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**Project conducted on behalf of
Savannah Environmental (Pty) Ltd**

Baseline Health Assessment Report for the Rapid Appraisal Health Impact Assessment of the Phakwe Richards Bay Gas Power 3 Combined Cycle Power Plant in Richards Bay

Report No 022-2022 Rev 1.0

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05 May 2022

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A handwritten signature in black ink is written over a circular professional seal. The seal is for the Institute of Environmental Professionals (I.E.P.) and contains the text: "WILLEM C. VAN NIEKERK", "QUALIFIED ENVIRONMENTAL PROFESSIONAL", "No. 07960163", and "INSTITUTE OF ENVIRONMENTAL PROFESSIONALS PRACTICE".

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05 May 2022

Expertise and Declaration of Independence

This report was prepared by INFOTOX (Pty) Ltd (“INFOTOX”). Established in 1991, INFOTOX is a professional scientific company, highly focused in the discipline of Health Sciences. Both occupational and environmental human health risks, as well as risks to ecological receptors, are addressed.

Dr Willie van Niekerk, Managing Director of INFOTOX, has BSc, Hons BSc and MSc degrees from the University of Potchefstroom and a PhD from the University of South Africa. He is a Qualified Environmental Professional (Environmental Toxicologist QEP), certified by the Institute of Professional Environmental Practice (IPEP) in the USA (No 07960160), and a registered Professional Natural Scientist registered in South Africa (Pr Sci Nat, Environmental Science, No 400284/04). Dr Van Niekerk has specialised in chemical toxicology and human health risk assessments, but he has experience in many other areas in the disciplines of analytical and environmental sciences.

Dr Marlene Fourie has BSc and Hons BSc degrees from the University of Stellenbosch and MSc and PhD degrees from the University of Pretoria. Her field of specialisation is reproductive biology/toxicology. Dr Fourie also has an MSc-degree in epidemiology from the University of Pretoria. Following positions as Medical Natural Scientist at the Andrology Unit, Department of Urology, University of Pretoria and the Pretoria Academic Hospital from 1987 to 2001, she joined INFOTOX as a Medical Biological Scientist. Dr Fourie has conducted many health risk assessments and projects relating to the health status of communities. She is registered as a Professional Natural Scientist (Pr Sci Nat, Toxicological Science, No 400190/14).

This specialist report was compiled for Savannah Environmental (Pty) Ltd. We do hereby declare that we are financially and otherwise independent of Savannah Environmental (Pty) Ltd.

Signed on behalf of INFOTOX (Pty) Ltd, duly authorised in the capacity of Managing Director:

The image shows a handwritten signature in black ink, which appears to be 'W. van Niekerk'. To the right of the signature is a circular professional seal. The seal contains the text 'PROFESSIONAL ENVIRONMENTAL PRACTICE' around the top edge, 'WILLEM C. A. VAN NIEKERK' around the bottom edge, and 'QUALIFIED ENVIRONMENTAL PROFESSIONAL' in the center. There is also a small star at the bottom of the seal.

Willem Christiaan Abraham van Niekerk

05 May 2022

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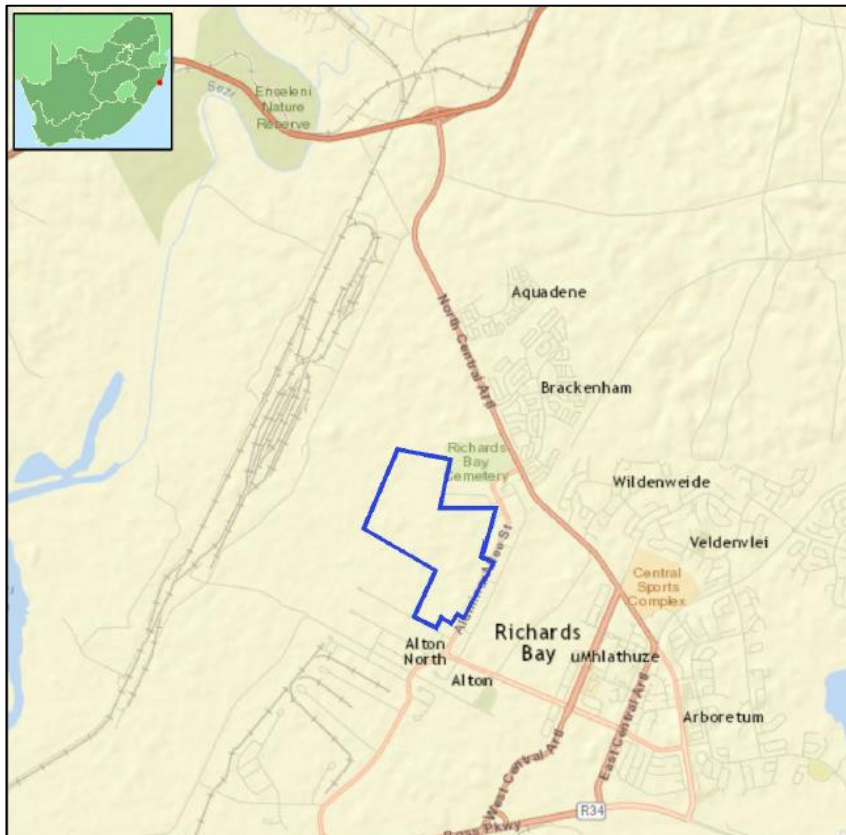
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1 Introduction

