Environmental Management and Maintenance Plan – Watercourse in Erf 7284, Dana Bay, Western Cape.

DRAFT FINAL REPORT

For:

Cape EAPrac

By:

Dr. J.M. Dabrowski

Confluent Environmental

April 2022

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aquatic consulting & research

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April 2022

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

1.1 Project Background

A non-perennial drainage line flowing through Erf 7284, Dana Bay has been identified as requiring upgrades to existing stormwater infrastructure. A hydrological analysis for a 20-year return flood (performed by V3 Consulting Engineers) indicates high energy and velocity runoff entering the watercourse. Two gabion structures that had previously been placed in the watercourse to attenuate stormwater flows have failed, which has contributed to severe erosion of the embankment that presents a risk of active slope failure. This has resulted in neighbouring residents constructing informal tyre retaining walls to stabilise the embankment and protect their properties.

Upgrades to existing stormwater infrastructure have therefore been proposed and design recommendations include an energy breaker to manage the high energy and velocity of the runoff, a step spillway, stilling basin and bio-conveyance channel. Prescribed regular maintenance is also recommended. These upgrades have prompted to the need to obtain the relevant environmental and water authorisations as required by the National Environmental Management Act (NEMA) and the National Water Act (NWA), respectively.

1.2 Key Legislative Requirements

1.2.1 National Environmental Management Act (NEMA, 1998)

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

1.2.2 National Water Act (NWA, 1998)

The Department of Water & Sanitation (DWS) is the custodian of South Africa's water resources and therefore assumes public trusteeship of water resources, which includes watercourses, surface water, estuaries, or aquifers. The National Water Act (NWA) (Act No. 36 of 1998) aims to protect water resources, through:

- The maintenance of the quality of the water resource to the extent that the water resources may be used in an ecologically sustainable way;
- The prevention of the degradation of the water resource; and
- The rehabilitation of the water resource.

A watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;

- A wetland, 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 includes, where relevant, its bed and banks.

No activity may take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). According to Section 21 (c) and (i) of the National Water Act, a Water Use License (WUL) is required for any activities that impede or divert the flow of water in a watercourse or alter the bed, banks, course or characteristics of a watercourse. The regulated area of a watercourse for section 21(c) or (i) of the Act water uses means:

a) The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or
c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

Maintenance and management activities will require work to be undertaken within a non-perennial drainage line flowing through Erf 7284 which will therefore fall within the regulated area of a watercourse. Any water use activities that do occur within the regulated area of a watercourse must therefore be assessed using the DWS Risk Assessment Matrix (GN 509) to determine whether activities may be generally authorised (Low Risk according to the Risk Assessment Matrix) or require a WUL (Medium or High Risk according to the Risk Assessment Matrix).

1.3 Scope of Work

Based on the key legislative requirements listed above, the scope of work for this report includes the following:

- A desktop review of freshwater features and provincial and national freshwater conservation plans relevant to the site;
- Undertake a site visit to the study area to verify the sensitivity of aquatic biodiversity within the proposed development footprint; and
- Develop a Maintenance and Management Plan to guide the construction and maintenance of stormwater infrastructure.

2 METHODS

2.1 Desktop Assessment

A desktop assessment was conducted to contextualize the affected watercourses in terms their local and regional setting, and conservation planning. An understanding of the biophysical attributes and conservation and water resource management plans of the area assists in the assessment of the importance and sensitivity of the watercourses, the setting of management objectives and the assessment of the significance of anticipated impacts. The following data sources and GIS spatial information were consulted to inform the desktop assessment:

- National Freshwater Ecosystem Priority Area (NFEPA) atlas (Nel at al., 2011);
- Western Cape Biodiversity Spatial Plan (CapeNature, 2017); and
- DWS hydrological spatial layers.

2.2 Baseline Assessment

A site visits was conducted on the 31st of March 2022, with the objective of identifying and classifying the watercourse, determining its Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS), and assessing the impacts of the maintenance activities on the watercourse.

2.2.1 Watercourse Classification

Classification of watercourses is important as this determines the PES and EIS assessment methodologies that can be applied. Furthermore, classification of the watercourse provides a fundamental understanding of the hydrological and geomorphic drivers that characterise the watercourse and therefore assists in the interpretation of impacts to the watercourse. The watercourses was categorised into discrete hydrogeomorphic units (HGMs) based on their geomorphic characteristics, source of water and pattern of water flow through the watercourse. These HGMs were then classified according to Ollis et al. (2013).

2.2.2 Present Ecological State

An important factor that influences the diversity and abundance of aquatic communities is the condition of the surrounding physico-chemical habitat. Habitat loss, alteration, or degradation generally results in a decline in species diversity. The PES of the affected watercourse was assessed using the Index of Habitat Integrity (IHI) (see Appendix 1).

2.2.3 Ecological Importance and Sensitivity

The ecological importance of a watercourse is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience) (Resh et al. 1988; Milner 1994). Both abiotic and biotic components of the system are taken into consideration in the assessment of ecological importance and sensitivity. The EIS of the affected watercourses was assessed using the methodology described in Appendix 2.

3 STUDY SITE

Erf 7284 falls in Dana Bay, just west of Mossel Bay, within quaternary catchment K10A (Figure 1). The property is located within the urban area of Dana Bay and is bisected by a non-perennial drainage line. Below Erf 7284, the drainage line passes through a relatively large undeveloped area, characterised by a steep, meandering valley, which is mapped as a seep wetland (Figure 2). Mean annual precipitation for the catchment is approximately 415 mm the majority of which falls in the summer months from October through to March.

