WETLAND ASSESSMENT WITHIN THE COEGA INDUSTRIAL DEVELOPMENT ZONE

Prepared for:

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ACRONYMS

CARA	Conservation of Agricultural Resources Act
CBD	Central Business District
DWS	Department of Water and Sanitation
ECBCP	Eastern Cape Biodiversity Conservation Plan (Berliner & Desmet, 2007)
EIS	Ecological Importance and Sensitivity
GA	General Authorisation
GIS	Geographic Information System
IDZ	Industrial Development Zone
NFEPA	National Freshwater Ecosystems Priority Areas (Nel *et al*., 2011)
NMBM	Nelson Mandela Bay Municipality
PES	Present Ecological State
SABIF	South African Biodiversity Information Facility, a SANBI database that contains both faunal and floral species records
SANBI	South African National Biodiversity Institute
SWMP	Storm Water Management Plan
WUL	Water Use License
WULA	Water Use License Application

1 INTRODUCTION

The Coega Development Corporation (CDC) appointed Scherman Colloty & Associates (SC&A) to assess and delineated all wetlands located within this Coega Industrial Development Zone (Figure 1), which is located within the Nelson Mandela Bay Municipality (NMBM). The CDC proposes to develop commercial and industrial initiatives in partnership with key tenants that will be provided land within the respective development zones (Figure 1). The associated infrastructure such as roads, pipelines (water & sewer) and electrical services, where not already provided will also need to be installed.

Although the Coega IDZ has an existing environmental authorisation, in most instances additional environmental authorisations and licenses must still be obtained for development specific activities. One such requirement is obtaining a Water Use License (WUL) under the National Water Act (Act 36 of 1998) (NWA). It is thus important to understand the position of all known wetlands, their Present Ecological State and Ecological Importance and Sensitivity, as this will influence the license requirements as stipulated by the Department of Water and Sanitation (DWS), i.e. water use is not only the amount of water needed by a development (abstraction/consumptive use), but also activities that may impact on a water resource function and ecological attributes thus necessitating a license. The intention of this report is to strategically identify wetlands that will trigger the need for a WUL, as identifying these license needs on a project by project basis does not always allow sufficient time to obtain a WUL prior to construction. Also this report presents an opportunity to include, where feasible any wetlands into the Coega Open Space Management Plan, by way of integrating these systems into future Storm Water Management Plans. This then allows for integrated planning on a regional scale, by minimising the cumulative impact on wetlands within the OSMP and also allows for links in the greater NMBM via its Bioregional Plan. This is assuming that the wetland’s landscape position allows for the inclusion of these areas into a SWMP.

It is thus also important to understand the legislative context and is discussed in more detail Section 1.2 below, but for the purposes of this report it is also necessary to define the difference between a <u>watercourse</u> and <u>water resource</u> as defined by the NWA. Watercourses are defined as follows:

- A river;
- A spring;
- A *natural* channel in which water flows regularly or intermittently;
- <u>A wetland</u>; lake or dam into which, or from which, water flows; and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse include, where relevant, its bed and banks.

Artificial canals, estuaries and groundwater systems are not considered watercourses but are important forms of water resource that require management. The definition and classification of wetlands and wetland types is discussed Section 2.1

This report will thus define the various wetland "watercourses" and their respective regulated zones as stated in the National Water Act. Thus depending on the level of impact or risk presented by a development a Water Use License or General Authorisation maybe required. Note that the level of impact or risk is project dependent and can only be assessed using the Risk Assessment Matrix, contained in Appendix A of the DWS Notice 509 of 2016, published 26 August 2016, assessing project specific issues and impacts (See Appendix 1 of this report for the template Risk Matrix, which considers typical impacts anticipated within the IDZ).

1.1 Scope of Work

With the above in mind the following scope of work was used:

- A map demarcating the relevant local drainage area of the respective watercourses or wetland/s, i.e. the waterbody, its respective catchment and other areas within a 500m radius of the IDZ. This will demonstrate, from a holistic point of view the connectivity between the site and the surrounding regions, i.e. the hydrological zone of influence. Maps depicting demarcated waterbodies will be delineated to a scale of 1:10 000, following the methodology described by the DWS, together with a classification of delineated waterbodies and their functionality. This will also be linked to the present Coega OSMP and how these systems could be integrated into this plan
- The determination of the ecological state of any waterbodies including wetlands, estimating their biodiversity, conservation and ecosystem function importance with regard ecosystem services. Coupled with ground-truthing site visits, this will include the determination of the Present Ecological State and Ecological Importance and Sensitivity Scores required by DWS in the WUL process.
- Recommend buffer zones and No-go areas around any delineated aquatic zones based on the relevant legislation, e.g. any bioregional plans of conservation guidelines or best practice.
- Provide a generic risk assessment based on the potential industrial activity that will be developed in future within each of the IDZ Zone. This will however need to be refined for project specific activities during any BA or EIA, but will provide a baseline for those assessments.
- Provide mitigations regarding project related impacts, including engineering services that could negatively affect demarcated waterbodies.
- Supply the client with geo-referenced GIS shape files of the wetland / riverine areas.
- Provide one draft report for comment, with a maximum of two rounds of comments addressed. This report will contain the minimum requirements for the submission of a Water Use License with regard the following:
    - Riparian / Wetland delineation establishing the current baseline within the IDZ.
    - Present Ecological State and Ecological Importance and Sensitivity Scores
    - Risk Assessment (Generic)- Appendix 1
    - Generic Rehabilitation and Monitoring Guidelines – Appendix 2

The above detail can also be used in the inclusion of respective water use license application / GA documents submitted to DWS, thus providing potential tenants/developers, NMBM and DWS with information on future applications where applicable. The typical Water Use Authorisation Process (Section 21c & i) is shown in Appendix 3.

Figure 1: Coega IDZ zones (red lines) and Open Space Management Plan (green and blue areas)

Several terms and definitions were used in this report and the reader is referred to the box below for additional detail.

Definition Box

Present Ecological State is a term for the current ecological condition of the resource. This is assessed relative to the deviation from the Reference State. Reference State/Condition is the natural or pre-impacted condition of the system. The reference state is not a static condition, but refers to the natural dynamics (range and rates of change or flux) prior to development. The PES is determined per component - for rivers and wetlands this would be for the drivers: flow, water quality and geomorphology; and the biotic response indicators: fish, macroinvertebrates, riparian vegetation and diatoms. PES categories for every component would be integrated into an overall PES for the river reach or wetland being investigated. This integrated PES is called the EcoStatus of the reach or wetland.

EcoStatus is the overall PES or current state of the resource. It represents the totality of the features and characteristics of a river and its riparian areas or wetland that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services. The EcoStatus value is an integrated ecological state made up of a combination of various PES findings from component EcoStatus assessments (such as for invertebrates, fish, riparian vegetation, geomorphology, hydrology and water quality).

Licensing applications: Water users are required (by legislation) to apply for licenses prior to extracting water resources from a water catchment.

Ecoregions are geographic regions that have been delineated in a top-down manner on the basis of physical/abiotic factors. • NOTE: For purposes of the classification system, the 'Level I Ecoregions' for South Africa, Lesotho and Swaziland (Kleynhans *et al.,* 2005), which have been specifically developed by the Department of Water Affairs & Forestry (DWAF) for rivers but are used for the management of inland aquatic ecosystems more generally, are applied at Level 2A of the classification system. These Ecoregions are based on physiography, climate, geology, soils and potential natural vegetation.

1.2 Relevant legislation and policy

Locally the South African Constitution, seven (7) Acts and one (1) international treaty allow for the protection of rivers and water courses. These systems are thus protected from the destruction or pollution by the following:

- Section 24 of The Constitution of the Republic of South Africa;
- Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998;
- National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) inclusive of all amendments, as well as the NEM: Biodiversity Act, 2004 (Act 10 of 2004);
- National Water Act, 1998 (Act No. 36 of 1998);
- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);
- Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002);
- Nature and Environmental Conservation Ordinance (No. 19 of 1974);
- National Forest Act (No. 84 of 1998); and
- National Heritage Resources Act (No. 25 of 1999).

Apart from NEMA, the Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983) will also apply to this project. The CARA has categorised a large number of invasive plants together with associated obligations of the land owner. A number of Category 1 & 3 plants were found on the site investigated, thus any land owner and contractors must take extreme care to limit further spread of these plants. This aspect does however form part of the CDC Environmental Specifications and as such forms part of any Environmental Management Plan, together with teams that are currently removing alien stands within the IDZ

As mentioned previously this report can also be used as part of the relevant submissions to the Department of Water and Sanitation in terms the required Water Use Licenses (WUL), for any Section 21 c & i applications. These would deal with the licensing of any structures that will either impede or divert flow (e.g. bridges, culverts and stormwater ponds) or altering the bed or banks of water courses (e.g. road or internal services crossings). Any activity related to development, that falls within 500m of a wetland boundary or within the 1:100 year / riparian zones (See Figure 5 Section 8) will also require a Section 21 WUL.

However, it must also be stated that other water uses under Section 21 of the National Water Act include the following, noting that some of these activities pertain to artificial canals, dams and ponds:

S21(a)	Taking water from a water resource	Groundwater and surface water (none available in the Coega / Brak systems
S21(b)	Storing water	Dams, reservoirs and ponds
S21(c)	Impeding or diverting the flow of water in a watercourse	Bridges, culverts and any buildings within riparian zone, 1:100 yr flood line whichever is greater or within 500m of a wetland
S21(d)	Engaging in a stream flow reduction activity	As defined in Section 36 of the NWA e.g. commercial afforestation
S21(e)	Engaging in a controlled activity	See Section 37 and 38 of the NWA (1) The following controlled activities: (a) irrigation of any land with waste or water containing waste generated through any industrial activity or by a waterworks; (b) an activity aimed at the modification of atmospheric precipitation; (c) a power generation activity which alters the flow regime of a water resource; (d) intentional recharging of an aquifer with any waste or water containing waste; and (e) an activity which has been declared as such under section 38. (2) No person may undertake a controlled activity unless such person is authorised to do so by or under this Act Section 38 = any activity declared by the Minister
S21(f)	Discharging waste or water containing waste into a water resource through a pipe, canal, sewer or other conduit	Effluent transport
S21(g)	Disposing of waste in a manner which may detrimentally impact on a water resource	Discharge of effluent e.g. conservancy tanks and soakaways
S21(h)	Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process	Discharge from industrial activities
S21(i)	Altering the bed, banks, course or characteristics of a watercourse	Bridges, culverts and any buildings within riparian zone, 1:100 yr flood line whichever is greater or within 500m of a wetland
S21(j)	Removing, discharging or disposing of water found underground for the continuation of an activity or for the safety of persons	Mine dewatering
S21(k)	Using water for recreational purposes	Dams, lakes, slipways and jetties within freshwater systems

Provincial legislation and policy

Various guidelines on aquatic buffers have been issued in a number of the provinces, including the Eastern Cape Province and those stated in this report are based on accepted provincial guidelines as stated in the Eastern Cape Biodiversity Conservation Plan or ECBCP (Berliner and Desmet, 2007) (Table 1).

Table 1: Recommended buffer for this project for rivers are highlighted in blue as per Berliner & Desmet (2007).

River criterion used	Buffer width (m)	Rationale
Mountain streams and upper foothills of all 1:500 000 rivers	50	These longitudinal zones generally have more confined riparian zones than lower foothills and lowland rivers and are generally less threatened by agricultural practices.
Lower foothills and lowland rivers of all 1:500 000 rivers	100	These longitudinal zones generally have less confined riparian zones than mountain streams and upper foothills and are generally more threatened by development practices.
All remaining 1:50 000 streams	32	Generally smaller upland streams corresponding to mountain streams and upper foothills, smaller than those designated in the 1:500 000 rivers layer. They are assigned the riparian buffer required under South African legislation.

It is always recommended that any wetlands be excluded from development footprints inclusive of a 50m buffer as per the ECBCP guidelines. However, based on the latest Water Research Commission technical report - Buffer zone tool for the determination of aquatic impact buffers and additional setback requirements for wetland ecosystems (Macfarlane *et al.,* 2014) –and compared to the potential types of development the following buffers have been recommended for wetlands

Pans	= **48m (rounded up to 50m)**
Valley bottom wetlands	= **50m but as these wetlands are located within the floodplains, the riparian zone or 1:100-year flood line, whichever is larger will prevail.**

2 METHODS

This assessment was initiated with a survey of the pertinent literature, past reports that exist for the study region. Maps and Geographical Information Systems (GIS) were then employed to ascertain the extent and potential locality of various types of aquatic ecosystems and the associated habitats.

Various wetland assessment related site visits over time within the study area for a range of projects (December 2011, June 2012, May 2013, December 2013, June 2014, August 2015 and again in May 2016) have been conducted. Additional site visits specific to this project were also conducted August and September 2016, to ground-truth the desktop findings. Information was also collected to determine the PES and Ecological Importance and Sensitivity (EIS) of the various waterbodies observed. These analyses were based on the models developed by the Department of Water and Sanitation, with the results producing a rating (A – F), summarised in Table 2. The importance of the study area was also assessed against local and provincial conservation plans such as the NMBM Bioregional Plan and the Eastern Cape Biodiversity and Conservation Plan.

