HYDROLOGICAL IMPACT ASSESSMENT REPORT

WEST COAST RESOURCES (PTY)LTD

DMR Ref: NC0043-MR/102 AND NC0044-MR/102

7/28/2016

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Executive Summary

Letsolo Water and Environmental Services cc was appointed to conduct the Hydrological Impact Assessment Study for West Coast Resources (Pty) Ltd, hereafter referred to as WCR. WCR is a merger between Trans Hex Operations (Pty) Ltd, various companies and the Government Sector.

WCR intends to re-visit and mine a number of mines on the Namaqualand coast, particularly those in the existing mining licences for Koingnaas 475 and Samson's Bak 330.

Current Impacts from Existing Mining Activities.

Diamond mining itself does not require the use of hazardous substances, as it is mostly a physical process. The potential Hydrological Impacts Identified were rated low due to the arid conditions on site. WCR is re-establishing diamond mining in Koingaas area under the existing Environmental Authorisation of July 2012. The type of waste anticipated on site is General and industrial waste.

Sensitivities

The study area falls within Water Management Area 14(WMA 14) – Lower Orange. WMA14 includes the following major rivers: Ongers, Hartbees and Orange. The geographic extent of the Lower Orange WMA largely corresponds to that of the Northern Cape Province. It is situated in the western extremity of South Africa and borders on Botswana, Namibia and the Atlantic Ocean. According to the National Water Resource Strategy (2004), region's economy within the WMA14 depends extensively on mining and irrigation agricultural activities. Most of the mining activities are mainly extraction of alluvial diamonds and a variety of other minerals from locations both inland and along the coast.

Climate over the region is harsh semi-desert to desert. Rainfall is minimal, ranging from 400mm/a to as low as 20mm/a and is characterised by prolonged droughts. Because of the low rainfall, groundwater resources are also limited (National Water Resource Strategy, 2004).

The WMA14 has been dived into 3 sub-water management areas, which are Orange Coastal, Orange, and Orange Tributaries. For this specific study the sub area of interests is the Orange Coastal as all the quaternary catchments within the study area, namely F40A, F40D and F40F, fall in respectively.

Legislative Requirements

For this Hydrological Assessment, the principal act of relevance is The National Water Act, 1998 (Act 36 of 1998) which provides for the protection, usage, development, conservation, management and control of the country's water resources in an integrated manner. The Act provides the legal basis, upon which to develop tools and means to give effect to the protection of water resources.

The legal platform, on which the Hydrological Impact Assessment is based, is summarized briefly by the main legislation and Guidelines (prescribed by the Department of Water and Sanitation, previously known as the Department of Water Affairs and Forestry):

The study was conducted in line with the requirements of the National Water Act, 1998 (Act 36 of 1998) as well as the Best Practice Guidelines for the Protection of Water Resources and "Regulations 704" as published in Government Gazette, Volume 408, No 20119 of June 1999 (Also known as General Notice 704, 04 June 1999).

Area of Influence

The site falls within the F40A, F40D and F40F Quaternary Catchments. Five (5) site specific catchments were delineated in order to provide site specific storm water management measures. The delineated catchment areas are summarised as follows:

- Effective Catchment 1 (F40B, F40C and F40D)
- Effective Catchment 2 (F40E and F40F)
- F40A
- F40D
- F40F

Methodology

A holistic approach is followed whereby the project area was analyzed and compared against greater Water Management Areas (WMAs) and Quaternary Catchment Areas delineated by the Department of Water and Sanitation. During the early stages of the project, Desktop Assessment was conducted. During this phase, existing hydrological information was reviewed and assessed for relevance to the study area. Detailed investigations commenced in after the appointment.

A site visit was conducted in order to obtain an understanding of the hydrology in and around the site. Due to the nature of the water resources, no flow was observed at the nearby streams. Flood Calculations were conducted using the Standard Design Flood Method, in order to quantify the peak flows for Floodline delineation.

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GLOSSARY OF TERMINOLOGY

Catchment – The area from which any rainfall will drain into the watercourse or watercourses or part of the water course, through surface flow to a common point or common points.

Environment – The external circumstances, conditions and objects that affect the existence and development of an individual, organism or group; these circumstances include biophysical, social, economic, historical, cultural and political aspects. Environment means the surroundings within which humans exist and that are made up of-

(i) the land, water and atmosphere of the earth;

(ii) micro-organisms, plant and animal life;

(iii) any part or combination of (i) and (ii) and the interrelationships among and between them; and

(iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.

Hydrology. – The study of movement, distribution and quality of surface water and groundwater.

The Act – The National Water Act, (NWA) (Act 36 of 1998)

The Department – Means the Department of Water and Sanitation

Tributaries – A stream or river which flows directly into a larger river or stream.

Watercourse means -

(a) a river or spring;

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

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

(d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

Water quality – means the physical, chemical, toxicological, biological (including microbiological) and aesthetic properties of water that determine sustained (1) healthy functioning of aquatic ecosystems and (2) fitness for use (e.g. domestic, recreational, agricultural, and industrial). Water quality is therefore reflected in (a) concentrations or loads of substances (either dissolved or suspended) or micro-organisms, (b) physic-chemical attributes (e.g. temperature) and (c) certain biological responses to those concentrations, loads or physic-chemical attributes.

List of Abbreviations and Acronyms

/a	: Per annum
m^3	: Cubic meter
m^3/a	: Cubic meter per annum
BPG	: Best Practice Guideline
DWS	: Department of Water and Sanitation
EAP	: Environmental Assessment Practitioner
EIA	: Environmental Impact Assessment
EMP	: Environmental Management Plan / Programme
ha	: Hectares
IWULA	: Integrated Water Use License Application
IWWMP	: Integrated Water and Waste Management Plan
LoM	: Life of Mine
Mm	: Millimeter
MAP	: Mean Annual Precipitation
MAR	: Mean Annual Runoff
PCD	: Pollution Control Dam
SAWS	: South African Weather Services
WMA	: Water Management Area
WRC	: Water Research Commission

1. Introduction

Letsolo Water and Environmental Services cc was appointed to conduct the Hydrological Impact Assessment Study for West Coast Resources (Pty) Ltd, hereafter referred to as WCR. WCR is a merger between Trans Hex Operations (Pty) Ltd, various companies and the Government Sector.

WCR intends to re-visit and mine a number of mines on the Namaqualand coast, particularly those in the existing mining licences for Koingnaas 475 and Samson's Bak 330.

WCR is re-establishing diamond mining in Koingaas area (Koingnaas Mine) under the existing Environmental Authorisation of July 2012. Diamond mining itself does not require the use of hazardous substances, as it is mostly a physical process. However, management of waste on site may have an influence on storm water. The mine is focused on ensuring that all operations and facilities manage effluents, wastes, emissions and hazardous substances to prevent pollution.

The mining approach would involve the construction of cofferdams in the intertidal area to optimise the extraction of coastal diamond resources, an amendment of the current environmental authorisations over these mining rights areas is required. These Authorisations trigger the need for the Hydrological Impact Assessment Study. This report provides details relating to the methodology applied for the hydrological Impact Assessment as well as the findings made.

The identified potential Hydrological Impacts Associated with the proposed Diamond Mining Activity were categorised as follows:

- Sediment Transport;
- Alteration of Water Quality;
- Alteration of Catchment Characteristics

ll There potential impacts were rated low.

1.1 Details of specialist

(a) Details of the specialist who prepared the report;

Details of the specialist who prepared this report are summarised as follows:

Surname	: Phalane
First Names	: Ishmael Letsolo
Specialty	: Hydrology
Entity	: Letsolo Water and Environmental Services
Cell phone number	: 082 821 6621
Work telephone no.	: 012 321 0073
Identity no	: 800602 5393 082
Nationality	: South African
NQF Level 5	: Baccalaureus Technologiae: Civil Engineering
Professional Registration	: Engineering Council of South Africa Reg No. 201480763
	: Water Institute of South Africa
	: Institute of Directors of South Africa

(b) The expertise of that specialist to compile a specialist report including a curriculum vitae;

Mr Phalane has more than 13 years' experience in the field of Hydrological Engineering (Hydraulics, Water Quality and Quantity). Over the years Mr Phalane gained valuable experience in the implementation of the National Water Act, 1998 (Act 36 of 1998), National Water Resource Strategy, implementation of the General Authorizations as well as Water Use License Authorizations.

Mr Phalane has extensive experience in Hydrological Impact Assessment for Environmental Impact Assessments (EIA's), Environmental Management Program

Reports (EMPR's), Site Management Plans, Water Balance Calculations, Mine Closure Applications and Water Conservation/Demand Management Principles.

Mr Phalane was appointed as a Technical manager by the Department of Water and Sanitation (DWS) during the Revision of Government Notice 704 (GN704) for the period starting on the 10th of January 2013 and ending on the 31rst of December 2013.

Mr Phalane was also part of the technical team assessing the Water Use License Applications on Behalf of the Department of Water and Sanitation (Letsema Backlog Project). Specifically, to review Storm Water Management Plans (SWMP), Hydrological Impact Assessment Reports (HIAR), Water Quality Management Reports (WQMR), Integrated Water And Waste Management Plans (IWWMP) and Section 27 Water Use Motivations. Mr Phalane also compiled the Record of Recommendation to be considered and approved by the Director General (DWS), on behalf of the Regional Director (DWS) (01 April 2013 – 31 March 2014).

Mr Phalane was part of the negotiation team during the transfer of Sand-Vet Government Water Scheme to Sand Vet Water User Association in 2001.

In the field of Civil Engineering Mr Phalane gained valuable experience in calculation and analysis of hydrological data and liaison with different organizations in the private, governmental and international sectors, through negotiations with Irrigation Boards. He is practical and have the ability to, logically and strategically, resolve a problem and to work under pressure of a deadline.

As a director, Mr Phalane is involved in strategic decision making in line with the company's vision, mission and values to ensure long term sustainability of the company during the recession time and beyond by being competitive, by developing staff as well as personal development in top management.

In today's engineering industry, new technologies and practices are making a significant difference on how projects get delivered. But the application of new tools, technologies, and practices may seem confusing. With his extensive experience, Mr Phalane has the ability to assist.

2. A declaration that the specialist is independent in a form as may be specified by the competent authority;

I, Ishmael Phalane, act as the independent specialist. I declare that there are no circumstances that may compromise my objectivity in performing such work. I have expertise in conducting the Hydrological Impact Assessment specialist study and report relevant to the environmental authorisation applications.

I confirm that I have knowledge of the relevant environmental Acts, Regulations and Guidelines that have relevance to the proposed activity and my field of expertise and will comply with the requirements therein. 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 particulars furnished by me in this report are true and correct.

I realise that a false declaration is an offence in terms of regulation 48 of the National Environmental Management Act, 107 of 1998 (NEMA) and is punishable in terms of section 24F of the Act.

Signature of the environmental assessment practitioner:

Letsolo Water and Environmental Services cc

Name of company:

28 July 2016

Date:

3. An indication of the scope of, and the purpose for which, the report was prepared;

3.1 Scope of work

The Scope of work for the Hydrological Impact Assessment allows for the following:

- Identify Water Management Areas and Quaternary Catchment Areas in the Project area;
- Determine the current status of any surface water resources which are in the potential affected area or may be affected by the activities in terms of existing resource objectives, inclusive of water quality and in-stream flow;
- Flood line delineation;
- Develop and align the storm water management plan and water balance calculations in line with the Department of Water and Sanitation requirements.
- Review and update the surface water monitoring plan and parameters

3.2 Purpose of the Hydrological Impact Assessment

The Hydrological Impact Assessment is required to predict and quantify the potential impacts on surface water resources as well as to recommend reasonable mitigation measures. This Assessment is fundamental to the discipline of environmental management and is a requirement of environmental impact assessments (EIA), water use license applications (WULA), Environmental Management Programmes (EMP), mine closure plans and other studies.

In each instance there is a need to understand the future impact of a proposed / current activity and to then determine whether the management measures applied to that activity are appropriate or whether they should be modified. For the above reasons caution was fully exercised in applying hydrological impact prediction approaches and protocols developed to suit the regulatory environment.

4. The date and season of the site investigation and the relevance of the season to the outcome of the assessment;

A site visit was conducted on 23 June 2016. The purpose of the site visit was to obtain the understanding of current and intended activities in order to produce a site specific scope of work and clear deliverables.

No water quality samples were collected as the site investigation was undertaken during the dry season. No significant flow was observed on site nearby streams (Swartlintjies and Spoeg). Due to the nature of these streams, even during the wet season, flow is for a very short time.

5. A description of the methodology adopted in preparing the report or carrying out the specialised process;

A holistic approach is followed whereby the project area is analysed and compared against greater Water Management Areas (WMAs) and Quaternary Catchment Areas.

Desktop Assessment was conducted. During this phase, existing hydrological information was reviewed and assessed for relevance to the study area. A site visit was conducted in order to obtain an understanding of the hydrology in and around the site. Due to the nature of the water resources, no flow was observed during the assessment phase. Therefore, no water quality samples could be collected.

The specific process followed in the assessment is summarized as follows:

- Visual assessment of the site and obtaining an understanding of the hydrological conditions;
- Plotting of spatial data to asses hydrological characteristics;
- Building different computer models (for different applications) that represent the site as accurately as possible; and
- Analysing the models in order to obtain the most desirable outputs and deliverables.

There are different hydrological calculation methods that can be used to calculate flows and drainage in South Africa, the most common being:

- Rational method
- Alternative Rational method
- Unit Hydrograph method
- Standard Design Flood (SDF) method
- Empirical method

The Standard Design Flood (SDF) calculation method was selected as the most reliable method for the natural delineated catchments with a surface area exceeding 15km^2.

6. The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;

WCR has an existing converted mining rights and prospecting rights over the area. The Mining/Prospecting Rights and their portions comprise:

1. Koingnaas – reference number SNC 522 MRC
    a. Portion of remaining extent of the farm Somnaas No 474,
    b. Portion of the farm Koingnaas No 475,
    c. Portion of the farm Swartlintjies No 484,
    d. Adjacent Sea Strips now described as unalienated state land, Portion of the Farm Langklip No 489,
    e. Portion of the farm Mitchels Bay No 495 and adjacent Sea strips now described as state land.
2. Samson's Bak - reference number SNC 525 MRC
    a. Portion of the farm Elandsklip 333,
    b. Portion of the Farm Koignaas 475

c. Portion of the farm Noup 473,
d. Portion of the farm Samson's bak 330,
e. Portion of the farm Schulpfontein 472,
f. Portion of the Remaining Extent and Portion 1 of the farm Somnaas 474 and
g. Portion of the farm Zwart Dunnen 332

6.1 Study Area/Site location

West Coast Resources is situated within the jurisdiction of South Africa, west coast in Nama Khoi Local Municipality, Richtersveld Local Municipality and Kamiesberg Local Municipality, Namakwa District Municipality in the Northern Cape area.