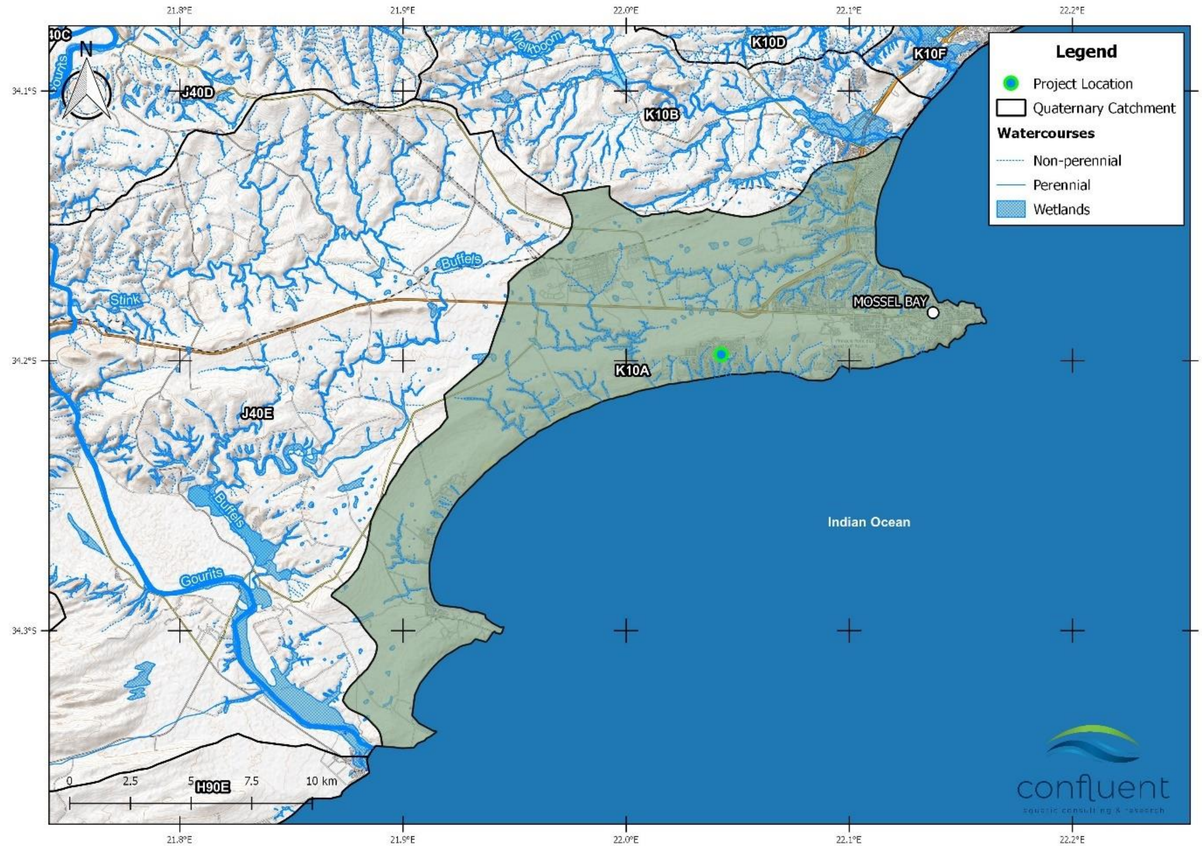

Figure 1: Location of Erf 7284 in quaternary catchment K10A.

Figure 2: Map showing Erf 7284 in relation to the non-perennial drainage line.

4 FRESHWATER FEATURES

4.1 Watercourse Classification

The site visit confirmed the watercourse is a non-perennial drainage line, which only receives intermittent flow, lasting a few hours to a few days, following heavy rainfall events. Given its location with an urban area and the high coverage of hardened surfaces in a steep catchment area, the drainage line receives relatively frequent stormwater inputs following rainfall events but does not flow permanently.

4.2 Conservation Planning

4.2.1 National

According to the Department of Forestry Fisheries and Environment (DFFE) Screening Tool, aquatic biodiversity within the site has been identified as **Very High** on the basis that the site falls within a Freshwater Ecosystem Priority Area (FEPA) (sub-quaternary catchment 9292). Rivers FEPAs achieve biodiversity targets for river ecosystems and threatened/near-threatened fish species and were identified in rivers that are currently in a good condition (A or B ecological category). Their FEPA status indicated that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources (Nel et al., 2011).

For river FEPAs, the whole sub-quaternary (or quinary) catchment is identified as a FEPA, although the FEPA status applies to the actual river reach within such a sub-quaternary catchment. The shading of the whole sub-quaternary catchment indicates that the surrounding land and catchment area needs to be managed in a way that maintains the good ecological condition of the river reach.

From the perspective of SQC 9292, the main unnamed river reach for which a FEPA status was assigned runs south of the Petro SA refinery into the Indian Ocean (Figure 3). Given its coastal location, the SQC includes numerous additional minor coastal rivers and streams that flow directly into the Indian Ocean, most of which do not flow into the main river reach that has been identified as a FEPA.

The site and the associated freshwater features that are considered in this report fall well outside the catchment area of this main river reach. The Very High sensitivity, as specified by the screening tool, is therefore not necessarily applicable to all freshwater features that fall within the SQC, particularly the short, non-perennial, urban drainage lines that flow directly into the sea.

