Report No: 109664/8804

REHABILITATION PLAN FOR THE WORKING FOR WETLANDS PROGRAMME, FREE STATE

PROJECT: MALUTI

C81D, C81F, C81H

agriculture, forestry & fisheries
Department:
Agriculture, Forestry and Fisheries
REPUBLIC OF SOUTH AFRICA

APRIL 2014

EXPANDED PUBLIC WORKS PROGRAMME
Creating opportunities towards human fulfilment

SANBI
Biodiversity for Life

Working for Wetlands

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REHABILITATION PLAN FOR THE MALUTI WETLAND PROJECT, FREE STATE: PLANNING YEAR 2014

AS PART OF THE

WORKING FOR WETLANDS PROGRAMME

FOR THE

SOUTH AFRICAN NATIONAL BIODIVERSITY INSTITUTE

MAIN REPORT

APRIL 2014

Prepared by:

Aurecon South Africa (Pty) Ltd
P O Box 494
Cape Town
8000
South Africa
Tel: 021 526 6022
Fax: 021 526 9500
Email: **franci.gresse@aurecongroup.com**

Prepared for:

Working for Wetlands Programme
South African National Biodiversity Institute
Private Bag X101
Pretoria
South Africa
Tel: 012 843 5000
Fax: 012 804 3211
Website: **www.sanbi.org**

This report is to be referred to in bibliographies as:

South African National Biodiversity Institute, South Africa. 2014. Rehabilitation Plan for the Maluti Wetland Project, Free State: Planning Year 2014. Prepared by Jenny Youthed, Aurecon South Africa (Pty) Ltd as part of the planning phase for the Working for Wetlands Rehabilitation Programme. SANBI Report No. 109664/8803

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PROJECT DETAILS

TITLE	Rehabilitation Plan for the Maluti Wetland Project, Free State: Planning Year 2014
PREPARED BY	Jenny Youthed of Aurecon South Africa (Pty) Ltd (Aurecon)
CONTRIBUTORS	Adam Teixeira-Leite of Eco-pulse Environmental Consulting Services Danie Louw of Aurecon Claire Blanché of Aurecon
CLIENT	South African National Biodiversity Institute (SANBI)
PROJECT NAME	Working for Wetlands Programme
REPORT STATUS	Final
REPORT NUMBER	109664/8803
SUBMISSION DATE	April 2014

Prepared for the South African National Biodiversity Institute by:

_____

J. Youthed
Project Staff
Aurecon SA (Pty) Ltd.

_____

E. Louw
Technical Director
Aurecon SA (Pty) Ltd.

Approved for the South African National Biodiversity Institute by:

_____

T. Nyambeni
SANBI Provincial Coordinator: Free State Province
South African National Biodiversity Institute
Planning, Monitoring and Evaluation

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WORKING FOR WETLANDS: CONTEXT DOCUMENT

1. Introduction

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 (DEA), Water Affairs (DWA) 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, also honours South Africa's commitments under several international agreements, especially the Ramsar Convention on Wetlands.

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 (EPWP) and using only local Small, Medium and Micro Enterprises (SMMEs). The EPWP seeks to draw significant numbers of unemployed 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 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 (**Figure 1**), 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:

- Wetlands offer services such as water provision, regulation, purification and groundwater replenishment are crucial in addressing objectives of water security and water for food security.
- Wetlands play a critical role in 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.
- Ecological infrastructure replaces the need for municipal infrastructure by providing the same or better benefit at a fraction of the costs.
- Wetlands retard the movement of water in the landscape, which offers the dual benefit of flood control and a purifying effect as the slow movement of water allows heavier impurities to settle and phreatic vegetation and micro-bacteria opportunity to remove nutrients. For these reasons, artificially created wetlands are often used in newer urban drainage systems to aid both mitigation of flooding and improvement of water quality.
- Wetlands function as valuable open spaces and create recreational opportunities for people that include hiking, fishing, boating, and bird-watching.
- Many wetlands also have cultural and spiritual significance for the communities living nearby. Commercially, products such as reeds and peat are also harvested from wetlands (Plate B).

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

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

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 CSIR study[1] 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 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 ecosystems 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 rehabilitation and conservation 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: by 2025, South Africa will be one of fourteen African countries classified as "*subject to water scarcity*". The conservation of wetlands is fundamental to the

[1] 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.

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.

The two main objectives of the WfWetlands Programme are **wetland conservation** in South Africa and **poverty reduction** through **job creation** and **skills development** amongst **vulnerable** and **marginalised** groups.

Wetland conservation: The strategic framework of the WfWetlands Programme underlines the need for a more refined planning process at catchment scale. Catchment scale planning seeks to promote ecosystem-scale outcomes, long-term custodianship, and the entrenchment 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 the process draws in a much wider stakeholder base.

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.

Skills development: In the 12 years since its inception, the WfWetlands Programme has invested R530 million in wetland rehabilitation and has been involved in over 900 wetlands, thereby improving or securing the health of over 70 000 hectares of wetland environment. The WfWetlands Programme currently has a budget of approximately R94 million per year, of which R32 million is allocated directly to paying wages. Being part of the Expanded Public Works Programme (EPWP), the WfWetland Programme has created more than 12 800 jobs and 2.2 million person-days of paid work. The local teams are made up of a minimum of 60% women, 20% youth and 1% disabled persons.

Training and Capacity Building during the Working for Wetlands Programme

The WfWetlands Programme has has established a working relationship with the Department of Public Works through the Working for Water programme. This partnership provides accredited training in accordance with the special public works Code of Good Practice agreements. Capacity building in the WfWetlands Programme operates primarily at two levels:

- The first concerns the need to ensure the development of adequate capacity to rehabilitate, manage and conserve wetlands in South Africa.
- The second relates to the commitment of the WfWetlands Programme as an EPWP to provide appropriate training to its workers in order for them to exit the programme with marketable skills and enhanced personal development.

Workers receive two days of training, either vocational or social development-related, for every 22 days worked. Vocational training includes technical matters related to project activities, occupational health and safety, first aid, fire awareness, and business skills (contractor development). Social development includes literacy, primary health, personal finance, HIV/Aids and diversity awareness.

Wage information sourced from the best practice guidelines suggests that workers and contractors would be paid daily rates of R 82 and R 251[2] respectively and would be employed on limited term contracts, i.e. 24 months in a five-year cycle. Employment of workers complies with the Ministerial Determination on Special Public Works Programmes (Government Notice No. R 63, 25 January 2002) and the Code of Good Practice for Employment and Conditions of Work for Special Public Works Programmes (Government Notice No. R 64, 25 January 2002). Targets for employment specify that the programme's workforce should comprise at least 60% women, 20% youth and 2% disabled people.

The WfWetlands Programme 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 and rehabilitation project objectives will be a key area of future focus. The WfWetlands Programme encourages municipalities to participate in provincial wetland forums as these forums are the platform for the roll out of all the programmes' processes, including planning for future work. Provincial 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.

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 EPWP on training, the WfWetlands Programme has provided 168 400 days of training in vocation and life skills).

[2]Without a Supervisor

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 (and flow is encouraged to disperse rather than to concentrate). Approximately 500 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).

Increased labour requirement for the Working for Wetlands Programme

In response to the government request to increase the labour component of all government funded projects, the WfWetlands Programme project team has had to consider, and where practically feasible incorporate, more labour intensive ways of rehabilitating wetlands in order to obtain the increased labour component. Accordingly the project team members have factored this requirement into their planning when designing structures for wetland rehabilitation.

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

- Earth berms or gabion systems to block artificial channels that drain water from or divert polluted water to the wetland;
- Concrete and gabion 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;
- Earth or gabion structures 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 re-vegetation of stabilised areas with appropriate wetland and riparian species;
- The 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;
- In some instances, the use of appropriate fire management and burning regimes. The removal of undesirable plant and animal species; and
- Alien invasive plant clearing is an important part of wetland rehabilitation (and this is supported by the Working for Water Programme).

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. SANBI is currently managing 35 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 over a two-year cycle as shown in the flow diagram in Plate C 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.

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.

The **Project Team** currently comprises the SANBI Programme Manager who oversees the WfWetlands Programme and Provincial Coordinators (PCs) who oversee the identification and implementation of projects in their regions. They are supported by a small team based at the Pretoria Botanical Gardens who fulfil various roles such as planning, monitoring and evaluation, implementation, 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 ecologists who provide scientific insight into the operation of wetlands and bring expert and often local knowledge to the project teams.

The programme makes use of external support to implement its work. External implementing agents are currently employed and some are Section 21 companies. Implementers are responsible for employing contractors and their teams (workers), and ensuring that rehabilitation plans are adequately implemented. Funds are transferred from SANBI to the implementing agents, who in turn pay contractors and their teams.

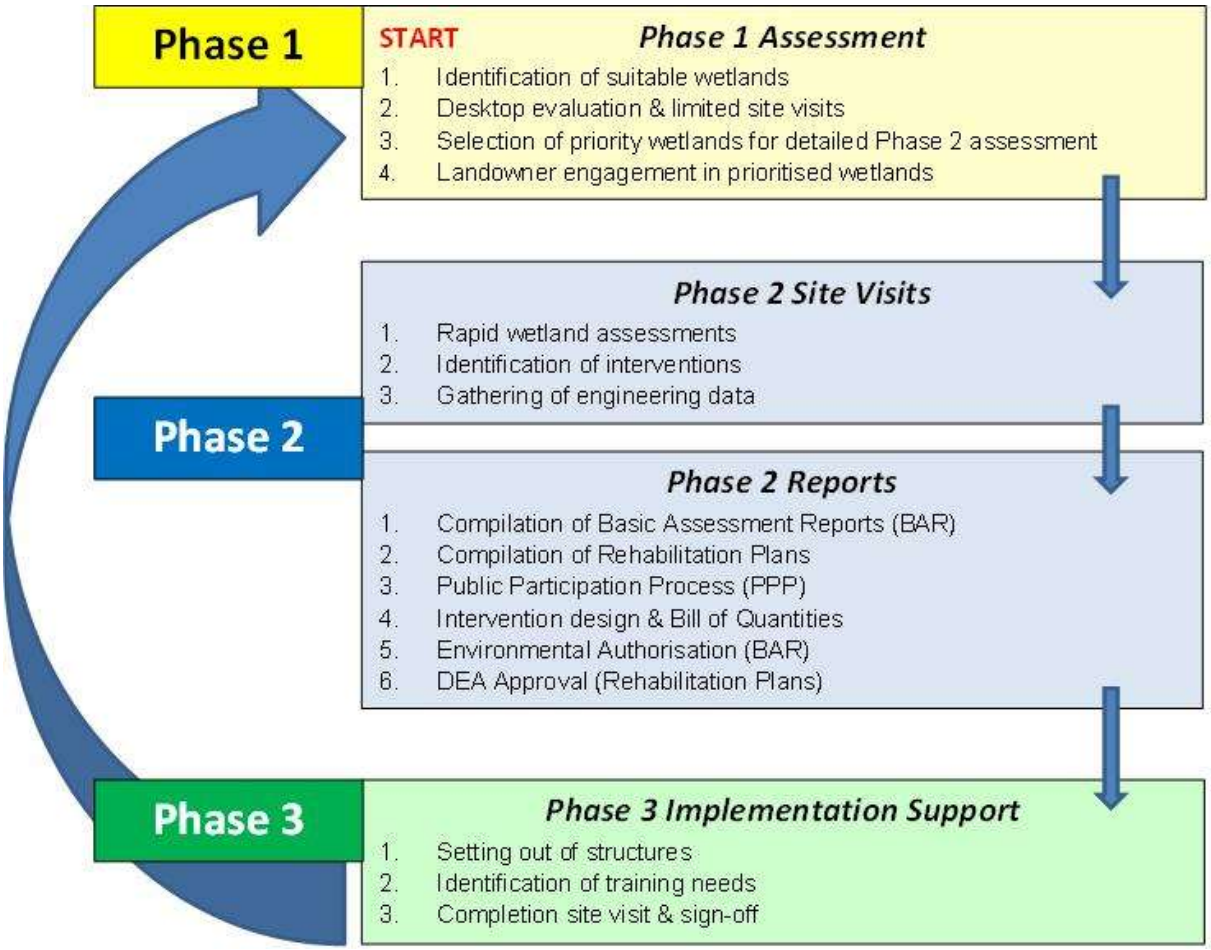

Plate C: The Working for Wetlands planning process (Phase 1 to Phase 3).

Phase 1 commences with a catchment and wetland prioritisation process for every province. The wetland ecologist 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 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 to by the various parties, specific rehabilitation objectives are determined for each wetland following a rapid wetland status quo analysis undertaken by the wetland ecologist.

Phase 2 requires site visits attended by the fieldwork team comprising a wetland ecologist, a design engineer, an environmental assessment practitioner, and a SANBI provincial coordinator. Other interested stakeholders or authorities, landowners and in some instances the implementing agents may also attend the site visits on some occasions. This allows a highly collaborative approach to be used, 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. Details of the proposed interventions are discussed, some survey work is undertaken by the engineers, and GPS coordinates and digital photographs are taken for record

purposes. 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.

During Phase 2, monitoring systems are put in place to support the continuous evaluation of interventions. The systems monitor both the environmental and social benefits of the interventions. As part of 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 PC, 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 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.

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, DWA, and the directly affected landowners is obtained, 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[3] listed in the Plan.

It is typically at this point in the process when the final construction drawings are issued to the implementing agents. Seventeen implementing agents 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.

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

Rehabilitation work within floodplain systems

Based on lessons learnt and project team discussions held during the National Prioritisation workshop in November 2010 SANBI 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, SANBI do not intend to stop undertaking rehabilitation work in floodplains entirely. Instead, SANBI propose to adopt an approach to the rehabilitation of floodplain areas that takes into account the following guiding principles:

1. As a general rule, avoid constructing hard interventions within an active floodplain channel; and rather
2. 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 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 WfWetlands Programme operates within the context of the Constitution of South Africa, Act No. 108 of 1996, whereby everyone has the right to have the environment protected and conserved for the benefit of present and future generations. This and other national legislation that protects the environment is indicated in **Table 1** below. This legislation informs and guides the WfWetlands Programme in terms of its vision and objectives, whilst simultaneously regulating the wetland rehabilitation activities which WfWetlands carries out.

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

Memorandum of Understanding for Working for Wetlands Programme
A Memorandum of Understanding (MOU) has been entered into between the DAFF, DEA, DWA and SANBI for the WfWetlands Programme. Through co-operative governance and partnerships, this MOU aims to streamline the authorisation processes required by the National Environmental Management Act, No. 107 of 1998, the National Water Act. No. 36 of 1998, and the National Heritage Resources Act, No. 25 of 1999 to facilitate efficient processing of applications for authorisation of wetland rehabilitation activities.

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 Affairs	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 Affairs	1970
• EIA Guideline Series, in particular: • Guideline 3 – General Guide to the Environmental Impact Assessment Regulations, 2006 (DEAT 2006) • Guideline 4 – Public Participation in support of the EIA regulations, 2006 (DEAT 2006) • Guideline 5 – Assessment of Alternatives and Impacts, 2006 (DEAT 2006) • Implementation Guidelines: Sector Guidelines for the EIA Regulations (draft) (DEA, 2010). • DEA&DP. 2013. Guideline on Public Participation (DEA&DP, March 2013). • DEA&DP. 2013. Guideline on Alternatives (DEA&DP, March 2013).	Department of Environmental Affairs	2006 - 2013
International Conventions, in particular:	International Conventions	N/A

Title of legislation, policy or guideline:	Administering authority:	Date:
• The Ramsar Convention • Convention on Biological Diversity • United Nations Conventions to Combat Desertification • New Partnership for Africa's Development (NEPAD) • The World Summit on Sustainable Development (WSSD)		

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)
  - In terms of Regulations pursuant to the NEMA, certain activities that may have a detrimental impact on the environment (termed Listed Activities) require an Environmental Authorisation from the Department of Environmental Affairs (DEA). The implementation of interventions will trigger NEMA Listing Notices 1 and 3 (G.N. R544 and G.N R546 respectively). In order to meet the requirements of these Regulations, it is necessary to undertake a Basic Assessment Process and apply for an EA. This was previously undertaken on an annual basis per Province as the Wetland Projects became known. However as from 2014, an application is now made per Province for Wetland Projects required in the next few planning cycles (anywhere from one to three planning cycles depending on the information gained through the Catchment Prioritisation Process).
  - **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 EA's 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.
  - 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[4] (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*[5]' and '*altering the bed, banks, course or characteristics of a watercourse*[6]' where they are specifically undertaken for the purposes of rehabilitating[7] a wetland for conservation purposes. SANBI are required to register the 'water use' in terms of the GA.

[4]Government Notice No. 1198, 18 December 2009
[5]Section 21(c) of the NWA, No. 36 of 1998
[6]Section 21(i) of the NWA, No. 36 of 1998

- 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. SANBI 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.

[7]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"*

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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 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), certain activities that may have a detrimental impact on the environment (termed Listed Activities) require Environmental Authorisation (EA) from the Department of Environmental Affairs (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 certain interventions triggers Listing Notices 1 and 3 (G.N. R544 and G.N R546 respectively).

In order to meet the requirements of the Regulations pursuant to NEMA, it was necessary to undertake a Basic Assessment Process. 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).

The EA that has been applied for will be inclusive of all Listed Activities that may be triggered whilst implementing the wetland rehabilitation interventions. Essentially this EA would authorise any typical wetland rehabilitation activities on condition that the specific intervention proposals are submitted in a Rehabilitation Plan to DEA for approval.

The Rehabilitation Plans for each Wetland Project will be prepared annually after sufficient field work and stakeholder consultation has been undertaken in the wetlands that have an EA. These Rehabilitation Plans will be submitted to DEA for approval as a condition of the EA for the respective Provincial BAR.

