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Hydrological Assessment for the Proposed Karpowership 132kV Transmission Line – Richards Bay Port

REPORT

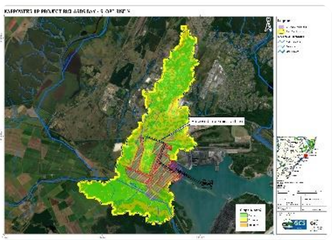
Version – Final 1

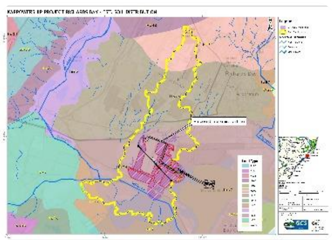
31 October 2022

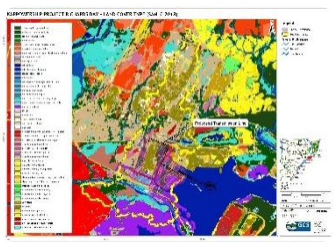
Triplo4 Sustainable Solutions (Pty) Ltd

GCS Project Number: 22-0886

Client Reference: 22-0886 Hydro 2







HYDROLOGICAL ASSESSMENT FOR THE PROPOSED KARPOWERSHIP 132kV TRANSMISSION LINE – RICHARDS BAY PORT

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DOCUMENT ISSUE STATUS

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Proof-Reader	Lisa Botha (BSc, Hons)		31 October 2022

LEGAL NOTICE

DECLARATION OF INDEPENDENCE

GCS (Pty) Ltd (GCS) was appointed to conduct this specialist hydrology study and to act as the independent hydrological specialist. GCS objectively performed the work, even if this results in views and findings that are not favourable. GCS has the expertise in conducting the specialist investigation and does not have a conflict of interest in the undertaking of this study. This report presents the findings of the investigations which include the activities set out in the scope of work.

APPENDIX 6 OF THE EIA REGULATION – CHECKLIST AND REFERENCE FOR THIS REPORT

Table 1 - Requirements from Appendix 6 of GN 326 EIA Regulation 2017

Requirements from Appendix 6 of GN 326 EIA Regulation 2017	Chapter
(a) Details of: (i) The specialist who prepare the reports; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix B.
(b) Declaration that the specialist is independent in a form as may be specialities by the competent authority	Appendix B.
(c) Indication of the scope of, and purpose for which, the report was prepared	Section 1.
(cA) Indication of the quality and age of base data used for the specialist report	Sections 1, 2 and 3.
(cB) A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 7.
(d) Duration, Date and seasons of the site investigation and the relevance of the season to the outcome of the assessment	Section 1.4.
(e) Description of the methodology adopted in preparing the report or carrying out the specialised process include of equipment and modelling used	Section 2.
(f) Details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associate's structures and infrastructure, inclusive of a site plan identifying alternative	Sections 1, 4 and 7.
(g) Identification of any areas to be avoided, including buffers	Section 8.1.
(h) Map superimposing the activity and associated structures and infrastructure on environmental sensitivities of the site including areas to be avoided, including buffers	Section 1, 3.
(i) Description of any assumptions made and uncertainties or gaps in knowledge	Sections 2, 4, and 5.
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity including identified alternatives on the environment or activities	Executive summary, Section 8.
(k) Mitigation measures for inclusion in the EMPr	Section 9.2.
(l) Conditions for inclusion in the environmental authorisation	Refer to Section 8.
(m) Monitoring requirements for inclusion in the EMPr or environmental authorisation	Refer to Section 8.
(n) Reasoned opinion – (i) as to whether the proposed activity, activities or portions thereof should be authorised. (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, and avoidance, management, and mitigation measures should be included in the EMPr, and where applicable, the closure plan	Section 8.3
(o) Description of any consultation process that was undertaken during preparing the specialist report	*None required.*
(p) A summary and copies of any comments received during any consultation process and where applicable all responses thereto	*None required.*
(q) Any other information requested by the competent authority	*None required.*

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LIST OF ACRONYMS

Acronym	Description
BA	Basic Assessment
BOD	Biological oxygen demand
COD	Chemical oxygen demand
CSWMP	The conceptual stormwater management plan
DEM	Digital Elevation Model
DWS	Department of Water and Sanitation
GCS	GCS Water and Environment (Pty) Ltd.
SW	Surface Water
GN704	General Notice 704
ha	Hectare
HRU	Hydrological Response Unit
IWULA	Integrated Water Use Licence Application
m^3	Cubic Metres
MAE	Mean annual evaporation
MAR	Mean Annual Runoff
MIPI	Midgley and Pitman
NEMA	National Environmental Management Agency
n-Value	Manning's Roughness Coefficients
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PCD	Pollution Control Dam
PFD	Process flow diagram
SDF	Standard design flood
SPP	Sewage Package Plant
TDS	Total dissolved solids
TIN	Triangulated Irregular Network
WMA	Water Management Area
WR2012	Water Resources of South Africa 2012

1 INTRODUCTION

GCS Water and Environment (Pty) Ltd (GCS) was appointed by Triplo4 Sustainable Solutions (Pty) Ltd (Triplo4) to undertake a hydrological assessment for the proposed development of a transmission line, associated with the proposed gas to power via Powerships project in Richards Bay, KZN (refer to Figure 1-3). The project is situated in Quaternary Catchment W12F of the Usuthu - Mhlatuze (DWS, 2016) Water Management Area.

1.1 Project Background

The Project Concept comprises gas engine power ships or barges provided by Karpower moored on a spread mooring close to the shore or in the protection of a harbour to export power via transmission cables to an Eskom transmission switching station on the shore (refer to Figure 1-1 and Figure 1-2).

The Project entails the generation of electricity by two Powerships moored in the Port of Richards Bay, fed with natural gas from a third ship, a Floating Storage & Regasification Unit (FSRU). The three ships will be moored in the port for the Project’s anticipated 20-year lifespan. A Liquefied Natural Gas Carrier (LNGC) will bring in liquified natural gas (LNG) and offload it to the FSRU approximately once every 20 to 30 days, dependent on power demand which is determined by the buyer, ESKOM. The FSRU stores the LNG onboard and turns the liquid form into gaseous form (Natural Gas) upon demand from the Powership (Regassification). Natural gas will be transferred from the FSRU to the Powerships via a subsea gas pipeline. The Project’s design capacity is 540MW. Electricity will be generated on Powerships by 27 reciprocating engines, each having a heat input in excess of 10MW (design capacity of 18.32MW each at full capacity). Heat generated by operation of the reciprocating engines is captured, and that energy is used to create steam to drive three steam turbines that each have a heat input of circa 15.45MW. The contracted capacity of 450MW, which cannot be exceeded under the terms of the RMIPPPP, will be evacuated via a 132kV transmission line over a distance of approximately 3km, from the Richards Bay Port tie-in point to the Eskom line, at a connection point (necessitating a new switching station) in proximity to the existing Bayside Substation, which feeds electricity into the national grid.

Figure 1-1: Proposed transmission line route from KPS to the national grid

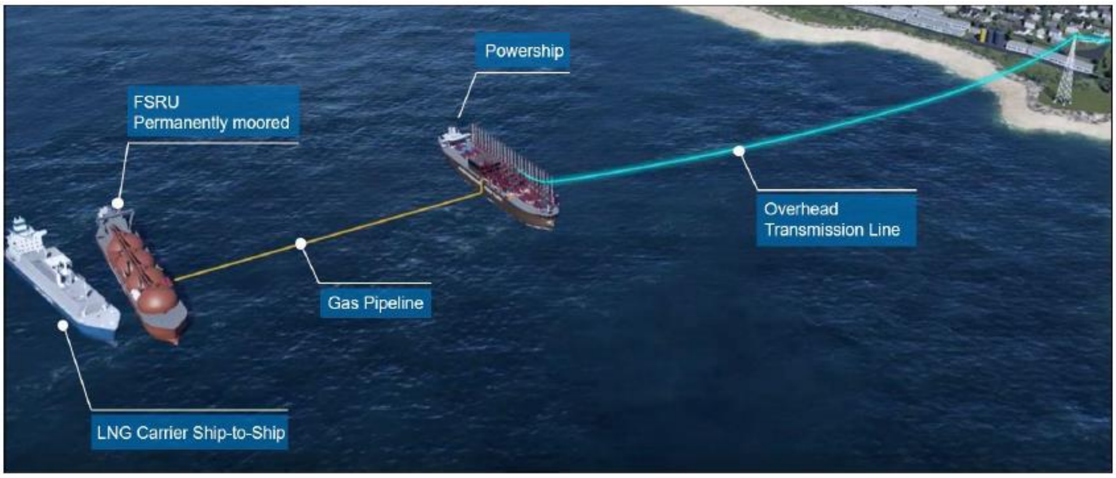

Figure 1-2: Generic Project Concept (Triplo4, METHOD STATEMENTS FOR THE PROPOSED KARPOWERSHIP FOR GAS TO POWER PROJECT, 2022)

1.2 Study relevance to the season in which it was undertaken

This study was undertaken as a once-off study and relies on historical hydrological and climate data for the site, as well as recognised hydrological and water resource databases for South Africa. Data generated during the time of this study is not seasonally bound as average yearly data was applied where required and as scientifically acceptable.

1.3 Objectives

The hydrological assessment focused on the proposed construction areas associated with the transmission lines and pylons (i.e. from the connection to the endpoint of the transmission line). The hydrological assessment report will supplement the Environmental Impact Assessment (EIA) for the Richards Bay Site.

The objectives of this study, were as follows:

- Evaluate the site's hydrological setting (i.e., climate, rainfall, drainage, etc.).
- Determine the 1:10, 1:20, 1:50, and 1:100-year peak flows for the recognised water courses in the study area.
- Undertake a hydrological risk assessment and compile mitigation measures; and
- Compile a surface water monitoring plan to monitor the impact on the receiving environment.

The report further considers *Appendix 6 of EIA regulations.*

1.4 Scope of work

To meet the study objectives, the scope of work (SoW) was defined as follows:

1. Hydrology Assessment:
    - Drainage area information revised using WR2012 and South African Weather Services (SAWS) data;
    - Catchment delineated using Geographic Information Systems (GIS) software;
    - Upstream irrigated areas determined using GIS software; and
    - General climate, rainfall and natural runoff evaluated.
2. Flood lines:
    - 1:50 and 1:100-year flood peaks were calculated using the Rational Method (RM), Standard Design Flood (SDF) and the Unit Hydrograph (UH) and the Empirical Method (EM);
    - River geometry derived from available elevation data; and
    - GeoHECRAS is used to route the flood peak through the channel geometry to determine flood depth for flood line mapping.
3. Risk and Mitigation Assessment:
    - A hydrological risk assessment was undertaken, to contextualize the potential surface water risk of the project.
4. Mapping and Reporting:
    - A project close-out report detailing the results of the hydrological study.

