Rayten Environmental (Pty) Ltd.

ENVIRONMENTAL MANAGEMENT ASSISTANCE (PTY) LTD

CLIMATE CHANGE IMPACT ASSESSMENT - BASELINE

NOMAMIX (PTY) LTD – VYGENHOEK PLATINUM MINE

JULY 2020

Rayten Project Number: ENV-EMA-20/7020

info@rayten.co.za 011 792 0880 086 592 0298 www.rayten.co.za

PO Box 1369 Bromhof 2154

REVISION AND APPROVAL PAGE

Revision Number	**1.0**		
Rayten Project Number	**ENV-EMA-20/7020**		
Report Title	**ENVIRONMENTAL MANAGEMENT ASSISTANCE (PTY) LTD** **CLIMATE CHANGE IMPACT ASSESSMENT - BASELINE** **NOMAMIX (PTY) LTD – VYGENHOEK PLATINUM MINE**		
	Name	**Signature**	**Date**
Author	Carita Hemsley *Environmental Scientist*		17 July 2020
Document Reviewer	Clive Wray *Member*		17 July 2020
Document Authorisation	Claire Wray *Environmental Scientist* *(Pri.Sci. Nat 400073/11)*		17 July 2020

Report Submission Summary		
Report Revision Number	1.0	17 July 2020
Report Revision Number		

DISCLAIMER

Information contained in this report was based on the last information received from Environmental Management Assistance and Nomamix (Pty) Ltd during June and July 2020. Where data supplied by the client or other external sources, including previous site investigation data, have been used, it has been assumed that the information is correct unless otherwise stated. No responsibility is accepted by Rayten Environmental (Pty) Ltd for incomplete or inaccurate data supplied by others. We are aware of the fact that there might have been changes since this report was submitted, however this report and its findings is based on the last information received from the client during June and July 2020. To the best of our knowledge the assumptions and findings are correct at the time of submission of the specialist report. Should any of the assumptions or findings prove to be incorrect subsequent to submission of the report we as the specialist cannot be held accountable. Note that although every effort has been made by Rayten Environmental (Pty) Ltd to obtain the correct information and to carry out an appropriate, independent, impartial and competent study, Rayten Environmental (Pty) Ltd cannot be held liable for any incident which directly or indirectly relates to the work in this document and which may have an effect on the client or on any other third party.

CONFIDENTIALITY

DECLARATION

PROJECT TITLE

Nomamix (Pty) Ltd – Vygenhoek Platinum Mine, Climate Change Impact Assessment Baseline Report.

Specialist:	Rayten Environmental (Pty) Ltd		
Contact person:	Carita Hemsley		
Postal address:	PO Box 1369, Bromhof, 2154		
Postal code:	2154	Cell:	*
Telephone:	0117920880	Fax:	086 592 0298
E-mail:	info@rayten.co.za		
Professional affiliation(s) (if any)	As per below		

Name of Practitioner: Rayten Environmental (Pty) Ltd

Name of Registration Body: South African Council for Natural Scientific Professions

Professional Registration No: 400073/11 (Claire Wray) and 400171/15(Gertrude Mafusire)

Declaration of accuracy of information provided:

Climate Change Impact Assessment Baseline report:

I, Carita Hemsley, declare that – General declaration

I am independent of the applicant;
I have the necessary expertise to conduct the assessments required for the report; and
I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
I will disclose to the applicant and the relevant authorities 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.
The information provided in this Climate Change Impact Assessment Baseline report is, to the best of my knowledge, in all respects factually true and correct. I am aware that the supply of false or misleading information to an authority is a criminal offence in terms of section 51(1)(g) of the NEM:AQA (No.39 of 2004).

Signature of the specialist:

Rayten Environmental (Pty) Ltd

Name of company (if applicable):

Date: 17 July 2020

EXECUTIVE SUMMARY

Rayten Environmental (Pty) Ltd (hereafter referred to as "Rayten") was appointed by Environmental Management Assistance (Pty) Ltd to compile a Climate Change Impact Assessment Baseline Report for Nomamix (Pty) Ltd – Vygenhoek Platinum Mine (hereafter referred to as "Vygenhoek Platinum Mine"), located at Portion 3 and 7 of the farm Vygenhoek 10 JT, in Ehlanzeni District Municipality, Mpumalanga Province, South Africa. Nomamix has applied for a mining right in terms of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002), as amended.

The main objective of the Climate Change Impact Assessment Baseline report is to assess the potential contribution of the project towards climate change, through the emission of Greenhouse Gases (GHGs). GHGs the proposed mine could emit include carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). Additionally, the effects that climate change could have on the project will also be assessed. MM5 meteorological data for the project area for the period 01 January 2017 – 31 December 2019 was used to determine the prevailing meteorological conditions at the site.

The terms of reference and scope of work for this climate change impact assessment baseline report are to describe the existing status of the biophysical environmental, in terms of climate, that will be affected by the mining activity, as well as to provide a list and description of potential impacts identified on the biophysical environment in terms of climate. A GHG emissions inventory and carbon footprint of the mining activity was thus not undertaken.

The main conclusions based on the information obtained during the Baseline Assessment can be summarised as follows:

Vygenhoek Platinum Mine is located at Portion 3 and 7 of the farm Vygenhoek 10 JT, in Ehlanzeni District Municipality, Mpumalanga Province, South Africa. There are proposed mining operations to be undertaken at the site and surrounding the site. The following activities are expected to be key sources of GHG emissions at the mine:

- Blasting (fugitive emissions resulting from the combustion of a complete explosives mix)
- Truck and mining equipment emissions from combustion of fuels
- Other combustion processes (e.g. gas, diesel & oil combustion)
- Transportation of the ore to the concentrator located offsite
- Septic tank
- Possible incinerator for treating sewage screenings
- Electricity consumption from the workshop, administrative office, weighbridge, and additional lighting of stockpile areas
- Construction of required infrastructure onsite

Other possible indirect GHG emission sources, include, but are not limited to:

- Employee commute and business travel
- Transportation of the septic tank waste to Steelpoort Sewage for treatment offsite
- Transportation of general and hazardous waste offsite

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LIST OF ABBREVIATIONS

CH_4	Methane
CO_2	Carbon dioxide
DEA	Department of Environmental Affairs
DEFF	Department of Environment, Forestry and Fisheries (prev DEA)
EIA	Environmental Impact Assessment
Gg	Gigagrams
GHG	Greenhouse Gas
IPCC	Intergovernmental Panel on Climate Change
LoM	Life of Mine
MW	Megawatt
N_2O	Nitrous oxide
NEM:AQA	National Environmental Management: Air Quality Act
PGMs	Platinum Group Metals
ROM	Run-of-Mine
SWDS	Solid Waste Disposal Sites
UNFCCC	United Nations Framework Convention on Climate Change

1. INTRODUCTION

Rayten Environmental (Pty) Ltd (hereafter referred to as "Rayten") was appointed by Environmental Management Assistance (Pty) Ltd to compile a Climate Change Impact Assessment Baseline Report for Nomamix (Pty) Ltd – Vygenhoek Platinum Mine (hereafter referred to as "Vygenhoek Platinum Mine"), located at Portion 3 and 7 of the farm Vygenhoek 10 JT, in Ehlanzeni District Municipality, Mpumalanga Province, South Africa (refer to Figure 1-1). Nomamix has applied for a mining right in terms of the Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002), as amended. As part of the mining right application, an Environmental Impact Assessment process must be undertaken. A climate impact assessment was identified as a requirement in the screening report for inclusion the Environmental Impact Assessment (EIA) report.

Figure 1-1: Site locality of Vygenhoek Platinum Mine

The main objective of the Climate Change Impact Assessment Baseline report is to assess the potential contribution of the project towards climate change, through the emission of GHGs. GHGs the proposed mine could emit include CO_2, CH_4 and N_2O. Additionally, the effects that climate change could have on the project will also be assessed. The terms of reference and scope of work for this climate change impact assessment baseline report are to describe the existing status of the biophysical environmental, in terms of climate, that will be affected by the mining activity, as well as to provide a list and description of potential impacts identified on the biophysical environment in terms of climate. A GHG emissions inventory and carbon footprint of the mining activity was thus not undertaken.

With the mining being undertaken by means of an open cast mining method, the following activities, which are expected to result in direct GHG emissions, will be undertaken: construction of support facilities and infrastructure, blasting to break down the hard overburden, blasting of the ore, transport of the ore to various stockpiles as well as to the Concentrator, waste management, a septic tank, combustion of fuels in mine vehicles, machinery and a generator, etc. A possible incinerator may be installed at a later stage for treating sewage screenings. Energy indirect GHG emissions will result from the use of imported electricity, heat or steam consumed onsite. Other indirect GHG emissions may occur, such as from employee commute and business travel, and the transportation of goods and services to and from the mine, when not controlled by the mining company itself. Therefore, assessment of impacts from the mining activity should not only focus on direct GHG emissions, but also on upstream and downstream emissions through the supply chain.

