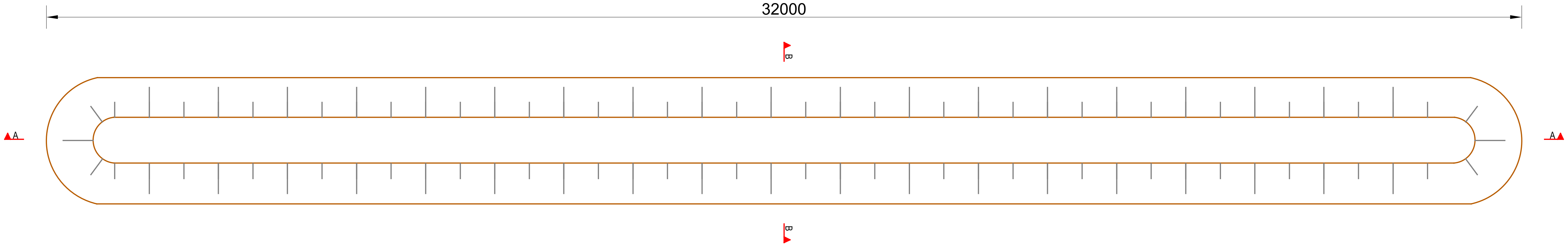
## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Earthworks - Construct berm | $m^3$ | R 840.00 | 16.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

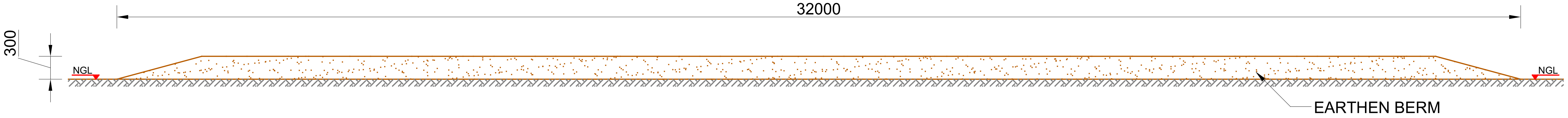
General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

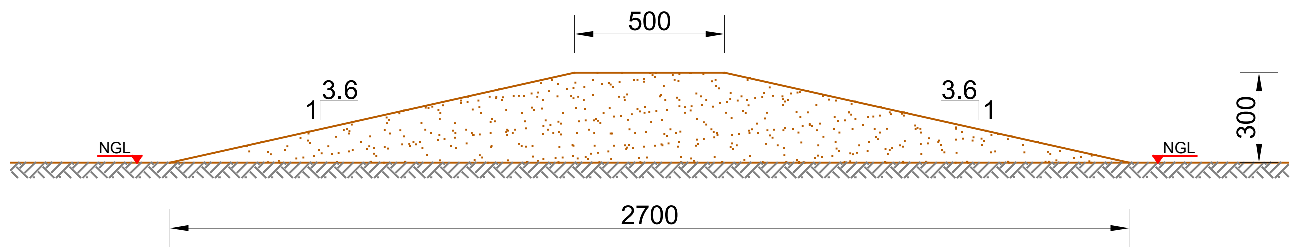
Create low-key berm feature using spoil material from intervention W32H-04-211-00




TYPICAL PLAN VIEW OF
EARTHEN BERM




SECTION A-A
(SECTIONAL VIEW)




SECTION B-B
SCALE 1:25

NOTES

1. AURECON AND GROUNDTRUTH ACCEPTS RESPONSIBILITY FOR THE ENGINEERING DESIGN TO THE EXTENT THAT THIS IS BASED ON AVAILABLE INFORMATION. THE AVAILABLE INFORMATION IS LIMITED TO WHAT COULD BE INTERPRETED DURING A SINGLE SITE VISIT OF NO LONGER THAN A FEW HOURS. NO GEOTECHNICAL, TOPOGRAPHICAL, GEOMORPHOLOGIC AND OTHER ENGINEERING RELATED SURVEYS HAVE BEEN UNDERTAKEN TO INFORM THE DESIGN. THIS IS NON-STANDARD ENGINEERING PRACTICE AND THEREFORE AURECON, GROUNDTRUTH AND THEIR ENGINEERS ARE INDEMNIFIED BY THE CLIENT AND DO NOT ACCEPT RESPONSIBILITY FOR THE ASSOCIATED RISK OF FAILURE FROM THE ABOVE LIMITATIONS OR ANY DAMAGES THAT MAY OCCUR.

2. AURECON, GROUNDTRUTH AND THEIR ENGINEERS ARE INDEMNIFIED AGAINST ANY ASSOCIATED DAMAGES AND ACCEPT NO LIABILITY ASSOCIATED WITH THE CONSTRUCTION AND IMPLEMENTATION OF ENGINEERING INTERVENTIONS DUE TO THE ENGINEERS HAVING LIMITED CONTACT WITH THE IMPLEMENTER DURING THE CONSTRUCTION PHASE RESULTING IN OUR INABILITY TO DILIGENTLY SUPERVISE AND ASSESS ANY PROGRESS.

ACRONYMS AND ABBREVIATIONS:

1. NGL - NATURAL GROUND LEVEL
2. C/C - CENTRE TO CENTRE
3. µm - MICRO METER

EARTHWORKS/ EARTH STRUCTURES:

4. ALL CUT AND FILL SLOPES TO BE NOT STEEPER THAN 1:4, UNLESS OTHERWISE SPECIFIED.
5. ALL EXPOSED DISTURBED SURFACES TO BE REVEGETATED, UNLESS OTHERWISE SPECIFIED. 100mm OF TOP SOIL TO COVER BERM. REVEGETATION TO BE UNDERTAKEN AT SUITABLE TIMING OF YEAR TO IMPROVE CHANCES OF TAKING.
6. SOIL FOR BERMS AND BACKFILL TO BE COMPACTED IN 100mm LAYERS AT OPTIMUM WATER CONTENT.

DISPERSIVE SOILS:
(ONLY APPLICABLE IN AREAS WITH DISPERSIVE SOILS)

1. IT IS CRITICAL TO ENSURE THAT THE FOUNDING SOIL NEVER DRIES OUT AND REMAINS AS UNDISTURBED AS POSSIBLE. THE BASE OF THE INTERVENTION SHOULD THEREFORE BE CONSTRUCTED AS SOON AS A PORTION OF EXCAVATION HAS BEEN FINISHED.
2. FILL MATERIAL TO BE GOOD QUALITY. WELL-GRADED GRAVEL OR CLAY (NOT DISPERSIVE CLAY FOUND IN PARTS OF THE FLOOD PLAIN).
3. ALL MATERIAL THAT IS EXCAVATED FROM THIS SITE AND RE-USED FOR BACKFILL SHALL BE WELL MIXED WITH 100kg OF LIME PER CUBIC METER OF SOIL, AND PLACED AND COMPACTED AT OPTIMUM MOISTURE CONTENT.

EARTHEN BERMS:

1. THE BERMS ARE TO BE SET OUT BY THE ENGINEER PRIOR TO CONSTRUCTION.
2. ALL VEGETATION AND TOPSOIL IS TO BE REMOVED FROM THE FOOTPRINT OF THE INTERVENTION AND STOCKPILED SEPARATELY FOR REUSE.
3. THE CHANNEL BANKS WITHIN THE FOOTPRINT OF THE STRUCTURE AREA TO BE SLOPED TO GRADIENTS OF 1:1.
4. MATERIAL FOR THE CONSTRUCTION MAY BE SOURCED FROM SLOPING THE CHANNEL BANKS IMMEDIATELY UPSTREAM AND DOWNSTREAM OF THE INTERVRENTIONS.
5. ALL MUD AND SOFT AMETRIAL IS TO BE REMOVED FROM THE BASE OF THE CHANNEL WITHIN THE FOOTPRINT OF THE STURCTURES.
6. AN IMPERMEABLE CLAY KEY WALL IS TO BE FOUNDED ON THE IMPERMEABLE IN SITU MATERIAL AT THE BASE OF THE STRUCTURE TO PREVENT TUNNELLING UNDER THE STRUCTURES.
7. THE CORE OF THE INTERVENTIONS IS TO BE CONSTRUCTED WITIH IMPERMEABLE CLAY MATERIAL OR ALTERNATIVELY MIXING THE IN SITU MATERIAL WITH A 5% BENTONITE MIXTURE.
8. MATERIAL IS TO BE MOISTENED AND COMPACTED IN 150mm LAYERS.
9. TOPSOIL AND VEGETATION IS TO BE REPLACED ON THE STRUCTURE AT THE END OF CONSTRUCTION.

aurecon
www.aurecongroup.com
GroundTruth
Water, Wetlands and Environmental Engineering

CLIENT: Working for Wetlands

| REV | DATE | REVISION DETAILS | APPROVED |
|---|---|---|---|
| A | 14/01/2019 | DRAFT FOR REHAB PLAN | T. PIKE |
| | | | |
| | | | |
| | | | |

| SCALE | SIZE |
|---|---|
| NTS | A3 |

DRAWN: K. MNCWABE
DESIGNED: R. DOMLEO
CHECKED: T.PIKE

DRAFT FOR REHAB PLAN

APPROVED
ENGINEER
DATE 08/02/2019
REGISTRATION No. 20130774

| | |
|---|---|
| PROJECT | WORKING FOR WETLANDS PROGRAMME 2017-2020 |
| PROVINCE - PROJECT AREA | KWAZULU NATAL - ISIMANGALISO |
| INTERVENTION DESCRIPTION | EARTHEN BERM |

| DRAWING No. | QUATERNARY No. | | WETLAND No. | | INTERVENTION No. | | PAGE NUMBER | | REV |
|---|---|---|---|---|---|---|---|---|---|
| | W32H | – | 04 | – | 207 | – | 01 OF 01 | – | A |

Plot Date: 8/2/2019 1:53:39 PM Office: GTSER Filename: Z:\GTE\GTE582_WFWET 2018\KZN\ISIMANGALISO\PLANNING 2018\DRAWINGS\ISIMANGALISO.DWG

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Berm removal |
| Rehabilitation Objectives | Excavate berm and backfill adjacent drain to reinstate diffuse flows through the wetland. |
| Latitude (D°M'S") | Start: 28°20'14.59"S<br>End: 28°20'15.19"S |
| Longitude (D°M'S") | Start: 32°22'49.58"E<br>End: 32°22'51.63"E |

## Location Photograph: W32H-04-208-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove berm | m³ | R 397.00 | 68.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate berm and backfill adjacent depression

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Berm removal |
| Rehabilitation Objectives | Excavate berm and backfill adjacent drain to reinstate diffuse flows through the wetland. |
| Latitude (D°M'S") | Start: 28°20'14.76"S<br>End: 28°20'15.24"S |
| Longitude (D°M'S") | Start: 32°22'49.41"E<br>End: 32°22'50.99"E |

## Location Photograph: W32H-04-209-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove berm | m³ | R 397.00 | 53.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate berm and backfill adjacent depression

Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Berm removal |
| Rehabilitation Objectives | Excavate berm and backfill adjacent drain to reinstate diffuse flows through the wetland. |
| Latitude (D°M'S") | Start: 28°20'14.98"S<br>End: 28°20'15.42"S |
| Longitude (D°M'S") | Start: 32°22'49.28"E<br>End: 32°22'50.88"E |

Location Photograph: W32H-04-210-00

Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove berm | m³ | R 397.00 | 53.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate berm and backfill adjacent depression

Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Reshaping embankment |
| Rehabilitation Objectives | Slope out embankment to create gentler gradient to promote diffuse flows through the wetland. |
| Latitude (D°M'S") | Start: 28°20'15.80"S<br>End: 28°20'16.03"S |
| Longitude (D°M'S") | Start: 32°22'48.50"E<br>End: 32°22'49.38"E |

Location Photograph: W32H-04-211-00

Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Reshaping | m³ | R 397.00 | 27.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Slope out embankment and use material for creation of berm feature for intervention W32H-04-207-00

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Old stream crossing removal |
| Rehabilitation Objectives | Excavate old crossing to unblock riparian channel and reinstate flows down the channel. |
| Latitude (D°M'S") | Start: 28°19'37.00"S<br>End: 28°19'37.34"S |
| Longitude (D°M'S") | Start: 32°22'07.49"E<br>End: 32°22'06.16"E |

## Location Photograph: W32H-05-201-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove stream crossing | $m^3$ | R 397.00 | 340.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old stream crossing and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to reinstate hydrological processes within the wetland. |
| Latitude (D°M'S") | Start: 28°19'37.93"S<br>End: 28°19'38.26"S |
| Longitude (D°M'S") | Start: 32°22'04.47"E<br>End: 32°22'03.15"E |

## Location Photograph: W32H-05-202-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 73.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to reinstate hydrological processes within the wetland. |
| Latitude (D°M'S") | Start: 28°19'39.33"S<br>End: 28°19'41.74"S |
| Longitude (D°M'S") | Start: 32°21'59.81"E<br>End: 32°21'51.66"E |

## Location Photograph: W32H-05-203-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 375.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to reinstate hydrological processes within the wetland. |
| Latitude (D°M'S") | Start: 28°19'52.60"S<br>End: 28°19'57.92"S |
| Longitude (D°M'S") | Start: 32°21'43.10"E<br>End: 32°21'51.09"E |

## Location Photograph: W32H-05-204-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 850.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to move the hydrological regime of the wetland towards a more natural state. |
| Latitude (D°M'S") | Start: 28°20'05.06"S<br>End: 28°20'04.46"S |
| Longitude (D°M'S") | Start: 32°22'14.51"E<br>End: 32°22'11.61"E |

## Location Photograph: W32H-06-201-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 333.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to eliminate open water spaces and allow diffuse flow throughout the wetland. |
| Latitude (D°M'S") | Start: 28°20'06.21"S<br>End: 28°20'07.28"S |
| Longitude (D°M'S") | Start: 32°22'18.13"E<br>End: 32°22'31.39"E |

## Location Photograph: W32H-07-201-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 235.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to eliminate open water spaces and allow diffuse flow throughout the wetland. |
| Latitude (D°M'S") | Start: 28°20'10.86"S<br>End: 28°20'07.87"S |
| Longitude (D°M'S") | Start: 32°22'34.53"E<br>End: 32°22'23.83"E |

## Location Photograph: W32H-07-202-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 860.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°21'46.99"S<br>End: 28°21'45.60"S |
| Longitude (D°M'S") | Start: 32°23'04.67"E<br>End: 32°22'57.64"E |

## Location Photograph: W32H-08-201-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 530.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Berm removal and backfill drain |
| Rehabilitation Objectives | Excavate old road and backfill drain to promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°21'45.77"S<br>End: 28°21'45.90"S |
| Longitude (D°M'S") | Start: 32°22'57.17"E<br>End: 32°22'58.16"E |

## Location Photograph: W32H-08-202-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove berm | $m^3$ | R 397.00 | 35.0 | |
| Earthworks - Backfill drain | $m^3$ | R 840.00 | 35.0 | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate berm and backfill adjacent drains

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°20'42.59"S<br>End: 28°20'41.89"S |
| Longitude (D°M'S") | Start: 32°22'35.77"E<br>End: 32°22'31.33"E |

## Location Photograph: W32H-09-201-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 315.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°19'06.93"S<br>End: 28°19'06.88"S |
| Longitude (D°M'S") | Start: 32°25'57.99"E<br>End: 32°26'00.91"E |

## Location Photograph: W32H-10-201-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 180.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and use spoil material for intervention W32H-10-202-00 and spoil excess at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Backfill road |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°19'07.02"S<br>End: 28°19'06.97"S |
| Longitude (D°M'S") | Start: 32°25'57.26"E<br>End: 32°25'58.25"E |

## Location Photograph: W32H-10-202-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Earthworks - Backfill road | m³ | R 840.00 | 45.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Backfill road with spoil material from intervention W32H-10-201-00

### Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°19'19.31"S<br>End: 28°19'12.49"S |
| Longitude (D°M'S") | Start: 32°25'46.10"E<br>End: 32°25'46.08"E |

### Location Photograph: W32H-11-201-00

### Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | m³ | R 397.00 | 650.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°19'26.88"S<br>End: 28°19'20.99"S |
| Longitude (D°M'S") | Start: 32°25'46.03"E<br>End: 32°25'46.13"E |

## Location Photograph: W32H-11-202-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | m³ | R 397.00 | 510.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material in road scar (intervention W32H-11-203-00)

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Backfill road scar |
| Rehabilitation Objectives | Backfill road scar to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°19'26.95"S<br>End: 28°19'29.87"S |
| Longitude (D°M'S") | Start: 32°25'46.02"E<br>End: 32°25'45.86"E |

## Location Photograph: W32H-11-203-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Earthworks - Backfill road scar | $m^3$ | R 840.00 | 70.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Backfill road scar in hill to natural ground level using spoil from road removal in intervention W32H-11-202-00

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Remove soil stockpile and backfill drain |
| Rehabilitation Objectives | Backfill drain so as to reinstate a natural flow direction in the southern portion of the wetland. |
| Latitude (D°M'S") | Start: 28°18'14.31"S<br>End: 28°18'08.90"S |
| Longitude (D°M'S") | Start: 32°26'31.41"E<br>End: 32°26'18.25"E |

## Location Photograph: W32H-12-201-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove soil stockpile | $m^3$ | R 397.00 | 1700.0 | |
| Earthworks - Backfill drain | $m^3$ | R 840.00 | 1700.0 | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate material adjacent to drain and from soil stockpile for backfilling drain

## Details

| | |
|---|---|
| Intervention | Isimangaliso |
| Designer | T. Pike |
| Design Date | 2019 FEB |
| Type | New |
| Description | Road removal |
| Rehabilitation Objectives | Excavate old road to surrounding natural ground level to clear old forestry disturbances and promote diffuse flows throughout the wetland. |
| Latitude (D°M'S") | Start: 28°19'32.28"S<br>End: 28°19'32.03"S |
| Longitude (D°M'S") | Start: 32°25'30.84"E<br>End: 32°25'19.37"E |

## Location Photograph: W32H-13-201-00

## Bill of Quantities

| Item | Units | Rate | Quantity | Total |
|---|---|---|---|---|
| Excavation - Remove road | $m^3$ | R 397.00 | 780.0 | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Total | | | | |

General construction notes as set out in the Construction Environmental Management Programme apply, along with all notes shown on design drawings and standard details. Where there is a conflict, the notes on design drawings apply.

The following site specific mitigation measures shall be implemented:

Excavate old road and spoil material at designated spoil pit

# Appendix D

# ENVIRONMENTAL AUTHORISATION

A Basic Assessment Report has been submitted to the Department of Environmental Affairs for consideration with an application for Environmental Authorisation (EA). Should the Department issue a positive decision, the EA will be included in this section prior to the Rehabilitation Plan being implemented. No construction may occur without an EA.

Also included in this Appendix is the decision from the responsible heritage authority. All requirements included in this decision must be adhered to.

**KWAZULU-NATAL**
**AMAFA AND RESEARCH INSTITUTE**

**ISIKHUNGO SAMAFA NOCWANINGO**
**SAKWAZULU-NATALI**

**KWAZULU-NATAL**
**AMAFA- EN NAVORSINGSINSTITUUT**

PO Box 2685
Pietermaritzburg 3200

Tel: 033 394 6543
Fax: 033 394 6552

email: bernadetp@amafapmb.co.za
Website: www.heritagekzn.co.za

**Project Title: Working For Wetlands- KwaZulu Natal**
Our Ref: 11908

Enquiries: Bernadet Pawandiwa
Tel: 033 394 6543
Email: bernadetp@amafapmb.co.za
Case ID: 11908

Date: Tuesday June 25, 2019



---

## FINAL COMMENT

**IN TERMS OF SECTION 38(8) OF THE NATIONAL HERITAGE RESOURCES ACT (ACT 25 OF 1999) AND THE KWAZULU-NATAL AMAFA AND RESEARCH INSTITUTE ACT (ACT 05 OF 2018)**

Attention: Working for Wetlands Programme

**RE: Working For Wetlands- KwaZulu Natal**

Thank you for the opportunity to comment on this proposal as outlined above. The case has been considered and the development can proceed as planned as it involves rehabilitation of wetland areas.

The KwaZulu Natal Amafa and Research Institute,(Formerly Amafa aKwaZulu Natal, Heritage KwaZulu Natal, Erferenis KwaZulu Natal), has no objection to the proposed development within limits of the stipulated conditions and mitigation measures.
You are also required to adhere to the below-mentioned standard conditions:
Conditions:

1. The KwaZulu Natal Amafa and Research Institute should be contacted if any heritage objects are identified during earth-moving activities and all development should cease until further notice.
2. No structures older than sixty years or parts thereof are allowed to be demolished altered or extended without a permit from the KwaZulu Natal and Amafa Research Institute.
3. Under no circumstances may any heritage material be destroyed or removed from site unless under direction of the KwaZulu Natal and Amafa Research Institute and a heritage specialist.
4. Should any remains be found on site that is potentially human remains, the South African Police Service (SAPS) should also be contacted. No SAPS official may disturb or exhume such remains, without the necessary permission from the KwaZulu Natal and Amafa Research Institute.
5. No activities are allowed within 50m of a site, which contains rock art.
6. Sources of all natural materials (including topsoil, sands, natural gravels, crushed stone, asphalt, etc.) must be obtained in a sustainable manner and in compliance with the heritage legislation.

Failure to comply with the requirements of the National Heritage Resources Act and the KwaZulu Natal Amafa and Research Institute Act could lead to legal action being instituted against the applicant. Should you have any further queries, please contact the designated official using the case number quoted above in the case header.

Yours faithfully

Bernadet Pawandiwa
Senior Heritage Officer

KwaZulu Natal Amafa and Research Institute

Terms & Conditions:
1. This approval does not exonerate the applicant from obtaining local authority approval or any other necessary approval for proposed work.
2. If any heritage resources, including graves or human remains, are encountered they must be reported to the Institute immediately.
3. The Institute reserves the right to request additional information as required.

# APPENDIX E

# LANDOWNER AGREEMENTS

WFW 001

SOUTH AFRICAN
national
biodiversity
institute
SANBI

# South African National Biodiversity Institute
# Working for Wetlands Programme

## Wetlands Survey and Inspection Consent

| Property Details | |
|---|---|
| **Property Type:** | iSimangaliso Wetland Park |
| **Farm Name:** | Kleinspan & Tshanetshe (iSimangaliso) |
| **Surveyor-General Key:** | |
| **Province:** | KZN |
| **Unique Wetland Number:** | |

| Owner Details | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Owner Name:** *(Full Names/Full Registered Name)* | | | | | | | | |
| **Person Type:** | | Company | | Close corporation | | Trust | | Natural person |
| **Registration/Identity Number:** | *(Where applicable. For a trust, attach a copy of the latest letters of trusteeship issued by the Master of the High Court.)* | | | | | | | |
| **Owner's chosen address for delivery of notices and documents:** | Postal Address : P/Bag X05 St. Lucia 3936. | | | | Physical Address : The Dredger Harbor St. Lucia | | | |

I/We hereby consent to the Working for Wetlands Programme of the SA National Biodiversity Institute ("SANBI") and its appointed implementers undertaking a wetland survey and viability study, at no cost to myself, to identify possible work on my/our property for the Kleinspan & Tshanetshe Project during the month of August 2010
I/We hereby agree to undertake a joint inspection of the property, at the request of SANBI. I/we hereby give ~~unhindered~~ access* to surveyors to conduct the wetland survey and viability study, on the property described above of which I am the owner. Access to my/our property will be subject to prior arrangement by SANBI or its appointed implementers.

| | | | |
|---|---|---|---|
| **Name** | AP Zaloumis | **Position** | CEO |
| **Signature** | | **Date** | |

| **Please fax or post this form to:** | **With a copy to:** |
|---|---|
| The Planning, Monitoring and Evaluation Manager,<br>Working for Wetlands, SA National Biodiversity Institute<br>Private Bag X101, PRETORIA, 0001,<br>Telephone: (012) 843 5200, Facsimile: (086) 555 9838 | |

* Subject to parks rules, instruction from the designated iSimangaliso official Mr Carl Myhill & requirement to inform him two weeks prior to the proposed survey. The scope of works for the proposed survey also require our approval.

WFW 002

SOUTH AFRICAN national biodiversity institute SANBI

# South African National Biodiversity Institute
# Working for Wetlands Programme

## Property Inspection
## Prior to Wetland Rehabilitation

| Property Details | |
|---|---|
| **Property Type:** | |
| **Registration Division:** | |
| **Farm Number:** | |
| **Portion Number:** | |
| **Farm Name:** | Kleinspan & Tshanetshe (iSimangaliso) |
| **Surveyor-General Key:** | N/A |
| **Province:** | KZN |
| **Unique Wetland Number:** | N/A |

| Intervention Number |
|---|
| *(Where there is more than one intervention on different parts of the same property, please complete a separate form for each intervention.)* |

| Owner Details | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Owner Name:** (Full Names/Full Registered Name) | | | | | | | | |
| **Person Type:** | | Company | | Close corporation | | Trust | | Natural person |
| **Registration/Identity Number:** | *(Where applicable. For a trust, attach a copy of the latest letters of trusteeship issued by the Master of the High Court.)* | | | | | | | |
| **Owner's chosen address for delivery of notices and documents:** *(Same as on WFW001)* | Postal Address : P/Bag X05 St Lucia 3936 | | | | Physical Address : The Dredger Harbour St. Lucia | | | |

| **Date of Inspection** | 10 & 11 Aug 2010 |
|---|---|

# Property Inspection Prior to Wetland Rehabilitation

*Mark the appropriate box with an X. Where necessary provide further information.*
*If a listed item does not apply to the farm/area where rehabilitation is being done, please state in the Remarks column.*

| Condition of : | Present | Very Poor | Poor | Good | Excellent | Remarks |
|---|---|---|---|---|---|---|
| Roads | | | | ✓ | | |
| Footpaths | | | | | | |
| Cattle Tracks | | | | | | |
| | | | | | | |
| Store Rooms/Buildings *(if to be used by contractors)* | | | | | | |
| Interior/Exterior : | | | | | | N/A. |
| Doors | | | | | | |
| Windows | | | | | | |
| Paint | | | | | | |
| | | | | | | |
| Erosion | | | | | | |
| | | | | | | |
| Fencing : | | | | ✓ | | |
| Fencing wire | | | | ✓ | | |
| Fencing posts | | | | ✓ | | |
| Fencing gates | | | | ✓ | | |
| | | | | | | |
| Litter | | | | | | NIL |
| | | | | | | |
| Watering holes | | | | | | X |
| Water collection points | | | | | | X |
| Water houses/pumps | | | | | | X |
| | | | | | | |
| River/stream crossings | | | | ✓ | | |
| | | | | | | |
| Invasive alien plants | ✓ | | | | | |
| | | | | | | |
| Fire breaks | ✓ | | | | | |
| | | | | | | |
| Other: *(Please state)* | | | | | | |
| | | | | | | |
| | | | | | | N/A. |
| | | | | | | |
| | | | | | | |

| Landowner | | Provincial Coordinator | | | |
|---|---|---|---|---|---|
| Name | | Name | | Name | |
| Signature | | Signature | | Signature | |
| Date | | Date | | Date | |

**Photos and additional information:**

N/A.

WFW 003

SOUTH AFRICAN
national
biodiversity
institute
S A N B I

# South African National Biodiversity Institute
# Working for Wetlands Programme

## Wetlands Rehabilitation Activities Consent

| Property Details | |
|---|---|
| **Property Type:** | |
| **Registration Division:** | |
| **Farm Number:** | |
| **Portion Number:** | |
| **Farm Name:** | |
| **Surveyor-General Key:** | |
| **Province:** | KZN. |
| **Unique Wetland Number:** | |

| Owner Details | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Owner Name:** (Full Names/Full Registered Name) | | | | | | | | |
| **Person Type:** | | Company | | Close corporation | | Trust | | Natural person |
| **Registration/Identity Number:** | (Where applicable. For a trust, attach a copy of the latest letters of trusteeship issued by the Master of the High Court.) | | | | | | | |
| **Owner's chosen address for delivery of notices and documents:** | Postal Address : P/Bag X05 St. Lucia 3936 | | | | Physical Address : The Dredger Harbour St. Lucia. | | | |

| **Project Name:** | |
|---|---|

I/We hereby consent to the Working for Wetlands Programme of the SA National Biodiversity Institute and its appointed consultants to undertake the necessary legal processes under the National Water Act (36 of 1998) and the National Environmental Management Act, as amended (107 of 1998) in order to obtain the requisite authorizations* I/We further consent to the Working for Wetlands Programme of the SA National Biodiversity Institute and its appointed implementers undertaking the wetland rehabilitation activities listed in annexure "WFW 003A" attached hereto, for the project referred to above, subject to my/our approval of the activities detailed in the relevant Wetland Rehabilitation Plan, on the property described above of which I am the owner.

| | | | |
|---|---|---|---|
| **Name** | Zaloumis AV | **Position** | CEO |
| **Signature** | [signature] | **Date** | |

| **Please fax or post this form to:** | **With a copy to:** |
|---|---|
| The Planning, Monitoring and Evaluation Manager, Working for Wetlands, SA National Biodiversity Institute, Private Bag X101, PRETORIA, 0001,<br>Telephone: (012) 843 5200, Facsimile: (086) 555 9838 | |

* subject to iSimangaliso approving each document and application before it is made.

WFW 003A

# Wetland rehabilitation activities to be carried out

[Note: To be added to/amended as appropriate]
** Please note that new EIA regulations may be published from time to time and the listed activities provided below will be updated as required by the legal requirements at the time.

| Activity number[1]. | Activity description |
|---|---|
| 1(d) | The construction of facilities or infrastructure, including associated structures or infrastructure, for resorts, lodges, hotels or other tourism and hospitality facilities in a protected area contemplated in the National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003). |
| 1(k) | The construction of facilities or infrastructure, including associated structures or infrastructure, for the bulk transportation of sewage and water, including storm water, in pipelines with - **(i)** an internal diameter of 0,36 metres or more; or **(ii)** a peak throughput of 120 litres per second or more. |
| 1(m) | The construction of facilities or infrastructure, including associated structures or infrastructure, for any purpose in the one in ten year flood line of a river or stream, or within 32 metres from the bank of a river or stream where the flood line is unknown, excluding purposes associated with existing residential use, but including - (i) canals; (ii) channels; (iii) bridges; (iv) dams; and (v) weirs. |
| 1(v) | The construction of facilities or infrastructure, including associated structures or infrastructure, for advertisements as defined in classes 1(a), 1(b), 1(c), 3(a), 3(b), 3(l) of the South African Manual for Outdoor Advertising Control. |
| 3 | The prevention of the free movement of sand, including erosion and accretion, by means of planting vegetation, placing synthetic material on dunes and exposed sand surfaces within a distance of 100 metres inland of the high-water mark of the sea. |
| 4 | The dredging, excavation, infilling, removal or moving of soil, sand or rock exceeding 5 cubic metres from a river, tidal lagoon, tidal river, lake, in-stream dam, floodplain or wetland. |
| 5 | The removal or damaging of indigenous vegetation of more than 10 square metres within a distance of 100 metres inland of the high-water mark of the sea. |
| 6 | The excavation, moving, removal, depositing or compacting of soil, sand, rock or rubble covering an area exceeding 10 square metres in the sea or within a distance of 100 metres inland of the high-water mark of the sea. |
| 11 | The decommissioning of a dam where the highest part of the dam wall, as measured from the outside toe of the wall to the highest part of the wall, is 5 metres or higher or where the high-water mark of the dam covers an area of more than 10 hectares. |
| 12 | The transformation or removal of indigenous vegetation of 3 hectares or more or of any size where the transformation or removal would occur within a critically endangered or an endangered ecosystem listed in terms of section 52 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004). |

NO

[1] Activity number in Regulation 386 published in GN No. 386 of 21 April 2006 of the NEMA.

WFW 004

# South African National Biodiversity Institute
# Working for Wetlands Programme

SOUTH AFRICAN national biodiversity institute
SANBI

## Terms and conditions for carrying out wetland rehabilitation on private land by or on behalf of the Working for Wetlands Programme of the South African National Biodiversity Institute

## Definitions

1. In these terms and conditions, unless the context otherwise indicates:

   1.1 "**SANBI**" means the South African National Biodiversity Institute, established, organised and existing under the National Environmental Management: Biodiversity Act, No. 10 of 2004, and includes its Working for Wetlands Programme;

   1.2 the "**Wetland Rehabilitation Plan**" means the plan for the rehabilitation of the wetland prepared by or on behalf of SANBI to which these terms and conditions are attached;

   1.3 the "**Property**" means the immovable property described in the Wetland Rehabilitation Plan on which the wetland is situated and which wetland is proposed to be rehabilitated in terms of the Wetland Rehabilitation Plan;

   1.4 the "**Landowner**" means the owner of the Property;

   1.5 the "**Rehabilitation Works**" means all work required for the rehabilitation of the wetland on the Property which is set out in the Wetland Rehabilitation Plan;

   1.6 the "**In Principle Consent**" means any consent (under the National Water Act as well as the National Environmental Management Act, as amended) in principle given by the Landowner to SANBI prior to the preparation of the Wetland Rehabilitation Plan;

   1.7 "**Contractor/s**" means the independent person/s or entity/ies contracted by SANBI to carry out any survey of the Property and to perform or to assist with the performance of the Rehabilitation Works, and includes workers employed by the Contractor.

## Agreement to Rehabilitation Works

2. The Landowner hereby agrees to the Rehabilitation Works being undertaken by or on behalf of SANBI on the basis set out in the Wetland Rehabilitation Plan, subject to these terms and conditions. This agreement constitutes the Landowner's consent to the Wetland Rehabilitation Plan,* as contemplated in any In Principle Consent. By this agreement, the Landowner also consents to ~~all~~ work that may have been done by or on behalf of SANBI for the Rehabilitation Works on these terms and conditions, prior to the date of signature of these terms and conditions by the Landowner. writing

3. SANBI will not charge the owner for its costs in preparing for and carrying out the Rehabilitation Works provided that the Landowner complies with all his/her obligations under these terms and conditions up to the date of completion of the Rehabilitation Works and at all times thereafter. However, the Landowner will be required to provide the support

* subject to the landowners term & conditions issued from time to time

and/or contributions to the Rehabilitation Works listed in the form attached hereto marked "WFW 004A".

## Before the commencement of the Rehabilitation Works

4. The parties record that SANBI's representative has conducted an inspection of the Property with the Landowner to determine the general condition of the Property with regard to fencing, litter, erosion, quality of roads and any other aspects that may be affected by the Rehabilitation Works, and that the Wetland Rehabilitation Plan has been prepared on the basis of the results of this inspection and in consultation with the Landowner, which report has been completed and signed by SANBI's representative and the Landowner.

5. The Landowner is aware that SANBI may in its absolute discretion appoint contractor/s to assist or undertake the Rehabilitation Works and will determine the terms and conditions under which the contractors are contracted, and will be notified in writing of any contractors so appointed. iSimangaliso needs to approve these appointees before work commences.

6. The Landowner shall provide SANBI or the contractors with ~~unhindered~~ access to the land as necessary for the completion or performance of the Rehabilitation Works. subject to iSimangaliso conditions and rules.

7. SANBI shall notify the Landowner of the approximate date on which Rehabilitation Works are likely to commence.

8. Should the Rehabilitation Works not commence within 6 (six) months of the Landowner being so notified, SANBI may, in its sole discretion, decide not to proceed with the Rehabilitation Works and, upon written notice to the Landowner to that effect, shall have no further obligation to do so.

9. In the event that the Rehabilitation Works are to be performed on a Property which has two or more land owners, or on adjoining land owned by different land owners, the performance of the Rehabilitation Works is subject to SANBI obtaining the consent to perform the Rehabilitation Works of all the applicable land owners. In the event that SANBI is unable to obtain consent from all the applicable land owners, SANBI reserves the right to terminate or reduce the scope of the Rehabilitation Works.

## In the course of the Rehabilitation Works

10. SANBI will be responsible for all negotiations and dealings with the contractors to the extent that this may be necessary.

11. ~~The Landowner~~ SANBI must take all reasonable precautions to prevent injury to persons doing Rehabilitation Works on the land other than injuries that would normally be associated with the carrying out of the Rehabilitation Works.

12. SANBI or its contractors will not be liable for any acts or omissions in the execution of the Rehabilitation Works, whether negligent or not.

13. The Landowner indemnifies SANBI and its contractors from all claims from whatsoever cause arising resulting from the execution of the Rehabilitation Works except where those claims arise from the fraudulent or wilful conduct of SANBI or its contractors.

14. The Landowner must attend all joint inspections of which the Landowner is a due notified. ~~In the event of the Landowner failing to attend any inspection despite having prior notice thereof, the Landowner shall abide by any conclusions reached by SANBI pursuant to such an inspection.~~ If, after any inspection, the parties agree that the Rehabilitation Works in an area is incomplete or inconsistent with the scope of the Rehabilitation Works as set out in the Wetland Rehabilitation Plan and that further work is required to complete the task,

SANBI will procure the completion of the Rehabilitation Works so that it is in accordance as set out in the Wetlands Rehabilitation Plan.

15. The Landowner shall not unnecessarily hinder or obstruct SANBI or its contractors in the execution of the Rehabilitation Works at any stage of the Rehabilitation Works.

16. The *Landowner shall notify* SANBI *of any fires that occur during the period* of the Rehabilitation Works and shall endeavour to minimise the impact of such fires on the Rehabilitation Works. SANBI acknowledges that iSimangaliso is required to burn from time to time as part of its conservation management process.

17. The performance of the Rehabilitation Works is at all times subject to sufficient budgeted funding allocated to that particular project in any given financial period. In the event that SANBI is unable to commence or continue with the Rehabilitation Works due to unforeseen circumstances or due to financial constraints on that particular project in any given financial period, SANBI may at any time before or during the commencement of the Rehabilitation Works cause the postponement of the Rehabilitation Works until such time as SANBI is again able to resume the Rehabilitation Works, or to reduce the scope of the Rehabilitation Works. Where there is a ecological risk to the wetland systems, SANBI will mitigate this risk, regardless of budget limitations.

