AQUATIC BIODIVERSITY ASSESSMENT FOR THE PROPOSED EXPANSION OF THE EXISTING MACASSAR WASTEWATER TREATMENT WORKS, CAPE TOWN

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Prepared By:

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EXECUTIVE SUMMARY

The existing Macassar Wastewater Treatment Works is located along the False Bay coastline at Macassar. Due to the significant development in the catchment area, this plant needs to be further extended. The upgrades will entail the construction of additional facilities and infrastructure for the treatment of wastewater on the property. It is proposed to expand the hydraulic capacity of the WWTW by 50Ml/d to a final design capacity of 80Ml/d for the entire, upgraded WWTW. It is also proposed to install additional electrical infrastructure as part of the refurbishment to supply power to the site from the nearest Eskom substation.

Aquatic features that are likely to be impacted by the proposed upgrade to the Macassar WWTW are the lower Eerste River and Estuary and some largely artificial wetland areas associated with past activities at the WWTW. The lower river and estuary are considered to be in a severely modified ecological state as a result of flow modification and water quality impacts arising from the discharge of treated wastewater from several WWTWs in the Kuils and Eerste River Catchment as well as storm water runoff. There is also an interbasin transfer of water into the upper Eerste River for irrigation purposes in the lower Eerste River.

The National Biodiversity Assessment for Estuaries (2011) indicated that the Eerste River Estuary should be given a high priority for rehabilitation due to the poor condition of the estuary, as well as the fact that the estuary occurs within a Marine Protected Area. The lower Eerste River is considered to be of moderate Ecological Importance and Sensitivity due to the indigenous fish that occur within the river system and the link of the lower river with the estuary and marine protected area. The lower river and estuary have also been mapped as a FEPA wetland/estuary.

The wetland areas likely to be impacted by the proposed activities are considered to be in a largely to severely modified ecological condition. They provide limited goods and services and are of low ecological importance and sensitivity. Loss of these wetland areas due to the proposed expansion of the WWTW would thus not be considered to be significant.

The existing discharge of treated wastewater from the Macassar WWTW has already considerably altered the estuary; thus the potential impact of an upgrade to this WWTW is likely to be less significant. The proposed upgrade to the existing WWTW will result in an improvement in the final treated wastewater quality, and as such, one could expect that the proposed upgrade would at least improve the existing water quality situation in the Eerste River Estuary. Of greater concern however is the large increase in the volume of the treated wastewater that would be discharged to the estuary as well as the cumulative impact of increased wastewater discharge volumes throughout the catchment of the Kuils / Eerste River System where all four large WWTW (Bellville, Stellenbosch, Zandvliet and Macassar) are needing to be increased in terms of their capacities.

The increase in the volumes of treated wastewater discharged to the lower Eerste River and Estuary would result in a further 'freshening' of the estuary as well as additional modification to the seasonal variability (quality and quantity) within the estuary that is considered important for maintaining biodiversity within the estuary. The resulting loss of variability in estuarine habitat will result in further loss of biotic diversity as well as more modification to the hydrodynamics within the Kuils/Eerste Estuary. Considering the increase in volume of treated wastewater to be discharged to

the estuary as well as the high priority that was been awarded to the estuary for its rehabilitation, it is recommended that the ecological flow requirement for the estuary be determined at a rapid or intermediate level and be considered in terms of the future volumes and water quality to be discharged to the estuary.

While cognisance must be given to the reality of the current situation, there will have to be a committed programme for the progressive reuse of the treated wastewater in the area and a significant reduction in the volumes that would be disposed of in the estuary. While there are already plans to do this, there will need to be a legal imperative to ensure that this commitment is implemented within agreed-upon timescales that are set as soon as technically possible. In particular, the re-use of the treated wastewater during the drier summer months should be encouraged to reduce the volumes that need to be discharged to the estuary, particularly during the low flow period when seawater intrusion and tidal exchange within the estuary would naturally have occurred.

The stipulated water quality requirement of the DWS (particularly for phosphates as the limiting nutrient to plant growth) to be achieved in the final effluent is supported to reduce eutrophication of the lower Eerste River and Estuary. It is recommended that the Special Limit for Ammonia of 2 mg/l or at least the General Limit of 6mg/l be specified for the final treated wastewater as this is a variable of concern within the currently treated wastewater. It is essential that there is ongoing monitoring to ensure that the WWTW is designed and operated to achieve the final treated wastewater quality indicated.

The construction activities should be limited to the already disturbed areas within the new footprint of the WWTW. Disturbed areas should be rehabilitated as far as possible after the construction activities are complete and monitored and managed after rehabilitation to prevent the growth of invasive alien plants.

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1. SPECIALIST DETAILS, EXPERTISE AND DECLARATION

1.1. BACKGROUND AND QUALIFICATIONS OF SPECIALIST CONSULTANT

Organisation: BlueScience (Pty) Ltd

Contact details: PO Box 455, Somerset Mall, 7137

Names: Ms. Toni Belcher

Profession: Aquatic Ecologists

Expertise: BlueScience provides water resource management services, including:

- Rivers and wetlands scoping and impact assessments;
- River rehabilitation plans and implementation;
- Wetland rehabilitation plans and implementation;
- Water use authorisation applications (WULA);
- Biomonitoring of rivers (macro-invertebrates, fish and water quality);
- Water use compliance auditing (internal auditing);
- Water use compliance monitoring and reporting for license holders (including water quality sampling and measurements);
- Ecological Reserve determination of rivers and wetlands;
- River Maintenance and Management Plans (MMP)
- NEMBA – alien vegetation assessment and management plans;
- Water resources capacity building and training

Summary of projects undertaken by BlueScience since July 2012:

Type of project	Number of projects undertaken
Dam developments	82
Other freshwater and freshwater impact assessments	564
River reach MMP	9
ESKOM	38
Renewable energy (WEF and Solar)	44
Roads (Provincial and National roads)	52
River monitoring and rehabilitation projects	68
Water resource study	15
Water use authorisation applications (not linked to a freshwater assessment study)	34
Water use authorisation audits and licensing monitoring)	9

1.2. DECLARATION OF INDEPENDENCE

I, **Antonia Belcher,** as the appointed specialist hereby declare/affirm the correctness of the information provided or to be provided as part of the application, and that I:

- in terms of the general requirement to be independent:
    - other than fair remuneration for work performed/to be performed in terms of this application, have no business, financial, personal or other interest in the activity or application and that there are no circumstances that may compromise my objectivity; or
    - ~~am not independent, but another specialist that meets the general requirements set out in Regulation 13 of GN No. 326 have been appointed to review my work (Note: a declaration by the review specialist must be submitted);~~
- in terms of the remainder of the general requirements for a specialist, am fully aware of and meet all of the requirements and that failure to comply with any of the requirements may result in disqualification;
- have disclosed/will disclose, to the Applicant, the Department and registered interested and affected parties, all material information that has or may have the potential to influence the decision of the Department or the objectivity of any report, plan or document prepared or to be prepared as part of the application;
- have ensured/will ensure that information containing all relevant facts in respect of the application was/will be distributed or was/will be made available to interested and affected parties and the public and that participation was/will be facilitated in such a manner that all interested and affected parties were/will be provided with a reasonable opportunity to participate and to provide comments;
- have ensured/will ensure that the comments of all interested and affected parties were/will be considered, recorded and submitted to the Department in respect of the application; and
- am aware that a false declaration is an offence in terms of Regulation 48 of the NEMA EIA Regulations, 2014 (as amended).

Date: 3 September 2024

Name of company: BlueScience (Pty) Ltd

Signature of the specialists: Belcher

2. INTRODUCTION

The existing Macassar Wastewater Treatment Works (WWTW) is located along the False Bay coastline at Macassar. The WWTW was constructed in about 1977 and is currently operated in terms of a water use licence (Reference 19/G22H/F/582) issued by the then Department of Water Affairs and Forestry (now Department of Water and Sanitation (DWS)), dated 21 July 2011. The Macassar WWTW receives sewage from Gordon's Bay, Strand, Somerset West and Macassar via the existing Macassar pump station, located nearby to the WWTW. Due to significant development in the catchment area, this plant needs to be further extended. The upgrades will entail the construction of additional facilities and infrastructure for the treatment of wastewater on the property.

The WWTW utilizes Conventional Activated Sludge treatment processes, with no primary settling (i.e. no primary sludge is generated, only secondary sludge). The present design capacity of the WWTW is about 30Ml/d (Ml/d = Mega litres per day) average dry weather flow. It is proposed to expand the hydraulic capacity of the WWTW by 50Ml/d to a final design capacity of 80Ml/d for the entire, upgraded WWTW. Installation of additional electrical infrastructure is also proposed as part of the refurbishment of the WWTW, to supply power to the site from the nearest Eskom substation.

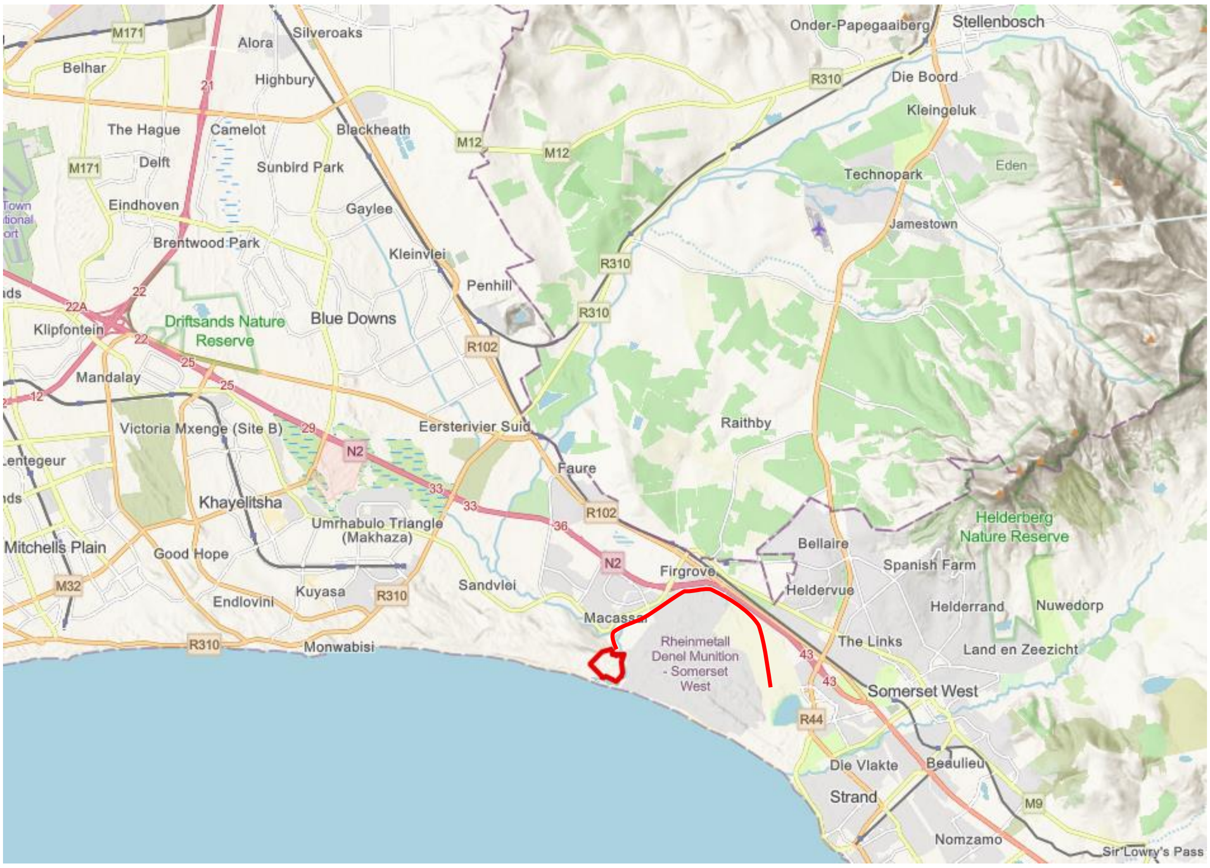


Figure 1. Location of the Macassar WWTW and proposed powerline (CapeFarmMapper, 2024)

The proposed new facilities at the WWTW will extend into undeveloped areas adjacent to the existing WWTW. Part of the proposed development area appears to have been utilized historically (>10 years ago) as oxidation ponds/sludge beds, but these are no longer in use and have largely re-vegetated. The proposed development will also result in the discharge of additional treated wastewater to the Eerste River Estuary.

This aquatic specialist assessment is specifically aimed at assessing the potential impacts of the proposed expansion works and additional discharge. This information is in support of the water-use license amendment application, as well as the basic assessment.

Table 1. Key information related to the water resources which may be impacted by the proposed activities

Descriptor	Name / details	Notes
Water Management Area	Breede-Olifants WMA	
Catchment Area	Eerste River	
Quaternary Catchment	G22H	
Present Ecological State (PES)	F (Critically modified)	DWAF 2012 rapid assessment for the Lower Eerste River (Appendix A)
Ecological Importance and Ecological Sensitivity (EI&ES)	Ecological Importance – Moderate Ecological Sensitivity – High	
Water resource	Wetlands within WWTW	
Latitude	34° 4'35"S	Location of the WWTW
Longitude	18°45'52"E	

The Screening Tool of the Department of Forestry, Fisheries and the Environment indicates the WWTW expansion works in which the site is located (blue polygon in Figure 2) to be of **low** sensitivity. The site is not located in a Strategic Water Resource Area, nor are there any aquatic critical biodiversity areas mapped within the new WWTW footprint. The proposed powerline will need to cross and follow the Eerste River as well as cross some wetland areas that are mapped as being of high sensitivity. The crossing at the Eerste River will either be via a road/pipe bridge crossing or drilling underneath the river.

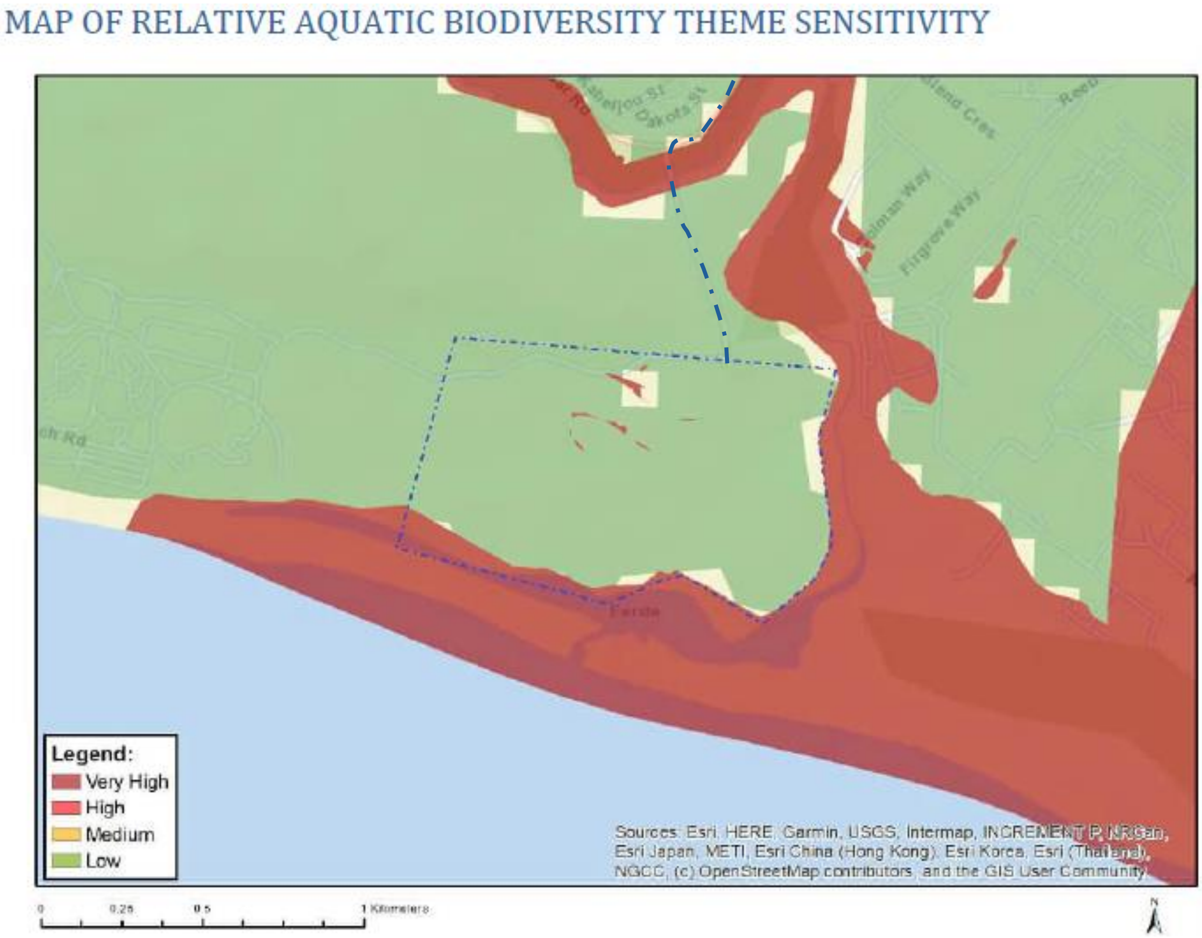


Figure 2. DFFE Screening tool map for aquatic biodiversity for the larger site and surrounding area

3. TERMS OF REFERENCE

The agreed-upon scope of work for this specialist aquatic assessment report comprises of the following tasks:

Task: Aquatic Specialist and water quality assessment for the proposed Macassar WWTW upgrade

1.1 Project Initialisation and desktop assessment;

1.2 Site assessment and mapping of any aquatic habitats;

1.3 Update the aquatic specialist assessment report for the river and estuary;

1.4. Review of report

4. METHODS, ASSUMPTIONS AND LIMITATIONS OF THE STUDY

Input into this report was informed by a combination of desktop assessments of existing freshwater ecosystem information for the study area and catchment, as well as a site visit. The site has been visited on several occasions, in September 2014, May 2021 and most recently for a single day in October 2023 and August 2024, in and following the winter rainfall period before and after both drought and flood events and is thus felt to be very suited to this assessment.

During the field visit, the characterisation and integrity assessments of the freshwater features were undertaken. Mapping of the freshwater features was undertaken using GPS Tracker and mapped in Google Earth and Planet GIS Professional. Past imagery of the site was consulted to determine past land use and modification activities that have taken place within the site.

The SANBI Screening Tool, SANBI Biodiversity GIS, Freshwater Biodiversity Information System and Cape Farm Mapper websites were consulted to identify any constraints in terms of fine-scale biodiversity conservation mapping as well as possible aquatic features mapped in the Freshwater Ecosystem Priority Areas maps. This information/data was used to inform the resource protection-related recommendations. Limitations and uncertainties often exist within the various techniques adopted to assess the condition of ecosystems. The following techniques and methodologies were utilized to undertake this study:

- Analysis of the freshwater ecosystems was undertaken according to nationally developed methodologies;

- The Resource Quality Objectives (RQOs) and assessment of assimilative capacity for the river reach were based on available data (recent as well as historical) obtained from the City of Cape Town as well as the Department of Water and Sanitation. The RQOs are generated through models that have been developed for the Department of Water and Sanitation, which contain certain assumptions and extrapolations to accommodate for the lack of reliable and comprehensive data sets. The RQOs for the wider lower Eerste River (Gazetted RQOs for the Berg River Catchment, 2019) were also considered; and

- Recommendations are based on professional opinion and best practice guidelines.

The level of aquatic assessment and the timing at which the site visit was undertaken is thus considered to be adequate for this study.

5. USE OF THE REPORT

This report reflects the professional judgment of its authors. The full and unedited content of this should be presented to the client. Any summary of these findings should only be produced in consultation with the authors.

6. DESCRIPTION OF THE PROPOSED ACTIVITY AND THE STUDY AREA

6.1. OVERVIEW OF STUDY AREA

The site is located adjacent to the lower reaches and estuary of the catchment of the Kuils / Eerste River (DWS quaternary catchment G22H) which is situated on Erf 1205, Macassar (Figure 3). The proposed powerline route follows the previous Eskom overhead line/cable route and existing roads heading up to the works where it falls within a road servitude. Both the WWTW and the WWTW are primarily within the floodplain of the Eerste River with the powerline extending into the wider floodplain of the Lourens River. This area falls within the eastern region of the CCT and is approximately 36 km south-east of Cape Town. The Eerste River is a relatively short river (roughly 40km) that originates in Jonkershoek northeast of Stellenbosch and enters False Bay just southeast of the site.

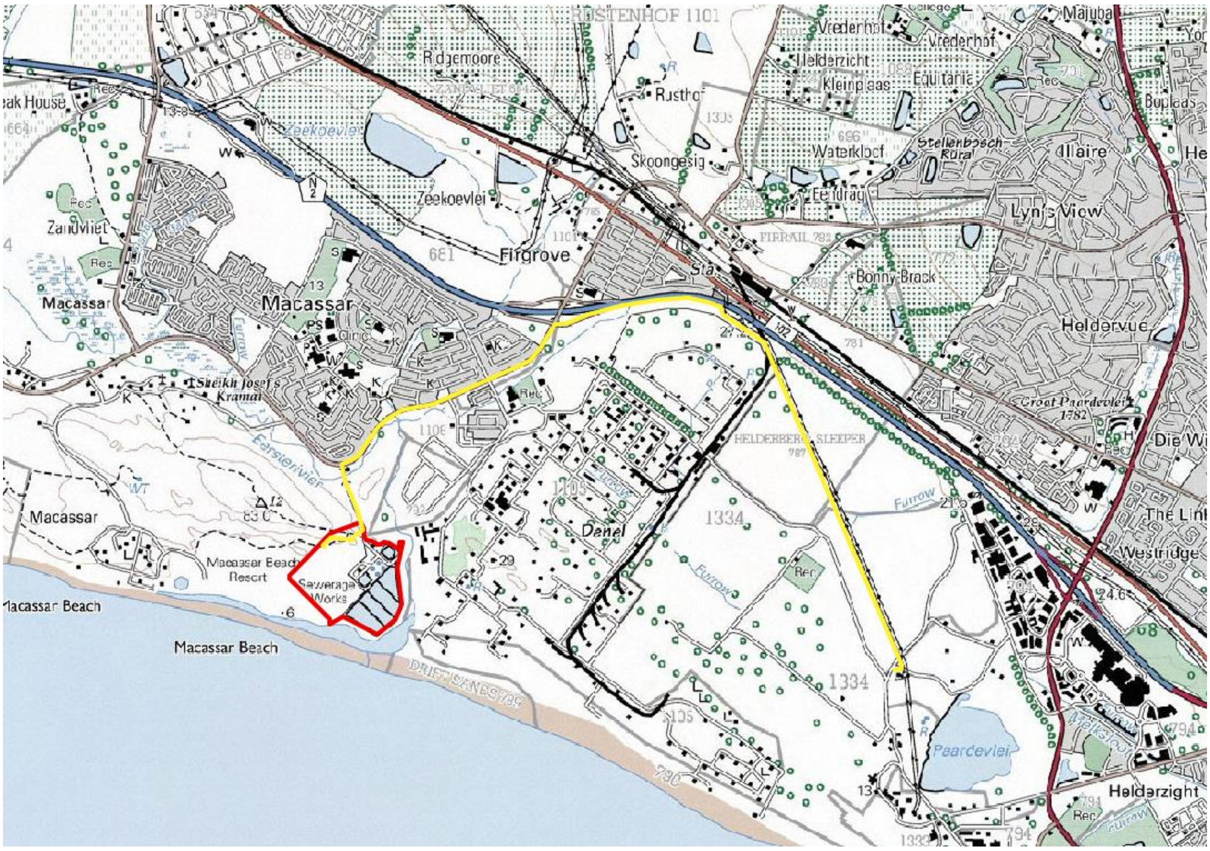


Figure 3. Topographical map (3418BA&BB) of the wider study area.

6.2. ACTIVITY DESCRIPTION

The proposed project is for the upgrading and expansion of the existing Macassar WWTW on Erf 1205, Macassar. The upgrades will entail the construction of additional facilities and infrastructure for the treatment of wastewater on the property (Figure 4). It is proposed to expand the hydraulic capacity of the WWTW by 50Ml/d to a final design capacity of 80Ml/d for the entire, upgraded WWTW. The upgraded treatment system will achieve improved treatment of wastewater and improved operation of the liquid and sludge process streams.

