CLIMATE CHANGE PHYSICAL RISK AND VULNERABILITY ASSESSMENT

FOR THE CATO RIDGE LAND DEVELOPMENT AND RELEASE PROJECT

Prepared by Promethium Carbon for:

Cato Ridge Development Company Ltd

and

Zutari (Pty) Ltd

17 March 2023

Executive Summary

The Cato Ridge Development Company Ltd (a wholly owned subsidiary of Assmang (Pty) Limited (Assmang)), propose releasing land parcels across three Phases within a study area in the Cato Ridge area (hereafter the project area) in eThekwini Metropolitan Municipality (eThekwini) as part of the Cato Ridge Land Development and Release Project (the Cato Ridge Project). The intention is to make land available for future developers. After discussions between the developer, the environmental assessment practitioner (EAP), and the South African Department of Forestry, Fisheries, and the Environment (DFFE), it was decided that a Climate Change Risk and Vulnerability Assessment (CCRVA) focusing on the physical risks should be conducted as part of the environmental authorization (EA) process. Zutari has been commissioned to conduct this CCRVA, which will be used as an input for the final environmental impact assessment (EIA). This CCRVA should be read in conjunction with the Specialist Greenhouse Gas Emission Inventory report submitted in February 2023 (and revised in March 2023).

The proposed development of the Cato Ridge Project includes light industry, warehousing and logistics facilities. However, this has not been confirmed and at this stage, only the unlocking of the land is certain. Should the proposed development as stated go ahead, the basic value chain will include manufacturing, storage, packing, loading, transportation and potentially export.

The Cato Ridge Project is located in a peri-urban area in the Outer West Region of eThekwini. The area's urbanization and rapid growth have impacted the natural systems' resilience, making it difficult to mitigate the effects of climate change. The project's 25 km 'sphere of influence' intersects with 58 wards across five municipalities, with a population of approximately 854 860 people and a population density of 1 800 people/km^2. The socio-economic vulnerability score for eThekwini is 3.7, making it among the least vulnerable in the country, while Cato Ridge has the highest vulnerability in terms of economic vulnerability and growth pressure.

The proposed development site is situated in a region with diverse flora and ecology and is classified as mixed land use. The surrounding area is comprised of over 10 ecosystem types, classified under four biomes. The majority of these ecosystems are either poorly or not protected, and five are classified as vulnerable or endangered under the Red List threat classification. The region contains several large natural or near-natural remnants of vegetation that form part of the municipal open-space network, including critical biodiversity areas, with high value in terms of ecosystem services supplied. Numerous small natural wetlands and non-perennial rivers, as well as two perennial rivers are located near the project site, providing important ecosystem services for the surrounding communities and industries.

The scope of this CCRVA was to build on the submitted GHG Inventory Report which detailed the potential impacts on climate change of the Project. Here the CCRVA speaks to the physical risks and their extent, that could impact on the resilience of the Project to climate change. It further details the vulnerability of the project and adaptation recommendations that could reduce the impacts of climate change and build resilience.

Climate change projections for southern Africa suggest that South Africa is warming at twice the global rate of temperature increase, with temperatures predicted to increase by up to 3°C by 2050 and between 3-6°C by 2100. Future precipitation is challenging to model, but projections show a likely decrease of up to 10% in mean annual precipitation in the western parts of the country and an increase of up to 10% in the central and eastern interior. The frequency, intensity, and unpredictability of extreme weather events such as droughts, storms, and floods are expected to increase, leading to significant impacts on natural and agricultural ecosystems, as well as society and the economy.

The approach to the CCRVA considers the lack of local guidance and regulations on CCRVAs at this stage, an makes use of several globally accepted best practices . Using these, a rating system for vulnerability of the core operations, project value chain and the broader socio-economic and environmental context. Data used were limited to those that are publicly accessible, and where possible, using the most up-to-date data from reputable international or local data repositories. Processing of data, where necessary was done in-house using GIS and data management software. These tools and data were used in conjunction with information received from the client and considering the specialist's background and understanding of climate-related impacts posed on the Cato Ridge Project. Climate projections for the locality are based on the Shared Socio-economic Pathways (SSPs). In this assessment, SP1-2.6 (SSP1), SSP2-4.5 (SSP2) and SSP 5-8.5 (SSP5) are presented. These refer to different future socio-economic scenarios, and emissions pathways as a result.

This report assesses the project's vulnerability and resilience to climate change through the analysis of available datasets, but notes that there is uncertainty in downscaling global models to illustrate climate projections at a local scale. Developers should be aware of this uncertainty, as it may result in decreased investment value over time and possible increases in maintenance costs.

The project area has a sub-tropical climate with year-round rainfall, warm summers, and cool dry winters. Temperatures range from around 20-26°C, with rare occurrences of temperatures exceeding 35°C. Mean annual rainfall is 940 ±178 mm/year, and heavy rainfall days (> 20 mm) occur around 6-7 days per annum. Mean wind speed is approximately 5.0 km/h and has remained relatively constant over the last four decades.

In the future, temperatures are projected to increase under all SSPs, by between 0.3 and 1.0°C by 2050. The increase in very hot days is not significant under the projections assessed. Mean annual precipitation is likely to increase slightly under SSP1, but decrease slightly under SSP2 and SSP5. This is likely to be commensurate with an increase in heavy rainfall days. As such, periods of rainfall may become more concentrated in storm events which could increase in frequency and intensity. The drought risk for the region is likely to increase somewhat, whilst water catchment stress and seasonal water variability are also projected to increase. Flood risk for the area is also projected to increase to a high risk compared to the baseline. Furthermore, despite being 40 km inland, the area is prone to the impacts of tropical storms and subtropical low pressure systems. These are associated with strong winds and heavy rainfall over short periods of

time, as seen during the floods of April 2022 across KwaZulu-Natal. Tracking of tropical cyclones has shown that these systems appear to be moving closer to South Africa's east coast and could become more common under climate change conditions. Although the site's location is relatively safe from a flooding perspective, the risk posed by such systems should be noted and accounted for in risk planning.

Over and above the potential impacts to the core operations of the site from warmer temperatures and increased rainfall, the site's value chain is also likely to be impacted. The supply of diesel and electricity are expected to be at risk due to extreme weather events, particularly those that impact water supply to electricity generation facilities. Extreme weather is also likely to have a knock-on effect on transport (e.g., through restricted road access) and storage of goods (e.g., increased refrigeration or cooling needs), which is particularly relevant for the intended use of the project area.

Climate change is expected to have significant social impacts, exacerbating resource scarcity and reducing the quality of life, particularly for vulnerable communities. Extreme weather events can worsen existing social challenges, disproportionately affecting those already facing poverty and limited access to resources. Climate change acts as a risk multiplier, increasing existing vulnerabilities and risks, which could lead to greater social unrest in communities surrounding development projects where dissatisfaction with basic services is already high.

From and environmental perspective, it is predicted that the climate zone itself could shift by the latter half of the century, leading to significant changes to the biodiversity of the surrounding areas. Already these ecosystems are highly fragmented and considered vulnerable to loss due to anthropogenic land conversion. Some of these systems are already beyond a point where they have lost some of the ecological functioning threshold and being poorly protected, are at a greater risk of further loss under climate change. These natural and near-natural areas surrounding the Cato Ridge project provide crucial ecosystem services, including climate resilience, carbon sequestration, and provisioning and regulating services. The clearing and degradation of these areas for development release carbon into the atmosphere, alter ecosystem functioning, and increase vulnerability to climate change impacts. The loss of natural ecosystems in eThekwini could result in monetary and non-monetary costs. Water sources are also at risk due to climate change, with freshwater and groundwater resources expected to come under increasing pressure. The Cato Ridge Project should manage runoff of water and pollutants to avoid compromising water resources downstream and minimize the risk of flooding.

The vulnerability assessment for the project considers rainfall changes and rainfall intensity as the weather variable with the highest consequence or impact rating, at 4/6, with a likelihood score of C. The next most significant variables in terms of vulnerability are tropical cyclones and water stress and drought, both of which have a consequence rating of 3/6 and likelihood ratings of 'likely' and 'very likely' respectively.

Several adaptation recommendations have been made. These include but are not limited to: using renewable energy onsite; linking to early warning systems; retrofitting facilities with insulating

materials that reduce heat discomfort and warm storage conditions; revegetating surfaces and limiting vegetation loss around the site; and ensuring water runoff is managed adequately. It is essential for the project team to take proactive steps to address the identified vulnerabilities and integrate climate change considerations into their planning, design, and operations to ensure the long-term resilience and sustainability of the development. By working collaboratively with relevant stakeholders and implementing appropriate measures, the project can not only mitigate the risks and potentially find opportunities presented by climate change to enhance the operations of the site in the long-term.

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Key Terms and Definitions[1]

Adaptive capacity	The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences. This ability relates largely to available resources of human systems and their socio-economic, structural, institutional, and technological characteristics and capacities.
Climate change	The United Nations Framework Convention on Climate Change (UNFCCC) defines climate change as: '*a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods*. The UNFCCC thus makes a distinction between climate change attributable to human activities altering the atmospheric composition and climate variability attributable to natural causes.
Climate change impacts	The consequences of realised risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather and climate events), exposure, and vulnerability. Impacts generally refer to effects on lives; livelihoods; health and well-being; ecosystems and species; economic, social and cultural assets; services (including ecosystem services); and infrastructure. Impacts may be referred to as consequences or outcomes and can be adverse or beneficial.
Climate change vulnerability	The degree to which a system is susceptible to and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.
Climate resilience	The capacity of interconnected social, economic and ecological systems to cope with a hazardous event, trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity and structure.
Climate variability	Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability).

[1] All terms and definitions are from the following sources unless otherwise specified:
- IPCC. 2022. Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner *et al* (eds.)]. Cambridge University Press. In Press.
- IPCC. 2021, Annex VII: Glossary [Matthews, J.B.R. *et al.* (eds.)]. In Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte *et al.* (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 2215–2256, doi:10.1017/9781009157896.022.

Exposure	Exposure is directly linked to climate parameters, that is, the character, magnitude, and rate of change and variation in the climate. Typical exposure factors include temperature, precipitation, evapotranspiration, and climatic water balance, as well as extreme events such as heavy rain and meteorological drought. Exposure is the contact between one or more biological, psychosocial, chemical, or physical; stressors, including stressors affected by climate change.
Extreme weather[2]	Is unexpected, unusual, or unforeseen weather and differs significantly to the usual weather pattern, such as droughts, floods, extreme rainfall, and storms.
Greenhouse Gas (GHG)	Greenhouse gasses (GHGs) are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth's surface, the atmosphere itself and by clouds. This property causes the greenhouse effect. The Kyoto Protocol deals with the following greenhouses gases, carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4), Sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).
Sensitivity	Sensitivity determines the degree to which a system is adversely or beneficially affected by a given climate change exposure and is a function of the natural and socio-economic context of a particular site.
Shared Socio-economic Pathways (SSPs)	Shared Socio-economic Pathways (SSPs) have been developed to complement the Representative Concentration Pathways (RCPs). By design, the RCP emission and concentration pathways were stripped of their association with a certain socio-economic development.
Shared Socio-economic Pathway 2 (SSP2)[3]	This is the "Middle of the Road" or medium pathway, which extrapolates the past and current global development into the future. In this scenario, there is a certain cooperation between states, but it is barely expanded. Global population growth is moderate, levelling off in the second half of the century. Environmental systems are facing a certain degradation.[4] This scenario is equivalent to RCP 4.5 in the IPCC's Fifth Assessment Report (AR5).
Shared Socio-economic Pathway 5 (SSP5)[3]	This is the "Fossil-fuelled Development" scenario. In the scenario, global markets are increasingly integrated, leading to innovations and technological progress. The social and economic development is based on an intensified exploitation of fossil fuel resources with a high percentage of coal and an energy-intensive lifestyle worldwide. The world economy is growing and local environmental problems such as air pollution are being tackled

[2] GIZ. 2014. The vulnerability sourcebook. Gesellschaft für Internationale Zusammenarbeit, Bonn, Germany.

[3] Riahi, K. *et al.* 2017. The Shared Socioeconomic Pathways and their energy, land use, and greenhouse gas emissions implications: An overview. *Global Environmental Change* **42** : 153-168. doi.org/10.1016/j.gloenvcha.2016.05.009.

[4] Böttinger, M and D. Kasang. 2021. The SSP Scenarios. Deutsches Klimarechenzentrum, Hamburg, Germany. Available at: https://www.dkrz.de/en/communication/climate-simulations/cmip6-en/the-ssp-scenarios.

successfully. This scenario is equivalent to RCP 8.5 in the IPCC's Fifth Assessment Report (AR5).

Social vulnerability drivers[5]

Social vulnerability is defined as a dynamic state of societies comprising exposure, sensitivity and adaptive capacity. It is characterised by high levels of dependence on natural resources for livelihoods and economic development, combined with increasing environmental degradation, which can both increase exposure (e.g., wetland destruction) and reduce adaptive capacity (e.g., declining river flows constraining water provision). Examples of social vulnerability drivers include poverty, low awareness and inability to migrate.

[5] Tucker, J., Daoud, M., Oates, N. et al. Reg Environ Change (2015) 15: 783. https://doi.org/10.1007/s10113-014-0741-6.

Acronyms and Abbreviations

°C	Degrees Celsius
AR5	Fifth Assessment Report
AR6	Sixth Assessment Report
C3S	Copernicus Climate Change Service
CCDS	Copernicus Climate Data Store
CCIA	Climate Change Impact Assessment
CCKP	Climate Change Knowledge Portal
CMIP6	Coupled Model Intercomparison Project Phase 6
CRV	Climate Risk and Vulnerability
CCRVA	Climate Change Risk and Vulnerability Assessment
DFFE	Department of Forestry Fisheries and the Environment
D'MOSS	Durban Metropolitan Open Space System
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
ENSO	El Niño–Southern Oscillation
EBRD	European Bank for Reconstruction and Development
EWS	eThekwini Water and Sanitation [Department]
GHG	Greenhouse gas
IAPs	Invasive alien plants
IBTrACS	International Best Track Archive for Climate Stewardship
ICMM	International Council on Mining and Minerals
IFC	International Finance Corporation

IOCB	Indian Ocean Coastal Belt
IPCC	Intergovernmental Panel on Climate Change
kld	Kilolitres per day
Ml	Megalitres
NDC	Nationally Determined Contribution
PDA	Proposed Development Area
RCP	Representative Concentration Pathways
SLR	Sea level rise
SSP	Shared Socio-economic Pathway
WCRP	World Climate Research Programme
WRI	World Resources Institute
WWTP	Wastewater treatment plant

Declaration of Independence

The authors of this report do hereby declare their independence as consultants appointed by Zutari to undertake a Climate Change Risk and Vulnerability Assessment for the Cato Ridge Development Company Ltd as part of the environmental authorisation process. Other than fair remuneration for the work performed the specialists have no personal, financial business or other interests in the project activity. The objectivity of the specialists is not compromised by any circumstances and the views expressed within the report are their own. The EDTEA declarations are appended.

Robbie Louw

Joshua Weiss

Shantal Beharie

Details of the Specialist Team

Promethium Carbon is a South African climate change and carbon advisory company based in Johannesburg. The company has been active in the climate change and carbon management space since 2004.

Promethium Carbon's climate change impact studies include an estimation of the carbon footprint of the activity or group of activities, as well as the vulnerability of the activity/ies to climate change. Promethium Carbon has calculated greenhouse gas inventories for over 60 entities and is proficient in applying the requirements of ISO/SANS 14064-1 and the Greenhouse Gas Protocol's accounting standards, as well as South Africa's Greenhouse Gas Reporting Guidelines. Promethium Carbon has also assisted around 40 clients develop climate change risk assessments, which includes the compilation of climate change specialist reports. Promethium Carbon's assessments include thorough analysis of historical and projected weather data specific to the region in which the client operates. Promethium Carbon's assessment of vulnerability goes beyond core operations to include impacts within the supply chain and broader network of the Lephalale Coal and Power Project.

Robbie Louw is the founder and director of Promethium Carbon. He has over 18 years of experience in the climate change industry. Robbie holds both a BCom Honours Degree in Economics as well as a BSc degree in Chemical Engineering. Robbie has significant experience with regards to climate change mitigation and adaptation. Robbie's chemical engineering background combined with his extensive experience in climate change has led to him leading several projects related to climate change risk and vulnerability, energy development and developing climate change mitigation and adaptation alternatives. His experience over a period of 35 years covers the chemical, mining, minerals process and energy fields, in which he was, involved in R&D, project, operational and management levels. Robbie is currently a member of The Southern African Institute of Mining and Metallurgy and the Institute of Directors in South Africa (IoDSA). In addition, Robbie is also a member of the Technical Working Group of the Climate Disclosure Standards Board (CDSB). Robbie's experience in climate change includes (but is not limited) to:

- Climate change risk and vulnerability assessments for large mining houses;
- Extensive experience in preparing carbon footprints. The team under his leadership has performed carbon footprint calculations for major international corporations operating complex businesses in multiple jurisdictions and continents;
- Carbon and climate strategy development for major international corporations;
- Climate change impact assessments for various companies and projects;
- Climate change scenario planning and analysis, particularly in terms of the recommendations of the Taskforce on Climate-related Financial Disclosure; and

- In depth understanding of South Africa's climate change regulations and carbon tax requirements.