## When the works have been completed

18. SANBI will notify the Landowner of completion of the Rehabilitation Works. SANBI or its contractor or authorised representative will as soon as possible thereafter carry out a joint inspection to determine the effectiveness of the Rehabilitation Works and shall furnish the Landowner with a certificate of completion of the Rehabilitation Works.

19. If SANBI is of the view in concurrence with iSimangaliso that the Rehabilitation Works has been completed to an acceptable standard, the Rehabilitation Works will be deemed to be completed ~~and the Landowner will be advised accordingly~~.

20. SANBI will inform the Landowner of the further maintenance (including the removal of alien vegetation) and rehabilitation measures that would mitigate problems that have been assessed in the quaternary catchment and recommend possible maintenance measures to be undertaken by the Landowner, with identified support, where applicable.

21. If the Landowner is dissatisfied with the Rehabilitation Works, the Landowner shall notify SANBI within 14 days of completion of the cause of dissatisfaction. If the Landowner fails to give such a notification to SANBI the Rehabilitation Works will be deemed to have been done in accordance with the Wetlands Rehabilitation Plan and to the full satisfaction of the Landowner. period mentioned

22. The Landowner shall not do anything (whether wilfully, negligently or otherwise) unless required for the [illegible] ecological processes of the law that:

22.1 damages or otherwise comprises the integrity and effectiveness of the rehabilitative structures forming part of the Rehabilitation Works, or

22.2 degrades the wetland being rehabilitated on the Property, nor allow any other person to do so.

The Landowner shall not for one year after the completion of the works effect any modifications and/or repairs to the rehabilitative structures without first having given SANBI prior written notice thereof and SANBI not, within 30 days of the date of that notice, having objected to those modifications and/or repairs. If SANBI does not object within the said 30 day period, the Landowner may proceed with such modifications and/or repairs.

In the event that the Landowner breaches his/her obligations in terms of this clause 22, SANBI shall be entitled to recover all of the costs of the Rehabilitation Works from the Landowner.

it becomes aware

23. The Landowner shall notify SANBI immediately in the event that the rehabilitative structures are destroyed or are damaged or require any material repair, and shall report to SANBI on the general state of the rehabilitative structures on SANBI's reasonable request.

24. The contract governed by these terms and conditions does not absolve the Landowner from complying with all applicable laws and regulations relating to the maintenance of wetlands on the Property. The Landowner shall, accordingly, observe and comply with all applicable laws and regulations in respect of the wetlands on the Property and the Rehabilitation Works and with all ~~his/her~~ obligations in terms of these terms and conditions.

25. The Landowner shall bind any lessees or occupants of the Property and his/her successors-in-title to the Property to the terms of the contract governed by these terms and conditions.

## Addresses for Service and Notices

26. The parties choose *domicilium citandi et executandi* for all purposes under these terms and conditions, including for the giving of any notice to the other of them in respect of the Rehabilitation Works and/or otherwise under these terms and conditions:

| | |
|---|---|
| **The Landowner:** | at the Property<br><br>with a copy to any other address which may have been given for the Landowner in the In Principle Consent; |
| **SANBI:** | c/o Working for Wetlands<br>Pretoria National Botanical Gardens<br>2 Cussonia Avenue<br>Brummeria<br>0184<br>PRETORIA |

Either party may change his/her/its *domicilium citandi et executandi* by 14 (fourteen) days' prior written notice to the other of them, citing the name of the project which appears in the In Principle Consent.

All notices in terms of these terms and conditions shall be sent by registered post.

## Dispute Resolution

27. If any dispute or difference shall arise between the parties concerning this Agreement, such dispute or difference shall be referred to mediation. The mediation shall be conducted in private by a sole mediator who is an independent person selected by the parties or, in the event that the parties cannot agree on a mediator, or if the selected mediator cannot perform his functions, a mediator or replacement mediator appointed by the Arbitration Foundation of South Africa (AFSA). The mediator may not make any decision which is binding upon the parties concerning the resolution of the dispute, the resolution of the dispute depending solely upon the parties achieving agreement. The parties shall bear the fees and costs of the mediator and the costs of the venue in equal shares.

The mediation will be terminated upon agreement in writing between the parties, or upon one or more parties withdrawing, or the mediator informing the parties that, in his opinion, no useful purpose will be achieved by continuing the mediation, or in the event of an agreement to resolve the dispute not being reached within thirty days of the first meeting with the mediator.

Should the mediation not have induced a settlement, any party to the dispute may, within fourteen days after receipt of the mediator's opinion, refer the dispute or difference to arbitration before an arbitrator nominated by the parties or, failing agreement between them within 7 (seven) days after the arbitration has been demanded, be an attorney or advocate of at least 10 (ten) years experience appointed by AFSA. The arbitrator shall have full and free discretion with regard to the proceedings. The arbitrator's decision shall be final and binding on the parties. The arbitrator may make an award as to his costs.

The provisions of the Arbitration Act, 42 of 1965 (as may be amended or replaced from time to time), shall apply to this arbitration.

The provisions of this clause 27 shall not debar either party from applying for or obtaining urgent interim relief from any competent Court.

Regardless of the outcome of the above, iSimangaliso reserves the right to have the matter dealt with in court. Z

## General provisions

28. No variation of, or addition to or agreed cancellation of, these terms and conditions shall be of any force or effect unless it is reduced to writing and signed by or on behalf of the parties.

29. No waiver or indulgence by either of the parties of whatsoever nature shall be of any force of effect, including a waiver or indulgence in respect of this clause, unless it is reduced to writing and signed by and on behalf of the parties.

30. If any particular provision and/or term of these terms and conditions are found to be defective or unenforceable or is cancelled for any reason (whether by any competent Court or otherwise) then the remaining provisions and/or terms shall continue to be of full force and effect. Each provision and/or term of these terms and conditions shall accordingly be construed as entirely separate and separately enforceable in the widest sense from the other provisions and/or terms hereof.

AP Zaloumis CEO

AGREED TO BY THE LANDOWNER BY HIS/HER EXECUTION OF THESE TERMS AND CONDITIONS at St Lucia on ________________ 20___

in the presence of the undersigned witnesses:

### As witness

| | | | |
|---|---|---|---|
| **Name** | | **Name** | |
| **Capacity** | | **Capacity** | |
| **Signature** | | **Signature** | |
| **Date** | | **Date** | |

**Details of support and/or contributions to be provided by landowner :**

# APPENDIX F

# ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPR)

# WORKING FOR WETLANDS PROGRAMME

# CONSTRUCTION ENVIRONMENTAL MANAGEMENT PROGRAMME

**Date: September 2017**
**Version: 5**

***Prepared by:***
*Aurecon South Africa (Pty) Ltd*
*PO Box 494*
*Cape Town*
*8000*

***Prepared for:***
*Working for Wetlands Programme*
*Department of Environmental Affairs:*
*Natural Resource Management*
*Private Bag X447*
*0001*

# REPORT CONTROL

| Document control | | | |
|---|---|---|---|
| **Report title** | Working for Wetlands Programme: Construction Environmental Management Programme | | |
| **Prepared by** | Aurecon South Africa (Pty) Ltd<br>PO Box 494<br>Cape Town<br>8000 | | |
| **On behalf of** | Working for Wetlands Programme (WfWetlands)<br>Department of Environmental Affairs: Natural Resource Management<br>Private Bag X447<br>0001 | | |
| **Client contact** | Ms Franci Gresse<br>Tel: 021 526 9400 | **WfWetlands contact** | Dr Farai Tererai<br>Tel: 012 399 8970 |

| Rev | Date | Author | Reviewer | Verifier | Approver |
|---|---|---|---|---|---|
| 1 | Sept. 2010 | SANBI | N/A | N/A | SANBI |
| 2 | Oct. 2012 | A. Beetge | A. Beetge | A. Beetge | U. Bahadur |
| 3 | July 2015 | Z. Palmer | F. Gresse | A. Beetge | F. Tererai |
| 4 | Nov. 2015 | Z. Palmer | F. Gresse | A. Beetge | F. Tererai |
| 5 | Sept. 2017 | M. Lowies &<br>F. Gresse | F. Gresse | A. Beetge | F. Tererai |

| Approval | | | |
|---|---|---|---|
| **Author signature** | | **Approver signature** | |
| **Name** | | **Name** | |
| **Title** | | **Title** | |
| **Date** | | **Date** | |

# TABLE OF CONTENTS

## *List of Annexures*

**Annexure A:** Basic Code of Conduct / Implementation

**Annexure B:** Site Environmental File & Templates

**Annexure C:** Sensitive Areas

**Annexure D:** Minimum Standards for Construction and Maintenance

**Annexure E:** Curriculum Vitae of EAP

## *List of Figures*

## *List of Tables*

## ACRONYMS

| | |
|---|---|
| **BAR** | Basic Assessment Report |
| **DAFF** | Department of Agriculture, Forestry and Fisheries |
| **DEA** | Department of Environmental Affairs |
| **DWS** | Department of Water and Sanitation |
| **EAP** | Environmental Assessment Practitioner |
| **ECO** | Environmental Control Officer |
| **EMPr** | Construction Environmental Management Programme |
| **EPWP** | Expanded Public Works Programme |
| **GPS** | Global Positioning System |
| **IE** | Implementing Entity |
| **NEMA** | National Environmental Management Act (Act 107 of 1998) |
| **NRM** | Natural Resource Management |
| **PC** | Provincial Coordinator[1] |
| **PDP** | Professional Driving Permit |
| **PIP** | Project Implementation Plan |
| **PPE** | Personal Protective Equipment |
| **PPR** | Project Progress Report |
| **SABS** | South African Bureau of Standards |
| **SAHRA** | South African Heritage Resources Agency |
| **SEP** | Site Environmental File |
| **SETA** | Sector Education and Training Authority |

[1] Also referred to as Assistant Director: Wetlands Programme.

# DEFINITIONS

**Alien species[2]:**

(a) a species that is not an indigenous species; or

(b) an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention.

**Approved:** Means approved in terms of the applicable legal requirements (e.g. NEMA approval/ Environmental Authorisation) and/or has been approved by the WfWetlands Programme's Deputy Director: Planning, Monitoring and Evaluation and/or an authorised representative of the WfWetlands Programme.

**Archaeological[3]**:

(a) material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures;

(b) rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;

(c) wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which the South African Heritage Resource Agency (SAHRA) considers to be worthy of conservation; and

**Auditing[4]:** A systematic, documented, periodic and objective evaluation which provides verifiable findings, in a structured and systematic manner, on:

(a) the level of performance against and compliance of an organisation or project with the provisions of the requisite environmental authorisation or Environmental Management Programme (EMPr) and, where applicable, the closure plan; and

(b) the ability of the measures contained in the EMPr, and where applicable the closure plan, to sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the undertaking of the activity.

**Authority***:* National, regional or local authority, that has a decision-making role or interest in the project.

**Basic Assessment Report (BAR):** A report as described in Regulation 19 of GN R982 (2014, as amended) of the National Environmental Management Act (No. 107 of 1998, as amended) (NEMA).

**Best Management Practice (BMP):** Procedures and guidelines to ensure the effective and appropriate implementation of wetland rehabilitation by WfWetlands implementers.

[2] National Environmental Management: Biodiversity Act (No. 10 of 2004)
[3] National Heritage Resources Act (No. 25 of 1999)
[4] Regulation 34 of GN R982 (2014, as amended) of NEMA

**Cement laden water:** Means water (fresh or wash water) which has been in contact with partially cured concrete/mortar or raw cement product and which contains suspended and dissolved cement solids.

**Commence:** The start of any physical activity, including site preparation and any other activity on site furtherance of a listed activity or specified activity, but does not include any activity required for the purposes of an investigation or feasibility study as long as such investigation or feasibility study does not constitute a listed activity or specified activity.

**Contaminated water:** Means water contaminated by the Implementing Entity's activities such as with hazardous substances, hydrocarbons, paints, solvents and runoff from plant, workshop or personnel wash areas but excludes water containing cement/ concrete or silt.

**Corrective (or remedial) action***:* Reactive response required to address an environmental problem that is in conflict with the requirements of the EMPr. The need for corrective action may be determined through monitoring, audits or management review.

**Dam[5]:** Any barrier dam and any other form of impoundment used for the storage of water, excluding reservoirs.

**Dangerous goods:** Goods containing any of the substances as contemplated in South African National Standard No. 10234, supplement 2008 1.00: designated "*List of classification and labelling of chemicals in accordance with the Globally Harmonized Systems (GHS)"* published by Standards South Africa, and where the presence of such goods, regardless of quantity, in a blend or mixture, causes such blend or mixture to have one or more of the characteristics listed in the Hazard Statements in section 4.2.3, namely physical hazards, health hazards or environmental hazards.

**Decommissioning[6]:** To take out of active service permanently or dismantle partly or wholly, or closure of a facility to the extent that it cannot be readily re-commissioned.

**Dust[7]:** Any material composed of particles small enough to pass through a 1 mm screen and large enough to settle by virtue of their weight into the sampling container from the ambient air.

**Eco-log:** A cylindrical sleeve made from, for example wire mesh, filled with organic material and/or soil used to prevent and/or repair minor erosion.

**Ecosystem services or 'eco services':** The services such as sediment trapping or water supply, supplied by an ecosystem (in this case a wetland ecosystem).

**Endangered species**: Means any indigenous species listed as an endangered species in terms of section 56 of the National Environmental Management Biodiversity Act ((No. 10 of 2004).

**Endemic:** An "endemic" is a species that grows in a particular area (i.e. it is endemic to that region) and has a restricted distribution. It is only found in a particular place. Whether something is endemic or not depends on the geographical boundaries of the area in question and the area can be defined at different scales.

[5] GN R983 (2014, as amended) of NEMA
[6] GN R983 (2014, as amended) of NEMA
[7] National Dust Regulations GN R827 (2013)

**Environment[8]:** Means the surroundings within which humans exist and that are made up of:

i. the land, water and atmosphere of the earth;

ii. micro-organisms, plant and animal life;

iii. any part or combination of i) and ii) and the interrelationships among and between them; and

**iv.** the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

**Environmental Assessment Practitioner (EAP):** The individual responsible for the planning, management and coordination of the environmental impact assessments, strategic environmental assessments, environmental management plans and/or other appropriate environmental instruments introduced through regulations of NEMA.

**Environmental Impact Assessment (EIA):** A study of the environmental consequences of a proposed course of action via the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application.

**Environmental impact:** An environmental change caused by some human act.

**Environmental impact:** Change in an environment resulting from the effect of an activity on the environment, whether positive or negative. Impacts may be the direct consequence of an individual's or organisation's activities or may be indirectly caused by them (DEAT, 1998).

**Erosion:** The loss of soil through the action of water, wind, ice or other agents, including the subsidence of soil.

**Establishment of grass:** Refers to all necessary procedures taken to produce an acceptable cover of specified live grass over an area.

**Gabion:** A structure made of wire mesh baskets filled with regularly sized stones, and used to prevent and/or repair erosion. They are flexible and permeable structures which allow water to filter through them. Vegetation and other biota can also establish in/around the habitat they create.

**Hazard:** Means a source of or exposure to danger.

**Invasive alien species control**:

(a) to combat or eradicate an alien or invasive species; or

(b) where such eradication is not possible, to prevent, as far as may be practicable, the recurrence, re-establishment, re-growth, multiplication, propagation, regeneration or spreading of an alien or invasive species.

**Implementing Entity:** The entity responsible for the construction of WfWetlands rehabilitation interventions by means of various contracted teams.

**Indigenous vegetation[9]:** 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.

[8] NEMA

[9] GN R983 (2014, as amended) of NEMA

**Interested and Affected Parties (I&APs)[10]:**

(a) all persons who, as a consequence of the public participation process conducted in respect of that application, have submitted written comments or attended meetings with the proponent, applicant or EAP;

(b) all persons who have requested the proponent or applicant, in writing, for their names to be placed on the register; c) all organs of state which have jurisdiction in respect of the activity to which the application relates.

**Intervention:** An engineered structure such as a concrete or gabion weir, earthworks or revegetation that that achieves identified objectives within a wetland e.g. raising of the water table within a drainage canal.

**Invasive species[11]:** Means any species whose establishment and spread outside of its natural distribution range-

(a) threaten ecosystems, habitats or other species or have demonstrable potential to threaten ecosystems, habitats or other species; and

(b) may result in economic or environmental harm or harm to human health.

**Listed invasive species:** Any invasive species listed in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of the National Environmental: Biodiversity Act (No. 10 of 2004).[12]

**Maintenance period:** The period after the Establishment Period (Practical Completion), up to and until the end of the Maintenance Period (i.e. a period of 12 months).

**Maintenance[13]:** Means actions performed to keep a structure or system functioning or in service on the same location, capacity and footprint.

**Mine:**

(a) used as a noun-

any excavation in the earth, including any portion under the sea or under other water or in any residue deposit, as well as any borehole, whether being worked or not, made for the purpose of searching for or winning a mineral;

any other place where a mineral resource is being extracted, including the mining area and all buildings, structures, machinery, residue stockpiles, access roads or objects situated on such area and which are used or intended to be used in connection with such searching, winning or extraction or processing of such mineral resource; and

(b) used as a verb-

in the mining of any mineral, in or under the earth, water or any residue deposit, whether by underground or open working or otherwise and includes any operation or activity incidental thereto, in, on or under the relevant mining area.

**Mitigation:** Actions to reduce the impact of a particular activity.

[10] Regulation 42 GN R983 (2014, as amended) of NEMA
[11] National Environmental Management: Biodiversity Act (No. 10 of 2004)
[12] Also refer to GN 864 (2016): Alien and Invasive Species Lists
[13] GN R983 (2014, as amended) of NEMA

**Mitigation[14]:** Means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible;

**Monitoring[15]:** The repetitive and continued observation, measurement and evaluation of environmental criteria to follow changes over a period of time and to assess the efficiency of control measures.

**Nursery conditions**: This refers to the necessary conditions that must be in place for maintaining strong healthy growth in all container plant materials on site. This includes for the protection of all container plants against wind, frost, direct sunlight, pests, disease and drought. It also includes for the provision of adequate and suitable water supply, fertilisers and all other measures necessary to maintain strong and healthy plant growth.

**Offensive odour:** Any smell which is considered to be malodorous or a nuisance to a reasonable person.

**Pollution[16]:** Means any change in the environment caused by substances;

(ii) radioactive or other waves; or

(iii) noise, odours, dust or heat,

emitted from any activity, including the storage or treatment of waste or substances, construction and the provision of services, whether engaged in by any person or an organ of state, where that change has an adverse effect on human health or wellbeing or on the composition, resilience and productivity of natural or managed ecosystems, or on materials useful to people, or will have such an effect in the future.

**Post-construction:** Refers to the period of 12 months after the completion of the construction works, the onset coinciding with the maintenance period.

**Potentially hazardous substance:** Any substance or mixture of substances, product or material declared to be a hazardous substance under section 2(1) of the Hazardous Substance Act (1973).

**Pre-construction**: Refers to the period leading up to the establishment on site by the Implementing Entity.

**Project:** A defined area for which an approved rehabilitation plan exists for the WfWetlands Programme.

**Public Participation Process (PPP):** A process of involving the public in order to identify issues and concerns, and obtain feedback on options and impacts associated with a proposed project, programme or development. Public Participation Process in terms of NEMA refers to a process in which potential interested and affected parties are given an opportunity to comment on, or raise issues relevant to specific project matters.

**Quaternary Catchment:** A fourth order catchment in a hierarchal classification system in which a primary catchment is the major unit and that is also the “principal water management unit in South Africa”[17]

---

[14] GN R983 (2014, as amended) of NEMA
[15] DEAT, 1998
[16] National Environmental Management Act (No. 107 of 1998, as amended)
[17] DWS Groundwater Dictionary. Available online: http://www.dwaf.gov.za/Groundwater/Groundwater_Dictionary/index.html?introduction_quaternary_catchment.htm

**Reasonable:** Means, unless the context indicates otherwise, reasonable in the opinion of the relevant environmental authority.

**Rehabilitation:** Refers to re-instating the driving ecological forces (including hydrological, geomorphological and biological processes) that underlie a wetland, so as to improve the wetland's health and the ecological services that it delivers; and

Restoring processes and characteristics that are sympathetic to and not conflicting with the natural dynamic of an ecological or physical system[18].

**Scarifying**: Loosening the soil in areas which have become hard and compacted and which need to be loosened in order to facilitate revegetation.

**Shaping:** Finishing all slopes which do not form part of the permanent works so that they do not exceed the maximum gradient stipulated in the approved rehabilitation plan.

**Significant impact:** Means an impact that may have a notable effect on one or more aspects of the environment or may result in k with accepted environmental quality standards, thresholds or targets and is determined through rating the positive and negative effects of an impact on the environment based on criteria such as duration, magnitude, intensity and probability of occurrence.

**Silt laden water:** Means water (mostly overland surface runoff) containing a substantial concentration of suspended solids with increased turbidity. Usually occurs as a result of exposed/cleared ground surfaces, concentration of runoff and/or erosion of excavated or imported materials.

**Site:** This is the area described in the approved/authorised rehabilitation plan for the implementation of the rehabilitation measures. Where the area is not demarcated, it will include all adjacent areas, which are reasonably required for the activities for the Implementing Entity, and approved for such use by the Environmental Control Officer (ECO).

**Slope:** The inclination of a surface expressed as 1 unit of rise or fall for so many horizontal units.

**Subsoil**: The soil horizons between the topsoil horizon and the underlying parent rock.

**Topsoil:** The upper soil profile irrespective of the fertility appearance, structure, agriculture potential, fertility and composition of the soil, usually containing organic material and which is colour specific. Also referred to as the "O" and "A" horizons.

**Waste:** Any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes as defined in Schedule 3 the National Environmental Management: Waste Act (No. 59 of 2008)[19]. Examples include construction debris, chemical waste, used oils and lubricants, batteries, metal and wood off-cuts, excess cement/ concrete, wrapping materials, timber, tins and cans, drums, wire, nails, food and domestic waste (e.g. plastic packets and wrappers).

**Watercourse**:

(a) a river or spring;

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

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

[18] Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008
[19] National Environmental Management: Waste Act (No. 59 of 2008, as amended)

A reference to a watercourse includes, where relevant, its bed and banks

**Weir:** A dam-type structure placed across a watercourse to raise the water table of the surrounding ground and trap sediment on the upstream face without preventing water flow. Weirs are generally used to prevent erosion from progressing up exposed gullies.

**Wetland:** Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soils[20] and,

Land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants living there[21].

[20] National Water Act (No. 36 of 1998, as amended)
[21] Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008

This page was left blank intentionally

# 1 INTRODUCTION

## 1.1 Project Overview

Working for Wetlands is a government programme managed by the Natural Resource Management (NRM) Programme of the Department of Environmental Affairs (DEA), and is a joint initiative with the Departments of Water and Sanitation (DWS), and Agriculture and Forestry and Fisheries (DAFF). In this way the programme is an expression of the overlapping wetland-related mandates of the three parent departments, and besides giving effect to a range of policy objectives, it also honours South Africa's commitments under several international agreements, especially the Ramsar Convention on Wetlands.

The programme is mandated to protect pristine wetlands, promote their wise-use and rehabilitate those that are damaged throughout South Africa, with an emphasis on complying with the principles of the Expanded Public Works Programme (EPWP) and using only local Small, Medium and Micro Enterprises (SMMEs). The EPWP seeks to draw significant numbers of unemployed people into the productive sector of the economy, gaining skills while they work and increasing their capacity to earn an income.

## 1.2 Purpose of the EMPr

An Environmental Management Programme (EMPr) is compiled as part of the requisite submissions contained in a Basic Assessment Report (BAR) or Environmental Impact Report (EIR) in order to obtain an Environmental Authorisation (EA) to proceed with a listed activity(ies) as defined in GN R982 (2014, as amended) of the National Environmental Management Act (No. 107 of 1998), as amended. Upon approval of the BAR or EIR and resultant issuing of the EA, the EMPr becomes a legally binding document of which compliance has to audited by an independent and appropriately qualified auditor as per Regulation 34 of GN R982 (2014, as amended).

The EMPr's main purpose is to document general and specific avoidance, mitigation and termination actions in order to address general and project specific impacts as identified by means of the EIA and/or Phase 2 planning process. Implementation of the actions specified in the EMPr can be contractually delegated to various parties involved in the project execution. However, legal compliance with the EA and EMPr remains with the EA holder and cannot be delegated or transferred. It is therefore of utmost importance that WfWetlands ensures that all parties involved are familiar with the contents and requirements of the EMPr as non-conformances can ultimately have legal and financial consequences to primarily the EA holder but also subsequently all other parties involved.

## 1.3 Auditing of compliance with the EA and EMPr

Compliance auditing has been transformed from a vague requirement under the 2006 and 2010 EIA regulations to a very specific set of actions and outcomes which are to be achieved under the 2014 EIA regulations. An audit report is now also subject to a specified structure and with specific content requirements (Appendix 7 of GN R982), as amended. According to GN R982 Appendix 7 (Section 2) the objectives of an audit report include *inter alia* the following:

a) to report on—

   i. the level of compliance with the conditions of the environmental authorisation and the EMPr, and where applicable, the closure plan; and

   ii. the extent to which the avoidance, management and mitigation measures provided for in the EMPr, and where applicable, the closure plan achieve the objectives and outcomes of the EMPr, and closure plan;

b) identify and assess any new impacts and risks as a result of undertaking the activity;

c) evaluate the effectiveness of the EMPr, and where applicable, the closure plan;

d) identify shortcomings in the EMPr, and where applicable, the closure plan; and

e) identify the need for any changes to the avoidance, management and mitigation measures provided for in the EMPr, and where applicable, the closure plan.

As per Regulation 34, sub-regulation 4 of GN R982, where the findings of the environmental audit report contemplated in sub- regulation (1) of GN R982 indicate:

(a) insufficient mitigation of environmental impacts associated with the undertaking of the activity; or

(b) insufficient levels of compliance with the environmental authorisation or EMPr and, where applicable the closure plan;

the holder must, when submitting the environmental audit report to the competent authority in terms of sub-regulation (1), submit recommendations to amend the EMPr or closure plan in order to rectify the shortcomings identified in the environmental audit report.

When submitting recommendations in terms of sub-regulation (4), such recommendations must have been subjected to a public participation process, which process has been agreed to by the competent authority and was appropriate to bring the proposed amendment of the EMPr and, where applicable the closure plan, to the attention of potential and registered interested and affected parties, including organs of state which have jurisdiction in respect of any aspect of the relevant activity and the competent authority, for approval by the competent authority.

Given the strict and onerous above-mentioned requirements in terms of compliance with the EA and EMPr as well as auditing thereof, it is therefore of utmost importance that the EMPr specifies realistic and auditable avoidance, mitigation and cessation actions which can be applied across a wide range of project in various geographical settings. The approach to the structure and content of this EMPr is discussed in more detail under Section 1.7 below.

## 1.4 Frequency of compliance auditing

The ECO and Implementing Entity is responsible for ensuring compliance with the EMPr. The ECO shall inspect the site prior to commencement of any construction activity, at least once per month during construction and on completion of construction to establish the level of compliance with this CEMP. At sensitive sites, bi-weekly inspections shall take place as a minimum.

Monthly site audits shall be undertaken by the ECO and a bimonthly Project Inspection Report submitted to the Working for Wetlands Deputy Director: Planning, Monitoring and Evaluation for review prior to the annual Compliance Audit taking place.

The annual Compliance Audit Report shall be submitted to the DEA collating the year's completed checklists. It is the responsibility of the ECO to report any non-compliance, which is not correctly rectified to the DEA.

## 1.5 Content of an EMPr

Environmental management programmes are intended to be documents which indicate how the mitigation and management measures proposed for a project can be implemented in practice. As such they should be practical, reasonable and feasible. They must also meet the requirements of the legislation (Table 1), in particular regulation 19 (4) of the 2014 EIA regulations (GN R982).

**Table 1: Requirements of an EMPr as per Appendix 4 of the 2014 EIA regulations, GN R982 (2014, as amended)**

| Section | Description | Heading/ section in this EMPr |
|---|---|---|
| (a) | details of-<br>(i) the EAP who prepared the EMPr; and<br>(ii) the expertise of that EAP to prepare an EMPr, including a curriculum vitae; | Report control sheet Annexure E |
| (b) | a detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description; | Sections 1.1, 1.2 and 1.7 |
| (c) | a map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers; | Chapter 6 Annexure C |
| (d) | a description of the impact management outcomes, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including-<br>(i) planning and design;<br>(ii) pre-construction activities;<br>(iii) construction activities;<br>(iv) rehabilitation of the environment after construction and where applicable post closure; and<br>(v) where relevant, operation activities; | Chapters 3-5 |
| (f) | a description of proposed impact management actions, identifying the manner in which the impact management outcomes contemplated in paragraphs (d) will be achieved, and must, where applicable, including actions to -<br>(i) avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;<br>(ii) comply with any prescribed environmental management standards or practices;<br>(iii) comply with any applicable provisions of the Act regarding closure, where applicable; and<br>(iv) comply with any provisions of the Act regarding financial provisions for rehabilitation, where applicable; | Chapters 4-5 |
| (g) | the method of monitoring the implementation of the impact management actions contemplated in paragraph (f); | Chapters 4-5 |
| (h) | the frequency of monitoring the implementation of the impact management actions contemplated in paragraph (f); | Chapters 4-5 |
| (i) | an indication of the persons who will be responsible for the implementation of the impact management actions; | Section 2.1; Chapters 4-5 |
| (j) | the time periods within which the impact management actions contemplated in paragraph (f) must be implemented; | Section 2.1 |

| Section | Description | Heading/ section in this EMPr |
|---|---|---|
| (k) | the mechanism for monitoring compliance with the impact management actions contemplated in paragraph (f); | Chapters 4-5 |
| (l) | a program for reporting on compliance, taking into account the requirements as prescribed by the Regulations; | Sections 1.3 and 1.4 |
| (m) | an environmental awareness plan describing the manner in which-<br>(i) the applicant intends to inform his or her employees of any environmental risk which may result from their work; and<br>(ii) risks must be dealt with in order to avoid pollution or the degradation of the environment; and | Section 3.3 and Chapter 6 |
| (n) | any specific information that may be required by the competent authority. | NA |

## 1.6 Relevant legislation, guidelines and other documents

This EMPr should be read in the context of the following documents:

- Constitution of the Republic of South Africa Act (No. 108 of 1996)
- National Environmental Management Act, (No. 107 of 1998, as amended)
- National Environmental Management: Waste Act (No. 59 of 2008)
- National Forest Act (No. 84 of 1998)
- National Water Act (No. 36 of 1998)
- National Heritage Resources Act (No. 25 of 1999)
- Municipal Systems Act (No. 32 of 2000)
- Occupational Health and Safety Act (No. 85 of 1993)

***Note that the EMPr is not intended to replace any of the above, but rather augment them. Compliance with the EMPr does not exempt the EA holder, i.e. WfWetlands, from compliance with the legal or management requirements of any other licence or permit issued in terms of the project.***

## 1.7 The EMPr in the context of the WfWetlands programme

As discussed under the previous sections, an EMPr and compliance with the EMPr (including compliance auditing) is specifically and strictly regulated under the 2014 EIA regulations, as amended. The implementation of a standard EMPr across a programme as diverse as WfWetlands does however pose various challenges as a result of the wide variety of interventions, site conditions, types of wetland systems, ecological integrity and complexity and so forth.

As a result the EMPr has been written with the abovementioned challenges in mind. It therefore focuses on the typical activities and impacts related to a WfWetlands project and generic avoidance, mitigation and termination actions. The EMPr is augmented by a site specific Rehabilitation Plan which includes more site specific mitigation measures and requirements where required. It is recommended that compliance auditing takes into account the specific mitigation measures recommended in the accompanying Rehabilitation Plan for each individual project as well.

- Allowance will also be made throughout the document for minor deviations to allow for site specific scenarios but with the condition that each deviation be approved by the provincial Programme's Provincial Coordinator (PC) and in the case of major deviations by the DEA (also see Annexure B).

# 2 IMPLEMENTATION OF THE EMPr

The EMPr is ultimately intended to aid in the implementation of specific actions on site in order to ensure that the impacts of a project are avoided or mitigated during the various project implementation phases. A number of role-players are required to actively participate in the implementation of the EMPr with different roles and responsibilities typically assigned to each. The various roles and responsibilities are outlined below.

## 2.1 Role-players and their functions/responsibilities

### 2.1.1 DEA

| Responsible Entity: DEA | |
|---|---|
| • DEA (specifically the Legal Authorisations and Compliance Inspectorate) holds the ultimate authority and mandate in terms of ensuring environmental legislation is adhered to. | |
| **Responsibilities** | **Duration** |
| • Investigate reported non-compliances with EAs and EMPrs either as a result of findings by an ECO/auditor, reporting by the EA holder or public complaints.<br>• Enforce compliance and adherence to the EA, EMPr or any other environmental legislation through a number of administrative and legal procedures should it prove that a person or organisation is in contravention of an EA, EMPr or other environmental authorisation. | Project lifespan |

### 2.1.2 The EA holder

| Responsible Entity: WfWetlands | | |
|---|---|---|
| • Holds sole legal liability in terms of ensuring compliance to the EA and EMPr.<br>• Some responsibilities resulting from the EA or EMPr can be delegated or transferred contractually. | | |
| **Responsibilities** | | **Duration** |
| **Contractual** | • Ensure that the EA and EMPr is included in the contract documentation for a project in order to ensure that compliance with the EA and EMPr is contractually binding.<br>• Ensure that current standards and specifications forming part of the standard contract documentation allow for or are aligned to the requirements of the EA and EMPr.<br>• Ensure that all PCs and Implementing Entities are familiar with the requirements of the EA and EMPr. | Appointment; Project lifespan |

| Responsibilities | | Duration |
|---|---|---|
| **Approvals and licences** | • Identify, obtain and comply with all other necessary approvals, permits, authorisations and requirements set by the relevant National and Provincial Departments and Local Authority for the construction of engineering interventions for the rehabilitation of wetlands before any site preparation activities are undertaken. | Pre-construction |
| **Record keeping** | • Ensure that a proper record keeping system is in place to keep track of proof that copies of the EA and EMPr were issued to the PCs and Implementing Entities. | Pre-construction; Project lifespan |

### 2.1.3 The PC

| Responsible Entity: PC | | |
|---|---|---|
| • The PC shall be responsible for his/her specific province to ensure compliance with the EMPr. | | |
| **Responsibilities** | | **Duration** |
| **Approvals and licences** | • Be fully aware of and understand all the requirements of the EA(s) and EMPr(s) issued for projects in his/her province.<br>• Ensure compliance with the EA and implementation of the EMPr.<br>• Ensure that each Implementing Entity receives a copy of the EA and EMPr for distribution to each contractor, with proof of receipt (e.g. a transmittal note or similar).<br>• Ensure that each Implementing Entity fully understands the contents and requirements of the EA and EMPr and the legal and financial consequences of non-compliance. | Pre-construction; Project lifespan |
| **Communication** | • Communicate environmental issues associated with the site to the Implementing Entity, including having adequate environmental knowledge in the field of wetland rehabilitation to understand the detailed environmental issues associated with the project. | Pre-construction; Project lifespan |
| **Site management** | • Assist with developing a site environmental file and ensuring all documentation is filed correctly.<br>• Assist with site or project specific challenges or problems which might result in a non-conformance with the EA and EMPr.<br>• Provide guidance to Implementing Entities on practical solutions in achieving the outcomes and requirements of the EA and EMPr. | Pre-construction; Project lifespan |

| Responsibilities | | Duration |
|---|---|---|
| **Environmental training** | • Confirm that Environmental Awareness training has been undertaken on all sites prior to construction commencing. | Pre-construction |

### 2.1.4 The ECO

| Responsible Entity: ECO |
|---|
| • The PC shall perform the duties of the ECO via monthly inspections in order to minimise adverse environmental impacts and effects.<br>• Any changes to any environmental management documentation must be reviewed and understood by the ECO.<br>• The ECO has access to the construction site at all times.<br>• Remain appointed until the site has been rehabilitated as specified in the EMPr. |

| Responsibilities | | Duration |
|---|---|---|
| **Approvals and licences** | • Ensure compliance with the EA, EMPr, permits issued and all the environmental legislation.<br>• Be fully knowledgeable with the contents and the conditions of the EA and all amendments.<br>• Be fully knowledgeable with the contents of the latest revision of the EMPr.<br>• Be fully knowledgeable with the contents of all relevant environmental legislation, and ensure compliance with them. | Pre-construction |
| **Communication** | • Ensure that the contents of the EMPr are communicated to the Implementing Entity.<br>• Escalate serious or repeat non-conformances to the relevant competent authority (i.e. DEA, DWS, SAHRA, etc.). | Pre-construction; Project lifespan |
| **Site management** | • Approve the site layout plan (showing environmental sensitive/ no-go areas).<br>• Ensure that all relevant activities being undertaken on site are within the scope of the EA and within the boundaries of the approved layout plan. | Project lifespan |
| **Environmental training** | • Confirm that Environmental Awareness training has been undertaken on all sites prior to construction commencing. | Pre-construction |
| **Method statements** | • Ensure that all method statements required are submitted and approved prior to site establishment. | Pre-construction |

| Responsibilities | | Duration |
|---|---|---|
| **Record keeping** | • Keep and maintain a schedule of current site activities including the monitoring of such activities.<br>• Keep copies of all reports submitted to DEA.<br>• Obtain and keep record of all documentation including: environmental authorisation from DEA, EMPr, basic assessment, site layout plan, method statements, all communication detailing changes that may have environmental implications, site inspection checklist, Environmental awareness training attendance register, Environmental incident report, environmental performance certificates (once a project has been completed) photographic records (before, during and after development), records of non-compliance and corrective action taken to remediate, permits, licenses, and authorisations such as waste disposal certificates, hazardous waste landfill site licenses etc. which are required by this facility. | Project lifespan |
| **Audits** | • Compile an audit checklist which complies with the requirements of GN R982 Appendix 7 and is able to measure compliance against the EA, EMPr, other relevant permits and contract environmental specifications (where applicable).<br>• Escalate serious or repeat non-conformances to the relevant competent authority (i.e. DEA, DWS, SAHRA, etc.).<br>• Work with the Implementing Entity and relevant stakeholders to resolve any areas of non-compliance with appropriate corrective action.<br>• Assist the Implementing Entity in finding environmentally responsible solutions to problems.<br>• Giving a report back on the environmental issues at the monthly site meetings and other meetings that may be called regarding environmental matters.<br>• Submit final audit report to DEA upon project closure in accordance with the requirements of the EA and EMPr. | Project lifespan; Project closure |

#### 2.1.5 The Implementing Entity

| Responsible Entity: Implementing Entity |
|---|
| • The Implementing Entity will be acting as the Project Manager and is responsible for complying with the EMPr during the construction phase of the development on a day-to-day basis.<br>• The Implementing Entity will be responsible for any non-compliance with the EMPr and will pay for any remedial work that may result from non-compliance resulting directly from his/her negligence. Failure to comply with the EMPr is addressed in Section 2.2.3. |

| Responsibilities | | Duration |
|---|---|---|
| **Approvals and licences** | • Ensure that a copy of the EMPr, EA and any other applicable permit/licence are available on site. | Pre-construction; Project lifespan |
| **Communication** | • Submit all required documentation (e.g. proof of training, method statements, layout plans, and requests for deviations) to the ECO on a timely basis.<br>• Communicate any issues or concerns of the surrounding community regarding the development to the ECO or other responsible party and visa-versa.<br>• Ensure that all materials and equipment required for daily environmental compliance is ordered through the correct channels if such is not available. | Pre-construction; Project lifespan |
| **Site management** | • Ensure that appointed contractors, participants and sub-contractors are familiar with the EMPr and that they abide by it.<br>• Monitor and verify on a daily basis that the EMPr and specifications (if applicable) is adhered to at all times and taking the necessary action to ensure compliance is achieved where it is lacking.<br>• Ensure that site demarcation and no-go areas are maintained.<br>• Monitor and verify that environmental impacts as a result of construction activities are kept to a minimum.<br>• Ensure that all materials and equipment required for daily environmental compliance are available on site and ensure that the aforementioned is ordered through the correct channels if such is not available.<br>• Inspect the site and surrounding areas regularly with regard to compliance with the EMPr.<br>• Keep a photographic record of progress on site from an environmental perspective. | Project lifespan |
| **Environmental training** | • Provide environmental awareness training for all new personnel coming onto site and filing proof of such training in the Environmental File on site. | Pre-construction |
| **Method Statements** | • Ensure compliance with approved Method Statements. | Pre-construction; Project lifespan |

| Responsibilities | | Duration |
|---|---|---|
| **Record keeping** | • Submit all required documentation (e.g. proof of training, method statements, layout plans, and requests for deviations) to the ECO on a timely basis.<br>• File proof of environmental awareness training in the Environmental File kept on site.<br>• Keep and maintain a detailed incident (including spillage of fuels, chemicals, or any other material) and complaints register on site indicating how these issues were addressed, what rehabilitation measures were taken and what preventative measures were implemented to avoid re-occurrence of incidents/complaints.<br>• Ensure that all relevant documentation illustrating or proving environmental compliance are filed on site in the Environmental File for inspection by the ECO or Competent Authority.<br>• Keep a photographic record of progress on site from an environmental perspective. | Project lifespan |
| **Audits** | • Complete start-up and site closure checklists on a weekly or monthly basis or as otherwise specified. | Project lifespan |

## 2.2 Record keeping (site related activities)

The development of an EMPr for a project is an important and necessary task that is aimed at assigning responsibilities and mitigation options to a variety of activities. However, it can be an ineffective tool in the absence of auditing or monitoring activities. Auditing or monitoring activities involve the structured observation, measurement, and evaluation of environmental data over a period of time.