Savannah Environmental (Pty) Ltd appointed INFOTOX (Pty) Ltd (“INFOTOX”) to conduct a rapid appraisal health impact assessment (RAHIA) for the development of the gas-to-electricity power generation plant and related infrastructure located in Alton North, Richards Bay, within the uMhlatuze Local Municipality (LM) in the uThungulu District Municipality (DM), KwaZulu-Natal. The current General Orientation Map, compiled by Maroga (2020) is presented in Figure 1.1.



Note to Figure: The blue outline represents the proposed project site location.

Figure 1.1: General Orientation Map of the Richards Bay Gas-to-Power project (Maroga 2020).

This document presents the baseline health assessment for the RAHIA, according to the Good Practice guidance of the International Finance Corporation (IFC), a member of the World Bank Group (IFC 2009). INFOTOX is guided, amongst other IFC guidelines, by the *Introduction to Health Impact Assessment*.

2 Terms of reference for the RAHIA

According to the IFC, the RAHIA does not require new health data collection within the communities of concern, because data necessary to assess potential health impacts of the proposed development are extracted from existing health data sources in a desktop review. Concerning the gas-to-electricity power generation plant, the main focus of the RAHIA is the impact of substances released or dispersed into air on the health of surrounding communities. A significant influx of people settling in the area, due to the construction and operation of the facility, is not foreseen.

The baseline health status of the exposed communities is an important determining factor considered in the assessment of health impacts. The baseline health status assessment is compiled by INFOTOX, based on a desktop study of available health data for the receptor area. The intention of the desktop review of available published health literature is to provide baseline health data on the underlying burden of disease for the RAHIA and to identify specific vulnerabilities that might influence health impacts associated with the proposed operations.

In terms of the RAHIA, the geographical study area considered as impacted include those areas and communities where the proposed developments may have an impact on the environmental quality. Assessment of exposure in the residential areas to the likely airborne emissions from the project site is vital. The impact of such emissions on air quality is determined by an air dispersion modelling specialist. Amongst other factors, the specialist takes into account the local topographical and meteorological conditions in the modelling domain. The modelling domain is shown in Figure 2.1, provided by Airshed Planning Professionals (Pty) Ltd.