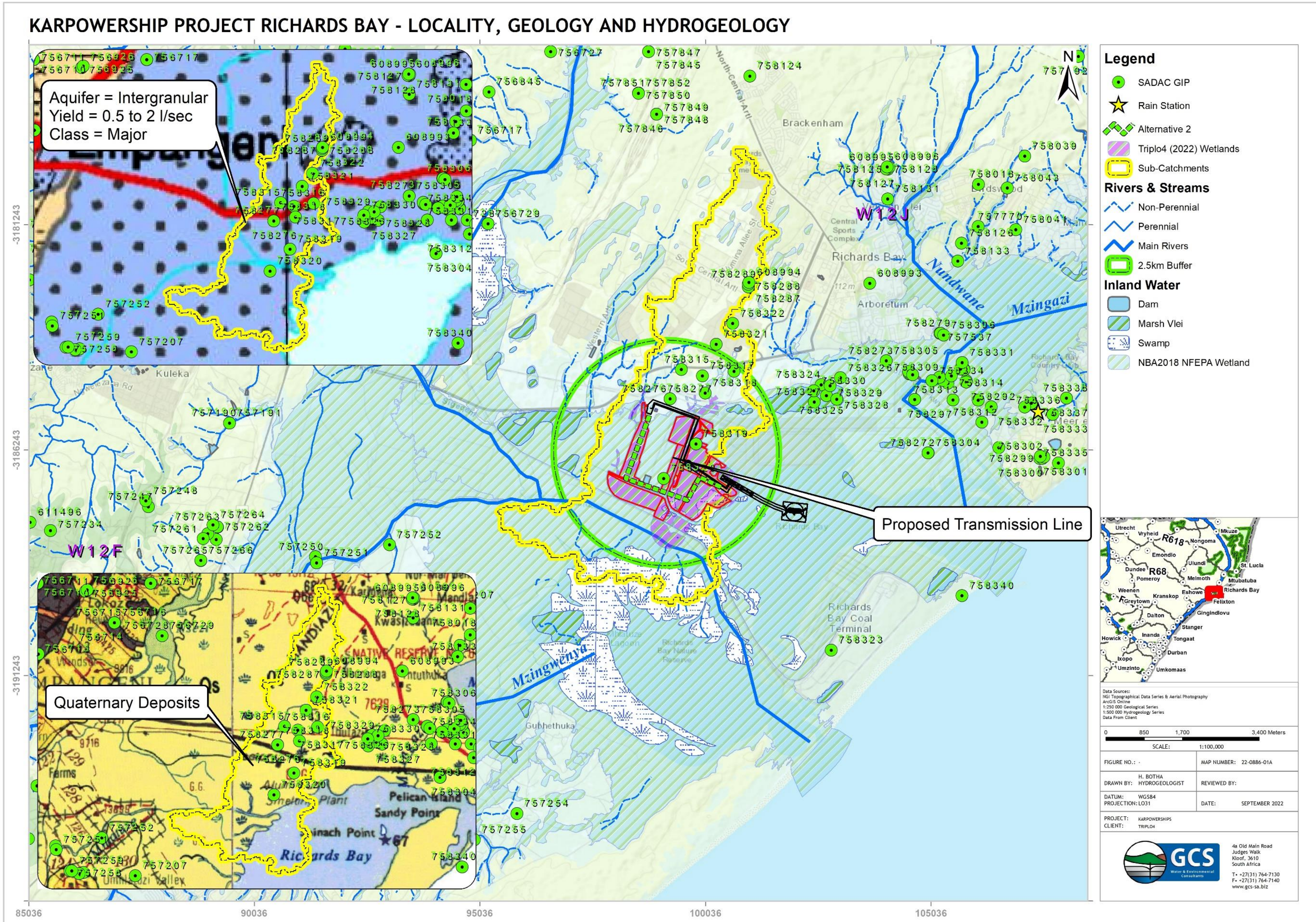

Figure 1-3: Site locality, local geology and hydrogeology

2 METHODOLOGY

The methodological approach for the study is described in the sub-sections below.

2.1 Legal considerations

The National Water Act, (Act 36 of 1998) (NWA) governs the use of water and protection of water resources in South Africa. There are two sets of regulations on water use thus far:

- Government Notice No. 704, 4 June 1999, National Water Act, 1998 (No. 36 of 1998): Regulations on the use of water for mining and related activities aimed at the protection of water resources (GN704).
- Government Notice No. 1352, 12 November 1999, National Water Act, 1998 (No. 36 of 1998): Regulations requiring that water use be registered.

In terms of Section 144 of the National Water Act of 1998 (Act 36 of 1998), a flood line, representing the highest elevation that would probably be reached during a storm with a return interval of 100 years, must be indicated on all plans for the linear development.

The National Environmental Management Act (Act 107 of 1998) (NEMA) stipulates that all relevant factors be considered for proposed developments to ensure that water pollution and environmental degradation are avoided. Section 2 of the Act establishes a set of principles that apply to the activities of all organs of the state that may significantly affect the environment. These include the following:

- Development must be sustainable
- Pollution must be avoided or minimized and remedied
- Waste must be avoided or minimized, reused or recycled
- Negative impacts must be minimized.

The requirements laid down by the National Building Regulations and Building Standards Act (Act 103 of 1977) in terms of development within the 1:50-year flood line area are based only on safety considerations without proper consideration and understanding of the underlying natural streamflow processes. The Town Planning and Townships Ordinance (Ordinance 15 of 1986) also makes provision in Regulation 44(3) for the extension of flood line areas up to 32 m from the centre of a stream in instances where the 1:50-year flood line is less than 62 m wide in total (CSIR, 2005).

Appendix 6 of GN 326 EIA Regulation 2017 regulations further govern hydrology assessments for EIAs. This hydrology report conforms to Appendix 6 of the EIA regulations, which include the following aspects (where applicable to this study) to be addressed:

(a) Details of:

(i) The specialist who prepare the reports; and

(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae

(b) Declaration that the specialist is independent in a form as may be specialities by the competent authority.

(c) Indication of the scope of, and purpose for which, the report was prepared:

(cA) Indication of the quality and age of base data used for the specialist report

(cB) A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change

(d) Duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment.

(e) Description of the methodology adopted in preparing the report or carrying out the specialised process including equipment and modelling used.

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(o) Description of any consultation process that was undertaken during preparing the specialist report.

(p) A summary and copies of any comments received during any consultation process and where applicable all responses thereto.

(q) Any other information requested by the competent authority.

2.2 Hydrological assessment

Hydrometeorological data for the study area were obtained from various sources including the South African Water Resources Study WR2012 database (Bailey & Pitman, 2015), South African Atlas of Agrohydrology, and Climatology (Schulze, 1997), and the Daily Rainfall Data Extraction Utility (Lynch, 2004). Moreover, sources such as the Köppen Climate Classification (Kottek M. , Grieser, Beck, Rudolf, & Rubel, 2006), World Climate Data CMIP6 V2.1 (Eyring, 2016), and Meteoblue (Meteoblue, 2022) were used to refine hydrological data.

These sources provided means of determining the Mean Annual Precipitation (MAP), Mean Annual Runoff (MAR), and Mean Annual Evaporation (MAE) of the study site as well as the design rainfall data. Data was applied to the site water balance calculations, runoff peak flow estimates for flood line modelling and stormwater runoff peak flow estimates for stormwater system sizing (where applicable to this study).

2.3 Flood Line Assessment

The magnitude of a flood is dependent on many factors, such as catchment size, slope and rainfall intensity. There are several different methods for determining floods and in general, different methods arrive at different conclusions as to the peak flow rate. The accepted approach is, therefore, to use several methods and then make a judgment call as to which method is the most applicable to the catchment under consideration, and use the results from this to route the flood through a channel and create a flood line from the simulated water depths.

2.3.1 Catchment Description and Delineation

The sub-catchments for the site were delineated using 30 m SRTM DEM (Farr & Kobrick, 2000). From this delineation, catchment characteristics, such as area, slopes and hydraulic parameters of the modelled river sections, were derived. The total surface area of the delineated sub-catchment is approximately 199 km^2. The delineated watershed for the farm is the entire quaternary catchment due to the river morphology and size of the rivers.

2.3.2 Peak Flood Determination and Methods

2.3.2.1 Rational Method (RM)

The Rational Method was developed in the mid-19th century and is one of the most widely used methods for the calculation of peak flows typically for smaller catchments (<15 square kilometres (km^2), it has been shown that this method can be used for catchments much larger than conventionally accepted (Pegram, 2003) (Smithers, 2012). However, it can be used for larger catchments with caution. The formula indicates that Q = CIA, where "I" is the rainfall intensity, A is the upstream runoff area and "C" is the runoff coefficient. "Q" is the peak flow.

2.3.2.2 Standard Design Flood (SDF)

The Standard Design Flood (SDF) method was developed specifically to address the uncertainty in flood prediction under South African conditions (Alexander, 2002). The runoff coefficient (C) is replaced by a calibrated value based on the subdivision of the country into 26 regions or WMA. The design methodology is slightly different and looks at the probability of a peak flood event occurring at any one of a series of similarly sized catchments in a wider region, while other methods focus on point probabilities (SANRAL, 2013).

2.3.2.3 Unit Hydrograph (UH) Method

The UH method is suitable for the determination of flood peaks as well as hydrographs for medium-sized rural catchments (15 to 5 000 km^2). The method is mainly based on regional analyses of historical data and is independent of personal judgement. The results are generally reliable, although some natural variability in the hydrological occurrences is lost through the broad regional divisions and the averaged forms of hydrographs. This is especially true in the case of catchments smaller than 100 km^2 in size (SANRAL, 2013).

2.3.3 Empirical Method: Midgely and Pitman (MIPI)

MIPI is an empirical method and is based on the correlation between peak flows and some catchment characteristics. Regional parameters are then mapped out for South Africa and the border with Botswana. These methods are most suitable for medium to large catchments (SANRAL, 2013).

2.3.4 Flood Line Modelling

Topographical survey data obtained from the Advanced Land Observation Satellite (ALOS) 30 m DEM (JAXA, 2018), were used to derive the hydraulic and river geometry parameters. River cross-sections and flow paths were prepared using HEC-RAS software. A visual assessment of the riverbanks was conducted using Google Earth Imagery to estimate Manning's roughness coefficients (n-values) along the river line. The flood lines generated were mapped in ESRI ArcGIS software and were used to evaluate potential flood risks.

2.4 Risk and Mitigation Assessment

Due to the assessment forming part of a larger risk assessment for the study area, the potential impacts and the determination of impact significance were assessed. The process of assessing the potential impacts of the project includes the following four activities:

1. Identification and assessment of potential impacts.
2. Prediction of the nature, magnitude, extent, and duration of potentially significant impacts.
3. Identification of mitigation measures that could be implemented to reduce the severity or significance of the impacts of the activity; and
4. Evaluation of the significance of the impact after the mitigation measures have been implemented i.e., the significance of the residual impact.

Per GNR 982 of the EIA Regulations (2014), the significance of potential impacts was assessed in terms of the following criteria:

I. Cumulative impacts.
II. Nature of the impact.
III. The extent of the impact.
IV. Probability of the impact occurring.
V. The degree to which the impact can be reversed.
VI. The degree to which the impact may cause irreplaceable loss of resources; and
VII. The degree to which the impact can be mitigated.

Table 2-1 provides a summary of the criteria used to assess the significance of the potential impacts identified. An explanation of these impact criteria is provided in Table 2-2.

The net consequence is established by the following equation:

Consequence = (Duration + Extent + Irreplaceability of resource) x Severity

And the environmental significance of an impact was determined by multiplying consequence by probability.

Table 2-1: Proposed Criteria and Rating Scales to be 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 (1)	The impact only affects the area in which the proposed activity will occur.
	Site (2)	The impact will affect only the development area.
	Local (3)	The impact affects the development area and adjacent properties.
	Regional (4)	The effect of the impact extends beyond municipal boundaries.

Criteria	Rating Scales	Notes
	National (5)	The effect of the impact extends beyond more than 2 regional/ provincial boundaries.
	International (6)	The effect of the impact extends beyond country borders.
Duration	Temporary (1)	The duration of the activity associated with the impact will last 0-6 months.
	Short-term (2)	The duration of the activity associated with the impact will last 6-18 months.
	Medium-term (3)	The duration of the activity associated with the impact will last 18 months - 5 years.
	Long-term (4)	The duration of the activity associated with the impact will last more than 5 years.
Severity	Low (1)	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected.
	Moderate (2)	Where 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.
	High (3)	Where 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 communities are substantially affected.
Potential for impact on irreplaceable resources	No (0)	No irreplaceable resources will be impacted.
	Yes (1)	Irreplaceable resources will be impacted.
Consequence	Extremely detrimental (-25 to -33)	A combination of extent, duration, intensity, and the potential for impact on irreplaceable resources.
	Highly detrimental (-19 to -24)	
	Moderately detrimental (-13 to -18)	
	Slightly detrimental (-7 to -12)	
	Negligible (-6 to 0)	
	Slightly beneficial (0 to 6)	
	Moderately beneficial (13 to 18)	
	Highly beneficial (19 to 24)	
	Extremely beneficial (25 to 33)	
Probability (the likelihood of the impact occurring)	Improbable (0)	It is highly unlikely or less than 50% likely that an impact will occur.
	Probable (1)	It is between 50 and 70% certain that the impact will occur.
	Definite (2)	It is more than 75% certain that the impact will occur, or the impact will occur.
Significance	Very high - negative (-49 to -66)	A function of Consequence and Probability.
	High - negative (-37 to -48)	
	Moderate - negative (-25 to -36)	
	Low - negative (-13 to -24)	
	Neutral - Very low (0 to -12)	
	Low - positive (0 to 12)	
	Moderate - positive (13 to 24)	
	High-positive (37 to 48)	
	Very high - positive (49 to 66)	

Table 2-2: Explanation of Assessment Criteria

Criteria	Explanation
Nature	This is an evaluation of the type of effect the construction, operation, and management of the proposed development would have on the affected environment. Will the impact of change on the environment be positive, negative, or neutral?
Extent or Scale	This refers to the spatial scale at which the impact will occur. The 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). The extent of 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 a small extent, are of very high importance, e.g., impacts on species of very restricted range. 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 activities and 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 irreplaceable resources	This refers to the potential for an environmental resource to be replaced, should it be impacted. A resource could 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, providing substitute resources is usually not possible, but in social systems, substitutes 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 to a very limited extent.
Consequence	The consequence of the potential impacts is a summation of the above criteria, namely the extent, duration, intensity, and impact on irreplaceable resources.
Probability of occurrence	The probability of the impact occurring is based on the 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 the 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 the probability of the impact occurring. The relationship between consequence and probability highlights that the risk (or impact significance) must be evaluated in 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 are 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 in predictions	Specialists and the EIR team were required to indicate 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. The degree of confidence is not taken into account 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.