MM5 meteorological data for the project area for the period 01 January 2017 – 31 December 2019 was used to determine the prevailing meteorological conditions at the site.

2. BRIEF PROJECT DESCRIPTION

Mining operations at the proposed Vygenhoek mining site will be undertaken by means of an open cast mining method. The mine is expected to have a Life of Mine (LoM) of 10 years. The first 5 months will be utilised to establish the mine site. From month 6 the topsoil will be removed, and overburden stripping will take place to open the ore resource. The first ore is expected to be mined from month 8. The mined ore will be stockpiled to have sufficient stock to supply the preferred Concentrator for processing. The supply to the Concentrator will be at a constant rate of 15 000 tonnes of ore per month. Refer to Table 2-1 for the implementation phases of the project and

Table 2-2 for the mine's expected production schedule over the LoM. Underground mining may be considered at a later stage to substitute the open cast mining; however, a feasibility study would need to be undertaken for this. The entire mining operation will be outsourced to a mining contractor.

Table 2-1: Implementation phases of the proposed Vygenhoek Platinum Mine project

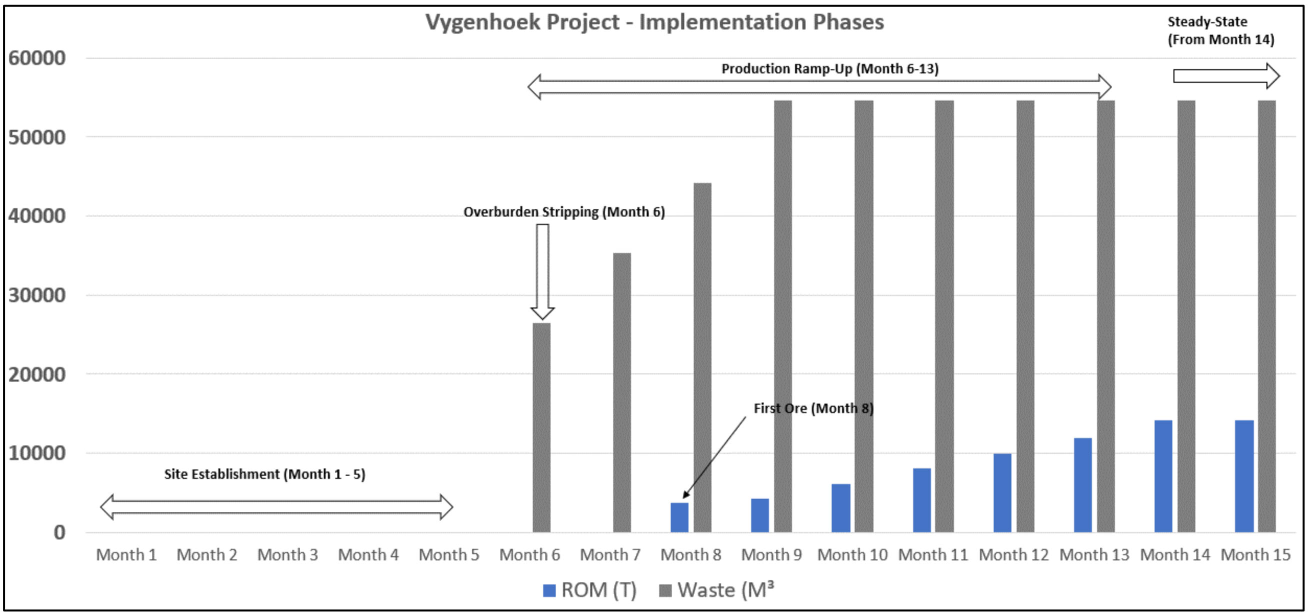
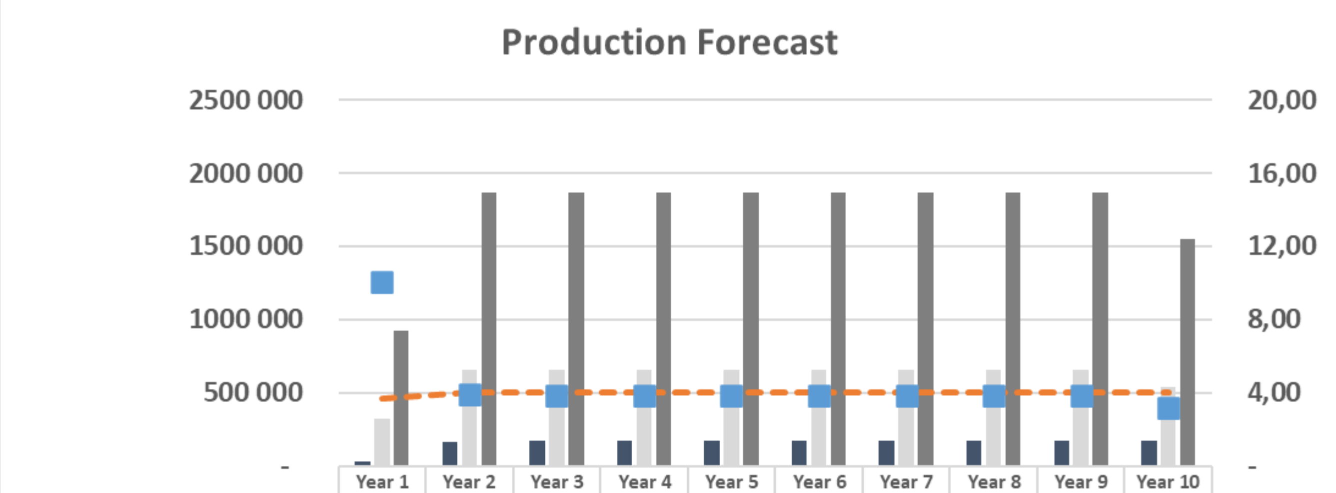


Table 2-2: Vygenhoek Platinum Mine production schedule over LoM of 10 years



	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Opencast ROM Tons (T)	32 258	167 697	169 964	169 964	169 964	169 964	169 964	169 964	169 964	170 449
Waste Volumes (M^3)	324 360	655 170	655 170	655 170	655 170	655 170	655 170	655 170	655 170	542 767
Waste Tons (T)	924 425	1867 235	1867 235	1867 235	1867 235	1867 235	1867 235	1867 235	1867 235	1546 887
4E Grade (g/t)	3,67	4,02	4,02	4,02	4,02	4,02	4,02	4,02	4,02	4,02
Stripping Ratio (T-M^3)	10	4	4	4	4	4	4	4	4	3

Due to the small size of the Vygenhoek project, the mine will only produce ore and will sell and transport this ore to one of the existing processing plants. A processing plant will not be constructed. There may be a possibility of having a mobile crusher on-site at a later stage. The Vygenhoek Project will not produce the final metals for marketing. The Run-of-Mine (ROM) ore will be sold and then a 4E Platinum Group Metals (PGMs) concentrate, consisting of Platinum (Pt), Palladium (Pd), Rhodium (Rh), and Gold (Au), with Nickel, Copper and Chrome as by products, will be produced.

2.1 Basic overview of the mining method

The surface sub-outcrop of the Vygenhoek project is planned to be mined using an advancing open pit mining method which allows for concurrent filling of the pit. The pit will be used to develop portals which will allow the remainder of the ore to be exploited using underground mining methods, if desired. The open pit planned applies a conventional open cast truck and shovel mining philosophy including the following steps:

- Removal of topsoil and storing it at a designated position;
- Removal of the overburden;
- Drilling and blasting will be required to break the hard overburden;
- The waste will be dumped in the pit behind the advancing face where possible with the remainder placed at the waste dump, separate from the topsoil;
- Drilling and blasting of the ore;

- Loading and hauling of the ore for stockpiling at the ROM pad or for transport to the preferred Concentrator;

A portion of the waste will be used in the construction of haul roads. Topsoil will be placed on top of backfill for the purpose of rehabilitation. The ore will be stockpiled on a ROM pad and transported to the Concentrator Plant by trucks. The open pit mining philosophy is based on a contractor-operated operation. A production shift cycle operating 9 hours a day, 6 days a week will be adopted.

Open pit mining operation will commence after the site establishment is completed. Initially, the removal of overburden will take place for a period of 6 months before any mining of ore is done. The first ore will be mined in month 8, and ore and waste mining will take place concurrently onwards. The pit will be mined from the North in a southerly direction, with backfilling of the mined-out areas taking place behind as the pit advances.

A map indicating the mining area and basic site layout is given in Figure 2-1.