Joshua Weiss Joshua holds an MSc in Conservation Biology and a BSc Hons in Ecology, Environment and Conservation. He has cumulatively over six years of experience using GIS to conduct ecological analyses, developing sensitivity maps and cartographic design; producing several other maps for various reports in suitable and meaningful ways. He has a background in natural capital accounting, natural resource mapping and ecosystem service modelling & mapping His work has also included developing scenario maps of degradation, alien invasive plant spread and general spatio-temporal vegetation change. He also has experience in sourcing and analysing up-to-date modelled climate data. He was part of the team that reviewed South Africa's Climate Change Adaptation Plans for South African Biomes and the Biodiversity Sector Climate Change Response Strategy has also previously been involved in avifaunal monitoring and reporting, particularly in the renewable energy space, as well as scoping and EIA reporting.

Shantal Beharie is a climate change advisor at Promethium. She has eight years of experience in the climate change/sustainability field. She holds a master's degree in environmental studies which focused specifically on historical climate change, as well as an honours degree in geography and a Bachelor's degree in environmental management. Shantal has experience in sustainability (corporate reporting, climate-change scenario analysis, CDP, ESG, TCFD, Science-based targets/net-zero) climate change risk and vulnerability assessments, carbon credit project documentation, climate impact assessments, strategic projects (environmental management frameworks, strategic environmental assessments and compiling state of environment reports), and policy development.

Report structure and reference in terms of NEMA Regulations (2014), Appendix 6

NEMA Regulations (2014) (as amended) - Appendix 6	Relevant section in report
Details of the specialist who prepared the report	Pages xv-xiii
The expertise of that person to compile a specialist report including a curriculum vitae	Pages xv-xiii
A declaration that the person is independent in a form as may be specified by the competent authority	Page xiv
An indication of the scope of, and the purpose for which, the report was prepared	Section 2.2
An indication of the quality and age of base data used for the specialist report	Sections 4.1.3
A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Sections 5 and 6. Cumulative impacts are not relevant in the context of physical risks due to climate change. Further the levels of acceptable change are relevant to the GHG inventory submitted separately.
The duration date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 4
Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternative	N/A
An identification of any areas to be avoided, including buffers	This is not relevant in terms of the climate change risk and vulnerability assessment. However, this report does make mention of the impacts of climate change on sensitive areas surrounding the proposed development
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	This is not relevant in terms of the climate change impact study. However, this report does define the boundaries for which the

NEMA Regulations (2014) (as amended) - Appendix 6	Relevant section in report
	project's vulnerability to climate change was determined.
A description of any assumptions made and any uncertainties or gaps in knowledge;	Page 20
A description of the findings and potential implications of such findings on the impact of the proposed activity or activities	Sections 5.2 & 6
Any mitigation measures for inclusion in the EMPr	N/A; included as part of the GHG inventory report.
Any conditions for inclusion in the environmental authorisation	None
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	N/A
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and regarding the acceptability of the proposed activity or activities	N/A
A description of any consultation process that was undertaken during preparing the specialist report	Section 2.2
A summary and copies of any comments received during any consultation process and where applicable all responses thereto	N/A
Any other information requested by the competent authority.	N/A

1 Introduction and Context

1.1 Project Description

The Cato Ridge Development Company Ltd (a wholly owned subsidiary of Assmang (Pty) Limited (Assmang)), propose releasing land parcels across three Proposed Development Areas (PDAs) within a study area in the Cato Ridge area (hereafter the project area) as part of the Cato Ridge Land Development and Release Project (hereafter the Cato Ridge Project). The intention is to make land available for future developers. A variety of land use options are being considered due to social and economic imperatives for the region. The project area is situated in the eThekwini Metropolitan Municipality (hereafter eThekwini), KwaZulu-Natal. It is situated adjacent and to the north of the N3 freeway, 25 km south-east of Pietermaritzburg and approximately 40 km north-west of the Durban central business district (Figure 1).

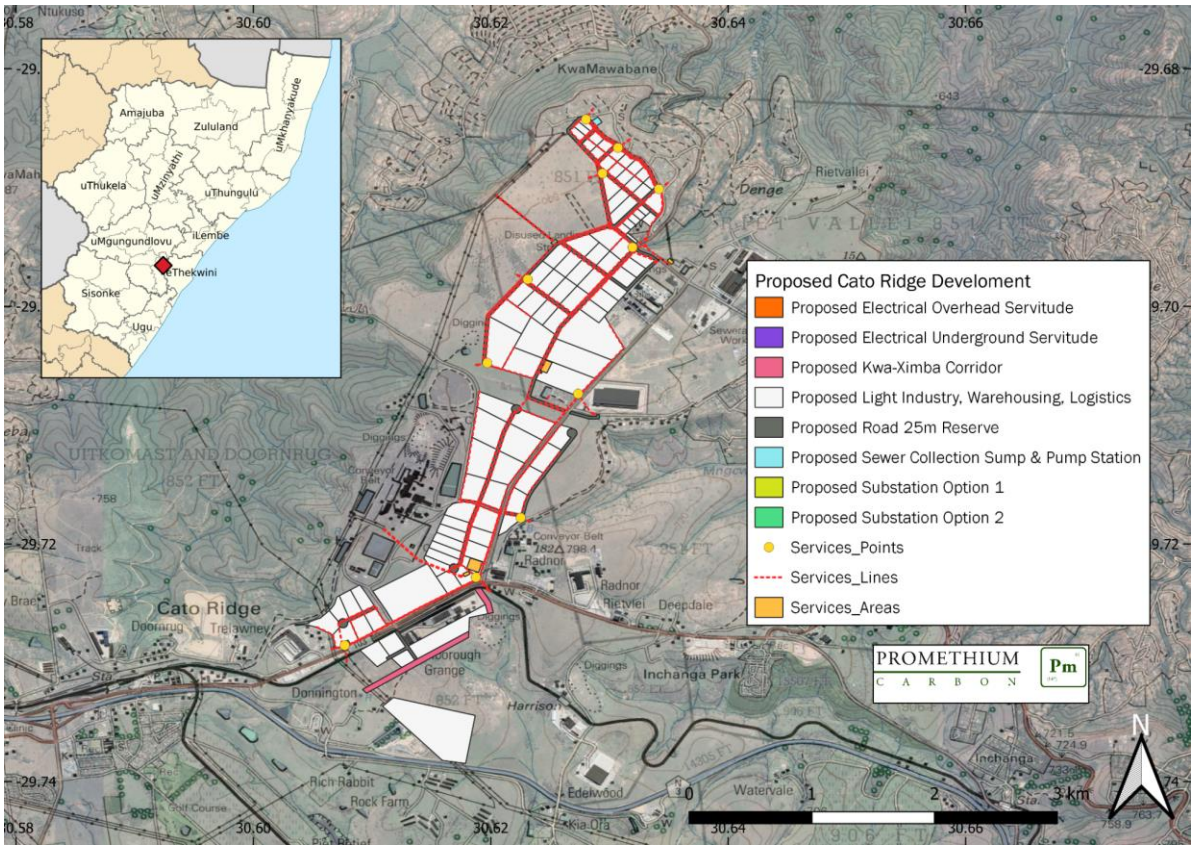

Figure 1: Location of the proposed Cato Ridge Development

Much of the surrounding land use is open land, comprising natural vegetation and degraded, but minimally transformed vegetation. Parts of this land form part of the Durban Metropolitan

Open Space System (D'MOSS).[6] The open space includes significant landholdings which have been acquired by eThekwini for conservation to expand and consolidate conservation holdings south of the N3. Additional land uses in the surrounding area include rural residential areas, informal settlements and industrial, warehousing and logistical developments.

Proposed infrastructure as part of the development include light industry, warehousing and logistics facilities replete with electrical servitudes, substations, a pump station and alterations to local roads to facilitate access to the site. After discussions between the developer, the environmental assessment practitioner (EAP), and the South African Department of Forestry, Fisheries, and the Environment (DFFE), it was decided that a Climate Change Risk and Vulnerability Assessment (CCRVA) focusing on the physical risks should be conducted as part of the environmental authorization (EA) process. Zutari has been commissioned to conduct this CCRVA, which will be used as an input for the final environmental impact assessment (EIA). This CCRVA should be read in conjunction with the Specialist Greenhouse Gas Emission Inventory report submitted in February 2023 (and revised in March 2023).

1.2 Project Context

1.2.1 Core operations

The proposed development of the Cato Ridge Project includes light industry, warehousing and logistics facilities as per the proposed footprint in Figure 1. However, this has not been confirmed and at this stage, only the unlocking of the land is certain.

1.2.2 Value chain

Should the proposed development as stated go ahead, the basic value chain will include manufacturing, storage, packing, loading, transportation and potentially export. However, without knowing more details on the proposed use of the site, further details on the value chain cannot meaningfully be expanded on.

1.2.3 Broader social context

The Cato Ridge Project is located in a peri-urban are in the Outer West Region of eThekwini, South Africa's third biggest Metropolitan Municipality (city). The City's population is around 3.7 million people. Despite their peri-urban nature they are still classified as being within a City Region but is within close proximity to Dense Rural Settlement Areas.[7] The urbanisation and rapid urban growth of eThekwini have impacted the City's natural systems and their ability to

[6] D'MOSS comprises interconnecting open spaces in public, private and traditional authority ownership that seeks to protect the biodiversity and associated ecosystem services of Durban.

[7] van Huyssteen, E. Green, C. Sogoni, Z., Maritz, J. & McKelly, D. 2018. South African Functional Town Typology (CSIR 2018 v2).

ameliorate climate change impacts through the resilience they provide. Although the City and surrounding areas have experienced relatively modest growth relative to other African cities, the patterns of growth have been highly uneven, with high growth in the population living in informal settlements. These settlements, unplanned by nature, are often located on the fringes of existing suburbs, encroaching on natural areas, nearer or on steep slopes or in the riparian areas of perennial rivers. They are thus more susceptible to natural hazards such as landslides and pluvial flooding.

The project area's 25 km 'sphere of influence' intersects 58 wards across five local municipalities over and eThekwini: Ndwedwe, uMshwathi, uMsunduze, Mkhabathini and Richmond. The population within a 25 km 'sphere of influence' is approximately 854 860 with a population density of 1 800 people/km^2.[8] Mean annual household income (as per 2011 Census) is R29 400; similar to the provincial mean. The employment rate (as per the 2011 Census) is around 25.2% which is lower than the provincial average and low by national standards.[9]

eThekwini has a socio-economic vulnerability score of 3.7, which places it in the lower third across South Africa, and is the second lowest in the province.[10] It has a low economic vulnerability score of 4.0,[11] making it among the least economically vulnerable in the country and province.[12] This is largely due to the heterogenous economy of the city and surrounds, with little reliance on a few economic activities.[13] Settlement vulnerability for Cato Ridge itself is highest in terms of economic vulnerability (7.4 out of 10) and growth pressure (6.4 out of 10) whilst socio-economic vulnerability is ranked at 5.5 out of 10 (Figure 2).

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8 WorldPop (www.worldpop.org - School of Geography and Environmental Science, University of Southampton; Department of Geography and Geosciences, University of Louisville; Departement de Geographie, Universite de Namur) and Center for International Earth Science Information Network (CIESIN), Columbia University (2018). Global High Resolution Population Denominators Project - Funded by The Bill and Melinda Gates Foundation (OPP1134076). https://dx.doi.org/10.5258/SOTON/WP00674.

9 Statistics South Africa (2011) South African Population Census 2011. Indicators derived from the full population Census https://wazimap.co.za/profiles/municipality-LIM362-lephalale/.

10 Score out of ten ranking the vulnerability of households in the municipality with regards to the overall vulnerability in terms of household composition, education, health, access to basic services and safety & security. A higher ranking indicates higher vulnerability.

11 Score out of ten ranking the vulnerability of households in the municipality with regards to the overall their susceptibility of the municipality to external shocks based on economic diversity, size of the economy, labour force, GDP growth rate and the inequality present in the municipality. A higher ranking indicates higher vulnerability.

12 Le Roux, A., van Niekerk, W., Arnold, K., Pieterse, A., Ludick, C., Forsyth, G., Le Maitre, D., Lötter, D., du Plessis, P. & Mans, G. 2019. Green Book Risk Profile Tool. Pretoria: CSIR. Available at: riskprofiles.greenbook.co.za

13 Wholesale and retail trade, catering & accommodation and government and community, social & personal services make up 56% of the municipalities gross value add (GVA).

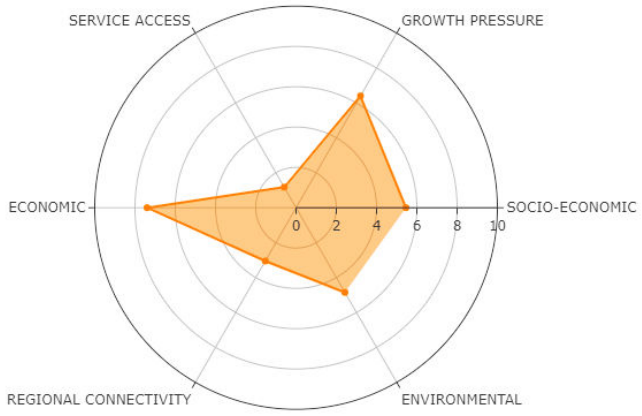

Figure 2: Settlement vulnerability for Cato Ridge.[12,14]

1.2.4 Broader environmental context

The proposed development is located within a mixed land use area (Figure 3) within a diverse region from a floristic and ecological perspective. The surrounding areas comprise over 10 ecosystem types of which eight occupy at least 25 km^2. These are classified under four biomes: Grassland, Savanna, Indian Ocean Coastal Belt (IOCB) and Forests. They are largely poorly or not protected and five of the ecosystem types are classified as vulnerable or endangered under the Red List threat classification (Table 1). There are several large natural or near-natural remnants of vegetation that form part of the D'MOSS network, within and near the project area, including critical biodiversity areas as determined by the Municipality. These areas account for a high proportion of the value attributed to ecosystem services that the region benefits from.[15]

[14] A high vulnerability score (closer to 10) indicates a scenario where an undesirable state is present e.g., low access to services, high socio economic vulnerabilities, poor regional connectivity, environmental pressure or high economic pressures.

[15] Turpie, J., Letley, G., Chrystal, R., Corbella, S. & Stretch, D. 2017. Promoting Green Urban Development in Africa: Enhancing the relationship between urbanization, environmental assets and ecosystem services. Part I: A Spatial Valuation of the Natural and Semi-Natural Open Space Areas in eThekwini Municipality. Prepared for AECOM on behalf of The World Bank.

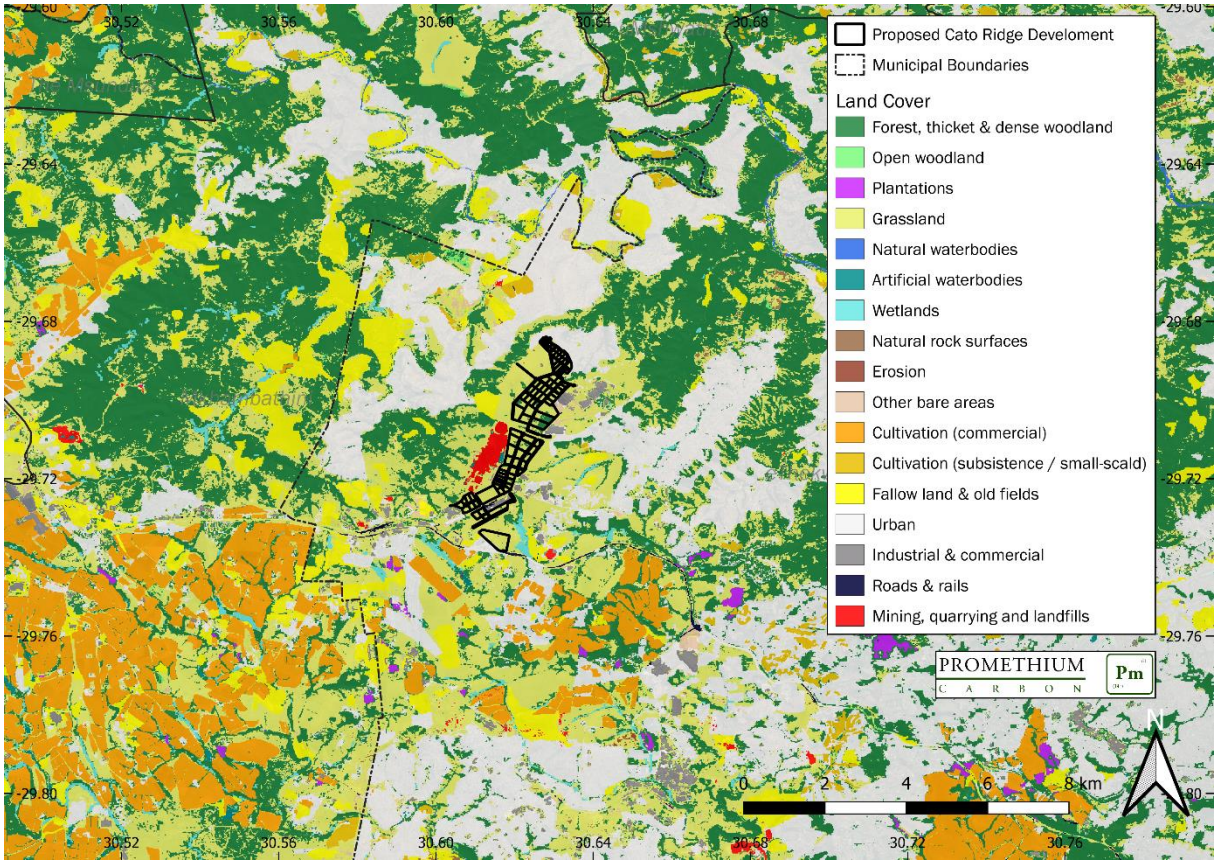

Figure 3: Land use and land cover in the vicinity of the project area.[16]

There are numerous small natural wetlands and non-perennial rivers within close proximity to the site. Two perennial rivers are also located nearby; the uMsunduze River, a tributary of the uMngeni River and the Sterkspruit, which flows unto the uMlazi River. These systems provide important ecosystem services beneficial to communities and industries in the region.

