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ELANDSFONTEIN COLLIERY

SURFACE WATER SPECIALIST STUDY

(BASELINE HYDROLOGY) SCOPING REPORT

Report prepared for

BEAL
CONSULTING ENGINEERING & PROJECT MANAGEMENT

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January 2020 | Report no. 272-Rep-002-Rev 0

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REVISION TRACKING

Rev 0: Original document

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1. EXECUTIVE SUMMARY

BEAL Consulting and Project Management (Pty) Ltd (BEAL) commissioned iLanda Water Services CC (iLanda) to conduct a surface water specialist investigation and surface water impact assessment in support of an Environmental Authorisation and amendment process to be followed for Anker Coal and Mineral Holdings SA (Pty) Ltd Elandsfontein Colliery.

The objective of this investigation is to assess the potential impact of the proposed activities and associated facilities on the local and regional surface water regime.

The project extent and mine lease area is located on a portion of the remaining extent of portion 8; remaining extent of portion 1; a portion of the remaining extent of portion 6; portion 44; portion 14 and the remaining extent of portion 7 of the Farm Elandsfontein 309 JS, situated approximately 4.0 km south of Kwa-Guqa and about 16.0 km west of Emalahleni, Mpumalanga Province, South Africa.

Elandsfontein colliery is in the upper reaches of the Olifants River catchment. The mining rights area is in quaternary catchment B20G. The mining rights area is located just west of Clewer and approximately 15km west, south west of Emalahleni. Elandsfontein is an operational colliery with significant development within the mining rights area.

A small tributary of the Grootspruit flows in a south westerly direction through the mining rights area. It's confluence with the Grootspruit is just to the west of the mining rights area. The Grootspruit flows from south to north along the western boundary of the mining rights area before turning west to meet the Saalklapspruit, approximately 5 km west of the mining right area. The Grootspruit is a tributary of the Saalklapspruit, which is a tributary of the Wilge River. The Wilge-Olifants river confluence is downstream of Witbank Dam, but upstream of Loskop and Flag Boshielo Dams.

The Grootspruit and its tributary are heavily reeded in places. Both river floodplains are highly impacted by mining related activities and poorly constructed/informal road crossings. Both rivers are marked as perennial streams on the 50 000 topo sheets.

Apart from the Elandsfontein mining operations, the Grootspruit catchment is undeveloped and consists mostly of impacted grasslands and dry land agriculture. The topography is relatively flat. Localised areas have steeper slopes, particularly in the vicinity of the streams. The Grootspruit is dammed with multiple farm dams. The water course has an ill-defined channel in the study area and contains significant reedbeds. The flood plains are not well developed.

The Elandsfontein mining operations occur on both sides of Grootspruit tributary along most of its length. The upper reaches are dammed with pollution control and water supply dams. The natural tributary has a poorly defined water course but is generally heavily reeded. The lower reaches have been modified and the stream is canalised for roughly half its length.

The mean annual precipitation of the mining rights area is 706 mm. The mean annual evaporation of the mining rights area is 1 689 mm (S-Pan).

The Department of Water and Sanitation require a climatic water balance that incorporates a list of years which have the wettest six months of the year, either November to April or May to October. In this case November to April is wetter than May to October. The wettest six months between November and April vary between 1432 mm and 948.6 mm.

The 50-year and 100-year peak 24-hr rainfall depths for the mining rights area are 115 mm and 130 mm respectively.

The Grootspruit has a 81.562 km^2 catchment up to just beyond the mining rights area. The tributary of the Grootspruit has a catchment measuring 8.169 km^2 up to its confluence with the Grootspruit. The mean annual runoff for the Grootspruit and its tributary are 3.57 Mm^3/a and 0.36 Mm^3/a respectively. Dry weather flows are between May and October.

The 50-year and 100-year flood peaks for the Grootspruit are 246 m^3/s and 326 m^3/s respectively, calculated at the point just beyond the mining rights area. The 50-year and 100-year flood peaks for the Grootspruit tributary are 55 m^3/s and 75 m^3/s respectively, calculated at its confluence with the Grootspruit.

The surface water buffer zone is the greater of the 100-year floodline or 100 m from the water course. The buffer zone for the Grootspruit is a combination of these buffers. The buffer zone for the Grootspruit tributary is predominantly the 100 m offset from the water course.

2. INTRODUCTION

BEAL Consulting and Project Management (Pty) Ltd (BEAL) commissioned iLanda Water Services CC (iLanda) to conduct a surface water specialist study for Elandsfontein Colliery. This report details the results of the study, as well as recommendations emanating from the work done.

2.1 Study Objectives

The study objectives are as follows:

- Baseline hydrological analysis
- Floodlines and buffer zones
- Surface water impact assessment

This report constitutes the outcome of the specialist studies undertaken by iLanda on behalf of BEAL, related to the environmental impact of Elandsfontein Colliery.

2.2 Battery Limits

The battery limits of the study are shown in Figure 1. All work is confined to this area unless otherwise specified.