2.5 Polycentric integrative approach to assessment

A polycentric approach to the proposed project requires the holistic consideration of all relevant factors, inclusive of potential impacts that the proposed Project could have on the local as well as the broader community. Section 2(4)(b) of NEMA states that Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option. Sustainable development as per NEMA requires the integration of social, economic, and environmental factors in the planning, implementation, and evaluation of proposed projects, to ensure that development serves the needs of present and future generations.

This specialist assessment considered both the positive and negative impacts of actual and potential impacts on the geographical, physical, biological, social, economic, and cultural aspects of the environment in a polycentric and holistic approach:

- To ensure that all aspects are weighed up against each other;
- To identify the risks and consequences of alternatives and options for mitigation of activities, to minimise negative impacts, maximise benefits, and promote compliance with the principles of environmental management as set out in section 2 of NEMA.

A specialist integrative workshop and weekly meetings were held during the EIA process where specialists raised matters to be considered by the specialist team and also verified technical information to prevent any discrepancies and where relevant, to coordinate approaches.

This approach ensured that there are no gaps contained between the various specialist reports and provides a holistic picture of the project and allows a polycentric assessment of environmental and socio-economic impacts and the identification of appropriate mitigations and recommendations for potential negative impacts and the maximisation of positive impacts and the value of the project to society.

2.5.1 Polycentric integrated specialist reports considered in the assessment

For this investigation, the following specialist reports were considered to verify potential cumulative impacts and sources in the receiving surface-groundwater environments.

- GCS (2022) Aquatic Assessment for the Richards Bay Port; and
- Triplo4 (2022) Wetland Delineation & Functional Assessment for the Proposed Transmission Lines from the Port of Richards Bay to the proposed Switching Station, uMhlathuze Local and Uthungulu District Municipalities, KwaZulu-Natal.

It was found that the sources and receivers as identified in this investigation, align with those of the reports reviewed and information brought forward weekly meetings held during the EIA process. The wetland report provided input in terms of verified wetland units that may be at risk, as indicated in the wetland and recognised water courses section of this report. The wetland report was further used to derive verified responsive soil types in the project area.

2.5.2 Polycentric approach to the recommendations and conclusions

The following specialists considered the hydrology findings and recommendations and internalised these within their reports to ensure a polycentric integrative approach to evaluations, assessment and recommendations:

- Aquatic Assessment; and
- Wetland Assessment.

2.6 Surface water monitoring plan

The monitoring network is based on the principles of a monitoring network design as described by the DWAF Best Practice Guidelines: G3 Monitoring (DWAF, 2007). The methodological approach that the monitoring plan follows is represented in Figure 2-1, below.

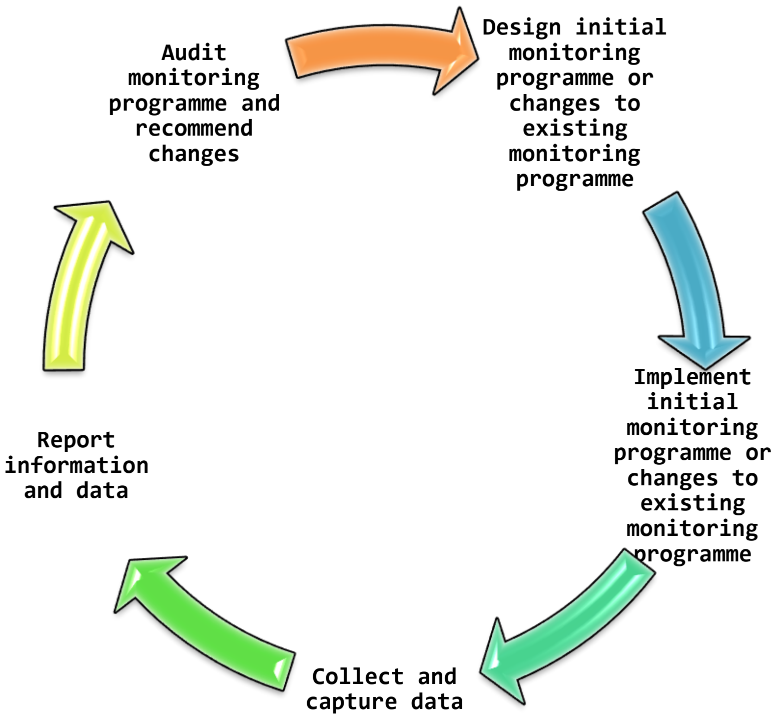


Figure 2-1: Monitoring Process

A surface water monitoring program that presents water quality constituencies to be analysed, the frequency of sampling, and the locality of sampling points were drafted. This plan included the construction and operational phase monitoring.

3 BASELINE HYDROLOGY

The proposed transmission line ("The Site") is situated near and in the port of Richards Bay, KwaZulu-Natal Province (refer to Figure 1-3). The site is situated in Quaternary Catchment W21F of the Pongola -Mtamvuna (DWS, 2016) Water Management Area (WMA 4).

One (1) sub-catchment was delineated for the project area and describes the natural drainage of the area. The site is bound to the south by a canal that drains to the Richards Bay harbour, and the Mhlatuze River is situated further downstream of the south (across the canal). Several non-perennial streams drain the site towards the north, and the southern portion is drained via several drainage lines. Elevations on the site typically range from 0 to 50 metres above mean sea level (mamsl).

3.1 Land cover & slope rise

Indigenous forest, grassland, thickets, bushes, short grass, long grass, sparsely woodland grasslands, and low shrubs dominate the sub-catchment (DEA, 2019) refer to Figure 3-1. Slope % rise for the general area is shown in Figure 3-2. Slope rise % was used to characterise the sub-catchment slope and runoff generation.

In the modelling process of the flood lines or stormwater runoff (whichever applies to this study), Manning's coefficient (n-values) values were set to represent natural stream systems and were supplemented by Google Earth Imagery and field observations. These "n" values were further derived from the available vegetation and land cover data for the site.