[16] Land cover data as per the 2020 South Africa National Land Cover product. Department of Forestry, Fisheries and the Environment, Pretoria.

Table 1: Ecosystem types within a 25 km radius (with an area greater than 20 km² of the proposed Cato Ridge project area and their threat and protection status.[17,18]

Ecosystem Type, Biome	Remarks	Protection level	Red List Status	Area within 25 km radius (km²)
Dry Coast Hinterland Grassland, Savanna	Dense, tall grassland dominated by unpalatable *Ngongoni* grass (*Aristida junciformis*). Heavily impacted by urban developments, plantations and IAPs.	Not protected	Vulnerable	679
Eastern Valley Bushveld, Savanna	Woodlands in a mosaic with thickets. Highly variable rainfall results in variable conditions and species. Almost none conserved and impacted by cultivation and invasive alien plants (IAPs).	Not protected	Least Concern	432
KwaZulu-Natal Hinterland Thornveld, Savanna	Open thornveld dominated by thorn-bearing trees on undulating plains. Very little conserved. Specialist considered area around study area as largely being Eastern Valley Bushveld.	Not protected	Least Concern	382
KwaZulu-Natal Sandstone Sourveld, Savanna	Short, species-rich grassland with scattered shrubs. Very small areas formally conserved and largely converted to urban land uses, cultivation and silviculture. Highly susceptible to development due to location on flatter topography.	Not protected	Endangered	341
Moist Coast Hinterland Grassland, Grassland	Dense, tall grassland dominated by unpalatable *Ngongoni* grass. Heavily impacted by urban developments, plantations and IAPs.	Not protected	Vulnerable	267
KwaZulu-Natal Coastal Belt Thornveld, Savanna	Grassland with scattered bushes and thicket on steep valley sides and hills. Very poorly conserved in small nature reserves.	Not protected	Vulnerable	87
KwaZulu-Natal Coastal Belt Grassland, IOCB	Mixed ecosystems with grassland interspersed by forests. Minimal protection and highly transformed by sugar cane plantations and urban infrastructure. Highly	Not protected	Endangered	43

[17] SANBI. (2006-2018). The Vegetation Map of South Africa, Lesotho and Swaziland, Mucina, L., Rutherford, M.C. and Powrie, L.W. (Editors), Online, http://bgis.sanbi.org/Projects/Detail/186, Version 2018.

[18] SANBI. 2018. Terrestrial ecosystem threat status and protection level layer [Vector] 2018. Available at: http://bgis.sanbi.org/Projects/Detail/222.

Ecosystem Type, Biome	Remarks	Protection level	Red List Status	Area within 25 km radius (km^2)
	invaded by IAPs.			
Scarp Forest, Forests	Fragmented patches of tall, species-rich and structurally diverse forest. Fairly well protected but exposed to exploitation outside protected areas. Local IAP infestations are a threat.	Moderately Protected	Least Concern	34

2 Background to Climate Change Impact Assessments and Climate Change Risk Assessments

The analysis presented in this report is aligned with the principles of the *National Environmental Management Act, 1998 (Act No 107 of 1998)* (NEMA) and *the National Water Act, 1998* (Act No 36 of 1998) (NWA). This report will inform and assist Zutari in preparing an EIA for the proposed project. In this context, the impacts of the Project on climate change and the climate change impacts on the Project must therefore be considered.

Before the legal precedent set by the *Thabametsi* case,[19] there was no express provision that stipulated that climate change is a relevant factor to be considered as part of an EIA in South Africa. For this reason - and given the lack of domestic guidelines to assess the climate change impacts of a specific activity - it was necessary to not only consider the principles of the National Environmental Management Act (NEMA), but to also consider international best practice and international laws which inform Climate Change Impact Assessments (CCIAs) and CCRVAs.

2.1.1 Context for the Cato Ridge Land Development and Release Project

We understand that the Cato Ridge Development Company proposes to develop a 450-500ha logistics and/or light industrial and/or warehousing development in Cato Ridge, eThekwini. The draft greenhouse gas (GHG) inventory that was submitted in February 2023 (and a revised version in March 2023), indicated that the project could result in 4.28 $MtCO_2e$ over the project lifetime. In addition, the project scoping report indicates that the development will result in some loss of natural ecosystems, which could impact on the area and the Municipality's resilience to climate change. As such, Zutari has commissioned this CCRVA in support of an EIA for the project.

The process is in accordance with the requirements of the 2014 EIA regulations promulgated in terms of the *National Environmental Management Act (NEMA: Act No 107 of 1998).* As part of the specialist requirements under NEMA regulations 12(1) for the EIA, Promethium Carbon will undertake a CCRVA for the Cato Ridge Project. The analysis presented in this report is aligned with the principles of the *National Environmental Management Act (NEMA), 1998 (Act No 107 of 1998): Environmental Impact Assessment Regulations, 2014 (GNR 982).*

Climate change is generally considered to be covered within existing environmental law frameworks since climate change impacts the environment and societies living in certain environments. South Africa's overarching environmental law framework is founded in NEMA.

[19] In 2017, in a landmark judgment, the Pretoria High Court set aside the environmental approval for the plant, holding that the relevant Minister was obliged to consider climate impacts in her decision, but had failed to do so. This was South Africa's first climate change court case.

The *Environmental Impact Assessment (EIA) Regulations of 2017* (which were promulgated under NEMA), were predominantly drafted to govern activities which have an impact on the environment within the Republic of South Africa. Therefore, applying NEMA's principles to a global phenomenon, such as climate change, presents a challenge.

2.2 Scope of the Climate Change Risk and Vulnerability Assessment

This CCRVA includes the following aspects and is based on the guidance from the *Thabametsi* judgement. The impact of the Project on climate change has already been detailed in the draft GHG inventory that was submitted in February 2023 (revised in March 2023). The **scope of work for this CCRVA only covers the impacts of climate change on the project**:

- An assessment of the **extent of impacts of climate change *on* the project** in terms of physical risks;
- The potential impacts of sub-tropical storms and tropical cyclones on the area of Cato Ridge. This will focus on the probability that storm tracks can change as a result of climate change, to come further inland;
- The **impact of climate change on other variables affecting the local climate** in the area, such as temperature and rainfall etc.;
- The **resilience of the (project) to climate change**, considering how climate change will impact on its operation, through factors such as rising temperatures, and extreme weather patterns; and
- Any **relevant measures to consider for adaptation** based on the risk assessment findings.

The analysis of climate change risks includes both physical and transitional risks. The scope of inclusion of these risks are set out in the table below:

Table 2: Coverage of risks in the CCRVA.

	Risk	Included/excluded
Physical risks	Risks such as extreme weather events, storms, droughts, etc.	**Included** in the CCRVA as it can significantly impact on the resilience of the project to climate change in the core operations, value chain, natural environment and social environment.
Transitional risks	Risks such as regulation, carbon pricing, and stranded asset risks	These risks are **excluded** from the CCRVA as they represent commercial risks to the owner of the project rather than environmental and societal risks that are governed in the context of NEMA

No stakeholder consultation or public participation meeting were conducted as part of this CCRVA.

2.3 Description of Project Activities and Associated Infrastructure

The final scoping report for the Cato Ridge Project highlights the following infrastructure requirements for the project.

2.3.1 Water requirements

The following water infrastructure will be required for the proposed development:

- One elevated water tower (500 m^3 or 0.1 ha); and
- Water distribution pipelines – the capacity and dimensions to be confirmed.

The proposed water reticulation infrastructure will be finalised in consultation with the eThekwini Water and Sanitation (EWS) Department. The intention is to tie into the existing bulk water line proposed in the southern sections, which will be confirmed in the next phase.

Water storage facilities, pipes and pump stations must be designed to meet the anticipated demand. Water-supply systems use high-capacity wells and intakes, pumps, and pipes, as well as a power source (e.g., electricity), to drive the pumps. Water storage will be required and used to provide adequate contact time for disinfection and to meet peak demand. The last component to consider is the distribution system that will use a gravity-fed system, but may also pump water to each erf, and various connection points will be connected to the existing water network.

2.3.2 Sewage

Through the phased development of the Project, the sewerage requirements will gradually increase for the study area. Over the development horizon, bulk service upgrades will be required. A sewer reticulation network will extend across the development to ensure each site can be adequately serviced. A 2Ml modular wastewater treatment plant (WWTP, 10 710 m^2) will be established at the intersection of the R103 and Eddie Hagen (within the Phase 1 (PDA 2) area). The WWTP will comprise 250 kld modules that would be brought online as demand increases. The plant will be used to treat wastewater for Phase 1 (PDA 2) only, after which, the plant will be decommissioned, and the development will then feed into the municipal trunk line proposed along Eddie Hagen Road in the year 2032.

2.3.3 Road network

The following roads are proposed as part of the development:

- The internal road network will be 20 m in width, including the road reserve;
- All internal roads required for the development will be a single lane in both directions. Each lane will be 3.5 m wide, totalling 7 m in width; and
- The total road reserve will be 6.5 m for each lane. The purpose of the road reserve is to accommodate bulk service infrastructure for stormwater, sewer, water and electricity; and
- The internal road network (including access roads) will equal a total length of 17 km (to be confirmed in the EIA phase).

2.3.4 Electricity

To cater for the electrical demands of the proposed phased development, the following electrical infrastructure is proposed:

- Two 0.15 ha substations are proposed as part of the development: one to cater for the electrical demands of Phase 1 (PDA 2) and Phase 3 (PDA 1) located in the south, and one to cater for Phase 2 (PDA 3) in the north.

Two options for the positioning of the Phase 2 (PDA 3) substation and associated distribution line have been proposed. The engineering design proposals will be determined in consultation with Eskom. The following transmission lines are proposed:

- Phase 1 (PDA 2): Approx. 788 m long 33kV powerline from ACRW to the new southern substation within Phase 1 (PDA 2).
- Phase 2 (PDA 3) – two alternative options:
    - Option 1 - (eastern) requires approx. 384m 33kV powerlines – described as "electrical cable with 7m servitude" below ground. The proposed substation is outside of the Assmang/CRDC landholdings and within an existing substation complex; or
    - Option 2 - (western) requires approx. 638m 132kV overhead powerlines with 36m servitude. The proposed substation and powerline are proposed on Assmang/ CRDC land outside the proposed Phase 2 (PDA 3) footprint.

2.3.5 Stormwater management

Stormwater infrastructure includes:

- Stormwater pipelines;
- Attenuation ponds;[20] and
- Stormwater discharge points.

[20] These will be dry and only fill during 1 in 50-year storm events (heavy rainfall events).

3 Climate Change Context

3.1 Projected Climatic Changes

GHG emissions from all sources accumulate in the atmosphere and contribute to global climate change. One of the main GHGs is carbon dioxide (CO_2) and just like all GHGs, CO_2 contributes to climate change by trapping heat in the atmosphere. The greater the concentration of GHGs, the greater the warming effect.

As a result of the continuous emissions of GHGs, it is a high likelihood that the mean global surface temperature will, at the very least, exceed 1.5°C above pre-industrial levels by 2100, and more likely to be in the range of 2.1 to 4.6°C above pre-industrial levels.[21] In addition, heavy precipitation events are likely to become more intense and frequent.[22] The irreversible melting of the ice sheets could be initiated, resulting in global sea level rise.[23] These climatic changes increase the possibility of irreversible changes in the way the planet, and in turn, human societies and economies will function.

Based on the most recent climate change projections for the southern African region[24], South Africa is warming at twice the global rate of temperature increase. Temperatures could increase by up to 3°C by ca. 2050 (Figure 4) and between 3-6°C by 2100 above the baseline period (ca. 2005). The north-western interior of South Africa (parts of the Northern Cape, the North-West and western Limpopo) is predicted to have the highest temperature anomaly in the future. Mean maximum and minimum temperatures are also likely to increase countrywide.

Whilst future precipitation is challenging to model, projections show mean annual precipitation is likely to decrease by up to 10% in the western parts of South Africa and increase by up to 10% in the central and eastern interior. Rainfall variability is likely to increase, with generally longer dry spells and shorter wet spells (fewer rain days) with higher intensity.[25,26] Furthermore, the timing of rainfall is also likely to shift; as evidenced by the later onset of rainy seasons across much of South Africa. These changes are likely to increase the frequency, intensity, and

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21 IPCC. 2021. Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P. *et al.* (eds.)]. United Nations, New York.

22 Tabari, H. 2020. Climate change impact on flood and extreme precipitation increases with water availability, *Sci. Rep.* **10**: 13768.

23 Mimura, N. 2013. Sea-level rise caused by climate change and its implications for society. *Proceedings of the Japan Academy, Series B* **89**: 281-301.

24 Engelbrecht, F., Le Roux, A., Arnold, K. & Malherbe, J. 2019. Green Book. Detailed projections of future climate change over South Africa. Pretoria: CSIR. Available at: https://arcg.is/1zKniq.

25 The World Bank Group. 2021. Climate Risk Profile: South Africa. The World Bank Group, Washington D.C.

26 DEA. 2018. South Africa's Third National Communication Under the United Nations Framework Convention on Climate Change. Department of Environmental Affairs, Pretoria.

unpredictability of extreme weather events such as droughts, storms, and floods,[27] leading to increased water stress in most catchments across the country.[28] These changes will have significant impacts on natural and agricultural ecosystems, as well as society and the economy, affecting food systems and security, water supply, ecosystem services, infrastructure, and human health and well-being.

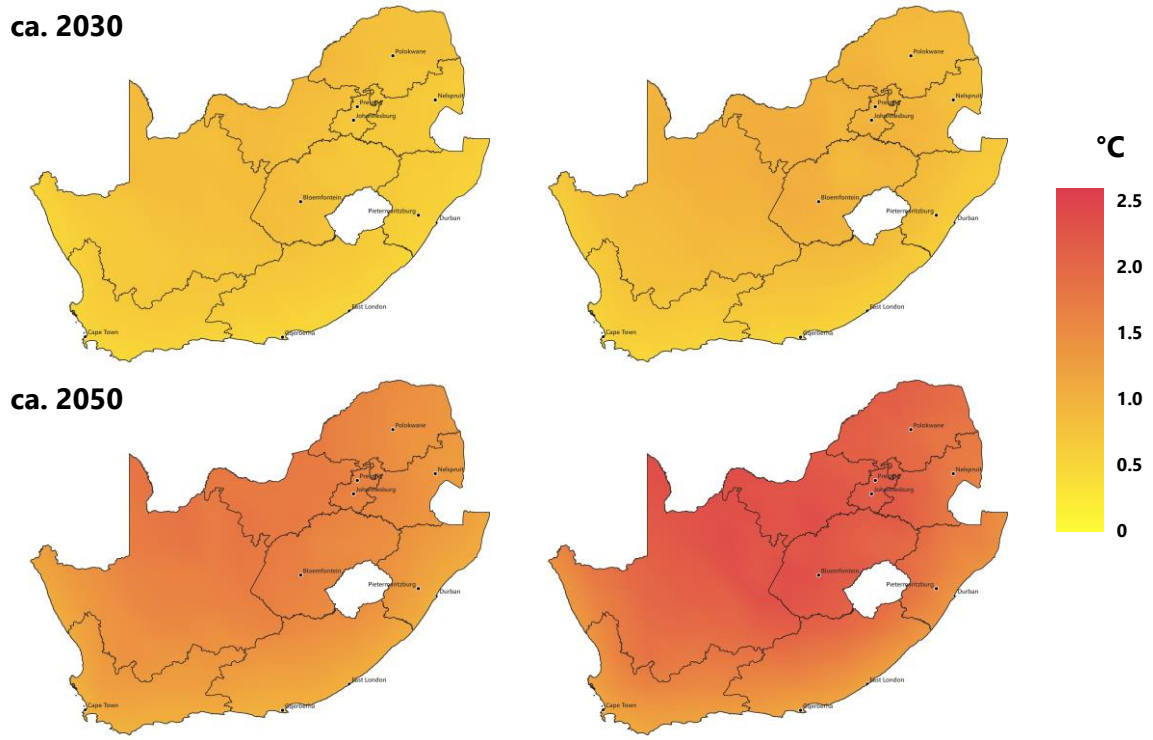

Figure 4: Projected mean annual temperature anomaly for 2020–2039 (ca. 2030) and 2040–2059 (ca. 2050) under SSP 2-4.5 (left) and SSP 5-8.5 (right). Data source: CMIP6.[29]

Despite the current situation, it remains possible for the global community to limit global warming to below 2°C. To achieve this, we must determine the amount of additional greenhouse gas (GHG) emissions that can be safely released by the global community. This is essential to prevent changes to the natural system that could render it unable to support socio-economic activities as we know them.