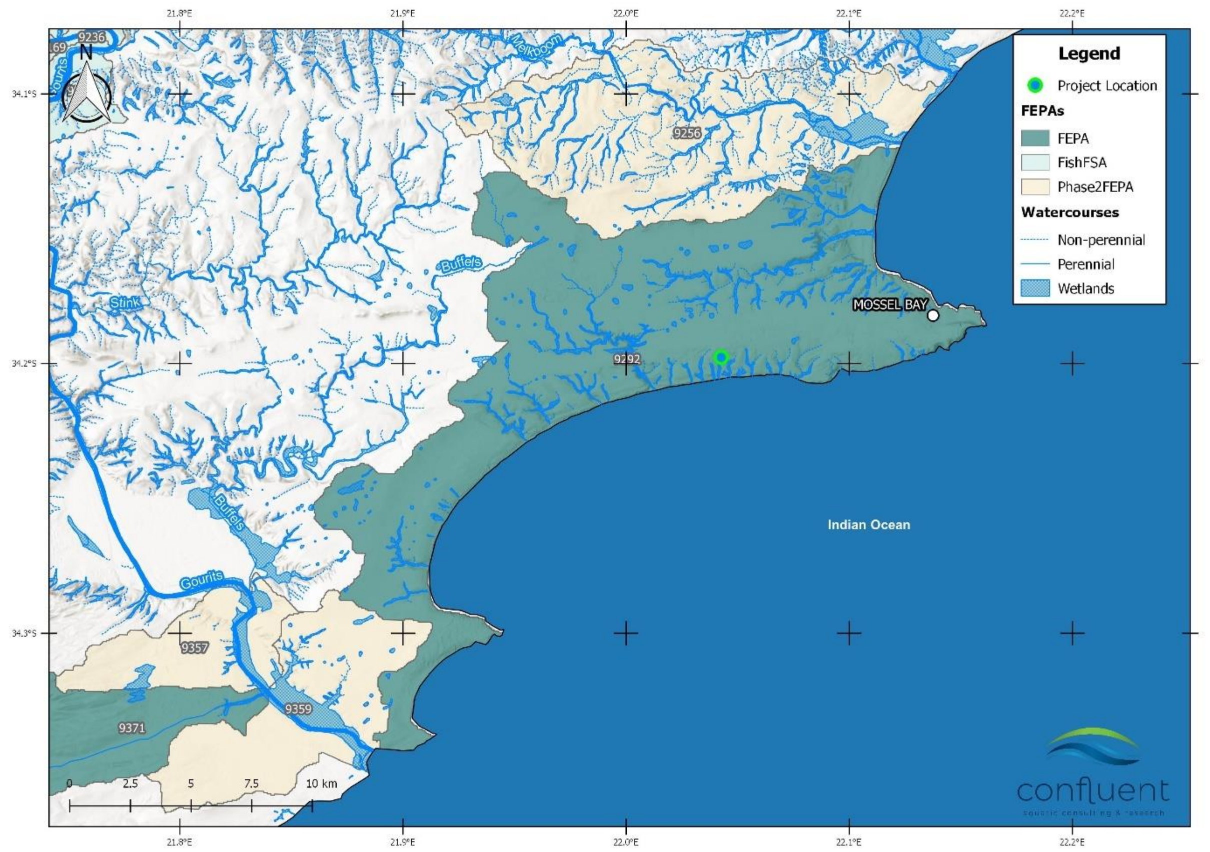

Figure 3: Map indicating the location of Erf 7284 in relation to FEPAs.

4.2.2 Provincial

According to the Western Cape Biodiversity Spatial Plan (WCBSP), the majority of the watercourse is categorized as aquatic ESA1, with small pockets as ESA2 (Figure 4). The definition and management objectives of each of the provincial conservation categories are listed in (Table 1). The proposal to construct stormwater infrastructure is planned to replace existing infrastructure that has failed (and is causing further degradation to the stream and broader hydrological network) and will not result in further loss of functional aquatic habitat. In addition, the proposals to address slope failure will also prevent further degradation of the watercourse in the short to long term.

Figure 4: Map of Erf 7284 in relation to the Western Cape Biodiversity Spatial Plan (WCBSP).

Table 1: Definitions and management objectives of the Western Cape Biodiversity Spatial Plan.

Category	Definition	Management Objective
ESA	Areas in a degraded or secondary condition that are required to meet biodiversity targets, for species, ecosystems or ecological processes and infrastructure.	Maintain in a natural or near-natural state, with no further loss of habitat. Degraded areas should be rehabilitated. Only low-impact, biodiversity-sensitive land-uses are appropriate.
ESA2	Areas that are not essential for meeting biodiversity targets, but that play an important role in supporting the functioning of PAs or CBAs, and are often vital for delivering ecosystem services.	Restore and/or manage to minimize impact on ecological processes and ecological infrastructure functioning, especially soil and water-related services, and to allow for faunal movement.

4.3 Existing Impacts

4.3.1 Stormwater Inputs

The drainage line receives high stormwater inputs via a culvert on Aloe Ferox Road (Figure 5). This has resulted in an alteration in the hydroperiod of the watercourse, causing an increase in the frequency, magnitude and velocity of flood events which has required the need for engineering interventions to mitigate associated erosion of the channel.

Figure 5: Stormwater inlet into the watercourse.

4.3.2 Gabion Structures

A series of gabion weirs had previously been constructed within the watercourse to attenuate high stormwater inputs. The volume and velocity of the discharge of the flow from the Aloe Ferox culvert enters the watercourse at a higher energy than the gabion weir structures can manage. As a result, the most upstream structure has failed and does not attenuate or absorb the energy of stormwater flows into the watercourse. A relatively deep eroded channel has formed along the upper eastern embankment which completely by-passes the gabion structure. This has resulted in undercutting and erosion of the eastern embankment. The most downstream gabion weir has silted up which renders the structure semi-functional as it is unable to attenuate the capacity of the upstream flow (Figure 6).

Figure 6: Photographs illustrating failed gabion structures and erosion of the eastern embankment.

4.3.3 Eroding Embankment

The eroding eastern embankment presents a risk of slope failure to properties immediately adjacent to the watercourse. As such the embankments have been stabilised using a combination of tyres, building rubble and wire mesh (Figure 7).

Figure 7: Photograph of tyres and rubble used to stabilise the eastern embankment.

4.3.4 Instream Habitat

The majority of instream habitat has been replaced by the gabion weir structures. Only a small section (approximately 20 m) of the lower reach of the watercourse is unaffected. The bed and banks of this section are heavily invaded by kikuyu grass (*Pennisetum clandestinum*) and the channel provides very limited instream functional aquatic habitat (Figure 8).

Figure 8: Photographs illustrating high density of *P. clandestinum* on the bed and banks of the watercourse.

4.4 Present Ecological State (PES)

While the impacts described above are severe, they are localised to a specific section of the stream alignment that falls within Erf 7284. When considered against the entire length of the drainage line the PES of the watercourse has been **Largely Modified** with a PES of **D** (Table 2).

Table 2: Present Ecological State (PES) of the non-perennial drainage line that passes through Erf 7284.

Modification	Drainage Line
Water abstraction	**0 –** No abstraction
Flow modification	**18 –** Increased frequency, magnitude and velocity of floods caused by stormwater inputs
Bed modification	**15 –** Sections of the bed have been covered by gabion structures and road crossings
Channel modification	**16 –** Increased stormwater inputs have resulted in modifications to the channel requiring the construction of gabion weirs.
Physico-chemical modification	**5 –** Minor inputs associated with stormwater.
Inundation	**0 –** No inundation
Alien macrophytes	**0** – None
Alien aquatic fauna	**0** - None
Rubbish dumping	**5 –** None
Instream IHI score	**55 (D – Largely Modified)**
Vegetation removal	**15** – Some minor vegetation removal to accommodate pastures
Invasive vegetation	**10** – Invasion by *P. clandestinum*
Bank erosion	**14 –** Serious erosion of embankment, but over a limited section of the river reach.
Channel modification	**10 –** Eroded channel due to alien invasive species.
Water abstraction	**2** – Minimally affected by exotic vegetation.
Inundation	**0–** None.
Flow modification	**0** – None
Physico-chemical modification	**0 –** None
Riparian IHI Score	**56 (D – Largely Modified)**
Combined Score	**56 (D – Largely Modified)**

4.5 Ecological Importance & Sensitivity (EIS)

Based on the in the impacts described above, and given its intermittent flow regime and low diversity of functional aquatic habitat, the stream offers very little function in terms of supporting a diverse assemblage of aquatic biota. Its main function is to convey surface runoff into more sensitive aquatic habitat located further downstream. The EIS of the watercourse is therefore considered to be **Low** (Table 3).