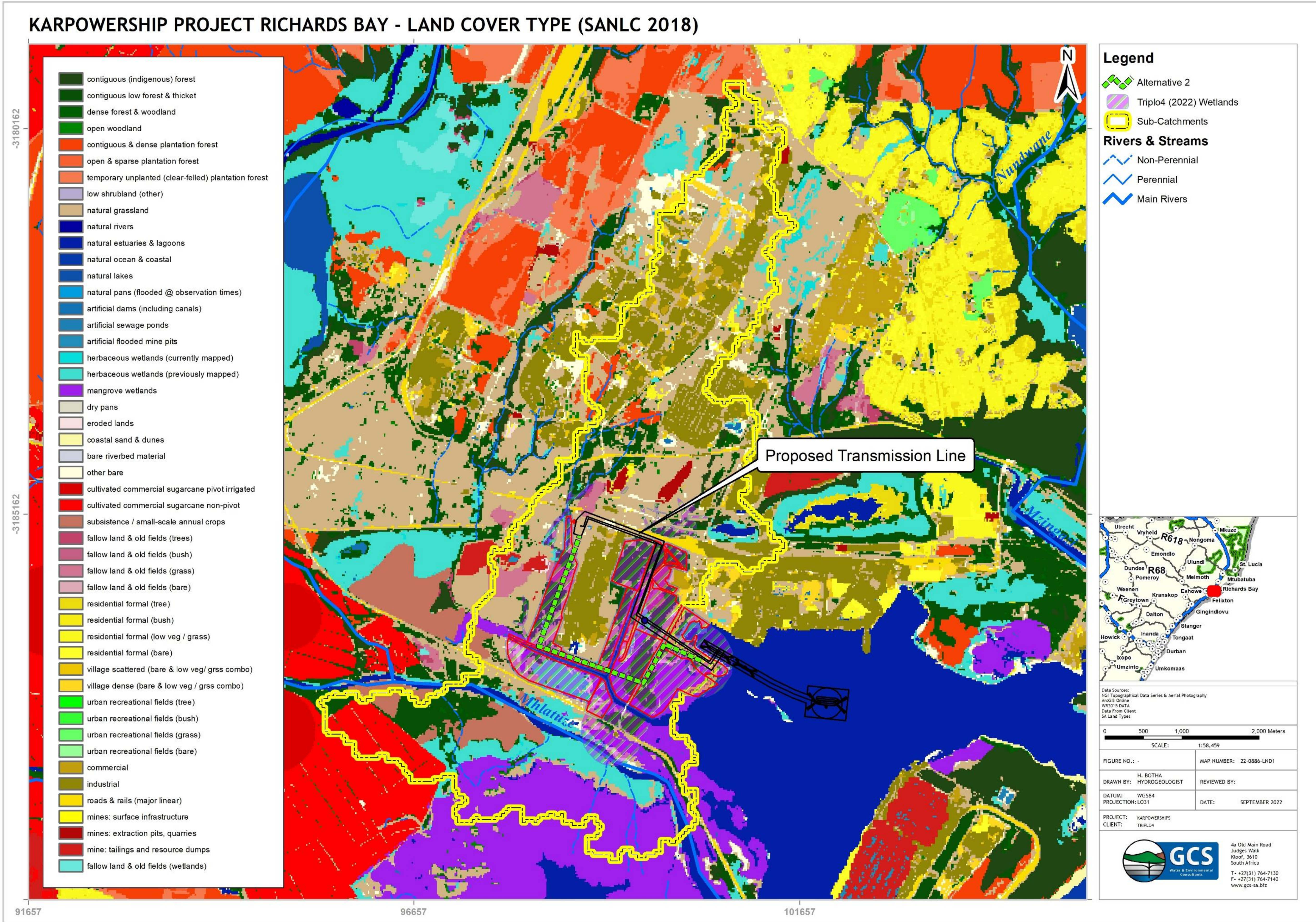


Figure 3-1: Sub-catchments and land cover

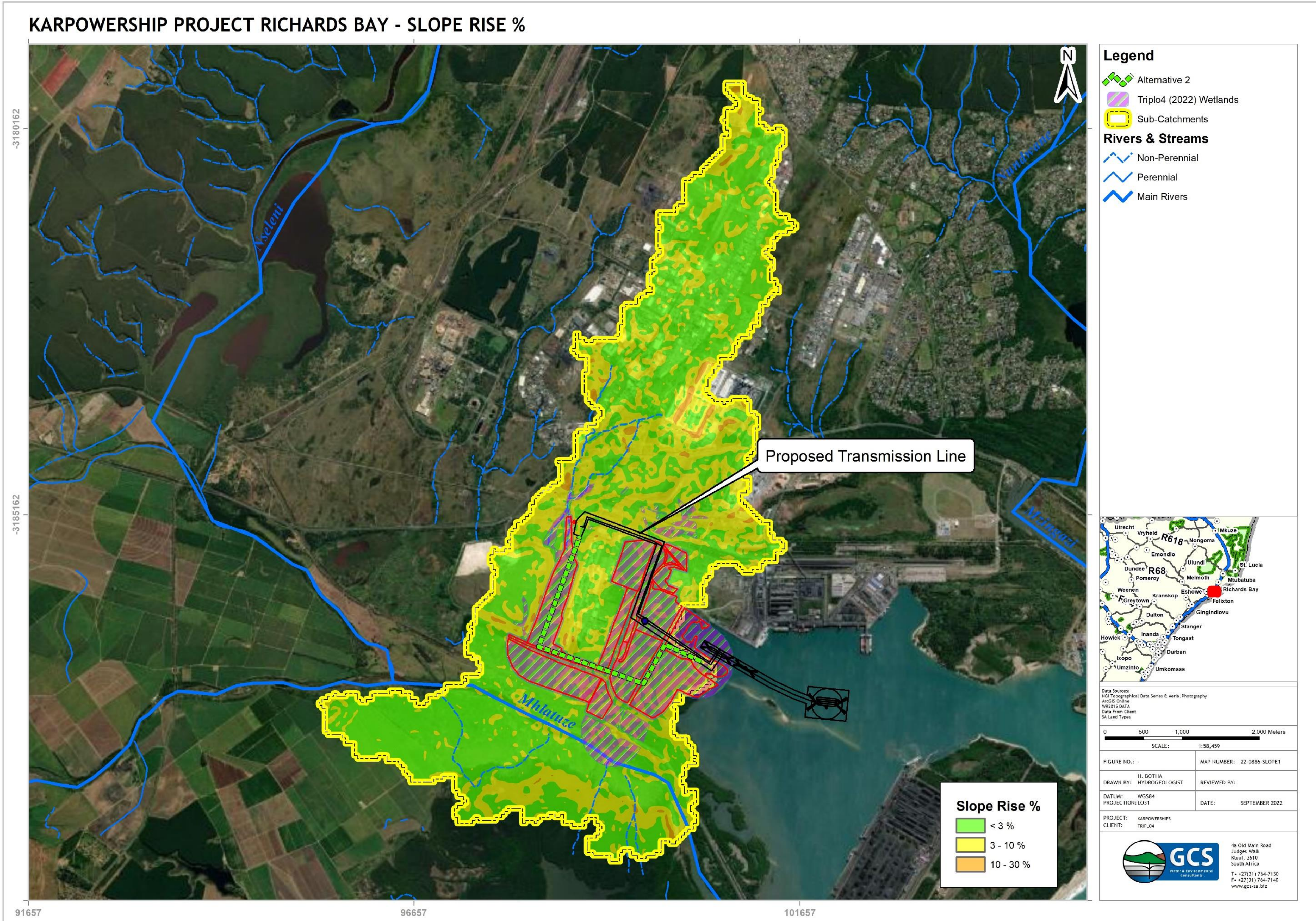


Figure 3-2: Sub-catchments and slope % rise

3.2 Local geology and soils

According to the 2732 Durban-1:250 000 Geological map series (DMEA, 1998), the local geology at the site is characterised by undifferentiated quaternary sands, underlain by older Swazian aged Gneiss (refer to Figure 1-3).

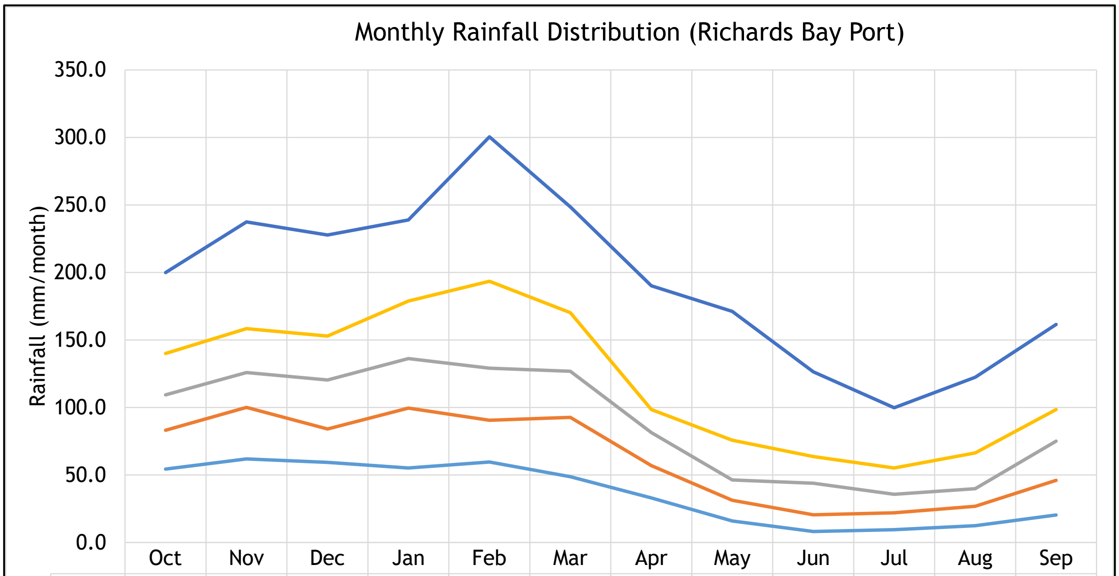
According to the Land types of South Africa database (ARC, 2006), the soils in the area predominantly consist of sandy soils classified as reclaimed land, associated with the Ia74 land type [Freely drained, yellow, eutrophic, apedal soils comprise > 40% of the land type (red soils comprise <10%)].

3.3 General Climate

This area falls in the Köppen-Geiger Climate Classification zone Cfa, where the C is associated with temperate climates, the f represents an area in which there is little to no dry season, which is site-dependent, and the a represents hot summers (Kottek M. J., Grieser, Beck, Rudolf, & Rubel, 2006).

3.3.1 Rainfall and Evaporation

MAP and MAE for the study area, obtained from WR2012, are 1 285 mm and 1 300 mm, respectively. Since evaporation is only slightly higher than rainfall, there will be a small loss of water from the surface of any water body. The catchment falls within a summer rainfall area where peak rainfall occurs in December and January (Figure 3-3).

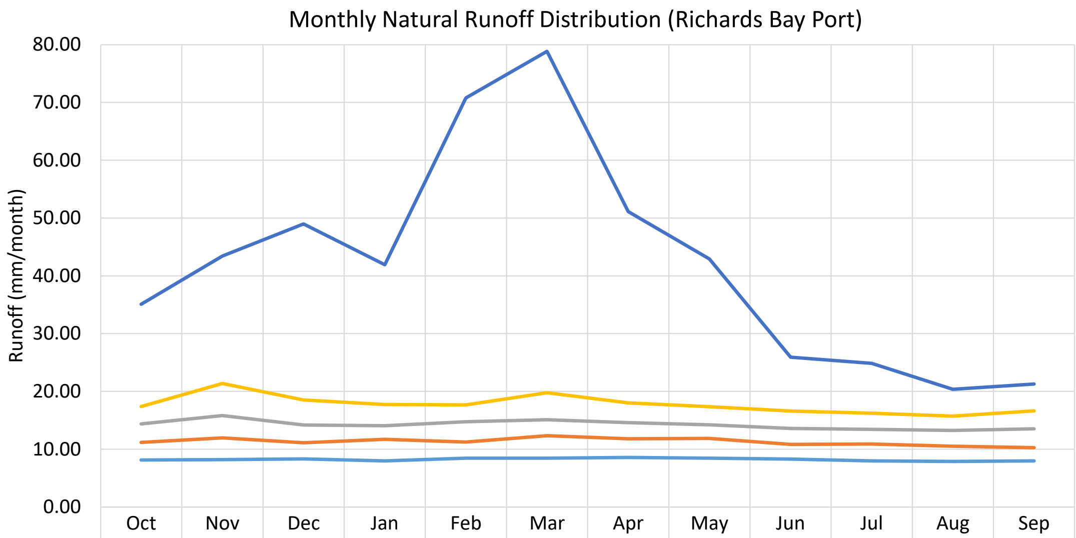


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
E90	54.4	61.9	59.4	55.2	59.6	48.7	32.9	15.9	8.1	9.5	12.4	20.3
E70	83.1	100.1	84.0	99.5	90.6	92.7	56.9	31.3	20.5	22.0	26.8	46.0
E50	109.4	125.8	120.3	136.2	129.0	126.8	81.3	46.3	43.9	35.7	39.8	75.0
E30	140.0	158.3	152.9	178.9	193.5	170.2	98.4	75.8	63.6	55.2	66.3	98.5
E10	199.9	237.4	227.7	238.8	300.4	248.6	190.1	171.1	126.4	99.8	122.3	161.5

Figure 3-3: Monthly rainfall and evaporation distribution for the W12F quaternary catchment

3.3.2 Quaternary Catchment Naturalised Runoff

Naturalised runoff simulations for the W12F quaternary catchment were obtained from the WR2012 database (Bailey & Pitman, 2015). The MAR was estimated to be 107.27 Mm^3/yr, equating to 276.5 mm/yr runoff, which represents approximately 21.71% of the MAP. These simulations are based on climate records from 1920 to 2009. The monthly distribution of naturalised runoff is shown in Figure 3-4.



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
E90	8.119	8.196	8.312	7.977	8.430	8.456	8.552	8.438	8.291	7.959	7.876	7.974
E70	11.160	11.946	11.106	11.691	11.232	12.343	11.791	11.845	10.822	10.884	10.515	10.276
E50	14.356	15.812	14.175	14.059	14.755	15.103	14.601	14.214	13.595	13.428	13.235	13.518
E30	17.392	21.366	18.503	17.719	17.665	19.781	18.015	17.338	16.613	16.227	15.732	16.619
E10	35.075	43.415	48.966	41.925	70.799	78.853	51.108	42.930	25.930	24.856	20.363	21.263

Figure 3-4: Monthly distribution of naturalised runoff for quaternary catchment W12F

3.3.3 Climate change considerations

Projected changes in climate for 2021 -2050 under the RCP 8.5 which could potentially impact the hydrological environment (CSIR, 2019), are recorded as follows:

- The projected increase in MAP by 2050 is – 53.24 mm/yr (less);
- Projected changes in very hot days are at least 9.2 more hot days compared to 2022;
- Projected increase in temperatures by as much as 1.77°C; and
- Projected increase in extreme rainfall days to increase by 1.38 days.

3.4 Surface and groundwater users within a 2.5 km buffer of the activity

According to National Groundwater Archive (NGA) and SADAC GIP borehole data for the project area, seven (7) groundwater users within a 2.5 km radius of the proposed transmission line – refer to Figure 1-3. Groundwater boreholes and surface water users fall within other drainage zones, and will likely not be impacted by the activities at the site (drainage for the site is towards the Mshwati River). The SADAC GIP boreholes are listed in Table 3-1.

Table 3-1: Groundwater users within a 2.5 km radius of the site

Site ID	Latitude (WGS84)	Longitude (WGS84)	Elevation (mamsl)	Water Level (mbgl)
758276	-28.77679349	-28.77679349	24	No Data
758277	-28.77679349	-28.77679349	24	No Data
758315	-28.77091324	-28.77091324	32	No Data
758317	-28.77212322	-28.77212322	28	No Data
758318	-28.77557334	-28.77557334	19	No Data
758319	-28.78575374	-28.78575374	5	No Data
758320	-28.79274409	-28.79274409	10	No Data

The Mhlatuze River is generally targeted for irrigation-related activities. WARMS 2019 data for the area suggest no surface water users downstream of the site.

3.5 Depth to groundwater

According to DWAF (2006), the groundwater depth on a quaternary scale is in the order of 16.5 mbgl. WRC (2015) data suggest that the groundwater table ranges from 3 to 15 mbgl, for the sub-catchment. The literature further suggests that the groundwater table mimics the surface topography. Shallower groundwater levels will typically be associated with low-lying areas near the Mhlatuze River.

3.6 Wetlands and recognised water courses

The site falls within an area classified as a subtropical wetland (estuary) (Van Deventer, 2018). The estuary is classified as being poorly protected.

Triplo4 (2022) undertook a wetland assessment and identified wetlands within a 500 m buffer of the proposed transmission line. The wetland areas and water courses are shown in Figure 3-5.