WCR is re-establishing diamond mining in Koingaas area under the existing Environmental Authorisation of July 2012. The operation of the mining activities will take place on Samson Bak Complex MR (farm Elnadsklip 333, Koingnaas 475, Noup 473, Samson's Bak 330, Schulpfontein 472, Zwart Dunnen 332 and Somnaas 474) and the Koingnaas Complex MR (farm Langklip 489, Mennels Vley 321, Koingnaas 475, Somnaas 474, Mitchell's bay 495 and Zwartlintjes River 484) within Namakwa District Municipality in the Northern Cape, South Africa.

West Coast Resources cover an area of 97 000 ha. West Coast Resources will have two plants in its operation of mining Alluvial Diamond during its life span. The plants will be situated on farm Koingnaas 475 and Mitchell's Bay 495 at West Coast Resources.

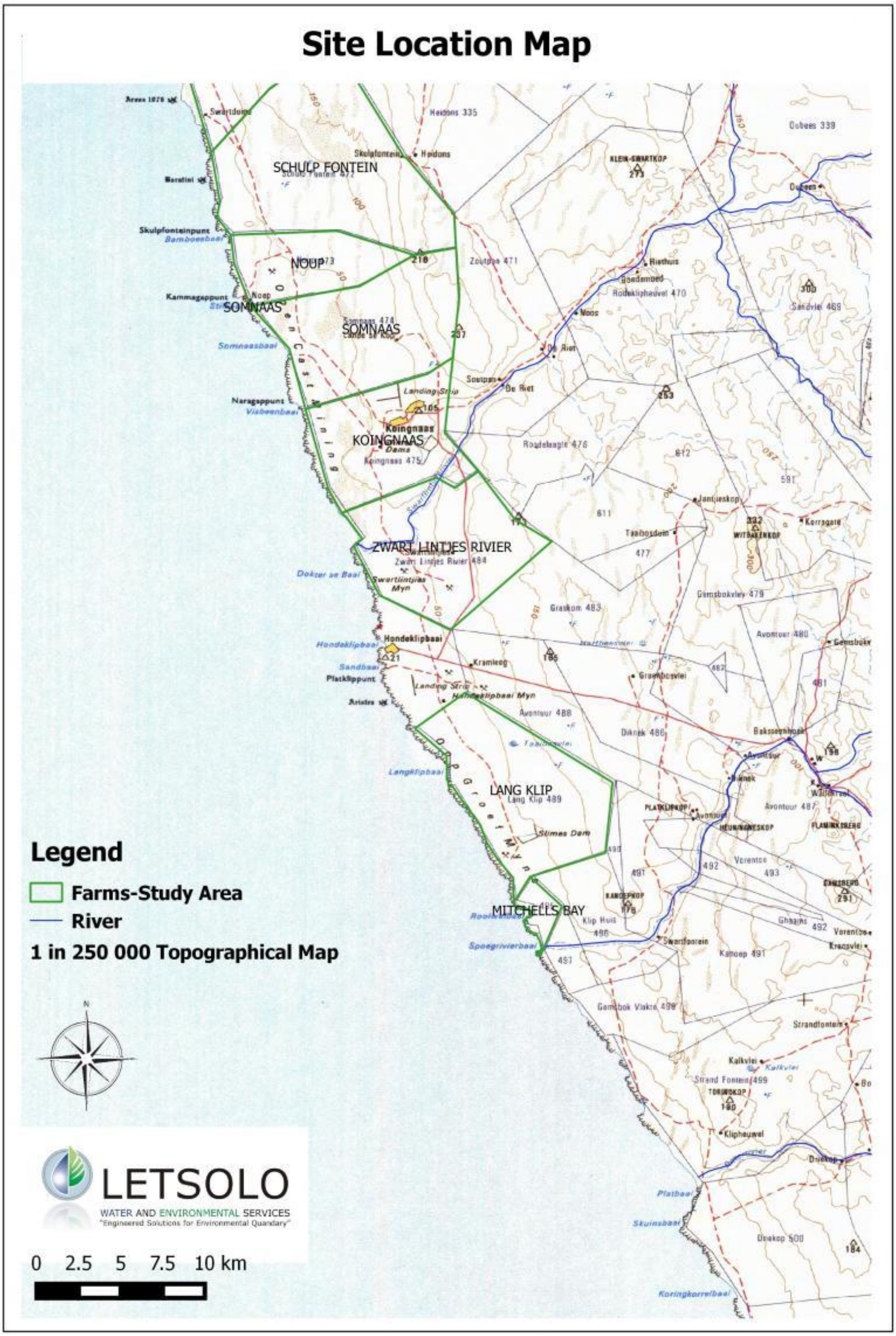


Figure 6.1-1: Site Location Map

6.2 Existing infrastructure

West Coast Resources is an existing mine which previously was under De Beer Consolidation Limited mine (Namaqualand mines), mining the alluvial diamond. When West Coast Resources (Pty) Ltd purchases the mine the existing structures was part of package.

The current activities are located as follows:

- Processing Plant located on the Remainder of the farm Koingnaas 475 and on the remainder of the farm Mitchell's Bay 495,
- WCR Buildings;
  - Administration buildings consisting of gate house, offices, first aid facility, parking bays, etc.;
  - Service buildings consisting of stores, weighbridge, substations, security kiosks, pump stations, access control building and emergency vehicle garage;
  - Workshop complex consisting of main workshops, workshop machinery/equipment, wash bay, tyre workshop, bulk fuel storage depot, light delivery vehicle workshop, etc.;
- Main entrance and access road;
- Haul roads;

6.3 Proposed Infrastructure

Over and above the existing infrastructure, the following mine related infrastructure will be required:

- Diversion berms and trenches, Slimes damsReturn Water / Pollution control dams (PCDs);

As indicated in **Figure 6.3-1**, all infrastructures which may have a potential impact on surface water resources were assessed. The hydrological characteristics of these activity areas are discussed further in the report.

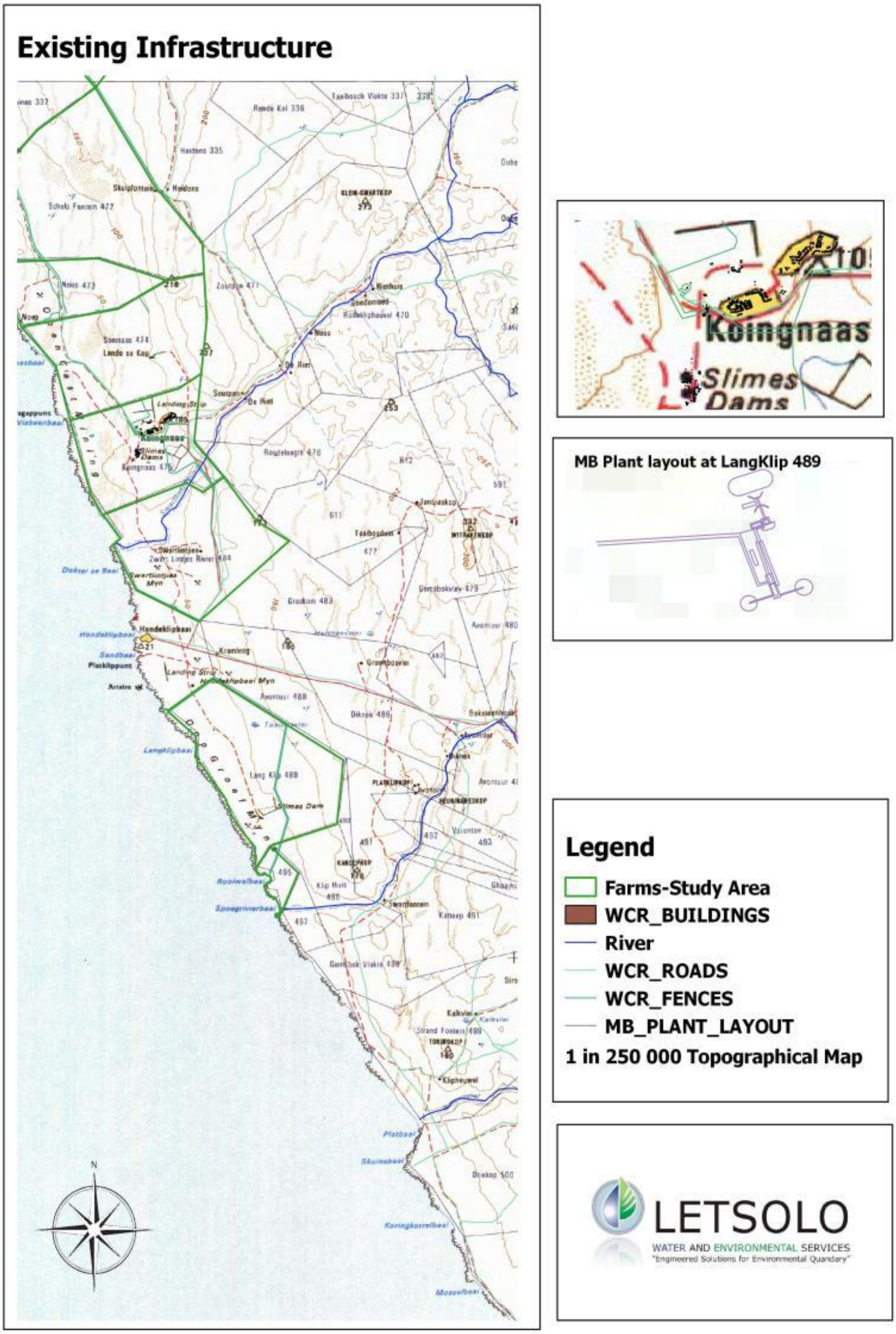


Figure 6.3-1 : Proposed Infrastructure

6.4 Catchment Analysis

The existing River systems in relation to the proposed project site are categorized in 3 Tiers as follows:

- Tier 1 : Water Management Area 14
- Tier 2 : Quaternary Catchment
- Tier 3: Site specific Catchment Areas

The WMA and catchment areas are discussed in detail below.

6.4.1 Source of Hydrological data

The following data, data sources, software, and methods were used in the assessment:

- Department of Water and Sanitation Hydrological Information Systems (B7E006):
    - Rainfall;
    - Evaporation;
- 1:50 000 topographical data (National Surveyor General) including the following:
    - Contours and
    - Rivers;
- The Utility Program for Drainage over South Africa (UPD) (SINOTECH, 2007):
- Google Earth Pro;
- Client data in the form of:
    - Total Project boundary;
    - Site specific boundaries;

6.4.2 Water Management Area (WMA14) – Lower Orange

The study area falls within WMA 14 – Lower Orange. WMA14 includes the following major rivers: Ongers, Hartbees and Orange.

The geographic extent of the Lower Orange WMA largely corresponds to that of the Northern Cape Province. It is situated in the western extremity of South Africa and borders on Botswana, Namibia and the Atlantic Ocean. According to the National Water Resource Strategy (2004), region's economy within the WMA14 depends extensively on mining and irrigation agricultural activities. Most of the mining activities are mainly extraction of alluvial diamonds and a variety of other minerals from locations both inland and along the coast.

Climate over the region is harsh semi-desert to desert. Rainfall is minimal, ranging from 20mm/a to a 400mm/a and is characterised by prolonged droughts. Because of the low rainfall, groundwater resources are also limited (*National Water Resource Strategy*, 2004).

The WMA14 has been dived into 3 sub-water management areas, which are Orange Coastal, Orange, and Orange Tributaries. For this specific study the sub area of interests is the Orange Coastal as all the quaternary catchments within the study area, namely F40A, F40D and F40F, fall in respectively.

6.4.3 Quaternary Catchments (F40A, F40D and F40F)

A catchment, in relation to a watercourse means the area from which any rainfall will drain into the watercourse or part of the water course through surface flow to a common point, or points (National Water Act, 1998, Act 36 of 1998).

The site falls within the F40A, F40D and F40F Quaternary Catchments.

6.4.4 Significant Surface Water Resources

The proposed mining activities are located in an arid area where there is little surface water resources.

According to the National Water Resource Strategy (2004) the Lower Orange WMA14 is impacted by upstream development, since it lies further downstream of five water management areas covering the Orange/Vaal basin. There are extensive inter-catchment transfers between most of these areas. For example the F40D quaternary catchment receives water from F40B quaternary catchment where the Swartlintjies River originates.

The study area lies in the F40A, F40D and F40F quaternary catchment regions that are draining to the sea with two significant non-perennial rivers, namely the Swartlintjies and the Spoeg River. However the study area lies mostly in F40A and F40F catchments.

The flow characteristics of the Swartlintjies and the Spoeg Rivers are epheral (Short lived). This makes it difficult to have 12 months of water quality data in any given year. Water quality samples can only be collected during the wet season and shortly after a significant storm event.

6.4.4.1 Swartlintjies River

The Swartlinntjies River originates in the high ground of the escarpment, between Springbok and Kamieskroon. The River makes its way south westward, through Koignaas and into the Atlantic Ocean. An estuary is present at the mouth which is situated 6km north of Hondeklip Bay.

The Swartlintjies River traverse through the two quaternary catchments, F40B (draining in the South Westerly direction) and F40C (draining in the North Westerly direction), to the F40D catchment where Swartlintjies river transverse Koingnaas farm 475 to Zwartlintjies River 484 farm before it discharges to the sea in the south westerly direction. The river is 70 km long in extent from F40C while it extent to 64km from the F40B.

Due to the extent of the effective catchment area, strong flow can occur after prolonged rains. But the River is usually dry. Except for a few pools of standing water (as indicated in Picture below) , due to the high water table towards the mouth of the River.

