



Environmental and Engineering Consultants

PROPOSED KIMBERLEY HOUSING DEVELOPMENT (OLIPHANT ESTATE TOWNSHIP)

INITIAL STUDY REPORT

January 2022

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EXECUTIVE SUMMARY

Rayten Engineering Solutions Pty) Ltd was appointed by Envirolution Consulting (Pty) Ltd to compile an Initial Air Quality Study Report for the proposed development of the Oliphant Estate Township (hereafter referred to as “Kimberley Housing Development”), located within the Francis Baard District Municipality and Sol Plaatje Local Municipality, in Kimberley, Northern Cape Province.

The main objective of the Initial Air Quality Study Report is to determine potential atmospheric emissions that could impact the proposed housing development and determine air quality mitigation measures that can be implemented at the proposed site, considering existing and proposed emission sources surrounding the project site.

The location of the proposed Kimberley Housing Development is within an area where the ambient air quality is relatively poor and high concentrations of criteria and non-criteria air pollutants are likely to be observed, due to existence of several industrial and non-industrial sources in nearby areas. While there are numerous emission sources within the Sol Plaatje Local Municipality, within which the proposed housing development is located, the most relevant sources are those located close to the proposed development, as they will likely have the greatest impacts (i.e. nuisance, air quality, health, noise and odour impacts) on the proposed housing development.

Existing emission sources near the proposed housing development have been identified as sewage works/wastewater treatment plants (WWTPs), i.e. the Galeshewe and Homevale WWTPs; informal settlements and townships, the largest of which include Retswele and Galeshewe Townships; and several unpaved and paved roads in surrounding areas. These emission sources are within a 3km radius of the proposed development. In addition to the existing sources, three mixed-use sites (commercial and residential), i.e. BMW, Colville and St Augustine sites, and two quarry sites (Roodepan and Voolruitigt Quarries) including two brick making facilities (Clay and Cement Brick facilities) are proposed to be developed by Kimberley Rehabilitation and Development (KRD) near the proposed Kimberley Housing Development.

Pollutants associated with existing emission sources in the area as well as the proposed KRD project are listed below for each source:

- Domestic Fuel Burning: particulate matter (PM₁₀ & PM_{2.5}), NO₂, SO₂, CO, polycyclic aromatic hydrocarbons and formaldehyde;
- Sewage works/WWTPs: VOCs such as acetone, toluene and ethylbenzene, greenhouse gases (GHGs) such as CO₂, CH₄ and nitrous oxide (N₂O), as well as odiferous and toxic gases, e.g. H₂S, NH₃ and mercaptans;
- Proposed KRD project – Mixed-use site activities: PM (total suspended particulates (TSP), PM₁₀ and PM_{2.5});
- Proposed KRD project – Roodepan Quarry and Clay Brick Facility activities: PM (TSP, PM₁₀ and PM_{2.5}), SO₂, HF, NO_x, sulphur trioxide (SO₃), CO, metals, and TOCs (including CH₄, ethane, VOCs, some hazardous air pollutants (HAPs), and fluorides;
- Proposed KRD project – Voorruitigt Quarry and Cement Brick Facility activities: PM (TSP, PM₁₀ and PM_{2.5}).

The pollutants listed above, as well as activities at the WWTPs and the proposed KRD project sites will likely have an impact on the proposed Kimberley Housing Development in terms of nuisance, air quality, odour, health and noise. It is thus recommended that ambient air quality monitoring, odour monitoring and noise monitoring be undertaken at the proposed housing development prior to commencement of the project (monitoring recommendations are detailed in Section 4). Monitoring will aid in determining baseline ambient air pollutant concentrations and dustfall rates, odour concentrations and noise levels in the area, which residents at the proposed residential area will likely be exposed to. These assessments would then aid in determining potential human health effects of pollutants associated with the various activities (i.e. existing WWTPs and proposed KRD project activities) on residents at the proposed Kimberley residential area, should this be required. Additionally, the AQIAR compiled by AIRSHED in 2021 for the proposed KRD project can be used to inform a health risk assessment study to assess how sensitive receptors near the proposed KRD project sites will be affected by pollutants from operations associated with the proposed project.

In conclusion, it is recommended that an air quality monitoring campaign, a health impact study and a noise monitoring study be conducted before commencement of operations at the proposed Kimberley Housing Development. Rayten believes that residents at the proposed residential area could be at high risk due to their proximity to existing and proposed emission sources in the area.