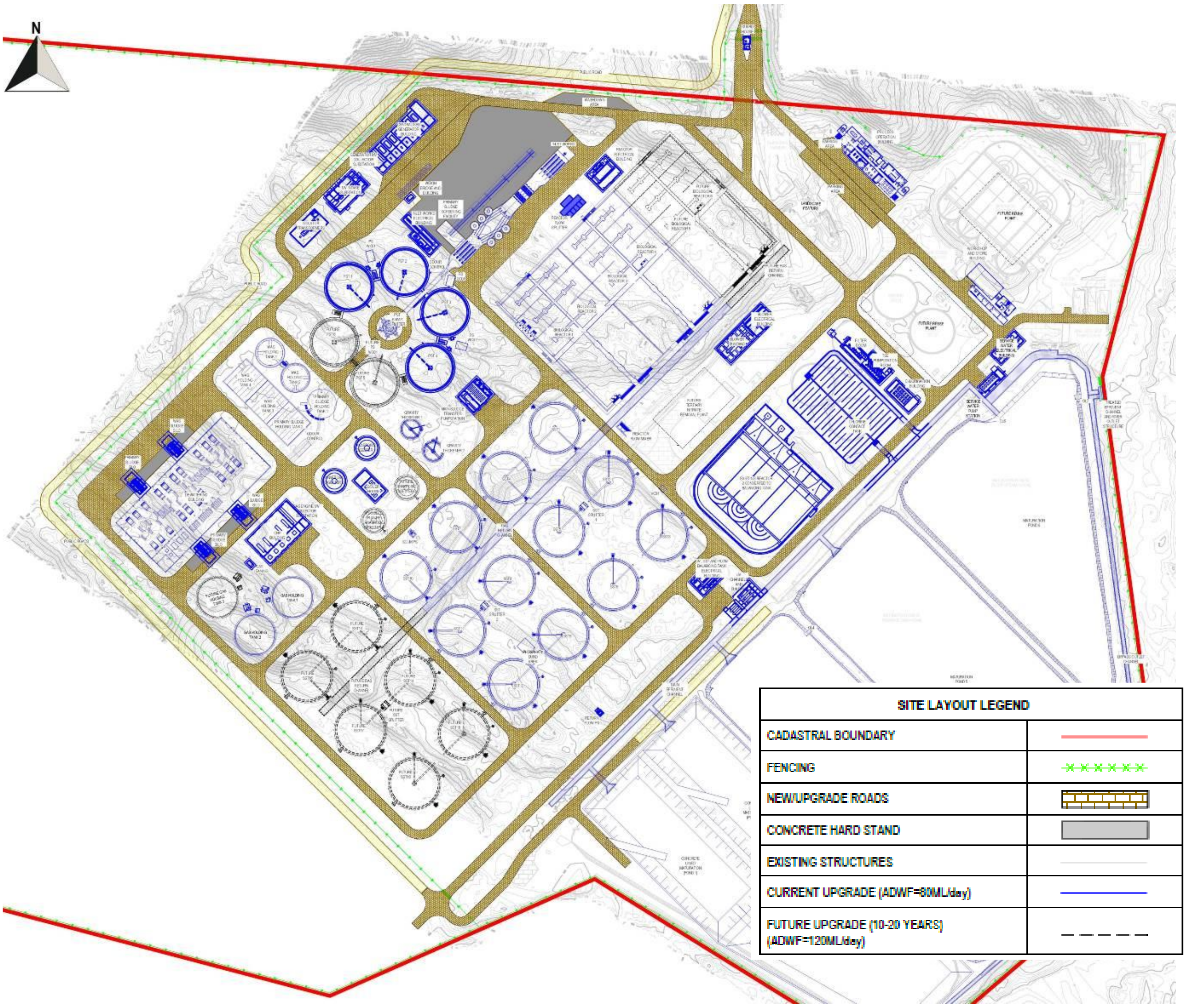


Figure 4. Concept Design for the Expansion of the Macassar WWTW (Zutari, 2023)

<u>The scope of the current proposal is to refurbish and improve the process units and facilities of the existing Macassar WWTW as follows:</u>

1. Inlet Works: New elevated inlet works and a primary sludge handling facility will be constructed

2. Primary Settling Tank Splitter: A new primary settlement tank splitter to split the flow to four new primary settling tanks

3. Primary Settling Tanks (PSTs): New PSTs

4. Reactor Flow Splitter: A new 3-way reactor flow splitter to split the flow to new biological reactors. The structure will also contain a controlled and passive overflow outlet which will convey flow to the offline balancing tank.

5. Biological Reactors: New reactor modules with the UCT process as the base configuration and the option to switch to a Modified Ludzack-Ettinger (MLE) process

6. Offline Balancing Tank: Modifying and refurbishing the existing biological reactor into an offline balancing tank. Flows coming into the works which are more than the peak wet weather flows and will include a passive overflow from the Inlet Works or the Reactor

7. Secondary Settling Tanks Splitter: New secondary settling tank splitters to split the flow into the new secondary settling tanks

8. Secondary Settling Tanks (SSTs): New secondary settlement tanks with sloped bottom floors

9. Effluent Conveyance Channels: This will comprise an outlet channel to collect the treated effluent from the SSTs and direct the flow into the disinfection system. It also comprises channels from the disinfection system to the river and a series of bypass channels and outlets to the maturation ponds.

10. Disinfection: A hybrid system of gas chlorination and UV disinfection. Effluent passing through the disinfection system will pass back into the effluent conveyance channel.

11. Primary Sludge Screening Facility: New primary sludge screening facilities will be constructed. The new inlet works structure will include a channel which will convey the primary sludge from the screening station to the gravity thickeners.

12. Gravity Thickeners: Primary sludge will be treated through thickening in new gravity thickeners

13. Anaerobic Digesters: New mesophilic anaerobic digesters

14. Waste Activated Sludge (WAS) Holding Tanks: New WAS holding tanks to store wasted sludge

15. Primary Sludge (PS) Holding Tanks: New PS holding tanks to store primary sludge

16. Dewatering Building: PS will be thickened on linear screens followed by the PS and the WAS being dewatered via belt presses

17. Sludge Silos: Sludge silos to store the primary and secondary sludge cake before disposal off-site

18. Main Sludge Transfer Pump Station: This building will host three types of pump systems, namely to pump primary sludge from the primary sludge screening facility to the gravity thickeners, pump thickened sludge from the gravity thickeners to the anaerobic digesters and pump waste-activated sludge from the bioreactors to the WAS holding tanks

19. Return Activated Sludge (RAS) Pump Station: A RAS pump station to pump sludge from the under flow of SSTs back into the biological reactors (anoxic zone)

20. Scum Pump Station: A scum pump station to pump scum from PSTs, Reactors and the SSTs to the Anaerobic Digesters

21. Return Flow Pump Station: A return flow pump station to pump sewage back to the inlet works.

22. Blower Building: A new blower facility to house the aeration equipment, including blowers, compressors and other necessary equipment required for aeration.

23. Boiler House Facility: A new boiler house facility, with a steam boiler system

24. Gas Holding Tanks: A new gas storage tanks, with a gas cleaning facility

25. Chlorination building: A new chlorination building will be required for the operation of the chlorine disinfection facilities

26. Service water pump station: A new service water pump station for treated effluent reticulation network (wash water) to be used for mechanical equipment and on-site requirements

27. Treated sewage effluent (TSE) infrastructure: Will comprise a new TSE pump station and filter building, used to pump treated effluent to off-site users

28. Ancillary Structures: The construction of small concrete structures including flow diversion, flow division, flow measurement, collection chambers and outlet structures

29. MV Substation: A new MV substation for onsite MV electrical requirements

30. Electrical Buildings: New MCC and Generator facilities housing all MCC and energy generation and electrical infrastructure for process units on site. This will comprise several buildings across the site. Some of the other electrical infrastructure will be incorporated into the footprint of the process unit or process building.

31. Combined Heat and Power Building: New building housing an internal combustion engine which generates electricity from the Biogas for onsite use. The infrastructure also includes a gas engine collector substation.

32. Weighbridge: A new weighbridge with a facility to house the control needed for the weigh bridge

33. Process Operations Building: A new two-storey administration building which will comprise a reception area, laboratory, offices, control room, canteen and kitchenette, board rooms and laundry on the ground floor. The second floor will include offices, storage, a kitchenette and eating area, ablutions, a boardroom and a braai area.

34. Workshop and store Building: A new two-storey workshop and store facility which will have a storage area, workshop area, kitchenette and eating area and ablutions on the ground floor. The second floor will include offices and ablution facilities.

35. Guard House: A new guard house facility which will house security personnel, the facility will include ablution facilities

36. Site Clearance and Bulk Earthworks: The site is to be cleared of all vegetation to make provision for the construction of new buildings, process structures, roads and other civil infrastructure. Bulk earthworks will be required for certain areas to level out dunes and to create platforms.

37. Flow Diversions and Demolition: Flow to be diverted to keep the existing plant in operation during the construction of the upgrade. Flow to be diverted to the new infrastructure after completion. Decommissioning and demolishment of older process units and older buildings, namely inlet works, secondary settling tanks and associated ancillary structures, 1 x biological reactor, 2 x RAS pump station buildings, associated ancillary structures, chlorine contact tank, dewatering building, sludge silo, guard house, inlet works MCC, administration building, workshop building, board rooms, chlorine building, wash water building and generator building.

38. Interconnecting Pipework: The interconnecting pipework is associated with directing flow through the new structures and connecting to the existing structures. It will also include the pipelines which will serve as overflow or emergency bypass pipelines.

39. Roadworks: Main access road (tarred), internal roads (paved and gravel) and public road to beach (gravel)

40. Stormwater Drainage: New stormwater drainage systems that include pipes, channels, inlet catchments and head walls to direct surface water off-site

41. Potable Water Reticulation: New potable water network for onsite requirements

42. Wash water Reticulation: New wash water reticulation network for onsite use, which includes use by mechanical equipment and on-site irrigation

43. Onsite sewage Reticulation: New onsite sewage reticulation network to return sewage the inlet works

44. Small Power and Lighting: New power and lighting requirements for all new roads, structures, and buildings

45. Building Electronics: New building electronic requirements for all new buildings

46. Sleeves: New sleeves for installation of electrical cables.

47. Fencing: A new access road fence and on-site fence

48. Maturation Pond Refurbishment: Cleaning and minor modifications to the existing ponds including the concrete lining of one of the ponds. The pond modification will also include a new effluent channel and internal modifications to allow flow in the ponds to be diverted through each of the respective ponds.

49. Fire Design for Site and New Buildings: All new buildings and sites to have fire designs depending on the building and site requirements.

50. Ventilation for New Buildings: New buildings to have adequate ventilation measures in place, suited to the buildings' use.

A portion of the proposed facilities (inlet works, sludge handling facilities and chlorine contact tank) will be developed within the footprint of the already transformed WWTW site on the property, while the remainder of the proposed facilities (reactors, settling tanks, roads, fencing) will extend into currently undeveloped areas on the property. These undeveloped areas were historically utilized as settling/oxidation ponds (more than 10 years ago) and although these areas have re-vegetated to some degree, signs of past disturbance/ transformation are still evident. The proposed development will necessitate the clearance of vegetation from within these undeveloped areas.

The following **additional electrical infrastructure** are proposed to connect the Macassar WWTW with the nearest Eskom substation near Paardevlei (Figure 5):

- 2 x 11 kV MV Cables (300mm apart) and a length of 6 941 m;
- Construction of the cables will require a trench depth of approx. 1 m and width of 1 m with a 500 mm offset on either side of the proposed route;
- The route follows the previous Eskom overhead line/cable route and then follows the existing roads heading up to the works. Sections of the proposed route fall within a road servitude;
- The crossing at the Eerste River will either be via a road/pipe bridge crossing or drilling underneath the river.

Figure 5. Proposed route of the proposed powerline (yellow line) between the Macassar WWTW and the Paardevlei Switching Station.

7. PHYSICAL CHARACTERISTICS OF THE STUDY SITE

7.1. VISUAL CHARACTERISTICS

The area lies within the coastal floodplain and consists of an undulating landscape (between 0 – 80 m above sea level), containing vegetated dune fields from a drier, windier recent past. A flatter, more subdued landscape occurs further inland that has been largely modified by development. The dunes tend to run northwest to southeast and are indicated to have naturally been vegetated with Cape Flats Dune Strandveld. While some of the dunes surrounding the WWTW are still undisturbed, the cover vegetation within the footprint of the works as well as the adjacent developed areas was previously modified and invaded with alien plants such as red-eyed wattle or rooikrans *Acacia Cyclops*. These areas have subsequently partially recovered and now contain indigenous shrubs, grasses and weeds.

Figure 6. Surrounding landscape at Macassar WWTW where there were previous oxidation ponds

The Eerste River and Estuary lie immediately to the east of the site, while to the west there is still largely natural vegetation remaining. The residential areas of Macassar and Firgrove occur approximately 1 to 2 km to the north of the site. The AECI complex lies on the eastern bank of the Eerste River and Estuary.

7.2 CLIMATE

The area has a Mediterranean climate and normally receives about 520mm of rain per year, mostly during winter. It receives the lowest rainfall (8mm) in February and the highest (80mm) in June (top,

Figure 7). The monthly distribution of average daily maximum temperatures shows that the average midday temperatures range from 19°C in July to 29°C in February. The region is the coldest during July when the mercury drops to 7°C on average during the night. (bottom, Figure 7). Prevailing winds are south-easterly during the summer and north-westerly during the winter.

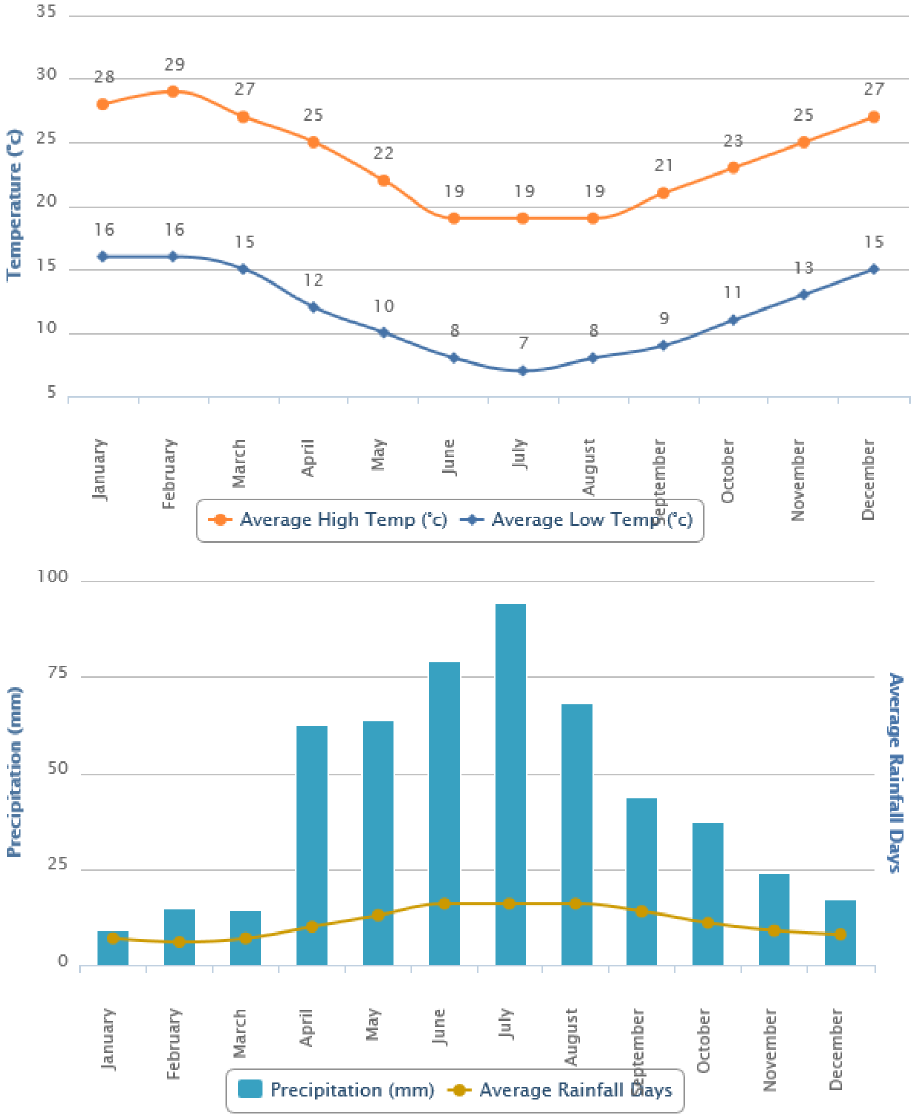


Figure 7. Average monthly rainfall and temperatures for the area (Worldweatheronline)

7.3 GEOLOGY AND SOIL

The study area consists largely of Quaternary quartz sand and calcareous dune sand of the Springfontein and Witzand Formations as well as surficial cover formed in situ on the Tygerberg Formation of the Malmesbury Group. The soils at the Macassar WWTW (Figure 8) consist of imperfectly drained greyish sandy soils, while further inland the soils are of restricted depth with low natural fertility, sandy texture and leached with an accumulation of organic material. Most of the proposed additional electrical infrastructure lies within plinthic catena soils with undifferentiated, upland duplex and/or margalitic soils.

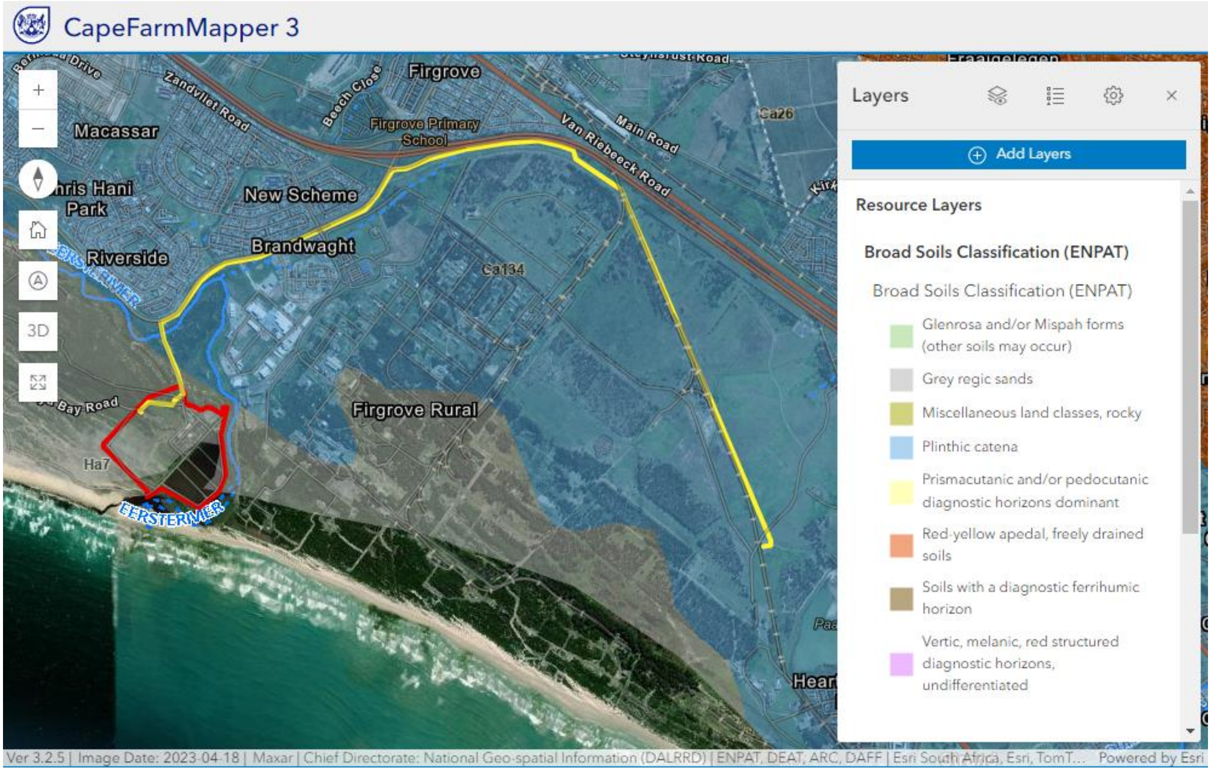


Figure 8. Soil map for the area (CapeFarmMapper, 2024)

7.4. FLORA

The mapped natural vegetation type at Macassar WWTW is broadly classified as Cape Flats Dune Strandveld (Figure 9) which is considered to be an endangered vegetation type. While some of the dunes surrounding the WWTW are still undisturbed, the cover vegetation within the footprint of the works as well as the adjacent developed areas have been disturbed and transformed. Other natural vegetation types that occur along the proposed electrical infrastructure route consist of Cape Flats Sand Fynbos which is considered a Critically Endangered vegetation type and Boland Granite Fynbos, a Vulnerable vegetation type. Cape Seashore Vegetation occurs along the shoreline and is considered Least Threatened. Immediately to the south and east of the site is the Estuarine Functional Zone with its estuarine vegetation, reeds and sedges (white and dark green dotted areas in Figure 9). The terrestrial vegetation within the study area is the subject of a separate botanical assessment (Boucher, 2023) undertaken for the project.

Vegetation along the banks of the Eerste River at the site consists mostly of the common *Phragmites australis* reed with patches of bulrush *Typha capensis*, together with exotic grasses and shrubs such as the castor oil plant *Ricinus communis* (Figures 10 and 11). Most of the floodplain wetland vegetation has been transformed into cultivated areas with exotic grasses (Figure 12)

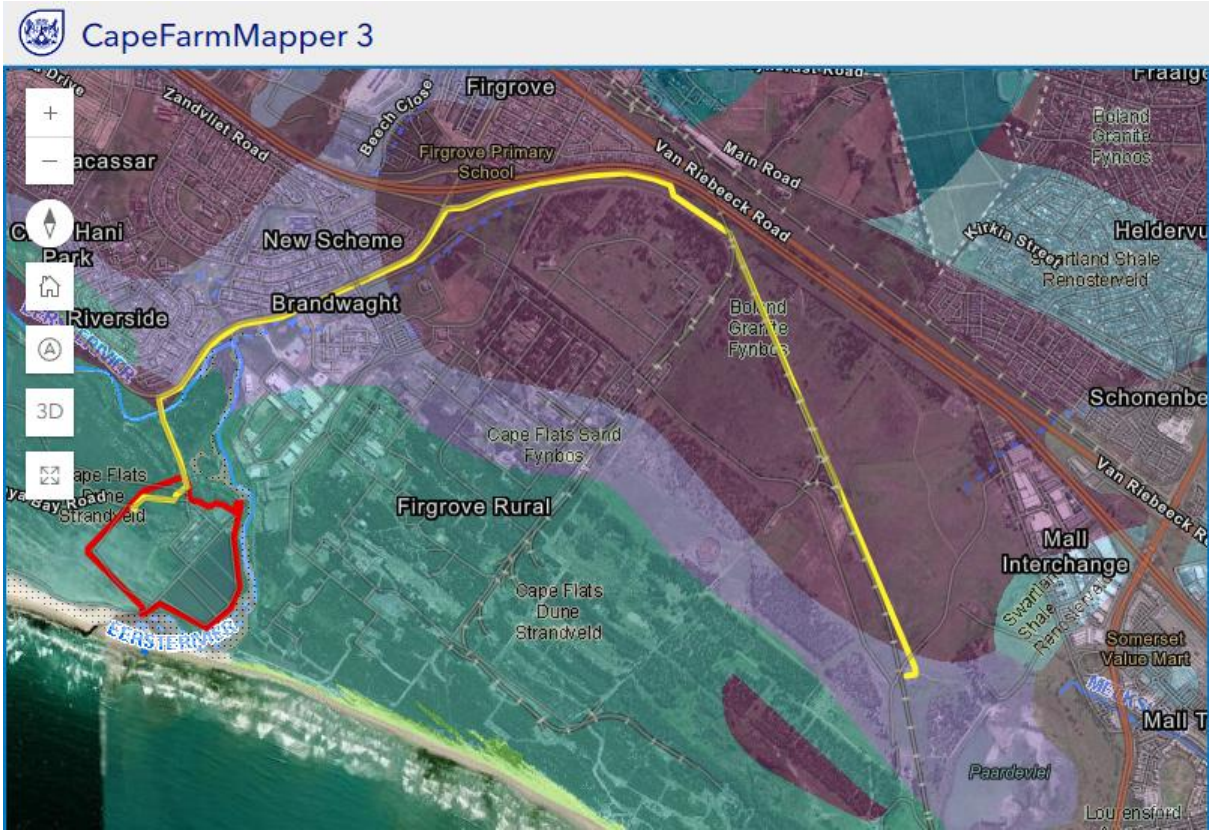


Figure 9. Vegetation types for the study area (SANBI Biodiversity GIS)

Figure 10. View of the Eerste River adjacent to the site

Figure 11. View of the Eerste River crossing where the powerline is proposed and the vegetation along the river at crossing.

