APPENDIX G: SPECIALIST REPORTS

Appendix G1: Freshwater specialist assessment

Appendix G2: HWC NID and heritage screener

Appendix G1: Freshwater specialist assessment

FRESHWATER ASSESSMENT FOR THE REHABILITATION OF THE DISTILLERY ROAD BRIDGE OVER THE PLANKENBRUG RIVER, STELLENBOSCH

Distillery Road Bridge
Prepared for: AECOM

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BASIS OF REPORT

EXECUTIVE SUMMARY

Introduction

The Distillery Road Bridge over the Plankenburg River in southwestern Stellenbosch is part of the only access route to a mixed business and residential area otherwise isolated by the river and railway. It is in a poor state of repair and has been reduced to a single lane, causing traffic interruptions, and appears to be deteriorating. It also makes no allowance for non-motorised transport, nor is the width in line with national standards for this class of road. The bridge also presents a narrow opening for river flow that may flood during 1:10-year flood events. The bridge sub- and superstructure therefore require urgent replacement due to safety concerns.

AECOM SA (Pty) Ltd (AECOM) has been appointed to undertake Structural Engineering Services for the rehabilitation and expansion of the bridge, and have in turn appointed SLR Consulting (South Africa) (Pty) Ltd to undertake a Basic Assessment, apply for a Water Use Authorisation and undertake a Freshwater Assessment for the proposed project.

The project area was defined for the assessment as broadly as possible to include the entire area around the bridge where any project-related activities may take place and therefore includes the entire area in which direct impacts may occur (refer to Figure A below). The actual disturbance footprint is likely to be significantly smaller than the defined 2.7ha project area, particularly if the proposed mitigation measures are implemented.

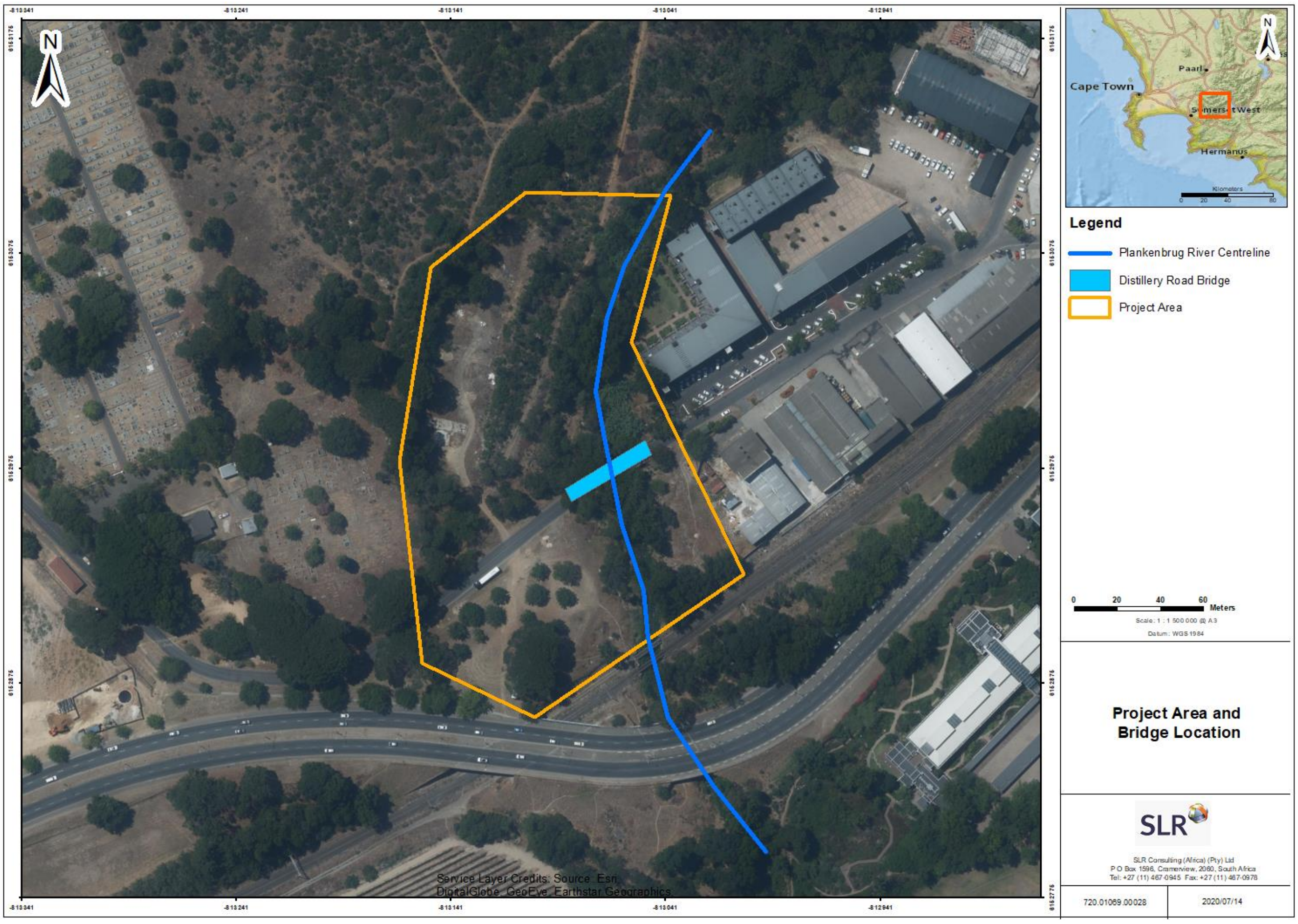

Figure A: Location of the project area and Distillery Road Bridge (blue block) relative to the Plankenbrug River. The large double lane road near the bottom of the map is Adam Tas Road

Desktop Assessment

The project area falls within the Southwestern Coastal Belt Ecoregion (DWA, 1999), the Berg Water Management Area and the G22H quaternary catchment (WCG, 2020). The terrestrial vegetation type is Critically Endangered Swartland Granite Renosterveld. Desktop resources indicated four potential Critical Biodiversity Area Class 1 (CBA1) wetlands within 500 m of the bridge and the Plankenbrug River which flows underneath it. One of the four wetlands is located on the Eerste River approximately 130 m upstream of the confluence with the Plankenbrug and therefore will not be impacted by the proposed project and was therefore excluded from further assessment. The WCBSP (2017) also indicated terrestrial CBA1 areas along the west bank of the river and ESA2 areas along the east bank.

The majority of the catchment (approximately 90%) is used for agriculture (primarily viticulture), with urban land uses dominating the remaining 10%. Given the current pollution sources in the catchment, the project is not expected to cause additional water quality impacts over and above the current situation and therefore water quality testing was not warranted.

Invasive freshwater fish and shrimps dominate the majority of the Eerste River catchment, although the hardy indigenous *Galaxius zebratus* and *Sandelia capensis* fish do remain in places. A sensitive redfin minnow species *Pseudobarbus sp.* was once endemic to this system but is now extinct from its home water. There are also no novel impacts on freshwater fauna likely from the proposed project, so no fauna-based assessments are likely to yield significant or useful results. Water quality and fauna-based assessment methods have therefore not been included in the site assessment.

Site Assessment

A site assessment was undertaken on the 5th of June 2020. The project area has been historically disturbed throughout and recently disturbed in certain areas during replacement of a pipeline downstream of the bridge and other construction work. Two large areas near the west bank of the river upstream and downstream of the bridge were used previously for stockpiling, parking and general construction operations and soils in these areas are compacted.

The two possible CBA1 wetlands adjacent to the bridge on the west bank did not exhibit wetland soils or hydrophytic vegetation and were situated within the disturbed, compacted areas used for construction operations and had limited terrestrial vegetation. The third wetland further south was found to be a grassy knoll without a wetland vegetation community situated at least 3 m higher than the river level. It is highly unlikely to have ever been impacted by the water quality or hydrological impacts associated with the river and is not likely to be impacted by the proposed project upstream and was therefore excluded from further assessment.

The Plankenbrug River was fast flowing in the vicinity of the bridge and sedimentation was restricted to isolated areas of slower flow out of the main current. Where sediment did accumulate, the grain sizes were mixed and included fine organic sediments. The banks were largely compacted and infilled, but upstream of the bridge on the west bank, the soils were alluvial and appeared more natural. The alluvial soils lacked wetland indicators and confirmed that this portion of the Plankenbrug River is a river and not a channelled valley bottom wetland. The steep infilled banks are indicative of historical channelling to constrain the river and prevent flooding of adjacent infrastructure.

Vegetation along the river margins was dominated by invasive alien species. The marginal vegetation within the river channel was dominated by herbaceous aliens interspersed with occasional indigenous species. Upstream of the bridge on the west bank of the river the riparian zone comprised a combination of mature alien and indigenous riparian trees, with an understory dominated by alien grasses and herbaceous species.

The remainder of the project area was terrestrial and dominated by bare soil and alien and indigenous grasses typical of disturbed sites. No indigenous terrestrial vegetation was noted within the project area apart from *Cynodon dactylon* grass.

Watercourse Assessment

The Plankenbrug River was assessed to determine Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) and the Recommended Ecological Category (REC) using the methods indicated in the DWA 1999 Resource Directed Measures for the Protection of Water Resources. A PES score of 44.94 was calculated using the River Intermediate Habitat Integrity (IHI) Assessment method which falls within a Category D (Largely Modified). An EIS median score of 2 was calculated which falls within the "Moderate" EIS Category. Given the Moderate EIS, the REC is set to maintain the PES score within an acceptable category and therefore remains within a Category D.

Impact and Risk Assessment

The following activities were identified that may impact the Plankenbrug River:

Construction Phase:

- Widening of the bridge by 10.2 m;
- Use of construction vehicles within the riparian zone and stream channel;
- Temporary diversion of parts of the stream during construction (within the limits of the stream channel);
- Excavation within the riverbed and banks;
- Use of concrete, construction chemicals, vehicles and toilets within and adjacent to the watercourse.

Operational Phase:

- Presence of a concrete structure within a watercourse;
- Presence of a bridge with an expanded opening.

The following impacts that may result from the above activities were identified and assessed using both the SLR Impact Assessment Method and the DWS (2015) Prescribed Risk Assessment matrix:

- Loss of approximately 255 m^2 of degraded riparian and marginal stream habitat by widening of the bridge;
- Disturbance of riparian and instream vegetation by operation of construction vehicles and by stockpiling of materials in the riparian zone and stream channel;
- Disturbance and compaction of sediment by operation of construction vehicles within the stream channel and riparian zone;
- Temporary, localised alteration of flow regime by flow diversion during construction;
- Potential water quality impact from spillage of construction chemicals, sewage from portable toilets and hydrocarbons from vehicles, along with localised mild reduction in dissolved oxygen during excavation of organic sediments in the stream bed;
- Direct biota mortality by operation of construction vehicles within the riparian zone and stream channel, diversion of the stream and during excavation of the bed and banks.

Operational phase:

- Slight increase in pH from leaching of hydroxyl ions from fresh concrete/cement;
- Reduced flow impedance by the new bridge, particularly during flood events.

The impact significance ratings for all potential impacts was Low or Very low before mitigation, and all were Very Low after mitigation. One operational phase impact (reduced flow impedance) received a positive rating. The results are summarised in Table A below:

Table A: Summary of the impact assessment results

Construction Phase Impacts	**Significance Rating (without mitigation)**	**Significance Rating (without mitigation)**
Loss of riparian and marginal stream habitat	Low	Very low
Disturbance of Riparian and Instream Vegetation by Construction Vehicles and Stockpiling	Very low	Very low
Disturbance and Compaction of Sediment in the Riparian Zone and Stream Channel	Very low	Very low
Flow diversion during construction	Very low	Very low
Water Quality Impacts	Very low	Very low
Direct Biota Mortality	Very Low	Very low
Operational Phase Impacts		
Water Quality Impact on pH	Very low	No mitigation
Reduced Flow Impedance due to new bridge design	Very low (Positive)	No mitigation

The results of the risk assessment using the DHSWS Prescribed Risk Matrix was similar. All ratings were in the Low Risk category after mitigation, which means that the project is eligible for registration under the General Authorisation in terms of GN 509 of 2016 and a Water Use Licence is not required.

Mitigation is only required for the construction phase. Proposed mitigation measures are as follows:

- Revegetate portions of the riparian zone that are disturbed by operation of construction vehicles during replacement of the bridge within four weeks after completion of construction works to prevent bank erosion and to improve habitat quality. Use locally indigenous plants of the following species for revegetation:
    - *Cyperus textilis* (marginal)
    - *Pteridium aquilinum* (marginal)
    - *Cliffortia strobilifera* (marginal)
    - *Olea europaea ssp. Africana* (riparian)
- Stockpile materials only within the two areas that have been historically disturbed and used during replacement of the pipeline.
- Determine the minimum operational area required within the riparian zone and stream channel for vehicular access. Demarcate this area with danger tape or a similar material and do not allow vehicular access to the stream channel or riparian zone outside of this demarcated area.
- Where possible, work from the downstream side of the bridge using either or both banks for access as this area has been recently disturbed and is least sensitive.
- If it is essential to access the area upstream of the bridge with vehicles, do so via the east bank and avoid entering the riparian area on the west bank with vehicles as far as possible.
- If it is essential to access the west bank of the river avoid removing indigenous trees within the riparian area (note: this is only applicable to the west bank upstream of the bridge). Consult an ecologist or botanist if needed to determine species.
- As far as possible, undertake work within the stream channel and banks during the summer months (November to March) to minimise the risk of erosion of the disturbed and compacted sediments during a rain event. Since the proposed project is urgent and relates to human safety, it is recommended that the relevant authorisations be processed quickly by the authorities to allow for this mitigation measure to be implemented should the authorisations be granted.
- Only divert flow if operationally necessary.
- Divert flow over as short a length of river as possible, but no more than 25m.

- Return flow to the original channel as soon as possible after completion.
- Designate a bunded area at least 30m from the stream bank for the placement of toilets, for the pouring and mixing of cement, concrete and construction chemicals and for the parking and servicing of vehicles and ensure that none of these activities occur outside of the designated bunded area.
- Do not use the river for washing vehicles.
- No river water may be abstracted for making concrete or for any other purpose.