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LIST OF ABBREVIATIONS

AQIA	Air Quality Impact Assessment
AQIAr	Air Quality Impact Assessment Report
As	Arsenic
CH ₄	Methane
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
Co	Cobalt
Cr	Chromium
Cu	Copper
DEA	Department of Environmental Affairs (now known as the Department of Forestry, Fisheries and the Environment)
GHGs	Greenhouse gases
HAPs	Hazardous Air Pollutants
HCl	Hydrogen Chloride
HF	Hydrogen Fluoride
H ₂ S	Hydrogen Sulphide
KRD	Kimberley Rehabilitation and Development
Mn	Manganese
NAAQS	National Ambient Air Quality Standards
NEMA	National Environmental Management Act
NEM:AQA	National Environmental Management Air Quality Act
NH ₃	Ammonia
Ni	Nickel
NMVOCs	Non-methane Volatile Organic Compounds
NO ₂	Nitrogen Dioxide
NO _x	Nitrogen Oxides
N ₂ O	Nitrous Oxide
O ₃	Ozone
Pb	Lead
PM ₁₀	Particulate Matter, aerodynamic diameter equal to or size less than 10µm
PM _{2.5}	Particulate Matter, aerodynamic diameter size equal to or less than 2.5µm
Sb	Antimony
SO ₂	Sulphur Dioxide
TOCs	Total Organic Compounds
TVOCs	Total Volatile Organic Compounds
V	Vanadium
VOCs	Volatile Organic Compounds
WWTPs	Wastewater Treatment Plants

1. INTRODUCTION

Rayten Engineering Solutions (Pty) Ltd was appointed by Envirolution Consulting (Pty) Ltd to compile an Initial Air Quality Study Report for the proposed development of the Oliphant Estate Township (hereafter referred to as “Kimberley Housing Development”), located within the Francis Baard District Municipality and Sol Plaatje Local Municipality, in Kimberley, Northern Cape Province.

The main objective of the Initial Air Quality Study Report is to determine potential atmospheric emissions that could impact the proposed housing development and determine air quality mitigation measures that can be implemented at the proposed site, considering existing and proposed emission sources surrounding the project site.

The location of the proposed Kimberley Housing Development is within an area where the ambient air quality is relatively poor and high concentrations of criteria and non-criteria air pollutants are likely to be observed, due to existence of several industrial and non-industrial sources in nearby areas (SSI Environmental, 2010).

The site location for the proposed housing development is given in Figure 1-1, with a dam, i.e. Kamfers Dam located just east of the proposed residential area.



Figure 1-1: Location of proposed Kimberley Housing Development (Source: Google Earth, 2022).

2. ATMOSPHERIC EMISSIONS AT THE PROJECT AREA

2.1 Pollutant/Atmospheric Emission Sources near the Project Area

Emission sources within the Sol Plaatje Local Municipality, where the proposed housing development is located, include combustion installations (boilers), motor vehicles, rail, Kimberley Airport, domestic fuel burning, landfills, sewage works, mining activities and the National Environmental Management: Air Quality Act (NEM:AQA) (Act No. 39 of 2004) Section 21 Listed activities (e.g. a foundry, petroleum product storage and handling facilities, a chemical fertiliser production facility, coal distributors, an asphalt plant as well as cremation and waste incineration activities) (SSI Environmental, 2010). The listed activities (and associated minimum emission standards) were issued by the DEA on 31 March 2010 (Government Gazette No. 33064 of 31 March 2010) and were amended in:

- 2013 (Government Gazette No. 37054 of 22 November 2013);
- 2015 (Government Gazette No. 38863 of 12 June 2015);
- 2018 (Government Gazette No.41650 of 25 May 2018; Government Gazette No.42013 of 31 October 2018);
- 2019 (Government Gazette No.42472 of 22 May 2019); and
- 2020 (Government Gazette No. 43174 of 27 March 2020).

The proposed Kimberley Housing Development is particularly in near proximity to two existing sewage works/wastewater treatment plants (WWTPs), i.e. the Galeshewe and Homevale WWTPs; informal settlements and townships, the largest of which include Retswele and Galeshewe Townships; and several unpaved and paved roads in surrounding areas (Figure 2-1). These emission sources are within a 3km radius of the proposed development. In addition to the existing sources, three mixed-use sites (commercial and residential), i.e. BMW, Colville and St Augustine sites, and two quarry sites (Roodepan and Voolruitstg Quarries) including two brick making facilities (Clay and Cement Brick facilities) are proposed to be developed by Kimberley Rehabilitation and Development (KRD) near the proposed Kimberley Housing Development. The quarry sites and brick making facilities will be located north and south-west of the proposed housing development (Figure 2-1).