Aquatic vegetation was assessed on the following basis:

- Vegetation type – verification of type and its state or condition based, supported by species identification using Germishuizen and Meyer (2003), Vegmap (Mucina and Rutherford, 2006 as amended) and the South African Biodiversity Information Facility (SABIF) database. The SABIF database contains older species records for areas, thus allowing a comparison of present versus past states. This data was also compared to past and present aerial images, although these are limited to the scale at which the narrow band of riparian vegetation could be observed due to image resolution.
- Plant species were further categorised as follows:
    - Terrestrial: species are not directly related to any surface or groundwater base-flows and persist solely on rainfall
    - Facultative: species usually found in wetlands (inclusive of riparian systems) (67 – 99% of occurrences), but occasionally found in terrestrial systems (DWAF, 2005)
    - Obligate: species that are only found within rivers and wetlands (>99% of occurrences) (DWAF, 2005)
- Mitigation measures or rehabilitation recommendations required

Table 2: Description of A – F ecological categories based on Kleynhans *et al*., (1999).

<table>
<tr><th>ECOLOGICAL CATEGORY</th><th>ECOLOGICAL DESCRIPTION</th><th>MANAGEMENT PERSPECTIVE</th></tr>
<tr><td>A</td><td>Unmodified, natural.</td><td>Protected systems; relatively untouched by human hands; no discharges or impoundments allowed</td></tr>
<tr><td>B</td><td>Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.</td><td>Some human-related disturbance, but mostly of low impact potential</td></tr>
<tr><td>C</td><td>Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.</td><td rowspan="2">Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation</td></tr>
<tr><td>D</td><td>Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.</td></tr>
<tr><td>E</td><td>Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.</td><td rowspan="2">Often characterized by high human densities or extensive resource exploitation. Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality</td></tr>
<tr><td>F</td><td>Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.</td></tr>
</table>

2.1 Delineation and assessment

During this study and due to the nature of the seasonal wetland and watercourses observed, it was decided that the accepted "Classification system for wetlands and other aquatic ecosystems in South Africa" of Ollis *et al*., (2013) (CSW) be adopted. This classification approach has integrated aspects of the HGM approached used in the WET-Health system as well as the widely accepted eco-classification approach used for rivers.

The CSW uses hydrological and geomorphological traits to distinguish the primary wetland units, i.e. direct factors that influence wetland function. Other wetland assessment techniques, such as the DWAF (2005) delineation method, only infer wetland function based on abiotic and biotic descriptors (size, soils & vegetation) stemming from the Cowardin approach (SANBI, 2009). Several transects were sampled perpendicular to the wetlands in which information of the soils (cores) and vegetation were collected. Notably wetlands are considered separate from riparian systems, which has bearing on the National Water Act, i.e. riparian systems are a type of water course, but are not wetlands.

The CSW has a six-tiered hierarchical structure, with four spatially nested primary levels of classification (Figure 1). The hierarchical system firstly distinguishes between Marine, Estuarine and Inland ecosystems (**Level 1**), based on the degree of connectivity the particular systems has with the open ocean (greater than 10 m in depth). Level 2 then categorises the regional wetland setting using a combination of biophysical attributes at the landscape level, which operate at a broad bioregional scale. This is opposed to specific attributes such as soils and vegetation.

Level 2 has adopted the following systems:

- Inshore bioregions (marine)
- Biogeographic zones (estuaries)
- Ecoregions (Inland)

Level 3 of the CSW assess the topographical position of inland wetlands as this factor broadly defines certain hydrological characteristics of the inland systems. Four landscape units based on topographical position are used in distinguishing between Inland systems at this level. No subsystems are recognised for Marine systems, but estuaries are grouped according to their periodicity of connection with the marine environment, as this would affect the biotic characteristics of the estuary.

Level 4 classifies the Hydrogeomorphic (HGM) units discussed earlier. The HGM units are defined as follows:

- Landform – shape and localised setting of wetland
- Hydrological characteristics – nature of water movement into, through and out of the wetland
- Hydrodynamics – the direction and strength of flow through the wetland

These factors characterise the geomorphological processes within the wetland, such as erosion and deposition, as well as the biogeochemical processes.

Level 5 of the assessment pertains to the classification of the tidal regime within the marine and estuarine environments, while the hydrological and inundation depth classes are determined for the inland wetlands. Classes are based on frequency and depth of inundation, which are used to determine the functional unit of the wetlands and are considered secondary discriminators within the CSW.

Level 6 uses of six descriptors to characterise the wetland types on the basis of biophysical features. As with Level 5, these are non hierarchal in relation to each other and are applied in any order, dependent on the availability of information. The descriptors include:

(i) Geology;
(ii) Natural vs. Artificial;
(iii) Vegetation cover type;
(iv) Substratum;
(v) Salinity; and
(vi) Acidity or Alkalinity.

It should be noted that where sub-categories exist within the above descriptors, hierarchical systems are employed, thus are nested in relation to each other.

The HGM unit (Level 4) is the **focal point of the CSW**, with the upper levels (Figure 3 – Inland systems only) providing means to classify the broad bio-geographical context for grouping functional wetland units at the HGM level, while the lower levels provide more descriptive detail on the particular wetland type characteristics of a particular HGM unit. Therefore, Level 1 – 5 deals with functional aspects, while Level 6 classifies wetlands on structural aspects.

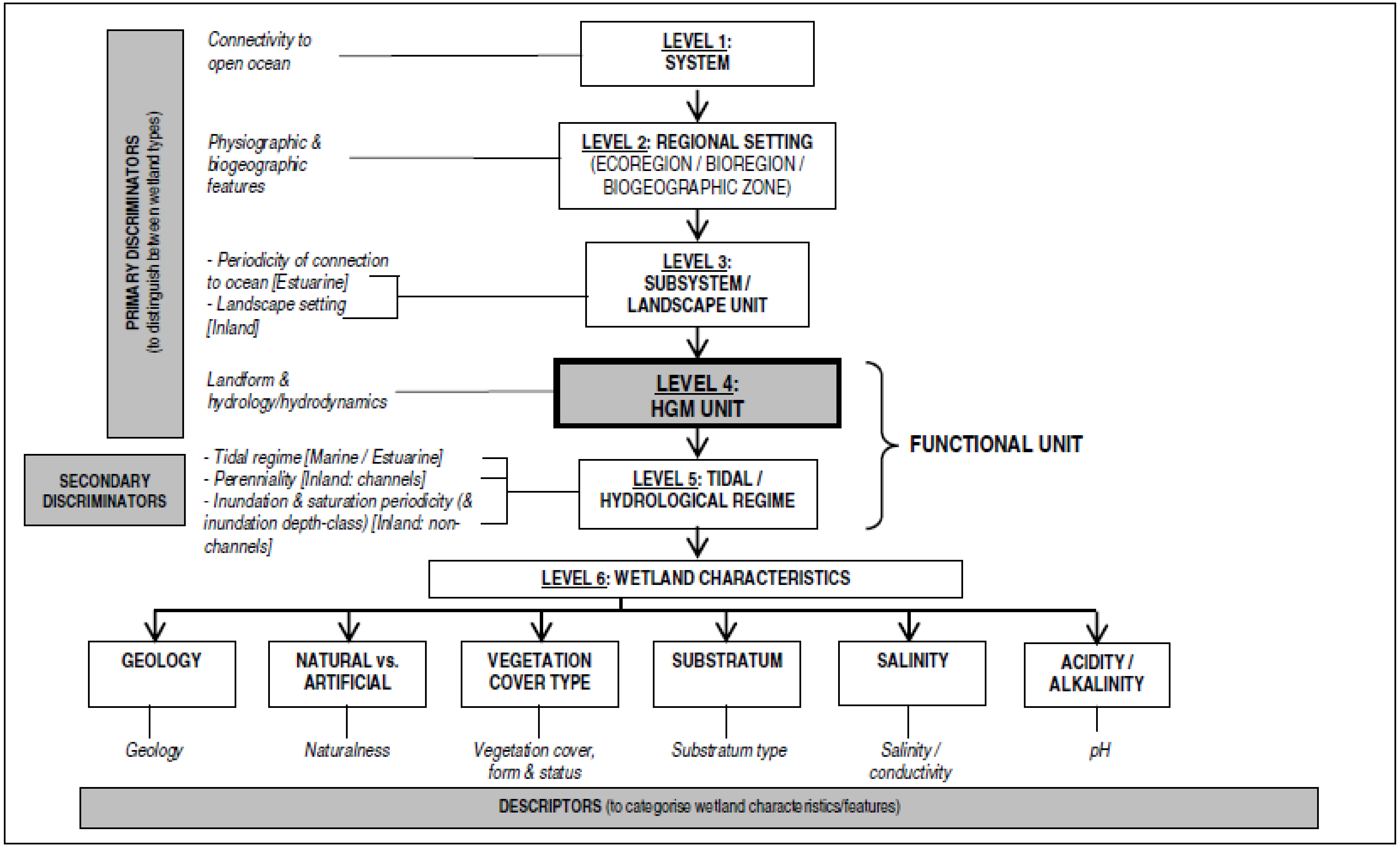


Figure 2: Basic structure of the National Wetland Classification System, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the tidal/hydrological regime, and 'descriptors' applied at Level 6 to categorise the characteristics of wetlands classified up to Level 5 (From Ollis *et al*., 2013).

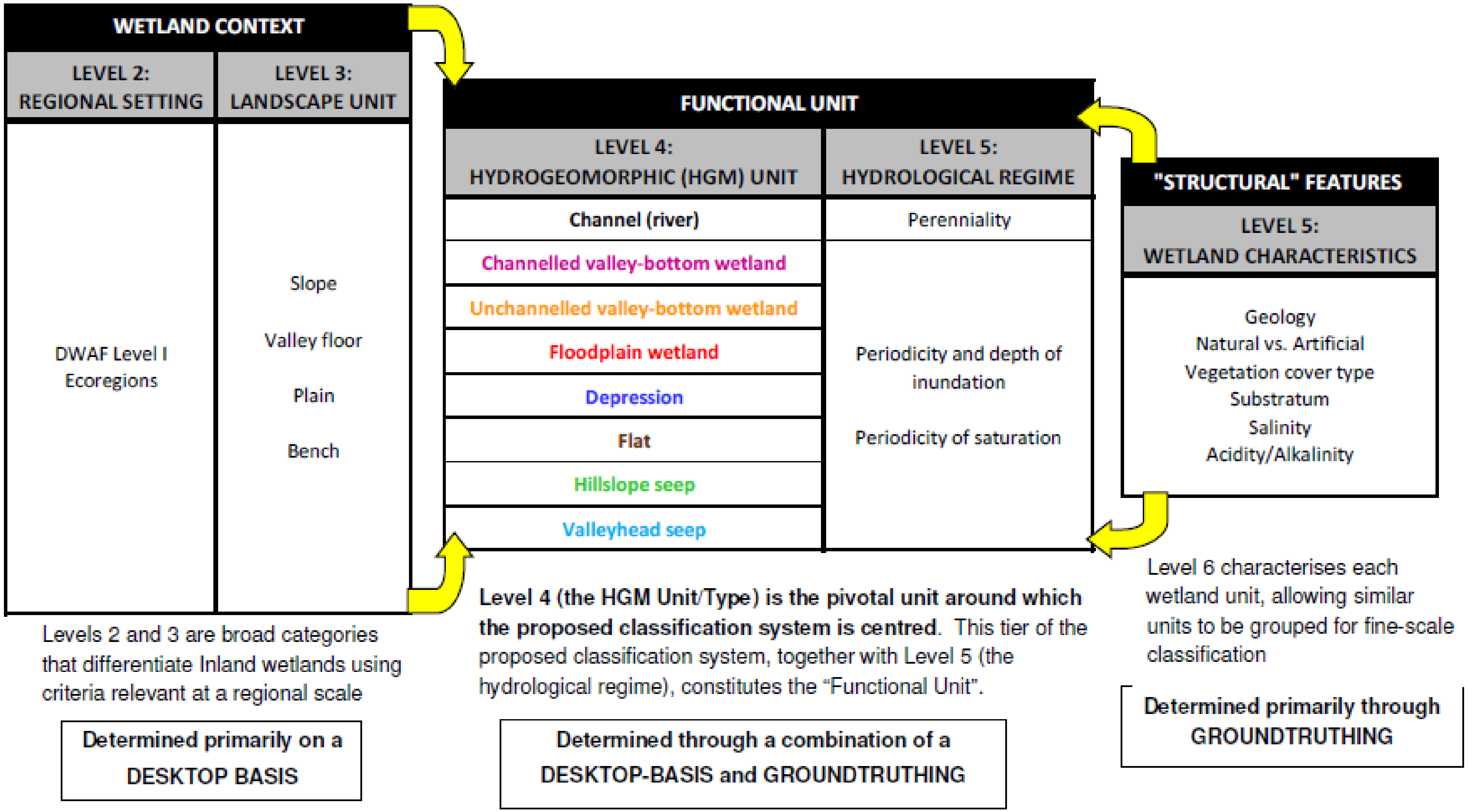


Figure 3: Illustration of the conceptual relationship of HGM Units (at Level 4) with higher and lower levels (relative sizes of the boxes show the increasing spatial resolution and level of detail from the higher to the lower levels) for Inland Systems (from Ollis *et al*., 2013).