II. CONTACT DETAILS

Details of the applicant: SANBI	
Contact Person:	Mr Umesh Bahadur
Street Address:	Pretoria National Botanical Garden, 2 Cussonia Ave, Brummeria, Pretoria, 0001
Postal Address:	Private Bag X101, Pretoria 0001
Tel:	012-843 5200
Fax:	086-555 9838
Email:	u.bahadur@sanbi.org.za

Details of the Provincial Coordinator: SANBI	
Contact Person:	Thilivhali Nyambeni
Postal Address:	P. O. Box 990, Harrismith 9880
Tel:	082 823 5366
Fax:	086 774 4129
Email:	t.nyambeni@sanbi.org.za

Details of the EAP: Aurecon	
Contact Person:	Dr Jenny Youthed
Street Address:	No 1 Pearce Street, Berea, East London
Postal Address:	PO Box 19553, Tecoma, 5214
Tel:	043 721 0900 (Dr Youthed)
Fax:	043 721 0902
Email:	Jenny.Youthed@aurecongroup.com

III. ABBREVIATIONS

BAR	Basic Assessment Report
BGIS	Biodiversity Geographical Information System
BMP	Best Management Practise
CARA	Conservation of Agricultural Resources Act
CEMP	Construction Environmental Management Programme
CPP	Catchment Prioritisation Process
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
EA	Environmental Authorisation in terms of the NEMA
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Programme
EPWP	Expanded Public Works Programme
GA	General authorisation in terms of the NWA
GIS	Geographical Information System
HIA	Heritage Impact Assessment
IA	Implementing Agent
I&APs	Interested and Affected Parties
IDP	Integrated Development Plans
M&E	Monitoring and Evaluation
MAP	Mean Annual Precipitation
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Area
NHRA	National Heritage Resources Act
NWA	National Water Act
NWI	National Wetlands Inventory
OHSA	Occupational Health and Safety Act
PC	Provincial Coordinator
PIP	Project Implementation Plan
PPP	Public Participation Process
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SMME	Small, Medium and Micro Enterprises
SPWP	Special Public Works Programme
WfWetlands	Working for Wetlands

IV. GLOSSARY OF TERMS

Auger: An instrument used for boring or perforating soils or rocks, in order to determine the quality of soil, or the nature of the rocks or strata upon which they lie, and for obtaining water (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

Avulsion: An abrupt change in the course of a stream from one flow path to another.

Bedload: Sediment that is transported by being rolled or bounced along the bed of the stream (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

Bedrock: The solid rock that underlies unconsolidated material, such as soil, sand, clay, or gravel (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

BAR: A report as described in regulation 23 of the EIA regulation, 2006 that describes the proposed activities and their potential impacts.

BID: A short document describing, and inviting I&APs to comment on, the proposed activities for which authorization is sought.

BMP: Procedures and guidelines to ensure the effective and appropriate implementation of wetland rehabilitation by WfWet implementers.

Biophysical: The biological and physical components of the environment (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 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 (consult DWAF [1994]) (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

Collation Report: A report describing the Basic Assessment process followed for a provinces and collating the Basic Assessment reports for the various WfWet Projects within a province.

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.

Eco-log: A cylindrical wire mesh sleeve 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).

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.

MP: Details the methods and procedures for achieving environmental targets and objectives.

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.

I&APs: People and organizations that have interest(s) in the proposed activities.

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

Implementer: The person or organization responsible for the construction of WfWet rehabilitation interventions.

Intervention: An engineered structure such as a concrete or gabion weir, earthworks or re-vegetation that that achieves identified objectives within a wetland e.g. raising of the water table within a drainage canal.

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').

Perched wetland: A wetland where the wetland water table is higher than the local and regional water-table (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

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 WfWet intervention generally defined by a quaternary catchment or similar management unit such as a national park in which a single implementer operates.

Q value: The peak flow (m^3/s) for which a structure is designed, based on a given likely return period rainfall within the catchment

Quaternary Catchment : All land area drained by a fourth order tributary river and its tributaries.

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.

Rehabilitation: Restoring processes and characteristics that are sympathetic to and not conflicting with the natural dynamic of an ecological or physical system (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 2008).

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.

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.” (SA Water Act of1998).

Wetland: Land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants living there (Wetland Management Series: WET-Origins, WRC Report TT 334/08, March 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 (EAP, Engineer, Wetland Ecologist, and SANBI PC) and their subsequent input into the Reporting, which includes intervention design drawings, the wetland status quo, in addition to input from SANBI’s PC. 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 therein when constructing all interventions, the designs of which have been included in this Report.
- SANBI’s PCs 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. These include:
  - WW(0): Standard operating procedure,
  - WW(1): Wetland survey and Inspection consent,
  - WW(2): Terms and Conditions for carrying out wetland rehabilitation,
  - WW(3): Wetland Rehabilitation Activities Consent, and
  - WW(4): Property Inspection Prior to Wetland Rehabilitation.
- SANBI have provided all relevant information and documentation required to compile this Rehabilitation Plan.
- Rehabilitation activities should not be carried out until the final Wetland Rehabilitation Plan has been approved by DEA and formally signed off by SANBI.
- The implementation of this rehabilitation plan must take into account all relevant provisions of Working for Wetlands Best Management Practices and Construction Environmental Management Plan, the recommendations of the Basic Assessments and the requirements of the Environmental Authorisation (EA) for the project.
- DEA’s prerequisite to increase the requirement of percentage of funding to be spent on labour within the Working for Wetlands (WfWet) programme, has been taken into consideration by the project team during the planning process for wetland rehabilitation.

- Due to the dynamic nature of site conditions and associated biophysical changes within wetlands, this wetland rehabilitation plan is only valid for the 2013/14 financial year. Where appropriate interventions that have not been previously implemented or included in the 2009/10, 2010/11, 2011/12, 2012/2013 and 2013/14 Project Implementation Plans (PIPs) were reviewed and where necessary re-designed for inclusion into the 2013/14 wetland 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 2014/15 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 SANBI's PC, the specialist wetland ecologists, the Engineer, EAP as well as comments from Interested and Affected Parties (I&APs). Until this Final Report has been finalised and signed off by SANBI, 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 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 SANBI's PCs based on their knowledge of past projects and 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 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 following reports for this project:

1. Phase 1 Report – December 2013; and
2. Other Phase 2 Planning Reports which include the:
    a. Basic Assessment Report (2014),
    b. Wetland Status Quo Report (**Appendix A** of this report).

VII. DISCLAIMER

- This Rehabilitation Plan is for the Maluti Wetland Project in the Free State Province. The plan is to be used to implement the interventions identified as necessary to rehabilitate the Maluti wetlands, and is to be approved by the Department of Environmental Affairs (DEA) as part of the conditions of Environmental Authorisation

(EA).

- The intervention points and wetland boundary polygons provided in this report are based on the shapefiles that have been provided by the South African National Biodiversity Institute (SANBI). The datasets included in the Phase 1 Reports have been updated by the Wetland ecologists and verified by the SANBI Provincial Co-ordinators (PCs). All reasonable efforts have therefore been made to ensure that the data is accurate. However Aurecon South Africa (Pty) Ltd (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 Aurecon Environmental Assessment Practitioner (EAP), Engineer, SANBI PC and the SANBI Planning, Evaluation and Monitoring Manager.
- All changes 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				
Umesh Bahadur	Programme Manager: Working for Wetlands		✓	
Eric Munzhedzi	Implementation Manager		✓	
Thilivhali Nyambeni	SANBI Provincial coordinator	✓		✓
NATIONAL STAKEHOLDERS				
Refer to **Appendix G**			✓(email notification)	
PROVINCIAL STAKEHOLDERS & I&APs				
Refer to **Appendix H**			✓(email notification)	
LANDOWNERS				
Refer to **Appendix E**			✓(E-copy of Rehab Plan)	

1 INTRODUCTION

1.1 Working for Wetlands programme overview

The Working for Wetlands (WfWetlands) Programme is a government programme (similar to Working for Water, Working on Fire and Working on Land) managed by the South African National Biodiversity Institute (SANBI) on behalf of the national government departments of Environmental Affairs (DEA), Water Affairs (DWA), and Agriculture, Forestry and Fisheries (DAFF), and 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 two main objectives of the programme are **wetland conservation** in South Africa and **poverty reduction** through job creation and skills development amongst vulnerable and marginalised groups.

The WfWetlands Programme forms part of the EPWP which 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 maximize employment creation, support for small business and the transfer of skills to the unemployed and poor.

In the 12 years since its inception, the WfWetlands Programme has invested R530 million in wetland rehabilitation and has been involved in over 900 wetlands thereby improving or securing the health of over 70 000 hectares of wetland environment. The WfWetlands Programme has created more than 12 800 jobs and 2.2 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 60% women, 20% youth and 2% disabled people.

1.1.1 Programme, projects and phases

In order to manage the WfWetlands Programme, prioritised wetlands that have been identified for rehabilitation have been grouped into "Wetland Projects" within each Province, and each Wetland Project encompasses several 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.

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. SANBI is currently managing 35 Wetland Projects countrywide, and approximately 500 interventions within these Wetland Projects will be implemented to meet the objectives of the Programme.

1.1.2 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 (and 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);
- Recreation of wetland habitat towards the conservation of biodiversity;
- Job creation and social upliftment.

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;
- Constructing structures (gabions 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.
- Removing invasive alien or undesirable plant species from wetlands and their immediate catchments as part of the Working for Water Programme.

1.1.3 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 structures 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 re-vegetation of stabilised areas with appropriate wetland and riparian species;
- The 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.

- 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;
- In some instances, the use of appropriate fire management and burning regimes.

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

1.2 Project team

The project team currently comprises the SANBI Programme Manager who oversees the WfWetlands Programme and provincial coordinators (PCs) who oversee the identification and implementation of projects in their regions. They are supported by a small team based at the Pretoria Botanical Gardens who fulfil various roles such as finance, 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 is assisted by an external team of Wetland Ecologists 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 SANBI Provincial Coordinators (PCs) who are each responsible for provincial planning and implementation.

1.3 Free State Wetland Projects

Wetland Projects for the 2014/2015 planning cycle were identified during the Phase 1 activities associated with the WfWetlands Programme. Catchment and wetland prioritisation assessments were undertaken by the wetland ecologist/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. SANBI'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, the following quaternary catchments (and associated wetland systems) were identified for the 2014/2015 planning cycle in the Free State Province (**Table 1**)

Table 1: Free State Wetland Projects

Project Name	*Wetland Number*	*Wetland System*
Seekoeivlei	C13C-01	Seekoeivlei
Seekoeivlei	C13C-04	Bergplaats
Maluti	C81D-01	Escol 1
	C81D-02	Escol 2
	C81D-03	Sterkfontein 1
	C81F-02	Monontsha (Qwa Qwa)
	C81H-11	Diatalawa (Maanhaar)

A basic EIA application has been lodged with the National DEA on the 14 February 2014 for the undertaking of listed activities in terms of NEMA. The DEA will issue an EA that will permit the WfWetlands Programme to undertake wetland rehabilitation in the abovementioned wetland systems within the Free State Province. This Rehabilitation Plan focuses on the wetlands in the table above and is to be submitted to DEA for their approval as a condition of the EA.

1.3.1 The Maluti a Phofung ("Maluti") Wetland Project

This document comprises the Rehabilitation Plan for the Maluti Wetland Project and includes the following wetland systems: Escol 1; Escol 2; Sterkfontein 1, Monontsha and Diatalawa. The Rehabilitation Plan will be the primary working document for the project via the implementation (construction/ undertaking of) of interventions[8] required to meet the wetland rehabilitation objectives. The document details the general methodology that has been adopted for the planning of rehabilitation interventions for identified wetlands. Details of the rehabilitation planning for each wetland and the selected intervention options (including designs, dimensions and locations) within each wetland are presented, along with baseline Monitoring and Evaluation (M&E) data.

Detailed wetland status quo reports and design drawings are included as **Appendix A** of this report. Upon approval of this Rehabilitation Plan by both DEA and the directly affected landowners, the work detail for the project will be implemented within a year with on-going monitoring being undertaken from thereon.

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

1.4 Project scope

The scope of this Wetland Project is detailed in the table below:

Table 2: Project Scope

Quaternary Catchments	C81D C81F C81H
Quaternary Catchment area (Ha)	C81D – 19 497 ha C81F – 64 240 ha C81H – 35 822
Number of wetlands identified during the assessment	5
Extension of existing work (previous financial year)	Yes
Work to commence at new wetlands in 2013/ 2014	Yes
Available budget for new interventions	R2, 947, 269.00
Available budget for maintenance to existing interventions	R52, 730.14
Estimated cost of new interventions	**Total: R 4 377 239.75** Escol 1 (C81D-01): R 1 590 418.95 Escol 2 (C81D-02): R 602 351.40 Sterkfontein 1 (C81D-03): R 700 223.11 Monontsha (C81F-02): R 646 611.27 Diatalawa (C81H-11): R 837 635.02
Estimated cost of maintenance to existing interventions	**Total: R52 730.14** Monontsha (C81F-02): R 18 165.00 Diatalawa (C81H-11): R34 565.14

2 GENERAL METHODOLOGY

Each Wetland Project is managed in three phases over a two-year cycle as shown in the flow diagram in 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.

2.1 Landowner consent

The flow diagram **Figure 1** also clearly demonstrates the point at which various consent forms must be approved via signature from the directly affected landowner. SANBI's PCs 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. These include:

- WW(0): Standard operating procedure
- WW(1): Wetland survey and Inspection consent,
- WW(2): Terms and Conditions for carrying out wetland rehabilitation,
- WW(3): Wetland Rehabilitation Activities Consent,
- WW(4): Property Inspection Prior to Wetland Rehabilitation, and
- WW(5): Notification of Completion of Rehabilitation.

Refer to **Appendix E** for a copy of the landowner agreements.

2.2 Phase 1

The wetland ecologist responsible for the Free State Province undertook a desktop study to determine the most suitable wetlands for the WfWetlands rehabilitation efforts. The involvement of Provincial Wetland Forums and other key stakeholders was 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 involved initial communication with local land-owners and other interested and affected parties to gauge the social benefits of the work. Limited fieldwork investigations or site visits to confirm the inclusion of certain wetland projects or units were also undertaken 2013. The following wetlands were prioritised and agreed to by the various parties for the Maluti Wetland Project:

1. Escol 1
2. Escol 2
3. Sterkfontein 1
4. Monontsha (Qwa Qwa)
5. Diatawala (Maanhaar)

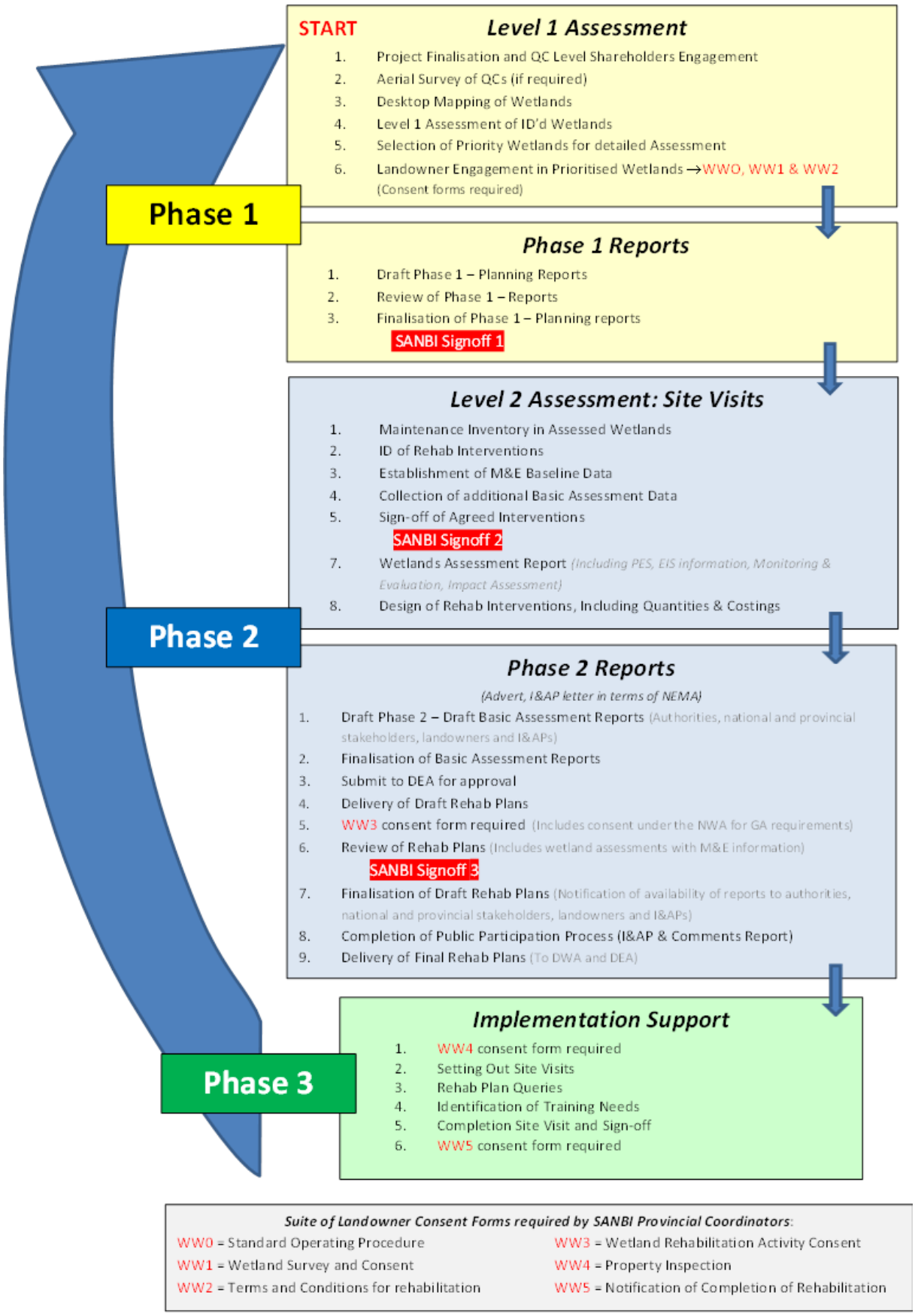

Figure 1: The three phases that must be undertaken for the successful rehabilitation of wetlands

2.3 Phase 2

2.3.1 Site visits

Phase 2 required site visits attended by the fieldwork team comprising a wetland ecologist, a design engineer and a SANBI provincial coordinator. Other interested stakeholders or authorities, landowners and the implementing agents also attended the site visits on this occasion. This allowed for a highly collaborative approach to be used, as options were discussed by experts from different scientific disciplines, as well as local inhabitants with deep anecdotal knowledge. The following site visits were undertaken for the Maluti Wetland Project during August/September 2013:

1. Escol 1
2. Escol 2
3. Sterkfontein 1
4. Monontsha
5. Diatalawa

The following team members attended the site visits:

- Adam Teixeira-Leite (wetland ecologist)
- Danie Louw (engineer),
- Thilivhali Nyambeni (SANBI PC),
- Nacelle Collins (Dept of Economic Development, Tourism & Environmental Affairs)
- Johan van der Schyff (implementing agent)

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. As part of Phase 2 site visit, a maintenance inventory of any existing interventions that were damaged and / or failing and thus requiring maintenance was compiled by the PC, in consultation with the Design Engineer.