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27 Republic of South Africa. 2021. First Nationally Determined Contribution under the Paris Agreement (Updated September 2021). Republic of South Africa, Pretoria.

28 Hofste, R.W. *et al.* 2019. Aqueduct 3.0: Updated Decision-Relevant Global Water Risk Indicators. World Resources Institute. Available at: https://www.wri.org/applications/aqueduct/water-risk-atlas.

29 Eyring, V., Bony, S., Meehl, G. A., Senior, C. A., Stevens, B., Stouffer, R. J., & Taylor, K. E. 2016. Overview of the Coupled Model Intercomparison Project Phase 6 (CMIP6) experimental design and organization, *Geosci. Model Dev.*, 9, 1937-1958, DOI: https://doi.org/10.5194/gmd-9-1937-2016.

3.2 Receiving environment

The local receiving environment is detailed in the Introduction and Context (Section 1). It includes mixed land use including natural and near-natural ecosystems in various states of condition and with different conservation importance, protection status and levels of degradation.

4 Approach and Methodology

The impacts of climate change are likely to result in increased climate-related vulnerabilities for the Cato Ridge Project. Climate change management should, therefore, not be limited to emission reductions (mitigation) but should also take into consideration measures for increasing the resilience of the Project (adaptation) in the face of climate change. Identifying impacts of climate change on the project will be considered in this assessment.

4.1.1 International Best Practice

Due to the current lack of local guidance and regulations regarding CCRVAs in South Africa, specifically with regards to unpacking and quantifying vulnerability to climate change, international best practice is used in this assessment. In this regard, this report makes use of globally accepted international best practices, including:

- National Climate Risk & Vulnerability (CRV) Assessment Framework;[30]
- World Bank Group: Integrating Resilience Attributes into Operations – Guidance Note for Project Task Teams;[31]
- International Finance Corporation (IFC) performance standards;[32]
- European Bank for Reconstruction and Development (EBRD) principles;[33]
- The Equator Principles;[34] and
- International Council on Mining and Minerals (ICMM): Adapting to climate change[35]

The abovementioned documents were used to develop a rating system (indicated in section 4.1.4 of this report) to determine vulnerability, to which the current project is benchmarked. This enables us to adequately assess climate change impacts considering available baselines and relevant information.

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30 Department of Forestry, Fisheries and Environment, 2020. National Climate Risk and Vulnerability Assessment Framework summary document, Pretoria: South Africa.

31 World Bank Group: Integrating Resilience Attributes into Operations - Guidance Note for Project Task Teams.

32 International Finance Corporation, 2012, *Performance Standards*, [Online] Available at: https://www.ifc.org/wps/wcm/connect/Topics_Ext_Content/IFC_External_Corporate_Site/Sustainability-At-IFC/Policies-Standards/Performance-Standards [Accessed on 30/08/2020].

33 Operating Principles for Impact Management EBRD Disclosure Statement April 2021.

34 The Equator Principles Association, 2020, *Equator Principles EP4*, [Online] Available at: https://equator-principles.com/about/ [Accessed on 30/08/2020]

4.1.2 Key Areas of Impact

The resilience and vulnerability assessment conducted for this CCRVA considers four key areas (listed in Table 3 below) related to the Cato Ridge Project that could impact the project's vulnerability to climate change impacts.

Table 3: Key areas of impact relevant for the Cato Ridge Land Development and Release Project

Area of Impact	Relevance
The core operations	These are operations that are performed by the project and that its management has complete control over.
The project value chain (both upstream and downstream);	The value chain relates to the fuel supply, goods and services the project requires to operate. These are operations that are related to the project but falls outside of the control of the project. These include activities of suppliers, customers, government, and the greater economic market.
The social environment (surrounding/impacted communities)	This includes the people that are both directly and indirectly affected by the project, such as employees, surrounding industry and local communities. The social context of this assessment refers to the communities/settlements (both urban and rural) that would be impacted, both directly and indirectly, by climate change. The impacts should be integrated into a more detailed socio-economic assessment
Broader environmental risks	This relates to the risks to the natural environment directly surrounding the operations of the project. The natural environment relates to natural capital in ecosystems that deliver valuable services to people, such as water supply, climate regulation, soil formation and disaster risk reduction.

For widescale considerations of the impacts of climate change, all four of the abovementioned aspects could be impacted by climate change, as well as from the development of the Cato Ridge Project.

4.1.3 Data used

This vulnerability assessment refers to various data sources in the process of determining the critical vulnerability factors faced by the project. Data sources are limited to those that are publicly available, and where possible, using the most up-to-date data from reputable international or local data repositories. These include, but are not limited to, the World Bank Climate Change Knowledge Portal (CCKP) and the Copernicus Climate Data Store (CCDS). The relevant data sources are referenced where applicable. Where processing was relevant, the data were processed in either Google Earth Engine, R (v4.2.0) and/or using GIS software (Esri ArcGIS Pro or QGIS).

These tools and data were used in conjunction with information received from the client and considering the specialist's background and understanding of climate-related impacts posed on the Cato Ridge Project.

4.1.4 Determining project vulnerability and resilience

The overall vulnerability of the Cato Ridge Project, and its surrounds to climate change impacts, can be determined by identifying the exposure, vulnerability, and adaptive capacity of the region in which the Project lies. The IPCC AR6 (2021)[36] defines vulnerability as: "*the propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt*"[37]. This definition aligns with the method for determining the Project's climate-related vulnerability, proposed in Figure 5, which itself closely resembles the IPCC's 2007 report.

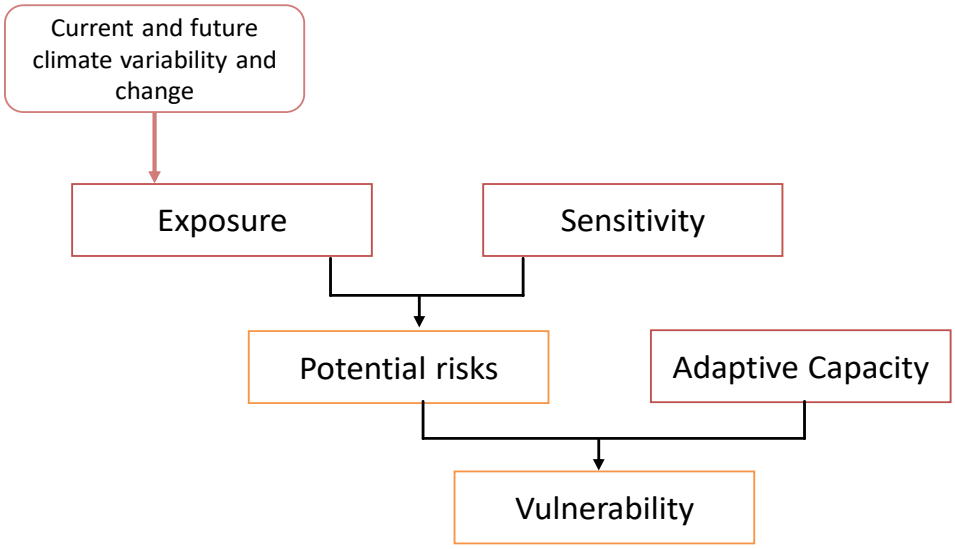

Figure 5: Interrelations of Exposure, Sensitivity and Adaptive Capacity, which makes up the basis of the vulnerability assessment.

Vulnerability to climate change is a challenging metric to derive due to the complexity and uncertainty inherent to climate change impacts and extreme events associated with climate change. A number of vulnerability assessment frameworks have been developed, many of which are built for purpose. The IPCC's concept of vulnerability and the factors determining vulnerability themselves have undergone a paradigm shift since the well-known concept of vulnerability developed in 2007.[38] Most climate change vulnerability assessment frameworks are qualitative in nature, including South Africa's *National Climate Risk & Vulnerability Assessment Framework*. This makes their application challenging in the context of impact assessments.

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36 IPCC, 2021: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Masson-Delmotte, V., P., *et al.* (eds.)]. Cambridge University Press. In Press.

37 IPCC, 2021, *Data Distribution Centre Glossary: Vulnerability*, IPCC [Website] Available at: https://www.ipcc-data.org/guidelines/pages/glossary/glossary_uv.html [Accessed on 16/03/2022].

38 Sharma, J. & Ravindranath, N.H. 2019. Applying IPCC 2014 framework for hazard-specific vulnerability assessment under climate change. *Environ. Res. Commun.* 1: 051004.

Here, we have used and adapted the *South African National Standard: Risk management – Risk assessment techniques SANS 31010:2010 / IEC/ISO 31010:2009* Probability-Consequences (Impacts) matrix. This matrix is relatively simple and introduces a scoring element similar to the impact significance scoring of a project as per South Africa's EIA Regulations included as part of the NEMA 2014 Regulations (as amended in 2017).

The matrix provides a score for each climate impact based on its likelihood/probability of happening and the consequences/impact on the proposed project/development (Figure 6). These are both determined through expert opinion and informed by the experience and knowledge of previous events of relevance to the project or region. The climate event's extent, magnitude/severity and duration are taken into consideration in determining the consequence/impact. The assessment would normally be made for a time in the future that is suitable for the project's expected lifetime. However, because this deepening is set to be in place in perpetuity, a timeline to limit the temporal extent of the potential impacts is up to the year 2050.

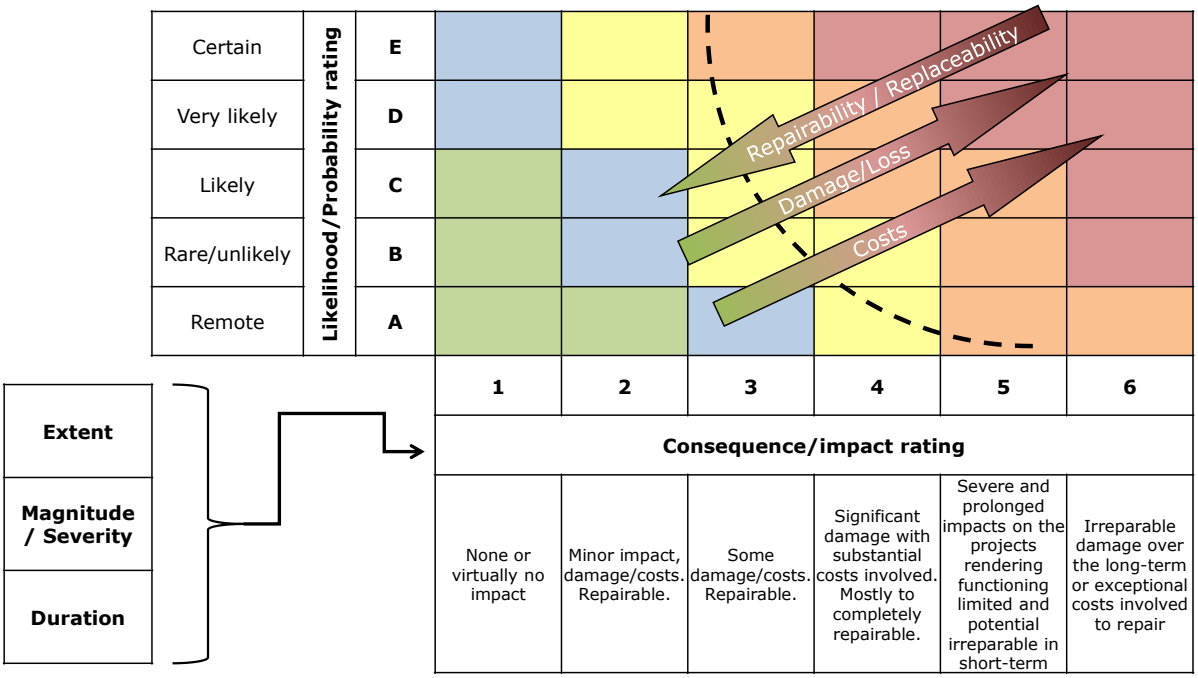

Figure 6: Risk assessment matrix used for determining climate change impacts on a project/development

4.1.5 Limitations and Assumptions

The project's vulnerability and resilience to climate change is assessed within this CCRVA through an analysis of available[39] datasets. It should be noted that climate data was extracted and

[39] This includes both spatial and temporal availability.

analysed at the finest scale possible. Modelling climate variables is challenging and thus most datasets for future climate are at a coarser resolution than observed or reanalysed climate data. Whilst every effort was made to use data from the relevant location, some data may represent an aggregation of a larger area. This introduces a level of uncertainty and higher variance than projections at regional or continental scales, however, the overall trend remains similar, and the interpretation is likely to remain the same. Where necessary, non-statistical adjustments have been made based on the historical trend.

Furthermore, while confidence is growing in global climate models, there is a much greater appreciation of uncertainties involved in downscaling global models to illustrate climate projections at a local scale[40]. This is particularly relevant for precipitation-related projections in southern Africa. This uncertainty should be noted by the project developers since the impacts of climate change may result in decreased investment value over time and possible increases in costs of maintenance.

[40] Bourne, A, P. deAbreu, C. Donatti, S. Scorgie, and S. Holness. 2015. A Climate Change Vulnerability Assessment for the Namakwa District, South Africa: The 2015 revision. Conservation South Africa, Cape Town.

5 Status Quo and Projected Climatic Changes

Understanding potential future climate change impacts and risks on the project relies on analysis of both near-historical and future projected/modelled climate data. Appropriate data sources were used for historical and near-future (ca. 1980-2021). Climate projections are primarily drawn out of datasets that form part of the Coupled Model Intercomparison Project Phase 6 (CMIP6).[41] We acknowledge the World Climate Research Programme (WCRP), which, through its Working Group on Coupled Modelling, coordinated and promoted CMIP6.[42] It should be noted that, like with any modelled data, there are inherent uncertainties in projections. Whilst the best available science is utilised, there is always a level of uncertainty involved with projections, with impacts further from the present naturally with a lower certainty than nearer impacts.

Future projections are based on Shared Socio-economic Pathways (SSPs, see Key Terms and Definitions above). In this assessment, SP1-2.6 (SSP1), SSP2-4.5 (SSP2) and SSP 5-8.5 (SSP5) are presented. SSP2 is seen as one of the most likely future scenarios given that it is premised on modest mitigation measures and meeting Nationally Determined Contributions (NDCs).[43] SSP1 aligns to a 1.5 °C world assuming low challenges to mitigation and adaptation, and SSP5 represents a pessimistic (and increasingly unlikely) scenario based on minimal mitigation and adaptation. These scenarios assist in understanding a range of futures and risks that could occur, and accounts for the inherent uncertainty of modelled future climate.

The main weather-related risks relevant to Cato Ridge Project are those that affect operations and accessibility. The proposed site is in a region with relatively high temperatures and experiences high annual rainfall. Uncomfortable heat levels impact labour productivity and have a direct bearing on the health and safety of personnel. Workers such as truck drivers and machinery operators could be impacted by direct exposure to increased temperatures, possibly resulting in heat stress. Heat stress and discomfort felt could lead to unforeseen incidents that could cause damage to equipment/or human injury. This could lead to high mortality rates, heat-related illnesses, increased injuries, more absenteeism, slow work pace, loss of productive capacity, and poor social well-being. Several weather indicators can be used to identify changes in uncomfortable days, one of which is the number of days (per annum) with dangerous heat, which is a heat index > 35°C. Trends in mean annual daily average and daily maximum temperatures are also useful for assessing general trends in conditions going forward.

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41 Eyring, V., Bony, S., Meehl, G. A., Senior, C. A., Stevens, B., Stouffer, R. J., and Taylor, K. E. 2016: Overview of the Coupled Model Intercomparison Project Phase 6 (CMIP6) experimental design and organization, *Geosci. Model Dev.*, 9, 1937-1958, DOI: https://doi.org/10.5194/gmd-9-1937-2016.

42 We thank the climate modelling groups for producing and making available their model output, the Earth System Grid Federation (ESGF) for archiving the data and providing access, and the multiple funding agencies who support CMIP6 and ESGF.