Conclusion and Recommendations

The Plankenbrug River is the only watercourse identified that may be impacted by the proposed project. The potential impact on or risk to the Plankenbrug River is low given the nature of the proposed bridge construction activities and the degraded nature of the site. No significant long-term negative impacts are likely if the proposed mitigation measures are implemented, which may in fact have a permanent positive impact on the watercourse due to the reduced flow impedance associated with the design of the proposed new bridge, when compared to the existing bridge.

It is therefore recommended that the required Environmental and Water Use Authorisations be granted, on condition that the proposed mitigation measures are implemented.

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ACRONYMS AND ABBREVIATIONS

Acronym / Abbreviation	Definition
BA	Basic Environmental Assessment under the NEMA
CBA	Critical Biodiversity Area
DHSWS	Department of Human Settlements, Water and Sanitation
EIS	Ecological Importance Sensitivity
ESA	Ecological Support Area
FRAI	Fish Response Assessment Index
GA	General Authorisation under the NWA
GNR	Government Notice Regulation
HGM	Hydrogeomorphic
IHIA	Intermediate Habitat Integrity Assessment
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NGI	National Geographical Information service
NNR	No Natural Remaining
NWM	National Wetlands Map
NWA	National Water Act
ONA	Other Natural Area
PA	Protected Area
PES	Present Ecological State
REC	Recommended Ecological Category
SANBI	South African National Biodiversity Institute
SARHP	South African River Health Programme
SASS5	The South African Scoring System for rivers version 5
WCBSP	Western Cape Biodiversity Spatial Plan
WCG	Western Cape Government
WMA	Water Management Area
WULA	Water Use Licence Application in terms of the NWA

GLOSSARY OF TERMS

Term	Definition
Limnetic	Characterised by open freshwater
Littoral	Within the margins of a lake or the sea
Wetland	Areas with permanently, seasonally or temporarily saturated soils such that hydromorphic soil features and a hydrophytic vegetation community is present or would be present under natural conditions.
Biopores	Holes in the soil created by roots and burrowing animals that aid infiltration.
Watercourse	Any freshwater feature including wetlands, river and drainage lines.

1. INTRODUCTION

1.1 BACKGROUND

The Stellenbosch Municipality appointed AECOM SA (Pty) Ltd to undertake Structural Engineering Services for the rehabilitation and expansion of the bridge on Distillery Road over the Plankenburg River, which is a tributary of the Eerste River. The superstructure of the bridge is at least 60 years old while the substructure may be considerably older. The construction materials and methods are non-standard and in one portion of the bridge, old railway tracks have been used for reinforcing. The superstructure and particularly its cantilever beams have become cracked and reinforcing has become corroded in places. Overall, the condition of the bridge is likely to deteriorate further over time and become increasingly unsafe. The two-lane bridge has been reduced to a single lane (one way at a time) due to safety concerns toward the outer edges of the bridge resulting in severe traffic congestion during peak hours.

The existing bridge is narrow and at only 8 m wide, with only 6m of road space and does not conform to current traffic standards for this road class. No allowance has been made for any form of pedestrian or other non-motorised transport. The opening under the bridge impedes flow during high flow events such that overtopping is likely to occur once in ten years on average. (AECOM 2020, *pers. comm*.)

Given the condition and inadequacy of the current structure, Stellenbosch Municipality must resolve the various safety issues and proposes complete rehabilitation and expansion of the super- and substructure of the bridge. SLR Consulting (Pty) Ltd. have therefore been appointed to conduct a Basic Environmental Assessment (BA), Water Use Licence Application (WULA) and freshwater specialist impact and risk assessment (this report) to inform both applications.

1.2 LOCATION AND PROJECT AREA

The bridge is located in the southwest corner of the Stellenbosch town. The bridge lies toward the southern extreme of Distillery Road and immediately north of the R310 (Adam Tas Road). It is the only access route for an isolated industrial area east of the bridge. The bridge structure is approximately 45 m long and spans a space of approximately 20 m from the top of the west bank to the top of the east bank.

Access for bridge construction may be required from both banks of the river, both upstream and downstream of the bridge. A storage/stockpiling, parking and general operational area will also be needed in close proximity to the bridge. An approximate project area has therefore been defined for the purposes of this study that includes the watercourse and both banks of the river, upstream and downstream of the existing bridge, a previously disturbed operational area used in replacement of an adjacent bulk water pipeline, and a reasonable margin surrounding these areas to cater for potential edge effects, covering approximately 2.7ha. Refer to Figure 1-1 below.

The project area for the purposes of this report should therefore be interpreted as the entire area in which direct impacts may occur. Large portions of the project area may also be undisturbed during construction and operation phases, particularly if the mitigation measures included in this report are applied. It is therefore significantly broader than the likely disturbance footprint.

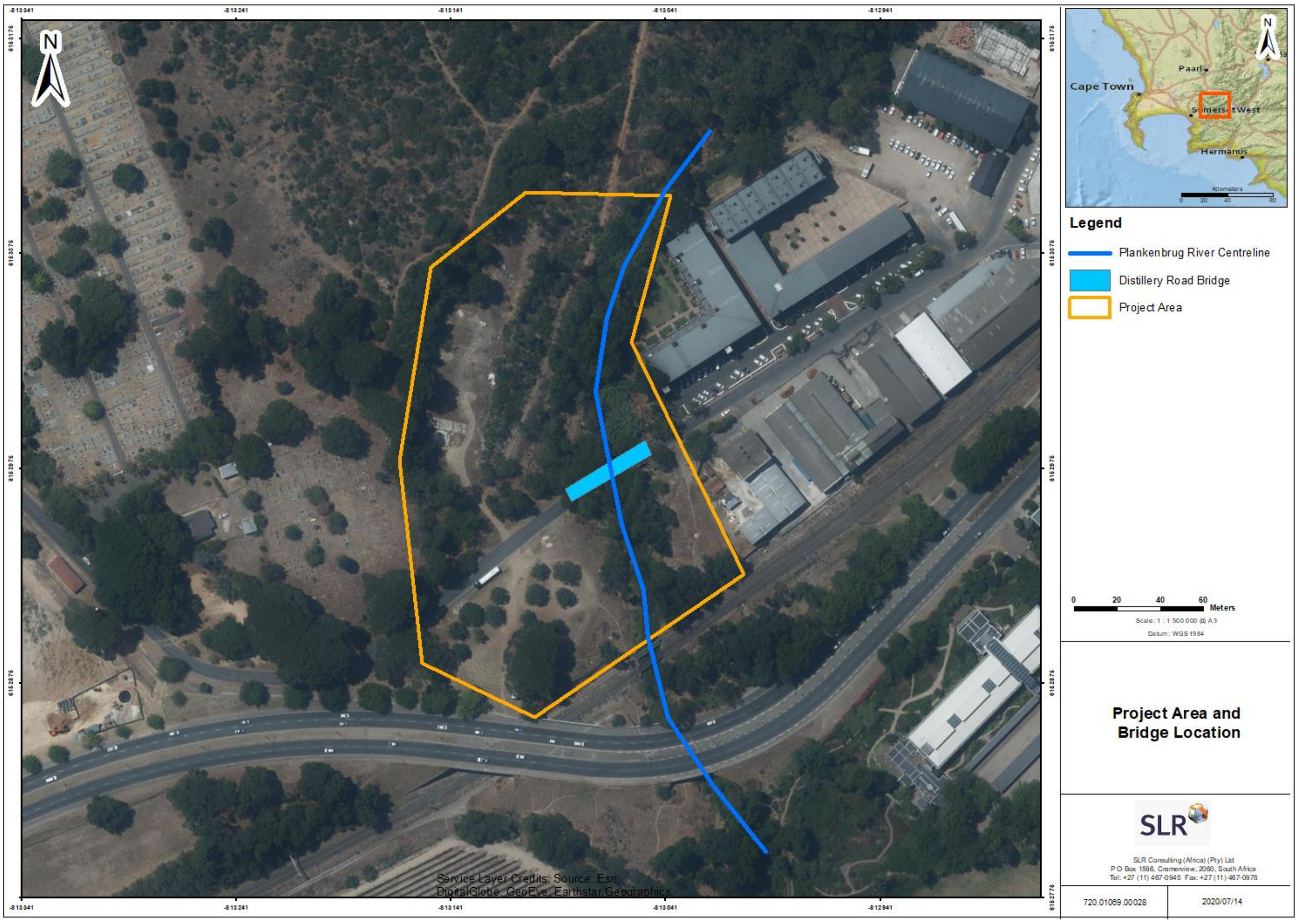

Figure 1-1: Location of the project area and Distillery Road Bridge relative to the Plankenbrug River. The large double lane road near the bottom of the map is Adam Tas Road

1.3 TERMS OF REFERENCE

The freshwater assessment involves the following scope of work:

- Review of available desktop resources including (but not limited to) the National Freshwater Ecosystem Priority Areas (NFEPA 2011) study, Western Cape Biodiversity Spatial Plan (WCBSP 2017), National Geographical Information service (NGI) watercourse databases and the SANBI (2018) National Wetlands Map.
- Use of publicly available satellite imagery to undertake initial desktop watercourse delineations where possible and to gather information on the nature of relevant catchments.
- Site assessment including confirmation/refinement of desktop delineations and assessment of watercourses within the likely project footprint and a brief description of watercourses including aspects relevant to the determination and assessment of freshwater-related impacts.
- Assessment of Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) for relevant watercourses and determination of the Recommended Ecological State (REC).
- Identification and assessment of potential freshwater impacts using the SLR Impact Assessment methodology.

- Identification and assessment of freshwater risks through application of the DWS Risk Assessment Matrix.
- Provision of mitigation measures to address identified freshwater impacts and risks.

1.4 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations apply to this report.

- Watercourses and other features of interest have been desktop delineated using satellite and aerial photography which may contain small errors in georectification. Desktop delineations were ground truthed with a Garmin Etrex 20 with an expected accuracy 3 m (95 percentile). It is however the opinion of the specialist that neither limitation is of material significance to the study and all freshwater constraints have been adequately identified.
- The study is limited to the upper 500 mm of soil, which is in compliance with Department of Water Affairs and Forestry (DWAF 2008) Updated Manual for the Identification and Delineation of Wetland and Riparian Areas.
- No South African River Health Protocol (SARHP) assessments (such as SASS5 and FRAI – invertebrate and fish indexes) or other fauna-based assessment methods such as the Samways and Simaika Dragonfly Biotic Index have been included in this study. Water quality, hydrology or instream habitat impacts of a scale that may impact aquatic fauna is in the opinion of the specialist highly unlikely to occur due to the nature of the proposed construction activities and due to the degraded urban nature of the stream which is not likely to support sensitive fauna (refer to Section 4 below). Fauna-based assessments would not provide useful information that would add value to the assessment.

2. APPLICABLE LEGISLATION

2.1 NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NEMA)

The NEMA (Act 107 of 1998) is the primary act that makes provision for sustainable development and all Specific Environmental Management Acts (SEMAs), such as the National Water Act, are subsidiaries thereof. Chapter 7 of the NEMA states the following:

"*Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment*."

The Act furthermore make provision for an Environmental Authorisation (EA) process that includes an evaluation of environmental impact through either an Environmental Impact Assessment (EIA) or Basic Assessment (BA) process depending on the nature and scale of the activities required for the proposed development. Government Notice Regulation (GNR)327 promulgated under the Act lists activities that require a BA in application for an EA. Activity number 19 in the listing notice requires a BA for:

"*The infilling of depositing of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles, or rock of more than 10 cubic metres from (i) a watercourse*;"

The proposed project will require excavation of more than 10 cubic metres (m^3) from the Plankenbrug River and therefore requires a BA in application for an EA which must include an assessment of freshwater impacts.

2.2 NATIONAL WATER ACT (NWA)

The NWA (Act 36 of 1998) has the following stated purpose (paraphrased from the Act retaining only the portions relevant to this report):

"*The purpose of this Act is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors –*

(d) promoting the efficient, sustainable and beneficial use of water in the public interest;

(g) protecting aquatic and associated ecosystems and their biological diversity;

(h) reducing and preventing pollution and degradation of water resources;

(k) managing floods and droughts,"

To this end, the Act and it's regulations make provision for a Water Use Authorisation process that seeks to balance the need for water use in the public interest, with the protection of aquatic ecosystems, prevention of pollution and degradation of watercourses and reasonable flood and drought management. The term 'Water Use' is very broadly defined and includes the following uses listed in Section 21:

"(a) taking water from a water resource;

(b) storing water;

(c) impeding or diverting the flow of water in a watercourse;

(d) engaging in a stream flow reduction activity contemplated in section 36;

(e) engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);

(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or

other conduit;

(g) disposing of waste in a manner which may detrimentally impact on a water resource;

(h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;

(i) altering the bed, banks, course or characteristics of a watercourse;

(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and

(k) using water for recreational purposes."

In the case of the proposed development, uses (c) and (i) are proposed as it includes excavation of the bed and banks and altering the manner in which the bridge impedes flow.

Many water uses have been generally authorised by means of several General Authorisation regulations promulgated under the Act (referred to as GAs). Water Uses (c) and (i) are generally authorised in terms of GN509 of 2016, subject to certain criteria and conditions. One criterion is that the proposed Water Use activities must be assessed via a specified risk assessment matrix which must indicate a Low Risk rating for the GA to be applicable.

Medium risk activities must follow the Water Use Licence (WULA) process that is more onerous and includes approval at the national rather than regional level. High risk activities also require Water Use Licence applications but are usually not approved other than in exceptional circumstances.

The following definitions are contained in the NWA and are necessary for interpretation of its regulations and are used extensively within this report:

"pollution'' means the direct or indirect alteration of the physical, chemical or biological properties of a water resource;

"protection'', in relation to a water resource, means -

(a) maintenance of the quality of the water resource to the extent that the water resource may be used in an ecologically sustainable way;

(b) prevention of the degradation of the water resource; and

(c) the rehabilitation of the water resource;

"resource quality'' means the quality of all the aspects of a water resource including -

(a) the quantity, pattern, timing, water level and assurance of instream flow;

(b) the water quality, including the physical, chemical and biological characteristics of the water;

(c) the character and condition of the instream and riparian habitat; and

(d) the characteristics, condition and distribution of the aquatic biota;

"watercourse'' means -

(a) a river or spring;

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

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

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

and a reference to a watercourse includes, where relevant, its bed and banks; and *"water resource'' includes a watercourse, surface water, estuary, or aquifer."*

Additionally, GN509 of 2016 defines regulated zones around watercourses within which activities may require a Water Use Authorisation (either WULA or GA registration) as follows:

'a) a river, spring or natural channel in which water flows regularly or intermittently "within the outer edge of the 1 in 100 year floodline or riparian habitat measured from the middle of the watercourse from both banks", and for b) wetlands and pans "within a 500 m radius from the boundary (temporary zone) of any wetland or pan" (when the temporary zone is not present then the seasonal zone is delineated as the wetland boundary), and for c) lakes and dams "purchase line plus a buffer of 50 m".'