### 2.2.1 Site Environmental File

The Site Environmental File (SEF) is a critical part of compliance record keeping, specifically in terms of proof of activities undertaken on a regular basis on site to ensure compliance with the EA and EMPr. The SEF is further a key component to demonstrate compliance to the ECO or relevant Competent Authority official during a compliance audit. The typical SEF contents should include *inter alia* the following:

1. **Rehabilitation Plan and EMP**

2. **Approvals and licences**
   2.1. EA
   2.2. Section 21(c) and (i) General Authorisation
   2.3. Waste licence (if applicable)
   2.4. Mining permit/licence (e.g. for proof of quarry legitimacy)

3. **Communication**
   3.1. Important correspondence e.g. notice to Competent Authority of commencement of construction
   3.2. Copy of public complaints register

4. **Site management**
    4.1. Approved layout
    4.2. Site instructions (or copies thereof)

5. **Environmental Training**
    5.1. Proof of toolbox talks, environmental awareness and induction (incl. attendance register and training material)

6. **Method statements**
    6.1. Approved method statements

7. **Records**
    7.1. Record of waste generation – quantity, type, fate (incl. general/hazardous, liquid/solid)
    7.2. Proof of legal/safe waste disposal
    7.3. Record of chemicals on site and Material Safety Data Sheets (MSDS)
    7.4. Record of water usage (if applicable)
    7.5. Log of topsoil samples (if applicable)

8. **Audits**
    8.1. ECO audit reports
    8.2. Internal audits/check conducted by the Implementing Entity
    8.3. Incident and non-conformance reports

Typical examples of checklists and other types of record keeping are included in Annexure B.

#### 2.2.2 Progress / Site Meetings

Environmental issues shall be put on the agenda as a discussion point during these meetings. The Implementer, or a designated person involved with environmental issues on the project, shall attend the progress and/or site meetings on a regular basis to provide feedback on any outstanding or contentious environmental matter.

#### 2.2.3 Failure to comply with the EA and EMPr

The WfWetlands Programme, as the holder of the Environmental Authorisation, is responsible for ensuring compliance with the conditions by any person acting on their behalf including Implementing Entities. The EA holder must notify the DEA in writing within the period specific in the EA if any condition in the Environmental Authorisation is or cannot be complied with. Upon receiving such notification the DEA (Compliance Directorate) will assess the reported non-conformance and inform the EA holder of further actions and submissions required.

In addition to the above, the ECO may order the Implementing Entity to suspend part or all of the works if, based on the ECO's reasoned opinion, the Implementing Entity has, is in the process of or will cause significant environmental damage and/or cause a non-conformance to the EA and/or EMPr. The ECO shall report this instruction to the WfWetlands' *Deputy Director: Programme Implementation* **within 24 hours** of the instruction being issued. Should the aforementioned suspension of work be as a result of negligence or actions by the Implementing Entity, no extension of time will be granted for such delays and all costs will be borne by the Implementing Entity. Apart from direct non-compliance with the EA or EMPr, the following will be regarded as indirect non-compliance:

- Failure to comply with corrective or other instructions issued by the Implementing Entities, ECO or Competent Authority within a specified time.
- Failure to produce the supporting documentation proving compliance with the EA or EMPr.
- Failure to ensure that sub-contractors appointed by the Implementing Entity comply with the EA and EMPr.

# 3 PRECONSTRUCTION/PLANNING PHASE

## 3.1 Compliance with environmental legislation

Ensure relevant approvals from regulatory authorities are obtained, in particular in terms of:

- National Environmental Management Act (No. 107 of 1998) (NEMA), as amended;
- National Water Act (No. 36 of 1998);
- National Environmental Management: Biodiversity Act, 2004 (No. 10 of 2004);
- National Forests Act (No. 84 of 1998);
- National Heritage Resources Act (No. 25 of 1999); and
- Other provincial and local environmental legislation.

## 3.2 Submission of method statements

- Method Statements must be compiled by the Implementing Entity.
- All Method Statements must be submitted and approved prior to site establishment commencing.
- The content and required actions of the Method Statements must be communicated to site staff through a compulsory environmental induction.
- Approved Method Statements will be dated and signed by all relevant parties (Implementing Entity, ECO, DEA, Engineer).
- Should a Method Statement need to be revised, a formal revision will be issued, signed and dated. The updated Method Statement will be filed in the SEF.
- The submitted Method Statements (see Annexure B) will include but not be limited to:
  - Site division, demarcation and no-go areas (incl. site camp establishment, access, construction working widths).
  - Site clearance and topsoil management.
  - Stockpiling and laydown areas.
  - Solid waste management (general and hazardous, incl. disposal).
  - Hazardous substances storage and management.
  - Contaminated water management and disposal.
  - Cement storage and handling as well as concrete batching.
  - Fuel storage and management.
  - Ablution facilities and eating areas.
  - Dust and noise/nuisance control.
  - Protection of flora, fauna and natural features.
  - Stormwater management and erosion.

- Site de-establishment and rehabilitation.

- The submission of a site layout plan (see Annexure B) by the IE to the ECO for approval is compulsory. The layout plan must indicate all areas of relevance including *inter alia*:
  - The location of the site camp as well as the site camp layout indicating the location of materials storage (general and hazardous), fuel storage, the site office, ablution facilities, vehicle/machinery parking areas.
  - Access to the site camp and intervention sites.
  - Any required stormwater management measures such as diversion berms, cut-off drains, silt fences etc.
  - Stockpiling and laydown areas.
  - Concrete/mortar mixing/batching areas.
  - No-go or sensitive areas.
  - Limit(s) of the construction footprint.

The layout plan must take into consideration the buffer distances and restrictions as specified in the EMPr. Where applicable[22] the IE must make use of multiple layout plans to indicate the location of the abovementioned areas.

## 3.3 Environmental induction/training

Training and induction forms an integral part of ensuring and maintaining compliance with the EA and EMPr. Every person on site needs to understand the importance of compliance with the EA and EMPr and their specific role(s) in achieving this. Environmental induction and/or training must be specific or relevant to the level of responsibility of the person receiving the training. Environmental training and/or induction shall comply with the following requirements:

- The Implementing Entity and any other staff with management responsibilities (e.g. HSE officer and the foreman) will undergo environmental compliance training prior to construction commencing. The induction/training shall include project specific requirements for compliance with the EA and EMPr and responsibilities assigned to each party.
- Once the Method Statement is approved, a copy of the Method Statement must be circulated and communicated to the responsible parties (see Section 3.2).
- General staff will receive a simplified environmental induction and/or training before the commencement of construction (i.e. site establishment). The induction/training shall address, but not be limited to, basic environmental awareness, basic health and safety awareness, prevention of water, soil, and air pollution, prevention of soil erosion and sedimentation, basic principles of materials handling and storage, fire risks, protection of fauna and flora, removal of invasive alien species (if relevant), emergencies and incident responses, spill response provisions, social responsibility, and administrative and reporting procedures.
- All project personnel shall further be trained in basic wetland awareness, including a basic understanding of the components of wetlands, how wetlands function, the benefits they provide,

[22] Where the “site” covers an extensive area or where a large number of interventions are to be constructed.

why they need to be conserved and used sustainably, and the importance of rehabilitation in contributing to wetland conservation and sustainable use.

- Where work takes place in areas containing dangerous game, especially nature reserves and national parks, participants shall receive training in basic animal behaviour. A person trained in dangerous animal behaviour shall be present and suitably equipped to deal with such threats at all times. Before work commences each day, the site shall be checked for dangerous animals by the trained person. First aid training shall include current treatments for snakebites.
- Provision must be made for quarterly refresher environmental training to be undertaken during the course of the contract. The Implementing Entity shall ensure that all attendees sign an attendance register, and shall provide the Implementer with a copy of the attendance register the day after each course.
- Daily/weekly *Toolbox Talks* should include an environmental topic/issue in addition to a Health and Safety topic/issue.
- Proof (training material, attendance registers, photos) of training and attendance to be filed in SEF.
- Include environmental considerations as an item on the agenda of the monthly site meetings.

# 4 CONSTRUCTION PHASE

## 4.1 Compliance with the EA and successful implementation of EMPr, environmental specifications and other permits/licences

**Identified impacts:** The EA, EMPr and other relevant permits and licences are only of value if the conditions/requirements contained in them are adhered to. As these documents are legal documents, non-conformance in terms of adherence/implementation may constitute an offence and be subject to suspension of the authorisation/permit/licence and possible penalties or fines.

**Objective of improved management:**

- Continued and consistent compliance with the EA and EMPr as well as environmental specifications and other permits/licences

**Specifications:**

- The ECO shall be responsible for the implementation of this EMPr for the duration of the construction phase and until rehabilitation is completed.
- The ECO shall have full access to the site at all times.
- Audits[23] undertaken by the ECO shall comply with the requirements of GN R982 (2014, as amended).
- Although the EA/licence/permit holder can transpose contractual liabilities to the Implementing Entity in terms of compliance with the EA, EMPr, Environmental Specification and any other relevant permits/licenses, the EA/licence/permit holder will remain legally liable in terms of compliance.

**Table 2: Compliance with the EA and successful implementation of EMPr, environmental specifications and other permits/licences**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • A copy of the EA, EMPr, Environmental Specifications and any other relevant permits/licenses will be kept in the SEF on site.<br>• The Implementing Entity will familiarise himself/herself with the contents and requirements of the EA, EMPr, Environmental Specifications and any other relevant permits/licenses. | Implementing Entity, EA holder, ECO |

[23] The ECO is responsible for providing an independent evaluation of compliance with the EMPr and not for enforcement of the conditions of the EMPr. The responsibility of enforcement of the conditions of the EMPr lies with the EA holder.

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • The Implementing Entity and/or EA holder will not knowingly proceed with any action which might compromise compliance with the EA, EMPr, Environmental Specifications or any other relevant permits/licenses. | |
| **Mitigation** | • Should a situation arise where compliance with the EA, EMPr, Environmental Specifications or any other relevant permits/licenses is likely to be compromised/deviated from due to exceptional circumstances or a change in scope of work, the Implementing Entity will notify the ECO immediately. The ECO will assess the type of deviation and its significance and will advise the Implementing Entity whether the deviation requires an amendment to the EA, EMPr, Environmental Specifications or any other relevant permits/licenses. | Implementing Entity, EA holder, ECO |
| **Stop work** | • Should a situation arise where there is accidental or intentional non-conformance with the EA, EMPr, Environmental Specification and any other relevant permits/licenses, the ECO may order all work to stop until such non-conformance has been assessed, reported to the relevant authority (if necessary) and appropriately mitigated<br>• A non-conformance will be recorded in writing by the ECO with a description (and photographic evidence where applicable) of the incident/non-conformance. A non-conformance report will contain detailed actions and action dates for each responsible party and will be signed off by the ECO and IE once completed/closed out. | Implementing Entity, EA holder, ECO |
| **Monitoring method and frequency** | • Daily/weekly monitoring by Implementing Entity.<br>• Formal monthly audits by ECO. | Implementing Entity, EA holder, ECO |
| **Management outcomes** | • Full and continued compliance with the EA, EMPr, Environmental Specifications and any other relevant permits/licenses.<br>• Identification of possible deviations in advance to avoid non-conformances.<br>• Independent and impartial monitoring of compliance by the ECO. | Implementing Entity, EA holder, ECO |

## 4.2 Site establishment

**Identified impacts**: Site establishment can often have a significant environmental impact in terms of vegetation clearance and/or the construction footprint and therefore needs to be carefully managed. It is also usually during site establishment that the site camp and laydown areas are identified and demarcated. If the aforementioned is not properly planned, it could have several secondary impacts such as water pollution, soil contamination, erosion and excessive dust.

**Objective of improved management**:

- To avoid excessive disturbance in terms of vegetation clearance and the construction footprint.
- Ensure that activities/facilities/site structures with pollution potential are located outside buffer zones and no-go areas, preferably in already disturbed or transformed areas. Examples include the site camp, material laydown areas, concrete batching plant, ablution facilities etc.
- Ensure that all activities remain within the approved construction footprint.

**Specifications**:

- Site establishment will not commence until such time that the EA appeal period has passed and will further be subject to the approval of the required method statements by the ECO.
- The wetland boundary shall be demarcated on the site plan and on site.
- Demarcation will be by means of brightly painted/white pegs/poles at least 1.5m in height and placed at regular (10m for linear of on every corner for non-linear) intervals on both sides of the approved construction footprint. **Demarcation shall be maintained for the duration of construction.**
- Danger tape and/or snow/barrier netting shall only be used for health and safety requirements along excavations or high risk areas.
- All areas outside approved and demarcated footprint are to be treated as no-go areas.

**Table 3: Specific avoidance, mitigation and cessation management measures related to impacts identified with site establishment**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • The Implementing Entity must prioritise the use of disturbed areas for site camp establishment, laydown areas and stockpile areas.<br>• The site camp shall be clearly demarcated and fenced subsequent to approval of the ECO. | Implementing Entity |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • The site camp, laydown and stockpile areas may not be established within any environmentally sensitive area. Refer to Annexure C for sensitivity and wetland boundary map.<br>• Should an extension/amendment to the construction footprint be required, the Implementing Entity must submit such a request to the ECO for approval prior to extending the construction footprint.<br>• All work will be executed within the approved working area.<br>• Temporary laydown areas will not be used for a period exceeding four (4) weeks and must be approved by the ECO prior to being used.<br>• Temporary laydown areas must be demarcated should it fall outside the approved construction footprint.<br>• The Implementing Entity is to ensure that all staff (e.g. plant operators, general workers) are informed of no-go areas as part of the induction/environmental awareness training. | |
| **Mitigation** | • Should the Implementing Entity disturb an area outside the approved footprint, then the Implementing Entity will be held liable to reinstate the impacted area to its original condition.<br>• All temporary footprint areas must be reinstated/rehabilitated at the end of construction. | Implementing Entity |
| **Stop work** | • Should the Implementing Entity fail to remain within the approved construction footprint or intentionally/negligently cause damage to a natural feature in a no-go area, the ECO reserves the right to suspend or partially suspend construction via written instruction in order to allow for the assessment, reporting and rectification of the impact.<br>• The aforementioned will be determined by the type and significance of the non-conformance and the risk of it reoccurring should construction proceed. | ECO, Engineer |
| **Monitoring method and frequency** | • Daily and weekly monitoring/inspections by the Implementing Entity.<br>• Formal monthly audits by the ECO. | ECO, Implementing Entity |

| Management Measure | Detailed Description | Responsibility |
| --- | --- | --- |
| **Management outcomes** | • Method Statements are submitted at least 14 days prior to the commencement of site establishment.<br>• Site establishment only commences after approval of the Method Statements.<br>• Already disturbed areas are prioritised for site camp, laydown and stockpile areas.<br>• Construction footprint and vegetation clearance is controlled and kept to a minimum.<br>• Activities are restricted to within the approved construction footprint.<br>• Demarcation remains visible and in place for the duration of construction. | Implementing Entity, EA holder, ECO |

### 4.3 Channels of communication for public complaints

**Identified impacts**: The construction activities could lead to nuisance impacts and impacts on the adjacent properties. This may result in complaints from the public and/or adjacent landowners

**Objectives of improved management**:

- To record and address (within a reasonable timeframe) any complaints by the public arising from the construction activities and the impacts thereof.

**Specifications**: None

**Table 4: Specific avoidance, mitigation and cessation management measures related to impacts identified with public complaints**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • The IE must contact the landowner and/or occupier of the land where the construction is to take place at last 10 working days prior to moving onto site.<br>• The IE must confirm the procedure to be followed for access including gates which must remain locked or open.<br>• The Implementing Entity must ensure that the site remains neat and that no littering occurs.<br>• Ensure that the public and adjacent landowners are informed well in advance of any construction activities to take place in the vicinity of their properties.<br>• Where the site is located in a nature reserve/park, the Implementing Entity must familiarise him/herself with the rules and regulations of the reserve/park and where necessary include such information in the environmental induction and training.<br>• Where the site is frequently visited by tourists, the Implementing Entity must ensure that his/her site does not cause a visual or noise disturbance.<br>• Also refer to the Code of Conduct attached under Annexure A. | Implementing Entity |
| **Mitigation** | • Provide a contact number of person responsible for the site on the site signage.<br>• Maintain a complaints register on site to allow public complaints to be recorded. | Implementing Entity |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • Verbal complaints must be recorded within 24 hours of being received with a copy provided to the complainant.<br>• Actions to address the complaints must be recorded in writing with sign-off by the ECO once the actions have been completed.<br>• Address all complaints within a reasonable timeframe (24 hours for initial contact and 5 working days to resolve minor issues or complaints).<br>• Ensure that actions are recorded in the SEF and the actions are implemented to avoid the future complaints regarding the same issue. | |
| **Stop work** | • Should a complaint relate to an action by the Implementing Entity which can cause/has caused a serious health and safety or environmental impact, the ECO may suspend or partially suspend work via instruction from the Engineer in order to assess the impact/complaint and identify any remedial actions required. | ECO |
| **Monitoring method and frequency** | • Reporting of serious complaints within 24 hrs to the ECO.<br>• Address all complaints within a reasonable timeframe (24 hours for initial contact and 5 working days to resolve minor issues or complaints).<br>• Ensure that all complaints are recorded in the complaints registered and that remedial actions are recorded, implemented and maintained.<br>• Daily and weekly monitoring/inspections by the Implementing Entity.<br>• Formal monthly audits by the ECO. | Implementing Entity, ECO |
| **Management outcomes** | • The public is timeously informed of construction activities which might impact them.<br>• Contact details of the Implementing Entity is visible on site signage at the site camp.<br>• A register is available at the site camp to record any community/public complaints. | Implementing Entity, ECO |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • All public complaints are recorded and closed out within a reasonable timeframe (24 hours for initial contact and 5 working days to resolve minor issues or complaints).<br>• Repeat complaints regarding the same matter/issue are avoided. | |

## 4.4 Vegetation clearance

**Identified impacts:** Various activities that take place during the construction phase require the removal of vegetation, including clearing of the construction footprint for construction activities, site camp establishment, laydown and stockpile areas and access roads.

**Objective of improved management:**

- To retain natural vegetation in terrestrially sensitive areas.
- To minimise the extent of disturbance of vegetation/habitats on-site.
- Avoid the loss of species of conservation concern.

**Specifications:**

- Vegetation clearance must be restricted to the approved construction footprint.
- Removal of vegetation must occur at increments and must only be done up to two weeks ahead of actual construction commencing in an area.
- No burning of vegetation will be allowed.
- Where vegetation consists of grasses, bulbs and shrubs, it will be cleared (i.e. complete removal of the vegetation with its root system) as part of the removal of topsoil (i.e. to a maximum depth of 30cm) in order to maximise organic content and the available seedbank in the topsoil.
- Where vegetation consists predominately of reeds, the reeds will be slashed/cut to 30cm in height, measured from ground level, with the remainder of the plant and its root/rhizome system removed with the topsoil layer (i.e. at a maximum depth of 30cm).
- Vegetation/ plant material is not allowed to be disposed of as waste at a landfill site and should be stored for mulching purposes upon completion of the construction works.

**Table 5: Specific avoidance, mitigation and cessation management measures related to impacts identified with vegetation clearance**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • Limit vegetation clearance in “sensitive areas” as identified in the BAR and as indicated on the maps under Annexure C.<br>• Prioritise the use of already disturbed and degraded areas for site camps, laydown and stockpiling areas. | Implementing Entity, ECO |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • Do not remove/clear vegetation outside the approved construction footprint.<br>• Ensure that site demarcation is maintained throughout the construction phase.<br>• Clearly mark shrubs and trees which should not be disturbed/damaged during construction.<br>• Remove/relocate species of conservation concern where possible and practical. | |
| **Mitigation** | • Ensure that all temporary footprint areas are rehabilitated at the completion of construction in a specific area.<br>• Ensure that topsoil is removed and conserved in order to ensure successful revegetation/rehabilitation (also see Section 4.5).<br>• Any area disturbed outside the approved construction footprint must be reinstated at the Implementing Entity's cost to the satisfaction of the ECO.<br>• Ensure that sufficient funds are allocated in the BoQ for rehabilitation of temporary footprints. | Implementing Entity, ECO, Engineer |
| **Stop work** | • Should the Implementing Entity fail to remain within the approved construction footprint or intentionally/negligently cause damage to a natural feature/vegetation in a no-go area, the ECO reserves the right to suspend or partially suspend construction via instruction from the EA holder in order to allow for the assessment, reporting and rectification of the impact.<br>• The aforementioned will be determined by the type and significance of the non-conformance and the risk of it reoccurring should construction proceed. | ECO, Engineer |
| **Monitoring method and frequency** | • Daily and weekly monitoring/inspections by the Implementing Entity.<br>• Formal monthly audits by the ECO. | Implementing Entity, ECO |
| **Management outcomes** | • Work is contained to the approved construction footprint.<br>• Site demarcation is maintained for the duration of construction. | Implementing Entity |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • Vegetation clearance is limited in sensitive areas.<br>• No site camps, laydown or stockpile areas in sensitive areas.<br>• Plants of conservation concern are relocated where possible and feasible (with the necessary permits/licences/approvals in place).<br>• Temporary footprint areas are rehabilitated once work in an area has been completed.<br>• Topsoil is removed and managed properly (see Section 4.5 below) to aid in successful rehabilitation. | |

## 4.5 Topsoil management

**Identified impacts:** Topsoil is an essential component to achieve successful rehabilitation/revegetation of a disturbed area. Poor topsoil management practices such as double handling, compaction, contamination, erosion and failing to control weeds/alien invasive species on stockpiles all contribute to the degradation and loss of topsoil. This in turn compromises the success of rehabilitation or results in additional costs to improve or import topsoil.

**Objective of improved management:**

- To ensure that topsoil is properly removed and managed during construction in order to enable successful rehabilitation at the completion of construction.

**Specifications:**

- Topsoil must be removed to a maximum depth of 30cm.
- Where the topsoil layer is shallow or alternating in depth, it must be removed to the maximum depth possible.
- Topsoil removal must occur at increments and will only be done up to two weeks ahead of actual construction commencing in an area.
- Topsoil will be removed with the appropriate equipment i.e. pointed or flat tip shovel/spade and a wheelbarrow~~.~~
- Topsoil stockpiles must be stored on level areas to a maximum height of 1.5m. The stockpile areas will be properly planned and will be approved as part of the site demarcation process and will be indicated on the site layout plan.
- Stockpiles will not block access routes or endanger any person or animal.
- The stockpiles must be protected from erosion and contamination by subsoil or imported materials.
- Topsoil will not be driven over or compacted and stockpiles will not be reworked or moved unnecessarily.
- Topsoil stockpiles must be kept free of weeds for the duration of construction until reapplied during rehabilitation.
- Topsoil will only be reapplied after all civil work has been completed in order to avoid compaction.

**Working in peat wetlands**:

Some of the wetlands identified for priority rehabilitation may occur in soils with a high organic composition, known as peat. These soils hold huge importance globally due to their nature to hold high levels of carbon (known as carbon sequestration). The following considerations should be made for site clearance in peatlands:

- Work shall only be done in periods with low rainfall (Winter rainfall areas - November to March and Summer rainfall areas - May to September).
- No material will be removed from the peatland for construction purposes e.g. boulders, rocks, sand.
- All access to the intervention site in the peatland will be by foot, no vehicles will be allowed in the peatland.
- Where materials need to be transported into the peatland, it will be done by means of wheelbarrows on demarcated walkways lined by wooden planks, geotextile or similar material.
- The Implementing Entity will use only one access path/point per Intervention Point and will not create multiple access paths or points.
- No foreign vegetable matter (e.g. mulch) may be brought into the wetland area (especially from alien species).
- Topsoil shall be removed specifically in the form of sods (20 to 20cm (length) x 20cm (width) x 20cm (depth)):
    - The first sod shall include the roots/rhizome layer (i.e. the rootstalks and their associated nodes/tubers)
    - The sods shall be stored in a wet area, on site, in their original orientation and order.
    - Vegetation can be cut short if it will make it easier to handle the sods.
    - Soil shall be stockpiled according to the different soil layers (i.e. in separate stockpiles) as per the soil profile. Where possible, soils shall be stockpiled as high as possible to retain moisture, but not higher than 0.5m.
    - Stockpiles will be located in a saturated area with shallow surface water immediately adjacent to the Intervention Point. Sods will be placed on the existing vegetation. Where vegetation height exceeds 30cm, the vegetation can be cut and used as mulch/cover layer.
    - The stockpile area will be indicated by means of painted pegs at each corner.
    - Stockpiles shall only be handled twice i.e. during removal and during placement for rehabilitation.
    - Stockpiles shall be covered with 10cm mulch or cloth (geotextile with <0.5cm aperture) to ensure that the moisture content is maintained by restricted evaporation and evapotranspiration.

**Table 6: Specific avoidance, mitigation and cessation management measures related to impacts identified regarding topsoil management**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • Ensure topsoil is stockpiled in areas on site where opportunity for compaction and contamination due to other construction activities are limited.<br>• Avoid moving/handling the topsoil more than twice (i.e. restricted to initial stripping and final reapplication).<br>• Ensure weeds and alien invasive species are removed from the stockpiles prior to reaching seed formation stage.<br>• Do not move topsoil between different areas on site i.e. it should be reapplied in the same area that it was removed from. | Implementing Entity |
| **Mitigation** | • Remove more than 15cm of topsoil where possible to compensate for areas of shallow/no topsoil as well as topsoil loss due to mismanagement.<br>• Apply mulch to the topsoil if the topsoil quality has been impacted significantly and will compromise the success of revegetation (based on the reasoned opinion of the ECO or wetland specialist).<br>• Enforce a stricter and more frequent weeding/alien invasive removal regime where there was failure to remove weeds/alien invasive species from topsoil stockpiles prior to seed formation stage. | Implementing Entity, ECO, Engineer |
| **Stop work** | N/A | |
| **Monitoring method and frequency** | • Use of approved site layout to confirm correct location of topsoil stockpiles.<br>• Continuous monitoring during initial topsoil removal/stripping.<br>• Weekly to bi-weekly monitoring of stockpiles for signs of erosion and weeds.<br>• Monthly audits for general topsoil management practices. | Implementing Entity, ECO |
| **Management outcomes** | • Topsoil is removed to a minimum depth of 15cm.<br>• Topsoil is not contaminated by other materials. | Implementing Entity |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • There is no compaction of topsoil.<br>• Topsoil is not eroded or washed away.<br>• Handling of topsoil is restricted to initial removal and final reapplication.<br>• The topsoil applied during rehabilitation matches the quality and thickness of topsoil removed during site clearance.<br>• Weeds and alien invasive species on topsoil stockpiles are removed on a regular basis prior to the plants reaching seed formation stage. | |

## 4.6 Materials management (non-hazardous)

Identified impacts:

- Material delivered to areas not approved by the ECO and Engineer e.g. outside the approved construction footprint, on steeply sloped areas, etc.
- Imported materials introduce new alien invasive species to site.
- Materials spilling from vehicles causing a safety or pollution risk.
- Materials are eroded and washed into wetland systems as a result of being stockpiled in areas with concentrated stormwater runoff or on sloped areas.
- Materials are mixed with the underlying natural ground surface causing contamination of soil, excessive quantities of material remaining on site after construction, localised plant die-off, increase in sedimentation etc.
- Wetland systems are impacted and/or polluted due to an insufficient buffer width between site camps, laydown and stockpile areas and water resource.
- Materials susceptible to wind erosion results in a dust nuisance and contamination of surrounding areas.
- Materials are stored on site for extended periods leading to the need for increased storage area due to materials not being used.

**Objectives of improved management:**

- Ensure material delivery and storage takes place in such a manner that it does not cause pollution or degradation of the surrounding environment.
- Plan material use and delivery in order to ensure that material storage on site does not take place for extended periods of time (i.e. > 4 weeks).
- Minimise the use of intact/undisturbed areas for material stockpiling/storage.
- Minimise exposure of materials to wind and water erosion.
- Ensure that materials are stored on site for the shortest possible period to limit the extent of areas required for storage and stockpiling.

**Specifications**: None

**Table 7: Specific avoidance, mitigation and cessation management measures related to impacts identified with materials management (non-hazardous)**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • It will be the Implementing Entity's responsibility to ensure that delivery drivers/suppliers are aware of the relevant EMPr requirements.<br>• The Implementing Entity shall ensure that materials are sourced from legal and approved sources. If unsure the Implementing Entity will obtain permission from the ECO prior to using a certain material resource.<br>• Imported materials shall be free of weeds, litter and contaminants.<br>• Materials shall be appropriately secured to ensure safe passage between destinations. Loads including, but not limited to, sand, stone chip, fine vegetation, refuse, paper and cement, shall have appropriate cover to prevent them spilling from the vehicle during transit. The Implementing Entity shall be responsible for any clean-up resulting from the failure by his employees or suppliers to properly secure transported materials.<br>• The Implementing Entity will identify appropriate storage and laydown areas prior to delivery to site. The areas will be approved by the ECO either as part of the required Method Statement or on an *ad hoc* basis.<br>• Open, disturbed areas will be prioritised for stockpiling and laydown areas.<br>• Bulk stockpile areas will be outside the wetland boundary and any other areas prone to seasonal flooding unless otherwise approved by the ECO.<br>• The Implementing Entity will schedule the delivery of materials in such a manner that it does not require excessive periods (>4 weeks) of on-site storage unless otherwise approved by the ECO e.g. where delivery/source distances are excessive.<br>• Minor stockpiles (not covering an area exceeding $4m^2$ unless otherwise approved by the ECO) will be allowed next to an Intervention Point for specific use at the Intervention Point.<br>• Minor stockpiles next to intervention sites will be utilised within 2 weeks of the material being stockpiled i.e. it will not be left adjacent to a planned or completed Intervention Point for an excessive period of time. | Implementing Entity |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • Laydown and storage areas where such occurs on vegetation, topsoil or in a wetland shall be on hessian, PVC sheeting or a similar material in order to separate the imported material from the vegetation/topsoil and to ensure easy and proper removal of excess material.<br>• Stockpile heights will be limited to 1.5m where the material is fine (i.e. susceptible to wind erosion) or in areas known to regularly (weekly to fortnightly basis) experience wind speeds exceeding 20km/h. Alternatively, material which can be windblown will be covered with shade cloth, PVC sheeting, hessian or similar suitable material.<br>• Stockpile areas will be flat and not subject to concentrated stormwater runoff or surface water flow.<br>• Materials such as precast pipes and culverts, gabions baskets, MacMat-R, hessian etc. can be placed directly on vegetated areas to avoid the disturbance and clearance of vegetation and topsoil. This will be at the discretion of the ECO based on the merits of avoiding vegetation and topsoil removal. | |
| **Mitigation** | • Should material be washed or blown into the surrounding environment, the Implementing Entity will be responsible for the removal/recovery of such material. Whether removal/recovery is required will be determined by the ECO based on the type of material, volume of material and whether the material can be recovered/removed without causing substantial additional degradation of the surrounding environment.<br>• Materials not used at a specific Intervention Point will be removed once the activity requiring the material has been completed e.g. stones for gabions.<br>• Where sand/fill material is legally sourced from a dam, existing borrow pit or similar with clear presence of invasive alien species, the Implementing Entity will allow for a weeding programme at the on-site stockpile area and Intervention Point. The weeding programme will span a winter and summer period consecutively to ensure that introduced invasive alien and weed species are removed prior to seed formation stage.<br>• All remaining/waste material will be removed off-site before or by the end of construction. | Implementing Entity |
| **Stop work** | N/A | |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Monitoring method and frequency** | • Daily and weekly monitoring/inspections by the Implementing Entity.<br>• Formal monthly audits by the ECO. | Implementing Entity, ECO |
| **Management outcomes** | • Imported materials are stored/stockpiled on already disturbed areas within the approved construction footprint.<br>• Material delivery and storage takes place as in such a manner that it does not cause pollution or degradation of the surrounding environment.<br>• Materials are not eroded and/or deposited in the surrounding environment.<br>• Materials are used within four weeks of delivery.<br>• No new or additional alien invasive species are introduced via imported material. Where such are imported, the Implementing Entity implemented a weeding programme spanning at least one winter and one summer i.e. a year.<br>• All imported material is removed from site at the completion of construction. | |

## 4.7 Hazardous chemicals and potential hazardous substances

**Identified impacts:**

- Includes, but are not limited to: drums of fuel, grease, oil, brake fluid, hydraulic fluid, paint, batteries and herbicides (for alien plant clearing), etc.
- Spills resulting in pollution of nearby aquatic systems and water resources.
- Spills resulting in soil contamination and degradation.
- Fauna and/or (indigenous) flora fatalities/die-off.
- Illegal/improper disposal of materials contaminated with hazardous product/spill.

**Objectives of improved management:**

- Ensure the controlled and documented management of hazardous chemicals and substances.
- Avoid and minimise spillages through proper storage and dispensing practices.
- Ensure that the appropriate mitigation measures are in place in the event of a spill.
- Ensure that hazardous materials are stored in designated/approved areas away from sensitive receptors/environments.

**Specifications**:

- The Implementing Entity must supply the ECO with a list of all hazardous materials that would be present on site during the construction period.