Figure 12. View of the floodplain wetland at the N2 Highway within the existing Eskom powerline corridor.

7.5. AQUATIC FEATURES

The Eerste River catchment covers approximately 400 km^2 of the eastern portion of the Cape Flats. The Eerste River rises on Dwarsberg in the Jonkershoek Mountains and flows for approximately 40 km before discharging into False Bay. The major tributary, Kuils River, rises east of Kanonkop and is approximately 30 km long to its point of confluence with the Eerste River. Wetland habitat has been mapped within and adjacent to the WWTW (Figure 13), however much of it is artificial and has formed as a result of the works.

Wetland areas have also been mapped along the proposed powerline route, in the western extent where it crosses the Eerste River, it is primarily associated with the river. Here the powerline follows the road and is within the road reserve where the wetland is already modified by the road. In the eastern extent, there is a large natural/semi-natural wetland mapped as well as some stormwater ponds.

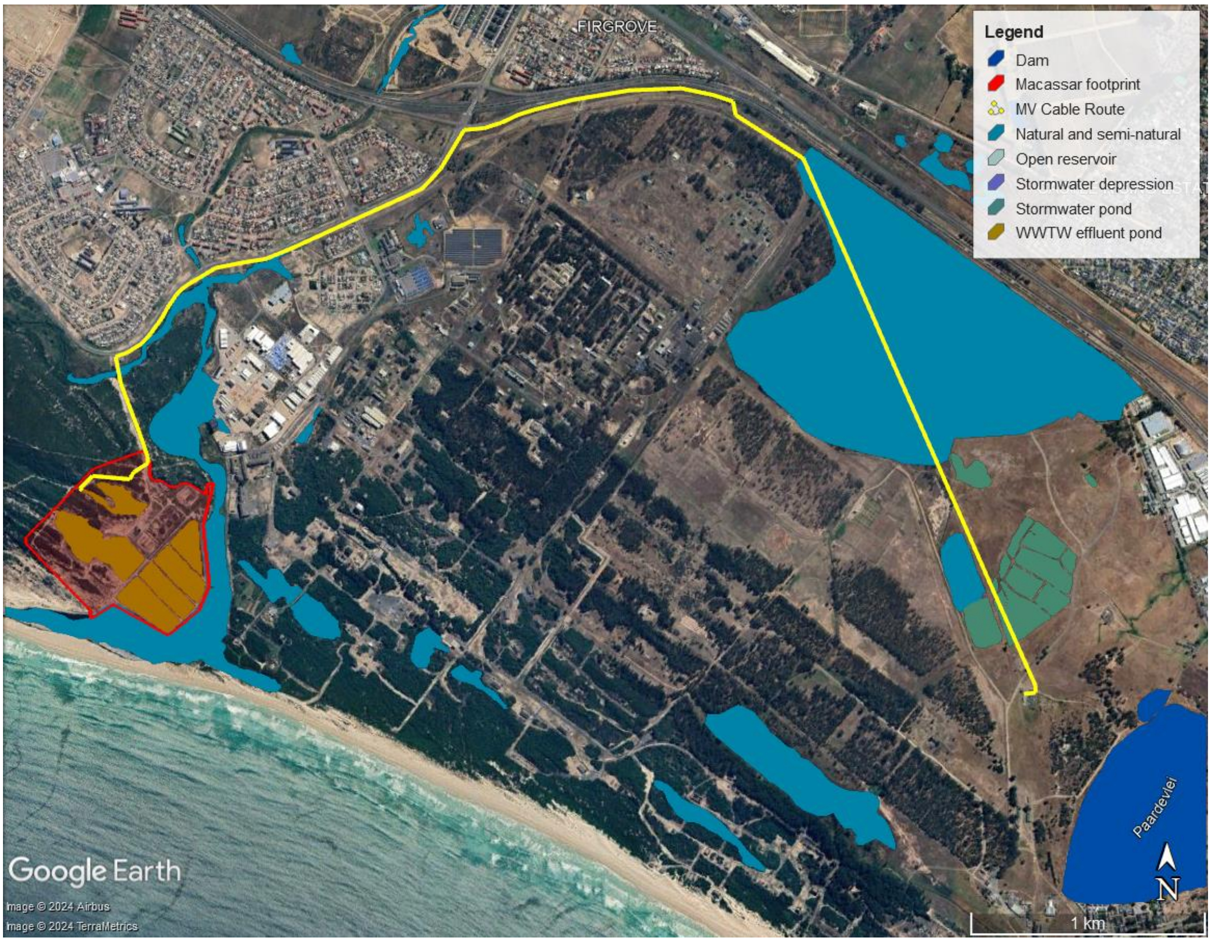


Figure 13. Google Earth image with the mapped rivers (blue line) and wetlands (green polygons) at the site

The Eerste River Estuary is small (approximately 10ha in extent) and dominated by river flow. After passing through the coastal dunes, it forms a small, elongated lagoon in the slack of the backshore area of the beach. The lagoon originally extended on both sides of the mouth, but the eastern portion has since been cut off by a causeway constructed in 1977 and has formed a marsh.

Tidal flows play a minor role in the dynamics of the mouth where limited intrusion of seawater only occurs under certain mouth and river flow conditions, causing an increase in salinity concentrations that is considered important for the maintenance of estuarine habitat and biota. The increased flow in the Eerste River as a result of the WWTW discharges has resulted in the fact that mouth closure does not occur anymore. The construction of the causeway resulted in the water area of the estuary being reduced which further reduced the saltwater intrusion.

The longshore current and the longshore sediment transport are from west to east at Macassar Beach. The median grain size of the sand on the beach is approximately 1200 microns, causing a much steeper beach slope. This results in stronger wave action at the mouth of the Eerste River.

The floodplain wetland along the existing Eskom powerline corridor is within the N2 Road Reserve, Denel property and agricultural land and comprises a perched system overlying clay soils. The cover vegetation comprises alien grasses and weedy shrubs as well as *Eucalyptu*s trees, with some patches of *Phragmites* reeds and *Typha* bulrushes in more permanently wet areas.

7.6 LAND USE

The land use in the immediate area surrounding the Macassar WWTW largely consists of undeveloped or natural open space to the west of the WWTW (woodland and shrubland, light and dark green areas in Figure 14), and dense urban development to the north of Macassar Road (industrial and residential, yellow and brown areas). The formally protected Macassar Dunes Nature Reserve of the City occurs approx. 2.7km to the west of the site.

The entire property on which the WWTW lies is zoned as utility with the surrounding areas to the north and east zoned as agricultural, and to the south and west as open space (environmental and public open space). The City has not identified the area for future development. It is to remain open space and natural open space. Further to the north and east of the WWTW are the dense residential areas of Macassar and Firgrove. The AECI site, immediately to the east of the WWTW is mapped as a Risk Industry area.

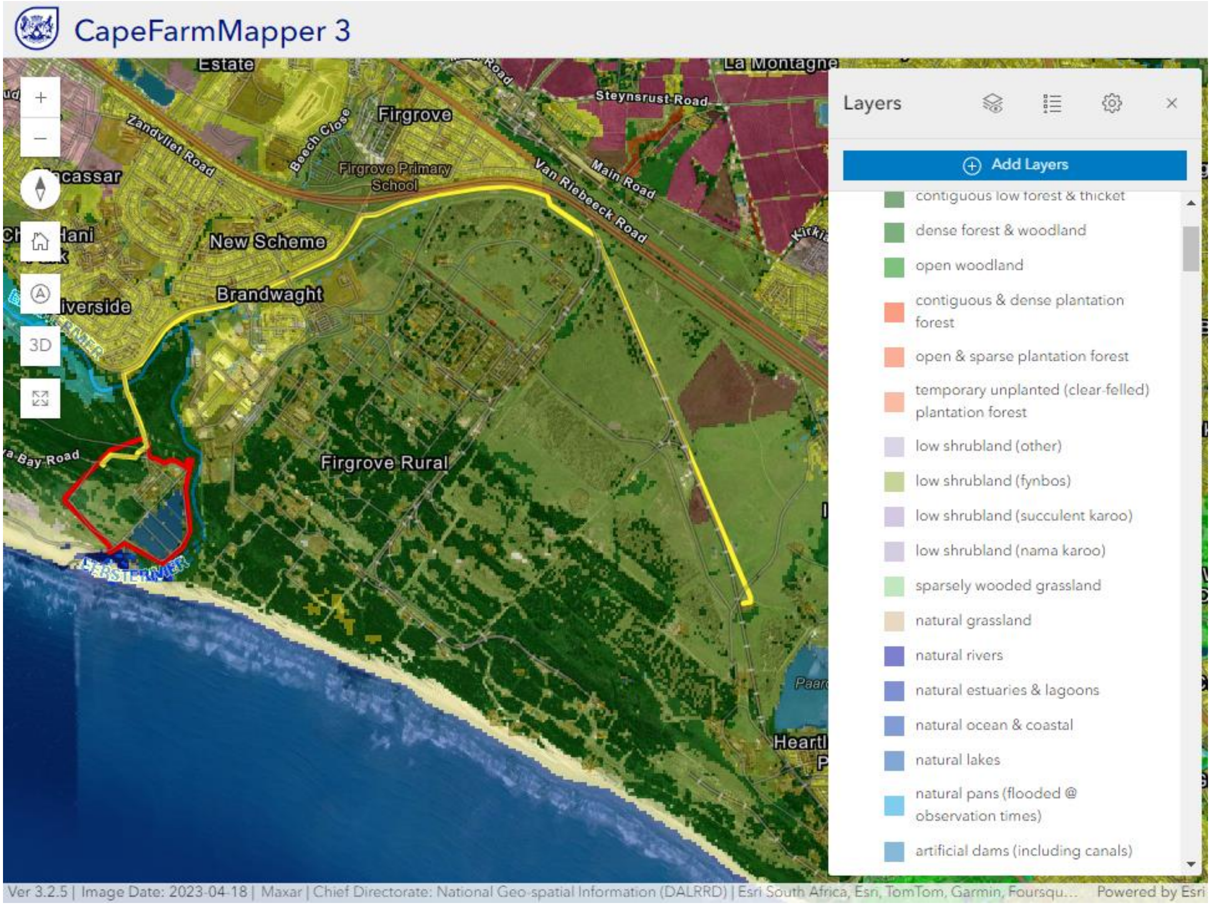


Figure 14. DFFE 2022 land cover map for the Macassar WWTW and surrounding areas (CapeFarmMapper, 2024)

8. ASSESSMENT OF FRESHWATER FEATURES AND THEIR SIGNIFICANCE

The following aquatic features have been identified and are discussed further in this section: Lower Eerste River; Eerste River Estuary; and Remnant wetland areas have largely been a result of ongoing disturbance of the topography in the area, particularly in association with the WWTW.

8.1. ASSESSMENT OF THE LOWER EERSTE RIVER

The Index for Habitat Integrity (IHI), Site Characterisation Assessment, geomorphology, riparian vegetation, macroinvertebrate, fish and water quality data obtained from past river health assessments and water quality sampling as well as the site assessment were used to provide information on the ecological condition of the lower Eerste River.

In terms of river health, previous assessments have been undertaken at several sites in the lower Eerste River. The sites where there is more data available that are recent and are most applicable to the Macassar WWTW are shown in Figure 15 (G2EERS-MACAS). This data has been used in this assessment. Water quality data was utilised from the CCT and DWA water quality databases, where recent water quality data was available for two sites in the study area (CCT - Eerste River u/s of

Macassar WTWW and DWS - at the Macassar Road as shown in Figure 15). Flow data in the lower Eerste River is only available at gauging station G2H15 (Figure 15). This was used to calibrate the environmental flow requirement data.

Figure 15. Monitoring sites on the lower Eerste River System as shown in Google Earth

8.1.1. DESCRIPTION OF THE LOWER EERSTE RIVER

The earliest images of the site (Figure 16) show the site and surrounding area before significant urban development. Historically the lower Eerste River consisted of a wider channel with old meander channels as it flowed through the dunes. The old channels became filled with sediment over time but are likely to have formed wetland areas and would have still carried flow from the river during the higher flow periods. Initially only the Denel (AECI) buildings had been constructed further to the east of the Eerste River at that time and much of the activity within the catchment comprised agriculture. The semi-braided river channel and associated wetland habitat are visible.

The estuary comprised a marsh area with little open water that seeped through the dunes to the sea. Historically the Eerste River Estuary consisted of a much larger surface water area that extended as a lagoon on both sides of the mouth. The eastern portion of which has been cut off from the estuary by a causeway constructed in 1977. In addition, the associated wetland areas of the estuary were historically much larger than is seen today because the WWTW appears to have been built in this floodplain area. Under unimpacted conditions, the estuary was a temporally open/closed estuary that closed during the summer and breached after the first winter rains

Figure 16. Aerial photograph of the study area taken in 1953 and in 1996 with the approximate location of the Macassar WWTW and powerline indicated by the red oval and line respectively.

Figure 16 (bottom) comprises an aerial image of the study area taken in 1996 after the construction of the WWTW. The aquatic habitats and immediate surrounding area looked similar to that of today. The N2 and Eskom corridors are also visible in this image, with more disturbance of the area visible that is present today. The floodplain wetland in the eastern portion of the study area is not clearly visible.

Figure 17. Upstream (top) and downstream (bottom) view of the Eerste River at the road bridge to the Macassar WWTW

Today, the river flows within an incised channel with a narrow riparian zone and eroded banks. There are also several alien invasive trees and shrubs present within the riparian zone. White milkwood *Sideroxylon inerme*, Cape willow *Salix mucronata* and dune currant rhus *Searsia laevigata* occur within the riparian zone of the lower river together with exotic grasses, trees and shrubs such as rooikrans *Acacia Cyclops*, Port Jackson willows *Acacia saligna*, red sesbania *Sesbania punicea* and castor oil plants *Ricinus communis.*

8.1.2. RIVER CLASSIFICATION

To assess the condition and ecological importance and sensitivity of the river, it is necessary to understand how the river might have appeared under unimpacted conditions. This is achieved by classifying rivers according to their ecological characteristics so that they can be compared to ecologically similar rivers.

River typing or classification involves the hierarchical grouping of rivers into ecologically similar units so that inter- and intra-river variation in factors that influence water chemistry, channel type, substratum composition and hydrology are best accounted for. Any comparative assessment of river condition should only be done between rivers that share similar physical and biological characteristics under natural conditions. Thus, the classification of rivers provides the basis for assessing river condition to allow comparison between similar river types. The primary classification of rivers is a division into ecoregions. Rivers within an ecoregion are further divided into sub-regions.

Ecoregions are groups of rivers within South Africa, which share similar physiography, climate, geology, soils and potential natural vegetation. For this study, the ecoregional classification presented in the Department of Water Affairs and Forestry in 1999, which divides the country's rivers into ecoregions, was used. The river assessed lies within the South Western Coastal Belt Ecoregion, with the characteristics described in Table 1.

Sub-regions (or geomorphological zones) are groups of rivers, or segments of rivers, within an ecoregion, which share similar geomorphological features, of which gradient is the most important. The use of geomorphological features is based on the assumption that these are a major factor in the determination of the distribution of the biota. Table 2 provides the geomorphological features of the lower Eerste River.

Table 2. Characteristics of the South Western Coastal Belt Ecoregion (Dominant Types In Bold)

Main Attributes	Characteristics
Terrain Morphology	Plains; Low Relief; **Plains Moderate Relief**; E: Closed Hills; Mountains; Moderate and High Relief
Vegetation types	Sand Plain Fynbos; Mountain Renosterveld; **West Coast Renosterveld;** Dune Thicket; Strandveld Succulent Karoo
Altitude (m a.m.s.l)	0-300; 300-900 limited
MAP (mm)	100 to 1000
Coefficient of Variation (% of annual precipitation)	20 to 39
Rainfall concentration index	30 to 60
Rainfall seasonality	Winter
Mean annual temp. (°C)	14 to 20
Median annual simulated runoff (mm) for quaternary catchment	<5; 20 to >250

8.1.3. SITE CHARACTERISATION

From the Site Characterisation assessment, the geomorphological and physical characteristics of the river assessed can be classified as follows:

Table 3. Geomorphological and Physical features of the Lower Eerste River

Geomorphological Zone	Lowland River
Lateral mobility	Largely unconfined
Channel form	Simple however there are historic meanders
Channel pattern	Single thread: moderate to low sinuosity
Channel type	Alluvium
Channel modification	Moderate modification in the lower reaches (flow and water quality impacts as well as some channelization and alien vegetation encroachment)
Hydrological type	Perennial (present day as a result of WWTW and stormwater discharges to the river)
Ecoregion	South Western Coastal Belt
DWA catchment	G22H
Vegetation type	Cape Flats Dune Strandveld / Cape Seashore Vegetation
Rainfall region	Winter

8.1.4. INDEX OF HABITAT INTEGRITY

The evaluation of the Index of Habitat Integrity (IHI) provides a measure of the degree to which a river has been modified from its natural state. This assessment was undertaken for the lower Eerste River near Macassar WWTW (Table 4). The methodology (DWAF, 1999) involves a qualitative assessment of the number and severity of anthropogenic perturbations on a river and the damage they potentially inflict upon the system. These disturbances include both abiotic and biotic factors, which are regarded as the primary causes of the degradation of a river. The severity of each impact is ranked using a scale from 0 (no impact) to 25 (critical impact).

The IHI assessment is based on an evaluation of the impacts of two components of the river, the riparian zone and the instream habitat. Assessments are made separately for both components, but data for the riparian zone are interpreted primarily in terms of the potential impact on the instream component. The total scores for the instream and riparian zone components are then used to place the habitat integrity of both in a specific habitat category.

Table 4. Index of Habitat Integrity Assessment results and criteria assessed in the lower Eerste River

Instream Habitat Integrity	Score	Riparian Zone Habitat Integrity	Score
Water Abstraction	8	Vegetation Removal	9
Flow Modification	18	Exotic Vegetation	12
Bed Modification	12	Bank Erosion	9
Channel Modification	12	Channel Modification	10
Water Quality	16	Water Abstraction	8
Inundation	16	Inundation	15
Exotic Macrophytes	10	Flow Modification	17
Exotic Fauna	10	Water Quality	16
Rubbish Dumping	11		
Instream Habitat Integrity Score	**33**	**Riparian Zone Habitat Integrity Score**	**24**
Integrity Class	**E**	**Integrity Class**	**E**

Impacts to instream habitat consist of flow modification and water quality impacts as a result of the discharge of treated wastewater from several WWTWs in the Kuils and Eerste River Catchments as well as stormwater runoff. There is also an interbasin transfer of water from the Breede River into the upper Eerste River for irrigation in the lower Eerste River. Disturbance of the riparian habitat has also taken place with the resulting growth of invasive alien plants. The river within the reach assessed is considered to be in a severely modified state in terms of its instream habitat and riparian habitat.

Table 5. Habitat Integrity categories (From DWAF, 1999)

Category	Description	Score (%I)
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	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.	0

8.1.5. MACROINVERTEBRATE ASSESSMENTS AND OTHER BIOTA

The South African Scoring System version 5 (SASS5) was used to estimate the river's water quality and aspects of its ecology, as the aquatic macro-invertebrate community contributes as a vital component to riverine ecosystems (recycling the energy budget, etc.). In addition to contributing to the biodiversity of the river, it also plays a role in the functioning of the river (food webs, water clarity, etc.). Due to the differing sensitivities of the organisms (some tolerant, others sensitive), the composition of the communities present can be used as an indicator estimate of the water quality and general river health at the sampling site.

The results from the SASS5 survey (Table 5) were assessed according to Figure 18 which indicates the biological bands for the South Western Coastal Belt lower geomorphological zone. In terms of Figure 18, the ecological condition of the lower Eerste River as determined using SASS5, is in a moderately modified condition. The majority of macroinvertebrate families occurring within the sites assessed are hardy, pollution-tolerant taxa.

Table 6. Summary of the SASS5 results for the river health sites on the lower Eerste River

Site	Date	SASS5 Score	No. of taxa	ASPT	Ecological Category
G2EERS-MACAS	22/09/2004	72	15	4.8	B
	26/09/2014	52	12	4.3	C

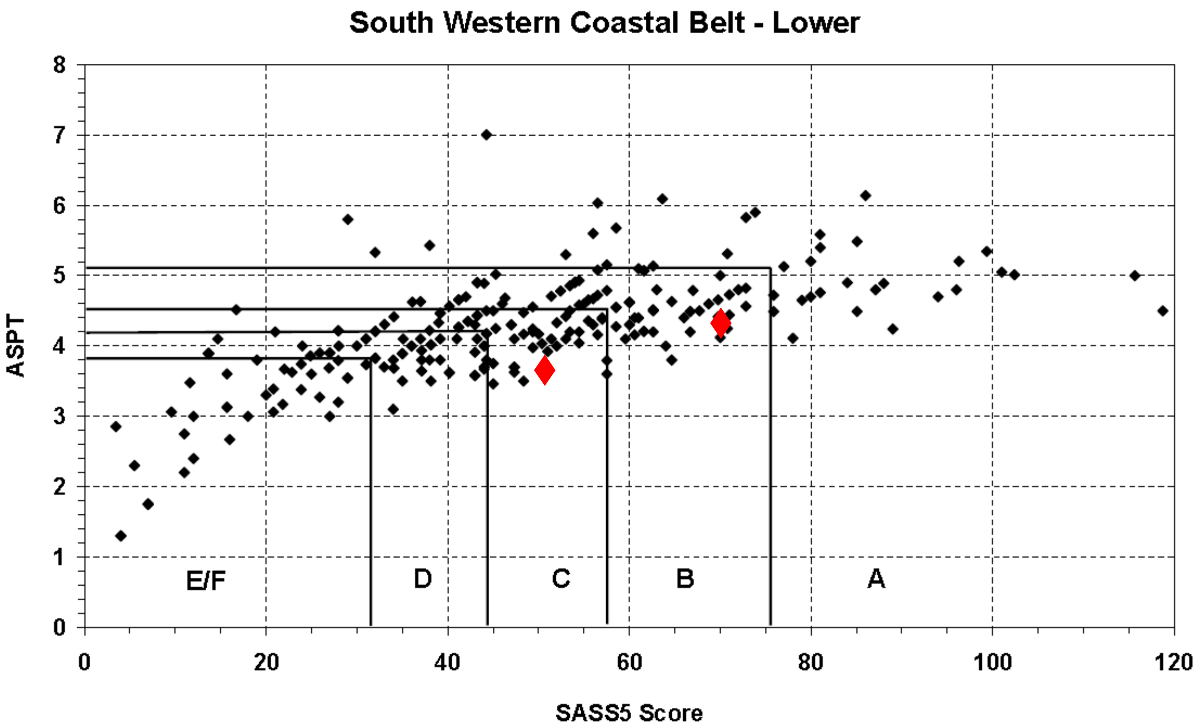


Figure 18. Data interpretation guidelines generated for SASS5 results, based on available data for the South Western Coastal Belt lower geomorphological zone

8.1.6. WATER QUALITY OF THE LOWER EERSTE RIVER

Past monitoring by the National Department of Water and Sanitation of the Kuils River at Kuils River (G2H21 from 1979 to 1983) and the Eerste River at Faure (1968-1978) indicated the following water quality characteristics for the rivers:

Site		Kuils River at Kuils River- G2H21	Eerste River at Faure - G2H15
Date		1979-1983	1968-1978
pH	Median Range	7 5.5 – 8	7 6.4 - 8.22
Electrical Conductivity (mS/m)	Median Range	96.2 24.7 -169.6	39.1 14.5-104.7
Nitrate/Nitrite (mg/l)	Median Range	5.51 0.02 - 91.35	0.36 0.02 - 1.35
Ortho phosphates (mg/l)	Median Range	2.47 0.003 - 15.35	0.20 0.007 - 0.959
Ammonium (mg/l)	Median Range	0.04 0.02 - 24.2	0.11 0.2 - 1.34

There have been major negative impacts on water quality in both rivers because of the impacts of urbanisation and agriculture described earlier in this report. The City of Cape Town has seven water quality monitoring points in the study area, five of which are routinely monitored (EK08, EK13, EK11, EK18 and EK17). Day and Clark (2012, in Day 2016) found that for the 2010 – 2011 period, water quality at all the Eerste/Kuils River sites was consistently poor. The major impacts on water quality were elevated levels of orthophosphate and nitrogenous wastes, low levels of dissolved oxygen and unacceptable levels of *E. coli* for human contact (Belcher 2015, Day 2016).