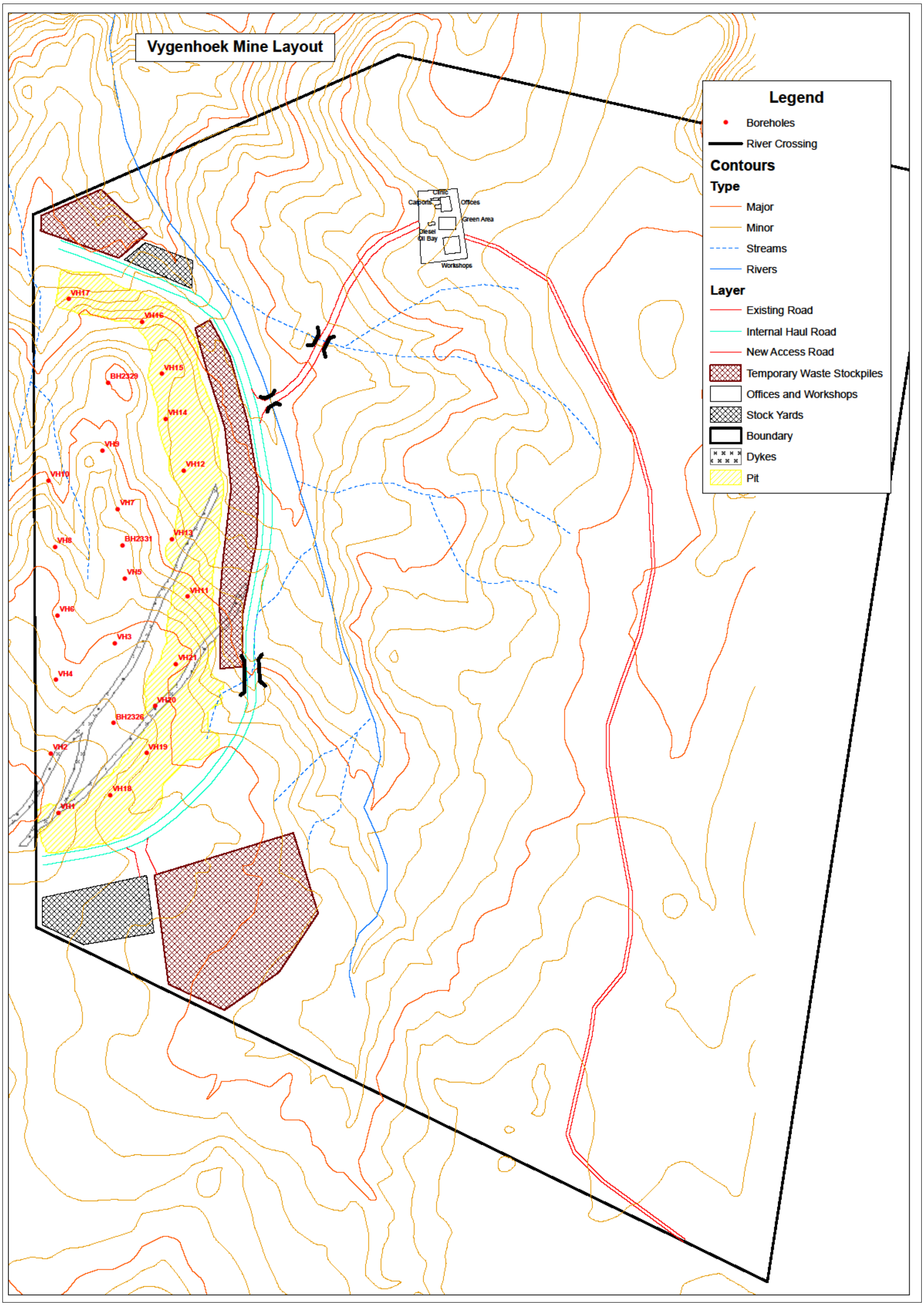


Figure 2-1: Vygenhoek Platinum Mine layout

2.2 Infrastructure and mining equipment

Infrastructure will be constructed, including: a workshop, administration office, and a weighbridge. Electricity will be used at these sites, while lighting will also be required at the stockpile area. The number of vehicles expected to be used onsite to undertake the mining activity are as follows:

- 5 Dump trucks for the transport of ore from the pit to the stockpile area;
- 2 Utility vehicles for the transport of material and explosives;
- 2 Drill rigs for the drilling of the benches;
- 5 Excavators for the stripping of ore and waste;
- 2 Bulldozers for the profiling of waste;
- 1 Grader for the maintenance of access roads and haul roads;
- 1 Water bowser for dust suppression of roads and waste dumps and screening areas;

The above-mentioned vehicles / mining equipment will be owned and controlled by the mining contractor.

3. LEGISLATION AND REGULATIONS

3.1 Climate Change

South Africa is at an advanced stage with formulating its national policy on mitigating the effects of climate change. The National Climate Change Bill is expected to be passed in the near future (with it currently being in Draft phase).

3.2 National Environmental Management: Air Quality Act

Air quality in South Africa is governed by the National Environmental Management: Air Quality Act (NEM:AQA) (No.39 of 2004); and as amended the NEM:AQA (No. 20 of 2014). The NEM:AQA makes provision for reasonable measures in order to protect the environment, prevent pollution and ecological degradation and secure ecological sustainable development. The NEM:AQA also provides national norms and standards for regulating air quality monitoring, management and control specific air quality measures and matters. As per the NEM:AQA, GHG means the gaseous constituents of the atmosphere, both natural and anthropogenic that absorb and re-emit infrared radiation.

On 14 March 2014, the following six greenhouse gases were declared as priority air pollutants in South Africa:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous Oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)
- Sulphur hexafluoride (SF_6)

National GHG Emission Reporting Regulations (Government Gazette No. 40762 of 3 April 2017), were published by the DEA. A person identified as a Category A data provider in terms Annexure 1 of these regulations, must register their facilities on the South African Greenhouse Gas Reporting System (SAGERS) and must submit a GHG emissions inventory and activity data in the required format given under Annexure 3 on an annual basis. A summary of GHG emitting activities required to report is given under section 4. The NEM:AQA and the National GHG Emission Reporting Regulations, establish the legislative framework for the national GHG reporting system in South Africa.

National Pollution Prevention Plan Regulations (Gazette No. 40996) were published on 21 July 2017 by the DEA. A pollution prevention plan will be required should the development do the following:

a) Undertake any of the following activities identified in Annexure A of the National GHG Emission Reporting Regulations (Government Gazette No. 40762 of 3 April 2017), which involves the direct emission of GHG more than 0.1 Megatonnes (Mt) annually measured as carbon dioxide equivalents ($CO_{2\text{-eq}}$); or
b) Undertake any of the following activities identified in Annexure A of the National Pollution Prevention Plan Regulations (Gazette No. 40996 of 21 July 2017) as a primary activity, which involves the direct emission of GHG more than 0.1 Megatonnes (Mt) annually measured as carbon dioxide equivalents ($CO_{2\text{-eq}}$);

Annexure A activities in terms of the National Pollution Prevention Plan Regulations include:

- Coal mining
- Production and /or refining of crude oil
- Production and/or processing of natural gas
- Production of liquid fuels from coal or gas
- Cement production
- Glass production
- Ammonia production
- Nitric acid production
- Carbon black production
- Iron & steel production
- Ferro-alloys production
- Aluminium production
- Polymers production
- Pulp and paper production
- Electricity production

Mining and Quarrying falls under category 1A2i in terms of Annexure 1 of the National GHG emission reporting regulations (Government Gazette No. 40762 of 3 April 2017). All facilities conducting this activity are required to register and report on their GHG emissions by the 31 March of every year if they trigger the required reporting thresholds (if they have stationary fuel combustion installations with a combined net heat input greater than 10MW).

3.3 Carbon Tax Act

The Carbon Tax Act No. 15 of 2019 was promulgated on 23 May 2019 and is implemented using a phased approach, allowing emitters time to transition to cleaner and more efficient technologies resulting in lower GHG emissions. Phase One is effective from 1 June 2019 to 31 December 2022.

Any person, company or entity who undertakes an activity (above a certain threshold) and is responsible for the release of GHG emissions is required to report on their emissions to the

Department of Environment, Forestry and Fisheries (DEFF) by the 31 March each year and pay tax on those emissions by July each year.

The tax rate is R120 per tonnes of $CO_{2\text{-eq}}$ (carbon dioxide equivalent) emitted by the generation facility or entity for the relevant reporting period. The carbon tax rate will increase by CPI + 2% during the first phase and thereafter by CPI. However, there are tax-free allowances that apply that can make the overall effective tax rate much lower between R6 and R48 per tonnes of $CO_{2\text{-eq}}$ emitted. Tax free allowances are capped at 95% and include:

- A basic tax-free allowance of 60% during Phase One (until December 2022).
- An additional tax-free allowance of 10% for process emissions.
- An additional tax-free allowance of 10% for fugitive emissions.
- An additional tax-free allowance of up to a maximum of 10% for trade exposed sectors.
- An additional tax-free performance allowance of up to 5% based on performance against intensity benchmarks.
- An additional tax-free allowance of 5% for companies who participate in the carbon budget system.
- An additional tax-free carbon offset allowance of 5% or 10% (depending on the sector).