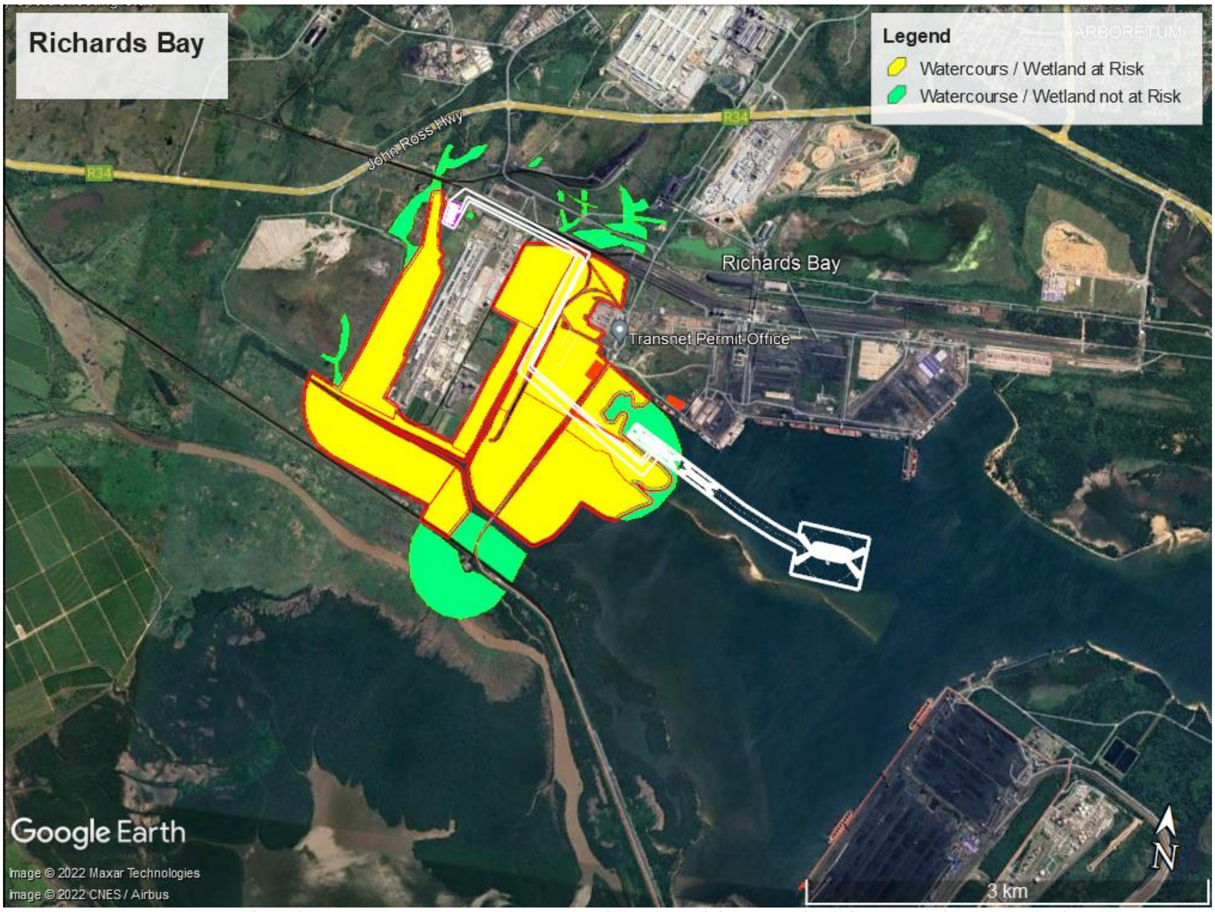


Figure 3-5: Wetland areas & watercourses identified by wetland specialists (Triplo4, 2022)

In terms of wetland geo-hydrology, baseflow is considered the most important contributor to wetland health. Baseflow (refer to Figure 3-6) is a non-process-related term to signify low amplitude high-frequency flow in a river during dry or fair-weather periods. Baseflow is not a measure of the volume of groundwater discharged into a river or wetland, but it is recognised that groundwater contributes to the baseflow component of river or wetland flow.

Available literature (WRC, 2015; DWAF, 2006) suggests groundwater contribution to baseflow ranges from 51.12 mm/yr [Pitman Model] to 131.37 mm/yr [Hughes Model], which relates to about 4 to 10% of the MAP.

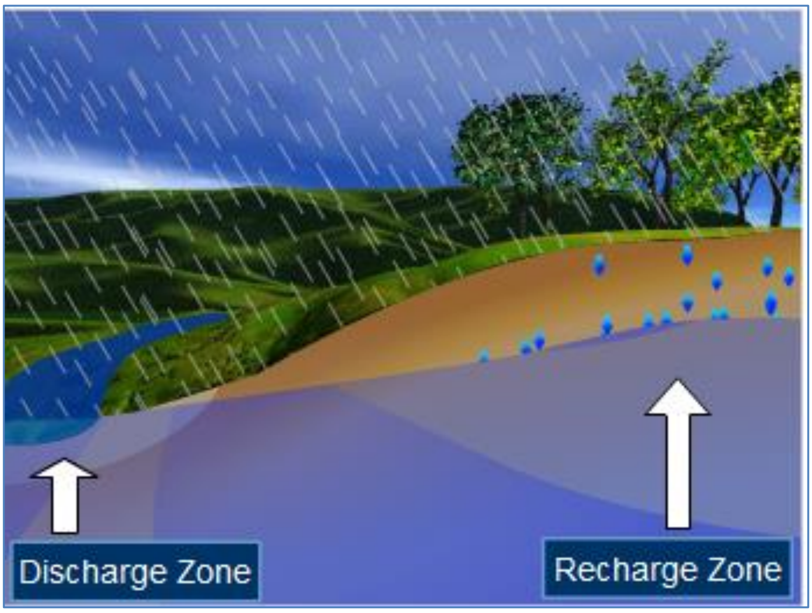


Figure 3-6: Groundwater baseflow concept (DWS, 2011)

3.7 Present ecological state (PES) and Ecological Importance and Sensitivity

The PES for quaternary catchment W21F is classified as Class C: Moderately Modified and the Ecological Importance and Sensitivity (EIS) as moderately sensitive (SANBI, 2011).

3.8 Overview of site hydrological cycle

Based on the information attained for the study area (as presented in this section), existing groundwater and surface water users, climate, runoff and estimated baseflow to wetland areas, a sub-catchment-specific hydrological cycle was developed (refer to Figure 3-7). *The impact of the proposed/existing activities at the site on the cycle was considered in the hydrological impact assessment.*

With regards to the hydrological cycle for the sub-catchment, the following is estimated:

- Average rainfall over the surface of HRU1 is in the order of 29.04 Mm^3/yr (50% of the total water budget);
- Average runoff accounts for a volume in the order of 2.42 Mm^3/yr (4.2% of the total water budget);
- The average groundwater contribution to baseflow to rivers/wetlands/streams is in the order of 1.16Mm^3/yr (2% of the total water budget);
- Evaporation accounts for a volume in the order of 21.8 Mm^3/yr (37.5% of the total water budget); and
- Groundwater use on a sub-catchment level accounts for 0.17 Mm^3/yr (0.3%) and surface water use accounts for 0 Mm^3/yr – very low volumes on a sub-catchment scale.

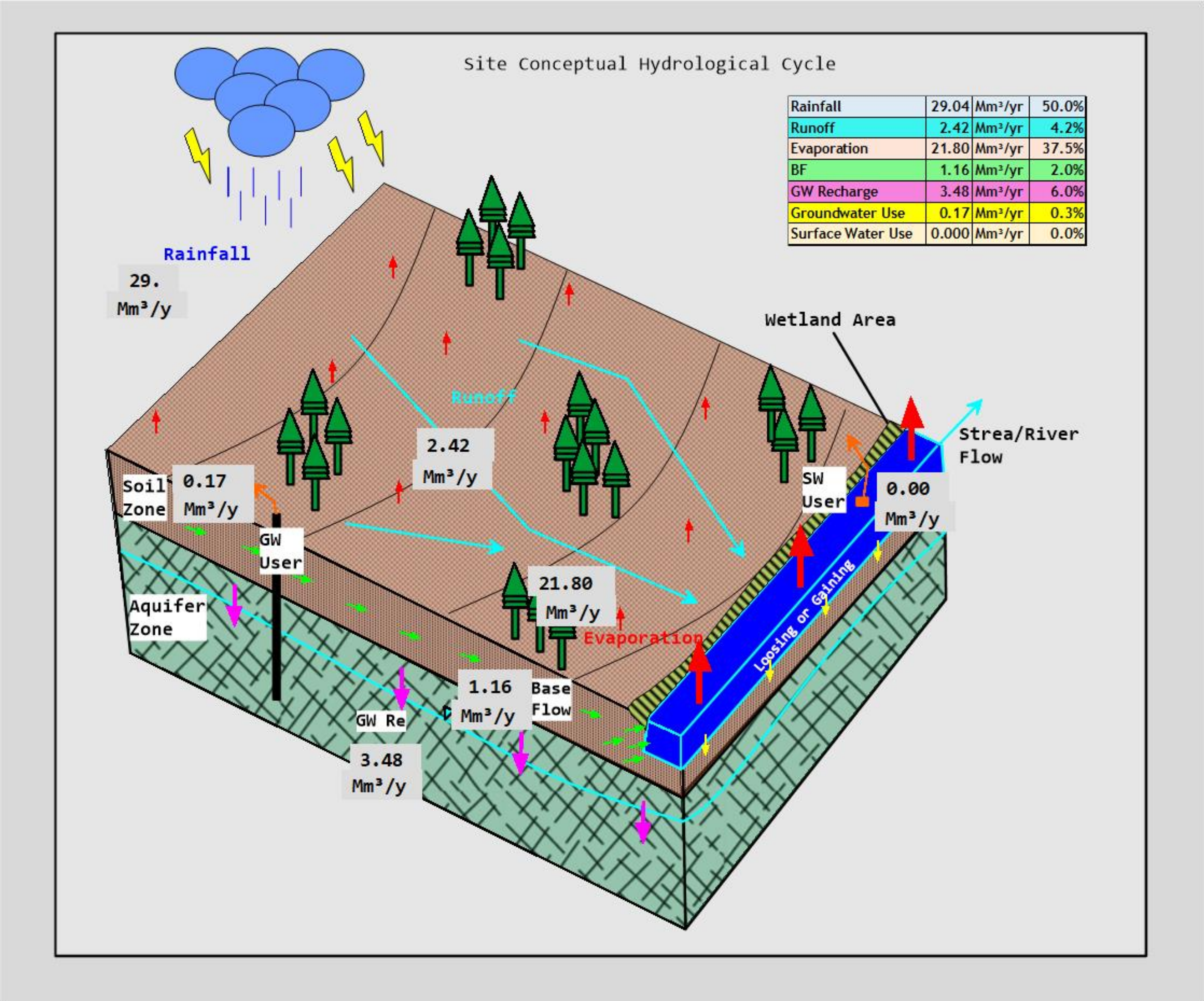


Figure 3-7: Simplified overview of the hydrological cycle at the site

4 WATER QUALITY

Literature suggests that the electrical conductivity (EC) for the rivers and streams associated with the project area and underlying aquifer generally ranges between 70 – 350 milli Siemens/meter (mS/m) and the pH ranges from 5 to 8. This indicates that water is generally suitable for domestic and recreational use (DWAF, 1996b); (DWAF, 2003); (King, Maritz, & Jonck, 1998).

5 FLOOD LINE ASSESSMENT

Peak floods in the Mhlatuze River adjacent to the proposed development at Richards Bay Port were calculated and listed in Table 5.1. Two river sections were modelled, eastern and western. Utility Programs for Drainage (UPD) software was used to derive peak flows using four different methods and after assessing the results, taking into consideration background knowledge of the methods, a peak flow that best suited all methods were chosen and input into GeoHECRAS (US Army Corps of Engineers, 2018). To be conservative, the Rational method was chosen to model the flood lines as it is the most widely used and generally accepted method for determining peak flows, and it was discovered that this method could be applied to catchments much larger than conventionally accepted (Pegram, 2003) (Smithers, 2012). The setup of the UPD software can be seen in Appendix A.

Table 5.1: Flood peak volumes calculated for the 10yr, 20yr, 50yr and 100yr return periods using different return periods.

Method	Eastern				Western			
	1:10yr	1:20yr	1:50yr	1:100yr	1:10yr	1:20yr	1:50yr	1:100yr
Rational Method (RM)	*357.33*	*443.01*	*575.29*	*707.03*	*152.44*	*189.04*	*245.57*	*301.92*
Unit hydrograph (UH)	167.68	229.44	336.36	452.02	53.71	73.96	109.57	148.75
Standard Design Flood (SDF)	278.12	389.81	553.90	690.06	140.62	197.09	280.05	348.89
Midgley and Pitman (Empirical)	185.09	251.19	348.14	440.69	79.02	107.24	148.63	188.13

5.1 Flood line modelling

5.1.1 Software

HEC-RAS 6.1 (September 2021) was used to model the flood elevation profile for the 1:50 and 1:100-year flood events. HEC-RAS is a hydraulic programme designed to perform one-dimensional hydraulic calculations for a range of applications, from a single watercourse to a full network of natural or constructed channels. The software is used worldwide and has consequently been thoroughly tested through numerous case studies.

5.1.2 Topography profile data

A triangulated irregular network (TIN) from the 30 m DTM (JAXA, 2022) forms the foundation for the HEC-RAS model and was used to extract elevation data for the river profile together with the river cross-sections. Furthermore, the TIN was used to determine placement positions for the cross-sections along with the river profile, such that the watercourse can be accurately modelled to the resolution of the provided topographical data. The positions of the river sections were further refined, by evaluating Google Earth Imagery and its correlation to the DTM elevations (i.e., does the actual position of a river/stream correlate to the sub-catchment drainage line generated).