The results provided below are based on the most recent data obtained for the Kuils/Eerste River at the following points for the period January 2017 to March 2022: Kuils River downstream of Baden Powel Drive (EK08); Eerste River on N2 Freeway and upstream (u/s) of the Kuils River confluence (EK13); Eerste River downstream (d/s) of Macassar WWTW (EK12); and Eerste River estuary downstream of Macassar WWTW (EK17).

Site		Kuils River at Baden Powel Drive (EK08)	Eerste River at N2 – EK13	Eerste River us Macassar WWTW	Eerste River ds Macassar WWTW
Date		2017 - 2022			
pH	Median Range	7.5 7.2 – 8.3	7.5 7.1 – 7.8	7.6 3.3 – 8.2	7.6 3.4 – 8.2
Electrical Conductivity (mS/m)	Median Range	97 54 - 130	54 20 - 116	88 37 - 107	149.5 42 - 2462
Nitrate/Nitrite (mg/l)	Median Range	0.4 0.053 – 11.8	1.601 0.185 – 7.87	0.8 0.09 – 17.2	0.561 0.05 – 13.1
Ortho phosphates (mg/l)	Median Range	2.2 0.5 – 6.5	0.633 0.093 – 13.457	2.23 0.1 – 43.4	3 0.1 – 9.2
Ammonium (mg/l)	Median Range	0.013 <0.001 – 0.254	0.003 <0.001 – 0.515	0.221 0.008 – 0.674	0.348 0.018 – 1.769
E.coli	Median Range	1300 10 – 1 440 000	820 <10 – 74 000	3700 720- >1 000 000	14 500 1000 – 450 000

More details on the water quality assessments are provided in Appendix B.

From the assessment of the past five years of data for the lower Kuils River, the lower Eerste River upstream of the confluence as well as, the lower Eerste River downstream of the confluence but upstream of the Macassar WWTW, the following observations can be made:

- The water quality in the lower river downstream of the confluence of the two rivers is closely associated with the upstream quality in the Kuils River. This is likely associated with a larger volume that is in the Kuils River and is a result of the discharge of treated wastewater into this river.

- As expected, the salinity (or electrical conductivity) is significantly higher in the Kuils River than in the Eerste River. Some seasonal variability occurs, with higher conductivity values occurring in late summer and lower values in late winter. There has been an overall slightly decreasing concentration in conductivity in the rivers over the past 5 years.

- Nitrate/nitrite concentrations are higher in the Eerste River than in the Kuils River, but there has been a decreasing trend in the river. This observation is expected, given the more extensive agricultural activity in the catchment of the Eerste River. A seasonal pattern is evident, with increasing concentrations in the rivers at all of the sites occurring at the beginning of winter, with the first rainfall flush off the catchment. Despite higher concentrations of nitrogen occurring in the Eerste River upstream of the confluence than in the Kuils River, the nitrogen concentrations in the river downstream of the confluence more closely resemble the concentrations occurring in the Kuils River. With these concentrations, there has been a slight increase in concentrations over the past 5 years.

- Orthophosphate concentrations tend to be higher in the Kuils River than in the Eerste River upstream of the confluence of the rivers. The orthophosphate concentrations in the Eerste River downstream of the confluence resemble those in the upstream Kuils River. Elevated orthophosphate concentrations have a seasonal pattern, tending to be higher in summer, and extending into early winter. There has been a slight increase in concentrations over the past five years.

- *E.coli* counts are similar for all three monitoring sites, with an increasing trend. There is not a clear seasonal trend, the counts have fluctuated between 100 counts/100 ml and 100 000 counts per 100 ml for most of the period, with counts of above 1 000 000 occurring during winter 2021.

The above water quality results were evaluated against the following guidelines or standards where available:

1. The General and Special Standards or Limits that are specified under the General Authorisations in terms of Section 39 of the National Water Act, 1998 (Act No. 36 of 1998), which apply to treated effluent that is discharged into a water body (Government Notice No. 665 of 6 September 2013).

2. Target water quality guidelines, which apply to the quality of water occurring in rivers required to minimise the impact of poor water quality on aquatic ecosystems in South Africa (DWAF, 1996).

A summary of the median concentrations measured at the sites for the period 2009 until 2014 is provided in the table below:

Table 7. Median and 95 percentile water quality concentrations in the lower Eerste River compared with the water quality of the final treated wastewater from the WWTW as well as the water quality limits and guidelines

Variable		D/s site Eerste River (DWS)	U/s site Eerste River (CCT–EK11)	Macassar WWTW	General Limit	Special Limit	WQ Guideline
Suspended solids (mg/l)	Median		13	7			<10% increase
	95%ile		17.3	24	25	10	
Chemical Oxygen Demand (mg/l)	Median		34	43			
	95%ile		42	69	75	30	
Electrical Conductivity (mS/m)	Median	81.3	88.5	92			<15% change
	95%ile	87.0	100	107	150	100	
pH (pH units)	Median	7.2	7.5	8			>0.5 units of 5% change
	95%ile	7.7	7.75	8.2	5.5 - 9.5	5.5 – 7.5	
Unionised ammonia (NH_3)	Median		0.09	3			<0.007 target or 0.1 acute toxicity value
	95%ile		0.38	10.3	6	2	
Ammonium (NH_4^+)	Median	1.6					
	95%ile	11.9					
Nitrate/Nitrite (NO_2/NO_3)	Median	2.7	0.93	2			
	95%ile	9.1	2.32	13.1	15	1.5	
Ortho-phosphates (PO_4)	Median	1.9	2.1	4		1	>15% change
	95%ile	5.5	3.62	10	10	2.5	

8.1.7. ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)

The EIS Assessment considers several biotic and habitat determinants surmised to indicate either importance or sensitivity. The determinants are rated according to a four-point scale (Table 8). The median of the resultant score is calculated to derive the EIS category (Table 9).

Table 8. Definition of the four-point scale used to assess biotic and habitat determinants presumed to indicate either importance or sensitivity

Scale	Definition
1	One species/taxon judged as rare or endangered at a local scale.
2	More than one species/taxon judged to be rare or endangered on a local scale.
3	One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.
4	One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books)

Table 9. Ecological importance and sensitivity categories (DWAF, 1999)

EISC	General description	Median
Very high	Quaternaries/delineations unique on a national and international level based on unique biodiversity. These rivers are usually very sensitive to flow modifications and have no or only a small capacity for use.	>3-4
High	Quaternaries/delineations unique on a national scale based on their biodiversity. These rivers may be sensitive to flow modifications but in some cases may have substantial capacity for use.	>2-≤3
Moderate	Quaternaries/delineations unique on a provincial or local scale due to biodiversity. These rivers are not usually very sensitive to flow modifications and often have substantial capacity for use.	>1-≤2
Low/ marginal	Quaternaries/delineations that are not unique on any scale. These rivers are generally not very sensitive to flow modifications and usually have substantial capacity for use.	≤1

Table 10. Results of the EIS assessment for the lower Eerste River

Biotic Determinants	Score
Rare and endangered biota	2
Unique biota	3
Intolerant biota	1
Species/taxon richness	2
Aquatic Habitat Determinants	
Diversity of aquatic habitat types or features	2
Refuge value of habitat type	1
Sensitivity of habitat to flow changes	1
Sensitivity of flow related water quality changes	1
Migration route/corridor for instream and riparian biota	2
National parks, wilderness areas, Nature Reserves, Natural Heritage sites, Natural areas, PNEs	2
RATINGS	1.7
EIS CATEGORY	**Moderate**

The lower Eerste River is considered to be of moderate Ecological Importance and Sensitivity. This is largely due to the indigenous fish that occur within the river system and the link of the lower river with the estuary and marine protected area. The Eerste/Kuils River had three primary freshwater fish species, Cape Galaxias *Galaxias zebratus*, Cape kurper *Sandelia capensis* and an undescribed species of redfin thought to be closely related to the Berg River redfin *Pseudobarbus phlegethon*. These species were recorded in the upper reaches of the Eerste River and may have occurred in the project area. African longfin eels *Anguilla mossambica* have also been recorded in the Eerste River. Marine and estuarine migrants such as estuarine round herring *Gilchristella aestuaria*, Cape Silverside *Atherina breviceps* and freshwater mullet *Myxus capensis* have also been recorded in the lower river system.

Amphibians occurring in the study area include:

- Clicking Stream Frog (*Strongylopus grayii*)
- Cape River Frog (*Amietia fuscigula)*
- Klipheuwel Dainty Frog (*Cacosternum aggestum*)
- Cape Caco (*Cacosternum capense)*
- Sand Toad (*Vandijkophrynus angusticeps*
- Cape Sand Frog (*Tomopterna delalandii)*
- Spotted Painted Reedfrog (*Hyperolius marmoratus* ssp. *verrucosus)*

The WWTW and adjacent estuary is also frequented by many waterbirds.

8.2. ESTUARY ASSESSMENT

The information contained in this section has been obtained largely from past assessments that have been undertaken of the Eerste Estuary such as the National Biodiversity Assessment for Estuaries undertaken in 2011, as well as in the development of a conservation plan for temperate South African estuaries based on biodiversity importance, ecosystem health and economic costs and benefits that was undertaken as part of C.A.P.E. in 2007.

8.2.1. DESCRIPTION OF THE EERSTE ESTUARY

Historically the Eerste River Estuary consisted of a much larger surface water area that extended as a lagoon on both sides of the mouth. The eastern portion of which has been cut off from the estuary by the causeway constructed in 1977. In addition, the associated wetland areas of the estuary were historically much larger than is seen today because the WWTW appears to have been built in this floodplain area. Under unimpacted conditions, the estuary was a temporally open/closed estuary which closed during the summer and breached after the first winter rains.

Today, the estuary is approximately 10.2 ha in extent and remains permanently open. The mouth position has also changed and estuarine surface area has been drastically reduced over the last 60 years. Since the development of the WWTW, an extensive eastern lagoon opening to the east has dried up to be replaced by a smaller western lagoon opening to the west. This, coupled with the loss of adjacent wetlands, has led to at least a 75 % reduction in habitat availability and diversity for aquatic biota.

Figure 19. View of the western lagoon that forms part of the Eerste River Estuary

A total of 20 fish species representing 12 families have been recorded from the lower Eerste River and Estuary. Fifteen of the fish species recorded from the Eerste can be regarded as either partially or completely dependent on estuaries for their survival (e.g. round herring *Gilchristella aestuaria,* leervis *Lichia amia*, flathead mullet *Mugil cephalus*, white steenbras *Lithognathus lithognathus*, elf *Pomatomus saltatrix,* harder *Liza richardsonii* and eels *Anguilla mossambica*). The remaining five species include two marine vagrants and three introduced freshwater species (rainbow trout *Oncorhynchus mykiss*, sharptooth catfish *Clarias gariepinus* and carp *Cyprinus carpio*).

A total of 43 species of waterbirds have been recorded at the Eerste River Estuary in six counts from 1976 to 2000. Total water bird counts on the estuary range between 89 and 1649 birds. Large numbers (several thousand) of terns are reported to roost at the estuary mouth. A reason for the high diversity and variability in numbers relates to the proximity of the estuary to the WWTW, with the avifaunal community having a strong freshwater element of ducks, coots, moorhens, etc.

The common *Phragmites australis* reed lines the banks of the lower Eerste River and Estuary with patches of bulrush *Typha capensis,* sedges *Scirpus* sp. and the small marsh flower *Cotula coronopifolia* occurring along the banks.

8.2.2. ESTUARY CLASSIFICATION

In terms of the broad physical features of estuaries, the Eerste River Estuary is classified as follows:

Table 11. Physical Characteristics of the Eerste River Estuary

Name of Estuary	Eerste
Biogeographic region	Cool Temperate
Estuary Type	River Mouth
Size	Medium/Small (10.2 ha)
Mouth condition	Present Day: Permanently open Historical: Perched estuary which historically closed during summer
Salinity	Freshwater dominated
Freshwater type	Turbid

Table 12. Mapped habitat cover for the Eerste River Estuary (Van Niekerk and Turpie, 2012)

Habitat cover	Area (ha)
Intertidal salt marsh	0.29
Supratidal salt marsh	-
Submerged macrophytes	-
Reeds & sedges	1.36
Mangroves	-
Sand/mud banks	6.15
Channel	2.4
Rocks	-
Swamp forest	-
Total	10.2

8.2.3. PRESENT ECOLOGICAL STATUS / ESTUARINE HEALTH

The scores provided below are from the Desktop National Health Assessment (Van Niekerk and Turpie, 2012), with individual ecological components graded from Excellent, good, fair to poor.

Table 13. Present Ecological Status

Criteria	**Score**
Hydrology	Fair
Hydrodynamics	Poor
Water Quality	Poor
Physical habitat	Poor
Habitat State	**Poor**
Microalgae	Poor
Macrophytes	Poor
Invertebrates	Poor
Fish	Poor
Birds	Poor
Biological State	**Poor**
Estuary Health State (Mean)	**Poor**
Ecological Category	**E (Severely Modified)**

The main difference between present and natural conditions is the increase in flows during the dry periods. This is because of the release of treated sewage water, which has the largest effect during the summer months.

The levels of nutrients entering the estuary through the river and the Macassar WWTW represent a risk in terms of eutrophication. Phytoplankton blooms in the surf zone near the mouth are often believed to be the result of the additional nutrient supply to the rivers and stormwater discharges into the Bay. Total ammonia levels, particularly those introduced from the WWTWs are also of concern in terms of their toxicity to aquatic organisms in the estuary. Accumulation of organic material in the estuarine sediments such that the sediments are almost entirely anoxic throughout the estuary has been reported. The relatively large numbers of birds that are still feeding on the mud banks of the estuary indicate that there must still be sufficient invertebrates subsisting on the surface of the sediments to sustain these birds (Gibb Africa, 2000).

Significant changes in the flow patterns, water quality and habitat availability have had significant impacts on the ecological condition as well as the biota present in the estuary today. For instance, more recent fish surveys have consisted of only five fish species, one of which was the introduced sharp-tooth catfish *Clarias gariepinus*. The drastically reduced number of fish species caught within the estuary (as compared to the 20 species previously caught in the estuary), as well as reduced catch rates and shrunken size distributions in the species caught, suggest that the Eerste River Estuary no longer provides a suitable habitat for estuarine fish.

8.2.4. ESTUARY IMPORTANCE SCORE AND RECOMMENDED ECOLOGICAL CATEGORY

The overall estuary importance score is calculated from the size score, habitat importance score, zonal type rarity score and biodiversity importance score. The following scoring of the Eerste River Estuary was obtained from the Development of a Conservation Plan for temperate South African estuaries based on biodiversity importance, ecosystem health and economic costs and benefits (Turpie and Clark, 2007) that were undertaken as part of the C.A.P.E. Estuaries Programme.

Table 14. Estuary Importance Score for the Eerste River Estuary

Criteria	Score (%)
Size Score	40
Habitat Importance Score	40
Zonal Type Rarity Score	10
Biodiversity importance score	64.5
Estuary importance score	**43.1**

Table 15. Estimates of the recreational, subsistence and nursery value of the Eerste River Estuary and the relative existence value (which is largely associated with scenic beauty).

Value	**Score**
Recreation	Low
Subsistence	Low
Nursery	Low/Medium
Scenic	Medium

The Eerste River Estuary is considered an important habitat for birds in the local context of False Bay in terms of the overall numbers and diversity of birds that it supports. At a national level, the estuary supports up to 6% of the estimated national coastal avocet population (Turpie 2000). The estuary is also noted for its small, but regular, population of the threatened African Black Oystercatcher (a red data species). Overall, however, the estuary is not considered important in a national or international context.

The National Biodiversity Assessment for Estuaries undertaken in 2011 (Van Niekerk and Turpie, 2012), indicated that, due to the poor condition of the estuary, as well as the fact that the estuary occurs within a Marine Protected Area, the estuary should be given a high priority for rehabilitation, particularly in terms of water quality. The assessment also indicated that the entire estuary should be given full protection status. The Recommended Ecological Category for the estuary was a D category (Largely modified).

8.3. WETLAND ASSESSMENT

A "*wetland*" is defined in the National Water Act, Act 36 of 1998 as "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*". The wetland features found adjacent to the Macassar WWTW are assessed in this section in terms of Wetland Health, Ecosystem Goods and Services and Ecological Importance and Sensitivity.

8.3.1. WETLAND DESCRIPTION

The wetland areas associated with the Eerste River Estuary adjacent to the Macassar WWTW and within the floodplain are in a highly modified state. The common *Phragmites australis* reed dominates the banks of the estuary together with some sedges *Scirpus* sp. Some intertidal salt marsh vegetation also occurs such as glasswort *Sarcocornia* sp. Vegetation within the artificially created and permanently inundated wetland is dominated by bulrushes (*Typha capensis*) while vegetation within the past oxidation or settling pond areas within the dunes consists of European weeds and alien grasses such as the saltwater couch *Paspalum vaginatum* with some arum lilies *Zantedeschia aethiopica*.

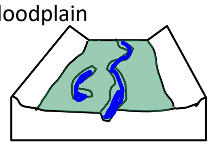
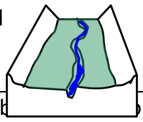
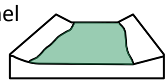
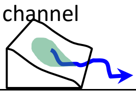
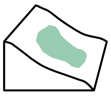
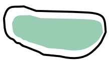
Figure 20. Aerial photograph of the wetland areas adjacent to the Macassar WWTW

Figure 21. Views of the estuarine wetland (top image), artificial wetlands within and adjacent to the WWTW (middle images) and the floodplain wetland (bottom image).

8.3.2. WETLAND CLASSIFICATION

The classification of the wetlands in the study area into different wetland types was based on the WET-EcoServices technique (Kotze *et al*, 2005). The WET-EcoServices technique identifies seven types of wetlands based on hydro-geomorphic characteristics (Table 16).

Table 16. Wetland hydro-geomorphic types typically supporting inland wetlands in South Africa

Hydro-geomorphic types	Description	Source of water	
		Surface	Sub-surface
Floodplain 	Valley bottom areas with a well-defined stream channel, gently sloped & characterized by floodplain features such as oxbow depressions & natural levees & alluvial transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and adjacent slopes.	***	*
Valley bottom with a channel 	Valley bottom areas with a well-defined stream channel but lacking floodplain features. May be gently sloped with net accumulation of alluvial deposits or have steeper slopes & characterized by the net loss of sediment. Water inputs from main channel and adjacent slopes.	***	*/ ***
Valley b ut a channel 	Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland & from adjacent slopes.	***	*/ ***
Hillslope seepage linked to stream channel 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.	*	***
Isolated Hillslope seepage 	Slopes on hillsides, characterized by the colluvial movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes Pans) 	A basin-shaped area with a closed elevation contour that allows for the accumulation of surface water and sometimes sub-surface water. An outlet is usually absent, being isolated from the stream network.	*/ ***	*/ ***

Water source:	*	Contribution usually small
	***	Contribution usually large
	*/ ***	Contribution may be small or important depending on the local circumstances
		Wetland

According to Table 16, the wetland features within the study area can be classified as follows:

Table 17: Classification of wetland areas within the study area

Name	Estuarine wetland areas	Wetlands associated with past WWTW activities	Floodplain wetlands
System	Estuarine	Inland	
Ecoregion	South Western Coastal Belt		
Landscape setting	Intertidal floodplain	Valley Floor Depression	Plain
Longitudinal zone	Estuary	Not applicable	Not applicable
Drainage	With channel inflow and outflow	Not applicable	Perched - rainfall
Seasonality	Seasonally to permanently inundated		Periodically inundated
Anthropogenic influence	Ongoing habitat disturbance and resulting alien plant invasion	Artificially created depressions	Past cultivation, N2 road and railway
Vegetation	Cape Seashore Vegetation	Highly modified Cape Flats Dune Strandveld	Highly modified Boland Granite Fynbos
Substrate	Sand		Weathered granite clays
Salinity	Estuarine (freshwater dominated)	Fresh	

The estuarine wetland has been dealt with in Section 7.2, no further assessment of this wetland has been undertaken.

8.3.3 WETLAND INTEGRITY

The Present Ecological Status (PES) Method (DWAF 2005) was used to establish the integrity of the wetlands in the study area and was based on the modified Habitat Integrity approach developed by Kleynhans (DWAF, 1999; Dickens *et al*, 2003). Table 18 shows the criteria and results from the assessment of the habitat integrity of the wetlands. These criteria were selected based on the assumption that anthropogenic modification of the criteria and attributes listed under each selected criterion can generally be regarded as the primary causes of the ecological integrity of a wetland.

Table 18. Habitat integrity assessment criteria for palustrine wetlands (Dickens *et al*, 2003)

Criteria	Relevance
Hydrologic	
Flow Modification	Abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime, volumes, velocity affect inundation of wetland habitats resulting in floralistic changes or incorrect cues to biota. Abstraction of groundwater.
Perm. Inundation	Impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.
Water Quality	
Water Quality Modification	From point or diffuse sources from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.
Sediment Load Modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands.
Hydraulic/Geomorphic	
Canalisation	Results in desiccation or change to inundation patterns of wetland and thus changes in habitats.
Topographic Alteration	Infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities that reduce or change wetland habitat directly in inundation patterns.
Biota	
Terrestrial Encroachment	Desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.
Indigenous Veg Removal	Direct destruction of habitat through farming, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).
Alien Fauna	Presence of alien fauna affecting faunal community structure.
Over utilisation	Overgrazing, over fishing, etc.

Table 19. Wetland habitat integrity assessment (score of 0=critically modified to 5=unmodified)

Criteria & Attributes	Permanently and periodically inundated wetland area associated with past WWTW activities	Periodically inundated floodplain wetland areas
Hydrologic		
Flow Modification	1.0	2.0
Permanent Inundation	1.5	2.0
Water Quality		
Water Quality Modification	1.0	2.5
Sediment Load Modification	2.0	2.0
Hydraulic/Geomorphic		
Canalisation	1.5	3.0
Topographic Alteration	1.5	2.0
Biota		
Terrestrial Encroachment	2.5	2.0
Indigenous Vegetation Removal	1.5	1.0
Invasive Plant Encroachment	2.5	1.5
Alien Fauna	3.0	2.0
Over utilisation of Biota	2.5	2.5
Total Mean	**1.9**	**2.04**
Category	**D**	**D**

Table 20. Relation between scores given and ecological categories

Scoring Guidelines Per Attribute*	Interpretation of Mean* of Scores for all Attributes: Rating of Present Ecological Status Category (PESC)
Natural, unmodified - score=5.	Within general acceptable range CATEGORY A >4; Unmodified, or approximates natural condition.
Largely natural - score=4.	CATEGORY B >3 and <4; Largely natural with few modifications, but with some loss of natural habitats.
Moderately modified- score=3.	CATEGORY C >2 and <3; moderately modified, but with some loss of natural habitats.
Largely modified - score=2.	CATEGORY D <2; largely modified. A large loss of natural habitats and basic ecosystem functions has occurred.
	OUTSIDE GENERALLY ACCEPTABLE RANGE
Seriously modified - rating=1.	CATEGORY E >0 and <2; seriously modified. The losses of natural habitats and basic ecosystem functions are extensive.
Critically modified - rating=0.	CLASS F 0; critically modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat.