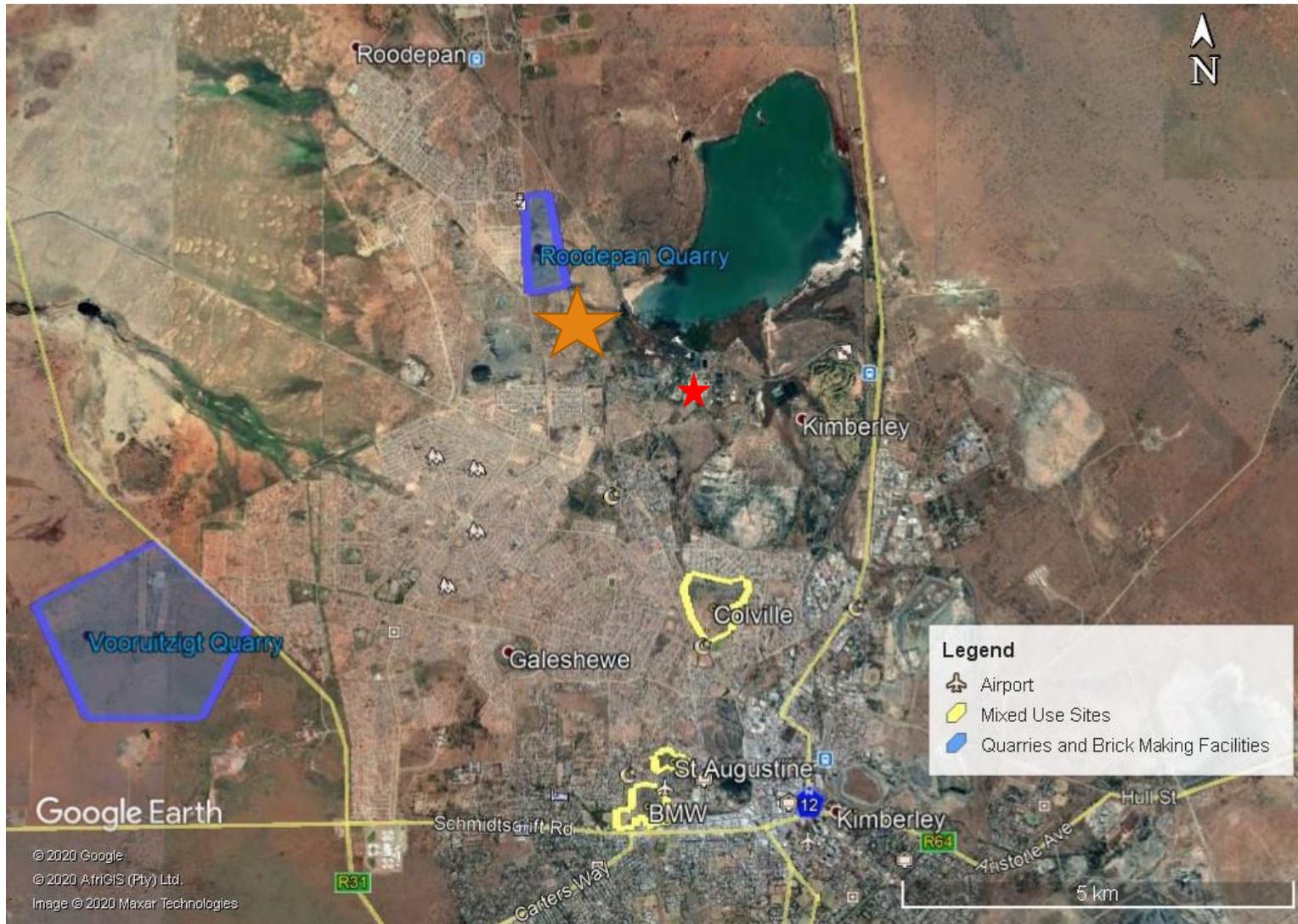


Figure 2-1: Location of proposed Kimberley Housing Development (orange asterisk) in relation to surrounding proposed KRD Project Sites (polygons) and existing WWTPs (green asterisk) (Source: AIRSHED, 2021).

2.2 Pollutants/Atmospheric Emissions in the Area

Pollutants likely to affect air quality at the project site include those associated with existing and proposed emission sources mentioned in Section 2.1 above. The pollutants are listed below for each source.

Pollutants Associated with Existing Emission Sources

- Section 21 (S21) Listed Activities: associated pollutants are listed in Table 2-1 below;

Table 2-1: Pollutants associated with S21 listed activities within the Sol Plaatje Local Municipality (Source: Government Gazette No. 43174 of 27 March 2020).