Picture 6.4.4.1-1: Swartlintjies River Upstream of Hondeklip Bay

6.4.4.2 Spoeg River

Originating in the F40E catchment is the non-perennial Augabies River flowing north westerly then south for 44.2km before it discharges to non-perennial Spoeg River within this catchment. The Spoeg River arises in the high ground of the escarpment near Garies. This River drains in a north west and then west towards the Atlantic Ocean at Mitchell's Bay.

The Spoeg River then flows in the north westerly direction again for 28.9 km within F40E catchment to drain into the F40F catchment where it continues to flow for 22.5 km in south westerly then west direction traversing the southern part of Mitchell's Bay 495 farm to discharge at the Sea/ Atlantic Ocean.

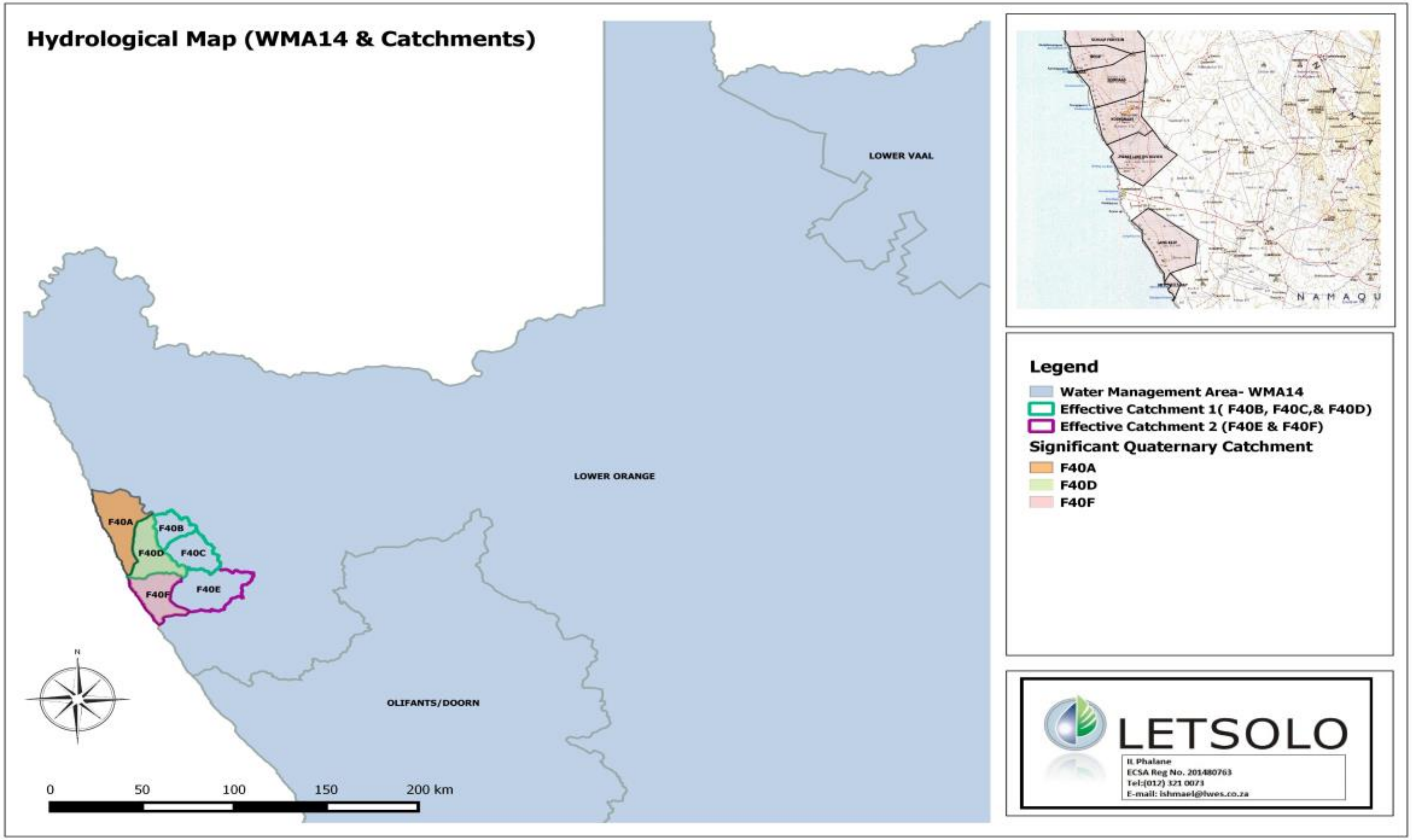


Figure 6.4.4.2-1: Hydrology Map (WMA14 and F40A, F40D, and F40 F Catchment)

6.5 Catchment Hydrology

The Department of Water and Sanitation (Hydrological Information System) was consulted in order to retrieve Hydrological data. Historic data for DWS Station F4E001, which is located in Hondeklip Bay area, was used for this assessment.

Table 6.5-0-1: Department of Water and Sanitation nearby Rainfall and Evaporation Station

Station Identity	Place	Latitude	Longitude
F4E001	Hondeklipbaai	30.31693	17.28269

6.5.1 Mean Annual Precipitation

Different rainfall data sources exist and data sets throughout the universe. All the sources have their own disadvantages and advantages. For the purpose of this study, hydrological information system from Department of Water and Sanitation (Hydrological Information System) was consulted in order to retrieve Hydrological data. Historic Hydrological data for Hondeklipbaai (F4E001) for a period starting on October 1964 and ending on September 1998 was used.

Mean Annual Precipitation (MAP) is representative of the average rainfall that occurs over an area during any given year. This rainfall is obtained by taking the total rainfall received over time at a specific point including any extreme periods and/or events and averaging it.

The rainfall data in table 5 shows that the study area experience low average rainfall between January and March, with the lowest average of 1.08 mm in January. The rainfall maximum average of 19.23 mm is experienced in June, with the high averages ranging between June and August.As indicated in Table 6.5.2.1, the site MAP is estimated at 108.46 mm

6.5.2 Mean Annual Evaporation

There is much less evaporation data that exists than data for rainfall and runoffs, however it is necessary to analyze the Mean Annual Evaporation (MAE). Evaporation is measured at dams and mostly stations that are operated by the department of Water and Sanitation (DWS), which provide such data used to interpret the monthly evaporation data for this specific study area. Same source as rainfall data was used, Hydrological data from Hondeklipbaai (F4E001), to obtain evaporation data.

Results shown in Table 6.5.2-1 below indicate that between May and July there is less average evaporation, with the minimum of 97.05 mm experienced in July. The higher averages are in November, December and in January, with the maximum of 213.96 mm in January.

As indicated in Table 6.5.2-1 and Figure 6.5.2-1, the site MAE is estimated at 1 775.89 mm.

Table 6.5.2-1: Rainfall and evaporation data

Description	Rainfall (mm)	Evaporation (mm)
Oct	8.34	165.95
Nov	6.61	197.04
Dec	5.47	211.39
Jan	1.08	213.96
Feb	2.80	168.25
Mar	3.52	158.43
Apr	10.08	121.37
May	11.84	109.91
June	19.23	97.08
Jul	16.42	97.05
Aug	14.44	107.81
Sep	8.63	127.65
Annual	***108.46***	***1775.89***

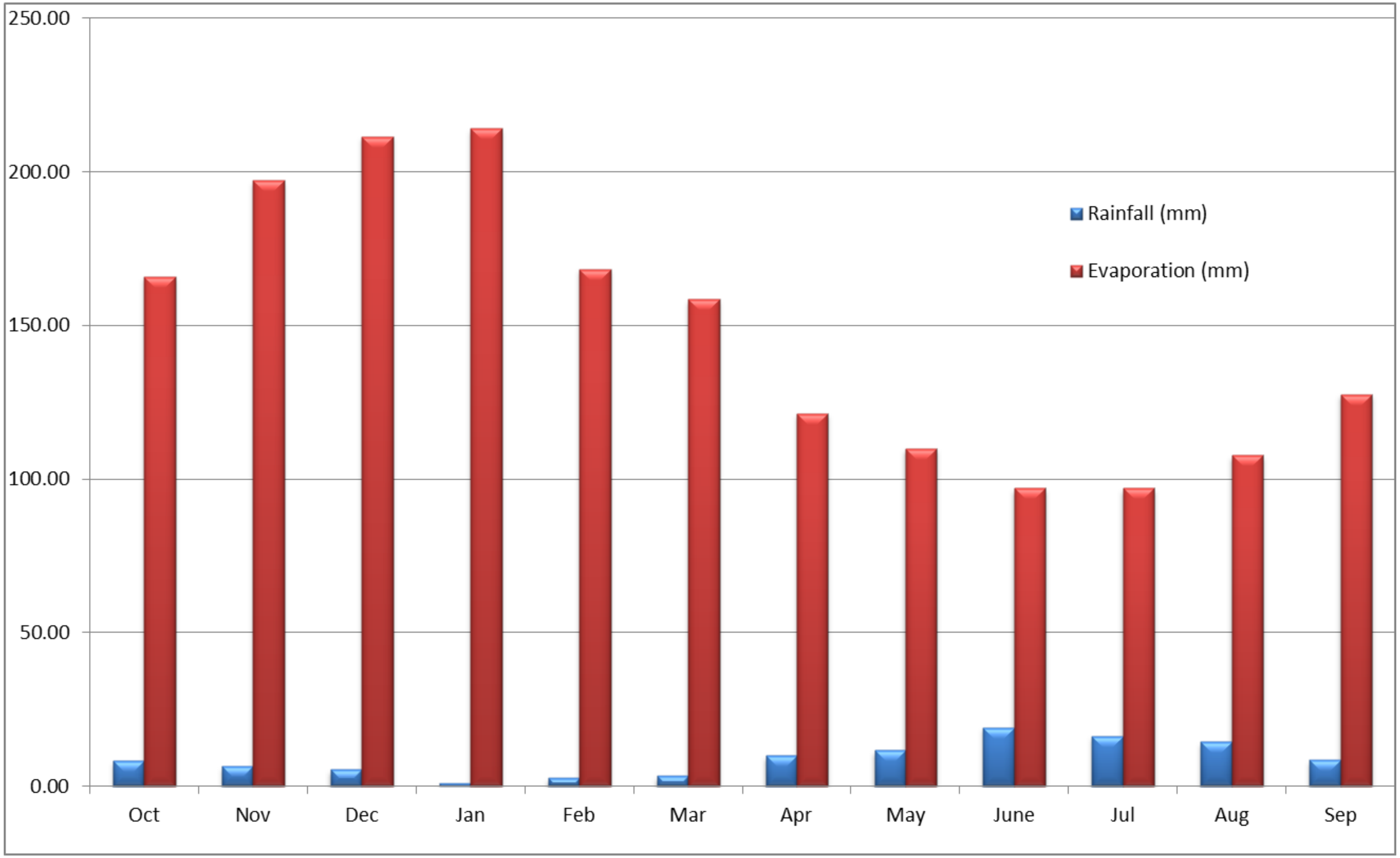


Figure 6.5.2-1: Rain and evaporation data (Hondeklipbaai (F4E001)).

6.5.3 Mean Annual Runoff

Runoff is the result of precipitation (rainfall) falling on a catchment and eventually running off from the catchment. The amount of rainfall that runs off is dependent on the catchment characteristics. Due to the complex nature of rainfall-runoff modeling it is not deemed necessary to set up specific models for small mining catchments (BPGs). Letsolo Water adopts a holistic approach and methodology whereby WR2005 quaternary catchment runoff data is downscaled to site specific runoff data by making use of area and volume relationships as well as a rainfall reduction factor.

The Mean Annual Runoff (MAR) calculations are highly dependent on the surface area. Runoff figures were analyzed statistically in a similar manner as rainfall. The MAR for the study area was sourced from the Water Research Commission database (WR2005). Table below provides activity based MAR and the quantified impact on the Effective and Quaternary Catchment Areas.

Table 6.5.3-0-1: MAR for DWS Catchment Areas

Description	Surface Area (km^2)	Catchment MAR (mm/annum)	Calculated MAR (m^3/annum)
Effective Catchment (F40B, F40C n F40D)	**1753**	**2.4**	**4 207 200**
Effective Catchment (F40E n F40F)	**1747**	**2.4**	**4 192 800**
F40A	1016	0.4	**406 400**
F40D	740	0.4	**296 000**
F40F	683	0.4	**273 200**

The table 6.5.3-1 above show the extent of the effective catchment within the study area to receive water from the upstream rivers.

Picture 6.5.3-1: Sandy Areas resulting in low MAR

Table 6.5.3-0-2: MAR for site infrastructure

	Farm Location	Latitude	Longitude	Surface Area (km^2)	Catchment MAR (mm/annum)	Calculated MAR (m^3/annum)
Slime Dams	1. Somnaas 474	30° 10' 2.64" S	17°13'57.72" E	0.89	0.4	**356**
	2. Somnaas 474 and Koingnaas 475	30° 9' 51.48" S	17°14'54.24" E	0.758	0.4	**303.2**
	3. Koingnaas 475	30° 11'54.24" S	17°14'39.84" E	2.07	0.4	**828**
	4. Koingnaas 475	30° 12'46.08" S	17°17'46.32" E	1.52	0.4	**608**
	5. Koingnaas 475 and Zwartlintjies 484	30° 14' 7.8" S	17°16'9.48" E	1.85	0.4	**740**
	1. Lang Klip 489	30° 22'34.68" S	17°19'18.84" E	1	0.4	**400**
	2. Lang Klip 489	30° 25'36.48" S	17°20'30.84" E	2.62	0.4	**1048**
	3. Lang Klip 489	30° 25' 5.16" S	17°21'12.96" E	1.71	0.4	**684**

6.6 Water Balance

The Water Balance (WB) of a development project is used to illustrate the cumulative flow of water through the system. The system comprises of many different individual components which each comprise of their own significant flows. The WB aims to ultimately provide cumulative flow for each component within the system.

The purpose of water balance calculations include:

- Providing the necessary information that will assist in defining and driving water management strategies.
- Auditing and assessment of the water reticulation system, with the main focus on water usage and pollution sources. This includes identifying and quantifying points of high water consumption or wastage, as well as pollution sources. Seepage and leakage points can also be identified and quantified when the balances are used as an auditing and assessment tool.
- Assisting with the design of storage requirements and minimizing the risk of spillage.
- Assisting with the water management decision-making process by simulating and evaluating various water management strategies before implementation.
- Paragraphs 6.6.1 – 6.6.4 seeks to provide the necessary guidance for the continuous management of water reticulation systems.