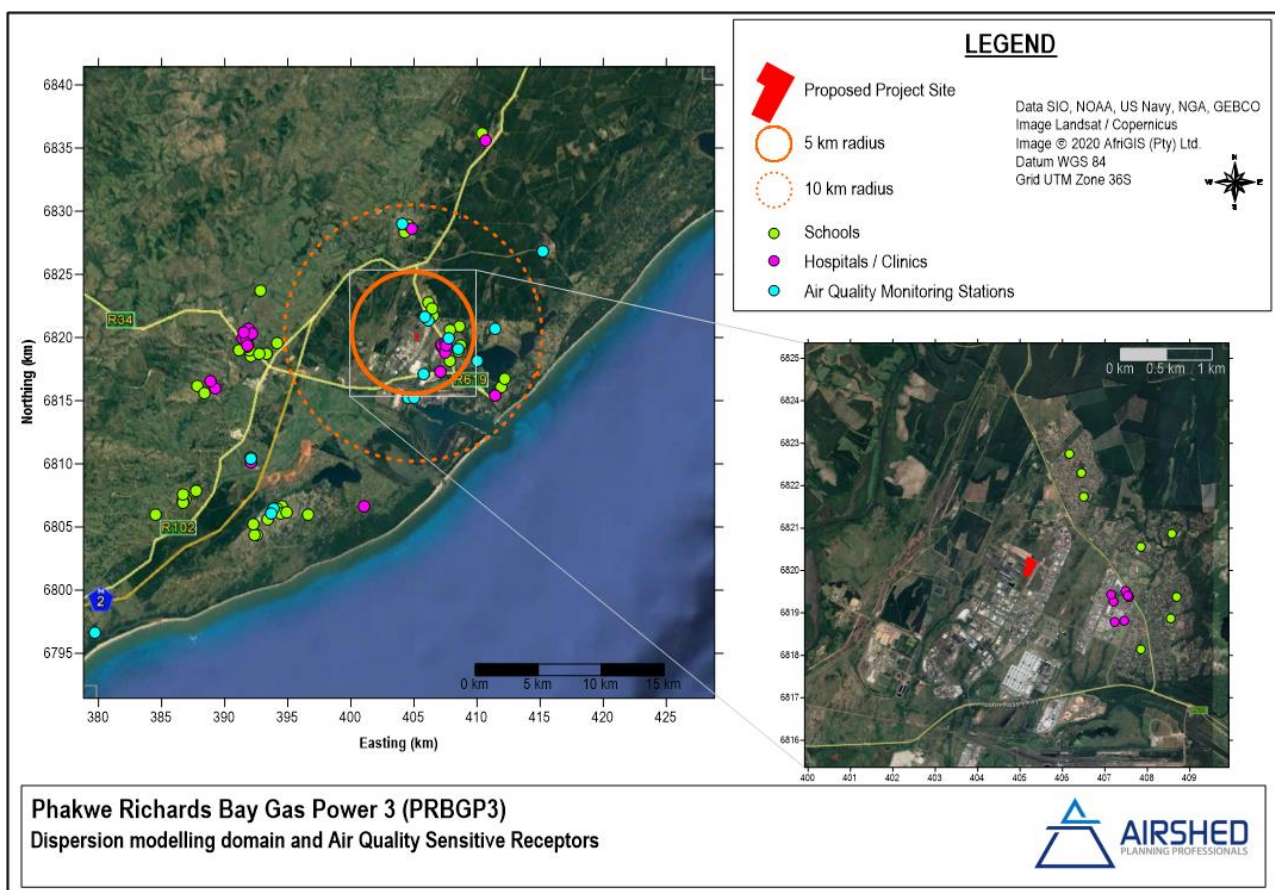
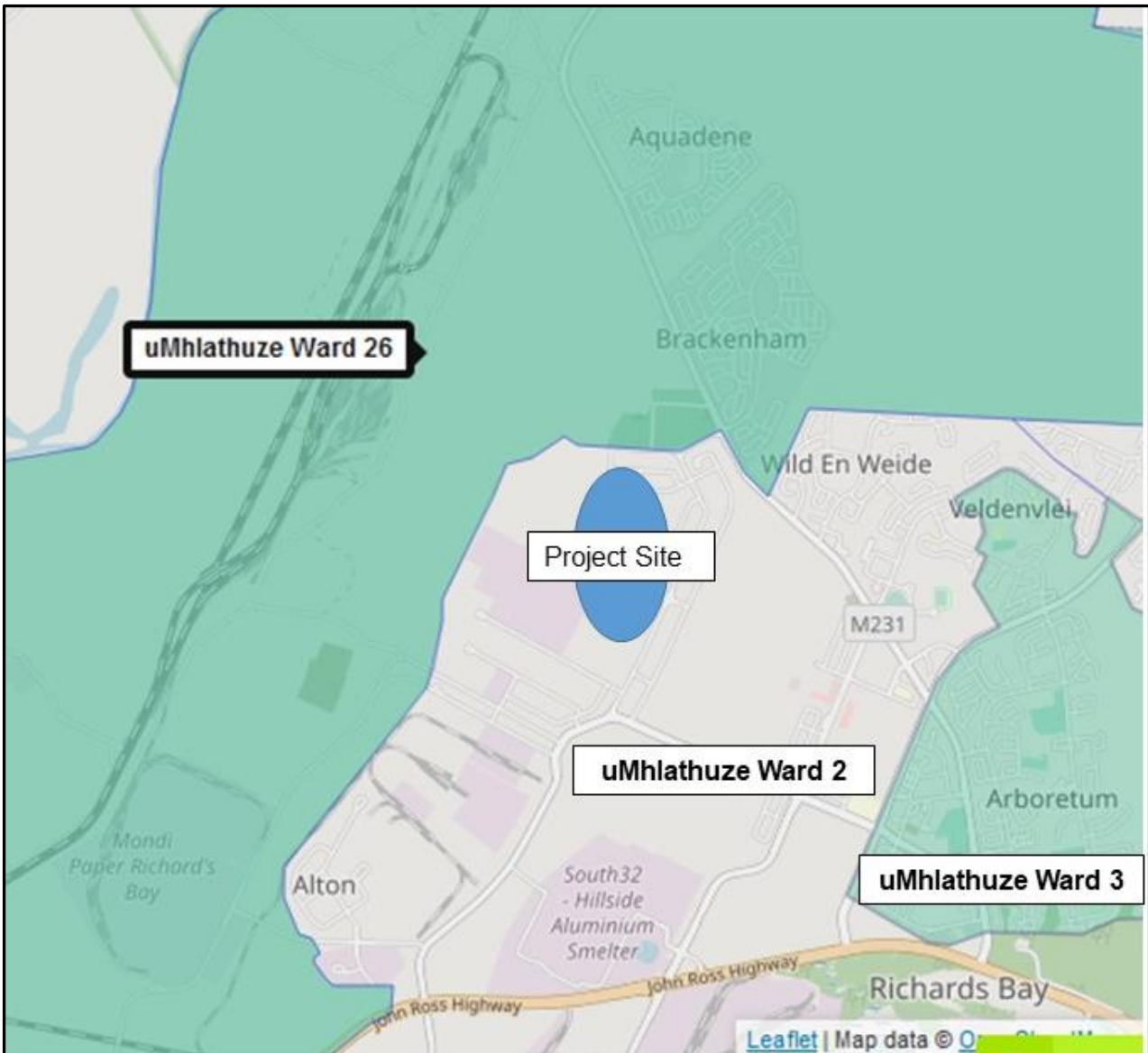


Figure 2.1: Air quality modelling domain of the Phakwe Richards Bay Gas Power 3 combined cycle power plant.