Both wetland areas can be considered to be in a largely modified ecological condition as a result of topographical changes, flow and water quality modification, removal of indigenous vegetation and growth of invasive alien plants.

8.3.4. ECOSYSTEM SERVICES SUPPLIED BY THE WETLANDS

The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines described by Kotze *et* al (2005). An assessment was undertaken that examines and rates the services listed in Table 21. The characteristics were scored according to the general levels of services provided. It is important to manage the wetlands to ensure that they can continue to provide the valued goods and services:

Table 21. Goods and services assessment results for wetlands (high=4; low=0)

Goods and services	Permanently and periodically inundated wetland area associated with past WWTW activities	Periodically inundated floodplain wetland areas
Flood attenuation	1.5	2.0
Stream flow regulation	1.5	1.0
Sediment trapping	2.5	2.0
Phosphate trapping	2.5	2.0
Nitrate removal	2.5	2.5
Toxicant removal	2.0	1.0
Erosion control	2.0	1.5
Carbon storage	2.0	1.5
Maintenance of biodiversity	2.0	1.5
Water supply for human use	2.0	0
Natural resources	1.0	0
Cultivated foods	0	1.0
Cultural significance	0	1.0
Tourism and recreation	0	1.0
Education and research	0	0

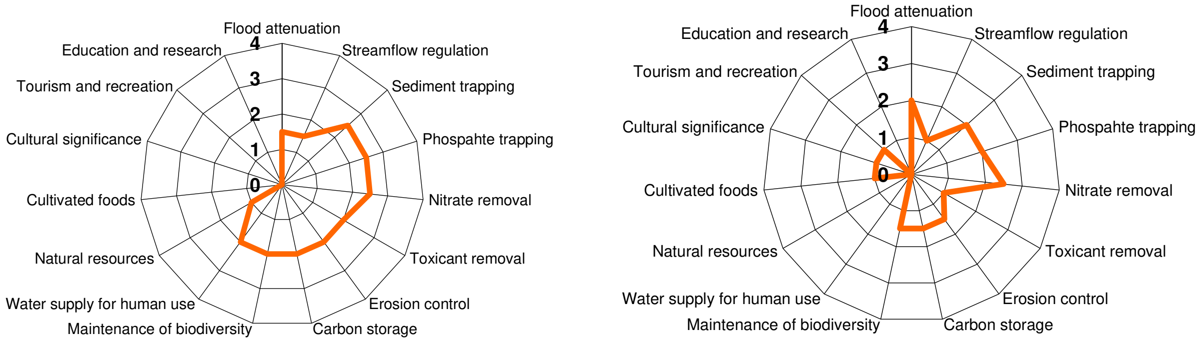


Figure 22. Ecosystem services provided by the wetland areas associated with past WWTW activities (left) and the floodplain wetlands (right)

From Figure 22 it can be seen that in terms of goods and services, the wetland areas provide limited goods and services.

8.3.5. ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS)

The EIS Assessment for the wetland areas is undertaken in the same manner as that for the river and considers several biotic and habitat determinants surmised to indicate either importance or sensitivity.

Table 22. Results of the EIS assessment for the wetland area

Biotic Determinants	**Permanently and periodically inundated wetland area associated with past WWTW activities**	**Periodically inundated floodplain wetland areas**
Rare and endangered biota	0.5	0.5
Unique biota	0.5	0.5
Intolerant biota	0.5	0.5
Species/taxon richness	0.5	1
Aquatic Habitat Determinants		
Diversity of aquatic habitat types or features	1	0.5
Refuge value of habitat type	1	0
Sensitivity of habitat to flow changes	0	1.0
Sensitivity of flow related water quality changes	0	1.0
Migration route/corridor for instream and riparian biota	0	0
National parks, wilderness areas, Nature Reserves, Natural Heritage sites, PNEs	1	1
EIS CATEGORY	**Low**	**Low**

The wetland areas associated with the Macassar WWTW and the adjacent floodplain are considered to be of a low to very low ecological importance and sensitivity with the only ecological importance and sensitivity largely being associated with the Eerste River Estuary and the Marine Protected Area.

8.4. RECOMMENDED ECOLOGICAL MANAGEMENT CATEGORY AND RESOURCE QUALITY OBJECTIVES

Table 23. Overall Ecostatus score (score between 0=critically modified and 5=natural/unmodified)

River Reach	**Lower Eerste River upstream of Macassar WWTW**
Bed modification	2.0
Flow modification	1.5
Introduced instream biota	2.0
Inundation	2.0
Riparian/ bank condition	2.0
Water quality modification	1.5
Habitat Integrity	1.8
Biotic	2.5
Instream biotic integrity	2.5
INSTREAM HEALTH	2.2
Rip Veg Integrity	2.0
RIP ZONE INT	1.9
RIVER HEALTH SCORE	41
ECOLOGICAL CATEGORY	D/E

According to the Present Ecological Status and Ecological Importance and Ecological Sensitivity that have been undertaken nationally in 2012, the Ecological Importance of the lower Eerste River is moderate, the Ecological Sensitivity is high and the Present Ecological Status is F (Critically modified). The Default Ecological Category (based on median PES and highest of EI or ES means) is B (Largely natural) however considering the level of development within the catchment it is unlikely that this is achievable. From the site assessment, the overall ecostatus of the lower Eerste River is a D/E category (Largely to Severely modified) and the ecological importance and sensitivity of the river are considered to be moderate.

The lower Eerste River and Estuary have a recommended ecological category of D (largely modified) in the gazetted Proposed Resource Classes and Resource Quality Objectives (RQOs) for the larger Berg Catchment (Government Gazette no 42451, dated 10 May 2019). The recommended ecological category for the determination of the environmental water requirements is a C/D category (moderately to largely modified). RQOs provided for the estuary are shown on the following page. No RQOs were included for the lower river.

Resource Name	Biophysical Node Name	TEC	Component	Sub-component	Indicator	RQO Narrative	RQO Numeric													
Eerste Estuary	Bxi3	D	Quantity	Surface flow	Flow	Freshwater inflow adequate to maintain water quality and habitat suitable for flora and fauna	Months	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Annual
							MMR/MAR (% Nat)	120 %	120 %	120 %	120 %	120 %	120 %	120 %	120 %	120 %	120 %	120 %	120 %	120 %
			Quality	Nutrients	DIN	Inorganic nutrient concentrations not to exceed TPCs for macrophytes and microalgae	River inflow: <1000 µg.l^{-1} Lower estuary: <1000 µg.l^{-1}													
					DIP		River inflow: <500 µg.l^{-1} Lower estuary: <500 µg.l^{-1}													
				Salinity	Salinity	Salinity distribution not to exceed TPCs for fish, invertebrates, macrophytes and microalgae	Average salinity in lower >10, maximum = 35													
				System variables	Dissolved oxygen	System variables not to exceed TPCs for biota	>4 mg.l-^{1}													
				Pathogens	Enterococci	Concentrations of waterborne pathogens should be maintained in an Acceptable category for full contact recreation	≤185 Enterococci/100 ml) (90th percentile, hazen system)													
					Escherichia coli		≤500 E. coli/100 ml (90th percentile, hazen system)													
			Habitat	Hydrodynamics	Mouth state Tidal variation	Habitat health adequate for microalgae, macrophytes, invertebrates, fish, birds and recreational use	Permanently open <10% change from present state													
			Biota	Microalgae	Biomass and community composition of phytoplankton and benthic microalgae community	Phytoplankton biomass and composition suitable for invertebrates, fish, birds and recreational use	Maintain low phytoplankton biomass (chlorophyll- a < 20 µg/ℓ) and a diversity of phytoplankton groups.													
				Macrophytes	Extent, distribution and richness of macrophytes	Macrophyte cover and composition suitable for invertebrates, fish, birds and recreational use	Restore and maintain the distribution and area cover of macrophyte habitats particularly salt marsh													
				Invertebrates	Macrofauna community composition, abundance and richness	Abundance and community composition of Invertebrates suitable for fish, birds	Restore and maintain species richness, distribution of species and mix (low species abundance, high dominance); Indicator species such as Capitella capitata, should not dominate benthic species at any site; Callianassa kraussi and Upogebia africana distribution patterns similar to reference state.													
				Fish	Fish community composition, abundance and richness	Abundance and community composition of fish community suitable for birds	Restore and maintain the full complement of estuarine resident and estuary associated marine present in the estuary with population sizes sufficient to ensure their persistence in perpetuity; Ensure that exotic freshwater species do not increase to levels where they can exclude any more indigenous species through predation or competitive interactions; Maintain recruitment of adult and juvenile fish at present levels.													
				Birds	Avifauna community composition, abundance and richness	Health avifauna community contributing to conservation of avifauna species in SA	Retain at least 90% of the baseline species richness, abundance and diversity of the bird community determined using regression slope based on a 3-year running average.													

9. ENVIRONMENTAL WATER REQUIREMENTS FOR THE LOWER KUILS / EERSTE RIVER SYSTEM

9.1 WATER QUANTITY

This section provides recommendations on the environmental or instream flow requirements (IFR) for the Kuils / Eerste River at Macassar WWTW. The Desktop Reserve model was used to determine the flow requirements, which it was extrapolated to the catchment area of the Kuils / Eerste River Catchment at the estuary (660 km^2 as shown in Figure 23). The following distribution curve (Figure 24), Reserve table (Table 24) and rule curves (Table 25) were generated for the Kuils/Eerste River for a C/D category ecological state. It should be noted that the output from the Desktop Reserve model does not provide recommendations relating to the capping of flows which is the more applicable criteria for decision-making regarding the impact of treated wastewater releases on the downstream ecosystem.

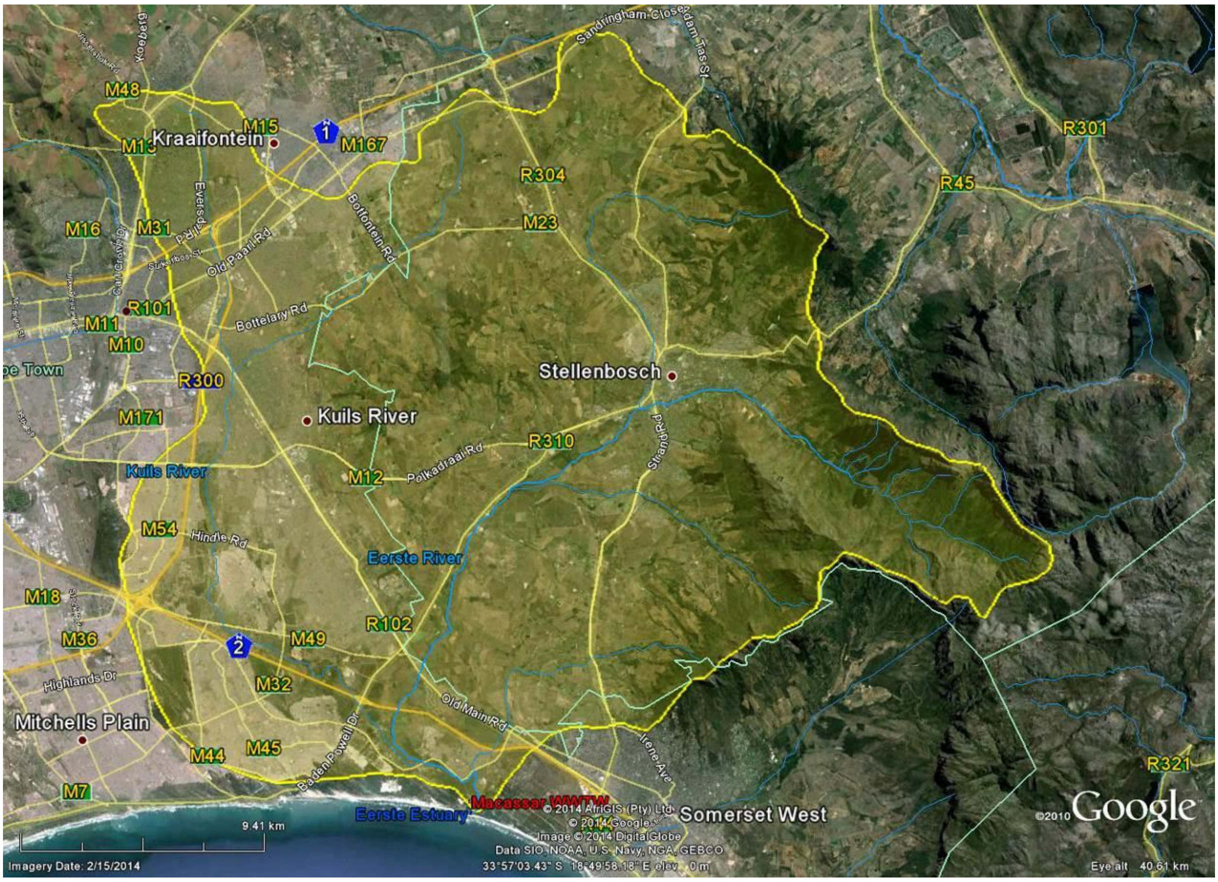


Figure 23. The Kuils / Eerste River Catcment Area, delineated in Google Earth

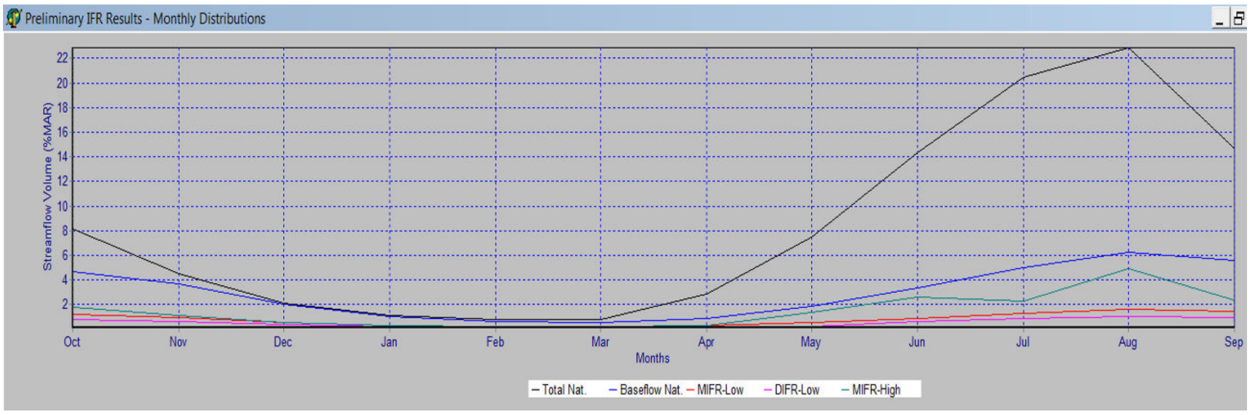


Figure 24. Monthly Distribution curve, where the black line is the natural flow distribution, the blue line is the natural baseflow (mostly groundwater contribution), MIFR – Low is the Maintenance Low Flow Environmental requirement (red line on graph), DIFR – Low is the Drought Low Flow Environmental requirement (pink line on graph) and MIFR – High is the Maintenance High flow environmental requirement –larger floods and freshets– within year (green line on graph*)

Table 24. Environmental flow requirement for the Kuils / Eerste Catchment at the estuary

Summary of Desktop (Version 2) estimate for the Kuils / Eerste Catchment at the estuary (Quaternary Catchment Areas G22E, G22F, G22G and G22H):

Annual Flows (Mill. cu. m or index values):
MAR = 112.409
S.Dev. = 50.833
CV = 0.452
Q75 = 1.280
Q75/MMF = 0.137
BFI Index = 0.355
CV(JJA+JFM) Index = 1.817

Ecological Category = C/D
Total IFR = 20.323 (18.08 %MAR)
Maint. Lowflow = 10.868 (9.67 %MAR)
Drought Lowflow = 7.008 (6.23 %MAR)
Maint. Highflow = 9.456 (8.41 %MAR)

Monthly Distributions (Mill. cu. m.)
Distribution Type : W.Cape(wet)

	Natural Flows			*Modified Flows (IFR)*			
				Low flows		*High Flows*	*Total Flows*
Month	*Mean*	*SD*	*CV*	*Maint.*	*Drought*	*Maint.*	*Maint.*
Oct	9.115	4.211	0.462	1.391	0.914	0.605	1.997
Nov	5.074	2.114	0.417	1.12	0.737	0.117	1.238
Dec	2.408	1.216	0.505	0.654	0.434	0	0.654
Jan	1.216	0.823	0.677	0.358	0.242	0	0.358
Feb	0.88	0.992	1.127	0.252	0.172	0	0.252
Mar	0.857	1.171	1.367	0.212	0.147	0	0.212
Apr	3.198	5.391	1.686	0.318	0.16	0	0.318
May	8.44	8.422	0.998	0.585	0.28	0.999	1.584
Jun	16.111	13.716	0.851	1.017	0.67	1.932	2.949
Jul	22.958	18.326	0.798	1.486	0.975	1.056	2.542
Aug	25.699	16.229	0.631	1.83	1.199	3.69	5.521
Sep	16.454	8.323	0.506	1.644	1.078	1.056	2.7

Table 25. Rule curves for the environmental flows for the Kuils / Eerste Catchment at the estuary

Desktop Version 2, Generated on 2014/09/30
Summary of IFR rule curves (Desktop Version 2) for estimate for the Kuils / Eerste Catchment at the estuary (Quaternary Catchment Areas G22E, G22F, G22G and G22H):
Regional Type : W.Cape(wet)
Ecological Category = C/D
Data are given in m^3 * 10^6 monthly flow volume

Month	**% Points**									
	10%	**20%**	**30%**	**40%**	**50%**	**60%**	**70%**	**80%**	**90%**	**99%**
Oct	1.152	1.152	1.145	1.129	1.095	1.029	0.911	0.729	0.51	0.369
Nov	0.77	0.77	0.766	0.756	0.736	0.695	0.623	0.512	0.378	0.292
Dec	0.382	0.382	0.38	0.373	0.359	0.333	0.291	0.236	0.186	0.163
Jan	0.209	0.209	0.208	0.205	0.197	0.183	0.16	0.13	0.103	0.091
Feb	0.163	0.163	0.162	0.159	0.153	0.142	0.125	0.102	0.081	0.072
Mar	0.13	0.13	0.13	0.128	0.125	0.119	0.107	0.09	0.069	0.055
Apr	0.201	0.201	0.2	0.197	0.191	0.18	0.159	0.126	0.088	0.062
May	0.85	0.85	0.844	0.83	0.799	0.74	0.634	0.47	0.273	0.146
Jun	1.71	1.71	1.701	1.683	1.646	1.572	1.433	1.179	0.766	0.342
Jul	1.674	1.601	1.532	1.467	1.4	1.268	1.171	0.994	0.706	0.41
Aug	3.65	3.393	3.162	2.955	2.755	2.37	2.169	1.804	1.209	0.598
Sep	1.834	1.731	1.638	1.552	1.459	1.293	1.145	0.916	0.641	0.463
Reserve Flows without High Flows										
Oct	0.854	0.854	0.849	0.839	0.817	0.774	0.697	0.579	0.436	0.344
Nov	0.71	0.71	0.707	0.698	0.68	0.644	0.58	0.482	0.364	0.287
Dec	0.382	0.382	0.38	0.373	0.359	0.333	0.291	0.236	0.186	0.163
Jan	0.209	0.209	0.208	0.205	0.197	0.183	0.16	0.13	0.103	0.091
Feb	0.163	0.163	0.162	0.159	0.153	0.142	0.125	0.102	0.081	0.072
Mar	0.13	0.13	0.13	0.128	0.125	0.119	0.107	0.09	0.069	0.055
Apr	0.201	0.201	0.2	0.197	0.191	0.18	0.159	0.126	0.088	0.062
May	0.359	0.359	0.357	0.352	0.341	0.319	0.281	0.223	0.152	0.106
Jun	0.688	0.688	0.685	0.679	0.667	0.645	0.601	0.522	0.393	0.261
Jul	0.973	0.973	0.969	0.96	0.944	0.912	0.85	0.738	0.555	0.368
Aug	1.198	1.198	1.193	1.183	1.163	1.123	1.047	0.909	0.684	0.452
Sep	1.043	1.043	1.037	1.024	0.998	0.945	0.851	0.707	0.532	0.42
Natural Duration curves										
Oct	5.559	4.286	3.816	3.286	2.957	2.834	2.684	2.173	1.893	1.281
Nov	3.183	2.407	2.238	1.89	1.779	1.632	1.478	1.292	1.154	0.934
Dec	1.475	1.075	0.963	0.825	0.777	0.739	0.687	0.601	0.53	0.403
Jan	0.765	0.5	0.478	0.411	0.385	0.351	0.302	0.276	0.239	0.19
Feb	0.612	0.446	0.343	0.293	0.244	0.215	0.198	0.174	0.136	0.103
Mar	0.694	0.392	0.273	0.209	0.172	0.146	0.134	0.116	0.086	0.071
Apr	2.975	1.728	1.13	0.787	0.567	0.49	0.332	0.201	0.135	0.062
May	8.214	4.383	3.495	2.546	2.218	1.762	1.157	0.933	0.541	0.265
Jun	15.378	10.258	6.512	5.729	5.023	3.457	2.546	1.933	1.574	0.64
Jul	16.868	13.837	11.399	9.088	6.47	5.066	3.558	2.908	2.468	1.512
Aug	19.232	13.43	11.216	10.047	8.983	6.433	5.75	4.271	3.356	2.796
Sep	10.563	8.41	7.631	6.289	5.775	4.869	4.371	3.646	3.391	2.643

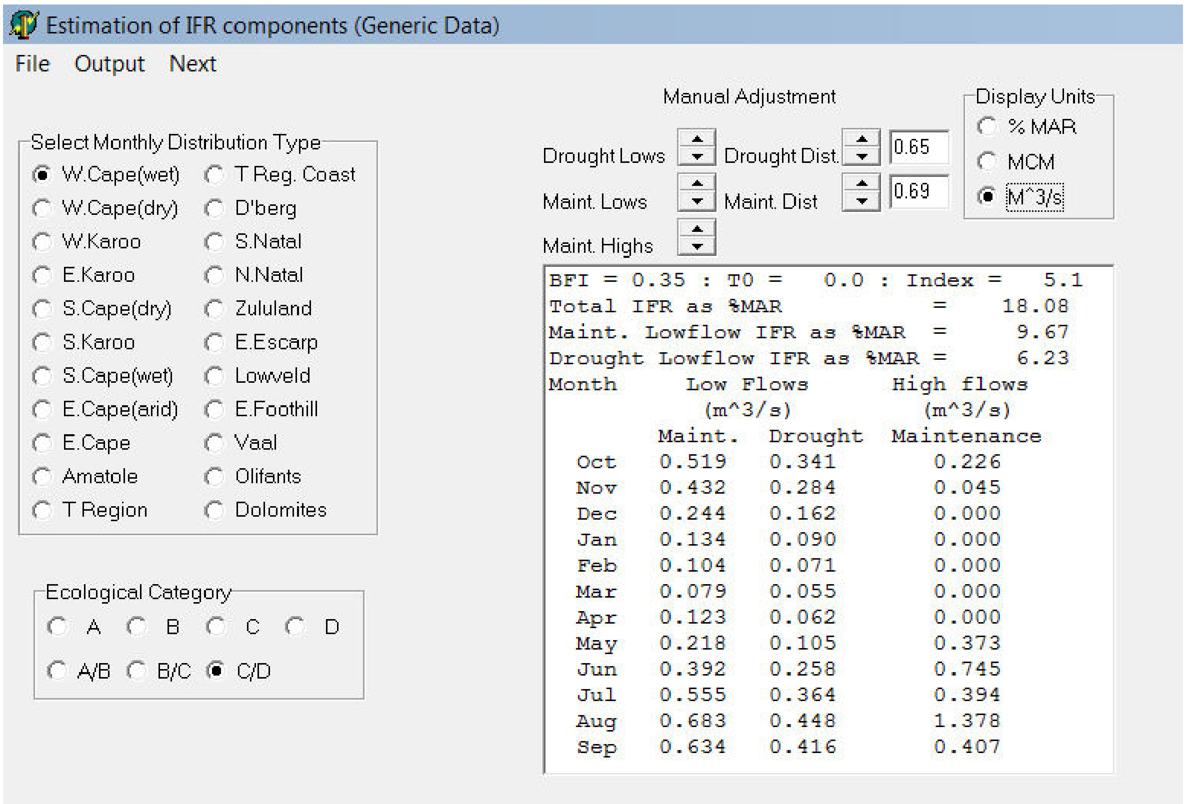


Figure 25. Screen dump from the Desktop Reserve Model (Environmental flow recommendations for the Kuils / Eerste River at Macassar WWTW and the Eerste River Estuary)

Table 26. Recommended Environmental flows for the Kuils / Eerste River at Macassar WWTW and the Eerste River Estuary, expressed as an average flow for each month of the year and given in l/s

Month	Average Environmental Flow (l/s)
Oct	745
Nov	477
Dec	244
Jan	134
Feb	104
Mar	79
Apr	123
May	591
June	1137
July	949
Aug	2061
Sept	1041

The implication of the environmental flow requirements for a treated wastewater discharge into the estuary is that the seasonal variability within the estuary should be maintained as far as possible through the capping of treated wastewater discharges to the estuary, particularly during the drier summer months. This would mean that as far as possible, the treated wastewater should rather be reused than released into the estuary.