Category	Sub-category	Associated pollutants
2: Petroleum Industry	2.4: Storage and Handling of Petroleum Products	Total Volatile Organic Compounds (TVOCs)
4: Metallurgical Industry	4.10: Foundries	Particulate Matter (PM), SO ₂ and NO ₂
5: Mineral Processing, Storage and Handling	5.1: Storage and Handling of Ore and Coal	Dustfall
5: Mineral Processing, Storage and Handling	5.10: Macadam Preparation	PM, SO ₂ and TVOCs
7: Inorganic Chemicals Industry	7.3: Production of Chemical Fertiliser	PM, and Total Fluoride measured as Hydrogen Fluoride (HF)
8: Thermal Treatment of Hazardous and General Waste	8.1: Thermal Treatment of General and Hazardous Waste	PM, CO, SO ₂ , NO ₂ , HCl, HF, Metals (Pb+As+Sb+Cr+Co+Cu+Mn+Ni+V), Mercury, Cadmium-Thallium, TOCs, NH ₃ and Dioxins & Furans
8: Thermal Treatment of Hazardous and General Waste	8.2: Crematoria and Veterinary Waste Incineration	PM, CO, NO ₂ , and Mercury

- Combustion installations, i.e. fuel-powered boilers: PM₁₀, CO, NO_x, CO₂ and SO₂;
- Aircraft: NO₂, CO₂, CO and smaller quantities of VOCs, SO₂, non-methane VOCs (NMVOCs), CH₄, Pb and PM;
- Motor vehicles and rail: primary pollutants include NO_x, hydrocarbons, SO₂, PM and Pb, CO is also produced from diesel-fuelled vehicles and diesel rail locomotives; secondary pollutants include CO₂, NO₂, ozone, sulphuric acid, nitric acid, sulphate and nitrate aerosols;
- Mining activities: Dustfall, PM₁₀, PM_{2.5}, NO₂, SO₂, CO;
- Domestic Fuel Burning: particulate matter (PM₁₀ & PM_{2.5}), NO₂, SO₂, CO, polycyclic aromatic hydrocarbons and formaldehyde;

- Landfills: CH₄, CO₂, VOCs, as well as odiferous and toxic gases, e.g. H₂S;
- Sewage works/WWTPs: VOCs such as acetone, toluene and ethylbenzene, greenhouse gases (GHGs) such as CO₂, CH₄ and nitrous oxide (N₂O), as well as odiferous and toxic gases, e.g. H₂S, NH₃ and mercaptans (SSI Environmental, 2010).

Pollutants Associated with Proposed Emission Sources

Pollutants of concern associated with the proposed KRD project activities (i.e. at the proposed three mixed use sites, Roodepan and Vooruitzigt Quarries, as well as the Clay and Cement Brick Facilities) will be emitted during the construction and operational phases of the project (AIRSHED, 2021).

Proposed activities at the three mixed-use sites include construction activities, clearing activities (removal of vegetation), and material handling (excavation and loading of clay), before transporting the clay to the Roodepan Quarry. At the proposed Roodepan Quarry, which will be used primarily to process clay from the three mixed-use sites in preparation for the clay brick manufacturing, proposed activities include stockpiling of coal and clay, screening of clay, blending of raw materials, materials handling, clay brick manufacturing [which triggers sub-category 5.9: ceramic production, in terms of S21 of the NEM:AQA (Act No. 39 of 2004)] and vehicle dust entrainment on unpaved access roads. The proposed Vooruitzigt Quarry will be used to mine material for use in the proposed cement brick making process, which will ultimately be used to supply building materials to the mixed-use developments. The proposed Vooruitzigt Quarry operations will include drilling and blasting as well as crushing and screening, materials handling, and vehicle dust entrainment on unpaved on-site roads (AIRSHED, 2021).

At the proposed Clay Brick Manufacturing facility, coal will be used for the firing of bricks in kilns. Diesel will also be used to power vehicles and machinery at all proposed KRD project sites. Thus, both stationary and mobile combustion will take place as part of the proposed activities. Pollutants of concern associated with the proposed KRD project activities include criteria air pollutants, GHGs and other non-criteria air pollutants and are as follows (AIRSHED, 2021):

- Mixed-use site activities: PM (total suspended particulates (TSP), PM₁₀ and PM_{2.5});
- Roodepan Quarry and Clay Brick Facility activities: PM (TSP, PM₁₀ and PM_{2.5}), SO₂, HF, NO_x, sulphur trioxide (SO₃), CO, metals, and TOCs (including CH₄, ethane, VOCs, some hazardous air pollutants (HAPs), and fluorides;
- Vooruitzigt Quarry and Cement Brick Facility activities: PM (TSP, PM₁₀ and PM_{2.5}).