3 The receptor population

The receptor communities within the modelling domain (Figure 2.1) are located mostly in municipal wards 2, 3 and 26 in Richards Bay in the uMhlatuze LM. A ward collage is presented in Figure 3.1. The method of calculation of the projected 2022 population from the last available ward population numbers is presented in Annexure 1 and the calculated numbers in Table 3.1.



Note to figure: The proposed project site is the approximate location.
 Source: <https://wazimap.co.za/profiles/municipality-KZN282-umhlathuze/>

Figure 3.1: Collage of the municipal wards surrounding the Phakwe Richards Bay Gas Power 3 combined cycle power plant.

Table 3.1: Projected receptor population numbers 2022.

Municipal ward	2011 census population	Annual growth rate	#t	Calculated Population 2022
uMhlathuze LM				
2	11 332	0.0281	11	15 436
3	12 908	0.0281	11	17 583
26	11 524	0.0281	11	15 698
Wards total	35 764	0.0281	11	48 718

* Wazimap (online)

** Annual intercensal growth rate (Stats SA 2018)

#t is the number of years of population growth considered in the calculation. In this case, it is the number of years since the last ward census (2011) reported in the public domain.

Infants, young children and older people are sensitive populations and particular attention is paid to the baseline health of these age groups in the uMhlathuze LM. Population numbers in age groups serve as an indication of the sizes of the sensitive groups. Age group numbers are differentiated to provincial level in the Stats SA annual mid-year population estimate reports, but age groups numbers are not differentiated to municipal or ward level. Likely age-group numbers in 2022 are thus extrapolated from the most recent (2011) under-5 age group percentage, which is available for Richards Bay from Stats SA (online). The demographic profile of the Richards Bay community might have changed since 2011, but the 2011 data are the most recent data available in the public domain, and the extrapolated information should be adequate for the purpose of this RAHIA. Potential shifts in the relative size of different age groups since 2011 are considered by comparison of the provincial under-5 (ages 0 to 4) age group percentage of KwaZulu-Natal in 2011 (Stats SA 2011) and in 2021 (the most recent estimate, Stats SA 2021a).

The KwaZulu-Natal 2021 under-5 age group population estimate is 1 214 414 from a total estimated population of 11 513 575, that is, 10.55 per cent in 2021, compared with 11.28 per cent in 2011 (Stats SA 2011). There is thus not an apparent trend of a major shift in the age group composition in KwaZulu-Natal between 2011 and 2021. The 2011 census indicated an under-5 age group percentage of 4.35 per cent in Richards Bay. Assuming that the Richards Bay demographics would be in agreement with the provincial trend, it is unlikely that there would be a major difference in the under-5 age group population by percentage in Richards Bay in 2021 as compared to 2011. Therefore, it was acceptable to extrapolate the 4.35 per cent fraction of under-fives to the receptor ward population numbers calculated for 2022, which would yield the numbers presented in Table 3.2.

The calculation of age group percentages is done to determine the size of the population that is sensitive to potential air quality impacts of the Phakwe Richards Bay electricity plant. Sensitivity of the receptor population is assessed from available health statistics, such as causes of mortality and hospital admission numbers. Hospital admission numbers are not available in the public domain, unless admissions numbers are the subject of health survey research, which is usually focussed on specific hospitals or causes for admission. Cause-of-death statistics reported annually by Stats SA are readily available for assessment and serve as the proxy for assessment of the health vulnerabilities of the receptor population, presented in Sections 4.1 to 4.3.

Assessment of vulnerability requires the alignment of age group numbers between two sets of statistics, namely, the Stats SA population numbers and the Stats SA cause-of-death numbers. Cause-of-death numbers are reported for the infant (younger than 1 years of age) and the 1-to-14 years age group. However, the small-area statistics (Stats SA online) population numbers for Richards Bay are reported in the under-5, 5-to-9 and 10-to-14 years groups, and not in the age group younger than 1 year. Therefore, the number and percentage of the Richards Bay ward populations in the age group younger than 15 is reported, as a proxy of the 1-to-14 years age group. Numbers are calculated with the procedure as described for the under-5 age group. The number and percentage of older people (older than 65 years) is similarly calculated and reported in Table 3.2.

Table 3.2: Calculated age group receptor numbers for 2022.

Municipal ward	All-ages population 2022	Under-5 age group %	Calculated under-5 age group number	Under-15 age group %	Calculated under-15 age group number	≥ 65 age group %	Calculated ≥ 65 age group number
uMhlathuze LM							
2	15 436	4.35	671	12.1	1 868	1.9	293
6	17 583	4.35	765	12.1	2 128	1.9	334
26	15 698	4.35	683	12.1	1 899	1.9	298
Wards total	48 718	4.35	2 119	12.1	5 895	1.9	926

4 Baseline health status

4.1 The all-ages population

The current health status of the uThungulu DM serves as the proxy for the baseline health status of the Phakwe project receptor communities in Richards Bay. This is the only viable option, because differentiated LM and small-area (e.g., municipal wards) health data are not available. The most recent release of cause-of-death data by Stats SA is the 2021 report of the causes of death in 2018 (Stats SA 2021b). The report of causes of death in 2019 has not yet been released. Causes of death are broadly categorised as either natural or non-natural causes. Examples of non-natural causes of death are transport accidents, intentional self-harm and assault. Natural causes are non-violent, non-intentional, non-accidental causes, such as heart attacks and pneumonia. These are not the result of accidental or intentional harm.