**Table 8: Specific avoidance, mitigation and cessation management measures related to impacts identified with hazardous materials management**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • All hazardous materials and products must be stored in containers marked as per SANS 10234 requirements i.e. in its original container.<br>• All containers will have lids and stored in a covered and bunded area or in a flammables/hazardous store with a metal drip tray able to contain 110% of the volume of the largest container. | Implementing Entity |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • A register of hazardous materials and products will be kept at the site officer or flammables/hazardous store together with up to date Material Safety Data Sheet (MSDS).<br>• Containers with a volume of more than 20ℓ will have proper dispensing equipment.<br>• Dispensing of hazardous materials into smaller containers or equipment will only occur at the site camp on a lined or impermeable surface.<br>• Hazardous materials and products will only be stored at the site camp. | |
| **Mitigation** | • The Implementing Entity must ensure that there is an emergency procedure in place to deal with accidents and incidents (e.g. spills) arising from hazardous substances.<br>• The Implementing Entity must ensure that all personnel on site are properly trained concerning the proper use, handling and disposal of hazardous substances.<br>• The Implementing Entity must report major incidents to the ECO immediately. Any spill incidents must be cleaned up immediately and in according with the emergency procedure | Implementing Entity |
| **Stop work** | • Should the Implementing Entity through negligent or wilful action/behaviour cause a significant/major spill or dispose of hazardous materials illegally, the ECO reserves the right to suspend or partially suspend construction via instruction from the EA Holder in order to allow for the assessment, reporting and rectification of the impact.<br>• Depending on the severity of the non-conformance, the ECO will also inform the relevant competent authority to confirm the Implementing Entity's liability to be prosecuted and/or fined. | ECO, EA Holder |
| **Monitoring method and frequency** | • Visual inspection.<br>• Immediate response to spillage.<br>• Completion of an incident form for major spillages (>5ℓ).<br>• Reporting of major spills within 24 hrs to the ECO. | Implementing Entity, ECO |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • Daily and weekly monitoring/inspections by the Implementing Entity.<br>• Formal monthly audits by the ECO. | |
| **Management outcomes** | • Hazardous materials are properly managed including recording keeping, storage, dispensing and disposal.<br>• Spillages are avoided and minimised through proper storage and dispensing practices.<br>• All personnel on site are properly trained concerning the proper use, handling and disposal of hazardous substances.<br>• The Implementing Entity has a designated and trained individual on-site to respond to spills on site.<br>• Spillages are removed/cleaned/treated immediately after occurring.<br>• Ensure that the appropriate mitigation measures are in place and implemented in the event of a spill.<br>• Hazardous materials are stored in designated/approved areas away from sensitive receptors/environments.<br>• Spills are reported to the ECO within 24hrs of occurring.<br>• Spilled hazardous product and materials used for clean-up are stored and disposed of as hazardous waste or collected by a registered service provider. | Implementing Entity, ECO |

## 4.8 Contamination of soils and water

**Identified impacts:** Soil and water can be contaminated or polluted by construction activities via several pathways. In terms of soil contamination, pollution can result in the soil being unsuitable for certain land uses and it can also indirectly contribute to sustained pollution of both surface and groundwater resources. The pollution of water resources can lead to numerous direct and indirect impacts including the following:

- Water becoming unsuitable for certain uses such as human consumption and certain agricultural activities due to a decline in water quality.
- A loss of aquatic biodiversity through a change in species composition and diversity and/or species die-off in reaction to a decline in water quality.
- An increase in alien invasive fauna and flora species as a result of higher tolerance capacity in terms of water quality changes/deterioration.
- Increased costs of treating contaminated water for human consumption.

**Objective of improved management:**

- To conduct/manage construction activities in such a manner that the contamination of soil and water resources is avoided and/or minimised.

**Specifications:** None

**Table 9: Specific avoidance, mitigation and cessation management measures related to impacts identified regarding contamination of soil and water**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • Ensure that all equipment, machinery and vehicles are in good working order.<br>• No maintenance will take place on site and broken equipment, machinery and vehicles must be removed off-site within 24 hours of the breakdown.<br>• Use drip trays for all stationary or parked equipment, machinery and vehicles showing signs of leakage.<br>• Ensure that substances that pose a risk of water/soil contamination are appropriately stored and disposed of (also refer to Section 4.7).<br>• Site camps are not allowed in a wetland.<br>• Hazardous materials storage areas are not allowed within 100m of watercourses. | Implementing Entity |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • Concrete mixers may only operate on a stable, level site.<br>• Concrete shall be mixed on trays or other suitable lining material to prevent contamination of the soil and/ or waterbodies.<br>• Ensure that minor mixing of concrete and mortar is done on impermeable surfaces or in wheel barrows.<br>• Store chemicals in clearly marked, sealable containers in bunded areas as approved by the ECO. Inspect the containers at regular intervals for any leaks.<br>• Use proper dispensing equipment on containers for hazardous products and store the dispensing equipment in weatherproof containers when not in use.<br>• Ensure that equipment and plant is in proper working condition and do not leak fuel or oil, especially during work in or near watercourses.<br>• Ensure designated staff are trained in the prevention and mitigation of spills.<br>• The construction camp and any major stockpiling or storage areas should be outside any watercourse unless otherwise approved by the ECO.<br>• Stormwater runoff must be diverted around the site camp and stockpile areas (material susceptible to erosion) by means of cut-off berms or trenches to avoid contamination of clean overland runoff.<br>• Stockpiles (topsoil, subsoil and imported materials such as sand and fill material) must be on flat surfaces in areas which are not susceptible to concentrated stormwater runoff or flow.<br>• Ablution facilities must be located outside the boundary of any watercourse unless otherwise approved by the ECO. Workers should not be allowed to urinate or defecate near or in bushes or rivers/streams. | |
| **Mitigation** | • All spills to be contained and adequately cleaned-up or treated *in situ.*<br>• Conduct activities with high pollution potential in the low rainfall months. | Implementing Entity |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • Use designated washing areas for all equipment used for concrete work with the necessary mechanisms in place to retain contaminated runoff and allow for the necessary treatment/filtering of polluted water. | |
| **Stop work** | • Should a major spill occur (as per Section 4.7), the ECO reserves the right to suspend or partially suspend construction via instruction from the EA Holder in order to allow for the assessment, reporting and rectification of the impact.<br>• Depending on the severity of the non-conformance and degree of negligence on the Implementing Entity's part, the ECO will also inform the relevant competent authority to confirm the Implementing Entity's liability to be prosecuted and/or fined. | ECO, EA Holder |
| **Monitoring method and frequency** | • Daily visual inspection of equipment, vehicles and machinery for signs of leaks.<br>• Immediate response to spillage of product or material with pollution potential.<br>• Completion of an incident form for major spillages (>5ℓ).<br>• Reporting of major spills within 24 hrs to the ECO.<br>• Daily and weekly monitoring/inspections by the Implementing Entity.<br>• Formal monthly audits by the ECO. | Implementing Entity, ECO |
| **Management outcomes** | • All activities and materials with a notable pollution potential or located away from any watercourse unless otherwise approved by the ECO.<br>• All the necessary pollution prevention measures are in place.<br>• Plant is in good and working condition with leaks repaired immediately or the plant removed from site where more extensive repairs are required.<br>• All hazardous products/materials are handled/managed correctly as per Section 4.7.<br>• All hazardous liquid product spills are cleaned/treated/removed immediately as per procedure under Section 4.7. | Implementing Entity |

## 4.9 Concrete mixing and cement handling

**Identified impacts:** Concrete batching/mixing operations can have several impacts, most notably soil and water pollution (increase in pH, TSS, TDS and minor levels of Aluminium, Iron and Magnesium oxides) as a result of cement laden runoff not being properly contained or purposeful discharge of cement laden runoff. Poor cement handling, storage and disposal practices can also contribute to the aforementioned impacts. Hardened concrete is however stable and inert as a waste.

**Objective of improved management:**

- Ensure proper cement handling, storage and disposal, avoiding discharge or disposal into the environment.
- Ensure that cement laden water/runoff from concrete/mortar mixing and application activities is collected and retained on site to allow for reuse in construction activities, avoiding discharge into the environment.

**Specifications:**

- A concrete batching plant/portable mixer will not be allowed to operate until a temporary washwater and runoff containment system has been constructed/established.

**Table 10: Specific avoidance, mitigation and cessation management measures related to impacts identified in terms of concrete batching and cement handling**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • Where concrete is mixed in bulk (i.e. portable concrete mixer), the following will apply:<br>o The mixer will be placed on a level, surfaced/lined area.<br>o Bulk mixing will not occur in the wetland unless the distance from the wetland boundary to the Intervention Point necessitates *in situ* mixing. This must be approved in all instance by the PC/ECO prior to the commencement of bulk mixing concrete.<br>• Cement storage will be in a closed container.<br>• Waste or contaminated cement powder will be stored in a marked container with a lid until disposal or reuse.<br>• Cement bags must be emptied properly and stored in a weatherproof container until disposal. | Implementing Entity, ECO |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • Minor concrete and mortar mixing will be done on an impermeable surface such as a wooden board, wheelbarrow, metal tray etc. | |
| **Mitigation** | • Equipment and containers used for minor concrete/mortar work and mixing will be washed in a designated container and the contents disposed of in the settling system at the concrete batching plant. Washwater can alternatively be reused in concrete/mortar mixing or application, but may not be disposed of onto the ground surface or into a water resource.<br>• Concrete (not cement) spills will be allowed to harden and removed within 2 days for reuse or disposal as a Type 4 waste to a Class D landfill. | Implementing Entity |
| **Stop work** | • Mismanagement of waste concrete and/or cement laden runoff can result in the suspension of bulk concrete mixing activities via instruction from the ECO until non-conformances have been rectified to the ECO's satisfaction. | Implementing Entity, ECO, Engineer |
| **Monitoring method and frequency** | • Daily visual inspection of areas where concrete/mortar work is taking place (Foreman).<br>• Weekly inspection of settling system at batching plant (Foreman).<br>• Reporting of major spills within 24 hrs to the ECO.<br>• Formal monthly audits by the ECO. | Implementing Entity, ECO |
| **Management outcomes** | • Cement laden runoff is contained to site in an appropriately sized settling system.<br>• Cement product is properly handled and stored and does not result in pollution of soil or water resources.<br>• No equipment or plant used for concrete/mortar mixing or application is washed in a watercourse.<br>• The settling system at the batching plant/portable mixer is maintained and does not overflow.<br>• Waste concrete is removed within 2 days and reused or disposed of as inert waste. | Implementing Entity |

## 4.10 Stormwater management, erosion and sedimentation

**Identified impacts:** The clearance of vegetation and earthworks associated with construction usually results in an increase in stormwater runoff volume and velocity. This in turn results in an increase in erosion and sedimentation, impacting both terrestrial and aquatic systems. Temporary structures, stockpiles and access roads can also further contribute to a concentration of runoff and resultant increase in erosion and sedimentation on site.

**Objective of improved management:**

- To avoid and mitigate the increase in stormwater volumes and velocity, thereby reducing erosion and sedimentation on site.

**Specifications:** None

**Table 11: Specific avoidance, mitigation and cessation management measures related to impacts identified in terms of stormwater management, erosion and sedimentation**

| Management Measure | Detailed Description | Responsibility |
| --- | --- | --- |
| **Avoidance** | • Vegetation and topsoil clearance will occur at increments and will only be done up to two weeks ahead of actual construction (i.e. excavation) commencing in an area.<br>• Material (excavated and imported) stockpiles will not be located in areas of concentrated runoff/flow. | Implementing Entity |
| **Mitigation** | • Stormwater generated on the cleared construction footprint will be allowed to discharge into the surrounding vegetation at regular intervals and will not be allowed to collect and concentrate in large volumes or discharge at high velocities.<br>• Disturbed areas must be rehabilitated as soon as possible after construction has been completed in order to stabilise exposed surfaces which are susceptible to erosion.<br>• Implement temporary stormwater management and erosion prevention measures in areas with high erosion potential (in consultation with the ECO). | Implementing Entity |
| **Stop work** | N/A | |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Monitoring method and frequency** | • *Ad hoc* visual inspections of site by the Implementing Entity after rainfall exceeding 15mm per day.<br>• Formal monthly audits by the ECO. | Implementing Entity, ECO |
| **Management outcomes** | • Exposed ground surfaces are limited and rehabilitated immediately after completion of construction activities in an area.<br>• Stormwater runoff is dissipated and allowed to discharge at regular intervals.<br>• Erodible stockpiles are located outside areas of stormwater concentration.<br>• The construction site does not contribute notably to erosion on-site and in the immediate vicinity of the site.<br>• Erosion is detected/identified and addressed/mitigated within 14 days of occurring.<br>• Temporary stormwater management and erosion prevention measures are implemented in areas with high erosion potential of signs of extensive erosion occurring. | Implementing Entity, ECO |

## 4.11 Dust nuisance

**Identified impacts:** Construction activities will typically lead to dust generation and general exhaust emissions from vehicles and construction plant. Given the limited extent of vegetation clearance and low number of vehicles and construction plant used on a typical WfWetlands site, dust generation is expected to generally be minimal and restricted to mostly a nuisance impact.

**Objective of improved management:**

- To limit the generation of dust and where needed mitigate dust nuisance.

**Specifications:**

- Watering for dust suppression purposes is only recommended in instances where dust will create a significant health and/or safety hazard.

**Table 12: Specific avoidance, mitigation and cessation management measures related to impacts identified regarding dust nuisance**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • As far as possible stockpile materials which are prone to become airborne away from areas where dust will be a nuisance or a hazard.<br>• Limit the height of stockpiles which could cause a dust nuisance to 1m.<br>• Where the abovementioned cannot be achieved, cover stockpiles consisting mostly of fine material with shade cloth, hessian or a similar acceptable cover.<br>• Limit earthworks in during windy conditions (i.e. winds above 40 km/h).<br>• Limit vehicle travelling speeds on unsurfaced roads to 40 km/h. | Implementing Entity |
| **Mitigation** | • Where dust poses a notable health and/or safety hazard, implement a watering schedule to address the particular area of concern.<br>• Ensure that a watering schedule is maintained over weekends and holidays where a dust nuisance could pose a health and/or safety hazard to the public using the road.<br>• Record and address any public/community complaints regarding dust generation in the Complaints Register. | Implementing Entity |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Stop work** | • Work causing excessive dust will be halted at wind speeds exceeding 40km/h.<br>• Where dust generation leads to/results in a complaint by the public or landowner, the ECO reserves the right to suspend or partially suspend work on site until the source of dust is identified and mitigation measures implemented. | Implementing Entity, ECO |
| **Monitoring method and frequency** | • Daily visual monitoring.<br>• Recording of public complaints regarding dust generation in Complaints Register. | Implementing Entity |
| **Management outcomes** | • The dustfall rate as specified under regulation 3 of GN R827 (National Environmental Management: Air Quality Act (No. 39 of 2004) - National Dust Control Regulations, 2013) is not exceeded.<br>• Stockpiles which could cause a dust nuisance are limited to 1m in height or covered with a suitable material.<br>• No public complaints are received regarding dust nuisance and/or health and safety hazard.<br>• Where required, a watering schedule is implemented where required i.e. where dust causes a health and/or safety hazard.<br>• Alternative dust binding products are used where long-term watering (> 4 weeks) over an extensive area (>1ha) is required.<br>• Vehicle travelling speed is limited to 40km/h on unsurfaced roads. | Implementing Entity, ECO |

## 4.12 Noise nuisance

**Identified impacts:** Typical construction activities can lead to excessive noise which could cause a disturbance or nuisance to neighbouring land uses/receptors. Typical construction related noise which would usually be regarded as permissible in urban areas might also be regarded as a disturbance in areas such as nature reserves or on farms.

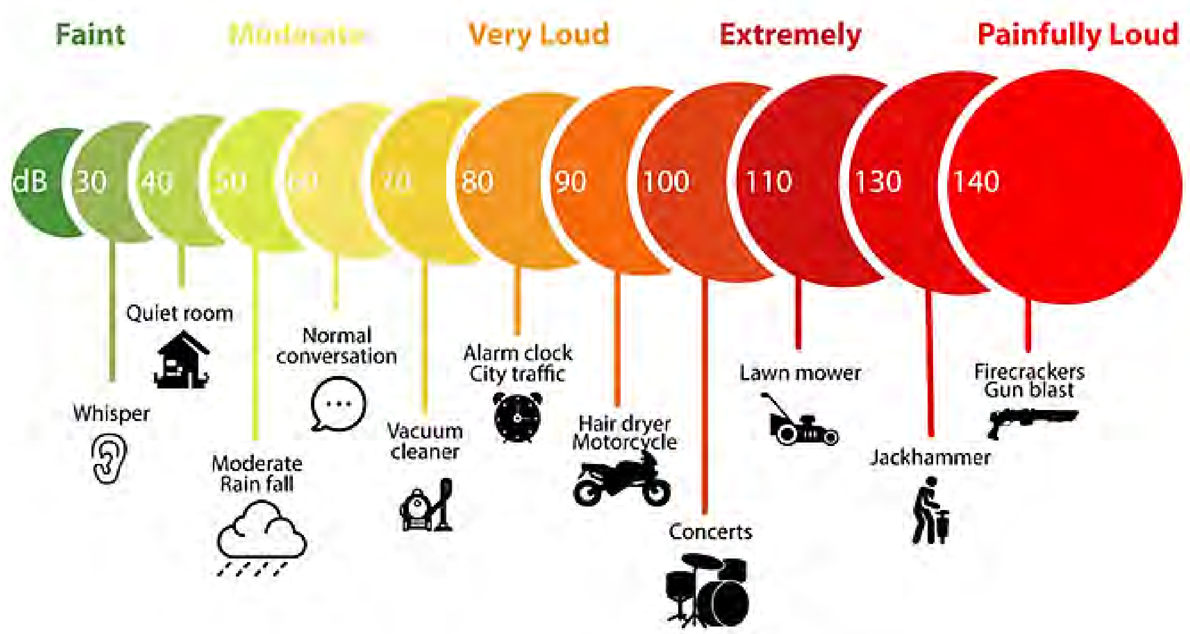



**Figure 1: Example of typical everyday noises and related dB values**[24]

**Objective of improved management:**

- Manage the level and duration of excessive noise generated as a result of construction activities and avoid resultant public complaints. Also ensure that sensitive receptors are notified in advance where excessive noise cannot be avoided for a certain period of time or activity.

**Specifications:** None

[24] http://ototronixdiagnostics.com/images/decibelthermometer-horizontal.jpg

Table 13: Specific avoidance, mitigation and cessation management measures related to impacts identified regarding noise nuisance

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • Fit silencers to equipment as required.<br>• Ensure equipment and vehicles are properly maintained and in working order.<br>• The Implementing Entity shall limit noise levels (e.g. install and maintain silencers on machinery). The provisions of SANS 1200A Sub-clause 4.1 regarding “built-up areas” shall apply to all areas within audible distance of residents whether in urban, peri-urban or rural areas.<br>• Appropriate directional and intensity settings are to be maintained on all hooters and sirens. | Implementing Entity |
| **Mitigation** | • Limit working hours with noisy equipment to weekdays between 07H00 and 18H00.<br>• Inform sensitive receptors in advance of construction activities.<br>• Construction activities generating output levels of 50dB (A) or more, in peri-urban areas, shall be confined to the hour’s 08h00 to 17h00 Mondays to Saturdays.<br>• Record and address any public/community complaints regarding noise generation in the Complaints Register.<br>• Request formal approval of extension of working hours by the ECO prior to implementing extended hours or working over weekends. | Implementing Entity, ECO |
| **Stop work** | N/A | |
| **Monitoring method and frequency** | • Daily monitoring (by means of a dB meter application on a cell phone) should any laud activities take place.<br>• Recording of public complaints regarding noise generation in Complaints Register. | Implementing Entity |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Management outcomes** | • Compliance with the Environment Conservation Act (No. 73 of 1989): Regulations in terms of Section 25 - Noise Control (GN R154, 1992)[25]. <br> • No public complaints are received regarding noise generation and/or health and safety hazard. | Implementing Entity, ECO |

[25] Please note: These regulations have been repealed in Gauteng by Gen N 5479 / PG 75 / 19990820; in the Free State by Gen N 24 / PG 35 / 19980424 and in the Western Cape by RN 627 / PG 5309 / 19981120. Proposed Noise Control Regulations have been published for Eastern Cape under Gen N 181 / PG 824 / 20011210. Please also note that various municipalities have their own By-Laws regarding noise control.

## 4.13 Ablution

**Identified impacts:** A lack of proper and well placed ablution facilities can result in poor working conditions, health risks as well as environmental pollution.

**Objective of improved management:**

- To provide sanitary working conditions and avoid heath risks and environmental pollution as a result of a lack of ablution facilities.

**Specifications:** None

**Table 14: Specific avoidance, mitigation and cessation management measures related to impacts identified in terms of ablution**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • Prior to construction commencing the Implementing Entity must provide sanitation for Contractors at a ratio of one (1) toilet for every 15 workers.<br>• Toilets should preferably be located outside the wetland boundary and must be approved by the ECO.<br>• Toilets shall be placed on level surfaces and secured to the ground outside areas susceptible to potential flooding.<br>• The Implementing Entity shall supply toilet paper at all toilets at all times. The Implementing Entity shall ensure that the workers make use of the toilets provided.<br>• The Implementing Entity shall be responsible for the cleaning, maintenance and servicing of the toilets.<br>• The Implementing Entity shall ensure that the toilets are protected from vandals. No litter or general waste shall be placed in the toilets.<br>• Upon completion of the contract, the pit latrines shall be filled in and all structures shall be removed from site.<br>• Washing areas with soap and sufficient clean water shall be provided for hand washing after use of ablutions. | Implementing Entity |
| **Mitigation** | N/A | |
| **Stop work** | N/A | |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Monitoring method and frequency** | • Daily inspection (by the Implementing Entity) to allow for timely removal/servicing of the ablution facilities.<br>• Monthly compliance audits (including checking of disposal slips where relevant) by the ECO. | Implementing Entity, ECO |
| **Management outcomes** | • A sufficient number of ablution facilities is provided at locations approved by the ECO.<br>• Toilets are placed on level areas and secured to the ground.<br>• Toilets are provided at a ratio of one (1) toilet for every 15 workers. | Implementing Entity |

### 4.14 Waste management

**Identified impacts:** The construction phase will produce typical construction waste such as general waste, waste containers, cement bags, off-cuts etc. The volumes of waste to be generated on a typical WfWetlands site are expected to be low.

**Objective of improved management:**

- To prevent general littering and to ensure that waste is correctly stored on-site and disposed of off-site. Licenced waste disposal facilities (landfill, transfer, recycling) can be found using the search function at the following link http://sawic.environment.gov.za/?menu=88.

**Specifications:** None

**Table 15: Specific avoidance, mitigation and cessation management measures related to impacts identified in terms of waste management**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • Waste will not be buried or burned on site.<br>• The quantity of materials and product brought to site will not be in notable excess of what is required for construction.<br>• Waste from other construction sites where the Implementing Entity is working will not be brought onto site or stored on site.<br>• Waste storage facilities will outside the wetland boundary or other sensitive areas.<br>• Waste storage facilities and containers will be weather and scavenger proof with sufficient capacity to avoid waste accumulating outside of the facility or containers.<br>• The Implementing Entity shall ensure that general and inert waste does not become contaminated by hazardous waste thereby generating larger volumes of hazardous waste requiring disposal at a Class A landfill. | Implementing Entity |
| **Mitigation** | • The Implementing Entity shall, in conjunction with the ECO, designate restricted areas for eating. The feeding, or leaving of food, for stray or other animals in the area is strictly prohibited. | Implementing Entity |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • Waste generated on site will be collected and transported to the waste storage area at the site camp on a daily basis.<br>• Each foreman will do a daily inspection/walkthrough of his area and ensure that it is litter free.<br>• Waste storage areas will be restricted to the site camp.<br>• Hazardous and general waste will be separated and designated and marked bins/containers provided for each.<br>• In the case of skippy bins being used, the bins will be covered with secured shade cloth or other cover approved by the ECO. Skippy bins are only allowed for storage of inert waste such as wood off-cuts, hardened concrete etc.<br>• Waste transport will be by means of an appropriate vehicle with containers and/or bags secured and covered to prevent waste being blown from the vehicle during transport.<br>• Used oil will be collected and taken to or collected by a registered oil recycling company.<br>• Other hazardous waste as per Schedule 3 of NEM:WA and Annexure 1 of GN R634 (2013) will be disposed of at a Class A landfill or collected by an approved service provider. Proof of safe transfer/disposal will be filed in the SEF.<br>• Waste disposal restrictions as per GN R636 (2013) shall apply. Of specific relevance is:<br>o Lead acid batteries, corrosive or oxidizing products.<br>o Waste which is flammable with a flash point lower than 61°C.<br>o Waste compressed gases.<br>o Re-usable, recoverable or recyclable used lubricating mineral oils, as well as oil filters, but excluding other oil containing wastes.<br>o Re-usable, recoverable or recyclable used or spent solvents. | |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | o Lamps.<br>o Tyres (whole or quartered).<br>o Liquid waste or waste with a moisture content of >40%. | |
| **Stop work** | N/A | |
| **Monitoring method and frequency** | • Daily inspection of working area for any litter/waste.<br>• Weekly checking of waste storage area to ensure timeous removal of waste off-site prior to storage areas becoming overfull.<br>• Proof of safe disposal filed in Environmental File and audited monthly by ECO. | Implementing Entity, ECO |
| **Management outcomes** | • No waste disposed of or burned on site.<br>• No visible littering.<br>• Waste transport does not result in waste being blown from the vehicle along the route.<br>• Appropriate and separate storage of different types of waste in approved locations.<br>• Proper record keeping of hazardous waste generated and safe and legal disposal thereof. | Implementing Entity |

## 4.15 Removal of alien invasive species

**Identified impacts:** The WfWetlands programme often involves the removal of alien invasive species as part of an intervention(s) to improve wetland functioning. The method for removal is usually specified in the aforementioned situation. A construction site, due to its inherent disruptive nature, does however also lead to conditions ideal for the establishment of weeds/pioneer species and alien invasive species (hereafter collectively referred to as “weeds”) which could compromise the habitat integrity and ecological functioning of the wetland system as well as downstream systems. It is therefore important to implement strict control measures to ensure that alien invasive species are not introduced into a system or/and are not allowed to dominate an area post-construction.

**Objective of improved management:**

- No new alien invasive/pioneer species are introduced into the wetland system and catchment.
- Emerging weeds are removed prior to seed formation stage.

**Specifications:**

- Where project activities include the eradication of invasive alien plants, Working for Water guidelines and policies shall be adhered to.
- Weeds will be removed prior to reaching seed formation stage.
- Prior to construction, the Implementing Entity shall ensure that invasive alien vegetation is cleared from the entire site in accordance to the applicable Working for Water guidelines and policies. Follow up clearing may be necessary if the species re-establish following the initial clearing.
- Species that are declared invasive species (according to NEMBA’s Alien and Invasive Species Regulations, 2014 (GN R598)) must be recorded and polygons of the affected area must be submitted to the Working for Water national alien invasive plant database.
- The Alien and Invasive Species Lists 2016 (GN 864) will apply when identifying species which require removal/eradication.
- No trees within the environmentally sensitive areas may be removed, whether alien species or not, unless permitted by the ECO.
- Other alien species (non-listed) occurring on site may not be used in the landscaping and should be removed from site where possible.
- Where an individual or group of an invasive alien specimens/plants has potential cultural or heritage value e.g. a blue gum lane, tree at a grave site, the landowner and/or community will be consulted prior to the removal of the specimen(s). The aforementioned might also be protected under the NHRA, in which case removal might not be allowed.

**Table 16: Specific avoidance, mitigation and cessation management measures related to the removal of Alien Invasive/pioneer species**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • Imported material shall be free of weeds.<br>• Stockpiles (topsoil and subsoil) will be checked for emerging weeds on a fortnightly basis.<br>• Topsoil sourced from areas with notable weeds infestation will not be used in other areas for rehabilitation or fill purposes. | Implementing Entity |
| **Mitigation** | • Where sand/fill material is legally sourced from a dam, existing borrow pit or similar with clear presence of invasive alien species, the Implementing Entity will allow for a weeding programme at the on-site stockpile area and Intervention Point. | Implementing Entity |
| **Stop work** | N/A | |
| **Monitoring method and frequency** | • Fortnightly inspections of disturbed/cleared areas and stockpiles for signs of emerging weeds.<br>• Monthly audit/visual inspection by ECO. | ECO |
| **Management outcomes** | • Construction activities are restricted to the approved construction footprint.<br>• The Implementing Entity's activities does not lead to the negligent or wilful damage to a natural feature. | Implementing Entity |

## 4.16 Impact on fauna

**Identified impacts**: Typical construction activities could lead to fatalities of small fauna e.g. birds, reptiles, rodents through direct impact and the destruction of habitat. The proposed project will however be limited to the road reserve which is already completely transformed and subject to daily traffic. The upgrade/replacement of culverts and bridges might result in the destruction of a number bird nests attached to the structures.

**Objective of improved management:**

- Protect fauna in the study area, preserve the ecological functioning along the development footprint as much as is possible.

**Specifications**: None

**Table 17: Specific avoidance, mitigation and cessation management measures related to impacts on fauna**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • Do a site walkthrough prior to construction commencing to remove any slow moving animals and to identify nesting sites, burrows etc.<br>• Demarcate nesting sites which should be avoided as no-go areas by means of painted pegs.<br>• Avoid disturbance of burrows, nests etc. where possible.<br>• Create awareness of conservation of fauna during environmental induction and toolbox talks.<br>• Fauna may not be captured, poisoned, trapped or killed.<br>• Do not feed wildlife.<br>• Where working in a nature reserve with potentially dangerous animals present, ensure that the team is accompanied by a suitably qualified game ranger at all times.<br>• A speed limit of 20 km/h in nature reserves will apply unless otherwise indicated by the reserve road signage.<br>• Inspect excavations for trapped animals prior to work commencing each day.<br>• Do not use pesticides on site. | Implementing Entity |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • Do not burn vegetation.<br>• Store waste in weather and scavenger proof bins to avoid ingestion of waste by wildlife. | |
| **Mitigation** | • Limit the construction footprint.<br>• Reinstate temporary footprints after construction has been completed.<br>• Report any animal fatalities of significance to the ECO and relevant reserve management (where applicable) and identify measures to avoid reoccurrence. | Implementing Entity, ECO |
| **Stop work** | N/A | |
| **Monitoring method and frequency** | • Daily inspections of trenches and excavations prior to construction commencing.<br>• Weekly inspections of demarcated no-go areas.<br>• Recording of incidents and near misses (e.g. vehicle-antelope collision) in the site diary and at site meetings.<br>• Disciplinary action against any construction staff guilty of purposefully capturing, poisoning, trapping or killing wildlife. | Implementing Entity |
| **Management outcomes** | • No unnecessary fauna fatalities.<br>• Limited habitat disturbance and reinstatement of temporary construction footprints. | Implementing Entity |

## 4.17 Protection of natural features

**Identified impacts:** Construction activities could result in damage to natural features such as rock outcrops and exposed rock faces/cliffs. The project is not located in an area associated with rock paintings, caves, waterfalls, trees of historical or cultural significance etc. and the risk of damage to natural features is generally considered low.

**Objective of improved management:**

- No damage to natural features due to negligent or purposeful action during construction.

**Specifications:**

- Demarcation will be by means of brightly painted/white pegs/poles at least 1.5m in height and placed at regular (10m for linear of on every corner for non-linear) intervals on both sides of the approved construction footprint.
- Danger tape and/or snow/barrier netting shall only be used for health and safety requirements along excavations or high risk areas.
- All temporary barriers and signage must be removed and the site restored on completion of the project.

**Table 18: Specific avoidance, mitigation and cessation management measures related to impacts on natural features**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • Construction activities shall be restricted to the approved construction footprint.<br>• Sensitive or no-go areas in close proximity (<100m) to the construction site will be demarcated with painted pegs and marked as no-go areas.<br>• The Implementing Entity shall not deface, paint, damage or mark any natural features (e.g. trees or rock formations) situated in or around the site for survey or other purposes unless agreed beforehand with the ECO and Engineer. | Implementing Entity |
| **Mitigation** | • Any features affected by the Implementing Entity as a result of negligence or wilful conduct shall be restored/ rehabilitated to the satisfaction of the ECO and/or relevant competent authority. | Implementing Entity |
| **Stop work** | N/A | |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Monitoring method and frequency** | • Monthly audit/visual inspection by ECO. | ECO |
| **Management outcomes** | • Construction activities are restricted to the approved construction footprint.<br>• The Implementing Entity's activities does not lead to the negligent or wilful damage to a natural feature. | Implementing Entity |

## 4.18 Protection of heritage resources (including palaeontological objects)

**Identified impacts:** The nature and location of typical WfWetlands interventions seldom have the potential to cause the destruction or lead to the discovery of palaeontological objects such as fossils. An exception is peat wetlands which can contain fossils at usually substantial depth. Heritage resources are identified during the EIA phase and indicated as no-go areas. There is however still the opportunity for the discovery or damage to new objects during the construction phase.

**Objective of improved management:**

- To avoid damage to known heritage objects and to ensure a protocol is in place in the case of discovery of an unknown heritage or palaeontological object.

**Specifications:** None

**Table 19: Specific avoidance, mitigation and cessation management measures related to impacts on heritage resources (including palaeontological objects)**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • The Implementing Entity shall avoid all "no-go" areas as identified during the EIA.<br>• General staff awareness training in terms of the protection and conservation of heritage resources during the environmental induction and toolbox talks. | Implementing Entity |
| **Mitigation** | • Should any cultural, archaeological or palaeontological artefacts/objects or evidence be discovered at any stage during construction, the Implementing Entity will cease work in the vicinity of the artefact/object and inform the ECO who will in turn inform the relevant specialists and authorities.<br>• Site staff is not allowed to collect or keep on artefact or object of cultural, archaeological or palaeontological significance. | Implementing Entity, ECO, Specialist |
| **Stop work** | • Should any cultural, archaeological or palaeontological artefacts/objects or evidence be discovered, partial suspension of construction activities in the immediate vicinity of the object might need to be required until the object can be evaluated and/or removed. | Implementing Entity, ECO, Specialist |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Monitoring method and frequency** | • Continuous during construction.<br>• Monthly audit by ECO in terms of no-go areas being maintained. | Implementing Entity |
| **Management outcomes** | • No-go areas (i.e. all areas outside the approved construction footprint) are treated as no-go areas with no disturbance of heritage/cultural objects on private land adjacent to the construction site.<br>• Proper procedure followed should any object or artefact be discovered during construction. | Implementing Entity |

## 4.19 Visual impact

**Identified impacts:** The nature of a typical WfWetlands project is seldom such that it causes significant visual disturbance, with the visual impact of the operational outcome usually being positive. Construction activities can however lead to temporary and permanent landscape scarring and impacts, which can be excessive if not controlled and mitigated properly.

**Objective of improved management:** Ensure that visual impacts caused by landscape scarring are minimised through proper planning and mitigated through successful rehabilitation.

**Specifications:** None

**Table 20: Specific avoidance, mitigation and cessation management measures related to visual impacts**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • Avoid excessive vegetation clearance.<br>• Ensure construction remains within the approved construction footprint.<br>• Do not paint or deface any natural feature. | EAP, ECO, Implementing Entity |
| **Mitigation** | • Ensure that materials used for construction limits visual impacts e.g. use natural colours where possible.<br>• Ensure that the site remains neat and tidy with no littering etc.<br>• Use shade cloth or construction cordon in areas specifically sensitive to visual disturbances e.g. areas frequented by tourists or the public.<br>• Record and address community complaints as per procedure specified under Section 4.3.<br>• Ensure rehabilitation is successful as specified under Section **5**. | Implementing Entity |
| **Stop work** | N/A | |
| **Monitoring method and frequency** | As specified for rehabilitation under Section **5**. | ECO |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Management outcomes** | • Visual impacts are minimised and managed.<br>• The extent of disturbance is minimised and limited to the approved construction footprint.<br>• The extent of intervention infrastructure remaining bare i.e. no vegetated is limited as best as possible.<br>• Rehabilitation meets the requirements and targets as per Section **5**. | Implementing Entity, ECO |

# 5 REHABILITATION PHASE

**Identified impacts:** Poor rehabilitation can often lead to secondary impacts such as erosion, an increase in alien invasive species, decreased biodiversity, decreased habitat connectivity, poor ecological integrity and functioning and so forth. Given the core focus of the WfWetlands programme, successful rehabilitation is also a key factor, but should entail more than the functioning of an intervention with focus on ensuring that the permanent footprint of the construction site and actual structure is minimal.

**Objective of improved management:**

- To ensure that construction footprints are rehabilitated and that site rehabilitation is undertaken in such a manner that the permanent footprint of the construction site of the Intervention Point is minimal.

**Specifications:**

- All working areas shall be rehabilitated once work has been completed and before the team leaves the site. This includes closure and rehabilitation of temporary access routes.
- All foreign material not utilised in the rehabilitation activities shall be removed from the site.
- Re-vegetation of all exposed soils, and measures to address any potential erosion risk shall be done before the team leaves the site.
- Where project activities include the eradication of invasive alien plants, Working for Water guidelines and policies shall be adhered to.
- All rehabilitated areas shall be considered “no-go” areas upon completion and the Implementing Entity shall ensure that none of his staff or equipment enters these areas.
- Specific Site Rehabilitation measures have been included in the project specific Rehabilitation Plans and shall be referred to for site closure. Due notice of the conditions of Environmental Authorisation and requirements of the General Authorisation for water uses (Annexure B) must be complied with.
- Specifically, on the completion of the construction activities:
  - All disturbed areas must be re-vegetated with local indigenous vegetation suitable to the area.
  - An active campaign for controlling new exotic and alien vegetation must be implemented within the disturbed areas.
  - Structures must be inspected after a major rain event (i.e. more than 50mm rainfall) or annually for the accumulation of debris, blockages, instabilities and erosion with concomitant remedial and maintenance actions.