5.1.3 Manning's roughness coefficients

Manning's roughness factor 'n' is used to describe the frictional characteristics of a specific surface. The selection of Manning's roughness factor is based on the surface characterisation of the river section being modelled. The surface characteristics investigated include vegetation cover and also the degree of meandering of the river. According to (Chow, 1959), meandering rivers can increase Manning's roughness factor by as much as 30%. A Manning's coefficient of 0.032 was chosen for the channel roughness and 0.045 for the left and right overbank.

5.1.4 Inflow and boundary conditions

Based on the HRUs and the confirmed drainage lines/streams in the project area, one (1) HEC-RAS river was defined, consisting of both normal depth (upstream) and critical depth slope boundary conditions. The normal depth slope was determined based on the ALOS DTM slope rise for the given sub-catchment drainage line.

5.1.5 Hydraulic structures

Hydraulic structures were not incorporated into the HEC-RAS model. The modelling of this hydraulic structure was hampered by the lack of good resolution topographical data (better than 30 m ALOS and 5 m contours).

5.1.6 Model assumptions

In line with the development of the flood lines, the following assumptions were made:

- The topographic data provided was of sufficient accuracy and coverage to enable hydraulic modelling at a suitable level of detail.
- The Manning's 'n' values used are considered suitable for use in the flooding events modelled, representing all the channels and floodplains.
- No abstractions or discharges into the stream sections were considered during the modelling.

- Hydraulic structures were not entered into the model due to the resolution of available topography data.
- Steady-state hydraulic modelling was undertaken, which assumes the flow is continuous at the peak rate; and
- A mixed flow regime that is tailored to both subcritical and supercritical flows was selected for running the steady-state model.

5.2 Flood Line Delineation

The delineated flood lines for the 1:10, 1:20, 1:50 and 1:100-year return periods for the Mhlatuze River that runs adjacent to the Richards Bay Port proposed development are presented in Figure 5-1 below. The aerial extent of the flood line reveals that there will be no impacts on the development, as the development falls outside the flood lines (> 500m away).

5.3 Site-specific sensitivity & buffers (avoidance areas)

The 1:100-year flood line area can be considered an exclusion area. With regards to downstream impacts (i.e. for the development portion outside the footprint of the flood line but directly downstream of the flood line), marginal impacts in terms of flood bank erosion or damage to infrastructure are expected. This is based on the flatter topography near the coastline, consideration of tide effects in inflowing surface water and calculated peak flows.

5.4 Limitations

Steady-state flood modelling was undertaken which is a conservative approach as it ignores the effect of storage within the system and therefore produces higher flood levels than would be expected to occur. A steady-state model will result in worst-case (conservative) estimates of flooding, and resultant flood levels and floodplain extents would decrease if unsteady state modelling were undertaken using an inflow hydrograph as opposed to continuous peak flow.

Despite the above mentioned, the Manning coefficients for the vegetation observed, and the low-resolution topographic data, the flood risk to the surface infrastructure has been adequately assessed for the project area.

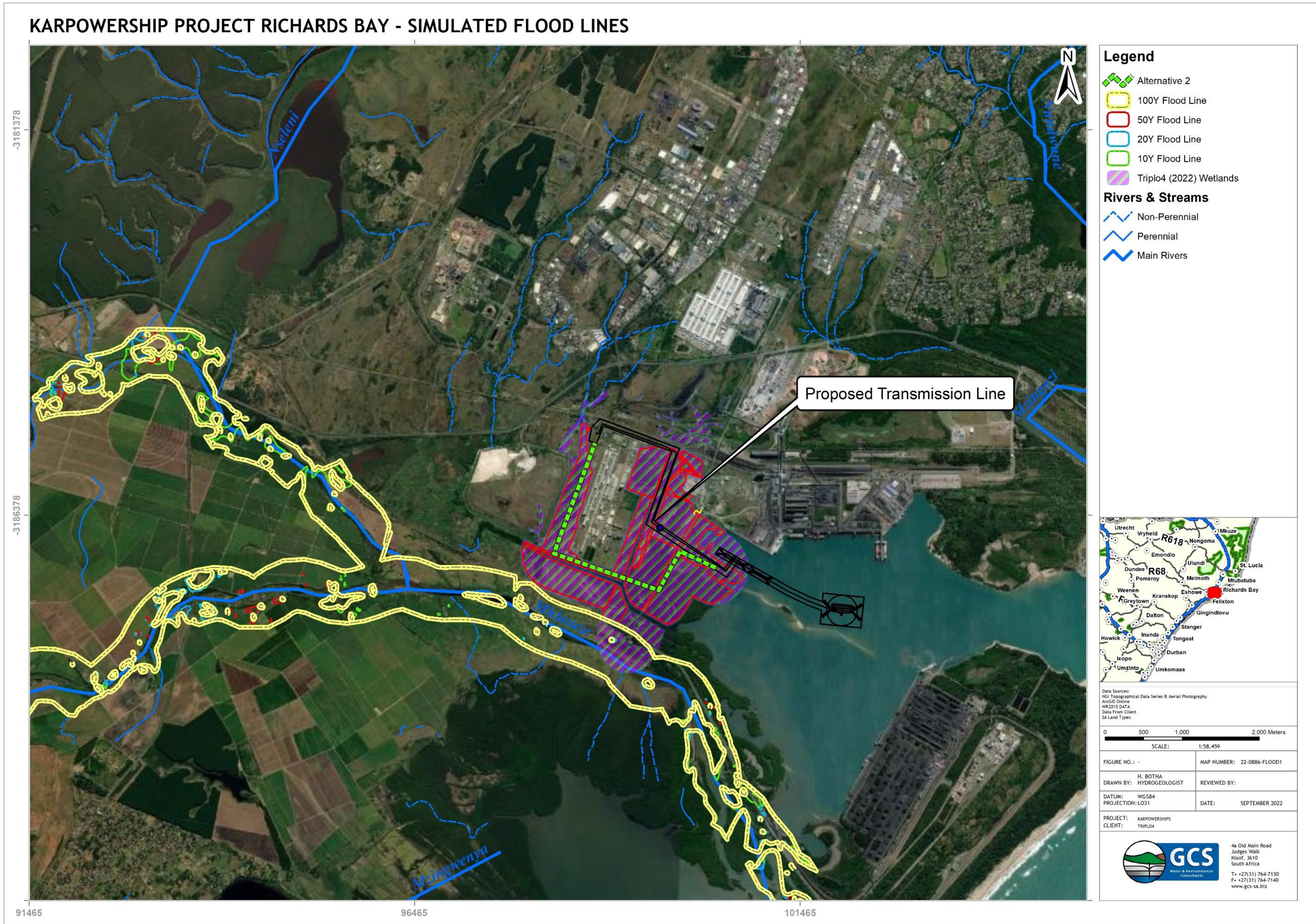


Figure 5-1: Delineated flood lines at the Richards Bay port

6 RISK AND MITIGATION ASSESSMENT

The anticipated hydrological risk concerning the construction and operation phase of the project was assessed. **As stated previously the study is limited to land-based activities associated with the project.** The SPR model (DWAF, 2008) was used to evaluate potential pollution sources and primary receptors within the study area.

Risk assessment entails the understanding of the generation of a hazard, the probability that the hazard will occur, and the consequences if it should occur. The net consequence is established by the following equation:

Consequence = (Duration + Extent + Irreplaceability of resource) x Severity

And the environmental significance of an impact was determined by multiplying consequence by probability. The risk significance rating is summarised in Table 6-1.

Table 6-1: Risk rating scale

Criteria	Rating Scales
Significance	Very high - negative (-49 to -66)
	High - negative (-37 to -48)
	Moderate - negative (-25 to -36)
	Low - negative (-13 to -24)
	Neutral - Very low (0 to -12)
	Low - positive (0 to 12)
	Moderate - positive (13 to 24)
	High-positive (37 to 48)
	Very high - positive (49 to 66)

Based on the available development layout plans the following will likely have an impact on the surface water bodies surrounding the site.

- Construction/preparation
  - The building of relevant surface infrastructure.
  - Areas will have to be cleared for construction lay down and to provide storage, ablution, and office space. This would expose bare soil and the soil will be “stockpiled” to be used to backfill the trench.
  - Construction vehicles will be constantly manoeuvring through the area, compacting the soil, and any mishaps or damages could cause leakages of fuel and oil from the vehicles.
  - Water from surface water bodies may be used for the washing of vehicles and other equipment, as well as for ablution purposes.

- Altering natural drainage lines may cause ponding or increased runoff patterns.
- Any flooding that occurs during this phase is likely to cause surface water contamination as soil and other debris are washed away into watercourses.

- Operational:
  - Alteration to natural flow processes due to the presence of infrastructure disturbing runoff patterns.
  - Hydrocarbon contamination associated with service vehicles.
  - Collapsible soils, as a result of backfilling development areas.
  - Switching station oil spillages (if constructed) will impact surrounding surface water bodies.
- Closure/decommission phase:
  - Similar impacts to the construction/preparation phase are expected.

6.1 Cumulative Impacts associated with similar projects

As the proposed activities will stretch over several sub-catchments and take place close to other proposed power development there will be cumulative impacts (however limited due to the project type).

The following similar projects are known to occur/are proposed within a 30 km radius of the study area (refer to Table 6-2).

Table 6-2: Similar projects within a 30km radius

Project name and description	Applicant
320MW Emergency Risk Mitigation Power Plant (RMPP) and associated infrastructure near Richards Bay. The Project site is to be located in Alton, near the Richards Bay Industrial Development Zone (IDZ). The facility will have an installed generating capacity of 320MW, to operate with liquified petroleum gas (LPG) or naphtha as an initial source and will convert to utilising natural gas once this is available in Richards Bay. EAP - Savannah Environmental	Phinda Power Producers (Pty) Ltd
RBGP2 400MW gas to power project at the RBIDZ 1F (proposed amendments to the existing Environmental Authorisation and EMPr). The scope includes 6 gas turbines for mid-merit/peaking plant power provision, with 2 steam turbines utilizing the heat from the engineers in a separate steam cycle, as well as 3 fuel tanks of 2000m^3 each for on-site fuel storage. EAP - Savannah Environmental	Richards Bay Gas Power (Pty) Ltd
Nseleni Independent Floating Power Plant - Port/ old Bayside complex. Floating gas powered power station made up of floating Combined Cycle Gas Turbine (CCGT) power plants and associated infrastructure for the evacuation of power from the NIFPP to the National Grid, in the Port of Richards Bay. Four Floating Power Barges generating a nominal 700 MW per barge resulting in 2 800 MW generation capacity. EAP – SE Solutions	Nseleni Power Corporation (Pty) Ltd and Anchor Energy (Pty) Ltd

Project name and description	Applicant
Eskom 3000 MV CCPP and associated infrastructure on Portion 2 of Erf 11376 and Portion 4 of Erf 11376 within the RBIDZ Zone 1D. The facility will operate with natural gas as the main fuel resource and diesel as a back-up resource. EAP - Savannah Environmental.	Eskom Holdings SoC Limited

Other proposed energy developments are situated in different drainage areas, rendering the likely impact associated with this project, zero. Any hydrological risk for this project will be confined to the delineated sub-catchments (worst case). Considering the sub-catchment conceptual hydrological cycle and the activities associated with the site and surroundings, no impacts are expected in terms of the hydrological cycle. This is due to the proposed site activities not significantly altering the hydrological functions of the given environment.

