SURFACE WATER QUALITY IMPACT ASSESSMENT REPORT

TRANS-CALEDON TUNNEL AUTHORITY & GBN JOINT VENTURE.

MOKOLO CROCODILE WATER AUGMENTATION PROJECT PHASE 2 (MCWAP-2A) – RIVER MANAGEMENT SYSTEM.

CONTRACT NO. 2A-C-PS48-22.

PREPARED FOR:	**GBN-JV & TCTA**
PREPARED BY:	**ENVIRONMENTAL ASSURANCE**
MONTH:	**NOVEMBER 2023**
REPORT NUMBER:	**SWB-REP-240-23_24**
VERSION:	**0.2**

ENVASS GROUP OF COMPANIES

DOCUMENT CONTROL		
Document Title	Mokolo Crocodile Water Augmentation Project Phase 2 (MCWAP-2) - River Management System Surface Water Quality Impact Assessment.	
Report Number	SWB-REP-240-23_24	
Version	0.2	
Date	November 2023	
Submitted to	Minenhle Luthuli GIBB	Deon Esterhuizen MDT Environmental
Distribution	Gibb Bigen Nyeleti Joint venture (GBN-JV & TCTA) & Trans-Caledon Tunnel Authority (TCTA) Environmental Assurance (Pty) Ltd.	

QUALITY CONTROL			
	Originated By	**Internal Review**	**Technical Review**
Name	Deon Fourie	Richard Viljoen	Andre Buys
Designation	Environmental Consultant *Pr. Sci. Nat - 145592*	Environmental Consultant *Candidate EAP* – 2023/7417	Environmental Consultant *Pr. Sci. Nat - 119183*
Signature			
Date	03-11-2023	16-11-2023	16-11-2023

DISCLAIMER

EXECUTIVE SUMMARY

Environmental Assurance (Pty) Ltd. (hereafter referred to as ENVASS) has been appointed by Gibb Bigen Nyeleti Joint Venture & Trans-Caledon Tunnel Authority (hereafter referred to as GBN-JV & TCTA & TCTA) to design, implement and maintain a monthly surface water quality monitoring programme related to the Phase 2 Mokolo Crocodile Water Augmentation Project (MCWAP-2) – River Management System (hereafter referred to as RMS). The monitoring is implemented to determine Surface Water Baseline and Impact Assessment at three (3) gauging weirs In the Crocodile (west) River. Additionally, to the "RMS" monitoring, the main focus of the report is to conduct a **Surface Water Quality Impact Assessment** at the three (3) gauging weir localities. Two (2) of the three (3) weirs are located outside Brits, in the North-west province, whilst the remaining one (1) weir is located close to Thabazimbi, in the Limpopo Province.

The report depicts the following:

1. Site description, observations and potential impacts determined;
2. Discussion on the current Surface water quality condition;
3. The legislative context of impact assessments;
4. Identify possible sources of impacts;
5. Recommendations and management for future construction and operational phases.

Below is an outline of a condense summary of the results and findings of the Impact Assessment:

The scope of work performed for the Phase 2 Mokolo Crocodile Water Augmentation Project (MCWAP-2) as in accordance with the EIA Regulations, promulgated in terms of Section 24 of the NEMA and the criteria drawn from the Integrated Environmental Management(IEM) Guidelines Series, Guideline 5: Assessment of Alternatives and Impacts, published by the Department of Environmental Affairs (April 1998). The objective of the report and impact assessment is to identify and assess all the significant impacts that may arise as a result of the Proposed rehabilitation construction at the weirs.

It is assumed that the rehabilitation construction phase and to a lesser extent the operational phase of the weir rehabilitation and re-construction can contribute to potential impacts (change in water quality, loss of natural vegetation, sediments runoff etc), on the Crocodile River and the surrounding environment, although off-site impacts are not expected, and the impact is anticipated to be largely localised and concentrated within the construction area. From the current water quality and impact assessment data obtained, typical 'river' water quality was recorded amongst the various localities. All of the sampled localities indicated exceedances of the DWAF 1999, in terms of Aquatic Ecosystems related to Total Dissolved Solids, Calcium and Iron. Increased Total Dissolved Solids, Calcium and Iron in rivers can occur due to natural weathering processes of rocks and minerals, composition of rocks and soil in the water, agricultural runoff and decomposition of organic matter. Additionally, Iron and Calcium levels may increase due to runoff from impervious surfaces, construction activities,

and wastewater discharges. Perpetual activity on impervious surfaces, attributed to continuous movement such as that of construction vehicles and machinery, hinders water from permeating the ground. Instead, rainwater cascades off these surfaces, collecting pollutants, sediments, and minerals such as iron and calcium as it flows. Subsequently, this runoff may find its way into rivers, adding to heightened mineral levels in the water. Construction activities have the potential to disrupt the natural landscape, unveiling soil to the risk of erosion. When rainwater traverses these perturbed areas, it has the capacity to transport sediments and minerals, encompassing iron and calcium, into adjacent water bodies. Domestic sewage and industrial effluents can contain elevated concentrations of these minerals, either as natural components or as byproducts of human activities.

It is essential to note that natural variability and human activities can interact to influence the chemical composition of rivers. While some level of calcium and iron is normal in river water, excessively high concentrations can impact water quality, aquatic ecosystems, and human uses of water.

In order to ensure and prevent this possible outcome, mitigation measures are provided in this report to enable the proposed development to minimise the impact.

The main findings from the impact assessment are as follows:

a) Site description and observations made during the assessment.

1. The water quality throughout the assessment has indicated typical 'river' water quality associated with increased Total Dissolved Solids, Calcium and Iron measured against the DWAF 1999 – *Aquatic Ecosystems* guidelines. Additional exceedances of the DWAF 1999 – *Aquatic Ecosystems* limits were related to pH, Aluminium and Total Suspended Solids.

2. The river and its surroundings support a rich biodiversity. The diverse ecosystems along its course provide habitats for a variety of plant and animal species, including fish, amphibians, reptiles, birds, and mammals.

3. Vegetation along the Crocodile River varies based on the landscape. It can include riverine forests, grasslands, and thornveld. The riverbanks and floodplain areas are often characterized by a mix of indigenous plants.

4. The Crocodile River is home to a range of wildlife, including hippos, crocodiles, various fish species, and a variety of birdlife. The river serves as a vital water source for both resident and migratory species.

5. The Crocodile River is a significant water resource for both agricultural and urban areas along its course. Its waters are used for irrigation, domestic water supply, and industrial purposes.

b) Potential impacts that may occur considering the observations made.

1. Potential alterations to the river's flow regime, including changes in water velocity, sediment transport, and the expected frequency and magnitude of floods.

2. Potential changes in water quality parameters, such as sediment concentration, nutrient levels, and dissolved oxygen, could be made based on the anticipated alterations in flow patterns and sediment transport associated with the reconstruction to the weirs.

3. The reconstruction of existing weirs and construction of a new weir could impact aquatic habitats, including potential changes in the composition and distribution of fish and other aquatic species.

4. Structures associated with construction such as a gantry, may reduce the construction footprint and minimize habitat disturbance when used correctly however making use of gantries has the potential to disturb sediments in the riverbed. This disturbance may lead to increased turbidity in the water, affecting aquatic ecosystems and potentially harming fish and other aquatic life. Additionally, the installation and use of a gantry may temporarily alter water flow patterns in the river.

5. Potential changes in sediment transport patterns can lead to localized erosion and downstream sedimentation issues.

6. Altered flow regimes may lead to increased erosion or stability issues in adjacent riverbanks.

7. The machinery associated with the reconstruction of existing weirs and construction of a new weir as well as the activities during the rehabilitation construction phase could impact terrestrial habitats, and natural vegetation in the surrounding environment.

8. Chemicals and fluids associated with construction machinery may potentially spill. Accidental spills of these substances can introduce harmful chemicals into the surrounding environment, potentially impacting the water quality of the river.

9. While the reconstruction of existing weirs and construction of a new weir has the potential for several impacts, it is anticipated that the scale and duration of the construction will be such that significant effects on the river and its surroundings are not expected. The calculated impact is considered to be low.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS

A list of commonly used acronyms, measurement units and definitions are included below for the purpose of ensuring uniformity in the interpretation of this report:

List of Acronyms	
CoC	Chain of Custody
DWS	Department of Water and Sanitation (Formerly Department of Water Affairs and Forestry – DWAF and Department of Water Affairs - DWA)
GBN-JV & TCTA	GIBB Bigen Nyeleti Joint Venture
ENVASS	Environmental Assurance (Pty) Ltd
EMPr	Environmental Management Programme
MCWAP-2	Mokolo Crocodile Water Augmentation Project Phase 2
NEMA	National Environmental Management Act 107 of 1998
NWA	National Water Act 36 of 1998
Measurement Units	
km^2	Squared Kilometers
m	Meters
mamsl	meters above mean sea level
mg/l	milligrams per litre

1. INTRODUCTION

Environmental Assurance (Pty) Ltd. (hereafter referred to as ENVASS) has been appointed by Gibb Bigen Nyeleti Joint Venture & Trans-Caledon Tunnel Authority (hereafter referred to as GBN-JV & TCTA) to design, implement and maintain a monthly surface water quality monitoring programme related to the Phase 2 Mokolo Crocodile Water Augmentation Project (MCWAP-2) – River Management System (hereafter referred to as RMS). The monitoring is implemented to determine a Surface Water Quality Baseline and Impact Assessment at three (3) gauging weirs In the Crocodile (west) River. Additionally, to the "RMS" monitoring, the main focus of the report is to conduct a **Surface Water Quality Impact Assessment at the three (3) gauging weir localities.** Two (2) of the three (3) weirs are located outside Brits, in the North-west province, whilst the remaining one (1) weir is located close to Thabazimbi, in the Limpopo Province.

A basic surface water quality impact assessment is a systematic process used to evaluate how a specific project, activity, or development might affect the surface water quality in a particular area. These assessments are commonly conducted for various projects such as industrial facilities, construction projects, transportation developments, and urban planning initiatives. The goal of such an assessment is to identify potential surface water quality issues, predict the likely impacts, and propose measures to mitigate or minimize these impacts.

The basic steps involved in a surface water quality impact assessment include:

- Project Description: Clearly define the project, including its location, size, and nature. Identify the sources of water pollutants associated with the project.
- Baseline Surface Water Quality Monitoring: Measure the existing surface water quality in the area where the project is planned. This step establishes a baseline to compare against future conditions.
- Pollutant Inventory: Identify and quantify the pollutants associated by the project. This includes sediment, chemicals, spilled fluids debris, etc.
- Impact Prediction: Evaluate the predicted water quality concentrations and compare them with relevant water quality standards and regulations. Determine the potential impact on surface water quality.
- Mitigation Measures: Recommend measures to mitigate or minimize the adverse water quality impacts. These can include technological improvements, changes in project design, implementation of pollutant control measures, or changes in project scheduling.
- Monitoring and Compliance: Develop a plan for monitoring surface water quality during and after project implementation to ensure that the proposed mitigation measures are effective in maintaining acceptable water quality levels.

- Reporting and Documentation: Prepare a comprehensive report detailing the assessment process, findings, methodologies used, and proposed mitigation measures. This report is often submitted to regulatory authorities for approval.

2. BACKGROUND

GIBB (Pty) Ltd, Bigen Africa Services (Pty) Ltd, and Nyeleti (Pty) Ltd Joint Venture (GBN-JV & TCTA) was appointed by the Trans-Caledon Tunnel Authority (the TCTA) for the Consultancy Services for MCWAP-2A RMS. The study area is the reach of the Crocodile River (West) downstream of the Hartbeespoort Dam up to the Vlieëpoort Abstraction Weir. Furthermore, the RMS will also be applicable to the reach of the Moretele River downstream of Klipvoor Dam up to its confluence with the Crocodile River (West), as well as to the reach of the Elands River downstream of Vaalkop Dam up to its confluence with the Crocodile River (West) (Retrieved from the scoping RFQ document).

The Mokolo Crocodile River (West) Water Augmentation Project Phase 2 (MCWAP-2A) will convey 75 million m^3/a from the Crocodile River (West) via a large diameter pipeline to the Lephalale Area from Vlieëpoort south of Thabazimbi. The earlier Mokolo Crocodile River (West) Water Augmentation Project (MCWAP) Feasibility Study concluded that water supply for the MCWAP-2A would be provided primarily from surplus treated wastewater return flows available at Hartbeespoort Dam. The Crocodile River (West) provides the most cost-effective means of conveying this available surplus water from Hartbeespoort Dam to the Proposed Vlieëpoort Diversion Weir near the town of Thabazimbi.

The Feasibility Study also identified the need for the implementation of a River Management System (RMS) in the Crocodile River (West) and some of its tributaries as part of the MCWAP-2A. The RMS is a key component of MCWAP-2A. It will support the efficient operation and functioning of the system, including the effective and efficient management of releases of water from the upstream dams in the Crocodile River (West) Catchment to ensure adequate river flow at Vlieëpoort for the MCWAP-2A, whilst maintaining the Existing Lawful Use (ELU) of water users in the Crocodile River (West) Catchment. Furthermore, the RMS will provide a framework to ensure that the Water Resource Class (further referred to as the Class), the Reserve and Resource Quality Objectives (RQOs) are adhered to as recently gazetted (Government Gazette No. 42775. Government Notice 562 of 2019). The RMS will include the following three river reaches:

- Reach 1: Crocodile River (West), from Hartbeespoort Dam to the downstream Vlieëpoort diversion weir.
- Reach 2: Moretele River downstream of Klipvoor Dam to its confluence with the Crocodile River (West).
- Reach 3: Elands River downstream of Vaalkop Dam to its confluence with the Crocodile River (West).

The RMS will, amongst others, consist of computer models and management systems and will utilise information from its associated infrastructure components. These will include flow gauging stations and abstraction meters to monitor stream

flows and water use and abstractions along the Crocodile River (West) and the other river reaches listed above. Critically, these abstractions and the associated impact on available river flows at Vlieëpoort for MCWAP-2A, must be carefully managed, specifically with consideration of the presence of alluvial aquifers adjacent the river channel.

The purpose of the RMS is therefore to ensure that the required flow is maintained at the Proposed Vlieëpoort Weir while at the same time allowing the existing lawful users to prevent unauthorised use of the water that is released from the Hartbeespoort Dam, strict control over water abstractions is required.

Eskom Holdings has two power stations, Medupi and Matimba, in the Lephalale Local Municipality (LIM362), which is located within the Waterberg District Municipality (DC36). The power stations are responsible for about 20% of the power capacity of RSA. These power stations run from one water source, the Mokolo River, having Mokolo dam constructed on it. Demand for water is also expected to increase significantly, due to the environmental requirements of the Department of Environment, Fisheries and Forestry (DEFF) for clean emissions of these power stations. Eskom needs to implement Flue Gas Desulphurisation to clean up the emissions, and this requires water. Water is also required to increase the social requirements, given the current water constraints at the Marapong and Steenbokpan residential areas, and the forecasted population increases envisaged in this area. There is also water earmarked for industrial development, which may include coal, mining and other requirements.

The Mokolo and Crocodile Water Augmentation Project Phase 2 (MCWAP-2) entails the River Management System, the construction of an Abstraction Weir and a Water Transfer System (pump station(s) and approximately 160 km pipelines), as well as the associated infrastructure and the implementation of measures to mitigate the impact of the Project on both the natural and social environment. The objective of the MCWAP-2 is to increase the supply of water to the envisaged developments of the Waterberg area, resulting from growth in energy demand. The Waterberg development is identified as a strategic development node for the country under Strategic Infrastructure Project-1 (SIP-1). This development is expected to result in economic growth, resulting in job creation, tax revenue and an upgraded social infrastructure. Water infrastructure is needed as a catalyst to achieve this social and economic development in the area.

Figure 1 represents locality maps of the interested areas, with a) representing the locality map of all three weirs, b) representing the Beestekraal weir, c) representing the Atlanta weir and d) representing the Paul Hugo weir.