2.2 Wetland condition and conservation importance assessment methods

To assess the Present Ecological State (PES) or condition of the observed wetlands, a modified Wetland Index of Habitat Integrity (DWAF, 2007) was used. The Wetland Index of Habitat Integrity (WETLAND-IHI) is a tool developed for use in the National Aquatic Ecosystem Health Monitoring Programme (NAEHMP), formerly known as the River Health Programme (RHP). The output scores from the WETLAND-IHI model are presented in the standard DWAF A - F ecological categories (Table 2), and provide a score of the Present Ecological State of the habitat integrity of the wetland system being examined. The author has included additional criteria into the model based system to include additional wetland types. This system is preferred when compared to systems such as WET-Health – wetland management series (WRC, 2009), as WET-Health (Level 1) was developed with wetland rehabilitation in mind, and is not always suitable for impact assessments. This coupled to degraded state of the wetlands in the study area, a complex study approach was not warranted, i.e. conduct a Wet-Health Level 2 and WET-Ecosystems Services study required for an impact assessment.

The WETLAND-IHI model is composed of four modules. The "Hydrology", "Geomorphology" and "Water Quality" modules all assess the contemporary ***driving processes*** behind wetland formation and maintenance. The last module, "Vegetation Alteration", provides an indication of the intensity of human landuse activities on the wetland surface itself and how these may have ***modified*** the condition of the wetland. The integration of the scores from these 4 modules provides an overall Present Ecological State (PES) score for the wetland system being examined. The WETLAND-IHI model is an MS Excel-based model, and the data required for the assessment are generated during a rapid site visit.

Additional data may be obtained from remotely sensed imagery (aerial photos; maps and/or satellite imagery) to assist with the assessment. The interface of the WETLAND-IHI has been developed in a format which is similar to DWS River EcoStatus models which are currently used for the assessment of PES in riverine environments.

Conservation importance of the individual wetlands was based on the following criteria:

- Habitat uniqueness
- Species of conservation concern
- Habitat fragmentation with regard ecological corridors
- Ecosystem service (social and ecological)

The presence of any or a combination of the above criteria would result in a HIGH conservation rating if the wetland was found in a near natural state (high PES). Should any of the habitats be found modified the conservation importance would rate as MEDIUM, unless a Species of conservation concern was observed (HIGH). Any systems that was highly modified (low PES) or had none of the above criteria, received a LOW conservation importance rating. Wetlands with HIGH and MEDIUM ratings should thus be excluded from development with incorporation into a suitable open space system, with the maximum possible buffer being applied. Wetlands which receive a LOW conservation importance rating could be included into stormwater management features, but should not be developed so as to retain the function of any ecological corridors.

3 STUDY AREA DESCRIPTION AND RESULTS

The study area is located within the south-eastern half of the Nelson Mandela Bay Municipality in the Eastern Cape (Figure 1 & 4). A site survey was conducted in August and September 2016, specifically for this study, but other aquatic assessments by SC&A within the IDZ have also been integrated into this assessment. Information collected in these surveys was used to ground truth the various aquatic features observed during the desktop assessment. The past SC&A reports were also used in this assessment, especially with regard the potential sensitive plant, bird or aquatic habitat that may occur within the upper reaches of the Brak and Coega River systems and form part of the study area

Several wetland and riverine (riparian) systems were again confirmed based on the results of the desktop analyses and the groundtruthing undertaken (Figure 4a). In terms of classifying aquatic ecosystems from a Hydrogeomorphic stand point the CSW results are summarised as follows and in Table 3:

3.1 Level 1 –Inland, estuarine or marine systems

The Coega IDZ would be described as containing Inland and Estuarine aquatic ecosystems (Level 1), part of which include the endorheic wetland areas.

The remnants of the Coega Estuary dominate the lower portion of this river catchment between ocean (Plate 1) and just below the R334 road bridge (river interface zone). The remaining estuarine intertidal areas are characterised by salt marsh areas that contain salt tolerant plant species, such as *Sarcocornia perennis* (Chickenclaws). This is a function of the soil characteristics and tidal input that allow salinities to vary between 15 to 40 ppt.

Within this Level, two separate freshwater or Inland groups of aquatic systems were observed and these included:

- Rivers and streams (linear water courses) such as the Coega River (above the river interface zone) and its various tributaries (Plate 2).
- Wetlands (which includes pans - Plate 3)

3.2 Level 2 - Regional Setting

The study area is located within the South Eastern Coastal Belt Ecoregion according to Kleynhans *et al*., (2009). This indicates that the expected waterbodies would are associated with coastal land forms which could include coastal plateaus or benches, coastal mountain ranges and steep river valleys, fed by relatively small catchments.

At a finer scale, the National Freshwater Ecosystem Priority Areas atlas (NFEPA) (Nel *et al*., 2011) indicated that the regional setting described in the form of wetland associated vegetation within the study region is dominated by aquatic ecosystems linked or dominated by vegetation with Albany Thicket Bontveld and Albany Thicket Valley characteristics.

All of these settings are located within the study area, with some of the benches allowing for the development of depression or pans, a wetland type with a small catchment and not associated with any riverine or drainage line features (i.e. Endorheic).

The river banks are moderately steep to steep within the survey area and are formed through a combination of the softer sediments contained within the regional geology and localised flooding events (Plate 2). The rivers are thus scoured and become incised over time and thus limit the development of wide floodplain areas, with the associated broad riparian zones. Thus, wide riparian zones are not a natural phenomenon of these types of systems.

3.3 Level 3 – Landscape Unit and Level 4 – Hydrogeomorphic (HGM) Unit

As mentioned previously several landscape units or settings were observed within the study area, each of these were associated with a HGM type of the Inland aquatic ecosystems included the following:

Landscape Unit	**HGM Type**
Benches (Hilltop) –	Pans
Valley bottoms	Steep channelled river and stream riparian areas (without wetlands)
	Shallow valley unchannelled valley bottom wetlands (e.g. reed bed areas or oxbows)

The respective HGM units in this study are shown in Figure 4 and summarised in Table 3.

It should also be noted that several man-made (stormwater ponds) and artificial systems were also observed, particular those associated with leaking pipeline lines. These are shown in Figure 4, but no further assessment was conducted on these. These waterbodies will disappear once the leaks are fixed, contained little biodiversity or true wetland function and were thus considered being of low importance.

3.4 Level 5 – Hydrological Regime

The study area hydrology was characterised mostly ephemeral surface water flows within the M30B quaternary catchment, which in turn feed the non-perennial Coega River, while the smaller streams and drainage lines are also ephemeral.

The valley bottom wetlands are all ephemeral systems and are seasonally inundated, while the Pans / Depressions showed greater evidence of being periodically inundated only every couple of years. This was based on the fact that the soils found in the auger samples in the valley bottom systems, showed greater signs of being permanently wet (gleyed, anoxic with fewer mottles) and the wetland plants although obligate species, were mostly seasonal species. The pans within the study area have not been observed inundated since 2013 when assessed for the Dedisa-Grassridge transmission line and Manganese Terminal rail line projects.

3.5 Level 6 – Wetland / Aquatic Ecosystem Characteristics (Descriptors)

Aquatic ecosystem descriptors provide relevant detail pertaining separating the character and or function of each of the observed HGM units (Level 5) from each other particularly in this assessment with regard to the following and summarised in Table 3:

- Geology
- Substratum type / soils
- Vegetation cover
- Natural versus artificial

Note this assessment focused mainly on natural systems as the objective of the investigations were to determine the functional links between remaining catchment areas, wetland importance and their relationships with any open space areas.

It was noted in this assessment that soil structure, particularly the clay %, was correlated between the type of wetland, the period of inundation and the degree of obligate / facultative wetland plant cover (Table 3) and is discussed in greater detail in the next section. This is important as the type of vegetation observed within each of the wetland areas seems to be a response to the soils / geology type and the interaction with surface run-off.

Plate 1: Remnant salt marsh and intertidal areas located in the lower portion of the Coega Estuary within the Port of Ngqura

Plate 2: A view southwards of the Brak River, a significant tributary of the Coega River, dominated by terrestrial thickets and very narrow riparian zones

Plate 3: A typical Endorheic Pan or doline that is located within the Bontveld areas of Zone 6 & 11 of the Coega IDZ. Photo was taken in 2013 after significant rainfall

3.5.1 Aquatic vegetation response to HGM type, hydrological regime and wetland characteristics (descriptors)

<u>Rivers and streams</u>

Broad instream aquatic and riparian zones were not evident, with only a few permanent riparian / obligate riparian species being observed within the Coega River and its tributaries (Figure 4). This was due to the steep nature of the river banks coupled to the local geology (hard sandstones), which precludes the development of wide riparian floodplains. The upstream impacts such as impoundments have also reduced the functionality of the riparian zone, while alien vegetation further reduces any available habitat. Any future protection and then rehabilitation of these systems should thus focus on clearing all of these systems of alien vegetation, and promoting the growth of natural Thicket and fynbos species.

Valley Bottom wetland and oxbows

Figure 4a-c also indicates the position of the valley bottom features, and within the study area, which are associated with the Coega River. Of interest are the two oxbow areas observed.

An oxbow lake is a small (usually crescent shaped) lake situated in an abandoned meander loop of a river channel. Oxbow lakes form as the river cuts through the neck of the meander to bypass the meander and shorten its course (Constantine and Dunne, 2008). In doing so, the old meander channel is blocked off, leaving a crescent shaped lake. Over time, oxbow lakes silt up and form marshes, and eventually form meander scars that are identified by distinctive vegetation. The name originates from the distinctive curved shape of the landform that resembles the curved collar (bow) placed around an ox's neck to which a plough is attached. It can also be called a horseshoe lake, a loop lake, or a cut-off lake.

In an ideal setting, a river would flow downhill in a straight line due to gravity. However, due to differing geology and landforms, rivers rarely flow in straight lines and will meander, often when it reaches a plain. This means that rivers will flow from side to side in curves, creating loops, or meanders (Pal and Kar, 2012). Meanders form as the river flow erodes sediment on the outside of a curve in the river's path. The outside bank erodes faster than the inside bank, as the water flow of the outside bank flows faster. The eroded sediment is deposited on the inside of the curve where the water is flowing more slowly. Over time, this creates a meander, and the loops of the meandering river get bigger and wider as the river continues flowing downstream.

After a period, due to the continuous deposition on the inside and erosion of the outside bank, the meander becomes heavily curved, and the neck of the meander becomes narrower. During a flood event, by lateral erosion, the river cuts through the neck, cutting off the meander. The river continues in the new, shortened course and the meander is abandoned. Sediment deposition seals off both ends, and the cut-off meander becomes an ox-bow lake. This process can occur over a time scale from a few years to several decades (Constantine and Dunne, 2008).

Oxbow lakes often form on low lying plains and near the confluence of a river with a larger body of water. Flood plains containing sinuous rivers are usually populated by longer oxbow lakes than those with low sinuosity. This is because rivers with high sinuosity have larger meanders, and therefore a greater opportunity for longer oxbow lakes to form. Oxbows are still-water lakes, with no inflow or outflow of water. Due to this, oxbow lakes often become wetlands, providing rich habitats for wildlife and can even dry up entirely.

Endorheic Pans / Depressions

A depression is a wetland ecosystem with closed or near-closed elevation contours, increasing in depth from the perimeter to a central area within which water typically accumulates. Depressions may be round-bottomed or flat-bottomed (referred to as pans) (Ford and Williams, 1989). Most depressions occur either where the water table intercepts the land surface (such as on coastal plains along the South African coastline), or in semi-arid settings where a lack of sufficient water inputs prevents areas where water accumulates from forming a connection with the open drainage network (Ollis *et al*., 2013).

There are three requirements for the formation of a pan;

1) an arid environment,
2) a substratum that is susceptible to easy weathering (karst), and contains a high proportion of leachable salts, and
3) a mechanism for the disruption of drainage, such as tectonic activity or windblown sands blocking rivers.

Surfaces that are predisposed to pan formation are typically low-angled, which encourages ponding and limits drainage development. Pans form either by dissolution of the surface of underlying bedrock, called solution pans, or by the collapse of underlying caves within bedrock, called collapse pans (Marker, 1988).