2.3.2 Wetland Status Quo assessments

The time and resources required for detailed assessments 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 ecologist to assess the impacts and threats within each wetland system:

- The hydro-geomorphic setting of the wetland was described according to Kotze *et al.* (2005);
- The overall health of the wetland at a Level 2 (detailed assessment level) using WET-Health (Macfarlane *et al.*, 2008) was described and verified;
- Based on the above findings, the specific impacts and/or threats to be addressed by structural rehabilitation were identified, and described at a Level 2 assessment (e.g. for headcut erosion, the specific dimensions and level of activity of headcuts 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 headcut erosion threatening to propagate through the wetland then an appropriate rehabilitation objective would be to halt propagation of the erosion headcut). The engineer was assisted by the wetland ecologist 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 of the predicted contribution that the identified rehabilitation interventions would make to improving wetland health and ecosystem delivery through addressing the identified impacts/threats was required. Without these assessments, a wetland rehabilitation programme is unlikely to have a well-informed basis on which to improve the rehabilitation's "return on investment" (with return being measured in terms of wetland health and ecosystem services delivery). This is directly linked into the *WfWet* Monitoring and Evaluation 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.
- 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.*, 2009).

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 health, both situations were scored on a scale of 0 (critically altered) to 10 (pristine), and this was undertaken for the hydrology, geomorphology and vegetation components of health.

The benefit achieved is the improvement in relation to the maximum score. For example, in areas threatened by headcut erosion which are to be rehabilitated by halting the spreading of the headcut, the benefits in terms of health would be determined based on the difference between the current health and the projected health if the headcut proceeded to erode

through the threatened area. In such a case, stopping the expansion of the headcut would presumably secure the current situation.

Refer to **Appendix A** which contains the Wetland Status Quo Reports.

2.3.3 Identification and location of intervention designs

The project teams evaluated the various rehabilitation intervention options available and selected the most appropriate intervention options 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 ecologist 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.

a. Intervention naming convention

A new naming convention was introduced in the 2011/2012 planning phase and this has been continued in this years' Rehabilitation Plans.

The **historical naming convention** for interventions is explained below:
A00A-00-000, where

Number	Explanation
A00A	quaternary number
00	wetland number
000	intervention number

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
200	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.

2.3.4 Collection of Monitoring & Evaluation Baseline and Basic Assessments Data

In accordance with WET-Rehab-Evaluate (Cowden & Kotze, 2007) 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 ecologist 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 & Kotze, 2007);
- WET-Health information (allowing the comparison of wetland ecological integrity before and after rehabilitation activities); and
- Details relating to the 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 ecologist 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 SANBI PC and landowner, as indicated by SANBI Signoff 2 in **Figure 1.**

2.3.5 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 SANBI. 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 SANBI PC.
- 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.

2.3.6 Development of the Rehabilitation Plan

The standardised Rehabilitation Plan format has been approved by SANBI Programme Manager: Planning, Monitoring and Evaluation.

Summaries of the wetland prioritisation, problems and rehabilitation objectives were documented in the Maluti Rehabilitation Plan. Detailed wetland status quo reports, based on, *inter alia*, the information collected during the implementation of WET-Tools, were prepared by the wetland ecologist, and included as **Appendix A** to this report.

The Final Maluti Rehabilitation Plan was submitted to the SANBI PC and wetland ecologist for review before it was made available to stakeholders for comment. Any comments

received during the comments period were taken into account in the finalisation of the Rehabilitation Plans.

a. Reporting Format

All relevant information acquired during the assessments and field visits has been included in this document and its appendices in a hierarchy as shown in **Figure 2** below.

- 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.

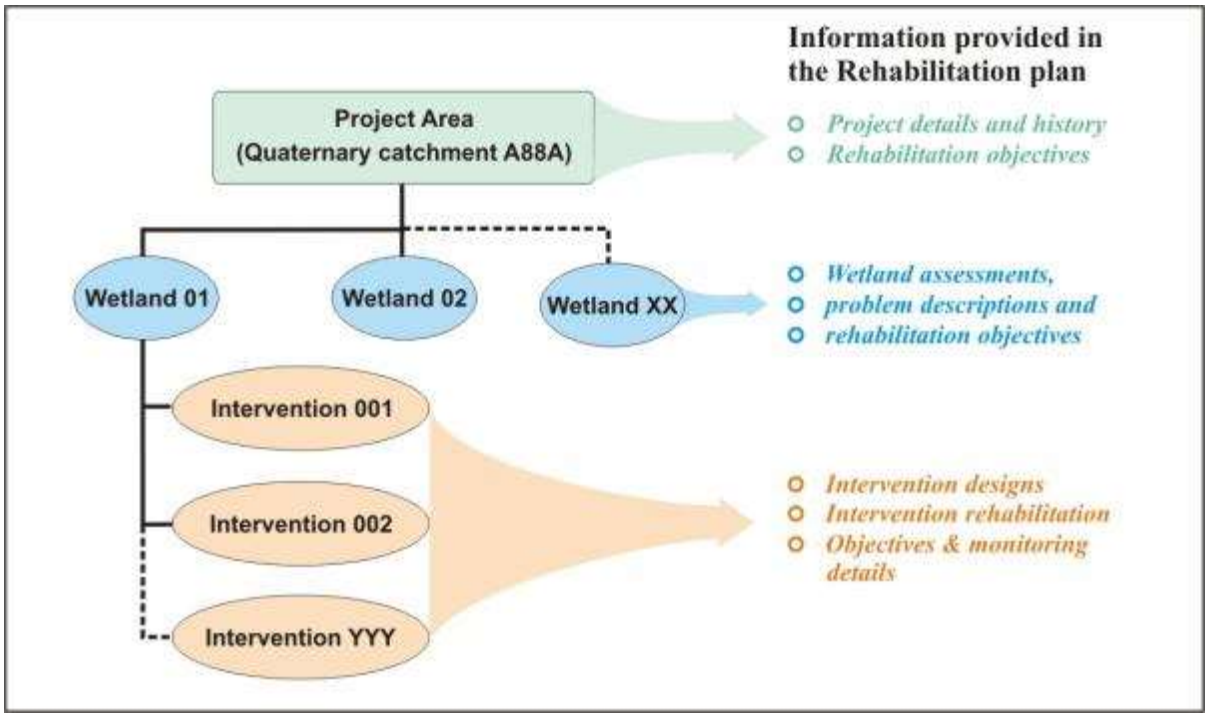

Figure 2: Hierarchy used in the Wetland Rehabilitation Plan

3 PROJECT DESCRIPTION

3.1 Project details

The Maluti a Phofung wetland rehabilitation project is located within DWA quaternary catchments C81D, C81E, C81F, C81H and C81K quaternary catchments in the south-eastern Free State Province, between the towns of Harrismith and Phuthaditjhaba. The project is located within the upper reaches of the Wilge River, a large perennial river system. Since Working for Wetlands has been involved, the Project has centred around the "Monontsha" wetland in Phutaditjaba (C81F-01,02,03), where employment and skills provision is the greatest critical social need. Aas this work has been completed, the project has radiated out into the neighbouring communal areas, hence the large number of quaternary catchments included in the Maluti project.

Prior to 2009, rehabilitation focused on the C81F and the C81H quaternary catchments. In 2008 an aerial survey confirmed that the majority of work in these catchments had been completed and that there was little potential for further rehabilitation work. A number of wetlands that could benefit from rehabilitation were identified in the adjacent catchments C81E and C81K and these wetlands were assessed during the previous planning cycle (2009-2012). Rehabilitation planning for the next planning cycle (2013/14) focused on new well as existing wetland projects located within catchments C81F and C81H (see work identified within catchment C81D located within the Sterkfontein dam Nature Reserve, asbelow). A total of 3 new wetland systems were assessed in 2013, with two existing wetland projects also assessed for additional rehabilitation opportunities to support the existing works at these sites.

Table 3: Project details

Project Name	Maluti a Phofung ("Maluti")
Region (Province)	Free State
Project Budget	R3, 000, 000
Planning Category	Category 2
Nearest Town/s	Phutaditjaba and Harrismith
Partnership	-

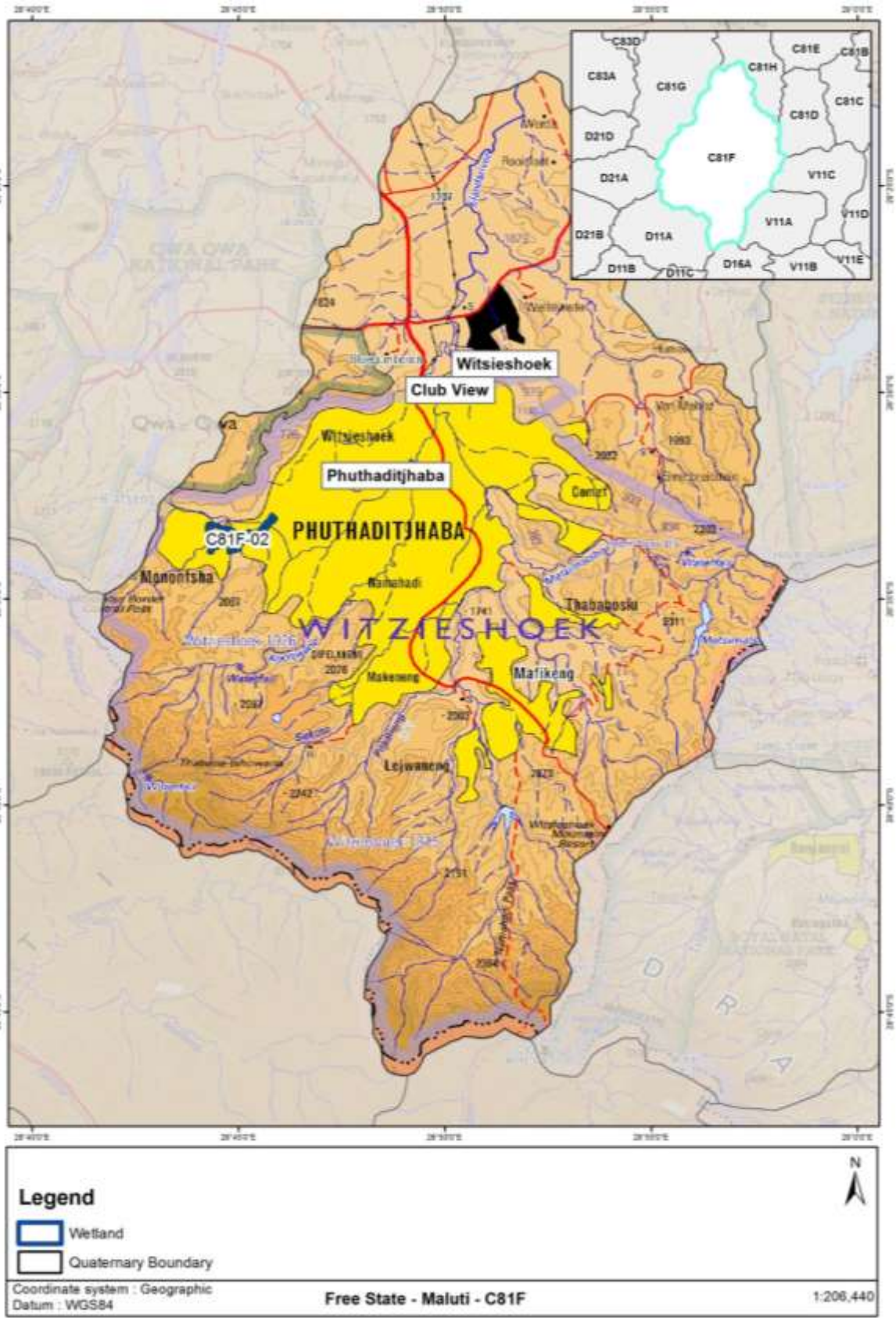

Figure 3: Topographic map showing C81F quaternary catchments' locality, cadastral boundaries and access routes

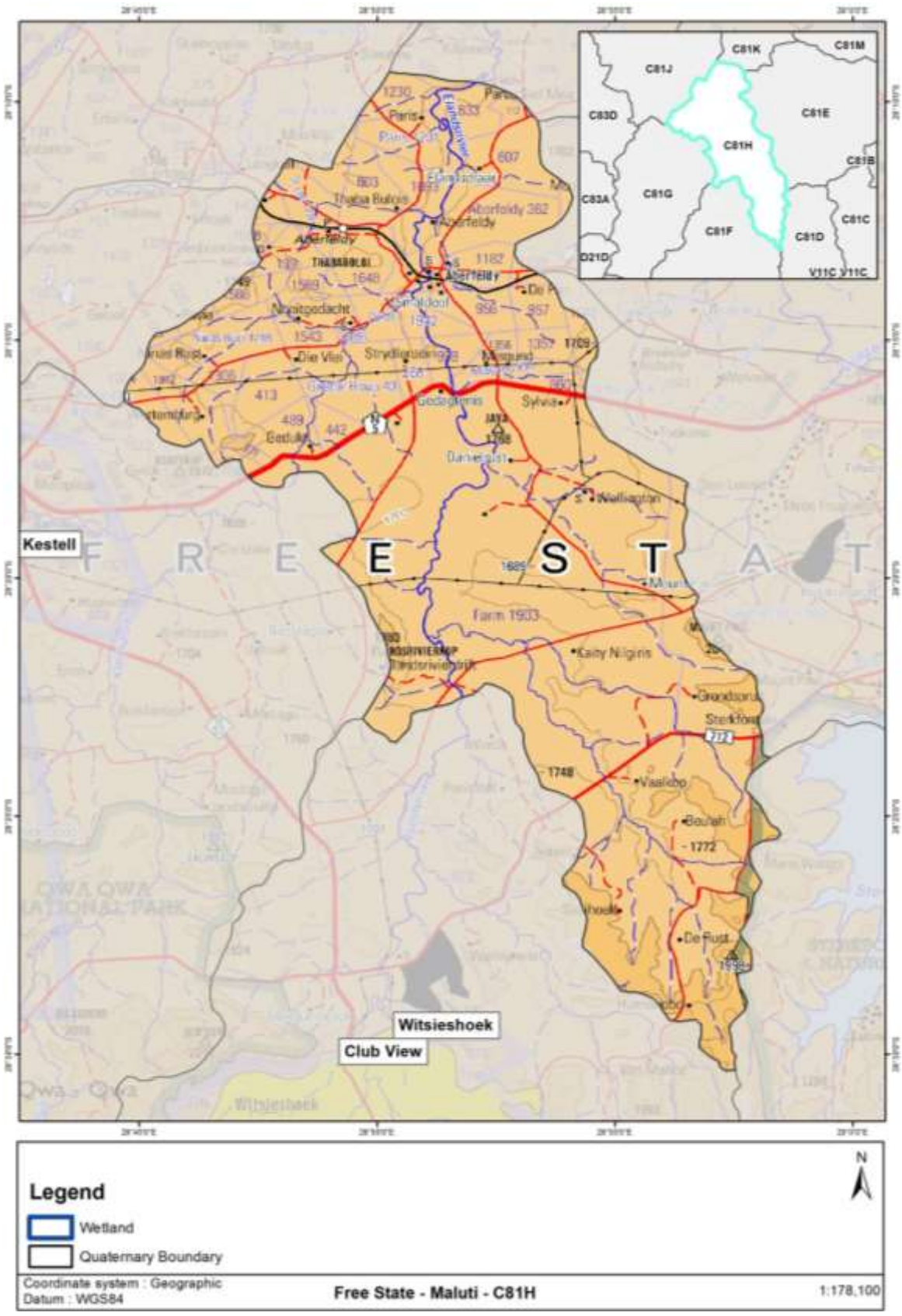

Figure 4: Topographic map showing C81H quaternary catchments' locality, cadastral boundaries and access routes

Table 4: Wetlands selected for rehabilitation

Wetland Number	Wetland Name	Problems	Proposed Rehab Action(s)	Priority
C81D-01	Escol 1	Erosion gullies, headcuts	• Deactivate headcuts • Stabilise existing gullies • Raise the water level in the lower wetland • Remove wattle trees	2
C81D-02	Escol 2	Erosion gullies, headcut, Eroding seep	• Deactivate headcuts • Stabilise existing gullies • Remove old cattle feeds from wetland • Concrete strips to stabilise dirt track across wetland	3
C81D-03	Sterkfontein	Gulley with headcuts	• Deactivate large headcut (drop-inlet)	1
C81F-02	Monontsha	Channel incision, urban environment impacts	• Support existing interventions	4
C81H01	Diatalawa	Incised channel with headcuts, trampling	• Raise the water level and support existing interventions • Stabilise erosion • Deactivate headcuts • Stabilise trampled areas • Maintenance of existing weirs	2

Table 5: Identified wetlands within the Maluti Wetland Project

Wetland Number	Wetland Name	Longitude	Latitude
C81D-01	Escol 1	28°58'22.41"E	28°24'23.25"S
C81D-02	Escol 2	28°58'44.97"E	28°24'47.71"S
C81D-03	Sterkfontein 1	29°01'33.27"E	28°30'20.75"S
C81F-02	Monontsha (Qwa Qwa)	28°44'48.77"E	28°33'25.45"S
C81H-11	Diatalawa (Maanhaar)	28°54'06.58"E	28°19'17.75"S

3.2 Landowner details

The landowners were identified for this Wetland Project (**Table 6**) and consent for any proposed wetland rehabilitation (subject to the approval of the Final Rehabilitation Plans) has been sought. Copies of the consent obtained are provided in **Appendix E**.

Table 6: List of Landowners and SG Key

Wetland Number	Property SG Key	Owner	Consent Obtained
C81D-01	F01500000000069200000 F01500000000069200002	DETEA (Sterkfontein Dam Nature Reserve)	Yes
C81D-02	F01500000000069200000		
C81D-03	F01500000000027700000		
C81F-02	F01500000000192600000		Yes
C81H-11	F01500000000190300050 F01500000000190300051		

1.1 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 components of the specified systems. In theory this information could be converted into a hectare equivalent which could serve as a baseline indicator to then provide a projection of the area of wetland habitat gained or secured. In practice the level of confidence associated with interpretations of this nature are usually low and difficult to defend and hence should be interpreted with great caution. For example, this approach should not be followed for hectare equivalents secured 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. In well-known systems rehabilitation plans can outline the following projected values for the proposed wetland rehabilitation, which can be used as an indicator of wetland rehabilitation success within each wetland system (**Table 7**).