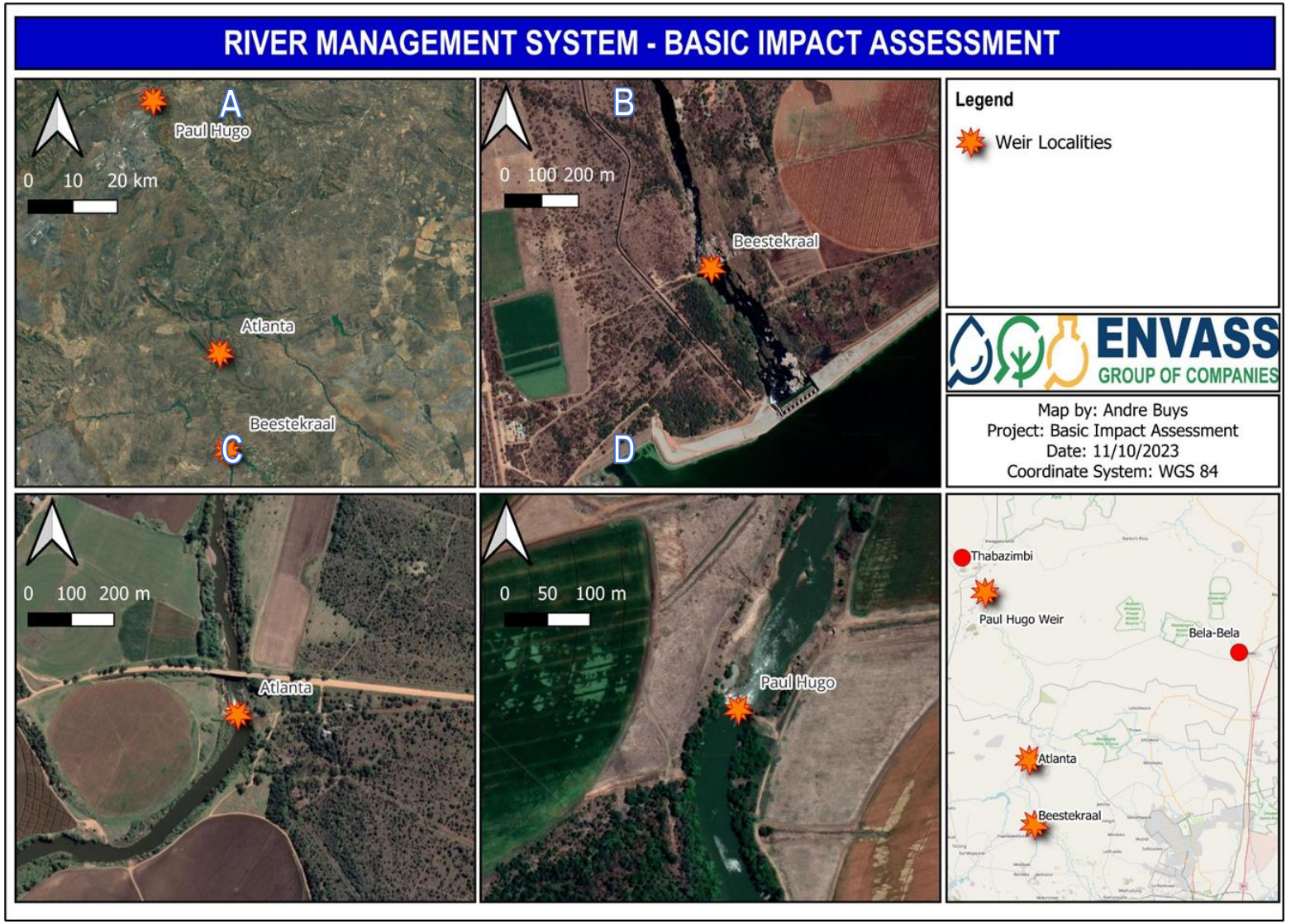

Figure 1: Locality Map of Weir localities

3. LEGISLATIVE CONTEXT AND REFERENCES

3.1. NATIONAL WATER ACT, ACT 36 OF 1998

The National Water Act, 1998 (Act of 1998) (NWA) provides the legal framework for the effective and sustainable management of water resources. It has a bearing on the scope of work for this project due to the primary objective of the water quality monitoring being to determine the baseline conditions. In doing so the source-pathway-receptor model can be utilised to determine the potential cause of exceedances and implement mitigation and/or rehabilitation efforts to remediate the impacts. This will allow for sustainable management of the proposed development that will conserve and protect the receiving watercourses.

The NWA recognises that the ultimate goal of water resource management is to achieve the sustainable use of water for the benefit of all South Africans. The NWA aims to protect, use, develop, conserve, manage and control water resources as a whole, thereby promoting the integrated management of water resources with the participation of all stakeholders.

The Department of Water and Sanitation (DWS) has overall responsibility for and authority over water resource management. This includes the equitable allocation and beneficial use of water in the public interest.

3.2. NATIONAL ENVIRONMENTAL MANAGEMENT ACT, ACT 107 OF 1998

Section 28 of the National Environmental Management Act (NEMA, Act 107 of 1998) places a duty of care on any person causing, has caused or may cause significant pollution or degradation of the environment to take reasonable measures to prevent such pollution or degradation from occurring, continuing, or, insofar as such harm to the environment is authorised by law or cannot be reasonably avoided or stopped and rectify such pollution of the environment.

4. SURFACE WATER QUALITY BASELINE EVALUATION

The purpose of this report is to determine a Baseline character at three (3) gauging weirs In the Crocodile (west) River. Additionally, to the "RMS" monitoring, the main focus of the report is to conduct a **Surface Water Quality Impact Assessment** at the three (3) gauging weir localities. Two (2) of the three (3) weirs are located outside Brits, in the North-west province, whilst the remaining one (1) weir is located close to Thabazimbi, in the Limpopo Province:

A surface water quality baseline evaluation is an assessment that establishes the initial or existing condition of water bodies such as rivers, lakes, streams, and other surface water sources. This evaluation involves the collection and analysis of data to determine the quality of the water, including its chemical, physical, and biological characteristics. The assessment entails the following:

4.1 Data Collection: Gathering information about the water source, including its location, flow rates, surrounding land use, historical data, and any potential pollution sources.

4.2 Sampling and Analysis: Collecting water samples from the predetermined localities throughout the Crocodile River and analysing them for various parameters such as pH, dissolved oxygen, turbidity, temperature, nutrient levels (nitrogen and phosphorus), heavy metals, pesticides, bacteria, and other pollutants.

All fieldwork was carried out by trained ENVASS environmental consultants and specialists, fully trained in all the methods of sampling as required. Sampling was conducted in accordance with the following guidelines:

- Guidance on the design of sampling programmes and sampling techniques:
    - SANS 5667-1:2008/ISO 5667-1:2006
- Guidance on the preservation and handling of water samples
    - SANS 5667-3:2006/ISO 5667-3:2003
- Guidance on sampling from lakes, natural and man-made
    - SANS 5667-4:1987/ISO 5667-4:1987
- Guidance on sampling of drinking water from treatment works and piped distribution systems
    - SANS 5667-5:2006/ISO 5667-5:2006
- Guidance on sampling of rivers and streams.
    - SANS 5667-6:2006/ISO 5667-6:2005
- Guidance on quality assurance of environmental water sampling and handling
    - SANS 5667-14:2016/ISO 5667-14:2014

DWAF best practice guideline – G3 – Water Quality Monitoring Programmes

Prior to departure for the monitoring fieldwork, all monitoring equipment and requirements are collected and confirmed through the Equipment Checklist (Attached as Appendix A). The checklist is utilised in order to ensure all required equipment is available and loaded for successful monitoring of the surface water sites. General surface water equipment includes:

- Project specific sampling field form (Inventory details on sampling localities);
- Project specific Laboratory Analysis Request Form and Chain of Custody Form;
- Project specific monitoring localities co-ordinates (Garmin Montana 650 GPS – WASS-enabled 3 meter accuracy));
- Sample storage/transit containers and ice packs (microbial preservation);
- Sampling container (as collected and provided by the laboratory), labels and marker pens;
- Sampling rope and bailers;
- Rubber boots or waders;
- Samplers/sampling equipment; and
- Insulated box (or cooler box) with sufficient sample bottles.

4.2.1 Surface water sampling: The following sampling protocol is utilised by ENVASS:

- Select a safe and accessible area to collect the relevant sample from the identified locality site;

- Samples are collected from the same location on a monthly basis in order to maintain representative conditions;
- Disinfect hands and wear gloves prior to sampling;
- Collect the required sealed sampling bottles (as provided by the laboratory) and clearly label with the relevant Sample Identification Number (Label and marking Pen);
- Ensure the labelling is adequate and dry prior to collecting the sample;
- Do not open or touch the inside of the sampling containers;
- Open sampling containers at the sampling locality and collect the sample directly from the sample container:
    - General chemistry and bacteriological samples are collected under the surface of the water body (approximately 10 centimetres or shallower below the surface, depending on water profile depth):
        - The chemistry one (1) litre bottle is rinsed with the sampling locality water (no preservatives included from laboratory bottles), followed by collection of a sample well above the base of the channel (unrepresentative of the natural water column);
        - A two hundred (200) ml bacteriological sample will be obtained to ensure 100 ml (as required) for each bacteriological measurement (*E.coli* and Faecal Coliforms);
    - Oil and Grease samples are collected on the surface of the water body through a one (1) litre container;
- Close sampling container and ensure no leakage is present;
- Preserve sample on site (Bacteriological samples will be kept cool to prevent growth);
- Document observations and complete the site specific field form which include:
    - Location, name and details of the sample site;
    - Date and Time of sample collected;
    - Method of collection (E.g. Grab Sample);
    - Name of sampler;
    - Flow status;
    - Colour / Turbidity observation;
    - Preservative or stabilizer added (if applicable);
    - Other data gathered at this point (e.g. stagnant water etc.);
- Safely store sampling containers in the insulated box; and
- File completed field form.

4.2.2 Surface water laboratory analysis: All samples taken are transported in line with SANAS requirements and submitted to an independent SANAS accredited laboratory (as required by the National Water Act, Act no 36 of 1998) (General Authorisations in terms of Section 39, as amended in 2004) (Chemtech Laboratories Accreditation No. T0361) within 48 hours in order to ensure representative chemical and bacteriological quality. Laboratory analysis results (turn-around time) is generally between five (5) to ten (10) working days. Once the field technician arrives at the laboratory, all

the samples are delivered to sample reception sighting the following extracts from the ENVASS Chain of Custody (CoC) (Appendix B):

- Analytical requests are already allocated to the project through collaboration between ENVASS and Chemtech Laboratories before commencement of the project;
- Project specific Laboratory Analysis Request Forms and Chain of Custody Forms are accompanied and submitted to reception;
- Confirmation of the delivered samples in accordance with the Field Forms, Laboratory Analysis Request Form and Chain of Custody Forms are conducted by an ENVASS and Chemtech Laboratory employee;
- The aforementioned forms as signed by representatives and samples submitted;
- Analysis of the samples are done in accordance with the ISO/IEC 17025:2005 standards by an accredited independent laboratory (SANAS) inclusive of:
    - Calibration of monitoring equipment and maintenance to ensure accurate data;
    - Provide error values in terms of accuracy and precisions of the analytical results; and
    - Ensure compliance with applicable legislation, standards and guidelines, including on advising on any changes in legislation.

The following package of variables forms part of the monitoring requirements related to the MCWAP-2 project:

Table 1: Water quality parameters for the Phase 2 Mokolo Crocodile Water Augmentation Project

MCWAP-2 Analysis Package Details	
Analysis Parameter	**Monthly Surface Water Analysis Package (Abstraction, Final Water & Handover Point)**
pH	X
Temperature (ºC)	X
Electrical Conductivity (EC) at 25ºC (mS/m)	X
Total Dissolved Solids (TDS) (mg/l)	X
Total Suspended Solids (TSS) (mg/l)	X
Dissolved Oxygen (DO) (mg/l)	X
Chemical Oxygen Demand (COD) (mg/l)	X
Turbidity (NTU)	X
Aluminium as Al (mg/l)	X
Ammonia as N (mg/l)	X
Cadmium as Cd (mg/l)	X
Calcium as Ca (mg/l)	X
Chloride as Cl (mg/l)	X
Chromium as Cr (mg/l)	X
Copper as Cu (mg/l)	X
Cyanide as CN (mg/l)	X
Fluoride as F (mg/l)	X
Iron as Fe (mg/l)	X
Lead as Pb (mg/l)	X
Manganese as Mn (mg/l)	X

MCWAP-2 Analysis Package Details	
Analysis Parameter	**Monthly Surface Water Analysis Package (Abstraction, Final Water & Handover Point)**
Mercury as Hg (mg/l)	X
Nitrate & Nitrite as N (mg/l)	X
Ortho-phosphate as P(mg/l)	X
Sodium as Na (mg/l)	X
Sodium Absorption Rate (SAR) (mg/l)	X
Soap, Oil and Grease (mg/l)	X
Zinc as Zn (mg/l)	X
Escherichia coli (E.coli) (CFU/100ml)	X
Faecal Coliforms (CFU/100ml))	X

4.3 Assessment of Water Quality: Comparing the results obtained from the analysis with established water quality standards or guidelines set by environmental agencies or regulatory bodies. This comparison helps in determining if the water quality meets the required standards or if there are any significant deviations or potential concerns. The results will be compared to the relevant fitness for use guidelines (South African Water Quality Guidelines) in order to provide current baseline conditions. It should be noted that where values are below the detection limit, the concentration is considered as below the specified ideal range.

Table 2: Guideline Limits

Variable	Unit	Domestic					Stock Watering				Irrigation				Recreation				Ecosystems			
		Ideal	Acceptable	Tolerable	Unacceptable	Totally unfit	Ideal	Acceptable	Tolerable	Unacceptable	Ideal	Acceptable	Tolerable	Unacceptable	Ideal	Acceptable	Tolerable	Unacceptable	Ideal	Acceptable	Tolerable	Unacceptable
pH		6.0 - 9.0	6.0 - 9.0	6.0 - 9.0	4.0 - 6.0; 9.0 -11.0	< 4.0 ; > 11.0					6.5 - 8.4	6.5 - 8.4	6.5 - 8.4	< 6.5 ; > 8.4	6.5 - 8.5	5.0 - 6.5; 8.5 - 9.0	5.0 - 6.5; 8.5 - 9.0	0 - 5.0; > 9.0	< 0.5 or 5% change	< 0.5 or 5% change	< 0.5 or 5% change	> 0.5 or 5% change
Electrical Conductivity (EC) at 25ºC	mS/m	0 - 70	70 - 150	150 - 300	300 - 450	> 450																
Total Dissolved Solids (TDS)	mg/l	0 - 450	450 - 1000	1000 - 2000	2000 - 3000	> 3000	0 - 1000	1000 - 2000	2000 - 3000	> 3000	40	40 - 90	90 - 270	270 - 540					< 15% change from unimpacted conditions			> 15% change from unimpacted conditions
Total Suspended Solids (TSS)	mg/l										50	50 - 100	> 100						100			
Dissolved Oxygen (DO)	mg/l																		80 % - 120 % saturation	> 60 % (Sub-lethal) - 7 day minimum	> 40 % (Lethal) - 1-day minimum	> 40 % extended duration
Chemical Oxygen Demand (COD)	mg/l																					
Turbidity	NTU	0 - 1	1 - 5	5 - 10	>10										3	3.0 - 1.5	1.5 - 1	< 1.0				
Ammonia as N	mg/l	0 - 1.0	1.0 - 2.0	2.0 - 10.0	>10.0														7	7 - 15	7 - 15	> 15
Nitrate & Nitrite as N	mg/l	0 - 6	6 - 10	10 - 20	>20		0 - 100	100 - 200	200 - 400	> 400	5	5 - 30	> 30						> 0.5	0.5 - 2.5	2.5 - 10	> 10
Calcium as Ca	mg/l	0 - 32	32 - 80	> 80			0 - 1000	0 - 1000	1000 - 2000	> 2000												
Chloride as Cl	mg/l	0 - 100	100 - 200	200 - 600	600 - 1200	> 1200	0 - 1500	1500 - 2000	2000 - 3000	> 3000	100	< 140	140 - 175	> 175					0.0002	0.0002 - 0.00035	0.0002 - 0.00035	> 0.00035
Sodium as Na	mg/l	0 - 100	100 - 200	200 - 400	400 - 600	> 600	0 - 2000	2000 - 2500	2500 - 4000	> 4000	70	70	70 - 115	> 115								
Fluoride as F	mg/l	0 - 1.0	1.0 - 1.5	1.5 - 3.5	3.5 - 4.0	> 4.0	0 - 2	2 - 4	4 - 6	> 6	2.0	2.0 - 15.0	> 15.0						0.75	0.75 - 1.5	0.75 - 1.5	> 1.5
Orthophosphate as P	mg/l																		< 5	5 - 25	25 - 250	> 250
Aluminium as Al	mg/l	0 -0.15	0.15 - 0.5	> 0.5			0 - 5	0 - 5	5 - 10	> 10	5	5 - 20	> 20						0.005 - 0.010	0.005 - 0.010	0.010 - 0.020	> 0.020
Cadmium as Cd	mg/l	0 - 0.005	0.005 - 0.010	0.010 - 0.020	0.020 - 1	> 1	0 - 0.01	0 - 0.01	0.01 - 0.02	> 0.02	0.01	0.01 - 0.05	> 0.05						0.00015	0.00015 - 0.0003	0.00015 - 0.0003	> 0.0003
Chromium as Cr	mg/l																		0.012	0.012 - 0.024	0.012 - 0.024	> 0.024
Copper as Cu	mg/l	0.0 - 1.0	1.0 - 3.0	3.0 - 30	30 - 200	> 200	0 - 0.5	0.5 - 1	1 - 2	> 2	0.2	0.2 - 5.0	> 5.0						0.0003	0.0003 - 0.00053	0.0003 - 0.00053	> 0.00053
Cyanide as CN	mg/l																		0.0001	0.0001 - 0.0004	0.0001 - 0.0004	> 0.0004
Iron as Fe	mg/l	0 - 0.1	0.1 - 0.3	0.3 - 1.0	1 - 10	> 10	0 - 10	0 - 10	10 - 50	> 50	5.0	5.0 - 20.0	> 20.0						< 10 % variation	< 10 % variation	< 10 % variation	> 10 % variation
Lead as Pb	mg/l	0 - 0.010	0.010 - 0.050	0.050 - 0.1	0.1 - 0.3	> 0.3	0 - 0.1	0.1 - 0.2	0.2 - 0.5	> 0.5	0.2	0.2 - 2.0	> 2.0						0.0002	0.0002 - 0.0005	0.0002 - 0.0005	> 0.0005
Manganese as Mn	mg/l	0 - 0.05	0.05 - 0.10	0.10 - 0.15	0.15 - 1.0	> 1	0 - 10	0 - 10	10 - 50	> 50	0.02	0.02 - 10.0	> 10.0						0.18	0.18 - 0.37	0.18 - 0.37	> 0.37
Mercury as Hg	mg/l	0 - 0.001	0.001 - 0.005	0.005 - 0.020	0.020 - 0.050	> 0.050	0 - 1	0 - 1	1 - 6	> 6									0.00004	0.00004 - 0.00008	0.00004 - 0.00008	> 0.00008
Zinc as Zn	mg/l	0 - 3	3 - 5	5 - 10	10 - 50	> 50	0 - 20	0 - 20	20 - 40	> 40	1	1.0 - 5.0	> 5.0						0.002	0.002 - 0.0036	0.002 - 0.0036	> 0.0036
Sodium Absorption Rate (SAR)	mg/l										2	2.0 - 8.0	8.0 - 15.0	> 15.0								
Soap, Oil and Grease	mg/l																					
Escherichia coli (E.coli)	(CFU/100ml)	0	0	0 - 10	10 - 20	>20					1	1 - 1000	> 1000		0 - 130	130 - 200	200 - 400	> 400				
Faecal Coliforms (CFU/100ml)	(CFU/100ml)	0	0	0 - 10	10 - 20	>20	0 - 200 0 - 1 000 for < 20 % of the samples	200 - 1000 1 000 - 5 000 for < 20 % of the samples	200 - 1000 > 50 % of the samples	1 000 - 5 000 for > 50 % of the samples	1	1 - 1000	> 1000		0 - 130	130 - 600	600 - 2000	> 2000				

Legend
Ideal
Acceptable
Tolerable
Unacceptable
Unfit

4.4 Identifying Trends or Patterns: Identifying trends, patterns, and potential sources of pollution that may impact the water quality. This could involve seasonal / periodic variations, point sources (like construction phase discharges), or non-point sources (such as runoff from agricultural areas).