Table 6.3: Estimated hydrological risks (construction/preparation phase)

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance		Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	
Vadose zone soils.	Disturbing vadose zone during soil excavations/construction activities.	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	Only excavate areas applicable to the project area. Cover excavated soils with a temporary liner to prevent contamination. Retain as much indigenous vegetation as possible. Exposed soils are to be protected using a suitable covering or revegetating.	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-4)	Probable (1)	Neutral/ Negligible (0 to -12) (-4)	Medium
	• Exposure of soils, leading to increased runoff from cleared areas and erosion of the watercourses, and thus increased the potential for sedimentation of the watercourses. • Soil compaction; and • Soil erosion.	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low - negative (-13 to -24) (-20)	Water quality monitoring of the downstream surface water. Place drip trays under vehicles at the site. Visual soil assessments for signs of contamination (monthly)	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral/ Negligible (0 to -12) (-10)	Medium
Primary Surface Water Receivers > Non-perennial streams > Mhlatuze River > Wetland system (Watercourses)	Surface water contamination and sedimentation from the following activities: o Equipment and vehicles are washed in the water bodies (when there is water); o Erosion and sedimentation of watercourses due to unforeseen circumstances (i.e. bad weather); and o Alteration of natural drainage lines which may lead to ponding or increased runoff patterns (i.e. may cause stagnant water levels or increase erosion).	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low - negative (-13 to -24) (-20)	Install a temporary cut-off trench to contain poor-quality runoff (if required) Routine inspections of all infrastructure (monthly)	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral/ Negligible (0 to -12) (-10)	Medium

Table 6.4: Estimated hydrological risks (operational phase)

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance		Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	
Soil disturbance & erosion and sedimentation of nearby watercourses.	Transmission line installation areas that were backfilled with collapsible soils may cause soil subsidence.	Net Result of Earthworks and development	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	• Only excavate areas applicable to the project area. • Retain as much indigenous vegetation as possible.	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-4)	Probable (1)	Neutral/ Negligible (0 to -12) (-4)	Medium
Water quality degradation of nearby watercourses	switching station spillages (incidnets only)	Spillages from switching station may run off into watercourses or leach through the soil. (incidents only)	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	• Ensure maintenance of switching station to prevent spillages (i.e. incidnets).	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-4)	Probable (1)	Neutral/ Negligible (0 to -12) (-4)	Medium
	Leakages from vehicles occurring during transmission line maintenance	Poor quality overland runoff or seepage from hydrocarbon spills from vehicles parked at the site.	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (0 to -6) (-5)	Probable (1)	Neutral/ Negligible (0 to -12) (-5)	• Water quality monitoring of the nearby river if there are visual signs of any sedimentation or surface pollution.	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-4)	Probable (1)	Neutral/ Negligible (0 to -12) (-4)	Medium

7 SURFACE WATER MONITORING

As the risks associated with the project is low to neutral, limited monitoring is proposed. The proposed monitoring will specifically be required during the construction phase, with only visual observations proposed for the operational phase of the transmission line.

During the construction phase, it is recommended that all vehicles are in good working order when entering the site (i.e., visual observations of any leakages that may emanate from the vehicle accessing the site) and parked in designated areas with drip trays. Weekly inspection of vehicles should be sufficient.

As part of the monitoring, visual observations (i.e., monthly inspections and inspections shortly after rainfall events) of the banks associated with the non-perennial streams and rivers and the general conditions of the areas cleared, should be adequate to determine if there is any sediment runoff taking place or erosion. Appropriate erosion controls should then be implemented (i.e. placing of gabion mattresses, berms, trenches etc. as determined by the ECO).

From the risk assessment undertaken, there are very few groundwater and surface water-related risks associated with this project. No permanent monitoring is proposed nor is dedicated groundwater monitoring. Regular (monthly or during maintenance runs) visual assessments of the transmission lines and switching station should be sufficient (i.e. signs of oil spills, sediment runoff, switching station leakages etc.) to monitor potential pollution. Sampling the non-perennial, wetlands and perennial streams downstream of the site will help to determine if the repair/maintenance activities are impacting the surface water quality (only if visual observations support potential pollution).

8 CONCLUSIONS

Based on the investigation undertaken, the following conclusions are made:

- The study site falls within a summer rainfall region and experiences peak rainfall and evaporation in February.
- The MAP, MAE, and MAR for the quaternary catchment are 1 285 mm, 1 300 mm and 107.27 Mm^3, respectively.
- The aerial extent of the flood line reveals that there will be no impacts on the development, as the development falls outside the flood lines (> 500m away).
- The development does not fall within the 1:100-year flood lines. Section 144 of the National Water Act stipulates that no "permanent" facilities should be placed within the 1:100-year flood line does not apply to the project.

8.1 Avoidance areas and overcoming

Limited sedimentation and erosion for the drainage lines and streams associated with the site are anticipated. The flood lines also suggest a low flooding risk associated with the desktop delineated drainage lines for the project area, and that the proposed transmission lines are situated outside flooding areas. *The 1:100-year flood line should be considered an avoidance area (buffer area) (CSIR, 2005).*

8.2 Mitigation measures for inclusion in the EMPr

The following mitigation measures should be and can realistically be implemented as part of the EMPr to further reduce the risk of flooding on site and contribution to stormwater generation potential:

- During the construction phase, it is recommended that sandbags and temporary berms be used, to manage stormwater runoff (if storms do occur). Temporary stormwater systems should be sufficient to manage the stormwater at the site during the construction phase.
- Ensure that eroded areas are re-vegetated, to ensure reduced sedimentation risk and reduced runoff volumes to the streams.
- The Department of Environmental Affairs (DEA) published a generic Environmental Management Plan (EMPr) for substations and powerlines (22 March 2019). It is proposed that the mitigation and monitoring plan presented in this report be further supplemented by the generic EMP document.
- It is proposed that water monitoring be implemented as discussed in Section 7, and as required.

- To prevent erosion and deposition during construction use:
  - Minimise vegetation disturbance during construction.
  - Re-vegetate as soon as possible to establish and maintain good ground cover across the site.
  - Conduct regular inspections and maintenance of the site to ensure that vegetation cover is adequate, and no rivulets are generated.
- Stormwater management should focus on the following, for each site, before the work takes place:
  - **Assess the site constraints and any site-specific concerns, including:**
    - Specific vegetation that may need to be identified and/or isolated from the site disturbance.
    - Highly erodible soils may require additional erosion control measures.
    - The type of construction should consider landform. Avoid slab-on-ground construction on steep sites.
    - Up-slope drainage catchments that may need to be diverted around the work site.
    - Workspace limitations may require site-specific sediment control measures and/or the extensive use of skips or bins for material storage and waste management.
    - Expected rainfall intensity during the period of disturbance (wet season vs dry season).
  - **Stabilise the site entry/exiting points:**
    - A stabilised site access must be established and if possible, limited to one point only. The access allows for the construction vehicles to enter the work area of goods while preventing the unnecessary tracking of sediment onto the nearby environment from multiple locations. A stabilised entry/exit point normally consists of a stabilised rock pad.
  - **Prevent erosion & manage stockpiles:**
    - Suitable material storage areas must be located up-slope of the main sediment barrier (e.g. sediment fence).

    - Stockpiles kept on site for more than two weeks will require an impervious cover (e.g. builder's plastic or geofabric) to protect against raindrop impact. Stockpiles of sandy material located behind a sediment fence will only need a protective cover if the stockpiles are likely to be exposed to strong winds.
    - On steep sites and sites with limited available space, erodible materials may need to be stored in commercial-sized bins or mini-skips before use.
  - **Manage Site Waste:**
    - Adequate waste receptacles must be provided on-site and maintained in a way that potential and actual environmental harm resulting from such material waste is minimised.
    - Building activities must be carried out on a pervious surface, such as grass or open soil, or in such a manner that all sediment-laden runoff is prevented from discharging into a water body.

8.3 Reasoned opinion on whether the activity should be authorized

This assessment cannot find any grounds or identify high hydrological risks to not proceed with the development of the proposed transmission lines. This is grounded on the assumption that the proposed mitigation measures (Section 6), EMPr and EIA recommendations are implemented during the construction and operational phase of the transmission lines.

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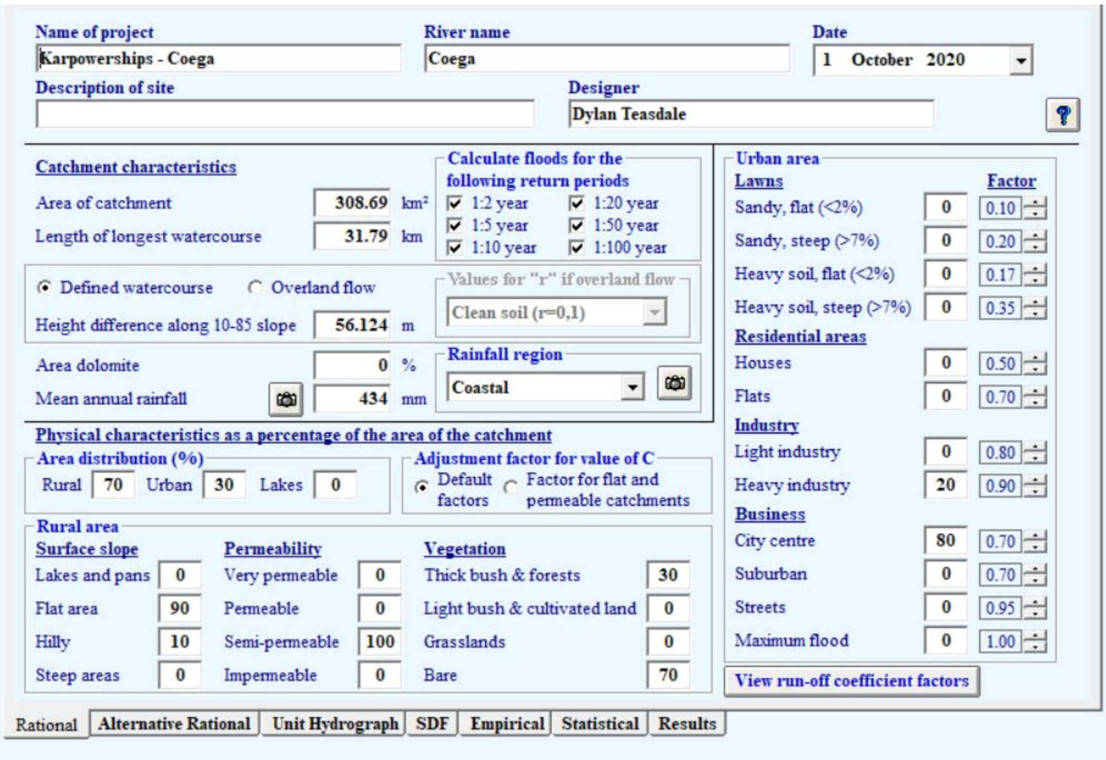
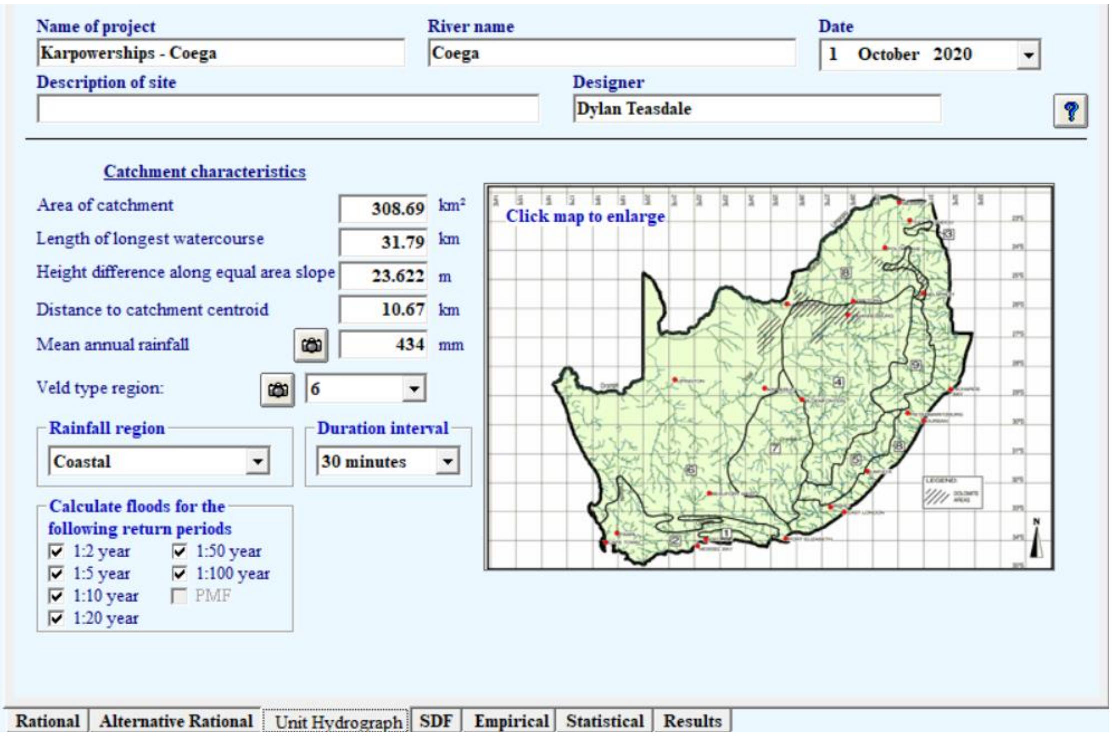
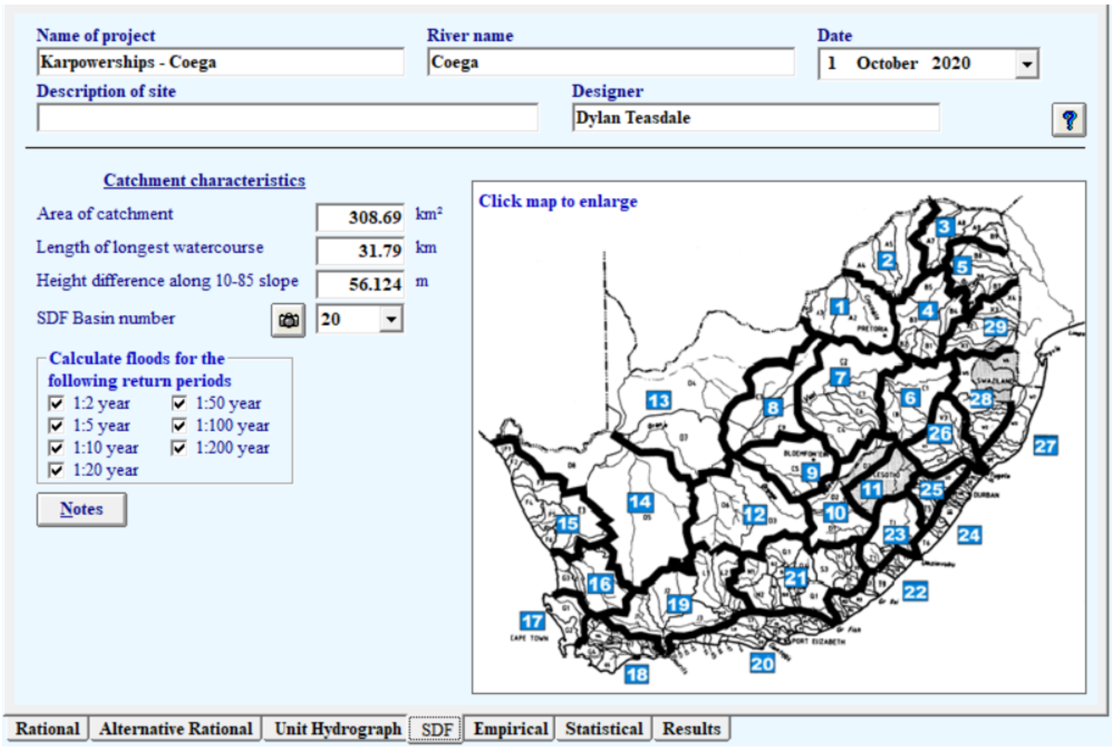
APPENDIX A: UPD SETUPS