The WWTW discharge point is in the Kuils / Eerste Estuary thus one also needs to look to determine the Reserve Requirement for the Estuary. This is included in the RQOs for the estuary, included in Section 7.4.

9.2 WATER QUALITY

Water Quality Objectives were determined for the Eerste River upstream of the estuary, based on the present water quality status discussed in Section 7.1.5 and provided in Appendix C, as well as the historical water quality. Historical water quality was obtained for sites G2H21 on the Kuils River and G2H15 on the Eerste River at Faure for the period 1979 to 1984 (Appendix C). Table 27 on the following page provides a summary of the historical and present-day water quality of the lower Kuils/Eerste River that was used to determine the water quality objectives.

The Resource Water Quality Objective (RWQO Version 4.1), DWAF 2006, Model was utilised to assess compliance of the present-day water quality in the lower Kuils/Eerste River with the downstream user water quality requirements and determine the allocable waste loads for the estuary downstream of the Macassar WWTW discharge.

Because there is no real reference data available to the lower Kuils/Eerste River System as the river has been subjected to water quality impacts for longer than there is water quality data available for the river, determining the 'allocable" waste loads becomes a difficult task. The water quality variables analyzed have also been limited. The reference data utilized as input into the model from all that was available and considered in Table 27, was the data from the lower Kuils/Eerste River System.

From the output of the model (Figure 26), currently, there is limited allocable load for the treated wastewater discharge to the river for the variables where there are water quality results if the downstream use is for non-contact recreational use as well as to maintain the receiving aquatic environment in a moderately to largely modified ecological state. The water variable of most concern in the treated wastewater to be discharged is ortho-phosphates. In general, an increase in the ortho-phosphates in rivers as a result of treated wastewater discharges is likely to result in increasing eutrophic conditions in the river and estuary.

Table 27. Physical water quality and nutrients (based on available data and information)

Parameter	Present status		Historical water quality		
Site	G22_1000009587 Macassar Road - lower Kuils / Eerste River	EK12 Eerste River u/s of discharge from Macassar WWTW (d/s of Kuils confluence)	G2H21 on the Kuils River at Kuils River	G2H15 on the Eerste River at Faure	Eerste River u/s of Macassar WWTW (d/s of Kuils confluence) – CCT EK12
Data period	2009-2014	2010-2014	1979-1983	1968-1978	1989-2000
pH					
Count:	13	56	161	23	115
Median:	7.2	7.5	7	7	7.7
Minimum:	5.8	7.3	5.5	6.4	7.0
Maximum:	7.9	10.1	8	8.22	8.1
5th percentile:	6.2	7.3	6.5	6.51	7.2
95th percentile:	7.7	7.75	7.6	8.04	7.9
Electrical Conductivity (mS/m)					
Count:	13	56	177	24	115
Median:	81.3	88.5	96.2	39.1	80
Minimum:	62.6	44	24.7	14.5	18
Maximum:	87.1	118	169.6	104.7	125
95th percentile:	87	110.3	135	88.6	100
Nitrate/Nitrite (mg/l)					
Count:	13	56	161	23	112
Median:	2.7	0.93	5.51	0.36	1.6
Minimum:	0.15	0.07	0.02	0.02	0.09
Maximum:	9.8	3.18	91.35	1.35	5.7
95th percentile:	9.08	2.32	12.67	1.26	3.18
Ortho phosphates (mg/l)					
Count:	13	55	156	20	13
Median:	1.88	2.1	2.47	0.20	1.58
Minimum:	0.1	0.67	0.003	0.007	0.76
Maximum:	5.7	3.99	15.35	0.959	2.38
95th percentile:	5.52	3.62	5.7	0.522	2.29
Ammonium (mg/l)		Ammonia (mg/l):			Ammonia (mg/l):
Count:	13	56	156	15	64
Median:	1.6	6.47	0.04	0.11	0.99
Minimum:	0.15	0.66	0.02	0.2	0.09
Maximum:	13.2	20.9	24.2	1.34	8.92
95th percentile:	11.94	18.13	0.315	0.82	5.79

Resource Water Quality Objectives 0.0 - Macassar WWTW.xml

File Tools Help

Introduction | Input | BestAEMC | References | Monthly-Flow | End-of-Pipe | Report

Project: Macassar WWTW
Study Unit:
Recommended ecological category:
G22H
Management Class: Heavily used/impacted
Spatial Extent: Water quality reach
Temporal Extent: Annual
Flow Assurance: 50 %
Target Flow: 0.915 m^3/sec = 28.855Mm^3/annum
Prepared on 2015/03/03
using version 0.0

Water Use	Existing?	Future?	Quality
International obligations	☐	☐	Tolerable
Strategic use	☐	☐	Tolerable
Ecological Reserve	☐	☐	C
Ecological Requirements	☑	☑	Fair
Basic Human Needs	☐	☐	Tolerable
Domestic use	☐	☐	Tolerable
Agriculture - Stock watering	☐	☐	Tolerable
Agriculture - Irrigation	☐	☐	Tolerable
Agriculture - Aquaculture	☐	☐	Tolerable
Industrial - Category 1	☐	☐	Tolerable
Industrial - Category 2	☐	☐	Tolerable
Industrial - Category 3	☐	☐	Tolerable
Industrial - Category 4	☐	☐	Tolerable
Recreation - Full contact	☐	☐	Tolerable
Recreation - Intermediate contact	☐	☐	Tolerable
Recreation - Non-contact	☑	☑	Tolerable

Water Quality Variable				Present State		Reference		RWQO	Stressed?	Allocatable Water Quality		Allocatable Loads	
Category	Variable	Units	Bound	Value	Percentile	Value	Percentile			Value	Confidence	Tonnes/annum	Percentile
Physical	Temperature	°C	Upper	24.2		24.2							
			Lower	12.46		11.5							
Physical	TSS	mg/l	Upper	34.2		51.75							
Chemical	Ammonia (NH_3-N)	mg/l	Upper	18.1	95.0	5.7		0.100	Yes	-18.000	95.0	-519.398	
Chemical	Conductivity	mS/m	Upper	100	95.0	88					95.0		
Chemical	NO_2 and NO_3	mg/l	Upper	2.32		1.26							
Chemical	pH	units	Upper	7.7		7.9		10.000	No	2.300			
			Lower	7.3	5.0	6.5		5.000	No	2.300	95.0		
Chemical	PO_4 as % TP	%	Upper	4.13		3.1							
Chemical	PO_4	mg/l	Upper	3.62	95.0	0.5		0.130	Yes	-3.490	95.0	-100.705	
Organic	COD	mg/l	Upper	42.3		72							
Organic	DO	mg/l	Upper	5.18		8.8		4.000	Yes	-1.180		-34.049	
			Lower	1.66		3.5							
Organic	DO	% saturation	Upper	53.8		106							

Figure 26. Screen dump of the Report generated from the RWQO Model using the water quality guidelines for aquatic ecosystems as well as downstream water user requirements

DWS has stipulated that the upgraded WWTW should be designed to adhere to the following limits:

- EC: 70 mS/m above the intake up to a maximum of 150mS/m;
- pH: 5.5-7.5;
- E-coli: 100 cfu/100mg/l;
- Orthophosphate: 1 mg/l;
- Ammonia- 10mg/l [CCT has designed for 6mg/l ammonia and not 10mg/l]; and
- Nitrate: 10 mg/l.

The required water quality could be expected to improve on the existing water quality stress within the lower river system as the limit of 1 mg/l for orthophosphate is a significant improvement on the current concentration of orthophosphates in the final treated wastewater (median of 4mg/l or a 95%ile of 10 mg/l value). It is recommended that the Special Limit for Ammonia of 2 mg/l or at least the General Limit of 6mg/l be specified as this is also a variable of concern within the current treated wastewater (10mg/l 95%ile or 3mg/l median value).

10. LEGISLATIVE AND CONSERVATION PLANNING REQUIREMENTS

The proposed upgrades to the Macassar WWTW need to take cognizance of the legislative requirements, policies, strategies, guidelines and principles of the relevant regulatory documents of the City of Cape Town area, such as the National Spatial Development Framework, the City of Cape Town's Integrated Development Plan and Biodiversity Plan, the River Corridor and Floodplain Management Policy, as well as the National Water Act (NWA) and the National Environmental Management Act (NEMA).

On 07 July 2016, the Department of Environmental Affairs and Development Planning issued an Environmental Authorisation (EA) to the City of Cape Town approving the proposed upgrade and expansion of the WWTW and associated infrastructure on the basis that they were necessary to continue to provide essential wastewater treatment services to the surrounding community. The activity items listed in the EA included the following:

1. The construction of 2 x 16 Ml/day conventional activated sludge bioreactor units

2. The construction of 6 settling tanks (clarifiers)with approximately 30m diameters each

3. The construction of new inlet works to receive a capacity of approximately 80 Ml/day

4. The construction of a new sludge dewatering facility with a capacity of 50 Ml/day

5. The construction of storage facilities for temporary storage of dewatered sludge with a capacity of approximately 200m3

6. The construction of a chemical dosing facility for the purpose of phosphate removal

7. The construction of a chlorine tank within the maturation pond with an approximate capacity of 900 m3

8. The construction of a new/upgraded outlet pipe from the maturation ponds into the Eerste River approximately 330 mm in diameter and 75 m in length

9. The construction of bunded storage areas for the storage of hazardous substances

10. The construction and upgrading of the access road and other internal roads

11. The construction of a boundary fence

12. The construction and installation of an odour control system at the inlet works and the sludge dewatering facility.

13. The construction of electrical infrastructure, including a new 12 kV infeed substation, a new underground medium voltage cable and a new motor control centre building to house a new 2 MVA standby generator, 2 MVA transformer and 11 KV switchgear

14. The construction of various associated internal infrastructure e.g. interconnecting pipes, storage rooms, pump stations, paved areas, etc.

The main purpose of the proposed project is to implement the already authorised upgrade of the WWTW, the construction of which has already commenced. However, due to the time that has passed since the approval in 2016, new design engineers have been appointed to finalise the detailed design, engineers have identified alternative technology options that will enable the works to run more efficiently and improve the quality of the effluent being discharged to the estuary.

10.1. NEMA AND ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS

NEMA is the overarching piece of legislation for environmental management in South Africa and includes provisions which must be considered to give effect to the general objectives of integrated environmental management. These provisions are contained in Section 24 (4)(a)(b) of the Act and will be considered during the EIA process. Chapter Seven of the NEMA states that:

"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 also clearly states that the landowner, or the person using or controlling the land, is responsible for taking measures to control and rectify any degradation. These may include measures to:

“(a) investigate, assess and evaluate the impact on the environment;

(b) inform and educate employees about the environmental risks of their work and the manner in which their tasks must be performed in order to avoid causing significant pollution or degradation of the environment:

(c) cease, modify or control any act, activity or process causing the pollution or degradation:

(d) contain or prevent the movement of pollutants or degradation: or

(e) eliminate any source of pollution or degradation: or

(f) remedy the effects of the pollution or degradation.”

NEMA ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS, GN R982 OF 2014

Activities listed in terms of Chapter 5 of NEMA in Government Notice No. R. 983, 984 and 985, dated 4 December 2014, trigger a mandatory Basic Assessment, or even a full scoping EIA process, before development. The proposed changes to the initial proposed upgrades to the WWTW that have already been authorised require a new environmental impact assessment and authorisation process. This report is intended to inform that new process.

10.2. NATIONAL WATER ACT, 1998 (ACT NO. 36 OF 1998)

The NWA guides the management of water in South Africa as a common resource. The Act aims to regulate the use of water and activities (as defined in Part 4, Section 21 of the NWA), which may impact water resources through the categorisation of ‘listed water uses’ encompassing water abstraction and flow attenuation within catchments as well as the potential contamination of water resources, where the DWS is the administering body in this regard.

Defined water use activities require the approval of DWS in the form of a General Authorisation or Water Use Licence authorisation. Government Notice No. 4167 of 8 December 2023 provides for General Authorisations for certain specified water use activities in terms of the disposal of wastewater which then do not require a licensing process. There are restrictions on the extent and scale of listed activities for which General Authorisations apply.

Section 22(3) of the National Water Act allows for a responsible authority (DWS) to dispense with the requirement for a Water Use Licence if it is satisfied that the purpose of the Act will be met by the grant of a licence, permit or authorisation under any other law.

Macassar WWTW is currently operated in terms of a water use licence (Licence No. 19/G22H/F/582), dated 21 July 2011, which allows for treated wastewater to be discharged into the Kuils / Eerste River.

Potential other water use activities that may not be included in the current WULA and are of relevance to the proposed upgrade activities for the WWTW are:

- Section 21(c): Impeding or diverting the flow of water in a watercourse; and
- Section 21(i): Altering the bed, banks, course or characteristics of a watercourse.

In terms of the definitions provided, activities included under Sections 21(c) and 21(i) are (amongst others) the construction of roads, bridges, pipelines, culverts and structures for slope stabilisation and erosion protection. DWS will need to be approached to guide whether approval for Section 21 (c) and (i) water uses would also be required in addition to Section 21(f) – discharge of treated wastewater to a water resource, Section 21(e) – irrigation of treated wastewater - and Section 21(g) - disposing of waste in a manner which may detrimentally impact on a water resource. This decision may be influenced by the location of the new expansion works.

10.3. WESTERN CAPE BIODIVERSITY SPATIAL PLAN AND CITY OF CAPE TOWN'S BIODIVERSITY NETWORK

The 2017 WCBSP maps indicate areas of land as well as aquatic features which must be safeguarded in their natural state if biodiversity is to persist, and ecosystems are to continue functioning. The main map categories are Critical Biodiversity Areas (CBA) (Terrestrial and Aquatic), Ecological Support Areas (ESA) (Critical and Other), Other Natural Remaining Areas and No Natural Remaining Areas. The first two mentioned categories represent the biodiversity priority areas that should be maintained in a natural to near-natural state. The last two mentioned categories are not considered priority areas and a loss of biodiversity within these areas may be acceptable.

Most of the Macassar WWTW has been mapped as an ESA that should be restored while the Eerste River immediately to the east is mapped as an aquatic CBA and the dunes to the west as terrestrial CBA (Figure 27).

Figure 27. 2017 Western Cape Biodiversity Spatial Plan for the area (obtained from CapeFarmMapper; 2024)

In 2003, the City of Cape Town committed to implementing a Biodiversity Strategy. This Strategy requires, amongst others, that a Biodiversity Network be established to enable the conservation of Critical Biodiversity Areas. These areas represent the minimum amount of terrestrial and freshwater habitat that is required to meet the City's biodiversity conservation targets. Wetland prioritization was analysed separately by specialist consultants (Snaddon et al. 2009). Priority wetlands occurring on natural remnants were included *post-hoc* in the BioNet as Critical Biodiversity Area (CBA) wetlands. Wetland ground-truthing indicated that priority wetlands located in transformed areas were degraded and in practice would be difficult to restore and conserve. The latter were assigned to either Ecological Support Area (ESA) status based on the level of transformation. Wetland ground-truthing has continued since the 2009 BioNet re-analysis and the wetland layer updated accordingly.

Figure 28. City of Cape Town Biodiversity Network for the area (City of Cape Town Map Viewer, 2024), where descriptions of the categories are provided in the table on the following page.

	Critical Biodiversity Area Category	**Critical Biodiversity Area Name**
	Protected: In Perpetuity	Protected Area that is Proclaimed in Perpetuity
	Protected: Not In Perpetuity	Protected Area that is Proclaimed for a Limited Period
	Conservation Area	Conservation Area that is not Yet Proclaimed
	CBA 1a	Irreplaceable Core Flora site
	CBA 1b	Irreplaceable High & Medium Condition site
	CBA 1c	Minset (Minimum Set C-plan algorithm) High & Medium Condition site
	CBA 1d	Irreplaceable Consolidation site
	CBA1e	Connectivity Site
	CBA 2	Restorable Irreplaceable site
	CESA	Unselected Natural Vegetation of Conservation Significance
	OESA	Transformed Site of Conservation Significance
	Other Natural vegetation	Unselected Natural Vegetation in high, medium or restorable condition

The Macassar WWTW and its surrounding open area have been mapped as a Connectivity Site (CBA 1e - orange area in Figure 28) or Irreplaceable High & Medium Condition site in terms of the terrestrial vegetation cover (CBA1B - maroon areas in Figure 28). Loss of CBA habitat will probably result in the extinction of some species and the inability to attain conservation targets. Conservation, low-impact recreation and environmental education are seen as compatible activities for these areas. The ESA areas may be required for the long-term ecological functioning of neighbouring natural ecosystems. The loss would result in the degradation of ecological processes and potential loss of biodiversity elements. The objective for these areas is to maintain as open space and where appropriate restore degraded land to natural or near-natural for improved ecological functioning. The coastline between the Eerste River Estuary and the Lourens River Estuary has also been demarcated as a Marine Protected Area.

10.4. NATIONAL WETLAND MAP AND FRESHWATER ECOSYSTEM PRIORITY AREAS

National Freshwater Ecosystem Priority Areas (FEPAs) are intended to provide strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. FEPAs were determined through a process of systematic biodiversity planning and were identified using a range of criteria for serving ecosystems and associated biodiversity of rivers, wetlands and estuaries. In terms of FEPAs mapped within the study area, there are no river FEPAs, nor Fish Sanctuaries/Support Areas in the immediate Kuils/Eerste River Catchment. The adjacent Lourens and Sir Lowry's Pass River Catchments have been mapped as a Fish Support Area. The lower Eerste River and Estuary have also been mapped as a natural FEPA wetland and estuarine area while there is a small artificial wetland mapped along the eastern extent of the powerline route and the WWTW ponds are mapped as artificial wetlands (Figure 29).

Figure 29. Freshwater Ecosystem Priority Areas for the study area (SANBI Biodiversity GIS, 2024)

The National Wetland Mape (version 5) has mapped the estuarine wetlands mapped in the FEPA Wetland mapping as well as the large floodplain wetland area along the eastern extent of the powerline (Figure 30).

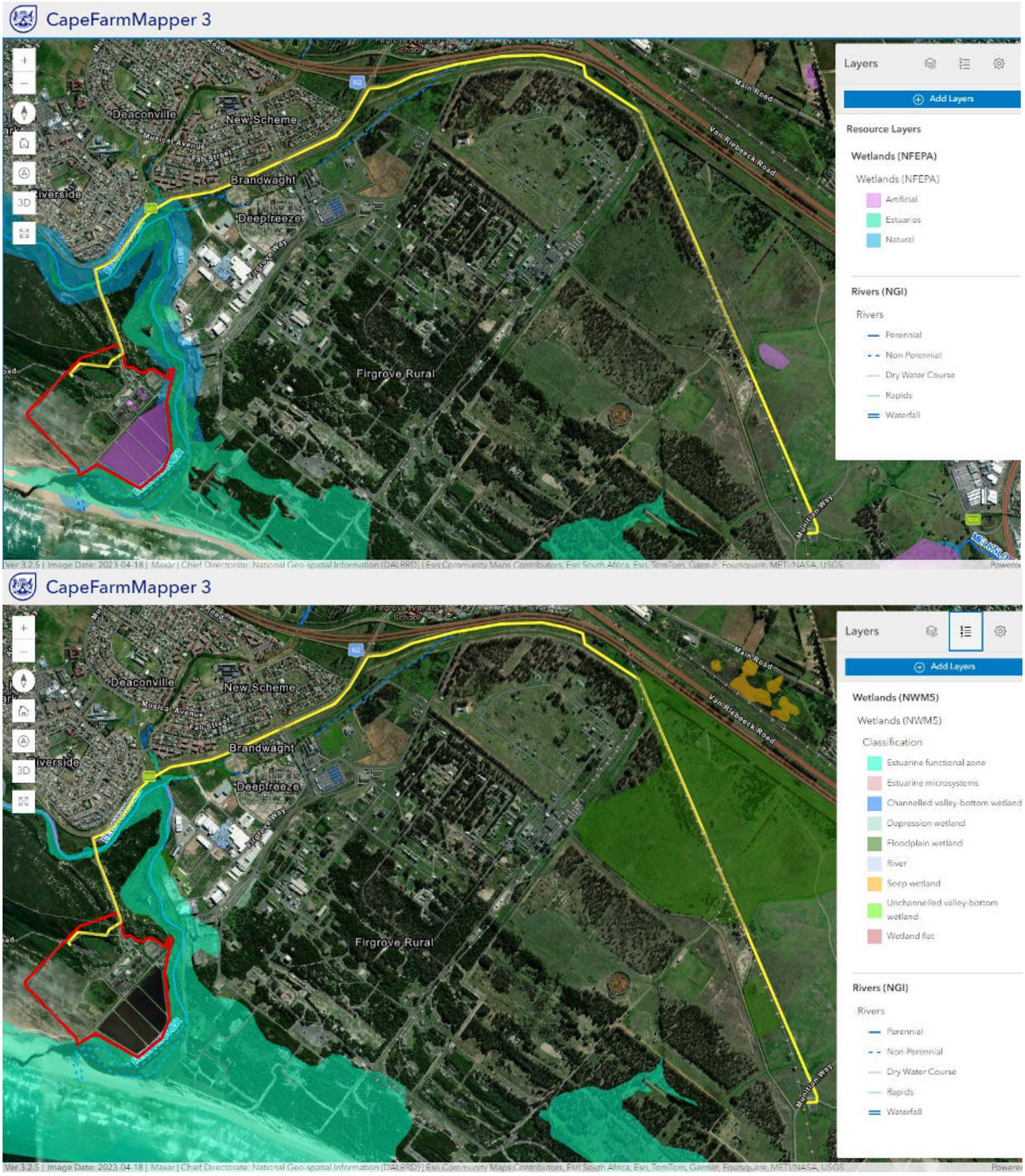


Figure 30. National Freshwater Ecosystem Priority Areas Wetlands (top) and National Wetland Mapping (bottom) in the vicinity of the site (obtained from CapeFarmMapper; 2024)

11. DESCRIPTION OF IMPACTS FROM THE PROPOSED ACTIVITIES

This section provides an assessment of the impacts on aquatic ecosystems that are likely to be associated with the proposed upgrade and expansions to the Macassar WWTW.

Due to the existing discharge of treated wastewater from the Macassar WWTW into the Eerste River, the estuary has already been considerably altered and thus the expected impact of an upgrade to this WWTW is likely to be less significant but the proposed increase in the discharge volume is nevertheless substantial. The proposed upgrade to the existing WWTW will result in an improvement in the final effluent quality, and as such, one could expect that the proposed upgrade would at least improve the existing water quality situation in the Eerste River Estuary. Thus of greater concern is the large increase in the volume of the treated wastewater that would be discharged to the estuary as well as the cumulative impact of increased wastewater discharge volumes throughout the catchment of the Kuils / Eerste River System where all four large WWTW (Bellville, Stellenbosch, Zandvliet and Macassar) are needing to be increased in terms of their capacities.