For this reason, all watercourses within 500 m of a development are typically identified at a desktop level and those that that are likely to be impacted are selected therefrom for further assessment.

Given that the proposed project would take place within 500m of several wetlands indicated by desktop resources and would include construction within a Plankenbrug River, a risk assessment in the prescribed format must be undertaken, informed by a freshwater assessment.

3. METHOD OF ASSESSMENT

3.1 DESKTOP ASSESSMENT

A desktop assessment was undertaken to provide context for a description of ecosystem processes and to identify fieldwork requirements and priorities. The following desktop resources were consulted:

- Cape Farm Mapper[1] was consulted for climate, elevation, geology and soil information and was used to display elements of the below resources where possible.
- The National Freshwater Ecosystem Priority Areas (NFEPA 2011) databases including wetland, river and dam spatial datasets, information on previous classifications, delineations, PES and EIS (where available) were used along with information on designated FEPAs and the reasons for their designations, where applicable.
- The National Geographical Information service (NGI) river, drainage line and catchment databases were used to identify these features primarily for desktop delineation and fieldwork planning, but also to understand the broader catchment context.
- The SANBI (2018) National Wetlands Map provided the location and approximate boundary of known wetlands and delineation confidence.
- The SANBI (2018) National Vegetation Map provided information on the applicable terrestrial vegetation types and their conservation status at the project site and in the catchment.
- Imagery from Google Earth© was used to determine catchment land use and the nature of recent changes in the project area from 2005 to present. Initial watercourse delineation was also undertaken on current (2020) Google Earth© imagery.
- The Western Cape Biodiversity Spatial Plan (WCBSP 2017) provided a spatial planning context in the form of terrestrial and aquatic Protected Areas (PAs), Critical Biodiversity Areas (CBAs), Ecological Support

[1] https://gis.elsenburg.com/apps/cfm/

Areas (ESAs), Other Natural Areas (ONAs) and No Natural Remaining (NNR) areas. The definitions of each of these categories and their subcategories are presented in Table 3-1 below.

Table 3-1: WCBSP spatial planning categories and their definitions (Pool-Stanvliet, *et. al.* 2017).

MAP CATEGORY	DEFINITION	DESIRED MANAGEMENT OBJECTIVE	SUB-CATEGORY
Protected Area	Areas that are proclaimed as protected areas under national or provincial legislation .	Must be kept in a natural state, with a management plan focused on maintaining or improving the state of biodiversity.	n/a
Critical Biodiversity Area 1	Areas in a natural 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.	CBA: River
			CBA: Estuary
			CBA: Wetland
			CBA: Forest
			CBA: Terrestrial
Critical Biodiversity Area 2	Areas in a degraded or secondary condition that are required to meet biodiversity targets, for species, ecosystems or ecological process and infrastructure.	Maintain in a functional natural or near-natural state, with no further loss of natural habitat. These areas should be rehabilitated.	CBA: Degraded
Ecological Support Area 1	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.	Maintain in a functional, near natural state. Some habitat loss is acceptable, provided the underlying biodiversity objectives and ecological functioning are not compromised.	ESA: Foredune
			ESA: Forest
			ESA: Climate Adaptation Corridor
			ESA: Coastal Resource Protection
			ESA: Endangered Ecosystem
			ESA: River
			ESA: Estuary
			ESA: Wetland
			ESA: Watercourse Protection
			ESA: Water source Protection
			ESA: Water Recharge Protection
Ecological Support Area 2	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 minimise impact on ecological infrastructure functioning especially soil and water-related services.	ESA: Restore from NN
ONA: Natural to Near-Natural	Areas that have not been identified as a priority in the current systematic biodiversity	Minimise habitat and species loss and ensure ecosystem functionality	ONA: Natural to Near-Natural

MAP CATEGORY	DEFINITION	DESIRED MANAGEMENT OBJECTIVE	SUB-CATEGORY
	plan, but retain most of their natural character and perform a range of biodiversity and ecological infrastructure functions. Although they have not been prioritised for biodiversity, they are still an important part of the natural ecosystem.	through strategic landscape planning. Offers flexibility in permissible land uses, but some authorisation may still be required for high-impact land uses.	ONA: Degraded
No Natural Remaining	Areas that have been modified by human activity to the extent that they are no longer natural, and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructure functions even if they are never prioritised for conservation action.	Manage in a biodiversity-sensitive manner, aiming to maximise ecological functionality. Offers the most flexibility regarding potential land uses but some authorisation may still be required for high impact land uses.	No Natural Remaining

3.2 WATERCOURSE INDENTIFICATION, CLASSIFICATION AND DELINEATION

Watercourses were identified and classified at a coarse scale using the definitions of the terms ‘watercourse’, ‘wetland’ and ‘riparian’ in the NWA. The definitions are as follows:

“(xxiv)``watercourse'' means –

(a) a river or spring;

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

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

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

and a reference to a watercourse includes, where relevant, its bed and banks”;

“(xxi)``riparian habitat'' includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas”;

(xxix)``wetland'' means land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.”

Further classification was undertaken by application of the Ollis *et al*. (2013) *Classification System for Wetlands and Other Aquatic Ecosystems in South Africa*, which includes both inland and estuarine components. The six-tiered classification system for inland watercourses is summarised in Table 3-2.

Table 3-2: Summary of the Ollis *et al.* (2013) classification system

Level	Categories/Descriptors
Level 1: General Setting	• Marine • Estuarine • Inland
Level 2: Regional Setting	• DWA Level 1 Ecoregions; OR • NFEPA WetVeg Groups; OR • Other spatial framework

Level	Categories/Descriptors
Level 3: Landscape Unit	• Valley floor • Slope • Plain • Bench
Level 4: Hydrogeomorphic Unit	• River • Floodplain wetland • Channelled valley-bottom wetland • Unchannelled valley-bottom wetland • Depression • Seep • Wetland flat
Level 5: Hydrological Periodicity	• Rivers: ○ Perennial ○ Non-perennial ▪ Seasonal ▪ Intermittent ▪ Unknown • Wetlands: ○ Permanently inundated ▪ Limnetic ▪ Littoral ▪ Unknown ○ Seasonally inundated ▪ Permanently saturated ▪ Seasonally saturated ▪ Intermittently saturated ▪ Unknown ○ Intermittently inundated ▪ Permanently saturated ▪ Seasonally saturated ▪ Intermittently saturated ▪ Unknown ○ Never inundated ▪ Permanently saturated ▪ Seasonally saturated ▪ Intermittently saturated ▪ Unknown ○ Unknown ▪ Permanently saturated ▪ Seasonally saturated ▪ Intermittently saturated
Level 6: Descriptors	• Natural/artificial • Salinity • pH • Substratum type • Vegetation cover type • Geology

Watercourse delineation was undertaken by application of the DWAF (2008) *Guidelines for the Identification and Delineation of Wetlands and Riparian Zones*. This method makes use of the following indicators to determine and delineate watercourse boundaries:

Wetlands:

1. Position in the landscape;
2. Soil form;
3. Wetland vegetation species; and
4. Presence of redoximorphic soil features.

Riparian zones:

1. Landscape position;
2. Alluvial soils and recently deposited material;
3. Topography; and
4. Vegetation.

For desktop delineation terrain units are identified using relief maps, general soil information is gathered from online databases and hydrophytic vegetation is identified by means of aerial photography. Field-based delineation makes use of visual identification of terrain units and hydrophytic vegetation communities and soils are sampled using a hand-auger.

Diagrams of typical cross sections through wetland and riparian habitat and soils extracted from DWAF 2008 are presented in Figures 3-1 and 3-2.

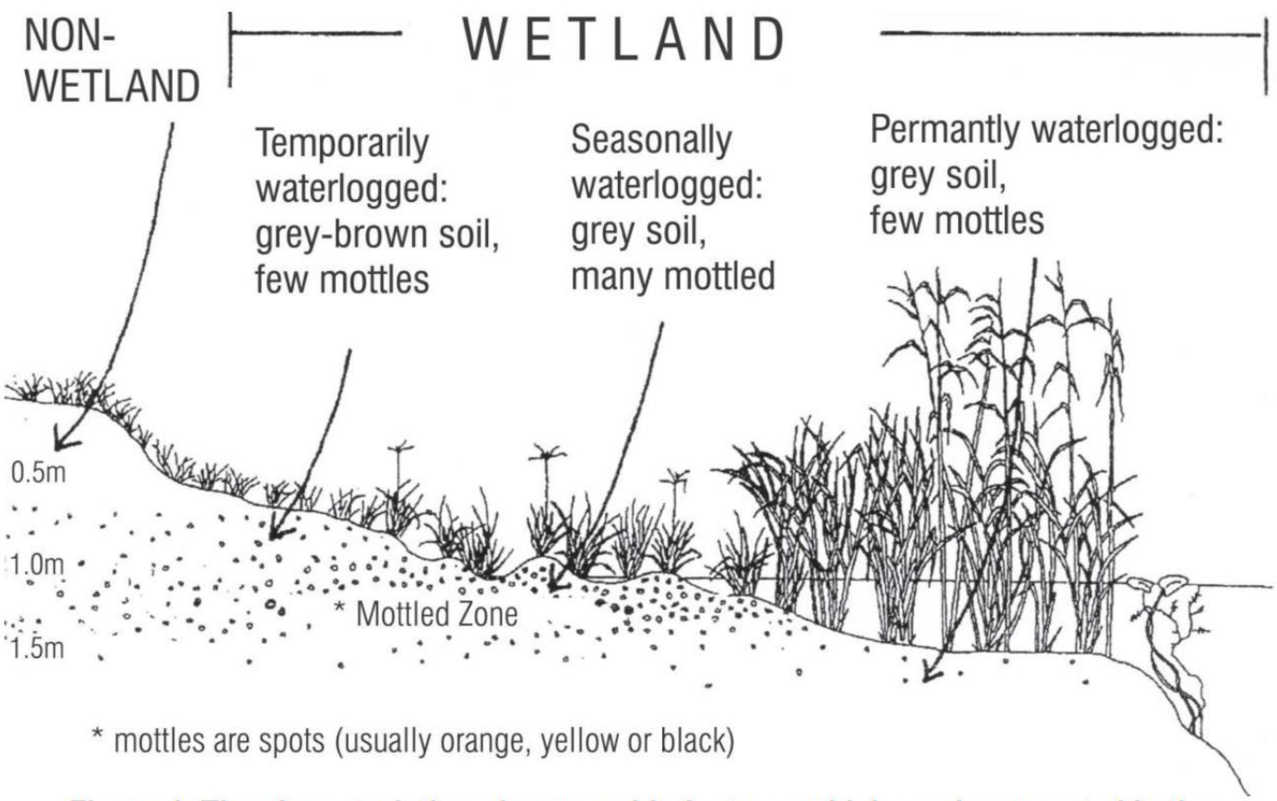

Figure 4: The characteristic redoxymorphic features which can be expected in the permanent, seasonal and temporary wetland zones.

Figure 3-1: A schematic diagram indicating the presence of various indicators in different wetland zones and indicating the wetland boundary (Source: DWAF 2008).

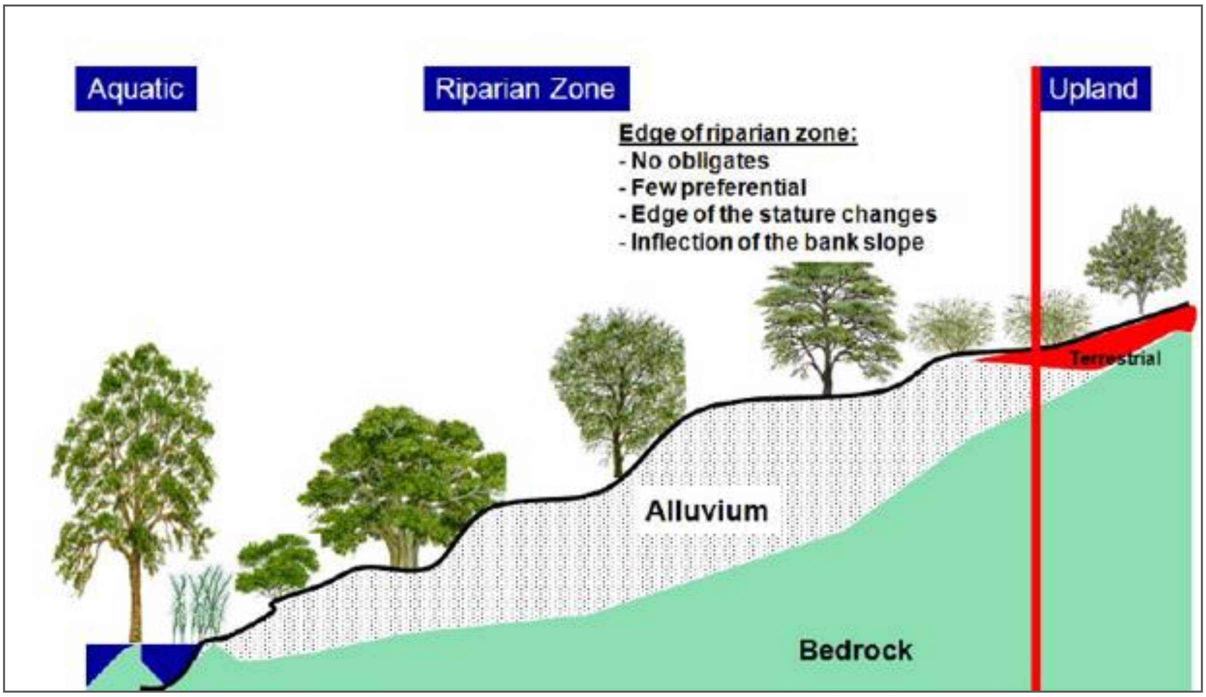

Figure 3-2: A schematic diagram representing the bank and riparian zone of a large river. The boundary between the riparian zone and upland area is indicated (Source: DWAF 2008).