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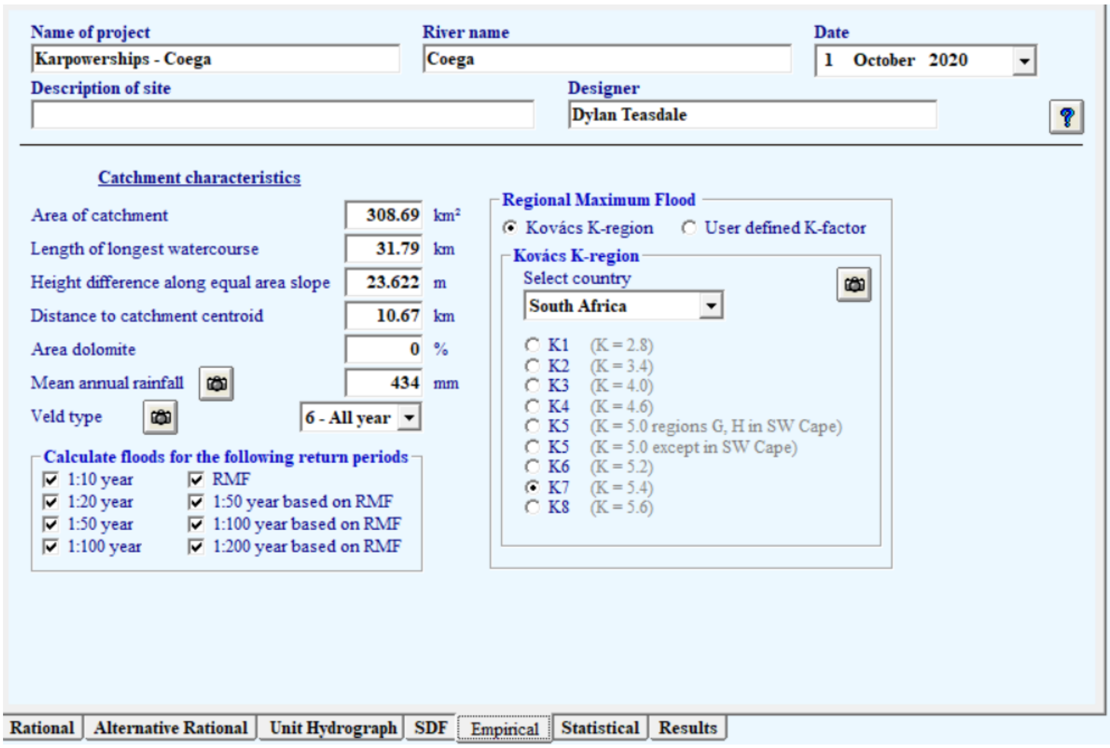
Karpowerships - Coega
River name
Coega
Date
1 October 2020
Description of site
Designer
Dylan Teasdale
Catchment characteristics
Area of catchment 308.69 km²
Length of longest watercourse 31.79 km
Height difference along 10-85 slope 56.124 m
SDF Basin number 20
Calculate floods for the following return periods
1:2 year
1:5 year
1:10 year
1:20 year
1:50 year
1:100 year
1:200 year
Notes
Click map to enlarge
Rational
Alternative Rational
Unit Hydrograph
SDF
Empirical
Statistical
Results


Name of project
Karpowerships - Coega
River name
Coega
Date
1 October 2020
Description of site
Designer
Dylan Teasdale
Catchment characteristics
Area of catchment 308.69 km²
Length of longest watercourse 31.79 km
Height difference along equal area slope 23.622 m
Distance to catchment centroid 10.67 km
Area dolomite 0 %
Mean annual rainfall 434 mm
Veld type 6 - All year
Calculate floods for the following return periods
1:10 year
1:20 year
1:50 year
1:100 year
RMF
1:50 year based on RMF
1:100 year based on RMF
1:200 year based on RMF
Regional Maximum Flood
Kovács K-region
User defined K-factor
Kovács K-region
Select country
South Africa
K1 (K = 2.8)
K2 (K = 3.4)
K3 (K = 4.0)
K4 (K = 4.6)
K5 (K = 5.0 regions G, H in SW Cape)
K5 (K = 5.0 except in SW Cape)
K6 (K = 5.2)
K7 (K = 5.4)
K8 (K = 5.6)
Rational
Alternative Rational
Unit Hydrograph
SDF
Empirical
Statistical
Results

APPENDIX B: DISCLAIMER AND DECLARATION OF INDEPENDENCE

The opinions expressed in this Report have been based on site /project information supplied to GCS Water and Environment (Pty) Ltd (GCS) by Triplo4 and are based on public domain data, field data and data supplied to GCS by the client. GCS has acted and undertaken this assessment objectively and independently.

GCS has exercised all due care in reviewing the supplied information. Whilst GCS has compared key supplied data with expected values, the accuracy of the results and conclusions are entirely reliant on the accuracy and completeness of the supplied data. GCS does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them.

Opinions presented in this report, apply to the site conditions and features as they existed at the time of GCS's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this report, about which GCS had no prior knowledge nor had the opportunity to evaluate.

APPENDIX C: DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Hydrological Assessment for the Proposed 132kV Karpowership Transmission Line – Richards Bay Port

SPECIALIST INFORMATION

Specialist Company Name:	GCS Environmental SA			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	2	Percentage Procurement Recognition	
Specialist name:	Hendrik Botha			
Specialist Qualifications:	MSc Environmental Sciences (Geohydrology & Geochemistry) BSc Hons. Environmental Sciences (Hydrology) BSc. Geology and Chemistry			
Professional affiliation/registration:	PR SCI NAT 400139/17			
Physical address:	1 Karbochem Road, Newcastle, KZN			
Postal address:				
Postal code:	2940	Cell:		
Telephone:	071 102 3819	Fax:		
E-mail:	hendrikb@gcs-sa.biz			

DECLARATION BY THE SPECIALIST

I, _Hendrik Botha, declare that –

- I act as the independent specialist in this application.
- I will perform the work relating to the application objectively, even if this results in views and findings that are not favourable to the applicant.
- I declare that there are no circumstances that may compromise my objectivity in performing such work.
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity.
- I will comply with the Act, Regulations and all other applicable legislation.
- I have no, and will not engage in, conflicting interests in the undertaking of the activity.
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken concerning the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority.
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

20/09/2022
3:51:22
Pr.Sci.Nat (400139/17)

Signature of the Specialist

GCS

Name of Company:

31 October 2022

Date

CV OF SPECIALIST

Hendrik Botha

Technical Director

CORE SKILLS

- Project management
- Analytical and numerical groundwater modelling
- Geochemical assessments and geochemical modelling
- Hydropedology and hydrological assessments
- Hydrology, floodline modelling & storm water management
- Groundwater vulnerability, impact, and risk assessments
- Technical report writing
- GIS and mapping

DETAILS

Qualifications

- BSc Chemistry and Geology (Environmental Sciences) (2012)
- BSc Hons Hydrology (Environmental Sciences) (2013)
- MSc Geohydrology and Hydrology (Environmental Sciences) (2014-2016)

Membership

- Groundwater Division of GSSA
- Groundwater Association of KwaZulu Natal Member
- International Mine Water Association (IMWA)

Languages

- Afrikaans - Speak, read, write.
- English - Speak, read, write.

Projects undertaken in

- South Africa
- Nigeria
- Namibia
- Liberia

PROFILE

Hendrik (Henri) Botha is currently the manager of the GCS Newcastle Office and occupies the role of principal hydrogeologist. Groundwater, geochemistry and surface hydrology, as well as knowledge of water chemistry together with GIS, analytical and numerical modelling skills, is some of his sought-after expertise. General and applied logical knowledge are his key elements in problem-solving.

Professional Affiliations:

SACNASP Professional Natural Scientist (400139/17)

Areas of Expertise:

- Waste classification and Impact Assessments
- Aquifer vulnerability assessments
- Geochemical sampling, data interpretation and modelling
- Geophysical surveys and data interpretation
- GIS
- Water quality sampling and data interpretation
- Groundwater impact and risk assessments
- Numerical and Conceptual Visual Modelling (Visual Modflow, ModflowFLEX, Voxler, RockWorks, Surfer and Excel)
- Hydropedology (Hydrological Soil Types) & Soils Assessments
- Floodline Modelling (HEC-RAS)
- Stormwater Management Systems and Modelling
- Surface Water Yield Assessments
- Water and Salt Balances

Page **1** of **8**

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/14/12/16/3/3/2007
Date Received:	02 November 2020

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

The Proposed Gas to Power Powership Project at the Port of Richards Bay, Umhlathuze Local Municipality, King Cetshwayo District, Kwazulu-Natal.

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	GCS (pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
Specialist name:	Hendrik Johannes Botha			
Specialist Qualifications:	MSc. Geohydrology and Geochemistry			
Professional affiliation/registration:	SACNASP Professional Natural Scientist (400139/17)			
Physical address:	74 Victoria Road Newcastle			
Postal address:	PO BOX 819 Gillits			
Postal code:	3603	Cell:	0711023819	
Telephone:	031 764 7130	Fax:	031 764 7140	
E-mail:	hendrikb@gcs-sa.biz			

2. DECLARATION BY THE SPECIALIST

I, Hendrik Johannes Botha , declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

GCS (pty) Ltd

Name of Company:

12/10/2022

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Hendrik Botha, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

GCS.

Name of Company

27-10-2022

Date

DATE AND SIGNATURE:

LEON PIETER BOTHA, MARRIAGE OFFICER AND COMMISSIONER OF OATHS, REG NO: BD 44601 CALEB MINISTRIES TRUST, TRUST: IT 4106/2009

Signature of the Commissioner of Oaths

2022-10-27

Date