Solution pans are formed on limestone and dolomite outcrops and are an example of karst topography, where a landscape feature is formed from the dissolution of permeable rocks. Rainwater is not able to drain through limestone, and thus begins to dissolve the carbonate rock on which it lies (Goff *et al*., 2016). Pans obtain their distinctive circular shape by growing laterally, rather than downward. This is outward growth is due to an accumulation of sediment within the pan, which inhibits dissolution on the floor while concentrating it on the edges of the pan. Once a solution pan is established, the centripetal focus of flow, and corrosion, will encourage its further development. Further dissolution will occur due to the greater biogenic CO^2 production in the thick soils that accumulate in the bottoms of pans. Such soils may stay damper longer because of drainage accumulation, thus the duration of active corrosion may also increase.

Climate is a major control of the development of solution pans, as high temperatures accelerate chemical reactions, and water is required to induce these reactions. In Southern Africa, for instance, where precipitation is relatively low, little solution can be expected. Pans differ from area to area in terms of vegetation cover, soil depth, and karst density. Vegetation growth, for instance, can increase the amount of CO^2 in the soil, making the water more acidic, which is crucial to the solution process.

In Southern Africa, pan distribution corresponds to rock and sediment types, with most pans found on the Kalahari sands, and the Dwyka tillites and Ecca shales of the Karoo Supergroup. South African pans are subject to seasonal aridity and variability in precipitation, which affects vegetation growth and CO^2 production (Marker, 2012). This results in lower rates of solution than in areas where rainfall is more evenly distributed. Soil-covered karst is typical of the region as the limestone often contains impurities in the form of silica, or because the carbonates are inter-bedded with insoluble layers.

The coastal pans of the Eastern Cape Province occur on the sandy limestone outcrops of the Alexandria Formation. This is one of Southern Africa's seven karst regions. The karst is most pronounced between the Sundays and the Great Fish Rivers, although small pans are found outside of this area (Marker, 2012). This limestone consists generally of a thin 0.5 to 1m basal beach pebble conglomerate, overlain by 1 to 3m of lithified marine limestone grading upwards into less lithified beach and aeolian limestone. The deposit becomes thinner inland and to the east reaching a maximum thickness of 180m in the southwest and overlies planed Palaeozoic strata. The area is essentially a fluviokarst (a karst landscape where there is evidence of past or present fluvial activity) with a high density of shallow solution pans where the limestone is thin overlying impermeable Palaeozoic strata, which restricts infiltration. In contrast, the thick limestone overlying Mesozoic sandstones of the southern Cape coast form deep funnel depressions.

Pans are generally classified as being endorheic (inward draining, with no surface outflow), although some are exorheic (outward draining) (Marker, 1988) Water drains from an endorheic depression by means of evaporation and infiltration only, whereas water can exit an exorheic depression as concentrated or diffuse surface flow, or as subsurface flow. Due to the inward draining of endorheic pans, they are able to capture runoff, and thus they reduce the volume of surface water that would otherwise reach the stream system and contribute to storm flows. The opportunity for attenuating floods however is limited by their position in the landscape, which is generally isolated from stream channels.

Solution pans play an important role in the connections between the karst surface and karst underground. They are thought to develop local geologies, hydrologies as well as local climates, depending on the size of the pan. Pans also form a specific soil type, affecting the vegetation type found within the pan. Karst environments, particularly pans are fragile and are more vulnerable to damage compared with other natural systems (Anica and Mojca, 2010). This is due to the nature of the karst hydrological system. For example, once thin soils are lost, their replacement time is very long, as there are only small quantities of insoluble residues in karst rocks that might form the inorganic basis of a new soil cover. Karsts are highly vulnerable to overuse and misuse, and requires specialist knowledge to manage properly, and can be extremely difficult to restore once damaged (Anica and Mojca, 2010). The World Commission on Protected Areas of the International Union for the Conservation of Nature and Natural Resources (IUCN) has drawn up guidelines for the protection of caves and karst that should be followed in order to avoid the destruction of these important features (Semlitsch and Bodie, 1998).

3.6 Present Ecological State and Ecological Importance and Sensitivity

3.6.1 Coega River and associated tributaries

In previous studies conducted by SC&A, the condition of the instream aquatic habitats in the study area, gave the present ecological status (PES) in terms of fish as a **D Class**, due to several impacts being found within the study areas and within the remainder of the catchment. The main impacts are related to destruction of indigenous riparian and marginal vegetation, increased sediment input and pollution from contaminated run-off from the upper catchment. This would apply to all streams within the study area due to the high degree of alien plant invasion as well as hydrological changes such as stormwater management from roads, livestock watering, impoundments and solid waste disposal.

From a riparian vegetation standpoint, the overall condition or Present Ecological State (PES) of the riparian vegetation was also assessed using accepted methodologies. The Department of Water Affairs did present a desktop analysis of the region in 1999 (Kleynhans *et al*., 1999), in which the overall PES for the river reaches within the study area and were rated as C (Moderately modified – Table 3). The PES system, using an updated DWS method revised by SC&A on a province wide scale was found lower. Due to the overall degradation of the river systems, the current riparian vegetation PES would be D (Largely Modified). This is due to the lack of riparian zone continuity and changes to the hydrological regime. During the WUL process for the Manganese Terminal and associated rail infrastructure, the DWS found that only 0.1% of the Ecological Reserve would be available for abstraction. This is due to the high level of disturbance in the upper catchment, that has reduced the present day base flows within the overall system.

Rivers and the associated riparian zones are protected by national legislation. This together with the associated flood risk associated with "flashy ephemeral" systems should preclude any development along these rivers, regardless of their conservation value. The Environmental Importance and Sensitivity or EIS is a measure of the conservation value. Due to the current disturbances within the study area the EIS would be rated as **MODERATE – LOW**. However, it must be noted that the Coega / Brak systems, inclusive of the lower floodplains and riparian systems are included as part of the OSMP, and with the exception of new road crossings are excluded from future development (Figure 4).

3.6.2 Wetlands

Several impacts occur within the wetland systems and these are related to alien trees, past / present grazing practices and changes in localised hydrology due to the proximity of the roads. Some of the depressions also contained dam walls or sand wining activities within the wetland boundary.

Based on the described methodology the Present Ecological State (PES) of the wetland areas were rated between **B** or Near Natural to **E**, i.e. seriously modified (i.e. <40 % of habitat remains or is functional, but still provides some form of ecological function in terms of habitat provision and flow attenuation) (Figure 4b). The scores were reduced by the alien vegetation; presence of the dam walls or overgrazing.

The Ecological Importance and Sensitivity (EIS) of the systems were rated between **High to Moderate**, due to the impacts already found within the various systems. The highest EIS rating was assigned to the intact pans /depressions due to the uniqueness of those environments, and provide important habitat for water fowl etc.

The PES and EIS scores for each of the respective wetlands is summarised in Figure 4b & 4c.

Table 3: 87 waterbodies were observed during the investigation

Wetland#	Wetland	PES	EIS	Level 1 System	Level 2 Regional Setting	Level 2 Landscape Unit	Level 4 Hydrogeomorphic Unit				Level 5 Hydrological Regime		Level 6 Wetland Characteristics
				Connectivity to Ocean	Eco-region	Landscape Setting	HGM Type	Longitudinal zonation / landform	Drainage outflow	Drainage inflow	5A Perennial / non perennial / unknown	5B Saturation periodicity	Geology / Natural or Artificial/ Vegetation / Substratum
							A	B	C	D	Seasonal / Intermittent / Unknown	Permanent / Seasonal / Intermittent / Unknown/	
1	Artificial Typha marsh	-	-	Inland	South Eastern Coastal Belt	Artificial	Artificial Typha marsh	-	-	Surface runoff	Intermittent	Intermittent	Artificial
2	Pan / depression	C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
3	Pan / depression	C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
4	Pan / depression	C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
5	Pan / depression	E	Low			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
6	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
7	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
8	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
9	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
10	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
11	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
12	Oxbow	B/C	High			Channelled Valley Bottom	Oxbow	Lowland river floodplain	Surface river flow	Surface runoff	Seasonal	Seasonal	Bontveld associates of the Albany Thicket
13	Oxbow	C/D	Moderate			Channelled Valley Bottom	Oxbow	Lowland river floodplain	Surface river flow	Surface runoff	Seasonal	Seasonal	Bontveld associates of the Albany Thicket
14	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
15	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
16	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline

Wetland#	Wetland	PES	EIS	Level 1 System	Level 2 Regional Setting	Level 2 Landscape Unit	Level 4 Hydrogeomorphic Unit				Level 5 Hydrological Regime		Level 6 Wetland Characteristics
17	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
18	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
19	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
20	Pan / depression	D	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
21	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
22	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
23	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
24	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
25	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
26	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
27	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
28	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
29	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
30	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
31	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
32	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
33	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
34	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
35	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
36	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
37	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
38	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline

Wetland#	Wetland	PES	EIS	Level 1 System	Level 2 Regional Setting	Level 2 Landscape Unit	Level 4 Hydrogeomorphic Unit				Level 5 Hydrological Regime		Level 6 Wetland Characteristics
39	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
40	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
41	Pan / depression	B/C	High			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
42	Dam	-	-			Artificial	Dam	-	-	Surface runoff	Intermittent	Intermittent	Artificial
43	Dam	-	-			Artificial	Dam	-	-	Surface runoff	Intermittent	Intermittent	Artificial
44	Detention Pond	-	-			Artificial	Detention Pond	-	-	Surface runoff	Intermittent	Intermittent	Artificial
45	Detention Pond	-	-			Artificial	Detention Pond	-	-	Surface runoff	Intermittent	Intermittent	Artificial
46	Pan / depression	C/D	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
47	Pan / depression	C/D	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
48	Pan / depression	C/D	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
49	Pan / depression	C/D	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
50	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
51	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
52	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
53	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
54	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
55	Pan / depression	D	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
56	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
57	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
58	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
59	Pan / depression	D	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
60	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline

Wetland#	Wetland	PES	EIS	Level 1 System	Level 2 Regional Setting	Level 2 Landscape Unit	Level 4 Hydrogeomorphic Unit				Level 5 Hydrological Regime		Level 6 Wetland Characteristics
61	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
62	Artificial Reed bed	-	-			Artificial	Artificial Reed bed	-	-	Surface runoff	Intermittent	Intermittent	Artificial
63	Artificial Typha marsh	-	-			Artificial	Artificial Typha marsh	-	-	Surface runoff	Intermittent	Intermittent	Artificial
64	Artificial Typha marsh	-	-			Artificial	Artificial Typha marsh	-	-	Surface runoff	Intermittent	Intermittent	Artificial
65	Detention Pond	-	-			Artificial	Detention Pond	-	-	Surface runoff	Intermittent	Intermittent	Artificial
66	Detention Pond	-	-			Artificial	Detention Pond	-	-	Surface runoff	Intermittent	Intermittent	Artificial
67	Detention Pond	-	-			Artificial	Detention Pond	-	-	Surface runoff	Intermittent	Intermittent	Artificial
68	Detention Pond	-	-			Artificial	Detention Pond	-	-	Surface runoff	Intermittent	Intermittent	Artificial
69	Artificial Typha marsh	-	-			Artificial	Artificial Typha marsh	-	-	Surface runoff	Intermittent	Intermittent	Artificial
70	Artificial Typha marsh	-	-			Artificial	Artificial Typha marsh	-	-	Surface runoff	Intermittent	Intermittent	Artificial
71	Pan / depression	B	High			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
72	Pan / depression	D	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
73	Pan / depression	D	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
74	Pan / depression - Transformed	E	Low			Bench	Pan / depression - Transformed	-	-	Surface runoff	Intermittent	Intermittent	Transformed - function lost due to sand mining
75	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
76	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
77	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
79	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
80	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
81	Pan / depression	C/D	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
82	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
83	Pan / depression	C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline

Wetland#	Wetland	PES	EIS	Level 1 System	Level 2 Regional Setting	Level 2 Landscape Unit	Level 4 Hydrogeomorphic Unit				Level 5 Hydrological Regime		Level 6 Wetland Characteristics
87	Pan / depression – Transformed	E	Low			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
84	Pan / depression	B/C	Moderate			Bench	Pan / depression	-	-	Surface runoff	Intermittent	Intermittent	Bontveld associates of the Albany Thicket / Alexandria Formation Doline
85	Coega Estuary	-	Low	Estuarine		Channelled Valley Bottom	Coega Estuary	Lowland estuarine floodplain	Surface river flow	Surface runoff	Tidal	Tidal	Coega Estuary - intertidal / supratidal saltmarsh
86	Coega / Brak River	D	Moderate-Low	Riparian		Riparian zone – none wetland							