3.2.1 Present Ecological State (PES)

The Present Ecological State of the Plankenbrug River was determined using the Intermediate Habitat Integrity Assessment (IHIA) method for rivers defined by Kemper *et al.* in Chapter 7, Appendix 4 of the DWA (1999) *Resources Directed Measures for the Protection of Water Resources*. The method involves assessment of 9 instream and 8 riparian zone individually weighted criteria against a scoring guideline. The scores for the instream and riparian zones are combined to produce an overall IHIA score between 0 and 100 which corresponds to an IHIA PES category as defined and described in Table 3-3 below.

Table 3-3: IHIA PES categories (From DWA 1999)

Category	Description	Score (% of total)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. Large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst	0

Category	Description	Score (% of total)
	instances the basic ecosystems functions have been destroyed and the changes are irreversible.	

3.2.2 Ecological Importance and Sensitivity (EIS)

The EIS of the Plankenbrug River was assessed using the method presented in Appendix R.7 of the DWAF (1999) Resource Directed Measures for the Protection of Water Resources. The method involves assessment of four biotic and six habitat determinants against a scoring guideline with ratings from 0 to 4 (zero is excluded for certain determinants). The median of all scores provides the overall EIS score which corresponds to an EIS category from “Low/marginal” to “Very High” as per Table 3-4 below:

Table 3-4: EIS Category Definitions (DWAF 1999)

EIS Category	Range of Median
Very high Ecologically important and sensitive on a national or even international level. These river systems and their biota are usually very sensitive to flow and habitat modifications and provide only a small capacity for use.	>3 and <=4
High Ecologically important and sensitive on a regional or national scale. These river systems may be sensitive to flow and habitat modifications.	>2 and <=3
Moderate Watercourses that are considered to be ecologically important and sensitive on a provincial or local scale. The biota of these watercourses is not usually sensitive to flow and habitat modifications.	>1 and <=2
Low/marginal Watercourses that are not ecologically important and sensitive at any scale. The biota within these watercourses is not sensitive to flow and habitat modifications.	>0 and <=1

3.2.3 Recommended Ecological Category (REC)

REC for the purposes of this report is defined as the optimum practically achievable PES for a watercourse or HGM unit and therefore the ecological management target. The REC is determined on a case by case basis in accordance with the method defined in the DWAF (1999) *Resource Directed Measures for the Protection of Water Resources* and elaborated on in Kleynhans *et al*. (2008). Watercourses that fall within PES Category A, must be maintained with this category and the REC is therefore set at Category A. For watercourses that fall within PES Categories B, C or D and possess High or Very High EIS scores, the REC will be set at least one category above the current PES if this is deemed to be practically achievable through rehabilitation. Where this is not achievable or where EIS scores are Moderate or Low/marginal, the REC will be set at the current PES. PES scores in the E and F Categories are considered unacceptable and the REC must be set at a Category D.

4. DESKTOP ASSESSMENT RESULTS

4.1 ECOLOGICAL SETTING

The project area falls within the Southwestern Coastal Belt Ecoregion (DWA 1999), Berg Water Management Area and the G22H quaternary catchment (WCG 2020). The historic terrestrial vegetation is of the Critically Endangered Swartland Granite Renosterveld vegetation type (SANBI 2018). The general characteristics of the site are summarised in Table 4-1 below.

Table 4-1: General characteristics of the site according to Cape Farm Mapper (WCG 2020).

Parameters	Local Conditions
Mean annual rainfall (mm)	631
Mean annual runoff (mm/annum)	78.32
Mean annual temperature (°C)	16.7°C
Elevation (m above mean sea level)	~95 m
Slope classification (%)	0-3%
Geology	Alluvium and terrace gravel
Soil characteristics	Undifferentiated deep deposits
Soil depth (mm)	< 450 mm
Soil clay content (%)	< 15%
Soil Erodibility Factor	0.38 (Moderate)

4.2 WATERCOURSES WITHIN 500M OF THE PROPOSED BRIDGE UPGRADE

4.2.1 Spatial Planning Databases

The NGI and DWS river and drainage line databases both indicated the presence of the perennial Plankenbrug River that flows beneath the Distillery Road Bridge (refer to Figure 4-1 below) but indicate the names “Krom” and “Klippies” river, respectively (Cape Farm Mapper, 2020). The Cape Farm Mapper ESRI (2019) basemap notes the river name as “Eerste”, although it is clearly distinct from the ‘Eerste’ into which it flows. Both databases also indicate the Eerste River flowing toward the west approximately 200 m south of the Distillery Road bridge, but no other watercourses. The recently released SANBI (2018) National Wetlands Map does not indicate any wetlands within 500 m of the bridge.

The NFEPA wetlands layer indicates only a covered reservoir on a hillside to the north and upslope of the approximate project footprint (see Figure 4-1). The covered reservoir is not at any risk from the proposed bridge upgrade given its location, elevation and nature. The bridge also does not fall within any identified FEPA indicated by the database.

The Western Cape Biodiversity Spatial Plan (WCBSP 2017) indicates the Plankenbrug River and riparian zone as a CBA1 watercourse. It also indicates two CBA1 wetland areas on the west bank of the Plankenbrug River within the project area approximately 50 m upstream and immediately downstream of the bridge, respectively. It indicates a third and fourth wetland outside of the project area, but within 500 m of the bridge. The third wetland is indicated immediately downstream of the Adam Tas Bridge and the fourth on the Eerste River, approximately 130 m upstream of the confluence with the Plankenbrug River. See Figure 4-2.

The latter wetland is far from the proposed project and upstream of the confluence and is therefore not susceptible to impact from construction work, changes in water quality or changes in hydrology. It does not therefore require further assessment. The remaining wetland outside of the approximate project footprint falls on the far side of Adam Tas bridge, which forms a physical barrier that would constrain sprawl of the construction footprint even under the worst-case scenario, so direct disturbance is extremely unlikely. If, however, this wetland receives significant water via bank overtopping, it may be susceptible to water quality or hydrology impacts, depending on the nature of its hydrological link to the Plankenbrug River. The two wetland areas situated within the project area may be impacted by direct disturbance if present.

The WCBSP (2017) also indicates areas of CBA1 terrestrial habitat to the west of the river and ESA2 to the east within the approximate project footprint.

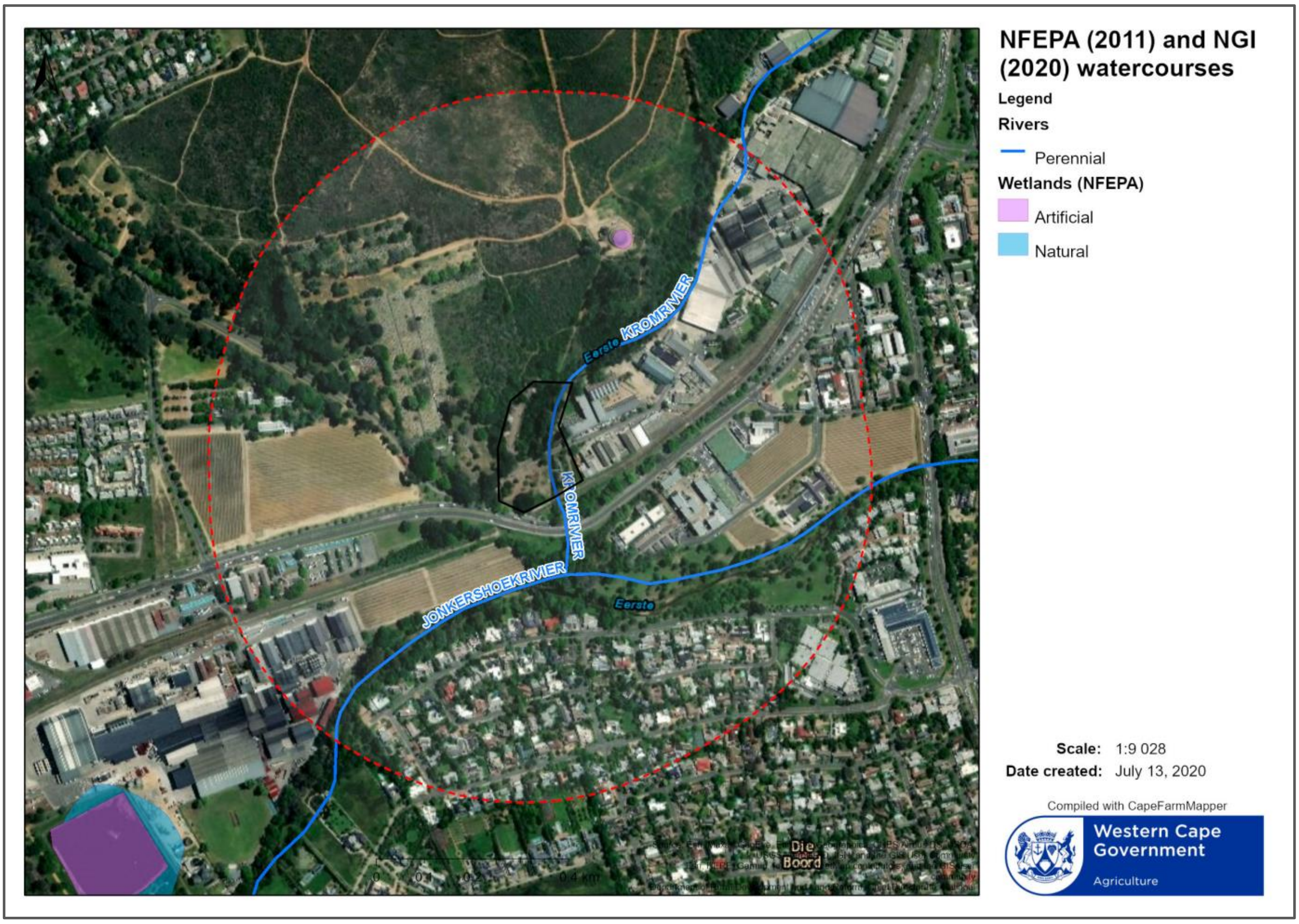

Figure 4-1: NGI rivers and drainage lines are indicated in blue, while NFEPA wetlands are indicated in pink (artificial) and blue (Natural). The project area is indicated in black, and the 500m boundary is indicated by a red dashed line.

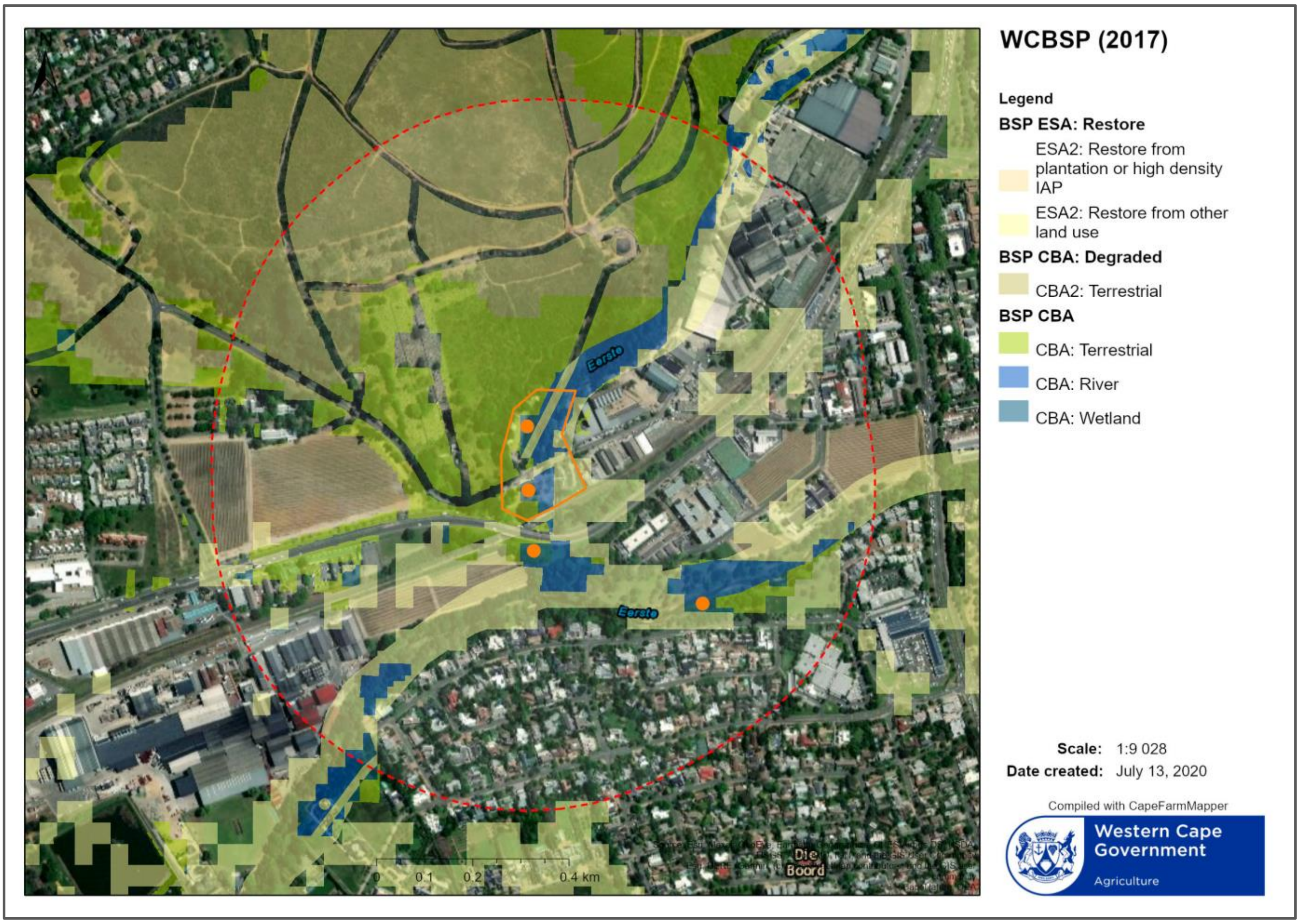

Figure 4-2: The WCBSP (2017) with the project area outlined in orange, the 500 m boundary outlined by a red dashed line and the four wetlands indicated by orange circles.

4.2.2 The Plankenbrug River Catchment

The Plankenbrug River and its tributaries drain the area from the Simonsberg to the ridge near the Devonvale Golf Estate. It also drains the residential areas of Cloetesville, Kayamandi and much of the Stellenbosch town, before flowing under the Distillery and Adam Tas road bridges to join the Eerste River. The catchment is dominated by a mixture of agriculture (predominantly vineyards) and urban land-uses.