3. POTENTIAL IMPACTS ASSOCIATED WITH EXISTING AND PROPOSED EMISSION SOURCES

Emission of pollutants from both the existing and proposed emission sources mentioned in Section 2.1 impacts human health and the environment in various ways. However, as the proposed Kimberley Housing Development is located near to the existing WWTPs and Galeshewe/Retswele townships, as well as the proposed KRD project emission sources, and is thus considered a sensitive receptor, this report focuses on potential impacts associated with emissions from the WWTPs, nearby townships and planned KRD project activities, which include nuisance effects, ambient air quality impacts, odour impacts, health impacts and noise impacts. It must be noted that the impacts are likely

to be higher nearer to the sources as well as at nearby sensitive receptors such as the proposed Kimberley Housing project. At sensitive receptors far from the proposed and existing activities, impacts are likely to be lower.

3.1 Nuisance Impacts

TSP will mainly be emitted from activities such as vehicle dust entrainment on paved roads at the proposed three mixed-use sites; screening and materials handling at the proposed Roodepan Quarry and Clay Brick Facility; and crushing, screening, mining and brick making at the proposed Vooruitzigt Quarry and Cement Brick Facility (AIRSHED, 2021). TSP in the form of dustfall (i.e. particles with an aerodynamic diameter greater than 20 µm) is classified as nuisance dust and can result in reduced visibility and cause physical damage to various materials and objects (<https://www.epa.gov>, 05 August 2019).

3.2 Air Quality Impacts

All pollutants emitted from the proposed KRD project, which are listed in Section 2.2, have the potential to affect ambient air quality in the area when released into the air. Based on the AIRSHED (2021) Air Quality Impact Assessment Report (AQIAR) for the proposed KRD project, the greatest air quality impacts, which have been classified as medium to high in the AQIAR, are associated with TSP (as dustfall), PM₁₀ and PM_{2.5} emissions produced from most of the proposed KRD project activities. Further, in the AIRSHED (2021) AQIAR, simulated PM₁₀ daily concentrations for the Roodepan Quarry and Clay Brick Facility are shown to exceed the applicable National Ambient Air Quality Standards (NAAQS) at nearest sensitive receptors outside the western and north-western boundaries. SO₂ and HF emissions associated with operation of the Zig-Zag Kiln at the proposed Clay Brick Facility are predicted to have a low impact on air quality.

Existing domestic solid fuel combustion in nearby townships (e.g. Retswele and Galeshewe) also impacts ambient air quality in the area through the release of combustion pollutants such include PM₁₀, PM_{2.5}, NO₂, SO₂ and CO, while WWTPs (e.g. Homevale and Galeshewe WWTPs) affect ambient air quality when pollutants such as VOCs, NH₃, H₂S and GHGs such as CO₂, CH₄ and nitrous oxide (N₂O) are emitted into the air.

Impacts on air quality for pollutants associated with the proposed KRD project and WWTPs are summarised below:

- VOCs contribute to atmospheric photochemical reactions & tropospheric ozone and smog formation. Additionally, VOCs act as heat trapping gases (King 1995; <http://www3.epa.gov>, 02 August 2019);
- NH₃ plays a major role in the direct and indirect effects of aerosols on radiative forcing, and can react with atmospheric sulphuric and nitric acids to form ammonium sulphate and nitrate aerosols (<http://www3.epa.gov>, 02 August 2019; Seinfeld and Pandis, 1998);
- Elevated atmospheric PM concentrations result in reduced visibility, also known as haze, and physical damage to various materials and objects (<https://www.epa.gov>, 05 August 2019);
- H₂S gas mainly acts as an odorant when emitted into the air;
- GHGs such as CO₂, CH₄ and nitrous oxide (N₂O) are associated with climate change and global warming (<http://www.bae.ksu.edu>, 02 August 2019; Copeland, 2014) in the long-term.

This is because GHGs are radiatively active, thereby contributing to the GHG effect in the troposphere (IPCC, 2001; NRC, 2001b; <http://www3.epa.gov>, 02 August 2019). Global warming leads to changes in ecosystems, and extreme weather events (<http://www.npi.gov.au>, 26 April 2019);

- CO can contribute to the formation of ozone through photochemical reactions with NO_x. Additionally, in the presence of aldehydes, CO contributes to formation of photochemical smog, which can cause reduced visibility (<https://en.wikipedia.org>, 19 January 2022);
- SO₂ and NO₂ may interact with water, oxygen and other chemicals in ambient air to form acid rain, which causes damage to plants and buildings (<https://www.sciencedirect.com>, 19 January 2022; <https://www.epa.gov>, 19 January 2022); and
- HF may convert to hydrofluoric acid upon contact with moisture in the air. Hydrofluoric acid is highly corrosive and may cause damage to buildings.