The possible impacts of the proposed upgrades to the WWTW on the receiving aquatic environments are listed below:

IMPACT - FLOW MODIFICATION

The largest potential impact of the proposed activities is because of the increase in the volume of treated wastewater discharged to the lower Eerste River and Estuary. The discharge when the WWTW is working at full capacity will be at least double the current discharge. This will result in a further 'freshening' of the estuary as well as added modification to the seasonal variability (quality and quantity) within the estuary which is important for maintaining biodiversity within the estuary. The resulting loss of variability in estuarine habitat will result in further loss of biotic diversity as well as more modification to the hydrodynamics within the Kuils / Eerste Estuary.

<u>Significance of impacts without mitigation:</u> Medium to high impact

<u>Proposed mitigation:</u>

- The use of the treated wastewater during the drier summer months should be encouraged to reduce the volumes that need to be discharged to the estuary, particularly during the low flow period when seawater intrusion and tidal exchange within the estuary may have naturally occurred. Considering the increase in the volume of treated wastewater to be discharged to the estuary as well as the high priority that was been awarded to the estuary for its rehabilitation, it is recommended that the ecological flow requirement for the estuary be determined at a rapid or intermediate level and considered in terms of the future volumes to be discharged to the estuary.
- While cognisance must be given to the reality of the current situation (i.e. that upgrading of the works must take place to accommodate the ever-expanding development of the

Strand/Somerset West/Macassar urban area and that there are very limited options for disposal of the treated wastewater, as well as considering the relatively lower ecological importance of the Eerste Estuary), there will have to be a committed programme for progressive reuse of the treated wastewater in the area and a significant reduction in the volumes that would be disposed to the estuary. While there are already plans to do this, there will need to be a legal imperative to ensure that this commitment is implemented within agreed-upon timescales that are set as soon as technically possible.

<u>Significance of impacts after mitigation:</u> Medium to low impact over the longer term should there be a systematic programme implemented for the reuse of the treated wastewater.

Nature	Flow modification	Status	-
Impact source(s)	Discharge of treated wastewater		
Impacted aquatic ecosystem	Lower Eerste River and Estuary		
Magnitude	*Extent*	Local to regional	
	Intensity	Medium	
	Duration	Long term	
	Reversibility	Reversible	
	Probability	Probable	
Significance	*Without mitigation*	Medium to high	M/H
	With mitigation	Medium to low	M
Confidence	Medium/high		
Degree impact can be reversed:	Low		
Irreplaceable loss of resources:	Medium to Low		
Cumulative impact	*Without mitigation*	Medium to high	
	With mitigation	Medium	
Degree impact can be avoided:	Medium		
Degree impact can be managed:	High		
Degree impact can be mitigated:	Medium		

IMPACT - WATER QUALITY IMPAIRMENT

The nature of this impact is highly dependent on the level of treatment achieved and the effluent quality standards that would be met by the proposed WWTW upgrade. DWS has stipulated that the upgraded WWTW should be designed to adhere to the following limits:

- EC: 70 mS/m above the intake up to a maximum of 150mS/m;
- pH: 5.5-7.5 ;
- E-coli: 100 cfu/100mg/l;
- Orthophosphate: 1 mg/l; and
- Nitrate: 10 mg/l.

The treated wastewater will still contain elevated nutrient (phosphate and nitrate) and ammonia concentrations. The elevated levels of nutrients in the final effluent contribute to the eutrophication of the river. Such conditions are associated with low species diversity, high levels of productivity and the nuisance growth of aquatic plants. The project engineers have indicated that the proposed additional works are primarily aimed at improving the final treated wastewater quality as well as the operation of the works.

Significance of impacts without mitigation: Medium negative impact

Proposed mitigation:

- The stipulated water quality requirement of the DWS (particularly for phosphates as the limiting nutrient to plant growth) to be achieved in the final effluent is supported to reduce eutrophication of the lower Eerste River and Estuary. It is recommended that the Special Limit for Ammonia of 2 mg/l or at least the General Limit of 6mg/l also be specified for the final treated wastewater as this is also a variable of concern within the current treated wastewater.

- An alternative mitigation measure would be to dispose of the wastewater in another way such as through reuse in line with the recommended mitigation for flow modification. Reuse of the treated wastewater rather than discharging it to the estuary is worth consideration, considering the treatment costs, the quality of the final treated effluent as well as the growing water demand.

- It is essential that there is ongoing monitoring to ensure that the WWTW is designed and operated to achieve the final treated wastewater quality indicated.

Significance of impacts after mitigation: Provided that the mitigation measures are effectively implemented, the water quality-related impacts of the developments should be limited and will result in an improvement in the current condition of the river.

Nature	Water quality impairment		Status	-
Impact source(s)	Operational phase – discharge of treated wastewater			
Impacted ecosystem	Aquatic life in the lower Kuils / Eerste River and Estuary			
Magnitude	*Extent*	Local to regional		
	Intensity	Medium to high		
	Duration	Medium to long term		
	Reversibility	Reversible		
	Probability	Probable		
Significance	*Without mitigation*	Medium		M
	With mitigation	Very Low – may result in an improvement due to an improvement in the existing wastewater quality		VL
Confidence	Medium			
Degree impact can be reversed:	Medium			
Irreplaceable loss of resources:	Medium to Low			
Cumulative impact	*Without mitigation*	Medium		
	With mitigation	Medium to low		
Degree impact can be avoided:	Medium			
Degree impact can be managed:	High			
Degree impact can be mitigated:	Medium			

IMPACT - LOSS OF WETLAND AND ESTUARINE HABITAT:

The already approved proposed expansion activities were planned to take place largely within the footprint of the WWTW; with some of the new facilities extending approximately 4 ha into previously undeveloped but disturbed areas adjacent to the WWTW. There is also the potential impact of the proposed additional electrical infrastructure along the approx. 7 km powerline route (approx. 1.5km of this is within mapped wetland habitat).

The area of the WWTW expansion includes wetland areas that are artificial or in a severely modified ecological state. Loss of the wetland areas associated with the works at the WWTW is thus not considered significant. The new proposed activities will result in an approximate area of about 22 ha to the west of the existing WWTW that will be developed. This area comprises terrestrial dune vegetation as well as the artificial wetland areas associated with the previous oxidation ponds and sludge drying areas.

Of greater concern is the further loss of estuarine habitat as a result of the increased volumes of treated wastewater discharged to the estuary. This aspect has been addressed under the flow modification impacts.

The updated design of the outlet structure at the estuary is proposed to be larger than the design that was authorised and will be constructed within the estuary functional zone. Energy dissipation measures to prevent erosion and scouring will be installed between the outlet and the estuary. Altogether these structures will be more than 10m^2 larger than the design that was authorised.

An additional concern of the extended works in this low-lying area is the impact of climate change and the potential for flooding of the area. The catchment of the river is becoming increasingly urbanised and there is currently a stormwater management project under consideration to construct berms along the lower Kuils and Eerste Rivers to prevent low-lying areas upstream of the WWTW. This is likely to have some impact on the flood levels at the works with the potential for flooding when there is an incoming tide that will hamper the discharge from the river into the sea.

Figure 31 shows the mapped wetland areas that would be impacted by the various proposed activities. While the wetland area would be lost by the construction of the proposed Activated Sludge Plant and associated infrastructure, the significance of the loss of this wetland area would be low since both wetlands occur largely within the footprint of the WWTW and are the result of sludge disposal into these areas. The development of this area and proposed upgrade to the WWTW would rather ensure that the area that is disturbed as a result of the activities associated with the WWTW would be more contained and there would be better potential to rehabilitate the disturbed areas to the west and north of the WWTW.

In terms of the other activities proposed as part of the upgrade, the new inlet works and sludge drying beds occur outside of any wetland areas and the chlorine contact tanks occur within the WWTW ponds of the WWTW. There are thus no potential concerns for these components of the proposed works from a freshwater ecosystem point of view. The new outlet pipe for the works will need to be constructed within the bank of the Eerste River Estuary. At this point, the bank is highly modified and largely consists of grassed banks with *Phragmites* reeds at the water edge. The proposed pipeline construction will thus have a limited impact, and the disturbed area can easily be rehabilitated once the work is complete.

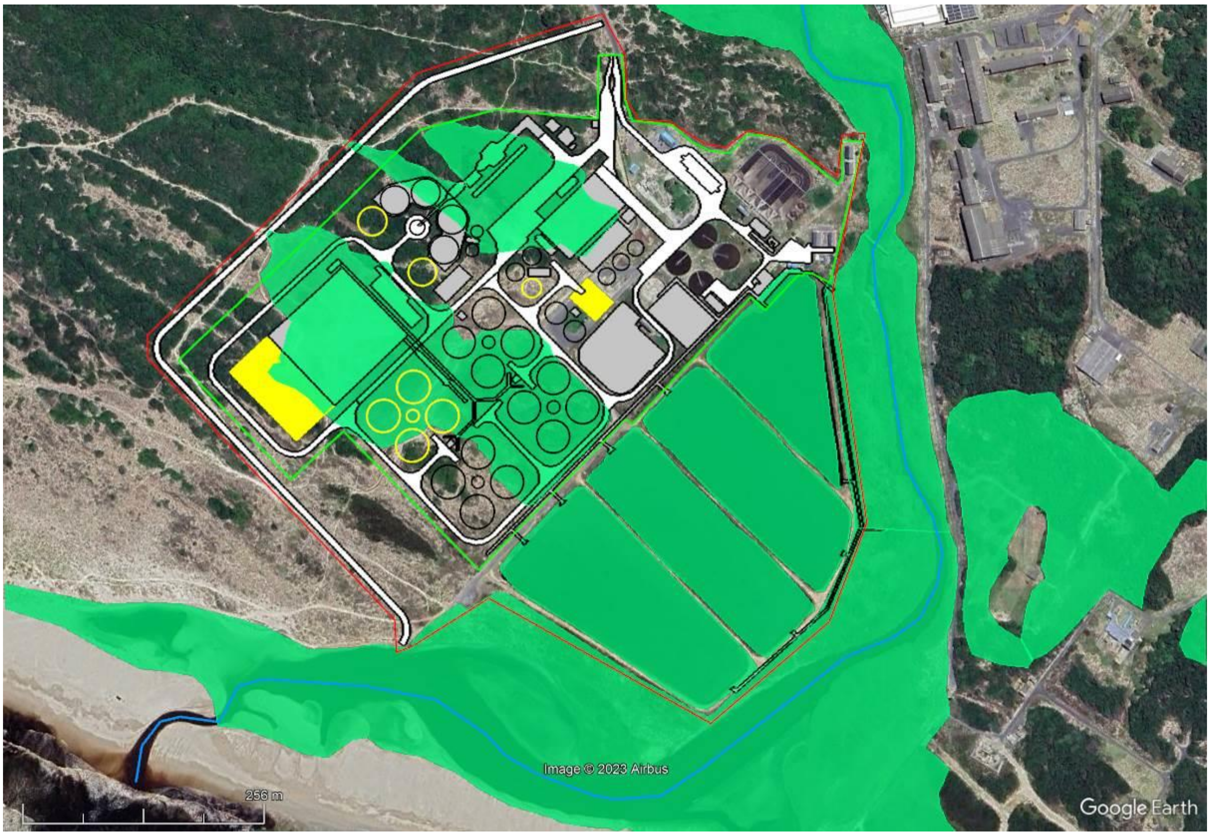


Figure 31. Google Earth image showing the various activities proposed at the WWTW in relation to mapped wetland areas.

In terms of the proposed new electrical infrastructure, the impact of the powerline at the Eerste River crossing and along the road reserve will be negligible as it will be within the footprint of already disturbed areas. The only area of concern along the route is thus along the eastern extent where a trench is proposed to be excavated to install the cable. The wetland in this area is a perched system, with seasonal inundation occurring following rainfall periods. The wetland habitat and functionality are already largely modified as a result of existing roads, rails, pipelines and powerlines constructed through the floodplain. Installation of the powerline could thus be adequately mitigated such that the potential impacts would be low.

<u>Significance of impacts without mitigation:</u> Medium negative impact – Localised loss/modification of wetland habitat is a possibility during and for a short duration following construction.

<u>Proposed mitigation:</u>

- The construction activities should be limited as far as possible within the wetland and riparian areas and the disturbed area should be rehabilitated afterwards. Use of already disturbed areas within the footprint of the WWTW and immediately to the west of the WWTW and away from the estuary is preferred.

- The proposed installation of the powerline within the western extent within the disturbed road reserve and attaching the cable to the bridge crossing the Eerste River is supported.

- Open trenching for the cable would be acceptable provided the works is undertaken during the low rainfall period (November to April) and the duration of the construction works is limited as far as possible.
- Before the construction activities, suitable indigenous wetland plants within the proposed trenching and construction areas could be identified and set aside for revegetating the disturbed areas immediately after construction is complete. It is essential that the clearing of invasive alien plants and in particular Port Jackson willows be undertaken during and after construction activities.
- The soil and cover vegetation removed to excavate the trench in which the cable is to be laid should be replaced over the line at the same level as the existing level.
- Use of machinery in the wetland areas should be limited as far as possible. Use of an excavator on tracks that can be driven along the excavated trench, excavating and backfilling as the pipeline is laid is recommended. The minimum area for the construction and lying of the cable in the eastern extent of the route should be demarcated and the wetland areas outside of the construction areas treated as no-go areas. Any areas significantly compacted by machinery will need to be ripped and revegetated following construction.
- All rubble associated with construction activities should be removed after the construction phase is complete.
- Control of invasive alien vegetation within the disturbed areas will need to continue for at least 5 years.

<u>Significance of impacts after mitigation</u>: The proposed expansion works may result in some localised loss of wetland habitat of very low significance.

Nature	Wetland and estuarine habitat loss	Status	-
Impact source(s)	Construction phase – modification or loss of wetland areas associated with the existing WWTW and electrical infrastructure as well as potential estuarine wetland habitat loss as a result of alteration to volumes of wastewater discharged		
Impacted aquatic ecosystem	Degraded floodplain and depression wetland areas as well as estuarine wetland habitat		
Magnitude	*Extent*	Local	
	Intensity	Medium	
	Duration	Medium to long term	
	Reversibility	Irreversible	
	Probability	Probable	
Significance	*Without mitigation*	Medium	M
	With mitigation	Very Low	VL
Confidence	Medium		
Degree impact can be reversed:	Low		
Irreplaceable loss of resources:	Medium to Low		
Cumulative impact	*Without mitigation*	Medium	
	With mitigation	Medium to low	
Degree impact can be avoided:	Medium to low		
Degree impact can be managed:	High		
Degree impact can be mitigated:	Medium to low		

CUMULATIVE IMPACTS

The cumulative impacts of increased treated wastewater discharges from all the WWTW within the Kuils / Eerste River Catchment are of concern, particularly in terms of the potential impact of the Eerste River Estuary. The estuary already exhibits evidence of loss of estuarine biodiversity as a result of the existing treated wastewater discharges. This estuary has been given a high priority for rehabilitation because it is already in a severely degraded ecological state but is linked to a Marine Protected Area and has been mapped as a FEPA wetland/estuary.

12. RISK ASSESSMENT

A risk assessment was carried out for the proposed activities (summary in Table 28) to inform the water use authorisation process as discussed in Section 9.2. The full risk assessment matrix can be seen in Appendix B. Works that fall outside of the existing footprint include the new inlet works, the Biological Reactors, the Primary and Secondary Settling Tanks, Waste Activated Sludge Holding Tanks and Dewatering Building, a boiler house facility and a new gas storage facility.

Table 28. Risk assessment for the proposed project activities

Phase	Activity	Impact	Risk Ratings
CONSTRUCTION	Expansion of WWTW footprint adjacent to the Eerste River Estuary	Habitat Disturbance or Loss	M
		Water quality impacts	L
	Increased discharge outlet at estuary	Habitat Disturbance	L
		Flow impact	L
	Installation of electricity infrastructure to nearest Eskom substatation	Habitat Disturbance	L
		Water quality impacts	L
OPERATION	Operation of WWTW adjacent to the Eerste River Estuary	Flow impact	M
		Water quality impacts	M
	Maintenance of WWTW related infrastructure	Habitat Disturbance	L
		Flow impact	L

The risk rating, (where Low (L) risk has a significance score of 1-55 and Moderate risk (M) has a score of 56-169) of the proposed activities is considered to be moderate to low. The proposed activity will need to be authorised through an integrated water use license application.

13. CONCLUSIONS AND RECOMMENDATIONS

Aquatic features that are likely to be impacted by the proposed upgrade to the Macassar WWTW are the lower Eerste River and Estuary and some largely artificial wetland areas associated with past activities at the WWTW. The lower river and estuary are considered to be in a severely modified ecological state as a result of flow modification and water quality impacts arising from the discharge of treated wastewater from several WWTWs in the Kuils and Eerste River Catchment as well as stormwater runoff. There is also an interbasin transfer of water into the upper Eerste River for irrigation purposes in the lower Eerste River.

The National Biodiversity Assessment for Estuaries (2011) indicated that the Eerste River Estuary should be given a high priority for rehabilitation due to the poor condition of the estuary, as well as the fact that the estuary occurs within a Marine Protected Area. The lower Eerste River is considered to be of moderate Ecological Importance and Sensitivity due to the indigenous fish that occur within the river system and the link of the lower river with the estuary and marine protected area. The lower river and estuary have also been mapped as a FEPA wetland/estuary.

The wetland areas likely to be impacted by the proposed activities are considered to be in a largely to severely modified ecological condition. They provide limited goods and services and are of low ecological importance and sensitivity. Loss of these wetland areas due to the proposed expansion of the WWTW would thus not be considered to be significant.

The existing discharge of treated wastewater from the Macassar WWTW has already considerably altered the estuary; thus the potential impact of an upgrade to this WWTW is likely to be less significant. The proposed upgrade to the existing WWTW provided the WWTW is constructed and operated according to the proposed design, will result in an improvement in the final treated wastewater quality, and as such, one could expect that the proposed upgrade would at least improve on the existing water quality situation in the Eerste River Estuary. Of greater concern however is the large increase in the volume of the treated wastewater that would be discharged to the estuary as well as the cumulative impact of increased wastewater discharge volumes throughout the catchment of the Kuils / Eerste River System where all four large WWTW (Bellville, Stellenbosch, Zandvliet and Macassar) are needing to be increased in terms of their capacities.

The increase in the volumes of treated wastewater discharged to the lower Eerste River and Estuary would result in a further ‘freshening’ of the estuary as well as additional modification to the seasonal variability (quality and quantity) within the estuary that is considered important for maintaining biodiversity within the estuary. The resulting loss of variability in estuarine habitat will result in further loss of biotic diversity as well as more modification to the hydrodynamics within the Kuils / Eerste Estuary. Considering the increase in the volume of treated wastewater to be discharged to the estuary as well as the high priority that was been awarded to the estuary for its rehabilitation, it is recommended that the ecological flow requirement for the estuary be determined at a rapid or intermediate level and be considered in terms of the future volumes and quality to be discharged to the estuary.

While cognisance must be given to the reality of the current situation, there will have to be a committed programme for the progressive reuse of the treated wastewater in the area and a significant reduction in the volumes that would be disposed of in the estuary. While there are already plans to do this, there will need to be a legal imperative to ensure that this commitment is implemented within agreed-upon timescales that are set as soon as technically possible. In particular, the re-use of the treated wastewater during the drier summer months should be encouraged to reduce the volumes that need to be discharged to the estuary, particularly during the low flow period when seawater intrusion and tidal exchange within the estuary would naturally have occurred.

The stipulated water quality requirement of the DWS (particularly for phosphates as the limiting nutrient to plant growth) to be achieved in the final effluent is supported to reduce eutrophication of the lower Eerste River and Estuary. It is recommended that the Special Limit for Ammonia of 2 mg/l or at least the General Limit of 6mg/l be specified for the final treated wastewater as this is a variable of concern within the current treated wastewater. It is essential that there is ongoing monitoring to ensure that the WWTW is designed and operated to achieve the final treated wastewater quality indicated.

The construction activities should be limited to the already disturbed areas within the new footprint of the WWTW. Disturbed areas should be rehabilitated as far as possible after the construction activities are complete and monitored and managed after rehabilitation to prevent the growth of invasive alien plants.

The risk rating, of the proposed activities is considered to be moderate. The proposed activity will need to be authorised through an integrated water use license application or amendment to their existing water use licence for the WWTW.

14. REFERENCES

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APPENDIX A: WATER QUALITY DATA

Figure A1. Barcode graph for DWA monitoring site G22_1000009587 in the lower Kuils River (Present water quality)

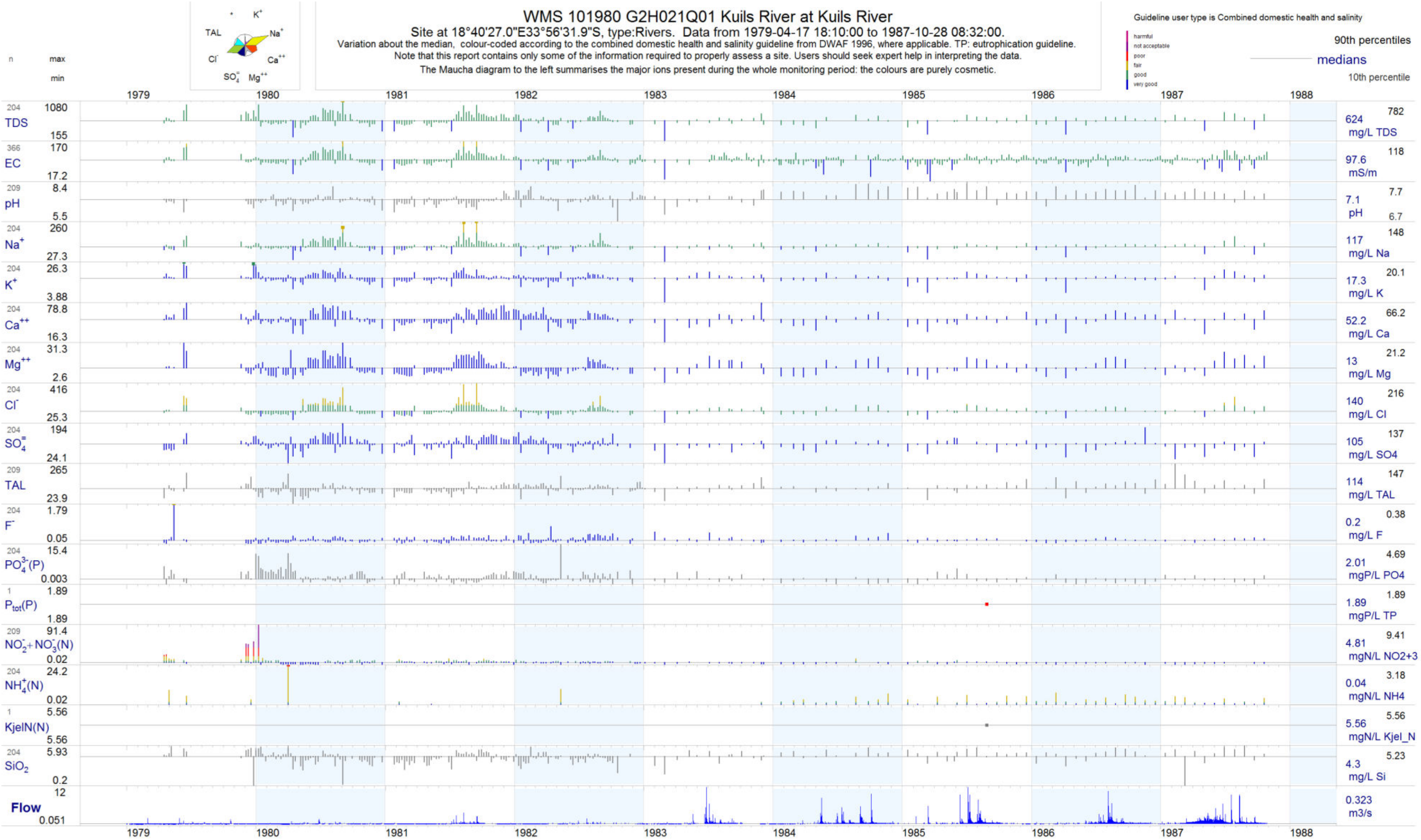


Figure A2. Barcode graph for DWA site G2H21 in the Kuils River at Kuils River (Historical water quality)