6.6.1 Clean water catchment area

Runoff from the clean water catchment will be allowed to freely flow back to the environment. Rainfall was regarded as the source of the clean water.

The results presented in Paragraphs 5.3.1 to 5.3.6 above, were used to interpolate the Peak Flows and Mean Annual Runoff for the underground working area. The hydrological characteristics of these areas are summarised as follows:

6.6.2 Dirty Water

Dirty Water Management will take into account GN704 guidelines relating to water management in mines. In general the on-site surface water management will maintain the activity footprint as small as possible, separate clean and dirty water runoff, prevent clean water runoff flowing onto the activity footprint and prevent dirty water runoff from the activity area from entering clean water runoff areas.

6.6.3 Water sources

Sea water will be abstracted and used at the plant.

6.6.4 Natural losses

Evaporation losses were calculated based on the estimated 1775.89 mm/annum.

6.6.5 Operational Assumptions

The following operational assumptions were made:

- Storage dam will be placed at the open-cast mining area, to collect seawater to be used at the plant. Seawater is abstracted for processing diamond mining and released back to the sea.
- PCD dam to be located at the lowest elevation of the operational area- screening plant facility, with 100m by 100m dimensions

6.6.6 Water balance calculations

Rainfall and evaporation data was used to quantify the annual rainfall and evaporation in cubic meters per annum (m^3/annum). Water use philosophies are summarised as follows:

Natural water sources are as follows:

- Rainfall (mm) was multiplied by the surface area and the runoff coefficient to determine the runoff for the following area:
  - Slimes dam area (Disposal area)
  - Water Return Dam (WRD)/ Pollution Control Dam (PCD) (Operational area)
- Direct rainfall in the recommended PCD was quantified using rainfall data and surface area of the dam.

Water requirements identified

- Dust suppression water as discussed in paragraph 7.2.2 above.

Natural Water loses

- Evaporation losses were quantified by multiplying evaporation with the surface area of exposed water storage areas.
- Plant losses

6.6.7 Component Water circuit

Water balance calculations were conducted for each component as summarised in the tables below:

Table 6.6.7-1: Processing plant water balance

Water-Balance	**Source: Water-In (m^3/annum)**		**Loss: Water-Out (m^3/annum)**		
Description	**Seawater-Storage dam**	**Return Water from PCD/RWD**	**RWD/PCD**	**Slime Dams**	**Plant losses**
Screening Plant	3120000	716065	1223040	2496000	117025
Total (m^3/a)	**3836065**		**3836065**		
Surplus/Deficit	**0**				

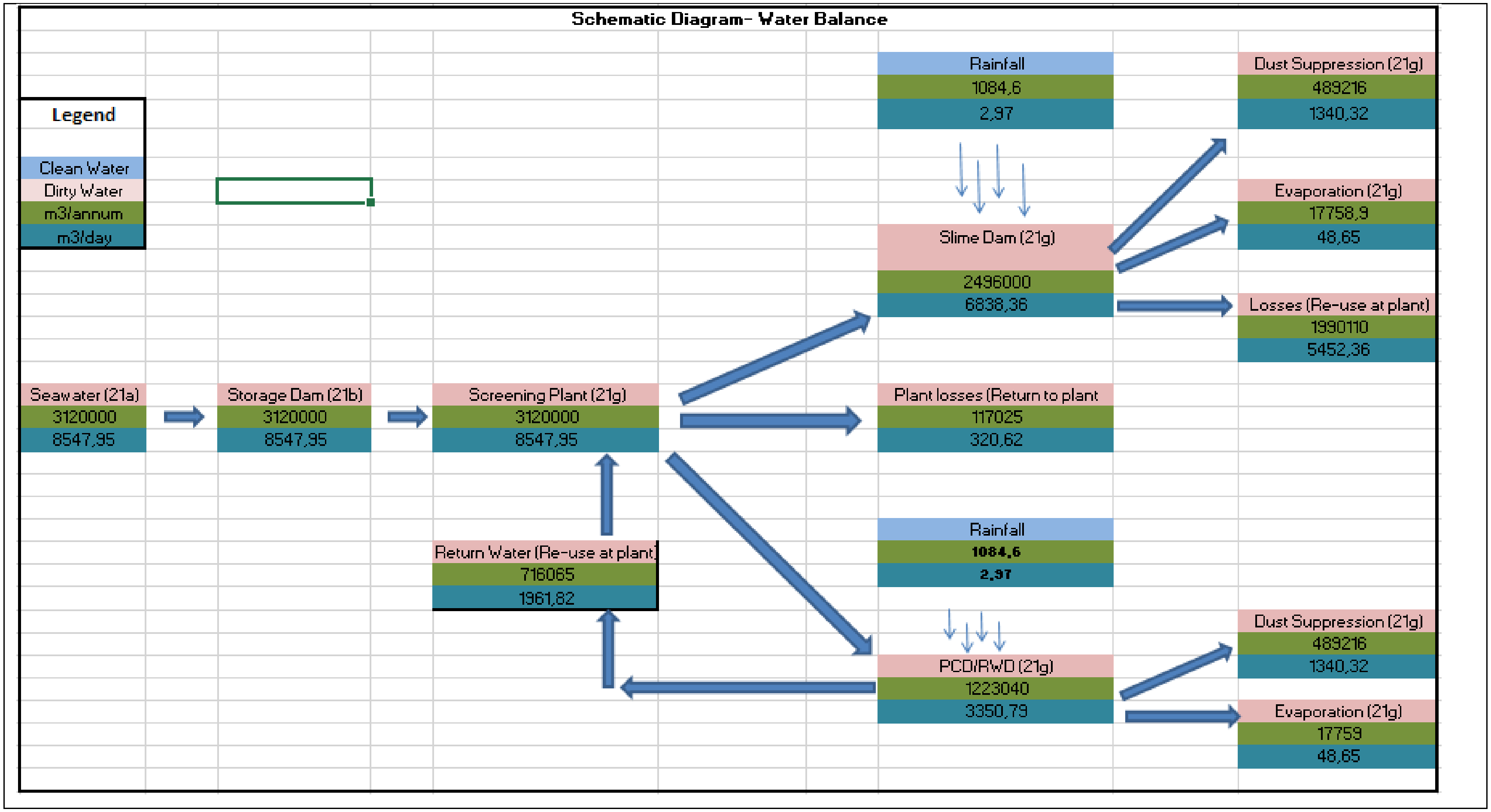
Table 6.6.7-2: Operational area water balance components

Water-Balance	Source: Water-In (m3/annum)	Source: Water-In (m^3/annum)	Loss: Water-Out (m^3/annum)		
Description	**Plant**	**Rainfall**	**Evaporation**	**Dust suppression**	**Return to Plant (losses)**
Slime Dams	2496000	1084.6	17758.9	489216	1990110
Total (m^3/a)	**2497084.6**		**2497084.6**		
Surplus/Deficit		**0**			

Table 6.6.7-3: PCD or RWD

Water-Balance	Source: Water-In (m3/annum)		Loss: Water-Out (m^3/annum)		
Description	**Plant**	**Rainfall**	**Evaporation (at 10% $Area_{O/C}$)**	**Dust suppression**	**Return to Plant (losses)**
PCD or RWD	1223040	1084.6	17759	489216	717150
Total (m^3/a)	**1224124.6**		**1224124.6**		
Surplus/Deficit		**0**			

Figure 6.6.7-1: Water Balance Sketch



6.6.8 Dewatering sites and volume

Section 21 (j) of the National Water Act, 1998 (Act 36 of 1998) entails: removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people.

The amount of water that will be removed from underground will be 600 000 m^3/a. This process of dewatering will take place on the following farm areas each with 150 000 m^3/a; Somnaas 474, Langklip 489, Zwartlinjies River 484 and Koingnaas 475

Table 6.6.8-0-1:

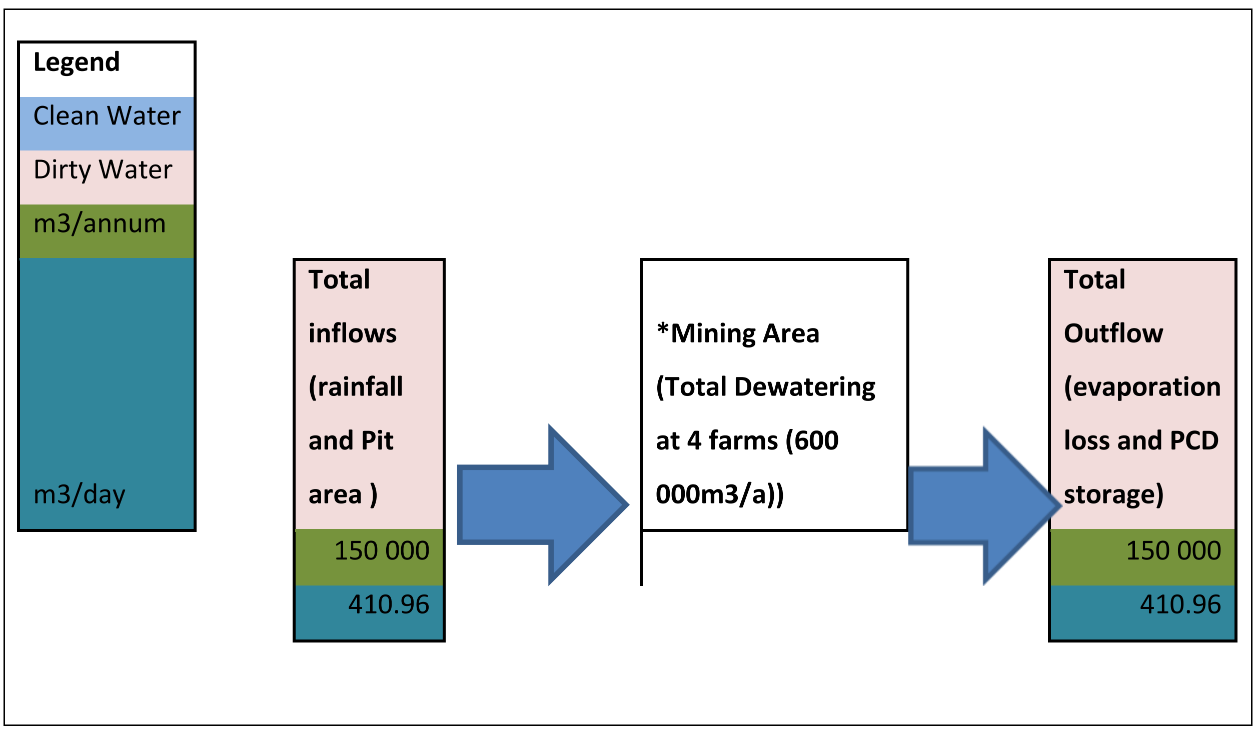
Type of water use	Description	Farm name	Co-ordinate	Volumes
Section (j): removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people	Removing Water from underground / dewatering.	Somnaas 474	E 17° 13' 25.86" S 30° 9' 47.76"	150 000 m3/a
Section (j): removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people	Removing Water from underground / dewatering.	Koingnaas 475	E 17° 17' 57.67" S 30° 17' 51.83"	150 000 m3/a

Section (j): removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people	Removing Water from underground / dewatering.	Langklip 489	E 17° 19' 31.75" S 30° 22' 37.70"	150 000 m3/a
Section (j): removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people	Removing Water from underground / dewatering.	Zwartlinjies River 484	E 17° 20' 54.06" S 30° 25' 51.08"	150 000 m3/a

Table 6.6.8-0-2: Component Water Balance at the opencast area

Water-Balance	Source: Water-In (m3/annum)	Loss: Water-Out (m^3/annum)
Description	**Total inflows (rainfall and pit area)**	**Total outflow (evaporation and PCD storage)**
Mining Area (Pit)	150000	150000
Total (m^3/a)	**150000**	**150000**

Figure 6.6.8-1: Water Balance for the dewatering component for S 21 (j)



*Dewatering activities at 4 different operational areas at a rate of 150 000m^3 per site. At a combined capacity of 600 000m^3.

7. An identification of any areas to be avoided, including buffers;

Flood calculations were conducted for each catchment area in order to quantify the final volumes discharging at the ocean.

7.1 Flood Calculations

A Standard Design Flood (SDF) Calculation Method was used to estimate the peak flows. A SDF is specific to a particular watershed, and specific to a particular length of time corresponding to the duration of the effective rainfall.