Carbon offsets can be used to reduce tax liability up to 5% or 10% depending on the sector. On 29 November 2019, the South African National Treasury published the Regulations for Carbon Offsets. The Regulation outlines the suitability of offset projects and the procedure which is required to be followed in claiming the offset allowance.

4. BASELINE ENVIRONMENT - CLIMATE

South Africa’s climate change response is part of a broader global effort to mitigate and manage the effects of global warming, embedded within the United Nations Framework Convention on Climate Change (UNFCCC) and associated international mechanisms (DEA, 2018). On the international front it is in the interest of developing countries to maintain the spirit of the Paris Agreement, for its ultimate test lies in the elements contained under article 2 of the Agreement. This speaks to the enhanced collective efforts to limit the increase in global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre industrial levels (DEA, 2018).

4.1 Climate change in South Africa

South Africa is at an advanced stage with formulating its national policy on mitigating the effects of climate change. The National Climate Change Bill is expected to be passed in the near future (with it currently being in Draft phase).

According to the Department of Environmental Affairs (2018) (DEA), in South Africa’s 3rd Climate Change Report, South Africa has warmed considerably in the last 80 years. Some parts of South Africa have “warmed at twice the global rate of warming”. South Africa is expected to experience extreme warming of between 4-6°C over the next six decades.

Changes in rainfall intensity, magnitude and seasonality, as well as extreme weather events and sea level rises are expected. The impacts of climate change on water resources will be particularly challenging. “Different human settlement types and locations have varying vulnerabilities and capacities, and will experience the hazards associated with the present and future climate changes to an unequal extent, with informal settlements and their populations being the most exposed" (DEA, 2018). South Africa is most likely to experience climate change impacts primarily affecting water resources (DWA, 2013). South Africa is classified as a water-stressed country, with less than 9% of annual rainfall ending up in the rivers, and only 5% filling groundwater aquifers (DEA, 2018). Impacts on water are due to changes in rainfall and evaporation rates, which themselves are influenced by wind speed and air temperatures. With a drier future climate scenario, it is expected that there will be reduced surface water availability.

The greatest warming has been observed in the west over the Western and Northern Cape, and in the north-eastern provinces of Limpopo and Mpumalanga, extending southwards to the coastal areas of Kwa-Zulu Natal. Moreover, increases have not been observed only in the annual and seasonal averages of minimum and maximum temperature, but also in their extremes. The Western and Northern Cape, Gauteng, Limpopo, and eastern Kwa-Zulu Natal, in particular, have experienced warming at a rate that is more than twice the global rate of warming.

Drier conditions also have adverse effects on people, with changing wind patterns leading to increased dust generation, resulting in respiratory problems.

4.1.1. Fuel combustion activities – Energy industries

South Africa's primary energy consumption is ranked 16th in the world. This energy intensity is high primarily due to the largescale, energy-intensive primary minerals beneficiation industries and mining industries (DEA, 2016). Additionally, the energy sector is heavily reliant on fossil fuels to generate this electricity. GHGs emitted as a result of the combustion of these fossil fuels are CO_2, CH_4, N_2O and H_2O. The industrial sector, which includes mining, is South Africa's largest consumer of energy. South Africa's energy demand shows that industry/manufacturing sectors consume the highest percentage of electricity (45%), followed by mining (20%).

Total GHG emissions in 2015 attributable to the energy sector were estimated at 429 907 Gg CO_2e. Of this, 400 948 Gg CO_2e were due to fuel combustion activities, equivalent to 93.2% of the energy emissions. Refer to Table 4-1 which shows the emissions per GHG from the energy sector in South Africa.

Table 4-1: South Africa's energy sector emissions in 2015 (DEA, 2016, pg 68)

Greenhouse gas source and sink categories	CO_2	CH_4	N_2O	Total
	Gg CO_2e			
1.ENERGY	**423 182**	**4 110**	**2 615**	**429 907**
1.A Fuel combustion activities	397 862	472	2 615	400 948
1.B Fugitive emissions from fuels	25 320	3 639	0	28 959
1.C Carbon dioxide transport and storage	NE	NE	NE	NE

However, it should be noted that, according to DEA (2018), "energy efficiency has been the largest contributor to climate change mitigation in the country, accounting for approximately 82% of GHG emission reductions since 2010".

4.1.2. *Fuel combustion activities – Manufacturing industries and construction*

Mining and Quarrying (with IPCC code 1A2i), falling under the Energy sector, reports under 'Manufacturing Industries and Construction' (IPCC code 1A2). The manufacturing industries and construction sector in South Africa produced an estimated 36 870 Gg CO_2e GHG emissions in 2015, equivalent to 8.6% of the emissions from the energy sector. A breakdown was not provided for each category reporting below Manufacturing Industries and Construction, therefore the percentage contribution of Mining and Quarrying towards these GHG emissions was not available.

The largest category of fuel consumed in 2015 in South Africa was sub-bituminous coal (77% of total fuel consumed) (DEA, 2016). The second highest fuel consumed was natural gas (15.72% of total fuel consumption in the manufacturing industries and construction category) in 2015.

4.1.3. *Fuel combustion activities – Transport*

In terms of the National Greenhouse Gas Emission Reporting Regulations (NGERs) (DEA, 2016), Road Transportation (IPCC sub-category 1A3b) is excluded from reporting. This means that companies are not expected to report their GHG emissions associated with their vehicle use and on-site mobile equipment. However, it is nonetheless useful to calculate these GHG emissions so as to understand the fuel consumption and its contribution towards climate change.

Road transport was responsible for the largest fuel consumed in the transport sector.

4.1.4. *Waste*

Among the sectors that contribute to the increasing quantities of GHGs into the atmosphere is the waste sector (DEA, 2016). The waste sector comprises 3 sources: Solid waste disposal, incineration and open burning of waste, and wastewater treatment and discharge. South Africa's Waste sector produces mainly CH_4 (95.6%), with smaller amounts of N_2O (4.2%) and CO_2 (0.2%). In 2015 the Waste sector produced 19 533 Gg CO_2e (3.6% of South Africa's gross GHG emissions). The largest source category is the Solid waste disposal which contributed 80.7% (15 756 Gg CO_2e) towards the total sector emissions.

Waste sector emissions have increased by 80.2% from the 10 838 Gg CO_2e in 2000. In South Africa the expected growth in the provision of sanitation services, particularly with respect to collecting and managing solid waste streams in managed landfills, is likely to result in an increase in emissions of more than 5% annually. Emissions from Solid waste disposal more than doubled between 2000 (7 814 Gg CO_2e) and 2015 (15 756 Gg CO_2e), while emissions from Incineration and open burning of waste and Wastewater treatment and discharge both increased by 24.9% over this period. Incineration of waste generates GHG emissions of CO_2, CH_4 and N_2O. Incineration can be in the form of open burning or incineration in a combustion chamber.

Wastewater treatment contributes to anthropogenic emissions, mainly CH_4 and N_2O. The generation of CH_4 is due to anaerobic degradation of organic matter in wastewater from domestic, commercial, and industrial sources. Wastewater can be treated on site (mostly industrial sources), or treated in septic systems and centralised systems (mostly for urban domestic sources), or disposed of untreated (mostly in rural and peri-urban settlements). Most domestic wastewater CH4 emissions are generated from centralised aerobic systems that are not well managed, or from anaerobic systems (anaerobic lagoons and facultative lagoons), or from anaerobic digesters where the captured biogas is not flared or completely combusted. Wastewater treatment and discharge were estimated to produce 3 427 Gg CO_2e in 2015, of which 78.2% (2 678 Gg CO_2e) was from CH_4.

4.2 Greenhouse Gases in South Africa

GHG aerosols and trace gases impact climate through their effect on the radiative balance of the earth. Aerosol particles have a direct effect by scattering and absorbing solar radiation and an indirect effect by acting as cloud condensation nuclei. Atmospheric aerosol particles range from dust and smoke to mists, smog and haze particles. Trace gases such as greenhouse gases absorb and emit infrared radiation which raises the temperature of the earth's surface causing the enhanced greenhouse effect. Common greenhouses gases include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulphur hexafluoride. Of these, carbon dioxide and methane are the major contributors to climate change.