43 Hausfather, Z. & Peters, G.P. 2020. Emissions – the 'business as usual' story is misleading. *Nature* 577: 618–620.

Another key risk for the Cato Ridge Project is change in precipitation, particularly extreme rainfall events that may result in localised flooding. This can impact access to the site and operations in terms of logistics movement. Future water availability is also critical to water supply for logistics and manufacturing operations at the site and along the value chain. In this regard, current water stress and future drought projections provide useful indications for operational risks.

5.1 Current climate

The project area falls within the temperate, dry winter, warm summer climate zone [44] experiencing a sub-tropical climate: rainfall occurs year-round but primarily in spring and summer, which are warm, whilst winters are drier and cool (Figure 7). Mean annual temperature is around 17.8°C. Mean maximum temperatures rage from around 26°C in late summer (February) to 20°C in winter (June and July). Temperatures rarely exceed 35°C. During the recent historical period (since ca. 1980) there have been an average of 2 very hots days (> 35°C) per annum. Mean minimum temperatures range from 6°C in winter to 17°C in summer. Mean annual rainfall is 940 ±178 mm/year. However, rainfall is highly variable on an annual and decadal basis, with multi-year wet and dry cycles attributed to the effects of the El Niño Southern Oscillation phenomenon. Rainfall peaks in October with a mean of 87 mm whilst there is usually less than 20 mm per month recorded between May and July. Heavy rainfall days (> 20 mm) are common with an average of 6 days per annum since 1980 and 7 days since 2010. Evaporation is relatively low compared to other regions in South Africa. Mean wind speed is approximately 5.0 km/h and shows little seasonal variation but is generally slightly higher in spring and lowest in autumn. Mean wind speeds have not changed meaningfully over the last four decades. There is no dominant wind direction, particularly for light winds (2-5 km/h). Light breezes tend to predominantly emanate out of the north-west and south-east (Figure 8).

[44] Beck, H. E. *et al.* 2018. Present and future Köppen-Geiger climate classification maps at 1-km resolution. *Sci. Data* **5**:180214 doi: 10.1038/sdata.2018.214.

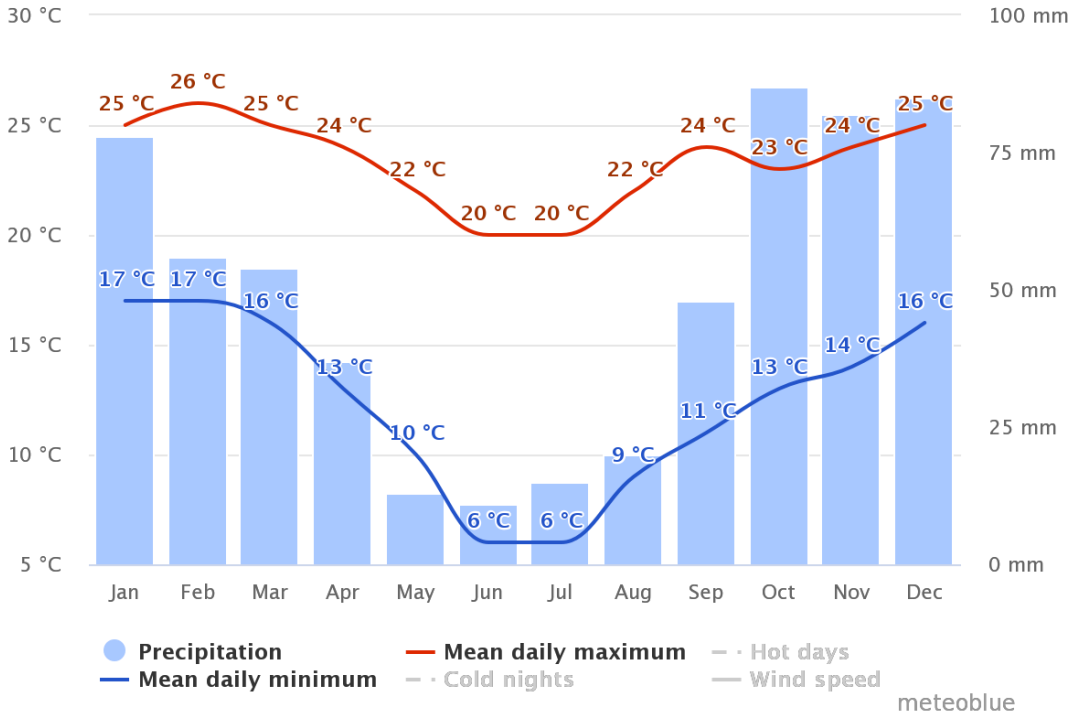

Figure 7: Annual temperature and precipitation profile for Cato Ridge. Source: Meteoblue.com

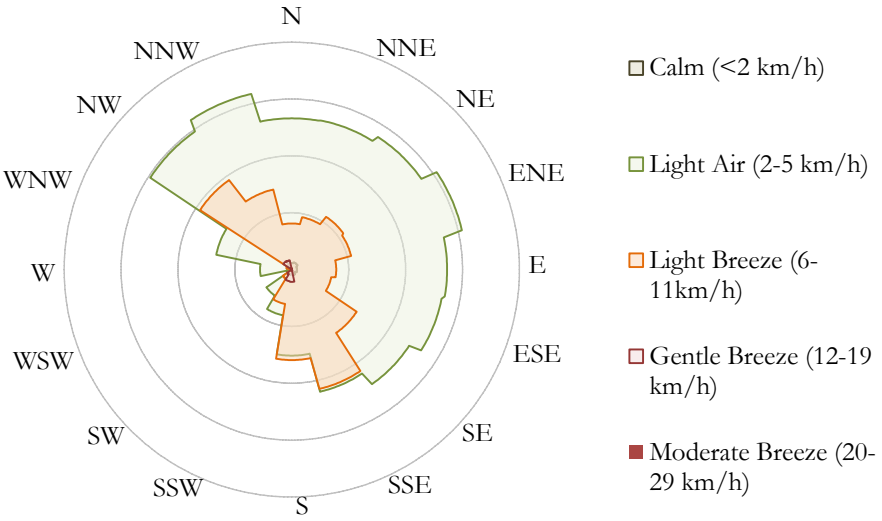

Figure 8: Wind rose based on mean monthly wind speed and direction since 1980 for the Cato Ridge area. Data source: Copernicus Climate Change Service (C3S).[45]

[45] Copernicus Climate Change Service (C3S). 2017. ERA5: Fifth generation of ECMWF atmospheric reanalyses of the global climate. Copernicus Climate Change Service Climate Data Store (CDS), 13 October 2022, https://cds.climate.copernicus.eu/cdsapp#!/home.

5.2 Climate trends and projected climate change

Human-induced global temperature increased by 1°C above pre-industrial levels in 2017. By the end of this century, the global mean temperature is likely to be 1.4-5.0°C warmer than pre-industrial levels. The Southern African region has increased by between 0.2-0.4°C per decade since 1980. It is likely to continue to warm be 1.5-5.5°C by 2100 relative to pre-industrial levels. The central interior of the region is likely to warm the most. Precipitation (although significantly more challenging to model) has also shifted, with a particular decline in the eastern parts of the subcontinent since the first half of the 20th century. The region is likely to continue to experience drier conditions under all future scenarios with the west coast of South Africa and Namibia likely to experience particularly dry conditions (up to 40% declines in annual precipitation).[46] These changes have had and will continue to have major implications for ecosystems and food production systems worldwide, as well as the living conditions of several populations.

5.2.1 Temperature

Mean annual temperature in the Cato Ridge area has increased by approximately 0.9°C since the early 1980s with a strong increasing trend. This is above the global average during the same period. Temperatures are predicted to continue to rise at a similar trajectory under all SSPs, with a slight increase above this trend under SSP5 closer to 2050. By 2050 temperatures could increase from the near-current (since ca. 2015) mean (±18.0°C) to ±18.4°C under SSP1 through to ±18.8°C under SSP5 (Figure 9). This represents at least a 1°C increase since the early 1980s.

[46] IPCC, 2021: Summary for Policymakers. In: Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the IPCC. doi:10.1017/9781009157896.001.

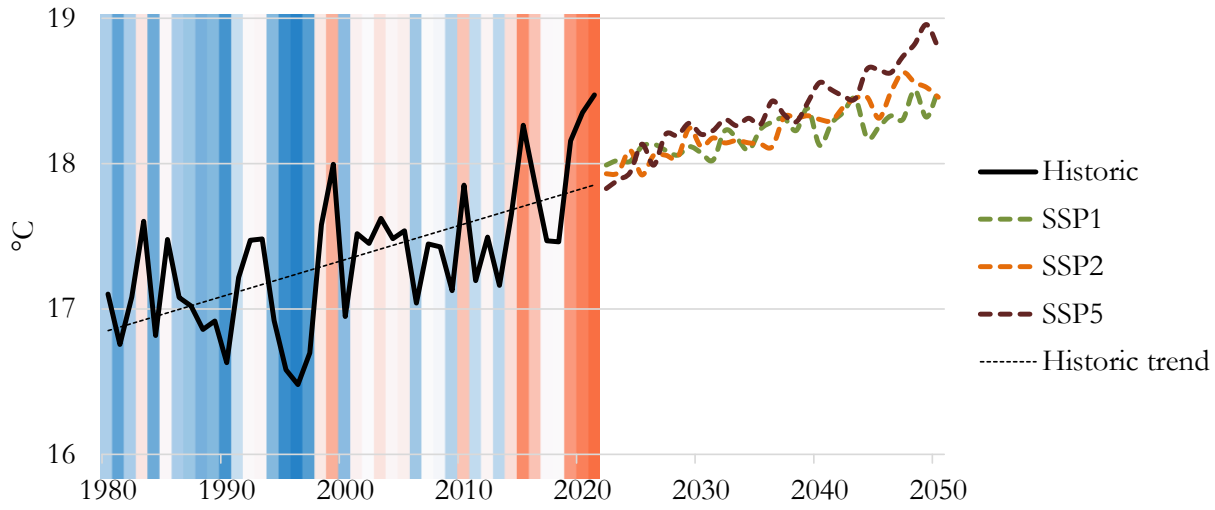

Figure 9: Near-historical and projected mean annual temperature and projected trends for the Cato Ridge area. Colour bars represent the mean temperature for the year relative to the mean for the time period shown. Data sources: Copernicus Climate Change Service (C3S)[45] and CMIP6.[41]

The near historical trend in very hot days shows a gradual increase over the last seven decades. There has been an average of 2.4 very hot days in the last decade. The climate models used show roughly 2.8 days per annum up to 2050, and thus no discernible increase in the short- to medium-term., i.e., a low risk. However, in the latter half of the century, the number of such days could significantly increase under SSP5, up to as much as 17 days per annum by the end of the century.

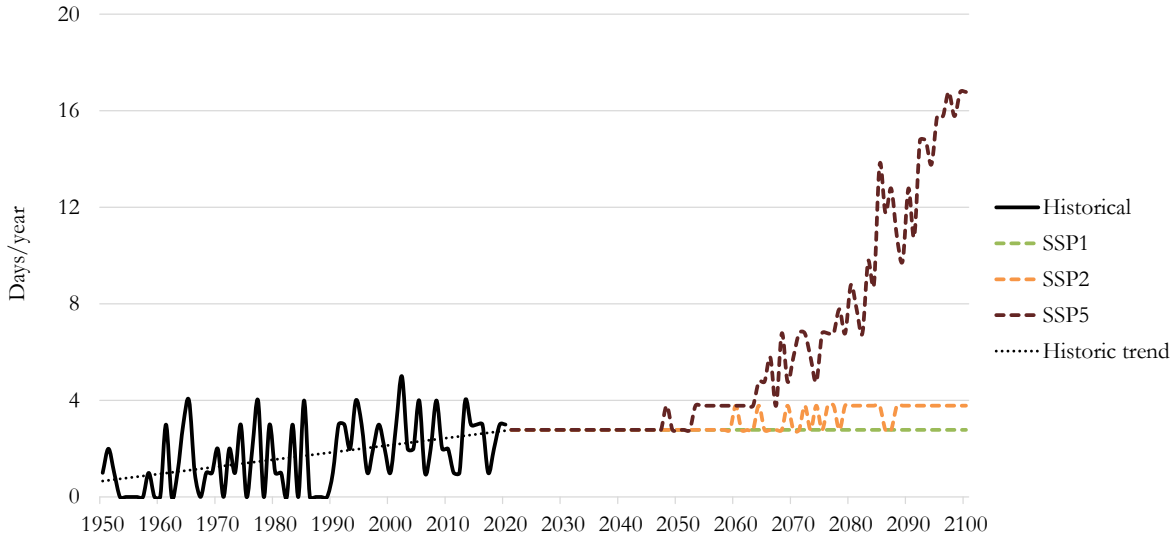

Figure 10: Number of very hot days per annum between 1950 and 2020 and the projected number of very hot days up to 2100 under three SSP trajectories for the Cato Ridge area. Data sources: C3S[45] and CMIP6.[41]

5.2.2 Precipitation

Mean annual precipitation around Cato Ridge shows a decreasing trend since 1980 with one particularly wet year in 1987. Precipitation trends are challenging to predict, however, the models used show that precipitation is likely to remain similar under SSP1 and SSP5 but decrease under SSP2 by ca. 2050. Projected precipitation shows limited significant change in trend with rainfall expected to decrease by 4-11% under the three SSP trajectories (Figure 11).

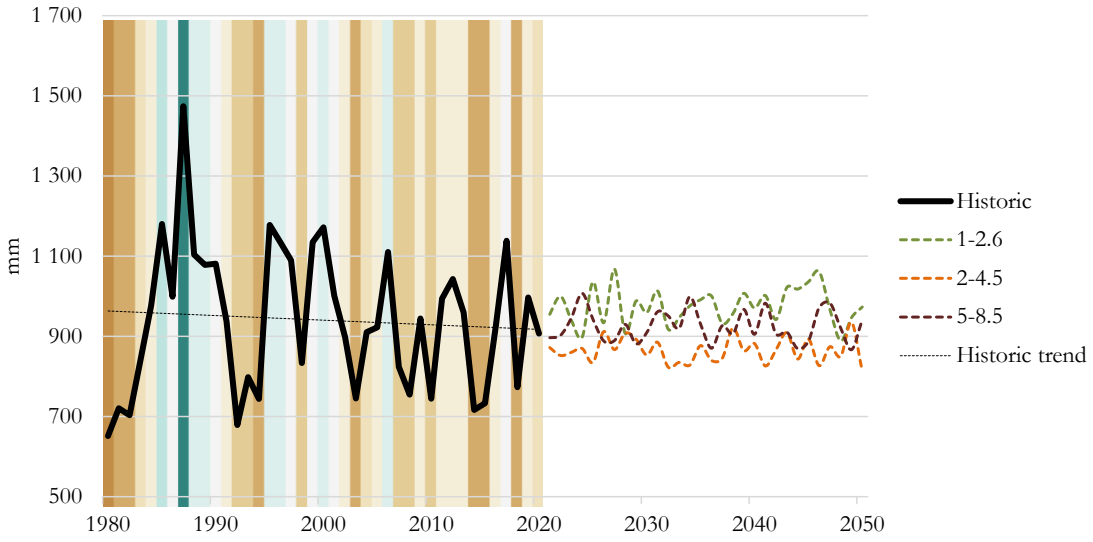

Figure 11: Near historical mean annual precipitation and projected trends in precipitation under three SSP trajectories for the Cato Ridge area. Colour bars represent the mean temperature for the year relative to the mean for the time period shown. Data source: C3S[45] and CMIP6.[41]

Because mean annual precipitation is so variable (Figure 11) and modelling precipitation is more challenging than temperature (due to several factors including topographic influence, isolated occurrence and non-linear interaction), it is useful to assess extreme rainfall events. Rainfall in excess of 20 mm/day is used as an indicator for heavy rainfall days.

5.2.3 Water stress and drought

South Africa is classified as a water-stressed country.[47] The mean annual precipitation of 450 mm is well below the global mean. As of 2018, South Africa withdrew almost 64% of its available renewable freshwater resources. Such a high percentage increases the competition among users, resulting in greater exposure to water stress. Given that climate projections indicate increased variability in rainfall over the subregion, the high levels of water stress are likely to increase in most catchment areas.

According to the World Resources Institute (WRI) *Aqueduct* tool, the Cato Ridge area falls within a water basin with a medium-high drought risk use (Figure 12). Water stress in the catchment area is expected to increase from medium-high to high under SSP2-4.5 up to 2040. Seasonal water variability[48] is also expected to increase from low-medium to medium-high. These metrics are challenging to model beyond a 20-year period and may well change significantly after 2050.

[47] Water stress is defined as the ratio of total water withdrawals to available renewable surface and groundwater supplies.

[48] Average within-year variability of available water supply, including both renewable surface and groundwater supplies. Higher values indicate wider variations of available supply within a year.