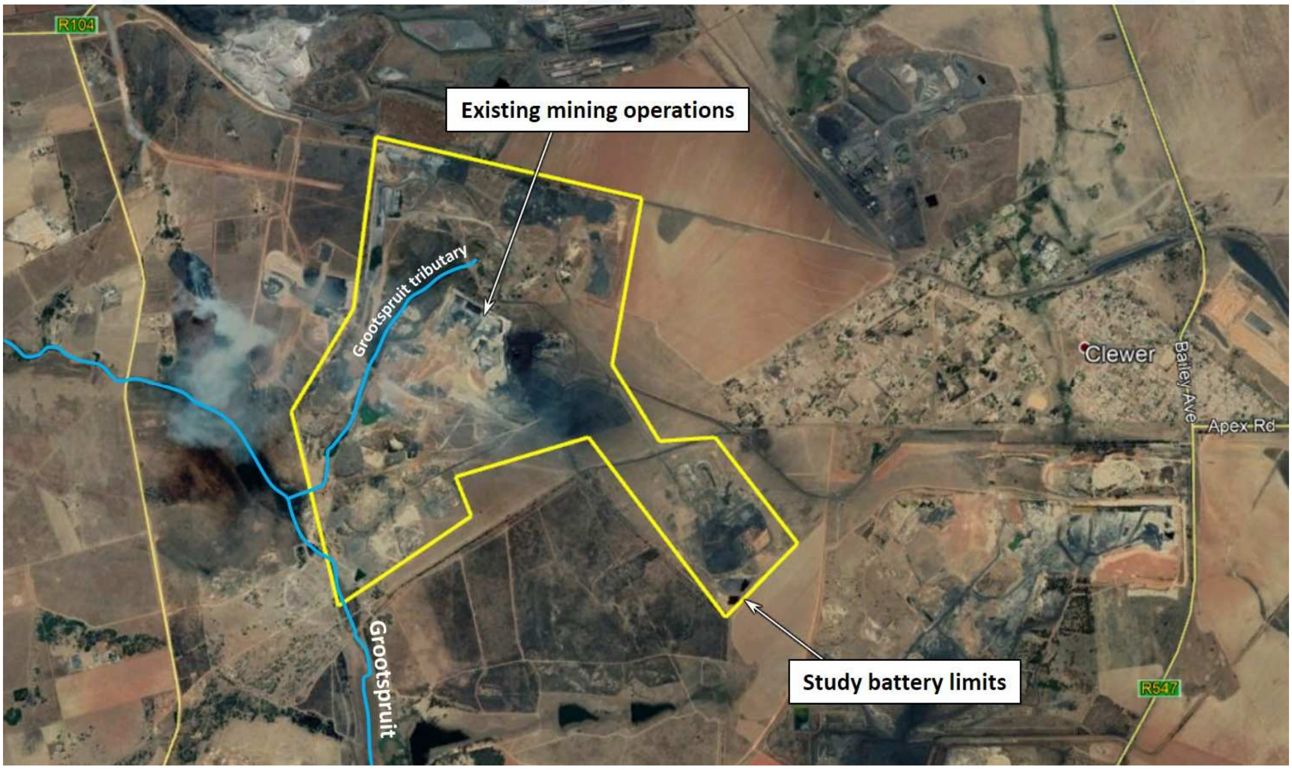

FIGURE 1: STUDY AREAS

2.3 Legislative and Policy Framework

The following legislation was adhered to;

- The South African National Water Act, Act 36 of 1998.
- GN 704, Regulations on the use of water for mining and related activities aimed at the protection of water resources (1999).
- Mineral and Petroleum Resources Development Act, Act 28 of 2002.

3. REGIONAL SETTING

Elandsfontein colliery is in the Mpumalanga Province of South Africa, in the upper reaches of the Olifants River catchment. The Grootspruit is a tributary of the Saalklapspruit, which is a tributary of the Wilge River. The Wilge-Olifants river confluence is downstream of Witbank Dam, but upstream of Loskop and Flag Boshielo Dams.

The Loskop and Flag Boshielo dams are located downstream of Witbank Dam and are an important source of domestic, irrigation and industrial water to their surrounding areas. The Olifants River is an international river, flowing through the Kruger National Park and into Mozambique. With the Olifants River flowing through the Kruger National Park, provision for meeting ecological requirements is one of the controlling factors for managing water resources throughout the Olifants River catchment.

The Wilge River catchment measures 4 360 km^2. The mean annual precipitation in this catchment is generally uniform with an average precipitation of approximately 670 mm, varying between 650 mm and 750 mm.

The mean annual evaporation (S-Pan) varies between 1 677 mm in the south western regions of the catchment and 1 800 mm in the north western regions of the catchment.

The natural vegetation in the catchment is predominantly grassland. Extensive irrigated and dry-land agricultural activities are prevalent, along with various forms of livestock farming. Power stations and mining activities occur in the Wilge River catchment, as do a number of small towns. These include Delmas, Bronkhorstspruit, Lionelton, Kendal, and New Largo.

4. LOCAL SETTING

The mining rights area is located in quaternary catchment B20G. The mining rights area is located just west of Clewer and approximately 15km west, south west of Emalahleni. Elandsfontein is an operational colliery with significant development within the mining rights area.

A small tributary of the Grootspruit flows in a south westerly direction through the mining rights area. It's confluence with the Grootspruit is just to the west of the mining rights area. The Grootspruit flows from south to north along the western boundary of the mining rights area before turning west to meet the Saalklapspruit, approximately 5 km west of the mining right area.

The Grootspruit and its tributary are heavily reeded in places. Both river floodplains are highly impacted by mining related activities and poorly constructed/informal road crossings. Both rivers are marked as perennial streams on the 50 000 topo sheets.

5. CATCHMENT DESCRIPTION

5.1 Grootspruit

Apart from the Elandsfontein mining operations, the Grootspruit catchment is undeveloped and consists mostly of impacted grasslands and dry land agriculture.

The topography is relatively flat. Localised areas have steeper slopes, particularly in the vicinity of the streams. The Grootspruit is dammed with multiple farm dams. The water course has an ill-defined channel in the study area and contains significant reedbeds. The flood plains are not well developed.

5.2 Grootspruit Tributary

The Elandsfontein mining operations occur on both sides of this stream along most of its length. The upper reaches are dammed with pollution control and water supply dams.

The natural tributary has a poorly defined water course but is generally heavily reeded. The lower reaches have been modified and the stream is canalised for roughly half its length.

6. BASELINE RAINFALL AND EVAPORATION

6.1 Mean Annual Precipitation and Evaporation

The mean annual precipitation of the mining rights area is 706 mm. The mean annual evaporation of the mining rights area is 1 689 mm (S-Pan). The monthly average rainfall, rainfall days, and evaporation rates are presented in Table 1. The Mpumalanga Highveld has distinct wet and dry seasons. 91% of the mining rights area's mean annual rainfall falls between October and April inclusively. 68% of the area's mean annual evaporation occurs in this period (Midgley et al., 1990).

TABLE 1: MEAN MONTHLY RAINFALL, RAIN DAYS AND EVAPORATION DATA FOR THE MINING RIGHTS AREA

Month	Ave Rainfall (mm)	Ave rain days	Ave Evaporation (mm S-Pan)
October	73.6	7.0	182.1
November	119.3	9.6	171.8
December	119.4	9.6	189.2
January	136.1	10.4	185.8
February	95.6	7.3	154.9
March	81.6	6.8	152.9
April	40.6	4.2	117.6
May	17.6	2.0	99.0
June	9.0	0.9	80.4
July	6.4	0.8	88.0
August	8.9	1.1	116.5
September	22.4	2.6	151.0
Mean Annual	**705.8***		**1689**

** Note: The sum of the mean monthly rainfall depths does not necessarily equal the mean annual precipitation.*

6.1.1 Climatic water balance

The Department of Water and Sanitation require a climatic water balance that incorporates a list of years which have the wettest six months of the year, either November to April or May to October. In this case November to April is wetter than May to October. The wettest six months between November and April are listed in Table 2.