The approach can be simplified as follows:

- In-stream flow volumes
    - The SDF method was used to calculate in-stream flow volumes for the 1:5, 1:50 and 1:100 24 hours storm events.
    - This information is later used for the delineation of flood lines.
- The delineated catchment area for which flood calculations were conducted are summarised as follows:
    - Effective Catchment 1 (F40B, F0C, and F40D)
    - Effective Catchment 2 (F40E and F40F)
    - F40A Catchment
    - F40D Catchment
    - F40F Catchment
- For in-stream calculations, the following catchment characteristics have an influence on the hydrological yield:
    - Area
    - Length of watercourse
    - Height difference along the slope

- Slope
- Drainage Basin Characteristics – Region 15

(Please refer to Paragraphs 7.1.1 to 7.1.5 below for hydrological characteristics)

According to SRK Consulting (2005) Region 15 covers drainage regions E3 and F on the west coast (Namakwaland). The region is generally arid rainfall less than 150mm per year and the soil are generally sandy with a low runoff potential

7.2 Effective Catchment 1

The hydrological characteristics for this area are summarised as follows:

Catchment characteristics:

Area of catchment	= 1753 km²
Length of longest watercourse	= 70.164 km
1085 height difference	= 529 m
Average slope	= 0.0101 m/m

Drainage basin characteristics:

Drainage basin number	= 15
Mean annual daily max rain	= 22 mm
Days on which thunder was heard	= 11 days
Runoff coefficient C2	= 5 %
Runoff coefficient C100	= 20 %
Basin mean annual precipitation	= 130 mm
Basin mean annual evaporation	= 2100 mm
Basin evaporation index MAE/MAP	= 16.15

7.3 Effective Catchment 2

The hydrological characteristics for this area are summarised as follows:

Catchment characteristics:

Area of catchment	= 1747 km²
Length of longest watercourse	= 66.1 km
1085 height difference	= 731 m
Average slope	= 0.0147 m/m

Drainage basin characteristics:

Drainage basin number	= 15
Mean annual daily max rain	= 22 mm
Days on which thunder was heard	= 11 days
Runoff coefficient C2	= 5 %
Runoff coefficient C100	= 20 %
Basin mean annual precipitation	= 130 mm
Basin mean annual evaporation	= 2100 mm
Basin evaporation index MAE/MAP	= 16.15

7.3.1 F40A

The hydrological characteristics for this area are summarised as follows:

Catchment characteristics:

Area of catchment	= 1016 km²
Length of longest watercourse	= 35.3 km

1085 height difference	= 124 m
Average slope	= 0.0047 m/m

Drainage basin characteristics:

Drainage basin number	= 15
Mean annual daily max rain	= 22 mm
Days on which thunder was heard	= 11 days
Runoff coefficient C2	= 5 %
Runoff coefficient C100	= 20 %
Basin mean annual precipitation	= 130 mm
Basin mean annual evaporation	= 2100 mm
Basin evaporation index MAE/MAP	= 16.15

7.3.2 F40D

The hydrological characteristics for this area are summarised as follows:

Catchment characteristics:

Area of catchment	= 740 km²
Length of longest watercourse	= 29.1 km
1085 height difference	= 142 m
Average slope	= 0.0065 m/m

Drainage basin characteristics:

Drainage basin number	= 15
Mean annual daily max rain	= 22 mm
Days on which thunder was heard	= 11 days
Runoff coefficient C2	= 5 %

Runoff coefficient C100	= 20 %
Basin mean annual precipitation	= 130 mm
Basin mean annual evaporation	= 2100 mm
Basin evaporation index MAE/MAP	= 16.15

7.3.3 F40F

The hydrological characteristics for this area are summarised as follows:

Catchment characteristics:

Area of catchment	= 683 km²
Length of longest watercourse	= 22.5 km
1085 height difference	= 110 m
Average slope	= 0.0065 m/m

Drainage basin characteristics:

Drainage basin number	= 15
Mean annual daily max rain	= 22 mm
Days on which thunder was heard	= 11 days
Runoff coefficient C2	= 5 %
Runoff coefficient C100	= 20 %
Basin mean annual precipitation	= 130 mm
Basin mean annual evaporation	= 2100 mm
Basin evaporation index MAE/MAP	= 16.15

Table 7.3.3-1: Summary of Flood Calculations

Catchment Description	Area (km^2)	Notes	1:50 year	1: 100 year
			Peak Flow (Q_{p50}) in m^3/s	Peak Flow (Q_{p100}) in m^3/s
Effective Catchment 1	1753	The define water course within this area is Swartlintjies River originates in both F40B and F40C quaternary catchment.	398.15	504.21
Effective Catchment 2	1747	Spoeg River originates within F40E quaternary catchment flowing to the F40F catchment which the study area falls within especially the Lang Klip 489 farm and Mitchel's Bay 495 farm which Spoeg transverses.	459.91	582.43
F40A catchment	1016	No define water course within this quaternary catchment.	289.36	366.44
F40D Catchment	740	Swartlintjies River flows for 29.1 km within this catchment to discharge to the sea.	266.61	337.63
F40F Catchment	683	Spoeg river flows for 22.5 km in the south westerly direction before it discharges to the sea.	287.66	364.29

7.4 Floodline Delineation

The run-off that is generated within a catchment through precipitation depends on the following Characteristics:

- Characteristics of the storm event;
- The response characteristics of the catchment; and
- The influence of temporal storage on the run-off.

The temporal distribution of the run-off is reflected in a hydrograph. The flood peak (QP) is reached as soon as the entire catchment contributes to the flood, which is also referred to as the time of concentration (TC). Flood lines are usually determined for areas where proposed infrastructure could be influenced by in-stream flood volumes and their respective levels. Swartlintjies and Spoeg Rivers were modelled and based on flow technical data, flood lines were delineated.

7.4.1 Source of Survey Data

The following data, data sources, software, and methods were used to generate contours and Digital Elevation Maps:

- 1:50 000 topographical data (National Surveyor General) including the following;
  - Contours and
  - rivers;
- Google Earth survey data sourced from Zonums Information System.;
- Client data in the form of *.ECW ;
  - Total Project boundary;
  - Site specific boundaries; and

7.4.2 Roughness parameters

In order to accurately model the flow in the river the roughness parameters along each cross section had to be defined. The river was divided into three sections i.e. the left bank, main channel and right bank. The positioning of the main channel was based on the anticipated flow in the river (low flows). The Manning n roughness values used for each of the three sections was 0.025 for gravelly river bed.

The following guidelines were used for the selection of the suitable Manning Coefficient:

Table 7.4.2-1: Manning Roughness Coefficient (Source: www.engineering tools.com)

Surface Material	Manning's Roughness Coefficient - *n* -
Earth, smooth	0.018
Earth channel - clean	0.022
Earth channel - gravelly	0.025
Earth channel - weedy	0.03
Earth channel - stony, cobbles	0.035
Floodplains - pasture, farmland	0.035
Floodplains - light brush	0.05
Floodplains - heavy brush	0.075
Floodplains - trees	0.15
Galvanized iron	0.016
Glass	0.01
Gravel,	0.023
Lead	0.011
Masonry	0.025
Metal - corrugated	0.022
Natural streams - clean and straight	0.03
Natural streams - major rivers	0.035

7.4.3 Flow data

Flood calculations were conducted and the peak flows are summarised in Table below:

Table 7.4.3-0-1: Summary of Flood Calculations (1:50 and 1:100 years)

Catchment Description	1:50 year	1: 100 year
	Peak Flow (Q_{p50}) in m3/s	Peak Flow (Q_{p100}) in m3/s
Effective Catchment 1 (F40B, F40C, and F40D)	398.15	504.21
Effective Catchment 2 (F40E and F40F)	459.91	582.43
F40A catchment	289.36	366.44
F40D Catchment	266.61	337.63
F40F Catchment	287.66	364.29

7.4.4 Hydraulic Model Used

The public domain and internationally accepted software package HEC-RAS (version 3.1.3) developed by the US Army Corps of Engineers was used to hydraulically model the river system. The system consists of three components i.e. flow data, geometric data and simulation options. These components are described in more detail below.

The software provides graphical output of the flow in the river as well as tabulated output of the calculated results. A list of errors and warnings are also provided as an output in order to carefully evaluate and interpret the obtained results.

7.4.5 Cross Section Data

Google Earth elevation data was sourced from Zonum Solutions (www.zonums.com). This data was revised in 2016 and is reliable for Hydraulics, Hydrology, Irrigation, Watershed management, Geographic Information Systems and Remote Sensing.Hec Ras Output

The 1:100 year flood-line restriction is the internationally accepted norm for the placement of anything that may be in danger of failing or have a potential safety hazard. This norm is also reflected in section 144 of the National Water Act in respect of the locality of townships.

The purpose of this paragraph is to summarise the output from a surface water assessment. The output variables can be defined as follows:

- E.G. Elev: Energy Grade line for calculated WS elevation
- Flow Area: Total Area of cross section active flow.
- Froude # Chnl: Froude Number for the main channel.
- Min Ch El: Minimum main channel elevation.
- Q total: Total flow in cross section
- Top W Chnl: Top Width of the main channel.
- Vel Chnl: Average Velocity of flow in main channel.

The following tables indicate the details relating to each river system:

Table 7.4.5-1: Swartlintjies River Output

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Upper	20	1 in 50	266.61	26.24	27.25	27.25	27.64	0.005707	2.94	100.39	130	0.96
Upper	20	1 in 100	337.63	26.24	27.4	27.4	27.84	0.005483	3.16	119.18	135.93	0.96
Upper	19	1 in 50	266.61	24.44	26.37	26.37	26.87	0.00618	3.16	84.46	83.87	1
Upper	19	1 in 100	337.63	24.44	26.55	26.55	27.13	0.005682	3.38	100.41	90.91	0.99
Upper	18	1 in 50	266.61	23.69	24.64	24.64	25.03	0.006736	2.78	95.75	122.56	1.01
Upper	18	1 in 100	337.63	23.69	24.78	24.78	25.23	0.006241	2.99	113.17	127.03	0.99
Upper	17	1 in 50	266.61	23.96	25.05	25.05	25.4	0.00711	2.62	101.75	148.58	1.01
Upper	17	1 in 100	337.63	23.96	25.18	25.18	25.58	0.006662	2.79	121.18	158.88	1
Upper	16	1 in 50	266.61	13.9	15.01	15.11	15.46	0.01136	3	89.01	151.12	1.25
Upper	16	1 in 100	337.63	13.9	15.09	15.22	15.65	0.012335	3.29	102.54	160.82	1.32
Upper	15	1 in 50	266.61	13.52	14.16	14.16	14.36	0.008487	2.01	132.33	327.36	1.01
Upper	15	1 in 100	337.63	13.52	14.23	14.23	14.47	0.007942	2.16	156.43	344.58	1
Upper	14	1 in 50	266.61	2.84	3.51	3.59	3.87	0.014357	2.67	99.97	240.87	1.32
Upper	14	1 in 100	337.63	2.84	3.56	3.68	4.01	0.015548	2.96	114.1	249.7	1.4
Upper	13	1 in 50	266.61	4.17	4.93	4.93	5.2	0.006201	2.55	123.47	238.06	0.95

Upper	13	1 in 100	337.63	4.17	5.03	5.03	5.33	0.00595	2.73	148.55	257.57	0.96
Upper	12	1 in 50	266.61	4.79	5.56	5.56	5.81	0.005931	2.45	129.03	260.59	0.93
Upper	12	1 in 100	337.63	4.79	5.65	5.65	5.93	0.005779	2.63	153.7	275.68	0.94

Table 7.4.5-2: Spoeg River Output

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(m3/s)	(m)	(m)	(m)	(m)	(m/m)	(m/s)	(m2)	(m)	
Lower	**10**	1 in 50	287.66	75.28	75.72	75.72	75.87	0.008279	2.07	172.83	578.73	1.01
Lower	**10**	1 in 100	364.29	75.28	75.77	75.77	75.94	0.007972	2.2	206.14	612.23	1.01
Lower	**9**	1 in 50	287.66	50.89	51.42	51.74	52.55	0.038691	5.1	63.9	160.42	2.25
Lower	**9**	1 in 100	364.29	50.89	51.48	51.86	52.84	0.040702	5.63	74.05	169.56	2.35
Lower	**8**	1 in 50	287.66	51.55	51.95	51.95	52.1	0.008655	2.03	174.38	606.69	1.02
Lower	**8**	1 in 100	364.29	51.55	52.01	52.01	52.17	0.008342	2.16	207.85	641.64	1.02
Lower	**7**	1 in 50	287.66	41.99	42.63	42.65	42.91	0.007142	2.5	131.04	279.1	1
Lower	**7**	1 in 100	364.29	41.99	42.71	42.75	43.03	0.0073	2.73	153.75	297.49	1.03
Lower	**6**	1 in 50	287.66	44.75	45.29	45.29	45.49	0.008103	2	147.71	386.57	0.99
Lower	**6**	1 in 100	364.29	44.75	45.36	45.36	45.59	0.007625	2.15	174.9	397.6	0.99

Lower	**5**	1 in 50	287.66	38.26	38.88	38.88	39.06	0.007862	2.56	155.62	423.52	1.04
Lower	**5**	1 in 100	364.29	38.26	38.95	38.95	39.16	0.00768	2.71	183.48	438.78	1.05
Lower	**4**	1 in 50	287.66	7.97	8.26	8.62	10.11	0.130487	6.22	49.18	204.76	3.74
Lower	**4**	1 in 100	364.29	7.97	8.3	8.71	10.53	0.134589	6.86	56.92	212.99	3.87

8. A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;

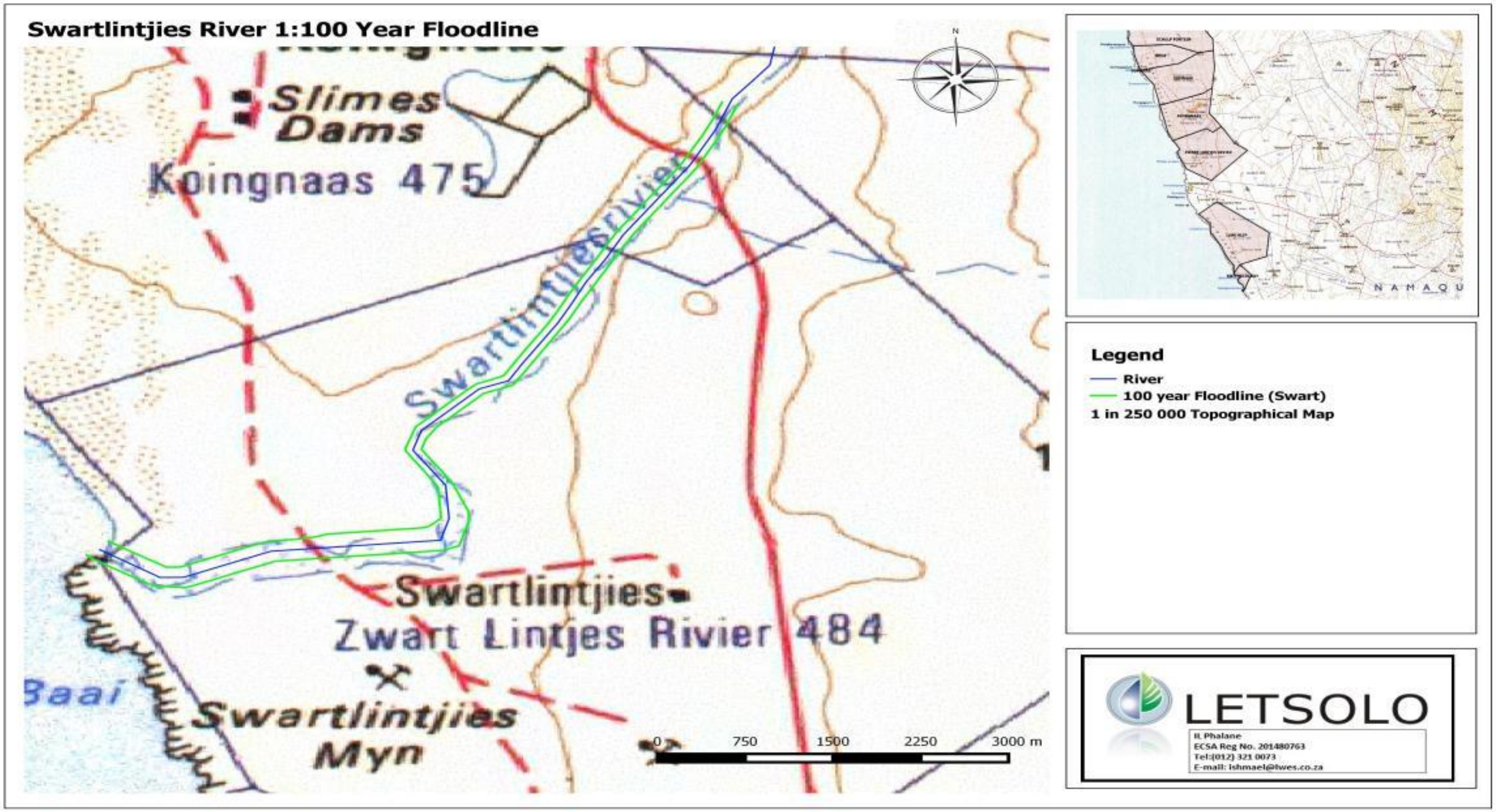


Figure 8-1: Floodline Map (including the 100m Buffer)