**Table 21: Specific avoidance, mitigation measures related to rehabilitation of the project footprint**

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| **Avoidance** | • Manage site demarcation and vegetation clearance as per Sections 4.2, 4.4 and 4.5 respectively.<br>• Ensure that sufficient topsoil is available through proper removal, stockpiling and maintenance procedures as specified under Section 4.5. | Implementing Entity |
| **Mitigation** | **General:**<br>• All waste will be collected and removed (also look beyond immediate working area for any waste which might have been blown into the surrounding area).<br>• All spoil and excess material must be removed material.<br>• All spills and waste concrete must be removed.<br>• All temporary markings and site demarcation must be removed.<br>• All temporary construction signage must be removed.<br>• Where temporary access roads cut across contours, diversion berms will be constructed at 30m intervals to avoid erosion and concentration of runoff prior to vegetation establishing. Mulching shall be applied to the decommissioned temporary access road.<br>**Shaping and revegetation:**<br>• Material will be backfilled in the order on which it was removed.<br>• Compacted soil shall be scarified prior to topsoil and seed application.<br>• Topsoil shall be applied at a minimum depth of 75mm.<br>• Where the Implementing Entity failed to manage topsoil properly, the Implementing Entity shall be held responsible to source topsoil of similar quality from a commercial source OR to remediate compromised topsoil by means of compost, fertiliser and seeding as agreed by the ECO. | Implementing Entity, ECO, Engineer |

| Management Measure | Detailed Description | Responsibility |
|---|---|---|
| | • Topsoil shall match the type and quality of topsoil removed from that area.<br>• Special care shall be taken where rehabilitation occurs across several wetland zones and or crossing between wetland and dryland habitats to match the soil removed to the area where it is reapplied.<br>• Seeding/re-seeding should, where possible, be timed to take advantage of the rainy season.<br>• All reinstated slopes will be at a gradient of 1:3 to 1:4.<br>• Slopes of 1:2 and 1:1 shall be stabilised by means of suitable geotextiles, hard structures or any other means as approved by the ECO.<br>• Slopes of 1:2 and 1:1 will be revegetated by means of sods and/or plugs of an approved indigenous grass specie. No Kikuyu shall be used for revegetation purposes.<br>• Local indigenous plants shall be used in the landscaping of the site. Plants that are proclaimed as problem plants or noxious weeds (see Section 4.15) are to be excluded from the landscaping plan and must be removed immediately, should they occur on site.<br>• Plants introduced into the project sites must be guided by ecological rather than horticultural principles. For example ecological communities of indigenous plants provide more biodiversity and habitat opportunities and would blend with natural vegetation.<br>• Where sods are sources from the surrounding environment, the sods must be 30x30cm, sourced in a checkered pattern in a flat area (i.e. not on slopes). The sods must be sourced 1m in radius apart and will be planted within 24 hours of removal unless otherwise approved by the ECO.<br>• Should the reshaping of watercourse banks be required it will match the natural preconstruction geomorphology and slope structure. Extensive reshaping of watercourse banks (and beds if applicable) will be done under close supervision of the ECO or relevant specialist. | |

| Management Measure | Detailed Description | Responsibility |
| --- | --- | --- |
| | • Areas where sods, plugs or seeds have been used as part of slope stabilisation measures will be watered at least every third day for a minimum period of 6 weeks unless the area is in a permanently wet zone of a wetland i.e. no watering required.<br><br>**Rehabilitation of peatlands**:<br>• Upon rehabilitation, the removed sods and soil stockpiles shall be placed back into the system in the original order/layers (i.e. deeper layers shall be placed first with the rhizosphere layer at ground level), and orientation (according to the natural slope). Should the moisture content of the sods be less than 90% moisture, the Implementing Entity shall be required to peg them with wooden stakes.<br>• The site shall be mulched (alternatively cloth/geotextile may be used) and livestock shall be fenced out for at least two seasons. Alternatively brush packs can be used to keep livestock and/or game away from the site.<br>• If compaction took place, the Implementing Entity shall loosen the soil with a fork on flat surfaces, and create small contour berms on paths with slopes. | |
| **Stop work** | N/A | |
| **Monitoring method and frequency** | • The Implementing Entity shall notify the ECO once rehabilitation in an area has been completed. The ECO shall be responsible for the technical, not contractual, sign-off of the rehabilitated sections. Only once the rehabilitation has been approved by the ECO, may the contractual sign-off be effected.<br>• The ECO shall conduct monthly inspections of rehabilitated areas for the first three months and then continue with inspections on a quarterly basis until the end of the contract period.<br>• The ECO should audit the site at the end of the Implementing Entity's retention period to establish whether rehabilitation has been successfully carried out. If not, the retention money could be used to implement additional rehabilitation measures. | Implementing Entity, ECO, Engineer |
| **Management outcomes** | • Vegetation clearance is limited to the approved construction footprint.<br>• All sloped areas are stable with no sign of slope failure or erosion. | Implementing Entity, ECO, Engineer |

# 6 EMERGENCY REPORTING AND PROCEDURES

The Implementing Entity must ensure that all emergency procedures are in place prior to commencing work. The nearest emergency service provider shall be identified and the up-to-date contact details of this emergency centre, as well as the police and ambulance services shall be displayed on a notice board and shall be made available to staff on-site. Emergency equipment including fire-fighting equipment shall be positioned at accessible locations near to areas where such emergencies may arise.

## 6.1 Emergency Awareness

The Implementing Entity shall ensure that site staff are aware of the procedure to be followed for dealing with emergencies, which shall include notifying the Implementer and relevant authorities of the event. All site staff shall be briefed regarding the requirements for dealing with potential emergencies including fires, accidental leaks and spillage of pollutants (also see Section 4.7 and 4.8), as well as Health and Safety incidents. Education of site staff shall focus on both preventative and remedial actions in the case of an emergency.

## 6.2 Incident Recording

The Implementing Entity shall complete an Incident Report (refer to template under Annexure B) in the case of any environmental emergencies, accidents or incidents (including near misses). The ECO shall monitor that the necessary procedures and responses are followed to close out any entries in the Environmental Incident Report. The aforementioned report will be filed in the SEF.

## 6.3 Fire

The Implementing Entity must take all reasonable measures to ensure that fires are not started as a result of construction activities on site, and shall also ensure that their operations comply with the Occupational Health and Safety Act (Act No. 85 of 1993). Where possible, all work done in the dry season shall be organised in liaison with the landowners so that it fits into their firebreak/ fire protection programme. No large open fires are permitted on site. Smoking on site shall only be permitted in designated areas and in the presence of a fire extinguisher.

Basic functional fire-fighting equipment (one back pack and at least five beaters) shall be made available at each work site at all times. In forestry areas there must also be two rake hoes per team. The Implementing Entity shall appoint a member of his staff to be responsible for the installation and inspection of this equipment. Where work will take place in a peatland or wetland with a high organic soil content, a Method Statement shall be prepared for the ECO's approval, detailing all the actions that will take place should a fire occur, as well as the relevant emergency contacts.

Where fuels and machines are used on site, the prescribed fire extinguishers in working condition must be made available by the Implementing Entity.

Sparks generated during welding, cutting of metal or gas cutting can result in fires. Every possible precaution shall therefore be taken when working with this equipment near potential sources of combustion. Such precautions include having an approved fire extinguisher immediately available at the site of any such activities.

The Implementing Entity is to ensure that he/ she has the contact details of the nearest fire station in case of an emergency.

This page is left blank intentionally

## Annexure A: Basic Code of Conduct / Implementation

- Private property access is only permitted on previous agreement with the affected landowner, or will be considered trespassing. Trespassing on adjacent properties shall be subject to disciplinary and legal action.
- Ensure that closed gates are kept closed. When in doubt, the landowner should be consulted.
- Teams working outside of the active site, or requiring access to private properties are to carry identification on their persons that includes their name, position, company of employ, and reference to the Working for Wetlands Project. Similarly, such information shall be displayed on vehicle dashboards/exteriors.
- All work shall be based on an approved rehabilitation plan.
- Any deviations from the planned specification need to be approved by the PC and the relevant Engineer.
- A construction supervisor shall be appointed. The appointment letter shall be made available on site.
- Work sites shall be properly planned and marked out, preferably in collaboration with the Implementing Entity. Areas shall be demarcated for vehicle access and parking, off-loading, mixing etc. (refer to Section 4.2).
- No unauthorised person may enter the work site.
- The location and position of all rehabilitation interventions shall be precisely demarcated by the Engineer and the Implementer, according to the rehabilitation plan.
- Dimensions of rehabilitation interventions shall also be marked out where appropriate (e.g. depth of an excavation).
- Implementation of all interventions will be done with a focus on cost-effectiveness and efficiency, while maintaining quality and appropriateness.

This page is left blank intentionally

## Annexure B: Site Environmental File & Templates

| Section | Template available |
|---|---|
| **1. Rehabilitation Plan and EMP** | |
| **2.** Implementing Entity **Agreements** | |
| 2.1. Undertaking in terms of Environmental Authorisation, Environmental Management Programme, Rehabilitation Plan and submitted Method Statements | **Yes** |
| **3. Approvals and Licenses** | |
| 3.1. Environmental Authorisation | |
| 3.2. Section 21(c) and (i) General Authorisation | |
| 3.3. Waste license (if applicable) | |
| **4. Communication** | |
| 4.1. Important correspondence e.g. notice to Competent Authority of commencement of construction | |
| 4.2. Copy of public complaints register | **Yes** |
| **5. Site Management** | |
| 5.1. Approved layout | |
| 5.2. Site instructions (or copies thereof) | |
| **6. Environmental Training** | |
| 6.1. Proof of toolbox talks, environmental awareness and induction (incl. attendance register and training material) | |
| **7. Method Statements** | |
| 7.1. Combined method statements | **Yes** |
| 7.2. Additional method statements | **Yes** |
| **8. Records** | |
| 8.1. Record of waste generation – quantity, type, fate (incl. general/hazardous, liquid/solid) | |
| 8.2. Proof of legal/safe waste disposal | |
| 8.3. Record of chemicals on site and Material Safety Data Sheets (MSDS) | |
| 8.4. Record of water usage (if applicable) | |
| 8.5. Request for deviations | **Yes** |
| **9. Audits** | |
| 9.1. Baseline Audit | **Yes** |
| 9.2. ECO audit reports | |
| 9.3. Internal audits/check conducted by the Implementing Entity | **Yes** |
| 9.4. Incident and non-conformance reports | **Yes** |
| 9.5. Site closure | **Yes** |

This page is left blank intentionally

| Section | Template available |
|---|---|
| 1. Rehabilitation Plan and EMP | |
| **2. Implementing Entity Agreements** | |
| **2.1. Undertaking in terms of Environmental Authorisation, Environmental Management Programme, Rehabilitation Plan and submitted Method Statements** | **Yes** |
| 3. Approvals and Licenses | |
| 3.1. Environmental Authorisation | |
| 3.2. Section 21(c) and (i) General Authorisation | |
| 3.3. Waste license (if applicable) | |
| 4. Communication | |
| 4.1. Important correspondence e.g. notice to Competent Authority of commencement of construction | |
| 4.2. Copy of public complaints register | Yes |
| 5. Site Management | |
| 5.1. Approved layout | |
| 5.2. Site instructions (or copies thereof) | |
| 6. Environmental Training | |
| 6.1. Proof of toolbox talks, environmental awareness and induction (incl. attendance register and training material) | |
| 7. Method Statements | |
| 7.1. Combined method statements | Yes |
| 7.2. Additional method statements | Yes |
| 8. Records | |
| 8.1. Record of waste generation – quantity, type, fate (incl. general/hazardous, liquid/solid) | |
| 8.2. Proof of legal/safe waste disposal | |
| 8.3. Record of chemicals on site and Material Safety Data Sheets (MSDS) | |
| 8.4. Record of water usage (if applicable) | |
| 8.5. Request for deviations | Yes |
| 9. Audits | |
| 9.1. Baseline Audit | Yes |
| 9.2. ECO audit reports | |
| 9.3. Internal audits/check conducted by the Implementing Entity | Yes |
| 9.4. Incident and non-conformance reports | Yes |
| 9.5. Site closure | Yes |

# 2 Implementing Entity Agreements

## 2.1 Undertaking in terms of Environmental Authorisation, Environmental Management Programme, Rehabilitation Plan and submitted Method Statements

| | |
|---|---|
| **PROJECT NAME:** | **………………………………………………………………….** |
| **IMPLEMENTING ENTITY:** | **………………………………………………………………….** |
| **DATE:** | **………………………………………………………………….** |

I, ________________________ (name), ID number ______________________________ hereby confirm the following:

1. I have received a copy of the Environmental Authorisation (EA), Environmental Management Programme (EMPr) and Rehabilitation Plan for this project.
2. I have familiarised myself with the contents of aforementioned documents and understand what is required from me as the Implementing Entity.
3. I understand that I will be audited against the EA, EMPr, Rehabilitation Plan and approved Method Statements.
4. I understand that the EA is legally binding and that a contravention of an EA condition can lead to the suspension of the EA and thus construction.
5. I understand that I am responsible for the actions of my employees and will ensure that all staff on site are aware of the requirements and restrictions as per the EA, EMPr, Rehabilitation Plan and Method Statements.

| | | |
|---|---|---|
| _____________________ | _________________________ | _________________________ |
| Signed | Designation | Dated |

| Section | Template available |
|---|---|
| 1. Rehabilitation Plan and EMP | |
| 2. Implementing Entity Agreements | |
| 2.1. Undertaking in terms of Environmental Authorisation, Environmental Management Programme, Rehabilitation Plan and submitted Method Statements | Yes |
| 3. Approvals and Licenses | |
| 3.1. Environmental Authorisation | |
| 3.2. Section 21(c) and (i) General Authorisation | |
| 3.3. Waste license (if applicable) | |
| **4. Communication** | |
| 4.1. Important correspondence e.g. notice to Competent Authority of commencement of construction | |
| **4.2. Copy of public complaints register** | **Yes** |
| 5. Site Management | |
| 5.1. Approved layout | |
| 5.2. Site instructions (or copies thereof) | |
| 6. Environmental Training | |
| 6.1. Proof of toolbox talks, environmental awareness and induction (incl. attendance register and training material) | |
| 7. Method Statements | |
| 7.1. Combined method statements | Yes |
| 7.2. Additional method statements | Yes |
| 8. Records | |
| 8.1. Record of waste generation – quantity, type, fate (incl. general/hazardous, liquid/solid) | |
| 8.2. Proof of legal/safe waste disposal | |
| 8.3. Record of chemicals on site and Material Safety Data Sheets (MSDS) | |
| 8.4. Record of water usage (if applicable) | |
| 8.5. Request for deviations | Yes |
| 9. Audits | |
| 9.1. Baseline Audit | Yes |
| 9.2. ECO audit reports | |
| 9.3. Internal audits/check conducted by the Implementing Entity | Yes |
| 9.4. Incident and non-conformance reports | Yes |
| 9.5. Site closure | Yes |

# 4 Communication

## 4.2 Copy of public complaints register

### COMPLAINTS REGISTER

| | |
|---|---|
| **PROJECT NAME:** | **…………………………………………………………………………** |
| **IMPLEMENTING ENTITY:** | **…………………………………………………………………………** |
| **DATE:** | **…………………………………………………………………………** |
| **REVISION:** | **…………………………………………………………………………** |

| Id. | Date | Time | Complainant Name | Address | Contact Details | Path for complaint (Phone, Discussion, email) | Description of complaint | Detail of investigation | Result of investigation | Corrective action | Response to complaint |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | | | |
| 2 | | | | | | | | | | | |
| 3 | | | | | | | | | | | |
| 4 | | | | | | | | | | | |
| 5 | | | | | | | | | | | |
| 6 | | | | | | | | | | | |
| 7 | | | | | | | | | | | |
| 8 | | | | | | | | | | | |

| Section | Template available |
|---|---|
| 1. Rehabilitation Plan and EMP | |
| 2. Implementing Entity Agreements | |
| 2.1. Undertaking in terms of Environmental Authorisation, Environmental Management Programme, Rehabilitation Plan and submitted Method Statements | Yes |
| 3. Approvals and Licenses | |
| 3.1. Environmental Authorisation | |
| 3.2. Section 21(c) and (i) General Authorisation | |
| 3.3. Waste license (if applicable) | |
| 4. Communication | |
| 4.1. Important correspondence e.g. notice to Competent Authority of commencement of construction | |
| 4.2. Copy of public complaints register | Yes |
| 5. Site Management | |
| 5.1. Approved layout | |
| 5.2. Site instructions (or copies thereof) | |
| 6. Environmental Training | |
| 6.1. Proof of toolbox talks, environmental awareness and induction (incl. attendance register and training material) | |
| **7. Method Statements** | |
| **7.1. Combined method statements** | **Yes** |
| 7.2. Additional method statements | Yes |
| 8. Records | |
| 8.1. Record of waste generation – quantity, type, fate (incl. general/hazardous, liquid/solid) | |
| 8.2. Proof of legal/safe waste disposal | |
| 8.3. Record of chemicals on site and Material Safety Data Sheets (MSDS) | |
| 8.4. Record of water usage (if applicable) | |
| 8.5. Request for deviations | Yes |
| 9. Audits | |
| 9.1. Baseline Audit | Yes |
| 9.2. ECO audit reports | |
| 9.3. Internal audits/check conducted by the Implementing Entity | Yes |
| 9.4. Incident and non-conformance reports | Yes |
| 9.5. Site closure | Yes |

# 7 Method Statements

*The Implementing Entity is to complete this section, taking cognisance of the relevant EA, EMP, environmental specifications and SANS.*

## 7.1 Combined method statements

| | |
|---|---|
| **PROJECT NAME:** | ………………………………………………………………… |
| **IMPLEMENTING ENTITY:** | ………………………………………………………………… |
| **DATE:** | ………………………………………………………………… |
| **REVISION:** | ………………………………………………………………… |

**ACRONYMS**

| | |
|---|---|
| **ECO** | Environmental Control Officer |
| **EMPr** | Environmental Management Programme |
| **NEMA** | National Environmental Management Act (Act 107 of 1998) |
| **SHE** | Safety Health Environment |

**DEFINITIONS**

**Alien species**[1]**:**

(a) a species that is not an indigenous species; or

(b) an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention.

**Approved:** Means approved in terms of the applicable legal requirements (e.g. NEMA approval/ Environmental Authorisation) and/or has been approved by the WfWetlands Programme's Deputy Director: Planning, Monitoring and Evaluation and/or an authorised representative of the WfWetlands Programme.

**Archaeological**[2]:

(a) material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures;

(b) rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;

(c) wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the

[1] National Environmental Management: Biodiversity Act (No. 10 of 2004)
[2] National Heritage Resources Act (No. 25 of 1999)

Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which the South African Heritage Resource Agency (SAHRA) considers to be worthy of conservation; and

**Auditing[3]:** A systematic, documented, periodic and objective evaluation which provides verifiable findings, in a structured and systematic manner, on:

(a) the level of performance against and compliance of an organisation or project with the provisions of the requisite environmental authorisation or Environmental Management Programme (EMPr) and, where applicable, the closure plan; and

(b) the ability of the measures contained in the EMPr, and where applicable the closure plan, to sufficiently provide for the avoidance, management and mitigation of environmental impacts associated with the undertaking of the activity.

**Authority***:* National, regional or local authority, that has a decision-making role or interest in the project.

**Best Management Practice (BMP):** Procedures and guidelines to ensure the effective and appropriate implementation of wetland rehabilitation by WfWetlands implementers.

**Cement laden water:** Means water (fresh or wash water) which has been in contact with partially cured concrete/mortar or raw cement product and which contains suspended and dissolved cement solids.

**Commence:** The start of any physical activity, including site preparation and any other activity on site furtherance of a listed activity or specified activity, but does not include any activity required for the purposes of an investigation or feasibility study as long as such investigation or feasibility study does not constitute a listed activity or specified activity.

**Contaminated water:** Means water contaminated by the Implementing Entity's activities such as with hazardous substances, hydrocarbons, paints, solvents and runoff from plant, workshop or personnel wash areas but excludes water containing cement/ concrete or silt.

**Corrective (or remedial) action***:* Reactive response required to address an environmental problem that is in conflict with the requirements of the EMPr. The need for corrective action may be determined through monitoring, audits or management review.

**Dam[4]:** Any barrier dam and any other form of impoundment used for the storage of water, excluding reservoirs.

**Dangerous goods:** Goods containing any of the substances as contemplated in South African National Standard No. 10234, supplement 2008 1.00: designated "*List of classification and labelling of chemicals in accordance with the Globally Harmonized Systems (GHS)"* published by Standards South Africa, and where the presence of such goods, regardless of quantity, in a blend or mixture, causes such blend or mixture to have one or more of the characteristics listed in the Hazard Statements in section 4.2.3, namely physical hazards, health hazards or environmental hazards.

**Decommissioning[5]:** To take out of active service permanently or dismantle partly or wholly, or closure of a facility to the extent that it cannot be readily re-commissioned.

[3] Regulation 34 of GN R982 (2014, as amended) of NEMA
[4] GN R983 (2014, as amended) of NEMA
[5] GN R983 (2014, as amended) of NEMA

**Dust[6]:** Any material composed of particles small enough to pass through a 1 mm screen and large enough to settle by virtue of their weight into the sampling container from the ambient air.

**Eco-log:** A cylindrical sleeve made from, for example wire mesh, filled with organic material and/or soil used to prevent and/or repair minor erosion.

**Endangered species**: Means any indigenous species listed as an endangered species in terms of section 56 of the National Environmental Management Biodiversity Act ((No. 10 of 2004).

**Endemic:** An "endemic" is a species that grows in a particular area (i.e. it is endemic to that region) and has a restricted distribution. It is only found in a particular place. Whether something is endemic or not depends on the geographical boundaries of the area in question and the area can be defined at different scales.

**Environment[7]:** Means the surroundings within which humans exist and that are made up of:

i. the land, water and atmosphere of the earth;

ii. micro-organisms, plant and animal life;

iii. any part or combination of i) and ii) and the interrelationships among and between them; and

**iv.** the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

**Environmental impact:** An environmental change caused by some human act.

**Environmental impact:** Change in an environment resulting from the effect of an activity on the environment, whether positive or negative. Impacts may be the direct consequence of an individual's or organisation's activities or may be indirectly caused by them (DEAT, 1998).

**Erosion:** The loss of soil through the action of water, wind, ice or other agents, including the subsidence of soil.

**Gabion:** A structure made of wire mesh baskets filled with regularly sized stones, and used to prevent and/or repair erosion. They are flexible and permeable structures which allow water to filter through them. Vegetation and other biota can also establish in/around the habitat they create.

**Hazard:** Means a source of or exposure to danger.

**Invasive alien species control**:

(a) to combat or eradicate an alien or invasive species; or

(b) where such eradication is not possible, to prevent, as far as may be practicable, the recurrence, re-establishment, re-growth, multiplication, propagation, regeneration or spreading of an alien or invasive species.

**Implementing Entity:** The entity responsible for the construction of WfWetlands rehabilitation interventions by means of various contracted teams.

**Indigenous vegetation[8]:** 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.

[6] National Dust Regulations GN R827 (2013)

[7] NEMA

[8] GN R983 (2014, as amended) of NEMA

**Interested and Affected Parties (I&APs)[9]:**

(a) all persons who, as a consequence of the public participation process conducted in respect of that application, have submitted written comments or attended meetings with the proponent, applicant or EAP;

(b) all persons who have requested the proponent or applicant, in writing, for their names to be placed on the register; c) all organs of state which have jurisdiction in respect of the activity to which the application relates.

**Intervention:** An engineered structure such as a concrete or gabion weir, earthworks or revegetation that that achieves identified objectives within a wetland e.g. raising of the water table within a drainage canal.

**Invasive species[10]:** Means any species whose establishment and spread outside of its natural distribution range-

(a) threaten ecosystems, habitats or other species or have demonstrable potential to threaten ecosystems, habitats or other species; and

(b) may result in economic or environmental harm or harm to human health.

**Listed invasive species:** Any invasive species listed in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of the National Environmental: Biodiversity Act (No. 10 of 2004).[11]

**Maintenance period:** The period after the Establishment Period (Practical Completion), up to and until the end of the Maintenance Period (i.e. a period of 12 months).

**Maintenance[12]:** Means actions performed to keep a structure or system functioning or in service on the same location, capacity and footprint.

**Mine:**

(a) used as a noun-

any excavation in the earth, including any portion under the sea or under other water or in any residue deposit, as well as any borehole, whether being worked or not, made for the purpose of searching for or winning a mineral;

any other place where a mineral resource is being extracted, including the mining area and all buildings, structures, machinery, residue stockpiles, access roads or objects situated on such area and which are used or intended to be used in connection with such searching, winning or extraction or processing of such mineral resource; and

(b) used as a verb-

in the mining of any mineral, in or under the earth, water or any residue deposit, whether by underground or open working or otherwise and includes any operation or activity incidental thereto, in, on or under the relevant mining area.

**Mitigation:** Actions to reduce the impact of a particular activity.

**Mitigation[13]:** Means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible;

[9] Regulation 42 GN R983 (2014, as amended) of NEMA
[10] National Environmental Management: Biodiversity Act (No. 10 of 2004)
[11] Also refer to GN 864 (2016): Alien and Invasive Species Lists
[12] GN R983 (2014, as amended) of NEMA
[13] GN R983 (2014, as amended) of NEMA

**Monitoring[14]:** The repetitive and continued observation, measurement and evaluation of environmental criteria to follow changes over a period of time and to assess the efficiency of control measures.

**Nursery conditions**: This refers to the necessary conditions that must be in place for maintaining strong healthy growth in all container plant materials on site. This includes for the protection of all container plants against wind, frost, direct sunlight, pests, disease and drought. It also includes for the provision of adequate and suitable water supply, fertilisers and all other measures necessary to maintain strong and healthy plant growth.

**Offensive odour:** Any smell which is considered to be malodorous or a nuisance to a reasonable person.

**Pollution[15]:** Means any change in the environment caused by substances;

(ii) radioactive or other waves; or

(iii) noise, odours, dust or heat,

emitted from any activity, including the storage or treatment of waste or substances, construction and the provision of services, whether engaged in by any person or an organ of state, where that change has an adverse effect on human health or wellbeing or on the composition, resilience and productivity of natural or managed ecosystems, or on materials useful to people, or will have such an effect in the future.

**Post-construction:** Refers to the period of 12 months after the completion of the construction works, the onset coinciding with the maintenance period..

**Potentially hazardous substance:** Any substance or mixture of substances, product or material declared to be a hazardous substance under section 2(1) of the Hazardous Substance Act (1973).

**Pre-construction**: Refers to the period leading up to the establishment on site by the Implementing Entity.

**Project:** A defined area for which an approved rehabilitation plan exists for the WfWetlands Programme.

**Quaternary Catchment:** A fourth order catchment in a hierarchal classification system in which a primary catchment is the major unit and that is also the “principal water management unit in South Africa”[16]

**Reasonable:** Means, unless the context indicates otherwise, reasonable in the opinion of the relevant environmental authority.

**Rehabilitation:** Refers to re-instating the driving ecological forces (including hydrological, geomorphological and biological processes) that underlie a wetland, so as to improve the wetland’s health and the ecological services that it delivers; and

Restoring processes and characteristics that are sympathetic to and not conflicting with the natural dynamic of an ecological or physical system[17].

**Significant impact:** Means an impact that may have a notable effect on one or more aspects of the environment or may result in k with accepted environmental quality standards, thresholds or targets

---

[14] DEAT, 1998

[15] National Environmental Management Act (No. 107 of 1998, as amended)

[16] DWS Groundwater Dictionary. Available online: http://www.dwaf.gov.za/Groundwater/Groundwater_Dictionary/index.html?introduction_quaternary_catchment.htm

[17] Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008

and is determined through rating the positive and negative effects of an impact on the environment based on criteria such as duration, magnitude, intensity and probability of occurrence.

**Silt laden water:** Means water (mostly overland surface runoff) containing a substantial concentration of suspended solids with increased turbidity. Usually occurs as a result of exposed/cleared ground surfaces, concentration of runoff and/or erosion of excavated or imported materials.

**Site:** This is the area described in the approved/authorised rehabilitation plan for the implementation of the rehabilitation measures. Where the area is not demarcated, it will include all adjacent areas, which are reasonably required for the activities for the Implementing Entity, and approved for such use by the Environmental Control Officer (ECO).

**Slope:** The inclination of a surface expressed as 1 unit of rise or fall for so many horizontal units.

**Subsoil**: The soil horizons between the topsoil horizon and the underlying parent rock.

**Topsoil:** The upper soil profile irrespective of the fertility appearance, structure, agriculture potential, fertility and composition of the soil, usually containing organic material and which is colour specific. Also referred to as the "O" and "A" horizons.

**Waste:** Any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes as defined in Schedule 3 the National Environmental Management: Waste Act (No. 59 of 2008)[18]. Examples include construction debris, chemical waste, used oils and lubricants, batteries, metal and wood off-cuts, excess cement/ concrete, wrapping materials, timber, tins and cans, drums, wire, nails, food and domestic waste (e.g. plastic packets and wrappers).

**Watercourse**:

(a) a river or spring;

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

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

A reference to a watercourse includes, where relevant, its bed and banks

**Weir:** A dam-type structure placed across a watercourse to raise the water table of the surrounding ground and trap sediment on the upstream face without preventing water flow. Weirs are generally used to prevent erosion from progressing up exposed gullies.

**Wetland:** Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soils[19] and,

Land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants living there[20].

[18] National Environmental Management: Waste Act (No. 59 of 2008, as amended)
[19] National Water Act (No. 36 of 1998, as amended)
[20] Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008

**SECTION 1: SITE ESTABLISHMENT**

| |
|---|
| Briefly describe where the site camp will be located. Also provide a layout on the next page. |
| **Coordinates:** |
| How will you demarcate the site camp (note no danger tape allowed) |
| |
| What will the size of the site camp be? |
| |
| Are there any sensitive areas, trees, shrubs or landscape features (e.g. a heritage site) that must be avoided to prevent disturbances and/or damage? How will disturbances or damage be prevented? |
| |

| | | |
|---|---|---|
| Is the site camp on a flat area (i.e. slope not exceeding 1:3)? | **Y** | **N** |
| Is the site camp located away from areas of stormwater concentration and areas prone to flooding? | **Y** | **N** |
| Are there any recently disturbed areas close to the site which can be used as a site camp? | **Y** | **N** |
| Is there sufficient space available at the identified site to accommodate all site camp components i.e. ablution facilities, eating areas, laydown areas, stockpile areas, vehicle parking area, concrete wash water settling area? | **Y** | **N** |
| Can the site camp remain at one location? I.e. it does not need to be moved on a regular basis (i.e. every two to four weeks) due to intervention sites being far apart? | **Y** | **N** |

**If, “No”, attach the approved for request for deviation form to the back of this document.**

**Indicate the following (ignore if not relevant):** Ablution facilities, waste storage area (general and hazardous), eating area, laydown area, stockpile area, concrete/mortar mixing/batching area, concrete wash water settling system, site office, access, vehicle parking area, any stormwater diversion measures required, the wetland boundary and sensitive features that must be avoided.

**Site camp layout (please use multiple layout plans if required).**

| |
|---|
| |

## SECTION 2: SITE DEMARCATION

Indicate the working area required for each intervention site.

| Intervention No | Type of intervention | Area required (incl. temporary laydown and stockpile areas, topsoil stockpiling, equipment etc.) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

How will you demarcate the working area required for each intervention?

| |
|---|
| |

## SECTION 3: ACCESS ROUTES/HAUL ROADS

Length of new access road required for each intervention site.

| Intervention No | Existing access (Y/N)? | Length of access road required |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

Describe how access roads will be made and demarcated (i.e. avoiding unnecessary access roads and the creation of multiple access roads).

| |
|---|
| |

**Include a simple layout indicating the proposed access routes as an addendum to this document.*

## SECTION 4: MATERIALS HANDLING, USE AND STORAGE

| | | |
|---|---|---|
| Briefly list the materials (**including volumes**) to be used during construction (e.g. bidim, gabion baskets, stones, gravel, shuttering oil, cement, sand, MacMat-R, geotextile): | | |
| | | |
| Where will the materials be off-loaded? | | |
| | | |
| Where are you sourcing the material from? | | |
| | | |
| If it is not a commercial source, have you written obtained permission from the ECO and any other relevant party e.g. the landowner, provincial roads, Department of Mineral Resources? Please attached a copy of the written permission/consent to the end of this **METHOD STATEMENT**. | **Y** | **N** |

| | | |
|---|---|---|
| Are the areas you've identified for stockpiling of bulk material outside of the wetland? If "No", consult with the ECO. | **Y** | **N** |
| Are the areas you've identified for stockpiling level (i.e. not steeper than 1:30)? If no, explain the measures which will be implemented to prevent materials washing away during rainfall. | **Y** | **N** |
| | | |
| Have you planned how to get the materials from the stockpile/laydown area to the intervention working area? Please provide details on the proposed methodology below. Differentiate between the various materials where required. | **Y** | **N** |
| | | |
| Do you have sufficient covered storage space for products such as cement, and shuttering oil? Please provide details of the storage areas to be used and the type of cover e.g. roofed, shade cloth, storage container. | **Y** | **N** |
| | | |
| Do you need to stockpile bulk materials e.g. rock, sand next to an intervention? If "Yes", please provide details on the duration of stockpiling, the volume and the measures to be taken to avoid erosion of material and contamination of topsoil. | **Y** | **N** |
| | | |
| Have you worked out a delivery schedule to avoid materials being stored on site for longer than 4 weeks? | **Y** | **N** |
| Is there any material which will be prone to become windblown e.g. sand? If yes, describe how you will contain the material. | **Y** | **N** |
| | | |

**SECTION 5: SOLID WASTE MANAGEMENT AND DISPOSAL**

| | | |
|---|---|---|
| What types of waste is expected to be generated during the construction period? | | |
| | | |
| List any wastes that are potentially hazardous[21] (e.g. empty sealant containers, materials from spill kit used to clean spillages, batteries, contents from portable toilets, herbicide containers): | | |
| | | |
| How will waste be stored on site (i.e. where and in what)? | | |
| **General:** | | |
| **Hazardous:** | | |
| How often, how and where will waste be disposed of? | | |
| **General:** | | |
| **Hazardous:** | | |
| Is a substantial quantity of vegetation clearance required? | **Y** | **N** |

[21] Refer to National Environmental Management: Waste Amendment Act 26 of 2014 and SANS 10234

| |
|---|
| If “yes” indicate how vegetation material not removed as part of topsoil stripping will be dealt with e.g. chipping, brush packing, donate to local community. |
| |

** Please remember to clearly indicate waste storage areas on the layout plan.*

**SECTION 6: HAZARDOUS CHEMICALS AND POTENTIAL HAZARDOUS SUBSTANCES**

List potentially hazardous substances to be used on the project. *(Hazardous being defined in terms of Hazardous Substances Act (No.187 of 1993) and associated regulations as well as SANS 10234. Examples include, but are not limited to: drums of fuel, grease, oil, brake fluid, hydraulic fluid, paint, batteries and herbicides (for alien plant clearing)).*

| |
|---|
| |

How and where will these substances be stored?

| |
|---|
| |

How will these substances be applied or dispensed?

| |
|---|
| |

How will spills be prevented?

| |
|---|
| |

In the event of a spill, how will it be mitigated?

| |
|---|
| **Procedure:** |
| **Materials:** |
| **Person responsible and contact details:** |

**Attach the relevant Material Safety Data Sheet (MSDS) of hazardous materials to be stored on site as an addendum to this document.*

**SECTION 7: FUEL**

What is the volume of fuel planned to be stored on site?

| |
|---|
| |

How and where will fuel be stored?

| |
|---|
| |

How will fuel be dispensed?

| |
|---|
| |

What precautions will be taken to prevent accidental spills or fires?

| |
|---|
| |

In the event of a spill, how will it be mitigated (i.e. cleaned up)?

| |
|---|
| **Procedures:** |
| **Materials:** |
| **Person responsible and contact details:** |

How will hydrocarbon contaminated materials be managed and disposed of? Note hydrocarbon contaminated soil is only allowed to go to a Class A landfill (previously H:H landfill site).

## SECTION 8: WATER USE

What source will be used to obtain water for construction purposes?

What source will be used to obtain water for drinking and sanitation purposes?

## SECTION 9: CONCRETE BATCHING AND CEMENT HANDLING

List activities where concrete or mortar will be used:

If ready mix is not used, where and how will concrete be mixed and how will it be transported to the intervention location?

How will cement laden runoff be managed? Specify for the concrete mixing area as well as washing of equipment.

Where and how will cement be stored?

How and where will cement bags be stored until taken off site?

How will excess concrete and concrete remains be disposed of?

## SECTION 10: ABLUTION FACILITIES

How many people will be on site?

How many toilets will be required at a ratio of 1 toilet for every 15 people?

What type of toilet will be used (e.g. chemical or pit latrine) and where will it be located?

If chemical toilets are used, specify how and when they'll be serviced.

## SECTION 11: EATING AREAS

Where will the eating area be located?

How will you prevent littering around the eating area?

** Also clearly indicate the designated eating area(s) on the layout plan.*

## SECTION 12: VEHICLES AND EQUIPMENT

Describe the number and type of vehicles to be used on site.

Where will vehicles be parked or equipment stored overnight, during weekends and during holidays?

Describe the procedure to be implemented for dealing with vehicles or equipment leaking oil or fuel:

Describe emergency equipment maintenance procedures:

| |
|---|
| **Procedure:** |
| **Materials:** |
| **Person responsible:** |

## SECTION 13: NOISE

Are there any houses nearby? Do you need inform the landowners of any noisy activities that will take place? How will this be done?