TABLE 2: WETTEST YEARS BETWEEN NOVEMBER AND APRIL

Rating	Year	Total rainfall between November and April (mm)
Wettest year	2000	1432
2nd wettest year	1917	1184.6
3rd wettest year	1975	1087.7
4th wettest year	1939	1079.1
5th wettest year	2009	1007.1
6th wettest year	1922	993.9
7th wettest year	1969	980.9
8th wettest year	1942	970.1
9th wettest year	1978	968.9
10th wettest year	1924	948.6

6.1.2 Sources of rainfall data

Daily rainfall data was sourced from the CCWR (Computing Centre for Water Research, Natal University) rainfall database (gauge number 0515382 – Witbank (MAG)). The gauge is located approximately 4 km east of the mining rights area. The CCWR data that was used contains daily records and patched records between September 1905 and December 1967, or over 72 years. An additional 46 years of daily data for Witbank (SAWB gauge number 0515412 2) was purchased from the South African Weather Bureau. The full data set therefore runs from September 1905 to August 2013. The data is considered representative of the mining rights area and is good quality.

6.1.3 Sources of evaporation data

The mean annual evaporation was sourced from the average evaporation for quaternary catchment B20G, documented in the Water Resources of South Africa, 2005 Study (Middleton and Bailey, 2009). Its monthly distribution was sourced from the Water Resources of South Africa Study data set, zone 4A (Midgley et al., 1990). The data is considered representative of the mining rights area.

6.2 Peak Rainfall Data

6.2.1 Maximum Monthly Rainfall Data

The maximum monthly rainfall data was distilled from the daily rainfall record (discussed in section 6.1.2) and is presented in Table 3.

TABLE 3: MAXIMUM MONTHLY RAINFALL DATA (MM)

Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
192.6	321.8	354.3	374.4	340.5	236.4	135.7	117.4	106.4	81.8	79.5	135.5

6.2.2 Peak 24-hr Rainfall Data

The peak 24-hr rainfall depths are presented in Table 4.

TABLE 4: PEAK 24-HR RAINFALL DEPTHS FOR THE MINING RIGHTS AREA

Recurrence Interval (year)	24-hour rainfall depth (mm)
2	53
10	83
20	96
50	115
100	130
200	146

The daily rainfall record, discussed in section 6.1.2, was analysed and the annual maximum series was extracted from the data. This annual maximum series was statistically analysed to determine various T-year recurrence interval 24-hour storm depths. A Log Pearson Type III fit was selected as the most appropriate statistical fit. The fit is slightly conservative, but results are appropriate to the region. This fit is shown in Figure 2. The rainfall record is long, consists of good data, is representative of the site, and is suitable be used to calculate peak rainfall.

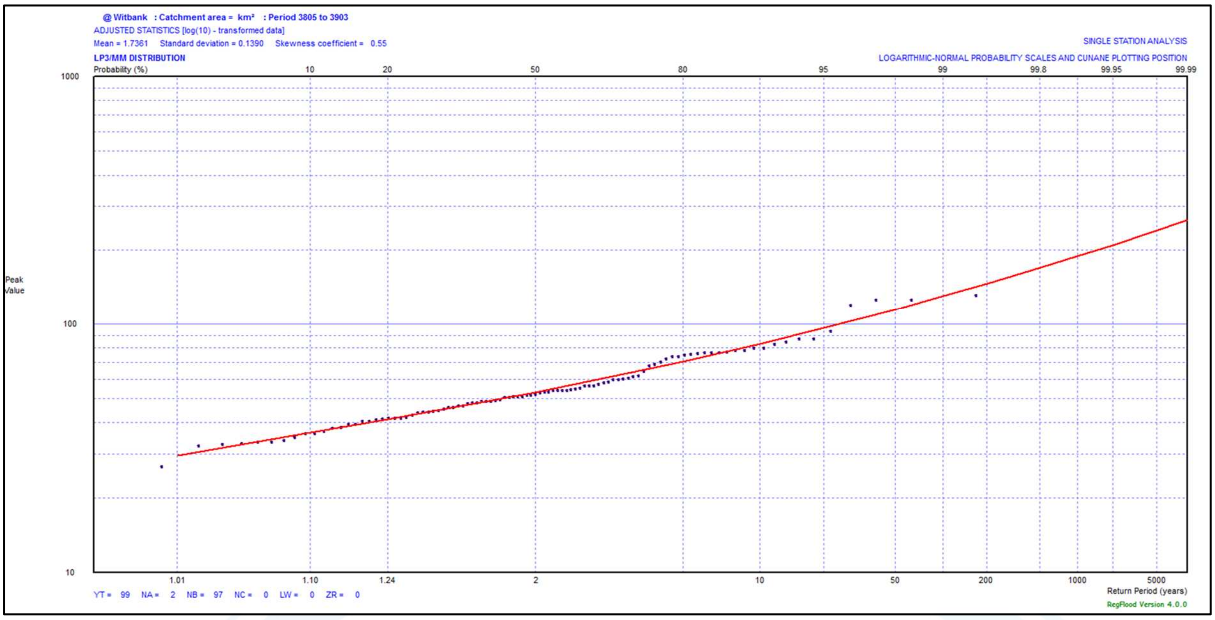

FIGURE 2: LOG EXTREME VALUE TYPE 1 STATISTICAL FIT TO THE ANNUAL MAXIMUM SERIES

7. BASELINE HYDROLOGY

7.1 Catchment Delineation

The Grootspruit has a 81.562 km^2 catchment up to just beyond the mining rights area. The tributary of the Grootspruit has a catchment measuring 8.169 km^2 up to its confluence with the Grootspruit. The catchment sizes and catchment boundaries are shown in Figure 3.

The mean annual runoffs for the catchments shown in Figure 3 are listed in Table 5.

TABLE 5: MEAN ANNUAL RUNOFF

Stream	Mean annual run-off (Mm^3/a)
Grootspruit	3.57
Grootspruit tributary	0.36

The mean annual runoff for the quaternary catchments B20G is 22.87 Mm^3 (Middleton and Bailey, 2009). The mean annual runoff values in Table 5 were scaled from the quaternary catchment runoff, based on relative catchment size.