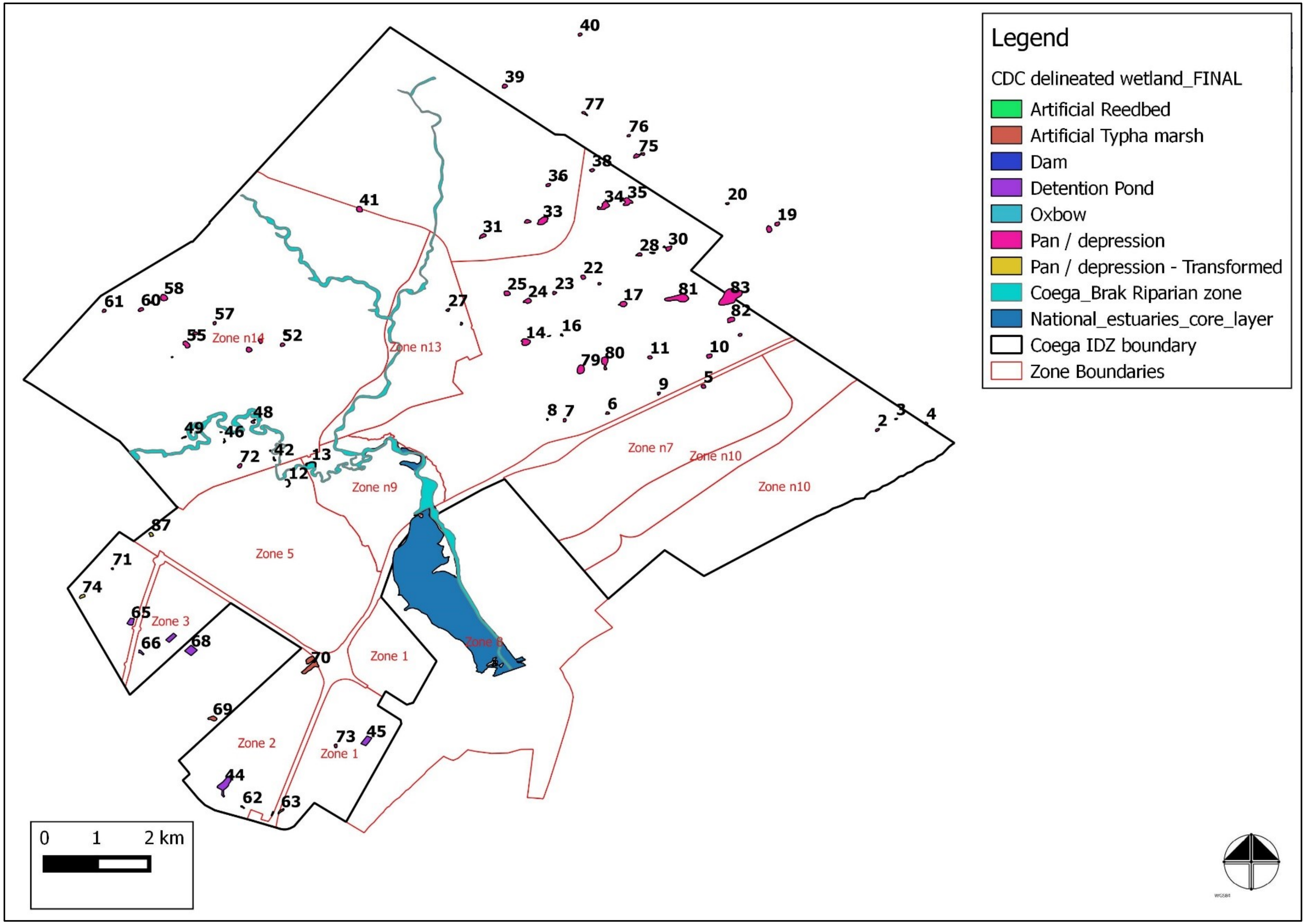


Figure 4a: The wetland and riparian delineation for the study area

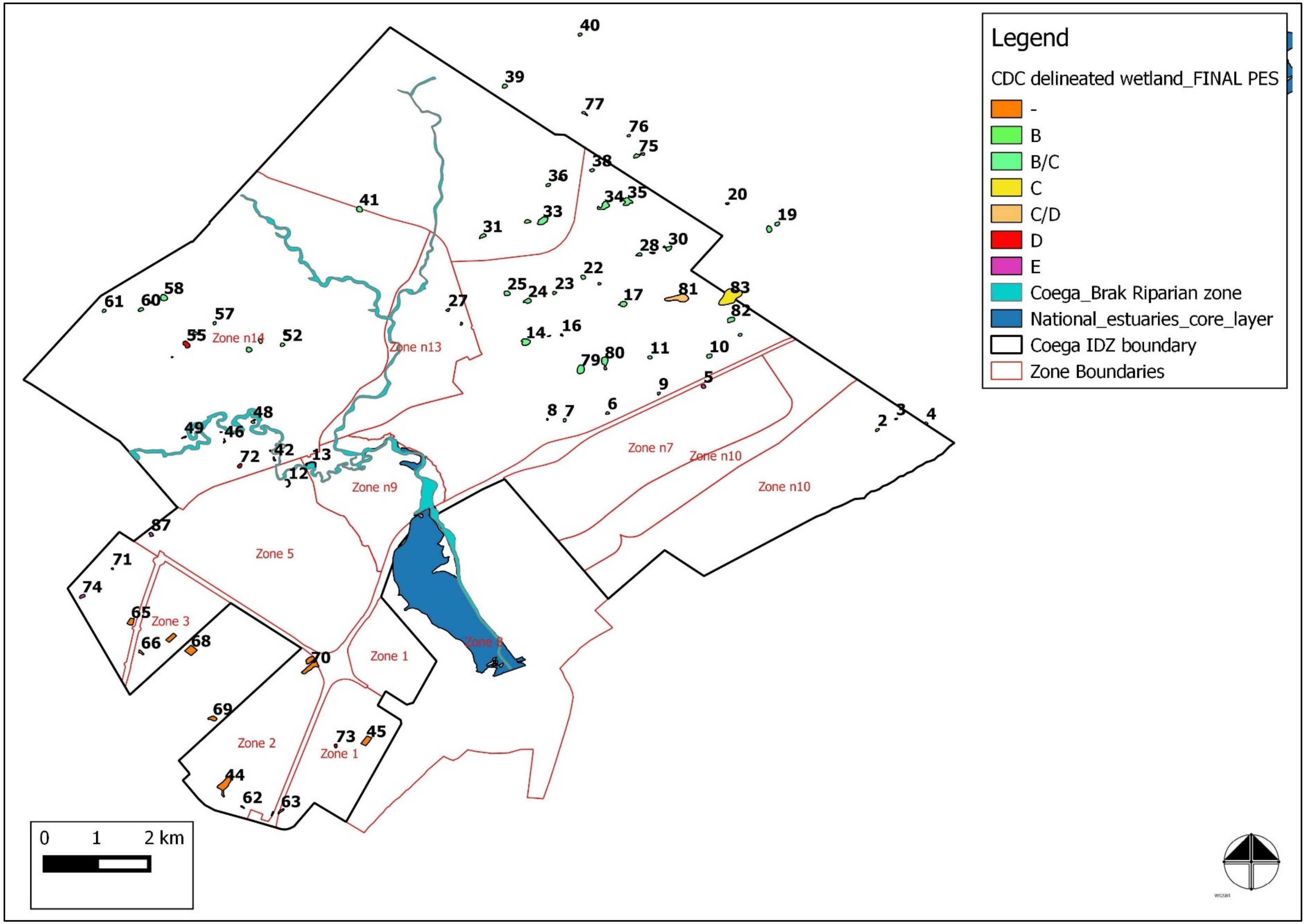


Figure 4b: The wetland delineation indicating the respective wetland Present Ecological State scores

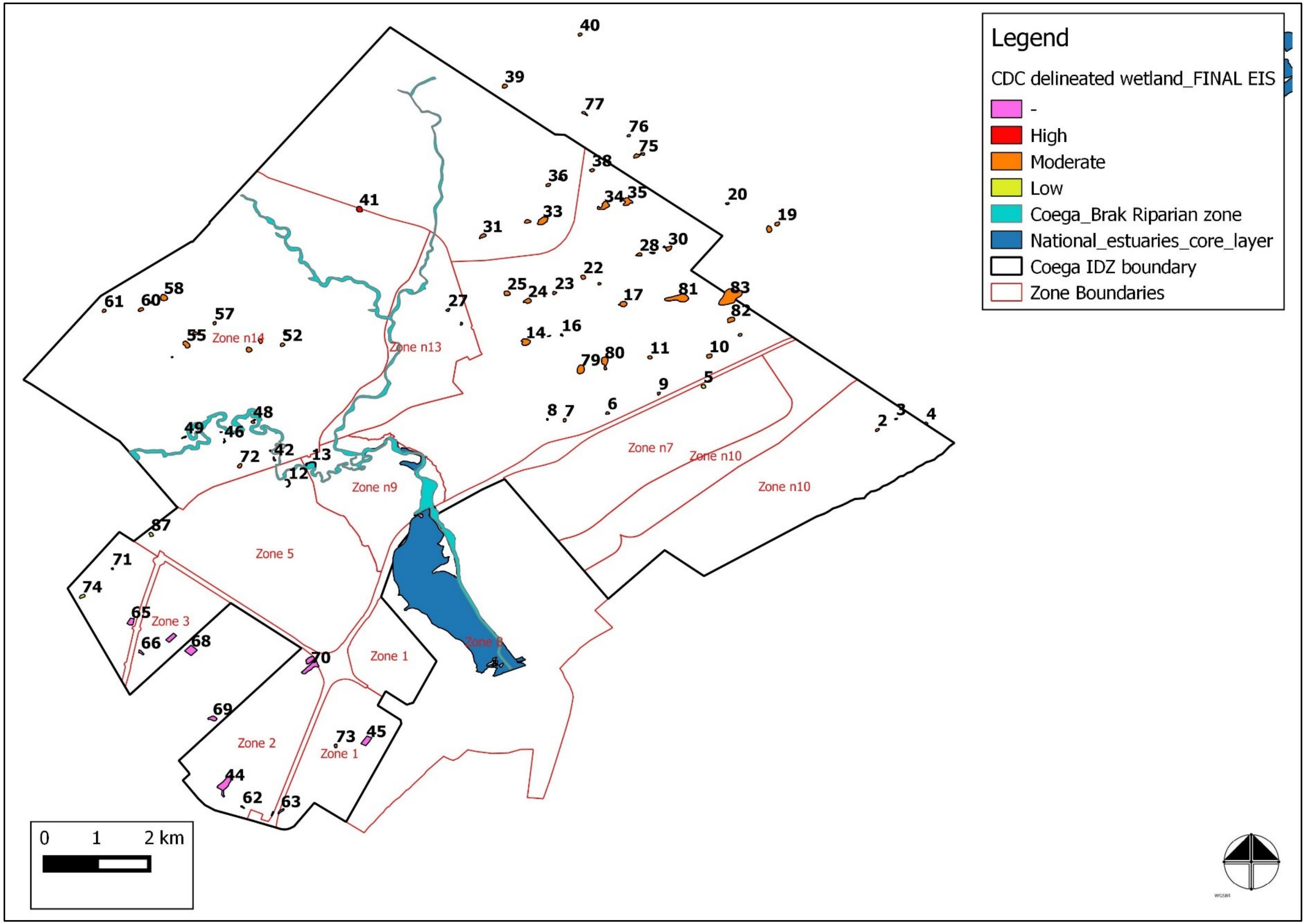


Figure 4c: The wetland delineation for the study area and the respective wetland Ecological Importance and Sensitivity Scores

4 CONCLUSION AND RECOMMENDATIONS

This assessment has focused on the greater Coega IDZ, to assess the state and functioning of the wetlands and water courses within the area. This with particular reference to future Water Use License requirements and the affected regulated zones (Figure 5). Figure 5 also indicates the Coega Estuary, but this is not regulated by the DWS.