The ten leading underlying natural causes of death are summarised in Stats SA (2021b). The highest-ranking (most important) causes of natural death in South Africa, KwaZulu-Natal province and the uThungulu DM are summarised in Table 4.1.1. The purpose of the summary is to compare the causes of death in the DM with the national and provincial causes of death, in order to facilitate the discussion of the causes of death as indicators of the health vulnerabilities of the receptor communities.

Diseases indicating vulnerability to the health effects of air pollutants, and that are represented amongst the most important natural causes of death, are diseases affecting the respiratory tract, including tuberculosis, diseases of the cardiovascular system and a compromised immune system. A compromised immune system, such as in persons infected with the human immunodeficiency virus (HIV), increases the vulnerability to respiratory diseases. Causes of death related to diseases of interest in a scenario of an air quality impact on health are shaded in Table 4.1.1 and DM percentages of these deaths higher than the provincial percentages are also shaded.

The causes of death from Stats SA (2021b) and included by INFOTOX in the cardiovascular (with stroke) mortality group are:

- Ischaemic heart diseases (codes I20 to I25)
- Cerebrovascular diseases (codes I60 to I69)
- Other forms of heart disease (codes I30 to I52)

For the purpose of this report, cerebrovascular diseases are equated to stroke. The codes in brackets are the Stats SA (2021b) grouping according to the 10th Revision of the ICD-10 codes, the disease classification codes of the International Statistical Classification of Diseases and Related Health Problems, maintained by the World Health Organization (WHO online).

The causes of natural deaths related to the respiratory tract and the cardiovascular system, and recorded amongst the 10 most important natural causes in the uThungulu DM (Table 4.1.1) are: tuberculosis ranked 1st at 8.0 per cent of all mortalities, cerebrovascular diseases, which include some diagnoses considered as cardiovascular diseases, ranked 3rd at 5.7 per cent and hypertensive diseases ranked 4th (4.8 per cent), which, if not controlled, predisposes to heart disease and stroke. The list continues with HIV ranked 5th at 4.6 per cent, other forms of heart disease the 6th leading cause of natural death (3.4 per cent), and influenza and pneumonia, ranked 8th at 2.2 per cent. Other

natural deaths related to the respiratory tract and the cardiovascular system, but which are not rated amongst the 10 leading causes, are ischaemic heart disease and chronic lower respiratory diseases. Since the lowest ranked cause amongst the 10 leading causes is renal failure at 1.9 per cent, it is logical that the respective percentages of death due to ischaemic heart disease and chronic lower respiratory diseases could not have been higher than 1.9 per cent.

The burden of death summary (Table 4.1.1) shows that the uThungulu DM communities are moderately more vulnerable to mortality due to tuberculosis and slightly more vulnerable to hypertensive mortality in comparison to the South African and KwaZulu-Natal population in general. Thus, the increased rates of mortality due to these diseases indicate a likely moderately increased vulnerability to the respiratory and slightly increased vulnerability to cardiovascular (with stroke) effects of exposure to the air pollutants of interest.

Table 4.1.1: National, provincial and DM leading underlying natural causes of death in 2018, all ages.

Cause of death with ICD10 codes	South Africa		KwaZulu-Natal		uThungulu DM	
	%	Rank	%	Rank	%	Rank
Tuberculosis (A15-A19)	6.0	1	6.8	3	8.0	1
Diabetes mellitus (E10-E14)	5.9	2	7.1	2	6.7	2
Cerebrovascular diseases (I60-I69)	5.1	3	5.7	4	5.7	3
Other forms of heart disease (I30-I52)	5.1	4	8.2	1	3.4	6
Human Immunodeficiency Virus (HIV) (B20-B24)	4.8	5	5.4	5	4.6	5
Hypertensive diseases (I10-I15)	4.5	6	3.8	6	4.8	4
Influenza and pneumonia (L09-J18)	3.9	7	3.3	7	2.2	8
Ischaemic heart disease (I20-I25)	3.0	8	2.9	8	Not ranked	
Chronic lower respiratory diseases (J40-J47)	3.0	9	Not ranked		Not ranked	
Malignant neoplasms of digestive organs (C15-C26)	2.4	10	2.1	10	1.9	9
Other viral diseases (B25-B34)	Not ranked		2.2	9	2.9	7
Renal failure (N17-N19)	Not ranked		Not ranked		1.9	10
Other natural causes of death	44.0	-	39.0	-	42.7	-
All non-natural causes of death	11.9	-	13.5	-	15.3	-
All deaths – natural and unnatural	100	-	100	-	100	-

#: Percentage of deaths due to cause

Rank: Rank of cause of death, from 1 to 10 based on the number of deaths

Not ranked: Not among the top 10 causes of death

Source: Stats SA 2021b.