The agricultural portions of the catchment are generally characterised by reduced surface roughness and both rivers and wetlands in these areas are largely channelled or constrained. Infiltration rates may be orders of magnitude lower than the natural case due to the reduced density of biopores[2] when compared to areas of natural vegetation (le Roux *et al.* 2015). Vineyards include large areas of exposed sediment and are therefore sediment sources. Fertilisers and pesticides are also used extensively in the agricultural portions of the catchment and elevated nitrate and phosphate levels in runoff from these areas was noted in the Thomas, *et al.* (2010) study on water quality in the Eerste/Kuils catchment, with total phosphorus levels over 8 times the natural background levels in runoff from vineyards.

Urban portions of the catchment represent hardened areas with reduced infiltration, increased runoff and increased storm peak flows. They are sources of various aquatic pollutants including sewage from leaking

[2] Biopores are holes, channels or spaces created in the soil by plant roots, insects, burrowing rodents and other animals.

pipelines, fertilizers used in gardens and petrochemicals in runoff from roads. The highest nitrate levels measured in the Thomas *et al*. (2010) study were associated with industrial and informal settlement areas and were more than six times higher than the natural background levels. Metals such as copper and zinc in runoff from roofs, pipes and other infrastructure may reach levels at which they become toxic to fish and other aquatic organisms. Urban portions of the catchment also generate litter, sometimes in large volumes. Hydroxyl ions leached from cement and concrete in the urban parts of the catchment also tend to increase pH to a limited degree, particularly in acidic catchments such as the catchment in question which exhibits natural soil and groundwater pH values of between approximately 4.5 and 6.5 (Meek *et al.* 2013).

Both urban and agricultural land-uses increase the opportunity for introduction of alien invasive plants and seeds to the catchment by well-known vectors including shoes, car tyres, gardening, compost and manure and earthmoving activities and river dispersal. They also create excellent conditions for the establishment and spread of alien invasive species through disturbance and nutrient enrichment, particularly along watercourses. Watercourses within the catchment exhibit distinct vegetation zones, most of which are alien dominated outside of the mountainous uppermost portions (Meek *et al.* 2013).

Two indigenous fish species, namely *Galaxius zebratus* and *Sandelia capensis*, are known to inhabit the Eerste River catchment (Garrow & Marr 2012). Both are relatively hardy and are known to occur in disturbed sites with impaired water quality including the Capricorn Lake (within the Capricorn Business Park) and the wetland at Intaka Island in Century City, Cape Town. Both may therefore be present within the project area, but neither are likely to be impacted significantly by the proposed development given their hardy nature. They seldom dominate however in areas where alien invasive species are present, particularly where water quality impairment is severe.

A unique species of redfin minnow similar to the Berg River redfin, once inhabited the Eerste River catchment, but is now extinct from the system due to water quality impacts, habitat degradation and the presence of alien fish (Garrow & Marr 2012).

Several alien invasive fish species are known to inhabit the catchment with *Onchorynchus mykiss* (Rainbow Trout) in the cold water of the upper reaches and *Pseudocrenilabrus philander* (southern mouthbrooder), *Cyprinus carpio* (common carp) and *Clarius capensis* (sharptooth catfish) known in the mid and lower reaches (Impson *et al.* 2017 and Mirimin *et al.* 2015). The alien invasive freshwater shrimp *Caridina africana* has also recently established itself in the Eerste catchment (Mirimin *et al.* 2015).

In summary, the relevant portion of the Plankenberg River can therefore be expected to exhibit increased overall runoff, increased storm peak flows, decreased base flow and impaired habitat quality due to alien invasive species encroachment, sedimentation and disturbance. Water quality is impaired in a variety of ways, but most notably by increased nutrient load and to a lesser degree, the presence of herbicides, pesticides, petrochemicals and other aquatic pollutants, which is likely to be exacerbated by extremely low water volumes in late summer (dry seasons) due to decreased base flow in keeping with catchment-wide impacts associated with the dominant land uses investigated by Thomas *et al.* (2010).

Resulting impacts that may be expected include erosion of the bed and banks in vulnerable areas, sedimentation of slower flowing sections and dominance of alien invasive macrophytes due to increased nutrient loads. Fish, macroinvertebrates and other biota present within this river reach are most likely limited to tolerant, non-sensitive species, with alien invasive species dominant.

The potential water quality and habitat impacts of the proposed project are currently present in the system at a much larger scale than may be contributed by the bridge. The additional impact from the proposed project on local fauna therefore note likely to be distinguishable from background variability, particularly given the tolerant nature of fauna that inhabit streams with catchments of this nature. Fauna-based assessments such as SASS 5 and FRAI are therefore, in the opinion of the specialist, unlikely to provide any useful information and have not been include in the site assessment.

5. SITE DESCRIPTION

5.1 OVERVIEW

A site assessment was undertaken on the 5th of June 2020 to determine the nature of the site, the location of the watercourses likely to be impacted and the condition of freshwater habitats. The survey was largely confined to the project area as defined in Section 1.2, but one possible wetland site approximately 140m to the south was also visited briefly. A photograph of the bridge is included in Figure 5-1 below. The project area was found to be largely typical of urban open space with large scale disturbance and general dominance of alien invasive and pioneer vegetation. The recently replaced pipeline was visible downstream of the bridge elevated approximately 2m above the water level in the river (see Figure 5-2).

The area downstream of the bridge on both banks has been severely disturbed historically and during replacement of the pipeline for at least 50 m below the bridge and is now dominated by alien vegetation and cosmopolitan pioneer species. Soils have been compacted by construction vehicles, stockpiling and earthworks associated with the pipeline replacement.

Upstream of the bridge, the eastern riverbank appears to be unnaturally steep given local topography, particularly since the bank on the inside of the riverbend. The top of the bank is levelled and compacted and devoid of riparian vegetation. These features indicate that this bank has likely been infilled to create an elevated, flat platform for construction of the adjacent development and to constrain floodwaters to the river channel.

Upstream of the bridge on the west bank of the river, approximately 10 to 20 m from the riverbank lies a cleared, compacted, levelled platform used early this year (2020) as a stockpiling and works area for the pipeline replacement. Between the platform and the riverbank however, the majority of the disturbance is historical. Areas of recent clearing and compaction that remain largely devoid of vegetation are indicated in Figure 5-3. Significant volumes of rubble and other dumped material covered by alien vegetation is common, and unnatural landscape features including compacted mounds, scraped areas and constructed slopes all indicated historical earthmoving within this area. A high density of wind-blown and dumped litter was also evident.

Figure 5-1: The Distillery Road Bridge over the Plankenbrug River.

Figure 5-2: The bulk-water pipeline downstream of the Distillery Road Bridge. The railway bridge immediately upstream of the Adam Tas Road bridge is visible in the background.

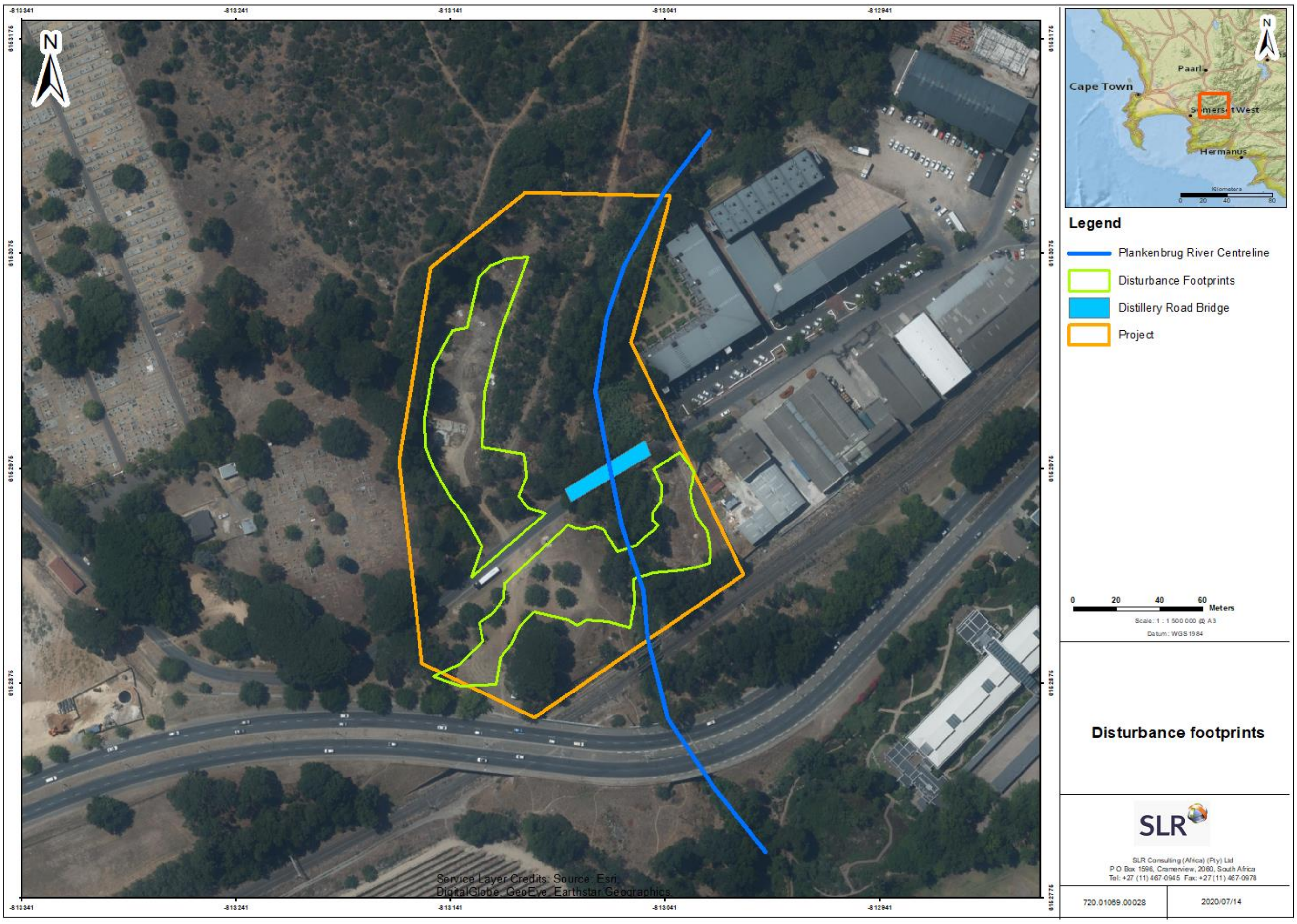

Figure 5-3: Cleared, compacted areas within the project area.

5.2 THE PLANKENBRUG RIVER

This reach of the Plankenbrug River is narrow and shallow at less than 2m wide and a depth of 30 to 50cm. The gradient of the stream bed is significant in the vicinity of the bridge, sufficient to produce swift and turbulent flow during the site assessment (see Figure 5-4). This reach is therefore not prone to sediment deposition and the bed was therefore largely rocky, despite a high concentration of suspended sediment visible within the water column. Sediment did however accumulate in eddies and small pockets of slower water and in these areas exhibited a mixture of grain sizes. Fine, dark organic sediments were present in deeper pockets mixed with other coarser sandy grains.

The riverbanks are high and steep, generally extending over 2 m above the river channel. The banks were augered using a hand auger and found uniformly to consist of loose, unconsolidated alluvial sediments (see Figure 5-5). Wetland soil indicators were absent from all augered soil samples which confirms that unlike many rivers in the area, this reach of the Plankenbrug River is a true river and not a channelled valley bottom wetland.

Water quality is most likely severely impaired due to the nature of the catchment land uses as discussed in 4.2.2 above. While no water quality testing was conducted, the water was visibly turbid and large volumes of litter was noted within the marginal vegetation as expected given the urban nature of the catchment.

Figure 5-4: Swift turbulent flow immediately downstream of the bridge.

Figure 5-5: A soil sample taken by hand auger from the top of the west bank of the river upstream of the bridge consisting of deep, unconsolidated alluvial sediments.

5.3 WETLANDS

The desktop study indicated the possible presence of two CBA1 wetlands on the west bank, immediately downstream and approximately 30 m upstream of the watercourse respectively, and approximately 30 m west of the riverbank, along with two others outside of the approximate project footprint. One of the four wetlands is indicated on the banks of the Eerste River upstream of the confluence with the Plankenberg River and was excluded from further assessment (refer to 4.2.1 above).

The second wetland that falls outside of the approximate project footprint is indicated immediately downstream of the Adam Tas Road Bridge, approximately 140 m downstream of the Distillery Road bridge. During the site visit, the site was found to be a grassy knoll dominated by the alien invasive *Pennisetum clandestinum* (see Figure 5-6) which occurs readily both within or without wetland soils and hydrology. The area was most notably found to be at least three metres higher than the river, elevated even above the road, and set back by approximately 30 m. It is unlikely that a wetland occurs at this location given the terrain. The elevation and distance from the river furthermore negate any potential water quality or hydrological impact from the proposed project even if wetland conditions do exist, since river water is highly unlikely to reach this area even under the most extreme flood conditions. Further assessment was therefore deemed unnecessary.

The two wetland areas indicated within the project area are located within the previous severe disturbance footprints related to the pipeline replacement and earlier construction work. The southern potential wetland area was devoid of hydrophytic vegetation and exhibited only hard, compacted terrestrial soils that were difficult to auger (see Figure 5-7). Soils were dry despite the season and where limited augering depth could be achieved and would not remain within the auger head.

The northern potential wetland area was largely similar, coinciding largely with the levelled platform and it's raised edge. It exhibited dry, compacted soils on the raised platform that could also not be augered effectively. The only vegetation consisted of sparse *Pennisetum clandestinum* between young *Eucalyptus cameldensis* (both alien invasive species) along the edge of the levelled platform (see Figure 5-8).

Given the terrestrial nature of the soils and vegetation within these two areas, and the complete absence of wetland indicators, it is concluded that neither wetland exists. Therefore, in the opinion of the specialist, no wetland impacts are expected to occur from implementation of the proposed project.

Figure 5-6: The grassy knoll indicated as wetland downstream of the Adam Tas Road bridge. The trees on the slopes below the grassy knoll are alien invasive species including *Quercus robur* and *Populus candescens*.