4.5 Establishing a Baseline: Using the collected data to establish a baseline for future assessments. This baseline serves as a reference point against which future changes or impacts on water quality can be measured.

4.6 Reporting and Recommendations: Creating a report that summarizes the findings, identifies any concerns or areas for improvement, and suggests potential mitigation measures or actions to maintain or improve water quality.

As soon as water quality data is received from the laboratory, it is verified and collated into a water quality management database through the appointed Data Co-ordinator (Mr. Deon Fourie, Professional Scientist). The database is submitted to the relevant project leader and reporting initiated.

The impact assessment report is compiled and sent electronically to GBN-JV & TCTA. The reporting component also includes monthly water quality reports as well as a final, collated baseline report which will describe the annual trend in variable analysis as well as provide a qualitative assessment of conditions.

ENVASS implements a Document Control Procedure which forms part of an Integrated Management System. All reports are initiated by the project leader which follows an internal quality review procedure for final sign-off by a Professional Registered Environmental Scientist. The DRAFT report is submitted to the client after internal quality assurance, for review and comment. Upon feedback from the client, amendments are conducted, and the Final report submitted to client.

Reporting will comprise of the impact assessment report, monthly water quality reports, as well as a baseline report (combination of monthly reports).

5. QUALITATIVE SURFACE WATER QUALITY ASSESSMENT

5.1 Rehabilitation construction phase

Table 3 provides a list of possible sources of water pollution associated with the proposed rehabilitation construction activities expected in preparation of the project. Additionally, construction related activities that may impact the surrounding environment are also listed. The subsequent sections provide a generic description of the parameters influencing particulate emission generation from the various aspects identified.

Table 3: Proposed rehabilitation construction and activities

Proposed Construction	Activity
Beestekraal Weir	
Site Bank Construction	Land clearing activities such as dozing of vegetation and topsoil. Grading of cleared land surfaces. Windblown dust from exposed surface. Vehicle and construction equipment activity on the unpaved roads. Tailpipe emissions from vehicles and construction equipment such as graders, scrapers and dozers.
Erosion Protection	
Proposed rehabilitation works	
Proposed right and left bank access roads	
Refurbishment of Weir	
Atlanta Weir	
Site Bank Construction	Land clearing activities such as dozing of vegetation and topsoil. Grading of cleared land surfaces. Windblown dust from exposed surface. Vehicle and construction equipment activity on the unpaved roads. Tailpipe emissions from vehicles and construction equipment such as graders, scrapers and dozers.
Erosion Protection	
Proposed rehabilitation works	
Proposed right and left bank access roads	
Refurbishment of Weir	
Paul Hugo	
Site Bank Construction	Land clearing activities such as dozing of vegetation and topsoil. Grading of cleared land surfaces. Windblown dust from exposed surface. Vehicle and construction equipment activity on the unpaved roads. Tailpipe emissions from vehicles and construction equipment such as graders, scrapers and dozers.
Erosion Protection	
Proposed rehabilitation works	
Proposed right and left bank access roads	
Gantry construction	
New Weir construction	

The reconstruction phase normally comprises a series of different operations including land clearing, topsoil removal, road grading, material loading and hauling, stockpiling, compaction, etc. Each of these operations will have their own duration and potential for surface water pollution.

5.1.1 Land clearing activities

Bulldozing and land clearing operations frequently disrupt the topsoil and vegetation, resulting in soil erosion. Without the protective cover of vegetation, soil can easily erode and wash into nearby rivers or streams. This sedimentation can increase turbidity, clouding the water and negatively affecting aquatic life by reducing light penetration and disrupting ecosystems. Removal of vegetation can expose the water to more direct sunlight, which can lead to increased water temperatures. Changes in water temperature can negatively impact aquatic life adapted to specific temperature ranges. Additionally, removing vegetation along riverbanks eliminates essential habitat for numerous species.

5.1.2 Clearing and grubbing of land surfaces

The process of clearing can significantly impact the landscape's hydrology, resulting in modifications to the water flow and increased runoff (Wagner et al., 2014). Alterations caused by clearing may change the natural drainage patterns of the land, consequently affecting the flow of water into nearby rivers. These changes can potentially lead to increased flooding or alterations in sediment transport dynamics within river systems (Jones et al., 2018).

Moreover, clearing activities have the potential to disrupt the natural nutrient cycling processes of the environment (Brown et al., 2019). Such disruptions can lead to imbalances in nutrient levels, which have been observed to contribute to issues such as increased nutrient concentrations fostering algal blooms, thereby impacting water quality in affected river systems (Smith et al., 2017).

These referenced studies and scholarly articles highlight the significance of grading activities in altering hydrology, changing drainage patterns, and affecting nutrient cycling, which collectively influence water quality in river ecosystems. For comprehensive details and specific findings, referring to the mentioned sources would offer a deeper understanding of the impacts of clearing on rivers and their surrounding environments.

5.1.3 Vehicle and construction equipment activity

Heavy machinery used in construction activities can lead to soil compaction and erosion, contributing to increased sediment runoff into rivers and subsequently affecting aquatic habitats (Smith et al., 2018). Construction vehicles, as part of these activities, are prone to leaks of oil, fuel, and other hazardous fluids, potentially resulting in soil contamination and the subsequent washing of pollutants into rivers through stormwater runoff (Roberts et al., 2017; He et al., 2020). This contamination poses a risk to water quality and the well-being of aquatic life (Roberts et al., 2017).

Furthermore, equipment and vehicles utilized in construction often involve various chemicals, including hydraulic fluids, paints, and cleaning agents. Improper handling or accidental spills of these substances can introduce harmful chemicals into the surrounding environment, potentially impacting the water quality of nearby rivers (He et al., 2020; Smith et al., 2018).

Please note that the specific sources may provide further insights into the impact of heavy machinery, construction vehicle emissions, and chemical usage on soil erosion, water contamination, and their effects on aquatic ecosystems and river quality.

5.1.4 Building material to be prepared and used on site

Manufacturing or preparing building materials such as concrete, cement, and bricks typically involves the use of raw materials and processing, which can result in the generation of sediment and dust. Improper handling or inadequate storage of these materials may contribute to soil erosion and runoff, thereby impacting sedimentation in nearby water bodies (Borges, 2017; NRDC, n.d.).

The production and processing of building materials often involves various chemicals. Cement production, for example, emits pollutants such as particulate matter, carbon monoxide, sulfur dioxide, and nitrogen oxides (Gosselin et al., 2014). Improper disposal of by-products or accidental spills from such manufacturing processes can result in the contamination of nearby water sources, thereby adversely impacting water quality and aquatic life (Gosselin et al., 2014; Borges, 2017).

Please note that the specific sources may provide detailed information on the generation of sediment, dust, and emissions during the manufacturing and processing of building materials, as well as the impact on water bodies and aquatic ecosystems.

5.1.5 Structural development such as temporary bridges, flood defences and embankments

Construction of embankments and temporary structures can alter the natural flow of rivers, influencing the hydrology of the river system and potentially causing changes in water velocity, flow patterns, and sediment transport (Graf, 1999; Olsen et al., 2019). These alterations may have downstream impacts, affecting the integrity of the ecosystem by disrupting aquatic habitats and organisms (Graf, 1999; Olsen et al., 2019).

Moreover, the erection of structures like temporary bridges and flood defences can create barriers that obstruct the movement of fish and other aquatic organisms (Beechie et al., 2008). This obstruction disrupts migratory patterns and access to crucial spawning areas, resulting in adverse effects on fish populations and the overall health of the river ecosystem (Beechie et al., 2008; Williams et al., 2012).

The construction of flood defences or embankments can induce changes in the natural flood patterns and hydrological dynamics of the river (Bednarek, 2001). These modifications not only alter water flow and flood regimes but also have far-reaching impacts on the ecological processes, influencing the overall health of the river and its surrounding landscape (Poff et al., 1997; Beechie et al., 2010).

5.2 Qualitative Impact Assessment

The temporary nature of the construction activities, and the likelihood that these activities will be localised and on small areas at any given time, reduces the potential for significant off-site impacts.

The closest residential receptors to the three weirs were identified as downstream receptors and/or receptors in close proximity and are summarized in Table 4 below.

Table 4 : Sensitive Receptors

Weir	ID	Latitude	Longitude	Description	Distance (m)
Beestekraal	Sensitive Receptor BK 1	-25.397843°	27.574044°	Shongololo Camping Site	630 m
Beestekraal	Sensitive Receptor BK 2	-25.407603°	27.566436°	Thaba lodge	970 m
Beestekraal	Sensitive Receptor BK 3	-25.407523°	27.569801°	Residential Houses (informal)	680 m
Atlanta	Sensitive Receptor AT 1	-25.206677°	27.559716°	Residential Farmhouse	220 m
Atlanta	Sensitive Receptor AT 2	-25.207234°	27.566377°	Residential Houses and Offices	860 m
Atlanta	Sensitive Receptor AT 3	-25.210931°	27.543096°	Residential Farmhouse	1550 m
Paul Hugo	Sensitive Receptor PH 1	-24.693229°	27.400652°	White Silo Guesthouse	830 m
Paul Hugo	Sensitive Receptor PH 2	-24.698166°	27.401296°	Residential Farmhouse	850 m
Paul Hugo	Sensitive Receptor PH 3	-24.693425°	27.395564°	Residential Houses (informal)	1360 m
Paul Hugo	Sensitive Receptor PH 4	-24.694591°	27.389419°	Residential Farmhouse and storage facility	2000 m

All sensitive receptors are more than 200 m from the proposed weirs and construction areas. These receptors were determined by identifying and assessing the areas, habitats, and communities that may be particularly vulnerable or impacted by the reconstruction activities. The receptors that were identified are the residential properties surrounding the weirs. It is assumed that the farmers make use of the river's water for crop watering through extraction and also come into contact with the water through recreational activities such as fishing. Residents who rely on the river for water supply or recreational activities may be concerned about potential changes in water quality due to construction. The release of sediments or contaminants into the water may raise environmental and health concerns.

It is difficult to estimate the distance of any potential impact, but it is deemed that impacts to the immediate environment of the reconstruction sites are unlikely to impact on receptors more than 500 meters from the source of emissions.

6. IMPACT ASSESSMENT

6.1 Impact Identification and Assessment Methodology

The objective of the impact assessment is to identify and assess all the significant impacts that may arise as a result of the Proposed construction. The potential impact rating is in accordance with the EIA Regulations, promulgated in terms of Section 24 of the NEMA and the criteria drawn from the Integrated Environmental Management (EM) Guidelines Series, Guideline 5: Assessment of Alternatives and Impacts, published by the Department of Environmental Affairs (April 1998). The methodology and Criteria were also included in the Tender and Scoping document.

It is crucial to also identify, mitigation measures for each impact in order to determine the significance of the residual impacts (the impact remaining after the mitigation measure has been implemented).

Table 5: Criteria and rating Scales which were used in the Assessment of the Potential Impacts

CRITERIA	RATING SCALES	NOTES
Nature	Positive	An evaluation of the effect of the impact related to the proposed development.
	Negative	
Extent	Footprint	The impact only affects the area in which the proposed activity will occur.
	Site	The impact will affect only the developmentarea.
	Local	The impact affects the development area andadjacent properties.
	Regional	The effect of the impact extends beyondmunicipal boundaries.
	National	The effect of the impact extends beyond morethan 2 regional/ provincial boundaries.
	International	The effect of the impact extends beyond countryborders.
Duration	Temporary	The duration of the activity associated with theimpact will last 0-6 months.
	Short term	The duration of the activity associated with theimpact will last 6-18 months.

CRITERIA	RATING SCALES	NOTES
	Medium term	The duration of the activity associated with theimpact will last 18 months-5 years.
	Long term	The duration of the activity associated with theimpact will last more than 5 years.
Severity	High negative	The severity of the impact is rated as High negative as the natural, cultural or social functions and processes are altered to the extent that the natural process will temporarily or permanently cease; and valued, important, sensitive or vulnerable systems or communitiesare substantially affected.
	Moderate negative	The severity of the impact is rated as Moderate negative as the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive or vulnerable systems or communities are negatively affected
	Low negative	The severity of the impact is rated as Lownegative as the impact affects the environmentin such a way that natural, cultural and social functions and processes are minimally affected
	Low positive	The severity of the impact is rated as Lowpositive as the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally improved
	Moderate positive	The severity of the impact is rated as Moderate positive as the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive or vulnerable systems or communities are positively affected
	High positive	The severity of the impact is rated as High positive as the natural, cultural or social functions and processes are altered to the extent that valued, important, sensitive or vulnerable systems or communities aresubstantially positively affected.
Potential for impact on irreplaceableresources	No	No irreplaceable resources will be impacted.
	Yes	Irreplaceable resources will be impacted.
	Extremely detrimental	
	Highly detrimental	

CRITERIA	RATING SCALES	NOTES
Consequence	Moderately detrimental	A combination of extent, duration, intensity and the potential for impact on irreplaceable resources.
	Slightly detrimental	
	Negligible	
	Slightly beneficial	
	Moderately beneficial	
	Highly beneficial	
	Extremely beneficial	
Probability (the likelihood of the impact occurring)	Unlikely	It is highly unlikely or less than 50 % likely thatan impact will occur.
	Likely	It is between 50 and 75 % certain that theimpact will occur.
	Definite	It is more than 75 % certain that the impact will occur or it is definite that the impact will occur.
Significance	Very high - negative	A function of Consequence and Probability.
	High - negative	
	Moderate - negative	
	Low - negative	
	Very low	
	Low - positive	
	Moderate - positive	
	High - positive	
	Very high - positive	

Table 6: Explanation of Assessment Criteria

CRITERIA	EXPLANATION
Nature	This is an evaluation of the type of effect (change) the construction, operation and management of the proposed development would have on the affected environment. Will the impact change in the environment be positive, negative or neutral?

Extent or Scale	This refers to the spatial scale at which the impact will occur. Extent of the impact is described as: footprint (affecting only the footprint of the development), site (limited to the site) and regional (limited to the immediate surroundings and closest towns to the site). Extent or scale refers to the actual physical footprint of the impact, not to the spatial significance. It is acknowledged that some impacts, even though they may be of small extent, are of very high importance, e.g., impacts on species of very restricted range. In order to avoid "double counting, specialists have been requested to indicate spatial significance under "intensity" or "impact on irreplaceable resources" but not under "extent" as well.
Duration	The lifespan of the impact is indicated as temporary, short,medium and long term.
Severity	This is a relative evaluation within the context of all the activitiesand the other impacts within the framework of the project. Does the activity destroy the impacted environment, alter its functioning,or render it slightly altered?
Impact on irreplaceableresources	This refers to the potential for an environmental resource to be replaced, should it be impacted. A resource could possibly be replaced by natural processes (e.g., by natural colonization from surrounding areas), through artificial means (e.g., by reseeding disturbed areas or replanting rescued species) or by providing a substitute resource, in certain cases. In natural systems, providingsubstitute resources is usually not possible, but in social systemssubstitutes are often possible (e.g., by constructing new social facilities for those that are lost). Should it not be possible to replace a resource, the resource is essentially irreplaceable e.g., red data species that are restricted to a particular site or habitat ofvery limited extent.
Consequence	The consequence of the potential impacts is a summation of above criteria, namely the extent, duration, intensity and impact on irreplaceable resources.
Probability of occurrence	The probability of the impact occurring based on professional experience of the specialist with environments of a similar nature to the site and/or with similar projects. It is important to distinguish between the probability of the impact occurring and probability that the activity causing a potential impact will occur. Probability is defined as the probability of the impact occurring, not as the probability of the activities that may result in the impact.
Significance	Impact significance is defined to be a combination of the consequence (as described below) and probability of the impact occurring. The relationship between consequence and probability highlights that the risk (or impact significance) must be evaluatedin terms of the seriousness (consequence) of the impact, weighted by the probability of the impact occurring. In simple terms, if the consequence and probability of an impact is high, then the impact will have a high significance. The significance defines the level to which the impact will influence the proposed development and/or environment. It determines whether mitigation measures need to be identified and implemented and whether the impact is important for decision- making.