Table 3: Ecological Importance and Sensitivity (EIS) of the non-perennial drainage line that passes through Erf 7284.

Determinant	Drainage Line
Presence of Rare & Endangered Species	**1** – Low probability of rare or endangered taxa.
Populations of Unique Species	**0 –** Very low probability of unique aquatic species.
Intolerant Biota	**0** - Very low proportion of biota is expected to be dependent on flowing water for the completion of their life cycle.
Species/Taxon Richness	**1** - Low diversity of fauna and flora expected on a local scale.
Diversity of Habitat Types or Features	**1** – Non-perennial, with little geomorphological variation.
Refuge value of habitat types	**2** – Some refuge at a local scale.
Sensitivity of habitat to flow changes	**1** – Limited habitat – not sensitive to changes in flow.
Sensitivity to flow related water quality changes	**1** – A non-perennial stream – not sensitive to modifications in water quality.
Migration route for instream and riparian biota	**2** – Migration route for riparian biota.
Protection Status	**0** – Not protected.
EIS Score	**0.9 (Low Importance and Sensitivity)**

5 PROPOSED MAINTENANCE ACTIVITIES

A hydrological analysis conducted by V3 Consulting Engineers (Beyi, 2021), revealed a high velocity and volume discharge into the watercourse which is the main cause of the gabion structure failure and associated erosion to the eastern embankment. Based on this analysis, a hydraulic design was carried out with a view to improve the attenuation and dissipation of stormwater runoff velocity and volume.

The recommended stormwater management systems are a stepped spillway as an energy dissipation structure to reduce flow velocity and a stilling basin with an outlet weir sill to manage volume (Figure 9 and Figure 10). These are designed to ensure protection of the watercourse embankments and private property situated on the eroding banks. These measures will also minimise attenuate stormwater flows and minimise the impact on more sensitive downstream habitat.

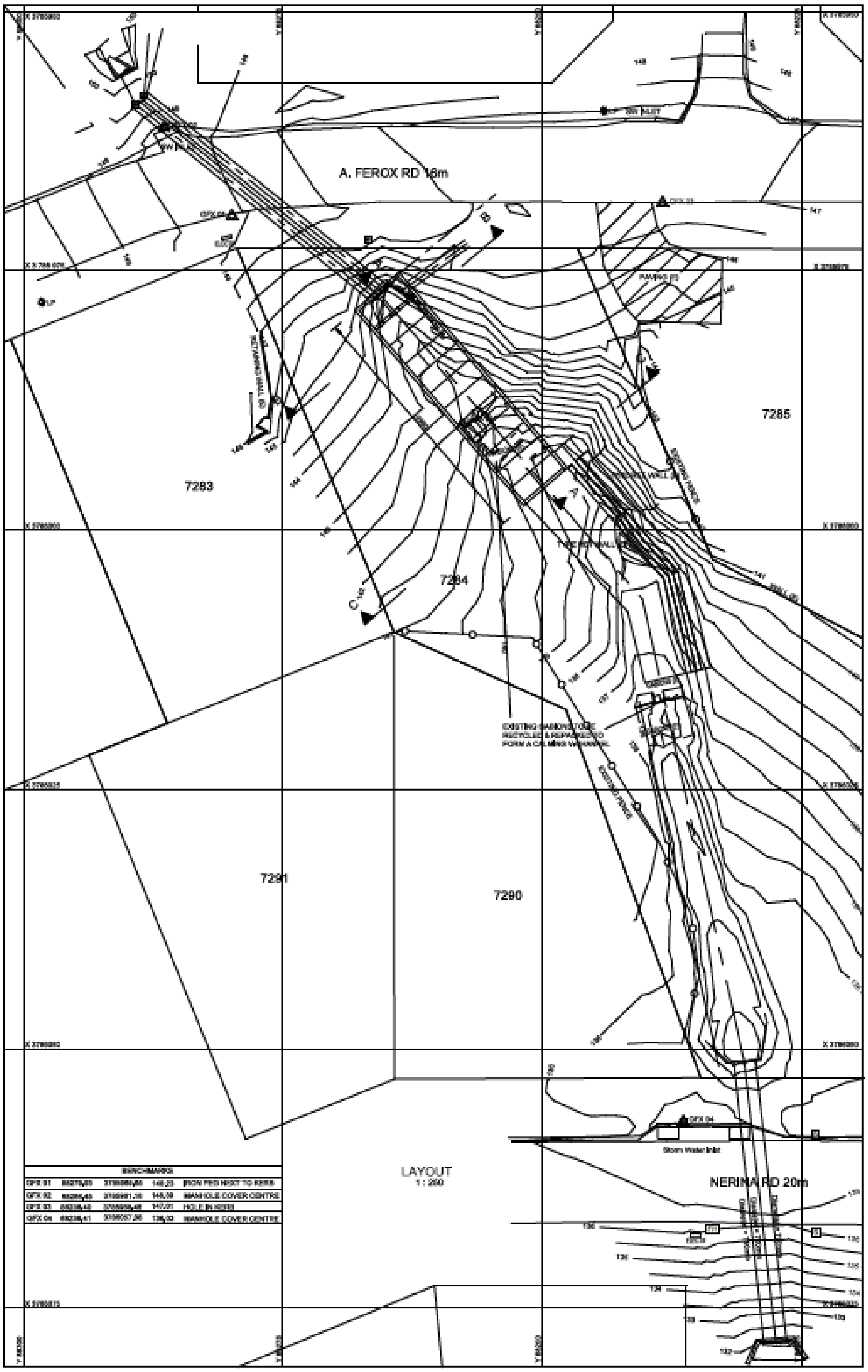

Figure 9: Plan layout of proposed stormwater infrastructure.