Describe the measures to be implemented to prevent excessive noise disturbance during construction:

**SECTION 14: DUST**

What is the distance to the closest occupied building and what type of building is it (e.g. house, school, clinic, etc.)

| |
|---|
| |

List activities and material that might lead to the generation of dust:

| |
|---|
| |

If closer than 100m from a sensitive receptor e.g. occupied building, road, orchard, describe the activities to be implemented to limit and mitigate the generation of dust:

| |
|---|
| |

**SECTION 15: IMPLEMENTING ENTITY'S SAFETY HEALTH ENVIROMENT (SHE) OFFICER**

Who will be responsible to ensure that Health and Safety and Environmental Requirements are implemented on site? Describe responsibilities of the relevant person:

| |
|---|
| **Name:** |
| **Responsibilities:** |
| **Reporting to:** |

**SECTION 16: ENVIRONMENTAL AWARENESS TRAINING**

Describe how environmental awareness and training for senior staff will be addressed:

| |
|---|
| |

Describe how environmental awareness and training for general labour will be addressed:

| |
|---|
| |

** Please include a copy of the training material and attendance register in the environmental folder.*

**SECTION 17: FIRE CONTROL**

List activities on site with a fire risk e.g. smoking areas, generators.

| |
|---|
| |

How will fires be prevented?

| |
|---|
| |

Describe the procedure to be followed in case of a fire on site:

| |
|---|
| **Process:** |
| **Materials**: |

| |
|---|
| **Responsible person**: |

**SECTION 18: COMMUNITY RELATIONS**

Who is/are the landowner(s) of the property/properties where work will be conducted?

| |
|---|
| |

Has the landowner been contacted and notified of construction commencing and are there any specific concerns or requests which need to be taken into account?

| |
|---|
| |

Describe how good community relationships will be ensured (e.g. complaints register, contact details of Implementing Entity on site):

| |
|---|
| |

**SECTION 19: PROTECTION OF FAUNA AND FLORA**

Are you working in a conservancy, nature reserve or biosphere? If, yes, what are the precautions to be taken to avoid the accidental or intentional killing and/or trapping of animals?

| |
|---|
| |

Are you aware of any nesting or breeding sites close to any of the interventions?

| |
|---|
| |

Describe the procedure to be followed pre-construction to check for slow moving animals in the vicinity of the construction area.

| |
|---|
| |

Describe the procedure to be followed to check excavations of 0.5m and deeper for trapped animals.

| |
|---|
| |

If you are working in an area with potentially dangerous animals, describe the measures to be taken to ensure the safety of staff.

| |
|---|
| |

Are there any trees or shrubs that may not be disturbed or damaged? Have these been clearly marked to prevent disturbances and potential damage?

| |
|---|
| |

**SECTION 20: STORMWATER MANAGEMENT**

Is the site located in floodplain or valley? If "Yes", have you verified the typical rainfall patterns in the area and when increased flow/flooding can be expected?

| |
|---|
| |

Are you aware of any major dams or impoundments upstream of the site? If yes, do you have the contact details of the entity/responsible person in control of releases from the dam or impoundment and have you notified them of work being undertaken downstream?

| |
|---|
| |

Are you doing work in the “seasonal” or “permanent zone” of the wetland i.e. an area that is seasonally or permanently wet? If “Yes”, describe the dewatering procedures to be followed (i.e. will pumping be required, where will the pumped water be discharged, how will you reduce sediment loads in pumped water, how will you prevent scouring at the pipe outlet?)

| |
|---|
| |

Do you need to divert flow to enable construction/work being undertaken? If “Yes”, provide details on the type and duration of the diversion.

| |
|---|
| |

**SECTION 21: EROSION AND SEDIMENTATION CONTROL**

How will you prevent the erosion of access roads?

| |
|---|
| |

Will there be significant exposed areas (areas exceeding 10$m^2$) during the rainfall season? If “Yes”, how will you protect bare soil surfaces exposed for a month or longer (e.g. stormwater diversion, temporary revegetation, geotextile)?

| |
|---|
| |

Do you need to work on steep (1:4) slopes? If “Yes”, describe the measures to be implemented to avoid the erosion of exposed ground surfaces, excavated material and construction material.

| |
|---|
| |

Are there any known stormwater structures discharging towards the site e.g. culverts, stormwater outlets. If “Yes”, is the diversion of the stormwater required to protect the site from erosion and how will it be done?

| |
|---|
| |

**SECTION 22: PROTECTION OF ARCHAEOLOGICAL AND PALAEONTOLOGICAL SITES**

Are you aware of any known heritage artefacts (e.g. old buildings, Stone Age sites, shell middens, caves, historic grave sites, monuments) close to the site? If “Yes”, describe how you will protect the site.

| |
|---|
| |

Describe the procedure to be followed in the event that an object of heritage, archaeological or paleontological is discovered:

| |
|---|
| |

| Section | Template available |
|---|---|
| 1. Rehabilitation Plan and EMP | |
| 2. Implementing Entity Agreements | |
| 2.1. Undertaking in terms of Environmental Authorisation, Environmental Management Programme, Rehabilitation Plan and submitted Method Statements | Yes |
| 3. Approvals and Licenses | |
| 3.1. Environmental Authorisation | |
| 3.2. Section 21(c) and (i) General Authorisation | |
| 3.3. Waste license (if applicable) | |
| 4. Communication | |
| 4.1. Important correspondence e.g. notice to Competent Authority of commencement of construction | |
| 4.2. Copy of public complaints register | Yes |
| 5. Site Management | |
| 5.1. Approved layout | |
| 5.2. Site instructions (or copies thereof) | |
| 6. Environmental Training | |
| 6.1. Proof of toolbox talks, environmental awareness and induction (incl. attendance register and training material) | |
| **7. Method Statements** | |
| 7.1. Combined method statements | Yes |
| **7.2. Additional method statements** | **Yes** |
| 8. Records | |
| 8.1. Record of waste generation – quantity, type, fate (incl. general/hazardous, liquid/solid) | |
| 8.2. Proof of legal/safe waste disposal | |
| 8.3. Record of chemicals on site and Material Safety Data Sheets (MSDS) | |
| 8.4. Record of water usage (if applicable) | |
| 8.5. Request for deviations | Yes |
| 9. Audits | |
| 9.1. Baseline Audit | Yes |
| 9.2. ECO audit reports | |
| 9.3. Internal audits/check conducted by the Implementing Entity | Yes |
| 9.4. Incident and non-conformance reports | Yes |
| 9.5. Site closure | Yes |

# 7 Method Statements

## 7.2 Additional method statements

**INFORMATION ON METHOD STATEMENTS**

Method Statements are to be completed by the person undertaking the work (i.e. the Implementing Entity). The Method Statement will enable the potential negative environmental impacts associated with the proposed activity to be assessed.

The Method Statement can only be implemented once approved by the PC in consultation with the ECO.

The Implementing Entity (and, where relevant, any sub-contractors) must also sign the Method Statement, thereby indicating that the works will be carried out according to the methodology contained in the approved Method Statement.

The PC and/or ECO will use the Method Statement to audit compliance by the Implementing Entity with the requirements of the approved Method Statement.

Changes to the way the works are to be carried out must be reflected by amendments to the original approved Method Statement; amendments require the signature of the PC, denoting that the changed methodology or works are necessary for the successful completion of the works, and where applicable the PC will consult with the ECO regarding to environmental concerns. The Implementing Entity will also be required to sign the amended Method Statement thereby committing him/herself to the amended Method Statement.

This Method Statement MUST contain sufficient information and detail to enable the PC (and ECO were applicable) to apply his/her mind to the potential impacts of the works on the environment. The Implementing Entity will also need to thoroughly understand what is required of him/her in order to undertake the works.

THE TIME TAKEN TO PROVIDE A THOROUGH, DETAILED METHOD STATEMENT IS TIME WELL SPENT. INSUFFICIENT DETAIL WILL RESULT IN DELAYS TO THE WORKS WHILE THE METHOD STATEMENT IS REWRITTEN TO THE ASD's SATISFACTION

# METHOD STATEMENT

| | |
|---|---|
| **PROJECT NAME:** | ………………………………………………………………………. |
| **IMPLEMENTING ENTITY:** | ………………………………………………………………………. |
| **DATE:** | ………………………………………………………………………. |

**PROPOSED ACTIVITY** *(give title of method statement):*

*E.g. construction of diversion structure, temporary damming of stream, deviation from standard rehabilitation procedures*

| | |
|---|---|
| **Scope** | |
| **Potential Impacts** | E.g. litter, spills, damage to flora, contamination of water |
| **Start Date:** | |
| **End Date:** | |
| **Description (i.e. how will the Method Statement be implemented?):** | |
| **Location:** | |
| **Person(s) responsible for implementing (Name and designation):** | |

## DECLARATIONS

### 1) Environmental Consultant/Environmental Control Officer

The work described in this Method Statement, if carried out according to the methodology described, is satisfactorily mitigated to prevent avoidable environmental harm:

| ______________________ | ______________________ | ______________________ |
|---|---|---|
| Signed | Print name | Dated |

### 2) Implementing Entity

I understand the contents of this Method Statement and the scope of the works required of me. I further understand that this Method Statement may be amended on application to other signatories and that the PC/ECO will audit my compliance with the contents of this Method Statement

| ______________________ | ______________________ | ______________________ |
|---|---|---|
| Signed | Print name | Dated |

### 3) Engineer/Engineer's Representative

The works described in this Method Statement are approved.

| ______________________ | ______________________ | ______________________ |
|---|---|---|
| Signed | Print name | Dated |

### 4) Approving authority: PC

| ______________________ | ______________________ | ______________________ |
|---|---|---|
| Signed | Print name | Designation |

Dated: ________________

| Section | Template available |
|---|---|
| 1. Rehabilitation Plan and EMP | |
| 2. Implementing Entity Agreements | |
| 2.1. Undertaking in terms of Environmental Authorisation, Environmental Management Programme, Rehabilitation Plan and submitted Method Statements | Yes |
| 3. Approvals and Licenses | |
| 3.1. Environmental Authorisation | |
| 3.2. Section 21(c) and (i) General Authorisation | |
| 3.3. Waste license (if applicable) | |
| 4. Communication | |
| 4.1. Important correspondence e.g. notice to Competent Authority of commencement of construction | |
| 4.2. Copy of public complaints register | Yes |
| 5. Site Management | |
| 5.1. Approved layout | |
| 5.2. Site instructions (or copies thereof) | |
| 6. Environmental Training | |
| 6.1. Proof of toolbox talks, environmental awareness and induction (incl. attendance register and training material) | |
| 7. Method Statements | |
| 7.1. Combined method statements | Yes |
| 7.2. Additional method statements | Yes |
| **8. Records** | |
| 8.1. Record of waste generation – quantity, type, fate (incl. general/hazardous, liquid/solid) | |
| 8.2. Proof of legal/safe waste disposal | |
| 8.3. Record of chemicals on site and Material Safety Data Sheets (MSDS) | |
| 8.4. Record of water usage (if applicable) | |
| **8.5. Request for deviations** | **Yes** |
| 9. Audits | |
| 9.1. Baseline Audit | Yes |
| 9.2. ECO audit reports | |
| 9.3. Internal audits/check conducted by the Implementing Entity | Yes |
| 9.4. Incident and non-conformance reports | Yes |
| 9.5. Site closure | Yes |

# 8 Records

## 8.5 Request for deviations from standard EMPr or Rehabilitation Plan requirement

**PROJECT NAME:** ………………………………………………………………………….

**IMPLEMENTING ENTITY:** ………………………………………………………………………….

**DATE:** ………………………………………………………………………….

**DEVIATION 1** *(Implementing Entity to complete)*

| | |
|---|---|
| **Description of deviation** | *E.g. mixing of concrete in wetland* |
| **Reason for deviation** | *E.g. major wetland system resulting in excessive transport distances* |
| **Start Date:** | |
| **End Date:** | |
| **Relevant section in EMPr** | |
| **Potential impacts associated with deviation** | *E.g. concrete spills in wetland, additional vegetation clearance, water pollution* |
| **Mitigation measures identified** | *E.g. mixing boards, dedicated wash bins, no cement storage in wetland next to mixing area, regular clean-up* |

**DEVIATION 2** *(Implementing Entity to complete)*

| | |
|---|---|
| **Description of deviation** | |
| **Reason for deviation** | |
| **Start Date:** | |
| **End Date:** | |
| **Relevant section in EMPr** | |
| **Potential impacts associated with deviation** | |
| **Mitigation measures identified** | |

**PC CHECKLIST**

| | | | | |
|---|---|---|---|---|
| **Does the deviation carry a high risk e.g. pollution, structure failure** | Yes | No | Unsure | If "yes" or "unsure" consult with Engineer |
| **Does the proposed deviation trigger a new listed activity** | Yes | No | Unsure | If "yes" or "unsure" consult with EAP |
| **Does the deviation involve a change in design of the IP** | Yes | No | Unsure | If "yes" or "unsure" consult with Engineer and Wetlander |
| **Is the deviation outside the approved wetland system?** | Yes | No | Unsure | If "yes" or "unsure" consult with EAP |

## DECLARATIONS

**1) Environmental Consultant/Environmental Control Officer**

The work described in this request for deviation does not trigger any additional listed activities and will not result in excessive environmental damage:

| ______________________ | ____________________________ | ____________________________ |
|---|---|---|
| Signed | Print name | Dated |

**2) Person undertaking the works/Implementing Entity**

I understand the scope of deviation requested and will implement the mitigation measures as indicated.

| ______________________ | ____________________________ | ____________________________ |
|---|---|---|
| Signed | Print name | Dated |

**3) Engineer/Engineer's Representative**

The works described in this Method Statement are approved.

| ______________________ | ____________________________ | ____________________________ |
|---|---|---|
| Signed | Print name | Dated |

**4) Approving authority**

| ______________________ | ____________________________ | ____________________________ |
|---|---|---|
| Signed | Print name | Designation |

Dated _________________

| Section | Template available |
|---|---|
| 1. Rehabilitation Plan and EMP | |
| 2. Implementing Entity Agreements | |
| 2.1. Undertaking in terms of Environmental Authorisation, Environmental Management Programme, Rehabilitation Plan and submitted Method Statements | Yes |
| 3. Approvals and Licenses | |
| 3.1. Environmental Authorisation | |
| 3.2. Section 21(c) and (i) General Authorisation | |
| 3.3. Waste license (if applicable) | |
| 4. Communication | |
| 4.1. Important correspondence e.g. notice to Competent Authority of commencement of construction | |
| 4.2. Copy of public complaints register | Yes |
| 5. Site Management | |
| 5.1. Approved layout | |
| 5.2. Site instructions (or copies thereof) | |
| 6. Environmental Training | |
| 6.1. Proof of toolbox talks, environmental awareness and induction (incl. attendance register and training material) | |
| 7. Method Statements | |
| 7.1. Combined method statements | Yes |
| 7.2. Additional method statements | Yes |
| 8. Records | |
| 8.1. Record of waste generation – quantity, type, fate (incl. general/hazardous, liquid/solid) | |
| 8.2. Proof of legal/safe waste disposal | |
| 8.3. Record of chemicals on site and Material Safety Data Sheets (MSDS) | |
| 8.4. Record of water usage (if applicable) | |
| 8.5. Request for deviations | Yes |
| **9. Audits** | |
| **9.1. Baseline Audit** | **Yes** |
| 9.2. ECO audit reports | |
| 9.3. Internal audits/check conducted by the Implementing Entity | Yes |
| 9.4. Incident and non-conformance reports | Yes |
| 9.5. Site closure | Yes |

# 9 Audits

## 9.1 Baseline audit/ inspection prior to commencement of construction

**PROJECT NAME:** ………………………………………………………………………

**IMPLEMENTING ENTITY:** ………………………………………………………………………

**DATE:** ………………………………………………………………………

**SECTION 1: WETLAND ZONE IN WHICH WORK WILL BE UNDERTAKEN:**

| | | | |
|---|---|---|---|
| Permanent | Seasonal | Temporary | Outside wetland boundary |

**SECTION 2: CONDITION OF VEGETATION**

| | | | |
|---|---|---|---|
| **Coverage:** | Poor | Moderate | Good |
| **Species diversity:** | Poor | Moderate | Good |
| **Grazing in wetland:** | Yes | No | |
| **Harvesting of vegetation in wetland:** | Yes | No | |
| **Level of alien invasive species infestation:** | Low | Moderate | High |

Insert photos:

| | |
|---|---|
| | |
| | |

**SECTION 3: SOIL**

| | | | |
|---|---|---|---|
| **Topsoil depth:** | ≥10cm | ≥30cm | ≥ 50cm |
| **Peat know to be present?** | Yes | No | |
| **Evidence of erosion** | Yes | No | |
| **Type of erosion** | Dryland | Gullies/donga | In-stream (undercutting, lateral, scouring) |
| | Stormwater outlets | Dispersed overland flow | Tunnelling (dispersive soils) |

**SECTION 4: IS THERE ANY EXISTING WASTE OR SPOIL ON SITE?**

| | |
|---|---|
| Yes | No |

If yes, specify the type and estimated quantity

| |
|---|
| |

Insert photos:

| | |
|---|---|
| | |
| | |

**SECTION 5: ARE THERE EXISTING ALIEN INVASIVE SPECIES ON THE SITE?**

| | |
|---|---|
| Yes | No |

If yes, list the species

| |
|---|
| |

Are any of the species Category 1a or b species? (Alien and Invasive Species Regulations, 2014 - GN R598/2014)

| | |
|---|---|
| Yes | No |

If yes, list the species and number/density of plants.

| |
|---|
| |

Insert photos:

| | |
|---|---|
| | |
| | |

**SECTION 6: ARE THERE EXISTING ACCESS ROADS TO THE SITE?**

| | |
|---|---|
| Yes | No |

If yes, what is the condition of the road(s)?

| | | |
|---|---|---|
| Good | Moderate | Poor |

**SECTION 7: ARE THERE OTHER IMPACTED OR DISTURBED AREAS**

| | | | | |
|---|---|---|---|---|
| Cleared area | Mining area | Kraal | Previous site camps | Ploughed agricultural land |
| Roads | Settlements | Other: | | |

**SECTION 8: EXISTING WATER QUALITY ISSUES**

| | | | | |
|---|---|---|---|---|
| High sediment loads (murky/cloudy water) | Eutrophication (excess algal growth) | High TDS (salt deposits) | Low pH (orange coloured water) | *E. coli* (leaking sewer lines, concentration of animals) |

**SECTION 9: IS THERE EXISTING FENCING ON THE PROPERTY WHERE THE WORK WILL BE CONDUCTED?**

| Yes | No |
|---|---|

If yes, what type of fencing and what is the condition of the fencing?

| |
|---|
| |

Insert photos:

| | |
|---|---|
| | |
| | |

**SECTION 10: ARE THERE ANY KNOW PROTECTED PLANT SPECIES ON SITE?**

| Yes | No |
|---|---|

If yes, list the species

| |
|---|
| |

Insert photos:

| | |
|---|---|
| | |
| | |

**SECTION 11: ARE THERE ANY SIGNIFICANT TREES OR CLUMPS OF TREES WHICH NEED TO BE CONSERVED?**

| Yes | No |
|---|---|

If yes, specify the species and location.

| |
|---|
| |

Insert photos:

| | |
|---|---|
| | |
| | |

**SECTION 12: ARE THERE ANY KNOWN OR VISIBLE HERITAGE OBJECTS (E.G. OLD KRAAL, OLD FURROW, CORNER POSTS, OLD BUILDINGS)?**

| Yes | No |
|---|---|

If yes, specify the type of object and location.

| |
|---|
| |

Insert photos:

| | |
|---|---|
| | |
| | |

**SECTION 13: ARE THERE ANY EXISTING ANIMAL (DOMESTIC OR WILD) CROSSINGS ON OR CLOSE TO THE SITE?**

| | |
|---|---|
| Yes | No |

If, yes, will the planned work impact on the crossings and movement of the animals?

| | |
|---|---|
| Yes | No |

**SECTION 14: ARE THERE ANY EXISTING SERVICES ON OR NEAR THE SITE (E.G. POWER LINES, SUB-STATIONS, PIPELINES, TELEPHONE LINES)?**

| | |
|---|---|
| Yes | No |

If yes, specify the type of infrastructure and whether it will be impacted by the activities on site

| |
|---|
| |

Insert photos:

| | |
|---|---|
| | |
| | |

| Section | Template available |
| --- | --- |
| 1. Rehabilitation Plan and EMP | |
| 2. Implementing Entity Agreements | |
| 2.1. Undertaking in terms of Environmental Authorisation, Environmental Management Programme, Rehabilitation Plan and submitted Method Statements | Yes |
| 3. Approvals and Licenses | |
| 3.1. Environmental Authorisation | |
| 3.2. Section 21(c) and (i) General Authorisation | |
| 3.3. Waste license (if applicable) | |
| 4. Communication | |
| 4.1. Important correspondence e.g. notice to Competent Authority of commencement of construction | |
| 4.2. Copy of public complaints register | Yes |
| 5. Site Management | |
| 5.1. Approved layout | |
| 5.2. Site instructions (or copies thereof) | |
| 6. Environmental Training | |
| 6.1. Proof of toolbox talks, environmental awareness and induction (incl. attendance register and training material) | |
| 7. Method Statements | |
| 7.1. Combined method statements | Yes |
| 7.2. Additional method statements | Yes |
| 8. Records | |
| 8.1. Record of waste generation – quantity, type, fate (incl. general/hazardous, liquid/solid) | |
| 8.2. Proof of legal/safe waste disposal | |
| 8.3. Record of chemicals on site and Material Safety Data Sheets (MSDS) | |
| 8.4. Record of water usage (if applicable) | |
| 8.5. Request for deviations | Yes |
| **9. Audits** | |
| 9.1. Baseline Audit | Yes |
| 9.2. ECO audit reports | |
| **9.3. Internal audits/check conducted by the Implementing Entity** | **Yes** |
| 9.4. Incident and non-conformance reports | Yes |
| 9.5. Site closure | Yes |

# 9 Audits

## 9.3 Internal audits/check conducted by the Implementing Entity

**PROJECT NAME:** ..........................................................................

**IMPLEMENTING ENTITY:** ..........................................................................

**DATE:** ..........................................................................

**WEEK:** *E.g. Week 1 / Week 2*..................................................

**SECTION 1: SITE CONDITIONS**

| |
|---|
| |

**SECTION 2: LAYDOWN AREAS & SITE OFFICES**

| | | EVALUATION | | |
|---|---|---|---|---|
| **ITEM** | **DESCRIPTION** | **Not to Standard** | **To Standard** | **NOTES** |
| 2.1 | Litter control | | | |
| 2.2 | Dust suppression | | | |
| 2.3 | Erosion control | | | |
| 2.4 | Storm water / Runoff control | | | |
| 2.5 | Toilets | | | |
| 2.6 | Fuel & oil storage & dispensing | | | |
| 2.7 | Material handling or Storage | | | |
| 2.8 | Waste management | | | |
| 2.8.1 | *Domestic Waste* | | | |
| 2.8.2 | *Hazardous Waste* | | | |
| 2.9 | Noise control | | | |

**SECTION 3: CONSTRUCTION SITES**

| | | EVALUATION | | |
|---|---|---|---|---|
| **ITEM** | **DESCRIPTION** | **Not to Standard** | **To Standard** | **NOTES** |
| 3.1 | Litter control/Recycle | | | |

| | | | | |
|---|---|---|---|---|
| 3.2 | Dust suppression | | | |
| 3.3 | Erosion control | | | |
| 3.4 | Toilets | | | |
| 3.5 | Eating areas | | | |
| 3.6 | Material handling and Storage | | | |
| 3.7 | No go areas, natural features and trees have not been damaged | | | |
| 3.8 | Drip trays | | | |
| 3.9 | Waste management | | | |
| 3.9.1 | *Domestic Waste* | | | |
| 3.9.2 | *Hazardous Waste* | | | |
| 3.10 | Noise control | | | |
| 3.11 | Environmental Awareness Training | | | |

**SECTION 4: COMPLAINCE WITH THE EA CONDITIONS AND EMP AND/OR ENVIRONMENTAL INCIDENTS**

| |
|---|
| |

**SECTION 5: GENERAL NOTES**

| |
|---|
| |

| Section | Template available |
|---|---|
| 1. Rehabilitation Plan and EMP | |
| 2. Implementing Entity Agreements | |
| 2.1. Undertaking in terms of Environmental Authorisation, Environmental Management Programme, Rehabilitation Plan and submitted Method Statements | Yes |
| 3. Approvals and Licenses | |
| 3.1. Environmental Authorisation | |
| 3.2. Section 21(c) and (i) General Authorisation | |
| 3.3. Waste license (if applicable) | |
| 4. Communication | |
| 4.1. Important correspondence e.g. notice to Competent Authority of commencement of construction | |
| 4.2. Copy of public complaints register | Yes |
| 5. Site Management | |
| 5.1. Approved layout | |
| 5.2. Site instructions (or copies thereof) | |
| 6. Environmental Training | |
| 6.1. Proof of toolbox talks, environmental awareness and induction (incl. attendance register and training material) | |
| 7. Method Statements | |
| 7.1. Combined method statements | Yes |
| 7.2. Additional method statements | Yes |
| 8. Records | |
| 8.1. Record of waste generation – quantity, type, fate (incl. general/hazardous, liquid/solid) | |
| 8.2. Proof of legal/safe waste disposal | |
| 8.3. Record of chemicals on site and Material Safety Data Sheets (MSDS) | |
| 8.4. Record of water usage (if applicable) | |
| 8.5. Request for deviations | Yes |
| **9. Audits** | |
| 9.1. Baseline Audit | Yes |
| 9.2. ECO audit reports | |
| 9.3. Internal audits/check conducted by the Implementing Entity | Yes |
| **9.4. Incident and non-conformance reports** | **Yes** |
| 9.5. Site closure | Yes |

# 9 Audits

## 9.4 Incident and non-conformance reports

### 9.4.1 Environmental Incident Report

**PROJECT NAME:** ……………………………………………………………………….

**IMPLEMENTING ENTITY:** ……………………………………………………………………….

**DATE:** ……………………………………………………………………….

**REVISION:** ……………………………………………………………………….

**SECTION 1: DESCRIPTION OF INCIDENT**

| |
|---|
| |

**SECTION 2: REMEDIAL ACTION REQUIRED**

| | |
|---|---|
| | |
| **Remedial Action Due Date:** | |

**SECTION 3: RELEVANT DOCUMENTATION**

| |
|---|
| |

**SECTION 4: SIGNATURES**

| | | | |
|---|---|---|---|
| **ECO:** | | **Implementing Entity:** | |
| **Name:** | | **Name:** | |
| **Date:** | | **Date:** | |

**SECTION 5: REMEDIAL ACTION COMPLETED**

| | |
|---|---|
| **Implementer to sign when remedial action has been completed and return original to ECO:** | |
| **Name:** | |
| **Date:** | |

**SECTION 6: REMEDIAL ACTION VERIFIED**

| | | | |
|---|---|---|---|
| **ECO:** | | **Implementing Entity:** | |
| **Name:** | | **Name:** | |
| **Date:** | | **Date:** | |

**SECTION 7: DRAWING/SKETCH**

### 9.4.2 Environmental Non-Conformance Notice

| | |
|---|---|
| **PROJECT NAME:** | ……………………………………………………………………… |
| **IMPLEMENTING ENTITY:** | ……………………………………………………………………… |
| **DATE:** | ……………………………………………………………………… |
| **REVISION:** | ……………………………………………………………………… |

**SECTION 1: INCIDENT SEVERITY**

| High | Medium | Low |
|---|---|---|
| Number of previous similar non-conformances on same contract: | | |

**SECTION 2: DESCRIPTION OF INCIDENT**

| |
|---|
| |

**SECTION 3: DRAWING/SKETCH**

| |
|---|
| |

**SECTION 4: REMEDIAL ACTION REQUIRED**

| | |
|---|---|
| | |
| Remedial Action Due Date: | |

**SECTION 5: DRAWING/SKETCH**

| |
|---|
| |

**SECTION 6: RELEVANT DOCUMENTATION**

| |
|---|
| |

**SECTION 7: SIGNATURES**

| | | | |
|---|---|---|---|
| **ECO:** | | **Implementing Entity:** | |
| **Name:** | | **Name:** | |
| **Date:** | | **Date:** | |

**SECTION 8: REMEDIAL ACTION COMPLETED**

| | |
|---|---|
| **Implementer to sign when remedial action has been completed and return original to ECO:** | |
| **Name:** | |
| **Date:** | |

**SECTION 9: REMEDIAL ACTION VERIFIED**

| | | | |
|---|---|---|---|
| **ECO:** | | **Implementing Entity:** | |
| **Name:** | | **Name:** | |
| **Date:** | | **Date:** | |

| Section | Template available |
|---|---|
| 1. Rehabilitation Plan and EMP | |
| 2. Implementing Entity Agreements | |
| 2.1. Undertaking in terms of Environmental Authorisation, Environmental Management Programme, Rehabilitation Plan and submitted Method Statements | Yes |
| 3. Approvals and Licenses | |
| 3.1. Environmental Authorisation | |
| 3.2. Section 21(c) and (i) General Authorisation | |
| 3.3. Waste license (if applicable) | |
| 4. Communication | |
| 4.1. Important correspondence e.g. notice to Competent Authority of commencement of construction | |
| 4.2. Copy of public complaints register | Yes |
| 5. Site Management | |
| 5.1. Approved layout | |
| 5.2. Site instructions (or copies thereof) | |
| 6. Environmental Training | |
| 6.1. Proof of toolbox talks, environmental awareness and induction (incl. attendance register and training material) | |
| 7. Method Statements | |
| 7.1. Combined method statements | Yes |
| 7.2. Additional method statements | Yes |
| 8. Records | |
| 8.1. Record of waste generation – quantity, type, fate (incl. general/hazardous, liquid/solid) | |
| 8.2. Proof of legal/safe waste disposal | |
| 8.3. Record of chemicals on site and Material Safety Data Sheets (MSDS) | |
| 8.4. Record of water usage (if applicable) | |
| 8.5. Request for deviations | Yes |
| **9. Audits** | |
| 9.1. Baseline Audit | Yes |
| 9.2. ECO audit reports | |
| 9.3. Internal audits/check conducted by the Implementing Entity | Yes |
| 9.4. Incident and non-conformance reports | Yes |
| **9.5. Site closure** | **Yes** |

# 9 Audits

## 9.5 Site closure

| | |
|---|---|
| **PROJECT NAME:** | ………………………………………………………………………. |
| **IMPLEMENTING ENTITY:** | ………………………………………………………………………. |
| **DATE:** | ………………………………………………………………………. |

**SECTION 1: SITE CLOSURE INSPECTION SHEET**

| | |
|---|---|
| **Slope:** | |
| **Alien invasives:** | |
| **Topsoil:** | |
| **Anti-erosion:** | |
| **Waste:** | |
| **Other:** | |
| **Timeframe for completion:** | |

PC signature

Implementing Entity signature

Date

Date

**SECTION 2: POST SITE CLOSURE INSPECTION COMMENTS**

| | |
|---|---|
| **Slope:** | |
| **Alien invasives:** | |
| **Topsoil:** | |
| **Anti-erosion:** | |
| **Waste:** | |
| **Other:** | |

Outstanding items:

1.____________________________________________________________

2.____________________________________________________________

3.____________________________________________________________

Completion date: ____________________

| | |
|---|---|
| PC signature | Implementing Entity signature |
| Date | Date |

## Annexure C: Sensitive Areas

Sensitive areas (incl. delineated wetland boundary)

This page is left blank intentionally

# Annexure D: Minimum Standards for Construction and Maintenance

*Note that maintenance information of structures (position, numbering and BoQ) will be determined as part of the planning process (by the PC and/or the Engineer) and will be included in the Rehabilitation Plan together with new wetlands. This information will be available on WetIS for inclusion in the PIPs. It is the Implementing Entity's responsibility to make provision for maintenance activities in the PIP as discussed and agreed with the PC.*

### Concrete Batching

- Concrete shall be mixed according to the correct MPa and mix information as specified in the construction notes of the respective design drawings.
- All material used in the mixing of concrete are to be of good quality, clean and clear of any organic material.
- Manufacturer's directions for mixing, consistency and treatment after pouring shall be complied with.
- Cement shall be stored in dry conditions for no longer than six weeks after delivery.
- When cement is stored temporarily infield it shall be kept on a dry waterproof base with a waterproof cover.
- The batching of concrete shall be done on a smooth impermeable surface (e.g. shutter ply-wood sheets). The batching area shall be prepared by cutting (not removing) the existing vegetation and covering the natural ground level (NGL) with Geotextile lining (minimum A4 grade). A sand retaining berm is to be constructed on top of the geotextile on the downstream end to contain any run-off. A 250µm plastic lining is to cover the geotextile and sand berm while secured to the NGL. The prepared area should be of sufficient size to prevent overspill of any material of substance. All wastewater resulting from batching of concrete shall be disposed of via a contaminated water management system and shall not be discharged into the environment.
- Contaminated water storage areas shall not be allowed to overflow and appropriate protection from rain and flooding shall be implemented.
- A demarcated site at least 20m away from water/ wetland edge shall be used for cement mixing. No batching activities shall occur directly on unprotected ground.
- Empty cement bags shall be stored in weather proof containers to prevent windblown cement dust and water contamination. Empty cement bags shall be disposed of on a regular basis via the solid waste management system, and shall not be used for any other purpose. Unused cement bags shall be stored so as not to be affected by rain or runoff events. In this regard, closed steel containers shall be used for the storage of cement powder and any additives.
- The Implementing Entity shall ensure that sand, aggregate, cement or additives used during the mixing process are contained and covered to prevent contamination of the surrounding environment.
- The Implementing Entity shall take all reasonable measures to prevent the spillage of cement/ concrete during batching and construction operations. During pouring, the soil surface shall be protected using plastic and all visible remains of concrete shall be physically removed on completion of the cement/ concrete pour and appropriately disposed of. All spoiled and excess

aggregate/ cement/ concrete shall be removed and disposed of via the solid waste management system.

- Construction using shuttering shall take into consideration the structure design dimensions and safe working heights to prevent over extension of shuttering. Steel shuttering panel sizes shall be used to match the dimensions of the final concrete section as close as possible.
- Concrete will be mixed and used on the same day. Time from mixing to final compaction should not exceed 45 minutes.
- The maximum haul distance of mixed concrete by means of wheel barrows should be limited to ensure the maximum time from mixing to final compaction does not exceed 45 minutes.
- Where sand, stone and cement are transported by wheelbarrow to their point of mixing the distance travelled should be limited to 150m.
- Where applicable, the location of the batching site (including the location of cement stores, sand and aggregate stockpiles) shall be as approved by the PC. The concrete batching plant shall be kept neat and clean at all times.
- Water used for mixing purposes will be of suitable non-potable quality and may not be obtained from natural water resources.

***Concrete Structures:***

- Concrete mix to follow the design specification.
- Participants shall be trained in concrete mixing and placing by an accredited organisation prior to performing construction of concrete structures.
- Concrete to be placed in 300mm layers and vibrated using a concrete vibrator.
- Minimum 50mm cover required on all concrete reinforcing and mesh unless otherwise specified.
- 250µm plastic sheets to be placed under structure.
- All concrete walls to be fully supported until they are backfilled to the designed level.
- All mesh reinforcing to have 500mm overlaps between sheets.
- Buttresses and walls to be cast monolithically with footing.
- Construction joints to be used wherever new concrete is cast against previously cast concrete.
- If rebar or mesh crosses a construction joint, it should be continuous through the joint and extend 600mm into each side.
- Foundation improvement to be constructed from 70kg sandbags made of BIDIM A4 and filled with sand or well graded gravel, where indicated.

***Gabion Structures:***

- Gabion work shall be done according to design specifications.
- Participants shall be trained in gabion construction by an accredited organisation prior to performing placing or construction of gabion structures.
- Gabion baskets and Reno mattresses to be constructed of minimum double twisted, hexagonal galfan galvanised wire mesh of nominal diameter and 80mm mesh. Frame wire to be 3.4mm outside diameter (o/d) and mesh wire to be 2.7mm o/d with partitions at 1m centres.

- Support and binding wire shall be a minimum 2.2mm. Lacing shall be done according to specification.
- Support wires (bracing) shall be in place according to manufacturer's specifications.
- All adjoining baskets shall be laced together according to manufacturer's specifications.
- Geotextile shall line all faces of the gabion baskets that are exposed to earth and certain water exposed sides with a minimum of 200mm overlap in all directions and stitched with either polyester of galvanised wire at 300mm c/c.
- Water corrosivity shall be determined at each site; if necessary PVC coated gabion gabion wire shall be used as specified.
- Soil dispersivity shall be determined at each site. If dispersive soils are detected, the ECO / Engineer shall be contacted.
- Density of fill material shall satisfy the gabion design. Clay bricks, weathered rock and sandstone and shale shall not be used as fill material. Any unconventional fill material shall be approved by the ECO / Engineer.
- Fill material shall not be smaller than mesh size.
- Where fill material is hauled to its point of placement by means of wheelbarrows, the haul distance shall not be greater than 150m.

***Stone Masonry Structures:***

- Stone to be packed and mortared in place using concrete with specified strength.
- Concrete mix to follow the design specification
- 100mm - 200mm stone to be used in all stone masonry, gabions and Reno mattresses. Stone fill must be non-friable & insoluble e.g. Granite, basalt, limestone or sandstone.

***Geo Cells:***

- Geo cells shall not be used in conditions that exceed their design specifications.
- Geo cell material shall be UV resistant.
- Geo cells shall be anchored in by the "trench" method and in such a way that prevents undermining of the cells.
- Fill material shall conform to the design specifications. The following general rules shall be applied: If soil is used to fill the cells, it shall be re-vegetated immediately with optimum prepared soil conditions.
- If concrete is used to fill the cells, some degree of permeability of the structure shall be permitted. If concrete is used as fill, concrete baffles should be inserted or as per specified design. Rock is not suitable for this purpose.

***Earth Works***

- Excavations may not exceed 1.5m depth without stepping, shoring and/or reinforcement.
- All excavated material temporarily stored shall be placed on Geotextile sheets covering the NGL. If stockpiled for extended periods, it will be done so at predetermined positions approved by the ECO.
- Excavation and compaction must comply with design specifications.

- The ECO / Engineer must be consulted for work undertaken in dispersive, unstable and organic soils.
- Backfilling in trenches must be done in layers of thickness not exceeding 100mm before compaction. Each layer shall be compacted using hand compactors or mechanical rammers at optimum moisture content.
- Where excavation material is hauled by means of wheelbarrows, the haul distance shall not be greater than 150m.

All earthworks shall be undertaken in such a manner so as to minimise the extent of any impacts caused by such activities, particularly with regards to erosion and dust generation. No equipment associated with earthworks shall be allowed outside of the Site and defined access routes unless expressly permitted by the ECO / Engineer.

***Rock Packing:***

- Stone must be non-friable and insoluble, e.g. granite, basalt, limestone or sandstone
- Rock packs placed across a stream to be tied min 1m into each bank.
- The ECO must approve the source of rocks if not supplied by suitable rock supplier.
- The haul distance may not be greater than 150m where rocks are transported to their point of placement by means of wheel barrows
- The size of rocks must comply with the specifications shown on the drawings and must be handled in a safe manner particularly during offloading/placing. Heavy duty gloves to be worn when handling rocks.

***Ecologs:***

- Wooden pegs used to anchor EcoLogs are to be no less than 40mm diameter and 1000mm in length.
- Pegs should protrude no less than 600mm from the soil @ 1000 c/c.

***MacMat / MacMat-R***

- MacMat / MacMat-R to be installed to manufacturers specifications.

***Working with Wire (Ecologs, fencing, silt traps)***

- Wire used must comply with the engineer's specifications.
- The appropriate tools are to be used for safe handling of wire.
- Heavy duty gloves must be worn when handling wire.
- No loose wire/sharp edges are to remain on completed interventions.
- All excess wire must be removed from the site.
- Stakes used for pegging should not present a tripping/piercing risk (as far as practically possible).