Degree of confidence inpredictions	Specialists and/or the EAP team were required to provide an indication of the degree of confidence (low, medium, or high) that there is in the predictions made for each impact, based on the available information and their level of knowledge and expertise. Degree of confidence is not considered in the determination of consequence or probability.
Mitigation measures	Mitigation measures are designed to reduce the consequence or probability of an impact, or to reduce both consequence and probability. The significance of impacts has been assessed both with mitigation and without mitigation.

Table 7: Impact Assessment Criteria and Rating Scales

Duration		Extent		Irreplaceable Resources		Severity		Consequence = (Duration + Extent + Irr) x Severity		Likelihood		Significance = Consequence * Likelihood		Confidence
1	Temporary	1	Footprint	1	Yes	-3	High - negative	-25 to -33	Extremely detrimental	1	Unlikely	-73 to -99	Very high - negative	Low
2	Short term	2	Site	0	No	-2	Moderate - negative	-19 to -24	Highly detrimental	2	Likely	-55 to -72	High - negative	Medium
3	Medium term	3	Local			-1	Low -negative	-13 to -18	Moderately detrimental	3	Definite	-37 to -54	Moderate - negative	High
4	Long term	4	Regional			0	Negligible	-7 to -12	Slightly detrimental			-19 to -36	Low - negative	
		5	National			1	Low -positive	0 to -6	Negligible			0 to -18	Very low - negative	
		6	International			2	Moderate - positive							
						3	High - positive	0 to 6	Negligible			0 to 18	Very Low - positive	
								7 to 12	Slightly beneficial			19 to 36	Low - positive	
								13 to 18	Moderately beneficial			37 to 54	Moderate - positive	
								19 to 24	Highly beneficial			55 to 72	High - positive	
								25 to 33	Extremely beneficial			73 to 99	Very high - positive	

6.2 Ascribing Significance for Decision-Making

The best way of expressing the environmental costs/impacts and the inherent benefit implications fordecision-making is to present them as risks. Risk is defined as the consequence (implication) of an event multiplied by the probability (likelihood)1 of that event. Many risks are accepted or tolerated daily because even if the consequence of the event is serious, the likelihood that the event will occuris low.

Various contingencies are provided to minimise the likelihood of the consequence (serious injury or death) in the event of the parachute not opening, such as a reserve parachute. In risk terms this means distinguishing between the inherent risk (the risk that a parachutist will die if the parachute does not open) and the residual risk (the risk that the parachutist will die if the parachute does not open but with the contingency of a reserve parachute) i.e., the risk before and after mitigation.

6.3 Consequence

The ascription of significance for decision-making becomes then relatively simple. It requires the consequences to be ranked and likelihood to be defined of that consequence. In **Table 8,** a scoring system for consequence ranking is shown. Two important features should be noted in the table, namely that the scoring doubles as the risk increases and that there is no equivalent 'high' score in respect of benefits as there is for the costs. This high negative score serves to give expression to thepotential for a fatal flaw where a fatal flaw would be defined as an impact that cannot be mitigated effectively and where the associated risk is accordingly untenable. Stated differently, the high scoreon the costs, which is not matched on the benefits side, highlights that such a fatal flaw cannot be 'traded off' by a benefit and would render the proposed project to be unacceptable.

Table 8: Ranking of Consequence

Environmental Cost	Inherent risk
Human health – morbidity / mortality, loss of species	High
Material reductions in faunal populations, loss of livelihoods, individualeconomic loss	Moderate – high
Material reductions in environmental quality – air, soil, water. Loss of habitat, loss of heritage and / or amenity	Moderate
Nuisance	Moderate – low
Negative change – with no other consequences	Low
Environmental Benefits	Inherent benefit
Net improvement in human welfare	Moderate – high
Improved environmental quality – air, soil, water. Improved individuallivelihoods	Moderate
Economic Development	Moderate – Low
Positive change – with no other consequences	Low

6.4 Likelihood

Although the principle is one of probability, the term 'likelihood' is used to give expression to a qualitative rather than quantitative assessment, because the term 'probability' tends to denote a mathematical/empirical expression. A set of likelihood descriptors that can be used to characterise the likelihood of the costs and benefits occurring, is presented in Table 9.

Table 9: Likelihood Categories and Definitions

Likelihood Descriptors	Definitions
Highly unlikely	The possibility of the consequence occurring is negligible
Unlikely but possible	The possibility of the consequence occurring is low but cannot bediscounted entirely
Likely	The consequence may not occur, but a balance of probability suggests it will.
Highly likely	The consequence may still not occur, but it is most likely that it will
Definite	The consequence will occur

It is very important to recognise that the likelihood question is asked twice. The first time the question is asked is the likelihood of the cause and the second as to the likelihood of the consequence. In the tables that follow the likelihood is presented of the cause and then the likelihood of the consequence is presented. A high likelihood of a cause does not necessarily translate into a high likelihood of the consequence. As such the likelihood of the consequence is not a mathematical or statistical 'average' of the causes but rather a qualitative estimate.

6.5 Residual Risk

The residual risk is then determined by the consequence and the likelihood of that consequence. The residual risk categories are shown in Table 10, where consequence scoring is shown in the rows and likelihood in the columns. The implications for decision-making of the different residual risk categories are shown in Table 11.

Table 10: Residual Risk Categories

		Residual risk				
Consequence	High	Moderate	High	High	Fatally flawed	
	Moderate –high	Low	Moderate	High	High	High
	Moderate	Low	Moderate	Moderate	Moderate	Moderate
	Moderate –low	Low	Low	Low	Low	Moderate
	Low	Low	Low	Low	Low	Low
		Highly unlikely	Unlikely but possible	Likely	Highly likely	Definite
		Likelihood				

Table 11: Implications for Decision-Making of the Different Residual Risk Categories

Rating	Nature of implication for Decision – Making
Low	Project can be authorized with low risk of environmental degradation
Moderate	Project can be authorized but with conditions and routine inspections
High	Project can be authorized but with strict conditions and high levels of complianceand enforcement
Fatally Flawed	The project cannot be authorized

6.6 Detailed Impact Assessment

All potential impacts associated with the activities have been categorised according to the respective phases (Rehabilitation and operational) during which they will occur. Impacts associated with each alternative has been outlined below and discussed in terms of their anticipated duration, extent, severity, probability and significance both prior and post mitigation measures being implemented. It is important to note that the Weirs have already been constructed, and the only proposed activity refers to the upgrading construction of the current infrastructure. No decommissioning assessment will form part of the assessment.

6.7 Construction Phase

Please refer below to some of the main impacts that may be experienced during construction.

Table 12: Construction Phase Impact Assessment for the Beestekraal Weir

WEIR REHABILITATION AND CONSTRUCTION – CONSTRUCTION AND MAINTENANCE.				
PROJECT PHASE	*Construction and Maintenance Phase.*			
DIRECT IMPACT	*Land Clearing activities such as clearing and grubbing of vegetation and topsoil. This can result in potential sedimentation and nutrient runoff.*			
INDIRECT IMPACT	*Suffocation of plant species within Critical Biodiversity Areas and Ecological Support Areas, as well as a decrease in water quality which could potentially affect surrounding ecosystems and residential areas.*			
CUMULATIVE IMPACT	***LOW***			
DIMENSION	**RATING**	**MOTIVATION**	**CONSEQUENCE**	**LIKELIHOOD**
PRE-MITIGATION				
DURATION	1	The duration of the activity associated with the impact is deemed not to last for more than 6 months and is therefore rated as Temporary.	- 3	2
EXTENT	2	The extent of the impact is rated as site as it will affect only the development area.		
SEVERITY	-1	The severity of the impact is rated as Low negative as the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected.	Negligible	Likely
IMPACT ON IRREPLACEBLE REOURCES	0	No irreplaceable resources will be impacted.		
SIGNIFICANCE	**- 6**	Very low negative		
PROPOSED MITIGATION MEASURES				

Reduce through controlling measures:

- *Appoint a responsible person, such as an environmental officer or safety, health & environmental manager, to ensure compliance with the EA / EMPr. This person should be responsible for the following:*
  - *ensure compliance with all legislative conditions;*
  - *implementation of all mitigation measures;*
  - *compilation and/or storage of relevant documents (such as maintenance checklists, complaints register, etc.). These documents should be readily available in the event of a site inspection;*
  - *submitting all required reports (e.g., annual report, etc.);*
  - *submitting a summary of complaints (monthly);*
  - *notifying the relevant Competent Authority when needed;*
- *Undertake/facilitate training for key personnel/contractors or staff to ensure compliance with the internal management plans and conditions.*

• *Conduct water quality monitoring and ensure that monitoring is undertaken in accordance with nationally or internationally acceptable methods.* • *Should an Environmental Management Programme (EMPr) be compiled for the proposed construction project as part of the EIA process, all recommendations and conditions contained within the EMPr must be implemented and complied with.*				
POST-MITIGATION				
DURATION	1	The duration of the activity associated with the impact will last up to 6 months and as such is rated as short term	*-3*	*2*
EXTENT	2	The extent of the impact is rated as footprint as it only affects the area in which the proposed activity will occur		
SEVERITY	-1	The severity of the impact is rated as Low negative as the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected.	*Negligible*	*Likely*
IMPACT ON IRREPLACEBLE REOURCES	0	No irreplaceable resources will be impacted.		
SIGNIFICANCE	0	Very low negative		
CONFIDENCE LEVEL				
LOW				

Table13: Construction Phase Impact Assessment for the Atlanta Weir

WEIR REHABILITATION AND CONSTRUCTION – CONSTRUCTION AND MAINTENANCE.				
PROJECT PHASE	*Construction and Maintenance Phase.*			
DIRECT IMPACT	*Land Clearing activities such as clearing and grubbing of vegetation and topsoil. This can result in potential sedimentation and nutrient runoff.*			
INDIRECT IMPACT	*Suffocation of plant species within Critical Biodiversity Areas and Ecological Support Areas, as well as a decrease in water quality which could potentially affect surrounding ecosystems and residential areas.*			
CUMULATIVE IMPACT	***LOW***			
DIMENSION	**RATING**	**MOTIVATION**	**CONSEQUENCE**	**LIKELIHOOD**
PRE-MITIGATION				
DURATION	1	The duration of the activity associated with the impact is deemed not to last for more than 6 months and is therefore rated as Temporary.	- 3	2
EXTENT	2	The extent of the impact is rated as site as it will affect only the development area.		
SEVERITY	-1	The severity of the impact is rated as Low negative as the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected.	Negligible	Likely
IMPACT ON IRREPLACEBLE REOURCES	0	No irreplaceable resources will be impacted.		
SIGNIFICANCE	**- 6**	Very low negative		
PROPOSED MITIGATION MEASURES				

Reduce through controlling measures:

- *Appoint a responsible person, such as an environmental officer or safety, health & environmental manager, to ensure compliance with the EA / EMPr. This person should be responsible for the following:*
  - *ensure compliance with all legislative conditions;*
  - *implementation of all mitigation measures;*
  - *compilation and/or storage of relevant documents (such as maintenance checklists, complaints register, etc.). These documents should be readily available in the event of a site inspection;*
  - *submitting all required reports (e.g., annual report, etc.);*
  - *submitting a summary of complaints (monthly);*
  - *notifying the relevant Competent Authority when needed;*
- *Undertake/facilitate training for key personnel/contractors or staff to ensure compliance with the internal management plans and conditions.*

- *Submit an application to the relevant Competent Authority, should any changes be required. The application should be submitted to the relevant licencing authority prior to the changes being made. Any changes to the following will require approval:*
    - *Production processes*
    - *Production increases*
    - *Ownership*
    - *Contact details*
    - *Type and quantities of input materials*
    - *Type and quantities of products*
    - *Production equipment*
    - *Treatment facilities*
    - *Building, plant, site layout or site works*
- *Conduct water quality monitoring and ensure that monitoring is undertaken in accordance with nationally or internationally acceptable methods.*
- *Maintain and report monthly to the Competent Authority a complaint register. Should a complaint be logged, a report, should be submitted to the authority.*
- *Should an Environmental Management Programme (EMPr) be compiled for the proposed construction project as part of the EIA process, all recommendations and conditions contained within the EMPr must be implemented and complied with.*

POST-MITIGATION				
DURATION	1	The duration of the activity associated with the impact will last up to 6 months and as such is rated as short term	*-3*	*2*
EXTENT	2	The extent of the impact is rated as footprint as it only affects the area in which the proposed activity will occur		
SEVERITY	-1	The severity of the impact is rated as Low negative as the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected.	*Negligible*	*Likely*
IMPACT ON IRREPLACEBLE REOURCES	0	No irreplaceable resources will be impacted.		
SIGNIFICANCE	0	Very low negative		

CONFIDENCE LEVEL
LOW

Table 14: Construction Phase Impact Assessment for the Paul Hugo Weir

WEIR REHABILITATION AND CONSTRUCTION – CONSTRUCTION AND MAINTENANCE.				
PROJECT PHASE	*Construction and Maintenance Phase.*			
DIRECT IMPACT	*Land Clearing activities such as clearing and grubbing of vegetation and topsoil. This can result in potential sedimentation and nutrient runoff.*			
INDIRECT IMPACT	*Suffocation of plant species within Critical Biodiversity Areas and Ecological Support Areas, as well as a decrease in water quality which could potentially affect surrounding ecosystems and residential areas.*			
CUMULATIVE IMPACT	***LOW***			
DIMENSION	**RATING**	**MOTIVATION**	**CONSEQUENCE**	**LIKELIHOOD**
PRE-MITIGATION				
DURATION	1	The duration of the activity associated with the impact is deemed not to last for more than 6 months and is therefore rated as Temporary.	- 3	2
EXTENT	2	The extent of the impact is rated as site as it will affect only the development area.		
SEVERITY	-1	The severity of the impact is rated as Low negative as the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected.	Negligible	Likely
IMPACT ON IRREPLACEBLE REOURCES	0	No irreplaceable resources will be impacted.		
SIGNIFICANCE	**- 6**	Very low negative		
PROPOSED MITIGATION MEASURES				

Reduce through controlling measures:

- *Appoint a responsible person, such as an environmental officer or safety, health & environmental manager, to ensure compliance with the EA / EMPr. This person should be responsible for the following:*
  - *ensure compliance with all legislative conditions;*
  - *implementation of all mitigation measures;*
  - *compilation and/or storage of relevant documents (such as maintenance checklists, complaints register, etc.). These documents should be readily available in the event of a site inspection;*
  - *submitting all required reports (e.g., annual report, etc.);*
  - *submitting a summary of complaints (monthly);*
  - *notifying the relevant Competent Authority when needed;*
- *Undertake/facilitate training for key personnel/contractors or staff to ensure compliance with the internal management plans and conditions.*

- *Submit an application to the relevant Competent Authority, should any changes be required. The application should be submitted to the relevant licencing authority prior to the changes being made. Any changes to the following will require approval:*
    - *Production processes*
    - *Production increases*
    - *Ownership*
    - *Contact details*
    - *Type and quantities of input materials*
    - *Type and quantities of products*
    - *Production equipment*
    - *Treatment facilities*
    - *Building, plant, site layout or site works*
- *Conduct water quality monitoring and ensure that monitoring is undertaken in accordance with nationally or internationally acceptable methods.*
- *Maintain and report monthly to the Competent Authority a complaint register. Should a complaint be logged, a report, should be submitted to the authority.*
- *Should an Environmental Management Programme (EMPr) be compiled for the proposed construction project as part of the EIA process, all recommendations and conditions contained within the EMPr must be implemented and complied with.*

POST-MITIGATION				
DURATION	1	The duration of the activity associated with the impact will last up to 6 months and as such is rated as short term	*-3*	*2*
EXTENT	2	The extent of the impact is rated as footprint as it only affects the area in which the proposed activity will occur		
SEVERITY	-1	The severity of the impact is rated as Low negative as the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected.	*Negligible*	*Likely*
IMPACT ON IRREPLACEBLE REOURCES	0	No irreplaceable resources will be impacted.		
SIGNIFICANCE	0	Very low negative		

CONFIDENCE LEVEL
LOW

7. MITIGATION PROGRAMME

Potential Impact	Mitigation measure
Sedimentation and Erosion - Soil disturbance during rehabilitation construction can lead to increased sedimentation and erosion	• Implement erosion control measures such as silt fences, sediment basins, and erosion control blankets. • Stabilize exposed soil areas with vegetation. • Schedule construction activities to minimize soil exposure.
Water Quality Changes - Runoff from construction sites can introduce pollutants into the river	• Use best management practices (BMPs) for stormwater management. • Install sedimentation basins and treatment devices to capture and treat runoff. • Limit the use of harmful chemicals and implement spill prevention measures
Habitat Disturbance – Rehabilitation construction activities can disrupt habitats for flora and fauna	• Conduct thorough ecological assessments before construction. • Implement buffer zones to protect sensitive habitats. • Replant native vegetation in disturbed areas post-construction.
Alteration of Flow Regime - Changes in river flow patterns can impact aquatic ecosystems	• Monitor and adjust flow regimes during and after rehabilitation construction.
Runoff and Stormwater Management - Increased impervious surfaces can lead to elevated runoff	• Design stormwater management systems to reduce runoff. • Incorporate permeable surfaces and green infrastructure.
Waste Management - Improper handling of construction waste can lead to pollution	• Implement waste management plans to reduce, reuse, and recycle materials. • Dispose of waste according to regulations.
Water Quality – Water quality may decrease due to activities associated with the rehabilitation construction phase	• Conduct a surface water quality monitoring program

8. WATER QUALITY MONITORING

The monitoring comprises of nine (9) surface water monitoring points three (3) gauging weirs In the Crocodile (west) River.