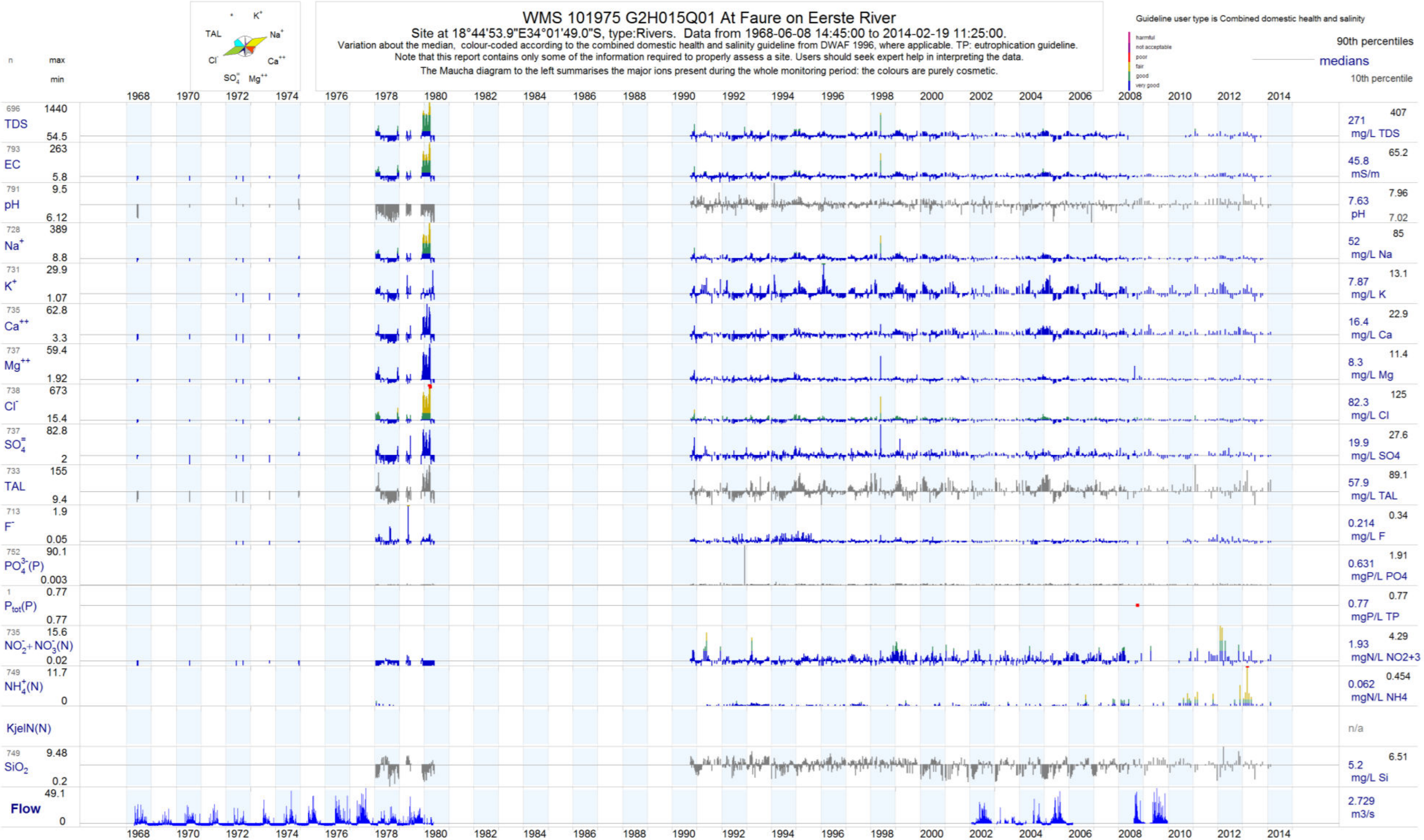
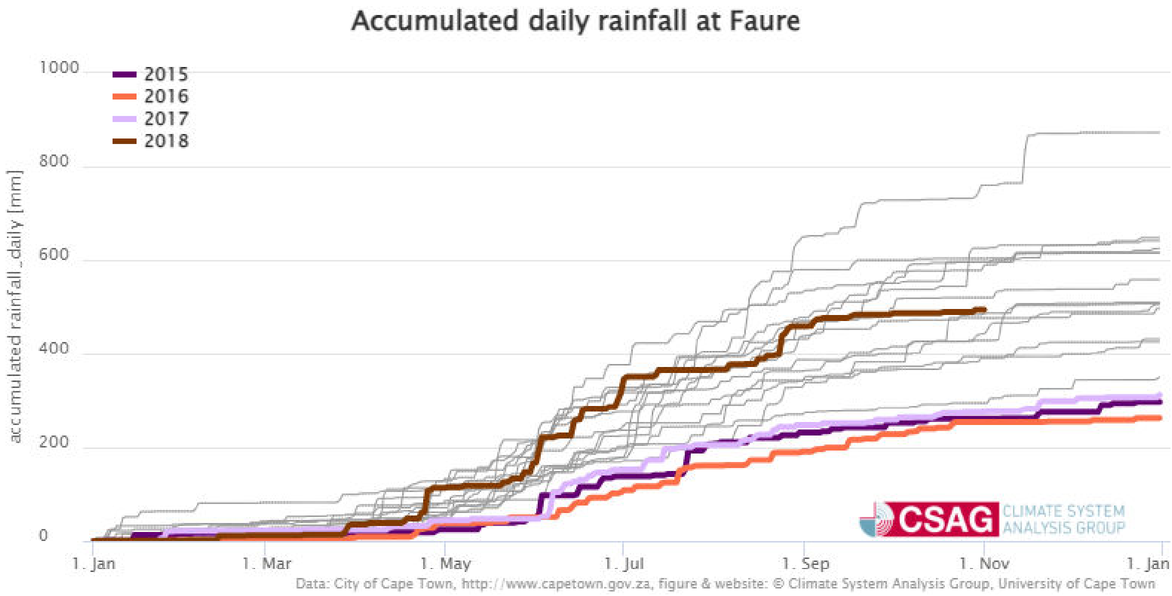


Figure A3. Barcode graph for DWA site G2H15 in the Eerste River at Faure (Historical water quality)

Below is the time series graph for the daily rainfall measured at Faure as the closest rainfall station to the study area for the period 2015 to 2018. This is to correlate to the water quality time series graphs that follow.



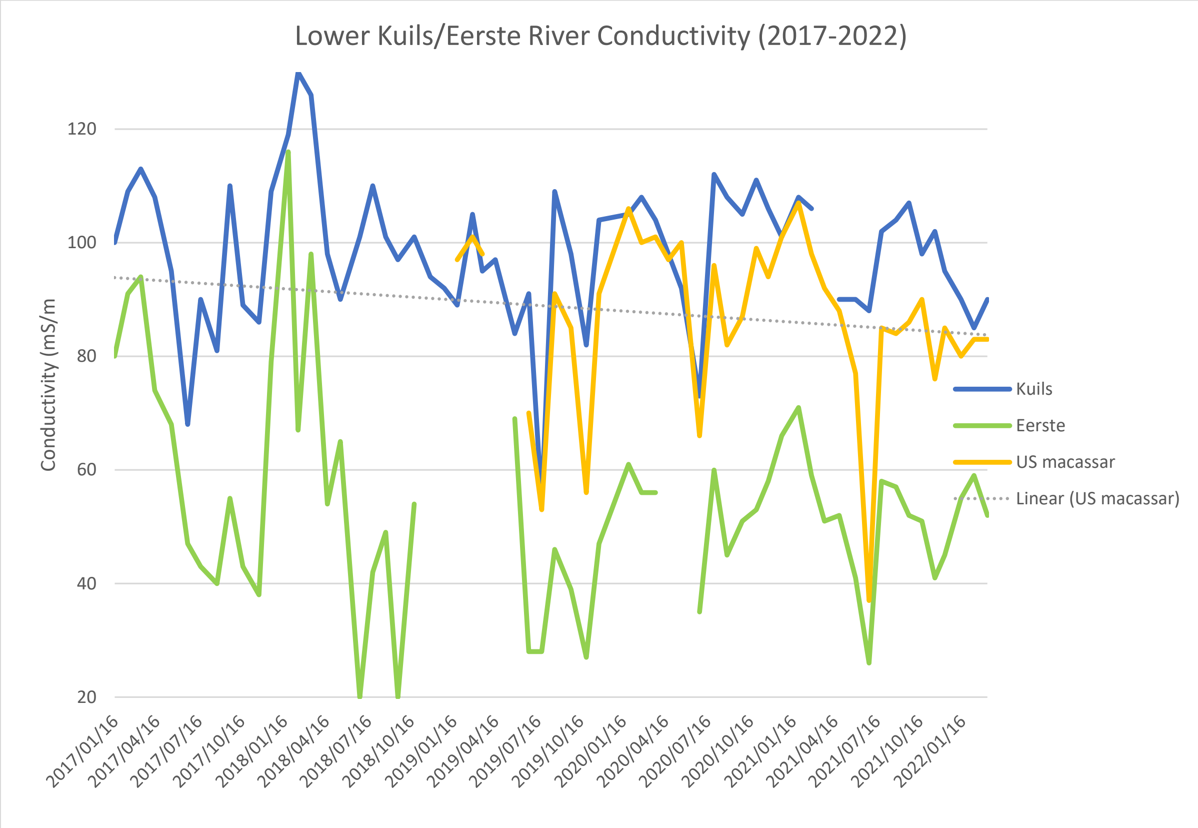
The results provided below are based on the most recent data obtained for the Kuils/Eerste River at the following points for the period January 2017 to March 2022: Kuils River downstream of Baden Powel Drive (EK08); Eerste River on N2 Freeway and upstream (u/s) of the Kuils River confluence (EK13); Eerste River downstream (d/s) of Macassar WWTW (EK12); and Eerste River estuary downstream of Macassar WWTW (EK17). The median concentrations for the variables have been categorised according to the water quality categories provided in the second table below.

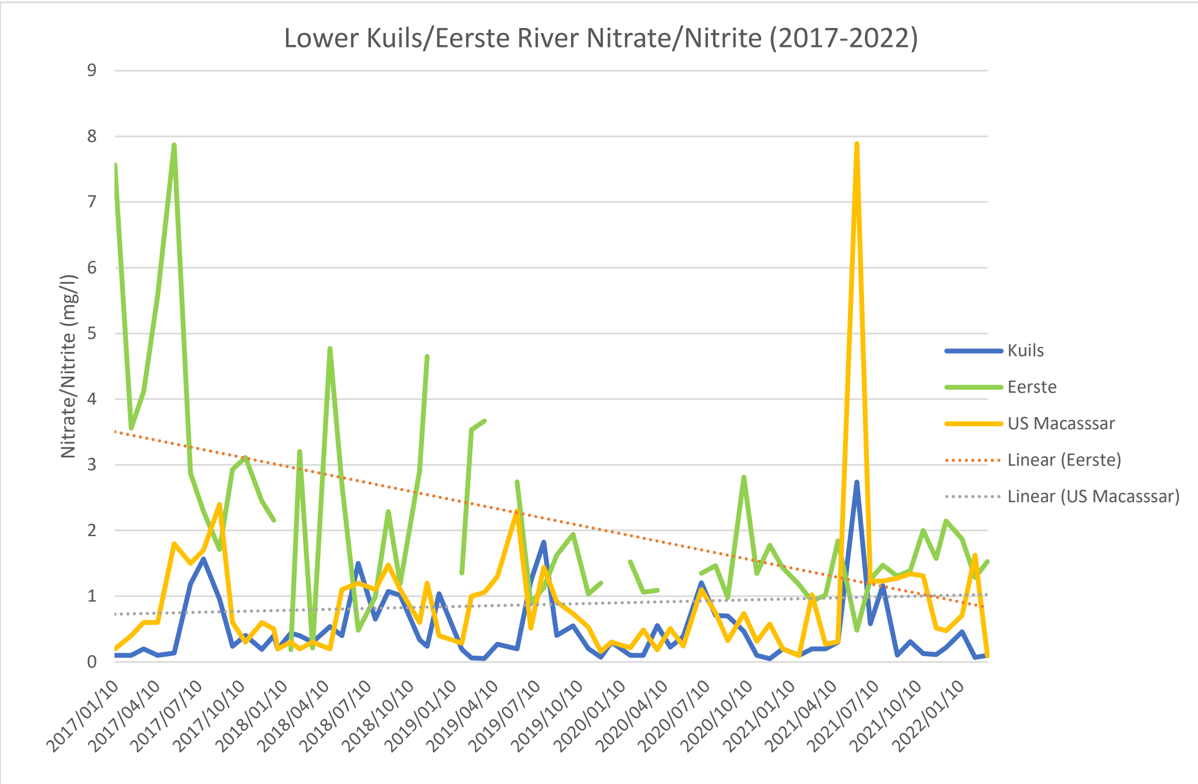
Site		Kuils River at Baden Powel Drive (EK08)	Eerste River at N2 – EK13	Eerste River us Macassar WWTW	Eerste River ds Macassar WWTW
Date		2017 - 2022			
pH	Median Range	7.5 7.2 – 8.3	7.5 7.1 – 7.8	7.6 3.3 – 8.2	7.6 3.4 – 8.2
Electrical Conductivity (mS/m)	Median Range	97 54 - 130	54 20 - 116	88 37 - 107	149.5 42 - 2462
Orthophosphates (mg/l)	Median Range	2.2 0.5 – 6.5	0.633 0.093 – 13.457	2.23 0.1 – 43.4	3 0.1 – 9.2
Nitrate/Nitrite (mg/l)	Median Range	0.4 0.053 – 11.8	1.601 0.185 – 7.87	0.8 0.09 – 17.2	0.561 0.05 – 13.1
Ammonium (mg/l)	Median Range	0.013 <0.001 – 0.254	0.003 <0.001 – 0.515	0.221 0.008 – 0.674	0.348 0.018 – 1.769
E.coli	Median Range	1300 10 – 1 440 000	820 <10 – 74 000	3700 720- >1 000 000	14 500 1000 – 450 000

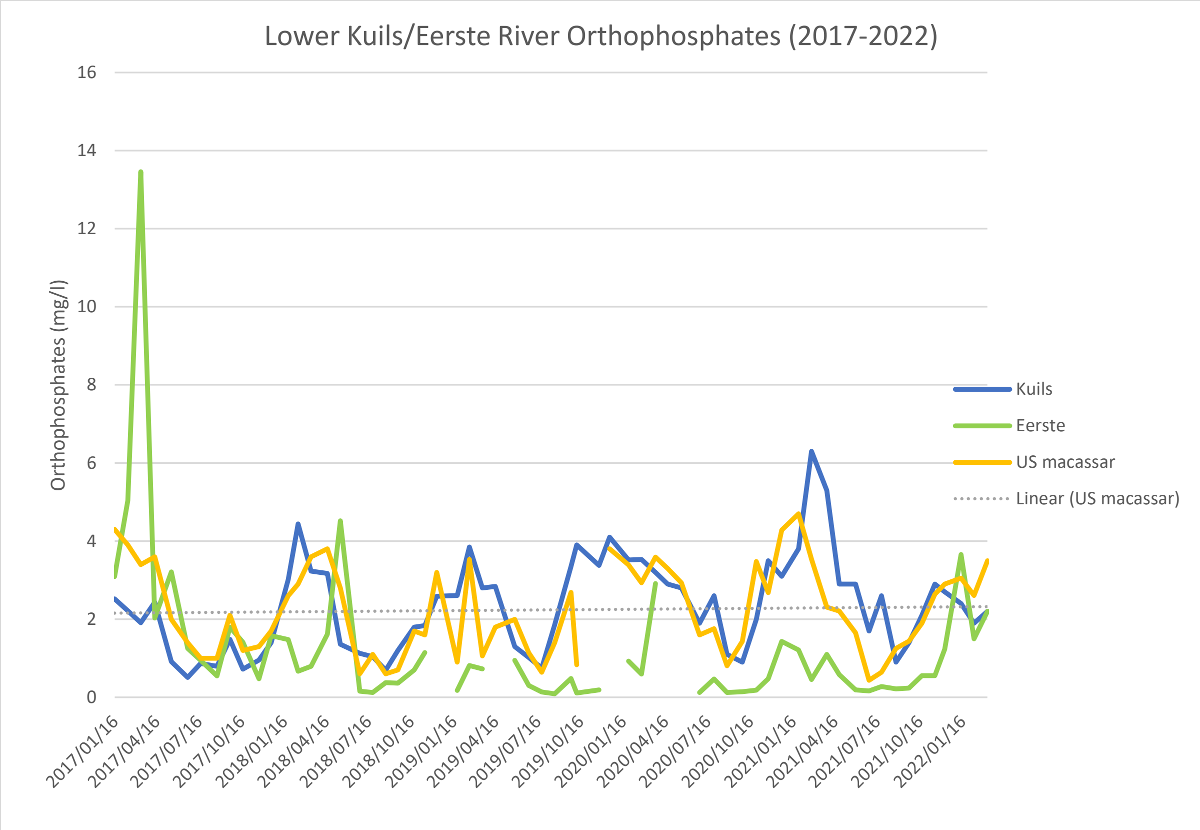
Category	**PO4-P**	**TIN**	**NH3-N**	***E.coli***
Good	<0.025	<0.7	<0.044	<400
Fair	0.025 - 0.075	0.7 - 1. 75	0.044 - 0.072	400 - 2500
Poor	0.075 - 0.125	1.75 - 3	0.072 - 0.1	2500 - 4000
Unacceptable	>0.125	>3	>0.1	>4000

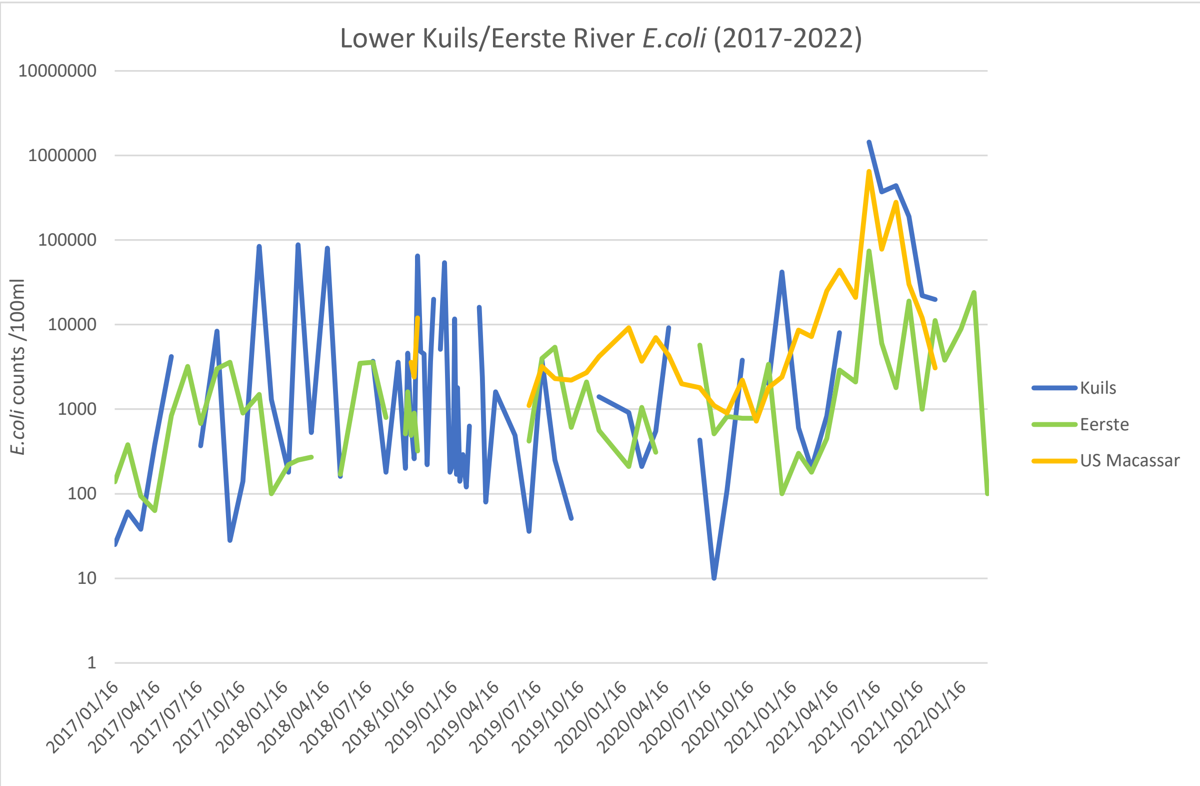
Where the above categories are based on Day (2020)

Time series graphs for each of the above water quality variables for the period January 2017 to March 2022 are provided below.






Lower Kuils/Eerste River Orthophosphates (2017-2022)
Orthophosphates (mg/l)
16
14
12
10
8
6
4
2
0
2017/01/16
2017/04/16
2017/07/16
2017/10/16
2018/01/16
2018/04/16
2018/07/16
2018/10/16
2019/01/16
2019/04/16
2019/07/16
2019/10/16
2020/01/16
2020/04/16
2020/07/16
2020/10/16
2021/01/16
2021/04/16
2021/07/16
2021/10/16
2022/01/16
Kuils
Eerste
US macassar
Linear (US macassar)


Lower Kuils/Eerste River *E.coli* (2017-2022)
E.coli counts /100ml
10000000
1000000
100000
10000
1000
100
10
1
2017/01/16
2017/04/16
2017/07/16
2017/10/16
2018/01/16
2018/04/16
2018/07/16
2018/10/16
2019/01/16
2019/04/16
2019/07/16
2019/10/16
2020/01/16
2020/04/16
2020/07/16
2020/10/16
2021/01/16
2021/04/16
2021/07/16
2021/10/16
2022/01/16
Kuils
Eerste
US Macassar

APPENDIX B: RISK ASSESSMENT

PROJECT: Macassar WWTW Upgrade, Cape Town

RISK ASSESSMENT MATRIX for Section 21 (c) and (i) Water Use activities - Version 2.0

Name of Assessor: Antonia Belcher **Signature:** Belcher

SACNASP Registration Number: SACNASP 400040/10 **Date:** 03-Sep-24

Risk to be scored for all relevant phases of the project (**factoring in specified control measures**). MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Ecological Importance	Hydrology	Water Quality	Geomorph	Vegetation	Fauna										
CONSTRUCTION	Expansion of WWTW footprint adjacent to the Eerste River Estuary	Habitat Disturbance or Loss	Eerste Estuary	E	Moderate	3	3	2	3	3	6	2	5	13	3	39	80%	31.2	M	High
		Flow impact	Lower Eerste	E	Moderate	3	2	2	3	3	6	2	1	9	3	27	40%	10.8	L	High
		Water quality impacts	Lower Eerste	E	Moderate	2	3	1	3	3	6	1	1	8	3	24	60%	14.4	L	High
	Increased discharge outlet at estuary	Habitat Disturbance	Lower Eerste	E	Moderate	1	1	1	1	1	2	1	2	5	3	15	60%	9	L	High
		Water quality impacts	Lower Eerste	E	Moderate	1	2	1	1	1	4	1	1	6	3	18	60%	10.8	L	High
		Flow impact	Lower Eerste	E	Moderate	2	2	2	1	1	4	1	1	6	3	18	60%	10.8	L	High
	Installation of electricity infrastructure to nearest Eskom substatation	Habitat Disturbance	Floodplain wetlands	D	Low	3	3	0	3	3	6	3	3	12	2	24	80%	19.2	L	High
		Flow impact	Floodplain wetlands	D	Low	3	1	0	3	3	6	2	2	10	2	20	80%	16	L	High
		Water quality impacts	Floodplain wetlands	D	Low	1	2	0	1	2	4	1	1	6	2	12	60%	7.2	L	High
OPERATION	Operation of WWTW adjacent to the Eerste River Estuary	Flow impact	Eerste Estuary	E	Moderate	4	3	3	3	3	8	2	4	14	3	42	80%	33.6	M	Medium
		Water quality impacts	Lower Eerste	E	Moderate	4	-4	3	3	3	8	2	4	14	3	42	80%	33.6	M	Medium
	Maintenance of WWTW related infrastructure	Habitat Disturbance	Eerste river/estuary	E	Moderate	1	1	0	1	2	4	1	2	7	3	21	60%	12.6	L	High
		Water quality impact	Lower Eerste	E	Moderate	1	2	0	1	2	4	1	1	6	3	18	60%	10.8	L	High