South Africa has already signed and/or ratified several international conventions and agreements for climate change including the:

- Vienna Convention for the Protection of the Ozone Layer in 1990;
- Montreal Protocol on Substances that Deplete the Ozone Layer in 1992;
- United Nations Framework Convention on Climate Change (UNFCCC) in August 1997;
- Kyoto Protocol in July 2002;
- Stockholm Convention on Persistent Organic Pollutants in 2002;
- Paris Agreement on Climate Change in April 2016.

On a National level, South Africa currently has a number of laws relating to the protection and management of the environment. The overarching legislation is contained within the provisions of the National Environmental Management Act of 1998. Climate change is referred to explicitly in the White Paper on Integrated Pollution and Waste Management of 2000 and referenced in the White Paper on a National Water Policy for South Africa, 1997. It is also specifically addressed in the Government's imminent National Water Resource Strategy.

5. BASELINE ASSESSMENT

5.1 Meteorological overview for the site

MM5 modelled meteorological data was used for the project area. MM5 meteorological data was obtained from Lakes Environmental for the period January 2017 to December 2019. The meteorological data is representative of recent prevailing weather conditions that will likely be experienced at the project site.

5.1.1. Temperature and Relative Humidity

Mpumalanga province generally experiences a sub-tropical climate characterised by hot summers and mild to cool winters, shifting to cold and frosty conditions in the Highveld regions. World Climate Data presented in the province's Vulnerability Assessment Report shows that the current mean annual temperatures are highest in the north-west and northeast regions of the province, while mean annual precipitation tends to increase towards the eastern regions of the province. The province is characterised by summer rainfall and thunderstorms, except the escarpment area which receives fair levels of precipitation throughout the year

Monthly average temperatures and relative humidity profiles at the project site for the period January 2017 to December 2019 are presented in Figure 5-1. Average monthly temperatures range from 11.7 – 20.4 ºC (Table 5-1). Highest temperatures are observed during the spring, summer and autumns months (September to April) and minimum temperatures are observed during the late autumn and winter months (May – August). Relative humidity has remained more or less consistent throughout the year, with the highest being in February (late summer) and lower between May – July (end of Autumn through to Winter).

Table 5-1: Hourly Minimum, Maximum and Monthly Average Temperatures for January 2017 - December 2019.

	TEMPERATURE in (°C) 2017 - 2019 (avg, min, max)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Average	20,0	20,0	19,2	16,9	14,2	12,0	11,7	14,0	16,6	17,6	18,9	20,4
Minimum	10,1	11,8	8,6	9,5	5,4	4,9	3,8	4,4	5,1	6,0	7,6	10,4
Maximum	30,5	29,4	28,1	27,0	22,6	20,9	22,0	24,1	27,2	30,1	29,1	31,0

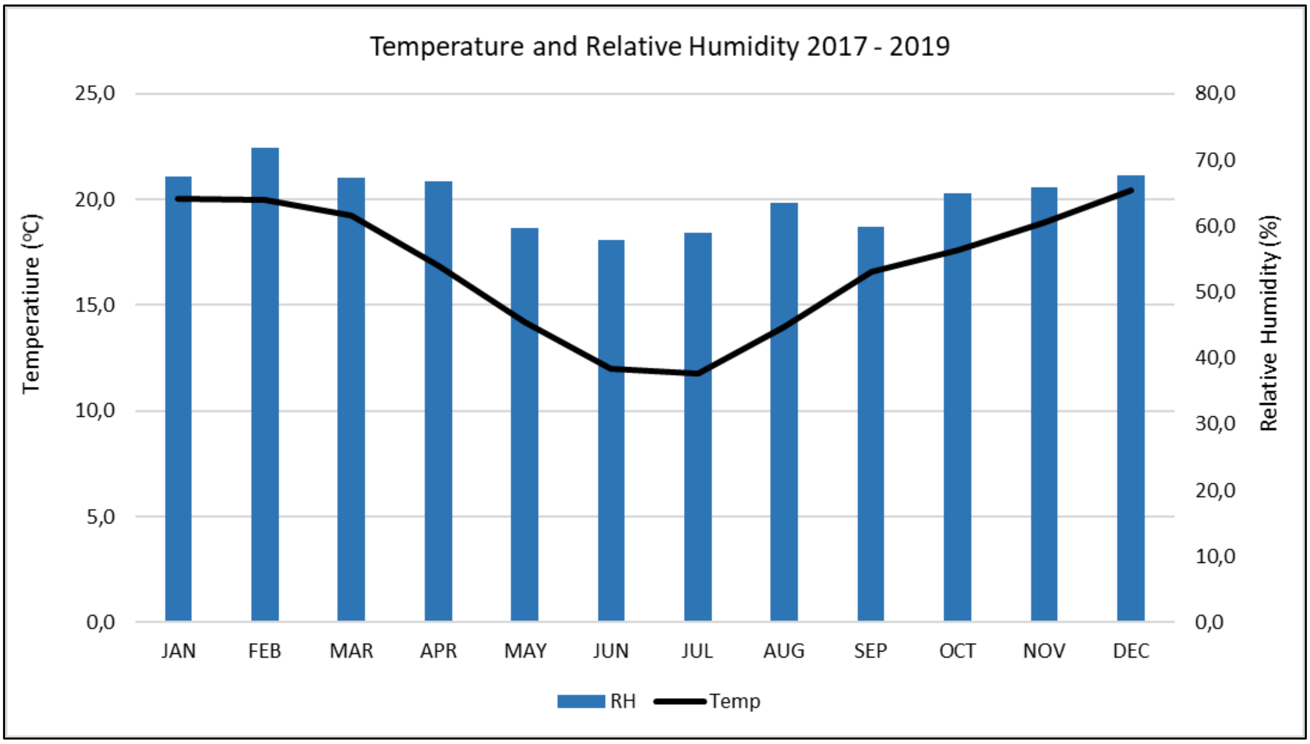


Figure 5-1: Monthly Average Temperature and Relative Humidity profiles for the project site for January 2017 - December 2019.

5.1.2. Precipitation

The region experiences a summer-rainfall area separated by the escarpment into two, namely, (a) the Highveld, which is characterised by cold frosty winters and moderate summers, and the (b) Lowveld which is characterised by mild winters and subtropical climate (MSDF, 2018). During winter the Highveld and Escarpment sometimes experience snow. The annual rainfall occurs mainly during summer in the form of heavy thunderstorms.

Monthly total rainfall at the project site for the period January 2017 to December 2019 is presented in Figure 5-2. The area receives most of its rainfall during the spring, summer and early autumn seasons during the months September - March. Little to no rainfall is observed during the late autumn and winter seasons from April to August (Table 5-2).

Table 5-2: Total Monthly Rainfall for January 2017 - December 2019.

	TOTAL RAINFALL in mm 2017 - 2019 (SUM OF)											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2017	86,11	106,93	40,13	18,29	16,51	0,00	0,00	1,02	20,57	127,76	107,95	102,62
2018	151,64	210,31	115,57	9,91	5,08	1,78	2,03	33,02	51,31	72,64	91,69	203,71
2019	207,52	117,35	54,10	38,86	33,53	0,00	0,00	2,54	22,10	47,24	117,60	265,18
Average	148,42	144,86	69,93	22,35	18,37	0,59	0,68	12,19	31,33	82,55	105,75	190,50

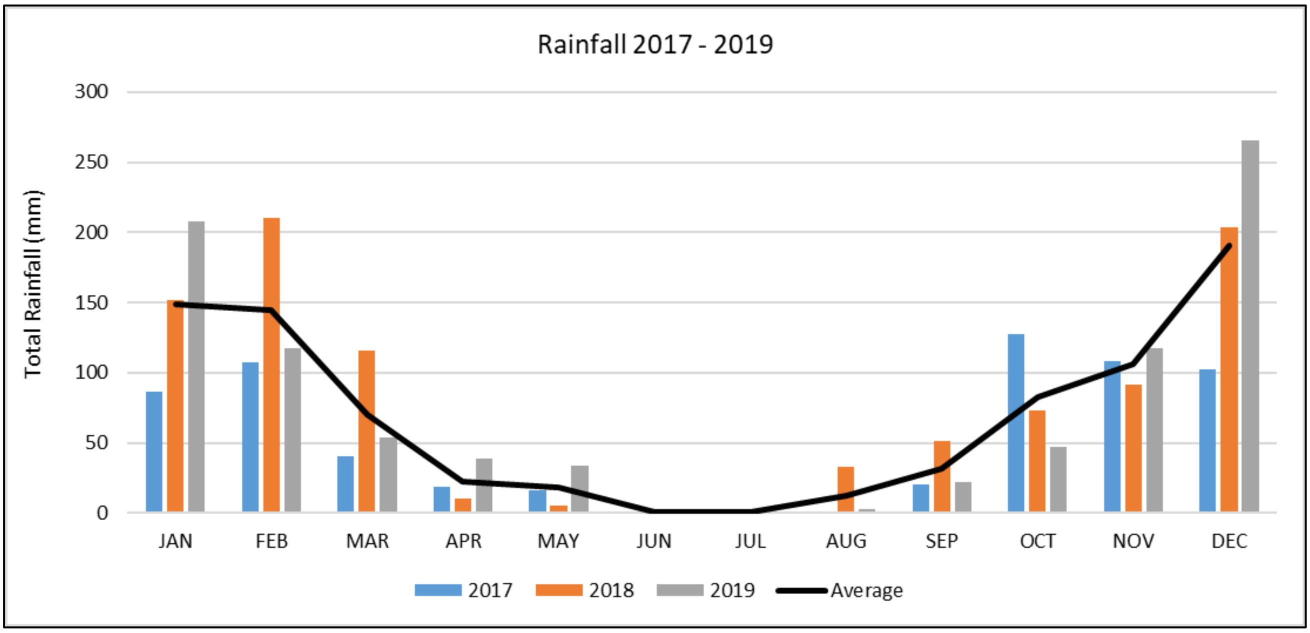


Figure 5-2: Total Monthly and Average Rainfall (mm) for the project site for the period January 2017 - December 2019.