The electricity generating facility is planned in an area with existing industrial enterprises and a number of formal, well-established urban residential areas where the usual medical facilities found in such areas can be expected. It is unlikely that there will be an influx of people seeking employment or working at the Phakwe Richards Bay electricity generating plant and also unlikely that the disposable incomes in receptor communities will be increased due the construction or operation of the facility. The receptor communities are already urbanised and a shift from a rural to an urban lifestyle is not relevant. Socio-economic changes due to the construction and operation of the facility are not foreseen in the defined receptor area, and communicable and non-communicable diseases due to socio-economic changes are thus not assessed.

4.2 Baseline health of the population younger than 15 years of age

The demographic data presented in Section 3 indicate that the population younger than 15 years of age presents a proportion of approximately 12.1 per cent, or a sizeable number of 5 895 of the total population in the receptor areas. Thus, it is important to assess the specific health vulnerabilities of this age group. Mortality data were obtained from the most recent release of cause-of-death data (Stats SA 2021b), as for the all-ages population.

Provincial cause of death data for the under 15 population are divided into the infant (younger than 1 year of age) and the 1-to-14 years age group. Most of the infant age group causes of death are those specific to the perinatal period, ranked 1st, 5th and 6th in Kwa-Zulu-Natal; causes affected by maternal factors and complications of pregnancy, labour and delivery (ranked 7th); related to the length of gestation and foetal growth (ranked 3rd); and congenital malformations (8th) and haemorrhagic and haematological disorders of the foetus and new-born (10th). Thus, amongst the 10 leading causes of death in this group, 7 causes are not directly related to environmental pollution or socio-economic factors on the community level, but to factors specific to the foetus, infant, mother or events at the time of delivery. These findings are as expected for the infant age group.

Considering that the majority of the highest ranked causes of death are not directly related to vulnerabilities to ambient air quality, the infant age group was not studied in particular, but detailed attention was given to the causes of death in the 1-to-14 years age group, where factors specific to the foetus, infant, mother or events at the time of delivery do not play an important role. This allows focus on the causes of death related to exposure to the pollutants of interest for the project, and for potential health impacts of socio-economic changes, if applicable. The leading causes of natural death in the population 1-to-14 years in South Africa and in Kwa-Zulu-Natal are summarised in Table 4.2.1 and compared and shaded as described for the all-ages population. Differentiated leading causes of death for the uThungulu DM, the uMhlatuze LM or Richards Bay are not available for this age group.

Deaths due to diseases indicating vulnerability to the health effects of air pollutants are shaded in Table 4.2.1. The causes of natural deaths related to the respiratory tract and the cardiovascular system, and recorded amongst the 10 most important natural causes in the KwaZulu-Natal province are: influenza and pneumonia, ranked 2nd at 6.2 per cent of all mortalities, other forms of heart disease, the 3rd leading cause of death (1.4 per cent), tuberculosis ranked 4th (3.4 per cent) and HIV ranked 5th at 3.0 per cent.

The burden of death summary (Table 4.2.1 below) shows that the receptor communities younger than 15 years of age in KwaZulu-Natal are moderately more vulnerable to mortality due to HIV compared to the South African population in general. The KwaZulu-Natal age group is comparably vulnerable to tuberculosis and significantly more vulnerable to other forms of heart disease.

Consistent trends of only amplified or only decreased vulnerability in the uThungulu DM versus the general South African and KwaZulu-Natal populations were not observed in the all-ages mortality statistics. Trends are mixed. If this observation of mixed trends should be extrapolated to the 1-to-14 years population, the DM might be comparably vulnerable to other forms of heart disease and to HIV, less vulnerable to influenza and pneumonia and slightly more vulnerable to tuberculosis as compared to the provincial population. Based on these postulated trends, there are no grounds to

assume a significantly increased vulnerability in the 1-to-14-years population, to the effects of exposure to the air pollutants of interest, in the uThungulu DM as compared to the KwaZulu-Natal population.

Table 4.2.1: Leading underlying causes of death in 2018 for the 1-to-14-years population.

Cause of death with ICD10 codes	South Africa		KwaZulu-Natal	
	%	Rank	%	Rank
Influenza and pneumonia (L09-J18)	6.8	1	6.2	2
Intestinal infectious diseases (A00-A09)	6.0	2	6.3	1
Tuberculosis (A15-A19)	3.3	3	3.4	4
Other forms of heart disease (I30-I52)	2.9	4	5.5	3
Cerebral palsy and other paralytic syndromes (G80-G83)	2.9	5	2.5	6
Malnutrition (E40-E46)	2.8	6	1.9	8
HIV (B20-B24)	2.2	7	3.0	5
Episodic and paroxysmal disorders (G40-G47)	1.6	8	2.1	7
Inflammatory diseases of the central nervous system (G00-G09)	1.4	9	1.8	9
Other bacterial diseases (A30-A49)	1.4	10	Not ranked	
Other disorders of the nervous system (G90-G99)	Not ranked		1.3	10
Other natural causes of death	39.3	-	33.2	-
All non-natural causes of death	29.4	-	32.7	-
All deaths – natural and unnatural	100	-	100	-

?: Percentage of deaths due to cause

Rank: Rank of cause of death, from 1 to 10 based on the number of deaths

Not ranked: Not among the top 10 causes of death

Source: Stats SA 2021b.