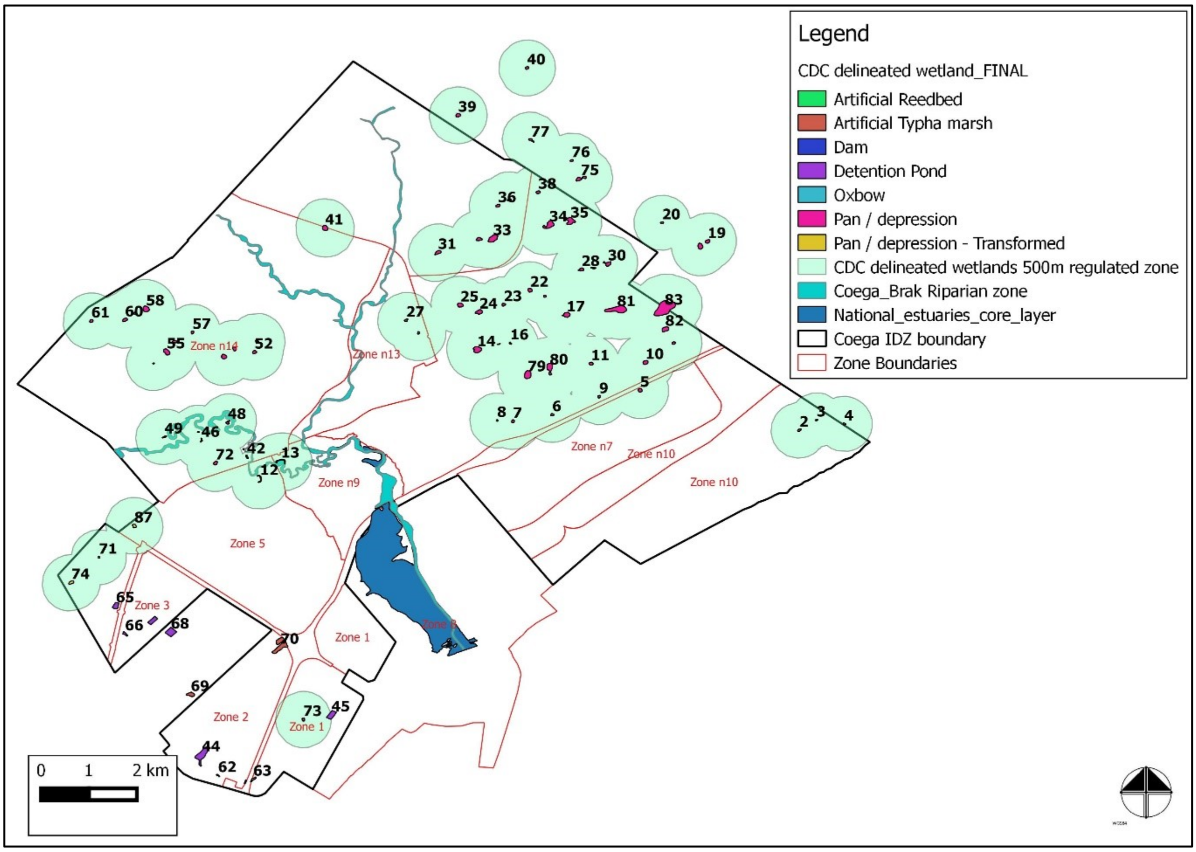


Figure 5: The results of the study and the respective regulated Water Use License Zones. The Coega Estuary, located between the two arrows is not regulated by the DWS

The freshwater ecosystems observed can be categorised based on their landscape positions and dependency on flows as follows:

<u>Pans / depressions</u>	Surface water runoff, with limited ground water links
<u>Valley bottom wetlands and rivers</u>	Surface flow and groundwater seepage dependent

A total of 87 waterbodies were identified in the study area, which included

1. 1 Estuary,
2. 14 artificial or man-made systems,
3. 2 Valley bottom channelled wetlands, and
4. 68 Pans / Depressions, two of which has been completely transformed by sand winning activities / quarrying (Figure 5).

The majority of the study area showed some degree of impact and this was largely due to the spread of alien vegetation, road and farming practices, which limits the functioning and importance of the riparian zones in particularly. This would also apply to the wetland areas, which have shown some degree of impact, however several of the pans showed a high degree of resilience and thus their respective Present Ecological State and Ecological Importance and Sensitivity Scores were high. The transformed wetlands, particular #87 near the Coega Kop quarry has been transformed by physical and hydrological means. These no longer functional as natural ponds but have become permanent stormwater detention ponds. Thus, the aquatic biota has responded and have been replaced by species atypical of these systems (mostly by *Typha capensis*). The consequent PES / EIS scores of these systems are thus low (= completely transformed).

Based then on the future development scenarios the following future cumulative impacts are anticipated:

<u>Increased flooding:</u> With an increase in hard surface areas, an increase in flooding or peak flows are anticipated within the water courses. This is could also be affected by the road crossings during high rainfall events.

<u>Increased sediment load in the rivers:</u> Elevated turbidity due to mobilization of fine sediment, particularly during the construction phase, can have a significant and even lethal impact on aquatic biota, including fish. These impacts include reduced primary production, smothering of benthic organisms and fish eggs, clogging and abrading of fish gills (leading to disease and death) and reduced feeding efficiency of visual predators.

<u>Chemical pollution</u>. During the construction of the infrastructure (culverts, bridges, roads) within the river channels and adjacent areas, a range of hazardous materials (sewerage, hydrocarbons, bitumen, cement, paints, cleaning/shutter fluids, etc.) associated with the construction activities and machinery used, could pollute the river unless great care and adequate precautions are taken. Similarly, sewerage, heavy metals and hydrocarbons are result from developed areas, infrastructure (pipeline and roads) and affect the waterbodies during the operational phases of development.

Potential loss of wetlands: It is recommended that any of these delineated areas be avoided in future together with any prescribed buffers (50m).

Loss of unique wetlands: The coastal pans / depressions occur with small zones or belts along the south African coastline, which are limited to plains or benches. These flat areas are thus highly sought after as they are easy to develop or cultivate. The study area thus contains a unique set of wetlands, in good condition and should thus not be lost or altered (physically or via changes to the hydrology). These clusters of wetland act as natural refugia in areas typically not linked to rivers, and within elevated areas above river valleys. Several of these clusters of pans exist within NMBM near Jachvlakte to the West, Kinkelbos to the East and within the study area. This is important as the wetlands allow for independent populations to survive, and should any population die out, then via wetland hopping, the pan and surrounding wetlands can be recolonised. This is relevant form a conservation point, and these clusters must then be integrated into conservation planning systems as corridors (Figure 6). This is currently being done on a provincial wide scale as part of the revision of the ECBCP for wetlands by SC&A, but will need to carried out a finer scale within the municipality and IDZ to ensure at minimum that at least a subset of these are conserved and or integrated into the Stormwater Management Plans.

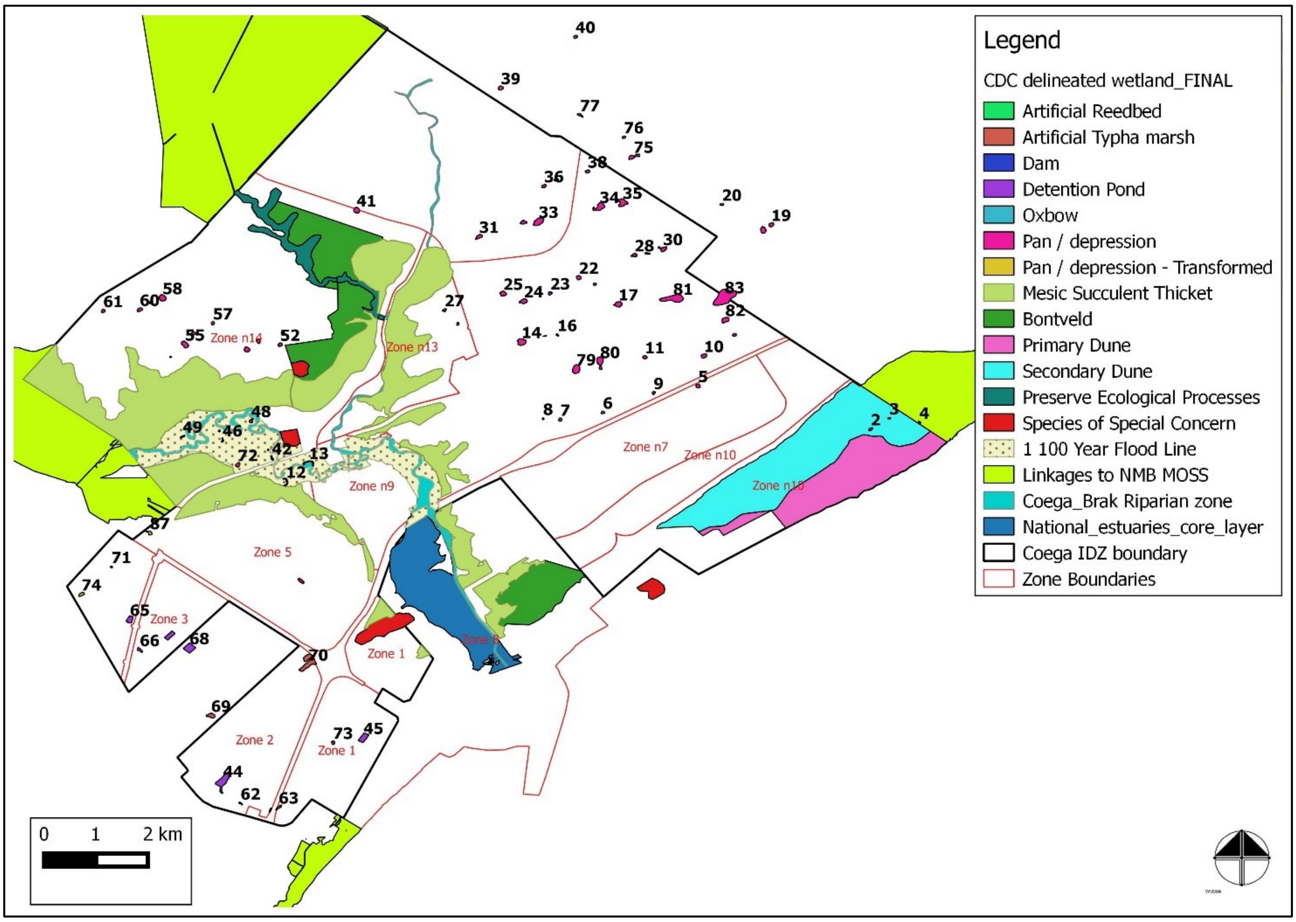


Figure 6: The current IDZ OSMP in relation to the delineated water bodies

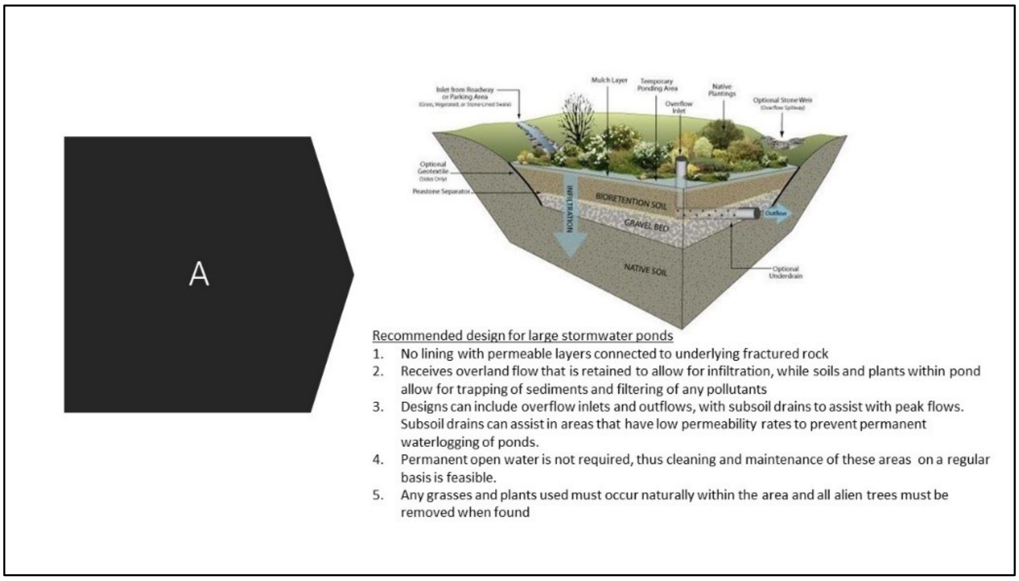
With regard design constraints, the pans are mostly dependent on surface water flows, thus any changes to their hydrological regimes will alter their form and function and thus these should be rehabilitated (See Appendix 2), i.e. all those shown with HIGH and MODERATE EIS in Figure 5c as a starting point, and then be excluded from future design plans together with a 50m buffer. This buffer would include the entire catchment for all of the pans assessed regardless of PES / EIS score.

All rivers and streams should be excluded from the development and all activities must be excluded from the 32m buffer or 1:100-year flood line, whichever is greater. This also applies to any channels associated with these areas.

Where it is not feasible to conserve the wetlands and it is suggested that these be integrated into the Stormwater Management Plan. Several design concepts particularly in the field of bioretention storm water management systems are possible. This will allow for the slowing of water velocities, passive treatment of any runoff (solid matter as well as potential harmful chemicals) and are easily integrated into the landscape design of the open space as well non-built up areas of developments (parking, road verges and walkways). These systems then allow for the maintenance of subsoil and shallow groundwater systems.

Several examples design are possible (see below Figure 7) and these will need to be discussed with the engineers to ensure that these are correctly sized, adequately spaced and are planted for suitable vegetation that naturally occurs within the region.

However, should the overall hydrology of any natural wetlands be altered, and the overall function and biodiversity be changed, this wetland would then be considered as modified and potentially be lost. This would be assessed as a High Risk (wetland lost) and a General Authorisation for that activity would not be a consideration.