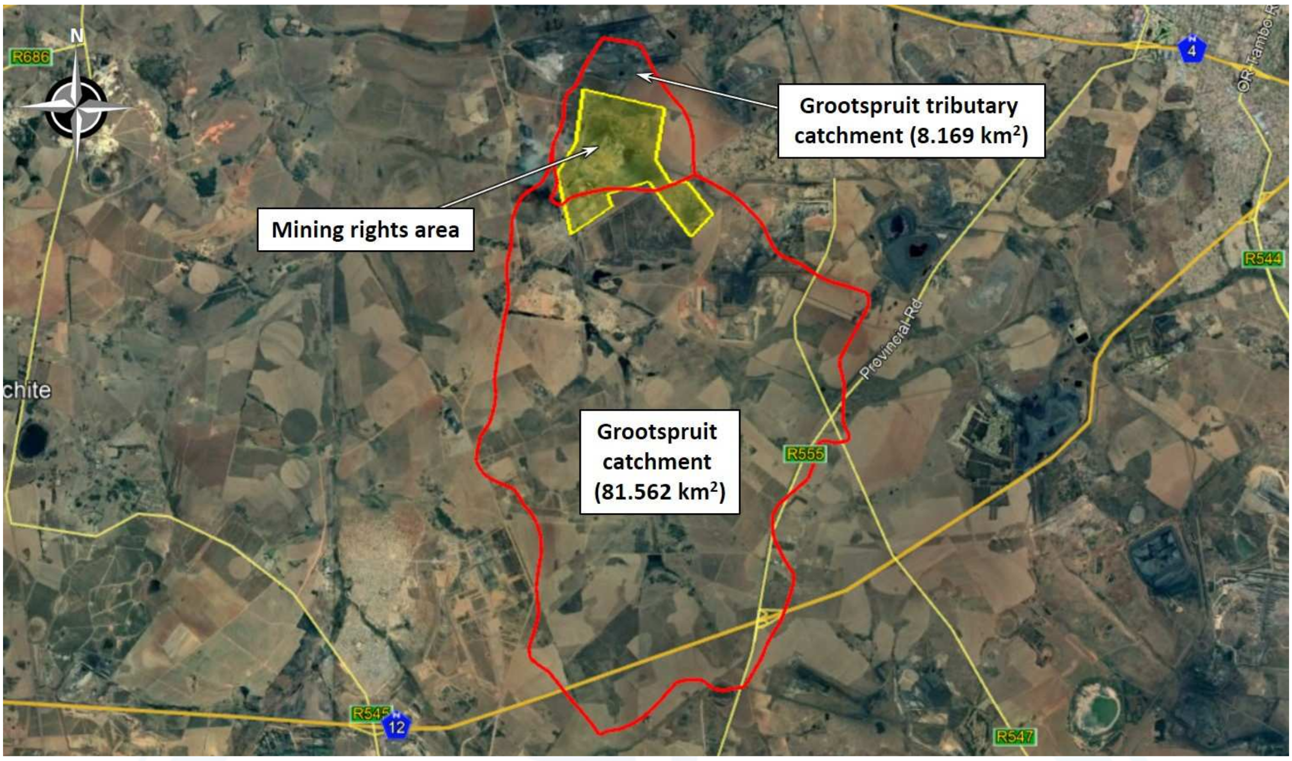

FIGURE 3: CATCHMENT DELINEATION

7.2 Normal Dry Weather Flows

Due to the small catchment size of the Grootspruit tributary, dry weather flows are likely to be very low and will often be limited to sub-surface flow only. Average dry weather flows appear high, but these are influenced by storm flow from occasional winter rainfall events and unseen subsurface flow.

The normal dry weather flows are based on the average monthly flows documented in the Water Resources of South Africa, 2005 Study (Middleton and Bailey, 2009) for quaternary catchment B20G. The flows were scaled based on relative catchment size. The dry weather flows are presented in Table 6. The dry weather flows have been highlighted in bold text.

TABLE 6: NORMAL DRY WEATHER FLOWS IN M³/MONTH (HIGHLIGHTED IN BOLD TEXT)

Month	Grootspruit	Grootspruit tributary
Oct	**166 194 m^3**	**16 645 m^3**
Nov	568 599 m^3	56 949 m^3
Dec	516 339 m^3	51 715 m^3
Jan	627 754 m^3	62 874 m^3
Feb	678 305 m^3	67 937 m^3
Mar	560 695 m^3	56 158 m^3
Apr	231 157 m^3	23 152 m^3
May	**88 768 m^3**	**8 891 m^3**
Jun	**49 264 m^3**	**4 934 m^3**
Jul	**33 327 m^3**	**3 338 m^3**
Aug	**26 342 m^3**	**2 638 m^3**
Sep	**26 250 m^3**	**2 629 m^3**

7.3 Flood Flow Analysis

The 50-year and 100-year flood peaks for the two streams were calculated and the results are presented in Table 7. The flood peaks were calculated for the catchments shown in Figure 3.

TABLE 7: PEAK FLOWS IN THE RIVERS AND STREAMS

Recurrence interval	Grootspruit	Grootspruit tributary
50-year	246 m^3/s	55 m^3/s
100-year	326 m^3/s	75 m^3/s

The Utility Programs for Drainage software was used to calculate the flood peaks. The Rational Method, Alternative Rational Method, SDF Method and Unit hydrograph Method were used to calculate the flood peaks. The Unit hydrograph Method was selected as the most appropriate flood peak to use for the Grootspruit. The Rational Method was selected as the most appropriate flood peak to use for the Grootspruit tributary.

8. FLOODLINES

8.1 Backwater analysis

The backwater analysis was performed using HEC-RAS. Cross sections for the Grootspruit and Grootspruit tributary were taken from survey data supplied by the client.

Both streams are small with ill-defined channels in most areas. Some areas have extensive reedbeds in the channels. The tributary is canalised in some places. The Grootspruit is generally free of trees and woody vegetation. The tributary has a stand of trees on one area that it flows through. The channels mostly consist of grasses, sedges and reed beds. The banks are well vegetated, mainly with grasses. A Manning's n of 0.04 was used within the overbank stations and 0.06 outside of the overbank stations.

The flood peaks presented in Table 7 were used to calculate the floodlines. The 50-year and 100-year floodlines are shown in Figure 4. The accuracy of the survey data cannot be verified. It is assumed that the survey data provided is a true reflection of the topography within the study area. The accuracy of the floodlines is dependent on the accuracy of the survey data.