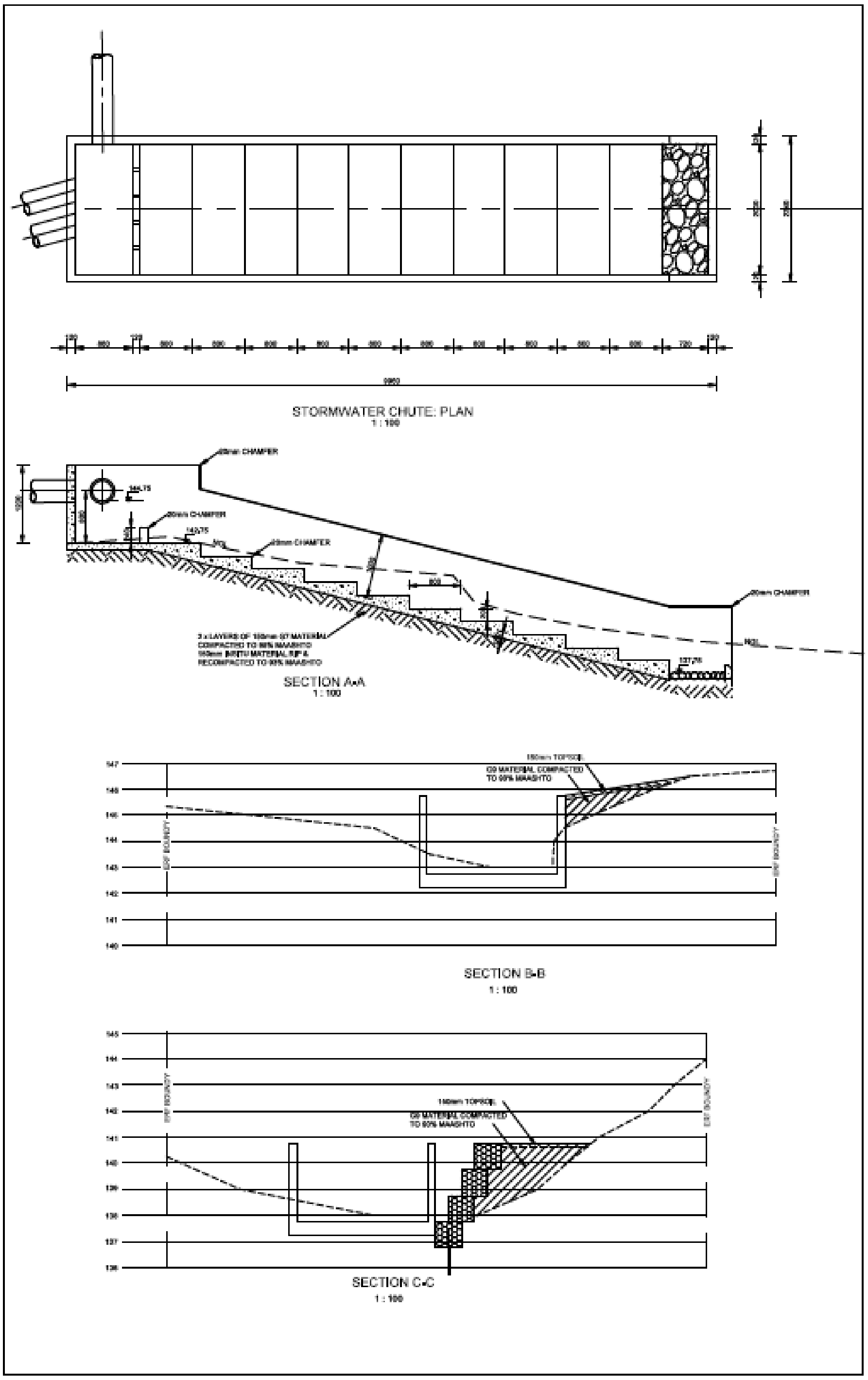

Figure 10: Plan and section drawings of the proposed stormwater chute, stilling basin and stabilisation of the embankment.

5.1 Energy Breaker

A 2 m deep stilling basin is has been proposed to break the energy of the runoff entering the watercourse from the Aloe Ferox Road culvert. The stilling basin will allow for water to fall on itself creating a stilling effect and then slowly discharge it through the toe drains into the stormwater chute (see Figure 9).

5.2 Step Spillway

According to the hydraulic analysis, the energy breaker at entry will not be sufficient to manage all the energy of the runoff. Thus, further energy management and dissipation is required. A stepped spillway will convey the runoff effectively whilst reducing the energy and velocity of the runoff. The advantage of the step spillway structure is that it reduces the scale of further dissipation structures that are needed downstream. The calculations yielded a 10-step concrete spillway with sidewalls to prevent scouring (see Figure 9 and Figure 10).

5.3 Stilling Basin

A final control structure is needed to transmit the flow from supercritical to subcritical. A stilling basin will produce a hydraulic jump and slowly discharge the controlled flow over the sill into the downstream bio-conveyance channel. The sill is reduced in size because of the efficacy of the step spillway that reduced energy before entering the stilling basin.

5.4 Bio-conveyance Channel

The downstream section between and the stilling basin and the outlet culvert on Nerina Road is a natural channel. Therefore, to promote groundwater regeneration and stormwater infiltration and reduction of peak discharge, a natural channel will be retained. Stone pitched walls will however be used to define the channel and protect the embankment from erosion and potential slope failure.

5.5 Maintenance

The system has been designed with maintenance in mind, which is critical to the long-term function and lifespan of the stormwater infrastructure. The design allows for conveyance of silt to prevent build-up and, therefore, reduce clogging and blockages. However, regular debris removal will need to take place together with cutting and removal of vegetation and overgrowth.

6 METHOD STATEMENTS

Method statements aimed at mitigating impacts associated with the construction and operation of the proposed stormwater infrastructure are described below. These are aimed primarily at protecting more sensitive wetland habitat located further downstream of Erf 7284.

6.1 Site Clearance

The site will be cleared to create a clean working area for the construction of stormwater infrastructure. Site clearance will involve the dismantling of the upstream gabion structure and the removal of the tyre embankment. Site clearance will expose the embankments and bare soil up to an area of approximately 400 m^2. This exposed soil is vulnerable to erosion which could cause sedimentation of the wetland area located further downstream. The site must therefore be managed with the main objective of preventing stormwater and surface runoff flows into the cleared area and the sedimentation of more sensitive wetland habitat located further downstream.