An increased disposable income in receptor communities, or an influx of people seeking employment or working at the facility, or a shift from a rural to an urban lifestyle in the receptor community is not expected, as discussed previously in Section 4.1. Non-communicable and communicable disease burdens related to socio-economic changes are not expected to change as a result of the construction or operation of the proposed facility.

4.3 Baseline health of the population aged 65 years and older

The demographic data presented in Section 3 indicate that the population aged 65 years and older presents a very low proportion of not more than 2 per cent of the total population, or a rather small number of 926 persons in the receptor areas. Nonetheless, considering the specific sensitivity of this age group to air quality impacts, the health vulnerabilities of this population are assessed. Mortality data were obtained from the most recent release of cause-of-death data (Stats SA 2021b) and are presented as described in Sections 4.1 and 4.2. Differentiated leading causes of death for the uThungulu DM, the uMhlathuze LM or Richards Bay age groups are not available.

In this group, 7 of the 10 leading causes of natural deaths in South African and in KwaZulu-Natal are related to the respiratory tract and the cardiovascular system. The burden-of-death summary (Table 4.3.1 below) shows that persons aged 65 years and older in KwaZulu-Natal are moderately more vulnerable to mortality due to cerebrovascular diseases compared to the South African population in general, significantly more vulnerable to other forms of heart disease and slightly more vulnerable to ischaemic heart disease and tuberculosis. It is also noted that the KwaZulu-Natal age group is moderately to slightly less vulnerable to hypertensive diseases, chronic lower respiratory diseases and to influenza and pneumonia.

Table 4.3.1: Leading underlying causes of death in 2018 in the population older than 65 years of age.

Cause of death with ICD10 codes	South Africa		KwaZulu-Natal	
	%	Rank	%	Rank
Diabetes mellitus (E10-E14)	9.3	1	11.6	2
Cerebrovascular diseases (I60-I69)	8.7	2	10.5	3
Hypertensive diseases (I10-I15)	8.4	3	7.3	4
Other forms of heart disease (I30-I52)	7.5	4	11.9	1
Ischaemic heart disease (I20-I25)	4.8	5	5.0	5
Chronic lower respiratory diseases (J40-J47)	4.6	6	3.0	7
Influenza and pneumonia (L09-J18)	3.8	7	3.3	6
Malignant neoplasms of digestive organs (C15-C26)	3.2	8	2.8	8
Tuberculosis (A15-A19)	2.4	9	2.5	9
Renal failure (N17-N19)	2.2	10	2.4	10
Other natural causes of death	42.3	-	36.6	-
All non-natural causes of death	2.8	-	3.0	-
All deaths – natural and unnatural	100	-	100	-

?: Percentage of deaths due to cause

Rank: Rank of cause of death, from 1 to 10 based on the number of deaths

Source: Stats SA 2021b.

Consistent trends of only amplified or only decreased vulnerability in the DM populations versus the general South African and KwaZulu-Natal populations were not observed in the all-ages mortality statistics. If these observations should be extrapolated to the population aged 65 years and older, the DM might be comparably vulnerable to ischaemic heart disease and to hypertensive diseases and slightly to moderately less vulnerable to influenza and pneumonia and chronic lower respiratory diseases. However, this age group in the DM might be moderately more vulnerable to tuberculosis, cerebrovascular disease and other forms of heart disease. Trends are thus mixed and, overall, a slightly to moderately increased vulnerability is possible to the effects of exposure to the air pollutants of interest in the uThungulu DM as compared to the range of vulnerability in the KwaZulu-Natal population. There is a degree of uncertainty related to this comparative assessment, but it is unlikely that an unobserved but significantly increased vulnerability exists in the older age group in the uThungulu DM.

A generally increased disposable income due to increased levels of employment is unlikely in this age group, in which the majority is likely to be retired. As discussed previously in Section 4.1, an influx of people seeking employment or working at the facility, or a shift from a rural to an urban lifestyle in the receptor community is not expected. Therefore, a shift in non-communicable and communicable disease burdens related to socio-economic changes is not expected.

4.4 Baseline health status summary

Diseases transmitted by vectors dependent on water or natural vegetation for breeding, such as malaria transmitted by the *Anopheles* mosquito, are not considered, because the Phakwe Richards Bay electricity generating plant will not create a change to the natural environment that will enhance the availability of such breeding grounds.