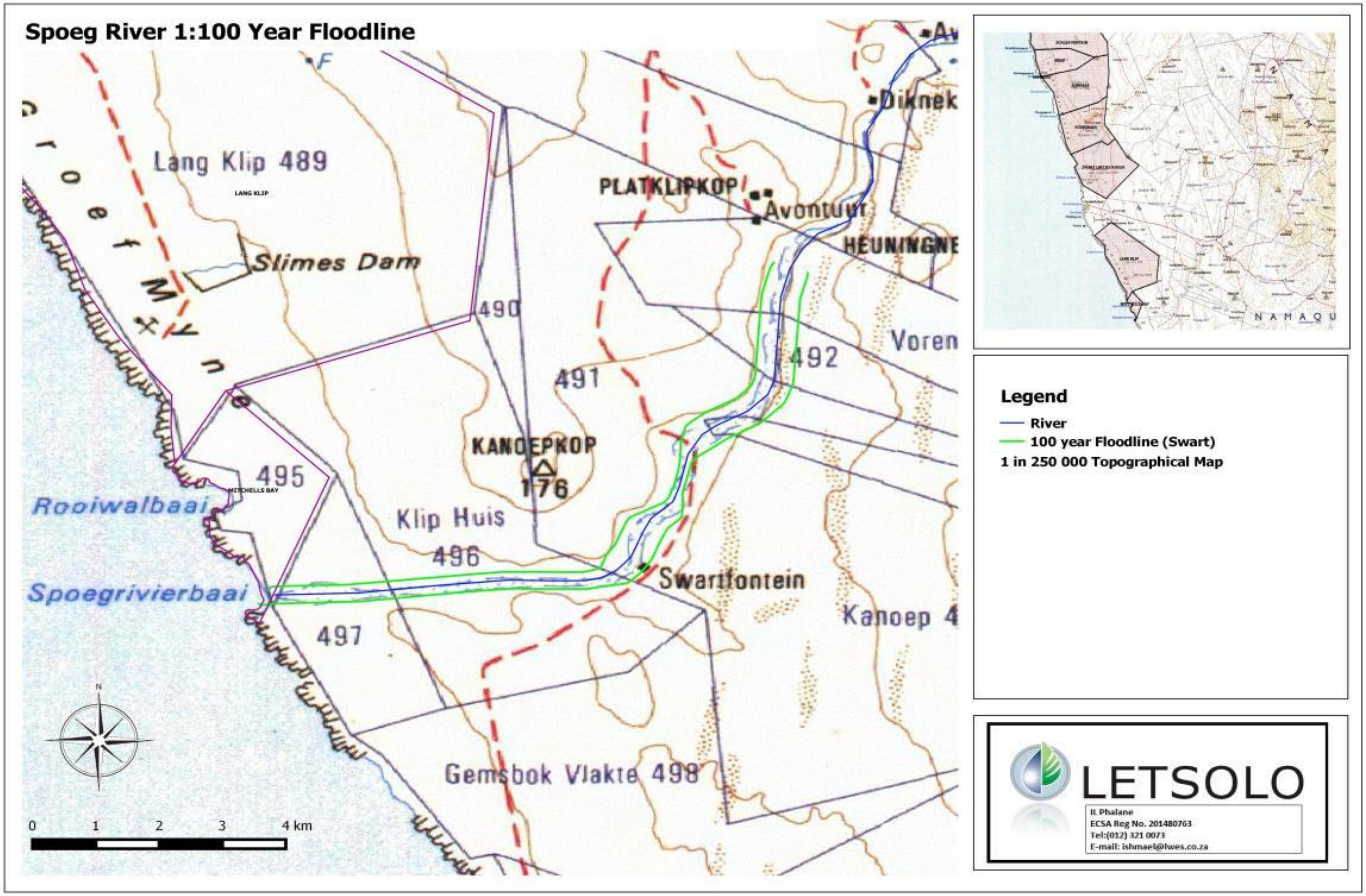


Figure 8-2:Spoeg River Floodline Map (including the 100m Buffer

9. A description of any assumptions made and any uncertainties or gaps in knowledge;

The hydrological Impact Assessment was based on the anticipated mining methods provided by the mine. The following assumptions relating to the operations of the mine are as follows:

9.1 Land Based (Opencast)

Opencast mining methods will be applied at some sections. Strip mining defines the mineable area as a series of parallel strips and the mining sequence is as follows:

- Overburden stripping
- Mechanical extraction of ore
- Bedrock cleaning

Overburden stripping involves the salvaging or stripping of the top soil or other growth medium, which is then either stockpiled or placed directly in another part of the mine undergoing reclamation. Mining of overburden will start at the end of the first strip and progress along the strip exposing the ore for eventual mining. Waste overburden from subsequent strips will be placed in adjacent mined-out strips where feasible.

Overburden from the first mine cut in the strip sequence will in all likelihood be backfilled to some of the multitude of existing mining voids and no new overburden dump disturbance will be created. Stripping will be carried out in advance of ore excavation with the objective of creating a six-month reserve of pre-stripped area. This will allow blending of ore to match plant and production requirements.

9.2 Surf Zone

This will be undertaken by diver-operated suction hoses. These hoses feed diamondiferous gravels to shore-based pumping units comprising a tractor, modified to drive a centripetal pump and a rotary classifier.

Surf zone mining is small scale operations that has been ongoing for many years and are approved under the current authorizations The oversize tailing heaps which accumulate around the classifier are dispersed during the high tide, or mechanically redistributed over the beach at the end of mining operations. Care is taken to deposit oversized tailing below the High Water Mark (HWM) to allow natural redistribution by wave action. A shore-based operation typically consists of two to four divers, their assistants, and the necessary equipment.

9.3 Beach and Offshore Channel Mining

Beach mining operations of mineralized gravel deposits has been on-going for many years. These gravel deposits are found in various places along the coast. WCR is currently continuing with these approved activities.

Beach mining operations of mineralized gravel deposits found in various places between the low and high water marks along the coast has been on-going for many years. WCR are currently continuing with these approved activities above the low water mark on a limited scale.

Please refer to Picture below for details.

Picture 9.3-1: Koignaas Off shore mining activity

9.4 Processing Infrastructure:

Koignaas Mine will start with construction of a new 200 tons per hour (tph) screening and scrubbing plant at Michell's Bay. The plant will feed to the existing 50 tph Michell's Bay plant.

10. LEGAL REQUIREMENTS

10.1 Introduction

This section contains the national and international requirements related only to Hydrological specialist field. For this Hydrological Assessment, the principal act of relevance is The National Water Act, 1998 (Act 36 of 1998) which provides for the protection, usage, development, conservation, management and control of the country's water resources in an integrated manner. The Act provides the legal basis, upon which to develop tools and means to give effect to the protection of water resources.

The main focuses of the NWA are summarized as follows:

To evaluate the natural Hydrological conditions for the specific site area and its larger surrounding areas (up and downstream catchments);

To evaluate Hydrological conditions for the specific project development and its associated processes and infrastructure;

To evaluate these Hydrological conditions under the following storm events;

- 1:50 year 24 hour storm; and
- 1:100 year 24 hour storm event.

To ensure that the Hydrological conditions as well as the specific project development and its associated processes and infrastructure are in harmony and that they can both exist and co-exist and operate optimally under all of these environmental conditions;

To ensure that the natural environment is preserved and protected as far as possible; and

To ensure that clean and dirty water is separated (collected, contained, and controlled) effectively.

10.2 South African Legal Framework

The Department of Water and Sanitation published the Best Practice Guidelines for Impact Prediction (BPG G4). Various tools and techniques have been developed to enable the assessment of future water quality impacts from mining operations to be made. It is important to understand that these tools were generally developed to answer very specific questions that are relevant to the regulatory environment.

The legal platform, on which the Hydrological Impact Assessment is based, is summarized briefly by the following main legislation and Guidelines (prescribed by the DWS, previously known as the Department of Water Affairs and Forestry (DWAF)):

General Notice 704 (GN704) of 1999, regulations on use of water for mining and related activities aimed at the protection of water resources. Specifically related to this proposed project the following restrictions are applicable in terms of GN704

Activity 4: “No person in control of mine or activity may:

- Locate or place any residue deposit, dam reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 meters from watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become water-logged, undermined, unstable or cracked;
- Except in relation to a matter contemplated in regulation 10, carry on any underground or opencast mining, prospecting or any other operation or activity under or within 1:50 year floodline or within a horizontal distance of 100 meters from any watercourse or estuary, whichever is the greatest;
- Place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation; or
- Use any area or locate any sanitary convenience, fuel depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year floodline of any watercourse or estuary.”

A description of the findings and potential implications of such finding on the impact of the proposed activity, including identified alternatives on the environment;

10.3 Methodology used in determining the significance of impacts

Assessment of predicted significance of impacts for a proposed development is by its nature, inherently uncertain – environmental assessment is thus an imprecise science. To deal with such uncertainty in a comparable manner, standardized and internationally recognized methodology has been developed, and is applied in this study to assess the significance of the potential environmental impacts of the proposed exploration activities. The significance of the impacts was determined through the following:

For each impact, the SEVERITY (size or degree scale), DURATION (time scale) and EXTENT (spatial scale) are described (Table 1-1). These criteria are used to determine the CONSEQUENCE of the impact (Table 1-2), which is a function of severity, spatial extent and duration.

Table 10.3-1: Ranking criteria for environmental impacts

SEVERITY/INTENSITY	H	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Irreplaceable loss of resources.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Noticeable loss of resources.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Limited loss of resources.
DURATION	L	Quickly reversible. Less than the project life. Short term (0-5 years)
	M	Reversible over time. Life of the project. Medium term (6-11 years)
	H	Permanent. Beyond closure. Long term (>11 years)
SPATIAL SCALE	L	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

Table 10.3-2: Determining the consequence

SEVERITY	DURATION		SPATIAL SCALE		
			Site Specific (L)	Local (M)	Regional/ National (H)
Low	Long term	H	Medium	Medium	Medium
	Medium term	M	Low	Low	Medium
	Short term	L	Low	Low	Medium
Medium	Long term	H	Medium	High	High
	Medium term	M	Medium	Medium	High
	Short term	L	Low	Medium	Medium
High	Long term	H	High	High	High
	Medium term	M	Medium	Medium	High
	Short term	L	Medium	Medium	High

The SIGNIFICANCE of an impact is then determined by multiplying the consequence of the impact by the probability of the impact occurring, as shown in Table 10.3-3, with interpretation of the impact significance outlined in
Table 10.3-4.

Table 10.3-3: Determining the Significance Rating

PROBABILITY (of exposure to impacts)		CONSEQUENCE		
		L	M	H
Definite/ Continuous	H	Medium	Medium	High
Possible/ frequent	M	Medium	Medium	High
Unlikely/ seldom	L	Low	Low	Medium

Table 10.3-4: The interpretation of the impact significance

SIGNIFICANCE	CRITERIA
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

Table 10.3-5: The interpretation of the status of the impact

IMPACT STATUS	CRITERIA
Positive	The impact benefits the environment
Negative	The impact results in a cost to the environment
Neutral	The impact has no effect on the environment

Once the significance of an impact has been determined, the CONFIDENCE in the assessment of the significance rating is ascertained using the rating systems outlined in Table 10.3-6

Table 10.3-6: Definition of confidence ratings

CONFIDENCE RATINGS*	CRITERIA
High	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact. Greater than 70% sure of impact prediction
Medium	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact. Between 35% and 70% sure of impact prediction.
Low	Limited useful information on and understanding of the environmental factors potentially influencing this impact. Less than 35% sure of impact prediction.

* The level of confidence in the prediction is based on specialist knowledge of that particular field and the reliability of data used to make the prediction.

The degree to which the impact can be reversed is estimated using the rating system shown in Table 10.3-7.

Table 10.3-7: Definition of Reversibility Ratings

REVERSIBILITY RATINGS	CRITERIA
Irreversible	Where the impact is permanent.
Partially Reversible	Where the impact can be partially reversed.
Fully Reversible	Where the impact can be completely reversed.

The degree to which there will be a loss of resources, as shown in Table 10.3-8 refers to the degree to which a resource is permanently affected by the activity, i.e. the degree to which a resource is irreplaceable.

Table 10.3-8: Definition of loss of resources

LOSS OF RESOURCES	CRITERIA
Low	Where the activity results in a loss of a particular resource but where the natural, cultural and social functions and processes are not affected.
Medium	Where the loss of a resource occurs, but natural, cultural and social functions and processes continue, albeit in a modified way.
High	Where the activity results in an irreplaceable loss of a resource.

Lastly, the degree to which the impact can be mitigated or enhanced is shown in Table 10.3-9.

Table 10.3-9: Degree to which impact can be mitigated

DEGREE TO WHICH IMPACT CAN BE MITIGATED	CRITERIA
None	No change in impact after mitigation.
Very Low	Where the significance rating stays the same, but where mitigation will reduce the intensity of the impact.
Low	Where the significance rating drops by one level, after mitigation.
Medium	Where the significance rating drops by two to three levels, after mitigation.
High	Where the significance rating drops by more than three levels, after mitigation.