Table 15: Monitoring Resources and Sampling Frequencies

Description	Locality Count	Monitoring Frequency
Surface Water Monitoring Localities along the pipeline route: • Beestekraal Weir	9	Monthly

• Atlanta Weir • Paul Hugo Weir		

The identified monitoring localities and descriptions are summarised within the table below. The localities are proposed in order to determine baseline water quality as well as to identify potential downstream water quality impacts. Upstream and downstream monitoring localities have been identified in terms of the relevant water resources present to determine associated influences related to the proposed development as well as to identify external influencing factors. The monitoring localities depicted in table 16 below, were deemed adequate to monitor and determine the potential impact of the proposed activity on the sensitive receptors identified in table 4, section 5.

Table 16: Monitoring Localities

Locality ID	DESCRIPTION	X Co-ordinate	Y-Co-ordinate
BSW-US	Beestekraal Weir Upstream	-25,4037	27,57517
BSW-MS	Beestekraal Weir Midstream	-25,4027	27,57482
BSW-DS	Beestekraal Weir Downstream	-25,3991	27,57369
ATL-US	Atlanta Weir Upstream	-25,2066	27,55779
ATL -MS	Atlanta Weir Midstream	-25,2057	27,5576
ATL -DS	Atlanta Weir Downstream	-25,2049	27,55754
PHW-US	Paul Hugo Weir Upstream	-24,6957	27,40873
PHW -MS	Paul Hugo Weir Midstream	-24,6943	27,40934
PHW -DS	Paul Hugo Weir Downstream	-24,6921	27,41032

Figures 2, 3 and 4 below illustrates the proposed monitoring localities as part of the mitigation and impact assessment monitoring programme.

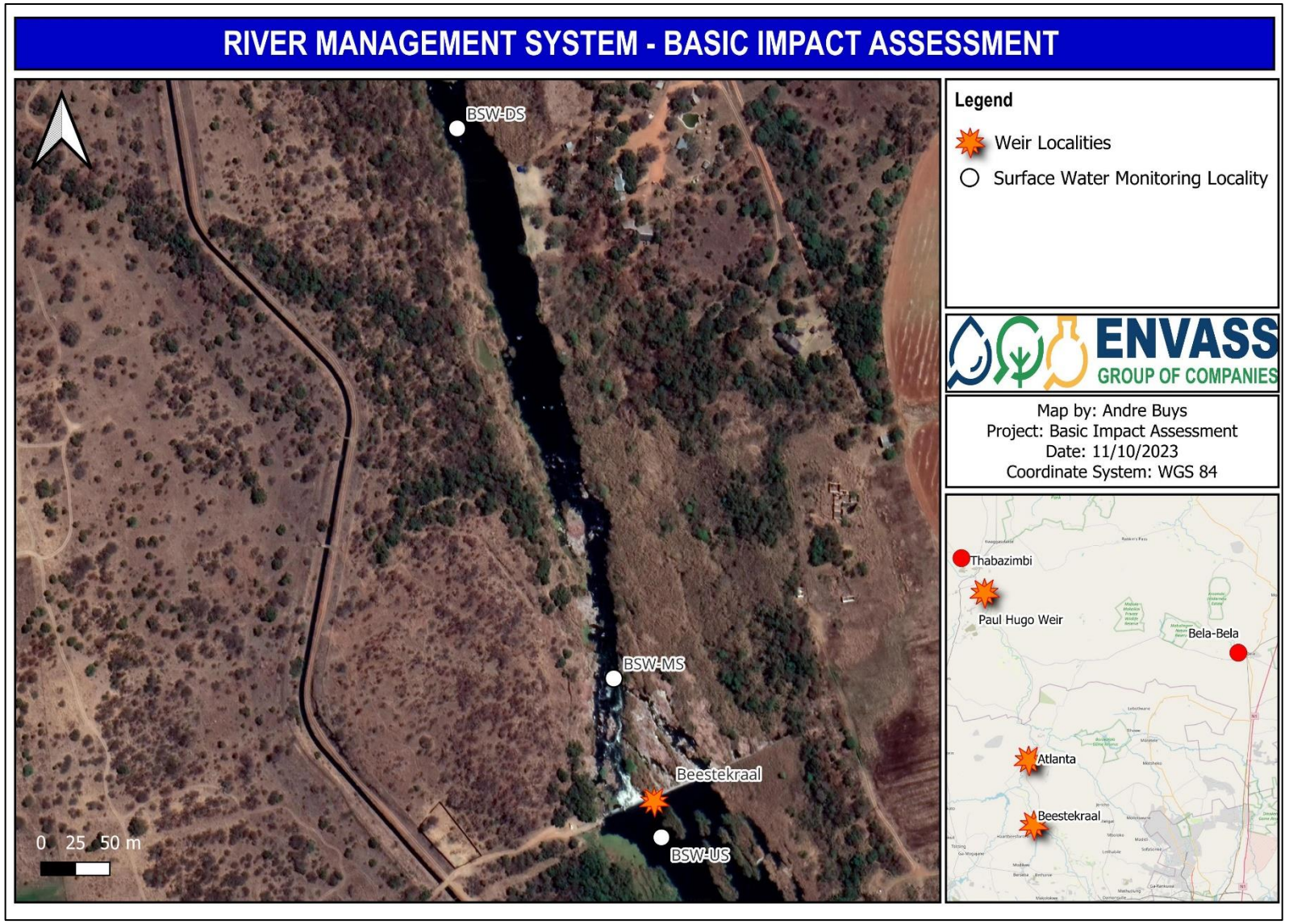

Figure 2: Beestekraal Monitoring Localities

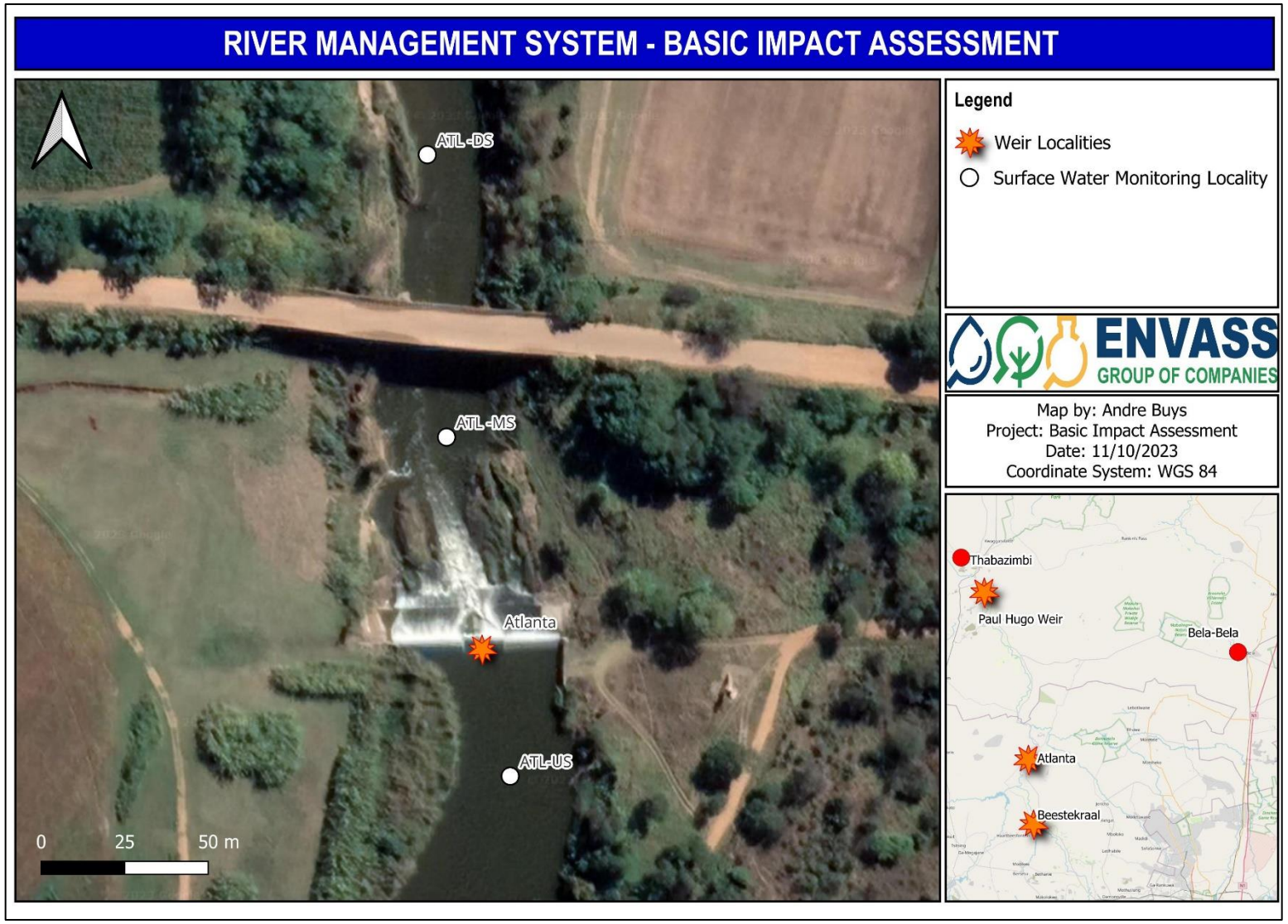

Figure 3: Atlanta Monitoring Localities

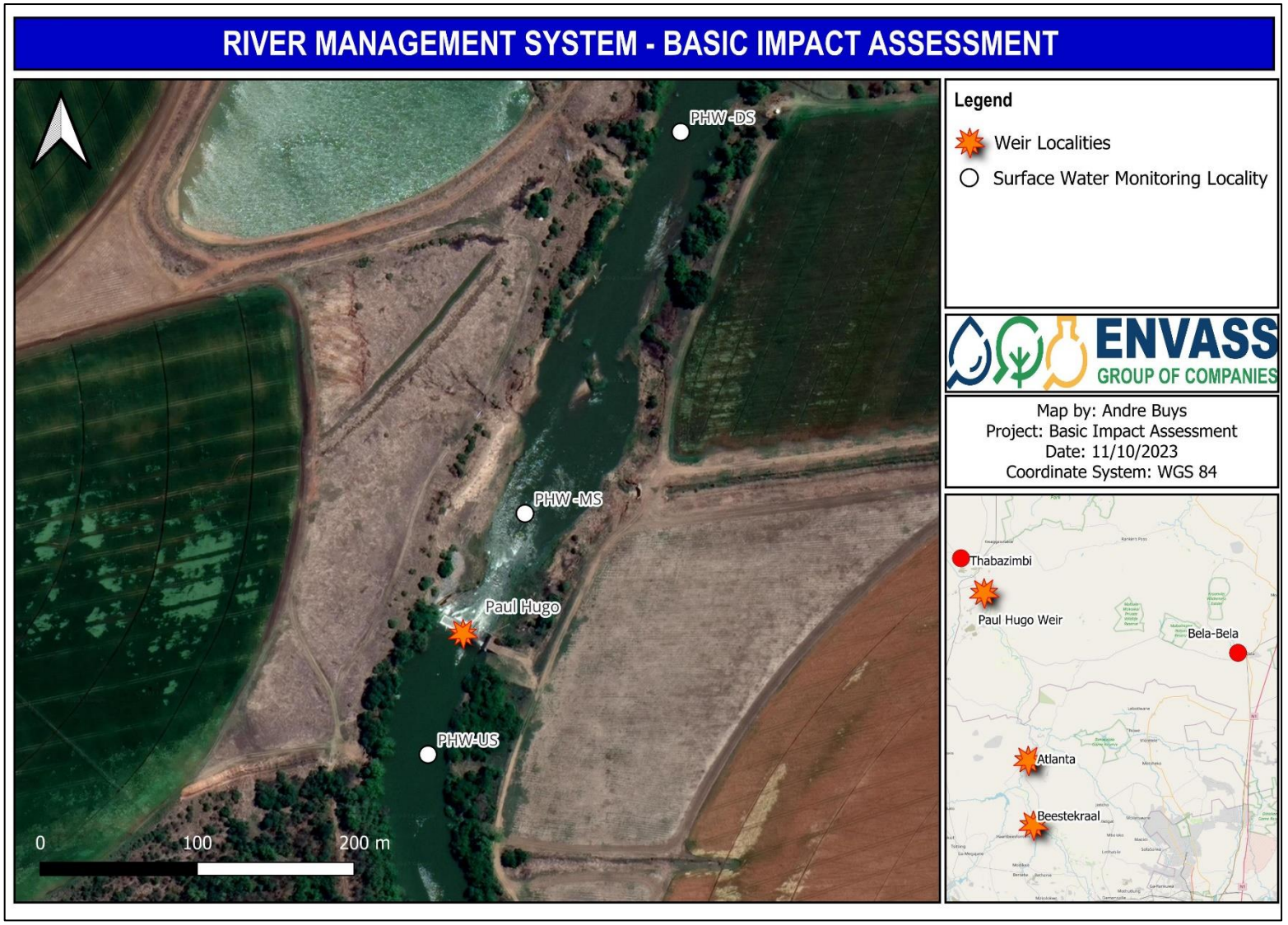

Figure 4: Paul Hugo Monitoring Localities

The following package of variables forms part of the monitoring requirements related to the MCWAP-2 project:

Table 17: Water quality parameters for the Phase 2 Mokolo Crocodile Water Augmentation Project

MCWAP-2 Analysis Package Details	
Analysis Parameter	**Monthly Surface Water Analysis Package (Abstraction, Final Water & Handover Point)**
pH	X
Temperature (ºC)	X
Electrical Conductivity (EC) at 25ºC (mS/m)	X
Total Dissolved Solids (TDS) (mg/l)	X
Total Suspended Solids (TSS) (mg/l)	X
Dissolved Oxygen (DO) (mg/l)	X
Chemical Oxygen Demand (COD) (mg/l)	X
Turbidity (NTU)	X
Aluminium as Al (mg/l)	X
Ammonia as N (mg/l)	X
Cadmium as Cd (mg/l)	X
Calcium as Ca (mg/l)	X
Chloride as Cl (mg/l)	X
Chromium as Cr (mg/l)	X
Copper as Cu (mg/l)	X
Cyanide as CN (mg/l)	X
Fluoride as F (mg/l)	X
Iron as Fe (mg/l)	X
Lead as Pb (mg/l)	X
Manganese as Mn (mg/l)	X
Mercury as Hg (mg/l)	X
Nitrate & Nitrite as N (mg/l)	X
Ortho-phosphate as P(mg/l)	X
Sodium as Na (mg/l)	X
Sodium Absorption Rate (SAR) (mg/l)	X
Soap, Oil and Grease (mg/l)	X
Zinc as Zn (mg/l)	X
Escherichia coli (E.coli) (CFU/100ml)	X
Faecal Coliforms (CFU/100ml))	X

9. WATER QUALITY RESULTS

9.1. MONTHLY SAMPLING REGISTER

Table 16 below illustrates the October 2023 sampling register as recorded by ENVASS during the Impact Assessment.