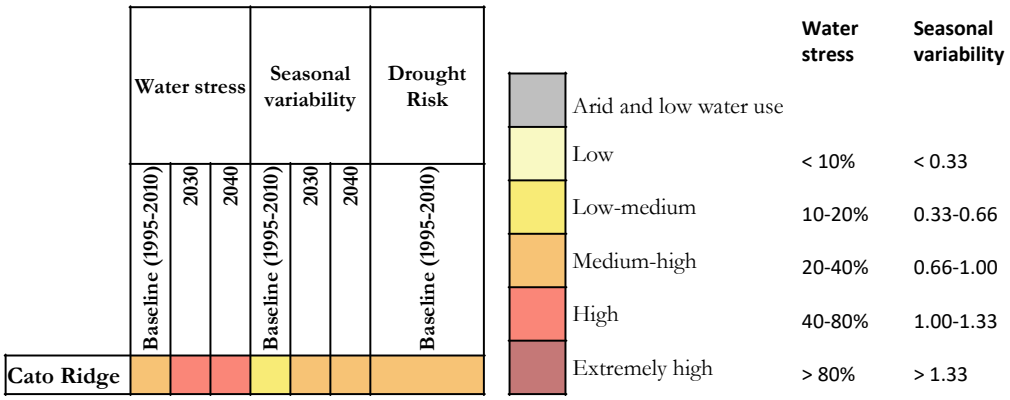

Figure 12: Water stress and seasonal variability classification for the Cato Ridge area currently (baseline) and for 2030 and 2040 under SSP2-4.5. Data source: WRI Aqueduct.[49]

Consecutive dry days[50] has shown a declining trend since the middle of the 20th century (Figure 13). There has been a mean of 20.3 consecutive dry days per annum since 1980. The number of such days is expected to average around 13.7 days per annum through to 2050, indicating a decrease in such periods going forward (Figure 13).

[49] Hofste, R.W. *et al.* 2019. Aqueduct 3.0: Updated Decision-Relevant Global Water Risk Indicators. World Resources Institute. Available at: https://www.wri.org/applications/aqueduct/water-risk-atlas.

[50] Number of days in the longest period without significant precipitation of at least 1mm.

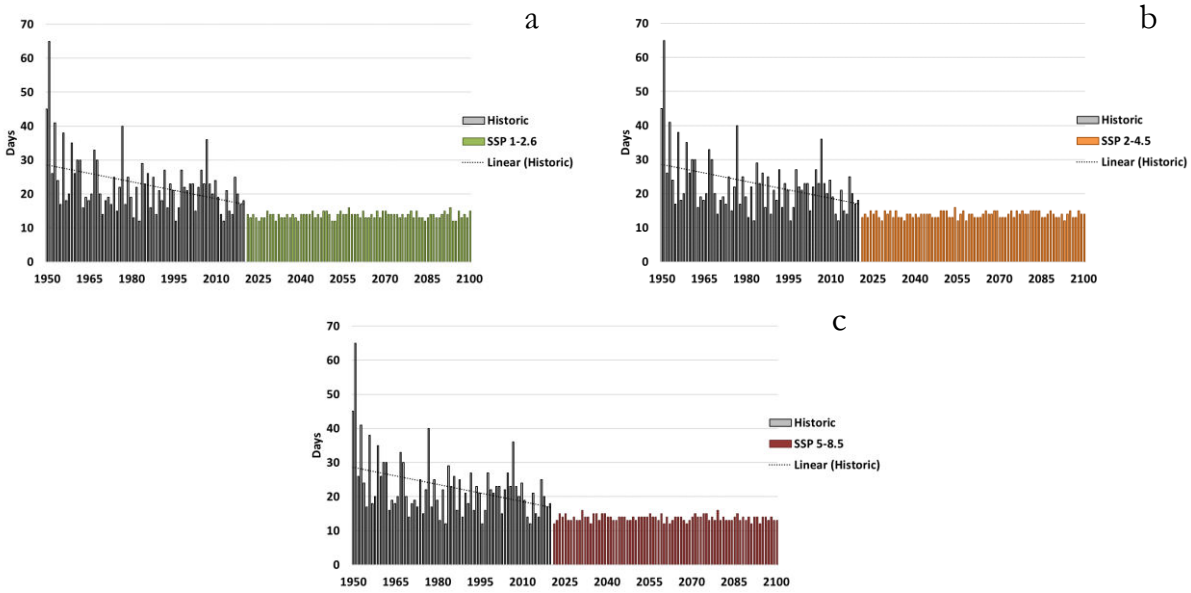

Figure 13: Historical and projected consecutive dry days at the MMC site under SSP1 (a), SSP2 (b) and SSP5 (c). Data sources: C3S[45] and CMIP6.[41]

Periods of drought place pressure on all commercial and industrial operations due to restrictions on water availability required in operations. To a degree, this has less of an impact on the proposed land use in the Cato Ridge Project, than for example, mining and construction. However, any operations requiring a consistent water supply could be impacted by longer dry spells and resulting water restrictions. Restrictions are likely to be compounded by increased water demands from higher urbanisation and settlement growth in and around eThekwini in decades to come.

Drought probability was assessed through the use of the Standardized Precipitation Evaporation Index (SPEI) with a 2-month window over the full period up to 2100. SPEI uses temperature and evaporation to evaluate the impacts on water demand. Following calculation, the SPEI results in values indicating the probability of experiencing severe medium-term drought with values of between -0.5 and -1 indicating mild drought, -1 to -1.5 being mild drought and values between -1 and -2 classified as severe drought.

Figure 14 indicates that the area has experienced a number of moderate and severe droughts in the last 30 years, most notably in 1992, 1993 and 2016. Models show limited impact from droughts in the future under all SSPs. However, this contradicts other modelled data indicating a potential increase in drought risk compared to the present.[12]

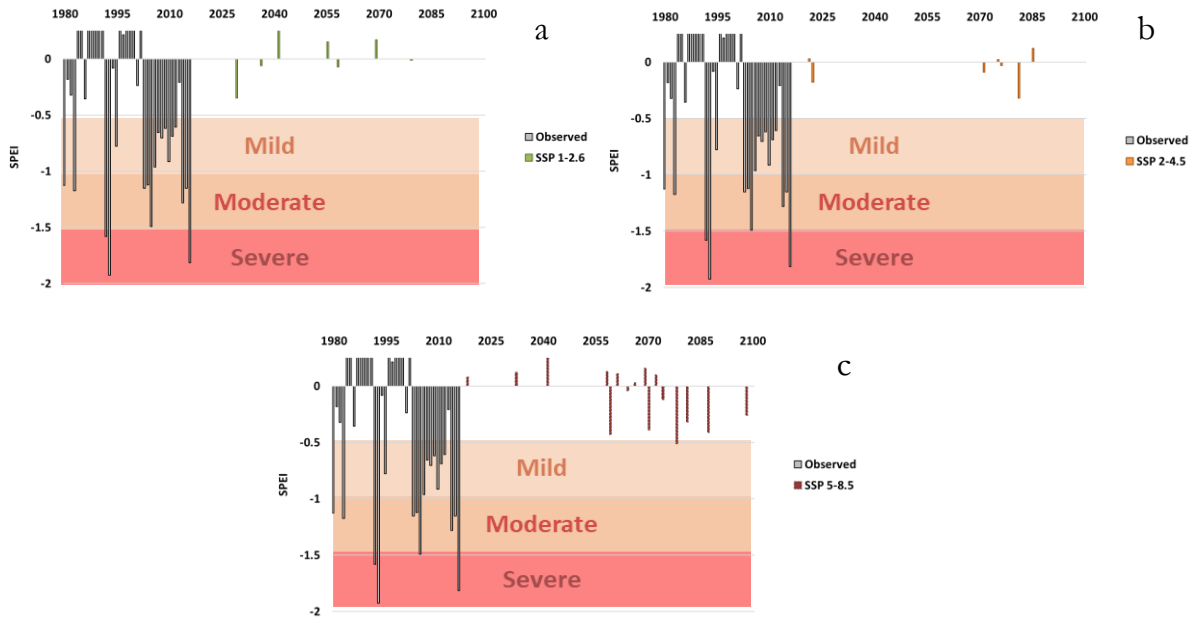

Figure 14: Near-historical and modelled future annual probability of experiencing severe medium-term drought for the Cato Ridge Land Development and Release Project. The threshold or severe drought is -2. Data sources: C3S[45] and CMIP6.[41]

5.2.4 Storms and storm-related weather impacts

The Cato Ridge area has experienced an average of 6-7 heavy rainfall days per annum since 1980, with 1995 having the highest number of such days with 13 days. Although total precipitation is unlikely to change significantly (Figure 11), models show that heavy rainfall days are likely to remain around 9-10 days per annum on average, indicating an increase from the historical trend. This appears to be the same under all three SSPs.

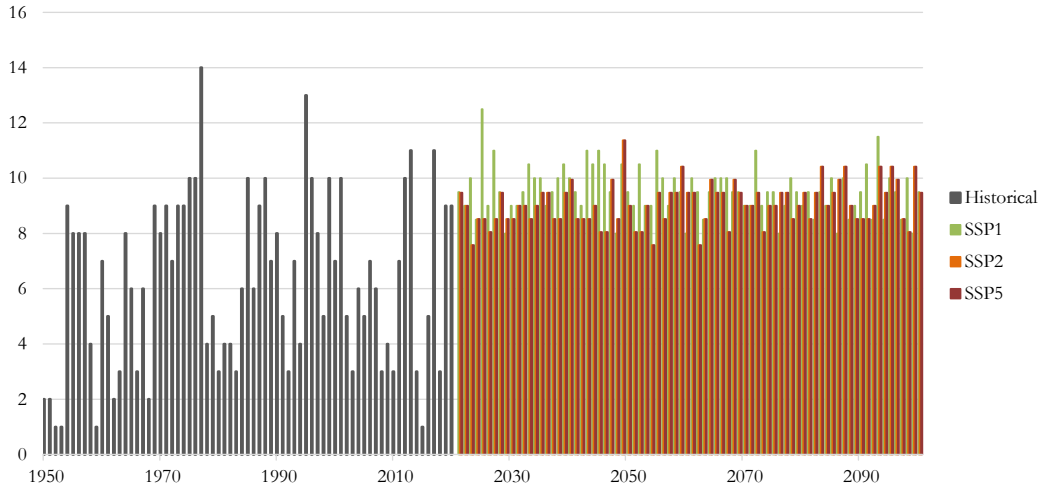

Figure 15: Near-historical and projected number of heavy rainfall days per annum for the Cato Ridge area. Data Source: C3S[45] and CMIP6.[41]

Cato Ridge is located in an area prone to both severe storms inland and, being situated only 40 km from the nearest coastline, is within the impact area of coastal storm systems such as cut-off lows [51] and subtropical depressions which can bring widespread rain lasting several days. Thunderstorm events are often accompanied by lightning and hail, which can and have caused severe damage in the province. In recent years, the province has experienced severe flooding and landslides due to storm events, which have resulted in loss of life and property.

Owing to its latitude, KwaZulu-Natal is impacted by tropical storms over the south-western Indian Ocean. However, it has been impacted less than Mozambique and Madagascar over which many spring and summer tropical storms pass directly over (the latter of which buffers the southern Africa mainland from many of these storms). That said, many tropical storms are occurring further west and south over the Indian Ocean and Mozambique Channel. There is evidence to suggest that these tropical storms are becoming more frequent within the vicinity or impacting South Africa's coastline despite rarely making landfall (Figure 17).[52]

Using tropical cyclone data from the International Best Track Archive for Climate Stewardship (IBTrACS) version 4.0 dataset,[53] we extracted all the available (since 1848) cyclone and storm tracks for the area covered by a bounding box including all of South Africa, Mozambique and

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51 Anti-cyclonic depression that results when air in the mid-atmosphere moving in an easterly direction is disturbed and through the development of a trough. This trough generally intensifies to form a low pressure system that 'cuts off' from the westerly often resulting in heavy rainfall for several days. They are most common in spring and autumn.

52 Fitchett J. 2018. Recent emergence of CAT5 tropical cyclones in the South Indian Ocean. *South African Journal of Science* 114(11/12), doi.org/10.17159/sajs.2018/4426.

53 Knapp, K. R., Kruk, M.C., Levinson, D.H., Diamond, H.J. and Neumann, C.J. 2010. The International Best Track Archive for Climate Stewardship (IBTrACS): Unifying tropical cyclone best track data. Bulletin of the American Meteorological Society 91: 363-376. doi:10.1175/2009BAMS2755.1.

Madagascar (Figure 16). For each storm, the minimum latitude and minimum longitude (i.e., the furthest south-west, hence closest to the southern African coastline) midpoint for each storm track was plotted against time with a particular focus on storms per decade. The 2000s was and remains the decade with the highest number of tropical storms since records began, followed by the 2010s.

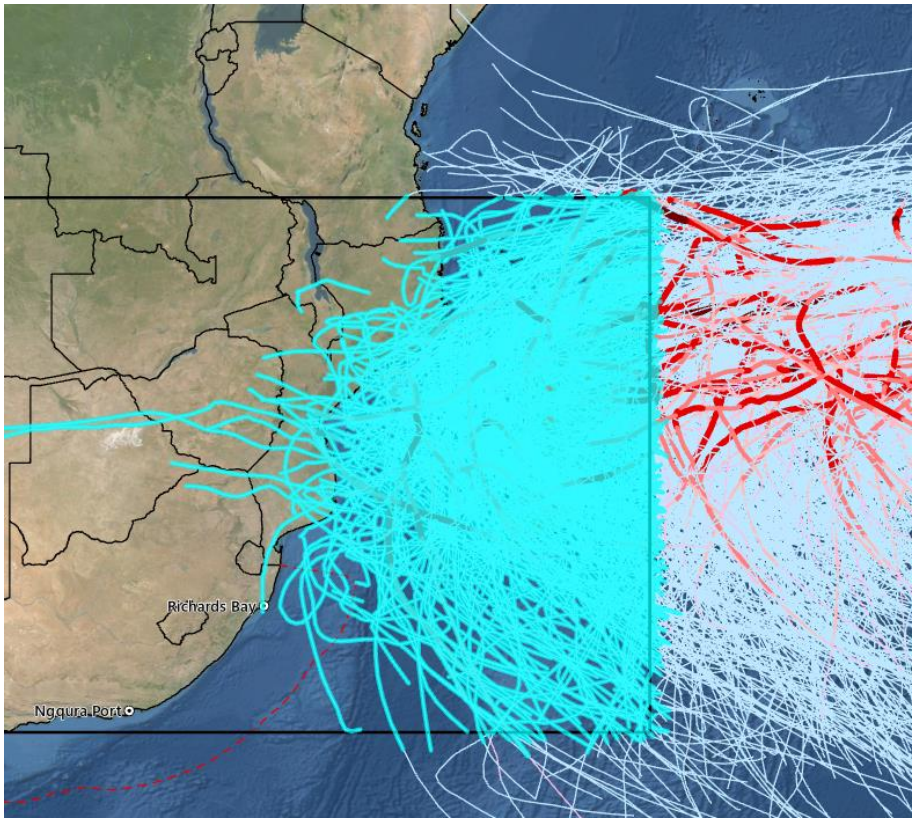

Figure 16: Selected storm and cyclone tracks from the IBTrACS dataset for analysis.

The maximum longitude of the midpoints of all recorded tropical storm track segments were plotted against time. There is a clear trend over the last 180 years of storms moving further west, closer to the east coast of southern Africa (Figure 17). It is also clear that tropical storms have become more frequent within South Africa's Exclusive Economic Zone (EEZ)[54] with the first ca. 1940 and moving beyond the latitude of Durban with three major storms since 2002.

[54] An area of the ocean, generally extending 200 nautical miles (370 km) beyond a nation's territorial coastline, within which a sovereign state has jurisdiction over both living and non-living resources.

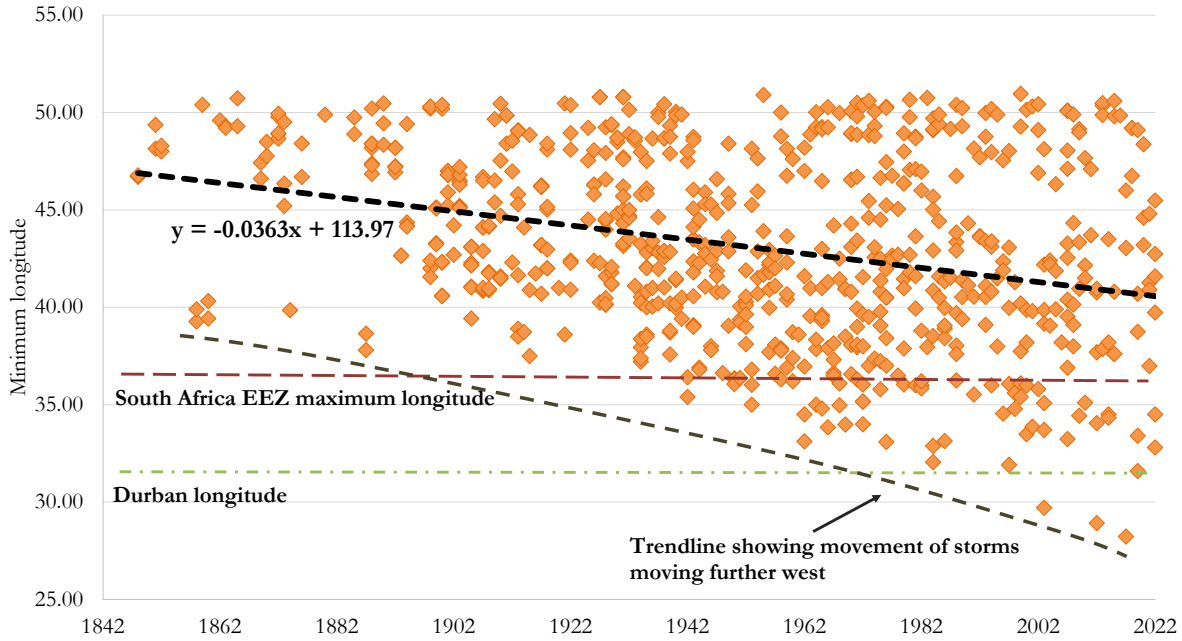

Figure 17: Plot of all recorded tropical storms in the IBTrACS record over time against the minimum longitude each storm reached.