Figure 5-7: The area indicated by the WCBSP (2017) as CBA1 wetland and terrestrial immediately downstream of the Distillery Road bridge, with no remaining natural vegetation. The pipeline that was replaced lies in the middle of this area and the soil is recently disturbed and compacted.

Figure 5-8: The area indicated by the WCBSP (2017) as a terrestrial and wetland CBA1 upstream of the Distillery Road bridge. This area was used during replacement of the pipeline as a staging and stockpiling area.

5.3.1 Aquatic and Terrestrial Vegetation

The assessed reach of the Plankenbrug River lacked true instream vegetation, which is in keeping with the water velocity, but significant marginal vegetation was present throughout the project area. Hydrophytic vegetation within and immediately adjacent to the flowing stream channel was dominated by alien invasive vegetation including *Commelina bengalensis*, *Arundo donax, Persicaria lapathifolia*, but with tolerant indigenous species such as *Cyperus dives, Cyperus textillis,* and *Isolepis prolifera* present in places. Both *C. dives* and *C. textillis* are common garden plants and may be garden escapees rather than indigenous elements. The range provided in van Ginkel *et. al.* (2011) for *C. dives* indicates that its natural range is limited to the Eastern Cape and Kwazulu-Natal and not the Western Cape, so it is almost certainly an introduced species. Downstream of the bridge, *Acacia saligna* (Port Jackson willow) and *Ricinus communis* (castor oil plant) are also present.

The river has a significant riparian zone much broader than the riverbank in places. Upstream of the bridge on west bank, the riparian zone includes a mix of alien and indigenous trees. Here, the understory is dominated by the alien invasive *Tropaeolum majus* and *Pennisetum clandestinum,* with a single patch of indigenous *Chasmanthus aethiopica.* The canopy was dominated by the indigenous *Olea europa ssp. africana* (wild olive) and the alien *Populus candescens* (poplar), with occasional *Eucalyptus camaldensus* (red river gum) towards the terrestrial extreme of the riparian zone.

The top of the east bank upstream and both banks downstream of the bridge is levelled and compacted with sparse terrestrial pioneer vegetation dominated by *Cynodon dactylon* and *Pennisetum clandestinum* grasses. Occasional *Quercus palustris* (Spanish oak) are also present scattered within the disturbed terrestrial area downstream of the bridge on the west bank. No vegetation was confirmed present that corresponds to the critically endangered historical renosterveld terrestrial vegetation type and given the degree of past disturbance, infilling and compaction, the indigenous vegetation and its seed bank is most likely entirely lost. There is therefore no sign of terrestrial vegetation that may correspond to the terrestrial CBA1 areas indicated by the WCBSP (2017) and no terrestrial vegetation impact is expected. Examples of aquatic and riparian vegetation are provided in Figures 5-9 to 5-12. Examples of the terrestrial areas are indicated in 5-5 and 5-6 above.

Figure 5-9: Marginal vegetation upstream of the bridge dominated by *Commelina bengalensis*, *Arundo donax, Persicaria lapathifolia* and *Populus candescens.*

Figure 5-10: A patch of *Cyperus textillis,* on the west bank upstream of the bridge.

Figure 5-11: Stream bank vegetation downstream of the bridge in the vicinity of the recently replaced pipeline including *Cyperus dives*, *Cyperus textillis*, young *Populus candescens* and *Persicaria lapathifolia*.

Figure 5-12: Riparian zone on the west bank of the river, north of the bridge dominated by *Tropaeolum majus, Pennisetum clandestinum*, *Olea Europa ssp. africana* and *Populus candescens.*

5.3.2 Watercourse Delineation

Of the watercourses indicated within the project area, only the Plankenbrug River was found to be present. The river was delineated by means of the DWAF (2008) delineation guidelines using a combination of alluvial soils, riparian vegetation and topography. The delineated watercourse covers approximately 0.79ha and is presented in Figure 5-13 below.

Figure 5-13: Delineated portion of the Plankenbrug River within the project area.

6. WATERCOURSE ASSESSMENT

6.1.1 Present Ecological State (PES)

The PES of the Plankenbrug River was determined by means of the DWA (1999) Intermediate Habitat Integrity Assessment IHIA method for rivers. The sample area was limited the stretch of river extending 25 m upstream and 25 m downstream of the bridge. The result of the assessment is presented in Table 6-1 below. An overall score of 44.94 was calculated which falls within the IHIA Category D described as "Largely Modified". A description of the category is highlighted in Table 6-2 below. The following key aspects influenced the IHIA score:

- Water abstraction: The majority of the catchment is agricultural and there are many irrigation dams within the catchment. Upstream abstraction is therefore a very significant factor and flows are likely well reduced from the natural state, particularly during summer (dry season).

- Flow modification: Extensive impoundment and abstraction has likely reduced overall flows considerably. The reduction in infiltration and surface roughness in the agricultural areas of the catchment (approximately 9000 ha) and catchment hardening in urban areas (approximately 900 ha) will however have increased wintertime (wet season) runoff and winter flows may be closer to natural levels, especially in late winter when the irrigation dams are largely overflowing. These factors will have led to a significant increase in storm peak flows, particularly in late winter. The river has been channelled and the bank height increased in places to protect developments, so flow is more concentrated than in the natural case. This is even more significant during moderate storm peak flows as bank overtopping will only occur during exceptional high flow events, further increasing storm peak flows.
  Flow modelling by AECOM indicates that the substructure of the existing bridge also impedes flow significantly under high flow conditions to the degree that the bridge is likely to overtop during a 1:10 year flood event.

- Bed modification: The large areas of bare soil associated with vineyards upstream ensures that large volumes of sediment is available for modification of the riverbed through sedimentation. Sedimentation is however limited near the bridge due to the slightly steeper stream gradient that results in a higher flow rate and regular scouring. That said, significant volumes of sediment were visible in the water column during the site assessment and sediment did accumulate wherever isolated areas of slower water are found. Significant recent rainfall in the weeks preceding the site assessment would also have scoured the bed to some degree so the observed state in June 2020 represented a minimum sedimentation period with more sediment likely present in the summer months.

- Channel modification: A high degree of channel modification was noted. The channel was deeply incised and both banks of the river were steep and high. The west bank of the river, particularly upstream of the bridge, consists of alluvial sediment and falls on the outside of a riverbend. It is therefore erosion-prone and likely naturally steep and high. The east bank however, and part of the west bank below the bridge, was levelled and compacted and exhibited clay soils with rubble in places and has likely been built up with fill material.

- Water quality modification: No water quality sampling was undertaken, but agricultural runoff tends to be nutrient rich from fertilizers and usually contains pesticides. Urban runoff also tends to be nutrient rich and may high concentrations of soap and other household substances. Urban areas are also sources of copper and zinc from roofing and pipes. Thomas *et al.* 2010 found serious water quality impairment throughout the majority of the Eerste River catchment, particularly in areas with urban and agricultural catchment land uses. It can therefore be stated with a high degree of confidence that water quality is severely impacted.

- Inundation: Although the existing bridge impedes flow to a degree, particularly during high flow events, the impedance is not sufficient to cause inundation-related impacts. No other impeding features cause inundation within the project area.

- Exotic macrophytes: Although natural vegetation elements were present in both the marginal instream and riparian vegetation, alien invasive species dominated all zones.

- Exotic aquatic fauna: A range of alien invasive fish species are known to inhabit the Eerste River catchment and are likely to dominate the assessed river reach.
- Solid Waste Disposal: Litter was present in the riparian zone, in the water column and particularly in the marginal vegetation in significant volumes typical of an urban stream. Much of it was likely carried down by stormwater, but active dumping within the riparian zone is

- Indigenous vegetation removal: Indigenous vegetation is largely absent, partly due to encroachment by alien invasive species, but largely by clearing and earthworks (both historical and recent) throughout the area. Some indigenous riparian trees and disturbance tolerant vegetation remains, but most of the indigenous vegetation has been cleared and then replaced by alien invasive species.

- Exotic vegetation encroachment: Exotic vegetation dominates the site.

- Bank erosion: The most significant bank erosion was noted on the west bank of the river upstream of the bridge where loose, unconsolidated alluvial sediments predominate. This is on the outer bend of the river where alternate bank erosion and deposition is a natural occurrence. Erosion banks are an important and increasingly scarce habitat, especially in an urban context and the observed erosion was very limited and in line with that expected under natural conditions. The remainder of the banks are well vegetated and significant erosion was not evident.

Table 6-1: Results of the IHI Assessment for the Plankenbrug River in the vicinity of the bridge.

PES Criteria	Impact score	Weight	IHI Score
Instream criteria			
Water abstraction	16	14	8,96
Flow modification	18	13	9,36
Bed modification	12	13	6,24
Channel modification	14	13	7,28
Water quality	17	14	9,52
Inundation	0	10	0
Exotic macrophytes	18	9	6,48
Exotic fauna	12	8	3,84
Solid waste disposal	10	6	2,4
Provisional Instream Habitat Integrity			45,92
Riparian zone criteria			
Indigenous vegetation removal	16	13	8,32

PES Criteria	Impact score	Weight	IHI Score
Exotic vegetation encroachment	20	12	9,6
Bank erosion	5	14	2,8
Channel modification	20	12	9,6
Water abstraction	16	13	8,32
Inundation	0	11	0
Flow modification	20	12	9,6
Water quality	15	13	7,8
Provisional Riparian Zone Habitat Integrity			43,96
Overall Habitat Integrity			44,94
PES Category			D

Table 6-2: Intermediate habitat integrity category descriptions (Kleynhans 1996 – used in Kemper *et al.* 1999) with the relevant Category D highlighted below in orange.

CATEGORY	DESCRIPTION	SCORE (% OF TOTAL)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-90
C	Moderately modified. A 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	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Modifications have reached a critical level and the lotic 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

6.1.2 Ecological Importance and Sensitivity (EIS)

The EIS for the Plankenbrug River in the vicinity of the bridge was determined using the method adopted by the former Department of Water Affairs in the Kleynhans (1999) *Resource Directed Measures for the Protection of Water Resources*. The results are presented in Table 6-3 and the category definitions in Table 6-4. The key considerations that influenced the EIS scoring are:

- No rare or endangered plant species were noted along this portion of the river and the level of historical disturbance in this area reduces the likelihood of such species being discovered in the future. Given the critically endangered status of the Swartland Granite Renosterveld terrestrial vegetation type historically present in this area, it is highly likely that rare or endangered species would have inhabited the site historically and there is a small chance that some may remain within the seedbank in less disturbed pockets and may emerge after fire.

- No populations of unique species were noted.
- Given high degree of disturbance, reduction in base flow and water quality impairment, sensitive aquatic biota are unlikely to be present and no sensistive plant species were noted. Nevertheless, some aquatic invertebrates and fish reliant on permanent flow are likely to be present.
- Indigenous species/taxon richness is low in both instream and riparian vegetation and is likely to be low for aquatic invertebrates and fish.
- The available riverine habitat types include a riparian zone, marginal emergent vegetation and instream stony habitat interspersed with pockets of sediment. The flow and stream gradient are largely uniform across the site.

Table 6-3: EIS Results

Determinant	Score	Confidence
	(0-4)	(1-4)
Biotic Determinants		
Rare and endangered biota	1	3
Unique biota	1	3
Intolerant (sensitive) biota	2	3
Species/taxon richness	1	3
Habitat Determinants (Instream and Riparian)		
Diversity of habitat types or features	2	4
Refuge value of habitat types	2	3
Sensitivity of habitat to flow changes	3	3
Sensitivity to flow related water quality changes	3	3
Aquatic/riparian migration route/corridor	1	3
Protected status: Ramsar Site, National Park, Wilderness area and Nature Reserve.	3	4
Total	**19**	
Median	**2**	
EIS Category	**Moderate**	

Table 6-4: EIS Category definitions with the relevant category indicated

EIS Category definitions	Range of EIS score
Very high: Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major drainage lines	>3 and <=4

EIS Category definitions	Range of EIS score
High: Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major drainage lines.	>2 and <=3
Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major drainage lines.	>1 and <=2
Low/marginal: Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major drainage lines.	>0 and <=1

6.1.3 Recommended Ecological Category (REC)

The PES score for the Plankenbrug River falls within the D Category. Given the Moderate EIS score, only maintenance of the PES category is required. The REC is therefore set at maintenance of a PES category D. Further degradation of a scale that may cause a permanent change of PES Category should not be authorised, although temporary disturbance and subsequent rehabilitation to the current ecological category may be considered.

7. IMPACT ASSESSMENT

7.1 PROPOSED ACTIVITIES

The proposed development includes removal of most of the current bridge structure and replacement with a new structure, while retaining and incorporating the central pillar of the substructure for heritage purposes. The new bridge structure will be 10.2 m wider than the current 8 m width, extending 2.4 m upstream and 7.8 m downstream. The substructure of the bridge will change completely from a single large midstream rock and cement pillar structure to a bridge anchored by pilings within the banks only with no instream obstructions. The total size of the opening under the bridge will be increased to accommodate 1:100-year flood events. The following activities were identified that may impact the watercourse:

Construction Phase:

- Widening of the bridge by 10.2 m;
- Use of construction vehicles within the riparian zone and stream channel;
- Temporary diversion of parts of the stream during construction (within the limits of the stream channel);
- Excavation within the riverbanks;
- Use of concrete, construction chemicals, vehicles and toilets within and adjacent to the watercourse.

Operational Phase:

- Presence of a concrete structure within a watercourse;
- Presence of a bridge with an expanded opening.

7.2 IMPACT IDENTIFICATION

The WULA/GA process requires assessment of four key impact categories, namely impacts on habitat (vegetation, sediments and rocky habitat), flow regime, water quality and biota. The following impacts related to these four categories were identified for the construction and operational phases:

Construction phase:

- Loss of approximately 255 m^2 of degraded riparian and marginal stream habitat by widening of the bridge;
- Disturbance of riparian and instream vegetation by operation of construction vehicles and by stockpiling of materials in the riparian zone and stream channel;
- Disturbance and compaction of sediment by operation of construction vehicles within the stream channel and riparian zone;
- Temporary, localised alteration of flow regime by flow diversion during construction;
- Potential water quality impact from spillage of construction chemicals, sewage from portable toilets and hydrocarbons from vehicles, along with localised mild reduction in dissolved oxygen during excavation of organic sediments in the stream bed;
- Direct biota mortality by operation of construction vehicles within the riparian zone and stream channel, diversion of the stream and during excavation of the bed and banks.