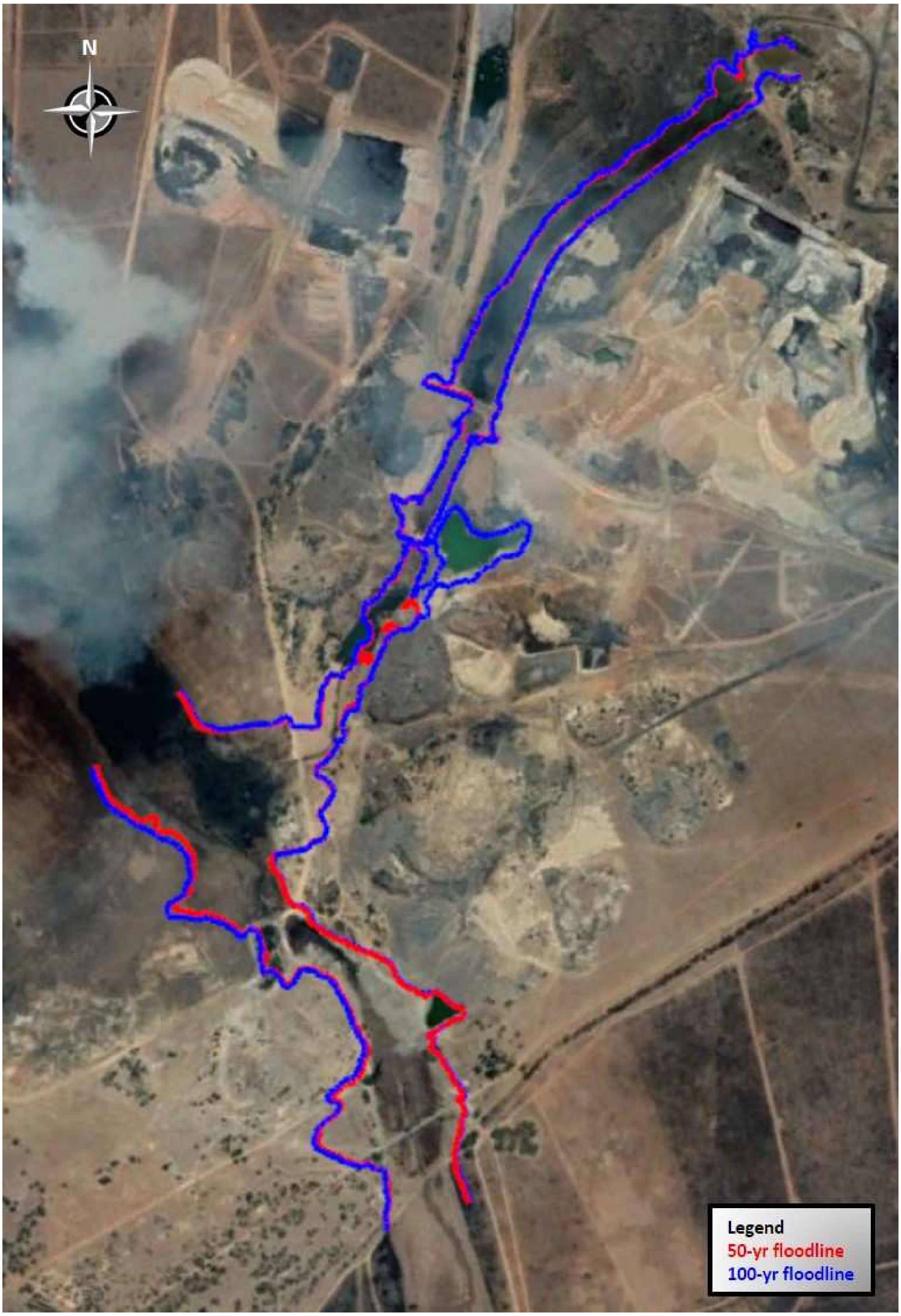

FIGURE 4: FLOODLINES

9. BUFFER ZONES

Section 4a of Government Notice 704 (GN 704) of the South African National Water Act states the following: "*No person in control of a 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 flood-line or within a horizontal distance of 100 metres from any watercourse…*".

Section 4b of Government Notice 704 of the South African National Water Act states the following: "*No person in control of a mine or activity may … carry on any underground or opencast mining, prospecting or any other operation or activity under or within the 1:50 year flood-line or within a horizontal distance of 100 metres from any watercourse…*"

Pollution control dams and stockpiles are required as part of the colliery so Section 4a of GN 704 will apply to these. Section 4b will apply to any opencast pits. The surface water buffer zone therefore is the greater of the 100-year floodline or 100 m from the water course. The buffer zones for the Grootspruit and its tributary are shown in Figure 5.

It must be noted that numerous infrastructures are located within the surface water buffer zones. This infrastructure should be applied to be exempt from the requirements of GN 704 or they should be removed.

FIGURE 5: SURFACE WATER BUFFER ZONES

10. IMPACT ASSESSMENT

10.1 Project Description

The project involves opencast and underground coal mining, the construction of topsoil, hards and softs dumps, the construction of run of mine stockpile areas, dry crushing and screening activities with their associated stockpiles, storm water management infrastructure (diversion channels and pollution control dams), and administration buildings.

10.2 Methodology for Impact Assessment

Activities on the mine have been taken through an impact assessment prior to and post mitigation measures. Impacts are noted when flow volumes, velocities, characteristics and qualities are antipated to change as a result of the mining activities. These changes can be to the detriment or the benefit of the receiving environment. This is done through a significance rating methodology which is guided by the requirements of the NEMA EIA Regulations 2014.

The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/ likelihood (P) of the impact occurring. This determines the environmental risk. In addition, other factors, including cumulative impacts and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S). The impact assessment will be applied to all identified alternatives. Where possible, mitigation measures will be recommended for impacts identified.

10.3 Determination of Environmental Risk

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER). The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact. For the purpose of this methodology the consequence of the impact is represented by:

$$c = \frac{(E + D + M + R) * N}{4}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 8 below.

TABLE 8: CRITERIA FOR DETERMINING IMPACT CONSEQUENCE

Aspect	Score	Definition
Nature	-1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction).
Magnitude/Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
	4	High (where natural, cultural or social functions or processes are altered to the 4 extent that it will temporarily cease), or

	5	Very high / don't know (where natural, cultural or social functions or processes 5 are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact

TABLE 9: PROBABILITY SCORING

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%),
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

$$ER = C * P$$

TABLE 10: DETERMINATION OF ENVIRONMENTAL RISK

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
	Probability	1	2	3	4	5

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in Table 11.

TABLE 11: SIGNIFICANCE CLASSES

Environmental Risk Score	
Value	Description
<9	Low (i.e. where this impact is unlikely to be a significant environmental risk).
≥ 9 - <17	Medium (i.e. where the impact could have a significant environmental risk),
≥ 17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre- mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

10.4 Impact Prioritisation

Further to the assessment criteria presented in the section above, it is necessary to assess each potentially significant impact in terms of:

1. Cumulative impacts; and
2. The degree to which the impact may cause irreplaceable loss of resources.

To ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

TABLE 12: CRITERIA FOR DETERMINING PRIORITISATION

Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable Loss of Resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 12. The impact priority is therefore determined as follows:

$$Priority = CI + LR$$

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 2 (Refer to Table 13).

TABLE 13: DETERMINATION OF PRIORITISATION FACTOR

Priority	Ranking	Prioritisation Factor
2	Low	1
3	Medium	1.125
4	Medium	1.25
5	Medium	1.375
6	High	1.5

In order to determine the final impact significance, the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is an attempt to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

TABLE 14: FINAL ENVIRONMENTAL SIGNIFICANCE RATING

Rating Environmental Significance Rating	
Value	Description
≤ -20	High negative (i.e. where the impact must have an influence on the decision process to develop in the area).
> -20 - ≤ -10	Medium negative (i.e. where the impact could influence the decision to develop in the area).
> -10	Low negative (i.e. where this impact would not have a direct influence on the decision to develop in the area).
0	No impact
<10	Low positive (i.e. where this impact would not have a direct influence on the decision to develop in the area).