6.1.1 Method Statement

- Construction activities must be timed to coincide with low rainfall probability (dry season – May to August) to avoid erosion of exposed banks;
- In the event that rainfall events do occur during site clearance and subsequent construction, stormwater originating from culverts located upstream of the cleared area must be diverted by means of a temporary pipe or channel around the construction area and into the watercourse below;
- Where diversion of flows is required, it must be such that it does not result in the passage of sediment-laden water into downstream areas, or cause erosion of the bed and banks of the watercourse;
- A temporary check dam (constructed with hay bales) must be placed downstream of the cleared area (i.e. within the proposed bio-conveyance channel) as a pre-cautionary measure to capture any sediment that is washed off the cleared area during rainfall events. The check dam and any accumulated sediment must be removed by hand once construction is complete;
- Post construction, any exposed areas of soil must immediately be revegetated with a fast-growing indigenous fynbos reclamation mix. For example, the seed company Sakata produces a mix of perennial grasses consisting of *Eragrostis curvula*, *Digitaria erianthus*, *Cynodon dactylon*, *Cenchrus cilliaris* and *Eragrostis tef* and is considered ideal for the purposes of this project;
- Re-vegetation measures for the banks must be implemented timeously. In this regard, the banks should be appropriately and incrementally re-vegetated as soon as construction allows;
- Stockpiles of excavated soil or rocks must be placed outside of the main channel (on as flat an area as possible) of the watercourse and protected to prevent surface runoff of material into the watercourse;
- Excavated material that will not be re-cycled for use in the maintenance activities must be removed from the site and disposed at a suitable facility;
- Chemical toilets should be provided on-site at 1 toilet per 10 construction workers/personnel;
- Waste from chemical toilets must be disposed of regularly (at least once a week) in a responsible manner by a registered waste contractor;
- Excavators and all other machinery and vehicles must be checked for oil and fuel leaks daily. No machinery or vehicles with leaks are permitted to work in the watercourse;
- No fuel storage, refuelling, vehicle maintenance or vehicle depots to be allowed within the watercourse; and
- Refuelling and fuel storage areas, and areas used for the servicing or parking of vehicles and machinery, must be located on impervious bases and should have bunds around them (sized to contain 110 % of the tank capacity) to contain any possible spills; and
- The watercourse should be inspected on a regular basis (at least weekly) by an appropriately qualified Environmental Control Officer (ECO) for signs of disturbance, sedimentation and pollution during maintenance activities. If signs of disturbance, sedimentation or pollution are noted, immediate action should be taken to remedy the

situation and, if necessary, a freshwater ecologist should be consulted for advice on the most suitable remediation measures.

6.2 Construction of Gabion Retaining Wall, Stilling Basin and Step Spillway

Construction of stormwater infrastructure will involve activities such as mixing of cement and concrete and the establishment of laydown areas and stockpiles of construction materials, which if not managed appropriately, could lead to unnecessary impacts on the watercourse.

6.2.1 Method Statement

In addition to those methods stated in Section 6.1, the following should be implemented.

- Since the gabions will be installed against the embankment where erosion potential is high, construction must be sequenced so that they are put in place with the minimum possible delay. Disturbance of areas where gabions are to be placed should be undertaken only when final preparation and placement can follow immediately behind the initial disturbance;
- A construction schedule must be developed and clearly defined so as to avoid multiple sites being exposed and unattended to at any moment in time. The completion date for each phase of development must be indicated and all clearing, excavation, and stabilisation operations must be completed before moving onto the next phase.
- Cement/concrete used in the construction must not be mixed on bare ground or within the watercourse. An impermeable/bunded area must be established in such a way that cement slurry, runoff and cement water will be contained and will not flow into the surrounding environment, the stream or riparian zone or contaminate the soil;
- All waste materials must be collected and disposed of at a suitable waste facility;
- The laydown area and stockpiles of construction materials must be place outside of the channel of the watercourse (on as flat an area as possible) and protected (e.g. through use of sandbags and/or tarpaulins) to prevent materials being washed into the watercourse; and
- Areas where instream maintenance activities will take place must be confined to clearly demarcated areas so as to prevent unnecessary disturbance of instream habitat outside of these areas.

6.3 Future Maintenance

Generic impacts are associated with the presence/operation of workers, machinery and materials required for maintenance activities within the watercourse and include the following:

- Pollution of watercourses through leakage of fuels, oils, and other pollutants from vehicles and machinery, or from washing of equipment and vehicles;
- The presence of workers on site will require the need for appropriate ablution facilities. Poor management of these facilities could potentially lead to sewage spills or leaks which could contaminate the watercourse;
- Storage of materials or the temporary lay-down of equipment within an area that drains in the direction of the watercourse;
- Dumping of excavated material into the watercourse;

- Poor management of waste generated during maintenance activities; and
- Mixing of concrete or cement in or in close proximity to the watercourse.

6.3.1 Method Statement

- A schedule must be drawn-up to prompt inspection of the stormwater infrastructure (at least once a month for the first six months and then once every six months thereafter), so that maintenance activities can be undertaken timeously so as to prevent damage to infrastructure and deterioration of the watercourse;
- Excavators and all other machinery and vehicles must be checked for oil and fuel leaks daily. No machinery or vehicles with leaks are permitted to work in the watercourse;
- No fuel storage, refuelling or vehicle maintenance to be allowed within the watercourse;
- Refuelling and fuel storage areas, and areas used for the servicing or parking of vehicles and machinery, must be located on impervious bases and should have bunds around them (sized to contain 110 % of the tank capacity) to contain any possible spills;
- The area(s) chosen for the stockpiling of imported building materials should be demarcated, and notices put up declaring what must be stockpiled where. No materials must be stockpiled within the channel of the watercourse;
- Chemical toilets should be provided on-site at 1 toilet per 10 persons;
- Waste from chemical toilets must be disposed of regularly (at least once a week) in a responsible manner by a registered waste contractor;
- Cement/concrete used in the maintenance must not be mixed on bare ground or within the watercourse. An impermeable/bunded area must be established in such a way that cement slurry, runoff and cement water will be contained and will not flow into the surrounding environment, the stream or riparian zone or contaminate the soil;
- Areas where instream maintenance activities will take place must be confined to clearly demarcated areas so as to prevent unnecessary disturbance of instream habitat outside of these areas;
- Sediment and vegetation cleared from stormwater infrastructure must not be dumped in the channel of the watercourse and must be disposed of at a suitable waste collection facility; and
- Workers must be properly instructed in the proper care of the environment, especially with respect to poaching, disturbance of nesting and roosting areas, disposal of human waste, garbage etc.

7 DWS RISK ASSESEMENT

The risk assessment matrix (Based on DWS 2015 publication: Section 21 (c) and (i) water use Risk Assessment Protocol) was implemented to assess risks of management and maintenance activities on the watercourse. The first stage of the risk assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions and methodology applied in the impact assessment are provided in Appendix 3 of this report.