Operational phase:

- Slight increase in pH from leaching of hydroxyl ions from fresh concrete/cement;
- Reduced flow impedance by the bridge, particularly during flood events.

7.3 IMPACT RATINGS (CONSTRUCTION PHASE):

7.3.1 Impact 1: Loss of riparian and marginal stream habitat

Criteria	Description
Nature of impact:	Widening of the bridge will result in loss of 60 m^2 of riparian and marginal stream habitat upstream of the existing bridge and 195 m^2 downstream of the bridge. The habitat will be replaced directly by the concrete bridge and will be lost permanently. The riparian habitat in the area where loss would occur is of a very low quality and is dominated by alien species with sparse herbaceous indigenous vegetation, so loss of indigenous vegetation would be minimal. There is however some rehabilitation potential in this area, which would be lost. Note that this excludes the broader disturbance footprint and includes only habitat that is permanently lost within the bridge expansion area.
Intensity of impact or risk:	Low
Extent and duration of impact:	Local; permanent
Consequence of impact or risk:	Low
Probability of occurrence:	Definite
Degree to which the impact may cause irreplaceable loss of resources:	Low
Degree to which the impact can be reversed:	Irreversible
Indirect impacts:	None
Cumulative impact prior to mitigation:	Low
Significance rating of impact prior to mitigation	Low
Degree to which the impact can be avoided:	None
Degree to which the impact can be managed:	Very Low
Degree to which the impact can be mitigated:	Medium - existing degraded habitat may be replaced by rehabilitation of other parts of the riparian zone, but the rehabilitation potential in the area of bridge expansion will be lost.
Proposed mitigation:	• Revegetate portions of the riparian zone that are disturbed by operation of construction vehicles during replacement of the bridge. This will increase the quality and availability of riparian habitat overall. • Use locally indigenous plants of the following species for revegetation: ○ *Cyperus textilis (marginal)* ○ *Pteridium aquilinum (marginal)* ○ *Cliffortia strobilifera (marginal)* ○ *Olea europaea ssp. Africana (riparian)*
Residual impacts:	Very low
Cumulative impact post mitigation:	Very low
Significance rating of impact after mitigation	Very Low

7.3.2 Impact 2: Disturbance of Riparian and Instream Vegetation by Construction Vehicles and Stockpiling

Criteria	Description
Nature of impact:	Heavy construction vehicles will be required to remove the current bridge structure and to install the new structure. This will involve operating within both the riparian zone and the stream bed. Riparian and marginal instream vegetation will be crushed and lost in this area temporarily. The vegetation is however dominated by alien invasive species and no indigenous riparian trees or significant patches of herbaceous indigenous vegetation are present in the area required for this operation. Materials will also need to be stockpiled during both the removal of the current structure and installation of the new structure.
Intensity of impact or risk:	Medium
Extent and duration of impact:	Local; Short term
Consequence of impact or risk:	Very low
Probability of occurrence:	Definite
Degree to which the impact may cause irreplaceable loss of resources:	Low
Degree to which the impact can be reversed:	Fully reversible
Indirect impacts:	None
Cumulative impact prior to mitigation:	Low
Significance rating of impact prior to mitigation	Very Low
Degree to which the impact can be avoided:	Low – stockpiling within the watercourse can be avoided, but vehicles will have to access the bridge structure and their operation within the watercourse is not avoidable.
Degree to which the impact can be managed:	Medium
Degree to which the impact can be mitigated:	Medium
Proposed mitigation:	• Stockpile materials only within the two areas historically disturbed and used during replacement of the pipeline. • Determine the minimum operational area required within the riparian zone and stream channel for vehicular access. Demarcate this area with danger tape or a similar material and do not allow vehicular access to the stream channel or riparian zone outside of this demarcated area. • Where possible, work from the downstream side of the bridge using either or both banks for access as this area has been recently disturbed and is least sensitive. • If it is essential to access the area upstream of the bridge with vehicles, do so via the east bank and avoid entering the riparian area on the west bank with vehicles as far as possible. • If it is essential to access the west bank of the river void removing indigenous trees within the riparian area (only applicable to the west bank upstream of the bridge). Consult an ecologist or botanist if needed to determine species. • Revegetate all areas of the riparian and marginal zones with appropriate species.

Criteria	Description
Residual impacts:	Very low
Cumulative impact post mitigation:	Very low
Significance rating of impact after mitigation	Very low

7.3.3 Impact 3: Disturbance and Compaction of Sediment in the Riparian Zone and Stream Channel

Criteria	Description
Nature of impact:	Operation of heavy vehicles and general construction activities within the riparian zone and stream channel would disturb sediment, potentially resulting in bank and stream-bed erosion. Compaction of the banks would also inhibit vegetation growth, thereby increasing potential for erosion by during rain events and subsequent sedimentation of the stream channel.
Intensity of impact or risk:	Low
Extent and duration of impact:	Local; Short term
Consequence of impact or risk:	Very low
Probability of occurrence:	Probable
Degree to which the impact may cause irreplaceable loss of resources:	Low
Degree to which the impact can be reversed:	Fully reversible
Indirect impacts:	None
Cumulative impact prior to mitigation:	Low
Significance rating of impact prior to mitigation	Very Low
Degree to which the impact can be avoided:	Very low
Degree to which the impact can be managed:	Low
Degree to which the impact can be mitigated:	Medium
Proposed mitigation:	• Demarcate the operation area within the riparian zone and stream channel and restrict access to the riparian zone and stream channel outside of this area as per 6.3.3 above. • Plant the entire demarcated operational area of the riparian zone and channel banks as per section 6.3.3 above to minimise erosion within 4 weeks of completion of the work within these zones. • As far as possible, undertake work within the stream channel and banks during the summer months (October to April) to minimise the risk of erosion of the disturbed and compacted sediments during a rain event. It is recognised that the proposed project is urgent and relates to human safety, so it is recommended that the relevant authorisations be processed quickly by the authorities to allow for this mitigation measure to be implemented should the authorisations be granted.
Residual impacts:	Very Low
Cumulative impact post mitigation:	Very Low
Significance rating of impact after mitigation	Very Low

7.3.4 Impact 4: Flow diversion during construction

Criteria	Description
Nature of impact:	Some construction work will be undertaken within stream channel on the overhead bridge structure and this may require minor stream diversion depending on the nature of the work required and the flow volume at the relevant time during the construction process. The diversion would be localised, affecting only approximately a 25m length of the river channel. The width of the active, flowing channel during the site assessment was under 3m, and would likely be far narrower during summer. Complete diversion can therefore be accomplished if required between the stream banks with a lateral movement of just over 3m at the most. Diversion may not be required at all should stream flow be minimal during construction.
Intensity of impact or risk:	Medium
Extent and duration of impact:	Local; Short term
Consequence of impact or risk:	Low
Probability of occurrence:	Possible
Degree to which the impact may cause irreplaceable loss of resources:	Low
Degree to which the impact can be reversed:	Fully reversible
Indirect impacts:	None
Cumulative impact prior to mitigation:	Low
Significance rating of impact prior to mitigation	Very Low
Degree to which the impact can be avoided:	Medium
Degree to which the impact can be managed:	Low
Degree to which the impact can be mitigated:	Medium
Proposed mitigation:	• If possible, undertake work within the stream channel during mid to late summer (November to March) to ensure that minimal flows are present at the time. • Only divert flow if operationally necessary. • Divert flow over as short a length of river as possible, but no more than 25 m. • Return flow to the original channel as soon as possible after completion.
Residual impacts:	Very Low
Cumulative impact post mitigation:	Very Low
Significance rating of impact after mitigation	Very Low

7.3.5 Impact 5: Water Quality Impacts

Criteria	Description
Nature of impact:	Spillage of petrochemicals from construction vehicles, sewage from portable toilets and spillage of construction chemicals may cause localised water quality impacts. The scale of these potential impacts is very small however

Criteria	Description
	given the scale of the urban portion of the catchment and the resulting baseline water quality impairment. Excavation may also release organic sediments which may reduce dissolved oxygen. Given the turbulent nature of the flow in the vicinity of the bridge which tends to quickly re-oxygenate the water, the scale of the impact is likely to be extremely localised. The sediments are also largely sandy, mixed with a fine organic component, and not primarily organic so the severity of the oxygen reduction is likely to very limited. Severe de-oxygenation that causes death of invertebrates or fish over any scale is not expected.
Intensity of impact or risk:	Low
Extent and duration of impact:	Regional; Short term
Consequence of impact or risk:	Very low
Probability of occurrence:	Probable
Degree to which the impact may cause irreplaceable loss of resources:	Low
Degree to which the impact can be reversed:	Fully reversible
Indirect impacts:	None
Cumulative impact prior to mitigation:	Low
Significance rating of impact prior to mitigation	Very Low
Degree to which the impact can be avoided:	Medium
Degree to which the impact can be managed:	Low
Degree to which the impact can be mitigated:	Medium
Proposed mitigation:	• Designate a bunded area at least 30 m from the stream bank for the placement of toilets, for the pouring and mixing of cement, concrete and construction chemicals and for the parking and servicing of vehicles and ensure that none of these activities occur outside of the designated area.
Residual impacts:	Very Low
Cumulative impact post mitigation:	Very Low
Significance rating of impact after mitigation	Very Low

7.3.6 Impact 6: Direct Biota Mortality

Criteria	Description
Nature of impact:	Biota including benthic invertebrates and amphibians are likely to be crushed by construction vehicles during excavation and general operation within the demarcated operational area of the stream channel. Diversion of the stream channel will likely also result in the desiccation and death of benthic invertebrates in the affected area, but this is likely to be repopulated rapidly on a scale of days by migration with lost individuals likely replaced on a scale of weeks to months by reproduction.
Intensity of impact or risk:	Low
Extent and duration of impact:	Local; Short term
Consequence of impact or risk:	Very low
Probability of occurrence:	Probable
Degree to which the impact may cause irreplaceable loss of resources:	Low
Degree to which the impact can be reversed:	Fully reversible
Indirect impacts:	None
Cumulative impact prior to mitigation:	Low
Significance rating of impact prior to mitigation	Very Low
Degree to which the impact can be avoided:	Low
Degree to which the impact can be managed:	Low
Degree to which the impact can be mitigated:	Low
Proposed mitigation:	• Avoid diversion if possible by undertaking work in the stream channel during summer, OR • Return flow as soon as possible to the affected area to minimise the duration of the diversion. • Demarcate the operational area as per Section 6.3.3 above and restrict access to vehicles within the remainder of the riparian zone and stream channel.
Residual impacts:	Very Low
Cumulative impact post mitigation:	Very Low
Significance rating of impact after mitigation	Very Low

7.4 IMPACT RATINGS (OPERATIONAL PHASE)

7.4.1 Impact 7: Water Quality Impact on pH

Criteria	Description
Nature of impact:	Hydroxyl ions are leached from cement by water which results in an increase in pH. The change in pH is at a maximum immediately after installation of the cement and reduces over time along an e-curve with a half-life in the order of years to decades. Acidic water (as in this case and the fynbos biome

Criteria	Description
	generally) tend to leach pH faster than alkaline water resulting in a shorter half-life and a higher initial change in pH. In this case, a large 900 ha urban area forms part of the catchment and drains directly into the Plankebrug River. This portion of the catchment contains a large volume of concrete and cement, not least of all the stormwater infrastructure itself. The scale of the potential impact on pH from construction of the bridge is extremely small compared to the scale of the existing impact and is unlikely to be measurable.
Intensity of impact or risk:	Very low
Extent and duration of impact:	Local; Medium term
Consequence of impact or risk:	Very low
Probability of occurrence:	Likely
Degree to which the impact may cause irreplaceable loss of resources:	Low
Degree to which the impact can be reversed:	Fully reversible
Indirect impacts:	None
Cumulative impact prior to mitigation:	Very low
Significance rating of impact prior to mitigation	Very low
Degree to which the impact can be avoided:	Low
Degree to which the impact can be managed:	Low
Degree to which the impact can be mitigated:	Low
Proposed mitigation:	• No mitigation is possible.
Residual impacts:	Very Low
Cumulative impact post mitigation:	Very Low
Significance rating of impact after mitigation	Very Low

7.4.2 Impact 8: Reduced Flow Impedance

Criteria	Description
Nature of impact:	The opening under the existing bridge is small and would reach capacity during a 1:10 year flood event. The new bridge design will include a larger overall opening to accommodate greater flood events. This adds a measure of safety for bridge users and also allows for reduced unnatural impedance during these events and slightly greater and more natural scouring throughout the catchment downstream.
Intensity of impact or risk:	Very low
Extent and duration of impact:	Regional; permanent
Consequence of impact or risk:	Very low
Probability of occurrence:	Definite

Criteria	Description
Degree to which the impact may cause irreplaceable loss of resources:	Low
Degree to which the impact can be reversed:	Low
Indirect impacts:	None
Cumulative impact prior to mitigation:	Low
Significance rating of impact prior to mitigation	Very low (Positive)
Degree to which the impact can be avoided:	Low
Degree to which the impact can be managed:	Low
Degree to which the impact can be mitigated:	Low
Proposed mitigation:	• The impact is positive; no further enhancement is required.
Residual impacts:	Very Low
Cumulative impact post mitigation:	Very Low
Significance rating of impact after mitigation	Very Low (Positive)

8. RISK ASSESSMENT

Freshwater risks have been assessed by means of the Risk Matrix prescribed by GN509 of 2016 for assessment of Section 21 (c) and (i) water uses for construction and operational phase activities and risks which correspond to the activities and risks listed and assessed in Section 6 above. The risk matrix is attached as Appendix B.

The factors considered and proposed mitigation measures in the Risk Assessment Matrix are identical to those described in Impact Assessment (Section 6 above). The risk rating for each freshwater risk identified was within the “Low” category and the overall risk rating is therefore “Low”. Activities that include only 21 (c) and (i) water uses and that are rated as “Low Risk” by application of the prescribed risk matrix are Generally Authorised by GN509 of 2016 and therefore require only registration of the water use under the General Authorisation.