5.2 Identified GHG Emitting Activities for the Mine

In terms of GHG emitting activities, Vygenhoek Platinum Mine would trigger the following activities in terms of Annexure 1 of the National GHG Emission Reporting Regulations (Government Gazette No. 40762 of 3 April 2017), if the applicable reporting thresholds are exceeded:

Applicable activities:

- Sector: Energy
  - 1A2i – Fuel Combustion Activities, Mining and Quarrying (if exceeding the 10MW reporting threshold)
- Sector: Waste
  - 4D1 – Domestic Wastewater Treatment and Discharge (if exceed ≥2 million litres/day reporting threshold); *the mine will only have a septic tank which will be pumped out every 3 months by a designated service provider and treated offsite at Steelpoort Sewage. However, septic tanks release GHG emissions in the form of CH_4, and these should be accounted for.
  - 4C1 – Waste Incineration (if a waste incinerator for treating sewage screenings is installed at a later stage) (if incinerating 1 tonne per hour or more, which is the reporting threshold)

Despite the above, and the related reporting thresholds, when reporting on Climate Change impacts, all emissions should be calculated, so as to obtain a holistic overview of the company's GHG emissions, and overall contribution to climate change.

5.3 Assumptions on the impact of the project on climate change

Nomamix will own the Vygenhoek Platinum Mine, however the mining work itself will be outsourced to an external contractor. Nomamix will have full financial and operational control over the mining activities, however, in terms of the contractor to whom the mining will be outsourced, the contractor will be responsible for all emissions as the mining machinery will be owned by them. Nomamix does not own any mining equipment and machinery.

There are proposed mining operations to be undertaken at the site and surrounding the site. The following activities are expected to be key sources of GHG emissions at the mine:

- Blasting (fugitive emissions resulting from the combustion of a complete explosives mix)
- Truck and mining equipment emissions from combustion of fuels
- Other combustion processes (e.g. gas, diesel & oil combustion)
- Transportation of the ore to the concentrator located offsite
- Septic tank
- Possible incinerator for treating sewage screenings
- Electricity consumption from the workshop, administrative office, weighbridge, and additional lighting of stockpile areas
- Construction of required infrastructure onsite

Other possible indirect GHG emission sources, include, but are not limited to:

- Employee commute and business travel
- Transportation of the septic tank waste to Steelpoort Sewage for treatment offsite
- Transportation of general and hazardous waste offsite

At this stage, GHG calculations will not be undertaken, however a general overview of potential contribution of certain activities towards climate change are discussed below. It is recommended that GHG calculations to estimate the proposed carbon footprint of the mine be undertaken. This will assist in establish the extent of the proposed mine's contribution towards climate change.

5.3.1 Blasting

Nomamix expects to use 0.8 – 1.2 kg of explosives per m^3 of hard overburden and hard UG2 (Reef). Explosives will not be used on topsoil, soft overburden and soft UG2 (Reef). Waste volumes over the 10-year LoM is expected to be 6 108 487 m^3, of which 90% will be hard overburden. To determine the potential contribution of this blasting (in terms of GHG emissions) to climate change, one would need to calculate the GHG emissions thereof. Information on the type of explosives used, the mass of the fossil fuel (if applicable) in the explosives, and the carbon content of the fossil fuel may be required.

According to Goswami & Brent (n.d.), GHG emissions from the detonation of explosives are of the order of 1 tonne of CO_2 for every 5 tonnes of explosives consumed. However, upstream emissions from the manufacture of ammonium nitrate can range from the equivalent of 1 to 4 tonnes of CO_2 for every tonne of explosives. In terms of the direct detonation of the explosives at the mine, it can be estimated, based on a maximum usage of 1.2 kg of explosives used per m^3 of hard overburden, and the calculation of ‘1 tonne of CO_2 for every 5 tonnes of explosives consumed’ that CO_2 emissions would be around 1 319.434 tonnes of CO_2 from the 6 597.17 tonnes of explosives used.

5.3.2 Diesel consumption

Diesel consumption is expected to be 160 000 litres per month. This equates to 19 200 000 litres over the 10-year LoM. 2.5% of the diesel used will be for the generators to generate electricity, while 97.5% will be for the mining operations. A total of 54 386.02 tonnes of CO_{2eq} would thus be emitted over the LoM, from combustion of diesel, based on the figures provided, as using IPCC default emission factors and calorific values for diesel.

Fossil fuel combustion is a major source of CO_2 emissions. CH_4 and N_2O are related to vehicle km travelled rather than fuel consumption and account for 5% of diesel engine emissions in terms of CO_2 equivalent (Amoako, *et al.* 2018). Diesel would mostly be used in mobile sources on the mine. Mobile equipment includes dump trucks, utility vehicles, drill rigs, excavators, bulldozers, a grader and a water bowser. A small percentage of diesel would be used in stationary combustion (in the generators). Most mines use diesel fuel only.

5.3.3 Liquefied Petroleum Gas (LP Gas) consumption

According to the World LP Gas Association (2007), the GHG footprint of LP Gas is relatively small compared to other fuels in terms of total emissions and emissions per unit of energy consumed. LP Gas has the lowest on-site emission rate of the major energy sources, with the exception of natural gas. Furthermore, LP Gas is not a GHG when released into the air as it is primarily a combination of propane and butane molecules, along with trace amounts of other compounds; the exact composition of which varies around the world. LP Gas vapor is not persistent in the atmosphere. It is commonly removed by natural oxidation in the presence of sunlight or knocked down by precipitation faster than it takes for it to become well-mixed and have impacts on global climate. Current measurements have not found a global climate impact from the emissions of propane or butanes.

It is expected that 1 800 kg of LP Gas (used on a rental basis from a service provider) will be consumed by the mine per month, which equates to 216 000 kg (216 tonnes) over the 10-year LoM. A total of 645.22 tonnes of CO_{2eq} will thus be emitted over the LoM, from the use of LP Gas in the mining operations.

5.3.4 Electricity consumption

Information has not been provided on whether the mine will make use of grid (Eskom) electricity on-site.

The mine will have 2 stationary generators (with 1 being a back-up generator). The mine expects to consume about 4 000 litres of diesel per month in these generators, which it is assumed will be used to electrify the infrastructure (workshop, administration office, weighbridge, and additional lighting of the stockpile area). GHG emissions thereof have been included under diesel consumption.

5.3.5 Construction of infrastructure onsite

Infrastructure expected to be constructed onsite include a workshop, administration office, security and access control area, onsite change houses / ablution facilities, contractor camp, surface water management areas (such as water supply dams, pollution control dams, mine residue facility return water dams, and dirty storm water controls), storage areas, etc. It has not been established whether the buildings to be constructed will be permanent structures, or if they will be temporary, such as in the form of moveable storage containers for the workshop and offices. The physical construction of buildings will generate more GHG emissions that the placement of temporary structures that can be used elsewhere after closure of the mine.

However, the footprint in terms of infrastructure is relatively small compared to other mines. If a processing plant were constructed onsite, this would have resulted in a greater GHG emissions profile. Larger mines may have processing plants, concentrator plants, smelters, etc all onsite, and owned, which would result in a substantially larger GHG emission profile.

It should however be noted that, although the ore will be processed by a concentrator not owned and managed by Nomamix, the mine is in part responsible for the GHG emissions generated by the concentrator, due to the role they play in feeding the concentrator with the raw materials needed to undertake their own processes.