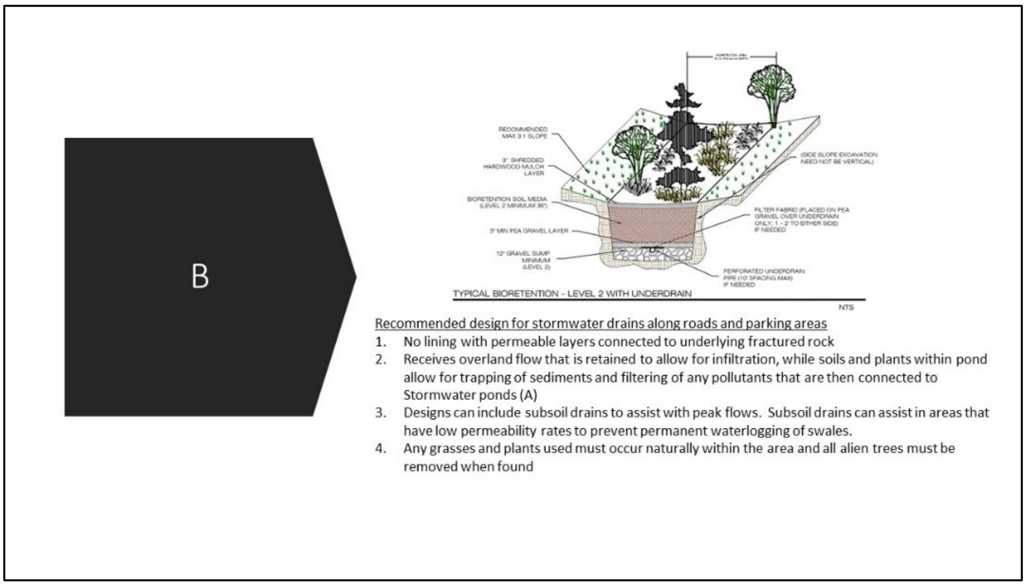


Figure 7: Conceptual designs and placement of a variety of bioretention stormwater management systems

As shown in the above concepts, a variety of options are available with regard scale, i.e. attenuation ponds to stormwater channels, that firstly cleans and filters the stormwater, prior to it being allowed to infiltrate the local groundwater systems. To reiterate the following should be included in the designs:

Recommended design for large stormwater ponds

1. No lining with permeable layers connected to underlying fractured rock
2. Receives overland flow that is retained to allow for infiltration, while soils and plants within pond allow for trapping of sediments and filtering of any pollutants
3. Designs can include overflow inlets and outflows, with subsoil drains to assist with peak flows. Subsoil drains can assist in areas that have low permeability rates to prevent permanent waterlogging of ponds
4. Permanent open water is not required, thus cleaning and maintenance of these areas on a regular basis is feasible
5. Any grasses and plants used must occur naturally within the area and all alien trees must be removed when found

Recommended design for stormwater drains along roads and parking areas

1. No lining with permeable layers connected to underlying fractured rock
2. Receives overland flow that is retained to allow for infiltration, while soils and plants within pond allow for trapping of sediments and filtering of any pollutants that are then connected to Stormwater ponds (A)
3. Designs can include subsoil drains to assist with peak flows. Subsoil drains can assist in areas that have low permeability rates to prevent permanent waterlogging of swales.
4. Any grasses and plants used must occur naturally within the area and all alien trees must be removed when found

5 REFERENCES

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6 APPENDIX 1: GENERIC RISK ASSESSMENT MATRIX AS PER DEPARTMENT OF WATER AND SANITATION NOTICE 509 OF 2016, APPENDIX A

Available as Excel spreadsheet

7 APPENDIX 2: GENERIC REHABLITATION AND MONITORING PLAN FOR WETLANDS

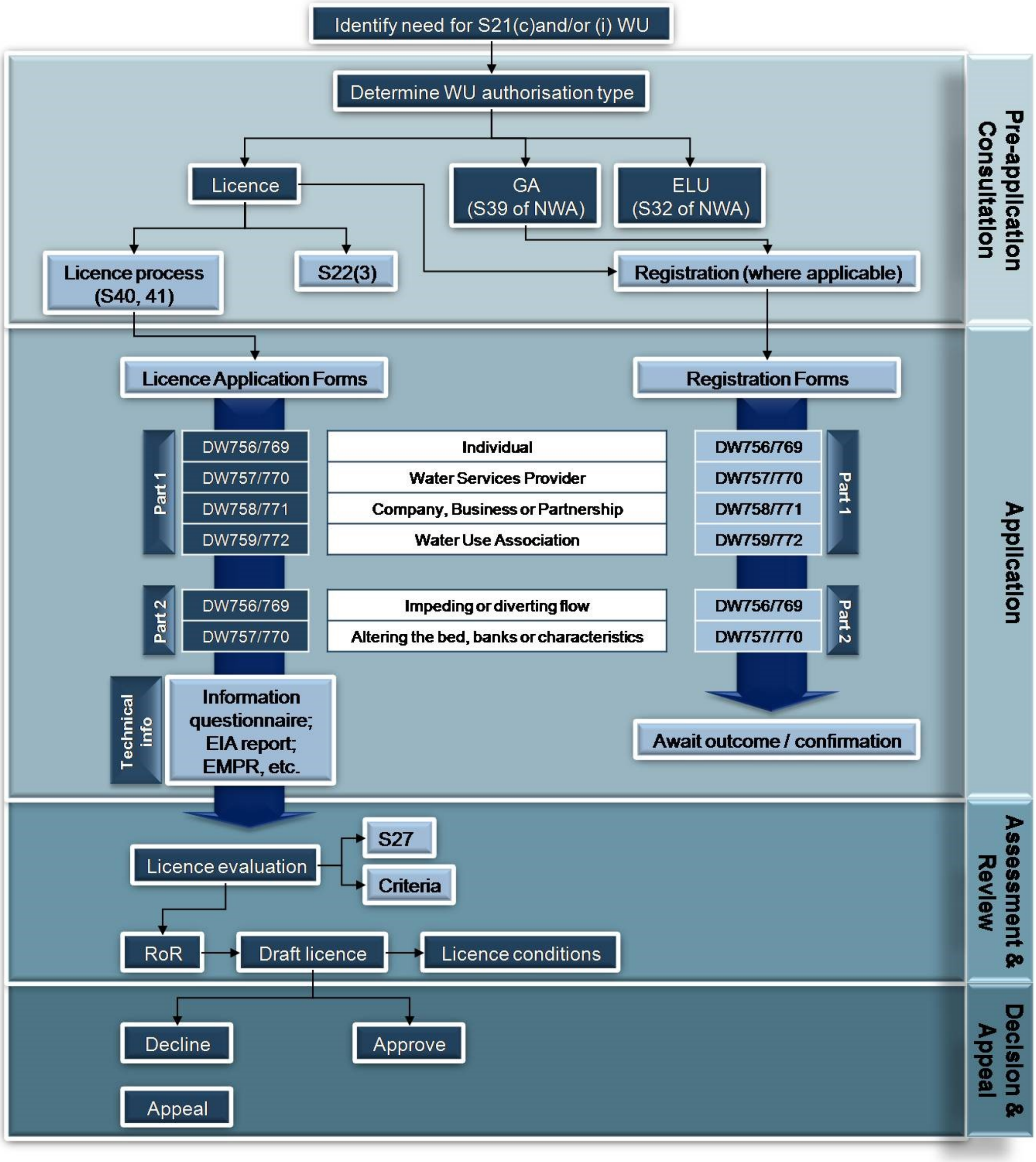
This must be adapted to suit project specific needs, and assumes no direct loss of any wetlands will occur

(Excel sheet available)

8 APPENDIX 3: WATER USE LICENSE PROCESS

A schematic representation of the Water Use License Process for Section 21 c & i uses. Although other Section 21 uses follow a similar process, not all have the General Authorisation option, such as those activities that deal with the transportation or storage of waste or effluent, e.g. sewers.

Adapted from DWS (2016) courtesy of Dr Roets



GENERIC:

WATER COURSE REHABILITATION PLAN

TEMPLATE

Prepared for:

COEGA DEVELOPMENT CORPORATION
P/B X6009
PORT ELIZABETH
6001

Prepared by:

Scherman Colloty & Associates
1 Rossini Rd
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Environmental and Aquatic Management Consulting
(CK 2009/112403/23)

SEPTEMBER 2016

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ACRONYMS

CARA	Conservation of Agricultural Resources Act
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation (previously DWA)
ECO	Environmental Control Officer
ECO/ESO	Environmental Site Officer
EMPr	Environmental Management Programme
ESO	Environmental Site Officer
SANBI	South African National Biodiversity Institute
WUL	Water Use License
WULA	Water Use License Application
WfW	Working for Water
WfWetlands	Working for Wetlands

Introduction

The objective of this document is to provide the developer / tenant with guidance with regards to rehabilitation **of any watercourse areas as well as the pans and valley bottom wetlands within the development areas located within the Coega Industrial Development Zone (Figure 1)** that may be affected. This document will also provide guidelines with regards to the monitoring of any actions that may be required as set out in the following sections. However, these should be read in conjunction with the project or site specific assessments and any prevailing environmental specifications.

Rehabilitation of the wetlands and water courses is required due to present day land use (grazing) and the high alien tree cover. This together with the inclusion of the stormwater management features, projects could provide a net benefit to the aquatic environment.

These documents will form part of the Contractors on site documents and compliance will be monitored by the appointed Environmental Control Officer (ECO) / Environmental Site Officer (ESO), and used interchangeably in this report.

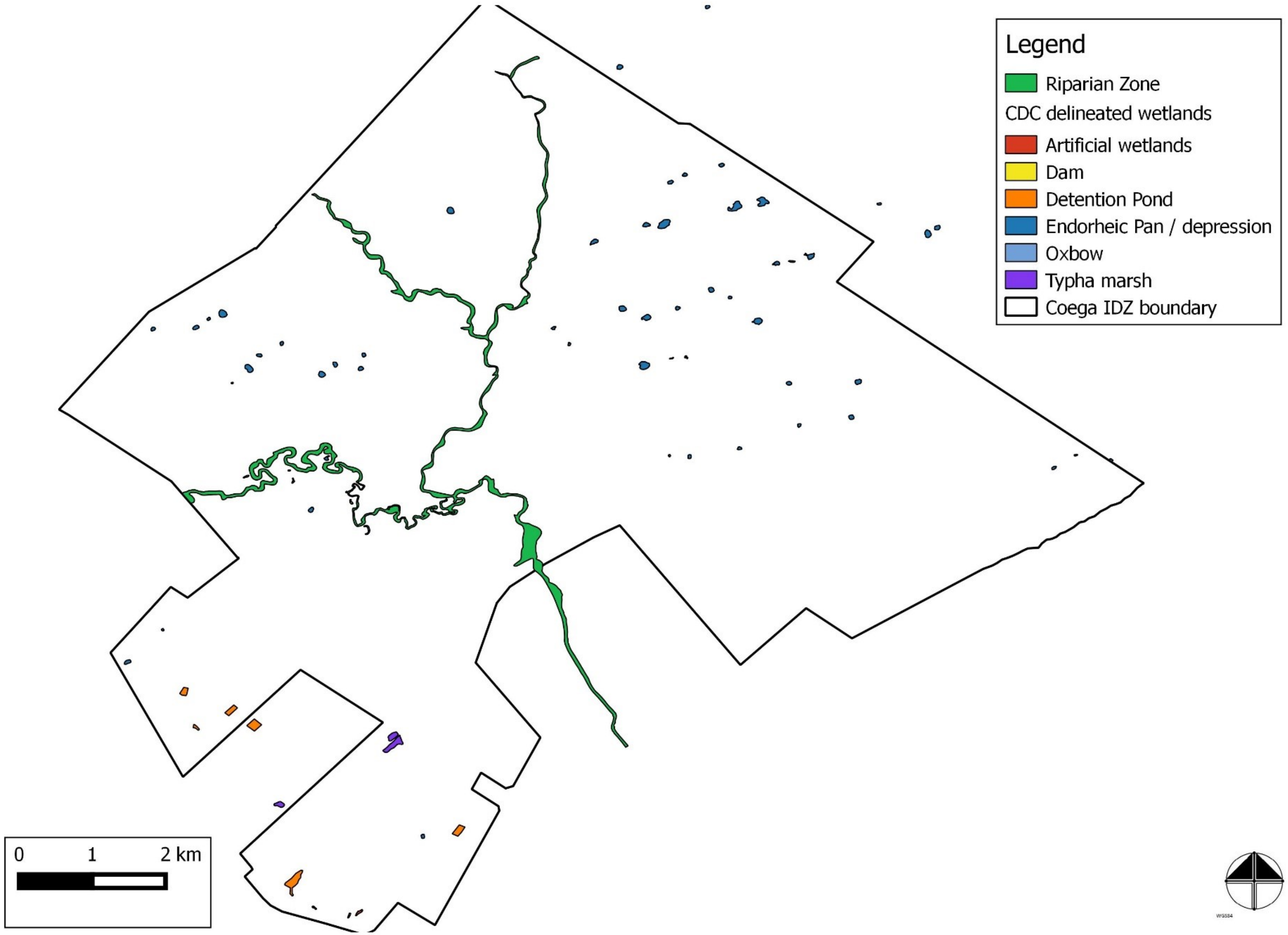

Figure 1: Locality map showing the delineated wetlands and the watercourses within the project area

Habitat Rehabilitation plan

Rehabilitation Goals and Objectives

Goals

1. Set the minimum requirements for the proposed project with regard to protecting and minimising the potential impacts immediately on the aquatic environment and over time for the terrestrial environment.
2. The proposed rehabilitation should address the proposed mitigations of the potential impacts assessed in the Specialist Assessment (SC&A, 2016) and as a minimum the impact significance after mitigation of Low must be upheld. In summary though, it has been proposed that once the alien vegetation is cleared from the water courses and around the pans (wetlands) (Figure 1), that invasive vegetation (trees or ruderal shrubs) be controlled.
3. Upon completion of all rehabilitation of the impacted areas, these should provide habitat integrity that would maintain the functioning of the aquatic zones and or surrounding terrestrial ecotones (transitional zones) so that these are not degraded and have the potential to erode when subjected to any surface water run-off.