Table 7: Projected Values

Wetland No.	Area (ha)	Current hectare equivalents	Projected hectare equivalents (without rehab)	Projected hectare equivalents (with rehab)	% Increase on current hectare equivalents	Projected hectare equivalents secured
C81D-01	23.6	17.7	11.1	18.2	43	7.6
C81D-02	11.6	9.8	4.6	9.6	49	4.8
C81D-03	15.8	9.5	5	8.9	35	3.3
C81F-02	214	Not assessed – maintenance and support of existing structures only				
C81H-11	54	40.9	38.8	44.2	21	8.7

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 (**Table 7**) only reflects the amount of hectares physically gained as a result of the interventions.

3.3 Prioritisation of wetlands

Based on the wetland status quo analyses conducted, the current progress of implementation within the project and the prioritisation of the rehabilitation interventions detailed in the following sections, the wetlands will be prioritised for rehabilitation in the following order (**Table 8**).

Table 8: List of prioritised wetlands

Wetland Number	Wetland Name	Problems	Proposed Rehab Action(s)	Priority
C81D-01	Escol 1	Erosion gullies, headcuts	• Deactivate headcuts • Stabilise existing gullies • Raise the water level in the lower wetland	2
C81D-02	Escol 2	Erosion gullies, headcut, Eroding seep	• Deactivate headcuts • Stabilise existing gullies • Remove old cattle feeds from wetland • Concrete strips to stabilise dirt track across wetland	3
C81D-03	Sterkfontein	Gulley with headcuts	• Deactivate large headcut (drop-inlet)	1

Wetland Number	Wetland Name	Problems	Proposed Rehab Action(s)	Priority
C81F-02	Monontsha	Channel incision, urban environment impacts	• To implement appropriate structures within the incised channel to support existing rehabilitation interventions.	3
C81H01	Diatalawa	Incised channel with headcuts, trampling	• To use appropriate interventions to raise the water level in the main channel and encourage overtopping. • To use appropriate structures to deactivate headcuts. • To use a combination of re-shaping/vegetation, supporting structures such as ecologs and fencing to secure and stabilise eroded/trampled areas.	2

3.4 Interventions required

The following table provides a list of interventions requiring redesign, maintenance and or new structures for this project and their associated new intervention number.

Table 9: Summary of the interventions including a cross reference of intervention numbers

Descriptive name	Old intervention number (if applicable)	New Intervention number	Proposed action	Reference document
NEW				
Escol 1 (C81D-01)				
Earthworks (reshaping + Mac-Mat)	N/A	C81D-01-201-00	Deactivate small headcut	Maluti Final Rehab Plan: March 2014
Gabion drop inlet + earth berms	N/A	C81D-01-202-00	Deactivate medium-sized headcut	Maluti Final Rehab Plan: March 2014
Earthworks (reshaping + Mac-Mat)	N/A	C81D-01-203-00	Deactivate small headcut	Maluti Final Rehab Plan: March 2014
Gabion drop inlet + earth berms	N/A	C81D-01-204-00	Deactivate large headcut	Maluti Final Rehab Plan: March 2014
Concrete weir	N/A	C81D-01-205-00	Raise the water level in the channel and activate adjacent wetland areas	Maluti Final Rehab Plan: March 2014
Concrete weir	N/A	C81D-01-206-00	Raise the water level in the channel and activate adjacent wetland areas	Maluti Final Rehab Plan: March 2014

Descriptive name	Old intervention number (if applicable)	New Intervention number	Proposed action	Reference document
Escol 2 (C81D-02)				
Gabion drop inlet	N/A	C81D-02-201-00	Deactivate large headcut	Maluti Final Rehab Plan: March 2014
Gabion drop inlet	N/A	C81D-02-202-00	Deactivate large headcut by diverting water away from the head cut	Maluti Final Rehab Plan: March 2014
Concrete strips	N/A	C81D-02-203-00	Facilitate vehicles crossing wetland, control erosion	Maluti Final Rehab Plan: March 2014
Sterkfontein 1 (C81D-03)				
Gabion drop inlet	N/A	C81D-03-201-00	Deactivate medium-sized headcut	Maluti Final Rehab Plan: March 2014
Monontsha (C81F-02)				
Concrete weir	N/A	C81F-02-205-00	To raise the water level in the incised channel and re-wet adjacent wetland areas	Maluti Final Rehab Plan: March 2014
Concrete weir	N/A	C81F-02-206-00	To raise the water level in the incised channel, re-wet adjacent wetland areas and support upstream structures	Maluti Final Rehab Plan: March 2014

Descriptive name	Old intervention number (if applicable)	New Intervention number	Proposed action	Reference document
Diatalawa				
Concrete weir	N/A	C81H-11-201-00	To raise the water level in the channel and encourage re-wetting of adjacent wetland areas	Maluti Final Rehab Plan: March 2014
Concrete weir	N/A	C81H-11-205-00	To raise the water level in the channel and encourage re-wetting of adjacent wetland areas	Maluti Final Rehab Plan: March 2014
Concrete weir	N/A	C81H-11-206-00	To raise the water level in the channel and encourage re-wetting of adjacent wetland areas	Maluti Final Rehab Plan: March 2014
Earthworks: reshaping river bank	N/A	C81H-11-207-00	Slope eroded bank and prevent further slumping	Maluti Final Rehab Plan: March 2014
Fencing and ecologs	N/A	C81H-11-208-00	Fencing of existing structure to prevent further cattle trampling	Maluti Final Rehab Plan: March 2014
MAINTENANCE (Monontsha (C81F-02)				
Earth berm		C81F-02-207-01	Raise existing earth berm to prevent flows entering drain on left bank	Maluti Final Rehab Plan: March 2014
MAINTENANCE Diatalawa (C81H-11)				
Maintenance (on existing concrete drop inlet weir		C81H-11-202-01	Maintenance on existing concrete drop inlet weir	Maluti Final Rehab Plan: March 2013

Descriptive name	Old intervention number (if applicable)	New Intervention number	Proposed action	Reference document
Maintenance (fencing of current structure)		C81H-11-203-01	Fence existing structure to prevent cattle trampling	Maluti Final Rehab Plan: March 2014
Maintenance (on existing concrete drop inlet weir)		C81H-11-204-01	Maintenance on existing concrete drop inlet weir	Maluti Final Rehab Plan: March 2013
INTERVENTION REDESIGNS				
N/A				

The intervention designs/ drawings included in this Rehabilitation Plan have been labelled according to the **new naming convention** only. For historical labelling of interventions, please use the table above (**Table 9**) as a cross reference.

4 ESCOL 1 – C81D-01

4.1 Wetland details

The Escol 1 wetland is located in quaternary catchment C81D, within the Sterkfontein Nature Reserve (protected area) near the towns of Harrismith and Phuthaditjhaba in the Free State Province. The assessment of the Escol 1 wetland (C81D-01), its problems, and the development of the rehabilitation objectives are described in detail in **Appendix A**: Wetland Status Quo Reports. The following sections provide a brief summary for this wetland.

Table 10: Summary of the wetland details

Wetland Name	**Escol 1**
Wetland Number	C81D-01
GPS Location	28°24'23.25"S/ 28°58'22.41"E
River System Name	Nuwejaarspruit
Land Use in Catchment	Nature conservation (Nature Reserve), small residential dwellings
Land Use in Wetland	Nature conservation (Nature Reserve)
No. of Properties Intersecting Wetland Area	1
Date of Planning Site Visit	11 September 2013
Wetland Assessor(s)	Adam Teixeira-Leite (Eco-Pulse Consulting)
Wetland Size	23.6 ha

4.1.1 Motivation for selection

This wetland was prioritised during Phase 1 planning. The proposed rehabilitation interventions are aimed at preventing further erosion within the wetland and will have the effect of securing the current level of ecological integrity of the broader wetland system and the supply of goods and services provided by the wetland.

4.1.2 Description

The Escol 1 wetland (C81D-01) is one of two wetlands on the farm Escol, located within the Sterkfontein dam Provincial Nature Reserve. The wetland is a small sized (~24 ha) naturally unchannelled valley bottom wetland system located on the north western edge of Sterkfontein dam. It occurs in a gently undulating landscape of relatively low-moderate topographic relief and is located in a valley bottom with hillslope components immediately adjacent to Sterkfontein dam. The local climate is characterized by a low mean annual precipitation of 735.8mm and a much higher mean annual potential evapotranspiration of 1797.7mm. This gives a MAP to PET ratio of 0.41 (vulnerability index of 1), which means that the wetland has a relatively high sensitivity to hydrological impacts (i.e. *changes in water input volumes and patterns).*

The control on the formation and dynamics of the system is naturally linked to local topography and the shallow underlying sandstone geology, with shallow and dispersive soils being particularly prone to soil erosion. The shallow geology which outcrops on the relatively steep hillslopes has formed seepage areas where the water table is close to the surface and exits the hillslopes forming wetland areas. In its natural state, the wetland would have been an unchannelled valley bottom system fed mainly by hillslope seepage from the adjacent hillslopes with limited input from surface runoff. Lateral sub-surface seepage is clearly an important hydrological input for this wetland system. The local base level has been artificially altered as a result of the creation of Sterkfontein dam (back-flooding of the valley by the dam has effectively set a new base level at an elevated topographic position).

The valley narrows and steepens in the middle section of the wetland and large erosion gullies have developed here (can be up to 8-10m wide and with gulley depth ranging from 2 – 3 metres). A combination of increased gradient, dispersive soils and catchment impacts/informal dirt roads crossing the wetland are the most likely causes of the extent of soil erosion in the lower half of the wetland. The gullies have eroded down to the relatively shallow underlying sandstone bedrock which limits the extent of further incision and down-cutting of the eroded channels. The wetland appears to have retained the majority of the eroded sediment from the gullies which has been deposited further downstream as lobes of sediment within the gullies which has stabilised with vegetation. Trampling by animals has caused disturbance of the floors and sidewalls of gullies. Where gulley sides are steep, these are largely un-vegetated and show signs of undercutting/slumping. A number of active headcuts are also present at the head of the gullies and appear to be slowly progressing upslope. There is a definite risk that these headcuts could pose a threat to the integrity of the more intact unchannelled wetland habitat to the west as erosion progresses up the valley.

The majority of the wetland appears to be seasonally activated and vegetated with a form of montane grassland that features a range of indigenous grass species. The upper and lower sections of the wetland are largely undisturbed and naturally vegetated with grasses including *Aristida spp, Eragrostis plana* (Tough love grass), *Hyparrhenia hirta* (Common thatching grass), *Agrostis lachnantha* (Bent grass), *Eragrostis curvula* (Weeping love grass), *Cynodon transvaalensis* (Fine couch grass), *Themeda triandra* (Red grass) and *Tristachya leucothrix* (Hairy trident grass). The floor of the eroded gullies towards the toe of the wetland

are wet areas vegetated with rushes including *Juncus oxycarpus* and *Juncus punctorius.* A number of scattered exotic woody species have also become established within the erosion gullies, including *Salix babylonica* (weeping willow), *Salix fragilis* (Brittle/crack willow) and *Acacia mearnsii* (Black wattle). Wetland habitat diversity is generally considered to be quite low for this seasonally wet grass-dominated system.

4.1.3 Rehabilitation

This wetland was prioritised during Phase 1 planning. The proposed rehabilitation interventions are aimed mainly at preventing further erosion within the wetland and will have the effect of securing the current level of ecological integrity of the broader wetland system and the supply of goods and services provided by the wetland. Structures planned within the lower wetland will also assist in improving system hydrology to some extent within a section of the wetland by facilitating rewetting of the wetland areas by stabilising erosion gullies and promoting over-bank flooding.

4.2 Site photos

View E, looking downslope towards the toe of the wetland with Sterkfontein dam in the background

View W, looking upslope towards vegetated headcut

View SE, looking downstream from the head of the erosion gulley towards the vegetated gulley downstream

View NW, looking upslope towards intact section of unchannelled wetland in the north-east

Figure 5: Site Photos of the Escol 1 wetland

4.3 Wetland problems

The main impacts to this wetland unit are associated with extensive gulley erosion in the lower and mid sections of the wetland which has significantly affected water distribution and retention patterns. A number of headcuts also pose a threat to the integrity of more intact upstream habitat should these continue to progress up the valley. Other less significant but noticeable impacts include:

- Effect of dirt roads crossing the wetland on habitat and water movement; and
- Alien trees in the catchment and in the erosion gullies within the wetland.

4.4 Rehabilitation objectives

Details of the current rehabilitation objectives, together with the planned strategy for achieving these objectives are summarized in **Table 11** below:

Table 11: Summary of rehabilitation objectives and strategies for wetland C81D-01

Rehabilitation objective	Rehabilitation strategy
To deactivate headcuts and secure intact wetland habitat in the upper wetland.	• To use a combination of re-shaping/vegetation and hard structures (depending on size of the individual headcuts) in order to prevent headcuts from eroding headward.
To re-instate more natural water distribution	• To install concrete weirs and earthen

Rehabilitation objective	Rehabilitation strategy
and retention patterns in order to improve the overall functioning of the wetland and associated habitat for important wetland-dependant biota.	berms in order to raise the water-level within eroded channels and re-activate adjacent wetland areas in the lower section of the wetland.

4.5 Summary of proposed interventions

The new interventions that are proposed are discussed in detail in the subsequent sections of this report. The table below (**Table 12**) provides a summary of the new interventions. The "implementation order" as depicted in the table indicates the timing order in which interventions should be implemented within the wetland (number 1 first). The "priority" as depicted in the table indicates the relative importance of each intervention across the project as a whole – if interventions have to be omitted for any reason, those with the lowest priority (highest number) across the whole project should be omitted first.

Please note that the location of the interventions described in Section 4.7 may change as a result of changes in the landscape (due to continued erosion, for example) during the time period that has lapsed between the initial planning site visit and the actual implementation thereof.

Table 12: Summary of proposed new interventions, C81D-01

Intervention Number	Intervention Structure Type	Implementation Order	Priority	Structure Cost (Excl. Vat)
C81D-01-201-00	Earthworks (reshaping + Mac-Mat)	2	1	R 33 238.13
C81D-01-202-00	Gabion drop inlet + earth berms	1	2	R 521 913.28
C81D-01-203-00	Earthworks (reshaping + Mac-Mat)	3	1	R 35 027.50
C81D-01-204-00	Gabion drop inlet + earth berms	4	2	R 800 691.40
C81D-01-205-00	Concrete weir	5	3	R 190 334.44
C81D-01-206-00	Concrete weir	6	3	R 176 802.08
			Total	**R 1 758 006.83**

4.6 Design selection and sizing

The objectives of the interventions are to prevent further headcut erosion, ensure diffuse flow into wetland areas to increase the water table level, rehydrate wet soils and promote and increase in hydrophytic vegetation. The most appropriate and cost effective method of doing this was considered to involve:

- The construction of a hard structure (concrete or gabion weir) in the main drain with the spillway set at a level that would allow for the back flooding.
- Constructing a combination of concrete, gabion and earthen diversion structures that would divert flows out of the main drain and into the wetland. Earthen diversions were specified in areas of low energy and will be vegetated to increase their stability. Concrete and gabion diversion structures were specified where higher energy is expected.
- Labour-day component and the availability of material were the most influencing factors taken into consideration.
- The aesthetic/ visual impacts of the proposed interventions should be kept to an absolute minimum. This could be obtained by introducing colouring pigment in the concrete and “filleting” of visible sharp edges during concrete costing with shutters.
- All the disturbed ground and new earth structures need to be re-vegetated.

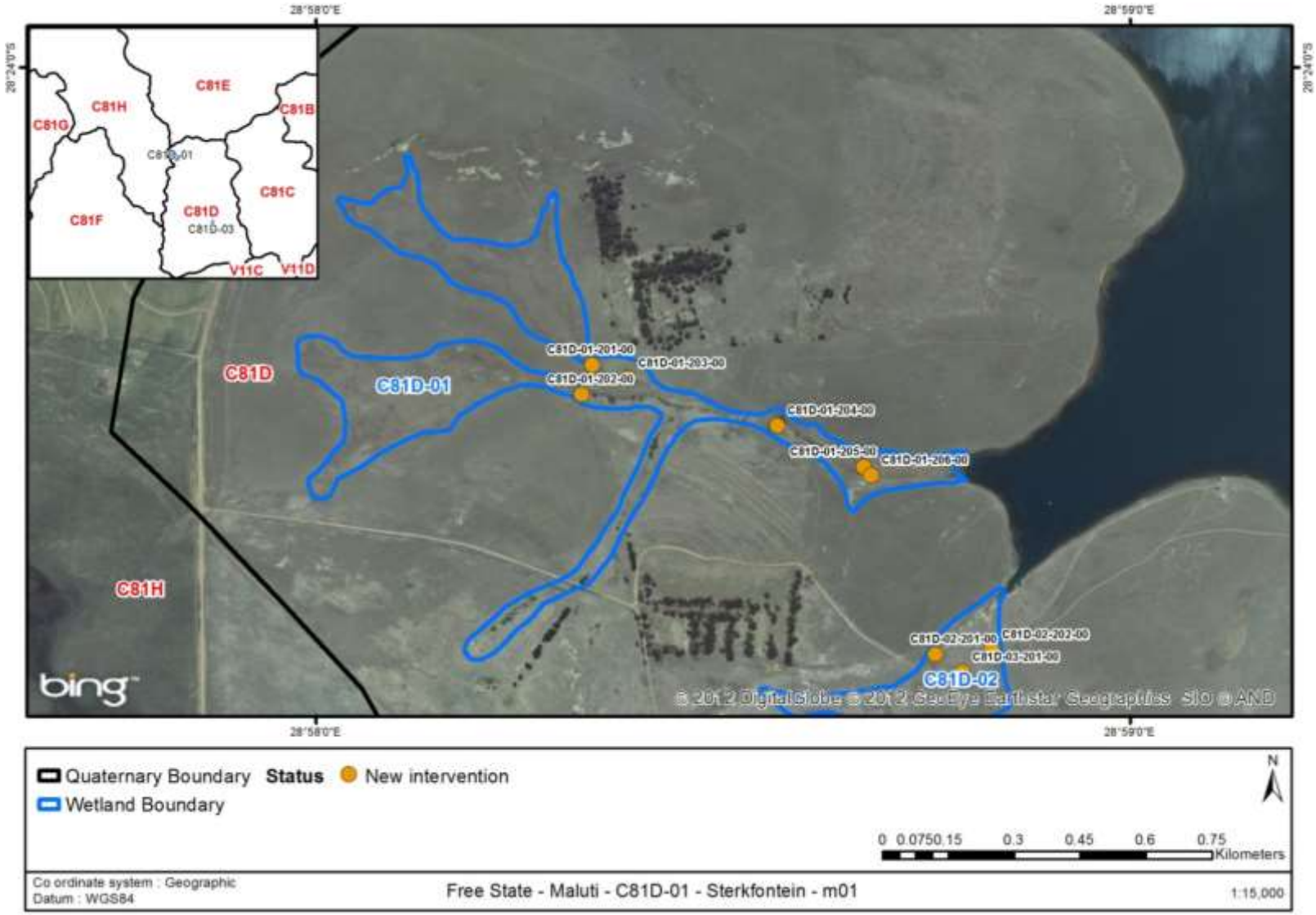

Figure 6: Wetland map, C81D-01 with proposed new wetland interventions indicated.