9. CONCLUSION AND RECOMMENDATIONS

The project area has been screened for the presence of watercourses at a desktop level and during a site assessment. The only watercourse identified is the Plankenbrug River. The alluvial soils along the riverbank that lack mottling and other wetland soil indicators confirm that the river is not a channelled valley bottom wetland, but a true river. The outer edge of the river's riparian zone was delineated at a desktop level and confirmed during the site assessment. The PES and EIS of this river reach were calculated and found to fall within the "D" (Largely Modified) and "Moderate" categories, respectively. The REC was therefore determined to be a Category D which requires maintenance of the current PES and not rehabilitation as a management target.

Six construction phase and two operational phase impacts were assessed in accordance with the SLR impact assessment methodology. All impacts were assessed as Very Low significance after application of the proposed mitigation measures, and one operational phase impact – the improvement of flow through reduced impedance of river flow – is an overall positive impact. The prescribed water use risk matrix was also applied. All impacts were assessed and fell within the "Low" risk category after application of the mitigation measures, resulting in an overall "Low" risk rating. A Water Use Licence is therefore not required, but registration of the water use under the General Authorisation must be undertaken.

The potential impact of bridge construction on the river is limited and may be further reduced by application of the proposed mitigation measures. The river is expected to naturally rehabilitate to the preconstruction state from all construction phase impacts given the required mitigation measures and no impact on its PES is likely. The increased size of the opening under the bridge is a significant positive impact in that it allows for more natural flows downstream and reduces the erosion and bank stability risk associated with bridge overtopping. The net long-term impact of the proposed development is therefore, in the opinion of the specialist, a positive impact.

It is therefore recommended that the Environmental and Water Use Authorisations be granted for this project, on conditions that the proposed mitigation measures be implemented.

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APPENDIX A: SLR METHODOLOGY TO DETERMINE THE SIGNIFICANCE RATINGS OF THE POTENTIAL ENVIRONMENTAL IMPACTS AND RISKS ASSOCIATED WITH THE PROPOSED ACTIVITIES

The identification and assessment of environmental impacts is a multi-faceted process, using a combination of quantitative and qualitative descriptions and evaluations. It involves applying scientific measurements and professional judgement to determine the significance of environmental impacts associated with the proposed project. The process involves consideration of, *inter alia*: the purpose and need for the project; views and concerns of interested and affected parties (I&APs); social and political norms, and general public interest.

1. Identification and Description of Impacts

Identified impacts are described in terms of the nature of the impact, compliance with legislation and accepted standards, receptor sensitivity and the significance of the predicted environmental change (before and after mitigation). Mitigation measures may be existing measures or additional measures that were identified through the impact assessment and associated specialist input. The impact rating system considers the confidence level that can be placed on the successful implementation of mitigation.

2. Evaluation of Impacts and Mitigation Measures

2.1. Introduction

Impacts are assessed using SLR's standard convention for assessing the significance of impacts, a summary of which is provided below. In assigning significance ratings to potential impacts before and after mitigation the approach presented below is to be followed.

1. **Determine the impact consequence rating:** This is a function of the "intensity", "duration" and "extent" of the impact (see Section 2.2). The consequence ratings for combinations of these three criteria are given in Section 2.3.
2. **Determine impact significance rating:** The significance of an impact is a function of the consequence of the impact occurring and the probability of occurrence (see Section 2.2). Significance is determined using the table in Section 2.4.
3. **Modify significance rating (if necessary):** Significance ratings are based on largely professional judgement and transparent defined criteria. In some instances, therefore, whilst the significance rating of potential impacts might be "low", the importance of these impacts to local communities or individuals might be extremely high. The importance/value which interested and affected parties attach to impacts will be highlighted, and recommendations should be made as to ways of avoiding or minimising these perceived negative impacts through project design, selection of appropriate alternatives and / or management.
4. **Determine degree of confidence of the significance assessment:** Once the significance of the impact has been determined, the degree of confidence in the assessment will be qualified (see Section 2.2). Confidence in the prediction is associated with any uncertainties, for example, where information is insufficient to assess the impact.

2.2. Criteria for Impact Assessment

The criteria for impact assessment are provided below.

Criteria	Rating	Description
Criteria for ranking of the INTENSITY (SEVERITY) of environmental impacts	ZERO TO VERY LOW	Negligible change, disturbance or nuisance. The impact affects the environment in such a way that natural functions and processes are not affected. People / communities are able to adapt with relative ease and maintain pre-impact livelihoods.
	LOW	Minor (Slight) change, disturbance or nuisance. The impact on the environment is not detectable or there is no perceptible change to people's livelihood.
	MEDIUM	Moderate change, disturbance or discomfort. Where the affected environment is altered, but natural functions and processes continue, albeit in a modified way. People/communities are able to adapt with some difficulty and maintain pre-impact livelihoods but only with a degree of support.
	HIGH	Prominent change, disturbance or degradation. Where natural functions or processes are altered to the extent that they will temporarily or permanently cease. Affected people/communities will not be able to adapt to changes or continue to maintain-pre impact livelihoods.
Criteria for ranking the DURATION of impacts	SHORT TERM	< 5 years.
	MEDIUM TERM	5 to < 15 years.

	LONG TERM	> 15 years, but where the impact will eventually cease either because of natural processes or by human intervention.
	PERMANENT	Where mitigation either by natural processes or by human intervention will not occur in such a way or in such time span that the impact can be considered transient.
Criteria for ranking the EXTENT / SPATIAL SCALE of impacts	LOCAL	Impact is confined to project or study area or part thereof, e.g. limited to the area of interest and its immediate surroundings.
	REGIONAL	Impact is confined to the region, e.g. coast, basin, catchment, municipal region, etc.
	NATIONAL	Impact is confined to the country as a whole, e.g. Namibia, etc.
	INTERNATIONAL	Impact extends beyond the national scale.
Criteria for determining the PROBABILITY of impacts	IMPROBABLE	Where the possibility of the impact to materialise is very low either because of design or historic experience, i.e. ≤ 30% chance of occurring.
	POSSIBLE	Where there is a distinct possibility that the impact would occur, i.e. > 30 to ≤ 60% chance of occurring.
	PROBABLE	Where it is most likely that the impact would occur, i.e. > 60 to ≤ 80% chance of occurring.
	DEFINITE	Where the impact would occur regardless of any prevention measures, i.e. > 80% chance of occurring.
Criteria for determining the DEGREE OF CONFIDENCE of the assessment	LOW	≤ 35% sure of impact prediction.
	MEDIUM	> 35% and ≤ 70% sure of impact prediction.
	HIGH	> 70% sure of impact prediction.
Criteria for the DEGREE TO WHICH IMPACT CAN BE MITIGATED - the degree to which an impact can be reduced / enhanced	NONE	No change in impact after mitigation.
	VERY LOW	Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact.
	LOW	Where the significance rating drops by one level, after mitigation.
	MEDIUM	Where the significance rating drops by two to three levels, after mitigation.
	HIGH	Where the significance rating drops by more than three levels, after mitigation.
Criteria for LOSS OF RESOURCES - the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable	LOW	Where the activity results in a loss of a particular resource but where the natural, cultural and social functions and processes are not affected.
	MEDIUM	Where the loss of a resource occurs, but natural, cultural and social functions and processes continue, albeit in a modified way.
	HIGH	Where the activity results in an irreplaceable loss of a resource.
Criteria for REVERSIBILITY - the degree to which an impact can be reversed	IRREVERSIBLE	Where the impact is permanent.
	PARTIALLY REVERSIBLE	Where the impact can be partially reversed.
	FULLY REVERSIBLE	Where the impact can be completely reversed.

2.3. Determining Consequence

Consequence attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity. The ratings and description for determining consequence are provided below.

Rating	Description *
VERY HIGH	Impacts could be EITHER: of high intensity at a regional level and endure in the long term; OR of high intensity at a national level in the medium term; OR of medium intensity at a national level in the long term.
HIGH	Impacts could be EITHER: of high intensity at a regional level and endure in the medium term; OR of high intensity at a national level in the short term; OR of medium intensity at a national level in the medium term; OR of low intensity at a national level in the long term; OR of high intensity at a local level in the long term; OR of medium intensity at a regional level in the long term.
MEDIUM	Impacts could be EITHER: of high intensity at a local level and endure in the medium term; OR of medium intensity at a regional level in the medium term; OR of high intensity at a regional level in the short term; OR of medium intensity at a national level in the short term; OR of medium intensity at a local level in the long term; OR of low intensity at a national level in the medium term; OR of low intensity at a regional level in the long term.
LOW	Impacts could be EITHER of low intensity at a regional level and endure in the medium term; OR of low intensity at a national level in the short term; OR of high intensity at a local level and endure in the short term; OR of medium intensity at a regional level in the short term; OR of low intensity at a local level in the long term; OR of medium intensity at a local level and endure in the medium term.
VERY LOW	Impacts could be EITHER of low intensity at a local level and endure in the medium term; OR of low intensity at a regional level and endure in the short term; OR of low to medium intensity at a local level and endure in the short term. OR **Zero to very low intensity** with any combination of extent and duration.

* Note: For any impact that is considered to be "Permanent" or "International" apply the "Long-Term" and "National" ratings, respectively.

2.4. Determining Significance

The consequence rating is considered together with the probability of occurrence in order to determine the overall significance using the table below.

		PROBABILITY			
		IMPROBABLE	POSSIBLE	PROBABLE	DEFINITE
CONSEQUENCE	VERY LOW	INSIGNIFICANT	INSIGNIFICANT	VERY LOW	VERY LOW
	LOW	VERY LOW	VERY LOW	LOW	LOW
	MEDIUM	LOW	LOW	MEDIUM	MEDIUM
	HIGH	MEDIUM	MEDIUM	HIGH	HIGH
	VERY HIGH	HIGH	HIGH	VERY HIGH	VERY HIGH

In certain cases it may not be possible to determine the significance of an impact. In these instances the significance is **UNKNOWN**.

APPENDIX B: DHSWS PRESCRIBED RISK ASSESSMENT MATRIX

Appendix B is attached as a separate Microsoft Excel table.

RISK ASSSESSMENT MATRIX
Author: J. Gericke (117997)
Title: Re-construction and widening of the Distillery Road Bridge over the Plankenbrug River

					Severity																	
Nr.	**Phases**	**Activity**	**Aspect**	**Impact**	**Flow Regime**	**Physico & Chemical (Water Quality)**	**Habitat (Geomorph+Vegetation)**	**Biota**	**Severity**	**Spatial scale**	**Duration**	**Consequence**	**Frequency of activity**	**Frequency of impact**	**Legal Issues**	**Detection**	**Likelihood**	**Significance**	**Risk Rating**	**Control Measures**	**Borderline LOW MODERATE Rating Classes**	**Type Watercourse**
1	Construction Phase	Widening of the bridge	Replacement of riparian habitat by bridge infrastructure	Loss of approximately 225m2 of riparian habitat	1	1	2	2	1,5	1	1	2	1	5	5	1	**12**	**24**	Low	•Rehabilitation of vegetation in portions of the riparian zone that are disturbed by operation of construction vehicles during replacement of the bridge which will	N/A	Plankenbrug River
2	Construction Phase	Use of construction vehicles within the stream channel and riparian zone, including excavation within the stream banks.	Disturbance of marginal and riparian vegetation	Reduced vegetation cover	1	1	3	2	1,75	1	1	3,75	1	1	5	1	**8**	**30**	Low	•Stockpile materials only within the two areas historically disturbed and used during replacement of the pipeline as per Figure xx in Section x above. •Determine the minimum operational area required within the riparian zone and stream channel for vehicular access. Demarcate this area with danger tape or a similar material and do not allow vehicular access to the stream channel or riparian zone outside of this demarcated area. •Where possible, work from the downstream side of the bridge using either or both banks for access as this area has been recently disturbed and is least sensitive. •If it is essential to access the area upstream of the bridge with vehicles, do so via the east bank and avoid entering the riparian area on the west bank with vehicles as far as possible.	N/A	Plankenbrug River
			Soil compaction and disturbance	Erosion and subsequent deposition downstream	1	2	2	1	1,5	2	1	4,5	1	1	5	2	**9**	**40,5**	Low	•Demarcate the operation area within the riparian zone and stream channel and restrict access to the riparian zone and stream channel outside of this area as above. •Plant the entire demarcated operational area of the riparian zone and channel banks to minimise erosion within 4 weeks of completion of the work within these zones. •As far as possible, undertake work within the stream channel and banks during the summer months (October to April) to minimise the risk of erosion of the disturbed and compacted sediments during a rain	N/A	Plankenbrug River
			Water quality	Reduced dissolved oxygen due to disturbance of partially organic	1	2	1	1	1,25	1	1	3,25	1	1	5	3	**10**	**32,5**	Low	None	N/A	Plankenbrug River
			Crushing of biota	Mortality of biota in the desigated operational area of the riparian zone and stream channel	1	1	1	3	1,5	1	1	3,5	1	1	5	3	**10**	**35**	Low	Demarcate the operation area within the riparian zone and stream channel and restrict access to the riparian zone and stream channel outside of this area as above.	N/A	Plankenbrug River
3	Construction Phase	Temporary stream diversion	Loss of water to the existing stream channel	Death of biota due to dessication and crushing	1	2	2	2	1,75	1	1	3,75	1	1	5	1	**8**	**30**	Low	•If possible, undertake work within the stream channel during mid to late summer (November to March) to ensure that minimal flows are present at the time. •Only divert flow if operationally necessary. •Divert flow over as short a length of river as possible, but no more than 25m. •Return flow to the original channel as soon as possible after completion.	N/A	Plankenbrug River
4	Construction Phase	Use of construction chemicals, concrete/cement, vehicles and toilets within and adjacent to the riparian zone and stream channel	Spillage	Impairment of water quality	1	2	1	1	1,25	2	1	4,25	1	2	5	3	**11**	**46,75**	Low	•Designate a bunded area at least 30m from the stream bank for the placement of toilets, for the pouring and mixing of cement, concrete and construction chemicals and for the parking and servicing of vehicles and ensure that none of these activities occur outside of the designated area.	N/A	Plankenbrug River
5	Operational Phase	Operation of a concrete structure within a watercourse	Water quality	Leaching of hydroxyl ions by acidic river water leads to increased pH of	1	2	1	1	1,25	1	1	3,25	1	2	5	3	**11**	**35,75**	Low	None	N/A	Plankenbrug River
6	Operational Phase	Opration of the new bridge	Increased size of the culvert	Reduced flow impedance	3	1	2	1	1,75	2	1	4,75	1	1	5	2	**9**	**42,75**	Low	None required - This is a POSITIVE impact.	N/A	Plankenbrug River

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