<u>Objectives</u>

1. The rehabilitation actions below must prevent any deterioration of any downstream areas in the form of water quality and quantity changes. This extends to the spilling of materials or substances used in the construction phase, and silts or sediment as a result of destabilised soils, which can erode.
2. Any construction areas and cleared alien vegetation must be left in a stable vegetated state once the works have been completed.
3. Re-vegetation must take place using the species stipulated in the specialist reports.
4. No alien plant growth should be allowed and measures must be taken to address this within any of the demarcated public open spaces areas.
5. Specific actions with regard the steep slopes must be adhered to prevent erosion.
6. Address all the monitoring actions to ensure successful rehabilitation of the disturbed areas.
7. Note this document deals with rehabilitation any additional specifications found in the EMPr must also be adhered to.

Rehabilitation Specifications (Actions)

- It is recommended that the contractor appoint a sub-contractor with experience in re-vegetation and that the Environmental Control / Site Officer has a horticultural and/ or landscaping background or has access to someone who has the experience and that the ECO/ESO consult with a qualified botanist with regard the handling and replanting of the vegetation.
- The Contractor to fulfil the rehabilitation of disturbed areas post harvesting.
- The following document should be consulted for further support with respect to information regarding rehabilitation, namely:

The Department of Water Affairs and Forestry, February 2005. Environmental Best Practice Specifications: Construction Integrated Environmental Management Sub-Series No. IEMS 1.6. Third Edition. Pretoria.

- These specifications may be modified by the ECO/ESO on consideration of site conditions.

During and post alien clearing rehabilitation activities within watercourses and wetlands

- Proper stockpile management of topsoil will be required during the construction phase, should any disturbance along tracks or roads occur

- Rehabilitation of disturbed areas must be implemented as these areas become available for rehabilitation. This should include provision of mulch from the harvested aliens be spread within the water courses to prevent any destabilisation of soil.
- Mulch must be spread over disturbed areas (150 – 200 mm thick).
- Rip and scarify along the contours of the newly compacted areas within the water course and wetland areas before mulch is applied.
- The re-growth of alien plant species (e.g. *Acacia mearnsii.*) will need to be monitored and removed as per the conditions of the Conservation of Agricultural Resources Act (CARA). Once the ECO/ESO has fulfilled the contract obligations, the removal of aliens will be the responsibility of the project proponent. The project proponent could implement a programme assisted by Working for Water to remove all the alien plants until such time that the alien growth had been halted.
- If necessary, restrict movement of livestock in newly rehabilitated areas, where possible, while taking into consideration drinking areas/paths.

Watering

- Watering is only essential as rehabilitation should ideally occur during the rainy season. If this is not possible, an initial watering period (supplemental irrigation) will be required to ensure plant establishment (germination and established growth).
- Generous watering during the first two weeks, or until the seeds have germinated, will be necessary (unless adequate rainfall occurs) i.e. seed beds will need to be kept moist for germination to occur.

Steep slopes

Areas that have a steep gradient and require seeding for rehabilitation purposes should be adequately protected against potential run-off erosion e.g. with coir, geotextile netting or other appropriate methodology. This will then aid in protecting the adjacent aquatic zones, from potential erosion in particular.

- Where stabilisation of sandy, dispersive slopes or slopes steeper than 1:3 will be required. The following methods may be required:
    - Benches (sand bags).
    - Packed branches (not alien plant species)
    - Coir or geotextile rolls.
- Stabilisation of near vertical slopes (1:1 – 1:2), if created during construction, will be required using hard structures that have a natural look. The following methods may be required:

- Gabions (preferred method).
- Retaining walls.
- Stone pitching.

- The slopes of all watercourses where large culverts are required. The following methods may be used:
    - Reno mattresses (preferred method).
    - Coarse rock (undersize rip-rap).
    - Sandbags
    - Re-vegetation

During and post alien clearing rehabilitation activities within terrestrial areas

- Proper stockpile management of topsoil will be required during the construction phase, should any disturbance along tracks or roads occur
- Rehabilitation of disturbed areas must be implemented as these areas become available for rehabilitation. This should include provision of mulch from the harvested aliens be spread within these areas to prevent any destabilisation of soil.
- Mulch must be spread over disturbed areas (150 – 200 mm thick) as and when required to prevent soil destabilisation
- Rip and scarify compacted areas before mulch is applied.
- The re-growth of alien plant species (e.g. *Acacia mearnsii.*) will need to be monitored and removed as per the conditions of the Conservation of Agricultural Resources Act (CARA). Once the ECO/ESO has fulfilled the contract obligations, the removal of aliens will be the responsibility of the project proponent. The project proponent could implement a programme assisted by Working for Water to remove all the alien plants until such time that the alien growth had been halted.
- If necessary, restrict movement of livestock in newly rehabilitated areas, where possible, while taking into consideration drinking areas/paths.

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- Watering is only essential as rehabilitation should ideally occur during the rainy season. If this is not possible, an initial watering period (supplemental irrigation) will be required to ensure plant establishment (germination and established growth).

- Generous watering during the first two weeks, or until the seeds have germinated, will be necessary (unless adequate rainfall occurs) i.e. seed beds will need to be kept moist for Sandbags

Maintenance and duration all aquatic and terrestrial areas

- Rehabilitation will occur in phases as areas for plant rehabilitation become available and post clearing i.e. once harvesting is completed and the remaining disturbed areas become available for plant rehabilitation.
- The rehabilitation period post construction is estimated to be over a period of 6 months (minimum) to 12 months (maximum), or otherwise specified by the ECO/ESO.
- The rehabilitation phase (including post seeding maintenance) should be at least a minimum of 6 months (depending on time of seeding and rainfall) to ensure establishment of plants with a minimum achievement of 60 % cover.
- If plant establishment is not achieved within the specified maintenance period, maintenance of these areas shall be continued until at least 60 % cover is achieved (excluding alien plant species).
- Additional seeding may be necessary to achieve 60 % cover.
- Any plant that dies during the maintenance period shall be replaced by the Horticultural Landscape Contractor.
- Succession of natural plant species should be encouraged. Species that should be encourage to grow are listed in the Appendix:

Normally 80% coverage is required but due to the nature and state of the surrounding environment, 60% should be adequate, as anything higher will immediately attract livestock and thus reduce the effectiveness of the rehabilitation efforts.

Monitoring plan

With regard the potential impacts of the project on the environment, other than the physical, the most detrimental impacts includes

- Increase in sediment loads, measured as increase suspended sediments, and
- Continued growth of the alien vegetation.

Over time, the project poses a net benefit to the environment should the rehabilitation objectives be met.

The following is however proposed with regard the potential impacts on the environment:

- Monitoring of any spills from plant of machinery, erosion of cleared areas or downstream sedimentation should occur on a daily basis, with any remediation being instituted immediately (Contractor's environmental representative reporting to the ECO).
- Monitoring of any vegetated areas must take place at least every month during construction, and every three months during a maintenance period (ECO/ESO & Contractor) for a six-month period (i.e. twice) after the project works has been completed
- Monitoring, which includes the cleaning and / or reinstatement of any erosion protection measures, should occur on a biannual basis for the lifespan of the project by the developer.

The ECO/ESO should determine and stipulate the period and frequency of monitoring required in consultation with relevant stakeholders and authorities. The Site Manager and ECO/ESO must ensure that the monitoring is conducted and reported.

The following protocols are recommended with regards to monitoring and should be read in conjunction with the EMPr:

- Monthly environmental auditing as stipulated in the EMPr.
- Immediate notification of any transgression must be made to the Site Manager (& ECO/ESO) and provision of suitable mitigation measures to rectify environmental damage.
- If transgressions continues, report such incidences to the DWS immediately, although such incidences must be recorded in the audit reports.

To this end, it is suggested that the ECO/ESO also consult the following guideline as reference:

Department of Water Affairs and Forestry, February 2005. ***Environmental Monitoring and Auditing Guideline****. Integrated Environmental Management Sub-Series No. IEMS 1.7. Third Edition. Pretoria.*

Compliance

The Site Manager, the Contractor and ECO/ESO who will attend to issues should be responsible in providing suitable audit reports at appointed intervals. These reports must be kept on record and be made available upon request by the Land Owner / Custodian of the Land and any Environmental Authority or I&AP requesting such.

- All persons employed by the Contractor or his sub-contractors must abide by the requirements of the specifications contained in this report.
- Any employees of the Contractor or his sub-contractors found to be in breach of any of the Environmental Specifications may be ordered to leave the site forthwith. The order may be given orally or in writing by the Site Manager on instruction by the ECO/ESO. Confirmation of an oral order will be given as soon as practicable but lack of confirmation in writing shall not be a cause for the offender to remain on site.
- Supervisory staff of the Contractor or his sub-contractor may not direct any person to undertake any activities which would place such person in contravention of the EMP.

The Contractor should be informed via the Monitoring and Auditing Reports as well as by means of direct instruction as to what corrective actions are required in terms of the EMP

Conclusion and Recommendations

In conclusion, the activities most likely to impact the aquatic habitats in the project area are the water courses and pans. However, this document provides for various rehabilitation & monitoring conditions or guidelines within the impacted areas, should these arise. It must be read in conjunction with the above mentioned SC&A (2016) specialist study, the reports cited in this document, the EMPr and the applicable Method Statements.

References

Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983).

Department of Water Affairs and Forestry, (2005). Environmental Monitoring and Auditing Guideline. Integrated Environmental Management Sub-Series No. IEMS 1.7. Third Edition. Pretoria.

Scherman Colloty and Associates (2016). Integrated wetland assessment within the Coega Industrial Development Zone for the Coega Development Corporation.

Appendix – Typical indigenous species that occur within the region

Aristida junciformis Trin. & Rupr.
Aspalathus (cf. rubens Thunb.)
Athanasia dentata (L.) L.
Bobartia orientalis J.B.Gillett subsp. orientalis
Canthium kuntzeanum Bridson
Cheilanthes (cf. viridis (Forssk.) Sw.)
Chrysocoma ciliata L.
Cliffortia (cf. linearifolia Eckl. & Zeyh.)
Cliffortia ilicifolia L.
Crassula ericoides Haw.
Diospyros scabrida (Harv. ex Hiern) De Winter var. cordata (E.Mey. ex A.DC.) De Winter
Eragrostis capensis (Thunb.) Trin.
Eragrostis curvula (Schrad.) Nees
Erica (cf. thamnoides E.G.H.Oliv.)
Erica pectinifolia Salisb.
Euclea polyandra (L.f.) E.Mey. ex Hiern
Gnidia coriacea Meisn.
Gymnosporia buxifolia (L.) Szyszyl.
Halleria lucida L.
Helichrysum anomalum Less.
Helichrysum cymosum (L.) D.Don
Helichrysum felinum Less.
Helichrysum nudifolium (L.) Less.
Helichrysum teretifolium (L.) D.Don
Hermannia salviifolia L.f.
Indigofera denudata L.f.
Lanaria lanata (L.) T.Durand & Schinz
Lasiosiphon anthylloides (L.f.) Meisn.
Leucadendron salignum P.J.Bergius
Leucospermum cuneiforme (Burm.f.) Rourke
Lobelia tomentosa L.f.
Metalasia (cf. densa (Lam.) P.O.Karis)
Montinia caryophyllacea Thunb.
Phylica axillaris Lam.
Polygala ericaefolia DC.
Pteronia incana (Burm.) DC.
Restio triticeus Rottb.
Schizaea pectinata (L.) Sw.
Searsia lucida (L.) F.A.Barkley
Searsia rosmarinifolia (Vahl) F.A.Barkley
Selago corymbosa L.
Senecio chrysocoma Meerb.
Senecio crenatus Thunb.
Senecio elegans L.
Senecio ilicifolius L.
Senecio pauciflosculosus C.Jeffrey
Senecio pterophorus DC.

Stoebe plumosa (L.) Thunb.
Tephrosia capensis (Jacq.) Pers.
Thamnochortus fruticosus P.J.Bergius
Thesium sp.