4.7 Intervention designs ("Escol 1")

4.7.1 Intervention: C81D-01-201-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Earthworks, Sloping 1:4 and MAC-MAT-R
Rehabilitation Objective	Deactivate small head cut
Latitude (DºM'S")	28°24'21.89 S"
Longitude (DºM'S")	28°58'20.34 E"
Engineering Drawings	C81D-01-201-00

Figure 7: Intervention site C81D-01-201-00 looking upstream.

4.7.1.1 Bill of quantities: C81D-01-201-00

Item	Units	Quantity	Unit Cost	Item Cost
Mac-Mat-R	m^2	108.00	R 250.00	R 27,000.00
Earthworks	m^3	2.63	R 525.00	R 1,378.13
Re-vegetation	m^2	108.00	R 45.00	R 4,860.00
			Total	**R 33 238.13**

4.7.1.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings. The following is guidance for working within an area with soils with high organic matter content.

4.7.2 Intervention: C81D-01-202-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Gabion drop inlet structure and Earth berms
Rehabilitation Objective	Deactivate head cut
Latitude (DºM'S")	28°24'24.07 S"
Longitude (DºM'S")	28°58'19.57 E"
Engineering Drawings	C81D-01-202-00

Figure 8: Intervention site C81D-01-202-00 looking upstream

4.7.2.1 Bill of quantities: C81D-01-202-00

Item	Units	Quantity	Unit Cost	Item Cost
Gabions	m^3	110.00	R 4 450.03	R 489 502.86
Concrete Capping	m^3	4.20	R 6 526.29	R 27 410.42
Revegetation	m^2	LS		R 5 000.00
			Total	**R 521 913.28**

4.7.2.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings

4.7.3 Intervention: C81D-01-203-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Earthworks, Sloping 1:4 and MAC-MAT-R
Rehabilitation Objective	Deactivate medium head cut
Latitude (DºM'S")	28°24'22.90 S"
Longitude (DºM'S")	28°58'23.02 E"
Engineering Drawings	C81D-01-203-00

Figure 9: Earthen diversion berm, C81D-01-203-00 looking upstream.

4.7.3.1 Bill of quantities: C81D-01-203-00

Item	Units	Quantity	Unit Cost	Item Cost
Mac-Mat-R	m^2	104.50	R 250.00	R 26,125.00
Earthworks	m^3	8.00	R 525.00	R 4,200.00
Re-vegetation	m^2	104.50	R 45.00	R 4,702.50
			Total	**R 35,027.50**

4.7.3.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings

4.7.4 Intervention: C81D-01-204-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Gabion drop inlet structure
Rehabilitation Objective	Deactivate large Head cut
Latitude (DºM'S")	28°24'26.38 S"
Longitude (DºM'S")	28°58'34.00 E"
Engineering Drawings	C81D-01-204-00

Figure 10: Intervention site C81D-01-204-00 looking upstream.

4.7.4.1 Bill of quantities: C81D-01-204-00

Item	Units	Quantity	Unit Cost	Item Cost
Gabions	m^3	151.80	R 4 450.03	R 675 513.95
Concrete Capping	m^3	6.75	R 6 526.29	R 44 052.46
Earthworks	m^3	145.00	R 525.00	R 76 125.00
Revegetation	m^2	LS		R 5 000.00
			Total	**R 800 691.40**

4.7.4.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings

4.7.5 Intervention: C81D-01-205-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Concrete Weir
Rehabilitation Objective	To raise the water level in the channel and activate adjacent wetland areas
Latitude (DºM'S")	28°24'29.42 S"
Longitude (DºM'S")	28°58'40.39 E"
Engineering Drawings	C81D-01-205-00

Figure 11: Concrete weir, C81D-01-205-00 looking upstream.

4.7.5.1 Bill of quantities: C81D-01-205-00

Item	Units	Quantity	Unit Cost	Item Cost
Concrete	m^3	31.50	R 5 883.63	R 185 334.44
Revegetation	m^2	LS		R 5 000.00
			Total	**R 190 334.44**

4.7.5.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings

4.7.6 Intervention: C81D-01-206-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Concrete Weir
Rehabilitation Objective	To raise the water level in the channel and activate adjacent wetland areas
Latitude (DºM'S")	28°24'30.06 S"
Longitude (DºM'S")	28°58'40.93 E"
Engineering Drawings	**C81D-01-206-00**

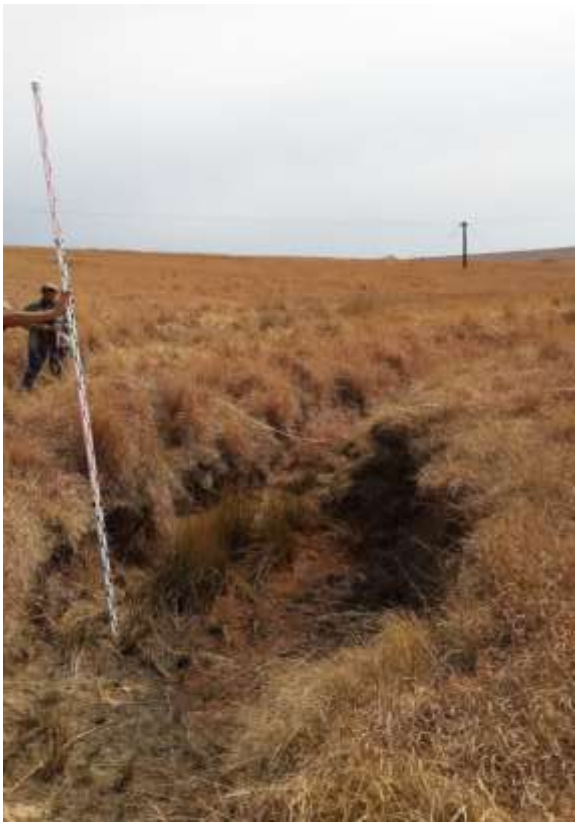

Figure 12: Concrete weir C81D-01-206-00 looking upstream

4.7.6.1 Bill of quantities: C81D-01-206-00

Item	Units	Quantity	Unit Cost	Item Cost
Concrete Weir	m^3	29.20	R 5 883.63	R 171 802.08

Item	Units	Quantity	Unit Cost	Item Cost
Revegetation	m^2	LS		R 5 000.00
			Total	**R 176 802.08**

4.7.6.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings

4.8 Construction Environmental Management Plan issues

The proposed rehabilitation is to be undertaken in a provincial nature reserve. The project team should access and manage the site in accordance with the relevant reserve management guidelines as well the WfWet best management practices. The implementation of these interventions must also take into account all relevant provisions of Working for Wetlands Best Management Practices and Construction Environmental Management Plan, the recommendations of the Basic Assessments submitted for Environmental Authorisation and the requirements of the Environmental Authorisation Record of Decision for the project.

The general construction notes, the Construction phase EMP (CEMP) are included as **Appendix B and F**.

4.9 Wetland management recommendations

The system is currently protected within the Sterkfontein Nature Reserve. Rehabilitation planned for the wetland is unlikely to affect current management practices and land use within the Reserve. Should recovery within the lower wetland area (where concrete weirs are planned) lead to very wet and boggy conditions, wildlife access to this area may need to be restricted though appropriate fencing of the wetland in this area.

4.10 Baseline M&E data

The collection of baseline information (baseline WET-Health and WET-Ecoservices assessments) was carried out to show changes in the system associated with the wetland rehabilitation activities. Note that baseline vegetation monitoring plots were not sampled for this wetland as interventions proposed are aimed mainly at preventing further wetland degradation rather than reinstating wetland habitat.

4.10.1 Fixed point photography

Please refer to Annexure 1 of the attached Wetland Status Quo Reports.

4.10.2 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 3 years after completion of the wetland rehabilitation activities.

The catchment of the "Escol 1" wetland (C81D-01) located in Sterkfontein Nature Reserve is largely intact with only minor impacts to catchment hydrology. The dominant impact affecting the wetland relates to extensive erosion in the middle-lower wetland which has resulted in large gullies that have affected wetland hydrology and geomorphology by channelling flows and actively removing sediment from the wetland. Vegetation condition has also been affected by erosion to a small-moderate extent. The overall level of impact of erosion is currently limited to a relatively small section of the wetland which is reflected in the assessment, with the wetland attaining an overall **"C" Category** or ***moderately modified*** rating (**Table 13**, below). The threat of headward erosion suggests that wetland condition is likely to deteriorate in the absence of mitigation (rehabilitation).

Table 13: Summary of present wetland health based on the Wet-Health assessment for wetland C81D-01

Wetland No	Ha	Hydrology		Geomorphology		Vegetation	
		Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
C81D-01	24	3.0	-1	1.8	-1	2.5	-1
PES Categories		**C**	↓	**B**	↓	**C**	↓
Wetland Impact Score		**2.52**					
Wetland PES		**C**					

5 Escol 2–C81D-02

5.1 Wetland details

The Escol 2 wetland is located in quaternary catchment C81D within the Sterkfontein Nature Reserve (protected area) near the towns of Harrismith and Phuthaditjhaba in the Free State Province. The assessment of the wetland, its problems, and the development of the rehabilitation objectives are described in detail in **Appendix A**: Wetland Status Quo Reports. The following sections provide a brief summary for this wetland. Please also refer to the table below.

Table 14: Summary of the wetland details

Wetland Name	**Escol 2**
Wetland Number	C81D-02
GPS Location	28°24'47.71"S/ 28°58'44.97"E
River System Name	Nuwejaarspruit
Land Use in Catchment	Nature Reserve, small residential dwellings
Land Use in Wetland	Nature Reserve, grazing
No. of Properties Intersecting Wetland Area	1
Date of Planning Site Visit	11 September 2013
Wetland Assessor(s)	Adam Teixeira-Leite
Wetland Size	11.6 ha

5.1.1 Motivation for selection

This wetland was prioritised during Phase 1 planning. The proposed rehabilitation interventions are aimed at preventing further erosion within the wetland and will have the effect of securing the current level of ecological integrity of the broader wetland system and the supply of goods and services provided by the wetland.

5.1.2 Description

The Escol 2 wetland (C81D-02) is one of two wetlands on the farm Escol, located within the Sterkfontein dam Provincial Nature Reserve. The wetland is a small sized (~12 ha) naturally unchannelled valley bottom wetland system located on the north western edge of Sterkfontein dam, immediately south of the Escol 1 wetland (C81D-01). It occurs in an undulating landscape of relatively low-moderate topographic relief at the head of the valley, immediately upstream and adjacent to Sterkfontein dam. The local climate is characterized by a low mean annual precipitation of 735.8mm and a much higher mean annual potential evapotranspiration of 1797.7mm. This gives a MAP to PET ratio of 0.41 (vulnerability index of 1.), which means that the wetland has a relatively high sensitivity to hydrological impacts (i.e. *changes in water input volumes and patterns).*

The control on the formation and dynamics of the system is naturally linked to local topography and the shallow underlying sandstone geology, with shallow and dispersive soils being particularly prone to soil erosion. The shallow geology which outcrops on the relatively steep hillslopes has formed seepage areas where the water table is close to the surface and exits the hillslopes forming wetland areas. In its natural state, the wetland would have been an unchannelled valley bottom system fed mainly by hillslope seepage from the adjacent hillslopes with limited input from surface runoff. Lateral sub-surface seepage is clearly an important hydrological input for this wetland system. The local base level has been artificially altered as a result of the creation of Sterkfontein dam (back-flooding of the valley by the dam has effectively set a new base level at an elevated topographic position).

A combination of dispersive soils activated by the water from the flooded dam and informal vehicle tracks crossing the lower half of the wetland is believed to have exacerbated soil erosion towards the toe of the system. This has resulted in the formation of large erosion gullies extending from the edge of Sterkfontein dam west towards the informal tracks. These gullies are large, exceeding 3m depth and are 6-10m wide in places, with most of the eroded sediment having been exported from the wetland and into the open water dam downstream. Where gulley sides are steep, these are largely un-vegetated and show signs of active undercutting leading to incision/widening of the gulley. Headcuts appear to be progressing slowly up the valley and there is a definite risk that these will pose a threat to the integrity and functioning of the more intact wetland habitat to the south-west (upslope). Within the more intact wetland to the west of the dirt track, a headcut has become stabilised by vegetation growth and natural subsurface soil pipe formation is evident. Hillslope seeps are common on the adjacent hillsides, some of which have been trampled by animals using the wetland, exposing the saturated soils.

The majority of the wetland appears to be seasonal in nature and vegetated with a form of montane grassland that features range of indigenous species of grasses. The upper section of the wetland (above the eroded zone) is largely undisturbed and naturally vegetated with grasses including *Aristida spp, Eragrostis plana* (Tough love grass), *Hyparrhenia hirta* (Common thatching grass), *Agrostis lachnantha* (Bent grass), *Themeda triandra* (Red grass) and *Tristachya leucothrix* (Hairy trident grass). Wetland habitat diversity is generally considered to be low. The toe of the wetland has been heavily eroded (gulley formation), with the gulley sides and floor being poorly vegetated.

5.1.3 Rehabilitation

The main aims of the rehabilitation work in the Escol 2 wetland would be to deactivate headcuts and secure intact wetland habitat in the upper wetland and to prevent further erosion caused by vehicles traversing the wetland via existing dirt tracks while facilitating their crossing the wetland system.

5.2 Site photos

View E, stable vegetated gulley in western section of the wetland

View S, hillslope seepage in wetland, trampled by animals

View N, large erosion gulley in lower wetland near the dam edge

View W, looking towards the head of the erosion gulley in the west

Figure 13: Site Photos of the Escol 2 wetland

5.3 Wetland problems

The main impacts to this wetland unit are associated with extensive gulley erosion in the lower section of the wetland which has significantly affected water distribution and retention patterns. A number of headcuts also pose a threat to the integrity of more intact upstream

habitat should these continue to progress up the valley. Other less significant but noticeable impacts include:

- Effect of dirt roads crossing the wetland on habitat and water movement; and
- Eroded seepage zones which have been trampled by wildlife.

5.4 Rehabilitation objectives

Details of the current rehabilitation objectives, together with the planned strategy for achieving these objectives are summarized in **Table 15** below:

Table 15: Summary of rehabilitation objectives and strategies for wetland C81D-02

Rehabilitation objective	Rehabilitation strategy
To deactivate headcuts and secure intact wetland habitat in the upper wetland.	To use appropriate interventions to de-activate headward erosion.
To prevent further erosion caused by vehicles traversing the wetland via existing dirt tracks and to facilitate their crossing the wetland	To install concrete road strips across the existing dirt track across the length of wetland traversed

5.5 Summary of proposed interventions

The new interventions that are proposed (**Table 16**) are discussed in detail in the subsequent sections of this report. **Table 16** provides a summary of the new interventions. The “implementation order” as depicted in the table indicates the timing order in which interventions should be implemented within the wetland (number 1 first). The “priority” as depicted in the table indicates the relative importance of each intervention across the project as a whole – if interventions have to be omitted for any reason, those with the lowest priority (highest number) across the whole project should be omitted first. Please note that the location of the interventions described in Section 5.7 may change as a result of changes in the landscape (due to continued erosion, for example) during the time period that has lapsed between the initial planning site visit and the actual implementation thereof.

Table 16: Summary of proposed new interventions, C81D-02

Intervention No.	Structure Type	Priority	Cost Estimate (R)
C81D-02-201-00	Gabion drop inlet	1	R 481 299.66
C81D-02-202-00	Earth berm	1	R 148 893.75
C81D-02-203-00	Concrete strips	2	R 168 000.00
		Total Estimated Cost	**R 770 351.4**

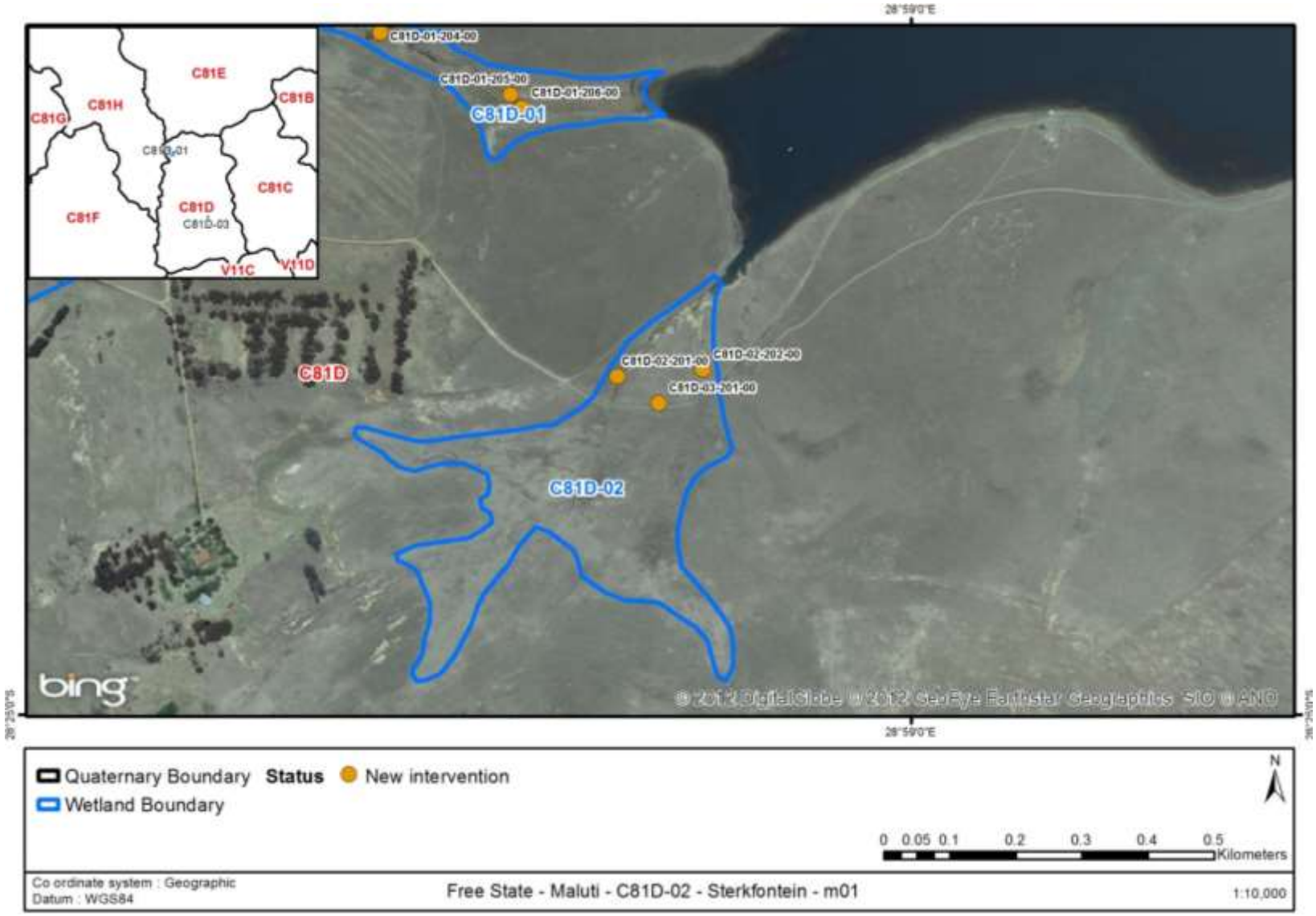

Figure 14: Wetland map, C81D-02 with proposed new wetland interventions indicated.