Table 18: October 2023 Monthly Surface Water Sampling Register

GBN-JV & TCTA Surface Water Monitoring								
Locality ID	Description	Co-ordinates		Sampler Name	Sampling Date	Sampling Time	Collection Method	Comments
		Latitude	Longitude					
Sandloop								
BSW-US	Beestekraal Weir Downstream	25°24'19.18"S	27°34'34.70"E	Deon Fourie	12/10/2023	10:30	Grab Sample	
BSW-MS	Beestekraal Weir Midstream	25°24'13.16"S	27°34'29.12"E		12/10/2023	10:35	Grab Sample	
BSW-DS	Beestekraal Weir Upstream	25°23'57.01"S	27°34'24.75"E		12/10/2023	10:45	Grab Sample	
ATL-US	Atlanta Weir Downstream	25°12'31.82"S	27°33'16.49"E		12/10/2023	11:20	Grab Sample	
ATL -MS	Atlanta Weir Midstream	25°12'22.96"S	27°33'28.52"E		12/10/2023	11:25	Grab Sample	
ATL -DS	Atlanta Weir Upstream	25°11'49.37"S	27°33'35.63"		12/10/2023	11:35	Grab Sample	
PHW-US	Paul Hugo Weir Downstream	24°42'8.79"S	27°24'36.81"E		12/10/2023	13:30	Grab Sample	
PHW -MS	Paul Hugo Weir Midstream	24°41'42.61"S	27°24'32.90"E		12/10/2023	13:37	Grab Sample	
PHW -DS	Paul Hugo Weir Upstream	24°41'19.16"S	27°24'40.40"E		12/10/2023	13:48	Grab Sample	

9.2. SURFACE WATER QUALITY RESULTS

Table 19: Receiving Environment Water Sample Results

Crocodile River - Beestekraal Weir								
Locality		BSW US		Domestic	Stock Watering	Irrigation	Recreation	Ecosystems
Date		12-Oct-23	Median					
Variable	Unit							
pH		7,89	7,89					
Electrical Conductivity (EC) at 25ºC	mS/m	69,8	69,80					
Total Dissolved Solids (TDS)	mg/l	434	433,65					
Total Suspended Solids (TSS)	mg/l	39	39,00					
Dissolved Oxygen (DO)	mg/l	7,77	7,77					
Chemical Oxygen Demand (COD)	mg/l	48	48,00					
Turbidity	NTU	2,53	2,53					
Ammonia as N	mg/l	<0.007	-					
Nitrate & Nitrite as N	mg/l	2,00	0,00					
Calcium as Ca	mg/l	46,522	46,52					
Chloride as Cl	mg/l	79,50	79,50					
Sodium as Na	mg/l	34,037	34,04					
Fluoride as F	mg/l	<0.016	-					
Orthophosphate as P	mg/l	<0.032	0,00					
Aluminium as Al	mg/l	0,012	0,01					
Cadmium as Cd	mg/l	<0.005	0,00					
Chromium as Cr	mg/l	<0.008	-					
Copper as Cu	mg/l	<0.008	-					
Cyanide as CN	mg/l	<0.001	0,00					
Iron as Fe	mg/l	0,014	0,01					
Lead as Pb	mg/l	<0.010	0,00					
Manganese as Mn	mg/l	0,033	0,03					
Mercury as Hg	mg/l	<0.001	0,00					
Zinc as Zn	mg/l	<0.010	0,00					
Sodium Absorption Rate (SAR)	mg/l	2,08	2,08					
Soap, Oil and Grease	mg/l	<1	-					
Escherichia coli (E.coli)	(CFU/100ml)	6	6,00					
Faecal Coliforms (CFU/100ml)	(CFU/100ml)	8	8,00					

Legend
Ideal
Acceptable
Tolerable
Unacceptable
Totally Unfit

Crocodile River - Beestekraal Weir								
Locality		BSW MS		Domestic	Stock Watering	Irrigation	Recreation	Ecosystems
Date		12-Oct-23	Median					
Variable	Unit							
pH		7,99	7,99					
Electrical Conductivity (EC) at 25ºC	mS/m	69,6	69,60					
Total Dissolved Solids (TDS)	mg/l	438	437,97					
Total Suspended Solids (TSS)	mg/l	17	17,00					
Dissolved Oxygen (DO)	mg/l	7,54	7,54					
Chemical Oxygen Demand (COD)	mg/l	44	44,00					
Turbidity	NTU	2,17	2,17					
Ammonia as N	mg/l	<0.007	-					
Nitrate & Nitrite as N	mg/l	2,18	0,00					
Calcium as Ca	mg/l	47,187	47,19					
Chloride as Cl	mg/l	80,80	80,80					
Sodium as Na	mg/l	34,644	34,64					
Fluoride as F	mg/l	<0.016	-					
Orthophosphate as P	mg/l	<0.032	0,00					
Aluminium as Al	mg/l	0,012	0,01					
Cadmium as Cd	mg/l	<0.005	0,000					
Chromium as Cr	mg/l	<0.008	-					
Copper as Cu	mg/l	<0.008	-					
Cyanide as CN	mg/l	<0.001	0,00					
Iron as Fe	mg/l	0,013	0,01					
Lead as Pb	mg/l	<0.010	0,00					
Manganese as Mn	mg/l	0,041	0,04					
Mercury as Hg	mg/l	<0.001	0,000					
Zinc as Zn	mg/l	<0.010	0,00					
Sodium Absorption Rate (SAR)	mg/l	2,10	2,10					
Soap, Oil and Grease	mg/l	<1						
Escherichia coli (E.coli)	(CFU/100ml)	0	0,00					
Faecal Coliforms (CFU/100ml)	(CFU/100ml)	0	0,00					

Legend	
Ideal	
Acceptable	
Tolerable	
Unacceptable	

Crocodile River - Beestekraal Weir								
	Locality	BSW DS		Domestic	Stock Watering	Irrigation	Recreation	Ecosystems
	Date	12-Oct-23	Median					
Variable	Unit							
pH		7,99	7,99					
Electrical Conductivity (EC) at 25ºC	mS/m	69,5	69,50					
Total Dissolved Solids (TDS)	mg/l	436	435,63					
Total Suspended Solids (TSS)	mg/l	18	18,00					
Dissolved Oxygen (DO)	mg/l	7,41	7,41					
Chemical Oxygen Demand (COD)	mg/l	45	45,00					
Turbidity	NTU	2,69	2,69					
Ammonia as N	mg/l	<0.007	0,00					
Nitrate & Nitrite as N	mg/l	2,30	0,00					
Calcium as Ca	mg/l	46,741	46,74					
Chloride as Cl	mg/l	81,60	81,60					
Sodium as Na	mg/l	34,073	34,07					
Fluoride as F	mg/l	<0.016	-					
Orthophosphate as P	mg/l	<0.032	0,00					
Aluminium as Al	mg/l	0,023	0,02					
Cadmium as Cd	mg/l	<0.005	0,00					
Chromium as Cr	mg/l	<0.008	0,00					
Copper as Cu	mg/l	<0.008	-					
Cyanide as CN	mg/l	<0.001	0,00					
Iron as Fe	mg/l	0,021	0,02					
Lead as Pb	mg/l	<0.010	0,00					
Manganese as Mn	mg/l	0,051	0,05					
Mercury as Hg	mg/l	<0.001	0,00					
Zinc as Zn	mg/l	<0.010	0,00					
Sodium Absorption Rate (SAR)	mg/l	2,08	2,08					
Soap, Oil and Grease	mg/l	<1	-					
Escherichia coli (E.coli)	(CFU/100ml)	7	7,00					
Faecal Coliforms (CFU/100ml)	(CFU/100ml)	9	9,00					

Legend
Ideal
Acceptable
Tolerable
Unacceptable
Totally Unfit

Crocodile River - Atlanta Weir								
Locality		ATL US		Domestic	Stock Watering	Irrigation	Recreation	Ecosystems
Date		12-Oct-23	Median					
Variable	Unit							
pH		7,89	7,89					
Electrical Conductivity (EC) at 25ºC	mS/m	76,5	76,50					
Total Dissolved Solids (TDS)	mg/l	490	490,43					
Total Suspended Solids (TSS)	mg/l	156	156,00					
Dissolved Oxygen (DO)	mg/l	7,51	7,51					
Chemical Oxygen Demand (COD)	mg/l	35	35,00					
Turbidity	NTU	4,76	4,76					
Ammonia as N	mg/l	<0.007	0,00					
Nitrate & Nitrite as N	mg/l	2,09	2,09					
Calcium as Ca	mg/l	49,908	49,91					
Chloride as Cl	mg/l	86,00	86,00					
Sodium as Na	mg/l	39,444	39,44					
Fluoride as F	mg/l	<0.016	-					
Orthophosphate as P	mg/l	<0.032	-					
Aluminium as Al	mg/l	0,024	0,02					
Cadmium as Cd	mg/l	<0.005	0,00					
Chromium as Cr	mg/l	<0.008	-					
Copper as Cu	mg/l	<0.008	-					
Cyanide as CN	mg/l	<0.001	0,00					
Iron as Fe	mg/l	0,028	0,03					
Lead as Pb	mg/l	<0.010	0,00					
Manganese as Mn	mg/l	0,032	0,03					
Mercury as Hg	mg/l	<0.001	-					
Zinc as Zn	mg/l	<0.010	0,00					
Sodium Absorption Rate (SAR)	mg/l	2,32	2,32					
Soap, Oil and Grease	mg/l	<1	-					
Escherichia coli (E.coli)	(CFU/100ml)	26	26,00					
Faecal Coliforms (CFU/100ml)	(CFU/100ml)	33	33,00					

Legend
Ideal
Acceptable
Tolerable
Unacceptable
Totally Unfit

Crocodile River - Atlanta Weir								
Locality		ATL MS		Domestic	Stock Watering	Irrigation	Recreation	Ecosystems
Date		12-Oct-23	Median					
Variable	Unit							
pH		7,94	7,94					
Electrical Conductivity (EC) at 25ºC	mS/m	35,8	35,80					
Total Dissolved Solids (TDS)	mg/l	346	346,05					
Total Suspended Solids (TSS)	mg/l	17	16,50					
Dissolved Oxygen (DO)	mg/l	7,43	7,43					
Chemical Oxygen Demand (COD)	mg/l	40	40,00					
Turbidity	NTU	2,94	2,94					
Ammonia as N	mg/l	<0.007	0,00					
Nitrate & Nitrite as N	mg/l	1,80	0,00					
Calcium as Ca	mg/l	50,057	50,06					
Chloride as Cl	mg/l	86,40	86,40					
Sodium as Na	mg/l	39,901	39,90					
Fluoride as F	mg/l	<0.016						
Orthophosphate as P	mg/l	<0.032						
Aluminium as Al	mg/l	0,023	0,02					
Cadmium as Cd	mg/l	<0.005	0,00					
Chromium as Cr	mg/l	<0.008						
Copper as Cu	mg/l	<0.008	0,00					
Cyanide as CN	mg/l	<0.001	0,00					
Iron as Fe	mg/l	0,029	0,03					
Lead as Pb	mg/l	<0.010	0,00					
Manganese as Mn	mg/l	0,035	0,04					
Mercury as Hg	mg/l	<0.001	0,00					
Zinc as Zn	mg/l	<0.010	0,00					
Sodium Absorption Rate (SAR)	mg/l	2,34	2,34					
Soap, Oil and Grease	mg/l	<1						
Escherichia coli (E.coli)	(CFU/100ml)	17	17,00					
Faecal Coliforms (CFU/100ml)	(CFU/100ml)	23	23,00					

Legend
Ideal
Acceptable
Tolerable
Unacceptable
Totally Unfit

Crocodile River - Atlanta Weir								
Locality		ATL DS		Domestic	Stock Watering	Irrigation	Recreation	Ecosystems
Date		12-Oct-23	Median					
Variable	Unit							
pH		8,00	8,00					
Electrical Conductivity (EC) at 25ºC	mS/m	76,0	76,00					
Total Dissolved Solids (TDS)	mg/l	483	482,73					
Total Suspended Solids (TSS)	mg/l	193	192,50					
Dissolved Oxygen (DO)	mg/l	8,31	8,31					
Chemical Oxygen Demand (COD)	mg/l	29	29,00					
Turbidity	NTU	4,68	4,68					
Ammonia as N	mg/l	<0.007						
Nitrate & Nitrite as N	mg/l	1,82	1,82					
Calcium as Ca	mg/l	48,590	48,59					
Chloride as Cl	mg/l	86,10	86,10					
Sodium as Na	mg/l	39,221	39,22					
Fluoride as F	mg/l	<0.016						
Orthophosphate as P	mg/l	<0.032						
Aluminium as Al	mg/l	0,054	0,05					
Cadmium as Cd	mg/l	<0.005	0,00					
Chromium as Cr	mg/l	<0.008						
Copper as Cu	mg/l	<0.008	0,00					
Cyanide as CN	mg/l	<0.001	0,00					
Iron as Fe	mg/l	0,054	0,05					
Lead as Pb	mg/l	<0.010	0,00					
Manganese as Mn	mg/l	0,022	0,02					
Mercury as Hg	mg/l	<0.001	0,00					
Zinc as Zn	mg/l	<0.010	0,00					
Sodium Absorption Rate (SAR)	mg/l	2,32	2,32					
Soap, Oil and Grease	mg/l	<1						
Escherichia coli (E.coli)	(CFU/100ml)	1	1,00					
Faecal Coliforms (CFU/100ml)	(CFU/100ml)	3	3,00					

Legend
Ideal
Acceptable
Tolerable
Unacceptable
Totally Unfit

Crocodile River - Paul Hugo Weir								
Locality		PHW US		Domestic	Stock Watering	Irrigation	Recreation	Ecosystems
Date		12-Oct-23	Median					
Variable	Unit							
pH		8,30	8,30					
Electrical Conductivity (EC) at 25ºC	mS/m	96,1	96,10					
Total Dissolved Solids (TDS)	mg/l	592	592,07					
Total Suspended Solids (TSS)	mg/l	303	302,50					
Dissolved Oxygen (DO)	mg/l	7,59	7,59					
Chemical Oxygen Demand (COD)	mg/l	36	36,00					
Turbidity	NTU	13,00	13,00					
Ammonia as N	mg/l	<0.007	0,00					
Nitrate & Nitrite as N	mg/l	2,23	2,23					
Calcium as Ca	mg/l	56,311	56,31					
Chloride as Cl	mg/l	136,80	136,80					
Sodium as Na	mg/l	57,911	57,91					
Fluoride as F	mg/l	<0.016	0,00					
Orthophosphate as P	mg/l	<0.032	0,00					
Aluminium as Al	mg/l	0,075	0,08					
Cadmium as Cd	mg/l	<0.005	0,00					
Chromium as Cr	mg/l	<0.008	0,00					
Copper as Cu	mg/l	<0.008	0,00					
Cyanide as CN	mg/l	<0.001	0,00					
Iron as Fe	mg/l	0,066	0,07					
Lead as Pb	mg/l	<0.010	0,00					
Manganese as Mn	mg/l	0,029	0,03					
Mercury as Hg	mg/l	<0.001	0,00					
Zinc as Zn	mg/l	<0.010	0,00					
Sodium Absorption Rate (SAR)	mg/l	3,16	3,16					
Soap, Oil and Grease	mg/l	<1						
Escherichia coli (E.coli)	(CFU/100ml)	4	4,00					
Faecal Coliforms (CFU/100ml)	(CFU/100ml)	6	6,00					

Legend
Ideal
Acceptable
Tolerable
Unacceptable
Totally Unfit

Crocodile River - Paul Hugo Weir								
Locality		PHW MS		Domestic	Stock Watering	Irrigation	Recreation	Ecosystems
Date		12-Oct-23	Median					
Variable	Unit							
pH		8,29	8,29					
Electrical Conductivity (EC) at 25ºC	mS/m	96,2	96,20					
Total Dissolved Solids (TDS)	mg/l	602	602,41					
Total Suspended Solids (TSS)	mg/l	64	64,00					
Dissolved Oxygen (DO)	mg/l	7,38	7,38					
Chemical Oxygen Demand (COD)	mg/l	31	31,00					
Turbidity	NTU	9,55	9,55					
Ammonia as N	mg/l	<0.007	0,00					
Nitrate & Nitrite as N	mg/l	2,39	2,39					
Calcium as Ca	mg/l	56,631	56,63					
Chloride as Cl	mg/l	135,10	135,10					
Sodium as Na	mg/l	58,085	58,09					
Fluoride as F	mg/l	<0.016	0,00					
Orthophosphate as P	mg/l	<0.032	0,00					
Aluminium as Al	mg/l	0,101	0,10					
Cadmium as Cd	mg/l	<0.005	0,00					
Chromium as Cr	mg/l	<0.008	0,00					
Copper as Cu	mg/l	<0.008	0,00					
Cyanide as CN	mg/l	<0.001	0,00					
Iron as Fe	mg/l	0,089	0,09					
Lead as Pb	mg/l	<0.010	0,00					
Manganese as Mn	mg/l	0,042	0,00					
Mercury as Hg	mg/l	<0.001	0,00					
Zinc as Zn	mg/l	<0.010	0,00					
Sodium Absorption Rate (SAR)	mg/l	3,15	3,15					
Soap, Oil and Grease	mg/l	<1						
Escherichia coli (E.coli)	(CFU/100ml)	8	8,00					
Faecal Coliforms (CFU/100ml)	(CFU/100ml)	11	11,00					

Legend
Ideal
Acceptable
Tolerable
Unacceptable
Totally Unfit

Crocodile River - Paul Hugo Weir								
Locality		PHW DS		Domestic	Stock Watering	Irrigation	Recreation	Ecosystems
Date		12-Oct-23	Median					
Variable	Unit							
pH		8,53	8,53					
Electrical Conductivity (EC) at 25ºC	mS/m	95,3	95,30					
Total Dissolved Solids (TDS)	mg/l	609	609,35					
Total Suspended Solids (TSS)	mg/l	174	173,50					
Dissolved Oxygen (DO)	mg/l	7,58	7,58					
Chemical Oxygen Demand (COD)	mg/l	37	37,00					
Turbidity	NTU	31,00	31,00					
Ammonia as N	mg/l	<0.007	0,00					
Nitrate & Nitrite as N	mg/l	1,59	1,59					
Calcium as Ca	mg/l	60,713	60,71					
Chloride as Cl	mg/l	135,80	135,80					
Sodium as Na	mg/l	60,650	60,65					
Fluoride as F	mg/l	<0.016	0,00					
Orthophosphate as P	mg/l	<0.032	0,00					
Aluminium as Al	mg/l	0,197	0,20					
Cadmium as Cd	mg/l	<0.005	0,00					
Chromium as Cr	mg/l	<0.008	0,00					
Copper as Cu	mg/l	<0.008	0,00					
Cyanide as CN	mg/l	<0.001	0,00					
Iron as Fe	mg/l	0,175	0,18					
Lead as Pb	mg/l	<0.010	0,00					
Manganese as Mn	mg/l	0,038	0,00					
Mercury as Hg	mg/l	<0.001	0,00					
Zinc as Zn	mg/l	<0.010	0,00					
Sodium Absorption Rate (SAR)	mg/l	3,19	3,19					
Soap, Oil and Grease	mg/l	<1						
Escherichia coli (E.coli)	(CFU/100ml)	2	2,00					
Faecal Coliforms (CFU/100ml)	(CFU/100ml)	5	5,00					

Legend
Ideal
Acceptable
Tolerable
Unacceptable
Totally Unfit

10. WATER QUALITY DISCUSSION

It was of the specialist's opinion to include baseline water quality results to adequately assess the impact of the proposed activities, therefore this section highlights the water quality as obtained during the initial site visit during the October 2023 sit visit. The aim of this section is to support the possible impacts identified based on the proposed activities and to support the impact assessment done. Additionally, the results are discussed below:

For ease of reference to the relevant sections below, the Freshwater Ecosystem Priority Area (FEPA) River Condition (RIVCON) classification description is described below:

- Class A: Unmodified and natural;
- Class B: Largely natural with few modifications;
- Class C: Moderately modified;
- Class D: Largely Modified;
- Class E: Seriously Modified;
- Class F: Critically / Extremely modified.