≥10 - < 20	Medium positive (i.e. where the impact could influence the decision to develop in the area).

The significance ratings and additional considerations applied to each impact will be used to provide a quantitative comparative assessment of the alternatives being considered. In addition, professional expertise and opinion of the specialists and the environmental consultants will be applied to provide a qualitative comparison of the alternatives under consideration. This process will identify the best alternative for the proposed project.

10.5 Summary of Impacts and Significant Ratings

10.5.1 Construction phase

Elandsfontein Colliery is an existing operation, so construction impacts are limited. However new roads and footprints may be constructed in the future.

Likely impacts are:

- Impacts due to topsoil stripping
- Impacts due to construction related pollution

Proposed management and mitigation measures are summarised as:

- Optimising areas that are stripped
- Optimising the timing of activities to limit storm water impacts, along with effective storm water management.
- Vegetation management.
- Maintenance of construction vehicles and effective storm water management around wash bays and service and storage areas.

10.5.2 Operational phase

Likely impacts are:

- Impacts due to contaminated water discharge
- Impacts due to leaking or burst dirty water pipes
- Loss of catchment yield
- Impacts due to wash bays and workshops
- Impacts due to vehicle fleet-related pollution

Proposed management and mitigation measures are summarised as:

- GN 704 compliance.
- Maintenance of pipelines.

- Maintenance of construction vehicles and effective storm water management around wash bays and service and storage areas.

10.5.3 Decommissioning phase

Likely impacts are:

- Impacts due to the removal of surface infrastructure and rehabilitation

Proposed management and mitigation measures are summarised as:

- Effective plant maintenance.
- Footprint optimisation.

10.5.4 Rehabilitation and closure phase impacts

Likely impacts are:

- Impacts due to pit decant.

Proposed management and mitigation measures are summarised as:

- Effective rehabilitation to reduce infiltration.
- Passive or active treatment of decant water.

10.5.5 Summary of impact rating scores

The impact and significant ratings are summarised in Table 15.

TABLE 15: IMPACT AND SIGNIFICANT RATINGS SUMMARY

IMPACT DESCRIPTION				Pre-Mitigation							Post Mitigation								Priority Factor Criteria			
Identifier	Impact	Alternative	Phase	Nature	Extent	Duration	Magnitude	Reversibility	Probability	Pre-mitigation ER	Nature	Extent	Duration	Magnitude	Reversibility	Probability	Post-mitigation ER	Confidence	Cumulative Impact	Irreplaceable loss	Priority Factor	Final score
1.1.1	Topsoil stripping	Alternative 1	Construction	-1	2	2	3	2	5	-11.25	-1	2	2	1	2	5	-8.75	Medium	2	1	1.13	-9.84
1.1.2	Construction related pollution	Alternative 1	Construction	-1	2	2	2	3	3	-6.75	-1	2	2	2	3	2	-4.5	High	2	1	1.13	-5.06
1.1.3	Contaminated water discharge	Alternative 1	Operation	-1	4	4	3	3	5	-17.5	-1	4	1	3	3	2	-5.5	High	1	1	1.00	-5.50
1.1.4	Loss of catchment yield	Alternative 1	Operation	-1	3	3	4	4	5	-17.5	-1	3	3	2	4	5	-15	Medium	2	3	1.38	-20.63
1.1.5	Pollution from wash bays and workshops	Alternative 1	Operation	-1	3	1	2	2	2	-4	-1	3	1	2	2	1	-2	Medium	2	1	1.13	-2.25
1.1.6	Contamination due to burst water pipes	Alternative 1	Operation	-1	3	2	3	2	4	-10	-1	2	2	2	2	3	-6	Medium	2	1	1.13	-6.75
1.1.7	Vehicle fleet related pollution	Alternative 1	Operation	-1	2	2	2	3	3	-6.75	-1	2	2	2	3	2	-4.5	Medium	1	1	1.00	-4.50
1.1.8	Removal of surface infrastructure	Alternative 1	Decommissioning	-1	2	2	3	3	5	-12.5	-1	2	2	1	3	5	-10	Medium	2	1	1.13	-11.25
1.1.9	Pit decant	Alternative 1	Rehab and closure	-1	3	5	3	5	5	-20	1	3	4	1	1	5	11.25	High	1	1	1.00	11.25

10.6 Impacts During the Construction Period

10.6.1 Impacts due to topsoil stripping

Impact assessment

During the construction phase, topsoil from all facility footprints will be stripped and stockpiled for future use. This may result in the following impacts:

- Areas that have been stripped of vegetation and topsoil will be prone to erosion. This could lead to increased suspended solids being deposited into the local streams. It is unlikely that impacts will extend beyond the Grootspruit and the Grootspruit tributary.
- The topsoil stockpile will be prone to erosion prior to it being vegetated. Natural re-vegetation will likely take more than one season to completely cover the topsoil stockpile. The resultant erosion could lead to increased suspended solids being deposited into the Grootspruit and the Grootspruit tributary.

The affected areas will be relatively small. Erosion impacts will be short-term and will cease once the facilities are constructed and the topsoil stockpile is vegetated.

Mitigation

Mitigation of the impacts should include the following:

- Areas that are stripped should be optimised to limit unnecessary stripping.
- Storm water from upslope of the stripped areas should be diverted around these areas to limit the amount of storm water flowing over from these areas.
- The timing of the topsoil stripping should be optimised to limit the time between stripping and construction. Where practical constraints exist and areas need to be left stripped for long periods, contour ploughing, or ripping could reduce run-off and hence reduce erosion.
- Dry season construction is preferable where practical.
- Hydro seeding of the topsoil stockpile is recommended to speed up vegetation cover. An appropriate seed mix should be designed by a vegetation specialist.

Cumulative impact

Topsoil stripping will add to sediment loads produced by erosion from upstream agricultural activities. While it occurs, the impact will be significant compared to upstream impacts of a similar nature. However, the impact will be temporary and will cease shortly after the dirty water management infrastructure is in place.

Irreplaceable loss of resources

The impacts are likely to be temporary as high flows will wash sediments out of river systems. There will likely to be no irreplaceable loss of resources.

10.6.2 Impacts due to construction related pollution

Impact assessment

During the construction phase a significant number of vehicles will be driving around the site. In addition to this, fuels are stored on site and chemicals are used during normal construction activities. This may result in the following impacts:

- If the construction vehicles are poorly maintained hydrocarbon spills could cause pollution if washed off roads by storm water.
- Vehicle wash bays are a common source of hydrocarbon pollutants.
- Leaks from fuel depots could result in surface water pollution.
- Spillage and unsafe storage of chemicals could result in surface water contamination.