5.6 Design selection and sizing (Escol 2) C81D-02

The objectives of the interventions are to prevent further headcut erosion, ensure diffuse flow into wetland areas to increase the water table level, rehydrate wet soils and promote and increase in hydrophytic vegetation. The most appropriate and cost effective method of doing this was considered to involve:

- The construction of a hard structure (concrete or gabion weir) in the main drain with the spillway set at a level that would allow for the back flooding.
- Constructing a combination of concrete, gabion and earthen diversion structures that would divert flows out of the main drain and into the wetland. Earthen diversions were specified in areas of low energy and will be vegetated to increase their stability. Concrete and gabion diversion structures were specified where higher energy is expected.
- Labour-day component and the availability of material were the most influencing factors taken into consideration.

5.7 Intervention designs ("Escol 2")

5.7.1 Intervention: C81D-02-201-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Gabion drop inlet
Rehabilitation Objective	Deactivate large Head cut
Latitude (DºM'S")	28°24'43.25 S"
Longitude (DºM'S")	28°58'45.63 E"
Engineering Drawings	C81D-02-201-00

Figure 15: Intervention site C81D-02-201-00 looking upstream from the left bank.

5.7.1.1 Bill of quantities: C81D-02-201-00

Item	Units	Quantity	Unit Cost	Item Cost
Gabions	m^3	101.90	R 4 450.03	R 453 457.65
Concrete Capping	m^3	3.50	R 6 526.29	R 22 842.02
Revegetation	m^2	LS		R 5 000.00
			Total	**R 481 299.66**

5.7.1.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

5.7.2 Intervention: C81D-02-202-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Earth berm to divert water away from the head cut
Rehabilitation Objective	Deactivate large Head cut
Latitude (DºM'S")	28°24'42.93 S"
Longitude (DºM'S")	28°58'49.83 E"
Engineering Drawings	C81D-02-202-00

Figure 16: Intervention site C81D-02-202-00 looking upstream from the left bank.

5.7.2.1 Bill of quantities: C81D-02-202-00

Item	Units	Quantity	Unit Cost	Item Cost
Earth structure	m^3	131.25	R 903.00	R 118 518.75
Revegetation	m^2	675.00	R 45.00	R 30 375.00
			Total	**R 148 893.75**

5.7.2.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

5.7.3 Intervention: C81D-02-203-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Concrete strips
Rehabilitation Objective	Stabilise erosion and facilitate vehicles crossing wetland
Latitude (DºM'S")	28°24'44.49 S"
Longitude (DºM'S")	28°58'47.66 E"
Engineering Drawings	Aurecon Standard Details: Road Strips

5.7.3.1 Bill of quantities: C81D-02-203-00

Item	Units	Quantity	Unit Cost	Item Cost
Concrete Strips	m^3	48.00	R 3 500.00	R 168 000.00
Revegetation	m^2	280.00	R 45.00	R 12 600.00
			Total	**R 180 600.00**

5.7.3.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

5.8 Construction Environmental Management Plan issues

The proposed rehabilitation is to be undertaken in a provincial nature reserve. The project team should access and manage the site in accordance with the relevant reserve management guidelines as well the WfWet best management practices. The implementation of these interventions must also take into account all relevant provisions of Working for Wetlands Best Management Practices and Construction Environmental Management Plan, the recommendations of the Basic Assessments submitted for Environmental Authorisation and the requirements of the Environmental Authorisation Record of Decision for the project.

The general construction notes, the Construction phase EMP (CEMP) are included as **Appendix B and F**.

5.9 Wetland management recommendations

The system is currently protected within the Sterkfontein Nature Reserve. Rehabilitation planned for the wetland is unlikely to affect current management practices and land use within the Reserve

5.10 Baseline M&E data

The collection of baseline information (baseline WET-Health and WET-Ecoservices assessments) was carried out to show changes in the system associated with the wetland rehabilitation activities. Note that baseline vegetation monitoring plots were not sampled for this wetland as interventions proposed are aimed mainly at preventing further wetland degradation rather than reinstating wetland habitat.

5.10.1 Fixed point photography

Please refer to Annexure 2 of the Wetland Status Quo Report (Appendix A of this rehabilitation plan).

5.10.2 Baseline WET-Health data

The catchment of the “Escol 2” wetland (C81D-02) located in Sterkfontein Nature Reserve is largely intact with only minor impacts to catchment hydrology. The dominant impact affecting the wetland is a large gully in the lower reaches of the wetland that has affected wetland hydrology and geomorphology by channelling flows and actively removing sediment from the wetland. Vegetation has also been affected by erosion to a small extent. The overall level of impact of erosion is limited due to the limited extent of erosion features at present which is reflected in the assessment, with the wetland attaining an overall **“B” Category** or ***largely natural*** rating (**Table 17**, below). The threat of headward erosion suggests that the status quo could be threatened in the absence of mitigation (rehabilitation), with an overall deterioration in wetland integrity and functioning expected in the short term (next 5 years).

Table 17: Summary of present wetland health based on the Wet-Health assessment for wetland C81D-02

Wetland No	Ha	Hydrology		Geomorphology		Vegetation	
		Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
C81D-02	12	2.0	-2	0.9	-1	1.6	-1
PES Categories		**B/C**	↓↓	**A/B**	↓	**B**	↓
Wetland Impact Score		**1.59**					
Wetland PES		**B**					

6 Sterkfontein –C81D-03

6.1 Wetland details

The Sterkfontein wetland is located in quaternary catchment C81D near the towns of Harrismith and Phuthaditjhaba in the Free State Province. The assessment of the wetland, its problems, and the development of the rehabilitation objectives are described in detail in **Appendix A**: Wetland Status Quo Reports. The following sections provide a brief summary for this wetland. Please also refer to **Table18**.

Table 18: Summary of the wetland details

Wetland Name	Sterkfontein 1
Wetland Number	C81D-03
GPS Location	28°30'20.75"S/ 29°01'33.27"E
River System Name	Nuwejaarspruit
Land Use in Catchment	Nature Reserve
Land Use in Wetland	Nature Reserve, grazing
No. of Properties Intersecting Wetland Area	1
Date of Planning Site Visit	11 September 2013
Wetland Assessor(s)	Adam Teixeira-Leite (Eco-Pulse Consulting)
Wetland Size	15.8 ha

6.1.1 Motivation for selection

This wetland was prioritised during Phase 1 planning. The proposed rehabilitation interventions are aimed at preventing further erosion within the wetland and will have the effect of securing the current level of ecological integrity of the broader wetland system and the supply of goods and services provided by the wetland.

6.1.2 Description

The “Sterkfontein 1” wetland (C81D-03) is located within the Sterkfontein dam Provincial Nature Reserve. The wetland is a small sized (~16 ha) naturally unchannelled valley bottom wetland system located on the southern edge of Sterkfontein dam. It occurs within a relatively steeply sloping, small V-shaped valley where the valley sides confine the extent of the wetland to a large degree. The local climate is characterized by a low mean annual precipitation of 735.8mm and a much higher mean annual potential evapotranspiration of 1797.7mm. This gives a MAP to PET ratio of 0.41 (vulnerability index of 1.), which means that the wetland has a relatively high sensitivity to hydrological impacts (i.e. changes in water input volumes and patterns).

The control on the formation and dynamics of the system is linked to local topography, the shallow underlying sandstone geology and the artificially created local base level as a result of flooding by the Sterkfontein dam. Water inputs into the wetland are primarily via adjacent hillslope seepage areas fed by groundwater which suggests that lateral sub-surface seepage is an important hydrological input for this system.

A combination of dispersive soils, water erosion at the edge of the flooded dam zone, steep valley gradients and catchment impacts/informal dirt road crossings has caused enhanced soil erosion in the lower half of the wetland which has resulted in the formation of a single, deep gully along the centre of the valley. This gulley varies from being 2-3m in depth and exceeds 6-8m width in places. The gully has eroded down to the underlying sandstone bedrock and a large proportion of the eroded sediment from the system has been exported downstream. The gulley side walls appear relatively stable and vegetated in areas where side walls are not too steep. Where gulley sides are steep, these are largely unvegetated and show signs of undercutting. An active headcut is present at the top of the gulley and there is a high risk that this headcut will proceed quite rapidly upstream, posing an immediate threat to the integrity and functioning of the remaining natural habitat at the head of the wetland system.

Soils within the upper intact wetland zone appear very wet (show signs of permanent saturation) within the centre of the valley, with the peripheral areas being seasonally activated and vegetated with a form of montane grassland that features range of indigenous species of grasses. Although much of the lower half of the wetland has been eroded, a section of wetland habitat in the south at the head of the valley remains largely undisturbed and naturally vegetated with grasses including *Aristida spp, Eragrostis spp., Hyparrhenia hirta* (Common thatching grass), *Agrostis lachnantha* (Bent grass), *Themeda triandra* (Red grass) and *Tristachya leucothrix* (Hairy trident grass). The wetter sections in the centre of the valley are vegetated with water-loving rushes such as *Juncus oxycarpus* and *Juncus punctorius*. Wetland habitat diversity is generally considered to be quite low.

6.1.3 Rehabilitation

The aim of rehabilitation in this wetland would be to deactivate the large active headcuts in order to secure intact wetland habitat in the upper wetland.

6.2 Site photos

View N, looking downslope over the wetland with Sterkfontein dam in the background

View S, looking downstream over the erosion gulley that proceeds south towards the dam

View SE, looking upslope towards the natural seepage zone on the southern hilllslope

View SSE, looking upslope over the intact wetland habitat at the top of the system

Figure 17: Site Photos of the Sterkfontein 1 wetland

6.3 Wetland problems

The main impact to this wetland unit is associated with extensive gulley erosion in the lower section of the wetland which has significantly affected water distribution and retention patterns. An active headcut is present at the top of the central erosion gulley and poses a significant threat to the integrity of remaining intact upstream habitat. Other less significant but noticeable impacts include:

- Effect of dirt roads crossing the wetland on habitat and water movement.

6.4 Rehabilitation objectives

Details of the current rehabilitation objectives, together with the planned strategy for achieving these objectives are summarized in **Table 19** below:

Table 19: Summary of rehabilitation objectives and strategies for wetland C81D-03

Rehabilitation objective	Rehabilitation strategy
To deactivate headcuts and secure intact wetland habitat in the upper wetland.	To construct a suitable structure in order to prevent headcut advancement.

6.5 Summary of proposed interventions

The new interventions that are proposed are discussed in detail in the subsequent sections of this report. **Table 20** provides a summary of the new interventions. The "implementation order" as depicted in the table indicates the timing order in which interventions should be implemented within the wetland (number 1 first). The "priority" as depicted in the table indicates the relative importance of each intervention across the project as a whole – if interventions have to be omitted for any reason, those with the lowest priority (highest number) across the whole project should be omitted first.

Please note that the location of the interventions described in Section 6.7 may change as a result of changes in the landscape (due to continued erosion, for example) during the time period that has lapsed between the initial planning site visit and the actual implementation thereof.

Table 20: Summary of proposed new interventions, C81D-03

Intervention No.	Structure Type	Priority	Cost Estimate (R)
C81D-03-201-00	Gabion drop inlet	1	R 572 465.08
		Total Estimated Cost	**R 572 465.08**

6.6 Design selection and sizing

The objectives of the interventions are to prevent further headcut erosion, ensure diffuse flow into wetland areas to increase the water table level, rehydrate wet soils and promote and increase in hydrophytic vegetation. The most appropriate and cost effective method of doing this was considered to involve:

- The construction of a hard structure (concrete or gabion weir) in the main drain with the spillway set at a level that would allow for the back flooding.
- Constructing a combination of concrete, gabion and earthen diversion structures that would divert flows out of the main drain and into the wetland. Earthen diversions were specified in areas of low energy and will be vegetated to increase their stability. Concrete and gabion diversion structures were specified where higher energy is expected.
- Labour-day component and the availability of material were the most influencing factors taken into consideration.

- The aesthetic/ visual impacts of the proposed interventions should be kept to an absolute minimum. This could be obtained by introducing colouring pigment in the concrete and “filleting” of visible sharp edges during concrete costing with shutters.

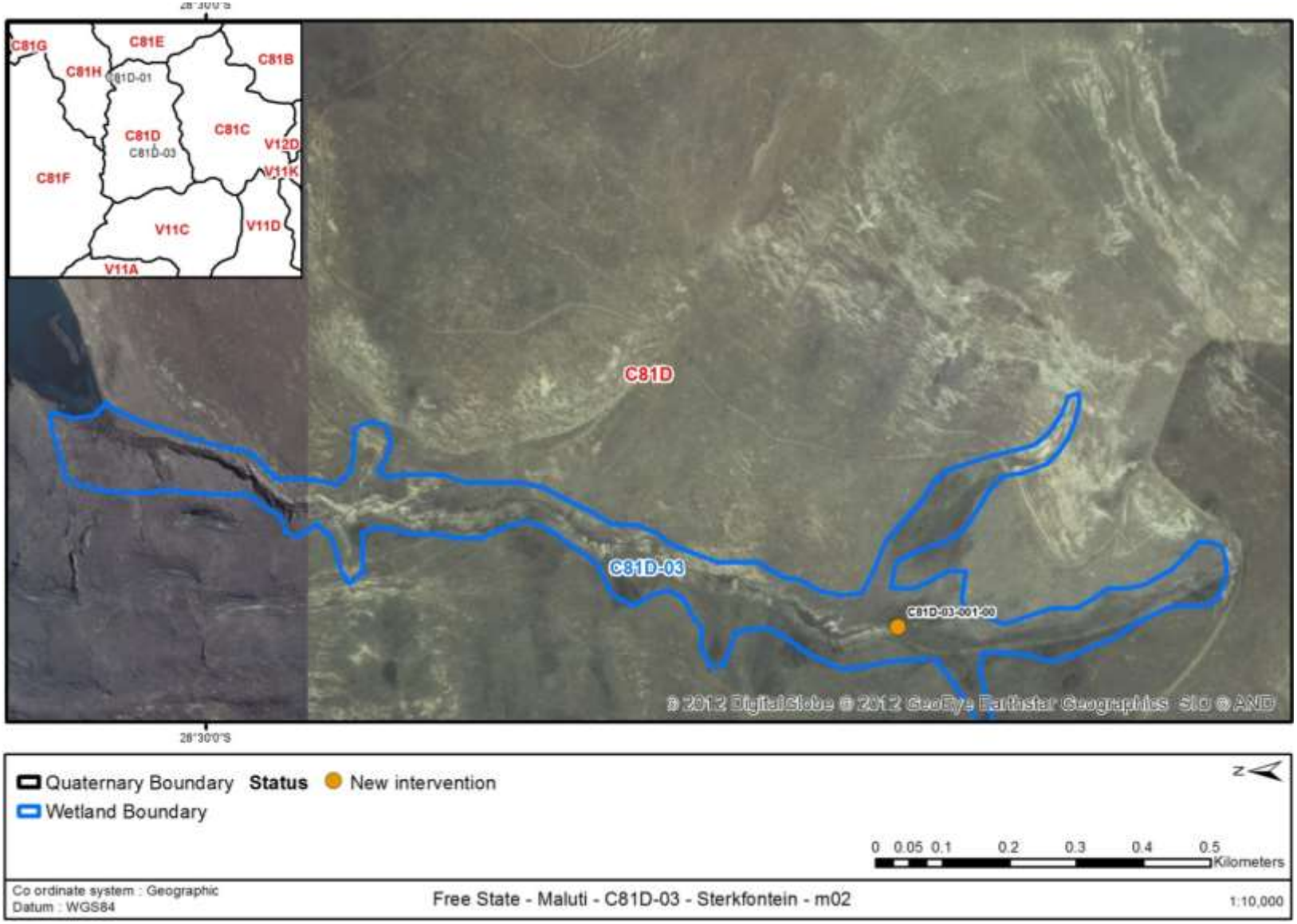

Figure 18: Wetland map, C81D-03 with proposed new wetland interventions indicated.