10.1. CROCODILE RIVER

The Crocodile River Catchment is estimated at a total area of 29 400 km^2 and is a significant tributary of the Limpopo River. The Crocodile River is considered one of the most pressured systems where water quality is influenced through industrial, mining and agricultural impacts. At present, the river falls within Class C (Moderately modified) (Nel *et al.*, 2011). Generally, similar variable exceedances and concentration levels were present throughout the monitoring localities.

Nine (9) monitoring localities form part of the watercourse:

Beestekraal Weir

- BSW US - Beestekraal Weir Upstream Locality;
- BSW MS - Beestekraal Weir Midstream Locality;
- BSW DS - Beestekraal Weir Downstream Locality;

All three localities presented with similar results during the during the monitoring period. During the October 2023 monitoring period, the following median concentration exceedances were recorded based on levels above the Acceptable Range:

- BSW US:
    - SAWQG Volume 1: Domestic: *E.coli* and Faecal Coliforms;
    - SAWQG Volume 2: Recreational: Turbidity;
    - SAWQG Volume 4: Irrigation: Total Dissolved Solids;

    - PSAWQG Volume 5: Stock Watering: No exceedances; and
    - SAWQG Volume 7: Aquatic Ecosystems: Aluminium (Al).

- BSW MS:
    - SAWQG Volume 1: Domestic: No Exceedances;
    - SAWQG Volume 2: Recreational: Turbidity;
    - SAWQG Volume 4: Irrigation: Total Dissolved Solids;
    - PSAWQG Volume 5: Stock Watering: No Exceedances; and
    - SAWQG Volume 7: Aquatic Ecosystems: Aluminium (Al).
- BSW DS:
    - SAWQG Volume 1: Domestic: *E.coli* and Faecal Coliforms;
    - SAWQG Volume 2: Recreational: Turbidity;
    - SAWQG Volume 4: Irrigation: Total Dissolved Solids;
    - PSAWQG Volume 5: Stock Watering: No Exceedances; and
    - SAWQG Volume 7: Aquatic Ecosystems: Aluminium (Al).

The remaining tested parameters presented ideal for the monitoring period.

Atlanta Weir

- ATL US - Atlanta Weir Upstream Locality;
- ATL MS - Atlanta Weir Midstream Locality;
- ATL DS - Atlanta Weir Downstream Locality;

All three localities presented similar results during the during the monitoring period. Exceedances of the SAWQG Volume 7: Aquatic Ecosystems are as follows:

- ATL US:
    - SAWQG Volume 1: Domestic: *E.coli* and Faecal Coliforms;
    - SAWQG Volume 2: Recreational: Turbidity;
    - SAWQG Volume 4: Irrigation: Total Dissolved Solids and Total Suspended Solids;
    - PSAWQG Volume 5: Stock Watering: No Exceedances; and
    - SAWQG Volume 7: Aquatic Ecosystems: Aluminium (Al).
- ATL MS:
    - SAWQG Volume 1: Domestic: *E.coli* and Faecal Coliforms;
    - SAWQG Volume 2: Recreational: Turbidity;
    - SAWQG Volume 4: Irrigation: Total Dissolved Solids;

    - PSAWQG Volume 5: Stock Watering: No Exceedances; and
    - SAWQG Volume 7: Aquatic Ecosystems: Aluminium (Al).
- ATL DS:
    - SAWQG Volume 1: Domestic: *E.coli* and Faecal Coliforms;
    - SAWQG Volume 2: Recreational: Turbidity;
    - SAWQG Volume 4: Irrigation: Total Dissolved Solids;
    - PSAWQG Volume 5: Stock Watering: No Exceedances; and
    - SAWQG Volume 7: Aquatic Ecosystems: Aluminium (Al).

The remaining tested parameters presented ideal for the monitoring period.

Paul Hugo Weir

- PHW US – Paul Hugo Weir Upstream Locality;
- PHW MS - Paul Hugo Weir Midstream Locality;
- PHW DS - Paul Hugo Weir Downstream Locality;

All three localities presented similar results during the during the monitoring period. Exceedances of the SAWQG Volume 7: Aquatic Ecosystems are as follows:

- PHW US:
    - SAWQG Volume 1: Domestic: Turbidity, *E.coli* and Faecal Coliforms;
    - SAWQG Volume 2: Recreational: Turbidity;
    - SAWQG Volume 4: Irrigation: Total Dissolved Solids and Total Suspended Solids;
    - PSAWQG Volume 5: Stock Watering: No Exceedances; and
    - SAWQG Volume 7: Aquatic Ecosystems: Aluminium (Al).
- PHW MS:
    - SAWQG Volume 1: Domestic: Turbidity, *E.coli* and Faecal Coliforms;
    - SAWQG Volume 2: Recreational: Turbidity;
    - SAWQG Volume 4: Irrigation: Total Dissolved Solids and Total Suspended Solids;
    - PSAWQG Volume 5: Stock Watering: No Exceedances; and
    - SAWQG Volume 7: Aquatic Ecosystems: Aluminium (Al).
- PHW DS:
    - SAWQG Volume 1: Domestic: Turbidity, *E.coli* and Faecal Coliforms;
    - SAWQG Volume 2: Recreational: Turbidity, *E.coli* and Faecal Coliforms;
    - SAWQG Volume 4: Irrigation: Total Dissolved Solids and Total Suspended Solids;
    - PSAWQG Volume 5: Stock Watering: No Exceedances; and
    - SAWQG Volume 7: Aquatic Ecosystems: Aluminium (Al).

The remaining tested parameters presented ideal for the monitoring period.

11. SURFACE WATER QUALITY GRAPHS

Chemical quality graphs were included related to the sampled river system and a brief summary presented below.