The affected areas will be the entire construction site. Spillage impacts will be short-term and will cease after the completion of construction. If soils have become contaminated, this will leach out over a prolonged period.

Mitigation

Mitigation of the impacts should include the following:

- All construction vehicles should be well maintained and inspected for hydrocarbon leaks weekly.
- Wash bay discharge water should flow through an oil separator.
- Fuel depots and refuelling areas should be bunded.
- Chemicals should be stored in a central secure area.
- Regular toolbox talks on the responsible handling of chemicals should be undertaken.

Cumulative impact

There are potential sources of hydrocarbon pollutants in the study area. Hydrocarbons are currently not measured in the rivers. It is recommended that hydrocarbon pollutants be measured at least once a quarter in water quality monitoring locations.

Irreplaceable loss of resources

The impacts are likely to be temporary as high flows will wash sediments and hydrocarbon pollution out of river systems. There will likely to be no irreplaceable loss of resources.

10.7 Impacts During the Operational Phase

10.7.1 Impacts due to contaminated water discharge

Impact assessment

Some of the study area should be considered as dirty areas. These areas include the opencast operations, the hards and ROM stockpiles, and any pollution control dams. Storm water and seepage generated from these dirty areas will likely be contaminated and have a detrimental effect on the water quality in the local streams, the Grootspruit and the Grootspruit tributary. These impacts will be most acute during the dry season when stream flows are low.

The colliery must undertake to comply with Government Notice 704 of the South African National Water Act (Act 36 of 1998). This act limits discharges of contaminated water from mining related activities to less than once in 50 years on average. Storm water from dirty areas must be routed to a dirty water management system, in accordance with Government Notice 704 of the National Water Act (Act 36 of 1998).

Should a legal discharge occur as a result of extreme rainfall conditions, the Grootspruit and the Grootspruit tributary, and the local streams should have enough capacity to dilute poor quality water. The impacts from extreme rainfall conditions should be low and will last for a short duration.

Mitigation

Mitigation of the impacts must include the following:

- Contaminated shallow seepage and storm water run-off must be collected and routed to a lined pollution control dam. The pollution control dam must be sized in accordance with Government Notice 704 of the South African National Water Act.
- The pollution control dam water levels must be constantly monitored. Steps and procedures must be put in place to manage situations where excess water builds up in the pollution control dam.
- The pollution control dam must be operated empty as far as practicable and cannot fulfil the same role as a water storage dam, unless specifically designed to fulfil both purposes.
- Water reuse from the pollution control dam must be maximised.

Cumulative impact

The impacts resulting from contaminated water discharges in accordance with Government Notice 704 of the South African National Water Act, Act 36 of 1998 will result in short-term water quality deterioration in the Grootspruit and the Grootspruit tributary.

Irreplaceable loss of resources

The impacts are likely to be temporary as high flows will wash sediments and salts out of river systems. There will likely to be no irreplaceable loss of resources.

10.7.2 Impacts due to leaking or burst dirty water pipes

Impact assessment

Water pipes may transport polluted water between the pollution control dam and other facilities on the proposed colliery. If any of these pipes burst, significant quantities of poor-quality water could be pumped into the environment.

Mitigation

Mitigation of the impacts should include the following:

- It is preferable to run the dirty water pipelines through areas already serviced by dirty water systems where possible.
- Pipelines should be subjected to frequent patrols. An efficient system of reporting should be available to allow the immediate tripping of pumps should a leak be found.

Cumulative impact

The impacts resulting from leaking or burst dirty water pipes will result in water quality deterioration in the Grootspruit and the Grootspruit tributary.

Irreplaceable loss of resources

The impacts are likely to remain in the medium term (a few seasons) until salts are leached from the temporary as high flows will wash sediments out of river systems. There will likely to be no irreplaceable loss of resources.

10.7.3 Loss of catchment yield

Impact assessment

During the operational phase storm water generated from the proposed mining areas and pollution control dams must be considered as dirty and must be collected in the dirty water system. This water would have contributed to the flow into the Grootspruit and the Grootspruit tributary and in the local wetlands. The impounding of this water will result in a small reduction in the yield of the catchment.

If surface subsidence occurs above the underground workings, this will reduce the yield of the Grootspruit and the Grootspruit tributary and the local wetlands. Run-off from this area would have contributed to the flow in these streams. This water will be intercepted and lost from the surface water system to evaporation and infiltration.

These potential losses are quantified in Table 16.

TABLE 16: LOSS OF CATCHMENT YIELD (% OF MAR)*

Parameter	Opencast area	Dirty areas reporting to the PCDs	Underground area (if surface subsidence occurs)
Total catchment loss	80 012 m^3/yr	51 831 m^3/yr	90 485 m^3/yr
Impact on Grootspruit	0.4%	0.5%	0.5%
Impact on Grootspruit tributary	18.1%	9.5%	20.6%
Impact on wetlands in Grootspruit**	0.4%	0.5%	0.5%
Impact on wetlands in Grootspruit tributary**	18.1%	9.5%	20.6%

** Note: MAR is mean annual run-off*
*** Note: The wetlands considered are those within the catchment boundaries shown in Figure 3.*

Refer to Figure 3 on page 10 for stream locations.

Mitigation

As is best practice, dirty areas should be minimised. This will have the dual benefit of smaller dirty water management systems and reduction in catchment yield loss.

The loss of catchment yield due to underground subsidence can be mitigated by preventing subsidence and surface cracking. The mine must commit to adhering to suitable surface subsidence safety factors.

Cumulative impact

The impact on the Grootspruit and the Grootspruit tributary and the local wetlands will be small.

Irreplaceable loss of resources

If surface subsidence occurs over the underground mining areas, surface water losses over the underground mining areas will be permanent. The permanent losses related to the opencast and dirty areas are likely to be temporary until these areas are rehabilitated.

10.7.4Impacts due to wash bays and workshops

Impact assessment

Organic and nutrient pollution may result from the wash bays and workshop areas. These areas should be bunded and all water should be contained, collected and routed to an appropriate treatment facility. Impacts are likely to be low and will last during the life of the colliery.

Mitigation

Mitigation of the impacts should include the following:

- All drains that collect the wash water and storm water must be maintained regularly. These should be free of debris and silt.
- All diversion canals, trenches and conduits must be designed to convey run-off from a 50-year design storm.
- The wash bays and workshops must be equipped with oil separators to remove hydrocarbons from wash down water.

Cumulative impact

There are potential sources of hydrocarbon pollutants in the study area. Hydrocarbons are currently not measured in the rivers. It is recommended that hydrocarbon pollutants be measured at least once a quarter in water quality monitoring locations.

Irreplaceable loss of resources

The impacts are likely to be temporary as high flows will wash sediments and hydrocarbons out of river systems. There will likely to be no irreplaceable loss of resources.