- Environmental Assessment Policy requires that, "as far as is practicable", cumulative environmental impacts should be taken into account in all environmental assessment processes. EIAs have traditionally, however, failed to come to terms with such impacts, largely as a result of the following considerations:
- Cumulative effects may be local, regional or global in scale and dealing with such impacts requires coordinated institutional arrangements; and
- Environmental assessments are typically carried out on specific developments, whereas cumulative impacts result from broader biophysical, social and economic considerations, which typically cannot be addressed at the project level.

However, when assessing the significance of the project level impacts, cumulative effects have been considered as far as it is possible (as High, Medium or Low) in striving for best practice. The sustainability of the project is closely linked to assessment of cumulative impacts. An example of what the impact table would look like is shown in Table 1-10 below.

10.4 Risk Rating

The potential risk associated with the proposed activity was conducted as indicated in the paragraphs below:

10.4.1 Impact Identification

The purpose of this section is to identify potential impacts which may be associated with the Project and which have to be further investigated as part of the specialist investigations and environmental impact assessment phase. It is important that interactions that could lead to potential impacts which may result from the Project aspects, or interactions that could lead to potential impacts which may be intensified as a result of the Project aspects, be identified (including potential areas of impact) to assist in focusing the specialist investigations.

10.4.2 Potential Impacts

This section contains a summary and a motivation of the potential interactions and impacts which may be associated with the project activities, specifically related to the Hydrological specialist field.

The identified potential impacts are summarised as follows:

- Deterioration of water quality
    - Physical processes are applied for Diamond mining. No chemical processes are anticipated. Water Quality Related Impacts were rated low.
- Change in flow regime / Hydrological Characteristics
    - Due to the nature of topsoil on site, infiltration rates are high and even though vegetation clearance activities are anticipated, the potential impact of a change in flow regime is rated low.
- Erosion/sediment transport

.

Table 10.4.2-1: Impact assessment for the proposed mining activities (below)

<table>
<tr><th>Activities</th><th>Impacts</th><th>Aspects affected</th><th>Pl Phase</th><th>Significance rating</th><th>Typical mitigation measures</th></tr>
<tr>
<td>Deterioration in water quality due to:
1. Spillages during maintenance of vehicles.
2. Generation of Waste (coarse and fine residue)
3. Sewage Disposal
4. Construction material
5. Seepage of Slimes storage facility
6. Leakage of Pipelines of the channel resource blocks for the plant area at Mitchell’s Bay</td>
<td>Deterioration in water quality
Potential health impact on surface water users and on the natural environment associated with the sea.
Rate of seepage is expected to below and the dilution effect of the sea is expected to lower the risk on surface water users.</td>
<td>Aspect Affected: Storm Water
1. Oil spillages during maintenance may be in contact with storm water.
2. Poorly managed waste may result in storm water getting into contact with material with a potential to pollute water.
3. Poor sanitation measures may result in contamination of storm water
4. Construction material may pose a risk to potential Storm water contamination.
5. Slimes if not properly managed, will result in the deterioration in water quality</td>
<td>Co
Construction, Operational and Rehabilitation</td>
<td><table>
<tr><th></th><th>Without mitigation</th><th>With mitigation</th></tr>
<tr><td>Severity</td><td>Low</td><td>Low</td></tr>
<tr><td>Duration</td><td>Medium</td><td>Low(slimes into existing voids)</td></tr>
<tr><td>Extent</td><td>Local</td><td>Local</td></tr>
<tr><td>Consequence</td><td>Low</td><td>Low</td></tr>
<tr><td>Probability</td><td>Medium</td><td>Low</td></tr>
<tr><td>Significance</td><td>Medium</td><td>Low</td></tr>
<tr><td>Status</td><td>Negative</td><td>Negative</td></tr>
<tr><td>Confidence</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Reversibility</td><td>Partial</td><td>Partial</td></tr>
<tr><td>Loss of resource</td><td>Low</td><td>Low</td></tr>
<tr><td>Degree to which the impact can be mitigated</td><td>Medium</td><td>Medium</td></tr>
</table></td>
<td>Aspect Affected: Storm Water
1. Maintenance of vehicles will be conducted on a clearly demarcated area at the workshop. Maintenance will be conducted on a concrete slab. Any spillages of oil and grease will be recovered through the oil collector.
2. Waste will be separated on site and disposed of at a registered landfill site.
3. Chemical Toilets will be utilised at remote locations.
4. Only Environmentally Friendly material must be used for construction purposes.
5. Slimes will be disposed of in existing voids from historic mining activities.</td>
</tr>
<tr>
<td>Change in Hydrological Yield resulting from:
1. Removal of vegetation;
2. Ponding water;</td>
<td>Factors which influence the change in Hydrological Yield Includes the following:
• Infiltration loss due to removal of vegetation</td>
<td>Aspect Affected: Storm Water
1. Vegetation clearance for establishment of required infrastructure.
2. Collection and storage of storm water in a dam</td>
<td>Construction, Operational and Rehabilitation</td>
<td><table>
<tr><th></th><th>Without mitigation</th><th>With mitigation</th></tr>
<tr><td>Severity</td><td>Low</td><td>Low</td></tr>
<tr><td>Duration</td><td>Medium</td><td>Low</td></tr>
<tr><td>Extent</td><td>Local</td><td>Local</td></tr>
</table></td>
<td>Aspect Affected: Storm Water
1. Vegetation clearance for establishment of required infrastructure must be managed as minimum as possible.</td>
</tr>
</table>

<table>
<tr>
<td>3. Facility (i.e slime dam) located within the 1:100 year flood line</td>
<td>• Evaporation loss due to ponding
• Change in flow direction due to facilities within the floodline</td>
<td></td>
<td></td>
<td>
<table>
<tr><td>Consequence</td><td>Low</td><td>Low</td></tr>
<tr><td>Probability</td><td>Medium</td><td>Low</td></tr>
<tr><td>Significance</td><td>Medium</td><td>Low</td></tr>
<tr><td>Status</td><td>Negative</td><td>Negative</td></tr>
<tr><td>Confidence</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Reversibility</td><td>Partial</td><td>Partial</td></tr>
<tr><td>Loss of resource</td><td>Low</td><td>Low</td></tr>
<tr><td>Degree to which the impact can be mitigated</td><td>Medium</td><td>Medium</td></tr>
</table>
</td>
<td>2. Clean water from the clean water catchment area will be allowed to freely flow back to the receiving environment. Ocean water will be abstracted for re-use at the plant.
3. Continuous monitoring of the tailings dam structure throughout the mining operations.</td>
</tr>
<tr>
<td>Erosion / Sediment Transport</td>
<td>Erosion from :
1. Slimes Dams ;
2. Haul roads;</td>
<td>Aspect Affected: Sediment Transport
1. Tailings Dams are associated with steep slopes and high porosity due to loosened material.
2. Erosion from the roads may result in scouring at the culvert crossings.</td>
<td>Construction, Operational and Rehabilitation</td>
<td>
<table>
<tr><td></td><td>Without mitigation</td><td>With mitigation</td></tr>
<tr><td>Severity</td><td>Low</td><td>Low</td></tr>
<tr><td>Duration</td><td>Medium</td><td>Low(slimes into existing voids)</td></tr>
<tr><td>Extent</td><td>Local</td><td>Local</td></tr>
<tr><td>Consequence</td><td>Low</td><td>Low</td></tr>
<tr><td>Probability</td><td>Medium</td><td>Low</td></tr>
<tr><td>Significance</td><td>Medium</td><td>Low</td></tr>
<tr><td>Status</td><td>Negative</td><td>Negative</td></tr>
<tr><td>Confidence</td><td>Medium</td><td>Medium</td></tr>
<tr><td>Reversibility</td><td>Fully</td><td>Fully</td></tr>
<tr><td>Loss of resource</td><td>Low</td><td>Low</td></tr>
<tr><td>Degree to which the impact can be mitigated</td><td>Medium</td><td>Medium</td></tr>
</table>
</td>
<td>Aspect Affected: Sediment Transport
1. The side slopes of the Tailings Dams must not exceed 1:3 (vertical: horizontal) in order to reduce flow velocity on the side slopes.
2. A maintenance schedule must be produced for maintenance of roads in order to prevent and manage sediment transport.</td>
</tr>
</table>

11. Any mitigation measures for inclusion in the EMPr;

11.1 Water quality

Sanitation – Chemical toilets must be made available at remote places. The effect of sewage on sea water is similar to the effect on freshwater. Sewage depletes the available oxygen at the point of discharge. Because the sea is large and has a much greater diluting effect than rivers, the potential impact t is localised. Designs of discharge outfalls for water removed from the mining area for the safe continuity of mining: The issue of raised turbidity raise a concern of the potential impact of discharge activities to the sea. The following factors affect the design and performance of sea outfalls:

- Waves and swell
  - Strong surf is favourable and increases the mixing energy near the shoreline.
- Tides
  - Tides can set up currents which either assist discharge, or hold the discharge back.
- Currents
  - Long shore currents are favourable in that they carry the discharge away from the outfall.
- Topography
  - The favourable location would be at a place where there is a steep sloping ocean floor.

11.2 Sediment Transport

Beached form a natural coastal protection. Sedimentation on coastal areas depends on the type of wave (Storm or swell) and the beach material (Sand or shingle). If the beach is of a mobile material, then there will be sedimentation. Mining along the beach may result in exposure of movable material. Whether beaches are stable or not, depends on the the rates of sediment transport from the feeding stream. The Mean Annual Runoff of the affected catchment areas is very low, and may not have a significant influence on the beach at the point of discharge of the river.

Table 11.2-1: Impacts to be mitigated in their respective phase

ACTIVITIES	PHASE	SIZE AND SCALE of disturbance	MITIGATION MEASURES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
Deterioration in water quality	• Construction, • Operational, • Rehabilitation, • Closure, • Post closure.		Aspect Affected: Storm Water 1. Maintenance of vehicles will be conducted on a clearly demarcated area at the workshop. Maintenance will be conducted on a concrete slab. Any spillages of oil and grease will be recovered through the oil collector. 2. Waste will be separated on site and disposed of at a registered landfill site. 3. Chemical Toilets will be utilised at remote locations. 4. Only Environmentally Friendly material must be used for construction purposes. 5. Slimes will be disposed of in existing voids from historic mining activities.	Section 19 of the National Water Act, 1998 (Act 36 of 1998). Management of emergency incidents.	Authorisation is required before the commencement of the activity.
Change in Hydrological Yield	• Construction, • Operational, • Rehabilitation, • Closure, • Post closure.		**Aspect Affected: Storm Water** 1. Vegetation clearance for establishment of required infrastructure must be managed as minimum as possible. 2. Clean water from the clean water catchment area will be allowed to freely flow back to the receiving environment. Ocean water will be abstracted for re-use at the plant.	Section 21 (a), (b) and (g) of the national Water Act, 1998 (Act 36 of 1998) - Consumptive water uses which may result in a reduction of water volumes from a water resource. This includes	Authorisation is required before the commencement of the activity.

				abstraction and storage of water.	
Erosion / Sediment Transport	• Construction, • Operational, • Rehabilitation, • Closure, • Post closure.		Aspect Affected: Sediment Transport 1. The side slopes of the Tailings Dams must not exceed 1:3 (vertical: horizontal) in order to reduce flow velocity on the side slopes. 2. A maintenance schedule must be produced for maintenance of roads in order to prevent and manage sediment transport.	Section 21 (c) and (i) of the national Water Act, 1998 (Act 36 of 1998) Non-Consumptive water uses which may result in a reduction of water volumes from a water resource. This includes abstraction	Authorisation is required before the commencement of the activity.

12. Any conditions for inclusion in the environmental authorisation;

The following inclusions are recommended:

12.1 Sizing and location of infrastructure

General Notice 704 (GN704) of 1999, regulations on use of water for mining and related activities aimed at the protection of water resources. Specifically related to this proposed project the following restrictions are applicable in terms of GN704

12.2 Location of infrastructure

General Notice 704 (GN704) of 1999, regulations on use of water for mining and related activities aimed at the protection of water resources. Specifically related to this proposed project the following restrictions are applicable in terms of GN704

Activity 4: "No person in control of mine or activity may:

- Locate or place any residue deposit, dam reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 meters from watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become water-logged, undermined, unstable or cracked;
- Except in relation to a matter contemplated in regulation 10, carry on any underground or opencast mining, prospecting or any other operation or activity under or within 1:50 year floodline or within a horizontal distance of 100 meters from any watercourse or estuary, whichever is the greatest;

- Place or dispose of any residue or substance which causes or is likely to cause pollution of a water resource, in the workings of any underground or opencast mine excavation, prospecting diggings, pit or any other excavation; or
- Use any area or locate any sanitary convenience, fuel depots for any substance which causes or is likely to cause pollution of a water resource within the 1:50 year floodline of any watercourse or estuary."

12.3 Capacity of the Pollution Control Dam

The pollution control dam must be designed, constructed, maintained and operated in such a way that it is not likely to spill into any clean water system more than once in 50 years. The pollution control dam must have a minimum freeboard of 0.8m above full supply level.

12.4 Restrictions on use of material

As indicated in GN 704, regulation 5, No person in control of a mine or activity may use any residue or substance which causes or is likely to cause pollution of a water resource for the construction of any dam or other impoundment or any embankment, road or railway, or for any other purpose which is likely to cause pollution of a water resource.

12.5 Surface Water Quality Monitoring

The surface water quality monitoring plan must include the proposed water monitoring points. This plan can be used as a management tool to ensure that potential impacts on surface water resources are managed according to the hierarchy of water and impact management. This tool will ensure that negative impacts are identified at the early stages and that the appropriate action is implemented for the protection of water resources.

Water Management System must be implemented for proper record keeping. This system must be populated with Water Quality Objectives (like RWQO published by the DWS) as well as monthly water quality results.

As indicated on the Water Quality Monitoring Map (, Four (4) water quality monitoring points are recommended on the two surface water resources for the study area.

However, it must be noted that due to the dry nature of the study area, it may not be possible to collect water samples unless after significant storm events.

Two additional monitoring points are recommended as follows:

- Sea Water Abstraction points;
- Discharge to the sea.