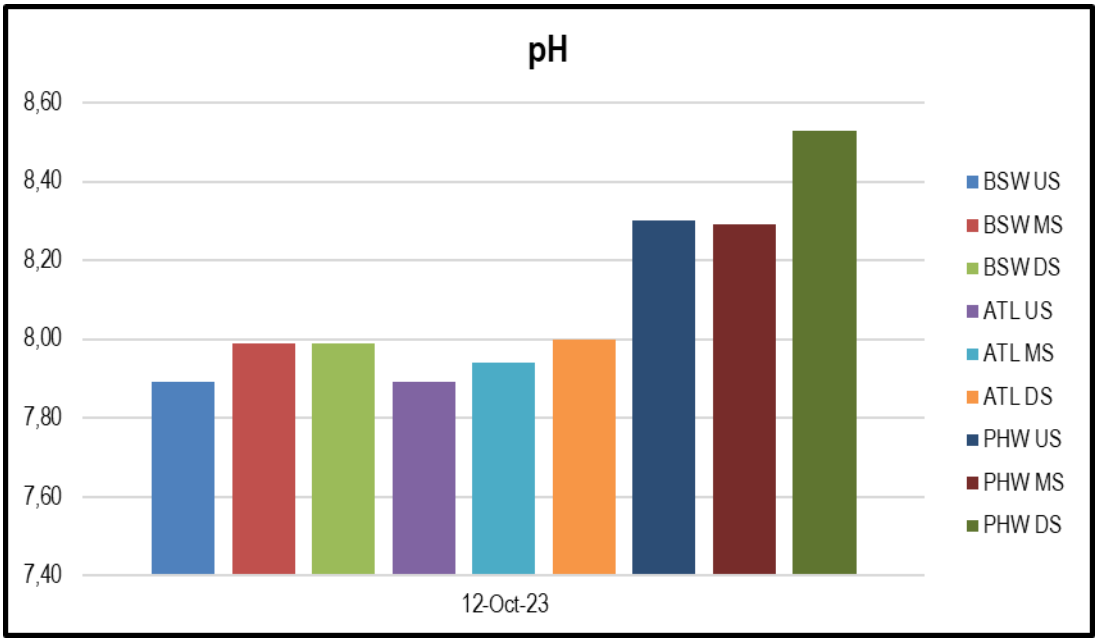

Figure 5 : pH level graph for Crocodile River

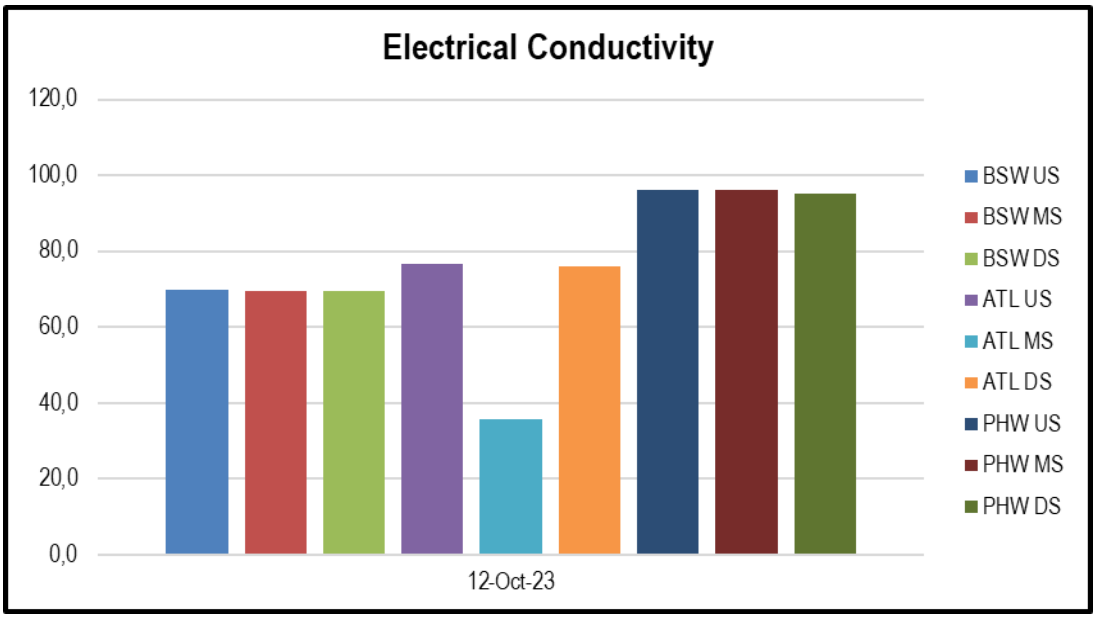

Figure 6: Electrical Conductivity (EC) concentration graph for Crocodile River

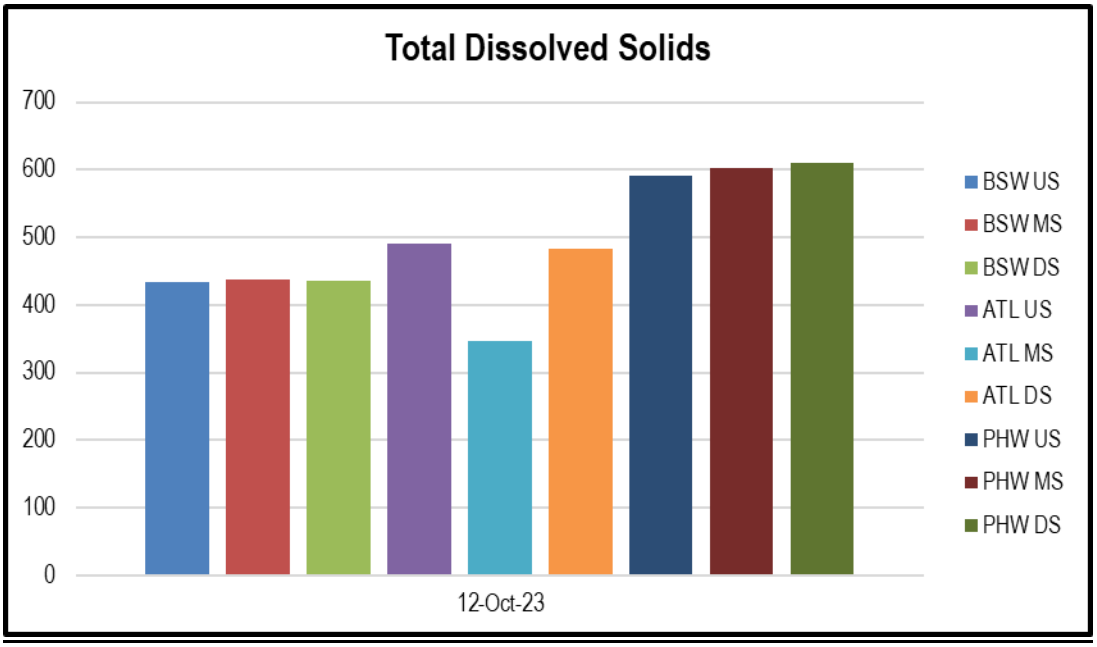

Figure 7: Total Dissolved Solids (TDS) concentration graph for Crocodile River

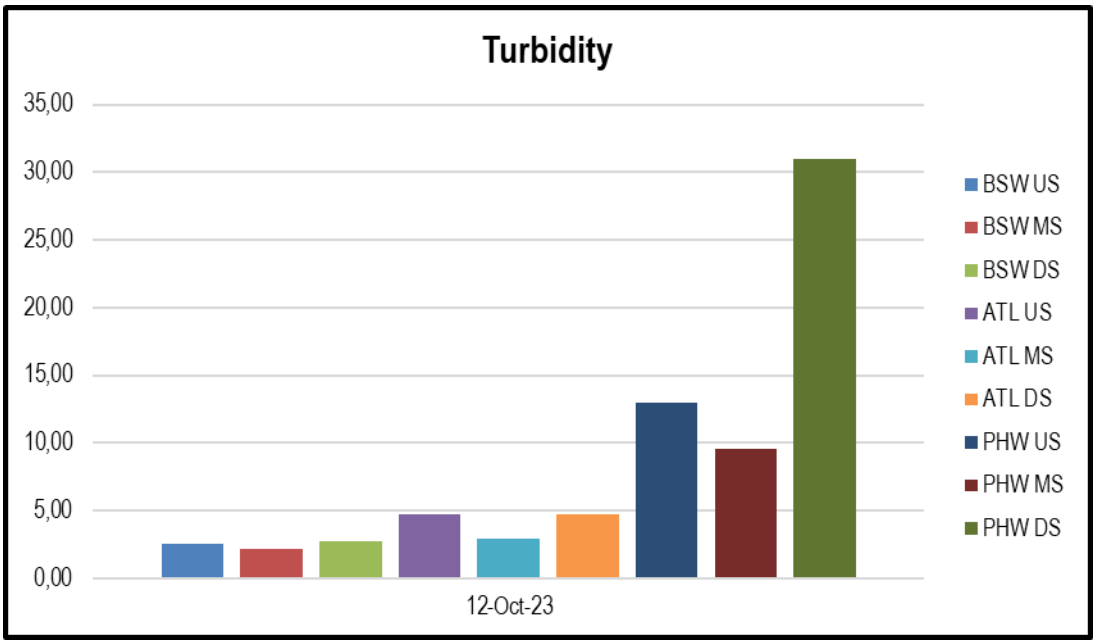

Figure 8: Turbidity level graph for Crocodile River

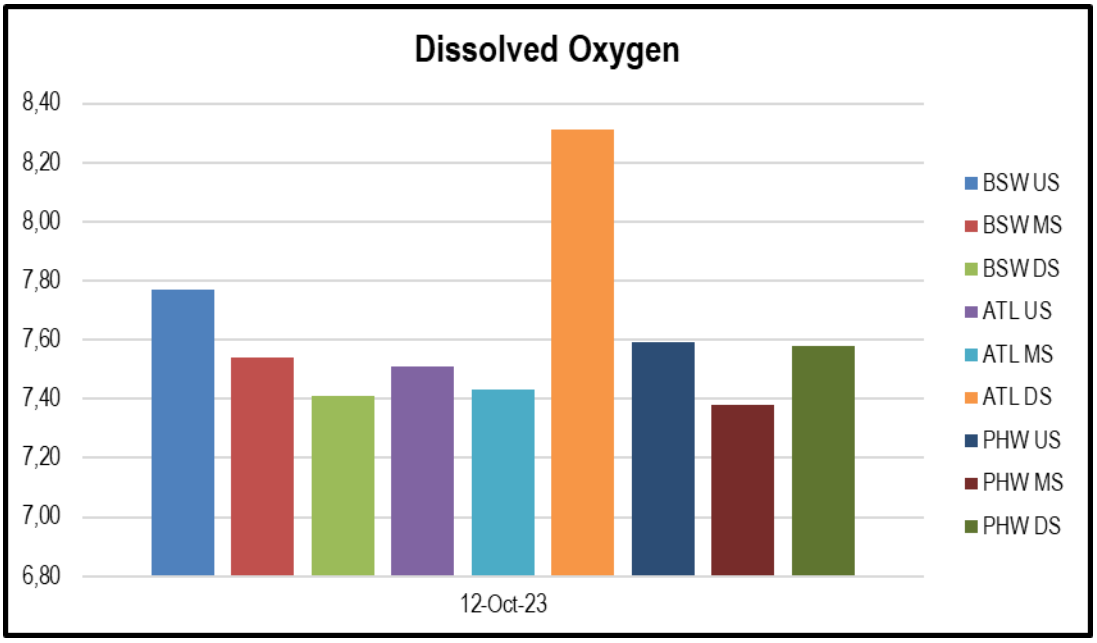

Figure 9: Dissolved Oxygen (DO) level graph for Crocodile River

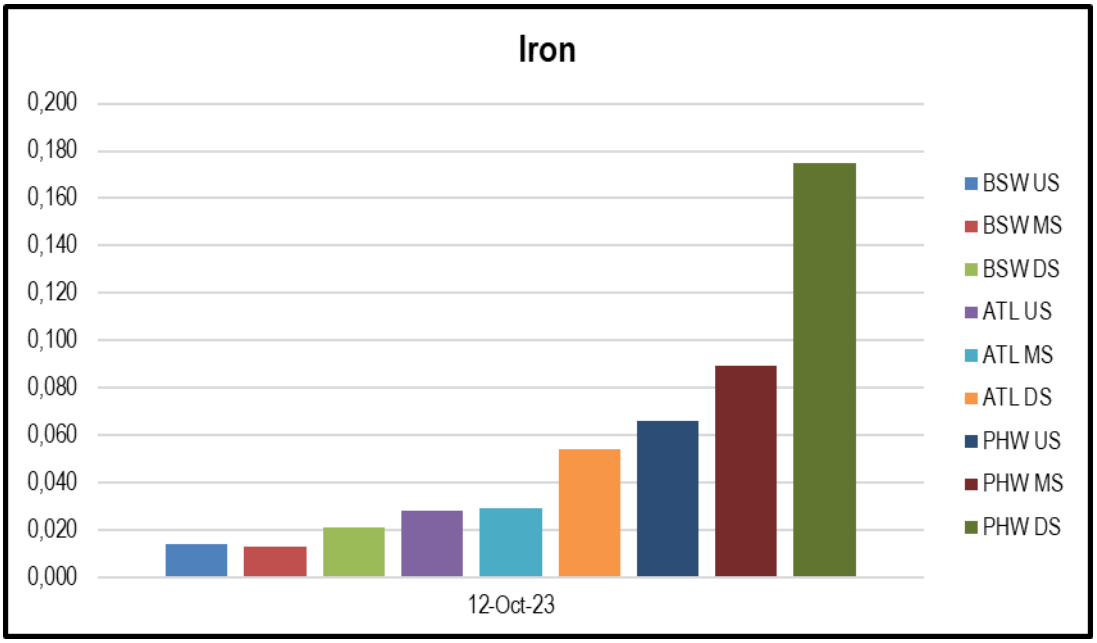

Figure 10: Iron (Fe) concentration graph for Crocodile River

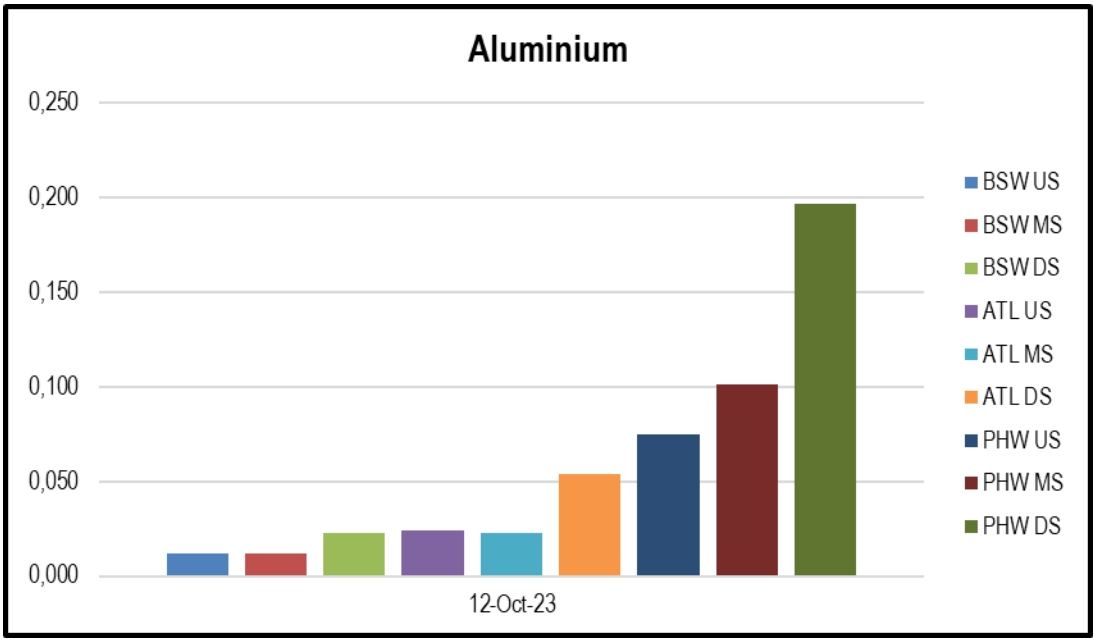

Figure 11: Aluminium (Al) concentration graph for Crocodile River

12. CONCLUSION AND ASPECTS TO CONSIDER

The scope of work performed for the MCWAP-2 is as per in accordance with Appendix 6 of the EIA Regulations (2014, as amended), promulgated in terms of Section 24 of the NEMA and the criteria drawn from the IEM Guidelines Series, Guideline 5: Assessment of Alternatives and Impacts, published by the Department of Environmental Affairs (April 1998). The objective of the report and impact assessment is to identify and assess all the significant impacts that may arise as a result of the proposed construction as well as to assess the potential impacts of the proposed construction activities, during construction and operational phases.

It is assumed that the construction phase and to a lesser extent the operational phase of the weir rehabilitation and re-construction will have an effect on water quality, flow regime, sediment concentration, nutrient levels, aquatic habitats and species as well as on the vegetation in the proposed reconstruction area, although off-site impacts are not expected, and the impact is anticipated to be largely concentrated within the construction area. In order to ensure and prevent this possible outcome, mitigation measures are provided in this report to enable the proposed development to minimise the impact.

The main findings (potential impacts) from the impact assessment are as follows:

Reconstruction phase:

1. Potential alterations to the river's flow regime, including changes in water velocity, sediment transport, and the expected frequency and magnitude of floods.
2. Potential changes in water quality parameters, such as sediment concentration, nutrient levels, and dissolved oxygen, could be made based on the anticipated alterations in flow patterns and sediment transport associated with the rehabilitation construction to the weirs.
3. The reconstruction of weirs could impact aquatic habitats, including potential changes in the composition and distribution of fish and other aquatic species.
4. Potential changes in sediment transport patterns can lead to localized erosion and downstream sedimentation issues.
5. Altered flow regimes may lead to increased erosion or stability issues in adjacent riverbanks.
6. The machinery associated with the reconstruction of weirs as well as the activities during the rehabilitation construction phase could impact terrestrial habitats, and natural vegetation in the surrounding environment.
7. Chemicals and fluids associated with construction machinery may potentially spill. Accidental spills of these substances can introduce harmful chemicals into the surrounding environment, potentially impacting the water quality of the river.

Operational phase:

For the operational phase the impact of the reconstructed weirs is reasoned to have little to no effect on the surrounding users. This is primarily due to the completion of construction activities. Any disturbances of the natural environment

surrounding the weirs which could possibly lead to sediment transport, spills associated with machinery and habitat loss are not relevant to this phase.

While the reconstruction of weirs has the potential for several impacts, it is anticipated that the scale and duration of the construction will be such that significant effects on the river and its surroundings are not expected. The calculated impact is considered to be low.

The mitigation measures identified throughout the impact assessment is as follows:

- Sedimentation and Erosion - Soil disturbance during rehabilitation construction can lead to increased sedimentation and erosion.
    - Implement erosion control measures such as silt fences, sediment basins, and erosion control blankets.
    - Stabilize exposed soil areas with vegetation.
    - Schedule construction activities to minimize soil exposure.
- Water Quality Changes - Runoff from construction sites can introduce pollutants into the river.
    - Use best management practices (BMPs) for stormwater management.
    - Install sedimentation basins and treatment devices to capture and treat runoff.
    - Limit the use of harmful chemicals and implement spill prevention measures.
- Habitat Disturbance – Rehabilitation construction activities can disrupt habitats for flora and fauna.
    - Conduct thorough ecological assessments before construction.
    - Implement buffer zones to protect sensitive habitats.
    - Replant native vegetation in disturbed areas post-construction.
- Alteration of Flow Regime - Changes in river flow patterns can impact aquatic ecosystems
    - Monitor and adjust flow regimes during and after rehabilitation construction.
- Runoff and Stormwater Management - Increased impervious surfaces can lead to elevated runoff
    - Design stormwater management systems to reduce runoff.
    - Incorporate permeable surfaces and green infrastructure.
- Waste Management - Improper handling of construction waste can lead to pollution.
    - Implement waste management plans to reduce, reuse, and recycle materials.
    - Dispose of waste according to regulations.
- Water Quality – Water quality may decrease due to activities associated with the rehabilitation construction phase.
    - Conduct a surface water quality monitoring program.

<u>The main findings from the impact assessment are as follows:</u>

<u>When assessing all available data, it is calculated to have a negligible Consequence and a very low to negative Significance. The cumulative Impact during Construction – and Operational phases is calculated at Low.</u>

In summary, the potential impacts associated with the proposed rehabilitation construction phase relate to habitat loss, change in water quality, disruption of aquatic and terrestrial ecosystems, loss of natural vegetation, change in natural flow and sedimentation and erosion. The mitigation measures determined throughout the impact assessment relate to habitat restoration, stormwater management plans, adequate flow management plans, implementation of erosion control measures, ecological assessments and waste management plans.

13. REFERENCES

- Department of Water Affairs and Forestry, 1996. South African Water Quality Guidelines, Volume 1, Domestic Use.
- Department of Water Affairs and Forestry, 1996. South African Water Quality Guidelines, Volume 2, Recreational Use.
- Department of Water Affairs and Forestry, 1996. South African Water Quality Guidelines, Volume 4, Agricultural Use: Irrigation.
- Department of Water Affairs and Forestry, 1996. South African Water Quality Guidelines, Volume 5, Agricultural Use: Livestock Watering.
- Department of Water Affairs and Forestry, 1996. South African Water Quality Guidelines, Volume 7, Aquatic Ecosystems.
- Nel, J. L., Murray, K. M., Maherry, A. M., Nel, J.L., Murray, K.M., Maherry, A.M., Petersen, C.P., Roux, D.J., Driver, A., Hill, L., Van Deventer, H., Funke, N., Swartz, E.R., Smith-Adao, L.B., Mbona, N., Downsborough, L. and Nienaber, S. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.

14. APPENDIX A – MONITORING LOCALITY SUMMARY TABLE

Surface Water Monitoring Localities:

BEESTEKRAAL WEIR	
Locality: BSW US Location: 25°24'19.18"S 27°34'34.70"E Description: Crocodile River – Beestekraal Weir Upstream	
Locality: BSW MS Location: 25°24'13.16"S 27°34'29.12"E Description: Crocodile River – Beestekraal Weir Midstream	
Locality: BSW DS Location: 25°23'57.01"S 27°34'24.75"E Description: Crocodile River – Beestekraal Weir Downstream	

ATLANTA WEIR	
Locality: ATL US Location: 25°12'31.82"S 27°33'16.49"E Description: Crocodile River – Atlanta Weir Upstream	
Locality: ATL MS Location: 25°12'22.96"S 27°33'28.52"E Description: Crocodile River – Atlanta Weir Midstream	
Locality: ATL DS Location: 25°11'49.37"S 27°33'35.63" Description: Crocodile River – Atlanta Weir Downstream	

PAUL HUGO WEIR	
Locality: PHW US Location: 24°42'8.79"S 27°24'36.81"E Description: Crocodile River – Paul Hugo Weir Upstream	
Locality: PHW MS Location: 24°41'42.61"S 27°24'32.90"E Description: Crocodile River – Paul Hugo Weir Midstream	
Locality: PHW DS Location: 24°41'19.16"S 27°24'40.40"E Description: Crocodile River – Paul Hugo Weir Downstream	

APPENDIX A – INDEPENDENT FORM AND CV

DEON FOURIE

DIVISIONAL HEAD / ENVIRONMENTAL CONSULTANT

Environmental Assurance (Pty) Ltd.

ENVIRONMENTAL ASSURANCE (PTY) LTD

394 Tram Street, New Muckleneuk, Pretoria, 0181

T : 012 460 9768 ; M : 0827876767; F : 012 460 3071 ; E mail : deon@envass.co.za

Date of Birth : 27/06/1990; Pretoria; South Africa

Ethnic Group and Gender : White Male ; Disabilities : None

AREAS OF EXPERTISE

- Report Writing
- Air Quality
- Data Analysis
- Site Investigation
- Field Sampling
- Water Quality
- GIS
- ECO
- Impact Assessments

CAREER HISTORY

Employer **ENVIRONMENTAL ASSURANCE (PTY) LTD**

Period May 2021– Current

Position **DIVISIONAL COORDINATOR / ENVIRONMENTAL CONSULTANT**

Responsibilities Responsible for the compliance monitoring of various mining- and other industrial sites. The scope of work for these mining sites include: ambient air quality sampling, surface and ground water monitoring. The overseeing of monthly schedules and coordination of compliance monitoring. c

CAREER HISTORY

Employer **AQUATICO SCIENTIFIC (PTY) LTD**

Period September 2016 – January 2019

Position **Environmental Field Technician**

Responsibilities Responsible for the compliance monitoring of ambient air quality, groundwater, surface water, and drinking water.

WORK EXPERIENCE AND SKILLS

Site inspections, surface water quality testing, data capture and analysis, ambient air quality monitoring and report writing.

TRAINING

Environmental Legal Compliance, Auditing and Monitoring -

EDUCATION AND QUALIFICATIONS

Unisa; B.Sc. (Hons). Environmental Management (Zoology Stream) – 2019
Unisa; B.Sc. Degree. Environmental Management (Zoology Stream) – 2015

PROJECT EXPERIENCE

Environmental consulting services for:

PROJECT DESCRIPTION	CLIENT
Air and Water Quality Monitoring, Site inspection and reporting	
	• Umlabu
	• Voorslag
	• Siyanda Bakgatla
	• Universal Coal
	• Exxaro Leeuwpan
	• Canyon Coal:
	○ Ukufisa
	○ Hakhano
	○ Singani
	○ Phalanndwa
	○ Pan Siding
	○ Rietkuil Siding
	○ Oosbank Siding
Environmental Monitoring – Dust Fallout and Water Quality	
	• PPC Slurry
	• Tshikondeni Coal
	• Polokwane Smelter
	• Glencore Tweefontein
	• Glencore Zonnebloem
	• Assmang Beeshoek
	• M Kotane Muni
	• Assmang Black Rock
	• TC Smelter
	• Bakubung
	• Medupi
	• PPC Dwaalboom

REFERENCES

CONTACT NAME	COMPANY	RELATIONSHIP	CONTACT NR
Emile van Druten	**ENVASS**	**Director**	**012 460 9768**
Andre Buys	**ENVASS**	**Business Unit Head**	**082 267 0338**

CERTIFICATION

I, **NAME & SURNAME**

Declare that, to the best of my knowledge, all the information contained herein is true.

Signature: 

On the 13th day of November 2023.

STATEMENT OF OBJECTIVENESS AND COMPETENCE

The author(s) of this document hereby declare that he/she/they:

- Act as an independent and objective consultant/s;
- Does not have any financial interest in the undertaking of this project or projects, other than remuneration for the work performed in terms of relevant legislation;
- Has and will not have a vested interest in the current and/or proposed activity, nor will engage in any directly conflicting interest associated with this project;
- Undertakes to function transparently and provide any information to a competent authority if compelled to do so by law or by consent of the involved parties;
- Based on the information provided by the client, due diligence studies or any other source or sources, have presented the results, discussion and conclusion, as applicable to the project concerned, to the best of his/her/their professional ability;
- Reserves the right to modify aspects pertaining to this study should additional information become available through ongoing research and further work on the relevant field/s;
- Undertakes to have the work peer reviewed on a regular basis by a competent specialist in the field/s of study;
- Is duly qualified and experienced to undertake the work at hand; and
- Adheres to the code of conduct as stipulated under Section 28 (3) of the Natural Scientific Professions Act 27 of 2003 as observed by the South African Council for Natural Scientific Professions (SACNASP).
- Signed by Deon Fourie:

_____

Date: 13-11-2023

Environmental Scientist	Relevant expertise
Deon Fourie Pr. Sci.Nat Registration No 145592	Has completed a B.Sc. in Environmental Sciences, followed by a B.Sc. (Hons). Deon has comprehensive experience and knowledge on compliance monitoring, project management and specialist reporting. As an environmental consultant, Anton has provided numerous environmental monitoring assessments, specialist input services and environmental audits.

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Deon Fourie

Registration Number: 145592

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Environmental Science (Professional Natural Scientist)

Effective **11 May 2023** Expires **31 March 2024**

Chairperson

Chief Executive Officer

To verify this certificate scan this code