Risks were assessed assuming full implementation of method statements described in Section 3. All ratings fall within a Low Risk class (Table 4 and Table 5). Given the low impact associated with all activities highlighted in this report, and according to Government Notice 509 of August 2016 (RSA, 2016) of the National Water Act, the proposed development of Erf 2353 is Generally Authorised and does not require a Water Use License. While the development is generally authorised, it is important to note that the water use activity should still be registered with the DWS. In this respect the following steps, as highlighted in the General Authorisation for Section 21 (c) and (i) water uses, are relevant:

1. Subject to the provisions of the General Authorisation, the applicant must submit the relevant registration forms to the responsible authority;
2. Upon completion of registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission;
3. On written receipt of a registration certificate from the Department, the applicant will be regarded as a registered water user and can only then commence with the water use as contemplated in the General Authorisation; and
4. The registration forms can be obtained from DWS Regional Offices or Catchment Management Agency office of the Department or from the Departmental website: http://www.dwa.gov.za/Projects/WARMS/Licensing/licensing1.aspx

Table 4: DWS Risk Assessment matrix for the construction phase of stormwater infrastructure in Erf 7284.

Phase	Activity	Aspect	Impact	Severity				Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	PES AND EIS OF WATERCOURSE
				Flow Regime	Water Quality	Habitat	Biota														
Construction Phase	Clearing of the site	Operation of machinery and vehicles in watercourse	Contamination of watercourse with hydrocarbons	1	2	1	1	1.25	1	1	3.25	1	1	5	1	8	26	Low	95	See Section 6.1	PES: D EIS: Low
Construction Phase	Clearing of the site	Operation of machinery and vehicles in watercourse	Disturbance of aquatic habitat	1	1	2	2	1.5	1	1	3.5	1	1	5	1	8	28	Low	95	See Section 6.1	PES: D EIS: Low
Construction Phase	Clearing of the site	Exposed soil	Erosion and disturbance of aquatic habitat	2	2	2	2	2	1	1	4	1	1	5	1	8	32	Low	95	See Section 6.1	PES: D EIS: Low
Construction Phase	Clearing of the site	Stockpiling of excavated material	Erosion and disturbance of aquatic habitat	1	2	1	1	1.25	1	1	3.25	1	1	5	1	8	26	Low	95	See Section 6.1	PES: D EIS: Low
Construction Phase	Clearing of the site	Excavation of bed and banks	Loss of aquatic habitat	1	1	2	1	1	1	1	3	1	1	5	1	8	24	Low	95	See Section 6.1	PES: D EIS: Low
Construction Phase	Construction of stormwater infrastructure	Mixing of concrete	Disturbance of aquatic habitat and water quality	1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low	95	See Section 6.1 & 6.2	PES: D EIS: Low
Construction Phase	Construction of stormwater infrastructure	Stockpiling of construction materials	Loss of aquatic habitat	1	1	1	1	1	1	1	3	1	1	5	1	8	24	Low	95	See Section 6.1 & 6.2	PES: D EIS: Low
Construction Phase	Construction of stormwater infrastructure	Waste material	Degradation of aquatic habitat	1	2	1	1	1.25	1	1	3.25	1	1	5	1	8	26	Low	95	See Section 6.1 & 6.2	PES: D EIS: Low

Table 5: DWS Risk Assessment matrix for the operational phase of stormwater infrastructure in Erf 7284.

Phase	Activity	Aspect	Impact	Flow Regime	Water Quality	Habitat	Biota		Severity	Spatial scale	Duration		Consequence		Frequency of activity	Frequency of impact	Legal Issues	Detection		Likelihood	Significance	Risk Rating	Confidence level	Control Measures	PES AND EIS OF WATERCOURSE
Operational Phase	Accumulation of silt and debris	Reduced energy dissipation of infrastructure	Erosion of bed and banks	**1**	**1**	**1**	**1**		**1**	**1**	**1**		**3**		**1**	**1**	**5**	**1**		**8**	**24**	**Low**	**95**	See Section 6.3	PES: D EIS: Low
	Growth of vegetation	Reduced energy dissipation of infrastructure	Erosion of bed and banks	**1**	**1**	**1**	**1**		**1**	**1**	**1**		**3**		**1**	**1**	**5**	**1**		**8**	**24**	**Low**	**95**	See Section 6.3	

8 CONCLUSION

The construction of stormwater infrastructure in the watercourse in Erf 7284 will replace existing gabion structures that have failed. The watercourse is located in the urban area of Dana Bay, is highly modified (**PES - D**), offers limited ecological function (**EIS - Low**) and the construction of stormwater infrastructure will not result in any further loss to aquatic biodiversity and will not compromise the national or provincial freshwater conservation management objectives of the watercourse and broader catchment area (subject to the implementation of the recommendations included in the method statements). The risk to the watercourse as determined by the DWS Risk Assessment is **Low** and the activities can therefore be generally authorised. The stormwater infrastructure is expected to improve the attenuation of stormwater flows which is considered as beneficial for the protection of more sensitive wetland and aquatic habitat located further downstream of Erf 7284. It is the view of this specialist that the MMP as presented in this report should therefore be authorised.

9 REFERENCES

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10 APPENDICES

Appendix 1 – Index of Habitat Integrity

Index of Habitat Integrity (IHI; Kleynhans, 1996). The IHI was regarded as the most appropriate method for assessing riverine habitats as it is not dependent on flow in the watercourse and, therefore, produces results that are directly comparable across perennial and non-perennial systems. The IHI was developed as a rapid assessment of the severity of impacts on criteria affecting habitat integrity within a river reach. Instream (water abstraction; flow modification; bed modification; channel modification; physico-chemical modification; inundation; alien macrophytes; rubbish dumping) and riparian (vegetation removal, invasive vegetation, bank erosion, channel modification, water abstraction, inundation, flow modification, physico-chemistry) criteria are assessed as part of the index. Each of the criteria are given a score (from 0 to 25, corresponding to no and very high impact, respectively – Table 6) based on their degree of modification, along with a confidence rating based on the level of confidence in the score.

Weighting scores are used to assess the extent of modification for each criterion (x):

$$Weighted\ Score = \frac{IHI_x}{25} \times Weight_x$$

Where;

- IHI = rating score for the criteria (Table 6);
- 25 = maximum possible score for a criterion; and
- Weight = Weighting score for the criteria (Table 7).