10.7.5Impacts due to vehicle fleet-related pollution

Impact assessment

During the operational phase a significant number of vehicles will be driving around the site. In addition to this, fuels are stored on site and chemicals are used during normal operational activities. This may result in the following impacts:

- If the vehicles are poorly maintained hydrocarbon spills could cause pollution if washed off roads by storm water.
- Vehicle wash bays are a common source of hydrocarbon pollutants.
- Leaks from fuel depots could result in surface water pollution.
- Spillage and unsafe storage of chemicals could result in surface water contamination.

The affected areas will be the entire expansion area. Impacts will be medium term and will cease after the cessation of mining. If soils have become contaminated, this will leach out over a prolonged period.

Mitigation

Mitigation of the impacts should include the following:

- All vehicles should be well maintained and inspected for hydrocarbon leaks weekly.
- Wash bay discharge water should flow through an oil separator.
- Fuel depots and refuelling areas should be bunded.
- Chemicals should be stored in a central secure area. Regular training on the responsible handling of chemicals should be undertaken. If contract plant is being used, responsible handling of chemicals and vehicle maintenance should be a key performance objective of the plant contractor.

Cumulative impact

There are potential sources of hydrocarbon pollutants in the study area. Hydrocarbons are currently not measured in the rivers. It is recommended that hydrocarbon pollutants be measured at least once a quarter in water quality monitoring locations.

Irreplaceable loss of resources

The impacts are likely to be temporary as high flows will wash sediments and hydrocarbons out of river systems. There will likely to be no irreplaceable loss of resources.

10.8 Impacts During the Decommissioning Phase of the Project

10.8.1Impacts due to the removal of surface infrastructure and rehabilitation

Impact assessment

During the decommissioning phase, most impacts will be associated with the removal of surface infrastructure, final pit closure and removal and rehabilitation of the ROM stockpiles and the hards dump. Haul roads will be removed, as will berms and diversion trenches.

During this process, short-term impacts will be moderate, as heavy earthmoving machinery will disturb large areas. Previously vegetated areas may be disturbed which will increase erosion potential. These short-term impacts will give way to long-term benefits.

Mitigation

Apart from due diligence care while performing decommissioning tasks, no mitigation is necessary. Due diligence care includes the following:

- Plant should be well maintained to ensure that hydrocarbon spills are minimised.
- Existing roads should be used where possible.
- New disturbed areas should be minimised.

Cumulative impact

Topsoil stripping will add to sediment loads produced by erosion from upstream agricultural activities. While it occurs, the impact will be significant compared to upstream impacts of a similar nature. However, the impact will be temporary and will cease shortly after the dirty water management infrastructure is in place.

Irreplaceable loss of resources

The impacts are likely to be temporary as high flows will wash sediments out of river systems. There will likely to be no irreplaceable loss of resources.

10.9 Impacts After the Closure Phase of the Project

10.9.1 Impacts due to pit decant

Impact assessment

The groundwater study has indicated that decant may occur from the mine workings.

After the colliery is closed, contaminated water management becomes passive. Groundwater inflows and recharge through the rehabilitated spoils may create decant from the opencast and underground workings. This decant will be driven by rainfall recharge through the rehabilitated surface and groundwater inflows. The decant water quality is likely to be poor and will contaminate the Grootspruit and the Grootspruit tributary. Decant flows will likely be seasonal and volumes will be dependent on the quality of rehabilitation done and the degree of surface subsidence. Poor rehabilitation will increase the decant volumes. The water quality is likely to remain poor in the long term (>20 years). Eventually as pollutants are leached out of the workings and natural stratification occurs, the seepage water quality will improve.

Mitigation

Mitigation of the impacts should include the following:

- The rehabilitation work should strive to minimise recharge and maximise run-off.
- A final void could be optimised to evaporate excess pit water if approved by the Department of Water Affairs.
- Where feasible, materials likely to produce the highest amounts of pollution should be replaced in sections of the pit where they will be permanently flooded, thus preventing oxidation of these materials.
- Should passive mitigation measures not be suitable, active alternatives can be considered such as some form of treatment, prior to release.
- The planned mining method and the commitment to adhering to appropriate safety factors must be made by the mine to prevent surface subsidence.
- Methods to stop or reduce decant volumes could include sealing some areas of the mine workings or leaving some areas unmined to act as a barrier to decant.
- Methods to improve the decant water quality could include flooding of the mining areas, where practical, to reduce oxygen ingress. Routing seepage through lime pits can also improve the water quality if the flows are low enough.

Cumulative impact

If the quality of rehabilitation is good and the void can balance the inflows, the cumulative impacts will be negligible. The same will apply if no surface subsidence occurs over the underground areas. Should decant occur, the impacts resulting from pit or underground workings decant will result in long term water quality deterioration in the Grootspruit and the Grootspruit tributary. The impacts resulting from pit decant are likely to result in water quality deterioration in the Grootspruit and the Grootspruit tributary. If this water is treated to discharge standards and released, then impacts will be positive as clean water will feed the natural river systems.

Irreplaceable loss of resources

The impacts are likely to be long term (>20 years) unless this water is treated. If the water is treated, the impacts will be negligibly negative to positive, and there will likely to be no irreplaceable loss of resources.

11. CONCLUSIONS

Elandsfontein colliery is an operational colliery with significant development within the mining rights area.

The mining rights area is in quaternary catchment B20G. The mining rights area is located just west of Clewer and approximately 15km west, south west of Emalahleni. Elandsfontein is an operational colliery with significant development within the mining rights area.

A small tributary of the Grootspruit flows in a south westerly direction through the mining rights area. It's confluence with the Grootspruit is just to the west of the mining rights area. The Grootspruit flows from south to north along the western boundary of the mining rights area before turning west to meet the Saalklapspruit, approximately 5 km west of the mining right area.

The Grootspruit and its tributary floodplains are highly impacted by mining related activities and poorly constructed/informal road crossings. Both rivers are marked as perennial streams on the 50 000 topo sheets.

The Elandsfontein mining operations occur on both sides of Grootspruit tributary along most of its length. The upper reaches are dammed with pollution control and water supply dams. The natural tributary has a poorly defined water course but is generally heavily reeded. The lower reaches have been modified and the stream is canalised for roughly half its length.

The proposed open cast and underground operation will create significant impacts if unmitigated. Mitigation will reduce these impacts significantly. In general, full compliance with GN 704 will result in very low impacts during the operational phase.

Post closure mine workings decant has the potential to create high long-term impacts on the Grootspruit and its tributary. If this decant water is treated and released, the impacts are likely to become positive.

12. REFERENCES

- Middleton, B.J. and Bailey, A.K., *Water Resources of South Africa*, 2005 study (WR2005), 2009. WRC Report No TT 382/08.
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