## Annexure E: Curriculum Vitae of EAP

# Franci Gresse

**Qualifications**

BSc (Hons) Conservation Ecology

Member, International Association of Impact Assessment (IAIA)

**Specialisation**

Environmental Impact Assessment Practitioner

**Years in industry**

8.08

Franci is a senior environmental practitioner in Aurecon's Cape Town office. She has been involved in various environmental investigations, including environmental impact assessments (EIA's), environmental management plans (EMP's), environmental management programmes (EMP's), rehabilitation plans maintenance management plans (MMP's) and fatal flaw analysis.

Franci has been involved with the Working for Wetlands rehabilitation programme for the past five years, of which she has been acting as the Team Leader for the environmental assessment practitioners (EAP's) for the last three years. The Working for Wetlands project won the 2012 Aurecon Chairman's Award for its positive contribution to the natural and social environmental. In addition, Franci has also been involved with a number of projects in the renewable energy sector.

Franci served on the committee of the South African affiliate of the International Association for Impact Assessment (IAIA) for the Western Cape Branch from 2009 to 2011, and remains a member. She completed a Bachelor of Science and an Honours Degree in Conservation Ecology at the University of Stellenbosch (South Africa).

## Experience

**Working for Wetlands plan 2016 - 2018, Regional South Africa, Department of Environmental Affairs: Natural Resource Management Directorate, 06/2016 - Date, Project Leader**

The Natural Resource Management Directorate of the Department of Environmental Affairs appointed Aurecon to provide environmental and engineering services for the Working for Wetlands Programme which is a national wetland rehabilitation programme. Responsibilities include the management and coordination of the overall project, management of the environmental authorisation component of the project, as well as the compilation of basic assessment reports (BAR) for the country. Other responsibilities include the compilation of wetland rehabilitation plans for the Western Cape, Northern Cape and Limpopo Provinces, liaison with authorities and the public (public participation process) and management of wetland specialists.

**Integrated Environmental Impact Assessment (EIA) for the proposed extension of the Ash Dam facility at Kriel power station, Mpumalanga Province, South Africa, Eskom Holdings, 06/2016 - date, Project Leader**

Appointed by Eskom to conduct an integrated environmental impact assessment (EIA) for the proposed construction of a fourth ash dam facility at the Kriel power station. Responsible for the general project management and finances, authority liaison and the compilation and review of the EIA documentation.

**Amended Environmental and Socio-Economic Impact Assessment for a concentrated solar plant facility near Arandis in the Erongo Region, 02/2016 – 10/2016, Project Leader**

Aurecon was appointed by the NamPower to amend the Environmental Clearance Certificate (ECC) issued for the Erongo Coal-fired Power Station at Arandis, to a Concentrated Solar Plant. Responsibilities included project management (programme, finances and client expectations), liaison with authorities and relevant stakeholders, review of specialist reports and the compilation and review of the Amendment Report.

# Franci Gresse Senior Environmental Impact Assessment Practitioner

**Table Mountain Group (TMG) Aquifer feasibility study and pilot project, Western Cape Province, South Africa, City of Cape Town, 2015 - date, Environmental Consultant**

The TMG Aquifer Feasibility Study and Pilot Project was initiated in 2002 and is a long term planning initiative to investigate the groundwater potential of the TMG Aquifer as a water source to augment Cape Town's water supply. Given the recommendations in the Exploratory Phase report, and the fact that the TMG Aquifer has since been utilised as a water resource in areas such as Hermanus and Oudtshoorn, the City of Cape Town decided to omit the Pilot Phase and rather proceed with an extended Exploratory Phase, which would include limited pump testing. Aurecon was appointed n to undertake the extended Exploratory Phase work. Responsibilities include the compilation of Environmental Management Plans for the additional test sites, liaison with the relevant authorities and landowners and management of the Environmental Control Officers on the project.

**Implementation of the Hoekplaas environmental authorisation (EA), Northern Cape Province, South Africa, Mulilo Renewable Energy, 11/2013 - 05/2015, Project Leader**

Aurecon assisted the holder of the environmental authorisation (EA) for the 100 MW photovoltaic (PV) facility in De Aar with the implementation of the environmental conditions to ensure compliance to all relevant environmental legislation. Responsible for the management of tasks and review of all documentation. Also assisting client with questions on the environmental impact assessment (EIA) process.

**Environmental impact assessment and compilation of an environmental management plan (EMP) for the Swakopmund-Mile 7 Water Supply, Phase 2, Swakopmund, Namibia, NamWater, 11/2013 - 10/2015, Project Leader**

NamWater appointed Aurecon to assist with the environmental impact assessment process for the proposed construction of a new bulk water pipeline between Swakopmund and Mile 7. Responsible for the management and review of the environmental impact assessment (EIA) reports and processes, as well as the project's finances.

**Working for Wetlands plan 2014 - 2016, Regional South Africa, South African National Biodiversity Institute (SANBI), 06/2013 – 05/2016, Task Leader**

The South African National Biodiversity Institute (SANBI) appointed Aurecon to provide environmental and engineering services for the Working for Wetlands Programme which is a national wetland rehabilitation programme. Responsible for the management of the environmental authorisation component of the project, as well as the compilation of basic assessment reports (BAR) for the country. Other responsibilities include the compilation of wetland rehabilitation plans for the Western Cape, Northern Cape, North West and Limpopo Provinces, liaison with authorities and the public (public participation process) and management of wetland specialists.

**Maintenance management plans (MMP's) for flood damaged road infrastructure, Western Cape Province, South Africa, Western Cape Provincial Government Department of Transport and Public Works, 06/2013 - Date, Project Staff**

The project entails the compilation of maintenance management plans (MMP's) for two local municipal areas (Laingsburg and Worcester), as well as obtaining the necessary permits/ water use authorisations. Personally involved during the project commencement with regards to strategy development, meetings with the relevant authorities and assistance with the development of the MMP's.

**Environmental impact assessment (EIA) for the expansion of approved solar energy facilities located near Prieska and De Aar, Northern Cape Province, South Africa, Mulilo Renewable Energy, 03/2013 - 09/2015, Phase Leader**

Mulilo Renewable Energy decided to expand the approved solar energy facilities on the farms Hoekplaas and Klipgats in Prieska, as well as on the farms Badenhorst Dam and Du Plessis Dam in De Aar. The expasion of Hoekplaas farm in Prieska includes ten additional 75 MW photovoltaic (PV) facilities and six additional PV units at Klipgats Pan farm. The expansion at Badenhorst Dam farm includes four additional 75 MW PV facilities and three additional PV units at Du Plessis Dam farm. Responsible for the management and review of the environmental impact assessment (EIA) reports and processes, as well as the project's finances.

**Fatal flaw study for two potential Wind Energy Facility (WEF) sites, Northern and Western Cape Provinces, South Africa, Juwi Renewable Energies (Pty) Ltd, 03/2013 - 04/2013, Environmental Practitioner**

The study entailed a fatal flaw analysis of two potential wind energy facility (WEF) sites in the Northern and Western Cape Provinces. Responsible for the assessment of the sites and compilation of the fatal flaw report.

**Richtersveld wind energy facility (WEF), Northern Cape Province, South Africa, TRE Tozzi Renewable Energy S.p.A and Guma Group, 07/2012 - 09/2013, Environmental Practitioner**

The project entailed a due diligence of the proposed wind energy facility (WEF) to review compliance with the requirements of the Department of Energy's independent power producer (IPP) process. Responsible for the review of the environmental reports and compilation of the due diligence report.

**Three photovoltaic (PV) energy facilities near Copperton, Northern Cape Province, South Africa, Mulilo Renewable Energy (MRE), 09/2011 - 05/2015, Environmental Practitioner**

The project entailed three environmental impact assessments (EIA's) for three photovoltaic (PV) energy facilities comprising 75 MW to 150 MW, located near Copperton. Responsible for the management the EIA process and project specialists, compilation of scoping and EIA reports and liaison with authorities.

**Fatal flaw study for four potential wind energy facility (WEF) sites, Northern and Western Cape Provinces, South Africa, Mainstream Renewable Power South Africa, 11/2011 - 05/2012, Environmental Practitioner**

The study entailed a fatal flaw analysis of four potential wind energy facility (WEF) sites across the Northern and Western Cape Provinces. Responsible for the management of specialists, review of reports, assessment of the sites and compilation of the fatal flaw report.

## Franci Gresse Senior Environmental Impact Assessment Practitioner

**Implementation of the Klipgats Pan environmental authorisation (EA), Northern Cape Province, South Africa, Mulilo Renewable Energy, 09/2011 - 05/2015, Project Leader**

Aurecon was appointed to undertake three environmental impact assessments (EIA's) for three proposed phtovoltaic (PV) solar energy plants near Copperton. The first PV solar energy plant will generate around 100 MW (preferred alternative) or 150 MW (alternative) on the Hoekplaas Farm (Farm 146/RE). The proposed PV plant will cover approximately 300 ha (preferred alternative) or 450 ha (alternative). The second includes a PV solar energy plant to generate roughly 100 MW on the farm Klipgats Pan (Farm 117/4) near Copperton in the Northern Cape. The proposed PV plant will cover an estimated 300 ha. An alternative site for a 100 MW PV plant with a 300 ha footprint is also being considered. The third comprises a PV solar energy plant to generate about 100 MW (preferred alternative) or 300 MW (alternative) on the farm Struisbult (Farm 104, portion 1) which will cover 300 ha to 900 ha. Responsible for managing tasks and reviewing all documentation for updating the environmental management plan (EMP) and implementing the environmental authorisation (EA). Also assisted client with questions on the EIA process.

**Proposed rehabilitation of Wetlands as part of the Working for Wetlands, Regional, South Africa, South African National Biodiversity Institute (SANBI), 08/2011 - 09/2013, Environmental Practitioner**

Appointed by the South African National Biodiversity Institute (SANBI) to conduct environmental impact assessments (EIA's) for the rehabilitation of specific wetlands in all provinces of South Africa over a five year period. Responsible for the compilation of basic assessment reports (BAR) and Wetland Rehabilitation Plans for the Western Cape, Northern Cape, Gauteng and Limpopo Provinces. Other responsibilities included liaison with authorities, public participation process, management of specialists and general project management of the environmental component of the project.

**Repair of flood damage to road structures in the Eden District Municipality, Western Cape Province, South Africa, Western Cape Provincial Department of Transport and Public Works, 01/2011 - Date, Environmental Practitioner**

The project entails the compilation of maintenance management plans (MMP) for seven areas with the Eden District Management Area to repair. Responsible for compilation of MMP's, review of reports and liaison with stakeholders and authorities.

**Environmental impact assessment (EIA) for the proposed extension of the Ash Dam facility at Kriel power station, Mpumalanga Province, South Africa, Eskom Holdings, 11/2009 - 12/2015, Environmental Practitioner**

Appointed by Eskom to conduct an environmental impact assessment (EIA) for the proposed construction of a fourth ash dam facility at the Kriel power station. Responsible for the general project management and finances, screening process, compilation of the scoping and EIA reports, public participation and the compilation of a waste management licence application.

## Franci Gresse Senior Environmental Impact Assessment Practitioner

**Environmental impact assessment (EIA) for proposed relocation of solar energy facility, Onder Rietvlei Farm, Aurora, Western Cape Province, South Africa, Solaire Direct Southern Africa, 2010 - 2011, Project Leader**

Appointed by Solaire Direct to undertake a basic environmental impact assessment (EIA) process for the proposed relocation of an approved, but not yet constructed 10 MW solar energy facility. Responsible for the management and review of the EIA process and finances.

**Environmental impact assessment (EIA) for proposed solar energy facility, Onder Rietvlei Farm, Western Cape Province, South Africa, Solaire Direct Southern Africa, 07/2010 - 02/2012, Environmental Practitioner**

Appointed by Solaire Direct to undertake a basic environmental impact assessment process for the proposed construction of a 10 MW solar energy facility. Responsible for the compilation of the draft and final reports, public participation process, management of specialists and general project management.

**Proposed Paarl Mountain and Ysterbrug pumping main upgrades, Western Cape Province, South Africa, Drakenstein Municipality, 06/2010 – 12/2015, Environmental Advisor**

The Drakenstein Municipality appointed Aurecon's engineers to investigate and plan the proposed upgrade of the Paarl Mountain and Ysterbrug Pumping Scheme. The upgrading of the pipelines feeding the Meulwater Water Treatment Works from the Bethel and Nantes dams, also part of this scheme, was also investigated. Responsible for providing advice on environmental processes required. Other responsibilities included the management of the independent environmental assessment practitioner and the review of all environmental impact assessment (EIA) documentation.

**Environmental sensitivity study (ESS) for a proposed solar energy facility on a farm Near Aurora, Western Cape Province, South Africa, Solaire Direct Southern Africa, 2010, Environmental Practitioner**

Appointed to provide and environmental sensitivity study (ESS) which inter alia highlights the potential constraints ('red flags') and opportunities presented by the site from an environmental perspective. Responsible for the compilation of the ESS.

**Proposed remediation, rehabilitation and restoration of the Spruit, Krom, Leeu and Palmiet Rivers, Western Cape Province, South Africa, Drakenstein Municipality, 2009 - 2010, Environmental Practitioner**

Appointed by the Drakenstein Municipality to undertake the requisite environmental impact assessment (EIA) process for the rehabilitation, remediation and stabilisation of four rivers in Paarl and Wellington. Responsible for the EIA and public participation processes.

**Proposed construction of a new pipeline from Bovlei Winer to Withoogte Dam, Wellington, Western Cape Province, South Africa, Drakenstein Municipality, 2009 - 2010, Environmental Practitioner**

The Drakenstein Municipality proposed to replace a section of the existing pipeline extending from the Withoogte Dam to the Welvanpas Reservoir near Wellington as part of the municipality's water master plan in order to improve the overall water supply. Responsible for the compilation of the environmental impact assessment (EIA) report, management of specialists and the public participation process.

# Franci Gresse Senior Environmental Impact Assessment Practitioner

**Proposed erection of Eskom communication sirens and public anouncement (PA) systems, Blaauwberg, Western Cape Province, South Africa, Eskom, 2009 - 2010, Environmental Practitioner**

The project entailed three environmental impact assessment (EIA) processes for the (a) erection of 10 new sirens in the Parklands area, (b) the relocation of one siren in Bloubergstrand, and (c) the upgrade of five sirens on farms near Melkbosstrand. Responsible for compiling environmental impact assessment (EIA) reports, and the public participation process.

**Overberg District Municipality integrated transport plan (ITP) strategic environmental informants, Western Cape Province, South Africa, Overberg District Municipality, 2009, Environmental Practitioner**

Aurecon's Transportation Unit was appointed to revise the integrated transport plan (ITP). The Environmental Unit was subcontracted to provide environmental input. Responsible for identifying and describing the relevant informants.

**Annandale Commercial: development of petrol filling station on portion of Erf 5561, Kuils River, Western Cape Province, South Africa, Communicate, 2009, Environmental Practitioner**

Appointed to compile a construction environmental management plan (CEMP) for the construction of a filling station on the corner of Gladioli Street and Amandel Drive, Kuils River. Responsible for the compilation of the project specification document as part of the CEMP.

**Environmental impact assessment (EIA) for the proposed Langezandt Quays development in Struisbaai Harbour, Western Cape Province, South Africa, Golden Falls (Pty) Ltd, 2008 - Date, Environmental Practitioner**

Aurecon was appointed to undertake an environmental impact assessment (EIA) process for the proposed development of a four storey development on Erf 848 within the Struisbaai harbour precinct. Responsible for drafting responses to the Department of Environmental Affairs' independent review report on the proposed development.

**Pre-feasibility and feasibility studies for augmenting the Western Cape water supply system, South Africa, Department of Water Affairs (DWA), 2008 - 2013, Project Staff**

The Department of Water Affairs commissioned pre-feasibility and feasibility studies for the augmentation of the Western Cape water supply system through the further development of the surface water resources. Surface water schemes to be investigated were identified by the Western Cape water supply system reconciliation strategy study. Responsible for the public participation process, managing environmental specialists, and compiling a socio-economic overview of the study area.

**Proposed redevelopment of the Blaauwberg Conservation Area: Eerstesteen Node, Western Cape Province, South Africa, City of Cape Town, 2008 - 2010, Environmental Practitioner**

The project entailed an environmental impact assessment (EIA) process for redeveloping the Eerstesteen Conservation Area on the West Coast. Responsible for compiling the EIA report, as well as managing specialists and the public participation process.

# Franci Gresse Senior Environmental Impact Assessment Practitioner

**Table Mountain Group aquifer feasibility study and pilot project, Western Cape Province, South Africa, City of Cape Town, 2008 - 2010, Environmental Control Officer**

The City of Cape Town initiated a study into the Table Mountain Group Aquifer as a potential water source to augment the city's supply. The feasibility and pilot project phase record of decision (RoD) required completion for site-specific environmental management plans (EMP's) for drilling sites that were assessed to be environmentally sensitive. Site-specific EMP's were designed for sensitive sites to ensure minimal environmental impact during the drilling phase. Responsible for monitoring compliance with the RoD and EMP during the drilling phase.

**Water reconciliation strategy for the Algoa water supply area, Eastern Cape Province, South Africa, 2008 - 2009, Environmental Practitioner**

This project provided an assessment of the environmental opportunities and constraints for a suite of water schemes in the Algoa water supply area. This was undertaken as part of a broader study in the area.

**Application for rectification in terms of Section 24G of the National Environmental Management Act (NEMA) for the unlawful commencement of a fruit processing factory on Op de Tradouw Farm, Number 69, Barrydale, Western Cape Province, South Africa, Schoonies Family Trust, 2008 - 2009, Environmental Practitioner**

The project consisted of an application for rectification in terms of Section 24G of NEMA. Responsible for compiling an environmental impact report and an environmental management plan (EMP) for the application, as well as managing the public participation process.

**Proposed development of apple and pear orchards on Soetmelksvlei Farm, Western Cape Province, South Africa, BETCO, 2008 - 2009, Project Staff**

This Agri-development project involved the development of 50 ha of apple and pear orchards in the Riviersonderend region. Responsible for compiling the basic assessment report, environmental management plan (EMP), and managing the specialists and public participation process.

**C.A.P.E. Olifants-Doring Catchment Management Agency project: Development of a catchment management strategy water resource protection sub-strategy for the Olifants-Doring Catchment, South Africa, CapeNature, 2008 - 2009, Environmental Practitioner**

Appointed by CapeNature to compile a catchment management strategy water resource protection sub-strategy for the Olifants-Doorn catchment. Responsible for compiling a database that lists all institutions and their respective mandates in terms of water resource protection and biodiversity conservation decision making for the Olifants-Doring Catchment, workshop arrangements, and general project related work.

**Environmental sensitivity study for the proposed Dasdrif poultry farm in Moorreesburg, Western Cape Province, South Africa, Eikenhoff Poultry Farms (Pty) Ltd, 2008, Project Staff**

The project consisted of an environmental sensitivity study (ESS) which, inter alia, highlighted the potential constraints ('red flags') and opportunities presented by the site from an environmental perspective. Responsible for compiling the ESS.

# Margaret Lowies

## Senior Environmental Scientist

Margaret is a senior environmental scientist currently based in Aurecon's Port Elizabeth office. She has over seven years of experience in environmental impact assessment (EIA) processes, water use licence applications, waste licence applications, environmental compliance auditing, mining permit applications, wetland assessments, due diligence assessments and water quality assessments. Most of these projects have been focussed at a municipal level within the various municipalities of the Eastern Cape, and her roles include both the technical work and overall project management. Her role as an environmental control officer (ECO) has also given her a very practical understanding of how projects of various scales are implemented.

She obtained a BSc degree in Geography and Environmental Management, a BSc in Geography (Hons) as well as an MSc degree in Geography from the University of Johannesburg, South Africa in 2008, 2010 and 2014 respectively. She is registered as an environmental assessment practitioner with the Environmental Assessment Practitioners Association of South Africa (EAPSA) and is a registered candidate natural scientist with the South African Council for Natural Scientific Professions (SACNASP). She is also member of the Institute of Waste Management of South Africa (IWMSA) and the South African affiliate of the International Association of Impact Assessment (IAIAsa).

**Qualifications**

MSc Geography

BSc (Geography and Environmental Management)

BSc Geography (Hons)

Environmental Assessment Practitioner, Interim Certification Board of Environmental Assessment Practitioners of South Africa

Candidate Natural Scientist, South African Council for Natural Scientific Professions (SACNASP)

Member, International Association for Impact Assessment (IAIAsa), South Africa

Member, Institute of Waste Management of Southern Africa (IWMSA)

**Specialisation**

Environmental Specialist

**Years in industry**

7

**Languages**

Afrikaans

English

## Experience

### Training & Capacity Building

**Working for Wetlands ECO training, South Africa,**

Having worked on the planning cycles of the Working for Wetlands Programme for many years, Margaret provided training on the importance of implementing the appropriate mitigation measures during wetland rehabilitation. This was guided by her experience as an Environmental Control Officer.

### Environmental Control Officer

**Construction of Zone 7 municipal infrastructure to service the TNPA Tank Farm, Eastern Cape Province, South Africa, Coega Development Corporation (CDC), 10/2007 - 12/2025, Environmental Control Officer**

The project involved the construction of roads, a stormwater detention pond and the installation of various services. Responsible for ensuring compliance with environmental assessment and CDC standard environmental specifications.

**Dordrecht water and sanitation services upgrade, Eastern Cape Province, South Africa, Chris Hani District Municipality, 10/2015 - 12/2017, Environmental Control Officer**

This project is divided into four future projects, which includes the construction of new sewage treatment facilities; the construction of new reticulation in Dordrecht; immediate water supply upgrades and long-term bulk water supply upgrades. Responsible for report review.

**Northern outfall sewers, Mthatha, Eastern Cape Province, South Africa, Amatola Water - Amanzi, 06/2013 - 12/2017, Environmental Control Officer**

The project entailed consulting engineering, social facilitation and environmental services for the construction of the outfall sewers along the banks of the Mthatha River. This involved the installation of 1 200 mm diameter sewer pipes, crossing the river above ground and below the river bed level. The sewage will discharge into a 17 m-deep pump station, from where it will be pumped into the head of the existing wastewater treatment works (WWTW).The project also entailed the application for a water use licence application (WULA). Responsible for management of environmental site officer, report writing and WULA report/application review.

**Construction of Graaff-Reinet solid waste site, Eastern Cape Province, South Africa, Camdeboo Local Municipality, 12/2010 - 12/2016, Environmental Control Officer**

The project comprised the construction of a new solid waste site outside Graaff-Reinet. Responsible for monitoring compliance with the environmental management plan (EMP) and record of decision (ROD).

**Construction environmental management plan (EMP) for Ugie particle board plant, Eastern Cape Province, South Africa, PG Bison, 08/2006 - 08/2016, Environmental Control Officer**

The project entailed a construction environmental management plan (EMP), operation environmental management plan (OEMP), atmospheric emissions license (AEL) reviews and ongoing monitoring for the Ugie particle board plant. Responsible for operational compliance auditing.

**Sidwadweni Bulk Regional Water Supply Scheme, Eastern Cape Province, South Africa, Amatola Water - Amanzi, 09/2012 - 07/2016, Environmental Control Officer**

The project included the construction of river abstraction, raw water reservoir, water treatment works (WTW), clear water pump station and bulk supply mains for the Sidwadweni Bulk Regional Water Supply Scheme. Responsible for report review.

**Idutywa East Water Supply Scheme (WSS), Eastern Cape Province, South Africa, Amathole District Municipality (ADM), 05/2006 - 12/2015, Environmental Control Officer**

Aurecon undertook the design and construction of the Idutywa East Water Supply Scheme (WSS) in the Eastern Cape Province. Responsible for ensuring environmental compliance and report review.

**Khayamnandi housing development project, Eastern Cape Province, South Africa, Nelson Mandela Bay Metropolitan Municipality (NMBMM), 02/2011 - 01/2015, Environmental Control Officer**

The project entailed environmental services for the development of Khayamnandi extension on erven 114, 609, 590 and 24337, Bethelsdorp, including the construction of 7 960 residential stands, business stands and community facilities and supporting infrastructure. Responsible for overall environmental monitoring and inputs as well as compilation/review of monthly audit reports.

**Cookhouse Wind Farm project, Eastern Cape Province, African Clean Energy Developments (ACED), 12/2012 - 12/2014, Environmental Control Officer**

Aurecon was appointed as owner's engineer for the construction of a 140 MW wind farm in the Eastern Cape Province of South Africa. The scope of services included design review, site supervision, environmental monitoring, health and safety monitoring and witnessing of commissioning and testing. The Cookhouse Wind Farm Stage 1 comprise 66 x Suzlon S88 2.1 MW wind turbines, associated roads and foundations, electrical reticulation, substation, supervisory control and data acquisitioning (SCADA) system as well as a 132 kV overhead line (OHL) to the Poseidon substation. The scope of owner's engineer services has been structured to align with the role and obligations of the owner's engineer defined in the draft engineering, procurement and construction (EPC) agreement for the project. Responsible for overseeing environmental compliance of the project including updating of the environmental management plan (EMP), approval of method statements, environmental authorisation and layout amendments, bi-weekly audits with a monthly environmental assessment (EA) and EMP compliance report.

## Advisory

**Reconciliation strategy for Algoa Water Supply System (WSS), Eastern Cape Province, South Africa, Department of Water and Sanitation, 04/2016 - 03/2019, Environmental Specialist - Advisory**

The project objectives are to put arrangements and resources in place for the ongoing implementation of the recommendations and maintenance of the Algoa Reconciliation Strategy; to evaluate the efficiency of the Orange-Fish-River Project and to remove potential operating system constraints for the sustainable delivery of the Orange River bulk water supply to the Lower Sundays River Government Water Scheme (LSRGWS) and to Nelson Mandela Bay Municipality (NMBM) for water requirements up to 2040. In order to evaluate the efficiency of the Orange River Project Aurecon will estimate water use efficiency; determine catchment yields of the Fish and Sundays catchments; give recommendations for the phasing-out of current gratis allocations; identify potential water savings and provide options for re-allocation as well as confirm an official allocation from the Teebus Tunnel to the Orange-Fish System (OFS) in the Eastern Cape. While the focus is on providing additional balancing storage in addition to the Scheepersvlakte Balancing Dam, the provision of storage at other potential locations in the bulk transfer infrastructure must also be considered. Responsible for ad hoc advisory relating to environmental legislation compliance and general environmental matters.

**Public Servant Association Social and Labour Plan (SLP), Eastern Cape Province, South Africa, Public Servant Association, 12/2010 - 02/2011, Environmental Assessment Practitioner**

The Social and Labour Plan (SLP) was done in order to obtain a mining right conversion for the Department of Mineral Resources (DMR) for the Gonubie Sand Mine. Responsible for compilation of SLP and communication with DMR.

## Integrated Environmental Permitting (EIAs, EMPs and MMPs)

**Working for Wetlands Programme, Department of Environmental Affairs, 06/2011 - 04/2018, Environmental Assessment Practitioner - Coordinator of the Mpumalanga and Eastern Cape Provincial teams**

Aurecon was appointed in 2011, 2013 and then again in 2016 for a three-year cycle for the design, planning, environmental, project and risk management of the Working for Wetlands programme. The programme's objective is to rehabilitate damaged wetlands throughout South Africa, with an emphasis on complying with the principles of the Expanded Public Works Programme (EPWP) through employing only local small, medium and micro enterprises (SMMEs). Involvement included site work, a rehabilitation plan and basic assessment report to enable the rehabilitation of various wetlands within the Mpumalanga and Eastern Cape provinces. Responsible for coordination of provincial team (wetland specialist, engineer and DEA Assistant Director) and report writing.

**Motherwell North Bulk Sewer, Eastern Cape Province, South Africa, Nelson Mandela Bay Metropolitan Municipality (NMBMM), 12/2015 - 10/2017, Project Leader/Environmental Assessment Practitioner**

Aurecon was appointed to undertake environmental authorisations for the Motherwell North Bulk Sewer project. This included environmental impact assessment (EIA), heritage, water use licenses (WUL) and specialist studies for the 1.5 m diameter collector sewer of 10 km. Responsible for project management and review of report.

**Misgund augmentation bulk water supply, Eastern Cape Province, South Africa, Amatola Water - Amanzi, 01/2014 - 06/2017, Environmental Assessment Practitioner/Specialist**

The project entailed a study to determine the technical feasibility of bulk water supply in Misgund as per the Department of Water Affairs (DWA) guidelines for Regional Bulk Infrastructure Grant (RBIG) projects. Responsible for environmental impact assessment (EIA) process, water use licence application (WULA) and wetland assessment.

**Upgrading and permitting of the Klipplaat landfill site, Eastern Cape Province, South Africa, Ikwezi Local Municipality, 10/2011 - 06/2016, Environmental Assessment Practitioner**

The project involved the upgrading and permitting of the existing Klipplaat landfill site. This includes a scoping-environmental impact assessment (EIA) process as well as waste licence application process. Responsible for managing the EIA process, including public participation and report writing and review.

**Bende water supply scheme, Eastern Cape Province, South Africa, Amathole District Municipality, 05/2014 - 02/2015, Environmental Assessment Practitioner**

Aurecon was appointed for the environmental management for the proposed implementation of two rural water supply schemes at Bende and Shixini in the Eastern Cape Province. Responsible for report review, appointment of specialists and management of environmental impact assessment (EIA) process.

**Upgrading of National Route 61 Section 6 (R61/6) from All Saints (Km 68.5) to Section 7 - Baziya (Km 12), between Baziya and Queenstown, Eastern Cape Province, South Africa, South African National Roads Agency Limited**

**(SANRAL), 04/2012 - 12/2014, Environmental Assessment Practitioner/Environmental Specialist**

Aurecon was appointed by Jeffares & Green (J&G), on behalf of the South African National Roads Agency Limited (SANRAL), to undertake an all environmental authorisation and public participation process (PPP) for the proposed road upgrade of National Route R61. The project involved the upgrading of a 36 km stretch of road as well as replacing five bridges. Responsible for project management, report writing and water quality specialist report.

**Social impact assessment (SIA) for augmentation of the Driftsands collector sewer, Eastern Cape Province, South Africa, Nelson Mandela Bay Metropolitan Municipality (NMBMM), 08/2011 - 10/2011, Environmental Assessment Practitioner**

The project involved a survey of households in the Walmer Township that are impacted by the augmentation of the Driftsands sewer collector. Responsible for coordination of survey, capturing of data and report writing.

### Other Environmental Permitting/ Management Projects

- Churchill water treatment works (WTW), Eastern Cape Province, 03/2007 – 12/2020, Environmental Assessment Practitioner
- Upgrade of Brickfields pre-treatment works in Nelson Mandela Bay Metropolitan Municipality, 12/2010 – 07/2020, Environmental Assessment Practitioner
- Sewer maintenance backlog study for the Nelson Mandela Bay Metropolitan Municipality, Eastern Cape Province, South Africa, Nelson Mandela Bay Metropolitan Municipality (NMBMM), 10/2004 - 07/2020, Environmental Assessment Practitioner
- Environmental impact assessment for pipe upgrade of Eastbury Drive Sewer, KwaZulu-Natal Province, South Africa, eThekwini Municipality, 06/2016 - 05/2019, Environmental Assessment Practitioner
- Environmental services for upgrading of R75, Eastern Cape Province, South Africa, South African National Roads Agency Limited (SANRAL), 02/2015 - 02/2018, Project Leader/Environmental Assessment Practitioner
- Woodchem water use licence, Mpumalanga Province, South Africa, KAP Diversified Industrial (Pty) Ltd, 04/2016 - 07/2017, Environmental Specialist
- Environmental impact assessment (EIA) for Coega wastewater treatment works (WWTW), Eastern Cape Province, South Africa, Nelson Mandela Bay Metropolitan Municipality (NMBMM), 12/2014 - 05/2017, Project Leader/Environmental Assessment Practitioner
- Water use licence application (WULA) and wetland assessment for Grassridge to Melkhout 132 kV line, Eastern Cape Province, South Africa, Eskom SOC Ltd, 11/2014 - 12/2015, Environmental Specialist/Project Leader
- Proposed construction of the Ingquza Hill Museum - basic assessment, Eastern Cape Province, South Africa, National Department of Arts and Culture, 08/2013 - 10/2013, Environmental Assessment Practitioner

# APPENDIX G

# STAKEHOLDER DATABASE

# Stakeholder Database

| Stakeholder | Contact | Organisation |
|---|---|---|
| **National Stakeholders** | Mr Mark Anderson | Birdlife South Africa |
| | Ms Mpume Ntlokwana | Department of Agriculture Forestry & Fisheries |
| | Ms Serah Muobeleni | Department of Agriculture Forestry & Fisheries: Land Use and Soil Management |
| | Mr Stanley Tshitwamulomoni | Department of Environmental Affairs: Biodiversity Conservation |
| | Mr Danie Smit | Department of Environmental Affairs: Sensitive Environments |
| | Ms Naomi Fourie | Department of Water and Sanitation |
| | Dr Paul Meulenbeld | Department of Water and Sanitation |
| | Ms Jackie Jay | Department of Water and Sanitation |
| | Ms Barbara Weston | Department of Water and Sanitation |
| | Mr Kelvin Legge | Department of Water and Sanitation |
| | Mr Bongani Madikizela | Water Research Commission |
| | Ms Olga Jacobs | SANParks: Biodiversity and Social Projects |
| | Mr Steven Segang | Endangered Wildlife Trust |
| | Mr Ahmend Khan | Department of Environmental Affairs |
| | Mr Louwrens Ferreira | Department of Environmental Affairs |
| | Mr Wemer Roux | Department of Environmental Affairs |
| | Ms Kerryn Morrison | Endangered Wildlife Trust |
| | Ms Tanya Smith | Endangered Wildlife Trust |
| | Morgan Griffiths | WESSA |
| | Mr Dumisani Mabona | Department of Environmental Affairs: Sensitive Environments |
| | Mr Umesh Bahadur | Department of Environmental Affairs: Working for Wetlands |
| | Mr Farai Tererai | DEA: Working for Wetlands: Manager: Planning, Monitoring and Evaluation |
| | Dr Piet-Louis Grundling | Department of Environmental Affairs: Working for Wetlands |

| Stakeholder | Contact | Organisation |
|---|---|---|
| | Mr Seoka Lekota | DEA: Biodiversity Conservation |
| | Ms Paballo Mohafa | DEA: World Heritage Compliance |
| | Ms Bernadet Pawandiwa | Amafa aKwaZulu-Natali |
| | Khosa Tsunduka | Department of Water and Sanitation |
| | Malaudzi Nkumbudzeni | Department of Water and Sanitation |
| | Lumka Kuse | Department of Water and Sanitation |
| | Xolani Hadebe | Department of Water and Sanitation |
| **Provincial Stakeholders: State Authority** | Mr Kwazi Hlongwane | Department of Agriculture, Forestry and Fisheries |
| | Mr Poovey Moodley | Department of Economic Development, Tourism and Environmental Affairs |
| | Mr Siyabonga Buthelezi | Department of Water and Sanitation |
| | Mr Andy Blackmore | Ezemvelo KZN Wildlife |
| | Mr Doug Burden | Duzi uMngeni Conservation Trust |
| | Ms Nonkululeko Mokeona | Department of Water and Sanitation |
| | Mr Angus Burns | World Wildlife Fund for Nature |
| | Ms Sue Viljoen | World Wildlife Fund for Nature |
| | Mr Lemson Betha | WESSA KZN |
| | Mr Dominic Wieners | Ezemvelo KZN Wildlife |
| | Mr Ivor Hoareau | Department of Water and Sanitation |
| | Krishnee Naidoo | Department of Water and Sanitation |
| | Ms Phumelela Phenyane | Ezemvelo KZN Wildlife |
| **Landowner** | Carl Myhill | iSimangaliso Wetland Park |
| **Municipal Stakeholders** | Mr Mondli Funeka | Mtubatuba Local Municipality |
| | Mr Bonga Ntanzi | Abaqulusi Local Municipality |
| | Mr Jerry Sibaya | Abaqulusi Local Municipality |
| | Mr S Chetty | Abaqulusi Local Municipality |
| | Ms Nokubonga Kunene | Abaqulusi Local Municipality |
| | Mr Velenkosi Fiki Hlabisa | Big Five Hlabisa Local Municipality |

| Stakeholder | Contact | Organisation |
|---|---|---|
| | Cllr CT Khumalo | Big Five Hlabisa Local Municipality |
| | Cllr HT Nkosi | Big Five Hlabisa Local Municipality |
| | Mr Solomon Mkhombo | Umkhanyakude District Municipality |
| | Mr Sbusiso Emmanuel Bukhosini | Umkhanyakude District Municipality |
| | Ms Hlengiwe Shandu | Zululand District Municipality |
| | Ms MM Kunene | Zululand District Municipality |
| | Mr Inkosi Elphas Mzamo Buthelezi | Zululand District Municipality |
| General I&APs | Brain Beyers | WESSA |
| | Ms Terry Calmeyer | ILISO Consulting Environmental |
| | Mr Gerhard Cilliers | Department of Water and Sanitation |
| | Mr Craig Cowden | GroundTruth |
| | Alex Dlamini | Invasive Alien Species Programme |
| | Mr Vaughan Koopman | Mondi Wetland Forum |
| | Mr Doug Mcfarlane | Eco-Pulse |
| | Mr Aldred Matsheke | KZN DEA |
| | Mr Greg Mullins | eThekwini Municipality |
| | Ms Joyce Pope | Umngeni Municipality |
| | Mr Damian Walters | Mondi Wetland Projects |
| | Ms Zama Madlala | RNR Conservancy |
| | Mr Sebenza Nduli | Private I&AP |
| | Mr Andreas Sithole | Hluhluwe Nature Reserve |
| | Mr Brent Cocoran | Mondi Group |
| | Mr Inkosi S Ngwane | Private I&AP |
| | Mr Nick Stubbs | Private I&AP |
| | Mr Derek Watson | Private I&AP |
| | Mr ME Dladla | Private I&AP |
| | Ms Catherine Hanekom | Ezemvelo KZN Wildlife: Tembe Elephant Park |

# APPENDIX H

# EAP & SPECIALIST CVs

## *Curriculum Vitae* – Craig Cowden

**Personal Details:**

| | |
|---|---|
| Name | Craig Cowden |
| Profession: | Wetland Ecologist |
| Date of Birth: | 14 March 1978 |
| Nationality: | South African |

**Key Qualifications:**

Seventeen years' experience in ecosystem functioning and management, specializing in wetland ecosystems. Involvement in a variety of studies to determine practical and applied ecological solutions. Specialist input into various studies, focusing on:

- Mapping and infield delineation of wetland habitat within various regions of Southern Africa, including South African provinces of KwaZulu-Natal, Mpumalanga, Free State, Eastern Cape and Gauteng, and Lesotho for inventory and management purposes.
- Assessment of various wetland ecosystems to highlight potential impacts, within current and proposed landscape settings, and recommend appropriate mitigation and offsets based on assessing wetland ecosystem service delivery (functioning) and ecological health/integrity.
- Assessment of various wetland ecosystems to plan appropriate wetland rehabilitation activities and performance evaluation and monitoring of wetland rehabilitation projects.
- Literature reviews and research relating to impacts, best management practices, promoting biodiversity, monitoring and evaluating rehabilitation within wetland ecosystems.