Table 6: Descriptive classes for the assessment of habitat modifications (Kleynhans, 1996)

Impact Class	Description	Score
None	No discernible impact, or the modification is located in a way that has no impact on habitat quality, diversity, size and variability.	0
Small	The modification is limited to very few localities and the impact on habitat quality, diversity, size and variability are also very small.	1-5
Moderate	The modifications are present at a small number of localities and the impact on habitat quality, diversity, size and variability is limited.	6-10
Large	The modification is generally present with a clearly detrimental impact on habitat quality, diversity, size and variability. Large areas are, however, not influenced.	11-15
Serious	The modification is frequently present and the habitat quality, diversity, size and variability in almost the whole of the defined area are affected. Only small areas are not affected.	16-20
Critical	The modification is present overall with a high intensity. The habitat quality, diversity, size and variability in almost the whole of the defined section are influenced detrimentally.	21-25

Table 7: Criteria and weights used for the assessment of instream and riparian zone habitat integrity

Instream Criteria	Weight	Riparian Zone Criteria	Weight
Water abstraction	14	Indigenous vegetation removal	13
Flow modification	13	Exotic vegetation encroachment	12
Bed modification	13	Bank erosion	14
Channel modification	13	Channel modification	12
Water quality	14	Water abstraction	13
Inundation	10	Inundation	11
Exotic macrophytes	9	Flow modification	12
Exotic fauna	8	Water quality	13
Solid waste disposal	6		
TOTAL	**100**		**100**

The estimated impacts of all criteria calculated this way are summed, expressed as a percentage and subtracted from 100 to arrive at an assessment of habitat integrity for the instream and riparian components, respectively. An IHI class indicating the present ecological state of the river reach is then determined based on the resulting score (ranging from Natural to Critically Modified – Table 8).

Table 8: Index of habitat integrity (IHI) classes and descriptions

Integrity Class	Description	IHI Score (%)
A	Unmodified, natural.	> 90
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 – 90
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 – 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	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.	0 – 19

Reference:

Department of Water Affairs and Forestry (DWAF) (2007). Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channelled valley bottom wetland types by M. Rountree (ed); C.P. Todd, C. J. Kleynhans, A. L. Batchelor, M. D. Louw, D. Kotze, D. Walters, S. Schroeder, P. Illgner, M. Uys. and G.C. Marneweck. Report no. N/0000/00/WEI/0407. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa

Appendix 2 – Ecological Importance & Sensitivity

The ecological importance and sensitivity (EIS) of the watercourse was assessed using a method developed by Kleynhans (1999). In summary, several biological and aquatic habitat determinants are assigned a score ranging from 1 (low importance or sensitivity) to 4 (high importance or sensitivity). These determinants include the following:

- **Biodiversity support:**
  - Presence of Red Data species;
  - Presence of unique instream and riparian biota;
  - Use of the ecosystem for migration, breeding or feeding.
- **Importance in the larger landscape:**
  - Protection status of the watercourse;
  - Protection status of the vegetation type;
  - Regional context regarding ecological integrity;
  - Size and rarity of the wetland types present;
  - Diversity of habitat types within the wetland.
- **Sensitivity of the watercourse:**
  - Sensitivity of watercourse to changes in flooding regime;
  - Sensitivity of watercourse to changes in low flow regime, and
  - Sensitivity to water quality changes.

The median value of the scores for all determinants is used to assign an EIS category according to Table 9.

Table 9: Ecological importance and sensitivity categories. Interpretation of average scores for biotic and habitat determinants.

Ecological Importance and Sensitivity Category (EIS)	Range of Median	Recommended Ecological Management Class
Very high: Quaternaries/delineations that are considered to be unique on a national or even international level based on unique biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3 and <=4	A
High: Quaternaries/delineations that are considered to be unique on a national scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) may be sensitive to flow modifications but in some cases, may have a substantial capacity for use.	>2 and <=3	B
Moderate: Quaternaries/delineations that are considered to be unique on a provincial or local scale due to biodiversity (habitat diversity, species diversity, unique species, rare and endangered species). These rivers (in terms of biota and habitat) are usually not very sensitive to flow modifications and often have a substantial capacity for use	>1 and <=2	C
Low/marginal: Quaternaries/delineations that are not unique at any scale. These rivers (in terms of biota and habitat) are generally not very sensitive to flow modifications and usually have a substantial capacity for use.	>0 and <=1	D

Reference:

Duthie, A. (1999). IER (Floodplain Wetlands) Determining the Ecological Importance and Sensitivity (EIS) and Ecological Management Class (EMC). Resource Directed Measures for Protection of Water Resources: Wetland Ecosystems. Department of Water Affairs and Forestry.

Appendix 3 - DWS Risk Assessment Methodology

Definitions:

- An activity is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation;
- An aspect is an 'element of an organizations activities, products and services which can interact with the environment'. The interaction of an aspect with the environment may result in an impact;
- Environmental impacts are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity;
- Resources are components of the biophysical environment and include the flow regime, water quality, habitat and biota of the affected watercourse; and
- Severity refers to the degree of change to the status of each of the receptors (Table 10). An overall severity score is calculated as the average of all scores receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- Spatial extent refers to the geographical scale of the impact (Table 11).
- Duration refers to the length of time over which the stressor will cause a change in the resource or receptor (Table 12).
- Frequency of activity refers to how often the proposed activity will take place (Table 13).
- Frequency of impact refers to the frequency with which a stressor (aspect) will impact on the resource (Table 14).

Method:

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary. In accordance with the method stipulated in the risk assessment key, all impacts for flow regime, water quality, habitat and biota were scored as a 5 (i.e. average Severity score of 5) as all activities will occur within the delineated boundary of the wetland.

Table 10: Scores used to rate the impact of the aspect on resource quality (flow regime, water quality, geomorphology, biota and habitat).

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5

Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland.

Table 11: Scores used to rate the spatial scale that the aspect is impacting on.

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

Table 12: Scores used to rate the duration of the aspects impact on resource quality.

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5

Table 13: Scores used to rate the frequency of the activity.

Annually or less	1
Bi-annually	2
Monthly	3
Weekly	4
Daily	5

Table 14: Scores used to rate the frequency of the activity's impact on resource quality.

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table 15: Scores used to rate the extent to which the activity is governed by legislation.

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5

Table 16: Scores used to rate the ability to identify and react to impacts of the activity on resource quality, people and property.

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table 17: Rating classes

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

Table 18: Calculations used to determine the risk of the activity to water resource quality

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance\Risk = Consequence x Likelihood