3.3 Odour Impacts

Odour impacts at the project area are mainly associated with emissions emanating from the WWTPs, which are located near the proposed Kimberley Housing Project. The emissions include NH₃, VOCs and H₂S. *“Odour emanates from a mixture of NH₃, VOCs and H₂S, and is an olfactory response to a mixture of compounds. Odour decreases with time after an emission event in response to dispersion (dilution), deposition, and chemical reactions”* (<http://www3.epa.gov>, 02 August 2019),

3.4 Health Impacts

As the proposed Kimberley Housing Development will be affected by emissions/pollutants from the existing WWTPs and the proposed KR D project activities (including emissions from nearby surrounding domestic fuel combustion activities), it is likely that residents of the proposed Kimberley Housing Development will also be affected in terms of health due to exposure to some of the pollutants. Health impacts are associated with exposure to certain threshold levels of pollutants over specified periods of time (i.e. short-term or long-term effects).

Pollutants of concern in terms of health, which are associated with the proposed KR D project activities, have been identified as SO₂ and PM in the AIRSHED (2021) AQIAR. The human health effects of these pollutants are discussed in more detail in Section 3.3. of the AIRSHED (2021) AQIAR. *“Exposure to SO₂ concentrations above certain threshold levels increases the prevalence of chronic respiratory disease and the risk of acute respiratory illness”* (AIRSHED, 2021). Acute exposure to SO₂ concentrations can lead to severe bronchoconstriction in some individuals, while others remain completely unaffected. Exposure to SO₂ over a 24-hour period has shown that when SO₂ concentrations exceed 250 µg/m³ in the presence of PM (such as sulphates), an exacerbation of symptoms is observed in selected sensitive patients. Long-term exposure to SO₂ has been found to be associated with an exacerbation of respiratory symptoms and a small reduction in lung function in children in some cases. In adults, respiratory symptoms such as wheezing, and coughing are increased (WHO, 2000).

Particulate air pollution is associated with health effects on the respiratory system (WHO, 2000). When looking at human health particle size is an important factor to consider because it controls where in the respiratory system a given particle will be deposited. Fine particles are thought to be

more damaging to human health than coarse particles as larger particles do not penetrate deep into the lungs compared to smaller particles. Larger particles are deposited into the extra thoracic part of the respiratory tract while smaller particles are deposited into smaller airways that lead to the respiratory bronchioles (WHO, 2000).

Recent studies suggest that short-term exposure to particulate matter leads to adverse health effects, even at low concentrations of exposure (below 100 µg/m³). Morbidity effects associated with short-term exposure to particulates include increases in lower respiratory symptoms, medication use and small reductions in lung function. Long-term exposure to low concentrations (~10 µg/m³) of particulates is associated with mortality and other chronic effects such as increased rates of bronchitis and reduced lung function. Those most at risk include the elderly, individuals with pre-existing heart or lung disease, asthmatics and children (WHO, 2000).

A case control study by Ventarakis *et al* (2016) on the impact of WWTPs on the quality of life when living near a WWTP shows that there is great risk for health symptoms such as respiratory and skin diseases, headaches, tiredness and concentration difficulties when exposed to aerosols from WWTPs. Gastrointestinal symptoms, irritability and mood swings may also occur (Ventarakis *et al.*, 2016). Further, exposure to VOCs from WWTPs over a short duration may potentially cause skin, eyes, nose and throat irritations, headaches, drowsiness, nausea and vomiting; exposure to low levels of VOCs over a longer duration period may potentially cause cancer, kidney and liver damage, chromosomal aberrations and blood disease (Duarte-Davidson *et al.*, 2001). While GHGs are emitted from WWTPs, there are no known health effects associated with low or background concentrations of GHGs.

Benzene is the only VOC that is legislated in terms of the NEM:AQA (Act 39 of 2004) and is a well-known carcinogen. Studies have shown that exposure to low-high concentrations of benzene can cause leukaemia (Cointreau, 2006; Duarte-Davidson *et al.*, 2001; Vrijheid, 2000; www.WHO.org, 2012). Bridges *et al.*, (2000) and Vrijheid (2000) argue that there should be no standard threshold limit for gases with carcinogenic properties. This suggests that people who are exposed to carcinogenic agents over a long period, irrespective of the concentration, are said to be at some level of risk to adverse health effects.