These additional monitoring points will be used as a management tool to identify and manage potential impact on Sea Water Quality from the mining activities. Should there be any significant impact from the mining processes, reasonable measures will be in place.

13. Any monitoring requirements for inclusion in the EMPr or environmental authorisation;

The purpose of the water quality monitoring is to provide timely and accurate water quality data as per the Department of Water and Sanitation's requirements, as well as to inform the management of West Coast Resources (Pty) Ltd about extent of possible mining impact on the surface water. This data is used for a variety of purposes, which may be summarized in broad terms as the determination of status and trends in resource water quality. Specific objectives of the water quality monitoring program are as follows:

- Determine whether water quality at sampling sites exceeds water quality standards as prescribed by the Department;
- Assess the status of water quality in the surrounding areas;

- Provide analytical water quality information which describes present conditions and changes.
- Data for the first month of sampling is insufficient for the purpose of generating water quality trends. These trends will be produced as soon as more data is recorded.
- Provide timely data for other users.

13.1 Data management and reporting

During field, laboratory, and data evaluation operations, effective data management is the key to providing consistent, accurate, and defensible data and data products. The management and reporting of field and laboratory data will generally follow the procedures outlined in the Best Practice Guidelines.

13.2 Monthly

Surface water samples must be collected on a monthly basis. A report summarising the findings must be produced monthly. This report is an internal report which is used to keep records of changing water qualities as well as to notify mine management team of the changes in water quality and areas of concerns..

13.3 Quarterly

The quarterly report must be produced to summarise the 3 months observations and analysis. This report will be submitted to the authorities in order to indicate compliance or challenges in relation to water quality changes. The quarterly report must include the following components:

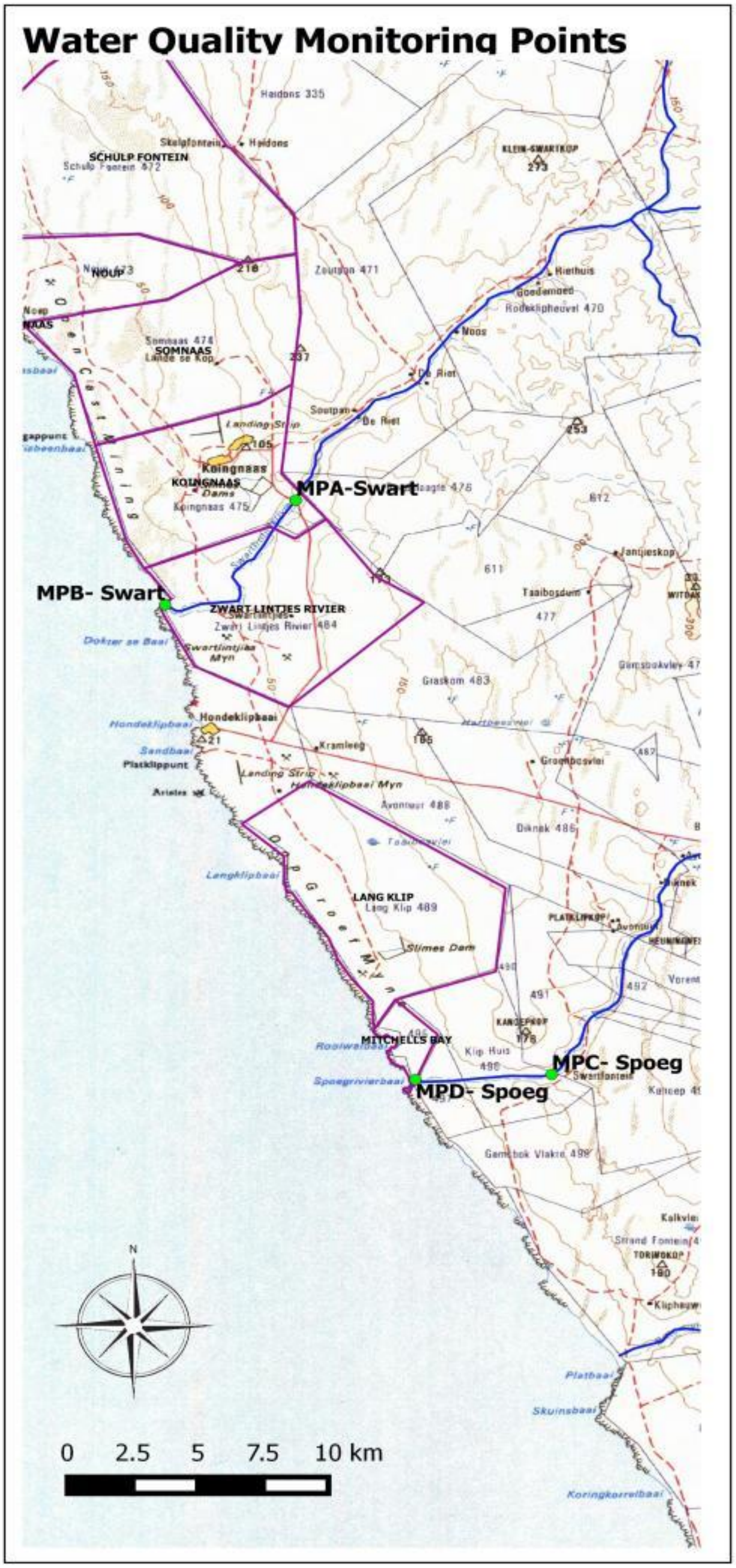
- Brief compliance assessment description;
- Brief description of monitoring actions performed;
- Flow characteristics (low/high flows);

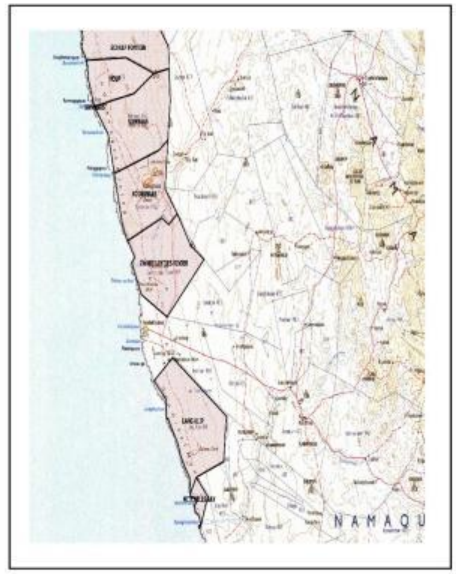
- Field parameters including odour and color observations;
- Highlight significant issues that require immediate corrective/ preventative action;
- Geographical presentations in a form of GIS maps indicating monitoring points and surface infrastructure; and
- Time dependent graphs for the selected water quality variables.

13.4 Annually

The annual report must consist of all the active environmental components. The following components should be included:

- Statutory/Regulatory Requirements;
- Monitoring Points and nearby surface Infrastructure;
- 12 months data captured;
- The compliance interpretation based on Resource Quality Objectives and SANS 241:2015 (Or any later version of SANS 241); and
- Recommendation of corrective measures.





Legend

- Farms-Study Area
- River
- 1 in 250 000 Topographical Map
- Monitoring Points-WCR

LONGITUDE	LATITUDE	LABEL
17.31307610	-30.21793310	MPA-Swart
17.26068478	-30.26376003	MPB- Swart
17.41542291	-30.46940320	MPC- Spoeg
17.36088473	-30.47159133	MPD- Spoeg

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Figure 13.4-1: Water Quality Monitoring Map

14. A reasoned opinion

(a) as to whether the proposed activity or portions thereof should be authorised; and

The proposed activity is recommended. In relation to the potential Hydrological Impacts, the proposed activity may be authorised. The Potential Hydrological Impacts are rated low.

The following surface activities require proper mitigation measures during the operational phase.

14.1 Oil Separator at the workshop area

The workshop will be a permanent building constructed with bricks, roofs. As part of stormwater management, the following measures are being considered:

- Impermeable concrete slab to prevent infiltration of contaminated water,
- Cut-off trench to restrict clean runoff from coming into contact with contaminated water stored in the grease and oil sump;
- Regular inspection at the oil separator and silt trap.

Provision has also been made for a wash bay. The design of the wash bay is in accordance with best practice and will be bunded, with a cut-off trench on the open side and will link to the oil separator and silt trap.

14.2 Sanitation

Chemical toilets will be provided at remote areas.

Conservancy tanks are used at the main office area for sanitation purposes. These tanks are emptied regularly by an external entity.

(b) if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;

No infrastructure may be located within the 1:100 years floodline area unless the authorisation is granted in accordance to section 21 (c) and (I) of the National Water Act.

15. A description of any consultation process that was undertaken during the course of preparing the specialist report;

A separate Public Consultation Process was followed.

16. A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and

A concern was raised regarding the impact s of storing sea water in the pollution control dam. In order to minimise water losses due to infiltration as well as the potential impact on groundwater resources, the water storage facilities must be lined.

17. Any other information requested by the competent authority

The content of the report covers the following key requirements:

- Catchment Characteristics
- Catchment Hydrology
- Water Balance Calculations
- Water Quality Management
- Risk Rating and Assessment
- Floodline Deliniation

18. Conclusion

Koingnaas is an existing mining area with most infrastructure requirements already in place. Infrastructure at each mine site and processing operation comprising electric power supply, roads, potable, fresh and seawater supplies, fuel supply and storage and workshops, have been established and maintained.

There are no fresh water sources, other than rain water in the region of the selected slimes sites.

Due to the mining methods applied on site, No chemicals are used in the beneficiation process as physical processes are implemented.

Existing mining voids in mined out areas were identified in central areas where processing plants would be placed over the life of the operation. The bedrock profiles in each of these areas were checked to ensure that the bedrock slope dipped towards the coast and that the site was within 1 km from the coastline. These attributes ensure that any seepage of seawater associated with the slimes would end up back in the ocean.

The identified potential impacts were rated low.

18.1 Legislative requirements

The study was conducted in line with the requirements of the National Water Act, 1998 (Act 36 of 1998) as well as the Best Practice Guidelines for the Protection of Water Resources and "Regulations 704" as published in Government Gazette, Volume 408, No 20119 of June 1999 (Also known as General Notice 704, 04 June 1999).

18.2 Domestic Water

Domestic water is sources from the underground water resource. This water must be monitored and compared against the Water Quality Guidelines for drinking water. Monitoring of this water will serve as a management tool in order to determine at the early stages if the water is suitable for domestic use.

19. Recommendations

Reasonable measures as recommended in this report must be implemented in order to reduce the impact on surface water resources. In view of the above conclusions, the following recommendations are made:

- Only environmentally friendly materials must be used during the construction phase to minimize pollution;
- Vegetation stripping must be limited to the minimum width required;
- The topography of all disturbed areas must be rehabilitated, in such a manner that it blends with the surrounding natural area. This will reduce soil erosion and improve natural re-vegetation;
- Storage of Contaminated Water is deemed a water use and the Department of Water and Sanitation must be consulted for an authorisation prior to the construction phase. Concurrent rehabilitation must be implemented in order to reduce desertification. The general philosophy that WCR has adopted is that any material excavated, moved or processed as part of any new mining or plant activity should be placed in such a way that it is part of the final rehabilitation solution. This will ensure that all operations are aligned with good environmental practice and will reduce the final closure liabilities. Backfilling existing mining voids with slimes generated from the processing plants is seen as the most effective and environmentally friendly way of disposing of slimes material.
- The final landform of the rehabilitated pits must be sustainable, free draining, minimize erosion and avoid ponding. Where final voids are maintained, these must be properly sloped to ensure a safe landscape.
- The disturbed area and footprint of the mine's operations must be kept as small as possible by mining strips.
- During the operational phase, uncontaminated surface water from the site must be allowed to freely flow to the environment.

19.1 Preferred liner for the PCD

4 PCD's are required at 4 the 4 operational areas (Somnaas, Koingnaas, Langklip and Mitchell's Bay). In line with GN 704 requirements, the PCD's must be lined. A liner is required to protect the groundwater resource by reducing infiltration. The secondary function is to reduce water losses, thus reducing pumping rates at the abstraction points. Two liner options for the containment of sea water were investigated. The sustainability of a clay liner was compared to High Density Polyethylene (HDPE) liner.

The water storage facility (PCDs) for the diamondiferous mining activity at the West Coast Resources will be used to store seawater. Sea-water is an aqueous solution containing a variety of dissolved solids and gases, and is very high in soluble sodium chloride. Whilst the study area is characterized by Aeolian sandy soil that is sensitive due to its vulnerability to erosion (ENVIROBRO, 2015), a liner for the PCD is needed. The clay soil chemically reacts with seawater where cations get exchanged allowing clay to change its primary form.

Clay has properties of swelling when in contact with water. The reduction in the swelling of the clay soils is proportional to the rate of saltwater infiltration.According to Elmashad and Atta (2015) swelling soil deposits are mainly in arid and semi-arid areas of which the study area is situated at in the Northern Cape.

Normally arid climate where strong heat is present high evaporation occurs. It is also common along coasts. Because of high temperatures in Northern Cape there is likelihood that the water from PCD will evaporate living high concentration of salts behind.

Research shows that high salt concentrations in the hydrating fluid increased the hydraulic conductivity (Petrov and Rowe, 1997).

Because of the abilities of seawater to react with the clay through exchange mechanisms a clay liner is not recommended for such activity. Suitable liner with excellent chemical resistant properties needs to be used and such is a geomembrane. HDPE geomembrane liner should be used for the PCD and according to the best practice guideline (2007) a minimum of 1.5 mm is recommended for geomembranes. However due to response of HDPE to high temperatures a 2 mm liner is recommendable.

19.2 Monitoring

No flow was observed during field investigations. No water quality samples could be collected. However, as part of the monitoring program, the Upstream and Downstream monitoring points are recommended. Chemical analysis is the only way to obtain indicative data for potential water quality deterioration. Two (2) monitoring points are recommended and indicated on the layout map (Figure 14). The monitoring points were strategically located to monitor water quality trends in the sensitive nearby water resource.

19.3 Re-use of water

Water that collects at the PCD/RWD can be used at the plant. During significant storm events that result in surplus water, excess water must be pumped to the pollution control dams.

19.4 Water balance

The ongoing management and update of water balance is critical. It is important that a review and management programme be developed and implemented in order to actively manage the water systems on the basis of the information provided by the balances.

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