6.7 Intervention designs

6.7.1 Intervention: C81D-03-001-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Gabion drop inlet
Rehabilitation Objective	Medium Head Cut
Latitude (DºM'S")	28°30'33.43 S"
Longitude (DºM'S")	29°01'30.51 E"
Engineering Drawings	C81D-03-001-00

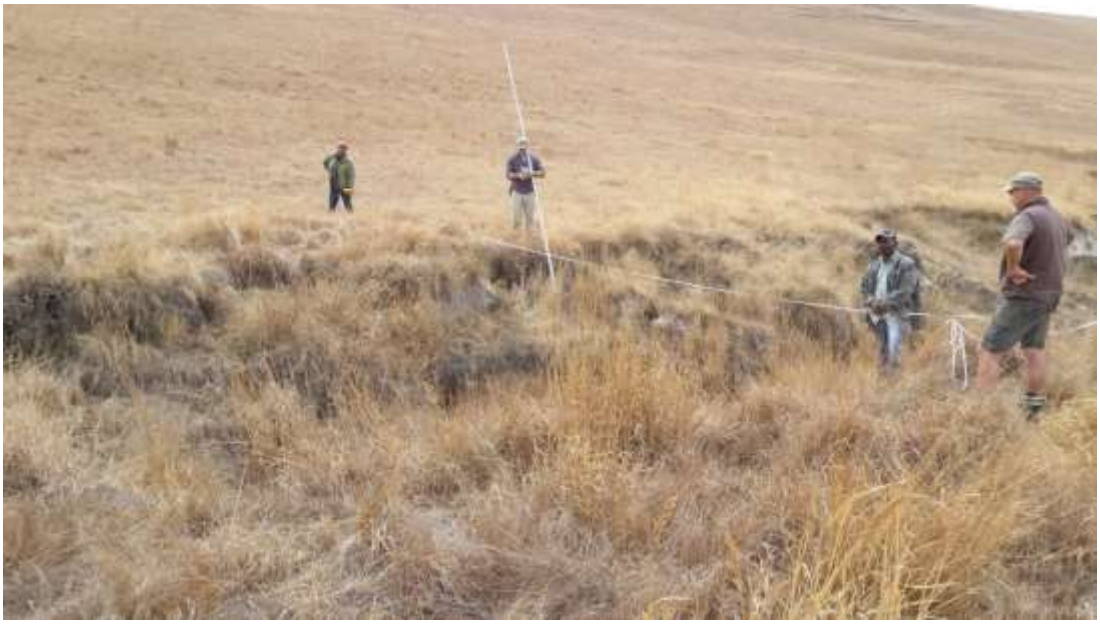

Figure 19: Intervention site C81D-03-001-00

6.7.1.1 Bill of quantities: C81D-03-001

Item	Units	Quantity	Unit Cost	Item Cost
Gabions	m^3	119.60	R 4 450.03	R 532 223.11
Concrete Capping	m^3	5.40	R 6 526.29	R 35 241.97
Revegetation	m^2	LS		R 5 000.00
			Total	**R 572 465.08**

6.7.1.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

6.8 Construction Environmental Management Plan issues

The proposed rehabilitation is to be undertaken in a provincial nature reserve. The project team should access and manage the site in accordance with the relevant reserve management guidelines as well the WfWet best management practices. The implementation of these interventions must also take into account all relevant provisions of Working for Wetlands Best Management Practices and Construction Environmental Management Plan, the recommendations of the Basic Assessments submitted for Environmental Authorisation and the requirements of the Environmental Authorisation Record of Decision for the project.

The general construction notes, the Construction phase EMP (CEMP) are included as **Appendix B and F**.

6.9 Wetland management recommendations

The system is currently protected within the Sterkfontein Nature Reserve. Rehabilitation planned for the wetland is unlikely to affect current management practices and land use within the Reserve.

6.10 Baseline M&E data

6.10.1 Fixed point photography

Please refer to Annexure 2 of the Wetland Status Quo Report (Appendix A of this rehabilitation plan)

6.10.2 Baseline WET-Health data

The wetland attains an overall **"C/D" Category"** reflecting ***moderately to largely modified*** conditions (**Table 21**). The dominant impact affecting the wetland relates to extensive erosion in the lower wetland which has resulted in a large gully that has affected wetland hydrology and geomorphology by channelling flows and actively removing sediment from the wetland. Vegetation has also been affected by erosion and subsequent desiccation. The threat of headward erosion suggests that the status quo could be threatened in the absence of mitigation (rehabilitation), with an overall deterioration in wetland integrity and functioning expected in the short term.

Table 21: Summary of present wetland health based on the Wet-Health assessment for wetland C81D-03

Wetland No	Ha	Hydrology		Geomorphology		Vegetation	
		Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
C81D-03	16	5.5	-1	2.4	-1	3.2	-1
PES Categories		**D**	↓	**C**	↓	**C**	↓
Wetland Impact Score		**3.97**					
Wetland PES		**C/D**					

7 Monontsha (Qwa Qwa) –C81F-02

7.1 Wetland details

The Monontsha wetland is situated within Phutaditjhaba in the C81F catchment. It has been considerably impacted on by human activities including extensive urban development. A summary of the wetland details is provided below (Table 26).

Table 22: Summary of the wetland details

Wetland Name	**Monontsha**
Wetland Number	C81F-02
GPS Location	28°33'25.45"S/ 28°44'48.77"E
River System Name	Tributary to Kgotjwane River
Land Use in Catchment	Agriculture, grazing, human settlement
Land Use in Wetland	Agriculture, grazing
No. of Properties Intersecting Wetland Area	1
Date of Planning Site Visit	12 September 2013
Wetland Assessor(s)	Adam Teixeira-Leite (Eco-Pulse Consulting)
Wetland Size	~214ha

7.1.1 Motivation for selection

This wetland was prioritised during Phase 1 planning. The proposed rehabilitation interventions are aimed at preventing further erosion within the wetland and will have the effect of securing the current level of ecological integrity of the broader wetland system and the supply of goods and services provided by the wetland. Rehabilitation has taken place in this wetland for a number of years and it was considered important to maintain and support this previous work.

7.1.2 Description

This is the largest HGM unit in the “Monontsha” wetland system, extending for approximately 5km up the length of the valley and covering an area of roughly 214 ha. The system is a narrow, historically unchannelled valley bottom wetland. The local climate is characterized by a low mean annual precipitation of 894.4mm and a much higher mean annual potential evapotranspiration of 1741.3mm. This gives a MAP to PET ratio of 0.51 (vulnerability index of 0.95), which means that the wetland is quite sensitive to hydrological impacts (i.e. *changes in water input volumes and patterns).*

The control on the formation and dynamics of the system is linked to local topography and the underlying geology. Water inputs into the wetland are primarily via surface runoff, with hillslope seepage areas providing a secondary input to a far lesser extent.

The wetland is supported by a fairly large catchment characterised by steep slopes with many areas being densely populated. Roads have been constructed across the wetland and channelization of river to facilitate road development and community use within the valley floor has occurred. Channels have eroded upstream linking with the excavated canals, forming deeply incised channels that proceed up the valley. Leaking sewers are also a concern in the area, with untreated sewage observed discharging into the wetland. A dense *Phragmites australis* reed bed is located in the central portion of the wetland where the valley is considerably wider than upstream. Agriculture has also modified a considerable portion of the wetland, which contains agricultural berms and which is heavily grazed by local livestock. The vegetation within the upper portion of wetland above the reedbed comprises short grazed grassland with the alien woody shrub *Sesbania punicea* scattered across the wetland.

7.1.3 Rehabilitation

The main aims of rehabilitation would be to support existing interventions within the incised channel in order to facilitate raising the water level in the channel and re-activating the adjacent wetland areas.

7.2 Site photos

View NE, incised channel looking downstream at site for proposed intervention (weir)

View SW, looking upslope over the broader floodplain that has been cultivated

View NW, looking upstream from proposed intervention on the main channel

View SE, looking downstream adjacent to the main channel at an area of the floodplain that has been burnt and extensively grazed by livestock

Figure 20: Site Photos of the Monontsha wetland

7.3 Wetland problems

The main impacts to this wetland unit are associated with channel incision, stream channel canalisation and cultivation. Land use change in the catchment (increase in hardened surfaces in the catchment as a result of agriculture and housing development) has led to a significant ant increase in the volume and velocity of storm flows reaching the wetland, which has resulted in the incision of channels and resultant sedimentation of wetland areas further downstream. Canalisation of channels is also evident in the HGM unit. Other less significant impacts include:

- Effect of roads and berms on wetland habitat and water movement;
- Impact of grazing livestock;
- Solid waste dumping/litter; and
- Leaking sewers adjacent to wetland areas.

7.4 Rehabilitation objectives

Details of the current rehabilitation objectives, together with the planned strategy for achieving these objectives are summarized in **Table 23** below:

Table 23: Summary of rehabilitation objectives and strategies for wetland C81F-02

Rehabilitation objective	Rehabilitation strategy
To support existing interventions within the incised channel in order to facilitate raising the water level in the channel and re-activating the adjacent wetland areas.	To implement appropriate structures within the incised channel to support existing rehabilitation interventions.

7.5 Summary of proposed interventions

The new interventions that are proposed are discussed in detail in the subsequent sections of this report. The table below (**Table 24**) provides a summary of the new interventions as well as those that need maintenance. The "implementation order" as depicted in the table indicates the timing order in which interventions should be implemented within the wetland (number 1 first). The "priority" as depicted in the table indicates the relative importance of each intervention across the project as a whole – if interventions have to be omitted for any reason, those with the lowest priority (highest number) across the whole project should be omitted first.

Table 24: Summary of interventions required, C81F-02

Intervention No.	Structure Type	Priority	Implementation order	Cost Estimate (R)
C81F-02-205-00	Concrete weir	2	3	412, 735.77
C81F-02-206-00	Concrete weir	2	2	243, 875.50
			Total:	**R674, 776.27**

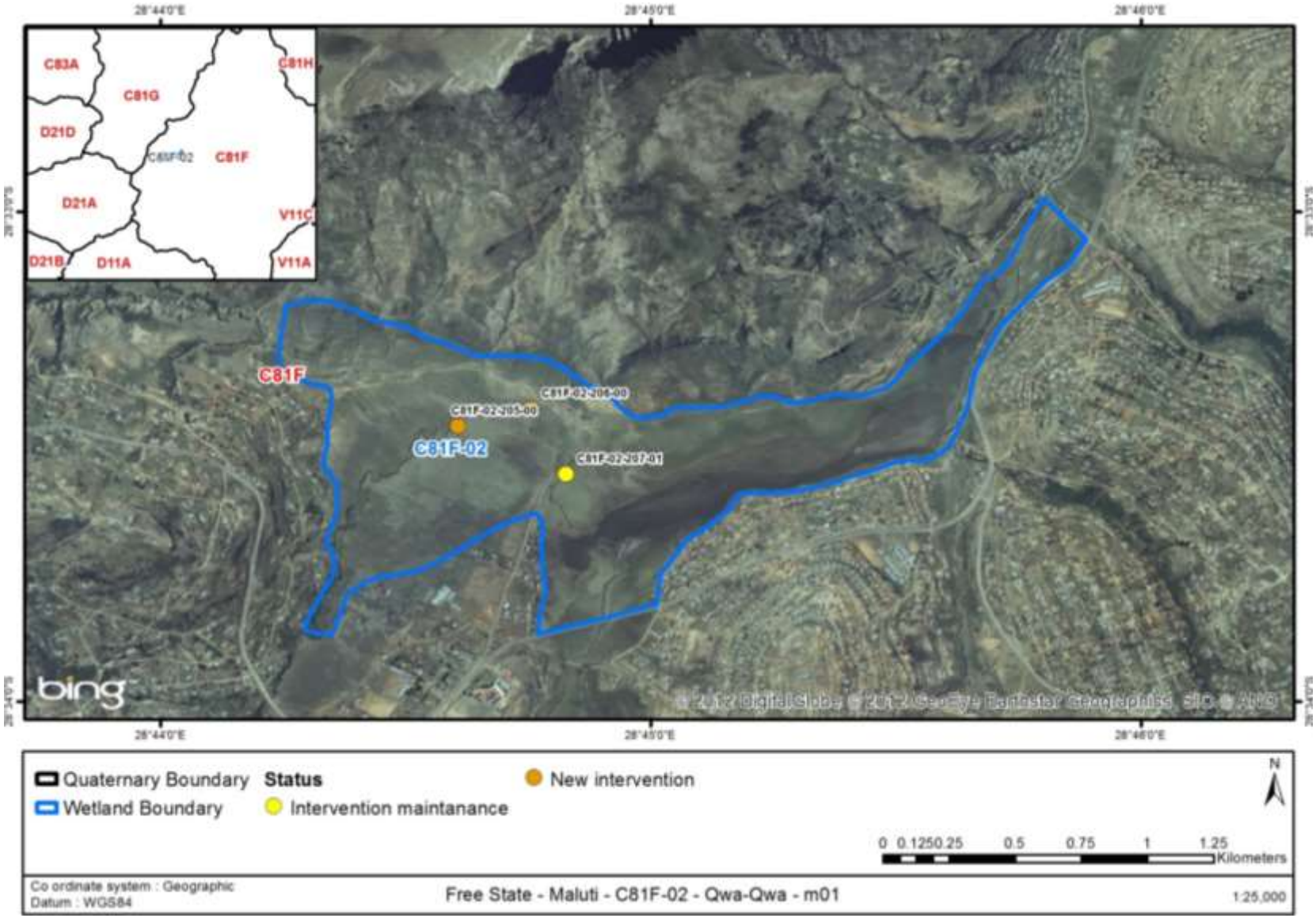

Figure 21: Wetland map, C81F-02 with proposed new wetland interventions indicated.

7.6 Design selection and sizing

The objectives of the interventions are to prevent further headcut erosion, ensure diffuse flow into wetland areas to increase the water table level, rehydrate wet soils and promote and increase in hydrophytic vegetation. The most appropriate and cost effective method of doing this was considered to involve:

- The construction of a hard structure (concrete or gabion weir) in the main drain with the spillway set at a level that would allow for the back flooding.
- Constructing a combination of concrete, gabion and earthen diversion structures that would divert flows out of the main drain and into the wetland. Earthen diversions were specified in areas of low energy and will be vegetated to increase their stability. Concrete and gabion diversion structures were specified where higher energy is expected.
- Labour-day component and the availability of material were the most influencing factors taken into consideration.
- The aesthetic/ visual impacts of the proposed interventions should be kept to an absolute minimum. This could be obtained by introducing colouring pigment in the concrete and “filleting” of visible sharp edges during concrete casting with shutters.

7.7 Maintenance designs

7.7.1 Intervention: C81F-02-205-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Concrete Weir
Rehabilitation Objective	To raise the water level in the channel and rewet adjacent wetland areas
Latitude (DºM'S")	28°33'26.21 S"
Longitude (DºM'S")	28°44'36.39 E"
Engineering Drawings	C81F-02-205-00

Figure 22: Intervention site C81F-02-205-00 looking down-stream from the right bank.

7.7.1.1 Bill of quantities: C81F-02-205-00

Item	Units	Quantity	Unit Cost	Item Cost
Concrete	m^3	69.30	R 5 883.63	R 407 735.77
Revegetation	m^2	LS		R 5 000.00
			Total	**R 412 735.77**

7.7.1.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

7.7.2 Intervention: C81F-02-206-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Concrete Weir
Rehabilitation Objective	To raise the water level in the incised channel, re-wet adjacent wetland areas and support upstream structures
Latitude (DºM'S")	28°33'24.05 S"
Longitude (DºM'S")	28°44'45.41 E"
Engineering Drawings	C81F-02-206-00

Figure 23: Intervention site C81F-02-206-00 looking upstream from the right bank.

7.7.2.1 Bill of quantities: C81F-02-206-00

Item	Units	Quantity	Unit Cost	Item Cost
Concrete	m^3	40.60	R 5 883.63	R 238 875.50
Revegetation	m^2	LS		R 5 000.00
			Total	**R 243 875.50**

7.7.2.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

7.7.3 Intervention: C81F-02-207-01

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Earth berm (Maintenance)
Rehabilitation Objective	Raise existing earth berm to prevent flows entering drain on left bank
Latitude (DºM'S")	28°33'32.09 S"
Longitude (DºM'S")	28°44'49.66 E"
Engineering Drawings	C81F-02-207-01

Figure 24: Intervention site C81F-02-207-01 looking upstream from the right bank.

7.7.3.1 Bill of quantities: C81F-02-207-01

Item	Units	Quantity	Unit Cost	Item Cost
Earth structure	m^3	17.50	R 903.00	R 15 802.50
Revegetation	m^2	52.50	R 45.00	R 2 362.50
			Total	**R 18 165.00**

7.7.3.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

7.8 Construction Environmental Management Plan issues

The proposed rehabilitation is to be undertaken on communally owned land and the project team should access the site and manage the site in accordance with the WfWet best management practices and specific requirements of the land users representatives. The implementation of these interventions must also take into account all relevant provisions of Working for Wetlands Best Management Practices and Construction Environmental Management Plan, the recommendations of the Basic Assessments submitted for Environmental Authorisation and the requirements of the Environmental Authorisation Record of Decision for the project.

The general construction notes, the Construction phase EMP (CEMP) are included as **Appendix B and F**.

7.9 Wetland management recommendations

The wetland vegetation is being heavily utilised by grazing livestock. The high animal numbers not only serve to reduce the vigour of the vegetation, but also destabilise the soil surface and the associated disturbance can leave the wetland vulnerable to colonisation by alien woody vegetation. Unless animal numbers are reduced, it is likely that habitat degradation will continue. Possibilities of fencing off more intact wetland vegetation (reed bed) are unlikely to be viable within this rural-communal area. The problem of leaking sewers discharging untreated human waste into the wetland downstream should ideally be addressed by the local municipality

7.10 Baseline M&E data

7.10.1 Fixed point photography

Please refer to Annexure 4 of the Wetland Status Quo Report (Appendix A of this rehabilitation plan)

7.10.2 Baseline WET-Health data

Wetland ecological status was not formally assessed for this wetland as a baseline wetland status quo analysis was undertaken in the past (2007) as part of previous wetland rehabilitation by Working for Wetlands. The focus of rehabilitation planning for this year (2013/14) was to inspect existing structures in the upper sections of the wetland and identify the need for any maintenance/upgrading of existing interventions or the need for additional structures to support existing interventions. The proposed rehabilitation for the wetland includes maintenance of existing structures, redesign of interventions that were planned in

the past but not implemented (for political reasons) and design of an additional supporting structure located between existing weirs already implemented. As such, the potential ecological gains from implementing proposed interventions are unlikely to contribute significantly from those previously recorded and were therefore not assessed.

8 Diatalawa – C81H-11

8.1 Wetland details

The “Diatalawa” wetland (C81H-11) is located in DWA quaternary catchment C81H, within an agricultural area situated midway between the towns of Harrismith and Kestell, approximately 33km west of Harrismith in the Free State Province. The assessment of the wetland, its problems, and the development of the rehabilitation objectives are described in detail in **Appendix A**: Wetland Status Quo Reports. The following sections provide a brief summary for this wetland. Please also refer to **Table 25**.

Table 25: Summary of the wetland details

Wetland Name	Diatalawa/Maanhaar
Wetland Number	C81H-11
GPS Location	28°19'17.75"S/ 28°54'06.58"E
River System Name	Tributary to Elands River
Land Use in Catchment	Agriculture, grazing, human settlement
Land Use in Wetland	Agriculture, grazing
No. of Properties Intersecting Wetland Area	1
Date of Planning Site Visit	12 September 2013
Wetland Assessor(s)	Adam Teixeira-Leite (Eco-Pulse Consulting)
Wetland Size	~54ha

8.1.1 Motivation for selection

The wetland was prioritised during Phase 1. The wetland has been notably altered by agricultural activities, with cultivation and the construction of small farm dams along the tributary river channels affecting flows into the downstream river and wetland to a small-moderate degree. The dominant impact however is associated with channel incision which has affected flow patterns and water distribution within the wetland itself. The resultant desiccating effect on adjacent wetland habitat has had a knock-on effect on wetland vegetation. The geomorphological integrity of the wetland is still predominantly intact, but has also been impacted as a result of channel incision. The threat of headward erosion of small headcuts and potential for further incision of channels suggests that the status quo could be threatened in the absence of mitigation (rehabilitation), with an overall slight deterioration in wetland integrity and functioning expected in the short term.