High intensity tropical storms have become more frequent in the South Indian Ocean since the first record of a category 5 storm in 1994.[52] Category 4 and 5 cyclone tracks are plotted per decade in Figure 18. It is difficult to pick out a trend and there is no clear pattern, it is clear that cyclones moving over the subcontinent into the interior of the region are all since 2000. It is also important to bear in mind that these tracks represent the centre of these systems which are themselves much larger and result in weather conditions over large areas well away from the storm centres.

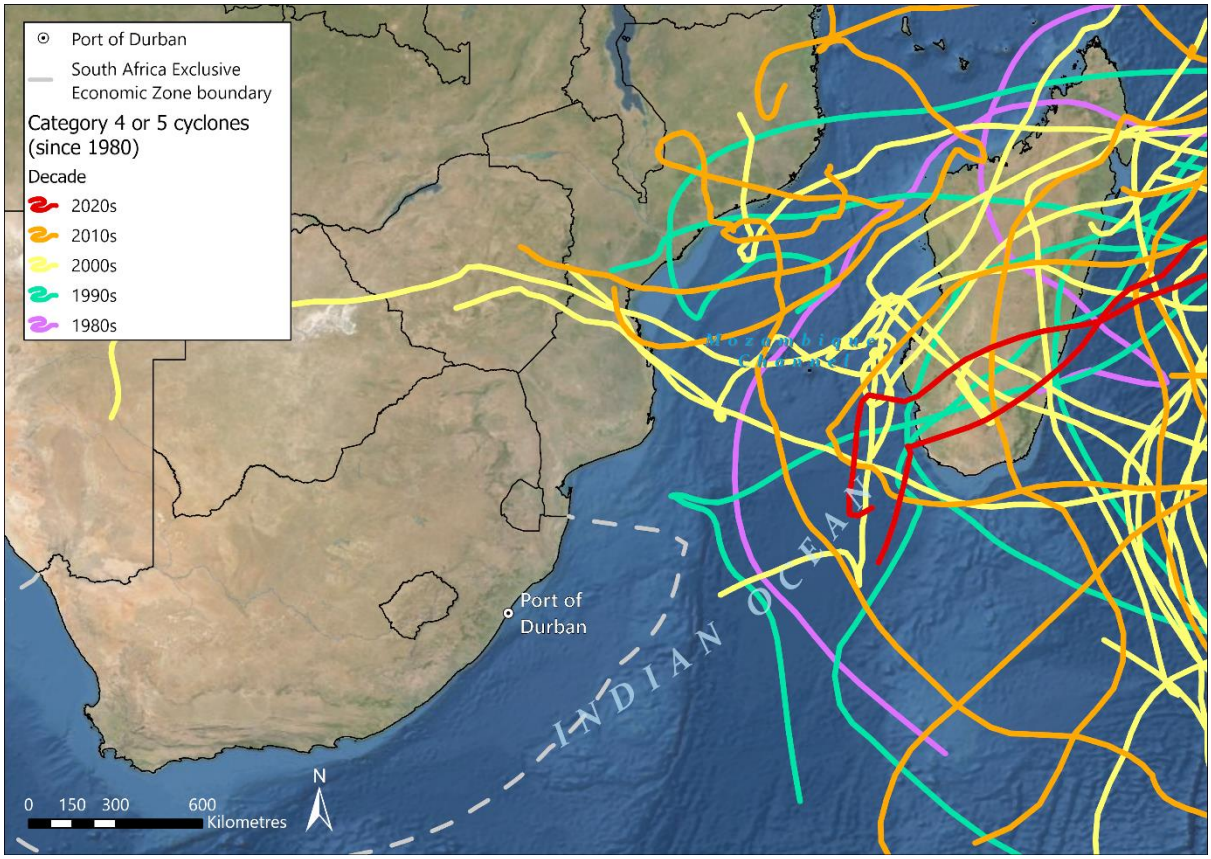

Figure 18: Category 4 and 5 cyclones tracks in the south-western Indian Ocean per decade. Excludes storms since December 2022.

Poor planning, a lack of suitable adaptation plans, and inadequate oversight of coastal and riparian zones have contributed to the damage and loss of life during previous storms. However, there is mounting evidence that climate change has also played a role in the increasing frequency and severity of these events.[55] According to a recent study, climate change may have exacerbated the 2022 storm and floods, potentially increasing the storm's intensity by 4-8%. These events are expected to become more frequent and intense as the global mean temperature continues to rise and alter global circulation patterns.[56]

Whilst there have been an insufficient number of high intensity cyclones to determine a statistically significant trend going forward, there is published evidence indicating that there has been a southward shift in high intensity storms[57, 52] and an analysis of storm track data suggests a

55 Engelbrecht, F. *et al.* 2022. Is climate change to blame for KwaZulu-Natal's flood damage? *Institute of Security Studies*. Accessed: 14 September 2022.

56 Pinto, I. *et al.* In press. Climate change exacerbated rainfall causing devastating flooding in Eastern South Africa. Available at: https://www.worldweatherattribution.org/wp-content/uploads/WWA-KZN-floods-scientific-report.pdf.

57 Fitchett J. 2018. Recent emergence of CAT5 tropical cyclones in the South Indian Ocean. *South African Journal of Science* 114(11/12), doi.org/10.17159/sajs.2018/4426.

slight trend of a westward shift of all tropical storms in region off the southern African east coast (Figure 17). Both of these trends indicate potentially greater frequency of tropical storms that could fall within South Africa's EEZ and indeed make landfall along the KwaZulu-Natal coastline. Sea surface temperature of at least 26.5°C is required for the formation of tropical cyclones.[57] The historical rise in sea surface temperature (and poleward shift in warmer water)[57] and projected increases going forward could further provide conditions for increased tropical storms in the future, that could well impact areas inland, leading to heavy strong winds and heavy rainfall over short time periods. Such storms could cause heavy rainfall and strong winds over short periods, leading to rivers breaching their banks and 1 in 100-year flood lines. The occurrence of these events depends on several interacting physical atmospheric and oceanic dynamics, resulting in significant uncertainty in their likelihood.

5.3 Summary

The current and future changes in climate for the Cato Ridge Project, are summarised in the table below.

Table 4: Current and future climate projections for the Cato Ridge Land Development and Release Project. [45,41,12,49]

		Projected change by 2040-2059 (median year 2050) relative to baseline		
Climate change impact	**Current/Near-historical**	**SSP 1**	**SSP 2**	**SSP 5**
Mean annual temperature	17.4 ±0.5°C; increasing trend	Increase of 0.3-0.5°C	Increase of 0.3-0.6°C	Increase of 0.6-1.0°C
Very Hot (uncomfortable) Days[58]	2 days/year (mean)	Increase of <1 day/year (mean)	Increase of <1 day/year (mean)	Increase of <1 day/year (mean)
Mean annual precipitation	940 ±178 mm/year; slight increasing trend	Mean increase of 47 mm/year	Mean decrease of 80 mm/year	Mean decrease of 20 mm/year
Extreme Rainfall Days[59]	Mean of 6 days per annum	Increase of 4 days per annum	Increase of 3 days per annum	Increase of 3 days per annum
Drought Risk	Medium-high	Not available		Medium risk of increase in drought conditions per decade compared to baseline

[58] A day when the maximum temperature exceeds 35°C.
[59] More than 20 mm of rain falling within 24 hrs over an area of 64 km².

		Projected change by 2040-2059 (median year 2050) relative to baseline		
Climate change impact	**Current/Near-historical**	**SSP 1**	**SSP 2**	**SSP 5**
Catchment water stress	Medium to high risk	Not available	Increase to high risk	Not available
Catchment seasonal water supply variability	Low-medium risk		Increase to medium-high risk	
Flood risk	Moderate	Not available		Slight increase in risk to high compared to baseline.
Damaging wind risk	Not available. There is limited information on projected changes in wind for non-terrestrial regions of South Africa. Wind velocity is expected to increase across all seasons in South Africa but to a very small degree (maximum 6% increase).[60]			

[60] Herbst, L. & Rautenbach, H. 2016. Climate change impacts on mean wind speeds in South Africa. *Clean Air Journal* 25: http://dx.doi.org/10.17159/2410-972X/2015/v25n2a2.

6 Project Vulnerability to Climate Change

Vulnerability is defined as the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes[61]. Project vulnerability to climate change is an approach to assessing the potential impacts of climate change on development projects and identifying strategies to increase their resilience to climate risks.

6.1 Core operations

6.1.1 Physical Risks

The Cato Ridge area is not predicted to experience any major climate impacts in the short- to medium-term. The ambient temperature is projected to continue to increase, whilst precipitation is largely projected to decline somewhat, despite a projected increase in heavy rainfall days. The main risks to the site, based on this assessment, are potential decreases in water security, through longer dry spells and higher drought likelihood. This necessitates augmentation and effective planning for adaptation. Furthermore, it has been seen in recent years, that extreme rainfall events are very much a part of the region's climate and are projected to increase, potentially in frequency and intensity. Evidence of tropical cyclones making landfall more frequently along KwaZulu-Natal's coastline in the future, could impact the site. There were significant impacts to similar developments (logistics hubs, storage units, warehouses) in predominantly low-lying or riparian areas during the floods of April 2022. Although this is somewhat mitigated by its location, the development should still recognise and plan for the potential flooding that may arise out of more frequent storm activity. Based on the location of the project area, erosion risks are low, and can be further reduced by revegetation and reducing disturbance of surrounding vegetated areas.

6.1.2 Labour and working conditions

Labour and working conditions are at the greatest risk from increased maximum temperatures and overall warming of ambient temperatures. Extremely warm days are not projected to increase significantly based on the data used, and is considered a low risk, however, the area is subject to rare hot days and warm spells, and precautionary measures should be put in place to mitigate the effects of such temperatures, both for people and for machinery needing to operate in such conditions.

[61] IPCC, 2022: Climate Change 2022: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. *et al.* (eds.)]. Cambridge University Press. In Press.

6.2 Value chain

6.2.1 Upstream value chain

The upstream value chain for the Cato Ridge Project will be impacted by climate change, as indicated for the main items used in the Project, in Table 5 below. The main challenges are likely to be due to impacts experience well beyond the geographical boundaries and even 'sphere of influence' of the site. Drier conditions forecast for much of the country may result in water supply challenges which are likely to place a burden on electricity suppliers. Eskom relies on sufficient water quantities in order to generate electricity at most power stations and this could be impacted by future water stress. In addition, diesel and gasoline used along the value chain both in heat and electricity generation and transport could be impacted if fuel supply chains such as shipping, and ports are disrupted by local- and regional-scale extreme weather events.

Table 5: Climate change impacts on the upstream value chain of the Cato Ridge Land Development and Release Project

Item	Aspects affected by the impacts of climate change
Electricity and Diesel	Climate change risks associated with the electricity (such as the disruption of electricity supply due to water scarcity) and diesel (such as extreme weather impacts on trade routes) supply chains are considered commercial risks which should already be taken into consideration by the project developer.
Transport and storage of all goods	It is anticipated that diesel will also be used onsite for machinery and generators. Similarly, all equipment and other such goods will be transported to the project site. These items will make use of the well-established road networks in and around the project area *Increased temperatures* Increasing ambient temperatures and extreme hot days increases exposure to heat and in turn, heat stress. Heat stress at work, as result of (climate-related) increasing temperatures, impacts workers health, safety, productivity, and social well-being. Therefore, the projects transport of goods and services workers may be exposed to heat stress and increased temperatures and will inevitably impact operations. In addition, storage areas for the various goods used by the project may experience increased temperatures and possible damage, thus causing delays in product deliveries to the project site. *Extreme weather events.* With increased rainfall variability, the Cato Ridge project may be exposed to erratic rainfall, periods of drought, but then also periods of intense rainfall. Increased flooding may also lead to pipeline damages, resulting in potential water supply constraints. This could lead to decreased road access to the project and cause delays in transport of goods into and out of the Project site.

6.2.2 Downstream value chain

The downstream value chain for the proposed Project will also be impacted by the effects of climate change, as indicated in Table 6 below.

Table 6: Climate change impacts on the downstream value chain of the Cato Ridge Land Development and Release Project

Item	Aspects affected by the impacts of climate change
Road access	*Extreme weather events.* With increased rainfall variability, the Cato Ridge Project may be exposed to erratic rainfall and periods of drought, but then, also periods of intense rainfall. This could lead to decreased road access (due to roads/bridges being washed away during flood or storm events) to the location and disrupt the distribution of supplies.
Sewerage treatment plants	*Extreme weather events* Consideration for extreme weather such as floods should be carefully considered. The impact of extreme weather events may lead to untreated sewer overflows, and increased flooding from WWTPs on the site.

6.3 Broader Social Context

Climate change is expected to have far-reaching social impacts, exacerbating resource scarcity and reducing quality of life, particularly for the most vulnerable communities. As seen in the devastating floods in KwaZulu-Natal in April 2022, sudden weather-related hazards can compound existing social challenges, disproportionately affecting those already facing poverty and limited access to resources. The economic strain resulting from these impacts, including population growth and increased poverty, is likely to make adapting to and coping with climate shocks and extreme events more challenging. Of particular concern is the projected increase in extreme rainfall days and drought incidence, which could further impact resource availability, settlement integrity, housing, labour productivity, and food production (both at a subsistence level and local commercial level). It has already been seen that local and provincial government are not able to adequately respond to these shocks. Deteriorating service delivery over several years has compounded poor climate change adaptation action in vulnerable communities and localities.

It is in these ways climate change acts as a climate risk multiplier, enhancing existing vulnerabilities and risks. If employment rates continue to decline in communities surrounding operations and dissatisfaction with basic service delivery and infrastructure increases, there is a risk of greater social unrest, particularly in communities surrounding development projects where dissatisfaction with basic services is already high. This frustration could be taken out on the users of the Cato Ridge Project.

6.4 Broader Environmental Context

Climate change is expected to have numerous impacts on the local environment. These will manifest in many ways and will vary in time and space, with some impacts occurring in the short term and the long term. At a macro level, the climate zone itself may shift. The site is located in

the Temperate, dry winter, warm summer climate zone, on the fringe of the Temperate, dry winter, hot summer zone. In the latter stages of the century, the area is predicted to be classified as a Temperate, dry winter, hot summer zone surrounded by Tropical, savannah and Temperate, no dry season, hot summer climate zones (Figure 19). Such changes are likely to include changes to the biotic components of these systems, with potentially significant changes in species composition and ecosystem structure.

These areas are already highly fragmented due to land conversation. This has created more fragmented patches of natural habitat which places strain on many species which may need to migrate or shift their distribution in order to remain within their climatic tolerance threshold. This is of particular relevance for some of the ecosystems surrounding the Cato Ridge Project, which are already considered Vulnerable or Endangered and at a greater risk of losing ecosystem integrity once they have reached an ecological functioning threshold.[62]

[62] See Driver, A. *et al.* 2015. Land and ecosystem accounting in KwaZulu-Natal, South Africa. Discussion document for Advancing SEEA Experimental Ecosystem Accounting Project, October 2015.