3.5 Noise Impacts

Noise impacts at the proposed Kimberley Housing project are associated with the proposed KRD project construction and operational activities, where mobile machinery such as excavators, bulldozers, and front-end loaders as well as trucks will likely be used. Movement of trucks and operation of machinery would result in increased noise levels in the area. WWTPs such as the Homevale and Galashewe WWTPs located near the proposed housing development normally have large pieces of mechanical equipment, which is used to clean sewage and used water prior to returning these to the environment. This equipment and processes associated with it create elevated noise levels. Examples of equipment used at WWTPs includes hydraulic pumps, generators, gensets, noisy pipes, and exhaust fans (<https://www.enoisecontrol.com>, 20 January 2022).

It must be noted that at the Kamfers Dam, located just east of the proposed housing development, wildlife such as flamingos may be found. Thus, noise impacts may also occur on the wild animals.

The impacts mentioned in Section 3.1 to Section 3.5 above should be assessed through e.g. ambient air quality monitoring, odour monitoring and noise monitoring, before commencement of the proposed housing development. Monitoring will aid in determining baseline ambient air pollutant concentrations & dustfall rates, odour concentrations and noise levels in the area, which residents at the proposed residential area will likely be exposed to. These assessments would then aid in determining potential human health effects of the various activities (i.e. existing WWTPs and proposed KRD project activities) and associated pollutants on residents at the proposed Oliphants Estate Township. Additionally, the AQIAR compiled by AIRSHED in 2021 for the proposed KRD project may be used to inform a health risk assessment study to assess how sensitive receptors near the proposed KRD project sites will be affected by pollutants from operations associated with the proposed project, should this be required.

4. RECOMMENDED MITIGATION MEASURES THAT CAN BE IMPLEMENTED

The following mitigation and/or monitoring measures can be initiated and implemented at the project area prior to development of the proposed housing project, depending on affordability and feasibility:

- Monthly dustfall monitoring and reporting: At least four (4) dust buckets must be installed in four principal wind directions around the proposed Kimberley Housing Development;
- Continuous PM₁₀ and PM_{2.5} monitoring and reporting: As the objective of the monitoring will be to assess PM concentrations that residents at the proposed residential area will be exposed to, the monitoring station can be installed near to the proposed housing development;
- Passive monitoring and reporting for VOCs (Benzene, Toluene, Ethylbenzene, and Xylene), H₂S and SO₂;
 - A siting exercise can be undertaken prior to commencement of dustfall and ambient air quality monitoring for PM, VOCs, H₂S and SO₂, should it be required.
- Odour monitoring and reporting; and
- Noise monitoring: This can be accompanied with a noise impact assessment study.

The monitoring recommendations given above can be continued after completion of the proposed housing development so that residents stay informed of the ambient air pollutant concentrations and dustfall rates, odour concentrations and noise levels that they will likely be exposed to on a regular basis. In terms of dustfall monitoring and ambient air quality monitoring for criteria air pollutants, measured dustfall rates can be compared against the applicable National Dust Control Regulations (NDCR) (2013), which were issued by the DEA on 01 November 2013; measured criteria air pollutant concentrations can be compared against the NAAQS, which were issued by the Minister of Water and Environmental Affairs on 24 December 2009 (and 29 June 2012 for PM_{2.5}). NDCR and NAAQS for criteria air pollutants are given in Table 4-1 and Table 4-2 below, respectively.

Table 4-1: South African National Dust Control Regulations.

RESTRICTION AREAS	DUST FALL RATE (D) ⁽¹⁾	FREQUENCY OF EXCEEDANCE
Residential Areas	D < 600	Two within a year, no two sequential months ⁽²⁾
Non-residential areas	600 < D < 1200	Two within a year, no two sequential months ⁽²⁾
<u>Notes:</u>		

- (1) Averaged over 1 month (30±2-day average) (mg/m²/day)
 (2) Per dust fall monitoring site.

Table 4-2: National Ambient Air Quality Standards for Criteria Pollutants.

POLLUTANT	AVERAGING PERIOD	CONCENTRATION (µg/m ³)	FREQUENCY OF EXCEEDANCE ⁽³⁾
Sulphur dioxide (SO ₂)	10 minutes	500 (191)	526
	1 hour	350 (134)	88
	24 hours	125 (48)	4
	1 year	50 (19)	0
Nitrogen dioxide (NO ₂)	1 hour	200 (106)	88
	1 year	40 (21)	0
Particulate Matter (PM ₁₀)	24 hours	75	4
	1 year	40	0
Particulate Matter (PM _{2.5})	24 hours	40 ⁽¹⁾ 25 ⁽²⁾	0
	1 year	20 ⁽¹⁾ 15 ⁽²⁾	0
Ozone (O ₃)	8 hours (running)	120 (61)	11
Benzene (C ₆ H ₆)	1 year	5 (1.6)	0
Lead (Pb)	1 year	0.5	0
Carbon monoxide (CO)	1 hour	30 000 (26 000)	88
	8 hours (calculated on 1 hourly averages)	10 000 (8 700)	11
Notes: *Values indicated in blue are expressed in PPB. (1) Compliance required by 1 January 2016 – 31 December 2029. (2) Compliance required by 1 January 2030. (3) Refers to the number of times exceedances are permitted in a calendar year.			