8.1.2 Description

The “Diatalawa” wetland (C81H-11) is a moderate sized (54 ha) channelled valley bottom wetland system located on a tributary river system to the east of the Elands River. The length of the wetland unit assessed is roughly 3.5km, measured along the thalweg of the valley, with the local elevation being between 1620 – 1660m a.m.s.l., giving an approximate wetland gradient of roughly 1%. The local climate is characterized by a low mean annual precipitation of 640.9mm and a much higher mean annual potential evapotranspiration of 1894.1mm. This gives a MAP to PET ratio of 0.3 (vulnerability index of 1.05), which means that the wetland has a high sensitivity to hydrological impacts (i.e. *changes in water input volumes and patterns).*

The wetland occurs within a relatively large, broad open valley with a relatively small-medium sized perennial river system running through it. The river flows in a north-westerly direction towards the larger Elands River. Towards the toe end of the wetland, the valley narrows and the longitudinal gradient becomes steeper. The wetland also narrows upstream towards the head of the system, which is fed by numerous smaller wetland arms. Water inputs into the wetland are primarily via surface runoff with limited groundwater input from adjacent low-lying hillslopes. Much of the water within the wetland is contained within the main channel which has become incised to a large extent as a result of land use alteration in the catchment and wetland unit. The wetland is probably seasonally flooded by overbank flows from the main channel but with some permanently inundated areas on the north side (right hand river bank) where the topography is flatter than on the southern side of the river.

Wetland habitat comprises short grazed grassland with *Juncus punctorius* and *Juncus oxycarpus* within some of the wetter seepage areas adjacent to the main river channel. Most of the grasses had been grazed down and were largely unidentifiable but are thought to comprise indigenous *Aristida spp, Eragrostis spp* and *Hyparrhenia*s *spp.* At the time of the assessment, there were also numerous occurrences of *Cirscium vulgare* (Scotch thistle – exotic species) growing in the drier wetland areas adjacent to the incised channel. The channel itself is vegetated with obligate wetland plant species including *Typha capensis* and *Phragmites australis,* with small stand of *Juncus punctorius* and *Juncus oxycarpus* as well. Wetland habitat diversity is generally considered to be moderate. The farm is fenced, with fence lines often traversing the wetland and the area is grazed by livestock with evidence of cattle trampling of seepage areas. The wetland comprises silty-loam mineral soils that are considered dispersive soils that are prone to erosion. A number of small headcuts are present within side channels of the river system that are actively eroding upstream.

8.1.3 Rehabilitation

Rehabilitation work by Working for Wetlands has been undertaken in this wetland in the recent past. The focus was on constructing a series of concrete weirs within a section of the incised channel to raise the water level as well as the shaping and stabilisation of erosion. Scope exists to continue with the rehabilitation of the incised channel upstream of existing rehabilitation interventions, to halt headcut progression and to stabilise additional erosion points. This will have the effect of securing and even improving the current level of ecological

integrity of the broader wetland system and the supply of goods and services provided by the wetland.

8.2 Site photos

View S, showing the trampled seepage zone

View N, slight depression in seasonal grassland

View SW, looking upstream showing the main channel with eroded outer bank

View E, showing trampling and erosion of a seepage zone

Figure 25: Site Photos of the Diatalawa Wetland

8.3 Wetland problems

The main impact to this wetland unit is associated with channel incision of the main river channel running through the wetland and the consequent impacts on wetland hydrology and vegetation condition in particular. Other less significant but noticeable impacts include:

- Threat of headward advance of small erosion headcuts;
- Erosion of river channel banks; and
- The effect of cattle grazing and trampling on wetland vegetation and soils.

8.4 Rehabilitation objectives

The following rehabilitation objectives have been identified:

Table 26: Summary of rehabilitation objectives and strategies for wetland C81H-11

Rehabilitation objective	Rehabilitation strategy
To raise the water level within incised channels and support existing interventions in the wetland, with the aim of stabilising erosion in the channels and facilitating the re-wetting of wetland areas adjacent to the main channel.	To use appropriate interventions to raise the water level in the main channel and encourage overtopping.
To secure intact wetland habitat in the lower wetland threatened by headcut advancement.	To use appropriate structures to deactivate headcuts.
To secure and stabilise eroded/trampled wetland areas and allow these areas to re-vegetate naturally.	To use a combination of re-shaping/vegetation, supporting structures such as ecologs and fencing to secure and stabilise eroded/trampled areas.

8.5 Summary of proposed interventions

The new interventions that are proposed are discussed in detail in the subsequent sections of this report. The table below (**Table 27)** provides a summary of the new interventions. The "implementation order" as depicted in the table indicates the timing order in which interventions should be implemented within the wetland (number 1 first). The "priority" as depicted in the table indicates the relative importance of each intervention across the project as a whole – if interventions have to be omitted for any reason, those with the lowest priority (highest number) across the whole project should be omitted first.

Table 27: Details of interventions planned in line with the rehabilitation strategy for the wetland C81H-11

Intervention No.	Structure Type	Priority	Implementation order	Cost Estimate (R)
C81H-11-201-00	Concrete weir	4	4	R 222 694.42
C81H-11-203-01	Fencing and ecologs	2	3	R 23 603.14
C81H-11-205-00	Concrete weir	4	5	R 269 763.49

Intervention No.	Structure Type	Priority	Implementation order	Cost Estimate (R)
C81H-11-206-00	Concrete weir	4	7	R 323 892.91
C81H-11-207-00	Earthworks: reshaping river bank	3	6	R 17 212.50
C81H-11-208-00	Fencing and ecologs	2	8	R 19 071.71
				R 876 238.17

8.6 Design selection and sizing

The objectives of the interventions are to prevent further headcut erosion, ensure diffuse flow into wetland areas to increase the water table level, rehydrate wet soils and promote and increase in hydrophytic vegetation. The most appropriate and cost effective method of doing this was considered to involve:

- The construction of a hard structure (concrete or gabion weir) in the main drain with the spillway set at a level that would allow for the back flooding.
- Constructing a combination of concrete, gabion and earthen diversion structures that would divert flows out of the main drain and into the wetland. Earthen diversions were specified in areas of low energy and will be vegetated to increase their stability. Concrete and gabion diversion structures were specified where higher energy is expected.
- Labour-day component and the availability of material were the most influencing factors taken into consideration.
- The aesthetic/ visual impacts of the proposed interventions should be kept to an absolute minimum. This could be obtained by introducing colouring pigment in the concrete and “filleting” of visible sharp edges during concrete costing with shutters.

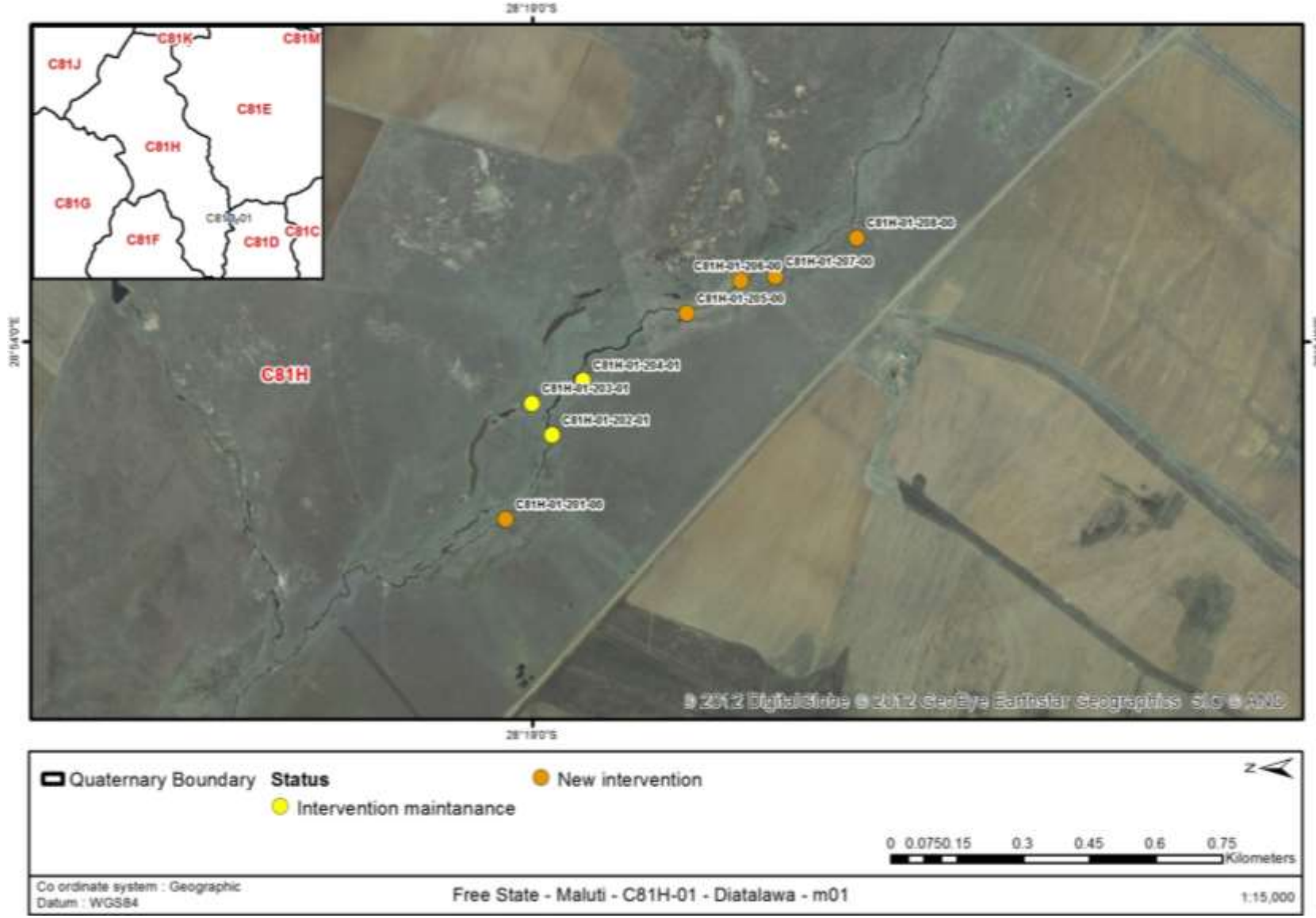

Figure 26: Wetland map, C81H-11 with proposed new wetland interventions indicated.

8.7 Maintenance designs (Diatalawa)

8.7.1 Intervention: C81H-11-202-01

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Maintenance
Rehabilitation Objective	Maintenance on existing concrete drop inlet weir
Latitude (DºM'S")	28°19'01.45 S"
Longitude (DºM'S")	28°53'53.18 E"
Engineering Drawings	C81H-11-202-01

Figure 27: Intervention site C81H-11-202-01

8.7.1.1 Bill of quantities: C81H-11-202-00

Item	Units	Quantity	Unit Cost	Item Cost
Earth Structure	m^3	6.00	R 903.00	R 5 418.00
Rock Packing	m^3	0.12	R 525.00	R 63.00
			Total	**R 5 481.00**

8.7.1.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

8.7.2 Intervention: C81H-11-203-01

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Fence and ecologs
Rehabilitation Objective	Fence off existing structure to prevent cattle trampling
Latitude (DºM'S")	28°18'59.96 S"
Longitude (DºM'S")	28°53'55.50 E"
Engineering Drawings	C81H-11-203-01

Figure 28: Intervention site C81H-11-203-01

8.7.2.1 Bill of quantities: C81H-11-203-01

Item	Units	Quantity	Unit Cost	Item Cost
Fencing	m	150.00	R 102.90	R 15,435.00
Ecologs	m^3	6.28	R 1,300.00	R 8,168.14
			Total	**R 23,603.14**

8.7.2.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

8.7.3 Intervention: C81H-11-204-01

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Maintenance
Rehabilitation Objective	Maintenance on concrete drop inlet weir
Latitude (DºM'S")	28°19'03.71 S"
Longitude (DºM'S")	28°53'57.19 E"
Engineering Drawings	C81H-11-204-01

Figure 29: Intervention site C81H-11-204-01.

8.7.3.1 Bill of quantities: C81H-11-204-01

Item	Units	Quantity	Unit Cost	Item Cost
Earth Structure	m^3	6.00	R 903.00	R 5,418.00
Rock Packing	m^3	0.12	R 525.00	R 63.00
			Total	**R 5,481.00**

8.7.3.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

8.8 Intervention designs (Diatalawa)

8.8.1 Intervention: C81H-11-201-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Concrete weir
Rehabilitation Objective	To raise the water level in the channel and encourage re-wetting of adjacent wetland areas
Latitude (DºM'S")	28°18'58.02 S"
Longitude (DºM'S")	28°53'47.00 E"
Engineering Drawings	C81H-11-201-00

Figure 30: Intervention site C81H-11-201-00 looking upstream from the right bank.

8.8.1.1 Bill of quantities: C81H-11-201-00

Item	Units	Quantity	Unit Cost	Item Cost
Concrete	m^3	37.00	R 5 883.63	R 217 694.42
Revegetation	m^2	LS		R 5 000.00
			Total	**R 222 694.42**

8.8.1.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

8.8.2 Intervention: C81H-11-205-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Concrete Weir
Rehabilitation Objective	To raise the water level in the channel
Latitude (DºM'S")	28°19'11.31 S"
Longitude (DºM'S")	28°54'02.09 E"
Engineering Drawings	C81H-11-205-00

Figure 31: Intervention site C81H-11-205-00 looking upstream from the right bank.

8.8.2.1 Bill of quantities: C81H-11-205-00

Item	Units	Quantity	Unit Cost	Item Cost
Concrete	m^3	45.00	R 5 883.63	R 264 763.49
Revegetation	m^2	LS		R 5 000.00
			Total	**R 269 763.49**

8.8.2.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

8.8.3 Intervention: C81H-11-206-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Concrete Weir
Rehabilitation Objective	To raise the water level in the channel
Latitude (DºM'S")	28°19'15.26 S"
Longitude (DºM'S")	28°54'04.48 E"
Engineering Drawings	C81H-11-206-00

Figure 32: Intervention site C81H-11-206-00 looking upstream from the right bank.

8.8.3.1 Bill of quantities: C81H-11-206-00

Item	Units	Quantity	Unit Cost	Item Cost
Earthworks	m^3	22.50	R 525.00	R 11 812.50
Revegetation	m^2	120.00	R 45.00	R 5 400.00
			Total	**R 17 212.50**

8.8.3.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

8.8.4 Intervention: C81H-11-207-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Earthworks, slope 1:4
Rehabilitation Objective	Slope eroded bank and prevent further slumping
Latitude (DºM'S")	28°19'17.82 S"
Longitude (DºM'S")	28°54'04.79 E"
Engineering Drawings	C81H-11-207-00

Figure 33: Intervention site C81H-11-207-00 looking upstream.

8.8.4.1 Bill of quantities: C81H-11-207-00

Item	Units	Quantity	Unit Cost	Item Cost
Earthworks	m^3	22.50	R 525.00	R 11 812.50
Revegetation	m^2	120.00	R 45.00	R 5 400.00
			Total	**R 17 212.50**

8.8.4.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

8.8.5 Intervention: C81H-11-208-00

Designer	Danie Louw
Design Date	October 2013
Intervention Description	Fence and ecologs
Rehabilitation Objective	Fencing of existing structure to prevent cattle trampling
Latitude (DºM'S")	28°19'23.77 S"
Longitude (DºM'S")	28°54'07.63 E"
Engineering Drawings	C81H-11-208-00

Figure 34: Intervention site C81H-11-208-00.

8.8.5.1 Bill of quantities: C81H-11-208-00

Item	Units	Quantity	Unit Cost	Item Cost
Fencing	m	142.00	R 103.00	R 14,626.00
Ecologs	m^3	3.02	R 1,300.00	R 3,920.71
Earthworks	m^3	1.00	R 525.00	R 525.00
			Total	**R 19,071.71**

8.8.5.2 Construction Notes

General construction notes as set out in **Appendix B** apply, along with all construction notes shown on design drawings.

8.10 Construction Environmental Management Plan issues

The project team should access the site and manage the site in accordance with the WfWet best management practices and specific requirements of the land users representatives. The implementation of these interventions must also take into account all relevant provisions of Working for Wetlands Best Management Practices and Construction Environmental Management Plan, the recommendations of the Basic Assessments submitted for Environmental Authorisation and the requirements of the Environmental Authorisation Record of Decision for the project.

The general construction notes, the Construction phase EMP (CEMP) are included as **Appendix B and F**.

8.11 Wetland management recommendations

Currently, the wetland is being utilised for livestock grazing, but following the implementation of the rehabilitation activities, sections of the wetland are likely to become inaccessible for livestock. Already there is evidence of cattle that have become stuck and died within the boggy parts of the wetland. The landowner should consider maintenance of existing fencing around the wetland and managing livestock access to limit grazing to the drier winter months only.

8.12 Baseline M&E data

8.12.1 Fixed point photography

Please refer to Annexure 5 of the Wetland Status Quo Report (Appendix A of this rehabilitation plan)

8.12.2 Baseline WET-Health data

The catchment of the "Diatalawa" wetland (C81H-11) has been notably altered by agricultural activities, with cultivation and the construction of small farm dams along the tributary river channels affecting flows into the downstream river and wetland to a small-moderate degree. The dominant impact however is associated with channel incision which has affected flow patterns and water distribution within the wetland itself. The resultant desiccating effect on adjacent wetland habitat has had a knock-on effect on wetland vegetation. The geomorphological integrity of the wetland is still predominantly intact, but has also been impacted as a result of channel incision. The wetland attains an overall **"C" Category** or ***moderately modified*** rating (**Table 28**, below). The threat of headward erosion of small headcuts and potential for further incision of channels suggests that the status quo could be threatened in the absence of mitigation (rehabilitation), with an overall slight deterioration in wetland integrity and functioning expected in the short term.

Table 28: Summary of present wetland health based on the Wet-Health assessment for wetland C81H-11

Wetland No	Ha	Hydrology		Geomorphology		Vegetation	
		Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
C81H-11	54	3.5	-1	1.2	-1	2.0	-1
PES Categories		**C**	↓	**B**	↓	**C**	↓
Wetland Impact Score		**2.43**					
Wetland PES		**C**					