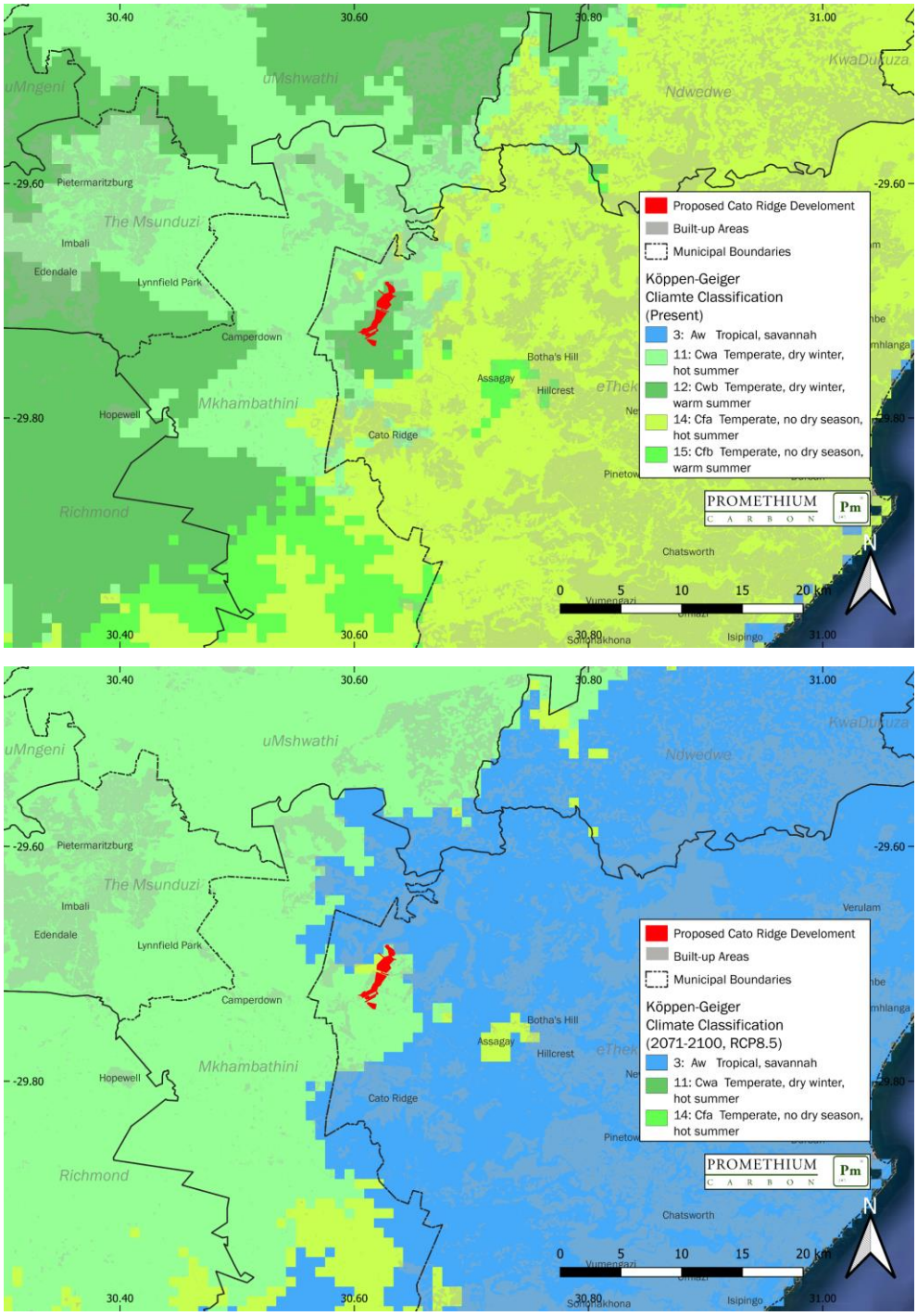

Figure 19: Figure 20: Köppen-Geiger Climate Classification for the present day (top) and for the projected future conditions (2071–2100) under climate change. Data Source: Beck *et al.* (2018).[44]

The natural and near-natural areas surrounding the Cato Ridge project and within the eThekwini region as a whole, are critical for providing climate resilience which is but one of several ecosystem services. Turpie *et al.* (2017) found that the annual value (in 2015 Rands) of open spaces and natural or near-natural areas in eThekwini totalled R4.17 billion overall.[15] However, it is arguably also necessary to clear these areas in order to develop facilities and industry that spurs much-needed economic growth and employment. The accompanying GHG Inventory detailed a high-level assessment of the ecosystem carbon stocks of the proposed development footprint. The report indicates that the total ecosystem carbon in this area could be as much as 57 650 t or

161 tC/ha. The clearing and degradation of natural systems releases carbon into the atmosphere which contribute to the global atmospheric stock of GHGs. This is likely to result in further alteration to ecosystem functioning and increased extreme weather and related impacts on human wellbeing, energy production and agriculture. Emissions from the construction phase of the Cato Ridge Project were estimated to be around 233 000 tCO_2e per annum.

The storage and sequestration of carbon in natural systems is a key ecosystem service. In eThekwini alone, the loss of natural ecosystems at the current rate could result in effective monetary losses around R34.3 million per annum,[15] and a non-monetary cost in increased vulnerability to and decreased resilience to climate change of the Municipality and region as a whole.

Being in a peri-urban setting, the natural systems around Cato Ridge provide additional benefits to residents, who are more directly reliant on natural ecosystems to meet their livelihood needs. These include provisioning services such as fuelwood, timber, food and medicinal plants and regulating services such as agricultural support through pollination. Climate change is likely to impact these, as well as aquatic related services such as water quality amelioration and sediment retention.

In terms of aquatic ecosystems perspective, the main risks to the Cato Project and indeed areas downstream, are related to water sources and their ability to supply high quantities of high quality water. Freshwater and groundwater resources are expected to come under increasing pressure under warmer and mostly drier conditions. These systems play a vital role in moderating floods and removing nutrients, toxins, sediments and pollutants. Ensuring these systems remain in a healthy condition is key to ensuring they continue to provide these regulating ecosystem services. Furthermore, restrictions on water use may become tighter, further emphasising the need to have employ a comprehensive water use plan.

The Cato Ridge Project should ensure that it manages runoff of water and soil, as well as sewage and pollutants, to ensure these are not released into natural systems, as far as they can within their control. Being situated in the upper reaches of some catchments, means that any uncontrolled outflow is likely to compromise water resources downstream, to the detriment of residents and industry. The potential for more frequent, potentially more severe extreme rainfall events enhances the risk of flooding within the site and poses a greater risk to unwanted materials flowing into watercourses.

6.5 Project Vulnerability Assessment

The vulnerability of the project to different physical risks associated with projected climate change was determined using the framework outlined in section 4.1.4. The assessment is shown in Figure 21. The assessment is based on a timeline up to 2050. The risks of a) rainfall changes and rainfall intensity; and b) tropical cyclones and storms, are both difficult to predict being stochastic in nature and both with inherent uncertainty in future projections for these. However, events to some degree are likely, hence their likelihood/probability rating of C. They can also vary significantly in their impact. We have been conservative and assumed a near worst-case scenario. Weather impacts from these climate events are very unlikely to result in irreparable damage but can be devastating as shown by the flood and storm damage from the April 2022

storm and resulting rainfall. Mitigating these will depend largely on the adaptive capacity of the project and its proponent. Both drought and water stress, and temperature rises are the most likely impacts based on the data assessed, but due to the nature of the development, carry lower impact ratings which can be significantly reduced through adaptation measures undertaken in the short-term.

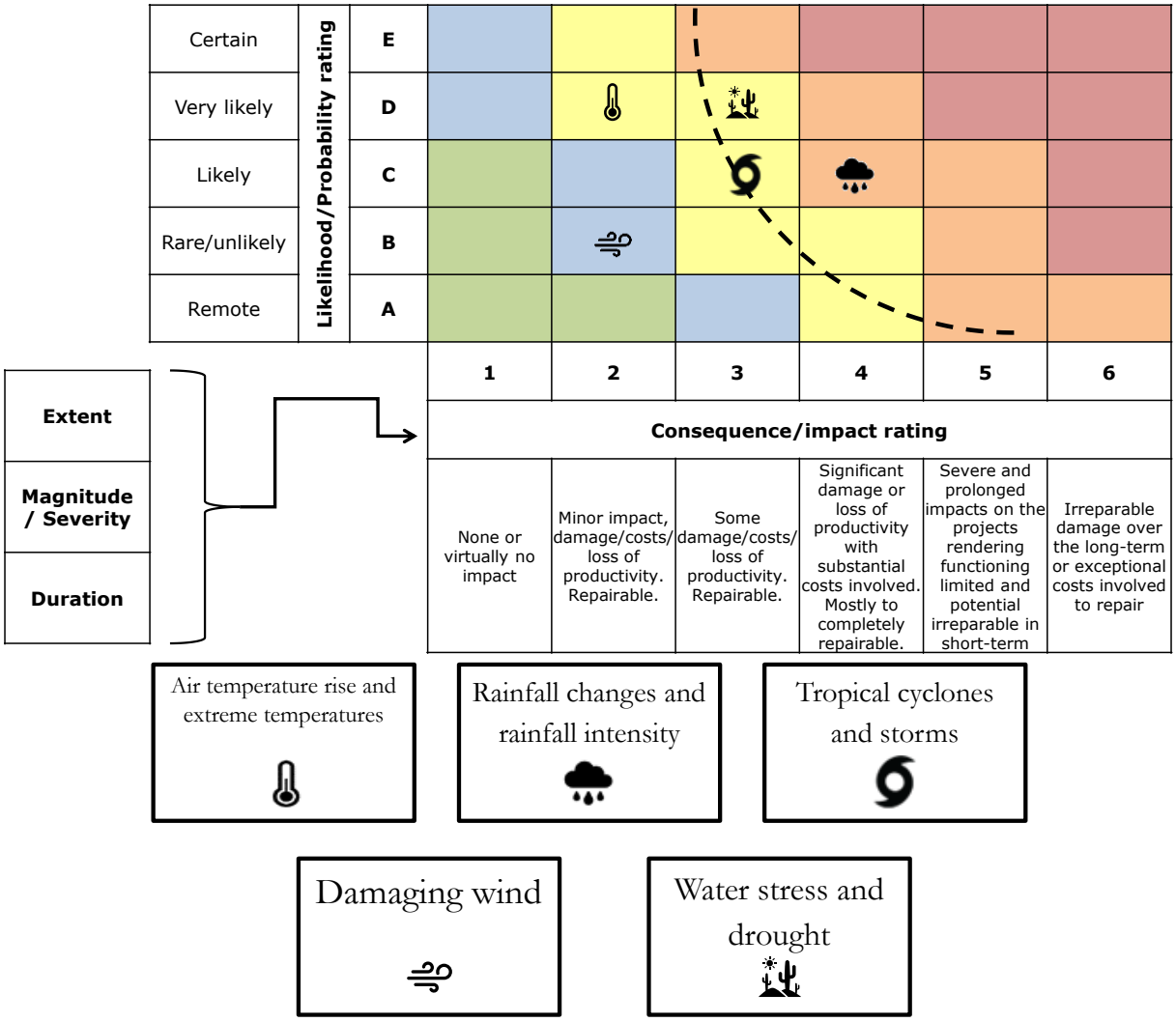

Figure 21: Climate Change vulnerability assessment for the Cato Ridge Land Development and Release Project

7 Recommended Adaptation Measures

Although some of the climate change risks are considered low, there is significant uncertainty in how climate change impacts may manifest and impact the infrastructure and operations of the future land use of the Cato Ridge Project. In order to reduce vulnerability and ensure greater resilience to climate shocks and challenges, several adaptation measures are recommended. These are for both the operational phase and the construction phase of the project, in anticipation of future climate change impacts. Recommendations that are suggested for the project have been categorised as follows:

- Adaptation measures during construction;
- Adaptation measures during operation; and
- Conditions of the environmental authorisation.

7.1 Adaptation measures recommended during construction (non-binding)

- Attenuation ponds have been designed in line with a 1:50 flood event. It is recommended that upgrading these to withstand 1:100 year flood events is investigated.
- It is recommended that vegetating of soil surfaces and restoring disturbed natural or near-natural habitat is undertaken to reduce the risk of landslides and flooding during extreme rainfall events.
- To reduce the impact of heat stress under projected warmer conditions, facilities, it is recommended that suitable insulation and cooling mechanisms are in place to buffer the impact on workforce and machinery.
- The facility should consider the use of off-grid renewable energy, particularly solar photovoltaic energy, to ameliorate the risk posed to electricity supply under more water stressed conditions.

7.2 Adaptation measures recommended during operation (non-binding for end users and managers)

- Following construction, stormwater drains should be monitored for blockages and defects regularly to ensure the maximum amount of runoff occurs during storm events. That said, any runoff should be managed in a way that ensures that it does not impact areas downstream within the catchment of the project area.
- Where possible, harvesting and recycling of stormwater and rainwater should be implemented as a mechanism to not only reduce costs of water supply, but also to reduce the impact on the site of prolonged dry spells.
- Climate-related risks should form part of standard risk assessment procedures and should be updated regularly, with the assistance of a specialist, if necessary.
- As part of the health and safety procedures of the site once operational, it is recommended that links to early warning systems are in place (i.e., information from service providers such as the South Africa Weather Service, can be accessed), and emergency response plans for extreme weather events are developed, for planning

purposes. This is to reduce potential damage and ensure unaffected continuity of operations as far as possible.

- Higher temperatures will result in greater water demand outside of the project area. Increased temperatures will also have an impact on evapotranspiration which in turn will reduce surface water resources and increase water stress, compounding the higher water demand. Usage of recycled water on site will likely significantly reduce the pressure on the facility/ies. It is recommended that these augmentation processes should be fully embedded into the long-term design of the facility.

7.3 Conditions of the environmental authorisation

Promethium has no conditions for environmental authorisation. The above measures, however, are highly recommended as implementing these are likely to reduce climate change vulnerability and increase resilience in respect of the project.

8 Conclusion

In conclusion, this CCRVA highlights the potential risks and challenges that the Cato Ridge Project may face in the future due to the changing climate and associated weather. The assessment provides valuable insights into the site's vulnerabilities and briefly outlines adaptation strategies and measures that can help minimise the adverse impacts of climate change on the project, the surrounding communities, and the local environment including connected landscapes. It is essential for the project team to take proactive steps to address the identified vulnerabilities and integrate climate change considerations into their planning, design, and operations to ensure the long-term resilience and sustainability of the development. By working collaboratively with relevant stakeholders and implementing appropriate measures, the project can not only mitigate the risks but potentially capitalise opportunities that arise from climate change to enhance the operations of the site in the long-term.

KWAZULU-NATAL PROVINCE
ECONOMIC DEVELOPMENT, TOURISM AND ENVIRONMENTAL AFFAIRS
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DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

Submitted in terms of section 24(2) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) or for a waste management licence in terms of section 20(b) of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008).

KINDLY NOTE:

1. This form is current as of **May 2021**. It is the responsibility of the Applicant / Environmental Assessment Practitioner ("EAP") to ascertain whether subsequent versions of the form have been released by the Department.

PROJECT TITLE

Cato Ridge Land Release and Development Project (DM/0006/2023: KZN/EIA/000)

DISTRICT MUNICIPALITY

eThekwini Metropolitan Municipality

1. SPECIALIST INFORMATION

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Project Consultant / EAP:	Zutari (Pty) Ltd

DECLARATION OF INTEREST BY SPECIALIST

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2. DECLARATION BY THE SPECIALIST

I, Indiana Mann are that --

General declaration:

- I act as the independent specialist in this application;
- do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- 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 declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I am aware that a person is guilty of an offence in terms of Regulation 48 (1) of the EIA Regulations, 2014, if that person provides incorrect or misleading information. A person who is convicted of an offence in terms of sub-regulation 48(1) (a)-(e) is liable to the penalties as contemplated in section 49B(1) of the National Environmental Management Act, 1998 (Act 107 of 1998).

Signature of the specialist:

Prometheum Carbon
Name of company:

06/04/23
Date:

DECLARATION OF INTEREST BY SPECIALIST

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ECONOMIC DEVELOPMENT, TOURISM AND ENVIRONMENTAL AFFAIRS
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PROJECT TITLE

Cato Ridge Land Release and Development Project (DM/0006/2023: KZN/EIA/000)

DISTRICT MUNICIPALITY

eThekwini Metropolitan Municipality

1. SPECIALIST INFORMATION

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Project Consultant / EAP:	Zutari (Pty) Ltd

DECLARATION OF INTEREST BY SPECIALIST

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2. DECLARATION BY THE SPECIALIST

I, JOSHUA WEISS are that --

General declaration:

- I act as the independent specialist in this application;
- do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
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- all the particulars furnished by me in this form are true and correct; and
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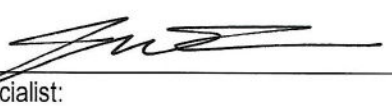

Signature of the specialist:

PROMETHIUM CARBON

Name of company:

03/04/2023

Date:

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DISTRICT MUNICIPALITY

eThekwini Metropolitan Municipality

1. SPECIALIST INFORMATION

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Professional affiliation(s) (if any)			

Project Consultant / EAP: Zutari (Pty) Ltd

DECLARATION OF INTEREST BY SPECIALIST

EAPASA Registered EAP number:	2021/4095		
Contact person:	Patrick Killick		
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2. DECLARATION BY THE SPECIALIST

I, R.T. Lowe are that --

General declaration:

- I act as the independent specialist in this application;
- do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
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Signature of the specialist:

Prometheus Carbon (Pty) Ltd.

Name of company:

4 April 2023

Date:

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Cato Ridge Land Release and Development Project (DM/0006/2023: KZN/EIA/000)

DISTRICT MUNICIPALITY

eThekwini Metropolitan Municipality

1. SPECIALIST INFORMATION

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E-mail:			
Professional affiliation(s) (if any)	None		

Project Consultant / EAP:	Zutari (Pty) Ltd

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2. DECLARATION BY THE SPECIALIST

I, Shantal Beharie are that --

General declaration:

- I act as the independent specialist in this application;
- do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
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Signature of the specialist:

Name of company:

Promethium Carbon

Date:

2023/04/04