5. SUMMARY AND CONCLUSION

Rayten Engineering Solutions (Pty) Ltd was appointed by Envirolution Consulting (Pty) Ltd to compile an Initial Air Quality Study Report for the proposed development of the Oliphant Estate Township (hereafter referred to as “Kimberley Housing Development”), located within the Francis Baard District Municipality and Sol Plaatje Local Municipality, in Kimberley, Northern Cape Province.

The main objective of the Initial Air Quality Study Report is to determine potential atmospheric emissions that could impact the proposed housing development and determine air quality mitigation measures that can be implemented at the proposed site, considering existing and proposed emission sources surrounding the project site.

The location of the proposed Kimberley Housing Development is within an area where the ambient air quality is relatively poor and high concentrations of criteria and non-criteria air pollutants are likely to be observed, due to existence of several industrial and non-industrial sources in nearby areas. While there are numerous emission sources within the Sol Plaatje Local Municipality, within which the proposed housing development is located, the most relevant sources are those located close to proposed development, as they will likely have the greatest impacts (i.e. nuisance, air quality, health, noise and odour impacts) on the proposed housing development.

Existing emission sources near the proposed housing development have been identified as sewage works/wastewater treatment plants (WWTPs), i.e. the Galeshewe and Homevale WWTPs; informal settlements and townships, the largest of which include Retswele and Galeshewe Townships; and several unpaved and paved roads in surrounding areas. These emission sources are within a 3km radius of the proposed development. In addition to the existing sources, three mixed-use sites (commercial and residential), i.e. BMW, Colville and St Augustine sites, and two quarry sites (Roodepan and Vooruitzigt Quarries) including two brick making facilities (Clay and Cement Brick facilities) are proposed to be developed by Kimberley Rehabilitation and Development (KRD) near the proposed Kimberley Housing Development.

Pollutants associated with existing emission sources in the area as well as the proposed KRD project are listed below for each source:

- Domestic Fuel Burning: particulate matter (PM₁₀ & PM_{2.5}), NO₂, SO₂, CO, polycyclic aromatic hydrocarbons and formaldehyde;
- Sewage works/WWTPs: VOCs such as acetone, toluene and ethylbenzene, greenhouse gases (GHGs) such as CO₂, CH₄ and nitrous oxide (N₂O), as well as odiferous and toxic gases, e.g. H₂S, NH₃ and mercaptans;
- Proposed KRD project – Mixed-use site activities: PM (total suspended particulates (TSP), PM₁₀ and PM_{2.5});
- Proposed KRD project – Roodepan Quarry and Clay Brick Facility activities: PM (TSP, PM₁₀ and PM_{2.5}), SO₂, HF, NO_x, sulphur trioxide (SO₃), CO, metals, and TOCs (including CH₄, ethane, VOCs, some hazardous air pollutants (HAPs), and fluorides;
- Proposed KRD project – Vooruitzigt Quarry and Cement Brick Facility activities: PM (TSP, PM₁₀ and PM_{2.5}).

The pollutants listed above, as well as activities at the WWTPs and the proposed KRD project sites will likely have an impact on the proposed Kimberley Housing Development in terms of nuisance, air quality, odour, health and noise. It is thus recommended that ambient air quality monitoring, odour monitoring and noise monitoring be undertaken at the proposed housing development prior to commencement of the project (monitoring recommendations are detailed in Section 4). Monitoring will aid in determining baseline ambient air pollutant concentrations and dustfall rates, odour concentrations and noise levels in the area, which residents at the proposed residential area will likely be exposed to. These assessments would then aid in determining potential human health effects of pollutants associated with the various activities (i.e. existing WWTPs and proposed KRD project activities) on residents at the proposed Kimberley residential area, should this be required. Additionally, the AQIAr compiled by AIRSHED in 2021 for the proposed KRD project can be used to

inform a health risk assessment study to assess how sensitive receptors near the proposed KRD project sites will be affected by pollutants from operations associated with the proposed project.

In conclusion, it is recommended that an air quality monitoring campaign, a health impact study and a noise monitoring study be conducted before commencement of operations at the proposed Kimberley Housing Development. Rayten believes that residents at the proposed residential area could be at high risk due to their proximity to existing and proposed emission sources in the area.

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