**Education and Training:**

- 2017 MSc (Environmental Science) Rhodes University, Grahamstown. MSc has been accepted pending corrections.
- 2017 Wetland Delineation Course - Wetland Training Institute, Convington (Louisiana), USA.
- 2017 Natural Processes for the Restoration of Drastically Disturbed Sites. VII World Conference on Ecological Restoration, Foz do Iguassu, Brazil, August 26, 2017.
- 2015 A Methodology for Determining Buffer Zones for Rivers, Wetlands and Estuaries. National Training and Development Workshop, Pretoria, Gauteng, November 24-25, 2017.
- 2005 Wetland Assessments to Inform Wetland Rehabilitation Planning - University of KwaZulu-Natal.
- 2001 Forest Certification Course - SGS Qualifor.
- 2001 Wetland Rehabilitation Planning and Implementation - Mondi Wetlands Project.
- 1999 B.Sc. (Agriculture) University of Natal, Pietermaritzburg – Four-year Degree (Honours equivalent), majoring in Wildlife Science & Zoology.

**Professional Memberships:**

- Professional Natural Scientist (Pr.Sci.Nat) in Ecological Science - The South African Council for Natural Scientific Professions (Reg. No. 400197/05)
- Founding Member - South African Wetland Society
- Member -Society of Wetland Scientists (International)
- Member -Society of Ecological Restoration (International)

**Professional Awards**:

- National Wetland Award under the "Stewardship" category awarded in 2013 in recognition of the wetland rehabilitation associated with the Greater Edendale Mall development.
- Mondi Wetlands Programme acknowledgment of "Contributions towards wetland conservation" awarded in 2012.

**Experience Record:**

2009 to Present: GroundTruth (GT) - Management of the wetland division within GT.
2001 to 2009: Land Resources International (LRI) - Management of the environmental division within LRI.

**Examples of Projects:**

- Implementation of wetland rehabilitation planning in various provinces, including KwaZulu-Natal, Mpumalanga, Limpopo, Gauteng, Free State and Western Cape for the Working for Wetlands Programme from 2005-2012, 2016-2018.
- Wetland specialist input and support to Burundi Nature Action and Association pour la Conservation de la Nature au Rwanda on behalf of the International Union for the Conservation of Nature – Netherlands Committee.
- Assessments of impacted wetland systems and rehabilitation planning to inform the offset requirements for proposed development at the Cascades Mall in Pietermaritzburg.
- Assessments of impacted wetland systems and rehabilitation planning to inform the offset requirements for Exxaro coal mining operations.
- Assessment of wetland systems potentially affected by the proposed expansion of Lumwana Mine near Solwezi, Zambia on behalf of SRK Consultants.
- Water Research Commission research project on developing a monitoring and evaluation framework to assess wetland rehabilitation in South Africa.

**Publications**

- **Cowden C**, Kotze DC, Ellery WN & Sieben EJJ. 2014. *Assessment of the long-term response to rehabilitation of two wetlands in KwaZulu-Natal, South Africa.* African Journal of Aquatic Science, Vol. 39, No. 3.
- Rivers-Moore NA, **Cowden C**. 2012. *Regional prediction of wetland degradation in South Africa. Wetlands Ecology and Management*, DOI 10.1007/s11273-012-9271-5.
- Macfarlane DM, Walters D & **Cowden C**, 2011. A wetland health assessment of KZN's priority wetlands. Draft Unpublished Report prepared for Ezemvelo KZN Wildlife, Pietermaritzburg.
- **Cowden C** & Kotze DC, 2009. WET-RehabEvaluate: Guidelines for the monitoring and evaluation of wetland rehabilitation projects. WRC Report No. TT 342/08, Water Research Commission, Pretoria.
- Kotze DC, **Cowden C**. 2009. KZN Biodiversity Stewardship Programme: Guidelines for the *in situ* Management of Ecosystems in KwaZulu-Natal, according to Biodiversity Conservation Principles – Wetlands. Unpublished Report prepared for Ezemvelo KZN Wildlife by Land Resources International, Pietermaritzburg.
- **Cowden C**, Ellery W, Kotze D, Grenfell M, McCulloch D, Woods D, Grenfell S, Bambus O. 2009. *Performance evaluation of the wetland rehabilitation undertaken at Killarney Wetland in Ntsikeni Nature Reserve, KwaZulu-Natal Province* ***In*** *Kotze DC, Ellery WN. 2009. WET-OutcomeEvaluate: An Evaluation of the rehabilitation outcomes at six wetland sites in South Africa.* WRC Report No. TT 343/09. Water Research Commission, Pretoria.

**Conference Presentations:**

- **Cowden C**, Kotze D, Walters D, Browne B. Monitoring and evaluation framework for wetland restoration in South Africa, using an urban wetland case study. *Presented during VII World Conference on Ecological Restoration.* Foz do Iguassu, Brazil, August 28 - September 1, 2017.
- **Cowden C**. Wetland specialist input into the Working for Wetlands rehabilitation planning cycle. 21st National Wetlands Indaba, Hoedspruit, Mpumalanga, October 25-28, 2016.
- **Madikizela B**, Cowden C, Kotze D, Ellery W. *Documenting lessons and refining the wetland restoration field of practice in South Africa: The response of two wetlands to Working for Wetlands Restoration, Presented during V World Conference on Ecological Restoration.* Wisconsin, USA, September 6-11, 2013.
- **Cowden C**, Kotze D, Ellery W. *Assessment of the long-term response of specific wetlands to rehabilitation interventions by Working for Wetlands, 17th National Wetlands Indaba*. Klein Kariba, Limpopo, October 23-26, 2012.
- **Cowden C**. *Urban Wetland Rehabilitation: A KwaZulu-Natal Case Study, 16th National Wetlands Indaba*. Didima, KwaZulu-Natal, October 18-21, 2011.

# Claire Blanché

**Senior Environmental Specialist**

Claire is currently employed as a senior environmental scientist in Aurecon's Cape Town office where she has worked on South African projects within the environmental impact assessment (EIA) process. She has a good understanding of the South African laws and regulations associated with these procedures.

In her capacity as a lead environmental scientist, Claire has led teams of consultants, specialists and scientists, focusing specifically on large-scale linear-type developments. She has gained skills in the execution of plant rescue and rehabilitation in linear projects and has contributed towards research and State of Environment Reporting, specifically in the fields of air quality and climate change.

She studied at the University of KwaZulu-Natal, South Africa and obtained a Master's degree in 2001 in the field of Environment and Development, including integrated environmental management (IEM) procedures, project management and panning, environmental auditing, environmental law, and rural land and community development), with specialisations in water resources and catchment management.

Between 2009 and 2011 Claire was an elected member of the national executive committee as well as a vice-chair KwaZulu-Natal committee member for the International Association for Impact Assessments South Africa (IAIAsa). She is currently also a lifetime inaugural member of the Golden Key International Honour Society (GKIHS) as well as an interim inaugural member of the Environmental Assessment Practitioners Association of South Africa (EAPASA).

### Working for Wetlands Programme, Regional, South Africa, South African National Biodiversity Institute (SANBI), 08/2011 - 09/2013, Co-Team Leader (Environmental Component)

Working for Wetlands (WfWetlands) is a government programme managed by the South African National Biodiversity Institute (SANBI), and is a joint initiative of the Departments of Environmental Affairs, Water Affairs and Agriculture, Forestry and Fisheries. The programme is mandated to rehabilitate damaged wetlands and to protect pristine wetlands throughout South Africa, with an emphasis on complying with the principles of the Expanded Public Works Programme which seeks to draw significant numbers of unemployed people into the productive sector of the economy, gaining skills while they work and increasing their capacity to earn an income. This project involved the basic assessment process to apply for environmental authorisation to work in many wetland projects throughout South Africa. It also involved the coordination of wetland ecologists, engineers and environmental scientists to deliver detailed rehabilitation plans for each wetland project, as well as the public participation processes associated with the rehabilitation proposals.

### Piketberg stormwater infrastructure upgrade project, Western Cape Province, South Africa, UDS Africa, 05/2012 - 04/2013, Project Leader

This project involved the basic assessment process and environmental management plan

### Qualification

MSc Environment and Development

BSc (Hons) Applied Environmental Science: Physical and Human Geography

BSc

### Specialisation

Senior Environmental Scientist

### Professional membership

Lifetime Inaugural Member, Golden Key International Honour Society (GKIHS)

Elected Member of the National Executive Committee, International Association for Impact Assessments South Africa (IAIASA)

Interim Inaugural Member, Environmental Assessment Practitioners Association of South Africa (EAPASA)

KwaZulu-Natal Committee Member: Vice-Chair, International Association for Impact Assessments South Africa (IAIASA)

Member, International Association of Impact Assessment (IAIA)

**17**

YEARS IN THE INDUSTRY

(EMP) for the proposed upgrade of the stormwater infrastructure in the town of Piketberg. Responsible as project leader.

### Borrow pits for the Department of Transport and Public Works, Western Cape Province, South Africa, Western Cape Government Department of Transport and Public Works, 11/2012 - Date, Team Leader (NEMA Component)

This project involves basic assessment processes and environmental management plans (EMP's) for approximately 50 borrow pits which will be used as material sources for road re-gravelling and maintenance programmes within the Overberg, Eden and Central Karoo Districts of the Western Cape. The broader project includes the identification of suitable material sources, and the legalisation of preferred borrow pits in terms of the National Environmental Management Act, No. 107 of 1998, the Minerals and Petroleum Resources Development Act, No. 28 of 2002, the National Heritage Resources Act, No. 25 of 1999, the National Water Act, No. 36 of 1998 and the Land Use Planning Ordinance, No. 15 of 1985. The project therefore required the coordination of these processes and detailed liaison with the relevant Organs of State.

### Horizontal dust flux monitoring for the Port of Saldanha terminal, Western Cape Province, South Africa, Transnet Ports Terminal (TPT), 10/2011 - 04/2012, Project Leader

This project involved the servicing of 24 horizontal dust flux monitoring stations for Transnet at their port terminal in Saldanha, and the monthly reporting on dust derived from the iron ore handling facilities. The project also included two annual audits.

### Jack Muller Park Core Conservation Zone (CCZ), Belville, Western Cape Province, South Africa, 04/2011 - 08/2011, Project Leader

This project involved the compilation of a specific Environmental Management Strategy and Plan (EMS and EMP) for the operation of the Core Conservation Zone (CCZ) within the greater Jack Muller Park. The CCZ comprises the threatened Cape Flat Sand Fynbos ecosystem, and required detailed aims and objectives for fire management, recreational activity management, invasive plant control, educational opportunities, and general park maintenance activities.

### Extension to Parys Cemetery, Paarl, Western Cape Province, South Africa, 02/2011 - 07/2011, Project Leader

This project involved the Basic Assessment (BA) process and Environmental Management Plan (EMP) for the proposed extension of the Parys cemetery in Paarl. The property proposed for development was considered of biodiversity significance, and careful layout design to avoid sensitive portions was required. The extension would also impact on the unmarked graves that historically formed part of the cemetery activities.

### Hillside 2 stormwater detention ponds and pipelines, Beaufort West, Western Cape Province, South Africa, 02/2011 - 07/2011, Project Leader

This project involved the Basic Assessment (BA) process and Environmental Management Plan (EMP) for two stormwater detention facilities (dams) and associated pipelines and culverts. The development alleviates flood risk to residential properties, as well as improves stormwater infrastructure for the town of Beaufort West.

### Air Quality Management (AQM) training and air emissions licensing training, Western Cape Province, South Africa, Cape Winelands District Municipality, 03/2011 - 06/2011, Project Leader

The aim of the project was to empower the Cape Winelands District Municipality in Air Quality Management (AQM) and emissions licensing in terms of the National Environmental Management: Air Quality Act (NEMAQA), enabling them to fulfil their responsibilities as air quality authorities across five local municipalities in the Cape Winelands District.

### Rehabilitation of the Western Aqueduct, Phase 1, KwaZulu-Natal Province, South Africa, eThekwini Water and Sanitation, 01/2009 - 12/2010, Project Leader

The Western Aqueduct project is a bulk water supply project. Responsible for managing the design and compilation of the Environmental Management Plan (EMP), rehabilitation strategy, rehabilitation specification and Bill of Quantities (BoQ) for the rescuing of indigenous plant materials from the proposed footprint of the 73 km bulk water pipeline, and the rehabilitation of the 30m-wide corridor following construction. This project was awarded the International Association for Impact Assessment South Africa's (IAIAsa) 2011 Special Recognition Certificate for excellence in project execution.

### Demolition of Athlone Cooling Towers, Western Cape Province, South Africa, City of Cape Town, 03/2010 - 08/2010, Project Leader

This project involved the expedient demolition of two benign cooling towers due to structural instability. Responsible for undertaking the development of an appropriate Environmental Management Plan (EMP) for the planning, demolition and clean-up of the towers. The project required the coordination of specialist teams for noise, dust and vibration mitigation, as well as the relocation of Peregrine Falcon nesting boxes, and the general Public Participation Process (PPP). This project won the Consulting Engineers South Africa's (CESA) Aon 2011 Commendation Award for projects under R50 million.

### Environmental impact assessment (EIA) for the Western Aqueduct, KwaZulu-Natal Province, South Africa, eThekwini Water and Sanitation, 01/2006 - 12/2008, Project Leader

Responsible for undertaking the Public Participation Process (PPP), and the scoping and Environmental Impact Assessment (EIA) processes associated with the 73 km bulk water pipeline, with a diameter of 1.6m. Duties included the design of an appropriate methodology to deal with the variety of biophysical and socio-economic environments along the route; the coordination of four renowned specialist teams; the public consultation with all Interested and Affected Parties (I&AP), including government departments, stakeholders and interest groups; the liaison between the engineering design team, the client and the specialist teams; and the compilation of the relevant reports, documents and correspondence.

### Umgeni Water pipeline specialist studies, Pietermaritzburg, KwaZulu-Natal Province, South Africa, Umgeni Water, 2007 - 2008, Project Leader

The project involved the potential development of an eco-estate, nature reserve and a conservation area characterised by the presence of endangered mistbelt species, including the near-extinct Gerbera aurantiaca (Hilton Daisy). The social aspects of the project required a holistic approach to client, authority and general public communications. Responsible for managing the biodiversity specialist study and the Public Participation Process (PPP), which formed part of the Basic Assessment (BA) process, for a water pipeline project.

### Bulk water pipeline, reticulation network and abstraction/treatment plant, Macambini, KwaZulu-Natal Province, South Africa, 2007 - 2008, Project Leader

The project provides potable water to agricultural and rural communities in Northern KwaZulu-Natal, and required the construction of an abstraction and treatment facility. Responsible for managing the Public Participation Process (PPP) for 170 km of bulk water pipelines and reticulation networks aimed at providing treated water to previously neglected areas (in terms of infrastructure provision).

### School access road upgrade project, Umzumbe, KwaZulu-Natal Province, South Africa, 2007, Project Leader

Responsible for supervising the Basic Assessment (BA) process and associated Public Participation Process (PPP) for an access road linking rural schools with local communities.

### Upgrading of Main Road P100, Ndwedwe, KwaZulu-Natal Province, South Africa, 2006, Project Leader

This project was an African Renaissance Road Upgrading Programme (ARRUP) initiative promoting development within a rural community. Responsible for managing and undertaking the environmental scoping investigations and Public Participation Process (PPP), and developing the Environmental Management Plan (EMP) for the construction and upgrade of the P100 Main Road in Ndwedwe, KwaZulu-Natal. Also responsible for managing the associated specialist investigations and compiled the environmental reports.

### Upgrading of Florida Road, Somtseu Road, and Florence Nightingale Drive in Durban, KwaZulu-Natal Province, South Africa, 2006, Project Leader

Responsible for managing and undertaking the environmental scoping investigations and Public Participation Processes (PPPs) for three road upgrade projects in the Durban area, aimed at improving safety and relieving congestion/parking inadequacies.

### Five projects on intersection and pedestrian safety improvements in the Greater Durban Area, KwaZulu-Natal Province, South Africa, 2006, Project Leader

Responsible for supervising the environmental investigations associated with the exemption applications for five separate road projects aimed at improving intersection and pedestrian safety.

### Tyburn Boulevard water pipeline, Westville, KwaZulu-Natal Province, South Africa, 2006, Project Leader

Responsible for managing and undertaking the environmental scoping investigations and Public Participation Process (PPP) for a new section of water pipeline linking the Dawncliff Reservoir water supply to the West End Office Park in Westville, KwaZulu-Natal. Also responsible for managing the associated specialist investigations for the environmental work.

### Valley of a Thousand Hills reservoir, Botha's Hill, KwaZulu-Natal Province, South Africa, 2006, Project Leader

Responsible for managing and undertaking the environmental scoping investigations and Public

Participation Process (PPP) for the construction of a water reservoir to supplement existing bulk water infrastructure.

### Westriding Aqueduct, KwaZulu-Natal Province, South Africa, 2005, Project Leader

Responsible for undertaking the environmental scoping investigations, social study and Public Participation Process (PPP) for the construction and upgrading of a water supply system (pipeline and reservoirs) in the Hillcrest area.

### Arlington Sawmill, Nottingham Road, Pietermaritzburg, KwaZulu-Natal Province, South Africa, 2005, Environmental Scientist

Responsible for managing and undertaking the environmental scoping investigation and Public Participation Process (PPP) for the relocation and upgrading of the Arlington Sawmill, including a scheduled process in terms of the Atmospheric Pollution Prevention Act (APPA). Also responsible for undertaking the specialist studies regarding air quality and noise level monitoring.

### Cathedral Peak Hotel, Drakensberg, KwaZulu-Natal Province, South Africa, 2005, Environmental Scientist

Responsible for assisting with the compilation of the Environmental Management Plan (EMP) for the hotel and infrastructure, including recreational and mountain activities, the golf course, the sewerage works, a trout farm, a piggery and chicken farm, and surrounding wilderness management; all stakeholder engagement, client/authority liaisons, and report design and compilation.

### Daimler-Chrysler Franchise and Industrial Park, KwaZulu-Natal Province, South Africa, 2005, Project Leader

Responsible for managing and undertaking the environmental scoping investigations and Public Participation Processes (PPPs) for projects requiring a change in landuse from agriculture to light industrial type.

### Victoria Country Club Estate, Pietermaritzburg, KwaZulu-Natal Province, South Africa, 2004, Environmental Scientist

The project entailed the merger of the Queen Elizabeth Park, headquarters of Ezemvelo KZN Wildlife, and the Victoria Country Club; and the addition of a five-village residential and office park estate to create an exclusive wildlife, recreational, commercial and residential development. Responsible for undertaking the design and compilation for the Environmental Management Plan (EMP) for the construction and operation of the golf and wilderness estate.

### Skozani aluminium recycling facility, Pietermaritzburg, KwaZulu-Natal Province, South Africa, 2004, Environmental Scientist

Responsible for managing and undertaking the environmental scoping investigation and Public Participation Process (PPP) for the proposed aluminium recycling facility, including a scheduled process in terms of the Atmospheric Pollution Prevention Act (APPA). Also responsible for undertaking the specialist studies regarding air quality and noise level monitoring.

### Mabhobhane access road, Maphumulo, Tugela Valley, KwaZulu-Natal Province, South Africa, 2004, Project Leader

Responsible for managing and undertaking the environmental scoping investigation and Public Participation Process (PPP), and developing the Environmental Management Plan (EMP) for the construction and upgrading of 13km of gravel road to provide a community access route to areas previously only reachable by four-wheel drive vehicles.

### Magabeni Community Project, Mnini, KwaZulu-Natal Province, South Africa, 2003, Environmental Scientist

The project's aim was to provide community skills development, food security, and income sustainability for 30 households. Responsible for managing and undertaking the environmental scoping investigation and Public Participation Process (PPP), and developed the Environmental Management Plan (EMP) for the proposed change in landuse from grazing land to irrigated agriculture, utilising treated effluent from the Magabeni Wastewater Treatment Works (WWTW).

Responsible for assisting with the environmental scoping investigation and Public Participation Process (PPP) for the 700 000 cubic metre farm dam; all stakeholder consultation, research, and report design and compilation.

# Franci Gresse

**Programme Manager**

### Qualifications

BSc (Hons) Conservation Ecology

Member, International Association of Impact Assessment South Africa (IAIAsa)

### Specialisation

Environmental Impact Assessment Practitioner

### Years in industry

10,08

Franci is a senior environmental practitioner in Aurecon's Cape Town office. She has been involved in various environmental investigations, including environmental impact assessments (EIA's), environmental management plans (EMP's), environmental management programmes (EMP's), rehabilitation plans maintenance management plans (MMP's) and fatal flaw analysis.

Franci has been involved with the Working for Wetlands rehabilitation programme for the past five years, of which she has been acting as the Team Leader for the environmental assessment practitioners (EAP's) for the last three years. The Working for Wetlands project won the 2012 Aurecon Chairman's Award for its positive contribution to the natural and social environmental. In addition, Franci has also been involved with a number of projects in the renewable energy sector.

Franci served on the committee of the South African affiliate of the International Association for Impact Assessment (IAIA) for the Western Cape Branch from 2009 to 2011, and remains a member. She completed a Bachelor of Science and an Honours Degree in Conservation Ecology at the University of Stellenbosch (South Africa).

## Experience

**Implementation of the Hoekplaas environmental authorisation (EA), Northern Cape Province, South Africa, Mulilo Renewable Energy, 11/2013 - 05/2015, Project Leader**

Aurecon assisted the holder of the environmental authorisation (EA) for the 100 MW photovoltaic (PV) facility in De Aar with the implementation of the environmental conditions to ensure compliance to all relevant environmental legislation. Responsible for the management of tasks and review of all documentation. Also assisting client with questions on the environmental impact assessment (EIA) process.

**Environmental impact assessment and compilation of an environmental management plan (EMP) for the Swakopmund-Mile 7 Water Supply, Phase 2, Swakopmund, Namibia, NamWater, 11/2013 - 10/2015, Project Leader**

NamWater appointed Aurecon to assist with the environmental impact assessment process for the proposed construction of a new bulk water pipeline between Swakopmund and Mile 7. Responsible for the management and review of the environmental impact assessment (EIA) reports and processes, as well as the project's finances.

**Working for Wetlands plan 2014 - 2017, Regional South Africa, South African National Biodiversity Institute (SANBI), 06/2013 - Date, Task Leader**

The South African National Biodiversity Institute (SANBI) appointed Aurecon to provide environmental and engineering services for the Working for Wetlands Programme which is a national wetland rehabilitation programme. Responsible for the management of the environmental authorisation component of the project, as well as the compilation of basic assessment reports (BAR) for the country. Other responsibilities include the compilation of wetland rehabilitation plans for the Western Cape, Northern Cape, North West and Limpopo Provinces, liaison with authorities and the public (public participation process) and management of wetland specialists.

**Maintenance management plans (MMP's) for flood damaged road infrastructure, Western Cape Province, South Africa, Western Cape Provincial Government Department of Transport and Public Works, 06/2013 - Date, Project Staff**

The project entails the compilation of maintenance management plans (MMP's) for two local municipal areas (Laingsburg and Worcester), as well as obtaining the necessary permits/ water use authorisations. Personally involved during the project commencement with regards to strategy development, meetings with the relevant authorities and assistance with the development of the MMP's.

**Environmental impact assessment (EIA) for the expansion of approved solar energy facilities located near Prieska and De Aar, Northern Cape Province, South Africa, Mulilo Renewable Energy, 03/2013 - 09/2015, Phase Leader**

Mulilo Renewable Energy decided to expand the approved solar energy facilities on the farms Hoekplaas and Klipgats in Prieska, as well as on the farms Badenhorst Dam and Du Plessis Dam in De Aar. The expasion of Hoekplaas farm in Prieska includes ten additional 75 MW photovoltaic (PV) facilities and six additional PV units at Klipgats Pan farm. The expansion at Badenhorst Dam farm includes four additional 75 MW PV facilities and three additional PV units at Du Plessis Dam farm. Responsible for the management and review of the environmental impact assessment (EIA) reports and processes, as well as the project's finances.

**Fatal flaw study for two potential Wind Energy Facility (WEF) sites, Northern and Western Cape Provinces, South Africa, Juwi Renewable Energies (Pty) Ltd, 03/2013 - 04/2013, Environmental Practitioner**

The study entailed a fatal flaw analysis of two potential wind energy facility (WEF) sites in the Northern and Western Cape Provinces. Responsible for the assessment of the sites and compilation of the fatal flaw report.

**Richtersveld wind energy facility (WEF), Northern Cape Province, South Africa, TRE Tozzi Renewable Energy S.p.A and Guma Group, 07/2012 - 09/2013, Environmental Practitioner**

The project entailed a due diligence of the proposed wind energy facility (WEF) to review compliance with the requirements of the Department of Energy's independent power producer (IPP) process. Responsible for the review of the environmental reports and compilation of the due diligence report.

**Three photovoltaic (PV) energy facilities near Copperton, Northern Cape Province, South Africa, Mulilo Renewable Energy (MRE), 09/2011 - 05/2015, Environmental Practitioner**

The project entailed three environmental impact assessments (EIA's) for three photovoltaic (PV) energy facilities comprising 75 MW to 150 MW, located near Copperton. Responsible for the management the EIA process and project specialists, compilation of scoping and EIA reports and liaison with authorities.

**Fatal flaw study for four potential wind energy facility (WEF) sites, Northern and Western Cape Provinces, South Africa, Mainstream Renewable Power South Africa, 11/2011 - 05/2012, Environmental Practitioner**

The study entailed a fatal flaw analysis of four potential wind energy facility (WEF) sites across the Northern and Western Cape Provinces. Responsible for the management of specialists, review of reports, assessment of the sites and compilation of the fatal flaw report.

**Implementation of the Klipgats Pan environmental authorisation (EA), Northern Cape Province, South Africa, Mulilo Renewable Energy, 09/2011 - 05/2015, Project Leader**

Aurecon was appointed to undertake three environmental impact assessments (EIA's) for three proposed phtovoltaic (PV) solar energy plants near Copperton. The first PV solar energy plant will generate around 100 MW (preferred alternative) or 150 MW (alternative) on the Hoekplaas Farm (Farm 146/RE). The proposed PV plant will cover approximately 300 ha (preferred alternative) or 450 ha (alternative). The second includes a PV solar energy plant to generate roughly 100 MW on the farm Klipgats Pan (Farm 117/4) near Copperton in the Northern Cape. The proposed PV plant will cover an estimated 300 ha. An alternative site for a 100 MW PV plant with a 300 ha footprint is also being considered. The third comprises a PV solar energy plant to generate about 100 MW (preferred alternative) or 300 MW (alternative) on the farm Struisbult (Farm 104, portion 1) which will cover 300 ha to 900 ha. Responsible for managing tasks and reviewing all documentation for updating the environmental management plan (EMP) and implementing the environmental authorisation (EA). Also assisted client with questions on the EIA process.

**Proposed rehabilitation of Wetlands as part of the Working for Wetlands, Regional, South Africa, South African National Biodiversity Institute (SANBI), 08/2011 - 09/2013, Environmental Practitioner**

Appointed by the South African National Biodiversity Institute (SANBI) to conduct environmental impact assessments (EIA's) for the rehabilitation of specific wetlands in all provinces of South Africa over a five year period. Responsible for the compilation of basic assessment reports (BAR) and Wetland Rehabilitation Plans for the Western Cape, Northern Cape, Gauteng and Limpopo Provinces. Other responsibilities included liaison with authorities, public participation process, management of specialists and general project management of the environmental component of the project.

**Repair of flood damage to road structures in the Eden District Municipality, Western Cape Province, South Africa, Western Cape Provincial Department of Transport and Public Works, 01/2011 - Date, Environmental Practitioner**

The project entails the compilation of maintenance management plans (MMP) for seven areas with the Eden District Management Area to repair. Responsible for compilation of MMP's, review of reports and liaison with stakeholders and authorities.

**Environmental impact assessment (EIA) for the proposed extension of the Ash Dam facility at Kriel power station, Mpumalanga Province, South Africa, Eskom Holdings, 11/2009 - 12/2015, Environmental Practitioner**

Appointed by Eskom to conduct an environmental impact assessment (EIA) for the proposed construction of a fourth ash dam facility at the Kriel power station. Responsible for the general project management and finances, screening process, compilation of the scoping and EIA reports, public participation and the compilation of a waste management licence application.

**Environmental impact assessment (EIA) for proposed relocation of solar energy facility, Onder Rietvlei Farm, Aurora, Western Cape Province, South Africa, Solaire Direct Southern Africa, 2010 - 2011, Project Leader**

Appointed by Solaire Direct to undertake a basic environmental impact assessment (EIA) process for the proposed relocation of an approved, but not yet constructed 10 MW solar energy facility. Responsible for the management and review of the EIA process and finances.

**Environmental impact assessment (EIA) for proposed solar energy facility, Onder Rietvlei Farm, Western Cape Province, South Africa, Solaire Direct Southern Africa, 07/2010 - 02/2012, Environmental Practitioner**

Appointed by Solaire Direct to undertake a basic environmental impact assessment process for the proposed construction of a 10 MW solar energy facility. Responsible for the compilation of the draft and final reports, public participation process, management of specialists and general project management.

**Proposed Paarl Mountain and Ysterbrug pumping main upgrades, Western Cape Province, South Africa, Drakenstein Municipality, 06/2010 - Date, Environmental Advisor**

The Drakenstein Municipality appointed Aurecon's engineers to investigate and plan the proposed upgrade of the Paarl Mountain and Ysterbrug Pumping Scheme. The upgrading of the pipelines feeding the Meulwater Water Treatment Works from the Bethel and Nantes dams, also part of this scheme, was also investigated. Responsible for providing advice on environmental processes required. Other responsibilities included the management of the independent environmental assessment practitioner and the review of all environmental impact assessment (EIA) documentation.

**Environmental sensitivity study (ESS) for a proposed solar energy facility on a farm Near Aurora, Western Cape Province, South Africa, Solaire Direct Southern Africa, 2010, Environmental Practitioner**

Appointed to provide and environmental sensitivity study (ESS) which inter alia highlights the potential constraints ('red flags') and opportunities presented by the site from an environmental perspective. Responsible for the compilation of the ESS.

**Proposed erection of Eskom communication sirens and public anouncement (PA) systems, Blaauwberg, Western Cape Province, South Africa, Eskom, 2009 - 2010, Environmental Practitioner**

The project entailed three environmental impact assessment (EIA) processes for the (a) erection of 10 new sirens in the Parklands area, (b) the relocation of one siren in Bloubergstrand, and (c) the upgrade of five sirens on farms near Melkbosstrand. Responsible for compiling environmental impact assessment (EIA) reports, and the public participation process.

**Proposed remediation, rehabilitation and restoration of the Spruit, Krom, Leeu and Palmiet Rivers, Western Cape Province, South Africa, Drakenstein Municipality, 2009 - 2010, Environmental Practitioner**

Appointed by the Drakenstein Municipality to undertake the requisite environmental impact assessment (EIA) process for the rehabilitation, remediation and stabilisation of four rivers in Paarl and Wellington. Responsible for the EIA and public participation processes.

**Proposed construction of a new pipeline from Bovlei Winer to Withoogte Dam, Wellington, Western Cape Province, South Africa, Drakenstein Municipality, 2009 - 2010, Environmental Practitioner**

The Drakenstein Municipality proposed to replace a section of the existing pipeline extending from the Withoogte Dam to the Welvanpas Reservoir near Wellington as part of the municipality's water master plan in order to improve the overall water supply. Responsible for the compilation of the environmental impact assessment (EIA) report, management of specialists and the public participation process.

**Overberg District Municipality integrated transport plan (ITP) strategic environmental informants, Western Cape Province, South Africa, Overberg District Municipality, 2009, Environmental Practitioner**

Aurecon's Transportation Unit was appointed to revise the integrated transport plan (ITP). The Environmental Unit was subcontracted to provide environmental input. Responsible for identifying and describing the relevant informants.

**Annandale Commercial: development of petrol filling station on portion of Erf 5561, Kuils River, Western Cape Province, South Africa, Communicate, 2009, Environmental Practitioner**

Appointed to compile a construction environmental management plan (CEMP) for the construction of a filling station on the corner of Gladioli Street and Amandel Drive, Kuils River. Responsible for the compilation of the project specification document as part of the CEMP.

**Overberg District Municipality integrated transport plan (ITP): strategic environmental informants, Western Cape Province, South Africa, Overberg District Municipality, 2009, Environmental Practitioner**

Aurecon's Transportation Unit was appointed to revise the integrated transport plan (ITP). The Environmental Unit was subcontracted to provide environmental input. Responsible for identifying and describing the relevant informants.

**Environmental impact assessment (EIA) for the proposed Langezandt Quays development in Struisbaai Harbour, Western Cape Province, South Africa, Golden Falls (Pty) Ltd, 2008 - Date, Environmental Practitioner**

Aurecon was appointed to undertake an environmental impact assessment (EIA) process for the proposed development of a four storey development on Erf 848 within the Struisbaai harbour precinct. Responsible for drafting responses to the Department of Environmental Affairs' independent review report on the proposed development.

**Pre-feasibility and feasibility studies for augmenting the Western Cape water supply system, South Africa, Department of Water Affairs (DWA), 2008 - 2013, Project Staff**

The Department of Water Affairs commissioned pre-feasibility and feasibility studies for the augmentation of the Western Cape water supply system through the further development of the surface water resources. Surface water schemes to be investigated were identified by the Western Cape water supply system reconciliation strategy study. Responsible for the public participation process, managing environmental specialists, and compiling a socio-economic overview of the study area.

**Proposed redevelopment of the Blaauwberg Conservation Area: Eerstesteen Node, Western Cape Province, South Africa, City of Cape Town, 2008 - 2010, Environmental Practitioner**

The project entailed an environmental impact assessment (EIA) process for redeveloping the Eerstesteen Conservation Area on the West Coast. Responsible for compiling the EIA report, as well as managing specialists and the public participation process.

**Table Mountain Group aquifer feasibility study and pilot project, Western Cape Province, South Africa, City of Cape Town, 2008 - 2010, Environmental Control Officer**

The City of Cape Town initiated a study into the Table Mountain Group Aquifer as a potential water source to augment the city's supply. The feasibility and pilot project phase record of decision (RoD) required completion for site-specific environmental management plans (EMP's) for drilling sites that were assessed to be environmentally sensitive. Site-specific EMP's were designed for sensitive sites to ensure minimal environmental impact during the drilling phase. Responsible for monitoring compliance with the RoD and EMP during the drilling phase.

**Application for rectification in terms of Section 24G of the National Environmental Management Act (NEMA) for the unlawful commencement of a fruit processing factory on Op de Tradouw Farm, Number 69, Barrydale, Western Cape Province, South Africa, Schoonies Family Trust, 2008 - 2009, Environmental Practitioner**

The project consisted of an application for rectification in terms of Section 24G of NEMA. Responsible for compiling an environmental impact report and an environmental management plan (EMP) for the application, as well as managing the public participation process.

**Proposed development of apple and pear orchards on Soetmelksvlei Farm, Western Cape Province, South Africa, BETCO, 2008 - 2009, Project Staff**

This Agri-development project involved the development of 50 ha of apple and pear orchards in the Riviersonderend region. Responsible for compiling the basic assessment report, environmental management plan (EMP), and managing the specialists and public participation process.

**Proposed extension of Lock Road, Kalk Bay, Western Cape Province, South Africa, Mr Rick Bartlett, 2008 - 2009, Project Staff**

The project comprised an environmental impact assessment (EIA) process for extending Lock Road to an existing erf. Involved during the final stages of the application.

**Water reconciliation strategy for the Algoa water supply area, Eastern Cape Province, South Africa, 2008 - 2009, Environmental Practitioner**

This project provided an assessment of the environmental opportunities and constraints for a suite of water schemes in the Algoa water supply area. This was undertaken as part of a broader study in the area.

**C.A.P.E. Olifants-Doring Catchment Management Agency project: Development of a catchment management strategy water resource protection sub-strategy for the Olifants-Doring Catchment, South Africa, CapeNature, 2008 - 2009, Environmental Practitioner**

Appointed by CapeNature to compile a catchment management strategy water resource protection sub-strategy for the Olifants-Doorn catchment. Responsible for compiling a database that lists all institutions and their respective mandates in terms of water resource protection and biodiversity conservation decision making for the Olifants-Doring Catchment, workshop arrangements, and general project related work.

**Environmental sensitivity study for the proposed Dasdrif poultry farm in Moorreesburg, Western Cape Province, South Africa, Eikenhoff Poultry Farms (Pty) Ltd, 2008, Project Staff**

The project consisted of an environmental sensitivity study (ESS) which, inter alia, highlighted the potential constraints ('red flags') and opportunities presented by the site from an environmental perspective. Responsible for compiling the ESS.

**Joint Maputo River Basin water resources study, Mozambique, Swaziland and South Africa, 2008, Project Staff**

The project provided an environmental opportunities and constraints assessment of a suite of potential dams in South Africa and Swaziland, within the Maputo River Catchment. This was undertaken as part of a broader study into the catchment.

**Department of Economic Affairs, Environment and Tourism (DEAET) decision-making support, South Africa, Department of Economic Affairs, Environment and Tourism (DEAET), 2008, Project Staff**

Responsible for assisting the DEAET with the review and processing of environmental impact assessment (EIA) applications in terms of the Environment Conservation Act.