Malnutrition, sexually transmitted diseases and other diseases ameliorated or evoked by lifestyle changes due to socio-economic impacts are not assessed. The electricity generating plant is planned in an area with existing industrial enterprises and a number of formal, well-established urban residential areas where the usual medical facilities found in such areas can be expected. It is unlikely that there will be an influx of people seeking employment or working at the facility and also unlikely that the disposable incomes in receptor communities will be increased due the construction or operation of the facility. The receptor communities are already urbanised and a shift from a rural to an urban lifestyle is not relevant. Socio-economic changes due to the construction and operation of the facility are thus unlikely in the defined receptor area, and communicable and non-communicable diseases due to socio-economic changes are not assessed.

Causes of death in the KwaZulu-Natal province and in the uThungulu DM are assessed as an indication of the vulnerability of the receptor population to the effects of an impact on air quality, due to emissions to air during the construction and operation of the Phakwe Richards Bay electricity generating plant. Diseases indicating vulnerability to the health effects of air pollutants, and that are represented amongst the most important natural causes of death, are diseases affecting the respiratory tract, including tuberculosis, diseases of the cardiovascular system and a compromised immune system. A compromised immune system, such as in persons infected with the human immunodeficiency virus (HIV), increases the vulnerability to respiratory diseases.

Younger children and older adults are more vulnerable to the effects of air pollution in general. The relevant age groups for which mortality data are readily available in the public domain are the group of children younger than 15 years of age and adults aged 65 years and older. Specific attention is given to the vulnerabilities in these groups. Cause of death data specific to the uThungulu DM are only available for the all-ages group. Thus, age-group data for Kwa-Zulu-Natal serve as a proxy for DM data.

Provincial cause of death data for the under 15 population are divided into the infant (younger than 1 year of age) and the 1-to-14 years age group. Most of the infant age group causes of death are those specific to the perinatal period; causes affected by maternal factors and complications of pregnancy, labour and delivery; related to the length of gestation and foetal growth; congenital malformations and haemorrhagic and haematological disorders of the foetus and new-born. Thus, amongst the 10 leading causes of death in this group, 7 causes are not directly related to environmental pollution or socio-economic factors on the community level, but to factors specific to the foetus, infant, mother or events at the time of delivery. These findings are as expected for the infant age group.

Considering that the majority of the highest ranked causes of death are not directly related to vulnerabilities to ambient air quality, the infant age group was not studied in particular, but detailed attention was given to the causes of death in the 1-to-14 years age group, where factors specific to the foetus, infant, mother or events at the time of delivery do not play an important role. This allows focus on the causes of death related to exposure to the pollutants of interest for the project.

Mortality numbers in the age groups 1-to-14 years and 65 years and older in the uThungulu DM are not available. Based on the observed mortality trends in the DM's all-ages group as compared to the KwaZulu-Natal all-ages group, likely trends in the uThungulu 1-to-14 years group were extrapolated from the KwaZulu-Natal 1-to-14 years causes of death. This procedure was also followed for the age group 65 years and older.

Based on these postulated trends, there are no grounds to assume a significantly increased vulnerability in the 1-to-14-years population, to the effects of exposure to the air pollutants of interest, in the uThungulu DM as compared to the KwaZulu-Natal population. A slightly to moderately increased vulnerability is possible to the effects of the air pollutants of interest in the age group 65 years and older in the DM as compared to the provincial population. There is a degree of uncertainty related to this comparative assessment, but it is unlikely that an unobserved but significantly increased vulnerability exists in the assessed age groups in the uThungulu DM.

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6 Annexure 1: Calculation of the projected 2022 wards populations

The population growth rate for calculating the 2022 ward population numbers based on the available 2011 numbers is the 2011 to 2016 intercensal growth rate of 2.3 per cent. The Ward Profiles based on Census 2011 statistics and prepared by the IDP Unit of the City of uMhlathuze (uMhlathuze IDP Unit 2017/2018) reported 2011 ward population numbers. However, on closer inspection it was found that one Ward Profile was missing, namely, for ward 34. Nonetheless, the sum of reported population numbers for wards 1 to 33 provided a total of 365 236, which is higher than the number of 362 778 provided for 2011 in the KwaZulu-Natal Community Survey Report (Stats SA 2018). This casts doubt on the accuracy of the numbers provided by the IDP Unit and INFOTOX has declined to use the provided ward population numbers. Instead, INFOTOX used the 2011 Census ward population numbers provided by Wazimap (online).

The intercensal growth rate of the uMhlathuze local municipality was reported in the 2016 KwaZulu-Natal Community Survey Report (Stats SA 2018) as 0.0281 (2.81 per cent). It is assumed that the annual growth rate has remained stable up to 2022. All relevant data for the calculation of the 2022 numbers, and the results of the calculations, are presented in Table 6.1.

$$P_2 = P_1 \times e^{kt} \quad \text{(Equation 6.1)}$$

Where:

P_2	Population number at end of period t
P_1	Population number at beginning of period t
k	Growth rate (per annum)
t	Growth period (years)

Table 6.1: Projected ward population numbers 2022.

Municipal ward	*2011 census population	Annual growth rate	#t	Calculated Population 2021
uMhlathuze LM				
2	11 332	0.0281	11	15 436
3	12 908	0.0281	11	17 583
26	11 524	0.0281	11	15 698
Wards total	35 764	0.0281	11	48 718

* Wazimap online

References to Annexure 1

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