5.3.6 Sewage treatment

A sewage treatment plant is not planned on being installed, however there will be a septic tank. This septic tank will be pumped out by a designated service provider every 3 months. The sewage will then be treated offsite at Steelpoort Sewage (about 40 km from the mine). Information has not been provided on the amount of sewage that will be contained in the septic tank. Septic tanks emit CH_4, and additional information would be required to calculate the GHG emissions thereof. That being said, the emissions from the septic tank are expected to be low. The tank will not be at full capacity throughout the 3-month periods between being emptied, and the tank itself will only service the 14 employees from Nomamix and 44 employees from the mining contractor, and any service providers that may visit the mine.

5.3.7 Waste

The mine will undertake temporary handling and storage of general and hazardous waste on-site. Hazardous waste may include oils, chemical waste, lubricants, fuels, explosives, raw material stockpiles, etc. General non-hazardous waste may include office waste, food waste, scrap metal, plastics and wood waste.

It is assumed that this will either be collected by an external contractor or transported by the mine to a landfill site capable of handling hazardous waste. To estimate GHG emissions from waste generated by the mine, the waste would need to be categorised into the appropriate waste streams, after which the required IPCC waste stream model will be applied to calculate the GHG emissions.

CH_4 emissions from waste stored temporarily onsite are not expected to generate any significant GHG emissions. CH_4 is generated as a result of degradation of organic material under anaerobic conditions, therefore it is only the total mass of decomposing material currently in the solid waste disposal site (SWDS) that matters, and not what (and how much) waste was deposited in that year. CH4 emissions can however be calculated once the projected amount of waste (waste composition) to be deposited annually at the SWDS is known.

These GHG emissions are also considered to be other indirect GHG emissions as, although generated by the mine, they will be managed by another organisation.

5.3.8 Potential incinerator

Emissions associated with waste incineration are CO_2, CH_4 and N_2O. The most significant of these would be CO_2. Proposed impacts from such an incinerator can only be established once information is provided on waste quantities and composition of the waste that would be screened. The quantity of waste screened (which will then be incinerated), and subsequent GHG emissions emitted, would however be assumed to be low, based on the population the sewage system (septic tank) will serve. Passing of sewage through screens is generally undertaken to separate and remove material to avoid blocking and damaging pipe works, pumps, valves and equipment.

5.3.9 Other indirect GHG emissions

The impact of other indirect GHG emissions cannot be assessed at this stage, however they are expected to be low.

A contractor camp will be constructed onsite, which should significantly reduce the majority of employee commute. In terms of transportation of the ore from the mine site to the concentrator, it is assumed that transportation thereof will be undertaken by the mining contractor, and that the GHG emissions thereof have been accounted for under diesel consumption emissions. The concentrator to be used is considered to be adjacent to the mine, thereby reducing distance to be travelled to deliver the ore, and reducing fuel consumption, and subsequently GHG emissions.

The general and hazardous waste generated by the mine, as discussed above, will be ultimately managed by another organization (presumable the waste disposal site selected), and the GHG emissions are therefore also considered to be other indirect GHG emissions.

5.3.10 Other impacts on climate change

During the construction phase, it is expected that some clearing of land may be required in terms of removing vegetation. This will result in the loss of carbon sink capacity due to vegetation not being available to convert the CO_2 emitted to oxygen. Current Google Earth images show the land as partially barren, however at the proposed pit location there are numerous trees and bushes that would most likely be cleared away.

5.4 Assumptions on the impact of climate change on the project

The level of impact associated with climate change on the proposed mining activity associated with Nomamix – Vygenhoek Platinum Mine is assessed below.

The impacts of climate change are already being seen in South Africa, and are projected to intensify over the coming decades. These impacts vary across the country, but are projected to include changes to long-term temperature and rainfall patterns (MSDF, 2018). An increase in extreme weather events including floods and droughts is also projected. Climate change is more than simply an increase in global temperatures; it encompasses changes in regional climate characteristics, including temperature, humidity, rainfall, wind and severe weather events, which also have economic and social dimensions.

Climate change poses significant threats to the basic provisions of life including water, the environment, health, and food production. Assuming moderate to high increases in greenhouse gas concentrations such as carbon dioxide, regional modelling scenarios indicate that the in north-eastern South Africa (which includes Mpumalanga) there have already been notable shifts in climate with significant increases in average temperatures (MSDF, 2018). This is further illustrated by stating that for the period 1995-2006, 11 of the 12 years ranked among the 12 warmest years on record since 1850. Observed trends include more frequent heat waves, and colder days and nights becoming less frequent.

Mpumalanga Province is expected to experience higher minimum, average and maximum temperatures over the next few decades. These temperature changes would be accompanied by increasing incidence and intensity of drought, possibly even in regions where total rainfall increases (such as along the Mpumalanga escarpment). Total annual rainfall is expected to increase by between 85 and 303 mm per year, with distinct increases along the escarpment (MSDF, 2018).

Water demand in Mpumalanga has increased due to rapid industrialisation, mining, urbanization and population growth, and it is stated that the province is unlikely to meet the water availability due to the climate change impact on the province.

The impacts of climate change pose serious risks for the mining sector. "The mining sector is extremely energy-intensive and one of the major emitters of greenhouse gases. Total CO_2 emissions vary across the industry, largely depending upon the type of resource mined as well as the design and nature of the mining process. It is widely recognised that available mining deposits are increasingly deeper and of declining ore grade. This will lead to growing demands for water as well as greater mine waste, thereby raising energy consumption, and increasing the industry's climate footprint" (Ruttinger, 2016). Some of the world's largest mining operations currently operate in remote, climate sensitive regions. The industry is not relocatable should natural environmental conditions become unsupportive for varying reasons. The mining sector requires a number of suitable natural conditions including, but not limited to, a habitable climate, access to water resources and supporting infrastructure to extract resources and process them for future domestic and/or international use.

Changing climatic conditions will have both direct (operational and performance-based) and indirect (securing of supplies and rising energy costs) impacts on the mining sector. These include but are not limited to water-related impacts (droughts, floods, storms, etc); heat-related impacts (bush fires and heat strokes); and sea level rise.

As discussed by Ruttinger (2016), key climatic impacts on various stakeholders across the resources sector, can include, but are not limited to:

- Increased demand for water conservation during droughts

- Increased demand for emergency services during flood events
- Reduced asset operating life
- Health and Safety risks for workforce
- Inability to meet performance targets resulting in impacts on share prices
- Increased demand for changing infrastructure design standards
- Increase in costs of water
- Disrupted access routes, leading to forced mine closures
- Potential employment loss due to lack of safe access to sites
- Conflicts with other water users in the region over water availability
- Force Majeure, sometimes also leading to disputes around delivery obligations
- Supply chain breakdowns

Mining operations typically use large volumes of water to mine and process minerals. Vygenhoek Platinum Mine will however not be processing any of the ore. The mine expects to consume 2 500 m^3 of water per month for dust control, and 20 000 litres per month of water obtained from a borehole, for use at the offices. It can therefore be assumed that water will not be used in the open cast pit. The representative of the mine has also confirmed that they will only obtain water from a borehole, and none of it will be recycled or reused. There will also not be any wastewater treatment undertaken onsite. With the mine not processing its own ore, its dependence on water is substantially reduced, thereby minimising the impact of climate change on water resources, and on the mine itself. The concentrator will however use more water to process the ore. If there are water shortages, this will impact the concentrator's ability to process the mine's ore, which will then negatively impact the mine's ability to sell its ore. If the concentrator is unable to take ore to process due to water shortages, the mine may need to stockpile the ore until such time as the situation improves, or it will have to transport its ore further distances for processing in locations not experiencing water shortages. This will however have an effect on diesel combustion, thereby increasing the mine's GHG emissions from mobile combustion sources.

Dust suppression is an important mitigation measure for mines. Excessive dust combined with windy conditions can have far reaching impacts, particularly on local communities and biodiversity. Rising temperatures and warmer, drier conditions in summer can exacerbate dust emissions. Therefore dust control measures are especially important in hot, dry conditions. In most mines, dust suppression involves spraying water to suppress the dust. Vygenhoek Platinum Mine will make use of a water bowser for dust suppression of roads and waste dumps and screening areas. Should water shortages occur, or if the borehole dries up, the mine will not be able to access water easily for dust suppression, and other general water requirements. It is assumed that the borehole will be fed by the Dwars River. Threats to the river system are largely attributed to the surrounding agricultural land uses which have impacted on the local aquatic ecosystems, as well as the increase in mining operations within the larger area. The river itself runs adjacent to the open cast pit (refer to Figure 5-3).

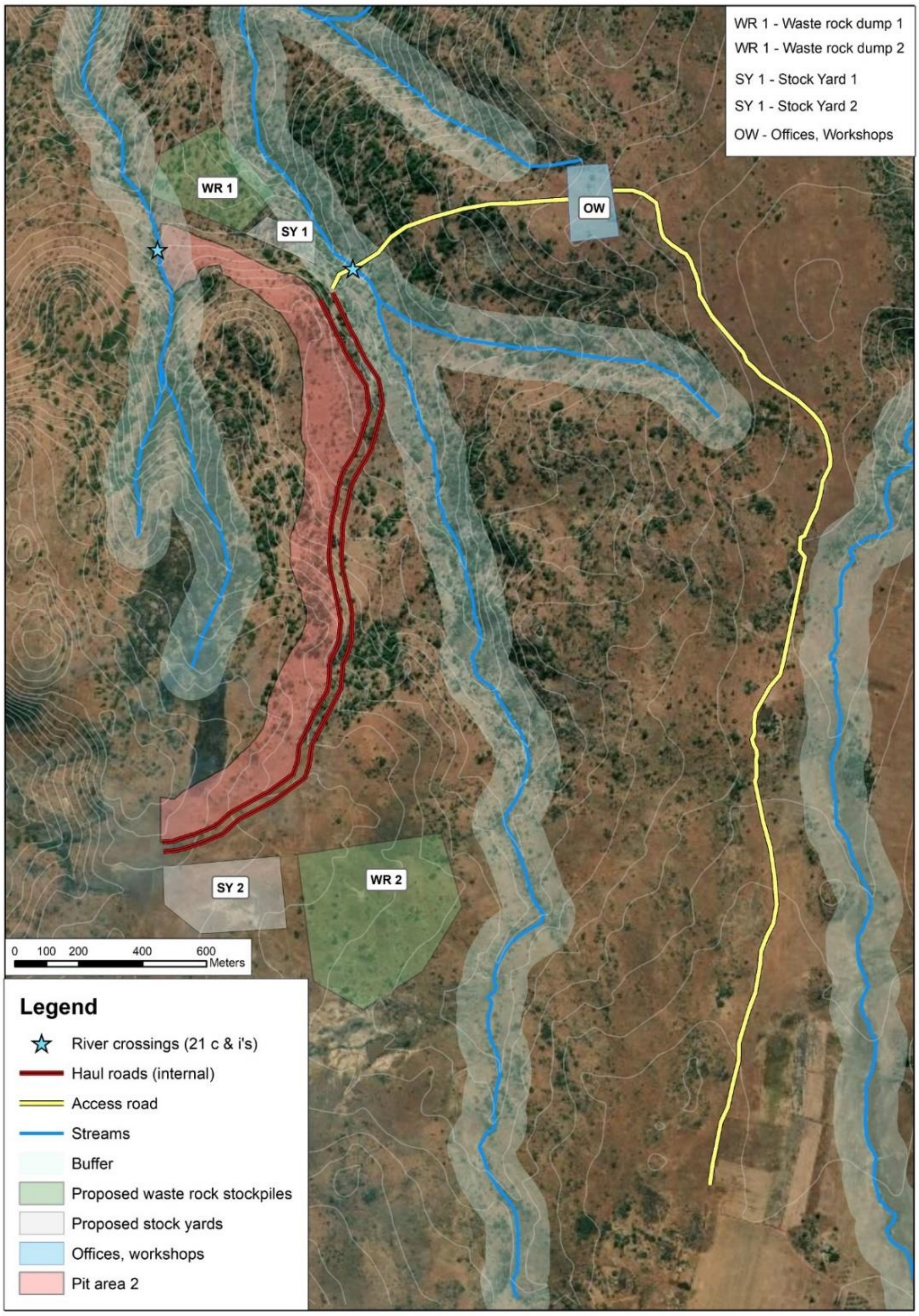


Figure 5-3: Site layout within the river system

The potential impact of climate change remains uncertain, and it is not possible to predict specific trends of the possible impacts it may have on the area. However, it can be anticipated that seasonal variations and fluctuations in water availability may increase. The variations between wet and dry periods may also become more pronounced and severe.

Flooding associated with high rainfall events has the potential to result in unplanned discharges from water storage dams at the operations. Infrastructure at Vygenhoek Platinum Mine such as buildings, storm water controls, water dams, wastewater collection and treatment systems, tailings and waste disposal ponds, transportation infrastructure such as river crossings and roads can all be easily affected by extreme conditions caused by changes in weather patterns.

5.5 Assumptions, Limitations and Exclusions

The following key assumptions, limitations and exclusions of the study are given below:

Assumptions

- Data/information provided by the client was assumed to be accurate and complete at the time of submission of this report;
- Material throughputs were based on information provided by the client. An excel sheet was provided with data for the life of mine. Not all figures were the same and an assumption was made as to which one to use. This however will not affect the assumptions made in this report specifically.
- It is assumed that water will not be used at the pit, as it was indicated borehole water will only be used for dust suppression and at the offices.
- It was assumed that grid electricity would not be utilised. It was indicated that there will be 2 generators, and these will be used for the electricity requirements.
- It was assumed that the mining contractor will deliver the ore to the preferred concentrator for processing;
- It was assumed that a service provider would collect all hazardous waste and general waste from the mine for safe disposal elsewhere;

Limitations

- Incomplete / insufficient preliminary data was provided, therefore commentary is made on this incomplete data only. Once more detailed engineering information is available, an estimated GHG calculation can be conducted as part of a more detailed GHG and climate change impact assessment report.
- The study is limited by the amount of detailed information that could be provided at the time of compilation of the report.
- Detailed information for each emission unit, energy source utilised and GHG emitting activity for the life of the mine is required to calculate the GHG emitting potential of the mining operation, as well as its contribution towards climate change. Therefore, observations and commentary made are based on a desktop study and research on other similar mines, and are for indicative purposes only.
- Emissions that are calculated are limited by the availability of data and emission factors from a reputable source. Additionally, the emissions calculated are in no way reflective of the exact GHG emissions of the mine. Thorough calculations would need to be undertaken on direct GHG emissions, indirect GHG emissions (such as if any grid electricity usage will be used), and any Scope 3 (other energy indirect emissions) that may be required to be calculated.
- Climate is changing, and what is occurring at the site location now is not necessarily what will be happening 5 or 10 years later. Research is continuously being undertaken to establish the potential spatial relationship between mining and climate change.

Exclusions

GHG calculations and a detailed climate change impact assessment report have not been compiled. This baseline report has been compiled as a desktop study only, and it is recommended that a full climate change impact assessment be undertaken at a later stage to fully assess the potential impact of the project on climate change. This would require a thorough calculation of all potential GHG emissions for the life of the mine.

5.6 Summary and Conclusions

The main conclusions based on the information obtained during the Baseline Assessment can be summarised as follows:

Vygenhoek Platinum Mine is expected to have a small footprint in terms of infrastructure, with a few offices, workshop, contractor camp, etc to be constructed. The mining will be completely outsourced to a mining contractor. The mining contractor owns the mining machinery and equipment. The mine will not have a processing plant. Ore will be stored until there are sufficient stockpiles to send to the preferred concentrator for processing, however the mine may utilise a mobile crusher at a later stage.

Mines in general of large consumers of electricity, fossil fuels and water. The water to be utilised will be obtained from a borehole. It will be used for dust suppression and water at the offices. It is therefore assumed that water will not be used at the pit, thus water requirements may be considered to be lower. Water usage should remain relatively stable (no expected sudden increases required, unless drier temperatures and more frequent stronger winds require more frequent dust suppression to be undertaken). It was indicated that diesel generators will be used for electricity, and an assumption was therefore made that grid electricity will not be used. Diesel usage will however be predominantly for use in mining vehicles and machinery. Fossil fuel use is thus expected to be low, compared to other mines that have conveyor belts, crushers, processing plants, etc. Additionally, the preferred concentrator that will be used to process the ore is considered to be “adjacent” to the mine, which lessens the use of diesel for transport of the ore to the plant.

Climate change itself can have various impacts on mines. With Vygenhoek Platinum Mine relying on water extraction from a borehole, there is a risk of the water drying up. Research has shown that the Mpumalanga Province has had water shortages, an increase in average temperatures, and varying weather and rainfall patterns. Increased temperatures can result in faster evaporation rates, which may impact the mine in terms of their water storage capacity (in their water supply dams, mine residue facility return water dams, and pollution control dams). Increased rainfall can also impact the mine in terms of flooding of the pit resulting in downtime, as well as damage to river crossings and infrastructure, etc. increased wind speeds and evaporation rates may also result in increased dust flareups, resulting in the requirement of increased dust suppression. Not only will this require additional water requirements, but the dust itself will have adverse impacts on the employees and any surrounding communicates in the area.

Overall, the expected impact of the mine on climate change, in terms of GHG emissions, is expected to be low, based on the information provided, and assumptions based on researched information only. The impact of climate change on the mine itself is expected to be low at present, however further research would be required on predicted impacts over the next 10 years (over the LoM).

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